COUNTY OF GALVESTON ENGINEERING DEPARTMENT

FRIENDSWOOD LAKES BLVD ROADWAY AND DRAINAGE IMPROVEMENTS

COUNTY OF GALVESTON, TEXAS

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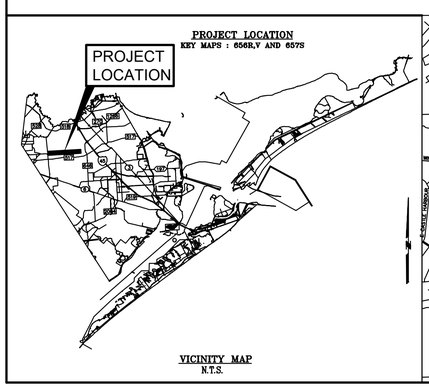
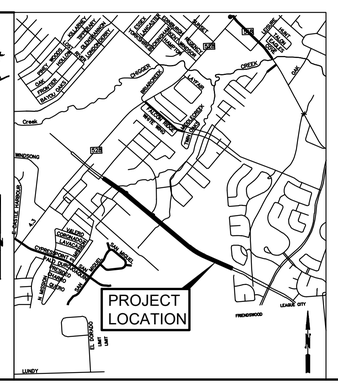


VICINITY MAP
N.T.S.



MAY 2020
PRECINCT # 4
COUNTY OF GALVESTON, TEXAS

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

TAI PROJECT No. 0600-1901
MAY, 2020

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\1 COVER SHEET .dwg

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STATE OF TEXAS
A.G.A.N. NANAYAKKARA
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LICENSED
PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

INDEX SHEET

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: NONE	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE02

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GENERAL NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE LATEST REVISED CITY OF FRIENDSWOOD STANDARD DETAILS AND TECHNICAL SPECIFICATIONS.
2. ELEVATION AND CONTOURS SHOWN ARE BASED ON NGVD OF 1929, 1978 RELEVELING.
3. TRENCH SAFETY SYSTEM TO MEET, AS A MINIMUM, THE REQUIREMENTS OF OSHA SAFETY AND HEALTH REGULATIONS PART 1926, SUBPART P.
4. EXISTING UNDERGROUND UTILITIES ARE NOT SHOWN. THE CONTRACTOR SHALL CONTACT THE UTILITY COORDINATING COMMITTEE AT (713-223-4567) FOR CENTERPOINT, TEXAS-NEW MEXICO POWER AND AT&T TELEPHONE AND TEXAS ONE-CALL SYSTEM (1-800-245-4545) FOR PIPELINES AND CABLE TV.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE DEPTH, LOCATION AND EXISTENCE OF ALL EXISTING UTILITIES WHICH MAY CONFLICT WITH THE PROPOSED CONSTRUCTION.
6. CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CONDITIONS IN THE FIELD BEFORE COMMENCING WORK. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO REPORT ANY AND ALL DISCREPANCIES TO THE OWNER AND THE ENGINEER IN A TIMELY MANNER.
7. CONTRACTOR SHALL ADEQUATELY PROTECT EXISTING STRUCTURES, UTILITIES, TREES, SHRUBS, OTHER PERMANENT OBJECTS AND ADJOINING PROPERTY.
8. NO OPEN EXCAVATIONS SHALL BE LEFT OPEN OVERNIGHT. ALL EXCAVATIONS WHICH CANNOT BE BACKFILLED OVERNIGHT SHALL BE COVERED, AS A MINIMUM, WITH STEEL PLATING WHEN IN PAVED AREAS; 3/4 INCH PLYWOOD, WOOD PLANKING WITH OSHA ORANGE PLASTIC EXPANDED MESH BARRIER AROUND PERIMETER IN UNPAVED AREAS, OR AS APPROVED BY THE CITY OF FRIENDSWOOD.
9. EXISTING PAVEMENTS, CURBS, SIDEWALKS AND DRIVEWAYS DAMAGED OR REMOVED DURING CONSTRUCTION BY THE CONTRACTOR FOR THEIR CONVENIENCE SHALL BE REPLACED PER CURRENT TECHNICAL SPECIFICATIONS BY THE CONTRACTOR AT HIS EXPENSE.
10. CONTRACTOR SHALL PLAN, SCHEDULE, AND PERFORM HIS WORK SO AS TO PROVIDE AND MAINTAIN SAFE PUBLIC TRAFFIC (INGRESS AND EGRESS) AS WELL AS NON-INCONVENIENCE TO ALL PROPERTY OWNERS ALONG THE PROJECT RIGHT OF WAYS DURING CONSTRUCTION PERIOD.
11. FOR LOCATIONS WHERE OPEN CUT CONSTRUCTION IS REQUIRED IN STREETS THE CONTRACTOR SHALL FURNISH AND MAINTAIN ADEQUATE BARRICADES, WARNING AND DIRECTING SIGNS, FLAGS, AND LIGHTS, NOTIFY CITY OF FRIENDSWOOD PROJECT MANAGER (281) 996-3380.
12. ALL SIGNS, BARRICADES, PAVEMENT MARKINGS, TRAFFIC SIGNALS, AND CHANNELIZING DEVICES USED TO HANDLE TRAFFIC SHALL BE SHOWN ON A TRAFFIC CONTROL PLAN (TO BE APPROVED BY THE CITY) AND SHALL CONFORM TO THE LATEST REVISIONS OF THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVISED FOR STREET AND HIGHWAYS (TMUTCD), "PART VI-TRAFFIC CONTROLS FOR STREET AND HIGHWAY CONSTRUCTION AND MAINTENANCE OPERATIONS."
13. CONTRACTOR SHALL NOTIFY THE CITY OF FRIENDSWOOD PROJECT MANAGER AND PUBLIC WORKS (281) 996-3380 48 HOURS PRIOR TO THE START OF CONSTRUCTION.

PAVING:

1. PAVEMENT SUBGRADE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD STANDARD DETAILS AND TECHNICAL SPECIFICATIONS, LATEST REVISIONS.
2. CONTRACTOR SHALL NOTIFY THE CITY AT (281) 996-3380, TWENTY-FOUR (24) HOURS PRIOR TO ALL LIMING AND PAVING OPERATIONS.
3. ALL RETURNS SHALL HAVE A TWENTY-FIVE (25) FOOT RADIUS AT BACK OF CURB UNLESS OTHERWISE NOTED.
4. GUIDELINES SET FORTH IN THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" SHALL BE OBSERVED.
5. ALL FILL IN EXISTING OR PROPOSED RIGHTS-OF WAY, INCLUDING BACKDRESSING BEHIND THE CURB, SHALL BE PLACED IN MAXIMUM LOOSE LIFTS OF EIGHT (8) INCHES OR LESS AND COMPACTED TO NINETY-FIVE PERCENT (95%) STANDARD PROCTOR DENSITY WITH AN OPTIMUM MOISTURE CONTENT OF ± 3%.
6. MINIMUM PAVEMENT REINFORCEMENT REQUIREMENT SHALL BE GRADE 60, NO. 4 REBAR, SPACED AT SIXTEEN (16) INCH ON CENTERS EACH WAY.
7. ALL PAVEMENT TO BE A MINIMUM OF SIX (6) INCHES THICK REINFORCED CONCRETE UNLESS OTHERWISE NOTED.
8. PAVING EXPANSION JOINTS SHALL BE PLACED AT A MAXIMUM OF SIXTY (60) FEET.
9. ALL CONCRETE USED FOR PAVEMENT SHALL BE CLASS "A" CONCRETE WITH A MINIMUM 5.0 SACK OF CEMENT PER CUBIC YARDS AND A MINIMUM 3,000 PSI COMPRESSIVE STRENGTH AT TWENTY-EIGHT (28) DAYS.
10. CLASS "A" HYDRATED LIME SHALL BE APPLIED FOR SUBGRADE STABILIZATION AT A MINIMUM OF 6%.
11. CONTRACTOR SHALL INSTALL STREET SIGNS AND STOP SIGNS PER CITY OF FRIENDSWOOD STANDARD DETAILS AND TECHNICAL SPECIFICATIONS.
12. ALIGNMENTS, CENTERLINE CURVE DATA, AND STATIONING FOR ALL CONSTRUCTION SHALL BE DETERMINED FROM SUBDIVISION PLAT.
13. FOR ALL CONCRETE TO BE REMOVED, A TWO (2) INCH DEEP SAW CUT SHALL BE PROVIDED PRIOR TO REMOVAL.
14. REPRESENTATIVES FROM THE CITY, THE OWNER AND THE TESTING LABORATORY SHALL BE PRESENT FOR ALL DENSITY TESTS, LIME OPERATIONS AND PLACEMENT OF CONCRETE PAVING.
15. UNDER NO CIRCUMSTANCES SHALL WATER BE ADDED TO A CONCRETE LOAD AFTER SLUMP TEST AND/OR CONCRETE CYLINDERS HAVE BEEN TAKEN.
16. BLUE REFLECTORIZED PAVEMENT MARKERS SHALL BE PLACED AT FIRE HYDRANT LOCATIONS AND OFFSET SIX (6) INCHES FROM THE CENTERLINE OF THE ROADWAY. REFLECTORS SHALL FACE FLOW OF TRAFFIC.
17. FOR PAVEMENT WIDTHS LESS THAN OR EQUAL TO TWENTY-EIGHT (28) FEET B/B OF CURB:
    - 17.1. MINIMUM STABILIZED SUBGRADE THICKNESS SHALL BE SIX (6) INCHES.
    - 17.2. MINIMUM CONCRETE SLAB THICKNESS SHALL BE SIX (6) INCHES.
18. FOR PAVEMENT WIDTHS GREATER THAN TWENTY-EIGHT (28) FEET B/B OF CURB AND ALL MAJOR ARTERIAL THOROUGHFARES:
    - 18.1. MINIMUM STABILIZED SUBGRADE THICKNESS SHALL BE EIGHT (8) INCHES.
    - 18.2. MINIMUM CONCRETE SLAB THICKNESS SHALL BE SEVEN (7) INCHES.

SANITARY SEWERS

1. FINISHED ELEVATION ON SANITARY MANHOLE RIMS SHALL BE THREE (3) INCHES ABOVE FINISHED GRADE WITHIN THE UTILITY EASEMENT. IF MANHOLE IS LOCATED ADJACENT TO A PUBLIC STREET, THE FINAL ELEVATION OF THE MANHOLE RIM SHALL BE TWO (2) INCHES ABOVE THE CURB OR CENTERLINE OF STREET FOR STREETS WITHOUT PERIMETER CURB.
2. WATER LINES AND SANITARY SEWERS SHALL BE INSTALLED IN SEPARATE TRENCHES AND BE A MINIMUM SEPARATION OF NINE (9) FEET.
3. POLYVINYL CHLORIDE (PVC) SHALL BE IN ACCORDANCE WITH ASTM D3034, SDR 26 FOR ALL DEPTHS.
4. ALL PVC PIPES (ALL TYPES AND SDR/DR WALL THICKNESS TO BE USED) SHALL HAVE A RUBBER GASKET EQUIPPED BELL AND SPIGOT JOINTS CONFORMING TO ASTM D3212. THE GASKET MATERIAL SHALL CONFORM TO ASTM F477, SOLVENT WELDED JOINTS WILL NOT BE APPROVED FOR CITY SANITARY SEWER LINES.
5. ALL DUCTILE IRON (DI) PIPE SHALL BE ONE HUNDRED FIFTY (150) PSI WITH EIGHT (8) MIL, BLACK VIRGIN POLYETHYLENE WRAP AS SPECIFIED IN ANSI/AWWA A21.5/C105.

SANITARY SEWERS (CONT.)

6. SANITARY SEWER MATERIALS AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD DESIGN STANDARDS. CONTRACTOR TO FURNISH TEST PLUGS AND RISERS. ALL SANITARY SEWER LINES TO BE AIR TESTED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
7. SANITARY SEWER TRENCHES UNDER OR WITHIN ONE (1) FOOT OF PROPOSED OR FUTURE PAVEMENT ARE TO BE BACKFILLED WITH CEMENT-STABILIZED SAND BACKFILL, AS SPECIFIED, TO WITHIN ONE (1) FOOT OF SUBGRADE. BEDDING WILL BE CEMENT-STABILIZED SAND BACKFILL (1.1 SACKS CEMENT PER TON OF SAND) FOR ALL SANITARY SEWERS.
8. WATER LINE/NEW SEWER LINE SEPARATION. WHEN NEW SANITARY SEWERS ARE INSTALLED, THEY SHALL BE INSTALLED NO CLOSER TO WATER LINES THAN NINE (9) FEET IN ALL DIRECTIONS. SEWERS THAT PARALLEL TO WATER LINES MUST BE INSTALLED IN SEPARATE TRENCHES. WHEN NINE (9) FEET OF SEPARATION CANNOT BE MAINTAINED, THE FOLLOWING GUIDELINES APPLY:
    - 8.1 WHEN THE SANITARY SEWER PARALLELS A WATER LINE, THE SANITARY SEWER SHALL BE CONSTRUCTED OF CAST IRON, DUCTILE IRON OR PVC MEETING ASTM SPECIFICATIONS WITH A PRESSURE RATING FOR BOTH THE PIPE AND JOINTS OF 150 PSI. THE VERTICAL SEPARATION SHALL BE A MINIMUM OF TWO (2) FEET BETWEEN OUTSIDE DIAMETERS AND THE HORIZONTAL SEPARATION SHALL BE A MINIMUM OF FOUR (4) FEET BETWEEN OUTSIDE DIAMETERS. THE SANITARY SEWER SHALL BE LOCATED BELOW THE WATER LINE.
    - 8.2 WHEN A SANITARY SEWER CROSSES A WATER LINE AND THE SEWER IS CONSTRUCTED OF CAST IRON, DUCTILE IRON OR PVC WITH A MINIMUM PRESSURE RATING OF 150 PSI; AN ABSOLUTE MINIMUM OF SIX (6) INCHES BETWEEN OUTSIDE DIAMETERS SHALL BE MAINTAINED. THE SANITARY SEWER SHALL BE LOCATED BELOW THE WATER LINE WHEN POSSIBLE AND ONE (1) LENGTH OF THE SANITARY SEWER PIPE MUST BE CENTERED ON THE WATER LINE.
    - 8.3 WHEN A SANITARY SEWER CROSSES UNDER A WATER LINE AND THE SEWER IS CONSTRUCTED OF ABS TRUSS PIPE, SIMILAR SEMI-RIGID PLASTIC COMPOSITE PIPE, CLAY PIPE OR CONCRETE PIPE WITH GASKETED JOINTS, A MINIMUM OF TWO (2) FEET OF SEPARATION SHALL BE MAINTAINED. THE INITIAL BACKFILL SHALL BE CEMENT-STABILIZED SAND (MINIMUM 1.1 SACKS OF CONCRETE PER TON OF SAND) FOR ALL SECTIONS OF SANITARY SEWER WITHIN NINE (9) FEET OF THE WATER LINE. THE INITIAL BACKFILL SHALL BE FROM ¼ DIAMETER BELOW THE CENTERLINE OF THE PIPE TO ONE PIPE DIAMETER (BUT NOT LESS THAN TWELVE (12) INCHES) ABOVE THE PIPE.
    - 8.4 WHEN A SANITARY SEWER CROSSES OVER A WATER LINE, ALL PORTIONS OF THE SANITARY SEWER WITHIN NINE (9) FEET OF THE WATER LINE SHALL BE CONSTRUCTED OF CAST IRON, DUCTILE IRON OR PVC PIPE WITH A PRESSURE RATING OF AT LEAST 150 PSI USING APPROPRIATE ADAPTERS. IN LIEU OF THIS PROCEDURE THE NEW SANITARY SEWER MAY BE ENCASED IN A JOINT OF 150 PSI PRESSURE CLASS PIPE AT LEAST EIGHTEEN (18) FEET LONG AND TWO (2) NOMINAL SIZES LARGER THAN THE NEW SANITARY SEWER. THE SPACE AROUND THE CARRIER PIPE SHALL BE SUPPORTED AT INTERVALS OF FIVE (5) FEET WITH SPACERS OR BE FILLED TO THE SPRINGLINE WITH WASHED SAND. THE ENCASEMENT PIPE SHOULD BE CENTERED ON THE CROSSING AND BOTH ENDS SEALED WITH NON-SHRINK CEMENT GROUT OR WITH A MANUFACTURED SEAL.
9. ALL PROPOSED SANITARY SEWER LINES SHALL BE DUCTILE IRON OR SDR 26 PVC. DUCTILE IRON PIPE SHALL ONLY BE USED AS APPROVED BY THE CITY OF FRIENDSWOOD.
10. FOR ALL PVC PIPE, USE MANHOLE WATER STOP GASKET AND CLAMP ASSEMBLY AT MANHOLE CONNECTIONS.
11. SANITARY SEWER MANHOLES SHALL BE STANDARD TYPE, UNLESS OTHERWISE NOTED. ALL SANITARY SEWER MANHOLES SHALL BE AT LEAST THREE (3) INCHES ABOVE FINISHED GRADE OR ABOVE 100 YEAR BASE FLOOD ELEVATION (BFE). FOR MANHOLES LOCATES IN THE 100-YEAR FLOOD PLAIN, VENT AND SEAL (BOLTED MANHOLE LID W/ FOUR (4) BOLTS, NO HOLES IN LID) THE MANHOLE TOP AND PROVIDE INFLOW PROTECTOR INSERT UNDER COVER. SECTIONS OF PRECAST MANHOLES SHALL BE JOINED WITH "RAM NEK" IN FLOOD PLAIN.
12. SANITARY SEWER LINES IN PIPE ZONE INSIDE LOT EASEMENT SHALL BE BACKFILLED WITH CEMENT-STABILIZED SAND OR SELECT FILL MATERIAL WITH A PI BETWEEN 20 AND 40.
13. IF WE SAND IS ENCOUNTERED IN TRENCH, USE SPECIAL BEDDING.
14. SANITARY SEWERS CROSSING UTILITIES OTHER THAN WATER LINES SHALL HAVE A MINIMUM CLEARANCE OF SIX (6) INCHES.
15. ALL PRECAST MANHOLES SHALL HAVE A TOP ADJUSTMENT CONSTRUCTED OF PRECAST PCC RINGS NO GREATER THAN TWENTY-FOUR (24) INCHES IN HEIGHT, SEALED WITH NON-SHRING GROUT, INSIDE AND OUTSIDE. BRICK MANHOLES SHALL NOT BE ALLOWED.
16. ALL SANITARY SEWER MANHOLE COVERS MUST INCLUDE THE WORD "SANITARY SEWER" AND "CITY OF FRIENDSWOOD". THEY MUST ALSO HAVE THE CITY SEAL.
17. SANITARY SEWER MANHOLE COVERS SHALL BE A MINIMUM OF THIRTY-TWO (32) INCHES IN DIAMETER.
18. ALL SANITARY SEWER MANHOLES SHALL HAVE AN INFLOW PROTECTOR,
19. DOGHOUSE MANHOLES ARE NOT ALLOWED. ALL MANHOLES SHALL BE PRECAST.

STORM SEWERS:

1. STORM SEWERS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISIONS.
2. ALL STORM SEWER PIPE SHALL BE REINFORCED CONCRETE PIPE (RCP), ASTM C76, CLASS III, TONGUE AND GROOVE, RAM-NEK JOINTS UNLESS OTHERWISE NOTED.
3. REINFORCED CONCRETE STORM SEWER (PIPE, BOX, ETC.) SHALL BE INSTALLED, BEDDED AND BACKFILLED IN CONFORMITY WITH CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS AND STANDARD DETAILS. STORM SEWER PIPE INSTALLED UNDER OR WITHIN ONE (1) FOOT OF PROPOSED OR EXISTING PAVEMENT SHALL BE BACKFILLED WITH CEMENT-STABILIZED SAND, (1.1 SACKS OF CEMENT PER TON OF SAND), TO THE BOTTOM OF THE SUBGRADE.
4. CONCRETE FOR INLETS AND MANHOLES SHALL BE CLASS "A" AND SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT TWENTY-EIGHT (28) DAYS.
5. ALL MANHOLES SHALL BE ADJUSTED TO FINISHED GRADE AFTER PAVING IS COMPLETE.
6. MINIMUM STORM SEWER SIZE IS TWENTY-FOUR (24) INCH DIAMETER. MINIMUM UPSTREAM ROADSIDE DITCH CULVERT SIZE IS EIGHTEEN (18) INCH DIAMETER.
7. ALL STORM SEWER MANHOLE COVERS MUST INCLUDE THE WORDS, "STORM SEWER" AND "CITY OF FRIENDSWOOD AND HAVE THE "CITY SEAL." MANHOLE COVERS SHALL BE THIRTY-TWO (32) INCHES IN DIAMETER EXCEPT AT CURB INLET COVERS WHICH ARE TWENTY-FOUR (24) INCHES.
8. CONTRACTOR SHALL PROVIDE A MINIMUM OF SIX (6) INCHES CLEARANCE AT ALL UTILITY CROSSINGS WITH STORM SEWERS.
9. ALL INLETS IN RESIDENTIAL DEVELOPMENTS TO BE TYPE "H-2" OR TYPE "B-B" WITH GRATES. ALL INLETS IN COMMERCIAL DEVELOPMENTS AND ON MAJOR THOROUGHFARES TO BE TYPE "H-2" ONLY, UNLESS OTHERWISE APPROVED BY THE CITY OF FRIENDSWOOD.
10. ALL DISTURBED AREAS IN DRAINAGE EASEMENTS OR DETENTION PONDS, SHALL BE HYDROMULCHED AS PER TECHNICAL SPECIFICATIONS SECTION 02910 – HYDROMULCH SEEDING OR APPROVED EQUAL.
11. DOGHOUSE MANHOLES ARE NOT ALLOWED. ALL MANHOLES SHALL BE PRECAST.

WATER LINES:

1. WATER LINE CONSTRUCTION AND TESTING IS TO BE PERFORMED IN ACCORDANCE WITH CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.

WATER LINES (CONT.):

2. ALL WATER MAINS SHALL HAVE A MINIMUM COVER OF FOUR (4) FEET MEASURED FROM CENTERLINE OF STREET OR EXISTING NATURAL GROUND WHICHEVER DEPTH IS GREATER, UNLESS OTHERWISE NOTED.
3. PRESSURE TEST OF ALL WATER LINES SHALL BE AT 150 PSI FOR FOUR (4) HOURS AND WITNESSED BY THE CITY PROJECT MANAGER, EXCEPT FIRE LINES WHICH SHALL BE TESTED AT 200 PSI FOR TWO (2) HOURS AND SHALL BE WITNESSED BY THE FIRE MARSHAL.
4. SINGLE METER SERVICE LINES SHALL BE ONE (1) INCH MINIMUM I.D., C.T.S. POLYETHYLENE, SDR-9.
5. CONTRACTOR TO FURNISH AND INSTALL SINGLE SERVICE METER BOXES AT FINISH GRADE.
6. FIRE HYDRANT ASSEMBLIES SHALL INCLUDE ONE (1) EACH LINE SIZE BY SIX (6) INCH TEE, ONE (1) EACH SIX (6) INCH GATE VALVE AND BOX, ONE (1) EACH FIRE HYDRANT WITH SIX (6) INCH LEAD PIPING AND TIE BACKS.
   FIRE HYDRANTS SHALL BE MUELLER SUPER CENTURION OR AFC ONLY.
7. WATER VALVES ON MAIN LINES SHALL BE LOCATED AS CLOSE AS POSSIBLE TO EXTENDED PROPERTY LINE AND SHALL CONFORM TO AWWA C-500, OPEN COUNTER CLOCKWISE LEFT, EQUIPPED WITH TWO (2) INCH SQUARE OPERATING NUT. OPERATING NUT SHALL BE A MAXIMUM OF FIVE (5) FEET BELOW FINISH GRADE.
8. WATER LINES FOUR (4) INCH THROUGH TWELVE (12) INCH I.D. SHALL COMPLY THE REQUIREMENTS OF AWWA STANDARD C-900-75, CLASS 150, SDR-18, WITH CAST IRON OUTSIDE DIAMETER AND GASKET BELL END. FITTINGS ARE TO BE MECHANICAL JOINTS IN ACCORDANCE WITH AWWA C-100 OR C-110.
9. ALL CONCRETE THRUST BLOCKING SHALL BE PLACED TO FORM A SOLID CONNECTION BETWEEN FITTINGS, VALVES, AND FIRE HYDRANTS AND UNDISTURBED EARTH. CONCRETE FOR THRUST BLOCKING SHALL BE CLASS "C" AND HAVE A MINIMUM OF 2,500 PSI COMPRESSIVE STRENGTH AT TWENTY-EIGHT (28) DAYS AND CONFORM TO CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS AND STANDARD DETAILS.
10. GRAY IRON AND DUCTILE IRON FITTINGS SHALL CONFORM TO AWWA C-110 AND END JOINTS OF FITTINGS AND MAIN VALVES SHALL CONFORM TO AWWA C-110 AND END JOINTS TO FITTINGS AND MAIN LINE VALVES SHALL CONFORM TO AWWA C-111 FOR RUBBER GASKETED JOINTS. GRAY IRON AND DUCTILE IRON FITTINGS SHALL BE CEMENT LINED OR EPOXY COATED.
11. MINIMUM BURY FOR ALL FIRE HYDRANTS SHALL BE FOUR (4) FEET UNLESS OTHERWISE NOTED. ALL FIRE HYDRANTS AND VALVE BOXES ARE TO BE ADJUSTED TO FINISH GRADE AFTER PAVING IS COMPLETE. PUMPER SERVICE CONNECTION TO FACE CURB.
12. INSTALL CONCRETE BLOCK BENEATH FIRE HYDRANTS BEFORE PLACING CONCRETE THRUST BLOCKING TO INSURE THAT FIRE HYDRANTS ARE INSTALLED LEVEL.
13. CONTRACTOR SHALL NOTIFY CITY PROJECT MANAGER OFFICE SEVENTY-TWO (72) HOURS PRIOR TO START OF CONSTRUCTION.
14. ALL WATER LINES TO BE BACKFILLED TO ONE (1) FOOT ABOVE TOP OF PIPE WITH BANK SAND. FOR PORTIONS OF PIPE LOCATED UNDER PAVEMENT, BACKFILL FROM INITIAL BACKFILL OF BANK SAND TO ONE (1) FOOT BELOW PROPOSED SUBGRADE UNDER PAVEMENT WITH CEMENT-STABILIZED SAND (1.1 SACKS OF CEMENT PER TON OF SAND).
15. ALL FIRE HYDRANTS ARE TO BE LOCATED AS SHOWN ON THE PLANS AND SET THREE (3) FEET BEHIND THE CURB, ONE (1) FOOT FROM PROPERTY LINE FOR STREETS WITH DITCHES OR AT AN APPROVED LOCATION ON RURAL SECTION ROADS. ALL FIRE HYDRANTS SHALL BE AUDITED AND PAINTED AS PER CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
16. ALL TAPPING SLEEVES SHALL BE STAINLESS STEEL FULL CIRCLE WITH MECHANICAL JOINT TAPPING SLEEVE.
17. THE CONTRACTOR SHALL NOT OPERATE EXISTING CITY WATER VALVES. THE CONTRACTOR SHALL NOTIFY THE CITY PROJECT MANAGER AND CONTACT THE PUBLIC WORKS DEPARTMENT TWENTY-FOUR (24) HOURS MINIMUM, BY FAXING DOCUMENT 01740 – UTILITY DIVISION ASSISTANCE REQUEST TO (281) 482-1083, FOR ANY VALVE OPERATION NECESSARY FOR THE PROJECT. IF ANY VALVE CLOSING RESULTS IN INTERRUPTED SERVICE TO RESIDENTS OR BUSINESSES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING PROPER NOTICE TO THE AFFECTED PARTIES TWENTY-FOUR (24) HOURS IN ADVANCE OF THE INTERRUPTION.
18. FOR ALL CONSTRUCTION WATER USAGE ON THE PROJECT, A FIRE HYDRANT METER SHALL BE OBTAINED FROM THE CITY AT THE PUBLIC WORKS DEPARTMENT AT 1306 DEEPWOOD DRIVE (281-996-3382). A DEPOSIT SHALL BE REQUIRED FOR THE METER AND A FEE SHALL BE CHARGED FOR ALL METERED WATER USAGE. THE CONTRACTOR SHALL SUPPLY A BACKFLOW PREVENTER FOR THE FIRE HYDRANT METER.

TESTING

ALL TESTING SHALL CONFORM WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS SECTION 01470 - TESTING LABORATORY SERVICES AND SECTION 01475 - TESTING PROCEDURES.

1. SECTION 02125 - EXCAVATION AND BACKFILL FOR UTILITIES:
   - 1.1. BACKFILL SHALL BE PLACED IN MAXIMUM LIFTS OF EIGHT (8) INCHES AND COMPACTED TO A DENSITY OF NOT LESS THAN 95% STANDARD PROCTOR WITH OPTIMUM MOISTURE BETWEEN PLUS 3% AND MINUS 3% OR AS OTHERWISE SPECIFIED BY THE SOILS LABORATORY. TEST SHALL BE TAKEN EVERY LIFT, EVERY 500 LINEAR FEET, OR BETWEEN MANHOLES, WHICHEVER RESULTS IN THE GREATEST NUMBER OF DENSITY TESTS.
   - 1.2. FIELD MOISTURE/DENSITY TEST SHALL BE PERFORMED AT A FREQUENCY OF AT LEAST ONE (1) TEST PER 500 SQUARE YARDS OF COMPACTED LIFT. THE DENSITY SHALL NOT BE LESS THAN 95% OF STANDARD PROCTOR WITH A MOISTURE CONTENT OF BETWEEN PLUS 3% AND MINUS 3% OPTIMUM MOISTURE, OR AS DETERMINED BY SOILS LABORATORY. MAXIMUM LIFT FOR TESTING COMPACTED FILL SHALL NOT EXCEED TWELVE (12) INCHES.
2. SECTION 02300 - CAST-IN-PLACE CONCRETE MANHOLES AND SECTION 02305 - PRECAST CONCRETE MANHOLES:
   - 2.1. EXFILTRATION TEST SHALL BE REQUIRED ON EACH MANHOLE SYSTEM.
     - 2.1.1. EACH MANHOLE IS TO BE PLUGGED, FILLED TO THE TOP OF THE RIM WITH WATER FOR THIRTY (30) MINUTES WITH THE ALLOWABLE LEAKAGE OF NOT MORE THAN ½ INCH; OR
     - 2.1.2. PLUG MANHOLE AND VACUUM TEST AT TEN (10) INCHES OF MERCURY WITH A LOSS OF NO MORE THAN ONE (1) INCH OF MERCURY FOR THE TIME TO BE DETERMINED BY THE WIDTH AND DEPTH OF THE MANHOLE.
3. SECTION 02400 - WATER LINES
   - 3.1. PRESSURE TEST:
     - 3.1.1. A TEST, TO BE SUCCESSFUL SHALL BE WITNESSED BY THE CITY'S PROJECT MANAGER FOR A FOUR (4) HOUR PERIOD, DURING REASONABLE HOURS. THE ALLOWABLE LEAKAGE SHALL BE NO GREATER THAN DETERMINED BY THE FOLLOWING FORMULA:

$$L = NDP^{\frac{1}{2}} / 7400$$

IN WHICH L IS THE ALLOWABLE LEAKAGE IN GALLONS PER HOUR OF TESTING, N IS THE NUMBER OF JOINTS IN THE LENGTH OF PIPE BEING TESTED, D IS THE NOMINAL INSIDE DIAMETER OF THE PIPE IN INCHES, AND P IS THE AVERAGE TEST PRESSURE DURING THIS TEST IN POUNDS PER SQUARE INCH. THE TEST PRESSURE SHALL BE 150 PSI FOR FOUR (4) HOURS. ALL VALVES, FIRE HYDRANTS, AND SERVICES ARE TO BE TESTED TOGETHER.

3.1.2 FIRE LINES SHALL BE TESTED AT 200 PSI FOR TWO (2) HOURS AND SHALL BE WITNESSED BY THE FIRE MARSHAL. LEAKAGE SHALL BE CALCULATED AS STATED ABOVE.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

GENERAL CONSTRUCTION NOTES

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE03

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TESTING (CONT.)

3.2 BACTERIAL TEST (BAC-T):

3.2.1 BACTERIAL SAMPLE IS REQUIRED FOR EACH 1,000 FEET OF WATER MAIN, OR CLOSER DEPENDING ON FIRE HYDRANT LOCATIONS, OR PORTION THEREOF. ALSO DEAD ENDS ARE SUBJECT TO TESTING, SUCH AS CUL-DE-SAC. THE FORM NEEDS TO BE LABELED "CONSTRUCTION" OR "SPECIAL." BOTH FORM AND SAMPLE ARE TESTED AT A LABORATORY APPROVED BY TCEQ. PAYMENT SHALL BE EXPECTED AT TIME OF SAMPLING. SAMPLINGS SHALL ONLY BE CONDUCTED ON TUESDAYS AND THURSDAYS WITH FORTY-EIGHT (48) HOUR NOTIFICATION GIVEN IN THE FORM OF DOCUMENT 01740 - UTILITY DIVISION ASSISTANCE FAXED TO (281) 482-1083.

4. SECTION 02500 - GRAVITY SANITARY SEWERS:

4.1 LOW PRESSURE AIR TEST - THE PIPE SHALL UNDERGO A LOW PRESSURE AIR TEST WHICH SHALL CONFORM TO ASTM C828 AND ASTM C494. THE PRESSURE SHALL BE FIVE (5) PSI FOR A DURATION AS DETERMINED BY THE LENGTH AND NOMINAL I.D. OF THE PIPE BEING TESTED.

4.2 MANDREL DEFLECTION TEST - FLEXIBLE AND SEMI-RIGID PIPE DIAMETER DEFLECTION TEST SHALL BE DONE NO SOONER THAN THIRTY (30) DAYS AFTER FINAL BACKFILL. RUN TEST WITH A MANDREL HAVING A DIAMETER EQUAL TO 95% OF THE INSIDE NOMINAL DIAMETER OF THE PIPE BEING TESTED. MANDREL SHALL BE NINE (9) ARM WITH STEEL PROVING RING 2½ INCH RING WIDTH. TO PASS, MANDREL SHALL PASS FREELY THROUGH THE PIPE, PULLED BY ONE (1) WORKER. NO MECHANICAL MEANS SHALL BE ALLOWED TO PULL THE MANDREL.

5. SECTION 02720 - LIME-STABILIZED SUBGRADE:

5.1 LIME

5.1.1 PERCENT LIME DETERMINATION TEST SHALL BE TAKEN BY A CERTIFIED TESTING LABORATORY IN ACCORDANCE WITH ASTM C977-92, BUT SHALL NOT BE LESS THAN 6%.

5.1.2 THE PERCENT LIME USED SHALL BRING THE SOIL TO A P.I. OF NOT MORE THAN 15.

5.1.3 HYDRATED LIME SHALL BE SAMPLED AND TAKEN AT THE DISTRIBUTION AREA OF THE TANKER TRUCK AND TESTED.

5.2. SUBGRADE

5.2.1. ALL SUBGRADE SHALL MEET THE FOLLOWING REQUIREMENTS WHEN TEST DRY BY LABORATORY SIEVES:

MINIMUM PASSING 1¾ INCH SIEVE - 100%
MINIMUM PASSING ¾ INCH SIEVE - 85%
MINIMUM PASSING #4 SIEVE - 60%

5.2.2. ALL SUBGRADE SHALL PASS A DENSITY TEST OF NOT LESS THAN 95% STANDARD PROCTOR. METHOD OF TESTING AS PER ASTM D698. TEST TO BE TAKEN EVERY 200 FEET AS MEASURED ALONG CENTERLINE OF THE ROADWAY AT VARYING DISTANCES FROM CENTERLINE OF THE ROADWAY, OR AS DIRECTED BY THE CITY.

5.2.3. THICKNESS TESTS SHALL BE TAKEN AT EVERY 200 FEET AS MEASURED ALONG THE CENTERLINE OF THE ROADWAY.

5.2.4. IF A SINGLE STORM EVENT PRODUCES ONE (1) INCH OR MORE OF RAINFALL, CONTRACTOR SHALL RETEST THE SUBGRADE FOR DENSITY. THE INTERVAL FOR DENSITY RETESTS SHALL BE NOT LESS THAN 500 FEET AS MEASURED ALONG THE CENTERLINE OF THE ROADWAY.

6. SECTION 02805 - CONCRETE PAVING:

6.1 THE CONCRETE PAVEMENT WILL BE TESTED FOR DEPTHS IN ACCORDANCE WITH ASTM C174 TEST. THICKNESS SHALL NOT BE DEFICIENT BY MORE THAN ¼ INCH.

7. SECTION 03300 - STRUCTURAL CONCRETE:

7.1 THE SLUMP, WHEN PLACING CONCRETE, SHALL NOT BE GREATER THAN FIVE (5) INCHES. THIS TEST SHALL BE TAKEN FOR EVERY FIFTY (50) CUBIC YARDS OF CONCRETE, BUT MAY BE TAKEN WHEN IN DOUBT BY THE TESTING LABORATORY TECHNICIAN OR THE CITY PROJECT MANAGER.

7.2 TEMPERATURE OF THE CONCRETE WILL BE TAKEN AS DIRECTED BY THE CITY PROJECT MANAGER AND SHALL BE LESS THAN 90° F.

7.3 THERE SHALL BE CYLINDERS TAKEN BY THE TESTING LABORATORY TECHNICIAN NUMBERING FOUR (4) CYLINDERS PER 100 CUBIC YARDS OF PAVING OR PART THEREOF FOR EACH DAYS PLACEMENT. TWO (2) CYLINDERS SHALL BE TESTED AT SEVEN (7) DAYS AND TWO (2) CYLINDERS SHALL BE TESTED AT TWENTY-EIGHT (28) DAYS WITH A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI IN TWENTY-EIGHT (28) DAYS IN ACCORDANCE WITH ASTM C31 TEST. ADDITIONALLY, TWO CYLINDERS SHALL BE TESTED AT THREE (3) DAYS.

PRIVATE UTILITY NOTES:

AT&T TEXAS/SWBT FACILITIES:

1. THE LOCATION OF AT&T TEXAS/SWBT FACILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION BEFORE COMMENCING WORK. CONTRACTOR AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THIS FAILURE TO EXACTLY LOCATE AND PRESERVE THESE UNDERGROUND UTILITIES.

2. THE CONTRACTOR SHALL CALL (800) 344-8377 A MINIMUM OF FORTY-EIGHT (48) HOURS PRIOR TO CONSTRUCTION TO HAVE UNDERGROUND LINES FIELD LOCATED.

3. WHEN EXCAVATING WITHIN EIGHTEEN (18) INCHES OF AT&T TEXAS/SWBT FACILITIES, ALL EXCAVATIONS MUST BE ACCOMPLISHED USING NON-MECHANIZED EXCAVATION PROCEDURES. WHEN BORING THE CONTRACTOR SHALL EXPOSE THE AT&T TEXAS/SWBT FACILITIES.

4. WHEN AT&T TEXAS/SWBT FACILITIES ARE EXPOSED, THE CONTRACTOR WILL PROVIDE SUPPORT TO THE CONDUIT DUCTS OR CABLES. WHEN EXCAVATING NEAR TELEPHONE POLES THE CONTRACTOR SHALL BRACE THE POLE FOR SUPPORT.

5. THE PRESENCE OR ABSENCE OF AT&T TEXAS/SWBT UNDERGROUND CONDUIT FACILITIES SHOWN ON THESE PLANS DOES NOT MEAN THAT THERE ARE NO DIRECT BURIED CABLES OR OTHER CABLES IN CONDUIT.

6. PLEASE CONTACT AT&T TEXAS DAMAGE PREVENTION MANAGER MR. ROOSEVELT LEE JR. AT (713) 567-4452 OR EMAIL HIM AT RL7259@ATT.COM, IF THERE ARE ANY QUESTIONS ABOUT BORING OR EXCAVATING NEAR OUT AT&T TEXAS/SWBT FACILITIES.

CENTERPOINT ENERGY EASEMENT:

NO APPROVAL TO USE, CROSS, OR OCCUPY CENTERPOINT FEE OF EASEMENT PROPERTY IS GIVEN. IF YOU NEED TO USE CENTERPOINT PROPERTY, PLEASE CONTACT CENTERPOINT ENERGY SURVEYING & RIGHT OF WAY DIVISION AT (713) 207-6248 OR (713) 207-5769.

CENTERPOINT ENERGY ELECTRIC FACILITIES:

1. CAUTION - OVERHEAD ELECTRICAL LINES. OVERHEAD LINES MAY EXIST ON THE PROPERTY. THE LOCATION OF OVERHEAD LINES HAS NOT BEEN DRAWN ON THESE DRAWINGS AS THE LINES ARE CLEARLY VISIBLE, BUT YOU SHOULD LOCATE THEM PRIOR TO BEGINNING CONSTRUCTION. TEXAS LAW, SECTION 752, HEALTH AND SAFETY CODE FORBIDS ACTIVITIES THAT OCCUR IN CLOSE PROXIMITY TO HIGH VOLTAGE LINES, SPECIFICALLY:

1.1 ANY ACTIVITY WHERE PERSON OR THINGS MAY COME WITHIN SIX (6) FEET OF LIVE OVERHEAD HIGH VOLTAGE LINES; AND

1.2 OPERATING A CRANE, DERRICK, POWER SHOVEL, DRILLING RIG, PILE DRIVER, HOISTING EQUIPMENT, OR SIMILAR APPARATUS WITHIN TEN (10) FEET OF LIVE OVERHEAD HIGH VOLTAGE LINES.

2. PARTIED RESPONSIBLE FOR THE WORK, INCLUDING CONTRACTORS ARE LEGALLY RESPONSIBLE FOR THE SAFETY OF CONSTRUCTION WORKERS UNDER THIS LAW. THIS LAW CARRIES BOTH CRIMINAL AND CIVIL LIABILITY. TO ARRANGE FOR LINES TO BE TURNED OFF OR REMOVED CALL CENTERPOINT ENERGY AT (713) 207-2222.

PRIVATE UTILITY NOTES(CONT.):

CENTERPOINT ENERGY GAS FACILITIES:

1. CAUTION - UNDERGROUND GAS FACILITIES. LOCATIONS OF CENTERPOINT ENERGY MAIN LINES (TO INCLUDE CENTERPOINT ENERGY, INTRASTATE PIPELINE, LLC WHERE APPLICABLE) ARE SHOWN IN APPROXIMATE LOCATION ONLY. SERVICE LINES ARE USUALLY NOT SHOWN. OUR SIGNATURE ON THESE PLANS ONLY INDICATES THAT OUR FACILITIES ARE SHOWN IN APPROXIMATE LOCATION. IT DOES NOT IMPLY THAT A CONFLICT ANALYSIS HAS BEEN MADE. THE CONTRACTOR SHALL CONTACT THE UTILITY COORDINATING COMMITTEE AT (800) 223-545-6001 OR 811 A MINIMUM OF FORTY-EIGHT (48) HOURS PRIOR TO CONSTRUCTION TO HAVE MAIN AND SERVICE LINES FIELD LOCATED.

2. WHEN CENTERPOINT ENERGY PIPE LINE MARKINGS ARE NOT VISIBLE CALL (713) 945-8037 (7:00 AM TO 4:30 PM) FOR STATUS OF LINE LOCATION REQUEST BEFORE EXCAVATION BEGINS.

3. WHEN EXCAVATING WITHIN EIGHTEEN (18) INCHES OF THE INDICATED LOCATION OF CENTERPOINT ENERGY FACILITIES, ALL EXCAVATION MUST BE ACCOMPLISHED USING NON-MECHANIZED EXCAVATION PROCEDURES.

4. WHEN CENTERPOINT ENERGY FACILITIES ARE EXPOSED, SUFFICIENT SUPPORT MUST BE PROVIDED TO THE FACILITIES TO PREVENT EXCESSIVE STRESS ON THE PIPING.

5. FOR EMERGENCIES REGARDING GAS LINES CALL (713) 659-3552 OF (713) 207-4200.

6. THE CONTRACTOR IS FULLY RESPONSIBLE FOR DAMAGES CAUSED BY THEIR FAILURE TO EXACTLY LOCATE AND PRESERVE THESE UNDERGROUND FACILITIES.

COMCAST FACILITIES:

1. CONTACT MR. BILL LEOPARD AT (281) 802-1679 OR MR. MOHAMMAD WOHEIDY AT (713) 895-1213 BEFORE PROCEEDING WITH CONSTRUCTION WORK IN THE VICINITY OF COMCAST/TIME WARNER CABLE FACILITIES.

2. WHEN EXCAVATING WITHIN EIGHTEEN (18) INCHES OF THE INDICATED LOCATION OF UNDERGROUND FACILITY, ALL EXCAVATION MUST BE ACCOMPLISHED USING NON-MECHANIZED EXCAVATION PROCEDURES.

TEXAS-NEW MEXICO POWER COMPANY ELECTRIC FACILITIES:

1. CAUTION - OVERHEAD ELECTRICAL LINES. TEXAS LAW, ARTICLE 1436C, PROHIBITS ALL ACTIVITIES IN WHICH PERSONS OR EQUIPMENT MAY COME WITHIN SIX (6) FEET OF ENERGIZED OVERHEAD POWER LINES, AND FEDERAL REGULATIONS, TITLE 29, PART 1910.180(1) AND PART 1926.550(A)(15) REQUIRE A MINIMUM CLEARANCE OF TEN (10) FEET FROM THESE FACILITIES. ABOVE LAWS CARRY BOTH CRIMINAL AND CIVIL LIABILITIES. IF THE CONTRACTOR PERFORMS ANY WORK NEAR OVERHEAD POWER LINES THEY MUST CALL (281) 996-0453 FOR THE LINES TO BE DE-ENERGIZED AND/OR MOVED AT THEIR EXPENSE PRIOR TO PERFORMING WORK.

2. NOTE: LOCATION OF TEXAS-NEW MEXICO POWER COMPANY FACILITIES ARE APPROXIMATE AND HAVE NOT BEEN VERIFIED BY ACTUAL FIELD CHECK.

3. OVERHEAD LINES MAY EXIST ON THE PROPERTY. WE HAVE NOT ATTEMPTED TO MARK THOSE LINES HAS SINCE THEY ARE CLEARLY VISIBLE, BUT YOU SHOULD LOCATE THEM PRIOR TO BEGINNING CONSTRUCTION.

4. TEXAS LAW, SECTION 752, HEALTH AND SAFETY CODE FORBIDS ACTIVITIES WHICH PERSONS OR THINGS MAY COME WITHIN SIX (6) FEET OF LIVE OVERHEAD HIGH VOLTAGE LINES.

5. CONTRACTORS ARE LEGALLY RESPONSIBLE FOR THE SAFETY OF CONSTRUCTION WORKERS UNDER THIS LAW. LAW CARRIES BOTH CRIMINAL AND CIVIL LIABILITY. TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED CALL TEXAS-NEW MEXICO POWER COMPANY AT (281) 996-0453.

6. CONTRACTOR TO NOTIFY THE "UNDERGROUND COORDINATING COMMITTEE" TELEPHONE (713) 223-4567 FORTY-EIGHT (48) HOURS BEFORE STARTING WORK IN STREET RIGHTS-OF-WAY OR EASEMENTS..

ENTERPRISE PIPELINE NOTES:

1. ...

WARNING!
HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM ENTERPRISE PRODUCTS OPERATING LLC

2. CONSTRUCTION PARAMETERS: NO EQUIPMENT WILL BE ALLOWED TO WORK OVER THE PIPELINE, UNLESS APPROVED BY COMPANY'S REPRESENTATIVE. COMPANY WILL REQUIRE A MINIMUM OF 72 HOURS WRITTEN NOTICE PRIOR TO CROSSING THE PIPELINE WITH HEAVY EQUIPMENT. EXCAVATORS MUST WORK/DIG PARALLEL TO THE PIPELINE, AND THE BUCKETS MUST HAVE BARRED TEETH. ANY EXCAVATION WITHIN EIGHTEEN (18) INCHES PLUS HALF THE DIAMETER OF THE PIPELINE WILL BE DONE BY HAND; HOWEVER, NO MECHANICAL EXCAVATION SHOULD EVER BE PERFORMED LESS THAN TWO (2) FEET FROM THE PIPELINE. NO VIBRATORY COMPACTION EQUIPMENT IS ALLOWED WITHIN THE EASEMENT. LANDOWNER'S CROSSING(S) WILL BE AS CLOSE TO NINETY (90) DEGREES AS POSSIBLE TO THE PIPELINE, BUT NOT LESS THAN FORTY-FIVE (45) DEGREES. COMPANY WILL REQUIRE PHYSICAL VERIFICATION OF PIPELINE DEPTH OF COVER AND ALIGNMENT, AT LANDOWNER'S EXPENSE, PRIOR TO WORK BEING PERFORMED NEAR THE PIPELINE. THE METHOD OF PHYSICAL VERIFICATION, WHETHER HYDRO-EXCAVATION OR OTHER MEANS, SHALL BE COORDINATED AND APPROVED BY COMPANY'S FIELD REPRESENTATIVE. IF THE PIPELINE IS NOT AT THE ANTICIPATED ALIGNMENT OR DEPTH, LANDOWNER SHALL ADJUST THE ENCROACHMENT ACCORDINGLY AT NO EXPENSE TO COMPANY. A MINIMUM OF FOUR (4) FEET OF COVER MUST BE MAINTAINED OVER THE PIPELINE.

3. ROADWAY EXTENSION AND CROSSING: LANDOWNER'S PROPOSED ROADWAY EXTENSION WITH MEDIAN SHALL BE CONSTRUCTED WITHIN THE PIPELINE EASEMENT WITH ITS MEDIAN CENTERED APPROXIMATELY OVER THE PIPELINE FROM STONEY LAKE DRIVE TO DITCH NO. 4 (STA. 54+00) WITH A MINIMUM SIX (6) FEET DEPTH OF COVER. APPROXIMATELY TWO HUNDRED (200) FEET OF WEST BOUND ROADWAY CONCRETE PAVEMENT WILL BE OVER THE PIPELINE AFTER CROSSING THE DITCH NO. 4 WITH A MINIMUM SEVEN (7) FEET DEPTH OF COVER AND WILL GRADUALLY OFFSET SOUTH OF THE PIPELINE EASEMENT. IN ANY PAVED AREAS, LANDOWNER WILL INSTALL EXPANSION JOINTS IN THE CONCRETE PAVEMENT AT NO GREATER THAN TEN (10) FOOT INTERVALS TO AID IN REMOVAL IF NECESSARY. LANDOWNER WILL BE RESPONSIBLE FOR ALL FUTURE COSTS ASSOCIATED WITH TRAFFIC CONTROL ITEMS AND APPURTENANCES, INCLUDING ANY COST ASSOCIATED WITH TRENCH MECHANICAL SHORING ITEMS, IN THE EVENT THAT COMPANY OR ITS DESIGNEE MUST ACCESS THE PIPELINE AND/OR ASSOCIATED EASEMENT TO PERFORM ROUTINE OR EMERGENCY MAINTENANCE.

4. HEAVY EQUIPMENT: COMPANY WILL REQUIRE A MINIMUM OF 72 HOURS WRITTEN NOTICE PRIOR TO CROSSING THE PIPELINE WITH HEAVY EQUIPMENT. WHEREVER LANDOWNER WILL CROSS THE PIPELINE AND/OR EASEMENT WITH HEAVY EQUIPMENT, LANDOWNER WILL PLACE MATTING OR OTHER SUITABLE MATERIAL OVER THE PIPELINE AND/OR EASEMENT AS DETERMINED BY COMPANY'S FIELD REPRESENTATIVE. LANDOWNER SHALL MAINTAIN A MINIMUM FOUR (4) FEET OF STABLE SOIL COVER ABOVE THE PIPELINE AT LOCATIONS WHERE CONSTRUCTION ACTIVITIES REQUIRE CROSSING OVER THE PIPELINE WITH HEAVY CONSTRUCTION EQUIPMENT. NO LARGE VIBRATORY COMPACTION EQUIPMENT IS ALLOWED WITHIN TEN (10) FEET FROM THE PIPELINE, ONLY WALK-BEHIND VIBRATORY ROLLERS/COMPACTORS ARE ALLOWED

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

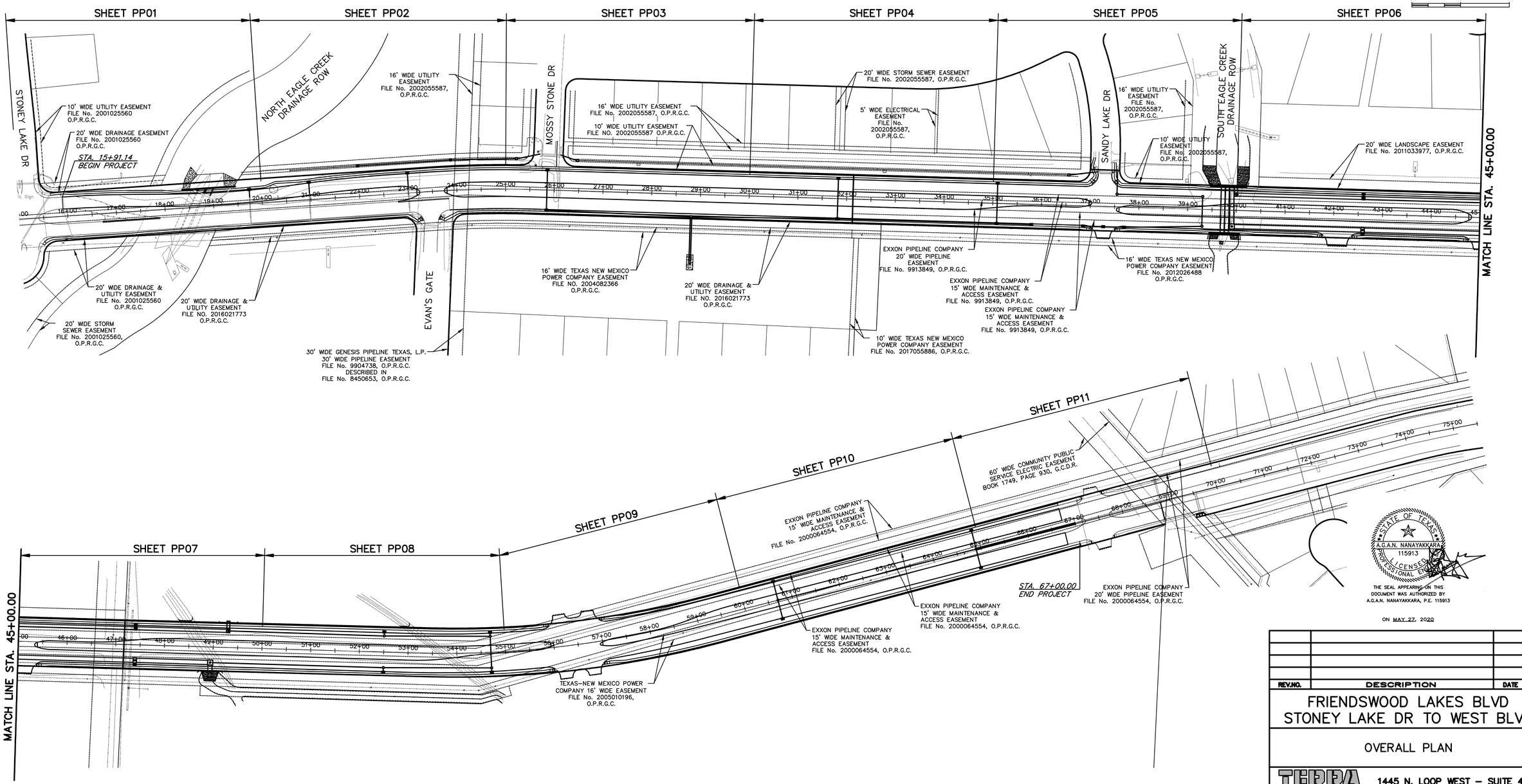
FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

GENERAL CONSTRUCTION NOTES

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST - SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE04

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\GE04 CONSTRUCTION NOTES.dwg May 27, 2020-10:31am Terra Associates Inc., Thanh Dao



STATE OF TEXAS
A.G.A.N. NANAYAKKARA
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ON MAY 27, 2020

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FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

OVERALL PLAN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 100'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE05

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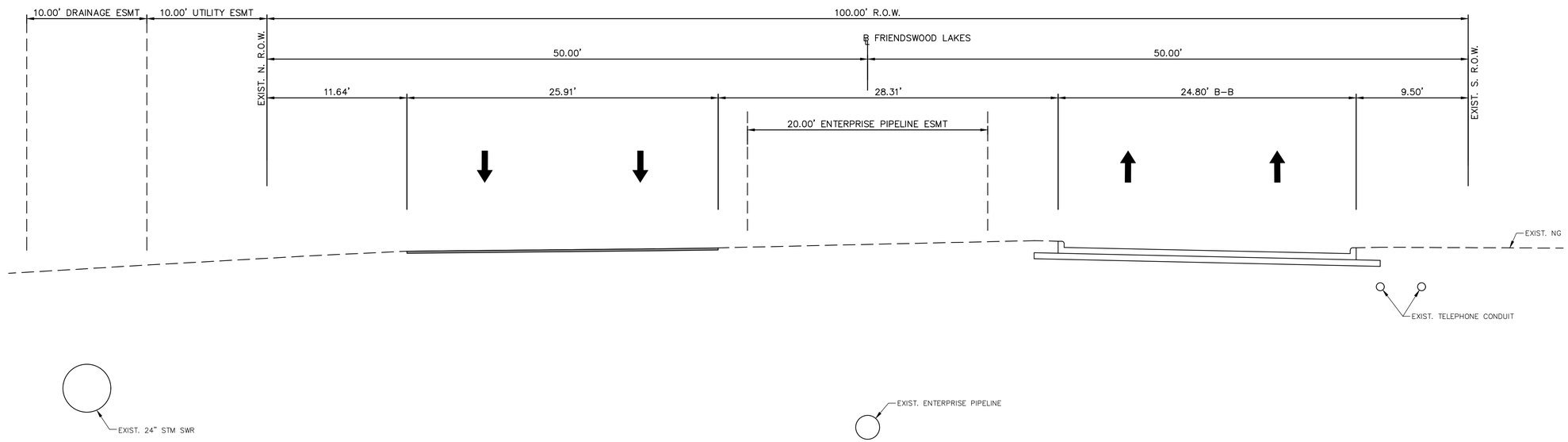
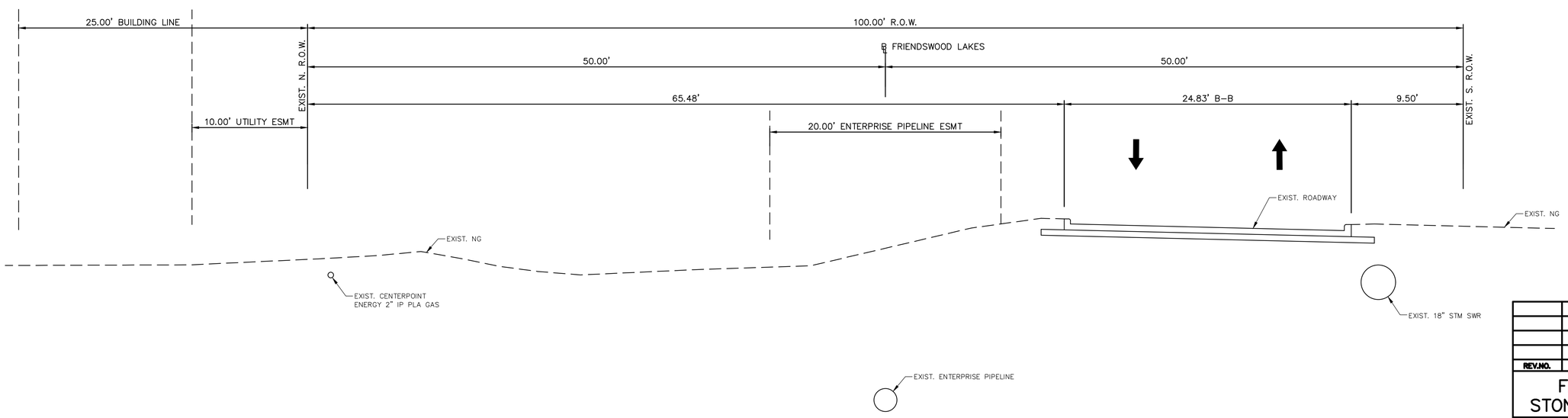


FRIENDSWOOD LAKES BLVD
EXIST. TYPICAL SECTION
STA. 16+00 TO STA. 17+88



FRIENDSWOOD LAKES BLVD
EXIST. TYPICAL SECTION
STA. 17+88 TO STA. 23+83

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED
PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

EXISTING TYPICAL SECTION

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
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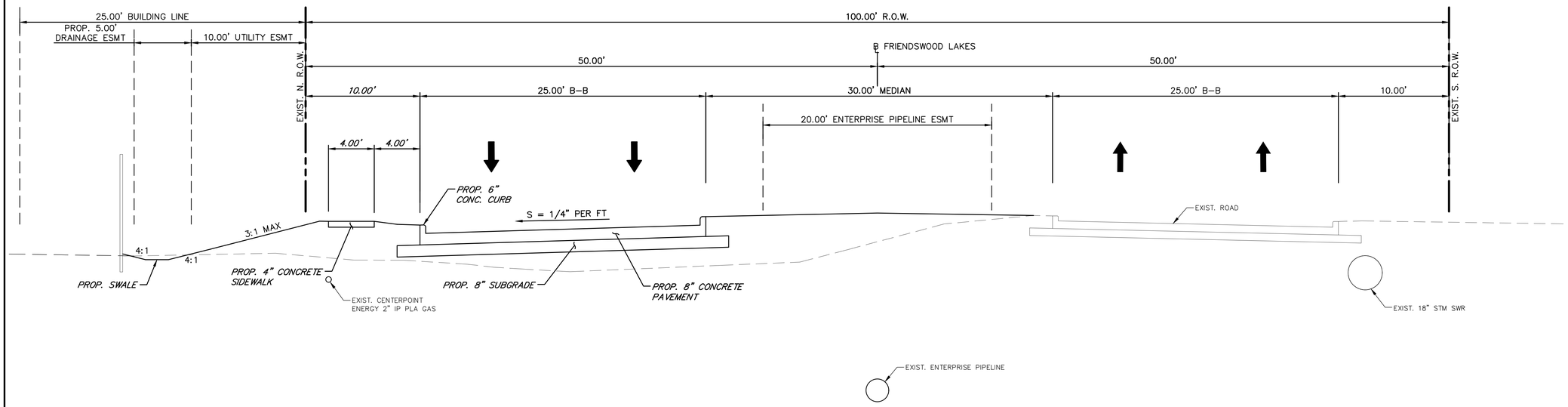
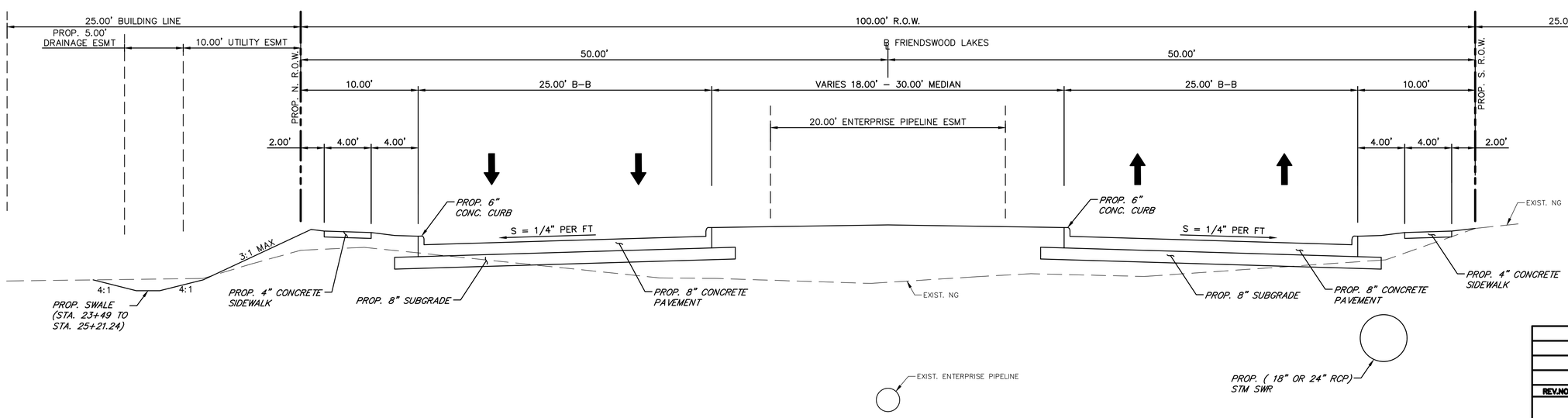


FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION
STA. 16+00 TO STA. 23+49



FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION
STA. 23+49 TO STA. 32+12.99

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

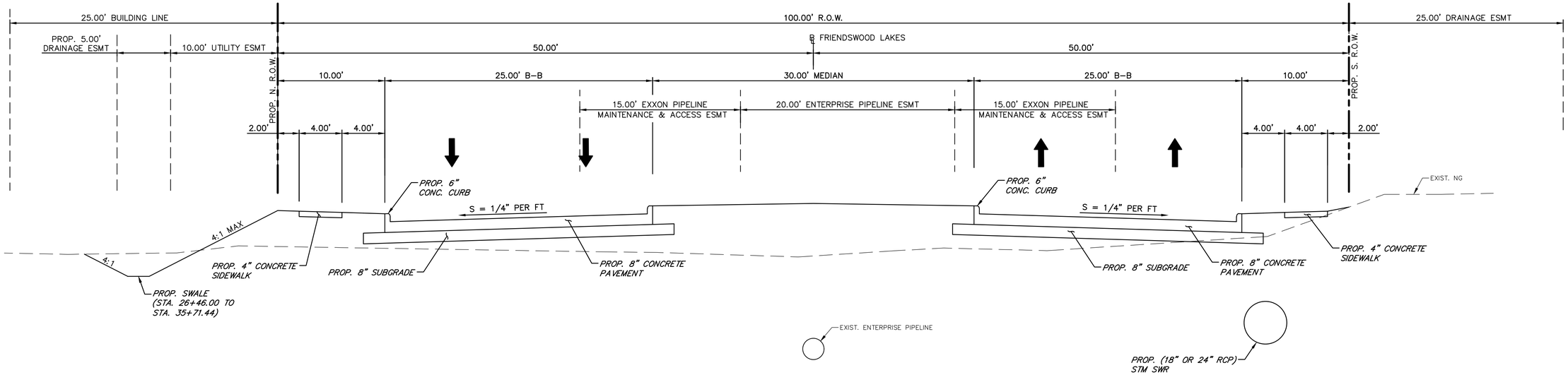
PROPOSED TYPICAL SECTIONS
(1 OF 4)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

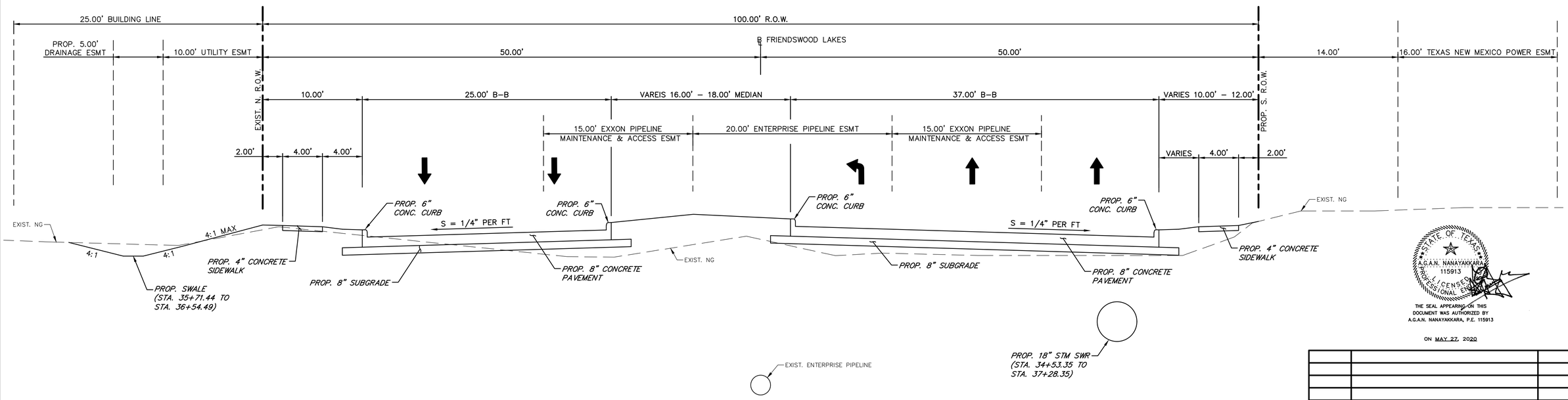
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE07

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\TY01.dwg May 27, 2020-10:31am Terra Associates Inc., Thanh Dao



FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION
STA. 32+12.99 TO STA. 34+53.35



FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION
STA. 34+53.35 TO STA. 37+28.35
STA. 53+48.81 TO STA. 56+47.34

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

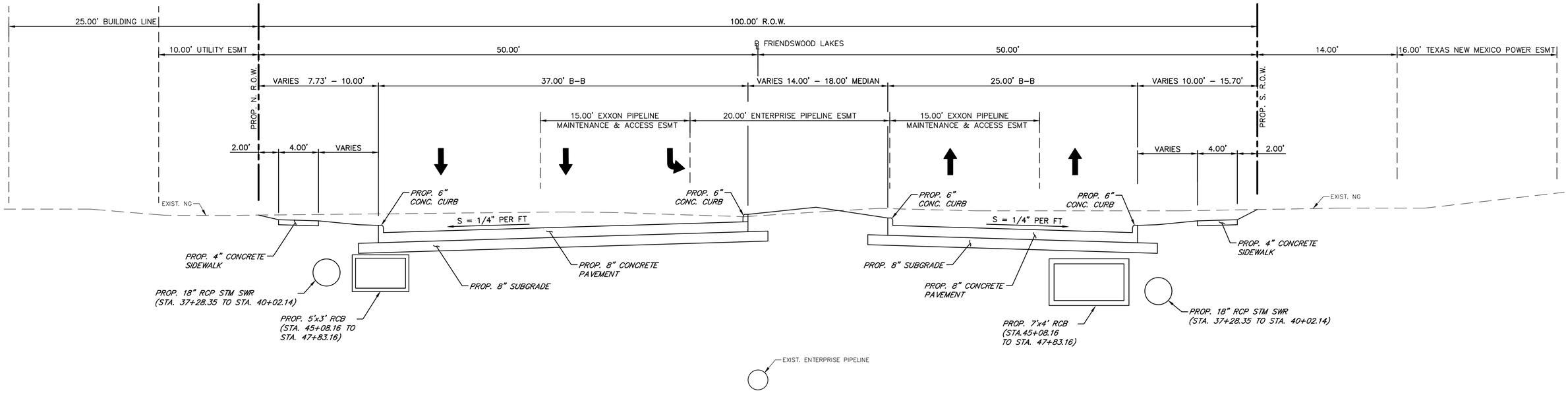
PROPOSED TYPICAL SECTION
(2 OF 4)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

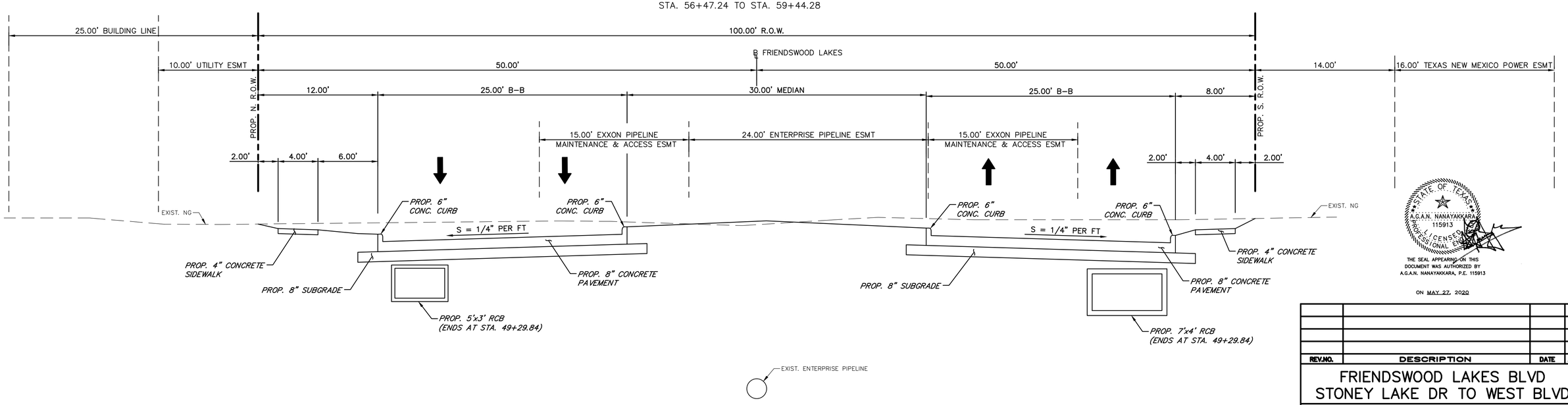
DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE08

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\GE08 PROPOSED TYPICAL SECTION (2 OF 2).dwg May 27, 2020-10:31am Terra Associates Inc., Thanh Dao



FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION

STA. 37+28.35 TO STA. 40+02.14
STA. 45+08.16 TO STA. 47+83.16
STA. 56+47.24 TO STA. 59+44.28



FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION

STA. 40+02.14 TO STA. 45+08.16
STA. 47+83.16 TO STA. 53+75.44

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
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LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

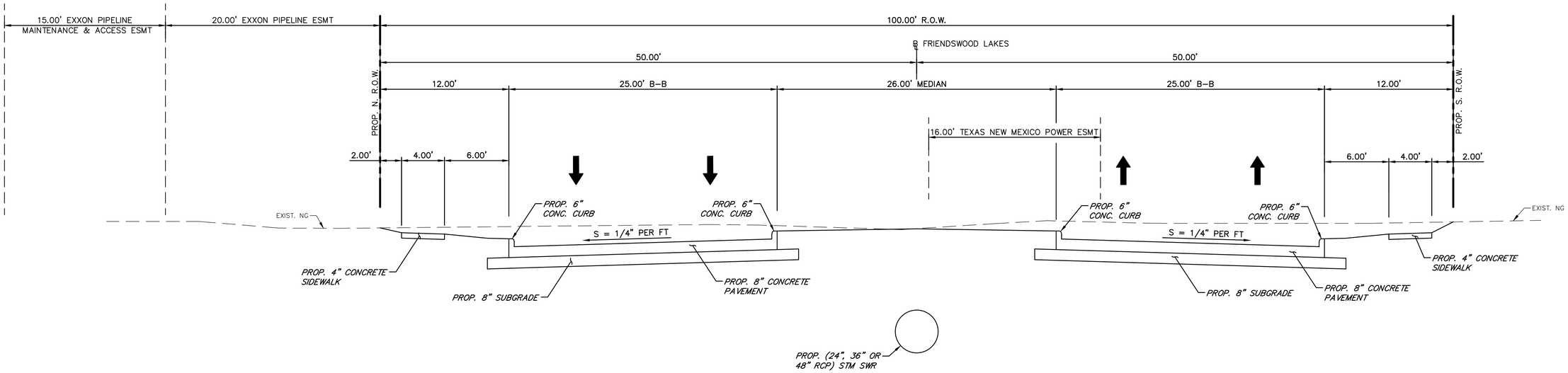
PROPOSED TYPICAL SECTION
(3 OF 4)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

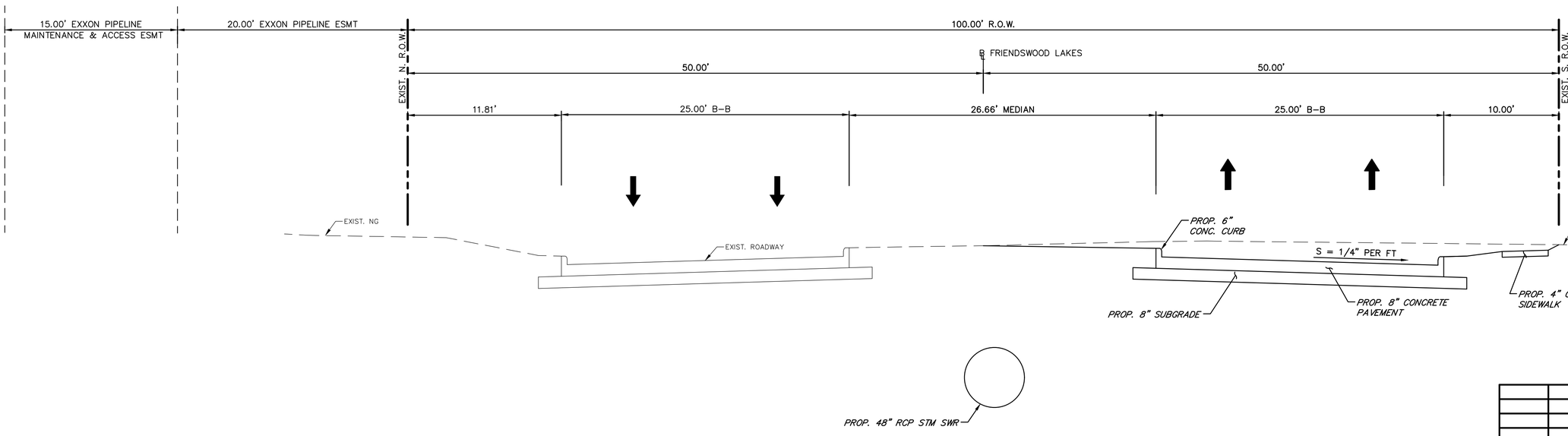
DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE09

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\GE09 PROPOSED TYPICAL SECTION (3 OF 4).dwg May 27, 2020-10:31am Terra Associates Inc., Thanh Dao



FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION

STA. 59+72.34 TO STA. 66+75.00
STA. 66+75.00 TO STA. 69+10.36 (ALT1)



FRIENDSWOOD LAKES BLVD
PROP. TYPICAL SECTION

STA. 69+10.36 TO STA. END (ALT1)

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

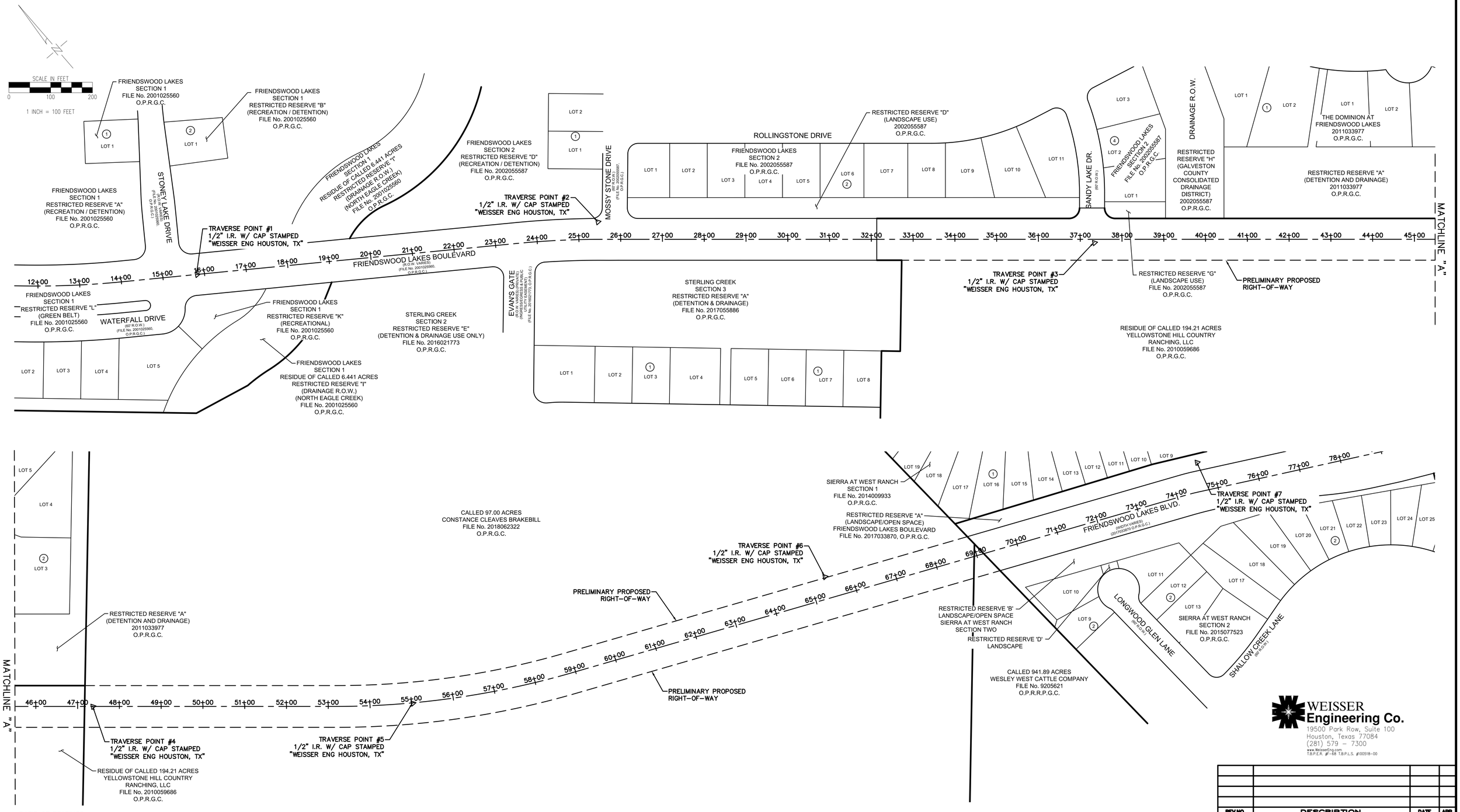
PROPOSED TYPICAL SECTION
(4 OF 4)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GE10

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\GE10 PROPOSED TYPICAL SECTION (3 OF 4).dwg May 27, 2020-10:31am Terra Associates Inc., Thanh Dao



BASIS OF BEARINGS:
TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE No. 4204 (NAD 83) (2001 Adj.) THE COORDINATES SHOWN HEREON ARE GRID COORDINATES AND MAY BE BROUGHT TO SURFACE BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 1.000129866.86. ALL DISTANCES ARE SURFACE.

BENCHMARK:
HARRIS–GALVESTON COASTAL SUBSIDENCE DISTRICT MON. #54
DESCRIPTION: STAINLESS STEEL ROD IN SLEEVE WITH CAP STAMPED "HGCSD 54 1986"
LOCATION: 1.1 MILES SOUTHWEST ALONG FARM ROAD 528 FROM THE INTERSECTION OF FARM ROAD 518 IN FRIENDSWOOD TO THE MARK ON THE LEFT, AT THE ENTRANCE TO CLEAR CREEK DRAINAGE DISTRICT ON THE SOUTHWEST SIDE OF A PARKING AREA, 86.0' SOUTHEAST OF THE CENTERLINE OF THE HIGHWAY, 73.6' NORTHEAST OF A UTILITY POLE AT THE WEST CORNER OF THE PROPERTY, 3.0' SOUTH–SOUTHWEST OF THE SOUTHWEST EDGE OF THE PARKING AREA. ACCESS TO DATUM POINT IS HAD THROUGH A 5–INCH LOGO CAP.
ELEVATION = 29.4', NAVD 88

WEISSER Engineering Co.
19500 Park Row, Suite 100
Houston, Texas 77084
(281) 579 – 7300
www.WeisserEng.com
T.B.P.E.R. #–68 T.B.P.L.S. #00518–00

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKE BLVD
STONEY LAKE DR TO WEST BLVD

SURVEY CONTROL OVERALL

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

STATE OF TEXAS REGISTERED WALTER P. SASS 4410 PROFESSIONAL LAND SURVEYOR

WALTER P. SASS
REGISTERED PROFESSIONAL LAND SURVEYOR
STATE OF TEXAS, No. 4410

DRAWN BY: W.E.C.	SCALE:	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: W.E.C.	DATE: APRIL, 2019	SHEET

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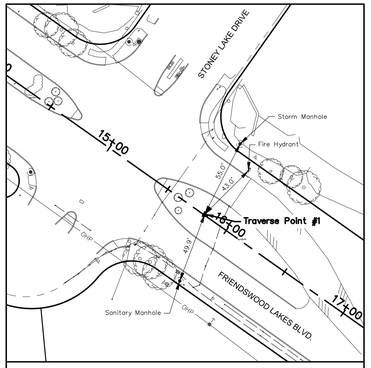
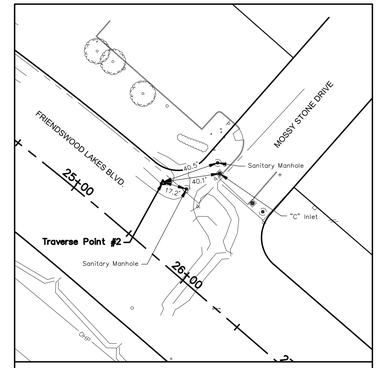
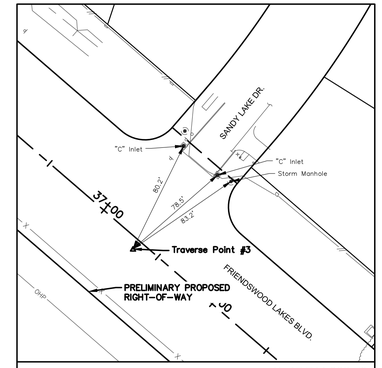
SCALE IN FEET
0 50 100
1 INCH = 50 FEET



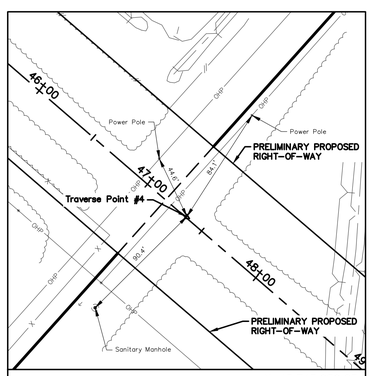
TRAVERSE POINT #1
1/2" I.R. W/ CAP STAMPED
"WEISSER ENG HOUSTON, TX"
N=13,745,955.53
E=3,175,835.30
ELEV. = 35.37'
STATION=15+81.21
OFFSET =0.68' Lt.



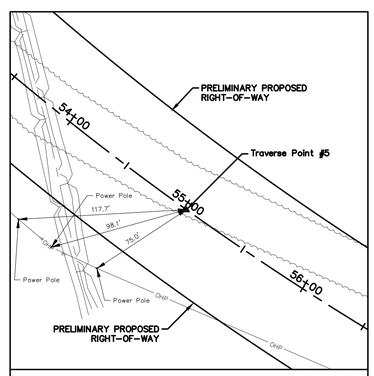
TRAVERSE POINT #2
1/2" I.R. W/ CAP STAMPED
"WEISSER ENG HOUSTON, TX"
N=13,745,423.57
E=3,176,643.55
ELEV. = 31.29'
STATION=25+44.64
OFFSET =42.90' Lt.



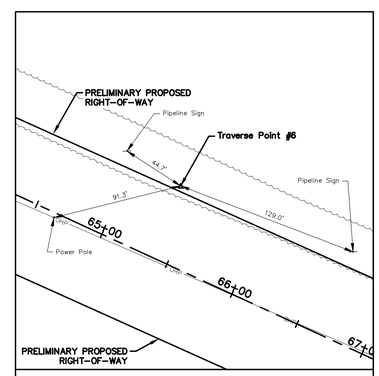
TRAVERSE POINT #3
1/2" I.R. W/ CAP STAMPED
"WEISSER ENG HOUSTON, TX"
N=13,744,608.39
E=3,177,509.89
ELEV. = 32.41'
STATION=37+33.16
OFFSET =7.19' Rt.



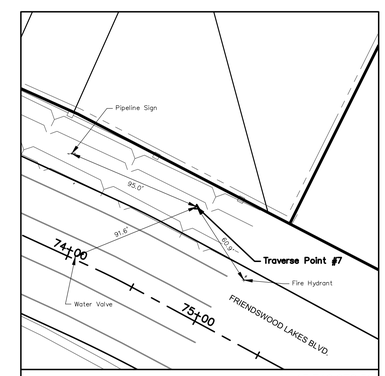
TRAVERSE POINT #4
1/2" I.R. W/ CAP STAMPED
"WEISSER ENG HOUSTON, TX"
N=13,743,959.03
E=3,178,273.45
ELEV. = 30.77'
STATION=47+35.61
OFFSET =0.96' Lt.



TRAVERSE POINT #5
1/2" I.R. W/ CAP STAMPED
"WEISSER ENG HOUSTON, TX"
N=13,743,463.95
E=3,178,858.03
ELEV. = 31.46'
STATION=55+01.99
OFFSET =0.16' Lt.



TRAVERSE POINT #6
1/2" I.R. W/ CAP STAMPED
"WEISSER ENG HOUSTON, TX"
N=13,743,048.02
E=3,179,801.97
ELEV. = 31.45'
STATION=65+35.88
OFFSET =53.72' Lt.



TRAVERSE POINT #7
1/2" I.R. W/ CAP STAMPED
"WEISSER ENG HOUSTON, TX"
N=13,742,672.51
E=3,180,654.84
ELEV. = 31.61'
STATION=74+63.19
OFFSET =70.99' Lt.

BASIS OF BEARINGS:
TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE No. 4204 (NAD 83) (2001 Adj.) THE COORDINATES SHOWN HEREON ARE GRID COORDINATES AND MAY BE BROUGHT TO SURFACE BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 1.00012986686. ALL DISTANCES ARE SURFACE.

BENCHMARK:
HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT MON. #54
DESCRIPTION: STAINLESS STEEL ROD IN SLEEVE WITH CAP STAMPED "HGCSD 54 1986"
LOCATION: 1.1 MILES SOUTHWEST ALONG FARM ROAD 528 FROM THE INTERSECTION OF FARM ROAD 518 IN FRIENDSWOOD TO THE MARK ON THE LEFT, AT THE ENTRANCE TO CLEAR CREEK DRAINAGE DISTRICT ON THE SOUTHWEST SIDE OF A PARKING AREA, 86.0' SOUTHEAST OF THE CENTERLINE OF THE HIGHWAY, 73.6' NORTHEAST OF A UTILITY POLE AT THE WEST CORNER OF THE PROPERTY, 3.0' SOUTH-SOUTHWEST OF THE SOUTHWEST EDGE OF THE PARKING AREA. ACCESS TO DATUM POINT IS HAD THROUGH A 5-INCH LOGO CAP.
ELEVATION = 29.4', NAVD 88

STATE OF TEXAS REGISTERED WALTER P. SASS 4410 PROFESSIONAL LAND SURVEYOR

WALTER P. SASS
REGISTERED PROFESSIONAL LAND SURVEYOR
STATE OF TEXAS, No. 4410

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Houston, Texas 77084
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www.WeisserEng.com
T.B.P.E.R. #-68 T.B.P.L.S. #100518-00

REV.NO.	DESCRIPTION	DATE	APP.

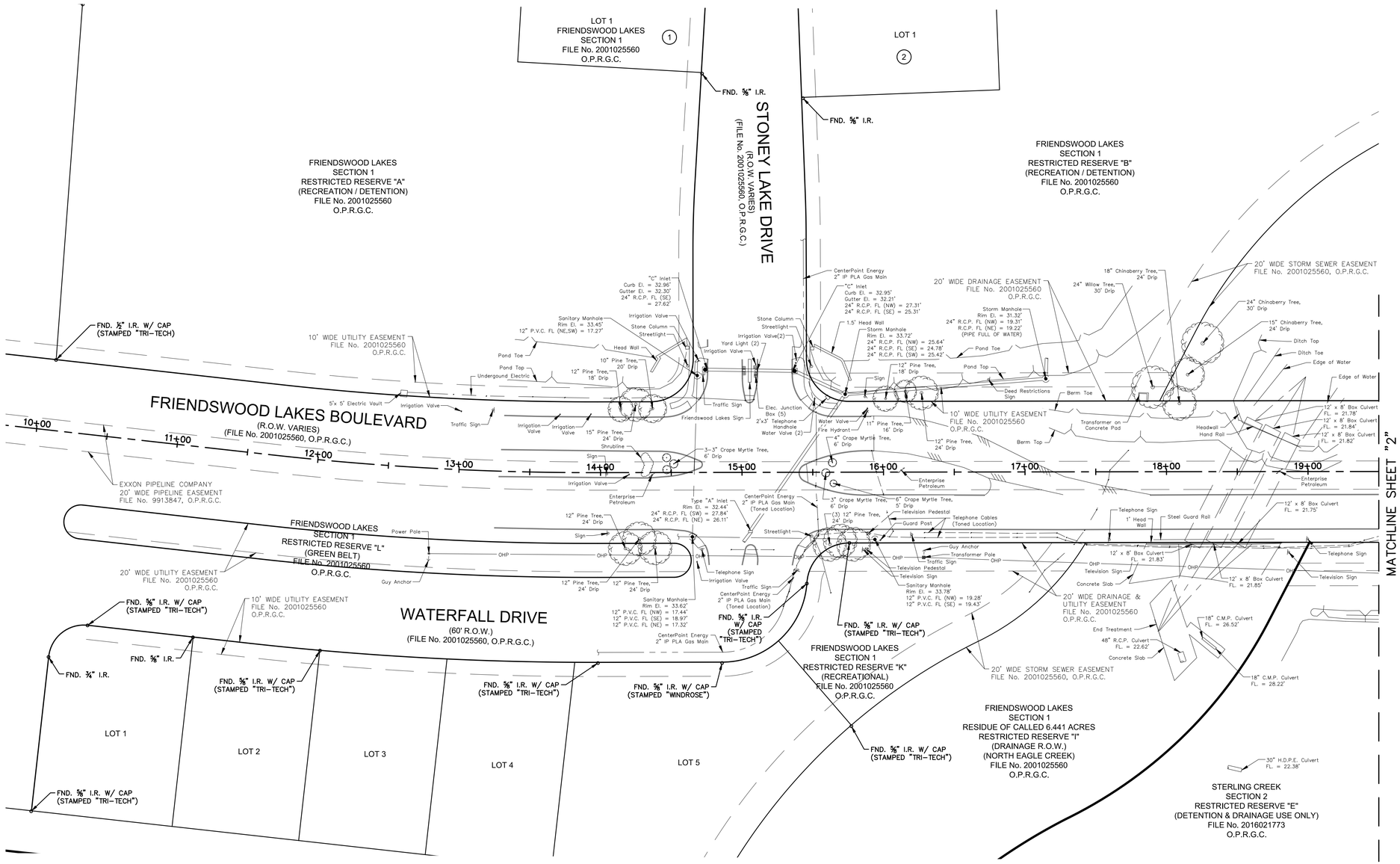
FRIENDSWOOD LAKE BLVD
STONEY LAKE DR TO WEST BLVD

SURVEY CONTROL DETAIL SHEET

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST - SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: W.E.C.	SCALE:	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: W.E.C.	DATE: APRIL, 2019	SHEET

P:\01453\dwg\Survey\01453 - Survey Control.dwg, Layout2, 12/10/19 12:28:30PM, dgatlep



SYMBOLS

- = AIR CONDITIONER
- = AERIAL MARKER
- = "BB INLET
- = "B" INLET
- = BENCHMARK
- = BILLBOARD
- = "C" INLET
- = "C1" INLET
- = "C2" INLET
- = "C2a" INLET
- = CABLE PEDESTAL
- = CIRCLE GRATE INLET
- = "D" INLET
- = "E" INLET
- = ELECTRIC JUNCTION BOX
- = ELECTRIC MANHOLE
- = ELECTRIC MANHOLE
- = ELECTRIC PEDESTAL
- = UNDERGROUND TRANSFORMER
- = FIRE HYDRANT
- = GAS METER
- = GUY ANCHOR
- = LIGHT STANDARD
- = MAILBOX
- = MANHOLE
- = METER POLE
- = PIPELINE VENT
- = PIPELINE MARKER
- = POWER POLE
- = SAMPLE WELL
- = SHRUB
- = SIGN
- = TELEPHONE MANHOLE
- = TELEPHONE PEDESTAL
- = TEMPORARY BENCHMARK
- = TONE MARK
- = TRAFFIC CONTROL BOX
- = TRAFFIC SIGNAL POLE
- = TRANSFORMER POLE
- = VALVE
- = WATER METER

SCALE IN FEET

0 40 80

1 INCH = 40 FEET

ABBREVIATIONS

C.M.	= CONTROL MONUMENT
FNC.	= FENCE
FND.	= FOUND
G.C.C.F.	= GALVESTON COUNTY CLERK'S FILE
G.C.D.R.	= GALVESTON COUNTY DEED RECORDS
G.C.M.R.	= GALVESTON COUNTY MAP RECORDS
I.P.	= IRON PIPE
I.R.	= IRON ROD
N.F.I.F.	= NOT FOUND IN FIELD
No.	= NUMBER
O.P.R.R.P.G.C.	= OFFICIAL PUBLIC RECORDS OF REAL PROPERTY, GALVESTON COUNTY, TEXAS
P.T.P.	= PINCHED TOP PIPE
P.V.C.	= POLYVINYL CHLORIDE PIPE
R.C.P.	= REINFORCED CONCRETE PIPE
R.O.W.	= RIGHT-OF-WAY
SQ. FT.	= SQUARE FOOT/FEET
S.W.B.T.	= SOUTHWESTERN BELL TELEPHONE
TYP.	= TYPICAL
VOL., PG.	= VOLUME, PAGE

FOR INTERIM REVIEW ONLY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW ONLY, UNDER THE AUTHORITY OF:

A.G.A.N. NANAYAKKARA
P.E. NO 115913
DATE: DECEMBER 10, 2019

AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION PURPOSES.

WEISSER
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BASIS OF BEARINGS:
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STATE OF TEXAS
REGISTERED
WALTER P. SASS
4410
PROFESSIONAL
LAND SURVEYOR

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REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKE BLVD
STONEY LAKE DR TO WEST BLVD

TERRA
ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
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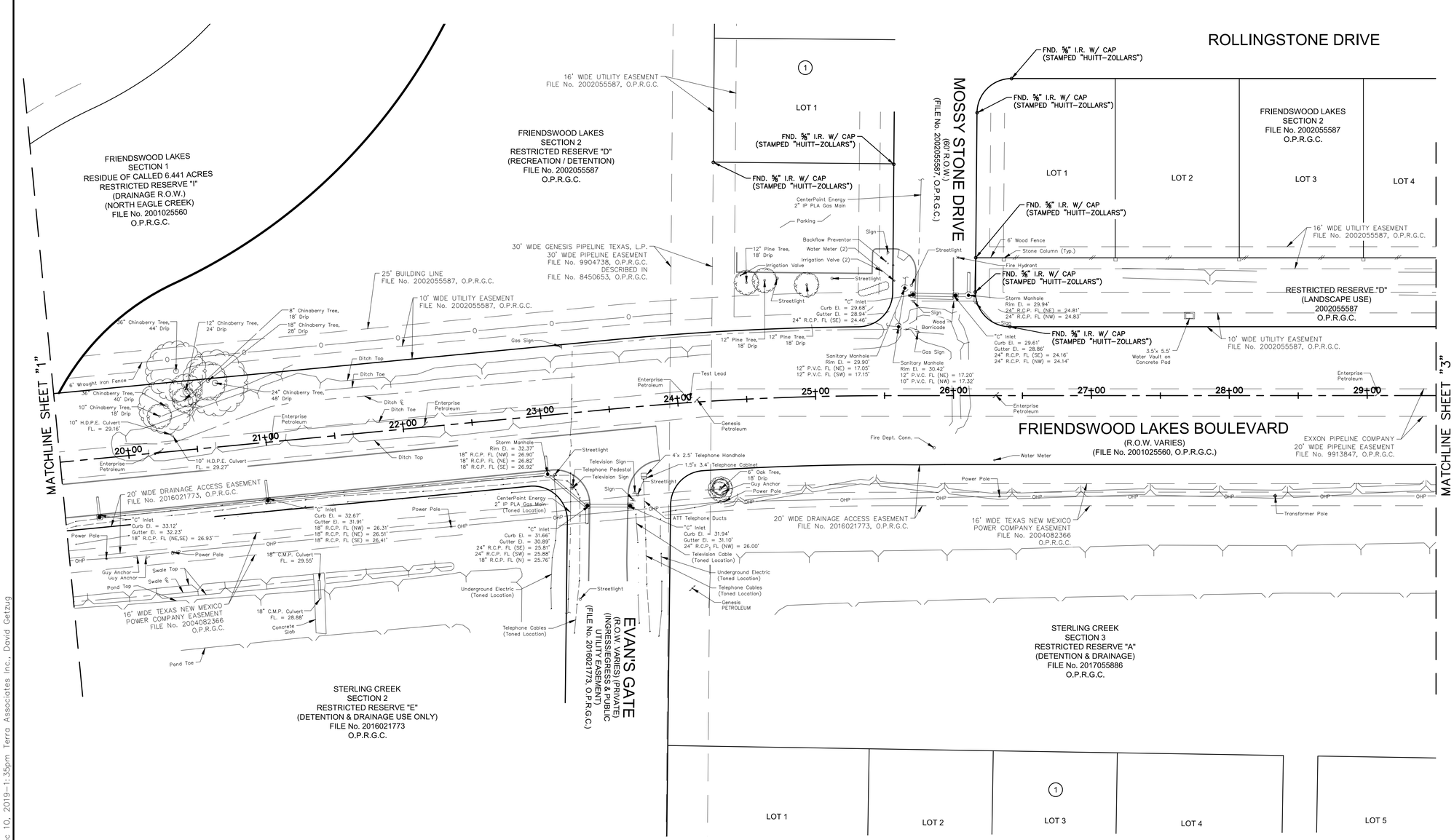
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: W.E.C.	SCALE:	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: W.E.C.	DATE: APRIL, 2019	SHEET

P:\CU452\dwg\Survey\CU452 – ROWMap–Existing.dwg Dec 10, 2019–1:34pm Terra Associates Inc., David Getzug



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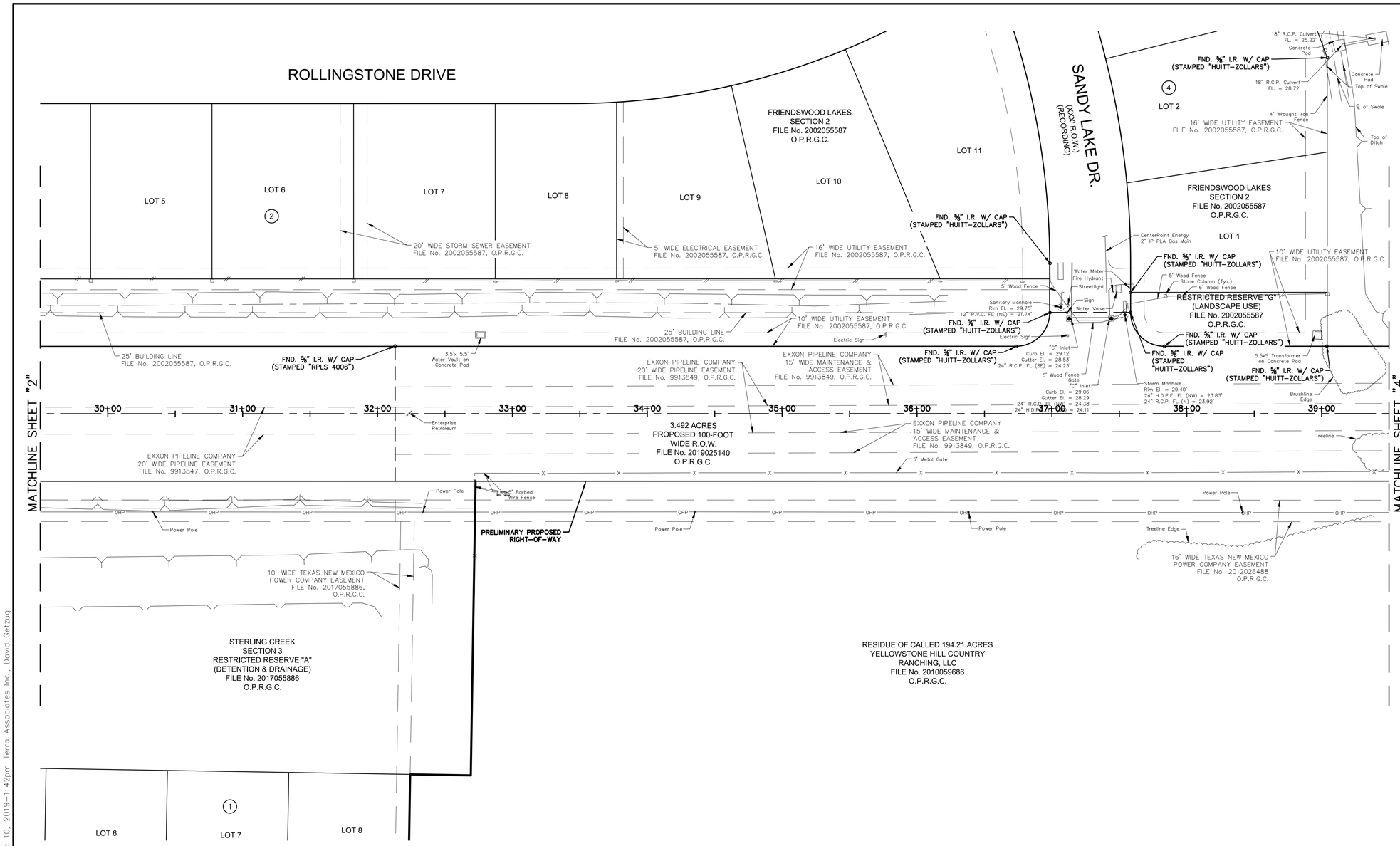

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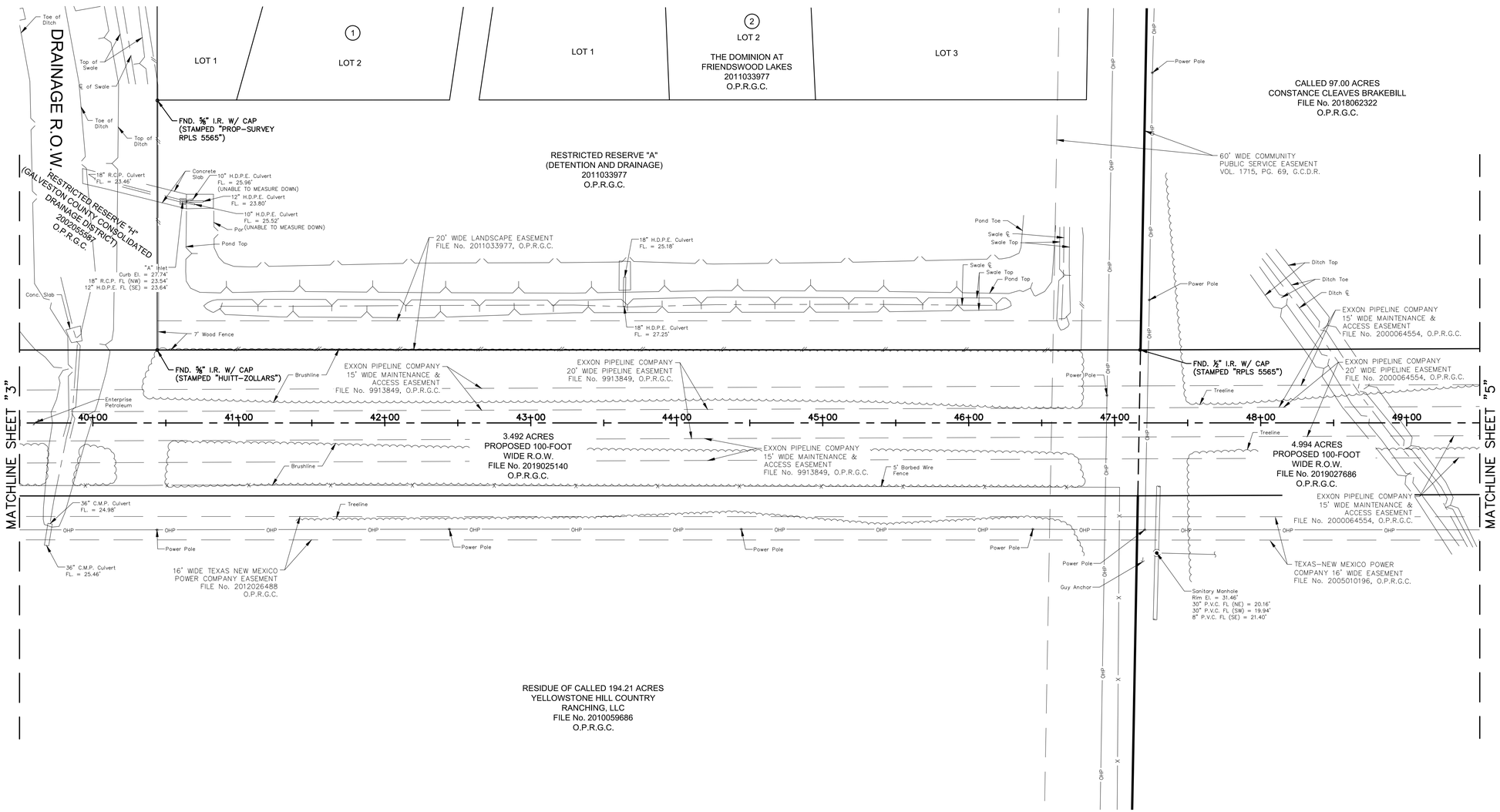

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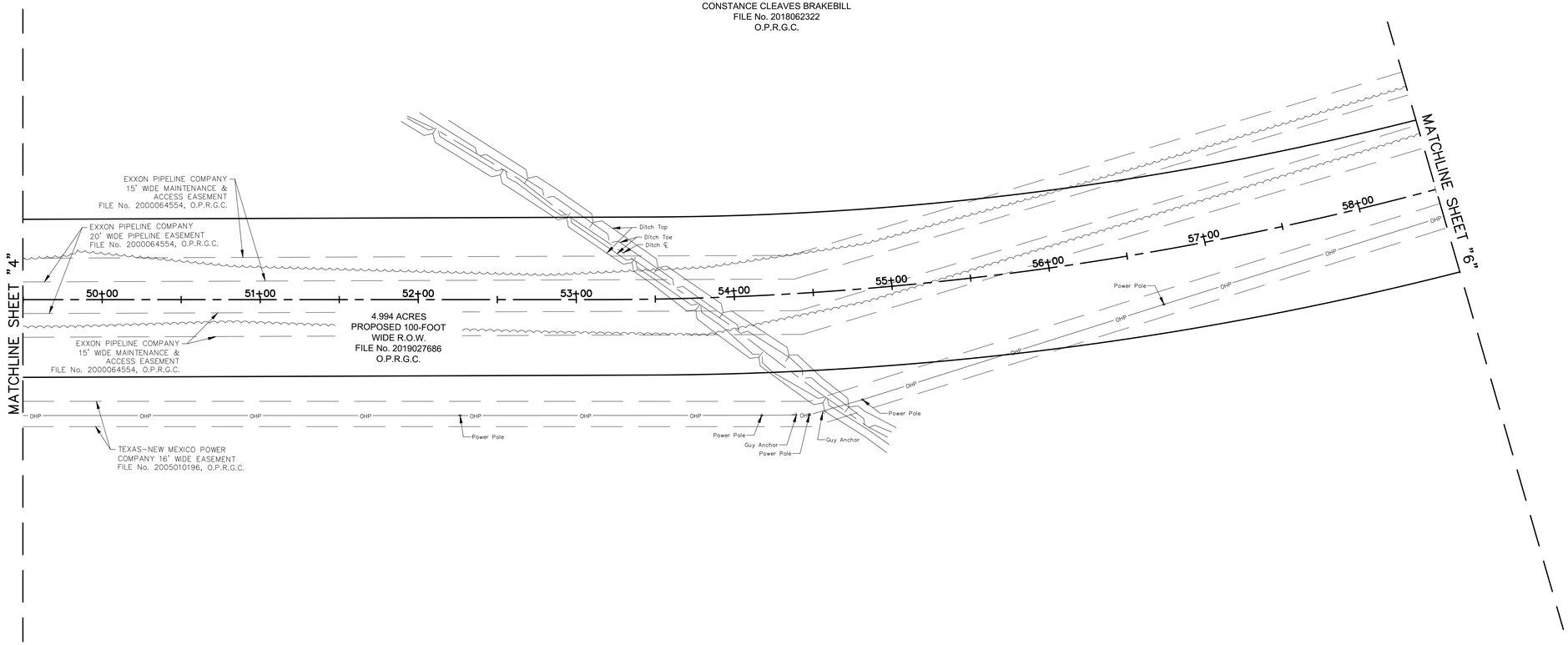

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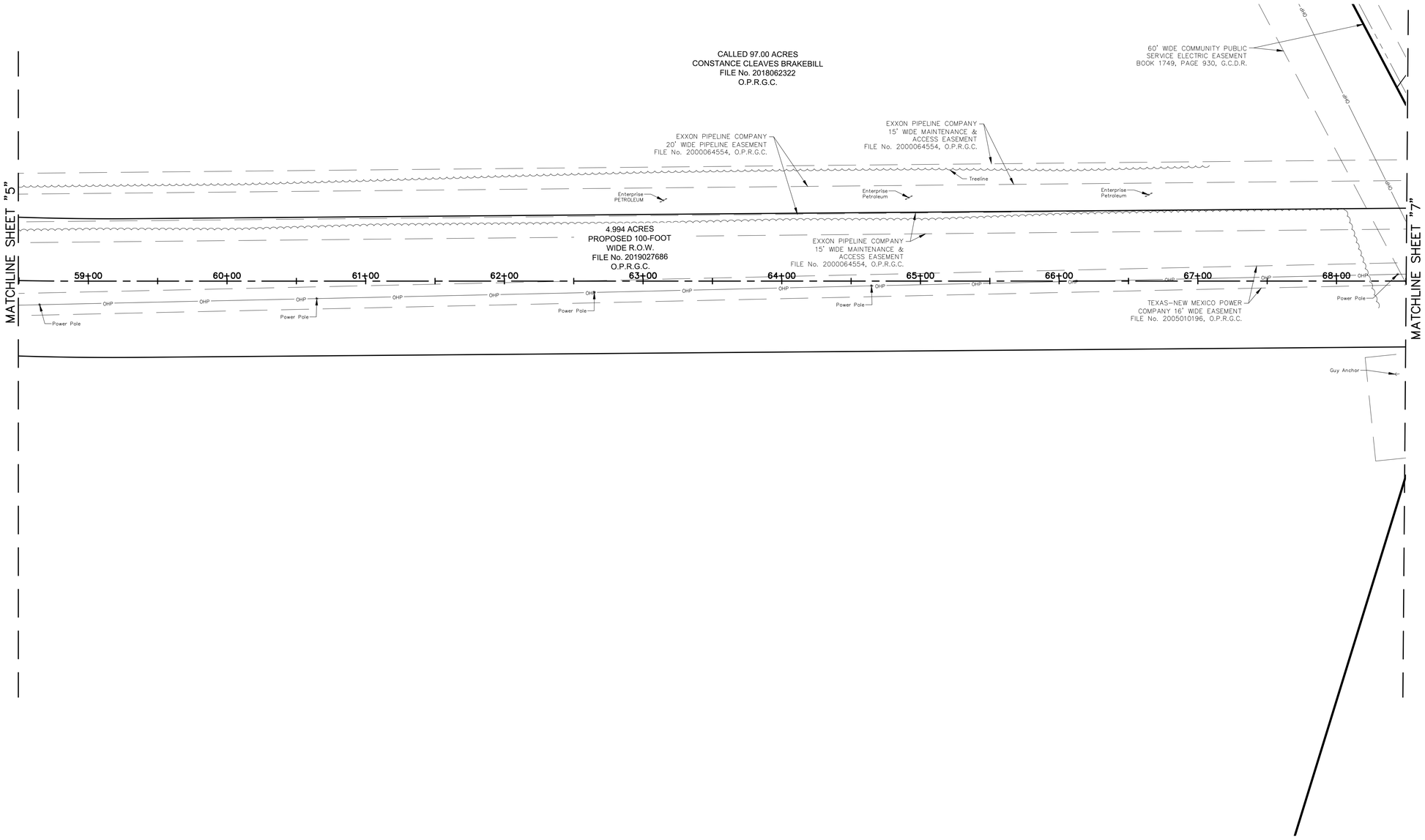

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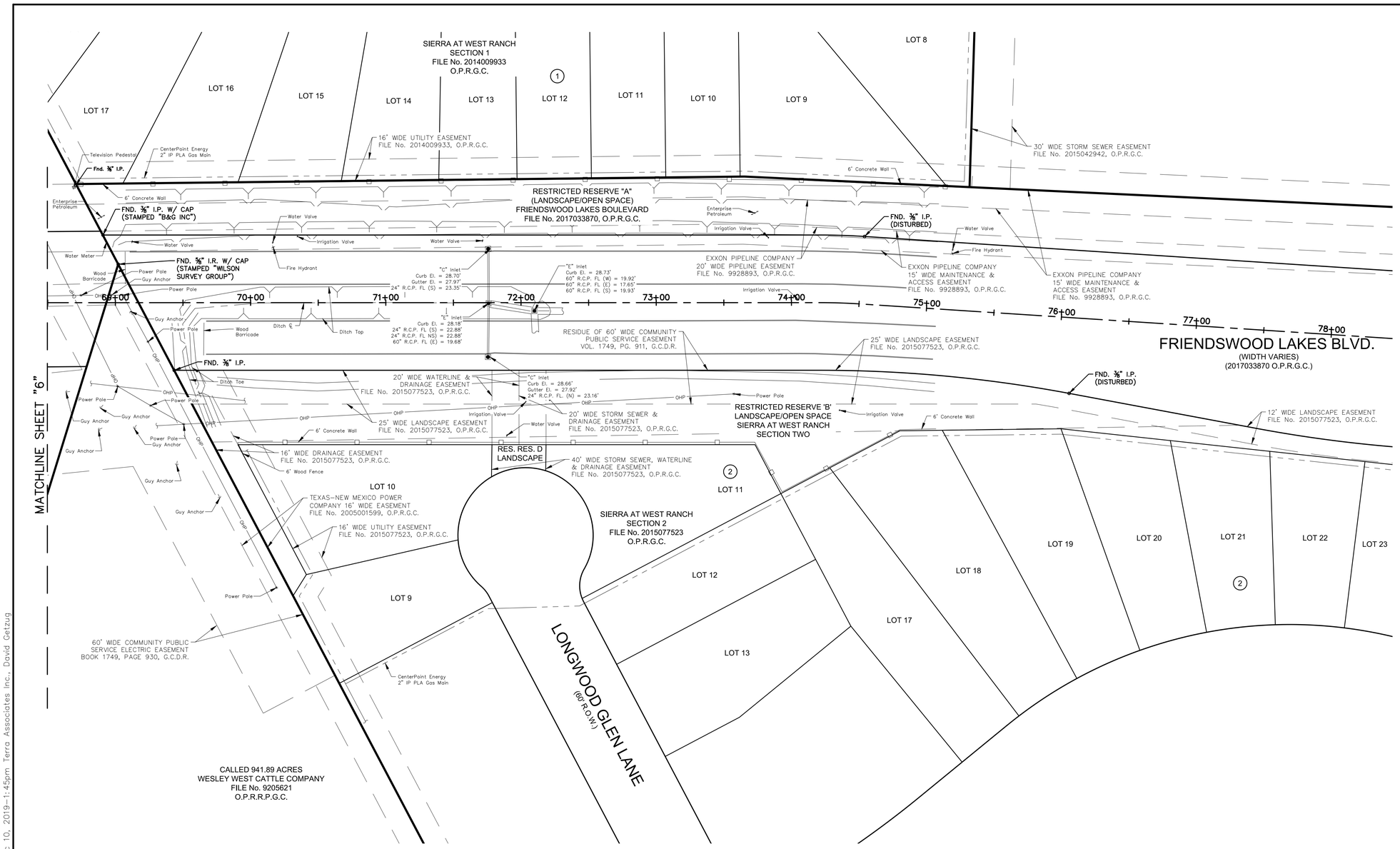

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P.V.C.	= POLYVINYL CHLORIDE PIPE
R.C.P.	= REINFORCED CONCRETE PIPE
R.O.W.	= RIGHT-OF-WAY
SQ. FT.	= SQUARE FOOT/FEET
S.W.B.T.	= SOUTHWESTERN BELL TELEPHONE
TYP.	= TYPICAL
VOL., PG.	= VOLUME, PAGE

FOR INTERIM REVIEW ONLY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW ONLY, UNDER THE AUTHORITY OF:

A.G.A.N. NANAYAKKARA
P.E. NO 115913
DATE: DECEMBER 10, 2019

AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION PURPOSES.

WEISSER
Engineering Co.
19500 Park Row, Suite 100
Houston, Texas 77084
(281) 579 - 7300
www.WeisserEng.com
T.B.P.E.R. #F-68 T.B.P.L.S. #100518-00

BASIS OF BEARINGS:
TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE No. 4204 (NAD 83) (2001 Adj.) THE COORDINATES SHOWN HEREON ARE GRID COORDINATES AND MAY BE BROUGHT TO SURFACE BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 1.00012986686. ALL DISTANCES ARE SURFACE.

BENCHMARK:
HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT MON. #54
DESCRIPTION: STAINLESS STEEL ROD IN SLEEVE WITH CAP STAMPED "HGCSD 54 1986"
LOCATION: 1.1 MILES SOUTHWEST ALONG FARM ROAD 528 FROM THE INTERSECTION OF FARM ROAD 518 IN FRIENDSWOOD TO THE MARK ON THE LEFT, AT THE ENTRANCE TO CLEAR CREEK DRAINAGE DISTRICT ON THE SOUTHWEST SIDE OF A PARKING AREA, 86.0' SOUTHEAST OF THE CENTERLINE OF THE HIGHWAY, 73.6' NORTHEAST OF A UTILITY POLE AT THE WEST CORNER OF THE PROPERTY, 3.0' SOUTH-SOUTHWEST OF THE SOUTHWEST EDGE OF THE PARKING AREA. ACCESS TO DATUM POINT IS HAD THROUGH A 5-INCH LOGO CAP.
ELEVATION = 29.4', NAVD 88

STATE OF TEXAS
REGISTERED
WALTER P. SASS
4410
PROFESSIONAL
LAND SURVEYOR

WALTER P. SASS
REGISTERED PROFESSIONAL LAND SURVEYOR
STATE OF TEXAS, No. 4410

REV.NO.	DESCRIPTION	DATE	APP.

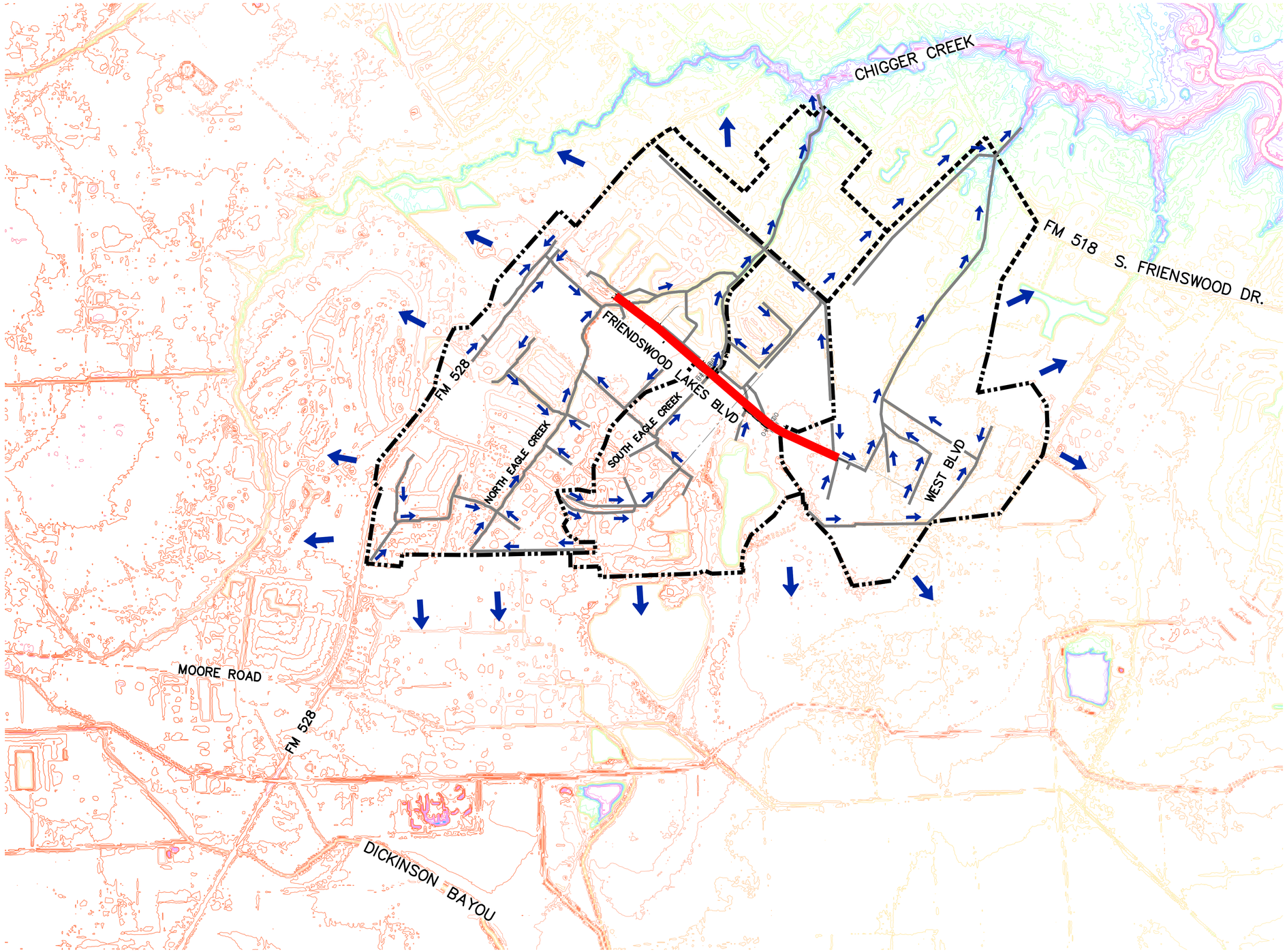
FRIENDSWOOD LAKE BLVD
STONEY LAKE DR TO WEST BLVD

TERRA
ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST - SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: W.E.C.	SCALE:	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: W.E.C.	DATE: APRIL, 2019	SHEET

P:\CU452\dwg\Survey\CU452 - ROWMap-Existing.dwg Dec 10, 2019-1:45pm Terra Associates Inc., David Getzug



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LEGEND

- DRAINAGE AREA DIVIDE
- STORM FLOW PATH
- STORM FLOW DIRECTION

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD STONEY LAKE DR TO WEST BLVD

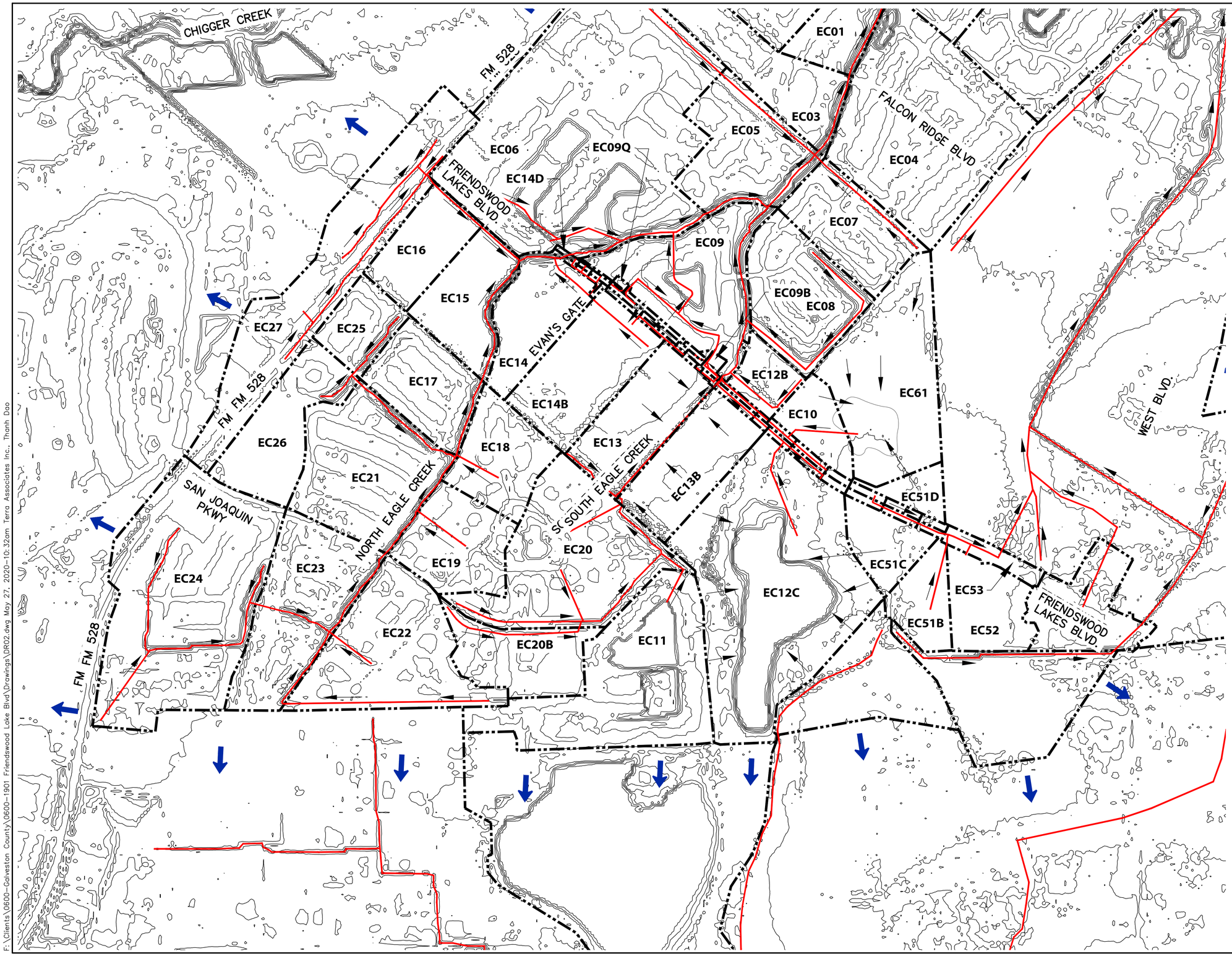
REGIONAL DRAINAGE FLOW PATTERN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 1000'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR01

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR01.dwg May 27, 2020-10:32am Terra Associates Inc., Thanh Dao



LEGEND

- DRAINAGE AREA DIVIDE
- STORM FLOW PATH
- STORM FLOW DIRECTION

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

OVERALL DRAINAGE AREA MAP

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 500'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR02

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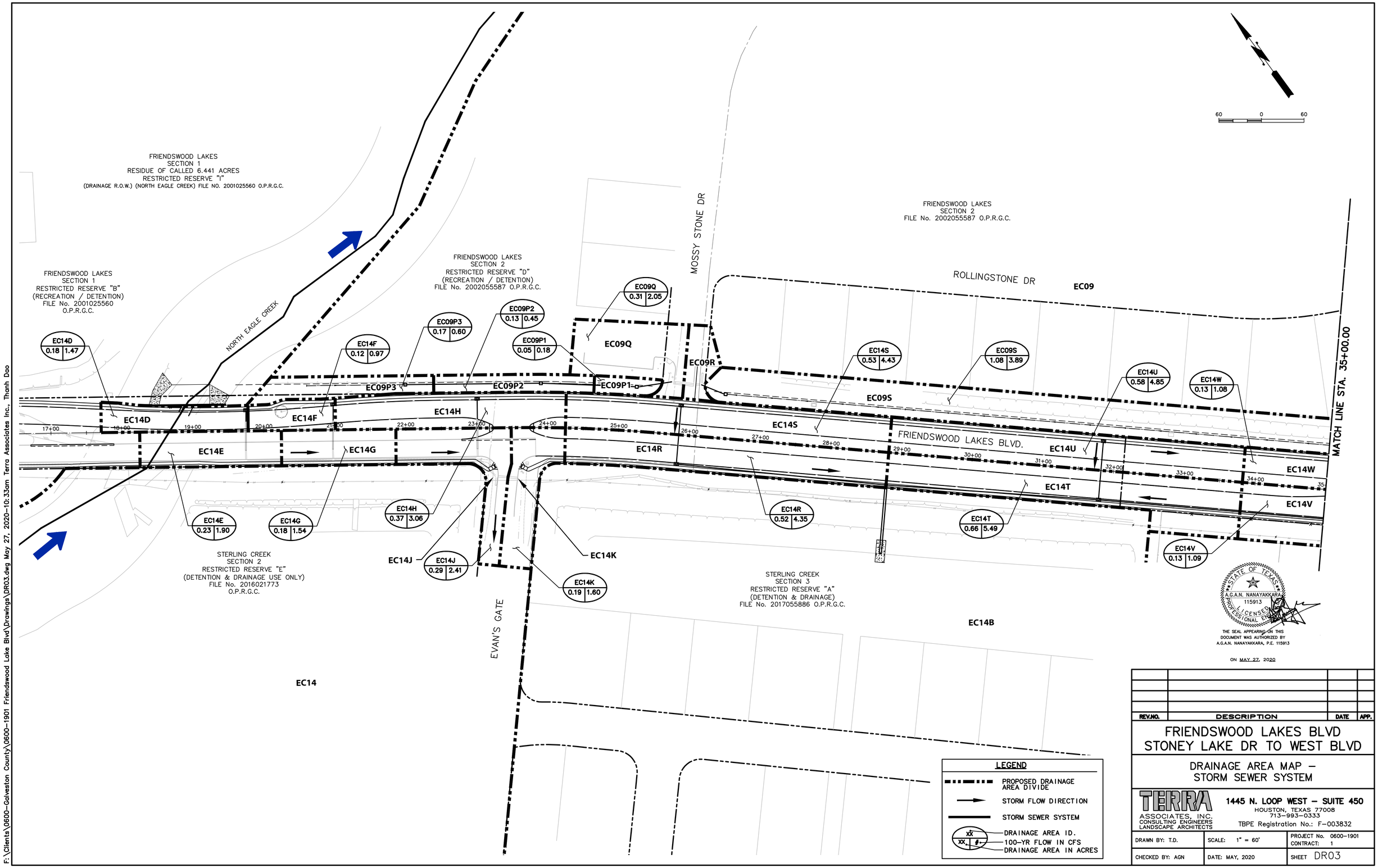

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE AREA MAP – STORM SEWER SYSTEM

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 60'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR03

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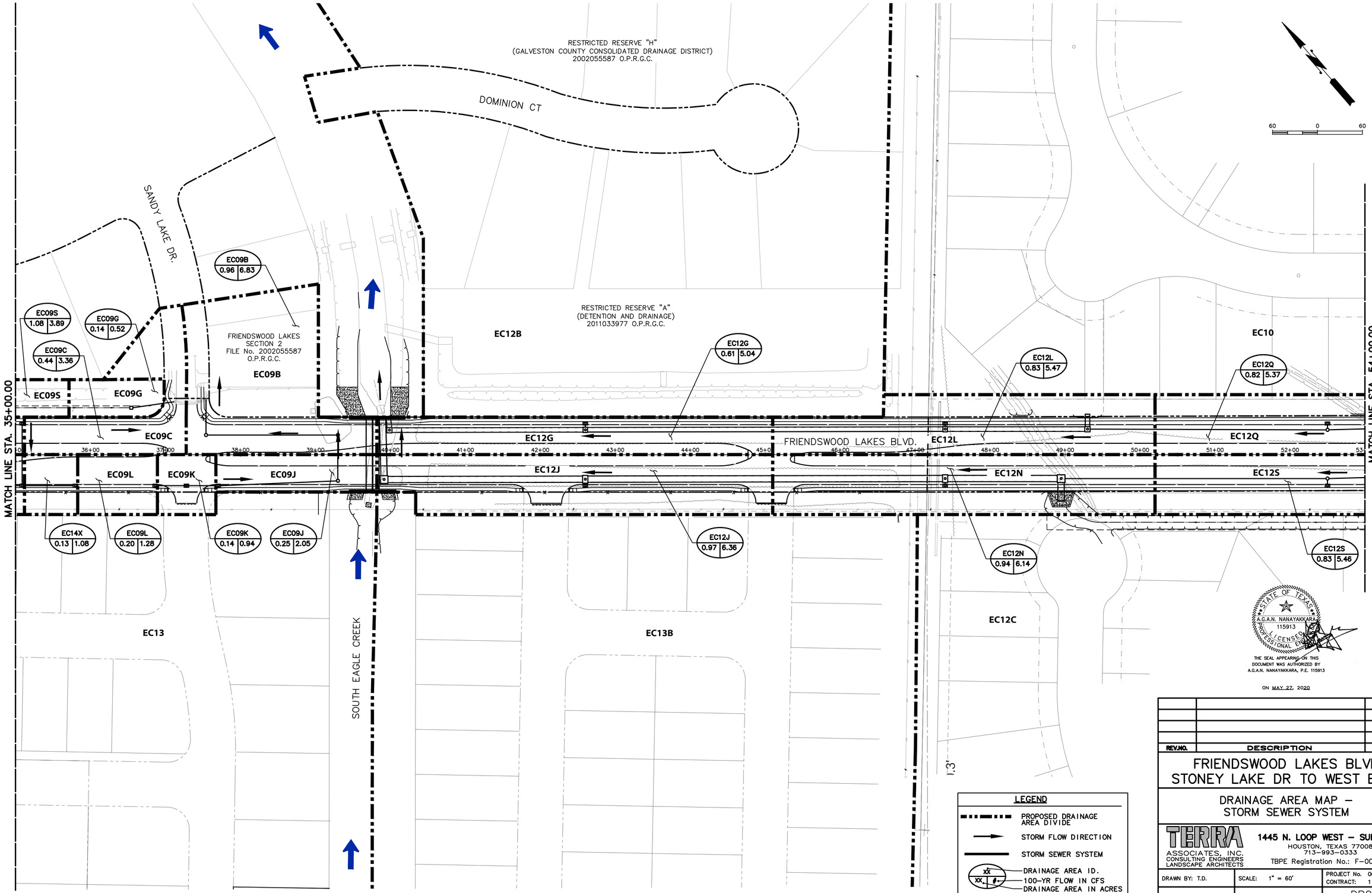

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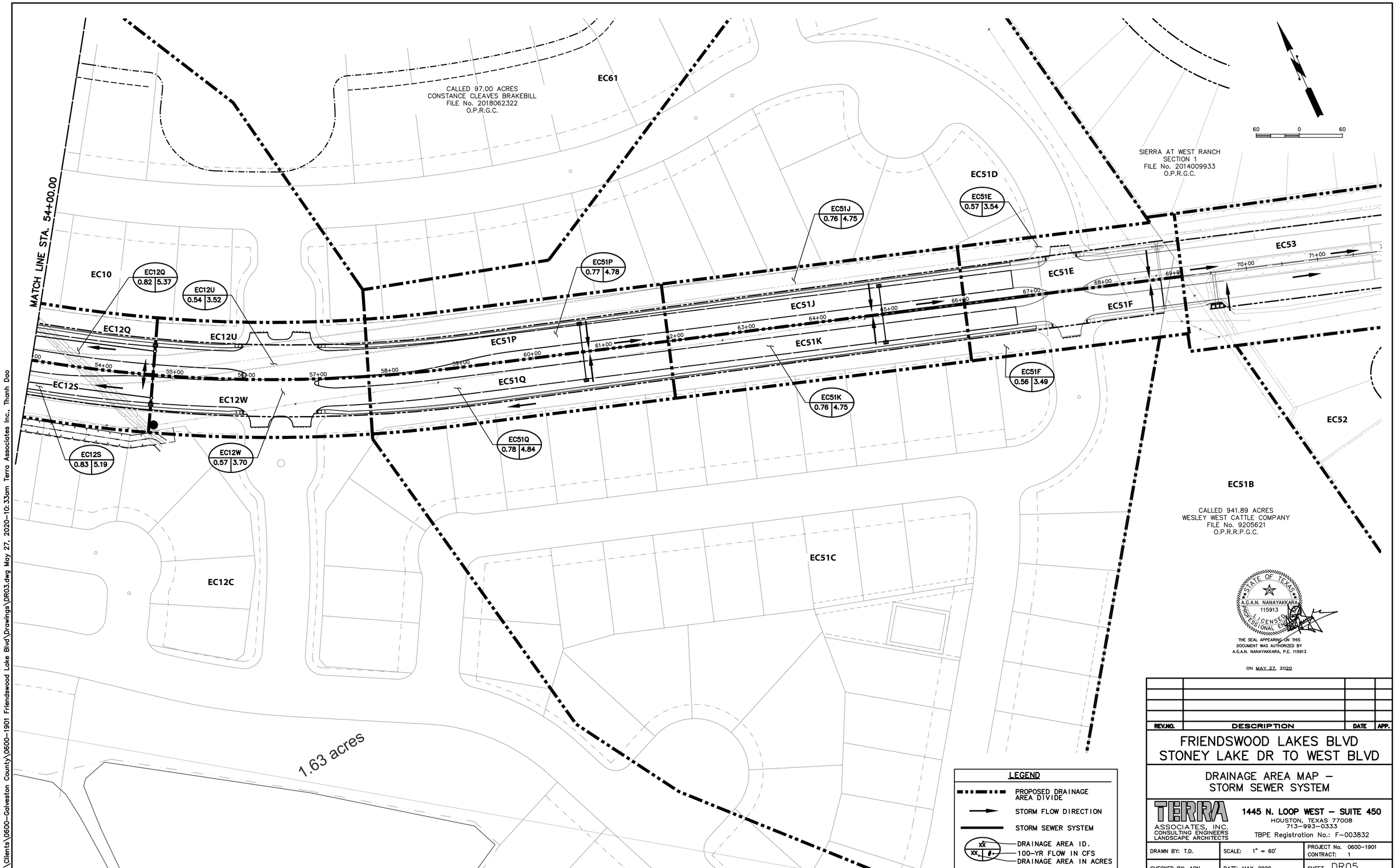

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED
PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE AREA MAP – STORM SEWER SYSTEM

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 60'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR05

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR03.dwg May 27, 2020-10:33am Terra Associates Inc., Thanh Dao

Friendswood Lakes Blvd Storm Sewer Design

From Node	To Node	Area: Individual Area	Area: Accum. Area	Land Use: Street Concrete C = 0.95	Land Use: Grass C=0.30	Land Use: SFR C=0.55	Land Use: Pasture C=0.20	Runoff Coeff.: Average C	Runoff Coeff.: Weighted C	Time of Concentration Calculation: Overland		Time of Concentration Calculation: Gutter/ditch		Time of Concentration Calculation: Pipe		Tc (From Node)	Tc (To Node)	Intensity: 5 Year	Intensity: 25 Year	Intensity: 100 Year	Flow (Individual Area): 5 Year	Flow (Individual Area): 25 Year	Flow (Individual Area): 100 Year	Flow Q (Accum.): 5 Year	Flow Q (Accum.): 25 Year	Flow Q (Accum.): 100 Year	Storm Sewer Pipe: Size	Storm Sewer Pipe: Slope	Storm Sewer Pipe: Design Capacity	Storm Sewer Pipe: Design Velocity	Flow line: Up-Stream	Flow line: Down-Stream
IDs	IDs	AC	AC	AC	AC	AC	AC			ft.	fps	ft.	fps	ft.	fps	min.	min.	in/hr	in/hr	in/hr	cfs.	cfs.	cfs.	cfs.	cfs.	cfs.	in or ft x ft	%	cfs.	fps.	ft.	ft.
IN-14D	IN-14E	0.18	0.18	0.10	0.08	0.00	0.00	0.69	0.692	33	1.5	200	1.5	70	3.0	10.00	10.39	6.35	7.47	9.52	0.78	1.01	1.47	0.77	1.00	1.45	18	0.26	5.36	3.0	27.110	26.928
IN-14E	IN-14G	0.23	0.41	0.13	0.10	0.00	0.00	0.69	0.692	39.5	1.5	150	1.5	122	3.0	10.39	11.07	6.24	7.37	9.36	1.02	1.31	1.90	1.75	2.27	3.28	18	0.26	5.36	3.0	26.856	26.539
IN-14F	IN-14G	0.12	0.12	0.07	0.05	0.00	0.00	0.69	0.692	28	1.5	120	1.5	72	3.0	10.00	10.40	6.35	7.47	9.52	0.52	0.67	0.97	0.51	0.66	0.96	18	0.26	5.36	3.0	26.726	26.539
IN-14G	MH-14J	0.18	0.71	0.10	0.08	0.00	0.00	0.69	0.692	39.5	1.5	88	1.5	204	3.0	11.07	12.20	6.07	7.20	9.11	0.82	1.06	1.54	2.97	3.87	5.57	18	0.26	5.36	3.0	26.539	26.008
IN-14H	MH-14J	0.37	0.37	0.21	0.16	0.00	0.00	0.69	0.692	34	1.5	200	1.5	72	3.0	10.00	10.40	6.35	7.47	9.52	1.63	2.11	3.06	1.62	2.09	3.03	18	0.26	5.36	3.0	27.040	26.853
MH-14J	IN-14J	0.00	1.07	0.00	0.00	0.00	0.00	1.00	0.692	0	0.0	0	0.0	37	3.0	12.20	12.41	6.04	7.17	9.06	0.00	0.00	0.00	4.49	5.86	8.43	18	0.26	5.36	3.0	26.008	25.912
IN-14K	IN-14J	0.19	0.19	0.11	0.08	0.00	0.00	0.69	0.692	39.5	1.5	80	1.5	34	3.0	10.00	10.19	6.39	7.50	9.57	0.86	1.11	1.60	0.85	1.10	1.60	24	0.26	11.54	3.7	26.000	25.912
IN-14J	OUT	0.29	1.56	0.16	0.13	0.00	0.00	0.69	0.692	39.5	1.5	155	1.5	120	3.0	12.41	13.07	5.94	7.07	8.92	1.29	1.66	2.41	6.40	8.38	12.02	24	0.26	11.54	3.7	25.912	25.600
IN-14S	IN-14R	0.53	0.53	0.30	0.23	0.00	0.00	0.69	0.692	39.5	1.5	297	1.5	83	3.0	10.00	10.46	6.34	7.46	9.51	2.37	3.05	4.43	2.34	3.02	4.38	18	0.26	5.36	3.0	28.216	28.000
IN-14R	MH-14P	0.52	1.06	0.29	0.23	0.00	0.00	0.69	0.692	39.5	1.5	297	1.5	297	3.0	10.46	12.11	6.08	7.21	9.13	2.32	3.00	4.35	4.44	5.79	8.33	18	0.26	5.36	3.0	28.000	27.228
IN-14X	IN-14V	0.13	0.13	0.07	0.06	0.00	0.00	0.69	0.692	39.5	1.5	70	1.5	70	3.0	10.00	10.39	6.35	7.47	9.52	0.58	0.75	1.08	0.57	0.74	1.07	18	0.26	5.36	3.0	28.033	27.851
IN-14W	IN-14V	0.13	0.13	0.07	0.06	0.00	0.00	0.69	0.692	39.5	1.5	110	1.5	83	3.0	10.00	10.46	6.34	7.46	9.51	0.58	0.75	1.08	0.57	0.74	1.07	18	0.26	5.36	3.0	28.215	28.000
IN-14V	IN-14T	0.13	0.39	0.07	0.06	0.00	0.00	0.69	0.692	39.5	1.5	110	1.5	327	3.0	10.46	12.28	6.06	7.19	9.09	0.58	0.75	1.09	1.64	2.14	3.07	18	0.26	5.36	3.0	27.851	27.000
IN-14U	IN-14T	0.58	0.58	0.33	0.26	0.00	0.00	0.69	0.692	39.5	1.5	300	1.5	83	3.0	10.00	10.46	6.34	7.46	9.51	2.59	3.34	4.85	2.56	3.31	4.79	18	0.26	5.36	3.0	28.216	28.000
IN-14T	MH-14P	0.66	1.63	0.37	0.29	0.00	0.00	0.69	0.692	39.5	1.5	300	1.5	300	3.0	12.28	13.94	5.82	6.95	8.75	2.93	3.79	5.49	6.58	8.65	12.36	24	0.18	9.60	3.1	26.540	26.000
MH-14P	OUT	0.00	2.69	0.00	0.00	0.00	0.00	1.00	0.692	0	0.0	0	0.0	97	3.0	13.94	14.48	5.75	6.88	8.64	0.00	0.00	0.00	10.69	14.09	20.10	36	0.12	23.11	3.3	25.116	25.000
IN-09L	IN-09K	0.20	0.20	0.07	0.13	0.00	0.00	0.55	0.545	39.5	1.5	100	1.5	42	3.0	10.00	10.23	6.38	7.50	9.56	0.68	0.88	1.28	0.68	0.88	1.27	18	0.26	5.36	3.0	25.378	25.269
IN-09K	IN-09J	0.14	0.34	0.05	0.09	0.00	0.00	0.55	0.545	39.5	1.5	40	1.5	42	3.0	10.23	10.47	6.34	7.46	9.51	0.50	0.65	0.94	1.17	1.51	2.19	18	0.26	5.36	3.0	25.269	25.160
IN-09J	MH-09F	0.25	0.58	0.14	0.11	0.00	0.00	0.69	0.607	39.5	1.5	210	1.5	160	3.0	10.47	11.36	6.20	7.32	9.30	1.09	1.41	2.05	2.20	2.86	4.13	18	0.27	5.41	3.1	25.160	24.736
MH-09F	MH-09E	0.00	0.59	0.00	0.00	0.00	0.00	1.00	0.607	0	0.0	0	0.0	60	3.0	11.36	11.69	6.15	7.27	9.22	0.00	0.00	0.00	2.18	2.84	4.09	18	0.26	5.36	3.0	24.736	24.580
MH-09E	MH-09D	0.00	0.59	0.00	0.00	0.00	0.00	1.00	0.607	0	0.0	0	0.0	176	3.0	11.69	12.67	6.00	7.13	9.01	0.00	0.00	0.00	2.13	2.78	4.00	18	0.26	5.36	3.0	24.580	24.122
MH-09D	MH-09A	0.00	0.59	0.00	0.00	0.00	0.00	1.00	0.607	0	0.0	0	0.0	47	3.0	12.67	12.93	5.96	7.09	8.95	0.00	0.00	0.00	2.12	2.77	3.97	18	0.26	5.36	3.0	24.122	24.000
IN-09G	IN-09C	0.14	0.14	0.00	0.14	0.00	0.00	0.30	0.300	38	1.0	80	1.5	59	3.0	10.00	10.33	6.36	7.48	9.54	0.28	0.36	0.52	0.27	0.35	0.51	18	0.26	5.36	3.0	24.653	24.500
IN-09C	IN-09B	0.44	0.59	0.14	0.11	0.19	0.00	0.63	0.550	39.5	1.5	230	1.5	31	3.0	10.33	10.50	6.34	7.45	9.50	1.79	2.31	3.36	2.04	2.64	3.83	24	0.16	9.05	2.9	24.230	24.180
IN-09B	MH-09A	0.96	1.54	0.16	0.13	0.67	0.00	0.59	0.576	39.5	1.5	260	1.5	10	3.0	10.50	10.56	6.33	7.44	9.48	3.65	4.71	6.83	5.63	7.29	10.56	24	1.90	31.18	9.9	24.110	23.920
MH-09A	OUT	0.00	2.13	0.00	0.00	0.00	0.00	1.00	0.585	0	0.0	0	0.0	10	3.0	12.93	12.98	5.95	7.09	8.94	0.00	0.00	0.00	7.41	9.71	13.92	24	0.18	9.60	3.1	23.830	23.812
IN-09P3	IN-09P2	0.17	0.17	0.00	0.17	0.00	0.00	0.30	0.300	85	1.0	140	2.0	190	3.0	10.00	11.06	6.24	7.37	9.37	0.32	0.41	0.60	0.31	0.41	0.59	18	0.26	5.36	3.0	26.185	25.691
IN-09P2	IN-09P1	0.13	0.29	0.00	0.13	0.00	0.00	0.30	0.300	12	1.0	150	2.0	135	3.0	11.06	11.81	6.13	7.25	9.20	0.24	0.31	0.45	0.54	0.70	1.01	18	0.26	5.36	3.0	25.691	25.340
IN-09P1	IN-09Q	0.05	0.34	0.00	0.05	0.00	0.00	0.30	0.300	12	1.0	60	2.0	50	3.0	11.81	12.08	6.09	7.21	9.13	0.10	0.13	0.18	0.63	0.82	1.18	18	0.26	5.36	3.0	25.340	25.210
IN-09Q	IN-09R	0.31	0.65	0.00	0.00	0.31	0.00	0.55	0.419	145	1.5	80	1.5	30	3.0	12.08	12.25	6.06	7.19	9.10	1.10	1.41	2.05	1.66	2.16	3.11	24	0.18	9.60	3.1	25.210	25.156
IN-09R	MH-09T	0.09	0.75	0.00	0.00	0.09	0.00	0.55	0.435	18	1.5	80	1.5	10	3.0	12.25	12.31	6.05	7.18	9.09	0.33	0.43	0.62	1.97	2.57	3.69	24	0.18	9.60	3.1	25.136	25.118
IN-09S	MH-09T	1.08	1.08	0.00	1.08	0.00	0.00	0.30	0.300	38	1.0	925	2.0	35	3.0	10.00	10.19	6.39	7.50	9.57	2.08	2.68	3.89	2.07	2.67	3.87	18	0.26	5.36	3.0	25.091	25.000
MH-09T	OUT	0.00	1.83	0.00	0.00	0.00	0.00	1.00	0.355	0	0.0	0	0.0	10	3.0	12.31	12.36	6.04	7.17	9.07	0.00	0.00	0.00	3.92	5.12	7.36	24	0.18	9.60	3.1	24.810	24.792
IN-12W	MH-12V	0.565	0.57	0.20	0.37	0.00	0.00	0.55	0.545	42	1.5	300	1.5	10	3.0	10.00	10.06	6.41	7.52	9.61	1.98	2.55	3.70	1.97	2.55	3.70	18	0.30	5.75	3.3	26.656	26.626
MH-12V	MH-12R	0.00	0.57	0.00	0.00	0.00	0.00	1.00	0.545	0	0.0	0	0.0	222	3.0	10.06	11.29	6.21	7.33	9.31	0.00	0.00	0.00	1.91	2.48	3.59	18	0.30	5.75	3.3	26.626	25.960
IN-12S	MH-12R	0.83	0.83	0.29	0.54	0.00	0.00	0.55	0.545	40	1.5	230	1.5	10	3.0	10.00	10.06	6.41	7.52	9.61	2.91	3.76	5.46	2.91	3.76	5.45	18	0.30	5.75	3.3	25.990	25.960
MH-12R	MH-12Y	0.00	1.40	0.00	0.00	0.00	0.00	1.00	0.545	0	0.0	0	0.0	355	3.0	11.29	13.26	5.91	7.05	8.88	0.00	0.00	0.00	4.51	5.91	8.46	24	0.20	10.12	3.2	25.460	24.750
MH-12Y1	MH-12Y	68.00	68.00	0.00	0.00	0.00	68.00	0.20	0.200	300	1.0	1000	2.0	15	3.0	13.33	13.42	5.89	7.03	8.85	80.28	105.27	150.79	80.12	105.10	150.50	7x4	0.10	135.88	4.9	24.092	24.077
MH-12Y	MH-12M	0.00	69.40	0.00	0.00	0.00	0.00	1.00	0.207	0	0.0	0	0.0	154	3.0	13.42	14.27	5.77	6.91	8.68	0.00	0.00	0.00	82.93	109.17	155.89	7x4	0.05	96.08	3.4	24.077	24.000
IN-12N	MH-12M	0.94	0.94	0.33	0.61	0.00	0.00	0.55	0.545	40	1.5	280	1.5	8	3.0	10.00	10.04	6.41	7.53	9.61	3.28	4.23	6.14	3.27	4.23	6.13	18	0.30	5.75	3.3	25.694	25.670
MH-12M	MH-12H	0.00	70.33	0.00	0.00	0.00	0.00	1.00	0.211	0	0.0	0	0.0	480	3.0	14.27	16.94	5.44	6.58	8.20	0.00	0.00	0.00	80.91	107.64	152.50	7x4	0.12	149.16	5.3	24.000	23.421
IN-12J	MH-12H	0.97	0.97	0.34	0.63	0.00	0.00	0.55	0.545	40	1.5	280	1.5	8	3.0	10.00	10.04	6.41	7.53	9.61	3.39	4.38	6.36	3.39	4.38	6.35	18	0.30	5.75	3.3	25.304	25.280
MH-12H	MH-12E	0.00	71.30	0.00	0.00	0.00	0.00	1.00	0.216	0	0.0	0	0.0	268	3.0	16.94	18.43	5.27	6.41	7.96	0.00	0.00	0.00	81.20	108.60	153.28	7x4	0.12	148.85	5.3	23.421	23.100
MH-12E	OUT	0.00	71.30	0.00	0.00	0.00	0.00	1.00	0.216	1	0.0	0	0.0	83	3.0	18.43	18.89	5.22	6.36	7.89	0.00	0.00	0.00	80.43	107.75	151.91	7x4	0.12	148.85	5.3	23.100	23.000
IN-12U	MH-12T	0.54	0.54	0.19	0.35	0.00	0.00	0.55	0.545	42	1.5	290	1.5	10	3.0	10.00	10.06	6.41	7.52	9.61	1.88	2.43	3.52	1.88	2.42	3.51	18	0.30	5.75	3.3	26.794	26.764
MH-12T	MH-12P	0.00	0.54	0.00	0.00	0.00	0.00	1.00	0.545	0	0.0	0	0.0	218	3.0	10.06	11.27	6.21	7.34	9.32	0.00	0.00	0.00	1.82	2.36	3.41	18	0.30	5.75	3.3	26.764	26.110
IN-12Q	MH-12P	0.82	0.82	0.29	0.53	0.00	0.00	0.55	0.545	40	1.5	230	1.5	10	3.0	10.00	10.06	6.41	7.52	9.61	2.87	3.70	5.37	2.86	3.70	5.37	18	0.30	5.75	3.3	26.140	26.110
MH-12P	MH-12X	0.00	1.36	0.00	0.00	0.00	0.00	1.00	0.545	0	0.0	0	0.0	320	3.0	11.27	13.04	5.94	7.08	8.93	0.00	0.00	0.00	4.40	5.76	8.26	24	0.20	10.12	3.2	25.610	24.970
MH-12X1	MH-12X	34.00	34.00	0.00	0.00	0.00	34.00	0.20	0.200	300	1.0	1000	2.0	15	3.0	13.33	13.42	5.89	7.03	8.85	40.14	52.64	75.39	40.06	52.55	75.25	5x3	0.10	59.65	4.0	24.171	24.156
MH-12X	MH-12K	0.00	35.36	0.00	0.00	0.00	0.00	1.00	0.213	0	0.0	0	0.0	190	3.0	13.42	14.47	5.75	6.88	8.65	0.00	0.00	0.00	43.33	57.10	81.48	5x3	0.05	42.18	2.8	24.156	24.061
IN-12L	MH-12K	0.83	0.83	0.29	0.54	0.00	0.00	0.55	0.545	40	1.5	280	1.5	8	3.0	10.00	10.04	6.41	7.53	9.61	2.92	3.77	5.47	2.92	3.77	5.46	18	0.30	5.75	3.3	25.804	25.780
MH-12K	MH-12F	0.00	36.19	0.00	0.00	0.00	0.00	1.00	0.221	0	0.0	0	0.0	480	3.0	14.47	17.14	5.42	6.56	8.17	0.00	0.00	0.00	43.31	57.66	81.64	5x3	0.14	70.58	4.7	24.061	23.389
IN-12G	MH-12F	0.61	0.61	0.34	0.27	0.00	0.00	0.69	0.692	39.5	1.5	280	1.5	8	3.0	10.00	10.04	6.41	7.53	9.61	2.69	3.48	5.04	2.69	3.47	5.04	18	0.30	5.75	3.3	25.294	25.270
MH-12F	MH-12D	0.00	36.80	0.00	0.00	0.00	0.00	1.00	0.229	0	0.0	0	0.0	263	3.0	17.14	18.60	5.25	6.39	7.94	0.00	0.00	0.00	44.20	59.16	83.46	5x3	0.14	70.58	4.7	23.389	23.020
MH-12D	OUT	0.00	36.80	0.00	0.00	0.00	0.00	1.00	0.229	0	0.0	0	0.0	17	3.0	18.60	18.69	5.24	6.38	7.92	0.00	0.00	0.00	44.12	59.06	83.30	5x4	0.12	100.45	5.0	23.020	23.000
IN-51P	MH-51R	0.77	0.77	0.27	0.50	0.00	0.00	0.55	0.545	42	1.5	298	1.5	40	3.0	10.00	10.22	6.38	7.50	9.56	2.68	3.46	5.02	2.67	3.45	4.99	18	0.26	5.36	3.0	23.972	23.868
IN-51Q	MH-51R	0.78	0.78	0.27	0.50	0.00	0.00	0.55	0.545	42	1.5	302	1.5	40	3.0	10.00	10.22	6.38	7.50	9.56	2.72	3.51	5.09	2.70	3.49	5.06	18	0.26	5.36	3.0	23.972	23.868
MH-51R	MH-51L	0.00	1.54	0.00	0.00	0.00	0.00	1.00	0.545	0	0.0	0	0.0	420	3.0	10.22	12.56	6.01	7.15	9.03	0.00	0.00	0.00	5.06	6.61	9.49	24	0.18	9.60	3.1	23.368	22.612
IN-51J	MH-51L	0.76	0.76	0.27	0.50	0.00	0.00	0.55	0.545	42	1.5	300	1.5	40	3.0	10.00	10.22	6.38	7.50	9.56	2.67	3.44	4.99	2.65	3.43	4.97	18	0.26	5.36	3.0	23.216	23.112
IN-51K	MH-51L	0.76	0.76	0.27	0.50	0.00	0.00	0.55	0.545	42	1.5	300	1.5	40	3.0	10.00	10.22	6.38	7.50	9.56	2.67	3.44	4.99	2.65	3.43	4.97	18	0.26	5.36	3.0	23.216	23.112
MH-51L	MH-51G	0.00	3.07	0.00	0.00	0.00	0.00	1.00	0.545	0	0.0	0	0.0	390	3.0	12.56	14.72	5.71	6.85	8.60	0.00	0.00	0.00	9.55	12.60	17.96	36	0.12	23.11	3.3	22.112	21.644
IN-51D	IN-51E	6.31	6.31	0.00	0.00	0.00	6.31	0.20	0.200	300	1.0	805	1.5	11	3.0	13.94	14.01	5.81	6.95	8.74	7.34	9.65	13.79	7.33	9.64	13.77	30	0.15	15.89	3.2	21.720	21.704
IN-51E	MH-51G	0.57	6.87	0.20	0.37	0.00	0.00	0.55	0.228	42	1.5	275	1.5	40	3.0	14.01	14.23	5.78	6.92	8.69	1.98	2.56	3.71	9.08	11.95	17.06	30	0.15	15.89	3.2	21.704	21.644
IN-51F	MH-51G	0.56	0.56	0.20	0.36	0.00	0.00	0.55	0.545	42	1.5	275	1.5	40	3.0	10.00	10.22	6.38	7.50	9.56	1.96	2.53	3.67	1.95	2.52	3.65	18	0.26	5.36	3.0	22.748	22.644
MH-51G	MH-51A	0.00	10.50	0.00	0.00	0.00	0.00	1.00	0.338	0	0.0	0	0.0	74	3.0	14.72	15.13	5.66	6.80	8.52	0.00	0.00	0.00	20.08	26.53	37.78	36	0.12	23.11	3.3	21.644	21.555
IN-51B	MH-51A	12.85	12.85	0.00	0.00	0.00	12.85	0.20	0.200	54	1.0	1160	1.5	46	3.0	13.79	14.04	5.80	6.94	8.73	15.01	19.72	28.20	14.92	19.62	28.04	3x3	0.18	43.65	4.8	21.638	21.555
MH-51A	OUT	0.00	23.35	0.00	0.00	0.00	0.00	1.00	0.262	0	0.0	0	0.0	222	3.0	15.13	16.37	5.51	6.65	8.30	0.00	0.00	0.00	33.69	44.73	63.47	48	0.25	71.82	5.7	21.555	21.000

Rainfall Intensity Variables

	5 Year	25 Year	100 Year
	in/hr	in/hr	in/hr
e	0.788	0.729	0.685
b	92.9	98.5	90.8
d	19.7	24	16.5
Cf	1	1.1	1.25

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE CALCULATIONS
(1 OF 7)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR06

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR12.dwg May 27, 2020-10:33am Terra Associates Inc., Thanh Dao

OUTPUT FOR DESIGN FREQUENCY OF: 5 YEARS

RUNOFF COMPUTATION FOR DESIGN FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
9L	0.55	0.20	10.00	10.00	6.38	0.000	0.702
9K	0.55	0.14	10.23	10.23	6.34	0.000	0.488
9J	0.69	0.25	10.47	10.47	6.20	0.000	1.070
9G	0.3	0.14	10.00	10.00	6.36	0.000	0.267
9C	0.63	0.44	10.33	10.33	6.34	0.000	1.757
9B	0.59	0.96	10.50	10.50	5.95	0.000	3.370

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
9L	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
9J	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
9L	CURB	0.702	0.702	0.000	0.000		3.62	5.00	6.85
9J	CURB	1.070	1.070	0.000	0.000		4.52	5.00	8.00

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
9K	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
9G	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
9C	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
9B	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
9K	CURB	5.00	N/A	N/A	0.488	15.022	0.251	4.60	4.60
9G	ARINL	5.00	N/A	N/A	0.267	15.022	0.250	N/A	N/A
9C	CURB	5.00	N/A	N/A	1.757	15.022	0.267	7.45	7.45
9B	CURB	5.00	N/A	N/A	3.370	15.022	0.313	9.50	9.50

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
9L	CURB	0.550	0.20	10.00	6.38		0.00	0.702
9K	CURB	0.550	0.34	10.33	6.34		0.00	1.186
9J	CURB	0.609	0.59	10.62	6.20		0.00	2.229
9G	ARINL	0.300	0.14	10.00	6.36		0.00	0.267
9C	CURB	0.550	0.58	10.65	6.34		0.00	2.024
9B	CURB	0.575	1.54	10.87	5.95		0.00	5.269
MH-09F	CRCMH	0.609	0.59	10.62	6.02		0.00	2.229
MH-09E	CRCMH	0.609	0.59	10.62	6.02		0.00	2.229
MH-09D	CRCMH	0.609	0.59	10.62	6.02		0.00	2.229
MH-09A	CRCMH	0.585	2.13	10.89	5.95		0.00	7.408
OUT	OUTLT	0.585	2.13	10.89	5.95		0.00	7.408

CONVEYANCE CONFIGURATION DATA

RUN #	NODE I.D. US	NODE I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH-09A	OUT	23.83	23.81	CIR 1	0.00	2.00	10.0	0.180	0.013
2	MH-09D	MH-09A	24.12	24.00	CIR 1	0.00	1.50	47.0	0.260	0.013
3	MH-09E	MH-09D	24.58	24.12	CIR 1	0.00	1.50	176.0	0.260	0.013
4	MH-09F	MH-09E	24.74	24.58	CIR 1	0.00	1.50	60.0	0.260	0.013
5	9J	MH-09F	25.16	24.74	CIR 1	0.00	1.50	160.0	0.265	0.013
6	9K	9J	25.27	25.16	CIR 1	0.00	1.50	42.0	0.260	0.013
7	9L	9K	25.38	25.27	CIR 1	0.00	1.50	42.0	0.260	0.013
8	9B	MH-09A	24.11	23.92	CIR 1	0.00	2.00	10.0	1.900	0.013
9	9C	9B	24.23	24.18	CIR 1	0.00	2.00	31.0	0.161	0.013
10	9G	9C	24.65	24.50	CIR 1	0.00	2.00	59.0	0.259	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.320 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	28.33	28.32	29.88	0.106	1.32	2.00	3.37	2.36	7.4	9.6	0.000
2	28.43	28.33	29.88	0.045	0.68	1.50	2.89	1.26	2.2	5.4	0.000
3	28.81	28.43	30.44	0.045	0.67	1.50	2.90	1.26	2.2	5.4	0.000
4	28.94	28.81	30.44	0.045	0.68	1.50	2.89	1.26	2.2	5.4	0.000
5	29.29	28.94	29.93	0.045	0.67	1.50	2.91	1.26	2.2	5.4	0.000
6	29.40	29.29	29.80	0.013	0.48	1.50	2.43	0.67	1.2	5.4	0.000
7	29.50	29.40	30.06	0.004	0.37	1.50	2.09	0.40	0.7	5.4	0.000
8*	28.33	28.33	29.93	0.054	0.56	2.00	7.39	4.42	5.3	31.3	0.000
9	28.38	28.33	29.80	0.008	0.64	2.00	2.33	0.64	2.0	9.1	0.000
10	28.53	28.38	30.06	0.000	0.21	2.00	1.52	0.09	0.3	11.6	0.000

* SUPERCRITICAL FLOW.

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	2.0	0.0	4	110.0
CIRCULAR	CONCRETE	1.5	0.0	6	527.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CURB ON GRADE		5.0	0.0	0.0	0.0	0.0	2
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	3
AREA INLET (TYPE E)		5.0	0.0	0.0	0.0	0.0	1
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	4
OUTLET		0.0	0.0	0.0	0.0	0.0	1

OUTPUT FOR ANALYSYS FREQUENCY OF: 100 YEARS

RUNOFF COMPUTATION FOR ANALYSIS FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
9L	0.55	0.20	10.00	10.00	9.56	0.000	1.052
9K	0.55	0.14	10.23	10.23	9.51	0.000	0.732
9J	0.69	0.25	10.47	10.47	9.30	0.000	1.604
9G	0.3	0.14	10.00	10.00	9.54	0.000	0.401
9C	0.63	0.44	10.33	10.33	9.50	0.000	2.633
9B	0.59	0.96	10.50	10.50	9.48	0.000	5.369

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
9L	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
9J	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
9L	CURB	1.052	1.052	0.000	0.000		4.48	5.00	7.95
9J	CURB	1.604	1.604	0.000	0.000		5.66	10.00	9.30

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
9K	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
9G	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
9C	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
9B	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
9K	CURB	5.00	N/A	N/A	0.732	15.022	0.253	5.35	5.35
9G	ARINL	5.00	N/A	N/A	0.401	15.022	0.251	N/A	N/A
9C	CURB	5.00	N/A	N/A	2.633	15.022	0.288	8.65	8.65
9B	CURB	5.00	N/A	N/A	5.369	15.022	0.410	11.30	11.30

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
9L	CURB	0.550	0.20	10.00	9.56		0.00	1.052
9K	CURB	0.550	0.34	10.30	9.51		0.00	1.778
9J	CURB	0.609	0.59	10.56	9.30		0.00	3.343
9G	ARINL	0.300	0.14	10.00	9.54		0.00	0.401
9C	CURB	0.550	0.58	10.57	9.50		0.00	3.032
9B	CURB	0.575	1.54	10.77	9.48		0.00	8.395
MH-09F	CRCMH	0.609	0.59	11.38	9.48		0.00	3.408
MH-09E	CRCMH	0.609	0.59	11.69	9.48		0.00	3.408
MH-09D	CRCMH	0.609	0.59	12.61	9.48		0.00	3.408
MH-09A	CRCMH	0.585	2.13	12.85	9.48		0.00	11.804
OUT	OUTLT	0.585	2.13	12.85	9.48		0.00	11.804

CONVEYANCE CONFIGURATION DATA

RUN #	NODE I.D. US	NODE I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH-09A	OUT	23.83	23.81	CIR 1	0.00	2.00	10.0	0.180	0.013
2	MH-09D	MH-09A	24.12	24.00	CIR 1	0.00	1.50	47.0	0.260	0.013
3	MH-09E	MH-09D	24.58	24.12	CIR 1	0.00	1.50	176.0	0.260	0.013
4	MH-09F	MH-09E	24.74	24.58	CIR 1	0.00	1.50	60.0	0.260	0.013
5	9J	MH-09F	25.16	24.74	CIR 1	0.00	1.50	160.0	0.265	0.013
6	9K	9J	25.27	25.16	CIR 1	0.00	1.50	42.0	0.260	0.013
7	9L	9K	25.38	25.27	CIR 1	0.00	1.50	42.0	0.260	0.013
8	9B	MH-09A	24.11	23.92	CIR 1	0.00	2.00	10.0	1.900	0.013
9	9C	9B	24.23	24.18	CIR 1	0.00	2.00	31.0	0.161	0.013
10	9G	9C	24.65	24.50	CIR 1	0.00	2.00	59.0	0.259	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.320 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	28.35	28.32	29.88	0.270	2.00	2.00	3.76	3.76	11.8	9.6	0.000
2	28.42	28.35	29.88	0.104	0.87	1.50	3.21	1.93	3.4	5.4	0.000
3	28.69	28.42	30.44	0.104	0.87	1.50	3.21	1.93	3.4	5.4	0.000
4	28.79	28.69	30.44	0.104	0.87	1.50	3.21	1.93	3.4	5.4	0.000
5	29.05	28.79	29.93	0.100	0.85	1.50	3.22	1.89	3.3	5.4	0.000
6	29.15	29.05	29.80	0.028	0.60	1.50	2.72	1.01	1.8	5.4	0.000
7	29.26	29.15	30.06	0.010	0.45	1.50	2.35	0.60	1.1	5.4	0.000
8*	28.36	28.35	29.93	0.137	0.71	2.00	8.42	5.13	8.4	31.3	0.000
9	28.41	28.36	29.80	0.018	0.80	2.00	2.60	0.97	3.0	9.1	0.000
10	28.56	28.41	30.06	0.000	0.26	2.00	1.71	0.13	0.4	11.6	0.000

* SUPERCRITICAL FLOW.

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	2.0	0.0	4	110.0
CIRCULAR	CONCRETE	1.5	0.0	6	527.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CURB ON GRADE		5.0	0.0	0.0	0.0	0.0	1
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	3
CURB ON GRADE		10.0	0.0	0.0	0.0	0.0	1
AREA INLET (TYPE E)		5.0	0.0	0.0	0.0	0.0	1
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	4
OUTLET		0.0	0.0	0.0	0.0	0.0	1

END

NORMAL TERMINATION OF HOUSTORM.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE CALCULATIONS
(2 OF 7)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR07

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR06.dwg May 27, 2020-10:33am Terra Associates Inc., Thanh Dao

OUTPUT FOR DESIGN FREQUENCY OF: 5 YEARS

RUNOFF COMPUTATION FOR DESIGN FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
09P1	0.3	0.05	11.81	11.81	6.09	0.000	0.091
09Q	0.55	0.31	12.08	12.08	6.06	0.000	1.033
09R	0.55	0.09	12.25	12.25	6.05	0.000	0.299
09S	0.3	1.08	10.00	10.00	6.39	0.000	2.070
09P2	0.3	0.13	11.06	11.06	6.13	0.000	0.239
09P3	0.3	0.17	10.00	10.00	6.24	0.000	0.318

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
09P1	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
09Q	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
09R	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
09S	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
09P2	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
09P3	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
09P1	ARINL	5.00	N/A	N/A	0.091	15.022	0.250	N/A	N/A
09Q	CURB	5.00	N/A	N/A	1.033	15.022	0.256	6.10	6.10
09R	CURB	5.00	N/A	N/A	0.299	15.022	0.250	3.85	3.85
09S	ARINL	5.00	N/A	N/A	2.070	15.022	0.274	N/A	N/A
09P2	ARINL	5.00	N/A	N/A	0.239	15.022	0.250	N/A	N/A
09P3	ARINL	5.00	N/A	N/A	0.318	15.022	0.251	N/A	N/A

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
09P1	ARINL	0.300	0.35	13.05	6.09		0.00	0.639
09Q	CURB	0.417	0.66	13.46	6.06		0.00	1.670
09R	CURB	0.433	0.75	13.68	6.05		0.00	1.966
09S	ARINL	0.300	1.08	10.00	6.39		0.00	2.070
MH09T	CRCMH	0.355	1.83	13.75	6.05		0.00	3.926
09P2	ARINL	0.300	0.30	11.90	6.13		0.00	0.552
09P3	ARINL	0.300	0.17	10.00	6.24		0.00	0.318
OUT	OUTLT	0.355	1.83	13.75	6.05		0.00	3.926

CONVEYANCE CONFIGURATION DATA

RUN #	NODE I.D. US	NODE I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH09T	OUT	24.81	24.79	CIR 1	0.00	2.00	10.0	0.180	0.013
2	09R	MH09T	25.14	25.12	CIR 1	0.00	2.00	10.0	0.180	0.013
3	09Q	09R	25.21	25.16	CIR 1	0.00	2.00	30.0	0.180	0.013
4	09P1	09Q	25.34	25.21	CIR 1	0.00	1.50	50.0	0.260	0.013
5	09S	MH09T	25.09	25.00	CIR 1	0.00	1.50	35.0	0.260	0.013
6	09P3	09P2	26.19	25.69	CIR 1	0.00	1.50	190.0	0.260	0.013
7	09P2	09P1	25.69	25.34	CIR 1	0.00	1.50	135.0	0.260	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.860 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	28.88	28.86	29.00	0.030	0.89	2.00	2.90	1.25	3.9	9.6	0.000
2	28.89	28.88	29.00	0.007	0.61	2.00	2.40	0.63	2.0	9.6	0.000
3	28.95	28.89	29.00	0.005	0.56	2.00	2.29	0.53	1.7	9.6	0.000
4	29.08	28.95	29.50	0.004	0.35	1.50	2.04	0.36	0.6	5.4	0.000
5	28.95	28.88	29.50	0.039	0.65	1.50	2.84	1.17	2.1	5.4	0.000
6	29.92	29.42	31.79	0.001	0.25	1.50	1.66	0.18	0.3	5.4	0.000
7	29.42	29.08	31.75	0.003	0.33	1.50	1.95	0.31	0.6	5.4	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	2.0	0.0	3	50.0
CIRCULAR	CONCRETE	1.5	0.0	4	410.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
AREA INLET (TYPE E)		5.0	0.0	0.0	0.0	0.0	4
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	2
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	1
OUTLET		0.0	0.0	0.0	0.0	0.0	1

OUTPUT FOR ANALYSYS FREQUENCY OF: 100 YEARS

RUNOFF COMPUTATION FOR ANALYSIS FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
09P1	0.3	0.05	11.81	11.81	9.13	0.000	0.137
09Q	0.55	0.31	12.08	12.08	9.10	0.000	1.552
09R	0.55	0.09	12.25	12.25	9.09	0.000	0.450
09S	0.3	1.08	10.00	10.00	9.57	0.000	3.101
09P2	0.3	0.13	11.06	11.06	9.20	0.000	0.359
09P3	0.3	0.17	10.00	10.00	9.37	0.000	0.478

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
09P1	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
09Q	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
09R	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
09S	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
09P2	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
09P3	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
09P1	ARINL	5.00	N/A	N/A	0.137	15.022	0.250	N/A	N/A
09Q	CURB	5.00	N/A	N/A	1.552	15.022	0.263	7.10	7.10
09R	CURB	5.00	N/A	N/A	0.450	15.022	0.251	4.45	4.45
09S	ARINL	5.00	N/A	N/A	3.101	15.022	0.303	N/A	N/A
09P2	ARINL	5.00	N/A	N/A	0.359	15.022	0.251	N/A	N/A
09P3	ARINL	5.00	N/A	N/A	0.478	15.022	0.251	N/A	N/A

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
09P1	ARINL	0.300	0.35	12.71	9.13		0.00	0.959
09Q	CURB	0.417	0.66	13.07	9.10		0.00	2.507
09R	CURB	0.433	0.75	13.27	9.09		0.00	2.954
09S	ARINL	0.300	1.08	10.00	9.57		0.00	3.101
MH09T	CRCMH	0.355	1.83	13.33	9.09		0.00	5.899
09P2	ARINL	0.300	0.30	11.69	9.20		0.00	0.828
09P3	ARINL	0.300	0.17	10.00	9.37		0.00	0.478
OUT	OUTLT	0.355	1.83	13.33	9.09		0.00	5.899

CONVEYANCE CONFIGURATION DATA

RUN #	NODE I.D. US	NODE I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH09T	OUT	24.81	24.79	CIR 1	0.00	2.00	10.0	0.180	0.013
2	09R	MH09T	25.14	25.12	CIR 1	0.00	2.00	10.0	0.180	0.013
3	09Q	09R	25.21	25.16	CIR 1	0.00	2.00	30.0	0.180	0.013
4	09P1	09Q	25.34	25.21	CIR 1	0.00	1.50	50.0	0.260	0.013
5	09S	MH09T	25.09	25.00	CIR 1	0.00	1.50	35.0	0.260	0.013
6	09P3	09P2	26.19	25.69	CIR 1	0.00	1.50	190.0	0.260	0.013
7	09P2	09P1	25.69	25.34	CIR 1	0.00	1.50	135.0	0.260	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.860 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	28.87	28.86	29.00	0.067	1.13	2.00	3.21	1.88	5.9	9.6	0.000
2	28.89	28.87	29.00	0.017	0.76	2.00	2.69	0.94	3.0	9.6	0.000
3	28.94	28.89	29.00	0.012	0.70	2.00	2.57	0.80	2.5	9.6	0.000
4	29.07	28.94	29.50	0.008	0.43	1.50	2.29	0.54	1.0	5.4	0.000
5	28.93	28.87	29.50	0.086	0.82	1.50	3.14	1.75	3.1	5.4	0.000
6	29.90	29.41	31.79	0.002	0.30	1.50	1.88	0.27	0.5	5.4	0.000
7	29.41	29.07	31.75	0.006	0.40	1.50	2.20	0.47	0.8	5.4	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	2.0	0.0	3	50.0
CIRCULAR	CONCRETE	1.5	0.0	4	410.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
AREA INLET (TYPE E)		5.0	0.0	0.0	0.0	0.0	4
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	2
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	1
OUTLET		0.0	0.0	0.0	0.0	0.0	1

END

NORMAL TERMINATION OF HOUSTORM.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE CALCULATIONS
(3 OF 7)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR08

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR07.dwg May 27, 2020-10:33am Terra Associates Inc., Thanh Dao

OUTPUT FOR DESIGN FREQUENCY OF: 5 YEARS

RUNOFF COMPUTATION FOR DESIGN FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
IN-14S	0.69	0.53	10.00	10.00	6.34	0.000	2.319
IN-14R	0.69	0.52	10.46	10.46	6.08	0.000	2.182
IN-14W	0.69	0.13	10.00	10.00	6.34	0.000	0.569
IN-14V	0.69	0.13	10.46	10.46	6.06	0.000	0.544
IN-14U	0.69	0.58	10.00	10.00	6.34	0.000	2.537
IN-14T	0.69	0.66	12.28	12.28	5.82	0.000	2.650
IN-14X	0.69	0.13	10.00	10.00	6.35	0.000	0.570

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
IN-14W	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
IN-14V	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
IN-14X	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
IN-14W	CURB	0.569	0.569	0.000	0.000		3.24	5.00	6.30
IN-14V	CURB	0.544	0.544	0.000	0.000		3.17	5.00	6.20
IN-14X	CURB	0.570	0.570	0.000	0.000		3.24	5.00	6.30

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
IN-14S	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
IN-14R	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
IN-14U	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
IN-14T	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
IN-14S	CURB	5.00	N/A	N/A	2.319	15.022	0.280	8.25	8.25
IN-14R	CURB	5.00	N/A	N/A	2.182	15.022	0.276	8.05	8.05
IN-14U	CURB	5.00	N/A	N/A	2.537	15.022	0.286	8.55	8.55
IN-14T	CURB	5.00	N/A	N/A	2.650	15.022	0.289	8.65	8.65

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
IN-14S	CURB	0.690	0.53	10.00	6.34		0.00	2.319
IN-14R	CURB	0.690	1.05	10.47	6.08		0.00	4.405
IN-14W	CURB	0.690	0.13	10.00	6.34		0.00	0.569
IN-14V	CURB	0.690	0.39	10.70	6.06		0.00	1.631
IN-14U	CURB	0.690	0.58	10.00	6.34		0.00	2.537
IN-14T	CURB	0.690	1.63	12.75	5.82		0.00	6.546
MH14P	CRCMH	0.690	2.68	14.27	5.82		0.00	10.762
IN-14X	CURB	0.690	0.13	10.00	6.35		0.00	0.570
OUT	OUTLT	0.690	2.68	14.27	5.82		0.00	10.762

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH14P	OUT	25.12	25.00	CIR 1	0.00	3.00	97.0	0.120	0.013
2	IN-14T	MH14P	26.54	26.00	CIR 1	0.00	2.00	300.0	0.180	0.013
3	IN-14V	IN-14T	27.85	27.00	CIR 1	0.00	1.50	327.0	0.260	0.013
4	IN-14W	IN-14V	28.22	28.00	CIR 1	0.00	1.50	83.0	0.259	0.013
5	IN-14U	IN-14T	28.22	28.00	CIR 1	0.00	1.50	83.0	0.260	0.013
6	IN-14R	MH14P	28.00	27.23	CIR 1	0.00	1.50	297.0	0.259	0.013
7	IN-14S	IN-14R	28.22	28.00	CIR 1	0.00	1.50	83.0	0.260	0.013
8	IN-14X	IN-14V	28.03	27.85	CIR 1	0.00	1.50	70.0	0.260	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.000 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	28.09	28.00	32.60	0.026	1.44	3.00	3.20	1.52	10.8	23.2	0.000
2	28.40	28.09	31.38	0.083	1.21	2.00	3.29	2.08	6.5	9.6	0.000
3	29.18	28.40	31.18	0.024	0.57	1.40	2.66	0.95	1.6	5.4	0.000
4	29.39	29.18	31.18	0.003	0.33	1.18	1.97	0.38	0.6	5.4	0.000
5	28.94	28.40	31.38	0.058	0.73	0.73	2.99	2.99	2.5	5.4	0.000
6	29.04	28.09	31.39	0.174	1.04	1.04	3.38	3.38	4.4	5.4	0.000
7	29.18	29.04	31.39	0.048	0.69	1.04	2.92	1.78	2.3	5.4	0.000
8	29.36	29.18	30.78	0.003	0.33	1.33	1.97	0.34	0.6	5.4	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	3.0	0.0	1	97.0
CIRCULAR	CONCRETE	2.0	0.0	1	300.0
CIRCULAR	CONCRETE	1.5	0.0	6	943.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	4
CURB ON GRADE		5.0	0.0	0.0	0.0	0.0	3
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	1
OUTLET		0.0	0.0	0.0	0.0	0.0	1

OUTPUT FOR ANALYSYS FREQUENCY OF: 100 YEARS

RUNOFF COMPUTATION FOR ANALYSIS FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
IN-14S	0.69	0.53	10.00	10.00	9.51	0.000	3.478
IN-14R	0.69	0.52	10.46	10.46	9.13	0.000	3.276
IN-14W	0.69	0.13	10.00	10.00	9.51	0.000	0.853
IN-14V	0.69	0.13	10.46	10.46	9.09	0.000	0.815
IN-14U	0.69	0.58	10.00	10.00	9.51	0.000	3.806
IN-14T	0.69	0.66	12.28	12.28	8.75	0.000	3.985
IN-14X	0.69	0.13	10.00	10.00	9.52	0.000	0.854

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
IN-14W	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
IN-14V	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
IN-14X	CURB	5.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
IN-14W	CURB	0.853	0.853	0.000	0.000		4.00	5.00	7.35
IN-14V	CURB	0.815	0.815	0.000	0.000		3.91	5.00	7.25
IN-14X	CURB	0.854	0.854	0.000	0.000		4.01	5.00	7.35

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
IN-14S	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
IN-14R	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
IN-14U	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
IN-14T	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
IN-14S	CURB	5.00	N/A	N/A	3.478	15.022	0.317	9.60	9.60
IN-14R	CURB	5.00	N/A	N/A	3.276	15.022	0.309	9.40	9.40
IN-14U	CURB	5.00	N/A	N/A	3.806	15.022	0.330	9.95	9.95
IN-14T	CURB	5.00	N/A	N/A	3.985	15.022	0.338	10.10	10.10

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
IN-14S	CURB	0.690	0.53	10.00	9.51		0.00	3.478
IN-14R	CURB	0.690	1.05	10.46	9.13		0.00	6.615
IN-14W	CURB	0.690	0.13	10.00	9.51		0.00	0.853
IN-14V	CURB	0.690	0.39	10.62	9.09		0.00	2.446
IN-14U	CURB	0.690	0.58	10.00	9.51		0.00	3.806
IN-14T	CURB	0.690	1.63	12.47	8.75		0.00	9.841
MH14P	CRCMH	0.690	2.68	13.90	8.75		0.00	16.181
IN-14X	CURB	0.690	0.13	10.00	9.52		0.00	0.854
OUT	OUTLT	0.690	2.68	13.90	8.75		0.00	16.181

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH14P	OUT	25.12	25.00	CIR 1	0.00	3.00	97.0	0.120	0.013
2	IN-14T	MH14P	26.54	26.00	CIR 1	0.00	2.00	300.0	0.180	0.013
3	IN-14V	IN-14T	27.85	27.00	CIR 1	0.00	1.50	327.0	0.260	0.013
4	IN-14W	IN-14V	28.22	28.00	CIR 1	0.00	1.50	83.0	0.259	0.013
5	IN-14U	IN-14T	28.22	28.00	CIR 1	0.00	1.50	83.0	0.260	0.013
6	IN-14R	MH14P	28.00	27.23	CIR 1	0.00	1.50	297.0	0.259	0.013
7	IN-14S	IN-14R	28.22	28.00	CIR 1	0.00	1.50	83.0	0.260	0.013
8	IN-14X	IN-14V	28.03	27.85	CIR 1	0.00	1.50	70.0	0.260	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.000 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	28.06	28.00	32.60	0.058	1.85	3.00	3.53	2.29	16.2	23.2	0.000
2	28.63	28.06	31.38	0.188	1.69	2.00	3.48	3.13	9.8	9.6	0.000
3	29.30	28.63	31.18	0.054	0.71	1.50	2.96	1.38	2.4	5.4	0.000
4	29.51	29.30	31.18	0.007	0.41	1.30	2.22	0.52	0.9	5.4	0.000
5	29.15	28.63	31.38	0.130	0.93	0.93	3.29	3.29	3.8	5.4	0.000
6	29.80	28.06	31.39	0.393	1.50	1.50	3.74	3.74	6.6	5.4	0.000
7	29.92	29.80	31.39	0.109	0.88	1.50	3.23	1.97	3.5	5.4	0.000
8	29.48	29.30	30.78	0.007	0.41	1.45	2.22	0.49	0.9	5.4	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	3.0	0.0	1	97.0
CIRCULAR	CONCRETE	2.0	0.0	1	300.0
CIRCULAR	CONCRETE	1.5	0.0	6	943.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	4
CURB ON GRADE		5.0	0.0	0.0	0.0	0.0	3
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	1
OUTLET		0.0	0.0	0.0	0.0	0.0	1

END

NORMAL TERMINATION OF HOUSTORM.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE CALCULATIONS
(4 OF 7)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR09

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR08.dwg May 27, 2020-10:33am Terra Associates Inc., Thanh Dao

OUTPUT FOR DESIGN FREQUENCY OF: 5 YEARS

RUNOFF COMPUTATION FOR DESIGN FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
12Y1	0.2	68.00	13.33	13.33	5.89	0.000	80.104
12J	0.55	0.97	10.00	10.00	6.41	0.000	3.420
12N	0.55	0.94	10.00	10.00	6.41	0.000	3.314
12S	0.55	0.83	10.00	10.00	6.41	0.000	2.926
12W	0.55	0.57	10.00	10.00	6.41	0.000	2.010

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
12W	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
12W	CURB	2.010	2.010	0.000	0.000		6.45	10.00	10.15

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
12J	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12N	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12S	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
12J	CURB	5.00	N/A	N/A	3.420	15.022	0.315	9.55	9.55
12N	CURB	5.00	N/A	N/A	3.314	15.022	0.311	9.45	9.45
12S	CURB	5.00	N/A	N/A	2.926	15.022	0.297	9.00	9.00

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
MH12V	CRCMH	0.550	0.57	10.06	6.41		0.00	2.010
MH12Y	BOXMH	0.207	69.40	13.42	6.41		0.00	92.112
MH12E	BOXMH	0.216	71.31	16.50	6.41		0.00	98.845
MH12H	BOXMH	0.216	71.31	15.64	6.41		0.00	98.845
MH12M	BOXMH	0.212	70.34	14.10	6.41		0.00	95.426
MH12R	CRCMH	0.550	1.40	11.31	6.41		0.00	4.936
12Y1	JCTBX	0.200	68.00	13.33	5.89		0.00	80.104
12J	CURB	0.550	0.97	10.00	6.41		0.00	3.420
12N	CURB	0.550	0.94	10.00	6.41		0.00	3.314
12S	CURB	0.550	0.83	10.00	6.41		0.00	2.926
12W	CURB	0.550	0.57	10.00	6.41		0.00	2.010
OUT	OUTLT	0.216	71.31	16.50	6.41		0.00	98.845

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
2	MH12E	OUT	23.10	23.00	BOX 1	7.00	4.00	83.0	0.120	0.013
3	MH12H	MH12E	23.42	23.10	BOX 1	7.00	4.00	268.4	0.120	0.013
4	MH12M	MH12H	24.00	23.42	BOX 1	7.00	4.00	480.0	0.121	0.013
5	MH12Y	MH12M	24.08	24.00	BOX 1	7.00	4.00	154.0	0.052	0.013
6	MH12R	MH12Y	25.46	24.75	CIR 1	0.00	2.00	355.0	0.199	0.013
7	MH12V	MH12R	26.62	25.96	CIR 1	0.00	1.50	222.0	0.300	0.013
18	12W	MH12V	26.65	26.62	CIR 1	0.00	1.50	10.0	0.270	0.013
19	12S	MH12R	25.99	25.96	CIR 1	0.00	1.50	10.0	0.300	0.013
20	12Y1	MH12Y	24.09	24.08	BOX 1	7.00	4.00	20.0	0.060	0.013
21	12N	MH12M	25.70	25.67	CIR 1	0.00	1.50	10.0	0.280	0.013
22	12J	MH12H	25.31	25.28	CIR 1	0.00	1.50	10.0	0.300	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 27.000 (FT)

RUN #	HYD. GR.LINE US (FT)	DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
2	27.06	27.00	30.51	0.069	2.69	4.00	5.25	3.53	98.8	130.5	0.000
3	27.25	27.06	29.82	0.069	2.70	3.96	5.22	3.56	98.8	130.0	0.000
4	27.57	27.25	29.97	0.064	2.63	3.83	5.19	3.56	95.4	130.7	0.000
5	27.58	27.57	30.41	0.060	3.50	3.57	3.76	3.68	92.1	85.7	0.000
6	28.12	27.58	30.12	0.047	0.99	2.00	3.20	1.57	4.9	10.1	0.000
7	28.71	28.12	30.78	0.036	0.61	1.50	2.96	1.14	2.0	5.8	0.000
18	28.73	28.71	30.78	0.036	0.63	1.50	2.85	1.14	2.0	5.5	0.000
19	28.14	28.12	30.12	0.077	0.76	1.50	3.27	1.66	2.9	5.8	0.000
20	27.58	27.58	30.41	0.045	2.97	3.50	3.85	3.27	80.1	92.1	0.000
21	27.59	27.57	29.97	0.099	0.83	1.50	3.28	1.88	3.3	5.6	0.000
22	27.27	27.25	29.82	0.105	0.83	1.50	3.40	1.94	3.4	5.8	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
BOX	CONCRETE	4.0	7.0	5	1005.37
CIRCULAR	CONCRETE	2.0	0.0	1	355.0
CIRCULAR	CONCRETE	1.5	0.0	5	262.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	2
BOX MANHOLE		0.0	0.0	0.0	0.0	0.0	4
JUNCTION BOX		0.0	0.0	0.0	0.0	0.0	1
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	3
CURB ON GRADE		10.0	0.0	0.0	0.0	0.0	1
OUTLET		0.0	0.0	0.0	0.0	0.0	1

OUTPUT FOR ANALYSYS FREQUENCY OF: 100 YEARS

RUNOFF COMPUTATION FOR ANALYSIS FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
12Y1	0.2	68.00	13.33	13.33	8.85	0.000	120.360
12J	0.55	0.97	10.00	10.00	9.61	0.000	5.127
12N	0.55	0.94	10.00	10.00	9.61	0.000	4.968
12S	0.55	0.83	10.00	10.00	9.61	0.000	4.387
12W	0.55	0.57	10.00	10.00	9.61	0.000	3.013

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
12W	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
12W	CURB	3.013	3.013	0.000	0.000		8.17	10.00	11.80

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
12J	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12N	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12S	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
12J	CURB	5.00	N/A	N/A	5.127	15.022	0.396	11.10	11.10
12N	CURB	5.00	N/A	N/A	4.968	15.022	0.387	11.00	11.00
12S	CURB	5.00	N/A	N/A	4.387	15.022	0.357	10.50	10.50

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
MH12V	CRCMH	0.550	0.57	10.05	9.61		0.00	3.013
MH12Y	BOXMH	0.207	69.40	13.41	9.61		0.00	138.096
MH12E	BOXMH	0.216	71.31	16.08	9.61		0.00	148.191
MH12H	BOXMH	0.216	71.31	15.31	9.61		0.00	148.191
MH12M	BOXMH	0.212	70.34	13.93	9.61		0.00	143.064
MH12R	CRCMH	0.550	1.40	11.18	9.61		0.00	7.400
12Y1	JCTBX	0.200	68.00	13.33	8.85		0.00	120.360
12J	CURB	0.550	0.97	10.00	9.61		0.00	5.127
12N	CURB	0.550	0.94	10.00	9.61		0.00	4.968
12S	CURB	0.550	0.83	10.00	9.61		0.00	4.387
12W	CURB	0.550	0.57	10.00	9.61		0.00	3.013
OUT	OUTLT	0.216	71.31	16.08	9.61		0.00	148.191

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
2	MH12E	OUT	23.10	23.00	BOX 1	7.00	4.00	83.0	0.120	0.013
3	MH12H	MH12E	23.42	23.10	BOX 1	7.00	4.00	268.4	0.120	0.013
4	MH12M	MH12H	24.00	23.42	BOX 1	7.00	4.00	480.0	0.121	0.013
5	MH12Y	MH12M	24.08	24.00	BOX 1	7.00	4.00	154.0	0.052	0.013
6	MH12R	MH12Y	25.46	24.75	CIR 1	0.00	2.00	355.0	0.199	0.013
7	MH12V	MH12R	26.62	25.96	CIR 1	0.00	1.50	222.0	0.300	0.013
18	12W	MH12V	26.65	26.62	CIR 1	0.00	1.50	10.0	0.270	0.013
19	12S	MH12R	25.99	25.96	CIR 1	0.00	1.50	10.0	0.300	0.013
20	12Y1	MH12Y	24.09	24.08	BOX 1	7.00	4.00	20.0	0.060	0.013
21	12N	MH12M	25.70	25.67	CIR 1	0.00	1.50	10.0	0.280	0.013
22	12J	MH12H	25.31	25.28	CIR 1	0.00	1.50	10.0	0.300	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 27.000 (FT)

RUN #	HYD. GR.LINE US (FT)	DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
2	27.13	27.00	30.51	0.155	3.63	4.00	5.84	5.29	148.2	130.5	0.000
3	27.55	27.13	29.82	0.155	3.64	4.00	5.81	5.29	148.2	130.0	0.000
4	28.24	27.55	29.97	0.145	3.53	4.00	5.79	5.11	143.1	130.7	0.000
5	28.45	28.24	30.41	0.135	4.00	4.00	4.93	4.93	138.1	85.7	0.000
6	28.78	28.45	30.12	0.106	1.27	2.00	3.51	2.36	7.4	10.1	0.000
7	29.27	28.78	30.78	0.082	0.77	1.50	3.30	1.70	3.0	5.8	0.000
18	29.29	29.27	30.78	0.082	0.80	1.50	3.17	1.70	3.0	5.5	0.000
19	28.79	28.78	30.12	0.173	0.98	1.50	3.58	2.48	4.4	5.8	0.000
20	28.47	28.45	30.41	0.103	4.00	4.00	4.30	4.30	120.4	92.1	0.000
21	28.25	28.24	29.97	0.222	1.11	1.50	3.55	2.81	5.0	5.6	0.000
22	27.55	27.55	29.82	0.236	1.10	1.50	3.68	2.90	5.1	5.8	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
BOX	CONCRETE	4.0	7.0	5	1005.37
CIRCULAR	CONCRETE	2.0	0.0	1	355.0
CIRCULAR	CONCRETE	1.5	0.0	5	262.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	2
BOX MANHOLE		0.0	0.0	0.0	0.0	0.0	4
JUNCTION BOX		0.0	0.0	0.0	0.0	0.0	1
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	3
CURB ON GRADE		10.0	0.0	0.0	0.0	0.0	1
OUTLET		0.0	0.0	0.0	0.0	0.0	1

END

NORMAL TERMINATION OF HOUSTORM.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE CALCULATIONS
(5 OF 7)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR10

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR09.dwg May 27, 2020-10:33am Terra Associates Inc., Thanh Dao

OUTPUT FOR DESIGN FREQUENCY OF: 5 YEARS

RUNOFF COMPUTATION FOR DESIGN FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
12G	0.69	0.61	10.00	10.00	6.41	0.000	2.698
12L	0.55	0.83	10.00	10.00	6.41	0.000	2.926
12Q	0.55	0.82	10.00	10.00	6.41	0.000	2.891
12U	0.55	0.54	10.00	10.00	6.41	0.000	1.904
12X1	0.2	34.00	13.33	13.33	5.89	0.000	40.052

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
12U	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
12U	CURB	1.904	1.904	0.000	0.000		6.25	10.00	9.95

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
12G	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12L	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12Q	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
12G	CURB	5.00	N/A	N/A	2.698	15.022	0.290	8.75	8.75
12L	CURB	5.00	N/A	N/A	2.926	15.022	0.297	9.00	9.00
12Q	CURB	5.00	N/A	N/A	2.891	15.022	0.296	8.95	8.95

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
12X1	JCTBX	0.200	34.00	13.33	5.89		0.00	40.052
12G	CURB	0.690	0.61	10.00	6.41		0.00	2.698
12L	CURB	0.550	0.83	10.00	6.41		0.00	2.926
12Q	CURB	0.550	0.82	10.00	6.41		0.00	2.891
12U	CURB	0.550	0.54	10.00	6.41		0.00	1.904
MH 12X	BOXMH	0.213	35.36	13.42	6.41		0.00	48.383
MH12D	BOXMH	0.229	36.80	17.00	6.41		0.00	54.007
MH12F	BOXMH	0.229	36.80	16.09	6.41		0.00	54.007
MH12K	BOXMH	0.221	36.19	14.40	6.41		0.00	51.309
MH12P	CRCMH	0.550	1.36	11.28	6.41		0.00	4.795
MH12T	CRCMH	0.550	0.54	10.05	6.41		0.00	1.904
OUT	OUTLT	0.229	36.80	17.00	6.41		0.00	54.007

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH12D	OUT	23.02	23.00	BOX 1	5.00	4.00	17.0	0.118	0.013
2	MH12F	MH12D	23.39	23.02	BOX 1	5.00	3.00	263.0	0.140	0.013
3	MH12K	MH12F	24.06	23.39	BOX 1	5.00	3.00	480.0	0.140	0.013
8	MH 12X	MH12K	24.15	24.06	BOX 1	5.00	3.00	190.0	0.047	0.013
9	MH12P	MH 12X	25.58	24.94	CIR 1	0.00	2.00	320.0	0.200	0.013
10	MH12T	MH12P	26.74	26.08	CIR 1	0.00	1.50	218.0	0.303	0.013
13	12U	MH12T	26.76	26.74	CIR 1	0.00	1.50	8.0	0.300	0.013
14	12Q	MH12P	26.11	26.08	CIR 1	0.00	1.50	9.0	0.300	0.013
15	12X1	MH 12X	24.18	24.16	BOX 1	5.00	3.00	20.0	0.100	0.013
16	12L	MH12K	25.77	25.75	CIR 1	0.00	1.50	8.0	0.300	0.013
17	12G	MH12F	25.26	25.24	CIR 1	0.00	1.50	8.0	0.300	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 27.000 (FT)

RUN #	HYD. US (FT)	GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	27.02	27.00	30.51	0.048	2.41	4.00	4.49	2.70	54.0	84.1	0.000
2	27.10	27.02	29.82	0.108	2.25	3.00	4.80	3.60	54.0	61.5	0.000
3	27.30	27.10	29.97	0.098	2.17	3.00	4.73	3.42	51.3	61.5	0.000
8	27.47	27.30	30.52	0.087	3.00	3.00	3.23	3.23	48.4	35.7	0.000
9	27.97	27.47	30.12	0.045	0.97	2.00	3.18	1.53	4.8	10.2	0.000
10	28.56	27.97	30.78	0.033	0.59	1.50	2.93	1.08	1.9	5.8	0.000
13	28.58	28.56	30.78	0.033	0.59	1.50	2.92	1.08	1.9	5.8	0.000
14	27.99	27.97	30.12	0.075	0.75	1.50	3.26	1.64	2.9	5.8	0.000
15	27.48	27.47	30.52	0.059	2.05	3.00	3.91	2.67	40.1	51.9	0.000
16	27.32	27.30	29.97	0.077	0.76	1.50	3.27	1.66	2.9	5.8	0.000
17	27.12	27.10	29.82	0.065	0.72	1.50	3.20	1.53	2.7	5.8	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
BOX	CONCRETE	4.0	5.0	1	17.0
BOX	CONCRETE	3.0	5.0	4	953.0
CIRCULAR	CONCRETE	2.0	0.0	1	320.0
CIRCULAR	CONCRETE	1.5	0.0	5	251.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
JUNCTION BOX		0.0	0.0	0.0	0.0	0.0	1
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	3
CURB ON GRADE		10.0	0.0	0.0	0.0	0.0	1
BOX MANHOLE		0.0	0.0	0.0	0.0	0.0	4
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	2
OUTLET		0.0	0.0	0.0	0.0	0.0	1

OUTPUT FOR ANALYSYS FREQUENCY OF: 100 YEARS

RUNOFF COMPUTATION FOR ANALYSIS FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
12G	0.69	0.61	10.00	10.00	9.61	0.000	4.045
12L	0.55	0.83	10.00	10.00	9.61	0.000	4.387
12Q	0.55	0.82	10.00	10.00	9.61	0.000	4.334
12U	0.55	0.54	10.00	10.00	9.61	0.000	2.854
12X1	0.2	34.00	13.33	13.33	8.85	0.000	60.180

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
12U	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
12U	CURB	2.854	2.854	0.000	0.000		7.91	10.00	11.55

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
12G	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12L	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
12Q	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
12G	CURB	5.00	N/A	N/A	4.045	15.022	0.341	10.15	10.15
12L	CURB	5.00	N/A	N/A	4.387	15.022	0.357	10.50	10.50
12Q	CURB	5.00	N/A	N/A	4.334	15.022	0.354	10.45	10.45

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
12X1	JCTBX	0.200	34.00	13.33	8.85		0.00	60.180
12G	CURB	0.690	0.61	10.00	9.61		0.00	4.045
12L	CURB	0.550	0.83	10.00	9.61		0.00	4.387
12Q	CURB	0.550	0.82	10.00	9.61		0.00	4.334
12U	CURB	0.550	0.54	10.00	9.61		0.00	2.854
MH 12X	BOXMH	0.213	35.36	13.41	9.61		0.00	72.536
MH12D	BOXMH	0.229	36.80	16.40	9.61		0.00	80.968
MH12F	BOXMH	0.229	36.80	15.59	9.61		0.00	80.968
MH12K	BOXMH	0.221	36.19	14.06	9.61		0.00	76.923
MH12P	CRCMH	0.550	1.36	11.15	9.61		0.00	7.188
MH12T	CRCMH	0.550	0.54	10.04	9.61		0.00	2.854
OUT	OUTLT	0.229	36.80	16.40	9.61		0.00	80.968

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
1	MH12D	OUT	23.02	23.00	BOX 1	5.00	4.00	17.0	0.118	0.013
2	MH12F	MH12D	23.39	23.02	BOX 1	5.00	3.00	263.0	0.140	0.013
3	MH12K	MH12F	24.06	23.39	BOX 1	5.00	3.00	480.0	0.140	0.013
8	MH 12X	MH12K	24.15	24.06	BOX 1	5.00	3.00	190.0	0.047	0.013
9	MH12P	MH 12X	25.58	24.94	CIR 1	0.00	2.00	320.0	0.200	0.013
10	MH12T	MH12P	26.74	26.08	CIR 1	0.00	1.50	218.0	0.303	0.013
13	12U	MH12T	26.76	26.74	CIR 1	0.00	1.50	8.0	0.300	0.013
14	12Q	MH12P	26.11	26.08	CIR 1	0.00	1.50	9.0	0.300	0.013
15	12X1	MH 12X	24.18	24.16	BOX 1	5.00	3.00	20.0	0.100	0.013
16	12L	MH12K	25.77	25.75	CIR 1	0.00	1.50	8.0	0.300	0.013
17	12G	MH12F	25.26	25.24	CIR 1	0.00	1.50	8.0	0.300	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 27.000 (FT)

RUN #	HYD. US (FT)	GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
1	27.01	27.00	30.51	0.109	3.28	4.00	4.94	4.05	81.0	84.1	0.000
2	27.65	27.01	29.82	0.243	3.00	3.00	5.40	5.40	81.0	61.5	0.000
3	28.70	27.65	29.97	0.219	2.94	3.00	5.23	5.13	76.9	61.5	0.000
8	29.07	28.70	30.52	0.195	3.00	3.00	4.84	4.84	72.5	35.7	0.000
9	29.39	29.07	30.12	0.100	1.25	2.00	3.49	2.29	7.2	10.2	0.000
10	29.89	29.39	30.78	0.073	0.74	1.50	3.26	1.62	2.9	5.8	0.000
13	29.91	29.89	30.78	0.073	0.75	1.50	3.25	1.62	2.9	5.8	0.000
14	29.40	29.39	30.12	0.169	0.97	1.50	3.57	2.45	4.3	5.8	0.000
15	29.10	29.07	30.52	0.134	2.77	3.00	4.35	4.01	60.2	51.9	0.000
16	28.71	28.70	29.97	0.173	0.98	1.50	3.58	2.48	4.4	5.8	0.000
17	27.66	27.65	29.82	0.147	0.93	1.50	3.53	2.29	4.0	5.8	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
BOX	CONCRETE	4.0	5.0	1	17.0
BOX	CONCRETE	3.0	5.0	4	953.0
CIRCULAR	CONCRETE	2.0	0.0	1	320.0
CIRCULAR	CONCRETE	1.5	0.0	5	251.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
JUNCTION BOX		0.0	0.0	0.0	0.0	0.0	1
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	3
CURB ON GRADE		10.0	0.0	0.0	0.0	0.0	1
BOX MANHOLE		0.0	0.0	0.0	0.0	0.0	4
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	2
OUTLET		0.0	0.0	0.0	0.0	0.0	1

==END==

NORMAL TERMINATION OF HOUSTORM.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE CALCULATIONS (6 OF 7)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR11

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\DR10.dwg May 27, 2020-10:33am Terra Associates Inc., Thanh Dao

OUTPUT FOR DESIGN FREQUENCY OF: 5 YEARS

RUNOFF COMPUTATION FOR DESIGN FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
51B	0.2	12.85	13.79	13.79	5.80	0.000	14.906
51P	0.55	0.77	10.00	10.00	6.38	0.000	2.702
51Q	0.55	0.78	10.00	10.00	6.38	0.000	2.737
51J	0.55	0.76	10.00	10.00	6.38	0.000	2.667
51K	0.55	0.76	10.00	10.00	6.38	0.000	2.667
51D	0.2	6.31	13.94	13.94	5.81	0.000	7.332
51E	0.55	0.57	11.77	11.77	5.78	0.000	1.812
51F	0.55	0.56	10.00	10.00	6.38	0.000	1.965

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
51E	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
51F	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
51E	CURB	1.812	1.812	0.000	0.000		6.07	10.00	9.75
51F	CURB	1.965	1.965	0.000	0.000		6.36	10.00	10.05

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
51P	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51Q	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51J	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51K	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51D	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
51B	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
51P	CURB	5.00	N/A	N/A	2.702	15.022	0.290	8.75	8.75
51Q	CURB	5.00	N/A	N/A	2.737	15.022	0.291	8.80	8.80
51J	CURB	5.00	N/A	N/A	2.667	15.022	0.289	8.70	8.70
51K	CURB	5.00	N/A	N/A	2.667	15.022	0.289	8.70	8.70
51D	ARINL	5.00	N/A	N/A	7.332	15.022	0.548	N/A	N/A
51B	ARINL	5.00	N/A	N/A	14.906	15.022	1.481	N/A	N/A

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
51P	CURB	0.550	0.77	10.00	6.38		0.00	2.702
51Q	CURB	0.550	0.78	10.00	6.38		0.00	2.737
51J	CURB	0.550	0.76	10.00	6.38		0.00	2.667
51K	CURB	0.550	0.76	10.00	6.38		0.00	2.667
51D	ARINL	0.200	6.31	13.94	5.81		0.00	7.332
51E	CURB	0.229	6.88	14.00	5.78		0.00	9.106
51F	CURB	0.550	0.56	10.00	6.38		0.00	1.965
MH51R	CRCMH	0.550	1.55	10.22	5.80		0.00	4.945
MH51L	CRCMH	0.550	3.07	12.49	5.80		0.00	9.793
MH51G	CRCMH	0.340	10.51	14.57	5.80		0.00	20.718
MH51A	CRCMH	0.263	23.36	14.90	5.80		0.00	35.624
51B	ARINL	0.200	12.85	13.79	5.80		0.00	14.906
OUT	OUTLT	0.263	23.36	14.90	5.80		0.00	35.624

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
5	51P	MH51R	23.97	23.87	CIR 1	0.00	1.50	40.0	0.260	0.013
6	51Q	MH51R	23.97	23.87	CIR 1	0.00	1.50	40.0	0.260	0.013
7	51J	MH51L	23.22	23.11	CIR 1	0.00	1.50	40.0	0.260	0.013
8	51K	MH51L	23.22	23.11	CIR 1	0.00	1.50	40.0	0.260	0.013
9	51D	51E	21.72	21.70	CIR 1	0.00	2.50	11.0	0.145	0.013
10	51E	MH51G	21.70	21.64	CIR 1	0.00	2.50	40.0	0.150	0.013
11	51F	MH51G	22.75	22.64	CIR 1	0.00	1.50	40.0	0.260	0.013
12	51B	MH51A	21.64	21.56	BOX 1	3.00	3.00	46.0	0.180	0.013
1	MH51A	OUT	21.56	21.00	CIR 1	0.00	4.00	222.0	0.250	0.013
2	MH51G	MH51A	21.64	21.56	CIR 1	0.00	3.00	74.0	0.120	0.013
3	MH51L	MH51G	22.11	21.64	CIR 1	0.00	3.00	390.0	0.120	0.013
4	MH51R	MH51L	23.37	22.61	CIR 1	0.00	2.00	420.0	0.180	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.200 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
5	29.66	29.58	30.58	0.066	0.75	1.50	3.04	1.53	2.7	5.4	0.000
6	29.66	29.58	30.76	0.067	0.76	1.50	3.04	1.55	2.7	5.4	0.000
7	29.10	29.02	30.21	0.064	0.75	1.50	3.03	1.51	2.7	5.4	0.000
8	29.10	29.02	30.21	0.064	0.75	1.50	3.03	1.51	2.7	5.4	0.000
9	28.69	28.68	29.53	0.032	1.21	2.50	3.13	1.49	7.3	15.7	0.000
10	28.68	28.64	29.53	0.049	1.36	2.50	3.34	1.86	9.1	16.0	0.000
11	28.73	28.64	29.53	0.035	0.63	1.50	2.80	1.11	2.0	5.4	0.000
12	28.69	28.62	29.20	0.031	1.30	3.00	3.82	1.66	14.9	36.1	0.000
1	28.62	28.20	29.20	0.061	1.99	4.00	5.70	2.83	35.6	72.1	0.000
2	28.64	28.62	29.53	0.096	2.21	3.00	3.70	2.93	20.7	23.2	0.000
3	29.02	28.64	30.21	0.021	1.37	3.00	3.13	1.39	9.8	23.2	0.000
4	29.58	29.02	30.58	0.047	1.02	2.00	3.08	1.57	4.9	9.6	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	1.5	0.0	5	200.0
CIRCULAR	CONCRETE	2.5	0.0	2	51.0
BOX	CONCRETE	3.0	3.0	1	46.0
CIRCULAR	CONCRETE	4.0	0.0	1	222.0
CIRCULAR	CONCRETE	3.0	0.0	2	464.0
CIRCULAR	CONCRETE	2.0	0.0	1	420.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	4
AREA INLET (TYPE E)		5.0	0.0	0.0	0.0	0.0	2
CURB ON GRADE		10.0	0.0	0.0	0.0	0.0	2
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	4
OUTLET		0.0	0.0	0.0	0.0	0.0	1

OUTPUT FOR ANALYSYS FREQUENCY OF: 100 YEARS

RUNOFF COMPUTATION FOR ANALYSIS FREQUENCY.

ID	C VALUE	AREA (ACRE)	TC (MIN)	TC USED (MIN)	INTENSITY (IN/HR)	SUPPLY Q (CFS)	TOTAL Q (CFS)
51B	0.2	12.85	13.79	13.79	8.73	0.000	22.436
51P	0.55	0.77	10.00	10.00	9.56	0.000	4.049
51Q	0.55	0.78	10.00	10.00	9.56	0.000	4.101
51J	0.55	0.76	10.00	10.00	9.56	0.000	3.996
51K	0.55	0.76	10.00	10.00	9.56	0.000	3.996
51D	0.2	6.31	13.94	13.94	8.74	0.000	11.030
51E	0.55	0.57	11.77	11.77	8.69	0.000	2.724
51F	0.55	0.56	10.00	10.00	9.56	0.000	2.944

ON GRADE INLET CONFIGURATION DATA

INLET ID	INLET TYPE	INLET LENGTH (FT)	SLOPES LONG (%)	SLOPES TRANS (%)	GUTTER N	GUTTER DEPR. (FT)	GRATE WIDTH (FT)	GRATE TYPE	POND WIDTH ALLOWED (FT)
51E	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00
51F	CURB	10.00	0.50	2.00	0.014	0.33	N/A	N/A	12.00

ON GRADE INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	TOTAL Q (CFS)	INTERCEPT CAPACITY (CFS)	Q BYPASS ALLOW (CFS)	Q BYPASS ACTUAL (CFS)	TO INLET ID	REQUIRED LENGTH (FT)	ACTUAL LENGTH (FT)	PONDED WIDTH (FT)
51E	CURB	2.724	2.724	0.000	0.000		7.69	10.00	11.35
51F	CURB	2.944	2.944	0.000	0.000		8.06	10.00	11.70

SAG INLETS CONFIGURATION DATA.

INLET ID	INLET TYPE	LENGTH/ PERIM (FT)	GRATE AREA (SF)	LEFT-SLOPE LONGI (%)	LEFT-SLOPE TRANSV (%)	RIGHT-SLOPE LONGI (%)	RIGHT-SLOPE TRANSV (%)	GUTTER N	GUTTER DEPRW (FT)	HEAD ALLOWED (FT)
51P	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51Q	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51J	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51K	CURB	5.00	0.00	0.50	2.00	0.50	2.00	0.014	1.50	1.50
51D	ARINL	5.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50
51B	ARINL	10.00	N/A	0.50	2.00	0.50	2.00	0.014	N/A	1.50

SAG INLETS COMPUTATION DATA.

INLET ID	INLET TYPE	LENGTH (FT)	GRATE PERIM (FT)	GRATE AREA (SF)	TOTAL Q (CFS)	INLET CAPACITY (CFS)	ACTUAL HEAD (FT)	PONDED LEFT (FT)	WIDTH RIGHT (FT)
51P	CURB	5.00	N/A	N/A	4.049	15.022	0.341	10.15	10.15
51Q	CURB	5.00	N/A	N/A	4.101	15.022	0.343	10.20	10.20
51J	CURB	5.00	N/A	N/A	3.996	15.022	0.338	10.10	10.10
51K	CURB	5.00	N/A	N/A	3.996	15.022	0.338	10.10	10.10
51D	ARINL	5.00	N/A	N/A	11.030	15.022	0.924	N/A	N/A
51B	ARINL	10.00	N/A	N/A	22.436	30.045	0.947	N/A	N/A

CUMULATIVE JUNCTION DISCHARGE COMPUTATIONS

NODE I.D.	NODE TYPE	WEIGHTED C-VALUE	CUMULAT. DR.AREA (ACRES)	CUMULAT. TC (MIN)	INTENS. (IN/HR)	USER SUPPLY Q CFS)	ADDITIONAL Q IN NODE (CFS)	TOTAL DISCH. (CFS)
51P	CURB	0.550	0.77	10.00	9.56		0.00	4.049
51Q	CURB	0.550	0.78	10.00	9.56		0.00	4.101
51J	CURB	0.550	0.76	10.00	9.56		0.00	3.996
51K	CURB	0.550	0.76	10.00	9.56		0.00	3.996
51D	ARINL	0.200	6.31	13.94	8.74		0.00	11.030
51E	CURB	0.229	6.88	13.99	8.69		0.00	13.691
51F	CURB	0.550	0.56	10.00	9.56		0.00	2.944
MH51R	CRCMH	0.550	1.55	10.20	8.73		0.00	7.442
MH51L	CRCMH	0.550	3.07	12.28	8.73		0.00	14.741
MH51G	CRCMH	0.340	10.51	14.18	8.73		0.00	31.184
MH51A	CRCMH	0.263	23.36	14.46	8.73		0.00	53.620
51B	ARINL	0.200	12.85	13.79	8.73		0.00	22.436
OUT	OUTLT	0.263	23.36	14.46	8.73		0.00	53.620

CONVEYANCE CONFIGURATION DATA

RUN #	NODE US	I.D. DS	FLOWLINE ELEV. US (FT)	FLOWLINE ELEV. DS (FT)	SHAPE #	SPAN (FT)	RISE (FT)	LENGTH (FT)	SLOPE (%)	N_VALUE
5	51P	MH51R	23.97	23.87	CIR 1	0.00	1.50	40.0	0.260	0.013
6	51Q	MH51R	23.97	23.87	CIR 1	0.00	1.50	40.0	0.260	0.013
7	51J	MH51L	23.22	23.11	CIR 1	0.00	1.50	40.0	0.260	0.013
8	51K	MH51L	23.22	23.11	CIR 1	0.00	1.50	40.0	0.260	0.013
9	51D	51E	21.72	21.70	CIR 1	0.00	2.50	11.0	0.145	0.013
10	51E	MH51G	21.70	21.64	CIR 1	0.00	2.50	40.0	0.150	0.013
11	51F	MH51G	22.75	22.64	CIR 1	0.00	1.50	40.0	0.260	0.013
12	51B	MH51A	21.64	21.56	BOX 1	3.00	3.00	46.0	0.180	0.013
1	MH51A	OUT	21.56	21.00	CIR 1	0.00	4.00	222.0	0.250	0.013
2	MH51G	MH51A	21.64	21.56	CIR 1	0.00	3.00	74.0	0.120	0.013
3	MH51L	MH51G	22.11	21.64	CIR 1	0.00	3.00	390.0	0.120	0.013
4	MH51R	MH51L	23.37	22.61	CIR 1	0.00	2.00	420.0	0.180	0.013

CONVEYANCE HYDRAULIC COMPUTATIONS. TAILWATER = 28.200 (FT)

RUN #	HYD. GR.LINE US (FT)	HYD. GR.LINE DS (FT)	CRIT.ELEV US (FT)	FR.SLOPE (%)	DEPTH UNIF. (FT)	DEPTH ACTUAL (FT)	VELOCITY UNIF. (F/S)	VELOCITY ACTUAL (F/S)	Q (CFS)	CAP (CFS)	JUNC LOSS (FT)
5	29.24	29.20	30.58	0.147	0.98	1.50	3.33	2.29	4.0	5.4	0.000
6	29.24	29.20	30.76	0.151	0.98	1.50	3.34	2.32	4.1	5.4	0.000
7	28.94	28.89	30.21	0.143	0.97	1.50	3.32	2.26	4.0	5.4	0.000
8	28.94	28.89	30.21	0.143	0.97	1.50	3.32	2.26	4.0	5.4	0.000
9	28.63	28.63	29.53	0.072	1.55	2.50	3.46	2.25	11.0	15.7	0.000
10	28.63	28.61	29.53	0.110	1.79	2.50	3.65	2.79	13.7	16.0	0.000
11	28.68	28.61	29.53	0.078	0.79	1.50	3.10	1.67	2.9	5.4	0.000
12	28.50	28.45	29.20	0.070	1.77	3.00	4.23	2.49	22.4	36.1	0.000
1	28.45	28.20	29.20	0.138	2.58	4.00	6.26	4.27	53.6	72.1	0.000
2	28.61	28.45	29.54	0.217	3.00	3.00	4.41	4.41	31.2	23.2	0.000
3	28.89	28.61	30.21	0.048	1.74	3.00	3.47	2.09	14.7	23.2	0.000
4	29.20	28.89	30.58	0.107	1.32	2.00	3.37	2.37	7.4	9.6	0.000

SUMMARY OF STORM DRAIN STRUCTURE QUANTITIES

NOTE:
THE CONVEY LENGTH SHOULD BE FROM UPSTREAM TO DOWNSTREAM INSIDE BOX.
THIS LENGTH MAY ALSO BE USED AS PAY ITEM.
USING HYDRAULIC LENGTH, FROM NODE CENTER TO NODE CENTER, MAY RESULT IN PROFILE ERROR,
AND THIS LENGTH SHOULD NOT BE USED AS PAY ITEM.

LINKS:

TYPE OF CONVEY STRUCTURE	MATERIAL	RISE (FT)	SPAN (FT)	NUMBER OF LINKS OF THIS TYPE	QUANTITY (FT)
CIRCULAR	CONCRETE	1.5	0.0	5	200.0
CIRCULAR	CONCRETE	2.5	0.0	2	51.0
BOX	CONCRETE	3.0	3.0	1	46.0
CIRCULAR	CONCRETE	4.0	0.0	1	222.0
CIRCULAR	CONCRETE	3.0	0.0	2	464.0
CIRCULAR	CONCRETE	2.0	0.0	1	420.0

NODES:

TYPE OF INLET STRUCTURE	TYPE OF GRATE	INLET LENGTH (FT)	GRATE WIDTH (FT)	GRATE LENGTH (FT)	GRATE AREA (FT)	GRATE PERIMETER (FT)	QUANTITY (EACH)
CURB IN SAG		5.0	0.0	0.0	0.0	0.0	4
AREA INLET (TYPE E)		5.0	0.0	0.0	0.0	0.0	1
CURB ON GRADE		10.0	0.0	0.0	0.0	0.0	2
CIRCULAR MANHOLE		0.0	0.0	0.0	0.0	0.0	4
AREA INLET (TYPE E)		10.0	0.0	0.0	0.0	0.0	1
OUTLET		0.0	0.0	0.0	0.0	0.0	1

END

NORMAL TERMINATION OF HOUSTORM.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

DRAINAGE CALCULATIONS (7 OF 7)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET DR12

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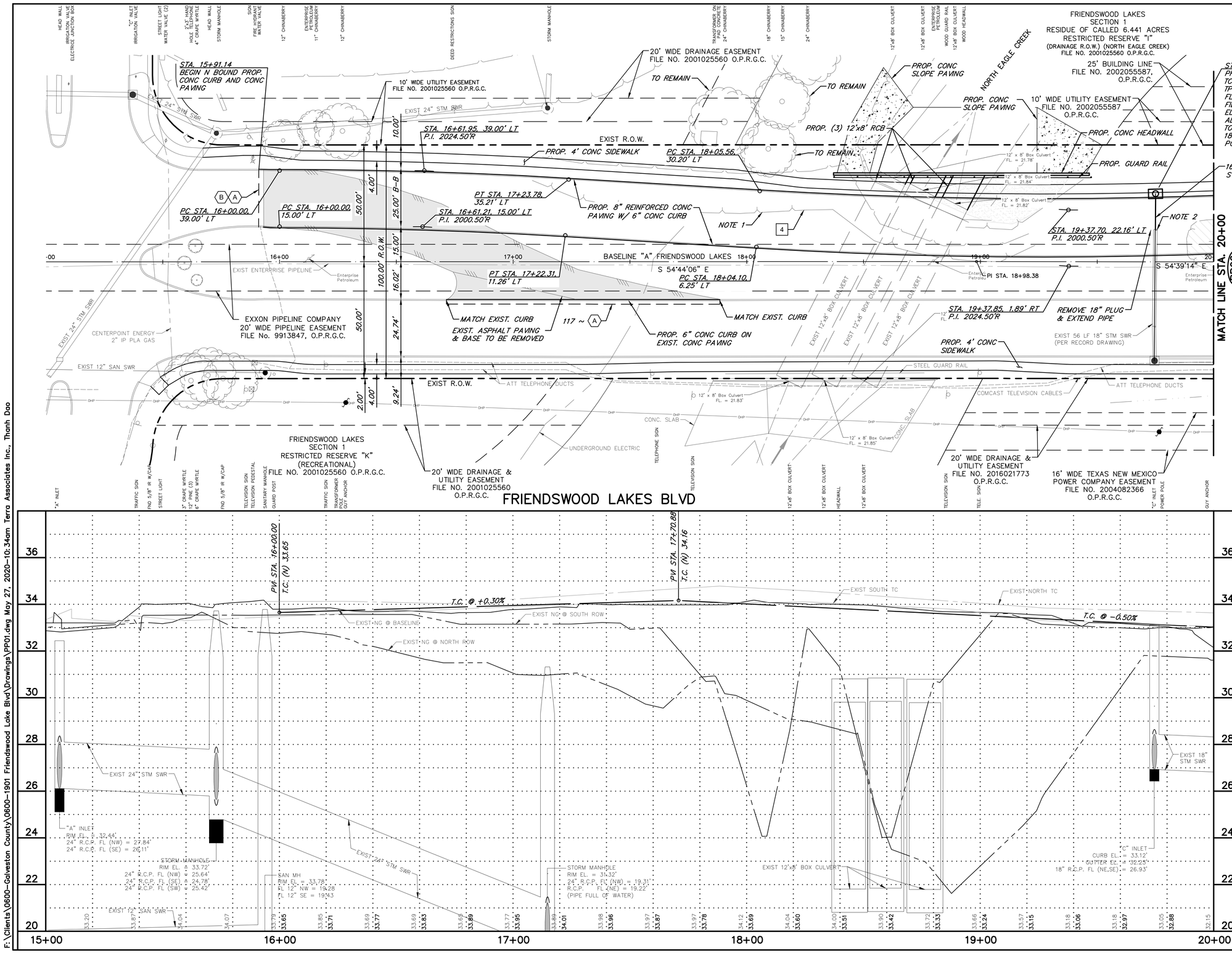

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE (COORDINATE TREE REMOVAL WITH CITY OF FRIENDSWOOD)
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 REPLACE BLOW OFF VALVE IN WATER WATER BOX AND ADJUST TO FINAL GRADE
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED
WITHOUT PRIOR WRITTEN PERMISSION FROM
ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES
PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 15+00 TO STA 20+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

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CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP01

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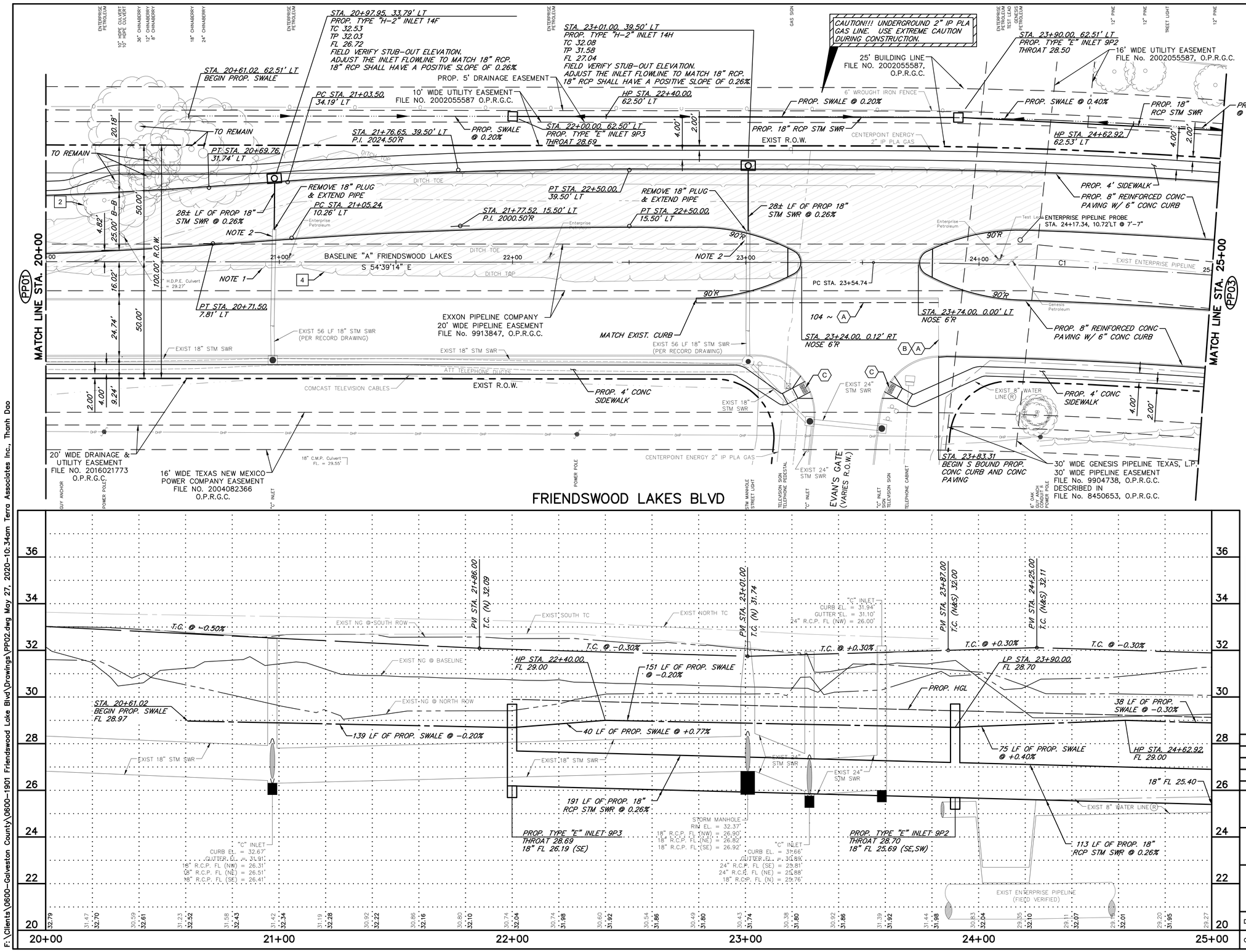

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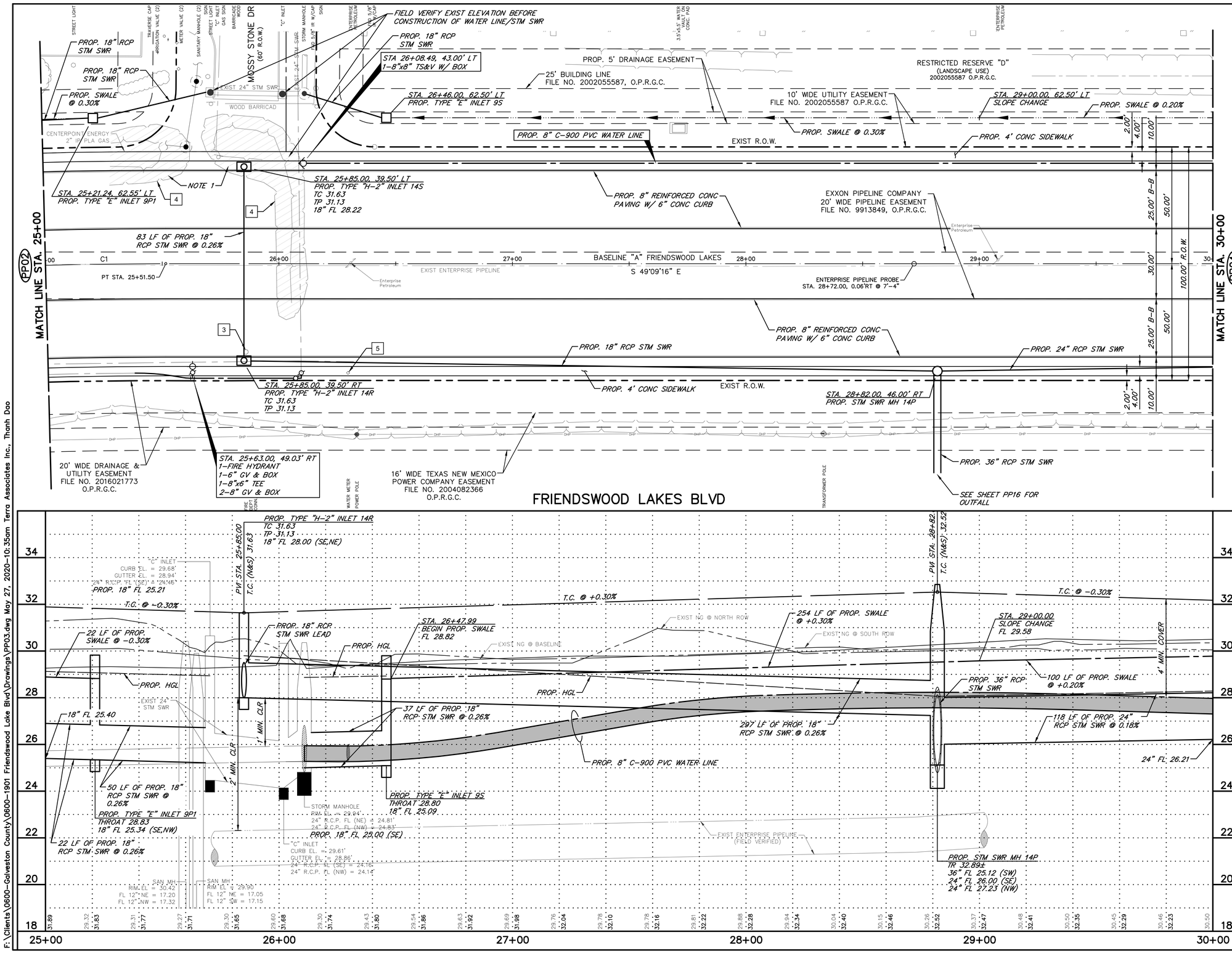

20 0 20

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE (COORDINATE TREE REMOVAL WITH CITY OF FRIENDSWOOD)
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 REPLACE BLOW OFF VALVE IN WATER WATER BOX AND ADJUST TO FINAL GRADE
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

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SEE SHEET GE04 FOR ADDITIONAL PIPELINES PROTECTION NOTES.

Curve Table

Curve #	Length	Radius	Delta	Chord Direction	Chord Distance
C1	196.76'	2050.00	5°29'57"	N51°54'17"W	169.69'

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 25+00 TO STA 30+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

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CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP03

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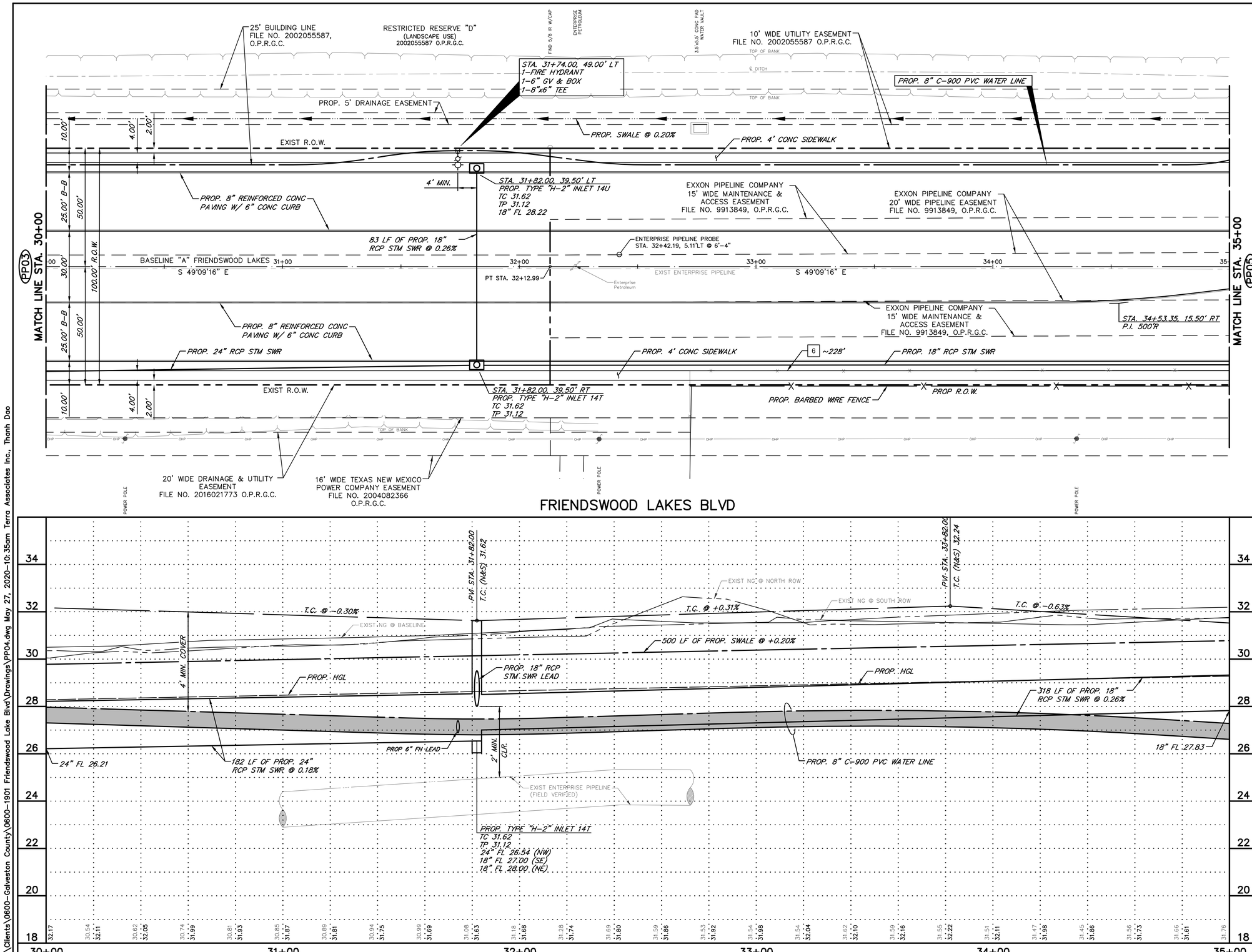

20 0 20

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) TYPE 7 WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE (COORDINATE TREE REMOVAL WITH CITY OF FRIENDSWOOD)
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 REPLACE BLOW OFF VALVE IN WATER WATER BOX AND ADJUST TO FINAL GRADE
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

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PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED
PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 30+00 TO STA 35+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

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CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP04

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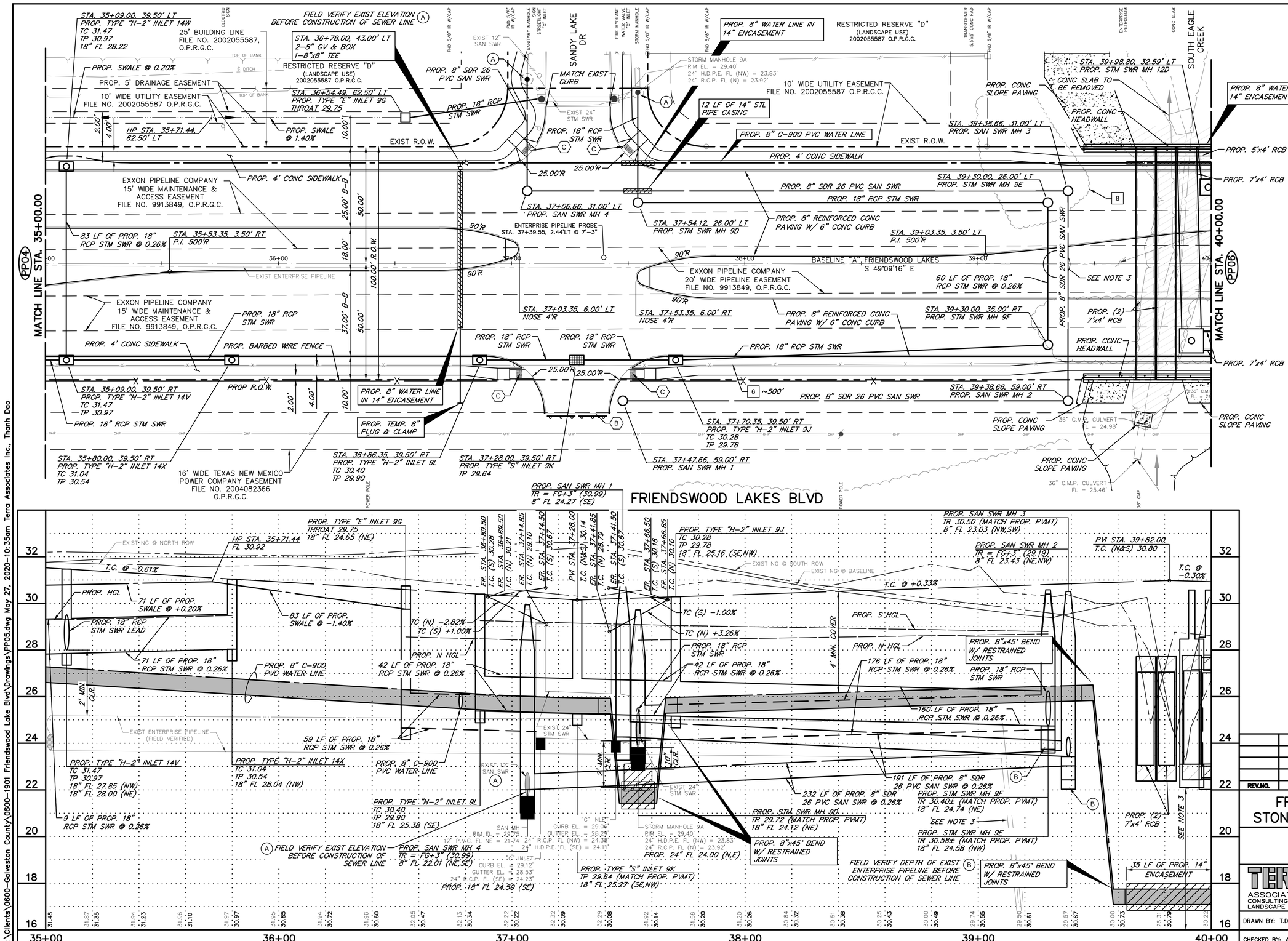

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE (COORDINATE TREE REMOVAL WITH CITY OF FRIENDSWOOD)
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 REPLACE BLOW OFF VALVE IN WATER WATER BOX AND ADJUST TO FINAL GRADE
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.
3. EXISTING ENTERPRISE PIPELINE WAS FIELD VERIFIED AND FOUND TO BE OUT OF RANGE BELOW ELEVATION 16. 2' MIN. CLR. TO BE MAINTAINED BETWEEN PROP. STORM RCB & EXIST. PIPELINE.

WARNING!

HIGH PRESSURE PIPELINE(S) EXCAVATION AND/OR CONSTRUCTION PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES PROTECTION NOTES.

STATE OF TEXAS — A.G.A.N. NANAYAKKARA — 115913 — PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD PLAN AND PROFILE STA 35+00 TO STA 40+00

TERRA ASSOCIATES, INC. CONSULTING ENGINEERS LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP05

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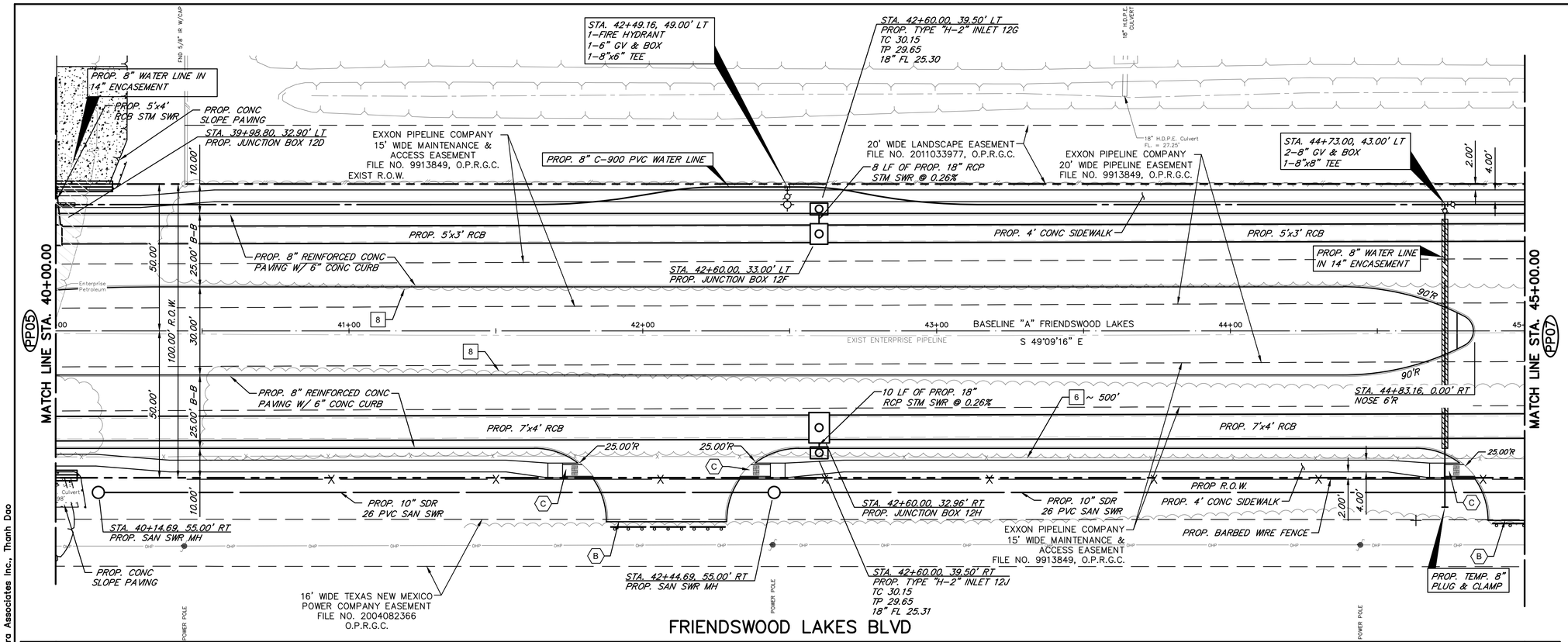

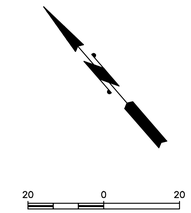

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 RELOCATE WATER METER
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.
3. EXISTING ENTERPRISE PIPELINE WAS FIELD VERIFIED AND FOUND TO BE OUT OF RANGE BELOW ELEVATION 16. 2' MIN. CLR. TO BE MAINTAINED BETWEEN PROP. STORM RCB & EXIST. PIPELINE.

WARNING!

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SEE SHEET GE04 FOR ADDITIONAL PIPELINES PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 40+00 TO STA 45+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901
		CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP06

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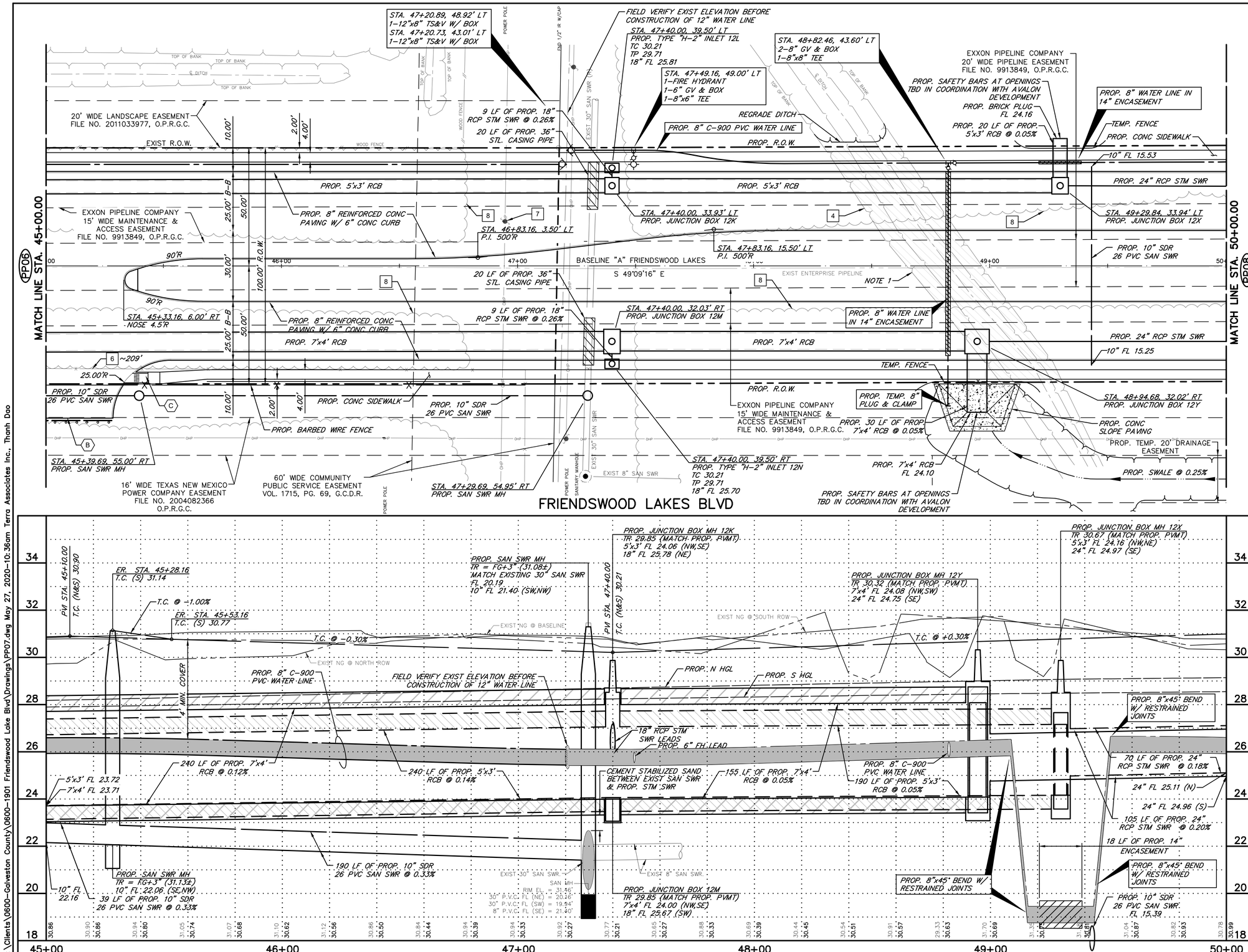

20 0 20

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 RELOCATE WATER METER
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

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WARNING!

HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 45+00 TO STA 50+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901
CHECKED BY: AGN	DATE: MAY, 2020	CONTRACT: 1
		SHEET PP07

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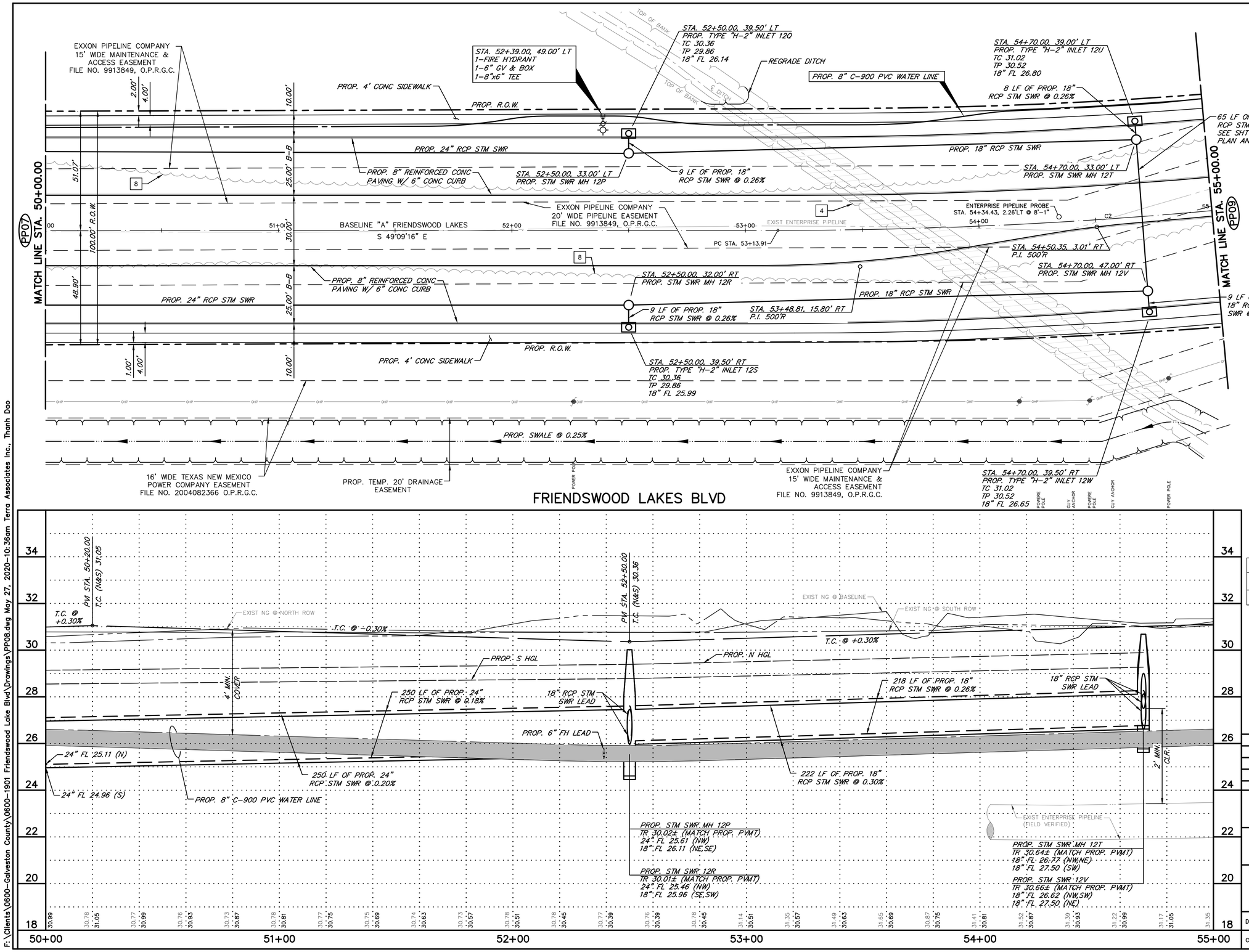

20 0 20

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 RELOCATE WATER METER
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED
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ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES
PROTECTION NOTES.

Curve Table

Curve #	Length	Radius	Delta	Chord Direction	Chord Distance
C2	577.42'	2050.00	16°08'18"	S57°13'25"E	575.51'

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 50+00 TO STA 55+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP08

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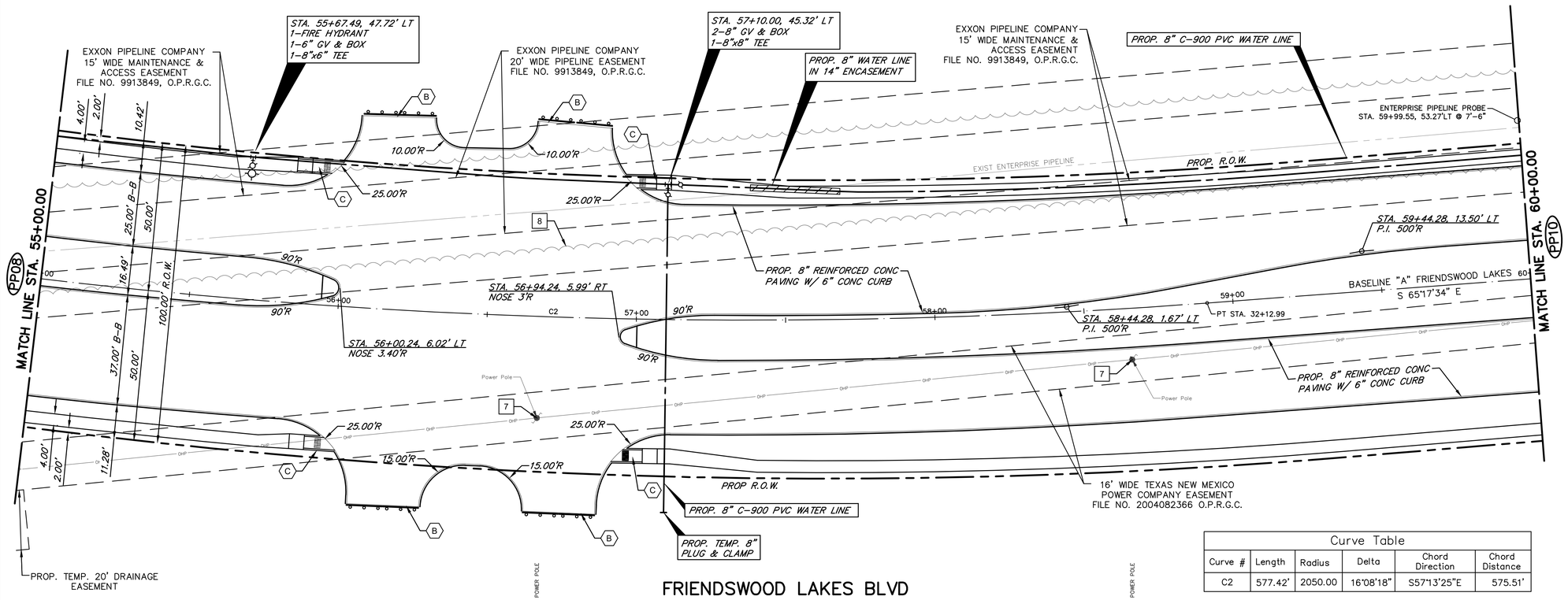
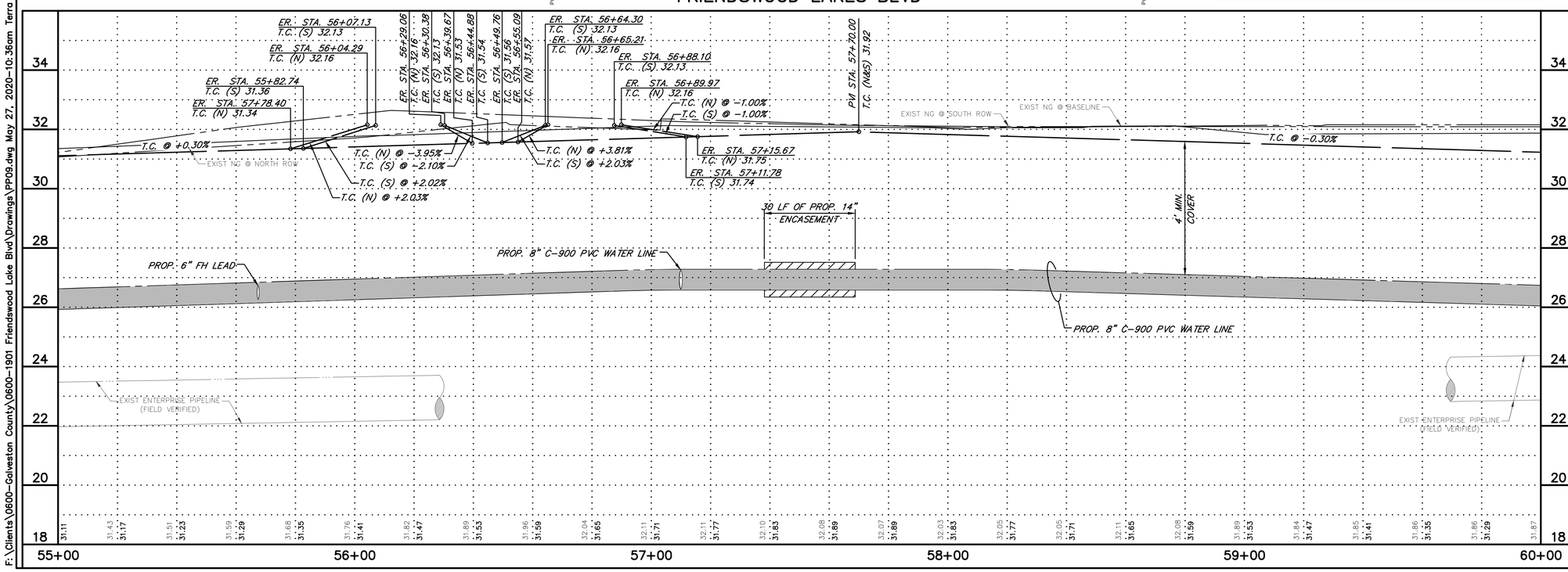


Curve Table					
Curve #	Length	Radius	Delta	Chord Direction	Chord Distance
C2	577.42'	2050.00	16°08'18"	S57°13'25"E	575.51'



TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 RELOCATE WATER METER
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED
WITHOUT PRIOR WRITTEN PERMISSION FROM
ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES
PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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DOCUMENT WAS AUTHORIZED BY
A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 55+00 TO STA 60+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901, CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP09

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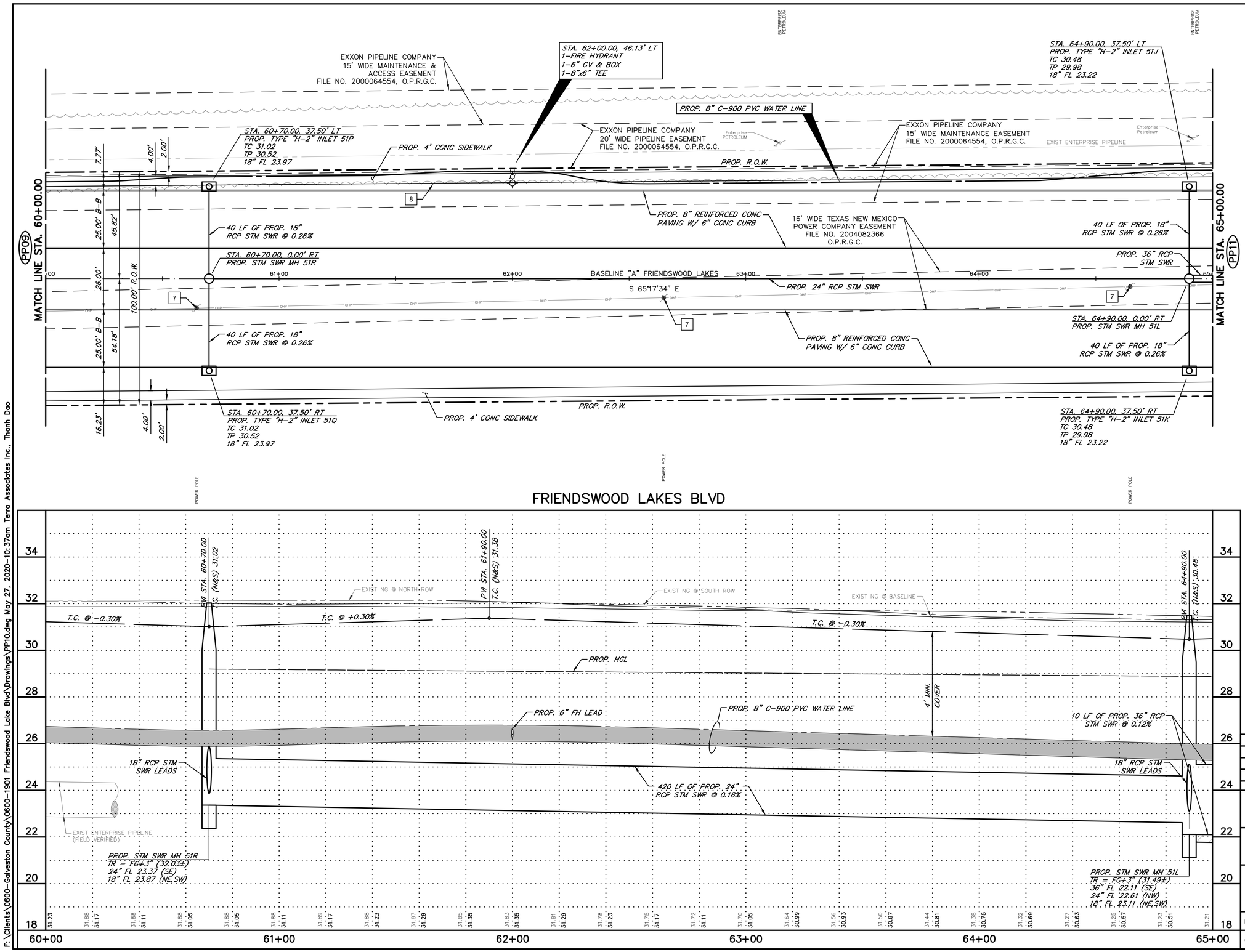

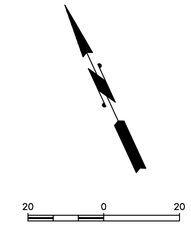

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 RELOCATE WATER METER
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 60+00 TO STA 65+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP10

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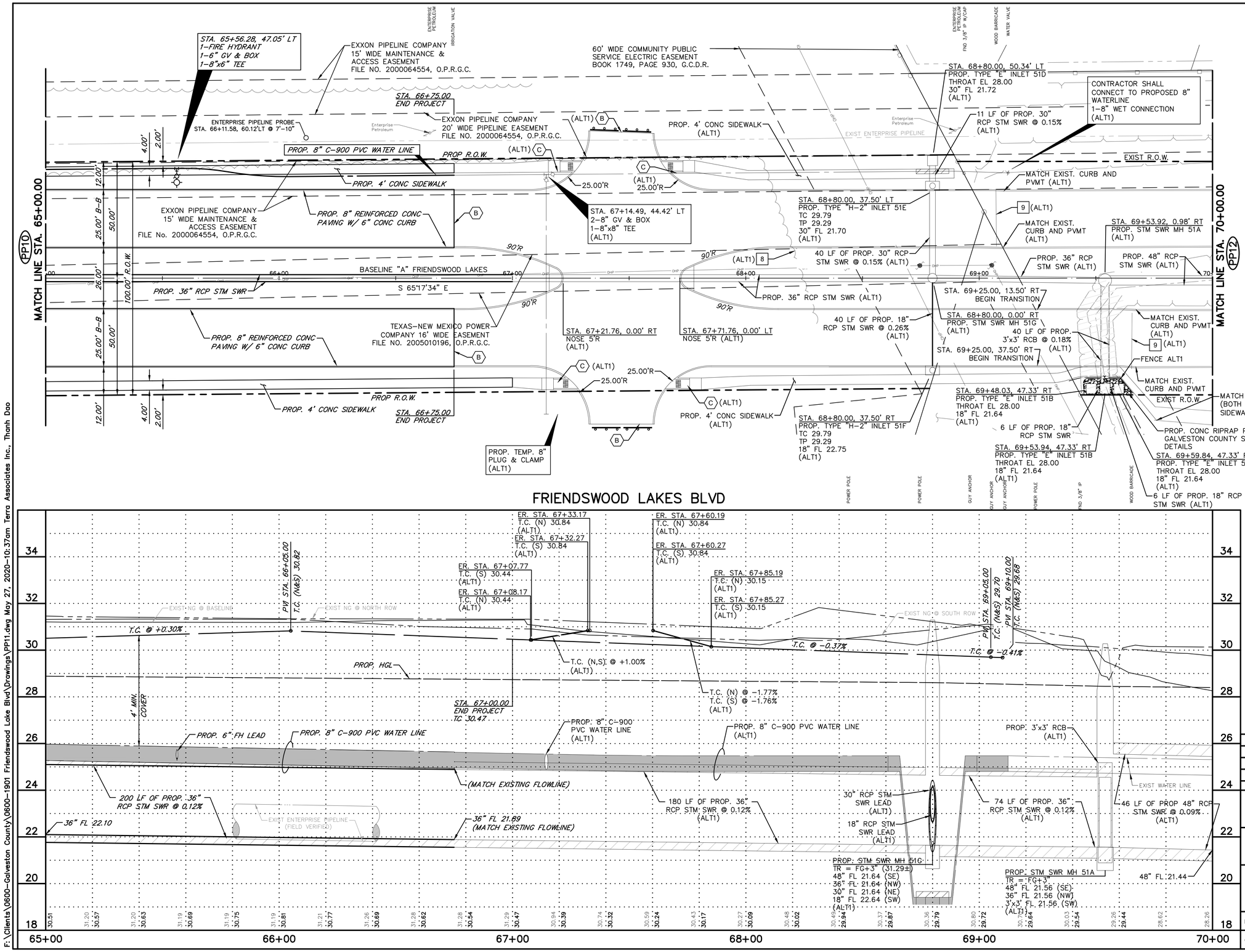

20 0 20

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 RELOCATE WATER METER
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

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PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 65+00 TO STA 70+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901
		CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP11

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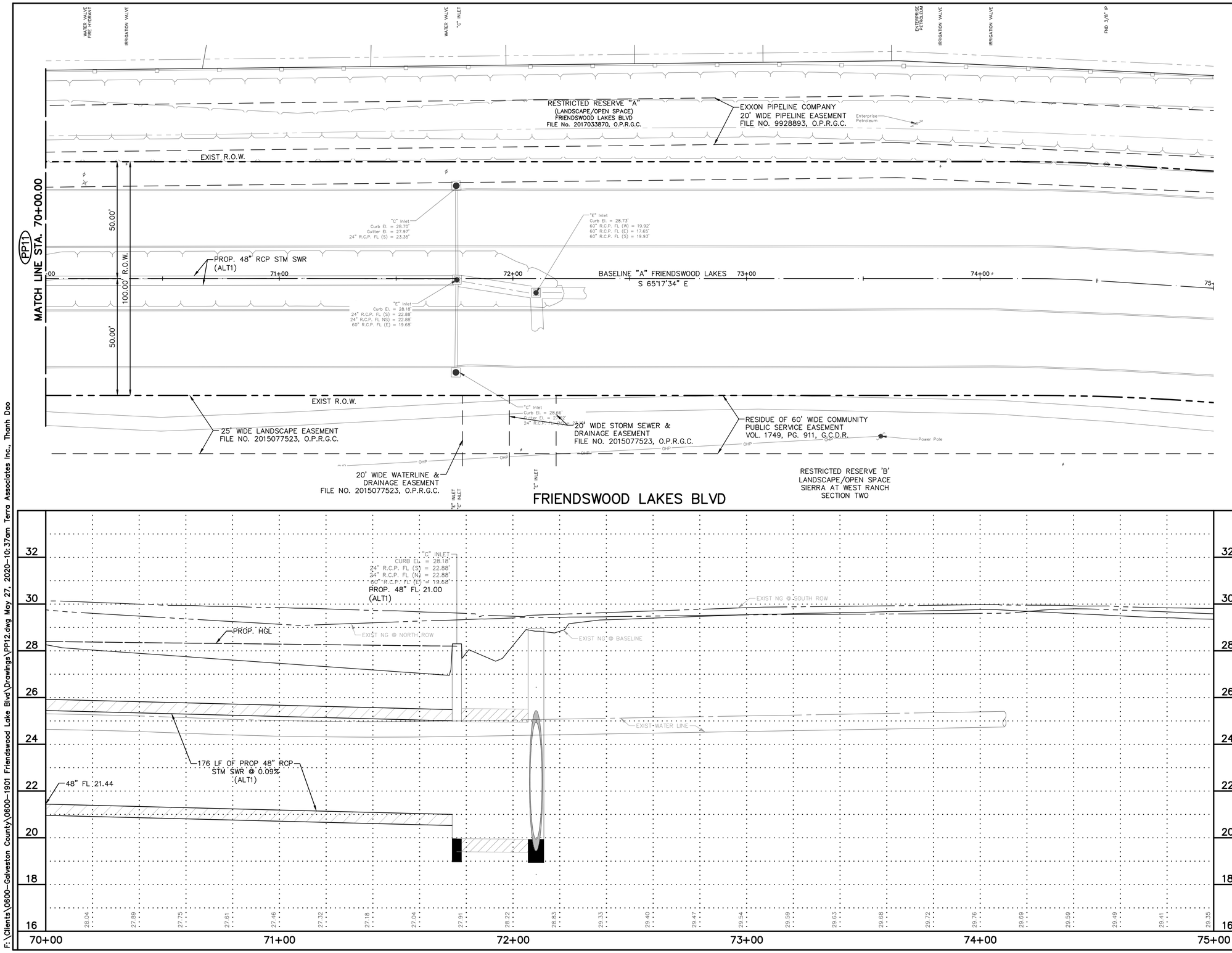

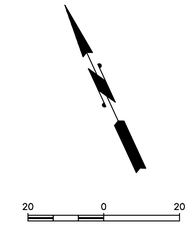

TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 RELOCATE WATER METER
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

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EXCAVATION AND/OR CONSTRUCTION PROHIBITED
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SEE SHEET GE04 FOR ADDITIONAL PIPELINES
PROTECTION NOTES.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED
PROFESSIONAL ENGINEER

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DOCUMENT WAS AUTHORIZED BY
A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE
STA 70+00 TO STA 75+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901, CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP12

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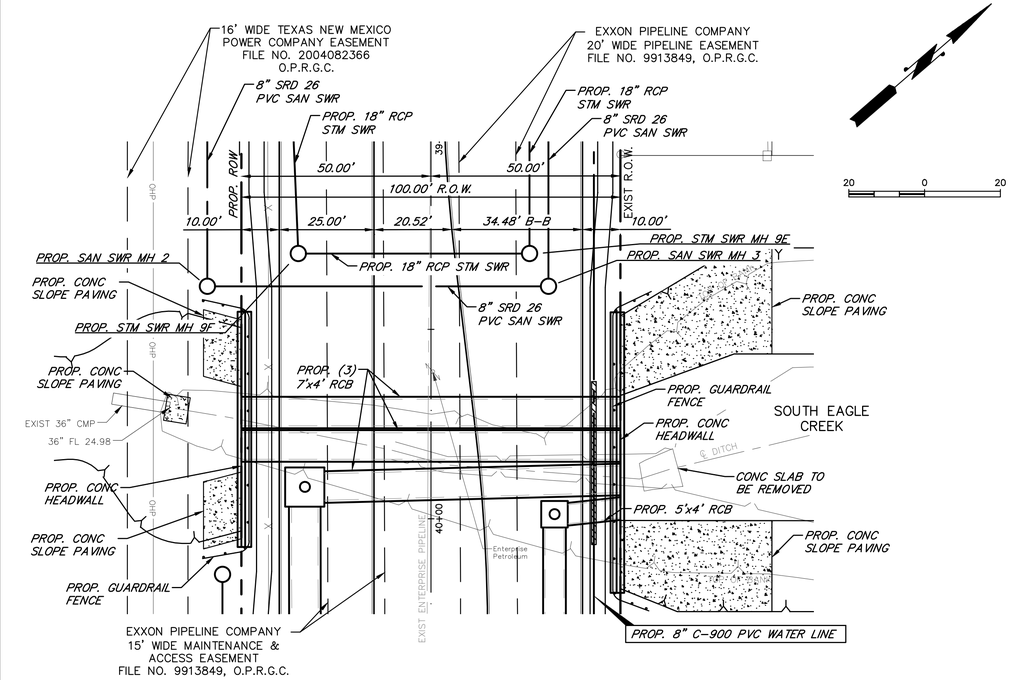
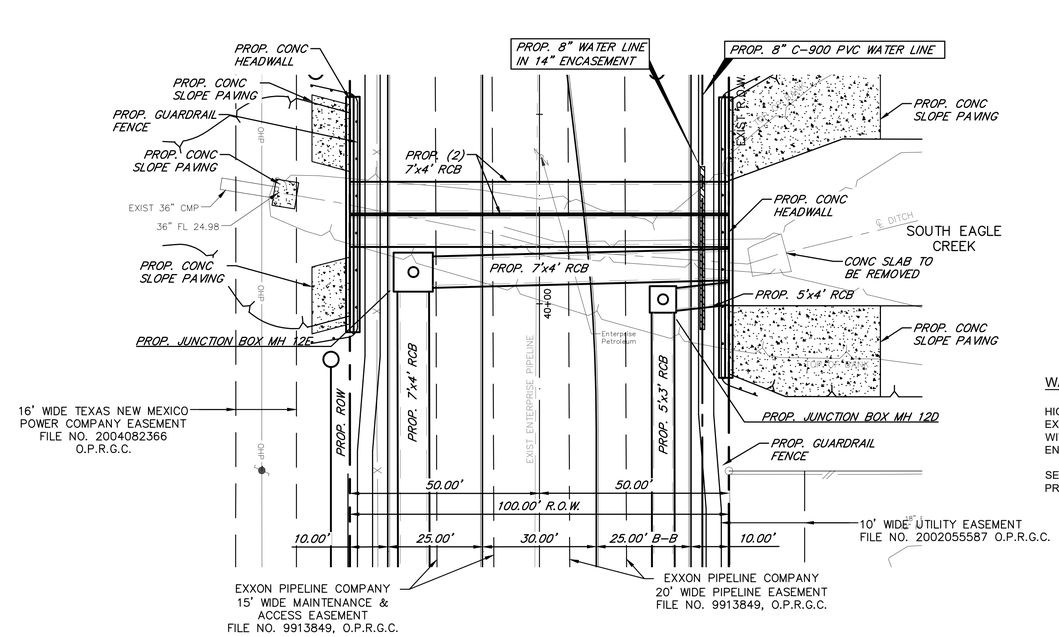


FRIENDSWOOD LAKES BLVD
24" STORM SEWER & 8" SANITARY SEWER



FRIENDSWOOD LAKES BLVD
2-7'x4' STORM SEWER

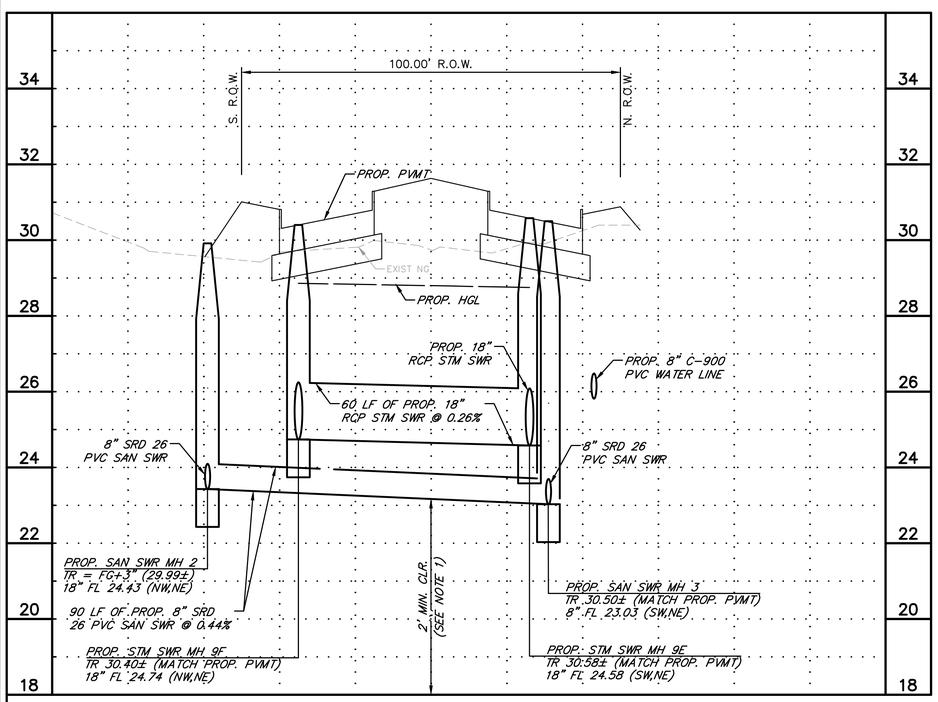
NOTES:

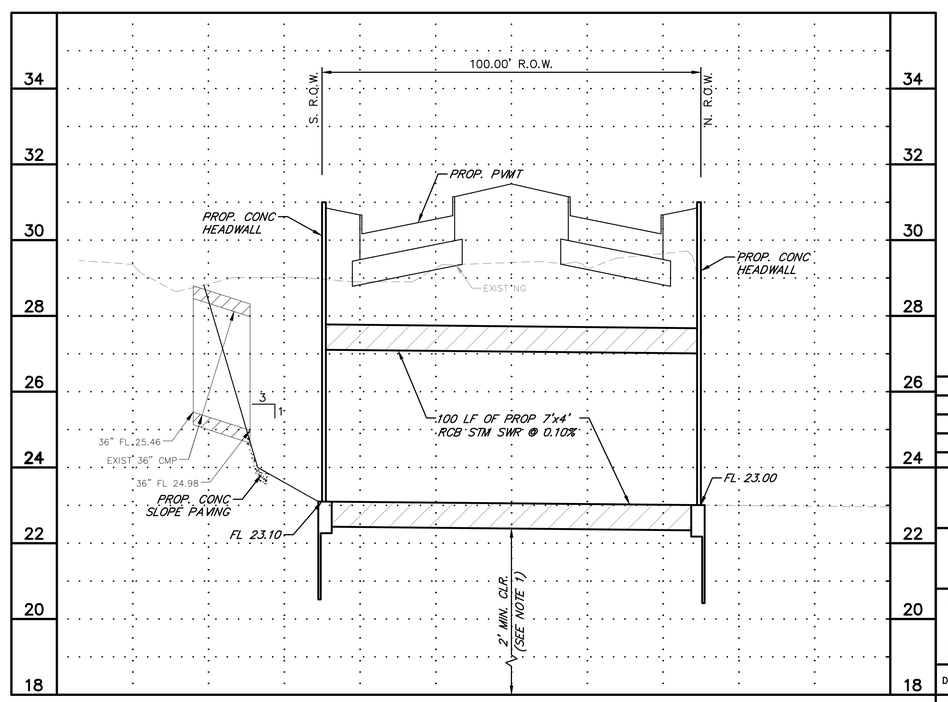
1. EXISTING ENTERPRISE PIPELINE WAS FIELD VERIFIED AND FOUND TO BE OUT OF RANGE BELOW ELEVATION 16. 2' MIN. CLR. TO BE MAINTAINED BETWEEN PROP. STORM RCB & EXIST. PIPELINE.

WARNING!

HIGH PRESSURE PIPELINE(S) EXCAVATION AND/OR CONSTRUCTION PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES PROTECTION NOTES.





STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
PLAN AND PROFILE CULVERT

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901, CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP13

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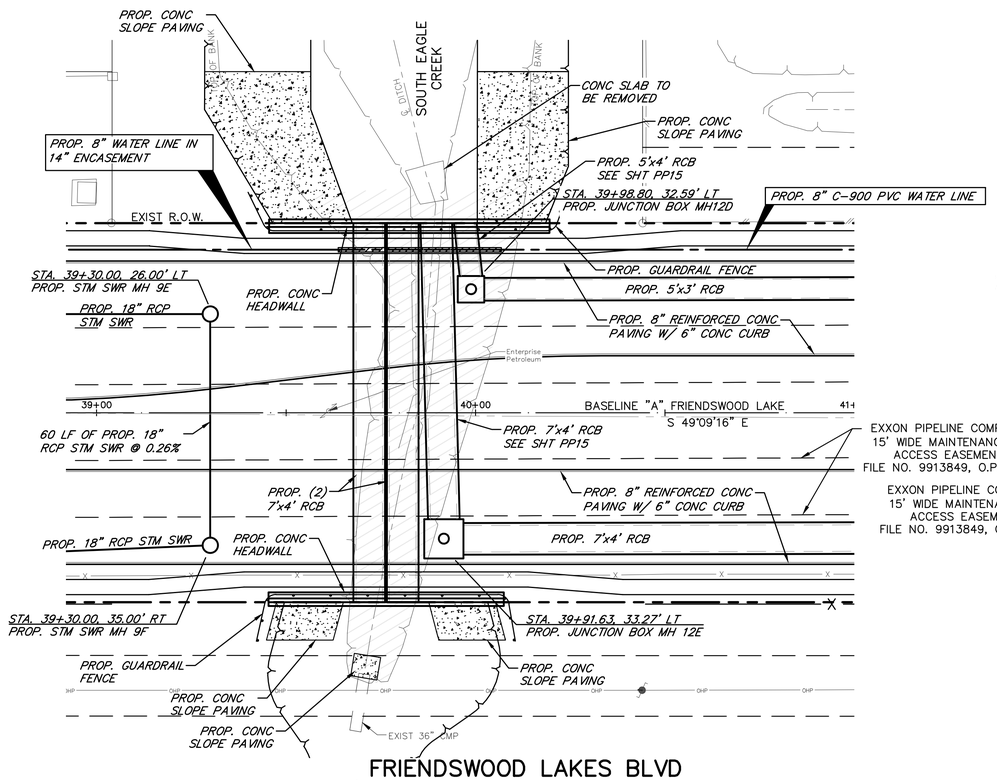
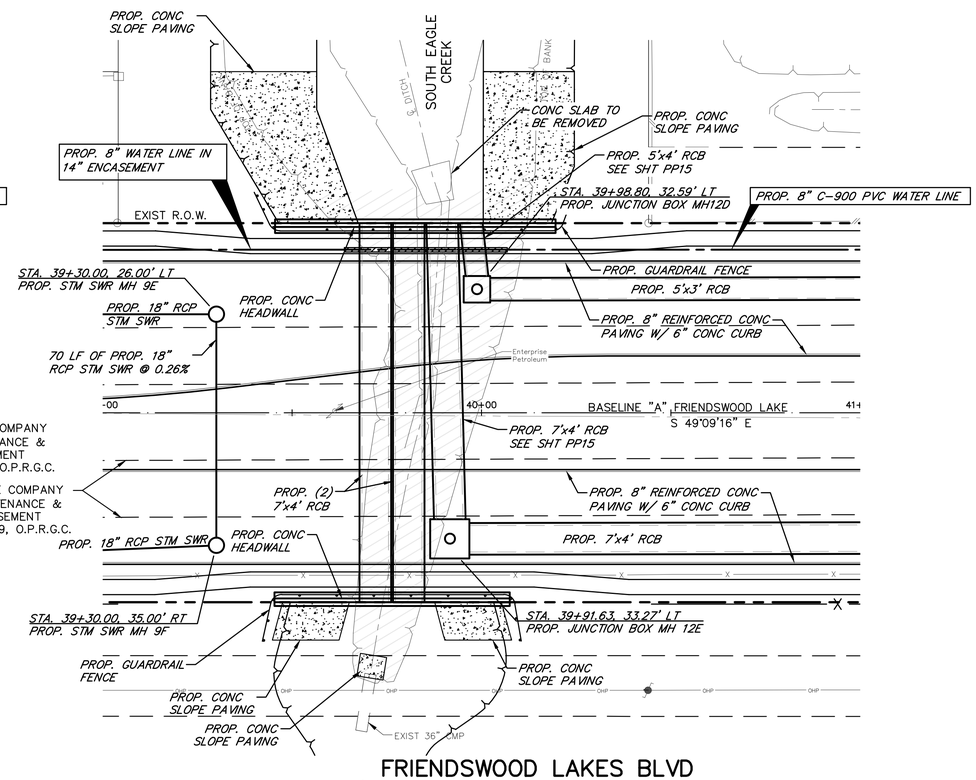
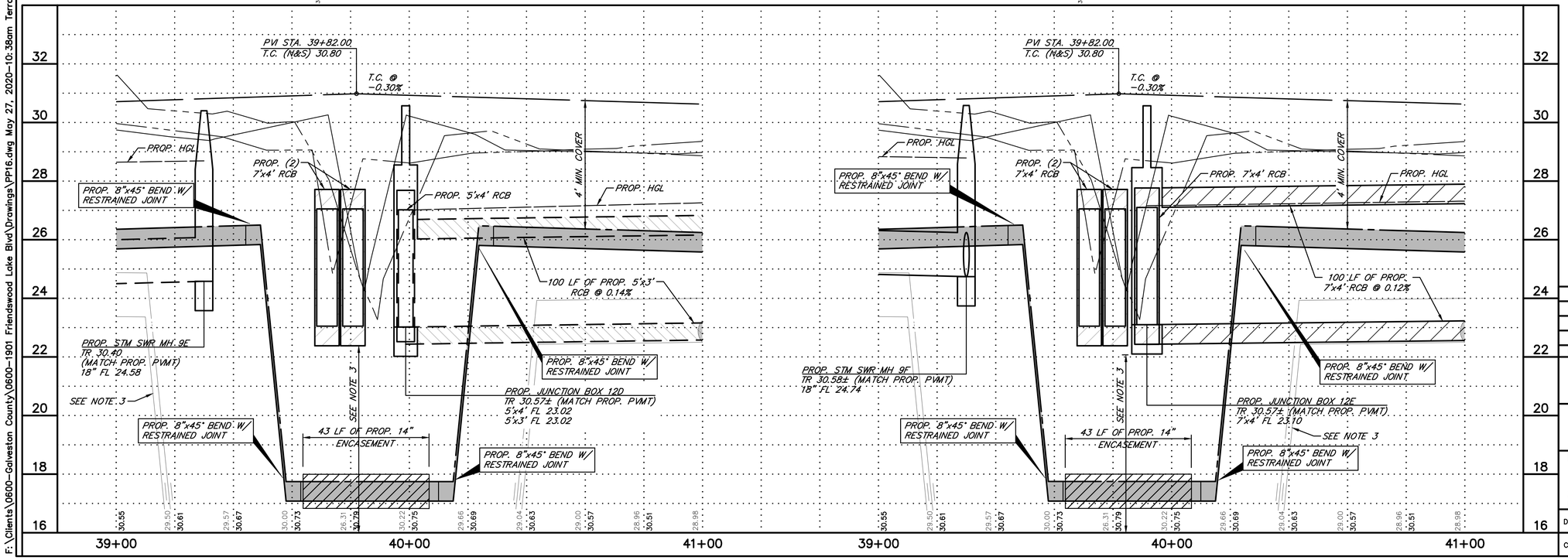
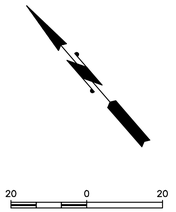


FRIENDSWOOD LAKES BLVD 5'x3' STORM SEWER



FRIENDSWOOD LAKES BLVD 7'x4' STORM SEWER





TO BE CONSTRUCTED

- (A) FULL DEPTH SAWCUT (2' FROM FACE OF CURB)
- (B) STANDARD PAVEMENT HEADER
- (C) TYPE 7 WHEEL CHAIR RAMP

TO BE REMOVED

- 1 CONCRETE PAVEMENT & CURB
- 2 TREE (COORDINATE TREE REMOVAL WITH CITY OF FRIENDSWOOD)
- 3 RELOCATE FIRE HYDRANT
- 4 DITCH
- 5 REPLACE BLOW OFF VALVE IN WATER WATER BOX AND ADJUST TO FINAL GRADE
- 6 BARBED WIRE FENCE
- 7 POWER POLE
- 8 WOODED AREA
- 9 WOODED BARRICADE

NOTES:

1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.
3. EXISTING ENTERPRISE PIPELINE WAS FIELD VERIFIED AND FOUND TO BE OUT OF RANGE BELOW ELEVATION 16. 2' MIN. CLR. TO BE MAINTAINED BETWEEN PROP. STORM RCB & EXIST. PIPELINE.

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD PLAN AND PROFILE CULVERT AT EAGLE CREEK

TERRA ASSOCIATES, INC. CONSULTING ENGINEERS LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP14

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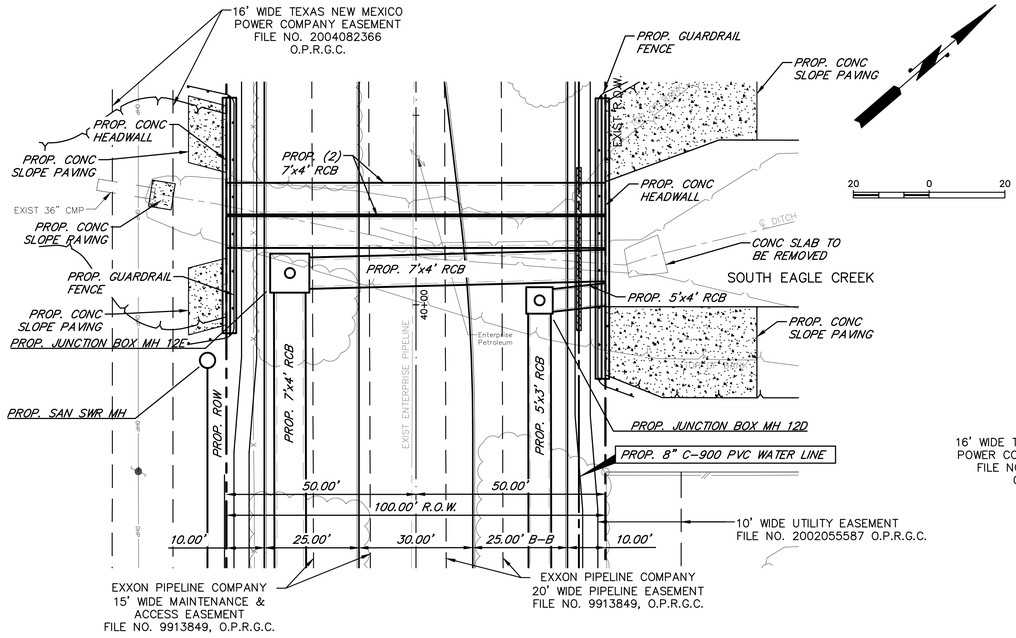
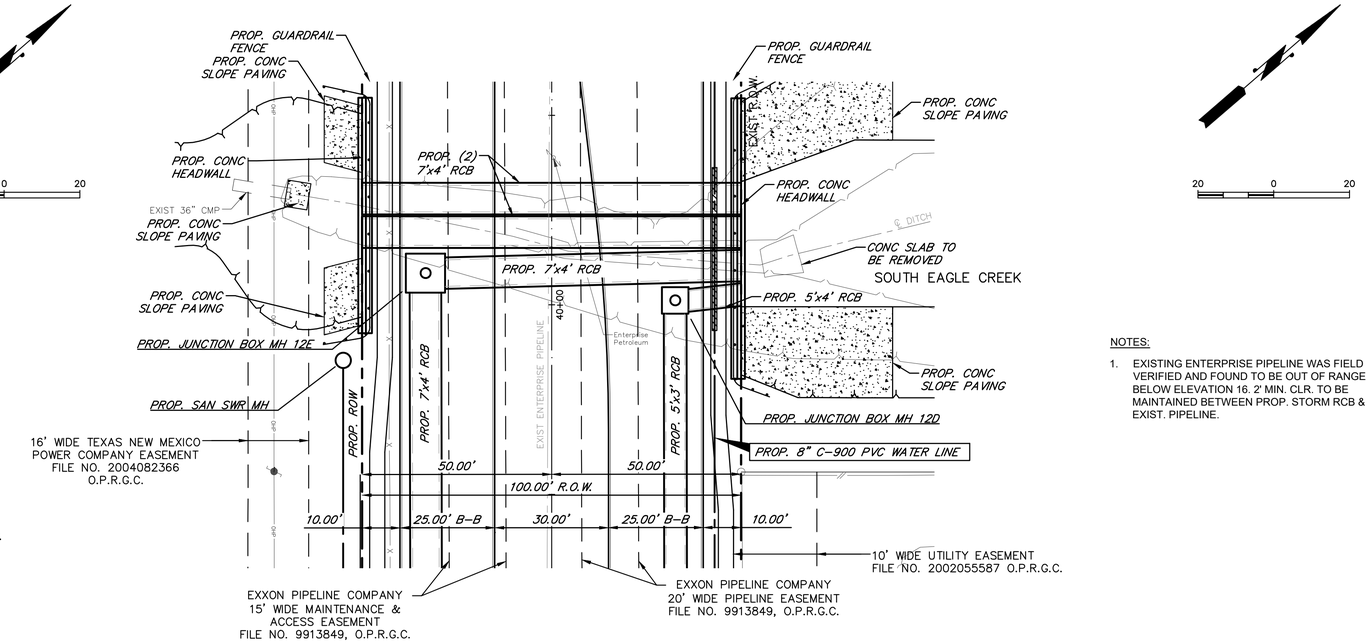


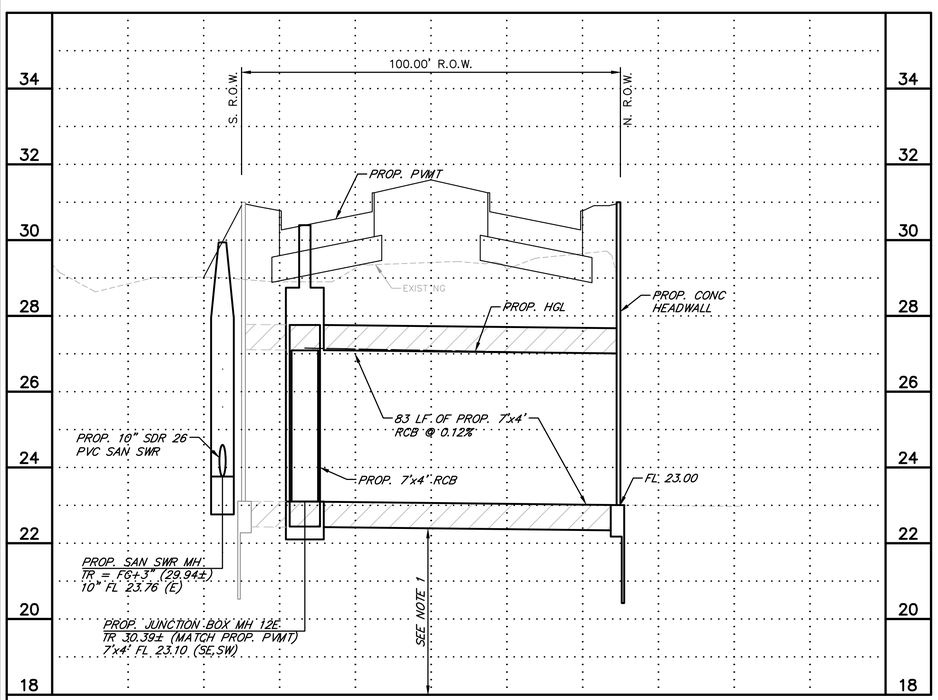
FRIENDSWOOD LAKES BLVD
7'x4' STORM SEWER

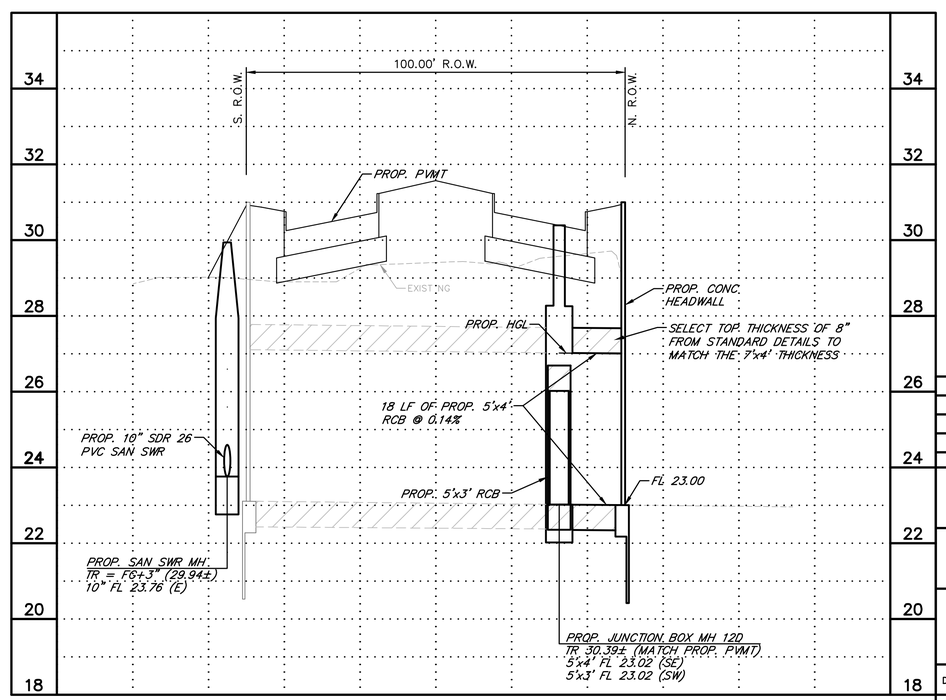


FRIENDSWOOD LAKES BLVD
5'x4' STORM SEWER

NOTES:

1. EXISTING ENTERPRISE PIPELINE WAS FIELD VERIFIED AND FOUND TO BE OUT OF RANGE BELOW ELEVATION 16. 2' MIN. CLR. TO BE MAINTAINED BETWEEN PROP. STORM RCB & EXIST. PIPELINE.





STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

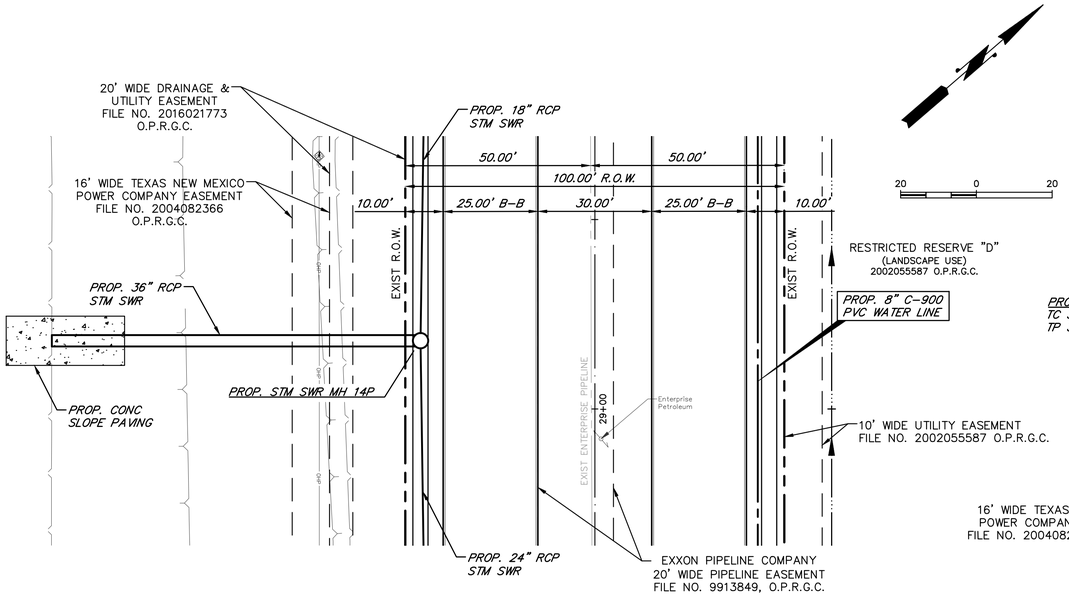
FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

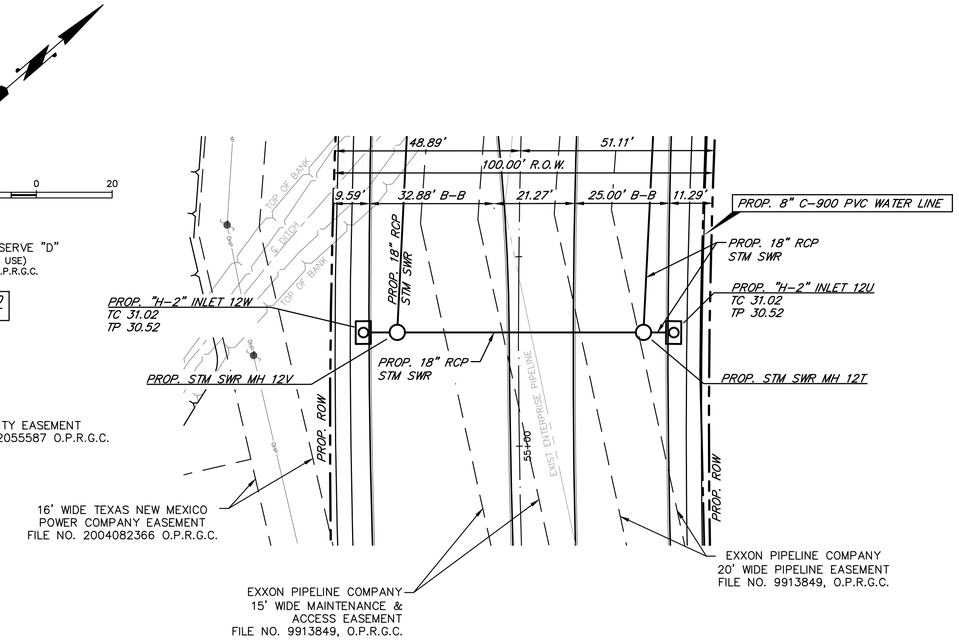
PLAN AND PROFILE CULVERT

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP15

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP17.dwg May 27, 2020-10:39am Terra Associates Inc., Thanh Dao



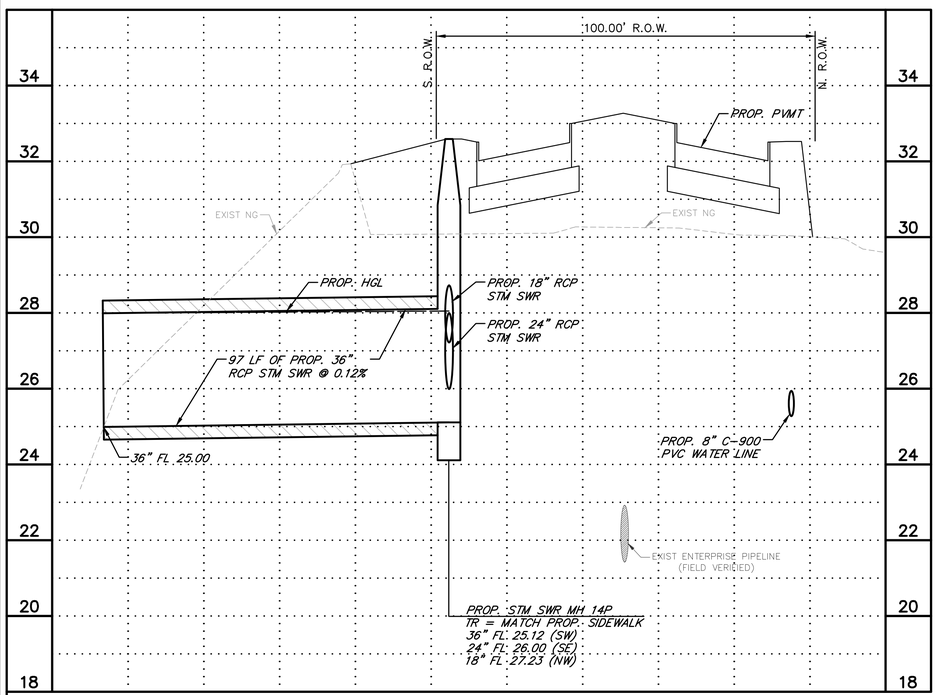


WARNING!

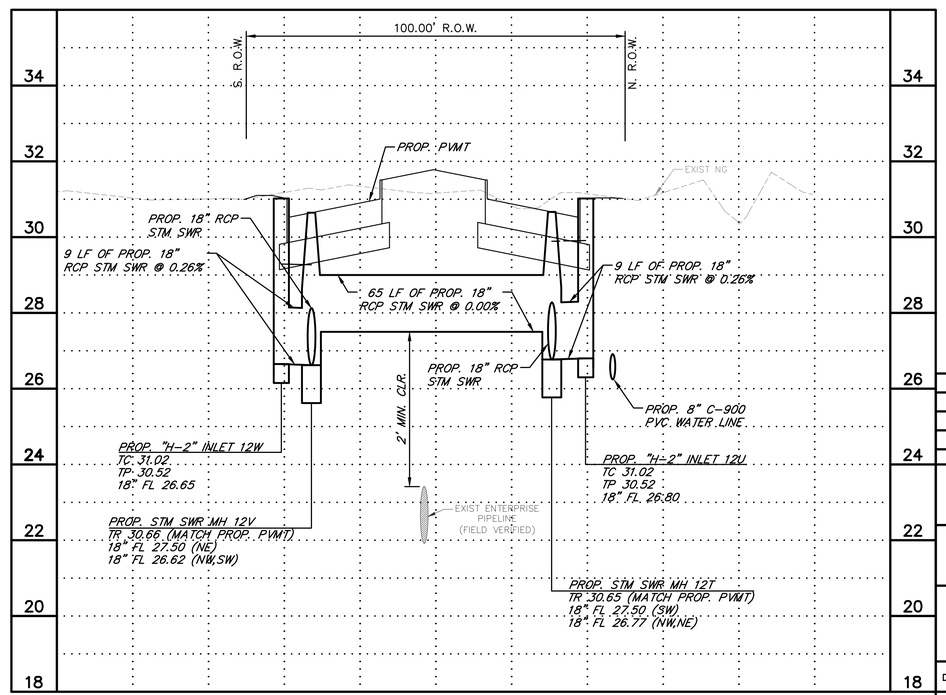
HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED
WITHOUT PRIOR WRITTEN PERMISSION FROM
ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES
PROTECTION NOTES.

36" STORM SEWER
FRIENDSWOOD LAKES BLVD



18" EQUALIZED STORM SEWER
FRIENDSWOOD LAKES BLVD



STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

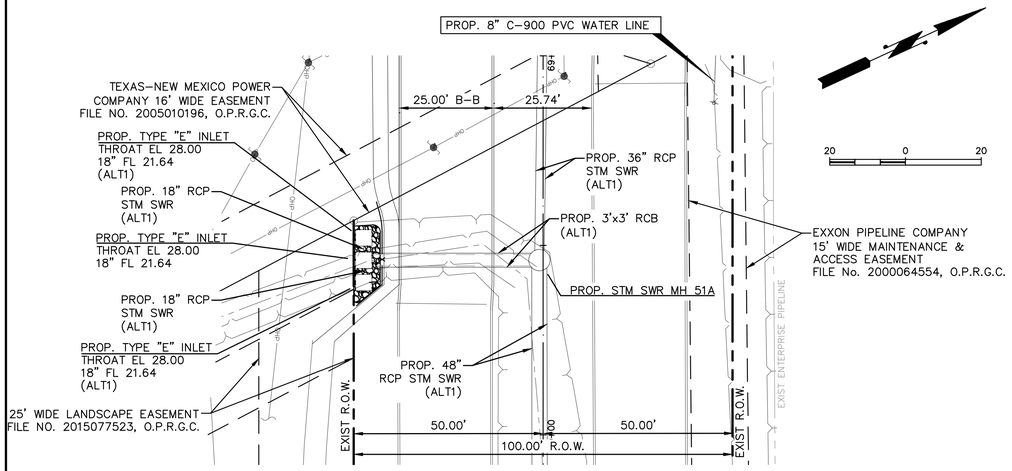
FRIENDSWOOD LAKE BLVD
PLAN AND PROFILE CULVERT

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

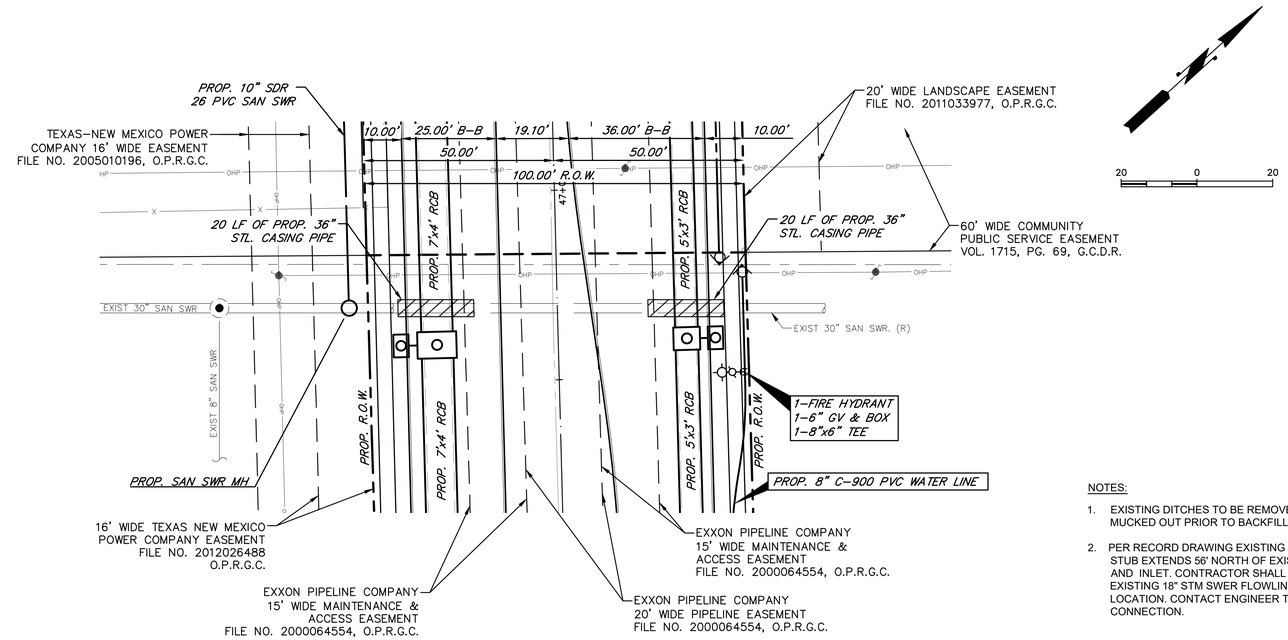
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP16

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP14.dwg May 27, 2020-11:01am Terra Associates Inc., Thanh Dao



3'x3' STORM SEWER
FRIENDSWOOD LAKES BLVD



EXIST 30" SANITARY SEWER
FRIENDSWOOD LAKES BLVD

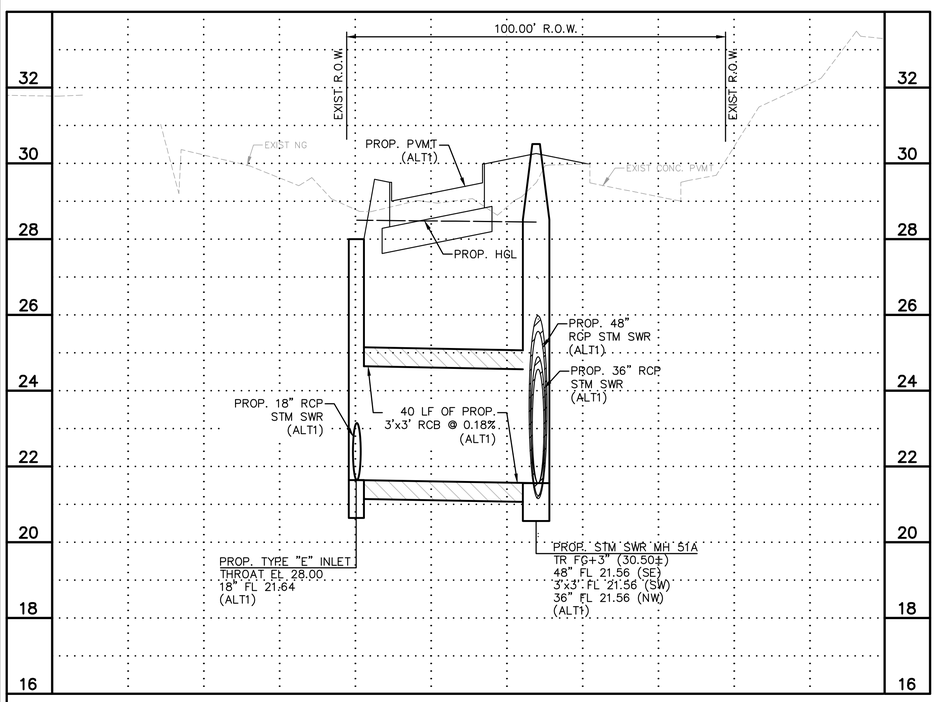
NOTES:

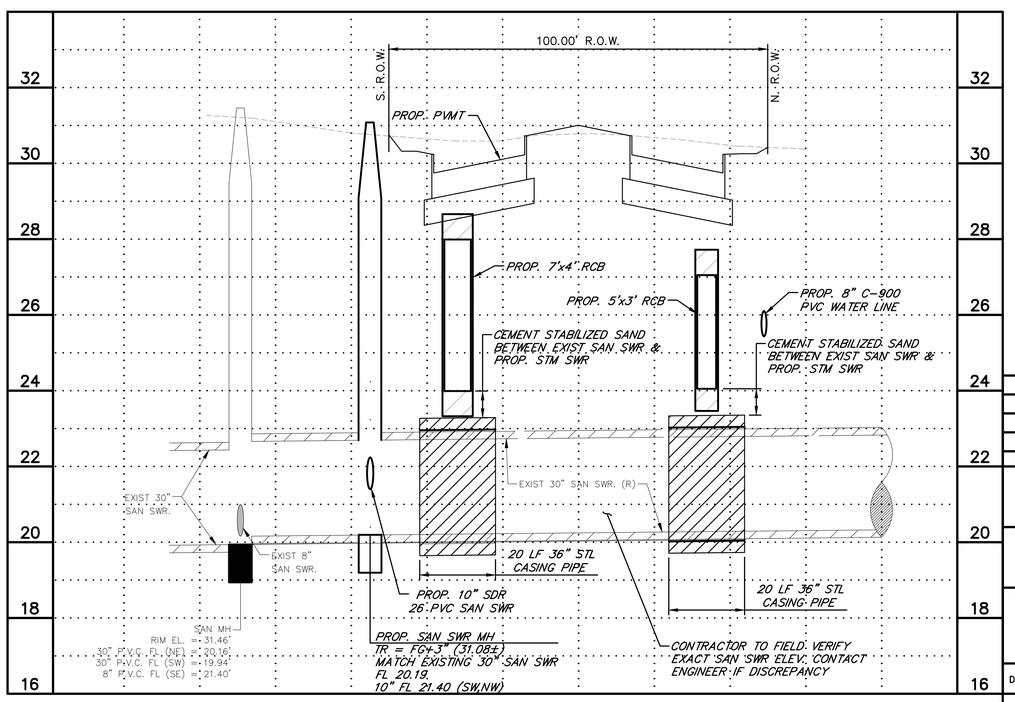
1. EXISTING DITCHES TO BE REMOVED SHALL BE MUCKED OUT PRIOR TO BACKFILLING.
2. PER RECORD DRAWING EXISTING 18" STM SWR STUB EXTENDS 56' NORTH OF EXISTING MANHOLE AND INLET. CONTRACTOR SHALL FIELD VERIFY EXISTING 18" STM SWER FLOWLINE, SLOPE AND LOCATION. CONTACT ENGINEER TO DISCUSS CONNECTION.

WARNING!

HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM ENTERPRISE PRODUCTS OPERATING LLC.

SEE SHEET GE04 FOR ADDITIONAL PIPELINES PROTECTION NOTES.





STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

PLAN AND PROFILE EXIST 30" SANITARY SEWER

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP17

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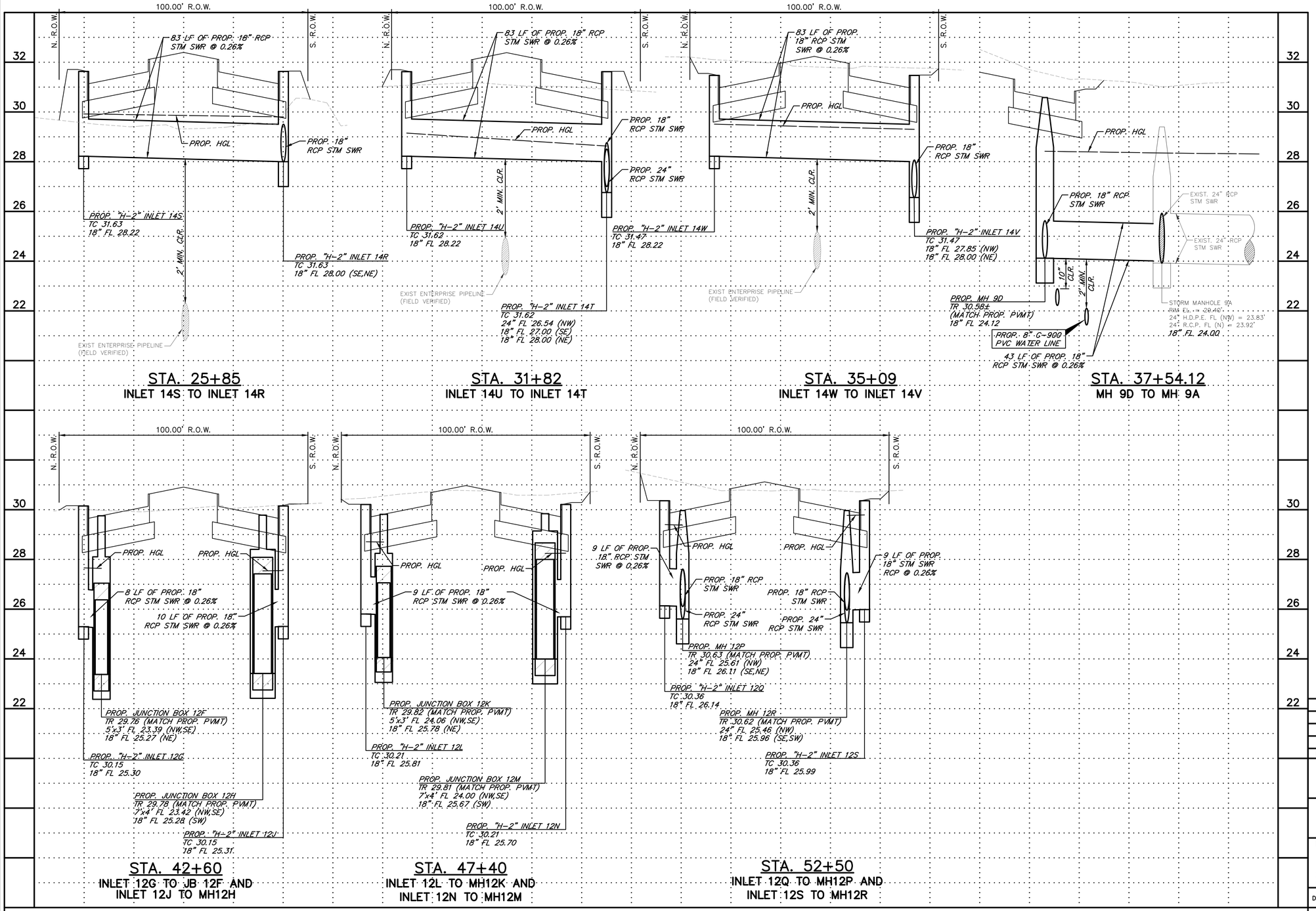

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

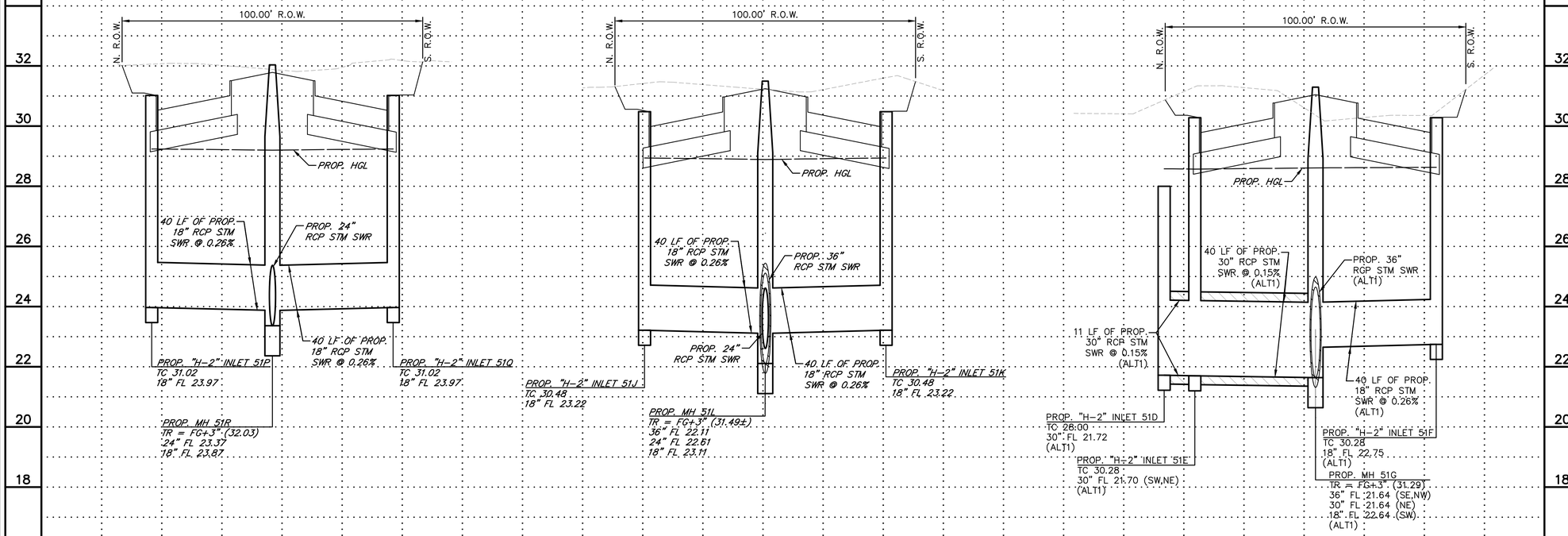
FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

STORM SEWER LATERALS (1 OF 2)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP18

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\STM SWR LATERALS (1 OF 2).dwg May 27, 2020-10:40am Terra Associates Inc., Thanh Dao



STA. 60+70
INLET 51P TO MH51R AND
INLET 51Q TO MH51R

STA. 64+90
INLET 51J TO MH51L AND
INLET 51K TO MH51L

STA. 68+80
INLET 51D TO INLET 51E TO MH51G
AND INLET 51F TO MH51G

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

STORM SEWER LATERALS
(2 OF 2)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP19

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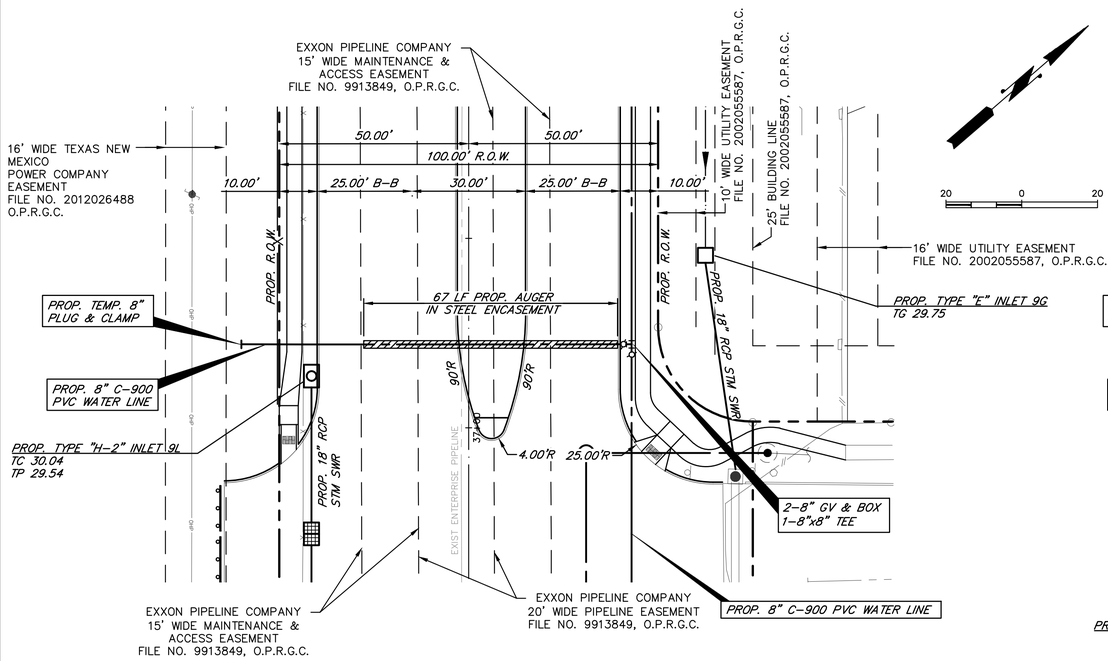
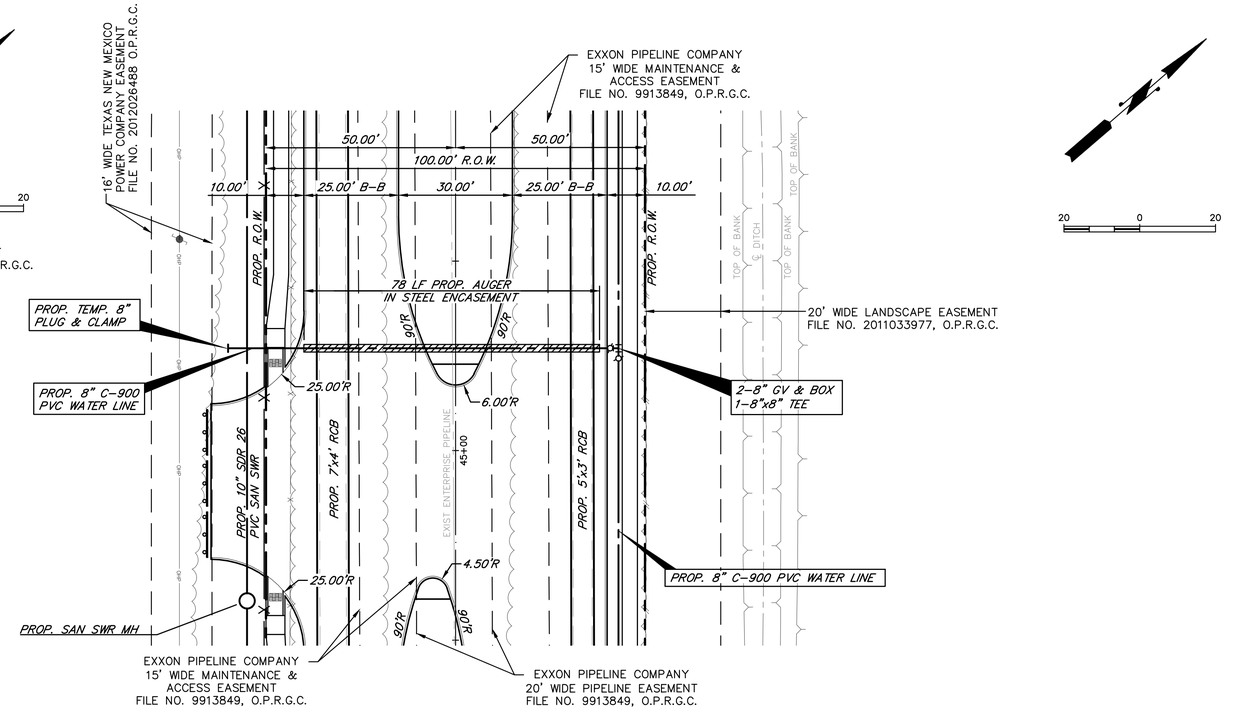
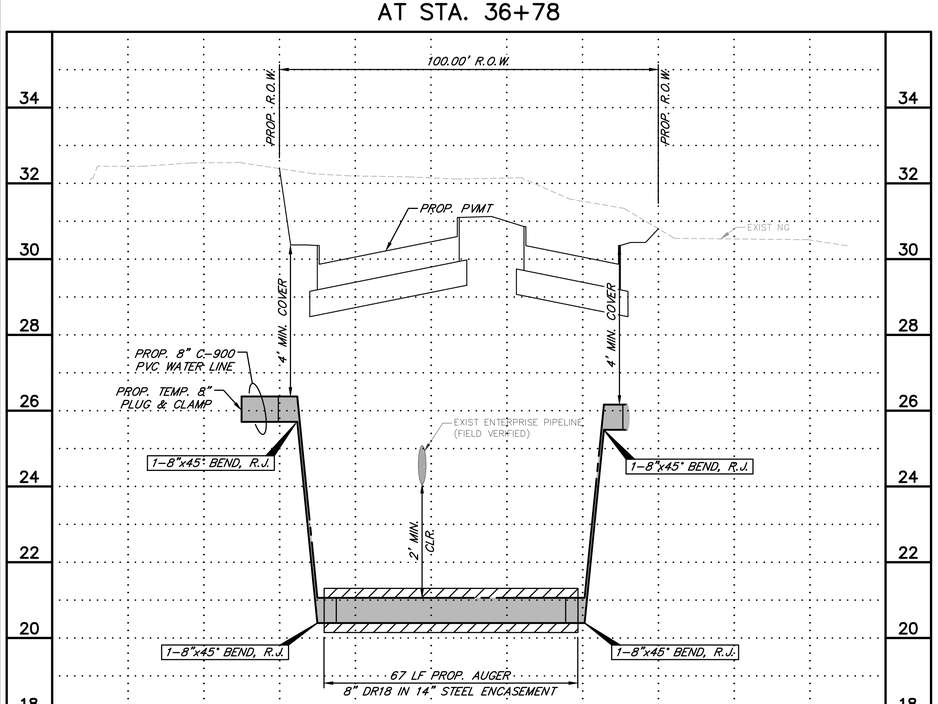
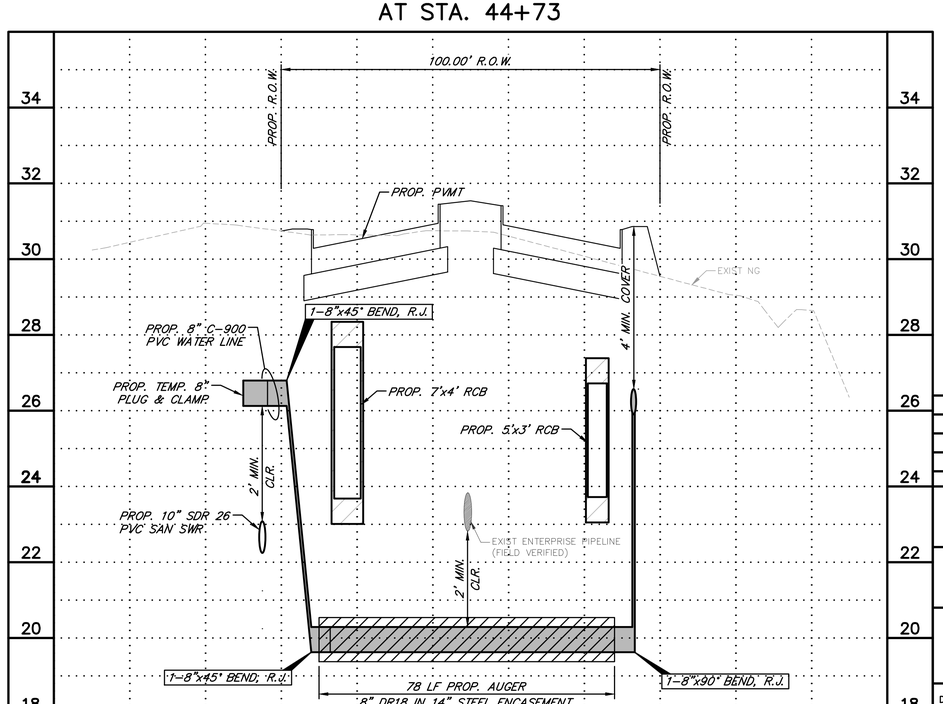


FRIENDSWOOD LAKES BLVD
8" WATER LINE CONNECTION
AT STA. 36+78



FRIENDSWOOD LAKES BLVD
8" WATER LINE CONNECTION
AT STA. 44+73





STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

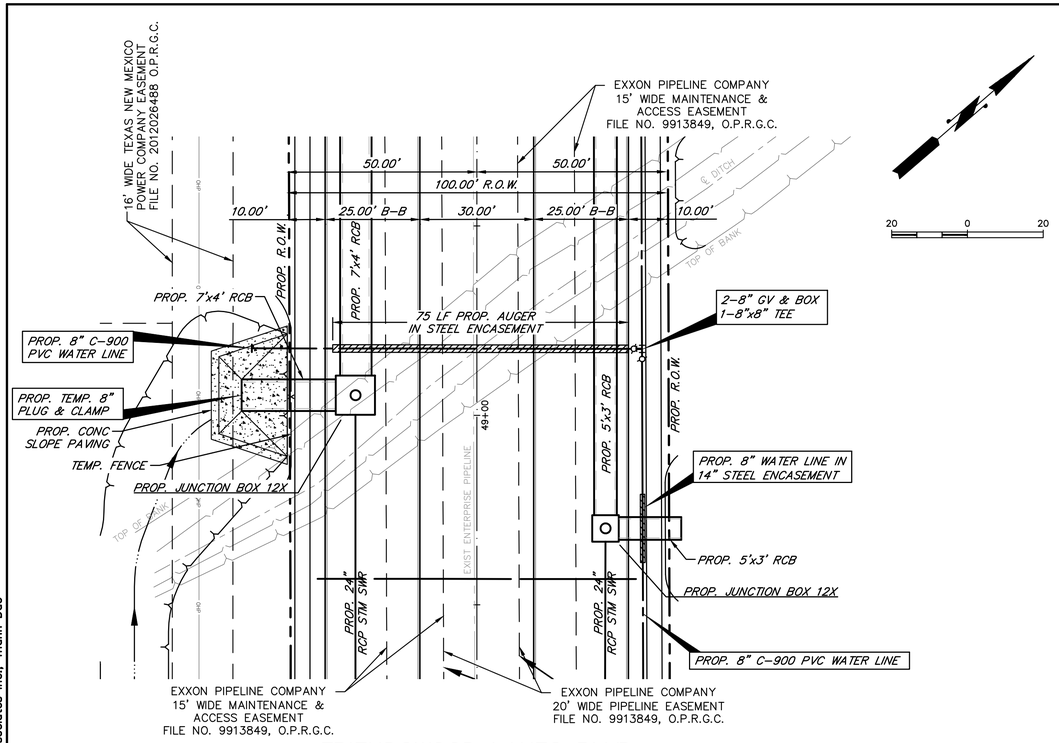
FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

PLAN AND PROFILE 8" WATER LINE
(1 OF 3)

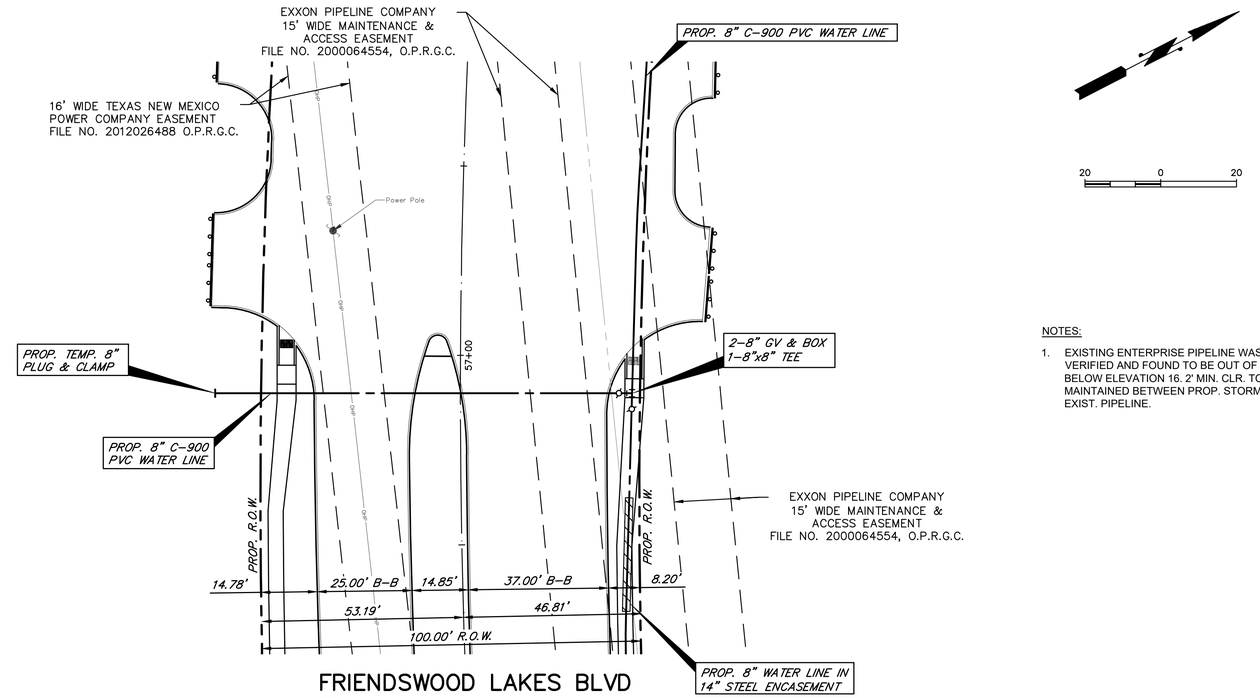
TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP20

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\WL CROSS-01.dwg May 27, 2020-10:41am Terra Associates Inc., Thanh Dao



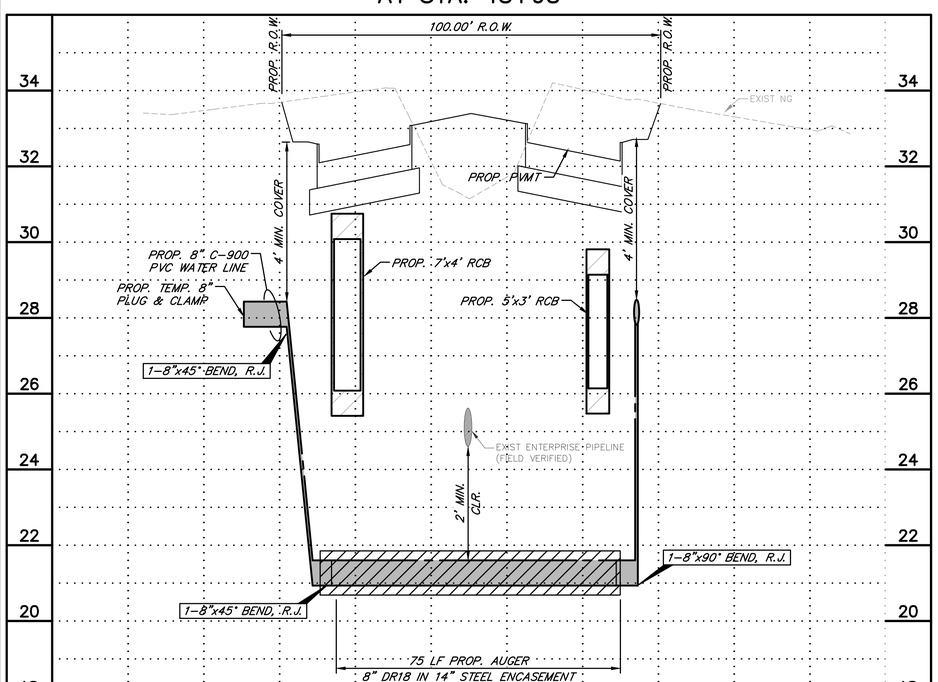
FRIENDSWOOD LAKES BLVD
8" WATER LINE CONNECTION
AT STA. 48+98

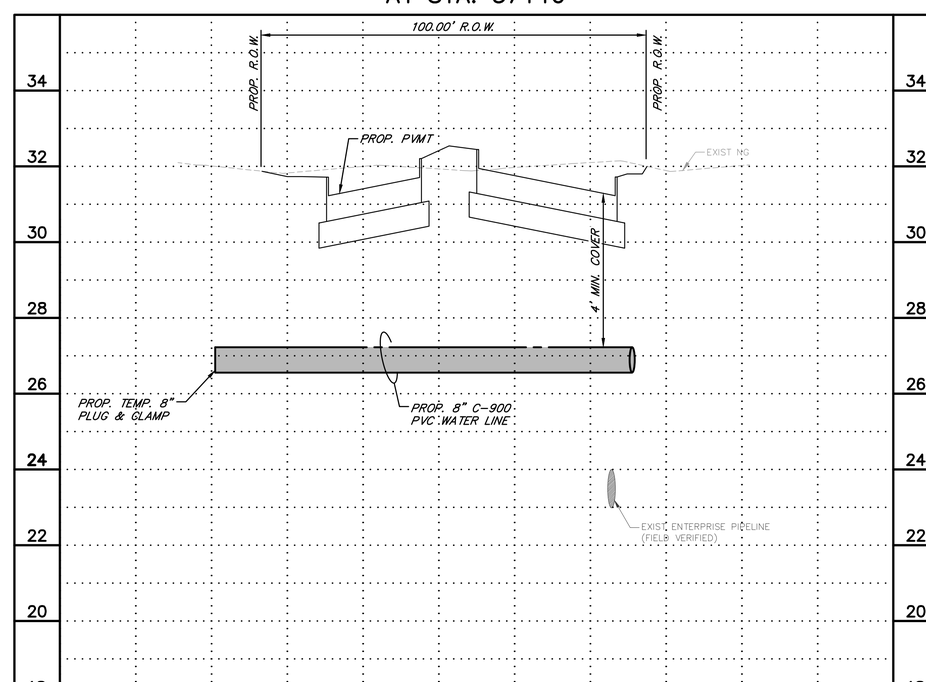


NOTES:

1. EXISTING ENTERPRISE PIPELINE WAS FIELD VERIFIED AND FOUND TO BE OUT OF RANGE BELOW ELEVATION 16. 2' MIN. CLR. TO BE MAINTAINED BETWEEN PROP. STORM RCB & EXIST. PIPELINE.

FRIENDSWOOD LAKES BLVD
8" WATER LINE CONNECTION
AT STA. 57+10





STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

PLAN AND PROFILE 8" WATER LINE
(2 OF 3)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP21

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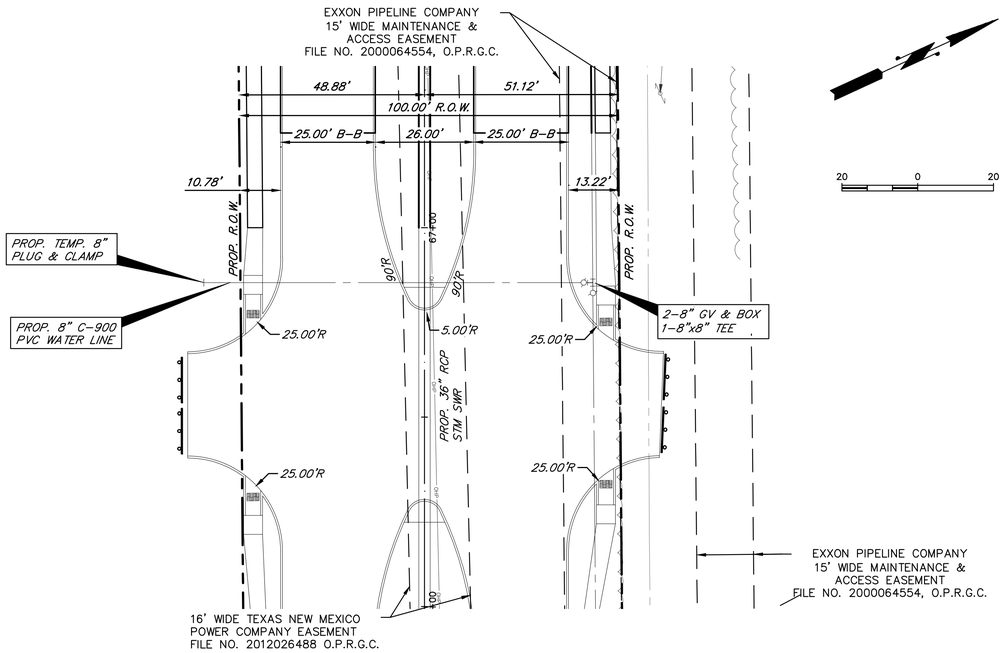
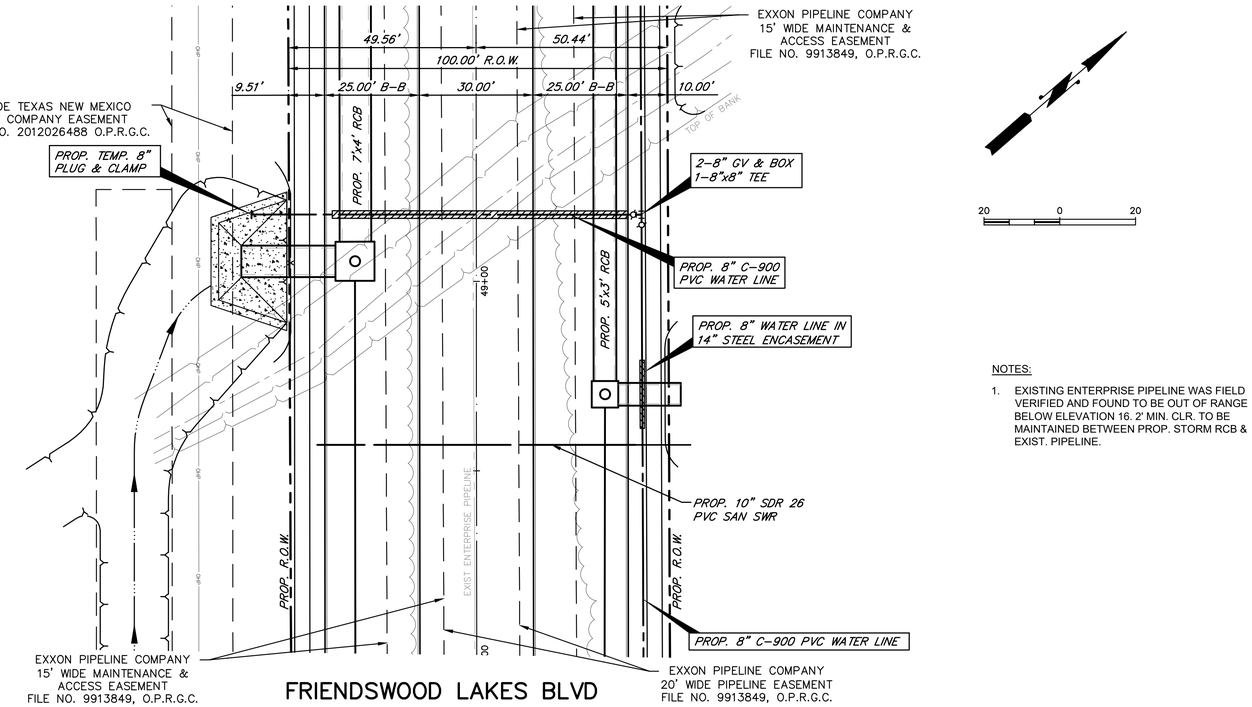


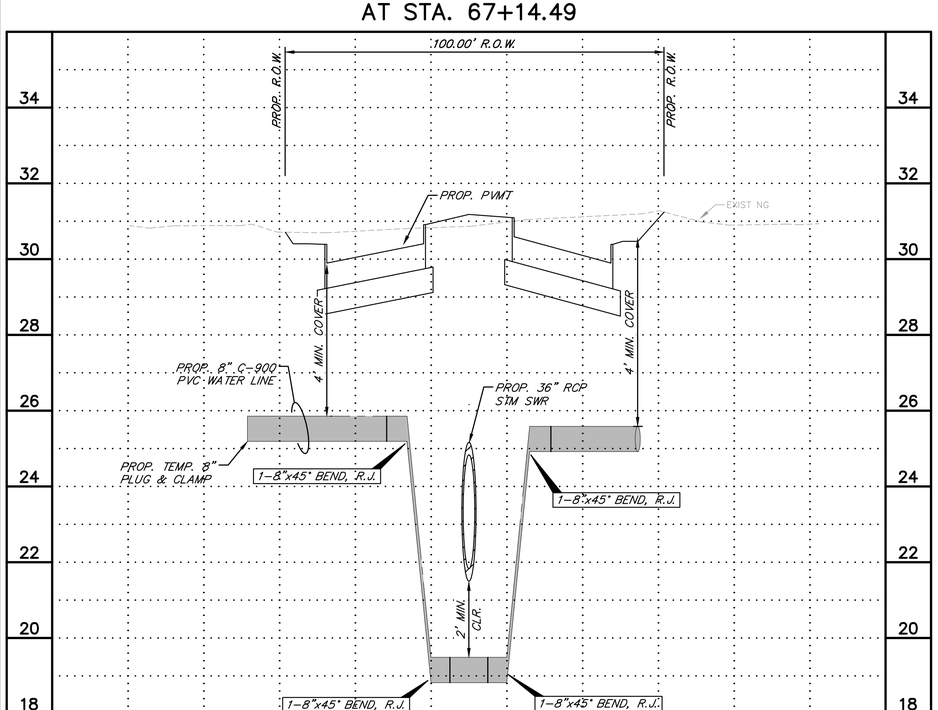
FRIENDSWOOD LAKES BLVD
8" WATER LINE CONNECTION
AT STA. 67+14.49

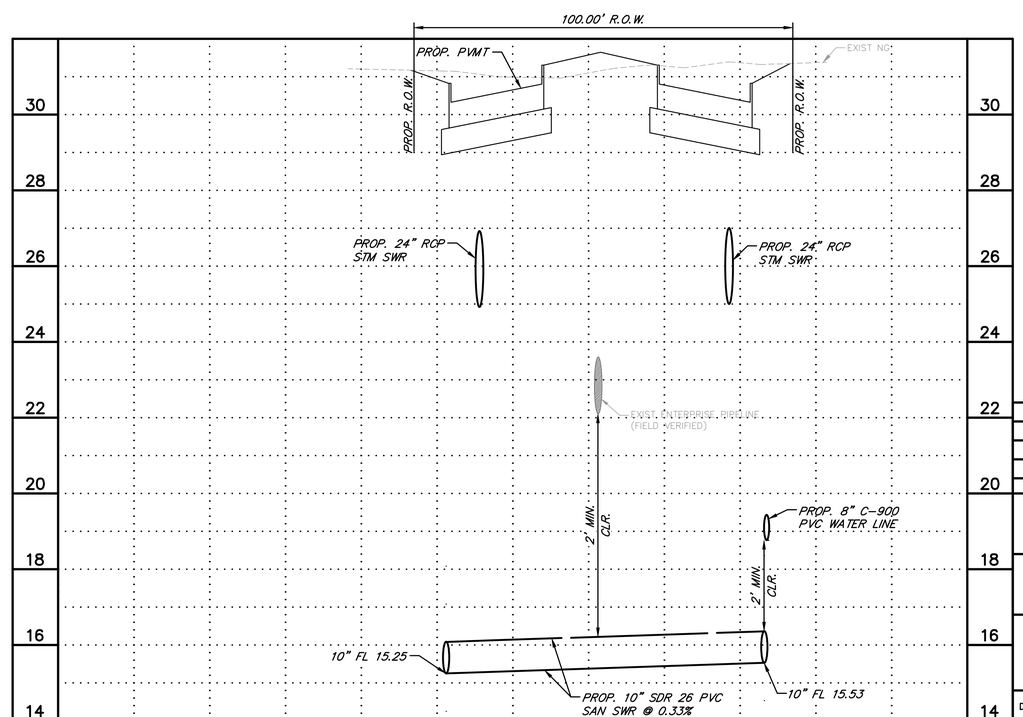


NOTES:

1. EXISTING ENTERPRISE PIPELINE WAS FIELD VERIFIED AND FOUND TO BE OUT OF RANGE BELOW ELEVATION 16. 2' MIN. CLR. TO BE MAINTAINED BETWEEN PROP. STORM RCB & EXIST. PIPELINE.

FRIENDSWOOD LAKES BLVD
10" SANITARY CROSSING
AT STA. 49+43.16





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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

PLAN AND PROFILE 8" WATER LINE
(3 OF 3)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901, CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP22

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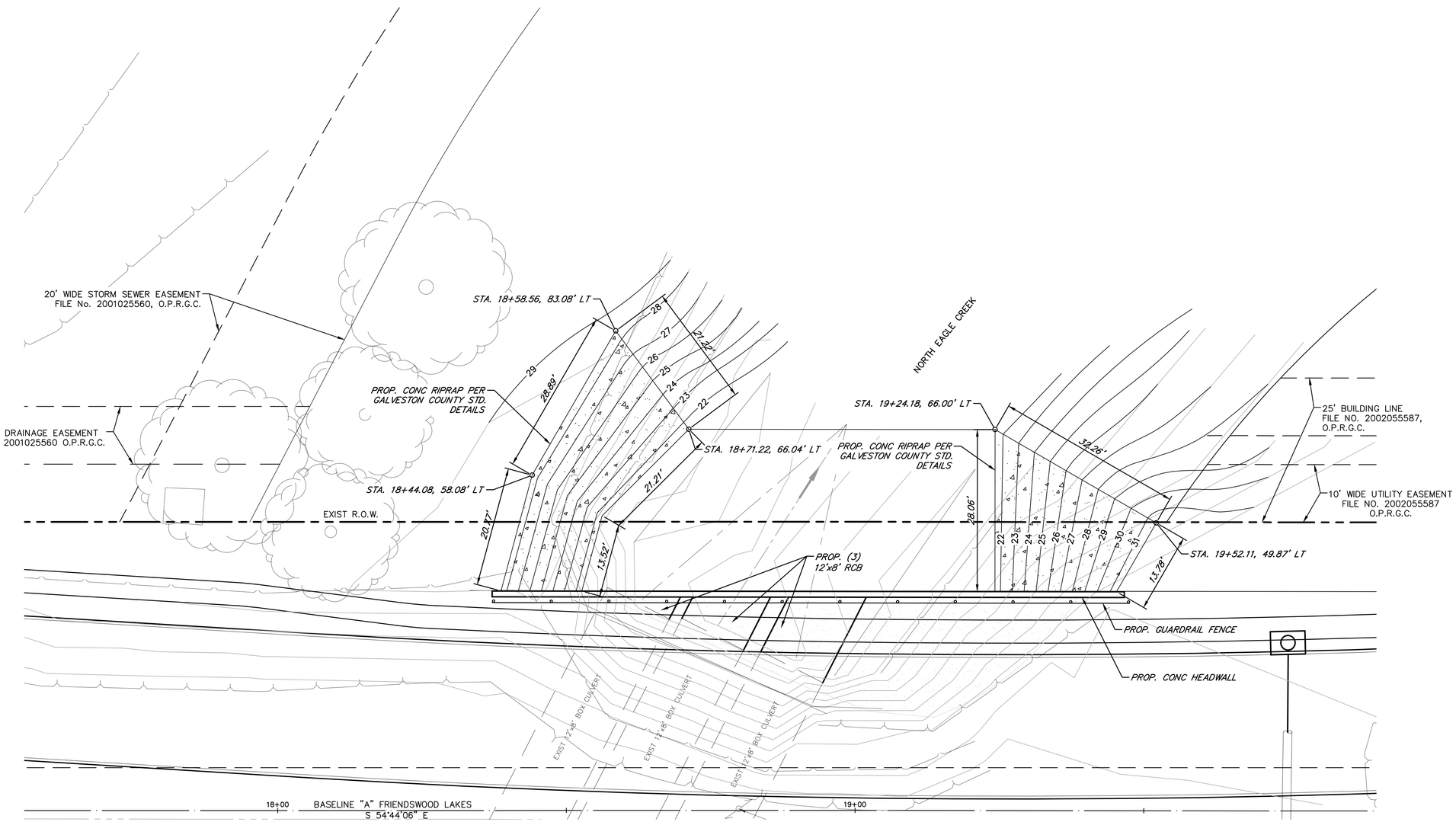

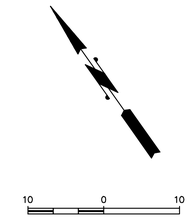

FILL BELLOW WATER SURFACE ELEVATION

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED
PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

FRIENDSWOOD LAKES BLVD
GRADING PLAN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 10'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GR01

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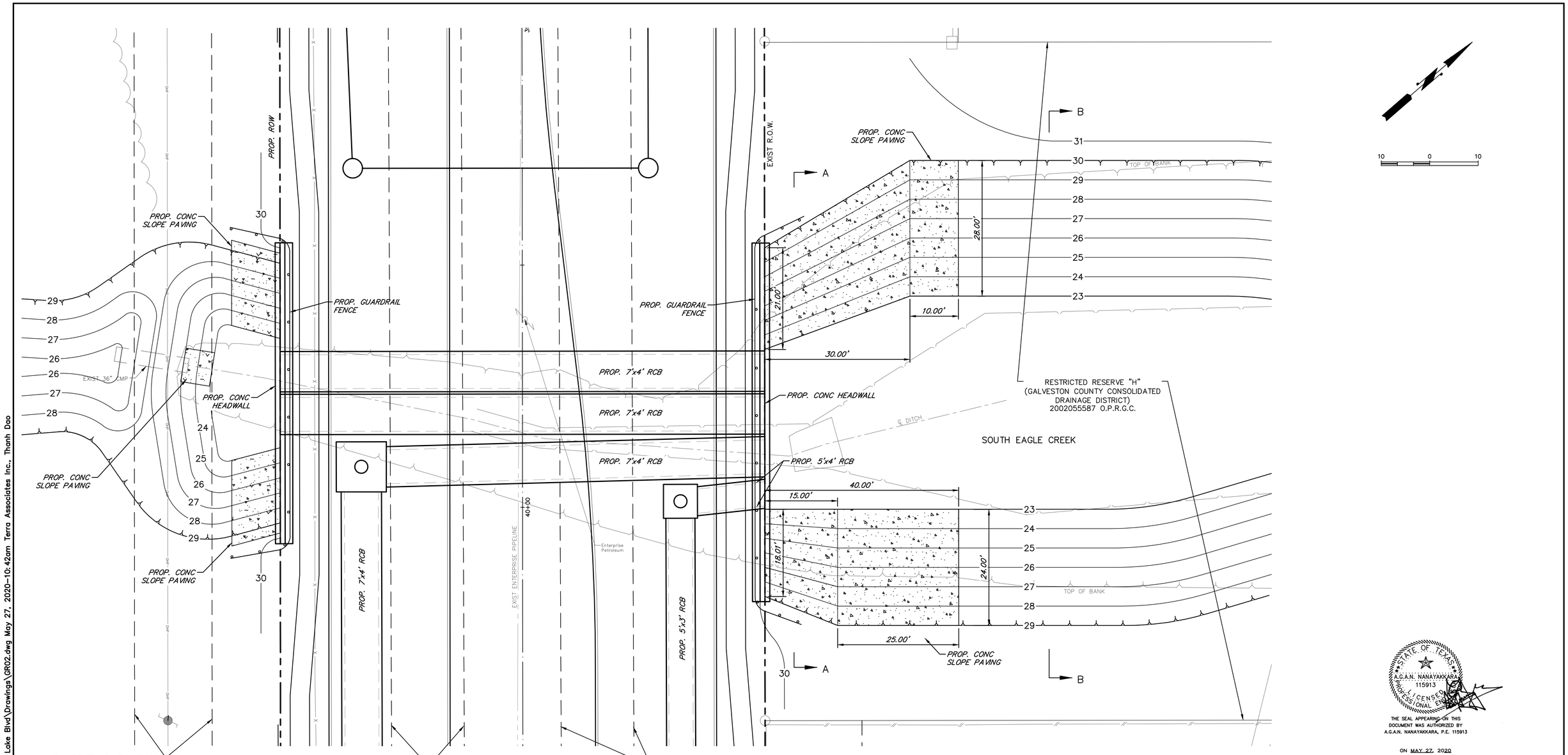

SECTION B–B
NTS

SECTION A–A
NTS

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

GRADING PLAN AT SOUTH EAGLE CREEK

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: 1" = 10'	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET GR02

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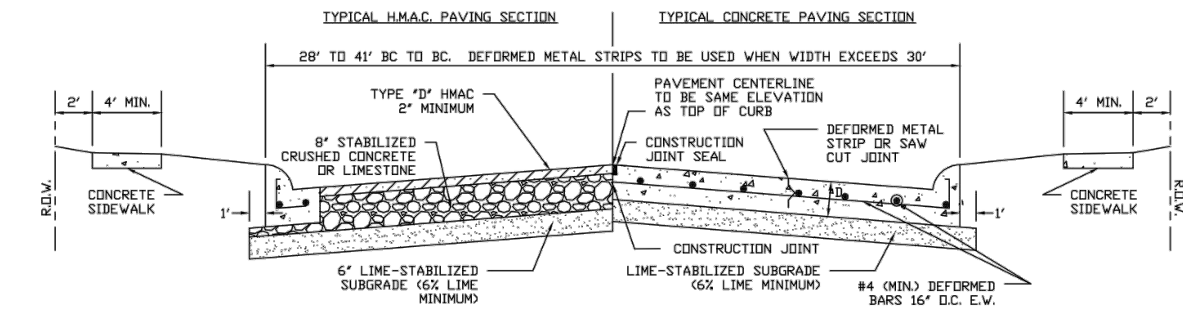
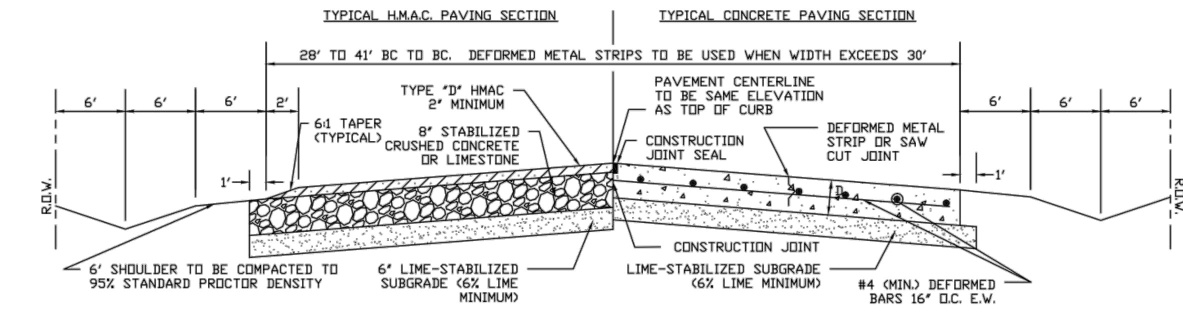
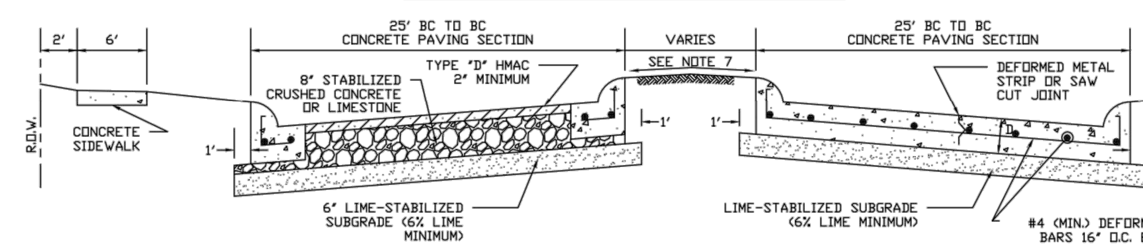


SINGLE ROADWAY CURB SECTION



SINGLE ROADWAY OPEN DITCH SECTION

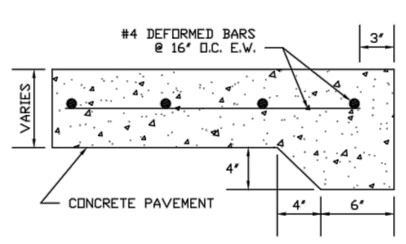


DOUBLE ROADWAY SECTION

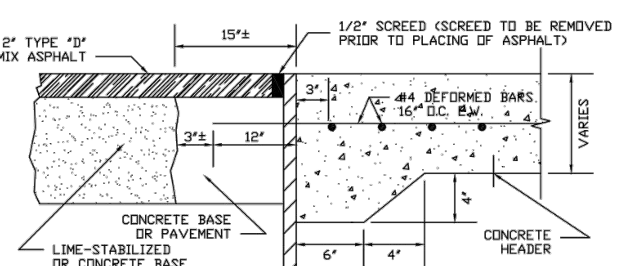
ROADWAY SECTIONS

NOTES:

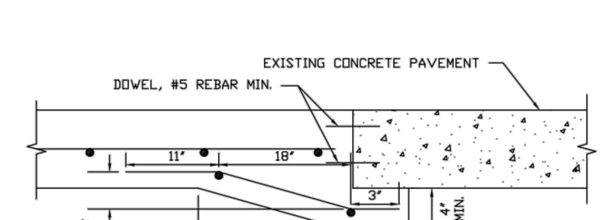
1. FOR ALL SIX (6) AND SEVEN (7) INCH PAVING USE #4 REBAR ON SIXTEEN (16) INCH CENTERS EACH WAY.
2. ALL REINFORCING BAR SHALL CONFORM TO ASTM A15-54T AND A305-53T.
3. THE LOCATION OF CONSTRUCTION JOINTS, CONTROL JOINTS AND DEFORMED STRIPS MAY BE VARIED, WITH THE APPROVAL OF THE CITY OF FRIENDSWOOD, TO SUIT THE PROPOSED CONSTRUCTION METHODS OF THE CONTRACTOR. THE MAXIMUM LENGTH BETWEEN LONGITUDINAL JOINTS SHALL NOT EXCEED 15' - 0".
4. ALL PAVEMENT CROSS-SECTION SHALL EITHER BE HYPERBOLIC OR TANGENT CROWN. MINIMUM SLOPE SHALL BE ONE-QUARTER (¼) INCH PER FOOT.
5. D = SIX (6) INCH OR SEVEN (7) INCH. SEE PAVING CONSTRUCTION ITEMS ON THIS SHEET.
6. MINIMUM SLOPE FOR ANY MEDIAN SHALL BE ONE-HALF (½) INCH PER FOOT.



CONCRETE PAVING HEADER

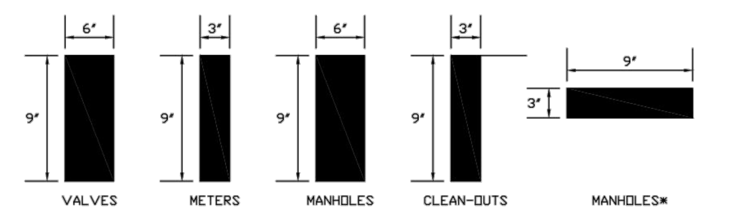


ASPHALT PAVING HEADER



UNDERCUT DETAIL

PAVING HEADERS

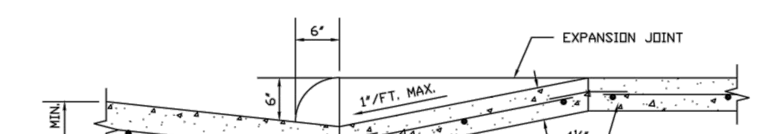


WATER LINES SANITARY SEWER STORM SEWER

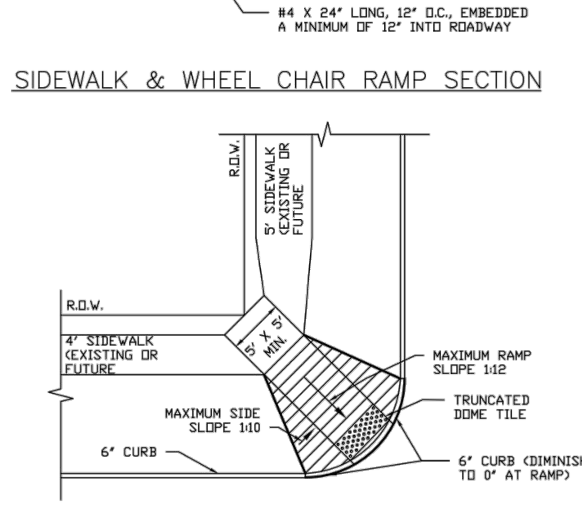
UTILITY MARKINGS

NOTES:

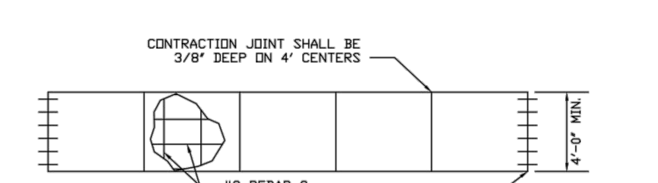
1. SAW CUT CURB OR EDGE AND APPLY APPROPRIATE MARKING AS LISTED BELOW.
2. WATER VALVE MARKING SHALL BE 6" X 9" IN SIZE MARKED IN BLUE PAINT ON CURB OR EDGE OF STREET.
3. WATER METER MARKING SHALL BE 3" X 9" IN SIZE MARKED IN BLUE PAINT ON CURB OR EDGE OF STREET.
4. SANITARY SEWER MANHOLE MARKING SHALL BE 6" X 9" IN SIZE MARKED IN GREEN PAINT ON CURB OR EDGE OF STREET.
5. SANITARY SEWER CLEAN-OUT MARKING SHALL BE 3" X 9" IN SIZE AND MARKED IN GREEN PAINT ON CURB OR EDGE OF STREET.
6. STORM SEWER MANHOLE MARKING SHALL BE 9" X 3" IN SIZE AND MARKED IN BLACK PAINT. *ONLY STORM SEWER MANHOLES SHALL BE MARKED NOT, INLETS.



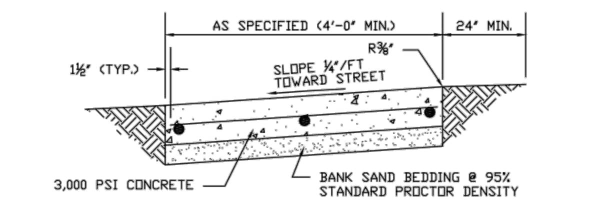
SIDEWALK & WHEEL CHAIR RAMP SECTION



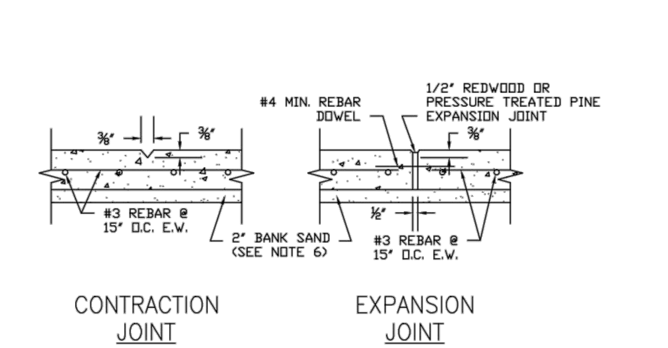
WHEELCHAIR RAMP - PLAN VIEW



SIDEWALK PLAN VIEW



SIDEWALK SECTION



SIDEWALK JOINTS

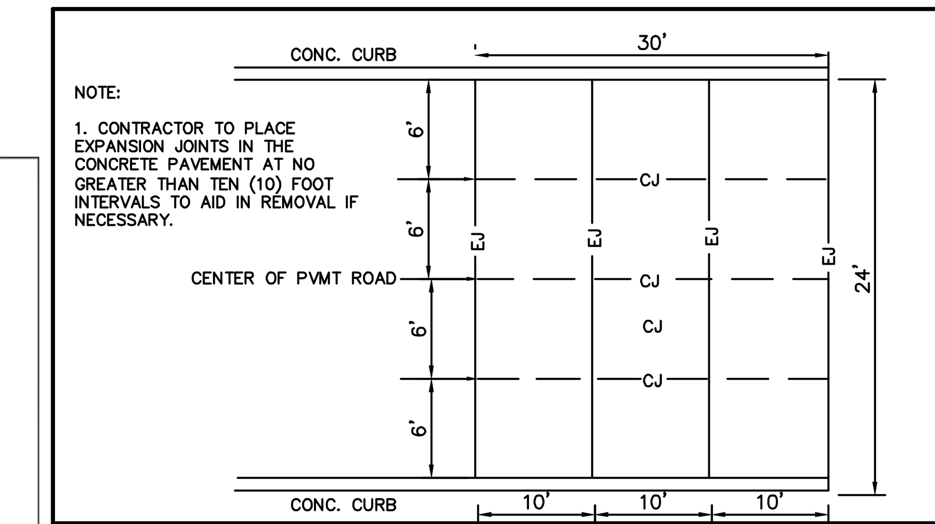
NOTES:

1. ALL EDGES SHALL BE ROUNDED WITH ⅜" RADIUS.
2. CONTRACTION JOINTS SHALL BE PLACED AT 4'-0" INTERVALS.
3. CONTRACTION JOINTS SHALL BE ⅜" DEEP AND HAVE TROWEL EDGE.
4. ½" EXPANSION JOINT MATERIAL REQUIRED WHERE SIDEWALKS ABUT BUILDINGS, CURBS, DRIVEWAYS, OR EXISTING SIDEWALKS.
5. EXPANSION JOINTS SHALL BE PLACED AT 20'-0" INTERVALS.
6. 2" INCH CLEAN BANK SAND SHALL BE TAMPED TO 95% STANDARD PROCTOR.
7. WHERE NEW SIDEWALK IS PLACED AGAINST EXISTING SIDEWALK, SAW CUT EXISTING SIDEWALK TO AN EVEN STRAIGHT LINE PRIOR TO INSTALLATION OF THE NEW SIDEWALK INSTALL #4 REBAR DOWEL INTO EXISTING SIDEWALK.

NOTES:

1. RAMP SHALL MEET ADA (AMERICANS WITH DISABILITIES ACT) AND TABA (TEXAS ARCHITECTURAL BARRIERS ACT).
2. FINISHED SURFACE OF WHEELCHAIR RAMP AND SIDE SLOPE SHALL BE GROOVED LATERALLY WITH ¼" WIDE BY ¼" DEEP GROOVES, SPACED AT 2¼" O.C. WITH BLACK BROOM FINISH. CONTRACTOR SHALL MAKE ADJUSTMENTS TO RAMPS TO FIT LOCAL CONDITION.
3. ALL CUTOUTS MUST HAVE BARRICADES INSTALLED UNTIL WHEELCHAIR RAMPS ARE COMPLETED.
4. MINIMUM CLEARANCE (WIDTH) OF RAMP SHALL BE THIRTY-SIX (36) INCHES.
5. FINISH SURFACES OF RAMP AND SIDE SLOPE SHALL BE TREATED WITH COLOR SO THAT THE SURFACES ARE IN CONTRAST WITH SURFACE COLOR OF ADJACENT SIDEWALKS AND STREETS.
6. CONTRAST COLOR OF WHEELCHAIR RAMPS AND SIDE SLOPES SHALL BE BLACK DYE PER CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.

SIDEWALKS AND WHEELCHAIR RAMPS



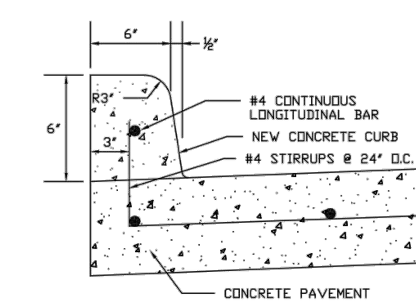
EXPANSION JOINT & CONTROL JOINT DETAIL FOR PAVING OVER PIPELINE
SCALE: N.T.S.

PAVING OVER PIPELINE NOTES :

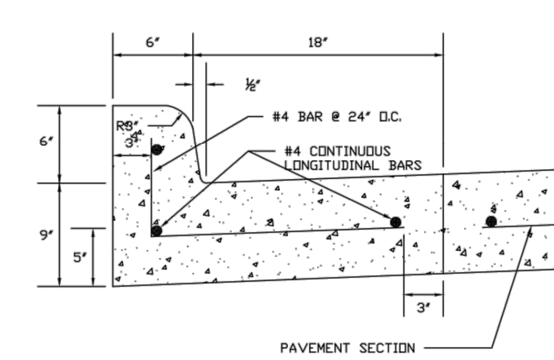
1. ...

WARNING!
HIGH PRESSURE PIPELINE(S)
EXCAVATION AND/OR CONSTRUCTION PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM ENTERPRISE PRODUCTS OPERATING LLC

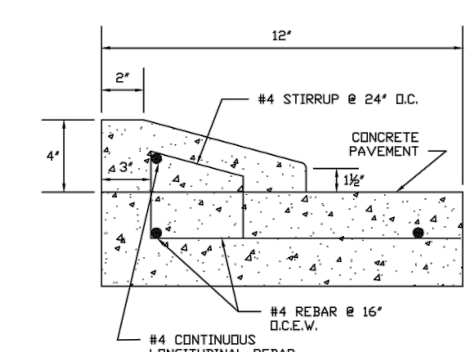
2. ROADWAY EXTENSION AND CROSSING: LANDOWNER'S PROPOSED ROADWAY EXTENSION WITH MEDIAN SHALL BE CONSTRUCTED WITHIN THE PIPELINE EASEMENT WITH ITS MEDIAN CENTERED APPROXIMATELY OVER THE PIPELINE FROM STONEY LAKE DRIVE TO DITCH NO. 4 (STA. 54+00) WITH A MINIMUM SIX (6) FEET DEPTH OF COVER. APPROXIMATELY TWO HUNDRED (200) FEET OF WEST BOUND ROADWAY CONCRETE PAVEMENT WILL BE OVER THE PIPELINE AFTER CROSSING THE DITCH NO. 4 WITH A MINIMUM SEVEN (7) FEET DEPTH OF COVER AND WILL GRADUALLY OFFSET SOUTH OF THE PIPELINE EASEMENT. IN ANY PAVED AREAS, LANDOWNER WILL INSTALL EXPANSION JOINTS IN THE CONCRETE PAVEMENT AT NO GREATER THAN TEN (10) FOOT INTERVALS TO AID IN REMOVAL IF NECESSARY. LANDOWNER WILL BE RESPONSIBLE FOR ALL FUTURE COSTS ASSOCIATED WITH TRAFFIC CONTROL ITEMS AND APPURTENANCES, INCLUDING ANY COST ASSOCIATED WITH TRENCH MECHANICAL SHORING ITEMS, IN THE EVENT THAT COMPANY OR ITS DESIGNEE MUST ACCESS THE PIPELINE AND/OR ASSOCIATED EASEMENT TO PERFORM ROUTINE OR EMERGENCY MAINTENANCE.



TYPE I - 6" CONCRETE CURB



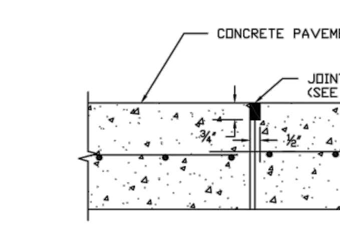
TYPE II - MONOLITHIC CONCRETE CURB AND GUTTER



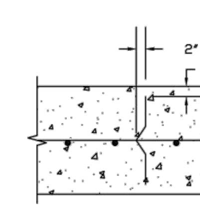
TYPE III - 4" x 12" CONCRETE CURB

CONCRETE CURB

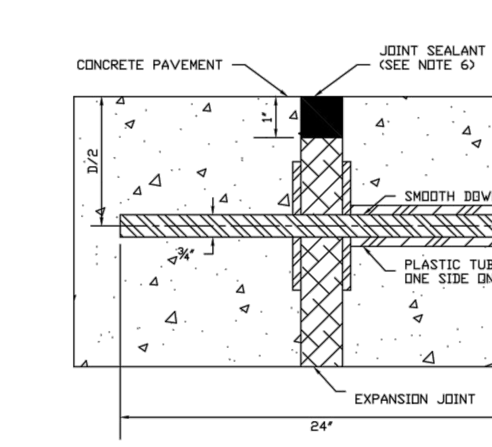
NOTE:
1. WHEN CONCRETE CURB IS TO BE PLACED ON EXISTING CONCRETE DOWEL IN #3 DEFORMED BARS @ 36" O.C. AND SET IN SULFUR, OR QUICK SETTING CEMENT.
2. MORTAR FINISH IS NOT REQUIRED WHEN CURB IS PLACED BY A MACHINE, BUT CURB SHALL STILL HAVE THE SAME OUTSIDE DIMENSIONS.



CONSTRUCTION JOINT



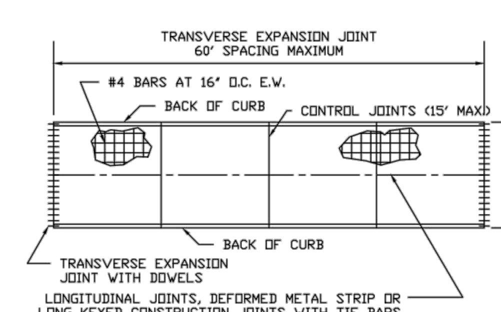
DEFORMED METAL STRIP



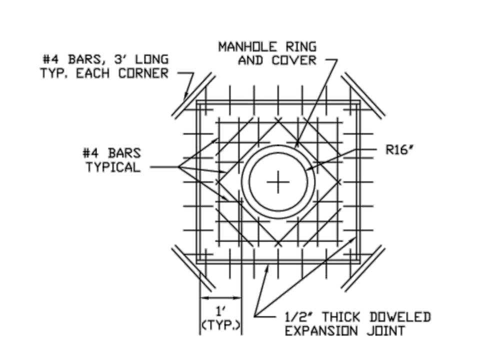
DOWEL EXPANSION JOINT

NOTES:

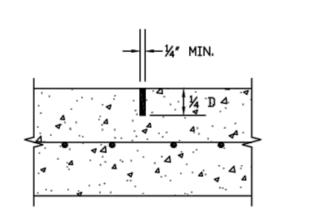
1. CANTILEVER TYPE. CAST MALLEABLE IRON LOAD TRANSMISSION UNIT-STARLUG MODEL D-27 OR EQUAL ON 22" O.C. ARE ACCEPTABLE ALTERNATIVES.
2. EXPANSION JOINT TO BE PLACED AT THE END OF EACH CURB RADIUS AND SPACED A MINIMUM OF 40'-0" APART. MATCH TO EXPANSION JOINTS IN PAVING PANELS.
3. STAKES FOR TRANSVERSE JOINTS SHALL NOT BE PLACED CLOSER THAN 6" TO A LONGITUDINAL JOINT. THE TOP OF STAKE SHALL NOT BE LESS THAN 1½" BELOW THE FINISH SURFACE.
4. LOCATION OF CONSTRUCTION JOINTS AND DEFORMED STRIPS MAY BE VARIED WITH THE APPROVAL OF THE CITY, TO SUIT PROPOSED CONSTRUCTION OF THE CONTRACTOR.
5. CONTROL JOINTS SHALL BE SPACED AT A MAXIMUM OF 15'-0".
6. JOINTS AND SEALANTS SHALL ADHERE TO CITY OF FRIENDSWOOD TECHNICAL SPECIFICATION 02840 - CONCRETE PAVEMENT JOINTS.



PAVING PANEL



MANHOLE BLOCKOUT



CONTRACTION JOINT

NOTES:
1. D = DEPTH OF CONCRETE.
2. SAW-CUT CONTRACTION JOINT TO DIMENSIONS SHOWN.

PAVEMENT JOINTS

PAVING CONSTRUCTION NOTES:

1. PAVEMENT AND SUBGRADE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD STANDARD DETAILS AND TECHNICAL SPECIFICATIONS, LATEST REVISION.
2. CONTRACTOR SHALL NOTIFY THE CITY OF FRIENDSWOOD PROJECT MANAGER AT (281) 996-3380 A MINIMUM OF TWENTY-FOUR (24) HOURS PRIOR TO ALL LIMING AND PAVING OPERATIONS.
3. ALL TURN-OUTS SHALL HAVE A TWENTY-FIVE (25) FOOT RADIUS AT THE BACK OF CURB UNLESS OTHERWISE NOTED.
4. GUIDELINES SET FORTH IN THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (TMUTCD), LATEST EDITION, SHALL BE OBSERVED.
5. ALL FILL IN EXISTING RIGHTS-OF-WAY, INCLUDING BACKDRESSING BEHIND THE CURB, SHALL BE PLACED IN A MAXIMUM LOOSE LIFTS OF TWELVE (12) INCHES OR LESS AND COMPACTED TO A NINETYU-FIVE PERCENT (95%) STANDARD PROCTOR DENSITY WITH A MOISTURE CONTENT THREE PERCENT (3%) ± ONE PERCENT (1%) OF OPTIMUM MOISTURE,
6. MINIMUM PAVEMENT REINFORCEMENT REQUIREMENT SHALL BE GRADE 60, NO, 4 REBAR, SPACED AS SIXTEEN (16) INCHES ON CENTER, EACH WAY.
7. ALL RESIDENTIAL OR COLLECTOR PAVEMENT TO BE A MINIMUM OF SIX (6) INCHES THICK REINFORCED CONCRETE, UNLESS OTHERWISE NOTED.
8. FOR PAVEMENT WIDTHS LESS THAN OR EQUAL TO TWENTY-EIGHT (28) FEET BACK OF CURB TO BACK OF CURB:

   8.1 MINIMUM CONCRETE SLAB THICKNESS SHALL BE SIX (6) INCHES.

   8.2 MINIMUM STABILIZED SUBGRADE THICKNESS SHALL BE SIX (6) INCHES.
9. FOR PAVEMENT WIDTHS GREATER THAN TWENTY-EIGHT (28) FEET FROM BACK OF CURB TO BACK OF CURB AND MAJOR ARTERIAL THOROUGHFARES:

   9.1 MINIMUM CONCRETE SLAB THICKNESS SHALL BE SEVEN (7) INCHES.

   9.2 MINIMUM STABILIZED SUBGRADE THICKNESS SHALL BE EIGHT (8) INCHES.
10. PAVING EXPANSION JOINTS SHALL BE PLACED AT A MAXIMUM OF SIXTY (60) FOOT INTERVALS.
11. ALL CONCRETE USED FOR PAVEMENT SHALL BE "CLASS A" CONCRETE, MINIMUM FIVE (5.0) SACKS OF CEMENT PER CUBIC YARD OF CONCRETE, 3,000 PSI COMPRESSIVE STRENGTH AT TWENTY-EIGHT (28) DAYS,
12. CLASS "A" HYDRATED LIME SHALL BE APPLIED FOR SUBGRADE AT A MINIMUM OF SIX PERCENT(5%).
13. CONTRACTOR SHALL INSTALL STREET SIGNS AND REGULATORY SIGNS PER CITY OF FRIENDSWOOD STANDARD DETAILS AND TECHNICAL SPECIFICATIONS, LATEST EDITION.
14. ALIGNMENTS, CENTERLINE CURVE DATA, AND STATIONING FOR ALL CONSTRUCTION SHALL BE DETERMINED FROM SUBDIVISION PLAT.
15. FOR ALL CONCRETE REMOVED, A MINIMUM OF THREE (3) INCH DEEP SAW-CUT SHALL BE PROVIDED PRIOR TO REMOVAL.
16. REPRESENTATIVES FROM THE CITY OF FRIENDSWOOD, THE OWNER, AND THE TESTING LABORATORY SHALL BE PRESENT FOR ALL GRADATIONS, DENSITY TESTING, LIME OPERATIONS, AND PLACEMENT OF CONCRETE OR ASPHALTIC PAVING.
17. UNDER NO CIRCUMSTANCES SHALL WATER BE ADDED TO A CONCRETE LOAD AFTER SLUMP TESTS HAVE BEEN TAKEN.
18. BLUE REFLECTORIZED RAISED PAVEMENT MARKERS SHALL BE PLACED ADJACENT TO FIRE HYDRANT LOCATIONS AT A POINT SIX (6) INCHES FROM THE CENTERLINE OF THE ROADWAY, ON THE SIDE OF THE FIRE HYDRANT (REFLECTORS SHALL FACE TRAFFIC FLOW).
19. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING LOCATION OF ALL EXISTING UTILITIES PRIOR TO EXCAVATION. DURING THE COURSE OF AND ALL CLEARING, GRUBBING, FILL, GRADING, EXCAVATION, OR OTHER CONSTRUCTION, CONTRACTOR SHALL ENSURE THAT STORM DRAINAGE PATHWAYS ARE MAINTAINED AND REMAIN OPEN TO ENSURE POSITIVE DRAINAGE AND SUCH CONVEYANCES ARE NOT IMPEDED OR BLOCKED IN ANY WAY. STORM SEWER INLETS SHALL BE PROTECTED FROM ENTRY OF SILT, TRASH, DEBRIS, AND ANY OTHER SUBSTANCES DELETERIOUS TO THE STORM SEWER SYSTEM AND/OR WATERWAYS RECEIVING STORM WATER RUNOFF. CONTRACTOR SHALL, AT COMPLETION OF WORK, FILL LOW SPOTS AND GRADE ALL RIGHTS-OF-WAY AND UTILITY EASEMENTS AND REGRADE/RESTORE DITCHES AS NECESSARY TO MAINTAIN AND/OR ESTABLISH POSITIVE DRAINAGE.

PAVING STANDARD DETAILS			DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION			
FILE NAME: PSD - 2017.DWG	DATE APPROVED: JULY 1, 2017			PROJECT NUMBER:	DATE SUBMITTED:	SHEET: XX OF XX
	SCALE: NTS	REVISED DATE: JUNE 2017				

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

PAVING CONSTRUCTION DETAILS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST - SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP30

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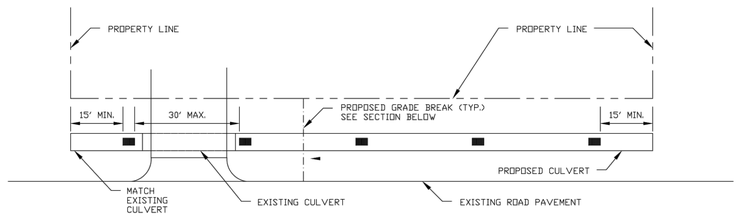
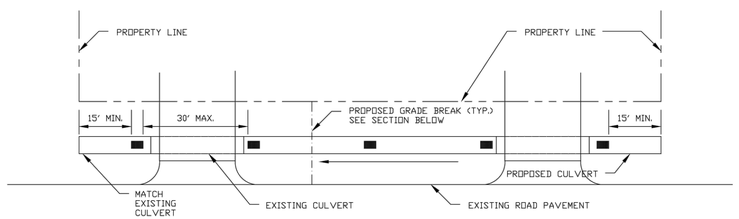
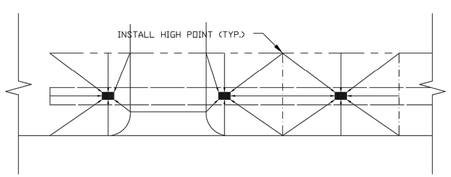


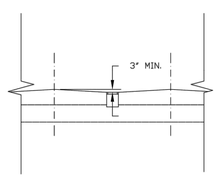
PLAN VIEW FOR SINGLE DRIVEWAY



PLAN VIEW FOR DOUBLE DRIVEWAY



DRAINAGE GRADING – PLAN

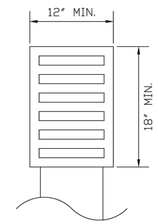


DRAINAGE GRADING – PROFILE

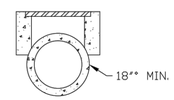
FILLING IN AN OPEN DITCH

NOTES:

1. MINIMUM LOT FRONTAGE SHALL BE ONE HUNDRED (100) FEET.
2. MINIMUM DISTANCE BETWEEN DRIVEWAYS SHALL BE FORTY-FIVE (45) FEET EDGE TO EDGE.



TOP VIEW



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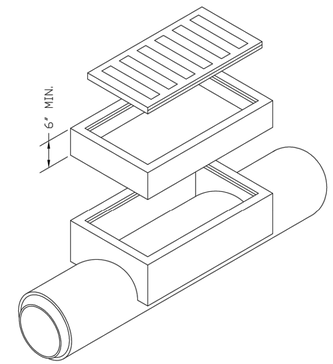
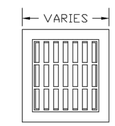
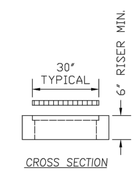


ISOMETRIC VIEW

TYPE S INLET



TOP VIEW



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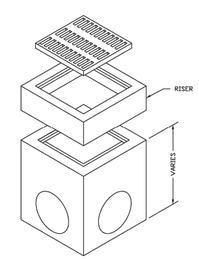

ISOMETRIC VIEW

TYPE A INLET

STORM SEWER STANDARD DETAILS (CONTINUED)

FILE NAME: SWSSD2 – 2017.DWG | DATE APPROVED: JULY 1, 2017 | SCALE: NTS | REVISED DATE: JUNE 2017

DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION

PROJECT NUMBER: | DATE SUBMITTED: | SHEET: XX OF XX

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

STORM SEWER DETAILS I

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP31

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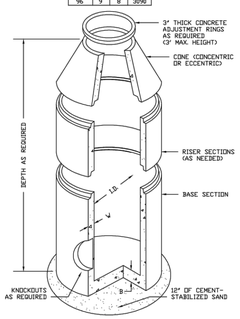
DIMENSIONS AND WEIGHTS			
ID SIZE (IN)	V (IN)	B (IN)	RISER WT./LF (LB)
48	5	6	860
60	6	8	1300
72	7	8	1811
96	9	8	3090

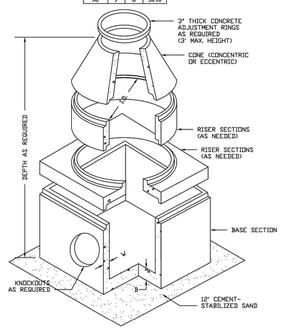


CONCRETE MANHOLE

NOTES:

1. LIFTING INSERTS AS REQUIRED.
2. ALL JOINTS SHALL BE SEALED WITH RAM-NEK OR APPROVED EQUAL.
3. MANHOLES TO BE PLACED ON 12" OF CEMENT-STABILIZED SAND.
4. CONCRETE DESIGN STRENGTH SHALL BE 4000 PSI AT 28 DAYS, RATED FOR H-20 LOADING.
5. FOR USE WITH PIPE 72" DIAMETER AND SMALLER ONLY.

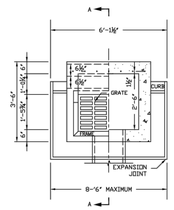
DIMENSIONS AND WEIGHTS			
ID SIZE (IN)	V (IN)	B (IN)	RISER WT./LF (LB)
48	5	6	860
60	6	8	1300
72	7	8	1811
96	9	8	3090



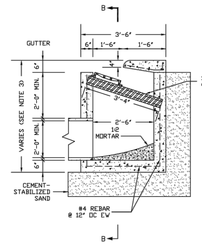
CONCRETE JUNCTION BOX

NOTES:

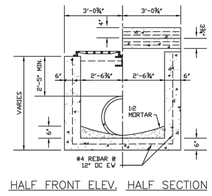
1. LIFTING INSERTS AS REQUIRED.
2. ALL JOINTS SHALL BE SEALED WITH RAM-NEK OR APPROVED EQUAL.
3. MANHOLES TO BE PLACED ON 12" OF CEMENT-STABILIZED SAND.
4. CONCRETE DESIGN STRENGTH SHALL BE 4000 PSI AT 28 DAYS, RATED FOR H-20 LOADING.
5. WIDTH VARIES ACCORDING TO PIPE SIZE.



HALF PLAN HALF HORZ. SECTION



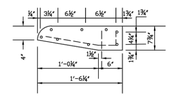
SECTION A–A



HALF FRONT ELEV. HALF SECTION

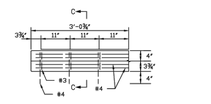
SECTION B–B

I BEAM SECTION



SECTION C–C

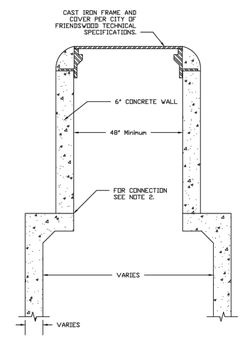
TYPE B AND B–B INLET



INLET TOP HALF FRONT ELEVATION

NOTES:

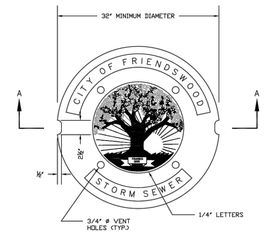
1. USE STANDARD CAST IRON FRAME AND GRATES.
2. LEADS SHALL LEAVE INLET AT LOCATION AND GRADE REQUIRED.
3. DIMENSION VARIES BASED ON PIPE DIAMETER AND WALL THICKNESS.
4. CENTER STEEL BEAM ON INLET AND CAST WALLS AS SHOWN (B–B INLET ONLY).
5. TYPE B AND B–B INLETS ARE FOR RESIDENTIAL USE ONLY.



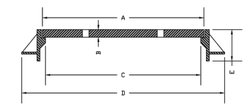
MANHOLE FOR BOX SEWERS

NOTE:

1. "E" INLET GRATE MAY BE USED IN PLACE OF MANHOLE COVER.
2. CONNECT MANHOLE TO TOP BY USING KEYWAY, DOWELING OR PRECAST JOINT.



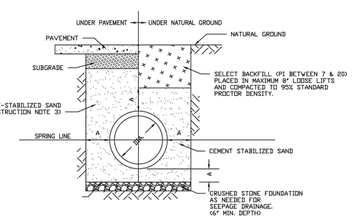
PLAN



SECTION A–A

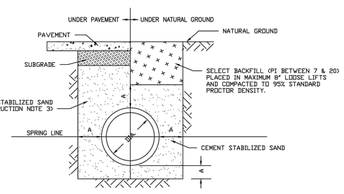
DIMENSIONS					
TYPE	A	B	C	D	E
H-2 INLET	23¾"	15¾"	22"	32¾"	6"
ALL OTHERS	32"	15¾"	30"	46"	6¾"

MANHOLE FRAME AND COVER



UNSATISFACTORY SOIL CONDITIONS

A	STORM SEWER DIAMETER
6"	36" OR LESS
12"	42" OR GREATER

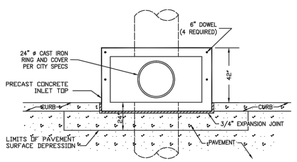


SATISFACTORY SOIL CONDITIONS

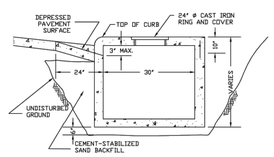
BEDDING AND BACKFILL

NOTES:

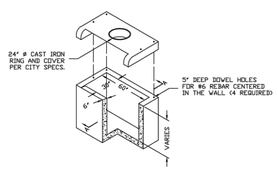
1. THE SATISFACTORY SOIL CONDITIONS METHOD SHALL BE USED FOR STORM SEWER PIPE WHERE THE SOIL CONDITIONS ARE AS FOLLOWS:
   1.A. STRATA FROM THE SPRING LINE TO 2 FT BELOW THE FLOWLINE OF THE PIPE CONSIST OF NON-WATERBEARING COHESIVE SOILS HAVING A SHEAR STRENGTH OF 1000 PSF OR GREATER.
   1.B. NO WET SAND STRATA EXIST IN AREA FROM 1 FT ABOVE THE TOP OF THE PIPE TO 3 FT BELOW THE FLOWLINE.
2. FOR ALL OTHER SOIL CONDITIONS USE THE DETAIL FOR UNSATISFACTORY CONDITIONS SHOWN ABOVE.



TYPE H–2 INLET PLAN VIEW



SECTION A – A
TYPE H–2 INLET
CROSS SECTION

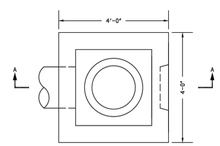


ISOMETRIC VIEW

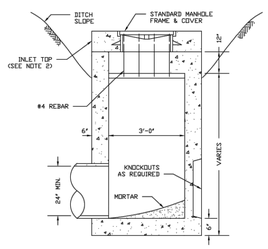
TYPE H–2 INLET

NOTES:

1. H–2 TYPE 1 LENGTH = 5'–0", H–2 TYPE 2 LENGTH 10'–0".
2. THIN WALL KNOCK-OUTS OR THRU HOLES FOR PIPE PER JOB REQUIREMENTS.
3. REFER TO PAVING DETAIL SHEET FOR INSTALLATION OF H–1 TYPE 1 5'–0" CURB INLET.
4. INLET WALLS MAY BE EXTENDED USING PRECAST RISER SECTION.
5. INLET TOPS SHALL BE SECURED TO THE INLET WALL USING #6 DOWELS DRILLED AND GROUTED A MINIMUM DEPTH OF 5" INTO THE INLET WALL.
6. INLET BACKFILL SHALL BE CEMENT-STABILIZED SAND TO THE TOP OF THE INLET FIRST STAGE.
7. GRADE 60, #4 REINFORCEMENT BARS TO CONFORM TO ASTM A615 ON REQUIRED CENTERS OR EQUAL.
8. GROUT ALL EXPOSED LIFT HOLES.



PLAN



SECTION A–A

TYPE E INLET

NOTES:

1. USE #4 REBAR IN THROAT OPENING AT 6" CENTERS.
2. CONNECT INLET TO TOP BY USING KEYWAY, DOWELING OR PRECAST JOINT.

STORM SEWER CONSTRUCTION NOTES:

1. STORM SEWERS SHALL BE CONSTRUCTED IN ACCORDANCE WITH CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS AND STANDARD DETAILS, LATEST REVISIONS.
2. ALL STORM SEWER PIPE SHALL BE REINFORCED CONCRETE PIPE (RCP), ASTM C–76, CLASS III, TONGUE AND GROOVE, UNLESS OTHERWISE NOTED AND APPROVED BY THE CITY.
3. REINFORCED CONCRETE STORM SEWER (PIPE, BOX, ETC.) SHALL BE INSTALLED, BEDDED AND BACKFILLED IN CONFORMITY WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS AND STANDARD DETAILS. STORM SEWER INSTALLED UNDER PROPOSED PAVEMENT SHALL BE BACKFILLED WITH CEMENT–STABILIZED SAND (1.1 SACKS OF CEMENT PER TON OF SAND, TO THE BOTTOM OF THE SUBGRADE. STORM SEWER INSTALLED UNDER EXISTING PAVEMENT SHALL BE BACKFILLED WITH CEMENT–STABILIZED SAND TO THE BOTTOM OF THE PAVEMENT.
4. CONCRETE FOR INLETS AND MANHOLES SHALL BE CLASS A AND SHALL HAVE A MINIMUM STRENGTH OF 4000 PSI AT 28 DAYS AND HAVE REINFORCING BARS TO MEET AASHTO H20–44 LOADING REQUIREMENTS.
5. ALL MANHOLES SHALL BE ADJUSTED TO FINISHED GRADE.
6. MINIMUM STORM SEWER SIZE IS TWENTY–FOUR (24) INCH INSIDE DIAMETER. MINIMUM ROADSIDE DITCH CULVERT IS EIGHTEEN (18) INCH INSIDE DIAMETER OR APPROVED EQUAL.
7. ALL STORM SEWER MANHOLES SHALL INCLUDE THE WORDS "STORM SEWER" AND "CITY OF FRIENDSWOOD." MANHOLE COVERS SHALL CONFORM TO THE STANDARD DETAILS SHOWN ON THIS SHEET.
8. CONTRACTOR SHALL PROVIDE A MINIMUM OF SIX (6) INCHES OF CLEARANCE AT ALL UTILITY CROSSINGS WITH STORM SEWER.
9. ALL INLETS, AT ROADWAY PAVEMENT IN RESIDENTIAL DEVELOPMENTS, SHALL BE TYPE "B", "B–B" OR "H–2". ALL INLETS IN COMMERCIAL DEVELOPMENTS, AND/OR ON MAJOR THOROUGHFARES SHALL BE TYPE "H–2" ONLY, UNLESS OTHERWISE APPROVED BY THE CITY OF FRIENDSWOOD.
10. ALL DISTURBED AREAS IN DRAINAGE EASEMENTS OR DETENTION PONDS, SHALL BE HYDRO–MULCHED AS PER TECHNICAL SPECIFICATION SECTION 02910 – HYDROMULCH SEEDING OR APPROVED EQUAL.
11. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO EXCAVATION. DURING THE COURSE OF ANY AND ALL CLEARING, GRUBBING, FILL, GRADING, EXCAVATION OR OTHER CONSTRUCTION, THE CONTRACTOR SHALL ENSURE THAT STORM DRAINAGE PATHWAYS REMAIN OPEN AND ARE MAINTAINED TO ENSURE POSITIVE DRAINAGE. CONVEYANCES ARE NOT TO BE IMPEDED OR BLOCKED IN ANY WAY. STORM SEWER INLETS SHALL BE PROTECTED FROM ENTRY OF SILT, TRASH, DEBRIS AND ANY OTHER SUBSTANCES THAT MAY DAMAGE THE STORM SEWER SYSTEM AND/OR WATERWAYS RECEIVING STORM WATER RUNOFF. AT COMPLETION OF WORK, THE CONTRACTOR SHALL FILL ALL LOW SPOTS, GRADE ALL RIGHTS–OF WAY, AND UTILITY EASEMENTS, AND REGRADE/RESTORE DITCHES AS NECESSARY TO MAINTAIN AND/OR ESTABLISH POSITIVE DRAINAGE.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

STORM SEWER STANDARD DETAILS

FILE NAME: SWSSD1 – 2017.DWG | DATE APPROVED: JULY 1, 2017 | SCALE: NTS | REVISED DATE: JUNE 2017

DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION

PROJECT NUMBER: | DATE SUBMITTED: | SHEET: XX OF XX

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

STORM SEWER DETAILS II

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP32

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP15 STM_DTLS.dwg May 27, 2020-10:43am Terra Associates Inc., Thanh Dao

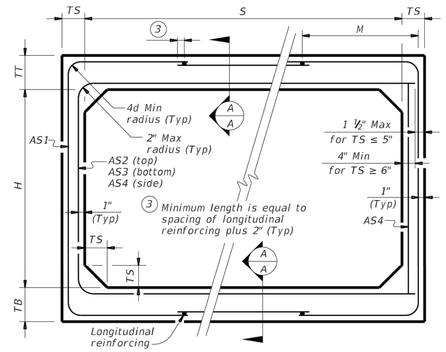
F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP17 SINGLE BOX CULVERT PRECAST 3 -0 SPAN.dwg May 27, 2020-10:43am Terra Associates Inc., Thanh Dao

BOX DATA

SECTION DIMENSIONS S (ft.)	H (ft.)	TT (in.)	TB (in.)	TS (in.)	Fill Height (ft.)	M (Min) (in.)	REINFORCING (sq. in. / ft.) (2) AS1	AS2	AS3	AS4	AS5	AS7	AS8	(1) Lift Weight (tons)
3	2	7	6	4	< 2	-	0.17	0.25	0.16	0.10	0.17	0.17	0.14	3.3
3	2	4	4	4	2 < 3	31	0.13	0.19	0.18	0.10	-	-	-	2.4
3	2	4	4	4	3 - 5	31	0.10	0.11	0.12	0.10	-	-	-	2.4
3	2	4	4	4	10	31	0.10	0.10	0.10	0.10	-	-	-	2.4
3	2	4	4	4	15	31	0.10	0.13	0.13	0.10	-	-	-	2.4
3	2	4	4	4	20	31	0.11	0.17	0.17	0.10	-	-	-	2.4
3	2	4	4	4	25	31	0.14	0.21	0.21	0.10	-	-	-	2.4
3	2	4	4	4	30	31	0.17	0.25	0.25	0.10	-	-	-	2.4
3	2	4	4	4	35	31	0.20	0.29	0.30	0.10	-	-	-	2.4
3	3	7	6	4	< 2	-	0.17	0.27	0.17	0.10	0.17	0.17	0.14	3.7
3	3	4	4	4	2 < 3	31	0.10	0.22	0.21	0.10	-	-	-	2.8
3	3	4	4	4	3 - 5	31	0.10	0.14	0.14	0.10	-	-	-	2.8
3	3	4	4	4	10	31	0.10	0.11	0.11	0.10	-	-	-	2.8
3	3	4	4	4	15	31	0.10	0.14	0.15	0.10	-	-	-	2.8
3	3	4	4	4	20	31	0.10	0.18	0.19	0.10	-	-	-	2.8
3	3	4	4	4	25	31	0.10	0.23	0.23	0.10	-	-	-	2.8
3	3	4	4	4	30	31	0.12	0.27	0.28	0.10	-	-	-	2.8
3	3	4	4	4	35	31	0.14	0.32	0.32	0.10	-	-	-	2.8

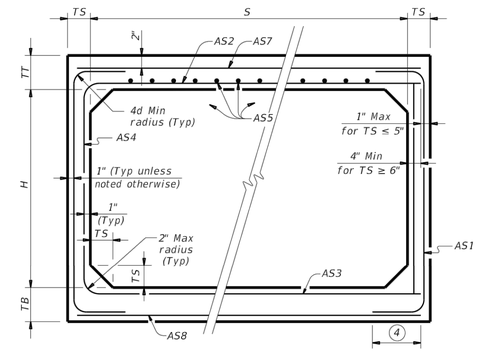
(1) For box length = 8'-0"

(2) AS1 thru AS4, AS7 and AS8 are minimum required areas of reinforcement per linear foot of box length. AS5 is minimum required area of reinforcement per linear foot of box width.



CORNER OPTION "A" CORNER OPTION "B"

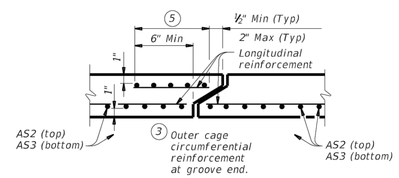
FILL HEIGHT 2 FT AND GREATER



CORNER OPTION "A" CORNER OPTION "B"

FILL HEIGHT LESS THAN 2 FT

(4) Length is equal to spacing of longitudinal reinforcing plus 2". (10" Min) (Typ)



SECTION A-A

(Showing top and bottom slab joint reinforcement.)

MATERIAL NOTES:

Provide 0.03 sq. in./ft. minimum longitudinal reinforcement at each face in slabs and walls. This minimum requirement may be met by the transverse wires when wire mesh reinforcement is used.

Provide Class H concrete (f'c = 5,000 psi).

GENERAL NOTES:

Designs shown conform to ASTM C1577. Refer to ASTM C1577 for information or details not shown.

See Box Culverts Precast Miscellaneous Details (SCP-MD) standard sheet for details and notes not shown.

In lieu of furnishing the designs shown on this sheet, the contractor may furnish an alternate design that is equal to or exceeds the box design for the design fill height in the table. Submit shop plans for alternate designs in accordance with Item "Precast Concrete Structural Members (Fabrication)".

HL93 LOADING

Texas Department of Transportation — Bridge Division Standard

SINGLE BOX CULVERTS PRECAST

3'-0" SPAN

SCP-3

FILE: scp03sts-20.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
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REVISIONS	DIST		COUNTY	SHEET NO.

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FILE:

STATE OF TEXAS — A.G.A.N. NANAYAKKARA — 115913 — LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SINGLE BOX CULVERT PRECAST
3' -0" SPAN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP33

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP18 SINGLE BOX CULVERT PRECAST 5 -0 SPAN.dwg May 27, 2020-10:43am Terra Associates Inc., Thanh Dao
DATE:
FILE:
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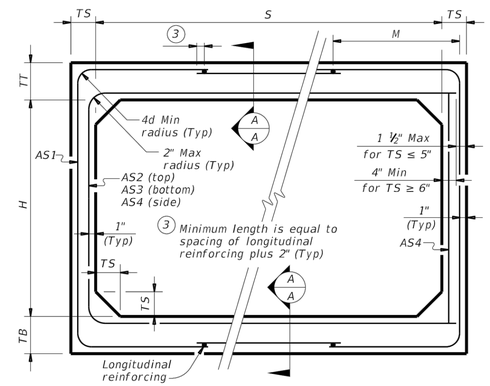
BOX DATA

SECTION DIMENSIONS					Fill Height	M (Min)	REINFORCING (sq. in. / ft.) (2)							(1) Lift Weight
S (ft.)	H (ft.)	TT (in.)	TB (in.)	TS (in.)	(ft.)	(in.)	AS1	AS2	AS3	AS4	AS5	AS7	AS8	(tons)
5	2	8	7	6	< 2	–	0.19	0.27	0.18	0.14	0.19	0.19	0.17	6.0
5	2	6	6	6	2 < 3	44	0.22	0.20	0.16	0.14	–	–	–	5.1
5	2	6	6	6	3 - 5	44	0.16	0.14	0.14	0.14	–	–	–	5.1
5	2	6	6	6	10	36	0.15	0.14	0.14	0.14	–	–	–	5.1
5	2	6	6	6	15	36	0.20	0.18	0.18	0.14	–	–	–	5.1
5	2	6	6	6	20	36	0.26	0.23	0.24	0.14	–	–	–	5.1
5	2	6	6	6	25	36	0.33	0.29	0.29	0.14	–	–	–	5.1
5	2	6	6	6	30	36	0.39	0.34	0.35	0.14	–	–	–	5.1
5	3	8	7	6	< 2	–	0.19	0.31	0.21	0.14	0.19	0.19	0.17	6.6
5	3	6	6	6	2 < 3	45	0.18	0.24	0.19	0.14	–	–	–	5.7
5	3	6	6	6	3 - 5	36	0.14	0.17	0.16	0.14	–	–	–	5.7
5	3	6	6	6	10	36	0.14	0.16	0.17	0.14	–	–	–	5.7
5	3	6	6	6	15	35	0.16	0.21	0.22	0.14	–	–	–	5.7
5	3	6	6	6	20	35	0.21	0.27	0.28	0.14	–	–	–	5.7
5	3	6	6	6	25	35	0.26	0.34	0.34	0.14	–	–	–	5.7
5	3	6	6	6	30	35	0.31	0.41	0.41	0.14	–	–	–	5.7
5	4	8	7	6	< 2	–	0.19	0.33	0.24	0.14	0.19	0.19	0.17	7.2
5	4	6	6	6	2 < 3	45	0.16	0.27	0.22	0.14	–	–	–	6.3
5	4	6	6	6	3 - 5	45	0.14	0.19	0.18	0.14	–	–	–	6.3
5	4	6	6	6	10	36	0.14	0.18	0.18	0.14	–	–	–	6.3
5	4	6	6	6	15	35	0.14	0.23	0.24	0.14	–	–	–	6.3
5	4	6	6	6	20	35	0.17	0.30	0.31	0.14	–	–	–	6.3
5	4	6	6	6	25	35	0.21	0.37	0.38	0.14	–	–	–	6.3
5	4	6	6	6	30	35	0.25	0.44	0.45	0.14	–	–	–	6.3
5	5	8	7	6	< 2	–	0.19	0.35	0.26	0.14	0.19	0.19	0.17	7.8
5	5	6	6	6	2 < 3	45	0.14	0.29	0.24	0.14	–	–	–	6.9
5	5	6	6	6	3 - 5	45	0.14	0.21	0.20	0.14	–	–	–	6.9
5	5	6	6	6	10	45	0.14	0.19	0.20	0.14	–	–	–	6.9
5	5	6	6	6	15	36	0.14	0.24	0.25	0.14	–	–	–	6.9
5	5	6	6	6	20	35	0.15	0.31	0.32	0.14	–	–	–	6.9
5	5	6	6	6	25	35	0.18	0.38	0.39	0.14	–	–	–	6.9
5	5	6	6	6	30	35	0.21	0.46	0.47	0.14	–	–	–	6.9

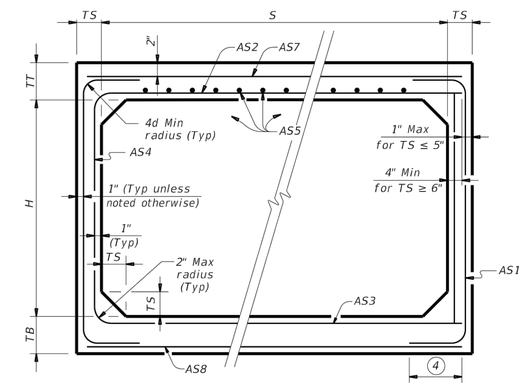
(1) For box length = 8'-0"

(2) AS1 thru AS4, AS7 and AS8 are minimum required areas of reinforcement per linear foot of box length. AS5 is minimum required area of reinforcement per linear foot of box width.



CORNER OPTION "A" CORNER OPTION "B"

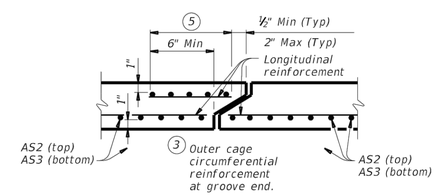
FILL HEIGHT 2 FT AND GREATER



CORNER OPTION "A" CORNER OPTION "B"

FILL HEIGHT LESS THAN 2 FT

(4) Length is equal to spacing of longitudinal reinforcing plus 2". (10" Min) (Typ)



SECTION A-A

(Showing top and bottom slab joint reinforcement.)

MATERIAL NOTES:

Provide 0.03 sq. in./ft. minimum longitudinal reinforcement at each face in slabs and walls. This minimum requirement may be met by the transverse wires when wire mesh reinforcement is used.

Provide Class H concrete (f'c = 5,000 psi).

GENERAL NOTES:

Designs shown conform to ASTM C1577. Refer to ASTM C1577 for information or details not shown.

See Box Culverts Precast Miscellaneous Details (SCP-MD) standard sheet for details and notes not shown.

In lieu of furnishing the designs shown on this sheet, the contractor may furnish an alternate design that is equal to or exceeds the box design for the design fill height in the table. Submit shop plans for alternate designs in accordance with Item "Precast Concrete Structural Members (Fabrication)".

HL93 LOADING

Texas Department of Transportation — Bridge Division Standard

SINGLE BOX CULVERTS PRECAST

5'-0" SPAN

SCP-5

FILE: scp05sts-20.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
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REVISIONS				
	DIST		COUNTY	SHEET NO.

STATE OF TEXAS — A.G.A.N. NANAYAKKARA — 115913 — LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SINGLE BOX CULVERT PRECAST
5'-0" SPAN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP34

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP19 SINGLE BOX CULVERT PRECAST 7 -0 SPAN.dwg May 27, 2020-10:43am Terra Associates Inc., Thanh Dao

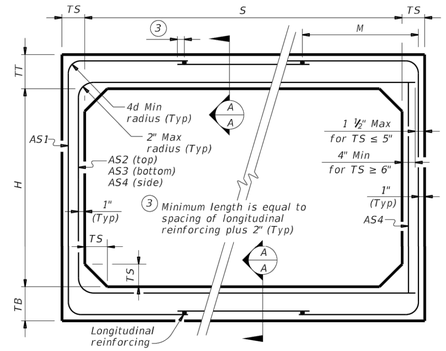
DISCLAIMER:
The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is assumed by TxDOT for any purpose whatsoever. TxDOT shall not be responsible for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

BOX DATA

SECTION DIMENSIONS S (ft.)	H (ft.)	TT (in.)	TB (in.)	TS (in.)	Fill Height (ft.)	M (Min) (in.)	REINFORCING (sq. in. / ft.) (2) AS1	AS2	AS3	AS4	AS5	AS7	AS8	(1) Lift Weight (tons)
7	3	8	8	8	< 2	-	0.23	0.31	0.22	0.19	0.19	0.19	0.19	9.6
7	3	8	8	8	2 < 3	47	0.27	0.25	0.24	0.19	-	-	-	9.6
7	3	8	8	8	3 - 5	43	0.19	0.19	0.19	0.19	-	-	-	9.6
7	3	8	8	8	10	43	0.21	0.20	0.21	0.19	-	-	-	9.6
7	3	8	8	8	15	43	0.28	0.26	0.27	0.19	-	-	-	9.6
7	3	8	8	8	20	43	0.36	0.34	0.35	0.19	-	-	-	9.6
7	3	8	8	8	25	43	0.45	0.42	0.43	0.19	-	-	-	9.6
7	3	8	8	8	30	43	0.54	0.50	0.51	0.19	-	-	-	9.6
7	4	8	8	8	< 2	-	0.21	0.34	0.25	0.19	0.19	0.19	0.19	10.4
7	4	8	8	8	2 < 3	43	0.23	0.28	0.28	0.19	-	-	-	10.4
7	4	8	8	8	3 - 5	43	0.19	0.22	0.19	0.19	-	-	-	10.4
7	4	8	8	8	10	43	0.19	0.23	0.23	0.19	-	-	-	10.4
7	4	8	8	8	15	41	0.24	0.30	0.30	0.19	-	-	-	10.4
7	4	8	8	8	20	41	0.31	0.38	0.39	0.19	-	-	-	10.4
7	4	8	8	8	25	41	0.38	0.47	0.48	0.19	-	-	-	10.4
7	4	8	8	8	30	41	0.46	0.57	0.57	0.19	-	-	-	10.4
7	5	8	8	8	< 2	-	0.19	0.36	0.27	0.19	0.19	0.19	0.19	11.2
7	5	8	8	8	2 < 3	47	0.21	0.31	0.31	0.19	-	-	-	11.2
7	5	8	8	8	3 - 5	43	0.19	0.24	0.21	0.19	-	-	-	11.2
7	5	8	8	8	10	43	0.19	0.25	0.26	0.19	-	-	-	11.2
7	5	8	8	8	15	41	0.21	0.32	0.33	0.19	-	-	-	11.2
7	5	8	8	8	20	41	0.27	0.41	0.42	0.19	-	-	-	11.2
7	5	8	8	8	25	41	0.33	0.51	0.52	0.19	-	-	-	11.2
7	5	8	8	8	30	41	0.40	0.61	0.62	0.19	-	-	-	11.2
7	6	8	8	8	< 2	-	0.19	0.38	0.30	0.19	0.19	0.19	0.19	12.0
7	6	8	8	8	2 < 3	59	0.19	0.33	0.34	0.19	-	-	-	12.0
7	6	8	8	8	3 - 5	47	0.19	0.25	0.23	0.19	-	-	-	12.0
7	6	8	8	8	10	43	0.19	0.26	0.27	0.19	-	-	-	12.0
7	6	8	8	8	15	41	0.19	0.34	0.35	0.19	-	-	-	12.0
7	6	8	8	8	20	41	0.24	0.43	0.45	0.19	-	-	-	12.0
7	6	8	8	8	25	41	0.29	0.53	0.55	0.19	-	-	-	12.0
7	6	8	8	8	30	41	0.35	0.64	0.65	0.19	-	-	-	12.0
7	7	8	8	8	< 2	-	0.19	0.40	0.33	0.19	0.19	0.19	0.19	12.8
7	7	8	8	8	2 < 3	59	0.19	0.36	0.37	0.19	-	-	-	12.8
7	7	8	8	8	3 - 5	59	0.19	0.27	0.25	0.19	-	-	-	12.8
7	7	8	8	8	10	47	0.19	0.27	0.29	0.19	-	-	-	12.8
7	7	8	8	8	15	43	0.19	0.35	0.37	0.19	-	-	-	12.8
7	7	8	8	8	20	43	0.22	0.44	0.46	0.19	-	-	-	12.8
7	7	8	8	8	25	43	0.27	0.54	0.57	0.19	-	-	-	12.8
7	7	8	8	8	30	41	0.32	0.65	0.67	0.19	-	-	-	12.8

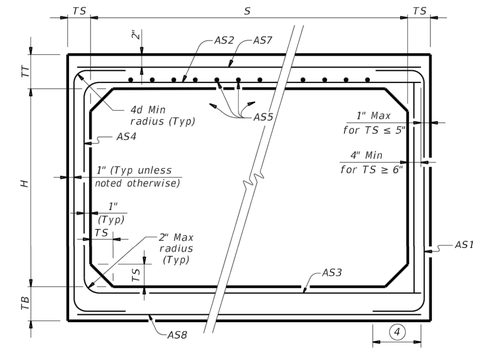
(1) For box length = 8'-0"

(2) AS1 thru AS4, AS7 and AS8 are minimum required areas of reinforcement per linear foot of box length. AS5 is minimum required area of reinforcement per linear foot of box width.



CORNER OPTION "A" CORNER OPTION "B"

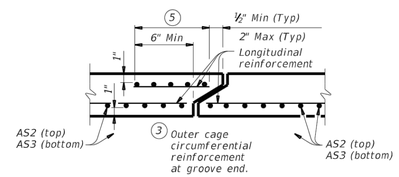
FILL HEIGHT 2 FT AND GREATER



CORNER OPTION "A" CORNER OPTION "B"

FILL HEIGHT LESS THAN 2 FT

(4) Length is equal to spacing of longitudinal reinforcing plus 2". (10" Min) (Typ)



SECTION A-A

(Showing top and bottom slab joint reinforcement.)

MATERIAL NOTES:

Provide 0.03 sq. in./ft. minimum longitudinal reinforcement at each face in slabs and walls. This minimum requirement may be met by the transverse wires when wire mesh reinforcement is used.

Provide Class H concrete (f'c = 5,000 psi).

GENERAL NOTES:

Designs shown conform to ASTM C1577. Refer to ASTM C1577 for information or details not shown.

See Box Culverts Precast Miscellaneous Details (SCP-MD) standard sheet for details and notes not shown.

In lieu of furnishing the designs shown on this sheet, the contractor may furnish an alternate design that is equal to or exceeds the box design for the design fill height in the table. Submit shop plans for alternate designs in accordance with Item "Precast Concrete Structural Members (Fabrication)".

HL93 LOADING

Texas Department of Transportation — Bridge Division Standard

SINGLE BOX CULVERTS PRECAST

7'-0" SPAN

SCP-7

FILE: scp07sts-20.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT February 2020	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST		COUNTY	SHEET NO.

STATE OF TEXAS — A.G.A.N. NANAYAKKARA — 115913 — LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SINGLE BOX CULVERT PRECAST
7' -0" SPAN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST - SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP35

DATE:
FILE:

TABLE OF DIMENSIONS AND REINFORCING STEEL
(Wings for one structure end)

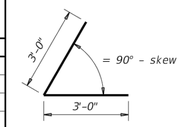
Dimensions					Variable Reinforcing				Estimated Quantities per ft of wing (2-wings) (4)		Estimated Quantities per ft of Toewall (1-toewall)	
Maximum Wingwall Height Hw	W	X	Y	Z	Bars J1		Bars J2					
					Size	Spa	Size	Spa	Reinf (Lb/Ft)	Conc (CY/Ft)	Reinf (Lb/Ft)	Conc (CY/Ft)
2'-6"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	48.64	0.406	6.85	0.071
2'-9"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	49.31	0.424	6.85	0.071
3'-0"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	49.98	0.444	6.85	0.071
3'-3"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	53.32	0.462	6.85	0.071
3'-6"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	53.98	0.480	6.85	0.071
4'-0"	3'-2"	1'-2"	1'-0"	7"	#4	1'-0"	#4	1'-0"	55.77	0.532	6.85	0.071
4'-6"	3'-2"	1'-2"	1'-0"	7"	#4	1'-0"	#4	1'-0"	59.77	0.568	6.85	0.071
5'-0"	3'-9"	1'-7"	1'-2"	7"	#4	1'-0"	#4	1'-0"	63.45	0.632	6.96	0.075
5'-6"	3'-9"	1'-7"	1'-2"	7"	#4	1'-0"	#4	1'-0"	67.46	0.668	6.96	0.075
6'-0"	4'-4"	2'-0"	1'-4"	7"	#5	1'-0"	#5	1'-0"	80.67	0.730	7.07	0.078
6'-6"	4'-4"	2'-0"	1'-4"	7"	#5	1'-0"	#5	1'-0"	85.05	0.768	7.07	0.078
7'-0"	5'-0"	2'-3"	1'-9"	8"	#5	1'-0"	#5	1'-0"	92.15	0.864	8.07	0.093
7'-6"	5'-0"	2'-3"	1'-9"	8"	#5	1'-0"	#5	1'-0"	96.54	0.902	8.07	0.093
8'-0"	5'-6"	2'-8"	1'-10"	8"	#5	6"	#5	6"	139.04	0.962	8.13	0.095
8'-6"	5'-6"	2'-8"	1'-10"	8"	#5	6"	#5	6"	144.47	1.000	8.13	0.095
9'-6"	6'-0"	2'-10"	2'-2"	9"	#5	6"	#5	6"	156.93	1.136	8.41	0.110
10'-6"	6'-5"	3'-0"	2'-5"	9"	#6	6"	#5	6"	196.27	1.234	8.57	0.117
11'-6"	7'-2"	3'-6"	2'-8"	11"	#6	6"	#6	6"	230.13	1.438	9.52	0.140
12'-6"	7'-8"	3'-9"	2'-11"	1'-0"	#7	6"	#6	6"	283.41	1.592	9.74	0.157
13'-6"	8'-2"	4'-0"	3'-2"	1'-2"	#8	6"	#6	6"	348.72	1.804	10.02	0.186
14'-6"	8'-10"	4'-5"	3'-5"	1'-4"	#9	6"	#6	6"	432.94	2.046	10.30	0.218
15'-6"	9'-6"	4'-10"	3'-8"	1'-6"	#9	6"	#7	6"	489.52	2.302	11.24	0.253
16'-0"	9'-11"	5'-0"	3'-11"	1'-7"	#9	6"	#7	6"	505.72	2.448	11.47	0.279

TABLE OF WINGWALL REINFORCING
(2-wings)

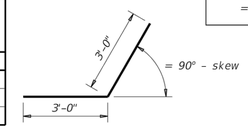
Bar	Size	No.	Spa
D1	#6	~	1'-0"
D2	#6	~	1'-0"
E1	#4	~	1'-0"
F	#4	~	1'-0"
G	#6	~	8"
M1	#4	4	~
P	#4	~	1'-0"
V	#4	~	1'-0"

TABLE OF TOEWALL REINFORCING

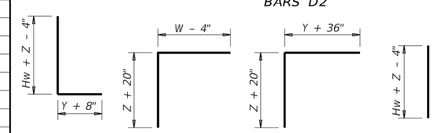
Bar	Size	No.	Spa
J3	#4	~	1'-0"
M2	#4	2	~
E2	#4	~	1'-0"



BARS D1



BARS D2



BARS J1 BARS J2 BARS J3 BARS V

WING DIMENSION FORMULAS:

(All values are in feet.)

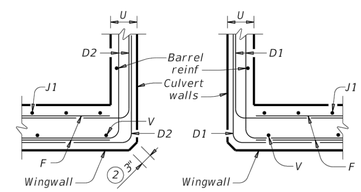
Hw = H + T + C
Lw = (Hw) (SL) ÷ cosine (θ) for Type PW-1
= (Hw - 1') (SL) ÷ cosine (θ) for Type PW-2 and Hw ≥ 4'
= (Hw - 0.5') (SL) ÷ cosine (θ) for Type PW-2 and Hw < 4'

For cast-in-place culverts:
Ltw = [(N) (S) + (N + 1) (U)] ÷ cosine (θ)

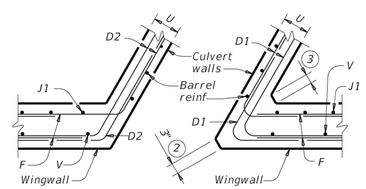
For precast culverts:
Ltw = [(N) (2 U + S) + (N - 1) (0.5')] ÷ cosine (θ)
Total Wingwall Area (two wings ~ SF)
= (2)(Hw)(Lw) for Type PW-1
= (2)(Hw)(Lw) - 6 SF for Type PW-2 and Hw ≥ 4'
= (2)(Hw)(Lw) - 1.5 SF for Type PW-2 and Hw < 4'

Hw = Height of wingwall
Lw = Length of wingwall
Ltw = Culvert toewall length
N = Number of culvert spans
SL:1 = Channel slope ratio. (horizontal: 1 vertical, usual value is 2:1)
θ = Culvert skew

See applicable box culvert standard sheet for S, H, T, and U values.



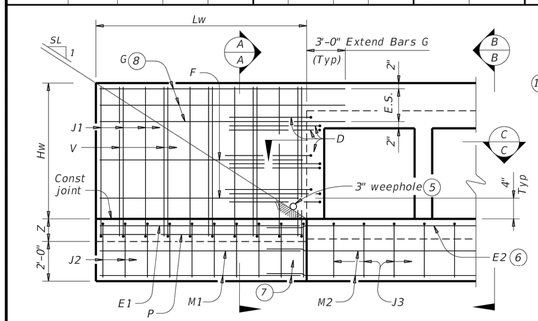
SECTION C-C - PW-1



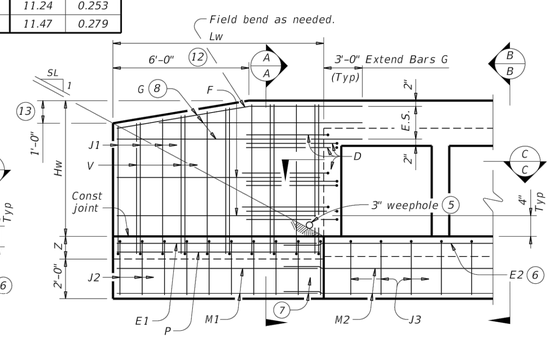
SECTION C-C - PW-2

1. Skew = 0°
2. At discharge end, chamfer may be ¾" minimum.
3. For 15° skew ~ 1"
   For 30° skew ~ 2"
   For 45° skew ~ 3"
4. Quantities shown are for two Type PW-1 wings. Adjust concrete volume for Type PW-2 wings. To determine estimated quantities for two wings, multiply the tabulated values by Lw. Quantities shown do not include weight of Bars D.
5. Provide weepholes for Hw = 5'-0" and greater. Fill around weepholes with coarse gravel.
6. Extend Bars E2 1'-6" minimum into the wingwall footing.
7. Lap Bars M1 1'-6" minimum with Bars M2.
8. Place Bars G as shown, equally spaced at 8" maximum. Provide at least two pairs of Bars G per wing.
9. 0" Min to 5'-0" Max. Estimated curb heights are shown elsewhere in the plans. For structures with pedestrian rail or curbs taller than 1'-0, refer to the Extended Curb Details (ECD) standard sheet. For structures with T631 or T631LS bridge rail, refer to the Mounting Details for T631 & T631LS Rails (T631-CM) standard sheet. Refer to the Box Culvert Rail Mounting Details (RAC) standard sheet for structures with bridge rail other than T631 or T631LS.
10. For vehicle safety, the following requirements must be met:
    - For structures without bridge rail, construct curbs no more than 3" above finished grade.
    - For structures with bridge rail, construct curbs flush with finished grade.

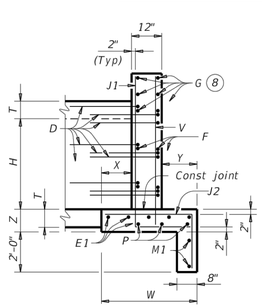
    Reduce curb heights, if necessary, to meet the above requirements. No changes will be made in quantities and no additional compensation will be allowed for this work.
11. 1'-0" typical. 2'-3" when the Box Culvert Rail Mounting Details (RAC) standard sheet is referred to elswhere in the plans.
12. 3'-0" for Hw < 4'.
13. 6" for Hw < 4'.



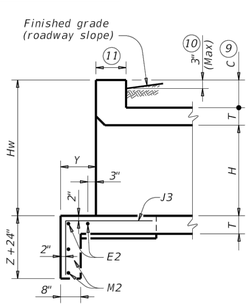
PARTIAL ELEVATION - PW-1



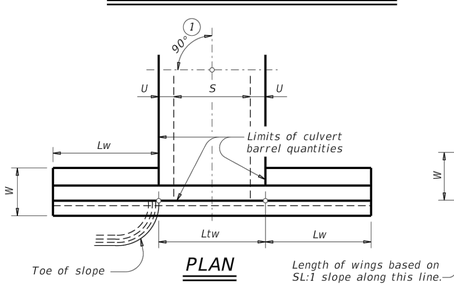
PARTIAL ELEVATION - PW-2



SECTION A-A
(Showing wing reinforcement.)

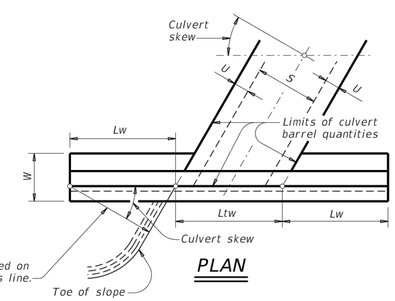


SECTION B-B
(Showing wing reinforcement.)



PLAN

DETAILS FOR NON-SKEWED BOX CULVERTS



PLAN

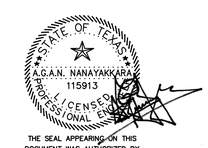
DETAILS FOR SKEWED BOX CULVERTS
(Showing 30° skew.)

DESIGNER NOTES:
Type PW-1 can be used for all applications and must be used if railing is to be mounted to the wingwall.
Type PW-2 can only be used for applications without a railing mounted to the wingwall.

MATERIAL NOTES:
Provide Class C concrete (f'c=3,600 psi).
Provide Grade 60 reinforcing steel.
Provide galvanized reinforing steel if required elsewhere in the plans.

GENERAL NOTES:
Designed in accordance with AASHTO LRFD Bridge Design Specifications.
Depth of toewalls for wingwalls and culverts may be reduced or eliminated when founded on solid rock, when directed by the Engineer.
See Box Culvert Supplement (BCS) standard sheet for wingwall type and additional dimensions and information.
Quantities for concrete and reinforcing steel resulting from the formulas given on this sheet are for the Contractor's information only.

Cover dimensions are clear dimensions, unless noted otherwise. Reinforcing dimensions are out-to-out of bars.



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ON MAY 27, 2020

Texas Department of Transportation — Bridge Division Standard

CONCRETE WINGWALLS
WITH PARALLEL WINGS FOR BOX CULVERTS TYPES PW-1 AND PW-2

PW

FILE: pwstde01-20.dgn	DN: GAF	CK: CAT	DW: TxDOT	CK: TxDOT
©TxDOT February 2020	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST		COUNTY	SHEET NO.

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

CONCRETE WINGWALLS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST - SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP36

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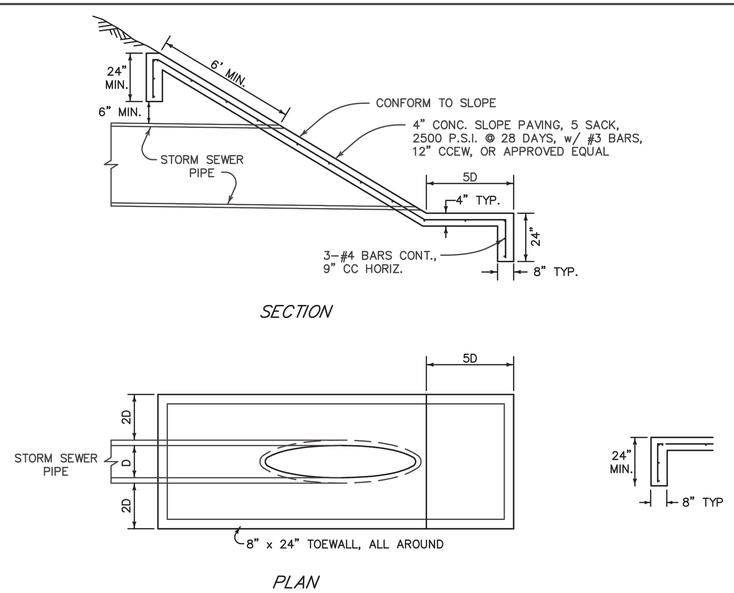
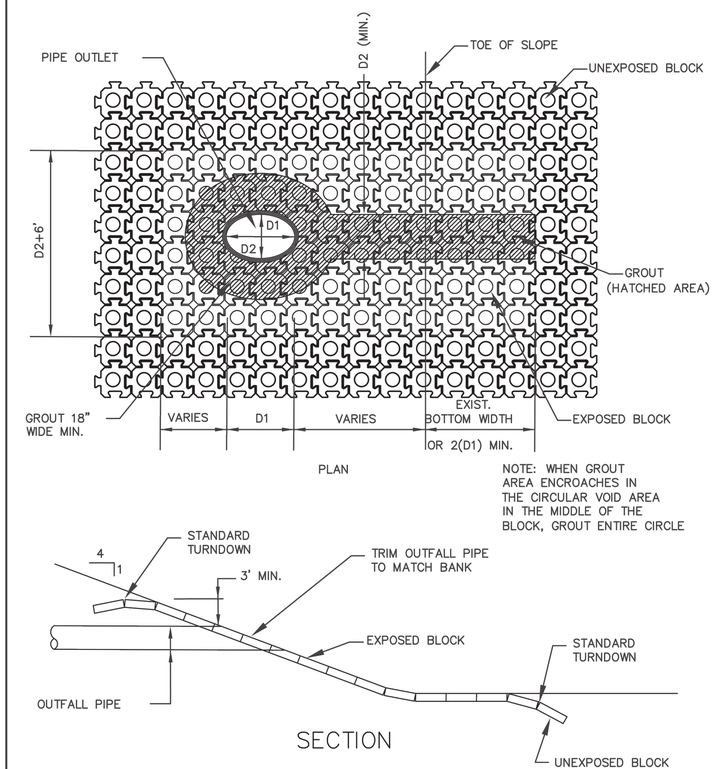
DATE:
FILE:

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP20 CONCRETE WINGWALLS.dwg May 27, 2020-10:43am Terra Associates Inc., Thanh Dao



DETAIL – TYPICAL STORM SEWER OUTFALL STRUCTURE

N.T.S.



DETAIL – PIPE OUTLET

N.T.S.

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

OUTFALL STRUCTURE DETAILS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP37

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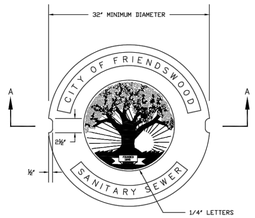
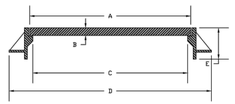


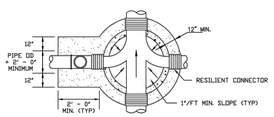
PLAN



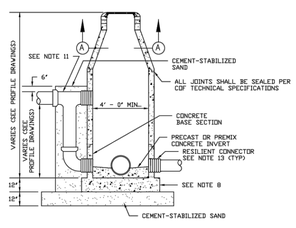
SECTION A–A

DIMENSIONS					
TYPE	A	B	C	D	E
H-2 INLET	23 3/8"	1 3/8"	22"	33 3/8"	6"
ALL OTHERS	32"	1 3/8"	30 3/8"	40"	6 1/2"

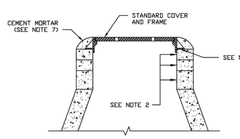
MANHOLE FRAME AND COVER



FOUNDATION PLAN



PROFILE VIEW



SECTION A

SANITARY SEWER MANHOLES

NOTES:

1. DEPTH OF MANHOLE DETERMINES SECTIONS REQUIRED.
2. PRECAST ADJUSTMENT RINGS SHALL BE PROVIDED FOR A COMBINED ADJUSTMENT HEIGHT OF AT LEAST TWELVE (12) INCHES. THE TOTAL HEIGHT OF ADJUSTMENT RINGS SHALL NOT EXCEED EIGHTEEN (18) INCHES.
3. MANHOLE WALL THICKNESS FOR DEPTHS EXCEEDING 12' - 0" SHALL BE DETERMINED TO MEET LOADING CONDITIONS. MINIMUM WALL THICKNESS SHALL BE FIVE (5) INCHES.
4. MANHOLE DROP AND INTERSECTING PIPES SHALL ONLY BE INSTALLED WHEN CALLED FOR IN THE PLAN AND PROFILE DRAWINGS.
5. SEAT MANHOLE FRAME IN SEALANT PER CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
6. ECCENTRIC PRECAST MANHOLE CONE MAY BE USED.
7. OMIT CEMENT MORTAR WHEN MANHOLE IS LOCATED IN PAVED AREAS. IN PAVED AREAS A BLOCKOUT SHALL BE SUPPLIED THAT IS TWO (2) FEET PAST THE OUTSIDE EDGE OF THE MANHOLE.
8. MINIMUM REINFORCING BARS IN THE BASE SHALL BE #5 @ 8" O.C.E.W. MINIMUM REINFORCING BARS IN MANHOLE, INCLUDING CONE, SHALL BE #4 @ 12" O.C.E.W.
9. PROVIDE BACKFILL TO MATCH ADJACENT PIPE TRENCH. BACKFILL PER CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
10. BRICK CONSTRUCTION SHALL NOT BE PERMITTED.
11. SANITARY SEWER DROP CONNECTION SHALL BE REQUIRED WHEN THE DIFFERENCE BETWEEN THE SANITARY SEWER FLOWLINE AND BOTTOM OF MANHOLE IS THIRTY (30) INCHES OR GREATER.
12. CONCRETE SHALL BE CLASS "A" CONCRETE WITH A DESIGN STRENGTH OF 4,000 PSI AT TWENTY-EIGHT (28) DAYS AND RATED FOR H-20 LOADING.
13. RESILIENT CONNECTOR SHALL BE RUBBER GASKETED SLEEVE AND STAINLESS STEEL CLAMP. RESILIENT CONNECTOR SHALL BE PER CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS AND SHALL BE WATERTIGHT.
14. PROVIDE SIX (6) INCH BASE EXTENSION FOR ALL MANHOLE DEPTHS GREATER THAN FIFTEEN (15) FEET AS MEASURED FROM INVERT FLOWLINE TO MANHOLE COVER.

SANITARY SEWER STANDARD DETAILS (MANHOLES)

FILE NAME: SSSD2 – 2017.DWG | DATE APPROVED: JULY 1, 2017 | SCALE: NTS | REVISED DATE: JUNE 2017

DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION

PROJECT NUMBER: | DATE SUBMITTED: | SHEET: XX OF XX

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SANITARY SEWER STANDARD DETAILS

TERRA ASSOCIATES, INC.
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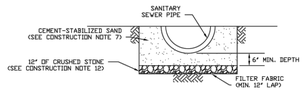
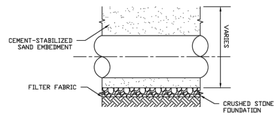
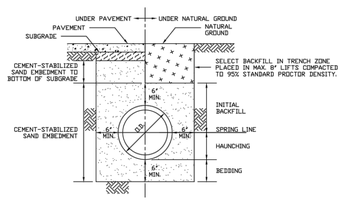


WET BEDDING CROSS-SECTION



WET BEDDING LONGITUDINAL-SECTION

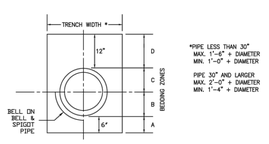


DRY STABLE TRENCH

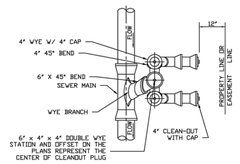
GRAVITY LINE BEDDING AND BACKFILL

BEDDING ZONE				
PIPE MATERIAL	A	B	C	D
CAST IRON	BS	BS	BS	EF
DUCTILE IRON (PRESSURE)	BS	BS	BS	EF
DUCTILE IRON (GRAVITY)	CS	CS	CS	EF
PVC (PRESSURE PIPE)	BS	BS	BS	EF
PVC (GRAVITY PIPE)	CS	CS	CS	EF
STEEL	BS	BS	BS	EF

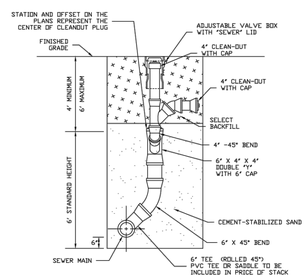
BS-BANK SAND
AB-AGGREGATE BEDDING (WET CONDITIONS ONLY)
ES-SELECT EARTH PLACED SAME DAY PIPE IS LAID
EF-EARTH FILL PLACED NEXT DAY (OR LATER) AFTER PIPE IS LAID
CS-CEMENT STABILIZED SAND



ORDINARY TRENCH EMBEDMENT & BACKFILL



PLAN VIEW

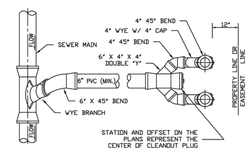


PROFILE VIEW

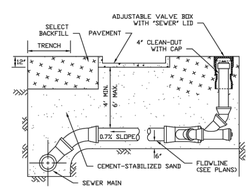
NEAR SIDE SERVICE CONNECTION

NOTES:

1. ONLY SDR26 PVC OR EQUIVALENT SHALL BE USED UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
2. USE SINGLE WYE BRANCH FOR SINGLE SERVICE AND DOUBLE WYE BRANCH FOR DOUBLE SERVICE.
3. MAIN STACKS SHALL BE A MINIMUM OF 6" IN DIAMETER.
4. ALL CONNECTIONS TO THE MAIN SANITARY SEWER SHALL BE APPROVED BY THE CITY OF FRIENDSWOOD UTILITIES DIVISION OF PUBLIC WORKS. SCHEDULE INSPECTIONS AT (281) 996-3380.
5. ALL SEWER LINES SHALL BE TESTED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS, LATEST REVISION.
6. INDIVIDUAL RESIDENTIAL CLEANOUTS SHALL BE 4" PVC.



PLAN VIEW



PROFILE VIEW

FAR SIDE SERVICE CONNECTION

NOTES:

1. ONLY SDR26 PVC OR EQUIVALENT SHALL BE USED UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
2. USE SINGLE WYE BRANCH FOR SINGLE SERVICE AND DOUBLE WYE BRANCH FOR DOUBLE SERVICE.
3. ALL CONNECTIONS TO THE MAIN SANITARY SEWER SHALL BE APPROVED BY THE CITY OF FRIENDSWOOD UTILITIES DIVISION OF PUBLIC WORKS. SCHEDULE INSPECTIONS AT (281) 996-3380.
4. ALL SEWER LINES SHALL BE TESTED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS, LATEST REVISION.
5. INDIVIDUAL RESIDENTIAL CLEANOUTS SHALL BE 4" PVC.

SANITARY SEWER SYSTEM CONSTRUCTION NOTES

1. FINISHED ELEVATION ON SANITARY MANHOLE RIMS SHALL BE THREE (3) INCHES ABOVE FINISHED GRADE IN UTILITY EASEMENTS. IF THE MANHOLE IS LOCATED ADJACENT TO A PUBLIC STREET, THE FINAL ELEVATION SHALL BE TWO (2) INCHES ABOVE THE TOP OF THE CURB OR TWO (2) INCHES ABOVE THE CENTERLINE OF THE STREET FOR STREETS WITH NO PERIMETER CURB (TOP OF CURB SHOULD EQUAL CENTERLINE OF STREET).
2. WATER LINES AND SANITARY SEWER LINES SHALL BE INSTALLED IN SEPARATE TRENCHES, PER ITEM EIGHT (8) BELOW.
3. ALL PROPOSED SANITARY SEWER LINES SHALL BE DUCTILE IRON OR PVC. PVC PIPE SHALL CONFORM TO ASTM D3034, SDR 26 FOR ALL DEPTHS.
4. ALL PVC PIPE (ALL TYPES SDR/DR WALL THICKNESS TO BE USED) SHALL HAVE RUBBER GASKET EQUIPPED BELL AND SPIGOT JOINTS CONFORMING TO ASTM D212. THE GASKET MATERIAL SHALL CONFORM TO ASTM F477. SOLVENT WELDED JOINTS WILL NOT BE APPROVED FOR CITY SANITARY SEWER LINES.
5. ALL DUCTILE IRON PIPE SHALL BE 150 PSI WITH EIGHT (8) MIL BLACK VIRGIN POLYETHYLENE WRAP AS SPECIFIED IN ANSI A21.5/AWWA C105.
6. SANITARY SEWER MATERIALS AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD DESIGN STANDARDS AND TECHNICAL SPECIFICATIONS, LATEST REVISION. CONTRACTOR TO FURNISH TEST PLUGS AND RISERS. ALL SANITARY SEWER LINES TO BE AIR TESTED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
7. SANITARY SEWER TRENCHES WITHIN OR UNDER ONE (1) FOOT OF PROPOSED OR FUTURE PAVEMENT TO BE BACKFILLED WITH CEMENT-STABILIZED SAND BACKFILL (1.1 SACKS OF CEMENT PER TON OF SAND) TO THE BOTTOM OF THE SUBGRADE. BEDDING, HAUNCHING, AND INITIAL FILL SHALL BE CEMENT-STABILIZED SAND FOR GRAVITY SANITARY SEWERS AND BANK SAND FOR FORCE MAIN SANITARY SEWERS.
8. WATER LINE/NEW SANITARY SEWER LINE SEPARATION. WHEN NEW SANITARY SEWERS ARE INSTALLED, THEY SHALL BE INSTALLED NO CLOSER THAN NINE (9) FEET IN ALL DIRECTIONS. SANITARY SEWERS THAT PARALLEL WATER LINES SHALL BE INSTALLED IN SEPARATE TRENCHES. WHEN NINE (9) FEET OF SEPARATION CANNOT BE MAINTAINED, THEN THE FOLLOWING GUIDELINES APPLY:
   - 8.1. WHEN THE SANITARY SEWER PARALLELS A WATER LINE, THE SANITARY SEWER SHALL BE CONSTRUCTED OF CAST IRON OR PVC MEETING ASTM SPECIFICATIONS WITH THE PRESSURE RATING FOR BOTH THE PIPE AND JOINTS OF 150 PSI. THE VERTICAL SEPARATION SHALL BE A MINIMUM OF TWO (2) FEET BETWEEN THE OUTSIDE DIAMETERS OF THE PIPE AND THE HORIZONTAL SEPARATION SHALL BE A MINIMUM OF FOUR (4) FEET BETWEEN THE OUTSIDE DIAMETERS OF THE PIPE. THE SANITARY SEWER LINE SHALL BE LOCATED BELOW THE WATER LINE.
   - 8.2. WHEN A SANITARY SEWER CROSSES A WATER LINE AND THE SANITARY SEWER LINE IS CONSTRUCTED OF CAST IRON, DUCTILE IRON OR PVC WITH A MINIMUM PRESSURE RATING OF 150 PSI; AN ABSOLUTE MINIMUM DISTANCE OF SIX (6) INCHES BETWEEN THE OUTSIDE DIAMETERS SHALL BE MAINTAINED. THE SANITARY SEWER LINE SHALL BE LOCATED BELOW THE WATERLINE WHEN POSSIBLE AND ONE (1) LENGTH OF THE SANITARY SEWER PIPE SHALL BE CENTERED ON THE WATER LINE.
   - 8.3. WHEN A SANITARY SEWER LINE CROSSES UNDER A WATER LINE AND THE SANITARY SEWER IS CONSTRUCTED OF ABS TRUSS PIPE, SIMILAR SEMI-RIGID PLASTIC COMPOSITE PIPE, CLAY PIPE OR CONCRETE PIPE WITH GASKETED JOINTS, A MINIMUM OF TWO (2) FEET OF SEPARATION SHALL BE MAINTAINED. THE INITIAL BACKFILL SHALL BE CEMENT-STABILIZED SAND (1.1 SACKS OF CONCRETE PER 1 TON OF SAND) FOR ALL SECTIONS OF SANITARY SEWER WITHIN NINE (9) FEET OF THE WATER LINE. THIS INITIAL BACKFILL SHALL BE FROM ONE QUARTER (¼) DIAMETER BELOW THE CENTERLINE OF THE PIPE TO ONE (1) PIPE DIAMETER, BUT NOT LESS THAN TWELVE (12) INCHES ABOVE THE TOP OF PIPE.
   - 8.4. WHEN A SANITARY SEWER CROSSES OVER A WATER LINE, ALL PORTIONS OF THE SANITARY SEWER WITHIN NINE (9) FEET OF THE WATER LINE SHALL BE CONSTRUCTED OF CAST IRON, DUCTILE IRON, OR PVC PIPE WITH A PRESSURE RATING OF AT LEAST 150 PSI USING APPROPRIATE ADAPTERS. IN LIEU OF THIS PROCEDURE THE NEW SANITARY SEWER MAY BE ENCASED IN A JOINT OF 150 PSI CLASS PIPE AT LEAST EIGHTEEN (18) FEET LONG AND A MINIMUM OF TWO (2) NOMINAL SIZES LARGER THAN THE NEW SANITARY SEWER. THE SPACE AROUND THE CARRIER PIPE SHALL BE SUPPORTED AT INTERVALS OF FIVE (5) FEET WITH SPACERS OR BE FILLED TO THE SPRING LINE WITH WASHED SAND. THE ENCASEMENT PIPE SHOULD BE CENTERED ON THE CROSSING AND BOTH ENDS SEALED WITH CEMENT GROUT OR WITH AN APPROVED MANUFACTURER SEAL.
9. FOR ALL PVC PIPE, USE MANHOLE WATER STOP GASKET AND CLAMP ASSEMBLY AT MANHOLE CONNECTIONS. CLAMP SHALL BE STAINLESS STEEL MATERIAL.
10. SANITARY SEWER MANHOLES SHALL BE STANDARD TYPE, UNLESS OTHERWISE NOTED. TOP OF RIMS OF ALL SANITARY SEWER MANHOLES SHALL BE AT OR ABOVE THE 100-YEAR BASE FLOOD ELEVATION AND HAVE INFLOW PROTECTORS UNDER THE COVERS. FOR MANHOLES LOCATED IN THE 100-YEAR FLOOD PLAIN, VENT AND SEAL THE MANHOLE COVERS. SECTIONS OF PRECAST MANHOLES SHALL BE JOINED WITH "RAM NEK" GASKET MATERIAL OR AS APPROVED BY THE CITY OF FRIENDSWOOD.
11. SANITARY SEWER LINES LOCATED IN OTHER AREAS NOT SPECIFIED IN ITEM 7 SHALL BE BACKFILLED ABOVE THE INITIAL BACKFILL WITH CEMENT-STABILIZED SAND OR SELECT BACKFILL MATERIAL WITH A PI BETWEEN TWENTY (20) AND FORTY (40).
12. IF WET SAND IS ENCOUNTERED IN THE FIELD, USE SPECIAL BEDDING.
13. SANITARY SEWERS CROSSING UTILITIES OTHER THAN WATER SHALL HAVE A MINIMUM CLEARANCE OF SIX (6) INCHES (ADDRESSED IN CITY OF FRIENDSWOOD TECHNICAL SPECIFICATION 02125 – EXCAVATION AND BACKFILL FOR UTILITIES).
14. ALL PRECAST CONCRETE MANHOLES SHALL HAVE THE TOP ADJUSTMENT CONSTRUCTED OF PRECAST PCC RINGS, SEALED WITH NON-SHRINK GROUT INSIDE AND OUTSIDE, AND BETWEEN EACH SECTION AND MANHOLE COVERS.
15. ALL SANITARY SEWER MANHOLE COVERS SHALL INCLUDE THE WORDS "SANITARY SEWER" AND "CITY OF FRIENDSWOOD" AND INCLUDE THE CITY OF FRIENDSWOOD SEAL. ALL MANHOLE COVERS SHALL HAVE A MINIMUM DIAMETER OF THIRTY-TWO (32) INCHES, AS SHOWN IN THE DETAIL ON THIS SHEET.
16. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING LOCATION OF ALL EXISTING UTILITIES PRIOR TO EXCAVATION. DURING THE COURSE OF ANY AND ALL CLEARING, GRUBBING, FILL, GRADING, EXCAVATION OR OTHER CONSTRUCTION, CONTRACTOR SHALL ENSURE THAT STORM SEWER DRAINAGE PATHWAYS ARE MAINTAINED AND REMAIN OPEN TO ENSURE POSITIVE DRAINAGE AND THAT SUCH CONVEYANCES ARE NOT IMPEDED OR BLOCKED IN ANY WAY. STORM SEWER INLETS SHALL BE PROTECTED FROM ENTRY OF SILT, TRASH, DEBRIS AND ANY SUBSTANCES DELETERIOUS TO THE STORM SEWER SYSTEM AND/OR WATERWAYS RECEIVING STORM WATER RUNOFF. CONTRACTOR SHALL, AT COMPLETION OF WORK, FILL LOW SPOTS AND GRADE ALL RIGHTS-OF WAY AND UTILITY EASEMENTS AND RE-GRADE/RESTORE DITCHES AS NECESSARY TO MAINTAIN AND/OR ESTABLISH POSITIVE DRAINAGE.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SANITARY SEWER STANDARD DETAILS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP39

SANITARY SEWER STANDARD DETAILS

FILE NAME: SSSD1 – 2017.DWG
DATE APPROVED: JULY 1, 2017
SCALE: NTS
REVISED DATE: JUNE 2017

FRIENDSWOOD TEXAS

DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION

PROJECT NUMBER:
DATE SUBMITTED:
SHEET: XX OF XX

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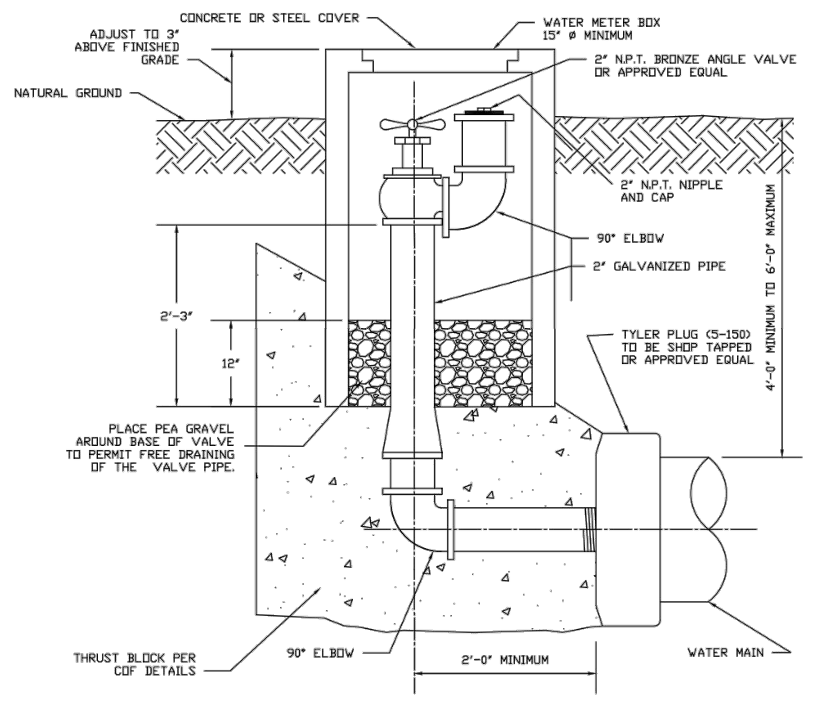
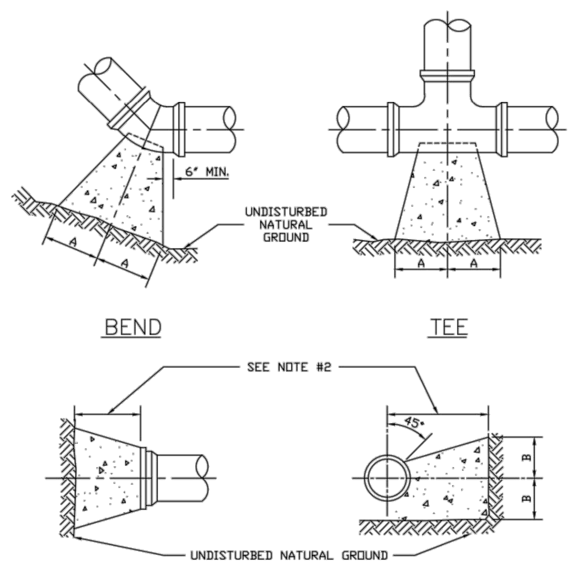
F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP24 WTR_DTLS.dwg May 27, 2020-10:43am Terra Associates Inc., Thanh Dao



BLOW-OFF VALVE ASSEMBLY

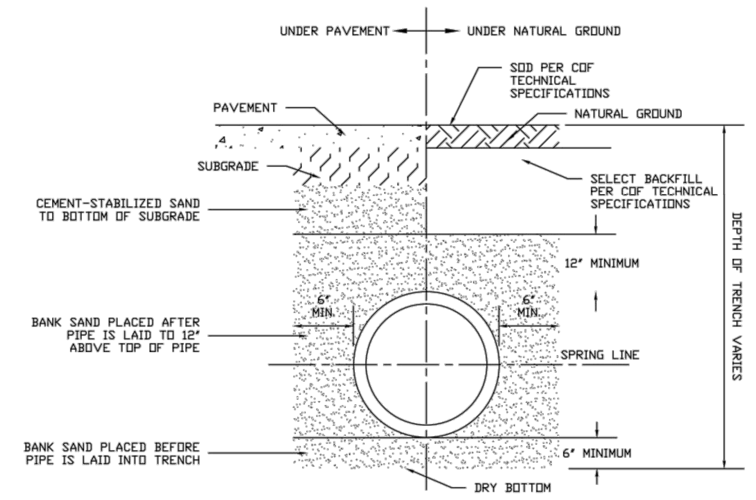
SIZE	90° BEND		45° BEND		22 ½° BEND		TEES		PLUGS	
	A	B	A	B	A	B	A	B	A	B
4"	10"	7"	6"	7"	3"	7"	7"	7"	10"	20"
6"	15"	10"	8"	10"	6"	8"	10"	12"	10"	21"
8"	22"	13"	12"	13"	8"	10"	13"	16"	12"	28"
10"	28"	17"	14"	17"	10"	15"	16"	20"	14"	30"
12"	29"	21"	16"	21"	11"	18"	18"	24"	16"	41"
14"	35"	24"	18"	24"	12"	20"	22"	27"	18"	45"
16"	38"	27"	21"	27"	12"	24"	24"	30"	20"	54"



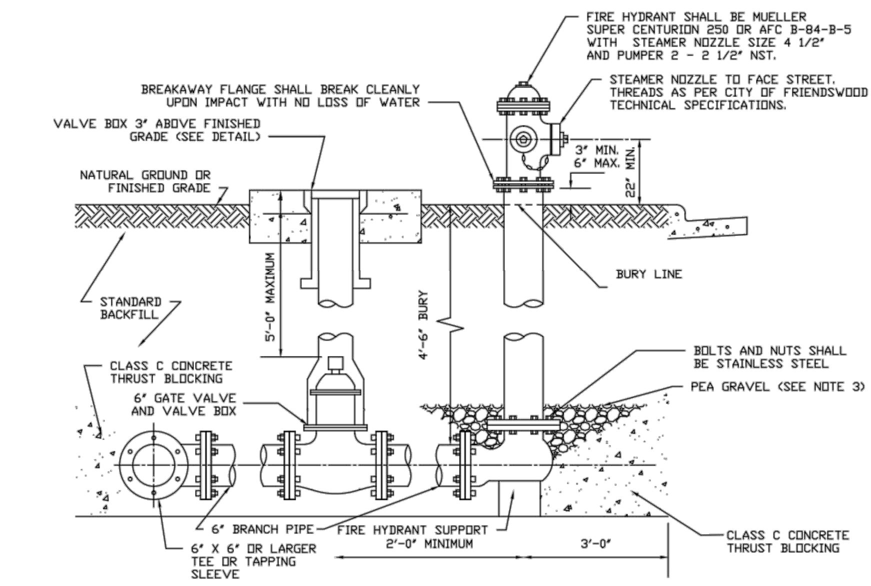
THRUST BLOCK

NOTES:

1. THRUST BLOCKS AT TRENCH FACE SHALL HAVE A MINIMUM BEARING SURFACE OF 10 SF AND THE LEAST DIMENSION SHALL BE NO SMALLER THAN 1.5 TIMES PIPE DIAMETER.
2. FROM THE BACK OF PIPE TO THE TRENCH WALL SHALL BE A MINIMUM OF 18" FOR PIPE DIAMETERS OF 10 INCHES AND LESS, AND A MINIMUM OF 24" FOR PIPE DIAMETERS OF 12 INCHES OR GREATER.
3. ALL CONCRETE SHALL BE CLASS "C", 2,500 PSI AS PER CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.

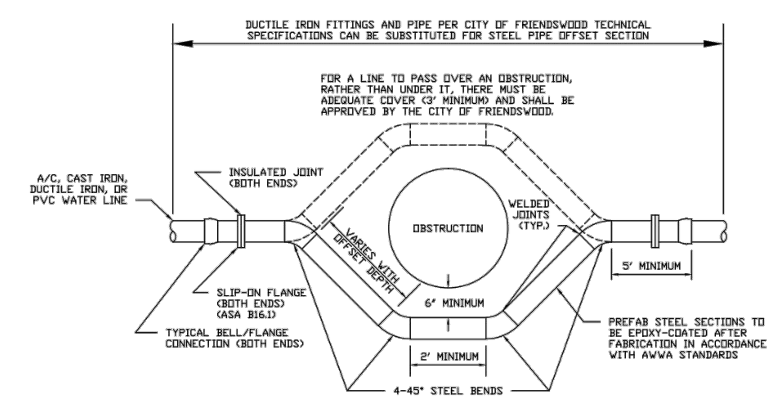


BEDDING AND BACKFILL



FIRE HYDRANT ASSEMBLY

1. RESTRAINED JOINTS SHALL BE USED (SEE FITTING ANCHOR DETAIL).
2. FIRE HYDRANTS SHALL BE AUDITED AND PAINTED ACCORDING TO THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
3. FILL PEA GRAVEL TO A MINIMUM DEPTH OF 6" OVER TOP OF FLANGE.

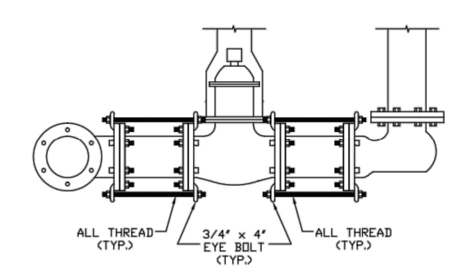


MINIMUM WALL THICKNESS FOR PIPE AND FITTINGS	
4"	0.250"
6"	0.280"
8"	0.322"
≥ 12"	0.375"

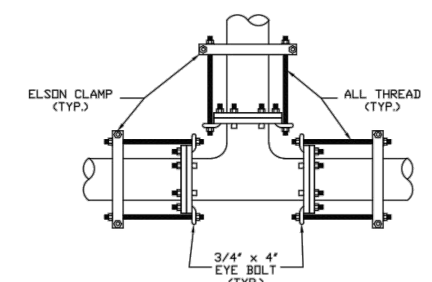
TYPICAL STEEL SECTION FITTINGS	
QTY.	DESCRIPTION
4	Ø" X 45° STEEL BENDS
2	Ø" BELL-FLANGE ADAPTERS
2	Ø" SLIP-ON FLANGES 150#
2	Ø" INSULATED JOINT KITS

STEEL PIPE OFFSET SECTION

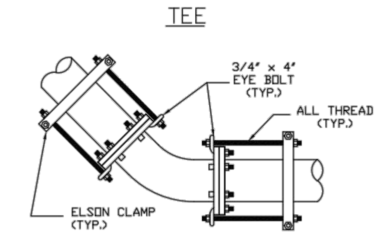
1. ALL MATERIALS AND COATINGS SHALL BE IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
2. RESTRAIN EXISTING PIPING BEYOND STEEL SECTION AS REQUIRED TO PREVENT MOVEMENT.
3. INSULATED JOINT SHALL BE MADE UP USING INSULATING GASKETS, PLASTIC BOLT SLEEVES AND WASHERS OF INSULATING GASKET MATERIAL BACKED WITH STAINLESS STEEL WASHERS OR OTHER METHODS APPROVED BY THE CITY ENGINEER.
4. NO FIELD FABRICATION OR INTERIOR COATING OF STEEL WATER PIPE OFFSETS ALLOWED.



FIRE HYDRANT ASSEMBLY



TEE

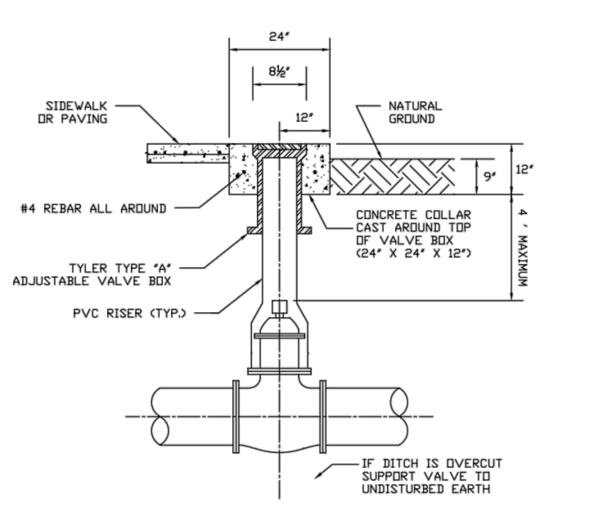


BEND

FITTING ANCHORS

NOTES:

1. MEGA-LUGS MAY BE USED IN PLACE OF ELSON CLAMPS AND ALL THREAD TO RESTRAIN JOINTS.
2. ALL NUTS, WASHERS AND ALL THREAD SHALL BE STAINLESS STEEL.



VALVE BOX INSTALLATION

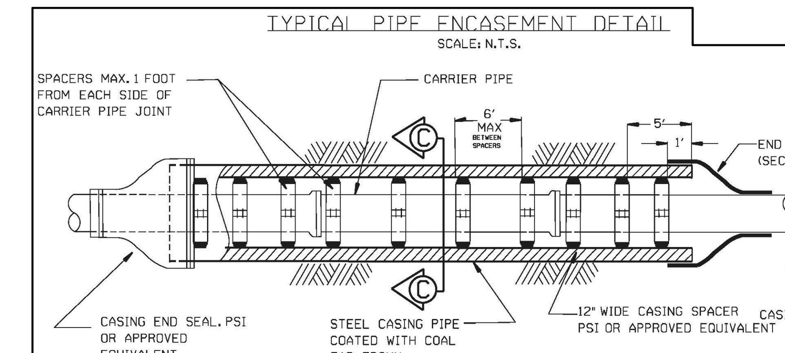
ALL FLUSHING AND GATE VALVES TO BE MECHANICAL JOINT AWWA STANDARD COUNTER-CLOCKWISE OPENING WITH RESILIENT SEATS.

WATER LINE CONSTRUCTION NOTES

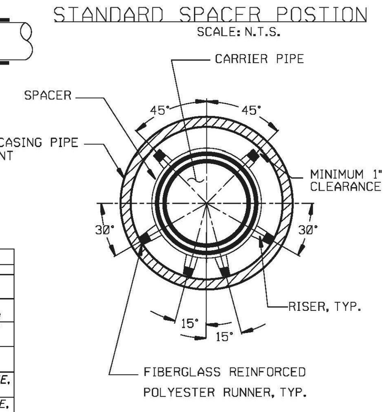
1. WATER LINE CONSTRUCTION AND TESTING SHALL BE PERFORMED IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
2. ALL WATER MAINS SHALL HAVE A MINIMUM OF FORTY-EIGHT (48) INCHES OF COVER MEASURED FROM CENTERLINE OF STREET OR EXISTING NATURAL GROUND, WHICHEVER DEPTH IS GREATER, UNLESS OTHERWISE NOTED.
3. HYDROSTATIC TESTING FOR MAIN DISTRIBUTION AND DOMESTIC SERVICES LINES SHALL BE AT ONE HUNDRED AND FIFTY (150) PSI FOR FOUR (4) HOURS AND SHALL BE WITNESSED BY COMMUNITY DEVELOPMENT PROJECT MANAGER (SECTION 01475 – TESTING PROCEDURES).
4. SINGLE METER SERVICE LINES SHALL BE ONE (1) INCH MINIMUM I.D., C.T.S, POLYETHYLENE, SDR-9.
5. CONTRACTOR TO FURNISH AND INSTALL SINGLE SERVICE METER BOXES AT FINISHED GRADE.
6. FIRE HYDRANT ASSEMBLIES SHALL INCLUDE ONE (1) EACH LINE SIZE BY SIX (6) INCH TEE, ONE (1) EACH SIX (6) INCH GATE VALVE AND ADJUSTABLE BOX, ONE (1) EACH FIRE HYDRANT WITH SIX (6) INCH LEAD PIPING AND TIE BACKS.
7. WATER VALVES ON MAIN LINES SHALL BE LOCATED AS CLOSE AS POSSIBLE TO EXTENDED PROPERTY LINE AND SHALL CONFORM TO AWWA C500, OPEN LEFT (COUNTERCLOCKWISE), EQUIPPED WITH TWO (2) INCH SQUARE OPERATING NUT.
8. WATER LINES FOUR (4) INCH THROUGH TWELVE (12) INCH I.D. SHALL COMPLY WITH ALL THE REQUIREMENTS OF AWWA STANDARD C900-75 CLASS 150, SDR-18 PVC, WHICH HAS AN OUTSIDE DIAMETER EQUAL TO CAST IRON PIPE OF THE SAME INSIDE DIAMETER, WITH GASKET BELL END.
9. ALL CONCRETE THRUST BLOCKING SHALL BE PLACED TO FORM A SOLID CONNECTION BETWEEN FITTINGS, VALVES, FIRE HYDRANTS AND UNDISTURBED EARTH. CONCRETE THRUST BLOCKING SHALL BE CLASS "C" CONCRETE WITH A MINIMUM OF 2,500 PSI COMPRESSIVE STRENGTH AFTER TWENTY-EIGHT (28) DAYS. ALL BOLTS AND NUTS AT FITTINGS AND FIRE HYDRANTS SHALL BE COVERED WITH PLASTIC BEFORE THRUST BLOCK IS PLACED.
10. GRAY IRON AND DUCTILE IRON FITTINGS SHALL CONFORM TO AWWA C110 AND END JOINTS OF FITTINGS AND MAIN VALVES SHALL CONFORM TO AWWA C110. ALL FITTINGS SHALL BE MECHANICAL JOINTS, CEMENT LINED OR EPOXY COATED.
11. MINIMUM BURY FOR ALL FIRE HYDRANT LEADS SHALL BE FOUR (4) FEET UNLESS OTHERWISE NOTED. ALL FIRE HYDRANTS AND VALVE BOXES ARE TO BE ADJUSTED TO FINISH GRADE AFTER PAVING IS COMPLETE.
12. INSTALL CONCRETE BLOCK BENEATH FIRE HYDRANT LEADS BEFORE PLACING CONCRETE THRUST BLOCKING TO INSURE THAT FIRE HYDRANTS ARE INSTALLED LEVEL.
13. CONTRACTOR SHALL CONTACT THE CITY'S PROJECT MANAGER A MINIMUM OF SEVENTY-TWO (72) HOURS PRIOR TO START OF CONSTRUCTION.
14. ALL WATER LINE TRENCHES TO BE BACKFILLED TO ONE (1) FOOT ABOVE TOP OF PIPE WITH BANK SAND. TRENCHES UNDER OR WITHIN ONE (1) FOOT OF PROPOSED OR FUTURE PAVEMENT, BACKFILL FROM TOP OF BANK SAND TO BOTTOM OF PROPOSED SUBGRADE UNDER PAVEMENT WITH CEMENT STABILIZED SAND (1.1 SACKS OF CEMENT PER TON OF SAND).
15. ALL FIRE HYDRANTS ARE TO BE LOCATED AS SHOWN ON THE PLANS AND SET THREE (3) FEET BEHIND THE CURB OR AT APPROVED LOCATION ON RURAL ROADS. ALL FIRE HYDRANTS SHALL BE AUDITED AND PAINTED AS PER CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS.
16. ALL TAPPING SLEEVES SHALL BE STAINLESS STEEL FULL CIRCLE WITH MECHANICAL JOINT TAPPING SLEEVE.
17. THE CONTRACTOR SHALL NOT OPERATE EXISTING CITY WATER VALVES. THE CONTRACTOR SHALL NOTIFY THE PROJECT MANAGER A MINIMUM OF TWENTY-FOUR (24) HOURS PRIOR TO ANY VALVE OPERATION NECESSARY FOR THE PROJECT. IF ANY VALVE CLOSING WILL RESULT IN INTERRUPTED SERVICE TO RESIDENTS OR BUSINESSES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING PROPER NOTICE TO THE AFFECTED PARTIES.
18. FOR ALL CONSTRUCTION WATER USAGE ON THE PROJECT, A FIRE HYDRANT METER SHALL BE OBTAINED FROM THE CITY AT THE PUBLIC WORKS DEPARTMENT AT 1306 DEEPWOOD DRIVE (281-996-3382). A DEPOSIT SHALL BE REQUIRED FOR THE METER AND A FEE SHALL BE CHARGED FOR ALL METERED WATER USAGE. THE CONTRACTOR SHALL SUPPLY A BACKFLOW PREVENTER FOR THE FIRE HYDRANT METER.
19. ALL SPRINKLER AND IRRIGATION LINES SHALL BE EQUIPPED WITH A BACKFLOW PREVENTION DEVICE ACCORDING TO IT'S APPLICATION AS REQUIRED BY TCEQ.
20. BLUE REFLECTORIZED PAVEMENT MARKERS SHALL BE PLACED ADJACENT TO THE FIRE HYDRANTS AND AT A POINT OFFSET SIX (6) INCHES FROM THE CENTERLINE OF THE ROADWAY (REFLECTOR SURFACES TO FACE TRAFFIC FLOW).
21. BACKFLOW PREVENTERS SHALL BE INSTALLED INSIDE THE BUILDING.
22. WHERE THE FIRE LINE EXCEEDS SIXTY (60) FEET FROM THE TAP TO THE RISER, THE BACKFLOW PREVENTER SHALL BE INSTALLED IN A VAULT AT THE PROPERTY LINE.
23. CONTROL VALVES FOR FIRE SPRINKLER SYSTEMS SHALL BE INSTALLED INSIDE THE BUILDING.
24. ALL VALVES CONTROLLING THE WATER SUPPLY FOR AN AUTOMATIC SPRINKLER SYSTEM SHALL BE ELECTRICALLY SUPERVISED AT THE FIRE ALARM PANEL.
25. ALL PUMPS, TANKS, WATER LEVELS AND TEMPERATURES, CRITICAL AIR PRESSURES, AND WATER-FLOW SYSTEMS ON ALL SPRINKLER SYSTEMS SHALL BE SUPERVISED AT THE FIRE ALARM CONTROL PANEL.
26. RISER ROOM FOR THE SPRINKLER SYSTEM SHALL HAVE ACCESS FROM THE EXTERIOR OF THE BUILDING OR FROM A COMMON SPACE IN THE BUILDING. AT NO TIME SHALL AN ACCESS TO A RISER ROOM BE WITHIN A TENANT SPACE UNLESS THE BUILDING IS OCCUPIED BY A SINGLE TENANT.
27. THE FIRE DEPARTMENT CONNECTION (FDC) SHALL BE LOCATED AWAY FROM THE BUILDING AT LEAST ONE AND ONE-HALF (1½) TIMES THE HEIGHT OF THE BUILDING.
28. THE FDC SHALL BE ON THE STREET SIDE OF THE BUILDING.
29. THE FDC SHALL HAVE KNOX BOX LOCKING FDC CAPS.
30. A FIRE HYDRANT SHALL BE LOCATED WITHIN ONE HUNDRED (100) FEET OF THE FDC.
31. INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES SHALL BE INSTALLED IN ACCORDANCE WITH IFC 2003 AND NFPA 24.
32. FIRE SERVICE LINES SHALL BE TESTED AT TWO HUNDRED (200) PSI FOR TWO (2) HOURS AND SHALL BE WITNESSED BY THE CITY FIRE MARSHAL.
33. WORKING PLANS SHALL BE SUBMITTED FOR APPROVAL BY THE CITY FIRE MARSHAL.
34. WORKING PLANS SHALL BE APPROVED, INSPECTED, AND TESTED BY THE CITY FIRE MARSHAL BEFORE THE BUILDING CAN BE OCCUPIED.
35. ALL VALVE OPERATING NUTS SHALL BE A MAXIMUM OF FOUR (4) FEET FROM TOP OF THE VALVE BOX. ANY EXTENSIONS REQUIRED TO ACHIEVE THE MAXIMUM LENGTH SHALL BE SUPPLIED BY THE CONTRACTOR AND ARE INCIDENTAL TO THE WORK.
36. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO EXCAVATION. DURING THE COURSE OF ANY AND ALL CLEARING, GRUBBING, FILL, GRADING, EXCAVATION OR OTHER CONSTRUCTION, CONTRACTOR SHALL ENSURE THAT STORM DRAINAGE PATHWAYS ARE MAINTAINED AND REMAIN OPEN TO ENSURE POSITIVE DRAINAGE AND THAT SUCH CONVEYANCES ARE NOT IMPEDED OR BLOCKED IN ANY WAY. STORM SEWER INLETS SHALL BE PROTECTED FROM ENTRY OF SILT, TRASH, DEBRIS, AND ANY SUBSTANCES DETERIOUS TO THE STORM SEWER SYSTEM AND/OR WATERWAYS RECEIVING STORM WATER RUNOFF. CONTRACTOR SHALL, AT COMPLETION OF WORK, FILL LOW SPOTS AND GRADE ALL RIGHTS-OF-WAY AND UTILITY EASEMENTS AND REGRADE/RESTORE DITCHES NECESSARY TO MAINTAIN AND/OR ESTABLISH POSITIVE DRAINAGE.

WATER DISTRIBUTION STANDARD DETAILS		DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION			
FILE NAME: WDSD - 2017.DWG	DATE APPROVED: JULY 1, 2017		PROJECT NUMBER:	DATE SUBMITTED:	SHEET: XX OF XX
	SCALE: NTS · REVISED DATE: JUNE 2017				

TYPICAL PIPE ENCASEMENT DETAIL
SCALE: N.T.S.



STANDARD SPACER POSTION
SCALE: N.T.S.



SECTION C-C
SCALE: N.T.S.

NOTE:
PSI (PIPELINE SEAL AND INSULATOR, INC.)

RACI CASING SPACERS

DR 18 C900 PVC PIPE: PIPE SIZE	STEEL CASING DIA.	RACI SPACERS
4"	10"	2F OR 2N
6"	12"	2F, IG OR 2M OR IE,IH OR 2P
8"	14"	3F, IG OR 2M, IN OR 2E, IH OR 2P, IQ
10"	16"	4F OR 3M OR 3E OR 3P
12"	20"	5F OR 3M, IN OR 3E, IH OR 3P, IQ
14"	22"	6F OR 4M OR 4E OR 4P
16"	24"	7F OR 5M, OR 4E, IH OR 5P

SDR 35 PVC SEWER PIPE: PIPE SIZE	STEEL CASING DIA.	RACI SPACER
6"	10"	2F, IG OR IM ,IN OR IE, 2H OR 2P, IQ
8"	12"	3F, IG OR IM, 2N OR 2E, IH OR IP, 2Q
10"	16"	4F OR 3M OR 3E OR 3P
12"	18"	5F OR 2M, 2N OR 3E, IH OR 2P, 2Q
15"	22"	6F OR 3M, 2N OR 4E, OR 3P, 2Q
18"	24"	7F OR 5M, OR 5E OR 5P

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

WATER DISTRIBUTION STANDARD DETAILS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP40

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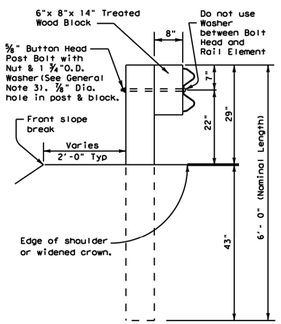
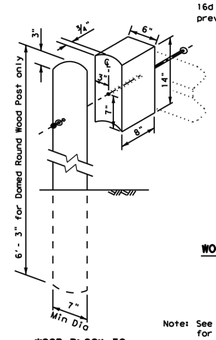
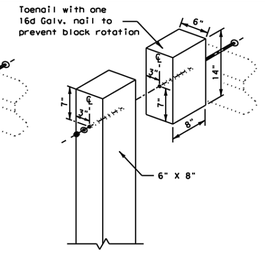


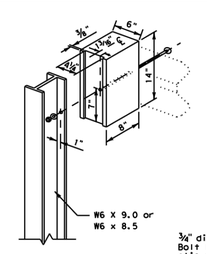
TYPICAL POST



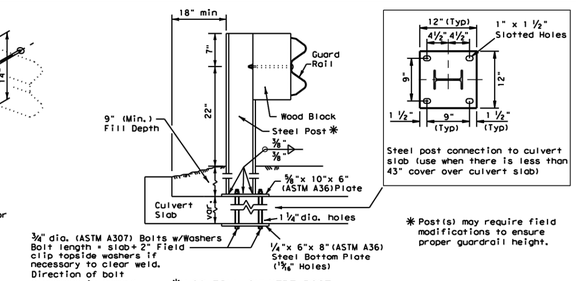
WOOD BLOCK TO ROUND WOOD POST



WOOD BLOCK TO RECTANGULAR WOOD POST



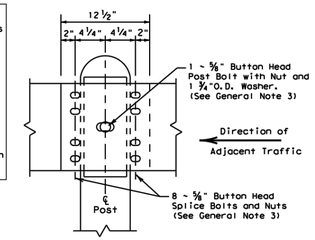
WOOD BLOCK TO STEEL POST



✱ Post(s) may require field modifications to ensure proper guardrail height.

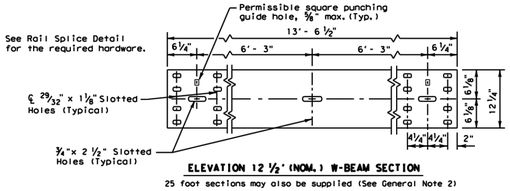
✱ LOW FILL CULVERT POST

FOR USE ON NON-BRIDGE CLASS CULVERTS ONLY



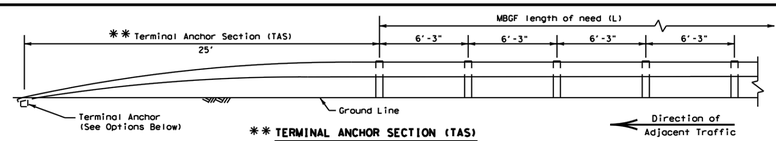
RAIL SPLICE DETAIL

Note: See Rail Splice Detail for the required hardware.



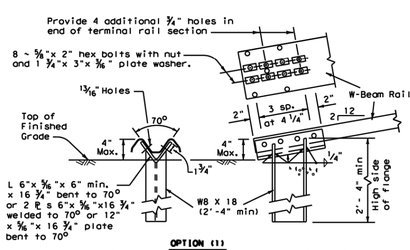
ELEVATION 12 1/2' (NOM.) W-BEAM SECTION

25 foot sections may also be supplied (See General Note 2)



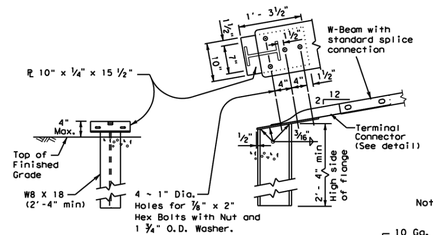
✱✱ TERMINAL ANCHOR SECTION (TAS)

Terminal anchor sections are only for downstream use, when located outside the horizontal clearance area of opposing traffic.



OPTION (1)

Note: This anchor post requires four additional 3/4" holes (shop or field) in the rail member with eight 5/8" hex bolts with nut and plate washer.

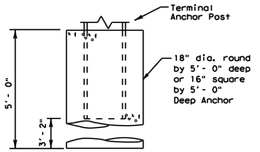


OPTION (2)

Note: This anchor post requires the use of the 10 ga. terminal connector with four 7/8" hex bolts with nut and washer.

TERMINAL ANCHOR POST OPTIONS

(See General Note 11)



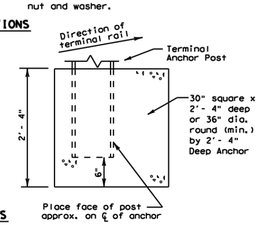
Notes:

Either concrete anchor may be used with either post option above.

No construction joint is allowed in the concrete anchor.

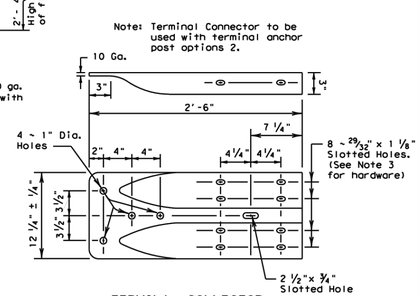
Terminal rail may be bolted to post and in twist position prior to placing concrete anchor.

If concrete anchor is precast, the area should be compacted as directed by the Engineer, when placed in the field.



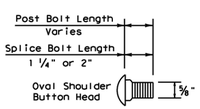
TERMINAL CONCRETE ANCHOR OPTIONS

(See General Note 11)



TERMINAL CONNECTOR

For connection hardware to concrete rails, see the MBGF transition standards.



BUTTON HEAD BOLT

Post and Splice Bolts (See General Note 3)

GENERAL NOTES

1. The type of post (round wood post, rectangular wood post, or steel post) will be shown elsewhere in the plans. The exact position of MBGF shall be shown elsewhere in the plans or as directed by the Engineer. Steel posts to be galvanized in accordance with Item 445, "Galvanizing."
2. Rail element shall meet the requirements of Item 540,"Metal Beam Guard Fence" except as modified on the plans. The Contractor may furnish rail elements of 12 1/2 or 25 foot nominal lengths.
3. Button head "post" bolts (ASTM A307) shall be of sufficient length to extend through the full thickness of the nut (ASTM A563) and Type A (1 3/4" O.D.)washer and not more than 1" beyond it. Button head "splice" bolts (ASTM A307) are 5/8" x 1 1/4" (or 2" long at triple rail splices) with a 5/8" double recessed nut (ASTM A563).
4. Fittings (bolts, nuts, and washers) shall be galvanized in accordance with Item 445, "Galvanizing." Fittings shall be subsidiary to the bid item.
5. Crown shall be widened to accommodate the Metal Beam Guard Fence.
6. The lateral approach to the guard fence, shall have a slope rate of not more than 1V:10H.
7. Unless otherwise shown in the plans, guard fence placed in the vicinity of curbs shall be positioned so that the face of curb is located directly below or behind the face of the block. Rail placed over curbs shall be installed so that the post bolt is located approximately 21 inches above the gutter pan or roadway surface.
8. If solid rock is encountered within 0 to 18" of the finished grade, drill a 22" dia. hole, 24" into the rock, or drill two 12" dia. front to back overlapping holes, 24" into the rock. If solid rock is encountered below 18",drill a 12" dia. hole, 12" into the rock or to the standard embedment depth, whichever is less. Any excess post length, after meeting these depths, may be field cut to ensure proper guardrail mounting height. Backfill with a cohesionless material.
9. Posts shall not be set in concrete, of any depth.
10. Special fabrication will be required at installations having a curvature of less than 150 ft. radius.
11. The terminal anchor section (TAS) post shall be set in Class A concrete (unless otherwise shown in the plans) in accordance with Item 421,"Hydraulic Cement Concrete." Concrete shall be subsidiary to the bid item requiring construction of the terminal anchor section (TAS). Terminal anchor post to be galvanized in accordance with Item 445, "Galvanizing."
12. Unless otherwise shown in the plans, a composite material post and/or block that meets the requirements of DMS-7210,"Composite Material Posts and Blocks for Metal Beam Guard Fence" may be substituted for posts and/or blocks of similar dimensions. The Construction Division, TxDOT maintains a Material Producer List (MPL) for producers of materials conforming to DMS-7210. Only producers on the MPL can furnish composite material posts and/or blocks.

ONLY FOR USE IN MAINTENANCE REPAIRS OR HIGHLY CONSTRAINED SITE CONDITIONS.

Texas Department of Transportation | Design Division Standard

METAL BEAM GUARD FENCE

MBGF-19

FILE: mbgf19.dgn	DN: TxDOT	CK: KM	DW: BD	CK: VP
© TxDOT NOVEMBER 2019	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST		COUNTY	SHEET NO.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

METAL BEAM GUARD FENCE
MBGF-19

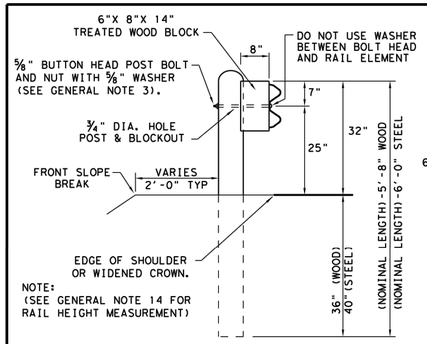
TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP41

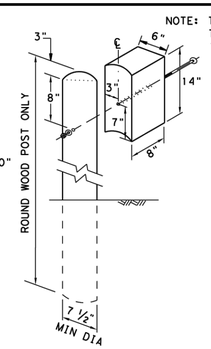
F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\PP25 MBGF19.dwg May 27, 2020-10:43am Terra Associates Inc., Thanh Dao

DATE:
FILE:

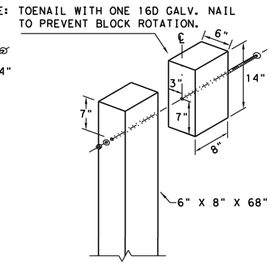
DISCLAIMER:
THE USE OF THIS STANDARD IS GOVERNED BY THE "TEXAS ENGINEERING PRACTICE ACT". NO WARRANTY OF ANY KIND IS MADE BY TXDOT FOR ANY PURPOSE WHATSOEVER. TXDOT ASSUMES NO RESPONSIBILITY FOR THE CONVERSION OF THIS STANDARD TO OTHER FORMATS OR FOR INCORRECT RESULTS OR DAMAGES RESULTING FROM ITS USE.



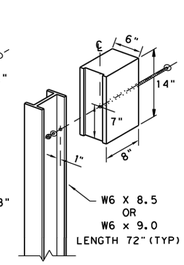
TYPICAL POST PLACEMENT



WOOD BLOCK TO ROUND WOOD POST

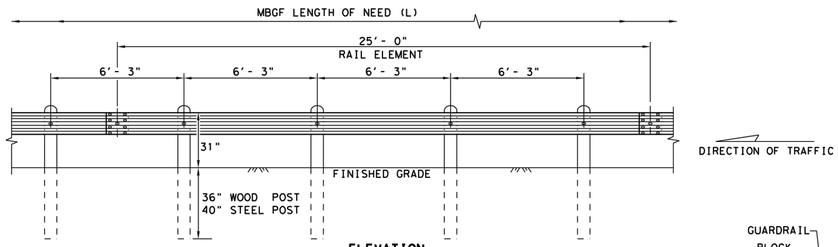


WOOD BLOCK TO RECTANGULAR WOOD POST



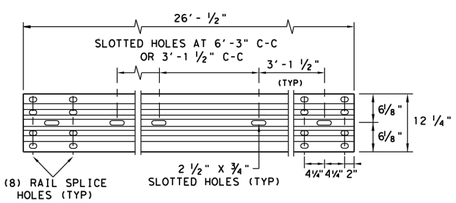
ROUTED WOOD BLOCK TO I-BEAM STEEL POST

NOTE:** "WOOD" INDICATES DIMENSIONS FOR BOTH ROUND AND RECTANGULAR WOOD POST SYSTEMS.



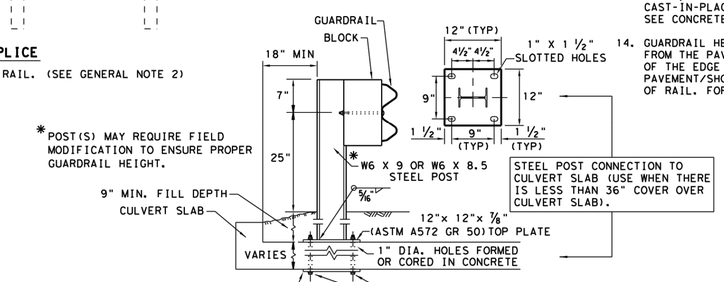
ELEVATION
MID-SPAN RAIL SPLICE

SHOWING A 25'- 0" SECTION OF W-BEAM RAIL. (SEE GENERAL NOTE 2)



ELEVATION 25'- 0" (NOM.) W-BEAM SECTION

NOTES: SEE GENERAL NOTE 2 FOR ALLOWABLE RAIL TYPES.
SEE RAIL SPLICE DETAIL FOR REQUIRED HARDWARE.



LOW FILL CULVERT POST

NOTE: TWO INSTALLATION OPTIONS.

1. BOLT-THROUGH OPTION: REQUIRES A 6" MIN. SLAB THICKNESS. 7/8" DIA (ASTM A449) HEAVY HEX BOLTS WITH TWO HARDENED WASHER EACH AND HEAVY HEX NUTS.
NOTE: BOLT LENGTH = SLAB PLUS 2 1/4" MIN.

2. EPOXY ANCHOR OPTION: THIS OPTION MAY ONLY BE USED IF THE CULVERT SLAB IS 9" MIN. THICK. THREADED ANCHOR RODS MUST BE 7/8" DIA. ASTM A449 OR A193 GRADE B7 WITH HEAVY HEX NUT, AND ONE HARDENED WASHER EACH. EMBED ANCHOR RODS 6" WITH HILTI HIT RE 500 EPOXY ADHESIVE. OTHER TYPE III CLASS C EPOXY ADHESIVES MEETING THE REQUIREMENTS OF DMS-6100, "EPOXIES AND ADHESIVES", MAY BE USED IF IT CAN BE DEMONSTRATED THAT THEY MEET OR EXCEED THE STRENGTH OF HILTI HIT RE 500 WITH THE SAME EMBEDMENT DEPTH AND THREADED ROD DIA. FOLLOW THE MANUFACTURER'S REQUIREMENTS FOR INSTALLING EPOXIED THREADED RODS. EXTEND RODS 1/4" MIN. BEYOND NUT.

NOTE: CULVERTS OF 25 FT. OR LESS, SEE GF(31)LS STANDARD FOR "LONG SPAN" OPTION.

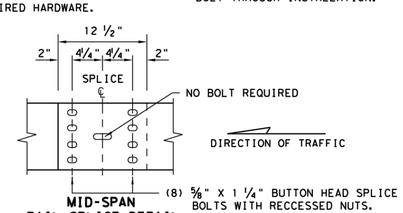
NOTE:
FOUR TYPES OF BUTTON-HEAD GUARD RAIL BOLTS COME WITH A RECCESSED NUT.

SPLICE BOLT LENGTH — VARIES
FBB01 = 1 1/4"
FBB02 = 2"
5/8"

POST & BLOCK LENGTH
FBB03 = 10"
FBB04 = 18"

BUTTON HEAD BOLT

NOTE: SEE GENERAL NOTE 3 FOR SPLICE & POST BOLT DETAILS.



MID-SPAN RAIL SPLICE DETAIL

NOTE: GF(31), MID-SPAN RAIL SPLICES ARE REQUIRED WITH 6'-3" POST SPACINGS.

GENERAL NOTES

1. THE TYPE OF POST (ROUND WOOD POST, RECTANGULAR WOOD POST, OR STEEL POST) WILL BE AS SHOWN IN THE PLANS. THE EXACT POSITION OF MBGF SHALL BE SHOWN IN THE PLANS OR AS DIRECTED BY THE ENGINEER. STEEL POSTS TO BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING."
2. RAIL ELEMENTS SHALL MEET THE REQUIREMENTS OF ITEM 540, "METAL BEAM GUARD FENCE" EXCEPT AS MODIFIED IN THE PLANS. THE CONTRACTOR MAY FURNISH RAIL ELEMENTS OF 25'- 0", OR 12'- 6" (NOM.) LENGTHS. RAIL ELEMENTS MAY HAVE SLOTTED HOLES AT 3'-1 1/2" C-C OR 6'-3" C-C. A SPECIAL LENGTH OF RAIL MAY BE MANUFACTURED TO ACCOMMODATE THE DOWNSTREAM ANCHOR TERMINAL (DAT) AND THE TRANSITION SECTIONS OF GUARDRAIL.
3. BUTTON HEAD "POST BOLTS & NUTS" SHALL MEET THE REQUIREMENTS OF (ASTM A307), AND SHALL BE OF SUFFICIENT LENGTH TO EXTEND THROUGH THE FULL THICKNESS OF THE NUT AND 5/8" WASHER (FWC16G) AND NOT MORE THAN 1" BEYOND IT. TRIM REMAINING BOLT LENGTH TO MEET REQUIRED LENGTH.
4. FITTINGS (BOLTS, NUTS, AND WASHERS) SHALL BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING." FITTINGS SHALL BE SUBSIDIARY TO THE BID ITEM.
5. CROWN SHALL BE WIDENED TO ACCOMMODATE THE METAL BEAM GUARD FENCE.
6. THE LATERAL APPROACH TO THE GUARD FENCE, SHALL HAVE A MAXIMUM SLOPE OF 1V:10H.
7. IF SHOWN ELSEWHERE IN THE PLANS OR AS DIRECTED BY THE ENGINEER, THE GUARD FENCE MAY BE FLARED AT A RATE OF 25:1 OR FLATTER.
8. UNLESS OTHERWISE SHOWN IN THE PLANS, GUARD FENCE PLACED IN THE VICINITY OF CURBS SHALL BE POSITIONED SO THAT THE FACE OF CURB IS LOCATED DIRECTLY BELOW OR BEHIND THE FACE OF THE RAIL. RAIL PLACED OVER CURBS SHALL BE INSTALLED SO THAT THE POST BOLT IS LOCATED APPROXIMATELY 25 INCHES ABOVE THE GUTTER PAN OR EDGE OF SHOULDER.
9. APPLICATIONS IN SOLID ROCK ARE ONLY ALLOWED WITH STEEL POSTS. IF SOLID ROCK IS ENCOUNTERED WITHIN 0 TO 18" OF THE FINISHED GRADE, DRILL A 24" DIA. HOLE, 24" INTO THE ROCK. IF SOLID ROCK IS ENCOUNTERED BELOW 18", DRILL A 12" DIA. HOLE, 12" INTO THE ROCK OR TO THE STANDARD EMBEDMENT DEPTH, WHICHEVER MAYBE LESS. ANY EXCESS POST LENGTH, AFTER MEETING THESE DEPTHS, MAY BE FIELD CUT TO ENSURE PROPER GUARDRAIL MOUNTING HEIGHT. BACKFILL WITH COARSE AGGREGATE MATERIAL.
10. POSTS SHALL NOT BE SET IN CONCRETE, OF ANY DEPTH.
11. SPECIAL FABRICATION WILL BE REQUIRED AT INSTALLATION LOCATIONS HAVING A CURVATURE OF LESS THAN 150 FT. RADIUS.
12. UNLESS OTHERWISE SHOWN IN THE PLANS, A COMPOSITE MATERIAL BLOCK THAT MEETS THE REQUIREMENTS OF DMS-7210, "COMPOSITE MATERIAL POSTS AND BLOCKS FOR METAL BEAM GUARD FENCE" MAY BE SUBSTITUTED FOR BLOCKS OF SIMILAR DIMENSIONS. THE CONSTRUCTION DIVISION, TXDOT MAINTAINS A MATERIAL PRODUCER LIST (MPL) FOR PRODUCERS OF MATERIALS CONFORMING TO DMS-7210 ONLY PRODUCERS ON THE MPL MAY FURNISH COMPOSITE MATERIAL BLOCKS.
13. FOR THE LOW FILL CULVERT OPTION, POSTS LOCATED PARTIALLY OR WHOLLY BETWEEN PRECAST BOX CULVERT UNITS, THE USE OF A CAST-IN-PLACE CONCRETE CLOSURE BETWEEN BOXES IS REQUIRED. THE LENGTH OF THE CAST-IN-PLACE CONCRETE CLOSURE SHALL ACCOMMODATE THE PLACEMENT OF THE LOW FILL CULVERT OPTION. SEE CONCRETE CLOSURE DETAILS ON BRIDGE STANDARD SCP-MD.
14. GUARDRAIL HEIGHT MEASUREMENT: WHEN THE GUARDRAIL IS LOCATED ABOVE PAVEMENT, MEASURE THE HEIGHT FROM THE PAVEMENT TO THE TOP OF THE W-BEAM RAIL. WHEN THE GUARDRAIL IS LOCATED UP TO 2 FT. OFF OF THE EDGE OF PAVEMENT OR FOR A PAVEMENT OVERLAY, USE A 10-FOOT STRAIGHTEDGE TO EXTEND THE PAVEMENT/SHOULDER SLOPE TO THE BACK OF RAIL, MEASURE FROM THE BOTTOM OF STRAIGHTEDGE TO THE TOP OF RAIL. FOR GUARDRAIL LOCATED DOWN A 10:1 SLOPE, MEASURE FROM THE NOMINAL TERRAIN.

NOTE: TRANSISTIONS TO BRIDGE RAILS OR TRAFFIC BARRIERS.
SEE GF(31)TL3 TR STANDARD FOR HIGH-SPEED TL-3 TRANSITIONS.
SEE GF(31)TL2 TR STANDARD FOR LOW-SPEED TL-2 TRANSITIONS.

Texas Department of Transportation — Design Division Standard

METAL BEAM GUARD FENCE TL-3 MASH COMPLIANT

GF(31)-19

FILE: gf3119.dgn	DN: TxDOT	CK: KM	DW: VP	CK: CGL/AG
©TxDOT: NOVEMBER 2019	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST		COUNTY	SHEET NO.

STATE OF TEXAS — A.G.A.N. NANAYAKKARA 115913 — LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

METAL BEAM GUARD FENCE GF (31) – 19

TERRA ASSOCIATES, INC. CONSULTING ENGINEERS LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP42

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DATE:
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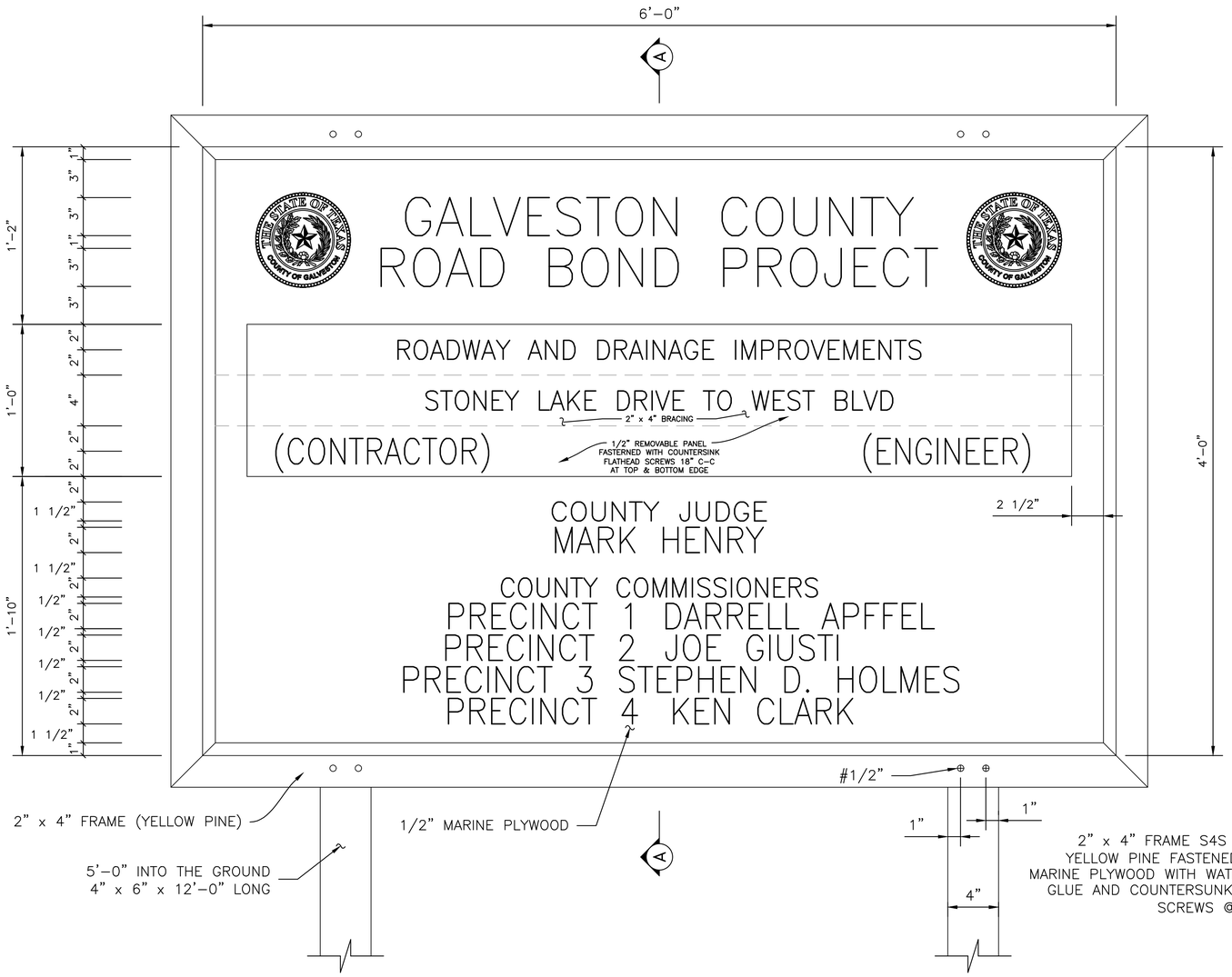

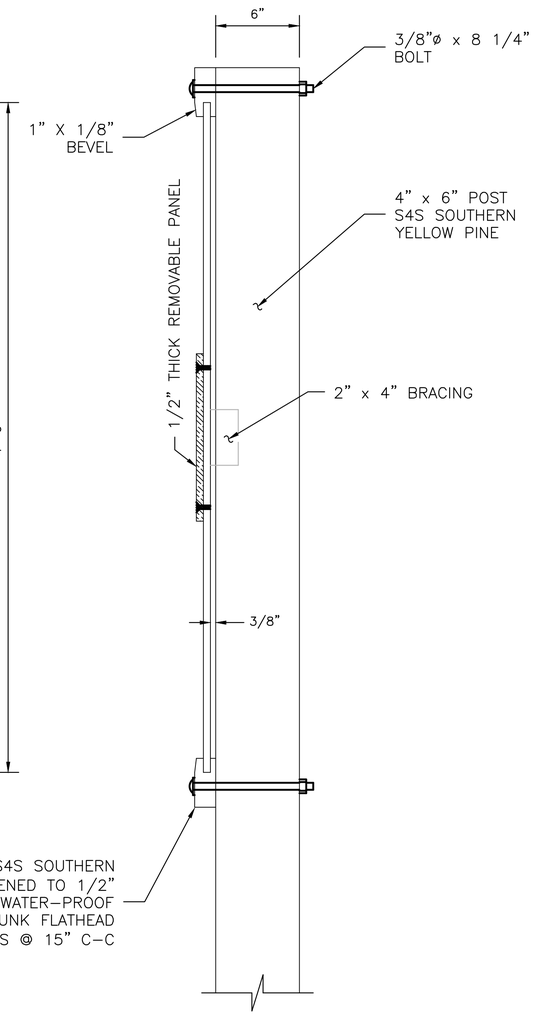

SECTION A–A

NOTES:

1. THE SIGN SHALL HAVE BLACK LETTERS WITH WHITE BACKGROUND.
2. SIGN SHALL BE MOUNTED ON 4" x 6" POSTS AND LOCATED BY THE ENGINEER.
3. REMOVABLE PANEL SHALL BE 1/2" MARINE PLYWOOD.
4. ALL BOLTS SHALL BE GALVANIZED OR CADMIUM PLATED.
5. 4" x 6" POST SHALL BE WOLMANIZED OR PENTACHLOROPHENOL TREATED.
6. ALL WOOD SURFACES SHALL HAVE PRIME COAT AND TWO (2) COATS OF SHERWIN–WILLIAMS KEM–LUSTRA ENAMEL OR EQUAL.
7. PROJECT SIGN WILL NOT BE PAID FOR DIRECTLY, BUT WILL BE CONSIDERED SUBSIDIARY TO ITEM 502: BARRICADES, SIGNS AND TRAFFIC HANDLING.

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

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FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

PROJECT SIGN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET PP43

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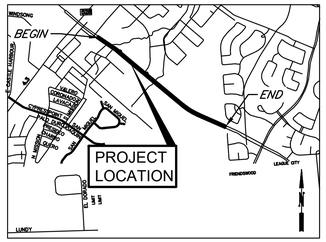


CONSTRUCTION WARNING SIGN SPACING

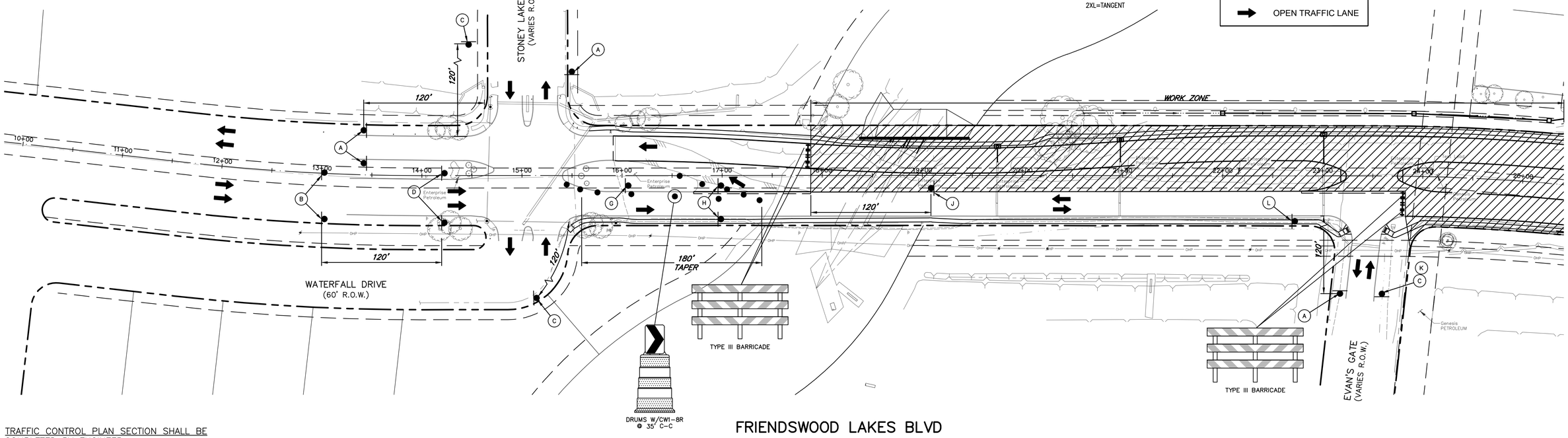
Posted Speed or 85% Speed (MPH)	X Min. Distance (feet)
30 or less	120
35	160
40	240
45	320
50	400
55	500
65	750

X=SIGN SPACING
L=TAPER
2XL=TANGENT

LEGEND

- WORK ZONE
- SIGN
- FLAGGER
- TYPE III BARRICADE
- FLASHING ARROW PANEL
- BARREL/DRUM
- OPEN TRAFFIC LANE

50 0 50



TRAFFIC CONTROL PLAN SECTION SHALL BE COMPLETED BY ENGINEER

ROADWAY	POSTED SPEED	TAPER LENGTH	SPACING CHANELIZED DEVICES		SIGN SPACING	BUFFER SPACING
			TAPER	TANGENT		
FRIENDSWOOD LAKES BLVD	30 MPH	180'	30'	60'–75'	120'	85'

NOTES:

ALL DRIVEWAYS TO REMAIN ACCESSIBLE AT ALL TIMES.

CONTRACTOR MUST COORDINATE WITH PROPERTY OWNERS FOR ACCESS TO THEIR PROPERTY AT ALL TIMES.

TRAFFIC NOTES:

1. ALL CONSTRUCTION SIGNS AND BARRICADES SHALL CONFORM TO THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, LATEST REVISION AND GALVESTON COUNTY STANDARD DETAILS.
2. ALL PAVEMENT MARKINGS SHALL BE INSTALLED IN ACCORDANCE WITH GALVESTON COUNTY STANDARD DETAILS AND SPECIFICATIONS.
3. CONTRACTOR TO COORDINATE WITH GALVESTON COUNTY TO DETERMINE HOURS OF CONSTRUCTION.

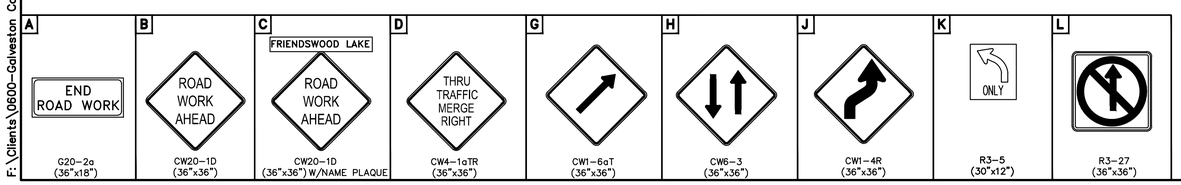
POSTED SPEED LIMIT:

FRIENDSWOOD LAKES BLVD: 30 MPH

TYPICAL TRANSITION LENGTHS AND SUGGESTED MAXIMUM SPACING OF DEVICES

Posted Speed *	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Device	
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent
30	$L=\frac{WS^2}{60}$	150'	165'	180'	30'	60'–75'
35		205'	225'	245'	35'	70'–90'
40		265'	295'	320'	40'	80'–100'
45	L=WS	450'	495'	540'	45'	90'–110'
50		500'	550'	600'	50'	100'–125'
55		550'	605'	660'	55'	110'–140'
60		600'	660'	720'	60'	120'–150'
65		650'	715'	780'	65'	130'–175'

* 85th Percentile Speed may be used on roads where traffic speeds normally exceed the posted speed limit.
** Taper lengths have been rounded off.



STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

TRAFFIC CONTROL PLAN
PHASE 1, STEP 1 (WEST END)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: 1" = 50'	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET TC01

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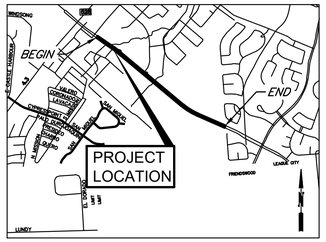

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2XL=TANGENT

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- WORK ZONE
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- FLAGGER
- TYPE III BARRICADE
- FLASHING ARROW PANEL
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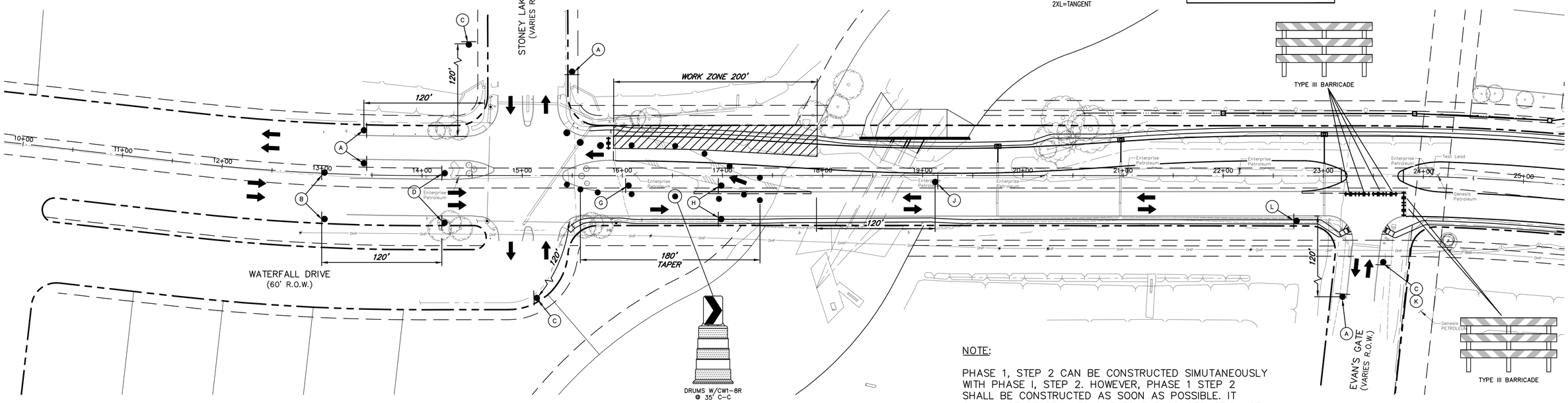
50 0 50



NOTE:

PHASE 1, STEP 2 CAN BE CONSTRUCTED SIMUTANEOUSLY WITH PHASE I, STEP 2. HOWEVER, PHASE 1 STEP 2 SHALL BE CONSTRUCTED AS SOON AS POSSIBLE. IT SHALL NOT BE DELAYED DUE TO THE CONSTRUCTION OF PHASE 1 STEP 1.

TRAFFIC CONTROL PLAN SECTION SHALL BE COMPLETED BY ENGINEER

ROADWAY	POSTED SPEED	TAPER LENGTH	SPACING CHANELIZED DEVICES		SIGN SPACING	BUFFER SPACING
			TAPER	TANGENT		
FRIENDSWOOD LAKES BLVD	30 MPH	180'	30'	60'–75'	120'	85'

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40		265'	295'	320'	40'	80'–100'
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50		500'	550'	600'	50'	100'–125'
55		550'	605'	660'	55'	110'–140'
60		600'	660'	720'	60'	120'–150'
65		650'	715'	780'	65'	130'–175'

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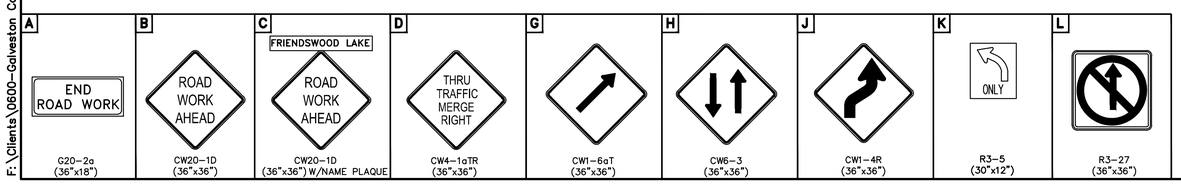
** Taper lengths have been rounded off.



STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

TRAFFIC CONTROL PLAN
PHASE 1, STEP 2 (WEST END)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: 1" = 50'	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET TC02

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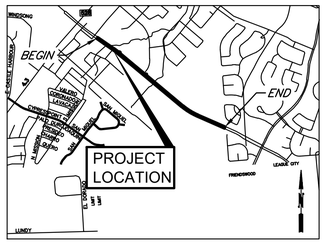


CONSTRUCTION WARNING SIGN SPACING

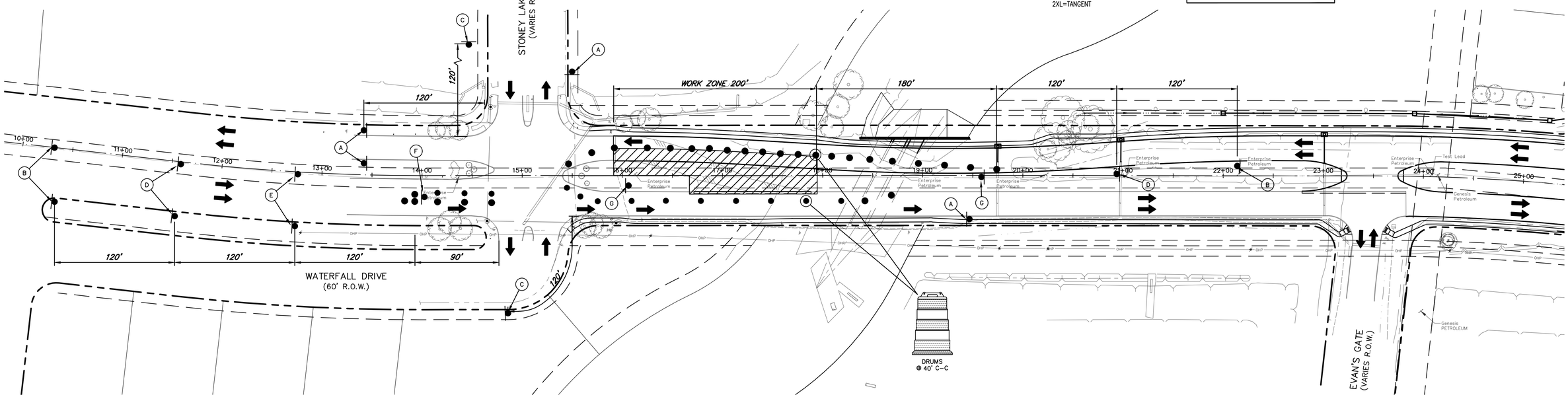
Posted Speed or 85% Speed (MPH)	X Min. Distance (feet)
30 or less	120
35	160
40	240
45	320
50	400
55	500
65	750

X=SIGN SPACING
L=TAPER
2XL=TANGENT

LEGEND

- WORK ZONE
- SIGN
- FLAGGER
- TYPE III BARRICADE
- FLASHING ARROW PANEL
- BARREL/DRUM
- OPEN TRAFFIC LANE

50 0 50



FRIENDSWOOD LAKES BLVD

TRAFFIC CONTROL PLAN SECTION SHALL BE COMPLETED BY ENGINEER

ROADWAY	POSTED SPEED	TAPER LENGTH	SPACING CHANELIZED DEVICES		SIGN SPACING	BUFFER SPACING
			TAPER	TANGENT		
FRIENDSWOOD LAKES BLVD	30 MPH	180'	30'	60'–75'	120'	85'

NOTES:

ALL DRIVEWAYS TO REMAIN ACCESSIBLE AT ALL TIMES.

CONTRACTOR MUST COORDINATE WITH PROPERTY OWNERS FOR ACCESS TO THEIR PROPERTY AT ALL TIMES.

TRAFFIC NOTES:

1. ALL CONSTRUCTION SIGNS AND BARRICADES SHALL CONFORM TO THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, LATEST REVISION AND GALVESTON COUNTY STANDARD DETAILS.
2. ALL PAVEMENT MARKINGS SHALL BE INSTALLED IN ACCORDANCE WITH GALVESTON COUNTY STANDARD DETAILS AND SPECIFICATIONS.
3. CONTRACTOR TO COORDINATE WITH GALVESTON COUNTY TO DETERMINE HOURS OF CONSTRUCTION.

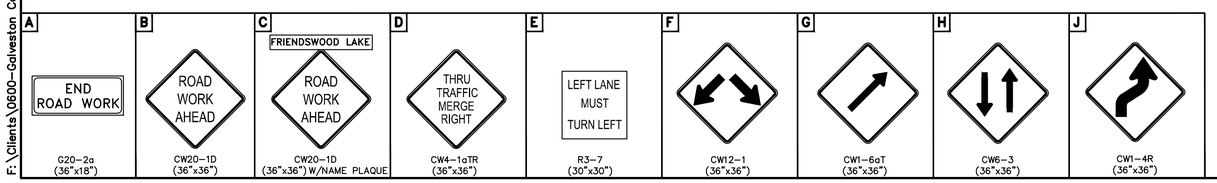
POSTED SPEED LIMIT:

FRIENDSWOOD LAKES BLVD: 30 MPH

TYPICAL TRANSITION LENGTHS AND SUGGESTED MAXIMUM SPACING OF DEVICES

Posted Speed *	Formula	Minimum Desirable Taper Lengths **			Suggested Maximum Spacing of Device	
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent
30	$L=\frac{WS^2}{60}$	150'	165'	180'	30'	60'–75'
35		205'	225'	245'	35'	70'–90'
40		265'	295'	320'	40'	80'–100'
45	L=WS	450'	495'	540'	45'	90'–110'
50		500'	550'	600'	50'	100'–125'
55		550'	605'	660'	55'	110'–140'
60		600'	660'	720'	60'	120'–150'
65		650'	715'	780'	65'	130'–175'

* 85th Percentile Speed may be used on roads where traffic speeds normally exceed the posted speed limit.
** Taper lengths have been rounded off.



STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

TRAFFIC CONTROL PLAN
PHASE 2 (WEST END)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: 1" = 50'	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET TC03

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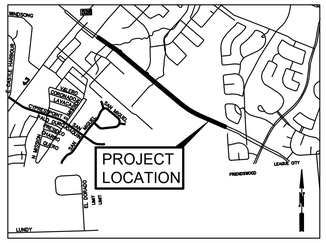


CONSTRUCTION WARNING SIGN SPACING

Posted Speed or 85% Speed (MPH)	X Min. Distance (feet)
30 or less	120
35	160
40	240
45	320
50	400
55	500
65	750

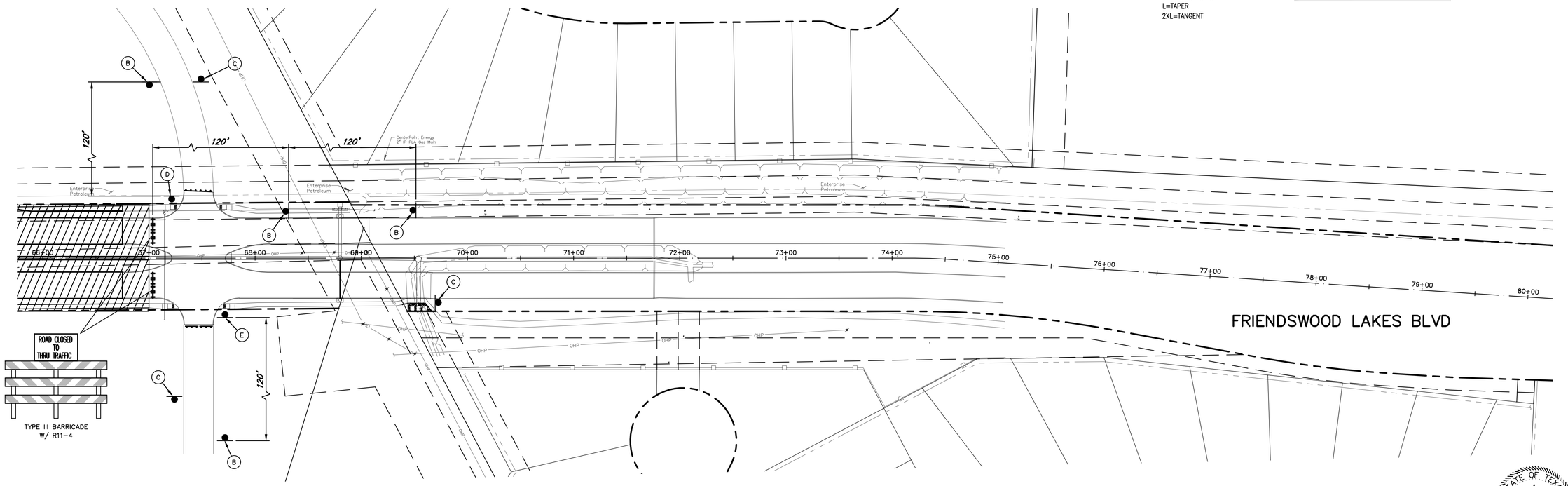
X=SIGN SPACING
L=TAPER
2XL=TANGENT

LEGEND

- WORK ZONE
- SIGN
- FLAGGER
- TYPE III BARRICADE
- FLASHING ARROW PANEL
- BARREL/DRUM
- OPEN TRAFFIC LANE

N

50 0 50



TYPICAL TRANSITION LENGTHS AND SUGGESTED MAXIMUM SPACING OF DEVICES

Posted Speed *	Formula	Minimum Desirable Taper Lengths ** 10' Offset	11' Offset	12' Offset	Suggested Maximum Spacing of Device On a Taper	On a Tangent
30	$L=\frac{WS^2}{60}$	150'	165'	180'	30'	60'–75'
35		205'	225'	245'	35'	70'–90'
40		265'	295'	320'	40'	80'–100'
45	L=WS	450'	495'	540'	45'	90'–110'
50		500'	550'	600'	50'	100'–125'
55		550'	605'	660'	55'	110'–140'
60		600'	660'	720'	60'	120'–150'
65		650'	715'	780'	65'	130'–175'

* 85th Percentile Speed may be used on roads where traffic speeds normally exceed the posted speed limit.
** Taper lengths have been rounded off.

TRAFFIC CONTROL PLAN SECTION SHALL BE COMPLETED BY ENGINEER

ROADWAY	POSTED SPEED	TAPER LENGTH	SPACING CHANELIZED DEVICES TAPER	TANGENT	SIGN SPACING	BUFFER SPACING
FRIENDSWOOD LAKES BLVD	30	150	30	60	120	90

POSTED SPEED LIMIT:

FRIENDSWOOD LAKES BLVD: 30 MPH

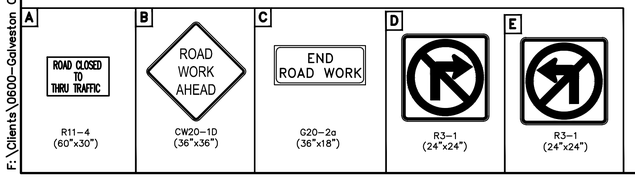
TRAFFIC NOTES:

1. ALL CONSTRUCTION SIGNS AND BARRICADES SHALL CONFORM TO THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, LATEST REVISION AND GALVESTON COUNTY STANDARD DETAILS.
2. ALL PAVEMENT MARKINGS SHALL BE INSTALLED IN ACCORDANCE WITH GALVESTON COUNTY STANDARD DETAILS AND SPECIFICATIONS.
3. CONTRACTOR TO COORDINATE WITH GALVESTON COUNTY TO DETERMINE HOURS OF CONSTRUCTION.

NOTES:

ALL DRIVEWAYS TO REMAIN ACCESSIBLE AT ALL TIMES.

CONTRACTOR MUST COORDINATE WITH PROPERTY OWNERS FOR ACCESS TO THEIR PROPERTY AT ALL TIMES.



STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

TRAFFIC CONTROL PLAN

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: 1" = 50'	PROJECT No. 0600–1901 CONTRACT: 1
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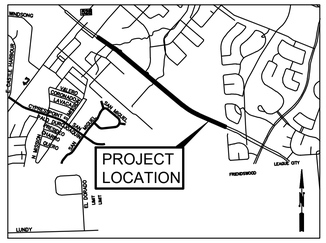
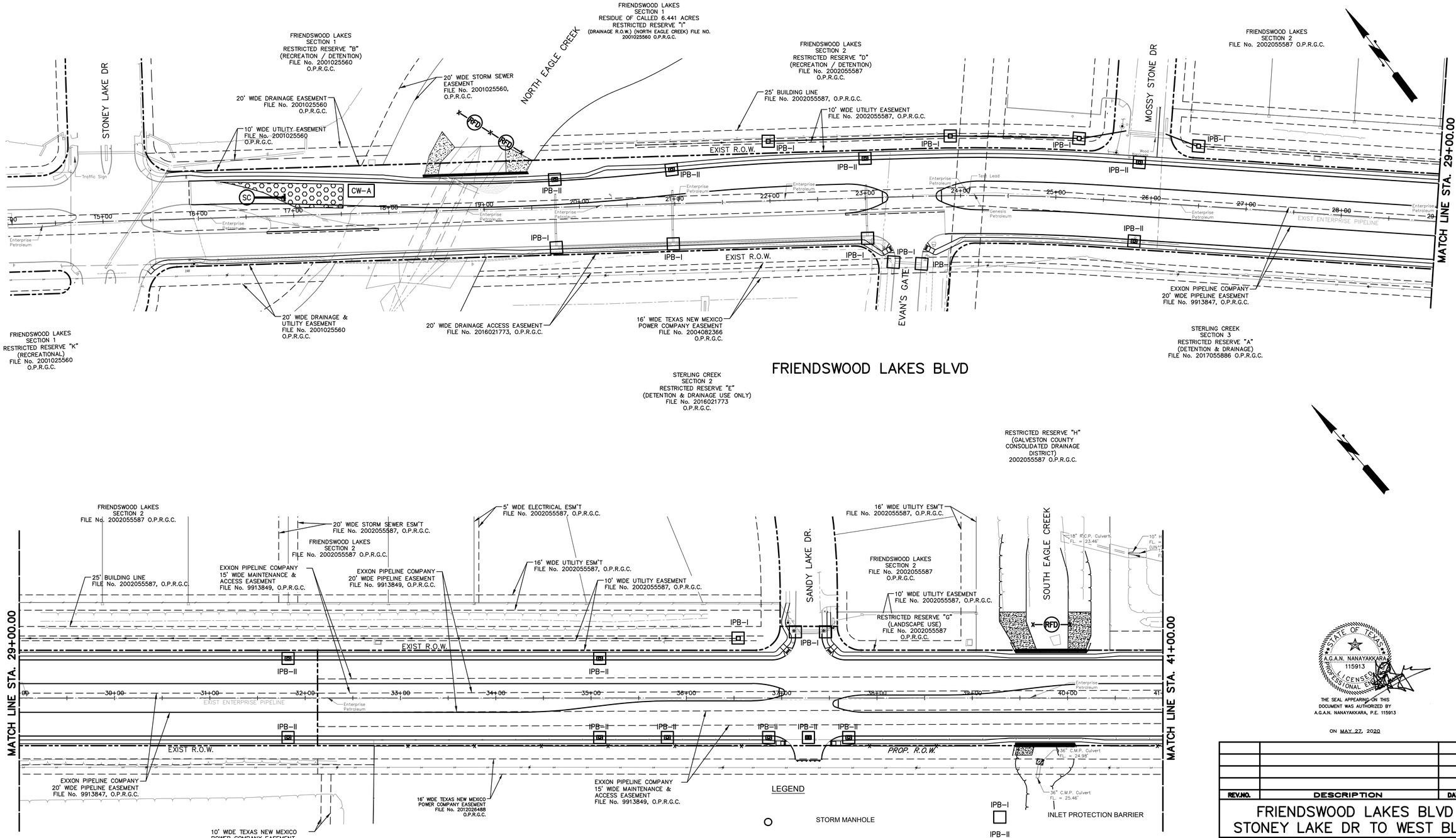

PROJECT LOCATION
LEAGUE CITY
FRIENDSWOOD
LAKE JACKSON
LAKE ALSATIA
CLEAR LAKE SHORES
EL DORADO
LAKE ROBINSON
LAKE CONCORDIA
LAKE ALMANOR
LAKE PARADISE
LAKE CONCORDIA
LAKE ROBINSON
LAKE ALSATIA
LAKE JACKSON
LAKE CONCORDIA
LAKE ALMANOR
LAKE PARADISE



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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

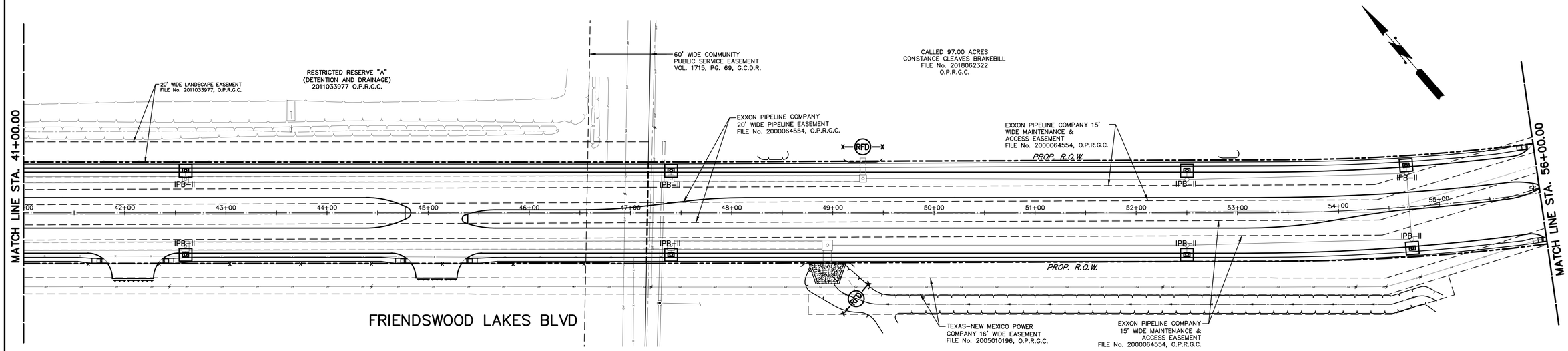
FRIENDSWOOD LAKES BLVD STONEY LAKE DR TO WEST BLVD

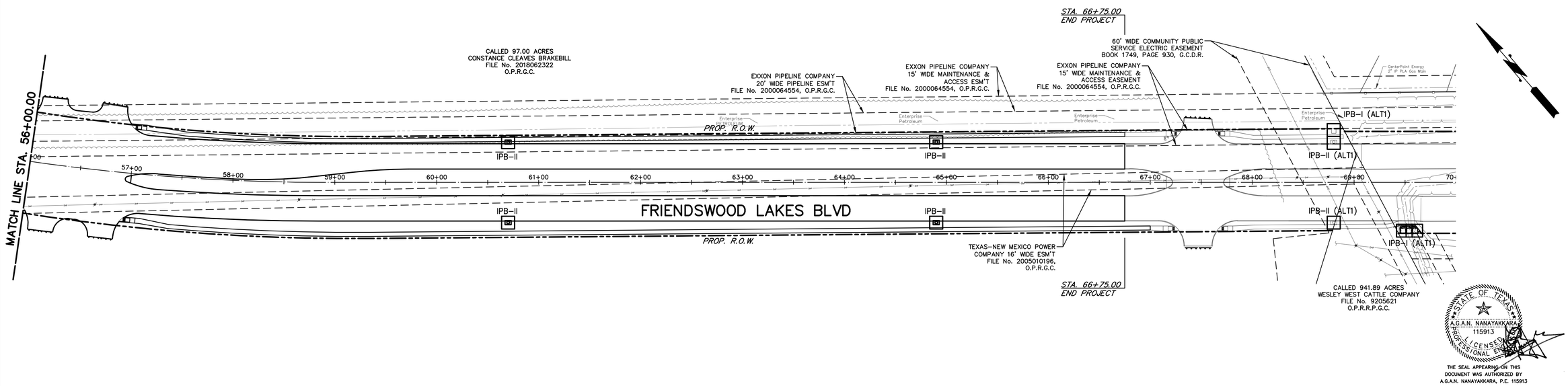
STORM WATER POLLUTION PREVENTION PLAN (1 OF 2)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 50'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SW3P01





STATE OF TEXAS
A.G.A.N. NANAYAKKARA
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LICENSED
PROFESSIONAL ENGINEER

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ON MAY 27, 2020

LEGEND

○	STORM MANHOLE
▭	TYPE "H-2" INLET
▫	TYPE "E" INLET
x—RFD—x	ROCK FILTER DAM
x—RFB—x	REINFORCED FILTER FABRIC BARRIER
IPB-I □	INLET PROTECTION BARRIER
IPB-II □	INLET PROTECTION BARRIER - STAGE II
SC	STABILIZED CONSTRUCTION EXIT
CW-A	CONCRETE TRUCK WASHOUT AREA (ABOVE GROUND)

50 0 50

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

STORM WATER POLLUTION PREVENTION PLAN (2 OF 2)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 50'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SW3P02

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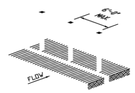
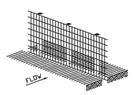


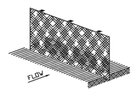
STEP 1:

SET POSTS AND EXCAVATE FOUR (4) INCH BY FOUR (4) INCH TRENCH UPSLOPE ALONG LINE OF POSTS (SEE NOTE 3).



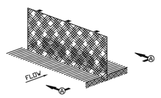
STEP 2:

SECURE WIRE FENCING TO POSTS (SEE NOTE 2).



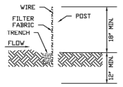
STEP 3:

ATTACH FILTER FABRIC MATERIAL TO WIRE FENCE AND EXTEND IT INTO TRENCH (SEE NOTE 3).



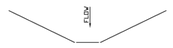
STEP 4:

BACKFILL AND COMPACT EXCAVATED SOIL (SEE NOTE 4).



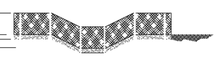
SECTION "A" – "A"

PLAN



PLAN

V–BOTTOM DITCH PROFILE



FLAT BOTTOM DITCH PROFILE

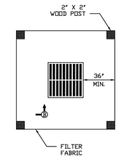
SILT FILTER FABRIC FENCE

NOTES:

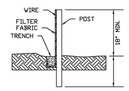
1. SET TWO (2) INCH BY TWO (2) INCH WOODEN STAKES EMBEDDED TWELVE (12) INCHES INTO GROUND. SPACING SHALL BE A MAXIMUM OF SIX (6) FEET APART FOR REINFORCED FILTER FABRIC FENCE AND A MAXIMUM OF THREE (3) FEET APART FOR NON-REINFORCED FILTER FABRIC FENCE.
2. REINFORCED FILTER FABRIC FENCE SHALL HAVE WOVEN WIRE FENCE WHICH SHALL BE FASTENED SECURELY TO FENCE POSTS.
3. FASTEN FILTER FABRIC FENCE AS FOLLOWS:
   3.1. REINFORCED FILTER FABRIC FENCE SHALL SECURELY FASTENED TO WOVEN WIRE FENCE WITH TIES SPACED EVERY TWENTY-FOUR (24) INCHES AT TOP AND MIDSECTION.
   3.2. NON-REINFORCED FILTER FABRIC FENCE SHALL BE FASTENED AT EVERY WOOD POST AT TOP AND MIDSECTION.
4. MINIMUM HEIGHT OF FILTER FABRIC SHALL BE EIGHTEEN (18) INCHES ABOVE NATURAL GROUND AND A MAXIMUM OF THIRTY-SIX (36) INCHES ABOVE NATURAL GROUND.
5. FILTER FABRIC SHALL EXTEND INTO THE FOUR (4) INCH BY FOUR (4) INCH TRENCH DOWN THE SIDE CLOSEST TO THE WOODEN POSTS, ACROSS THE BOTTOM OF THE TRENCH AND HALF WAY UP THE OPPOSITE SIDE.
6. ALL INSTALLATIONS OF SILT FENCE SHALL BE IN ACCORDANCE WITH THE CITY OF FRIENDSWOOD TECHNICAL SPECIFICATION SECTION 02005 – FILTER FABRIC SILT FENCE.
7. METAL STAKES OR T-POSTS MAY BE USED IN LIEU OF WOOD POSTS.

SC	STABILIZED CONSTRUCTION EXIT
X— FF —X	FILTER FABRIC SILT FENCE
X— RFB —X	REINFORCED FILTER FABRIC BARRIER
IPB–I	INLET PROTECTION BARRIER TYPE I
IPB–II	INLET PROTECTION BARRIER TYPE II
IPB–III	INLET PROTECTION BARRIER TYPE III
LPIP	LOW PROFILE INLET PROTECTOR
LPIGP	LOW PROFILE INLET GRATE PROTECTOR
CW–A	CONCRETE WASHOUT AREA – ABOVE GROUND
CW–B	CONCRETE WASHOUT AREA – BELOW GROUND

SWPPP SYMBOLS



PLAN

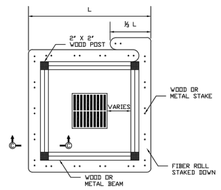


SECTION "B" – "B"

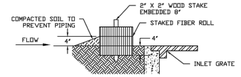
INLET PROTECTION TYPE I

NOTES:

1. MAXIMUM POST SPACING SHALL BE FOUR (4) FEET. ADDITIONAL POSTS MAY BE ADDED AS NEEDED. POSTS SHALL BE PLACED A MINIMUM AT EACH CORNER AS SHOWN.
2. PLACEMENT OF FILTER FABRIC BARRIER FROM INLET SHALL VARY ACCORDING TO SITE CONDITIONS. TYPICAL PLACEMENT SHALL BE A MINIMUM OF THIRTY-SIX (36) INCHES FROM INLET EDGE.



PLAN

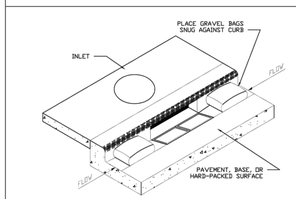


SECTION "C" – "C"

INLET PROTECTION TYPE II

NOTES:

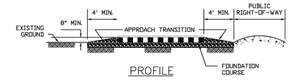
1. MAXIMUM POST SPACING SHALL BE FOUR (4) FEET. ADDITIONAL POSTS MAY BE ADDED AS NEEDED. POSTS SHALL BE PLACED A MINIMUM AT EACH CORNER AS SHOWN.
2. PLACEMENT OF FIBER ROLL FROM INLET SHALL VARY ACCORDING TO SITE CONDITIONS. TYPICAL PLACEMENT SHALL BE TWENTY-FOUR (24) INCHES FROM INLET.
3. FIBER ROLLS SHALL BE UTILIZED ONLY WHEN SITE CONDITIONS DO NOT PERMIT THE USE OF FILTER FABRIC BARRIER.
4. IF UNDERLYING MATERIAL IS BASE OR OTHER HARD-PACKED MATERIAL, THEN FIBER ROLLS MAY BE PLACED ON HARD PACKED SURFACE AND WEIGHTED DOWN WITH GRAVEL BAGS.



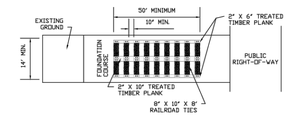
INLET PROTECTION BARRIER TYPE III

NOTES:

1. IPB TYPE III SHALL BE USED FOR EXISTING OR PROPOSED STAGE II TYPE "B", "B-B" AND "N-B" INLETS ONLY.
2. PLACE GRAVEL BAG IN THE GUTTER ON EACH SIDE OF THE INLET OPENING. GRAVEL BAG SHALL BE PLACED TIGHTLY AGAINST THE FACE OF CURB.
3. PLACE GRAVEL BAGS AT BACK OF CURB ALONG INLET.
4. DO NOT PLACE BAGS TO BLOCK THROAT OF INLET, UNLESS DIRECTED BY THE ENGINEER AND APPROVED BY THE CITY OF FRIENDSWOOD.



PROFILE

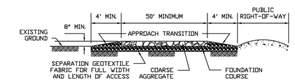


PLAN

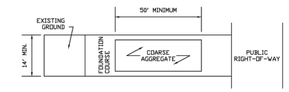
CONSTRUCTION ACCESS TYPE I

NOTES:

1. LENGTH SHALL BE AS SHOWN ON THE CONSTRUCTION DRAWINGS, BUT NOT LESS THAN FIFTY (50) FEET.
2. THICKNESS SHALL BE A MINIMUM OF EIGHT (8) INCHES.
3. WIDTH SHALL BE NOT LESS THAN FULL WIDTH OF ALL POINTS OF INGRESS AND EGRESS.
4. THE TREATED TIMBER PLANKS SHALL BE #2 GRADE MINIMUM, AND SHOULD BE FREE FROM LARGE AND LOOSE KNOTS.
5. THE TREATED TIMBER PLANKS SHALL BE ATTACHED TO THE RAILROAD TIES WITH ¾" X 6" MINIMUM LAG BOLTS. OTHER FASTENERS MAY BE USED AS APPROVED BY THE CITY.
6. APPROACH TRANSITION SHALL BE A MINIMUM OF EIGHT (8) INCHES IN DEPTH AND 6:1 SLOPE MINIMUM.
7. FOUNDATION COURSE SHALL BE A MINIMUM OF SIX (6) INCHES. FOUNDATION COURSE MATERIAL SHALL BE FLEXIBLE BASE, BITUMINOUS CONCRETE, PORTLAND CEMENT CONCRETE OR OTHER MATERIAL APPROVED BY THE CITY.
8. ACCESS SHALL BE GRADED TO PREVENT RUN-OFF FROM LEAVING SITE, ALLOWING DRAINAGE TO A SEDIMENT TRAPPING DEVICE.
9. CONSTRUCTION ACCESS SHALL ADHERE TO CITY OF FRIENDSWOOD SPECIFICATION 02020 – STABILIZED CONSTRUCTION ACCESS, ROADS, PARKING AND WASH AREAS.
10. STABILIZATION FOR OTHER AREAS SHALL HAVE THE SAME AGGREGATE THICKNESS AND WIDTH REQUIREMENTS AS THE STABILIZED CONSTRUCTION ACCESS, UNLESS OTHERWISE SHOWN ON THE CONSTRUCTION DRAWINGS.
11. STABILIZED AREA MAY BE WIDENED OR LENGTHENED TO ACCOMMODATE TRUCK WASHING AREA. AN OUTLET SEDIMENT TRAP MUST BE PROVIDED FOR TRUCK WASHING AREA.
12. STABILIZED CONSTRUCTION ACCESS SHALL BE MAINTAINED FREE OF SEDIMENT FOR THE DURATION OF THE PROJECT.



PROFILE

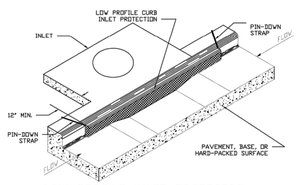


PLAN

CONSTRUCTION ACCESS TYPE II

NOTES:

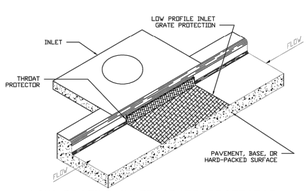
1. LENGTH SHALL BE AS SHOWN ON THE CONSTRUCTION DRAWINGS, BUT NOT LESS THAN FIFTY (50) FEET.
2. THICKNESS SHALL BE A MINIMUM OF EIGHT (8) INCHES.
3. WIDTH SHALL BE NOT LESS THAN FULL WIDTH OF ALL POINTS OF INGRESS AND EGRESS.
4. APPROACH TRANSITION SHALL BE A MINIMUM OF EIGHT (8) INCHES IN DEPTH AND 6:1 SLOPE MINIMUM.
5. FOUNDATION COURSE SHALL BE A MINIMUM OF SIX (6) INCHES. FOUNDATION COURSE MATERIAL SHALL BE FLEXIBLE BASE, BITUMINOUS CONCRETE, PORTLAND CEMENT CONCRETE OR OTHER MATERIAL APPROVED BY THE CITY.
6. ACCESS SHALL BE GRADED TO PREVENT RUN-OFF FROM LEAVING SITE.
7. CONSTRUCTION ACCESS SHALL ADHERE TO CITY OF FRIENDSWOOD SPECIFICATION 02020 – STABILIZED CONSTRUCTION ACCESS, ROADS, PARKING AND WASH AREAS.
8. STABILIZATION FOR OTHER AREAS SHALL HAVE THE SAME AGGREGATE THICKNESS AND WIDTH REQUIREMENTS AS THE STABILIZED CONSTRUCTION ACCESS, UNLESS OTHERWISE SHOWN ON THE CONSTRUCTION DRAWINGS.
9. STABILIZED AREA MAY BE WIDENED OR LENGTHENED TO ACCOMMODATE TRUCK WASHING AREA. AN OUTLET SEDIMENT TRAP MUST BE PROVIDED FOR TRUCK WASHING AREA.
10. STABILIZED CONSTRUCTION ACCESS SHALL BE MAINTAINED FREE OF SEDIMENT FOR THE DURATION OF THE PROJECT.



LOW PROFILE INLET PROTECTOR

NOTES:

1. LPIP SHALL BE REQUIRED IN HIGH TRAFFIC VOLUME ROADWAYS.
2. LPIP SHALL BE USED FOR EXISTING OR PROPOSED STAGE II TYPE "N-B" INLETS ONLY.
3. LPIP SHALL EXTEND A MINIMUM OF TWELVE (12) INCHES PAST THE THROAT OPENING OF THE INLET.
4. LPIP SHALL BE PINNED DOWN BEHIND THE CURB AS SHOWN.
5. ONLY GUTTER GATOR™ OR GUTTER GUARD™ SHALL BE USED, UNLESS PREVIOUSLY APPROVED BY THE CITY ENGINEER.



LOW PROFILE INLET GRATE PROTECTOR

NOTES:

1. LPIGP SHALL BE REQUIRED IN HIGH TRAFFIC VOLUME ROADWAYS.
2. LPIGP SHALL BE USED FOR EXISTING OR PROPOSED STAGE II TYPE "B" AND "B-B" INLETS ONLY.
3. THROAT PROTECTION SHALL BE A MINIMUM OF 4" IN HEIGHT.
4. ONLY GRATE GATOR™ OR INLET GUARD PLUS® SHALL BE USED, UNLESS PREVIOUSLY APPROVED BY THE CITY ENGINEER.

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) STANDARD DETAILS

FILE NAME: SW3PSD1 – 2017.DWG	DATE APPROVED: JULY 1, 2017	
	SCALE: NTS	REVISED DATE: JUNE 2017

DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION

PROJECT NUMBER:	DATE SUBMITTED:	SHEET: XX OF XX

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED
PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

STORM WATER POLLUTION PREVENTION PLAN DETAILS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713–993–0333
TBPE Registration No.: F–003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600–1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SW3P03

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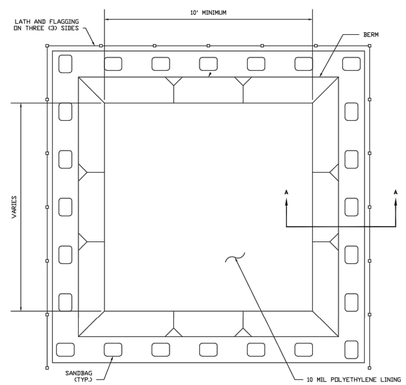
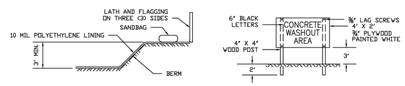


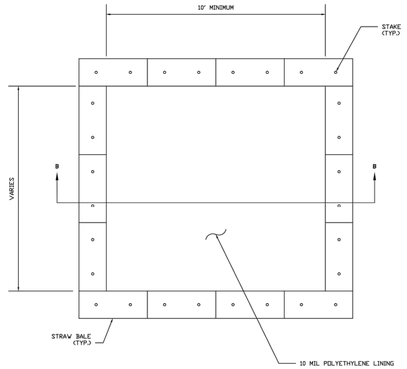
PLAN VIEW



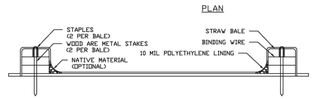
SECTION 'A-A'

SIGN DETAIL

ABOVE GROUND



PLAN



SECTION 'B-B'

STAPLE DETAIL

BELOW GROUND

CONCRETE WASHOUT AREA

NOTES:

1. ACTUAL LAYOUT TO BE DETERMINED IN THE FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN THREE (3) FEET OF THE CONCRETE WASHOUT FACILITY.

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) STANDARD DETAILS (CONT.)		DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION	
FILE NAME: SW3PSD2 – 2017.DWG	DATE APPROVED: JULY 1, 2017		PROJECT NUMBER: / DATE SUBMITTED: / SHEET: XX OF XX
	SCALE: NTS / REVISED DATE: JUNE 2017		

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

STORM WATER POLLUTION PREVENTION PLAN DETAILS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SW3P04

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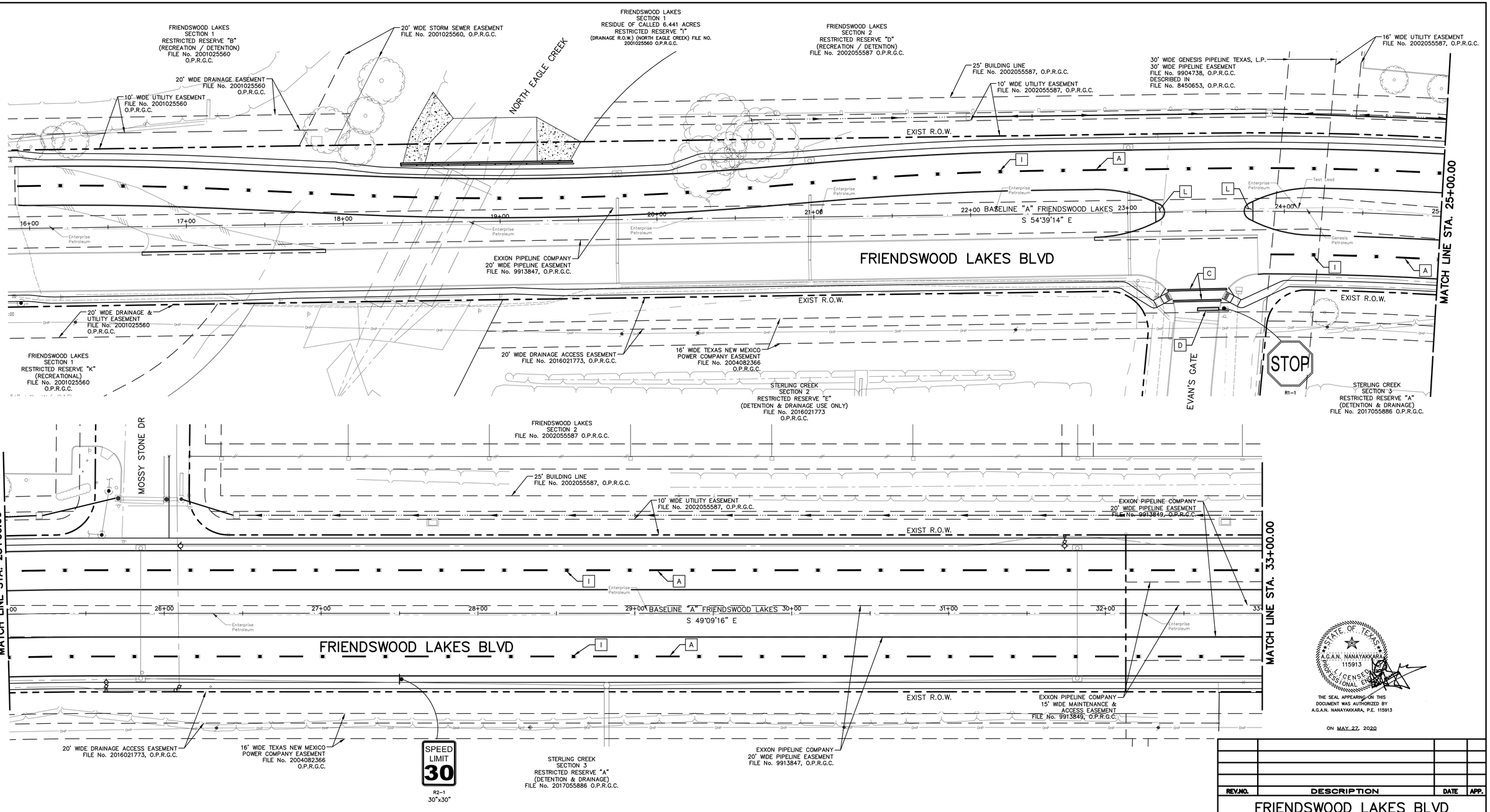

PAVEMENT MARKING LEGEND

- A THERMOPLASTIC PAV MRK TY I (W) (4") (BRKN)
- B THERMOPLASTIC PAV MRK TY I (W) (8") (SLD)
- C THERMOPLASTIC PAV MRK TY I (W) (12") (SLD)
- D THERMOPLASTIC PAV MRK TY I (W) (24") (SLD)
- E THERMOPLASTIC PAV MRK TY I (W) (ARROW)
- F THERMOPLASTIC PAV MRK TY I (W) (WORD)
- G REFLECTORIZED YELLOW PAINT FOR ESPLANADE (ER-ER)
- H REFL PAV MRK TY I-C-R
- I REFL PAV MRK TY II-C-R
- J NON-REFLECTORIZED WHITE RAISE TRAFFIC BUTTONS
- K THERMOPLASTIC PAV MRK TY I (W) (4") (SLD)
- L NOSE SURFACE COLORED BLACK

30 0 30

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SIGNING & PAVEMENT MARKING (1 OF 3)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 30'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SP01

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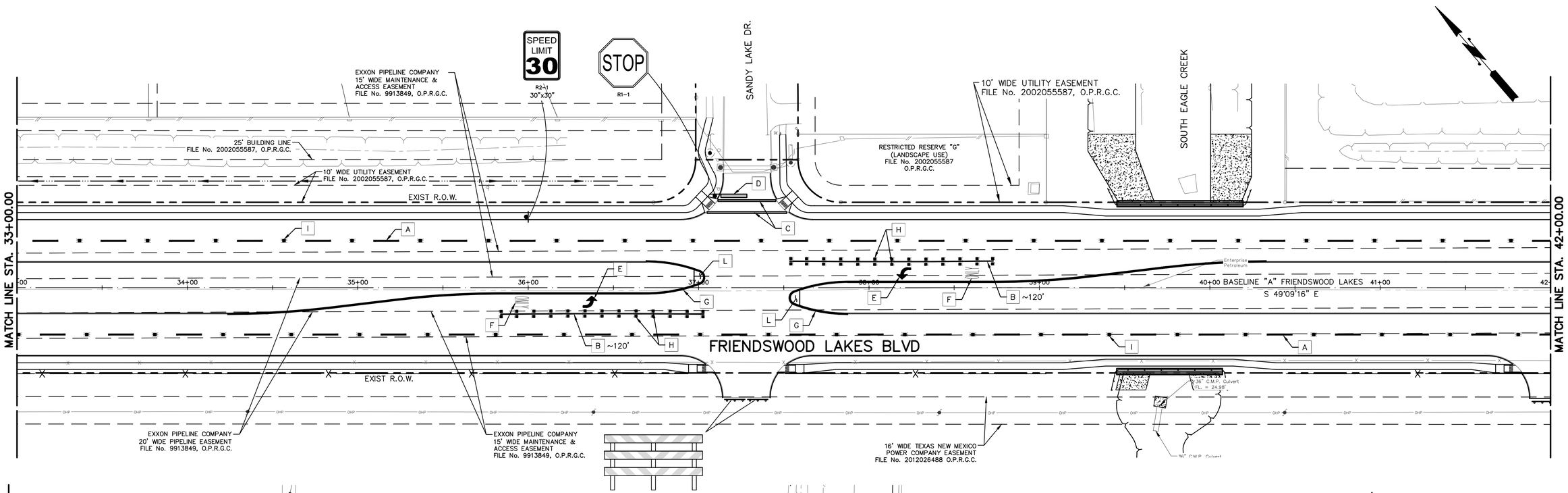

PAVEMENT MARKING LEGEND

- A THERMOPLASTIC PAV MRK TY I (W) (4") (BRKN)
- B THERMOPLASTIC PAV MRK TY I (W) (8") (SLD)
- C THERMOPLASTIC PAV MRK TY I (W) (12") (SLD)
- D THERMOPLASTIC PAV MRK TY I (W) (24") (SLD)
- E THERMOPLASTIC PAV MRK TY I (W) (ARROW)
- F THERMOPLASTIC PAV MRK TY I (W) (WORD)
- G REFLECTORIZED YELLOW PAINT FOR ESPLANADE (ER-ER)
- H REFL PAV MRK TY I-C-R
- I REFL PAV MRK TY II-C-R
- J NON-REFLECTORIZED WHITE RAISE TRAFFIC BUTTONS
- K THERMOPLASTIC PAV MRK TY I (W) (4") (SLD)
- L NOSE SURFACE COLORED BLACK

30 0 30

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SIGNING & PAVEMENT MARKING (2 OF 3)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 30'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SP02

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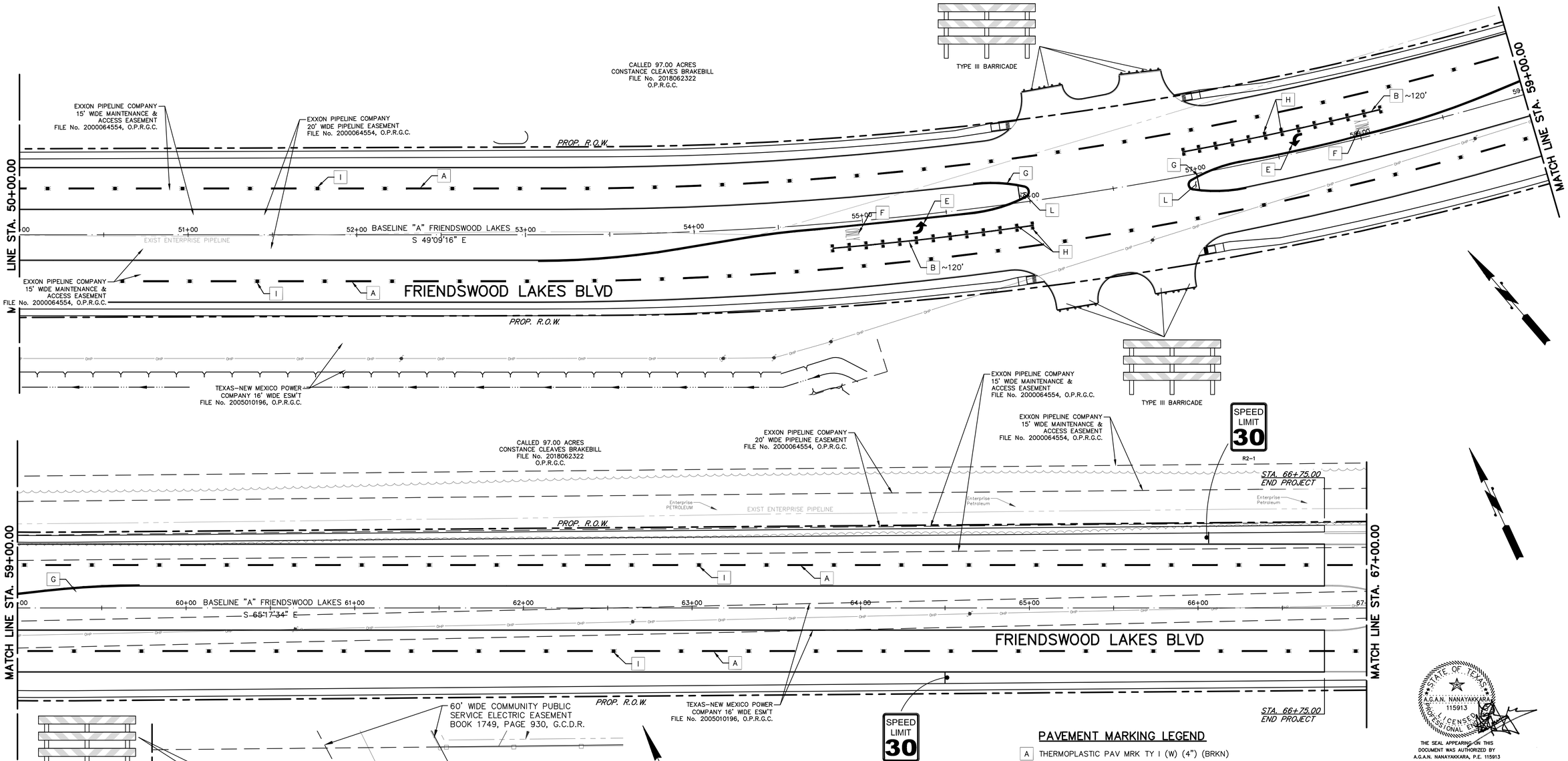

PAVEMENT MARKING LEGEND

A	THERMOPLASTIC PAV MRK TY I (W) (4") (BRKN)
B	THERMOPLASTIC PAV MRK TY I (W) (8") (SLD)
C	THERMOPLASTIC PAV MRK TY I (W) (12") (SLD)
D	THERMOPLASTIC PAV MRK TY I (W) (24") (SLD)
E	THERMOPLASTIC PAV MRK TY I (W) (ARROW)
F	THERMOPLASTIC PAV MRK TY I (W) (WORD)
G	REFLECTORIZED YELLOW PAINT FOR ESPLANADE (ER-ER)
H	REFL PAV MRK TY I-C-R
I	REFL PAV MRK TY II-C-R
J	NON-REFLECTORIZED WHITE RAISE TRAFFIC BUTTONS
K	THERMOPLASTIC PAV MRK TY I (W) (4") (SLD)
L	NOSE SURFACE COLORED BLACK

30 0 30

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

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ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

SIGNING & PAVEMENT MARKING (3 OF 3)

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 30'	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SP03

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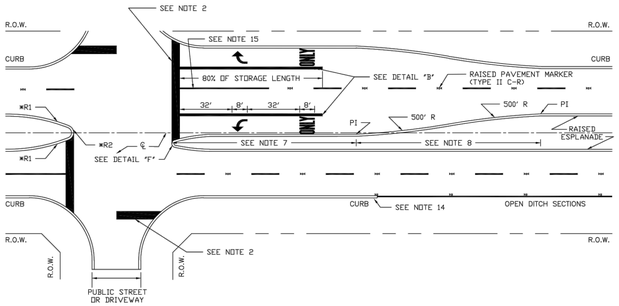
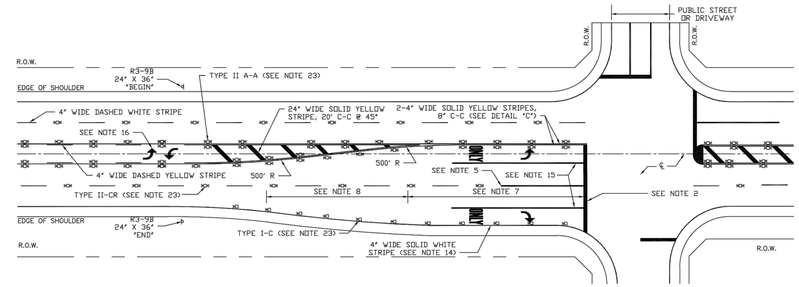
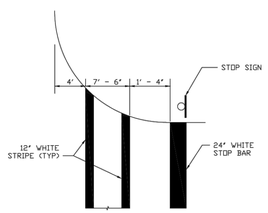


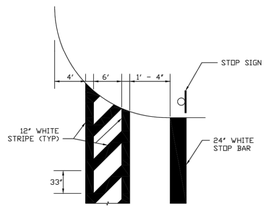
TYPICAL RAISED ESPLANADE SECTION



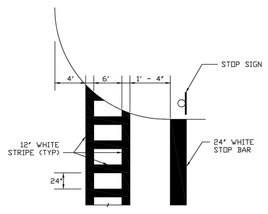
TYPICAL TWO-WAY LEFT TURN SECTION



STANDARD TYPE



SCHOOL ZONE TYPE 1

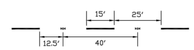


SCHOOL ZONE TYPE 2

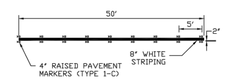
TYPICAL CROSSWALK PLACEMENT

ESPLANADE	*R1	*R2
<8'	N/A	W/2
8'-38'	90'	W/5
>38'	N/A	15'

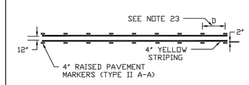
RADIUS DIMENSIONS



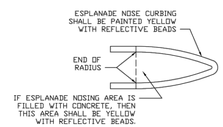
DETAIL A



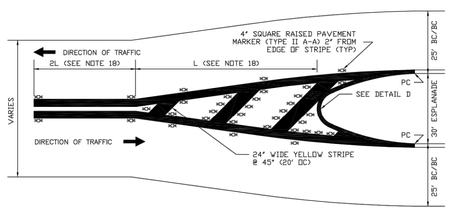
DETAIL B



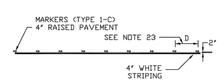
DETAIL C



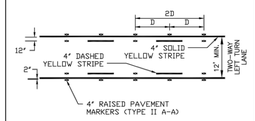
ESPLANADE NOSING PLAN VIEW



UNDIVIDED STREET TO ESPLANADE SECTION



DETAIL D



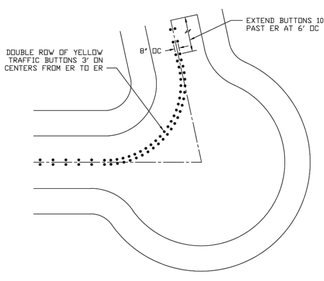
DETAIL E

TYPICAL CURB SECTION

DETAIL F

NOTE:

1. PAINT FROM THE BACK OF THE CURB TO THE GUTTER LINE.



TYPICAL BUTTON DETAIL FOR CURVES ≥ 60°

PERMANENT PAVEMENT MARKING CONSTRUCTION NOTES:

1. IF A CROSSWALK IS REQUIRED, SEE TYPICAL CROSSWALK PLACEMENT DETAIL AND CONFIRM WITH CITY TYPE TO BE USED AND LOCATION OF CROSSWALK.
2. ALL INTERSECTIONS WHERE A STOP SIGN/SIGNAL IS LOCATED SHALL HAVE A STOP BAR. STOP BARS SHALL BE LOCATED 4'-0" BEHIND CROSSWALKS, WHERE PEDESTRIAN CROSSWALKS ARE PROVIDED. STOP BARS SHALL BE 24" WIDE SOLID WHITE STRIPE EXTENDING ACROSS ALL APPROACH LANES TO INDICATE THE POINT AT WHICH THE STOP IS INTENDED OR REQUIRED TO BE MADE.
3. CROSSWALKS SHALL BE A MINIMUM INSIDE WIDTH OF 5', AT LOCATIONS WHERE ADDITIONAL VISIBILITY IS REQUIRED, WHERE TRAFFIC CONTROL DEVICES ARE NOT PRESENT, CONTINENTAL TYPE CROSSWALKS SHALL BE USED.
4. NOT ALL INTERSECTIONS ARE FOUR-WAY STOP CONTROLLED. AS SUCH, NOT ALL STRIPING AND MARKINGS MAY APPLY.
5. ON APPROACH TO INTERSECTION – BEGINNING WITH STOP BAR, INSTALL A 4" WIDE SOLID WHITE LINE FOR 50' FROM BACK OF STOP BAR, SKIP 25' AND BEGIN NORMAL LANE LINE.
6. ON EXIT FROM INTERSECTION – BEGINNING WITH THE CROSSWALK, OR 12' FROM CURB LINE OF INTERSECTING STREET, INSTALL 4" SOLID WHITE LINE FOR 50' AND BEGIN NORMAL LANE LINE.
7. TURN STORAGE BAYS SHALL BE A MINIMUM OF 100' FOR MINOR STREETS AND 150' FOR MAJOR STREETS.
8. TRANSITIONS TO STORAGE BAYS SHALL BE A MINIMUM OF 100', THOUGH 160' IS DESIRABLE.
9. ALL STREET CROSSINGS SHALL COMPLY WITH T.A.S AND A.D.A DETAILS AND CRITERIA.
10. PAVEMENT SURFACE AREAS PRIOR TO PLACEMENT OF PAVEMENT MARKINGS, AND/OR RAISED PAVEMENT MARKERS SHALL BE CLEANED IN ACCORDANCE WITH CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS (CDFTS). AREAS SHALL BE FREE OF CURING MEMBRANE, DIRT, GREASE, LOOSE AND/OR FLAKING EXISTING MARKERS AND OTHER FORMS OF DEBRIS. SURFACES SHALL BE DRY BEFORE APPLYING PAVEMENT MARKINGS OR RAISED PAVEMENT MARKERS.
    - 10.1. CONCRETE SURFACES SHALL BE CLEANED BY ABRASIVE BLASTING MEDIUM.
    - 10.2. ASPHALTIC PAVEMENT SURFACES SHALL BE CLEANED BY BRUSHING,WASHING, COMPRESSED AIR, AND/OR HIGH-PRESSURE WATER.
11. ALL PAVEMENT MARKINGS AT INTERSECTIONS SHALL BE THERMOPLASTIC IN ACCORDANCE WITH C.O.F.T.S. APPROVED PRODUCTS LIST.
12. ALL PAVEMENT MARKINGS SHALL BE SHOWN ON THE APPROVED CONSTRUCTION PLANS. ALL PAVEMENT MARKINGS SHALL BE RETRO-REFLECTIVE MATERIAL APPLIED TO ROAD SURFACE IN A MOLTEN STATE BY SCREED/EXTRUSION, SUSPENDED EXTRUSION OR SPRAY MEANS, WITH A SURFACE APPLICATION OF GLASS BEADS.
13. ALL ESPLANADE NOSING, AND CURBS IN LEFT TURN STORAGE BAYS SHALL BE PAINTED WITH YELLOW REFLECTORIZED PAINT AND SHALL COMPLY WITH T.M.U.T.C.D., A.D.A, T.A.S, AND C.O.F.T.S STANDARDS, AND ALL REVISIONS THEREOF.
14. ALL ROADWAYS WITHOUT A CURB SHALL HAVE A 4" SOLID WHITE REFLECTORIZED STRIPE 12" INSIDE THE EDGE OF THE PAVEMENT (SEED DETAIL D).
15. INTERSECTIONS HAVING TWO LANES IN ONE DIRECTION SHALL SEPARATE LANES BY INSTALLING AN 8" SOLID WHITE STRIPE FROM STOP BAR TO EIGHTY PERCENT (80%) OF TURN STORAGE BAY LENGTH (SEE DETAIL B).
16. REPEAT CENTER TURN ARROWS AT APPROXIMATELY EVERY 1000' THROUGHOUT TWO-WAY CENTER TURN LANE.
17. ALL PAVEMENT MARKINGS, AND/OR RAISED PAVEMENT MARKERS SHALL COMPLY WITH T.M.U.T.C.D., A.D.A., T.A.S., AND C.O.F.T.S. AND ALL REVISIONS THEREOF.
18. TRANSITIONS FROM UNDIVIDED TO DIVIDED AND/OR ESPLANADE SECTIONS:
    - 18.1 FOR SPEEDS 45 MPH AND GREATER USE L=W*S.
    - 18.2 S = POSTED OR STATUTORY SPEED LIMIT.
    - 18.3 W = WIDTH OF CENTER LANE OR ESPLANADE OR OFFSET DISTANCE.
    - 18.4 MINIMUM L IN URBAN AREAS SHALL BE 100'.
    - 18.5 MINIMUM L IN RURAL AREAS SHALL BE 200'.
    - 18.6L SHALL BE EXTENDED AS REQUIRED FOR SIGHT DISTANCE CONDITIONS.
19. THE COLOR OF RAISED PAVEMENT MARKERS UNDER DAYLIGHT AND NIGHTTIME CONDITIONS SHALL CONFORM TO THE COLOR OF THE MARKING FOR WHICH THEY SERVE AS A POSITIONING GUIDE OR FOR WHICH THEY SUPPLEMENT OR SUBSTITUTE.
20. ALL TRAFFIC BUTTONS AND RAISED PAVEMENT MARKERS SHALL BE INSTALLED ADJACENT TO STRIPES AT APPROXIMATELY 2" FROM EDGE OF BUTTON/MARKER TO STRIPE.
21. ALL BUTTONS AND RAISED PAVEMENT MARKERS SHALL BE INSTALLED WITH AN APPROVED EPOXY.
22. A BLUE REFLECTORIZED RAISED PAVEMENT MARKER (TYPE II B-B) SHALL BE SET 6" OFF CENTERLINE OF ROADWAY OR PAVEMENT STRIP ON THE ADJACENT SIDE OF ALL FIRE HYDRANTS.
23. SPACING OF RAISED PAVEMENT MARKERS TYPE II A-A, TYPE II C-R AND TYPE I-C:
    - 23.1 IN STORAGE BAYS AND TRANSITIONS TO STORAGE BAYS D=5' O.C.
    - 23.2 IN CURVES D=20' O.C.
    - 23.3 IN NORMAL ROADWAY D=40' O.C.
24. ALL MARKINGS SHALL HAVE A UNIFORM CROSS-SECTION, AND THE DENSITY AND QUALITY OF THE MARKINGS SHALL BE UNIFORM THROUGHOUT THEIR THICKNESS.
25. PAVEMENT MARKINGS, BUTTONS AND RAISED PAVEMENT MARKERS THAT ARE NOT IN ALIGNMENT OR SEQUENCE, AS SHOWN IN THE DRAWINGS OR STATED IN THE PROJECTS' SPECIFICATIONS SHALL BE REMOVED AND REPLACED AT THE CONTRACTORS' EXPENSE.
26. FOR SKEW INTERSECTIONS AND STREET WIDTHS NOT SHOWN, COORDINATE WITH THE C.O.F. DEPARTMENT OF PUBLIC WORKS, ENGINEERING DIVISION AT (281) 996-3380.

PERMANENT PAVEMENT MARKING STANDARD DETAILS			DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION		
FILE NAME: PPMSD – 2017.DWG	DATE APPROVED: JULY 1, 2017			PROJECT NUMBER:	DATE SUBMITTED:	SHEET: XX OF XX
	SCALE: NTS	REVISED DATE: JUNE 2017				

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

PERMANENT PAVEMENT MARKING DETAILS

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: N.T.S.	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET SP04

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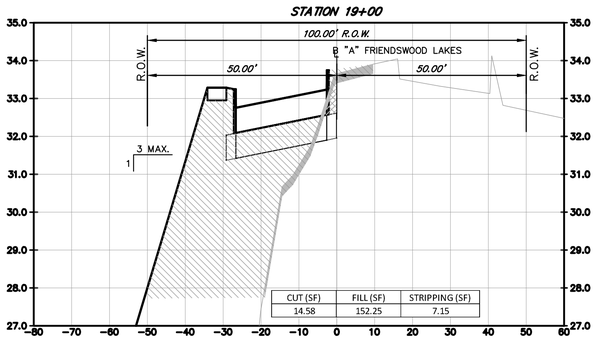
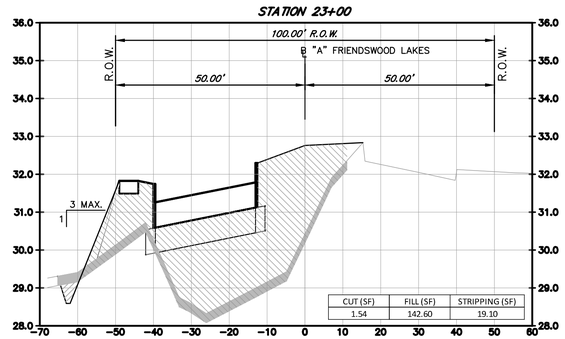
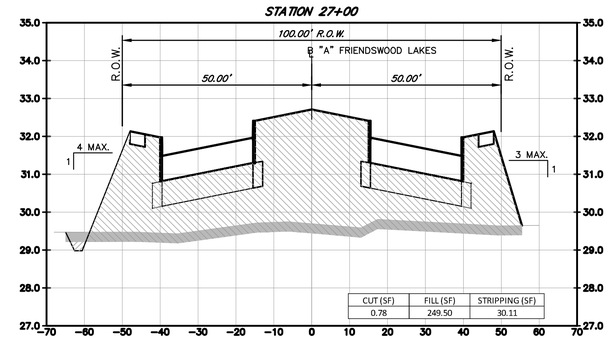
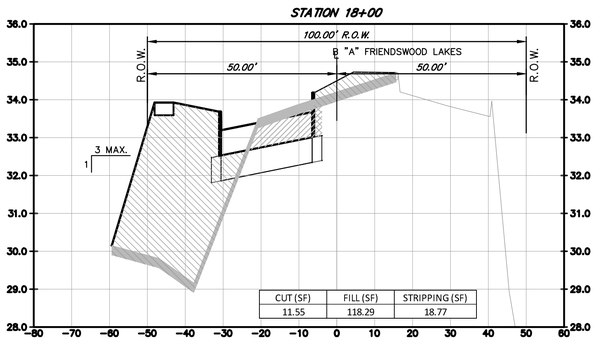
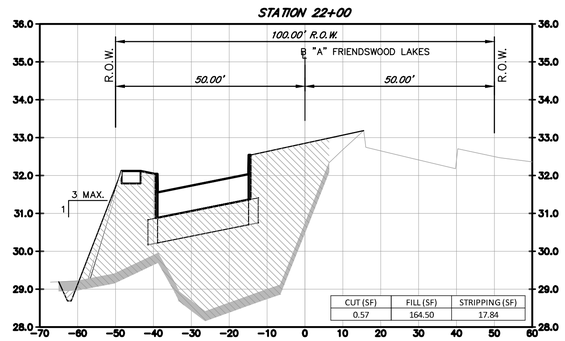
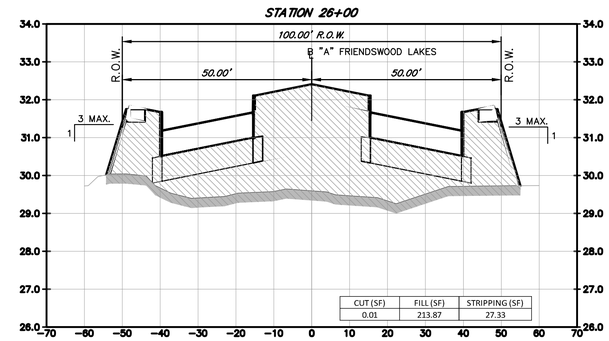


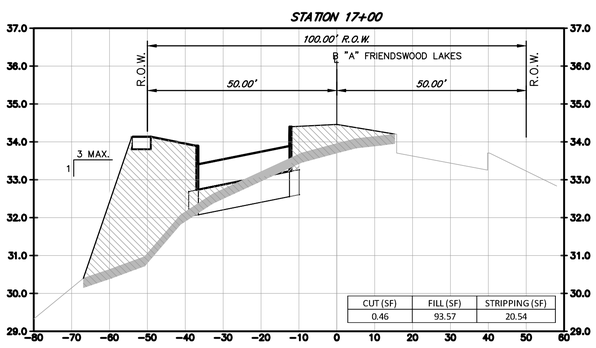


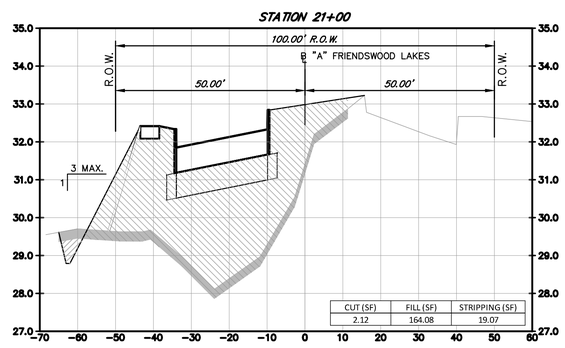


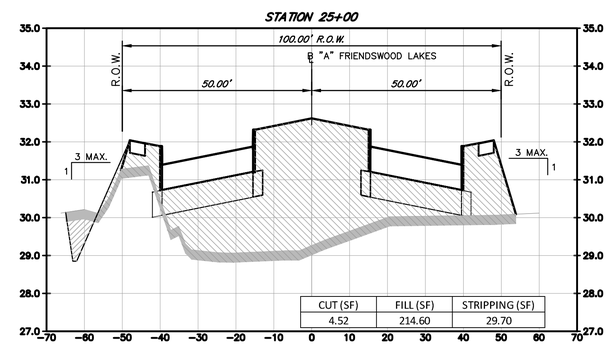


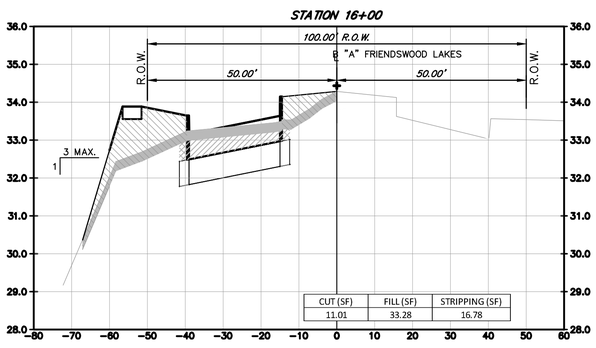


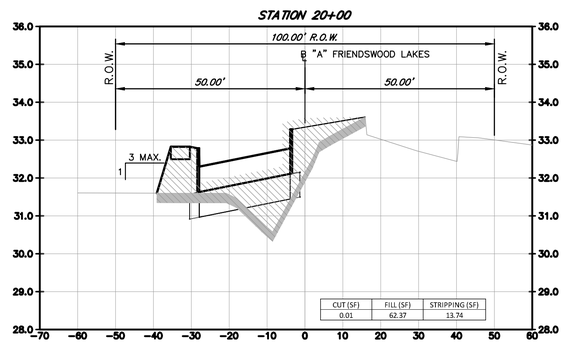


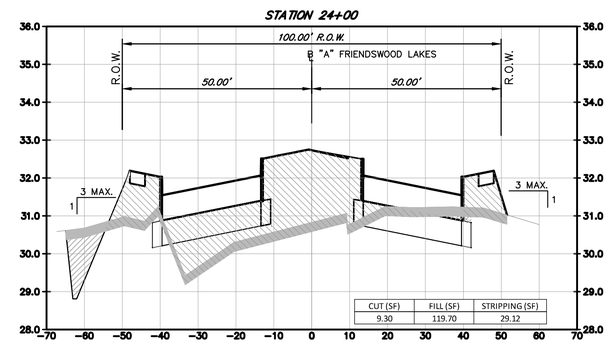












LEGEND

- 3" STRIPPING
- EMBANKMENT AREA
- ROADWAY EXCAVATION

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

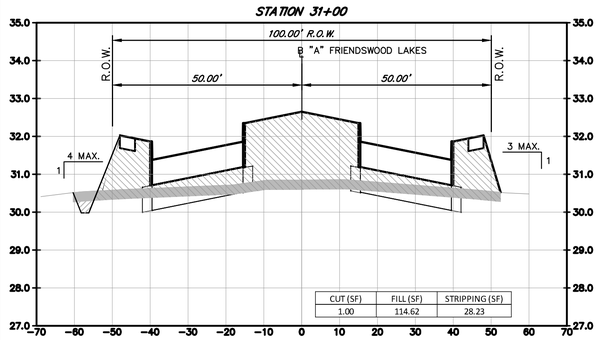
CROSS-SECTIONS
STA. 16+00 TO STA. 27+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET CS01

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\Xreference\C3D_Data\FW-Model-CrossSec.dwg May 27, 2020-10:47am Terra Associates Inc., Thanh Dao



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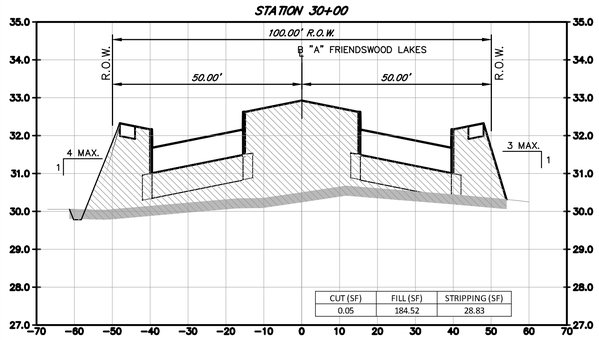

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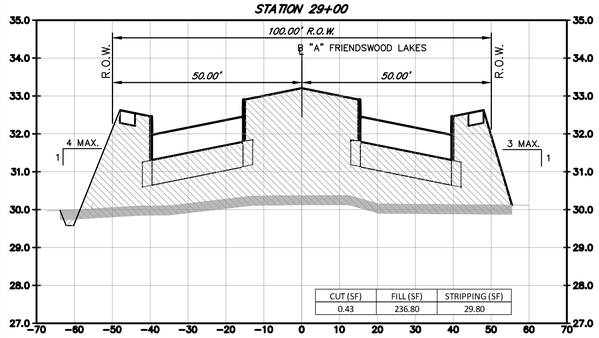

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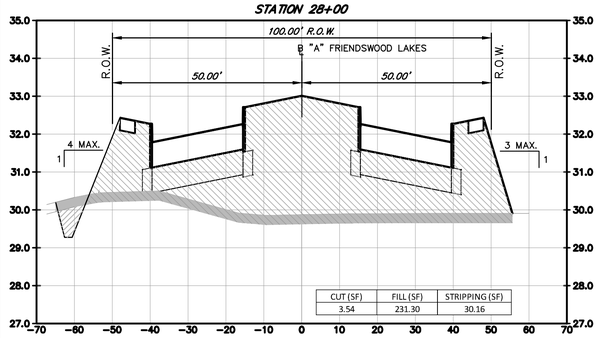

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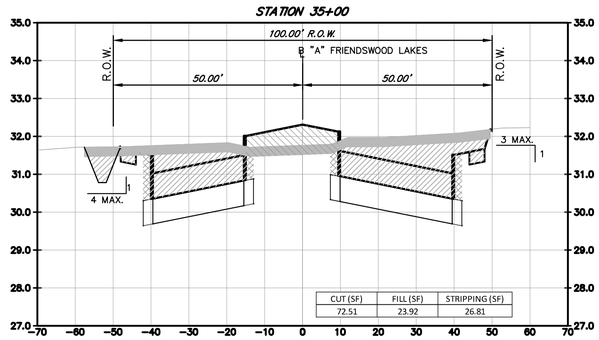

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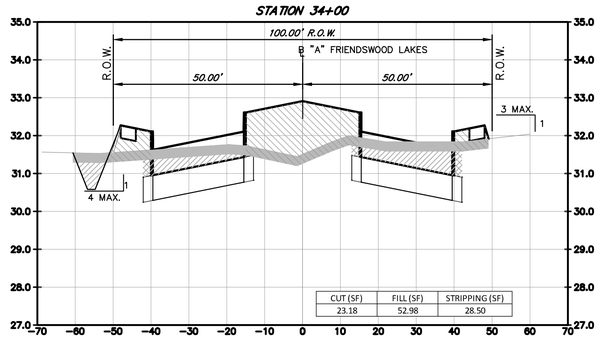

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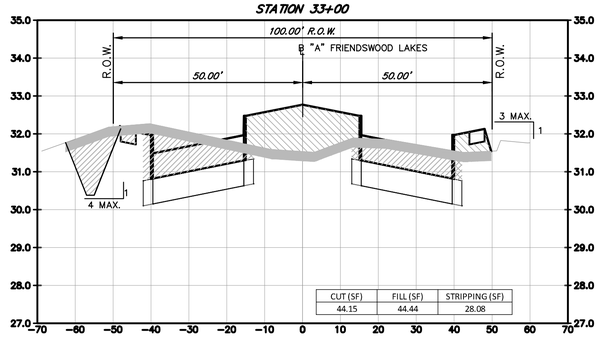
23.18	52.98	28.50



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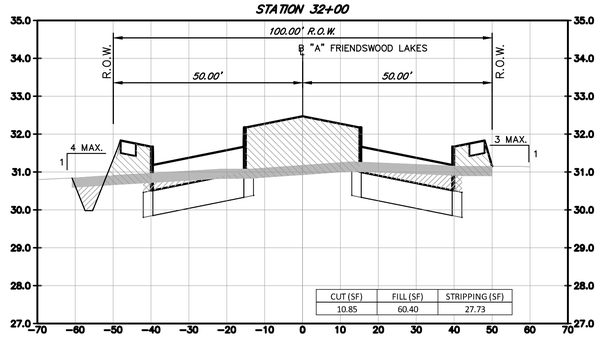

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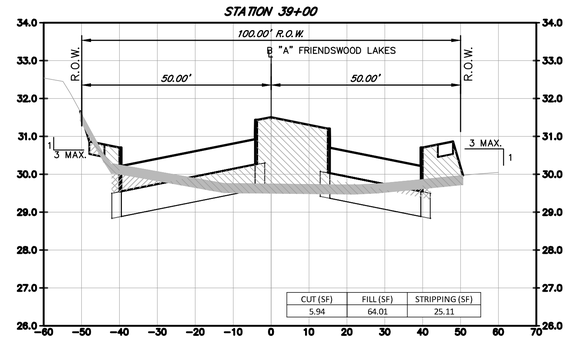

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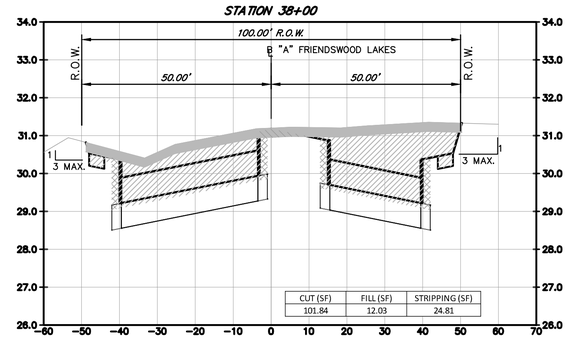

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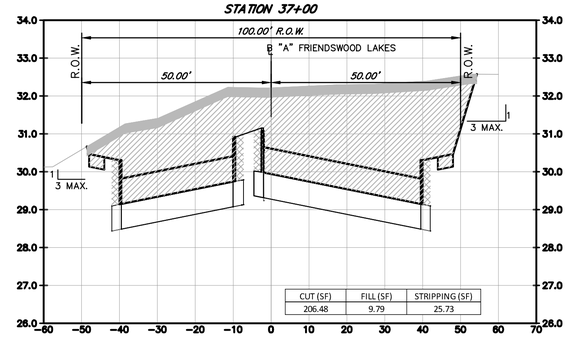

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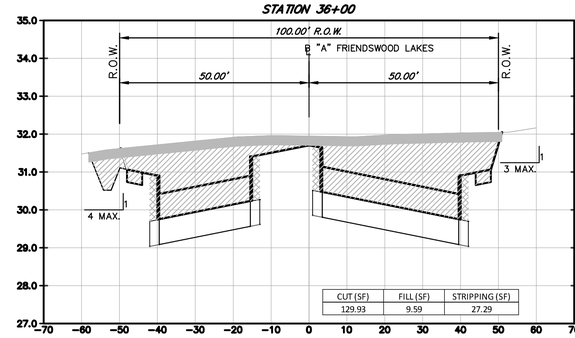
206.48	9.79	25.73



CUT (SF)	FILL (SF)	STRIPPING (SF)
129.93	9.59	27.29

LEGEND

- 3" STRIPPING
- EMBANKMENT AREA
- ROADWAY EXCAVATION

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

CROSS-SECTIONS
STA. 28+00 TO STA. 39+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

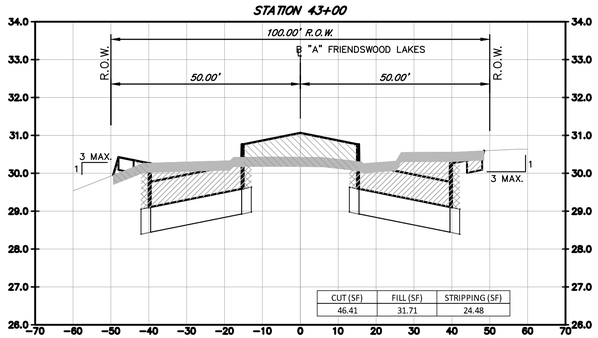
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET CS02

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\Xreference\C3D_Data\FW-Model-CrossSec.dwg May 27, 2020-10:47am Terra Associates Inc., Thanh Dao

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\Xreference\C3D_Data\FW-Model-CrossSec.dwg May 27, 2020-10:47am Terra Associates Inc., Thanh Dao

STATION 43+00



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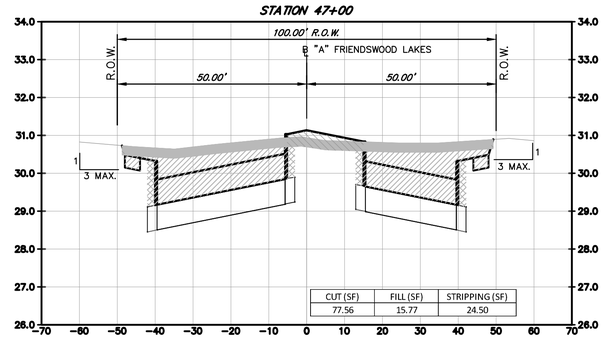
46.41	31.71	24.48

STATION 47+00



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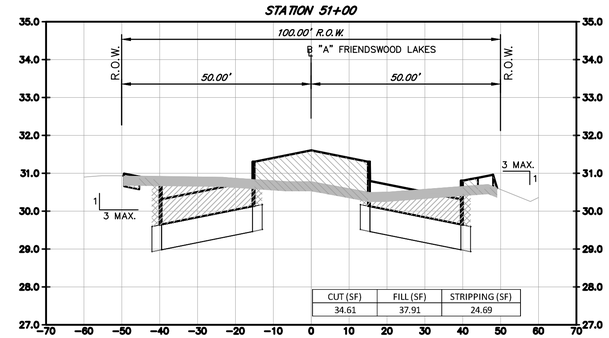

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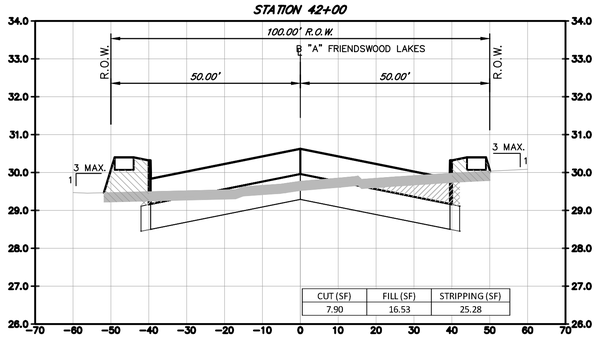
STATION 42+00



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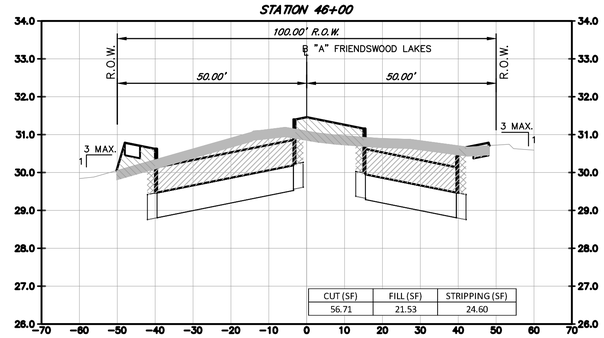
7.90	16.53	25.28

STATION 46+00



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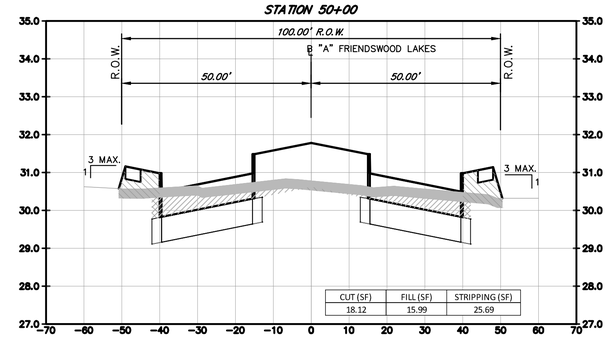
STATION 50+00



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18.12	15.99	25.69

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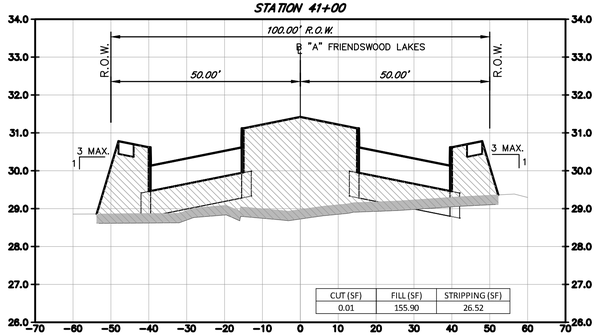

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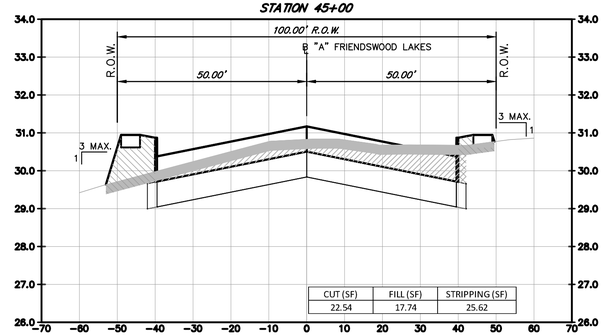

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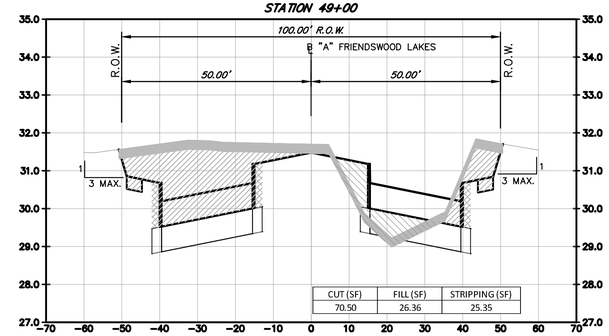
22.54	17.74	25.62

STATION 49+00



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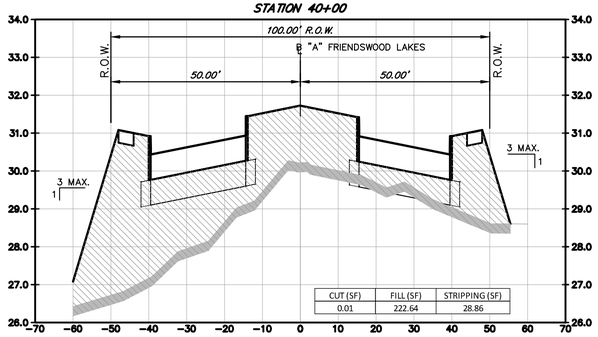

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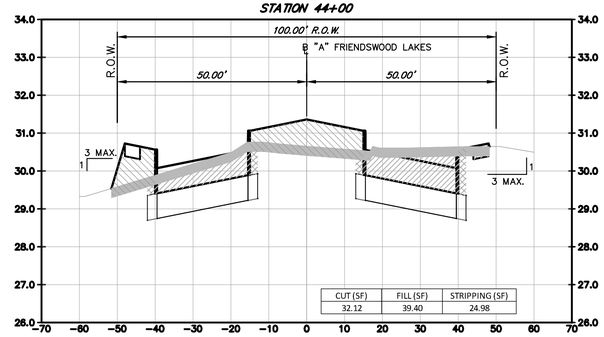

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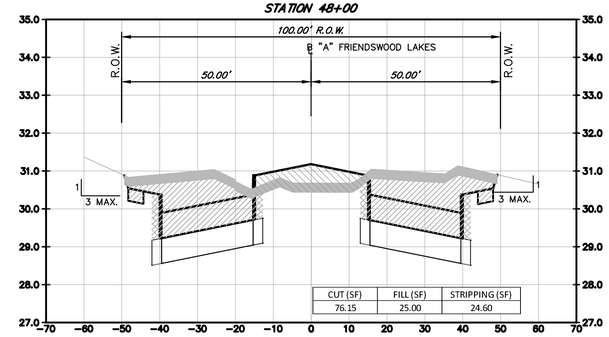


CUT (SF)	FILL (SF)	STRIPPING (SF)
76.15	25.00	24.60

LEGEND

- 3" STRIPPING
- EMBANKMENT AREA
- ROADWAY EXCAVATION

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

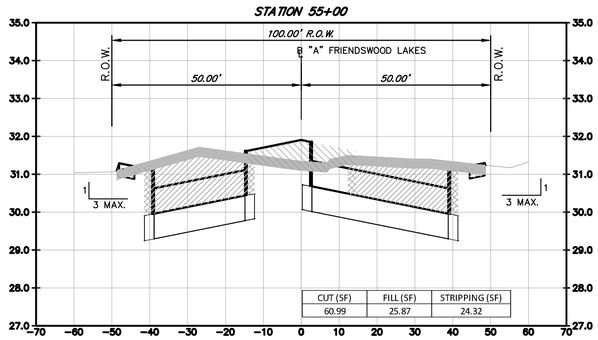
FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

CROSS-SECTIONS
STA. 40+00 TO STA. 51+00

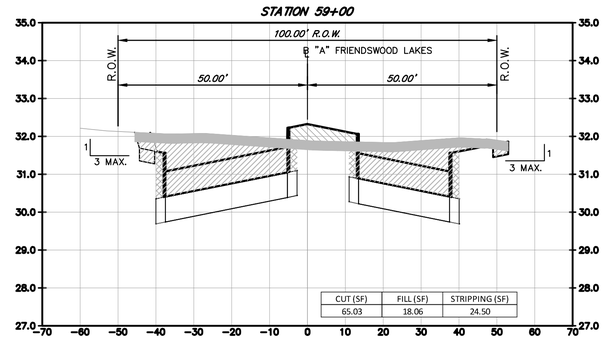
TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

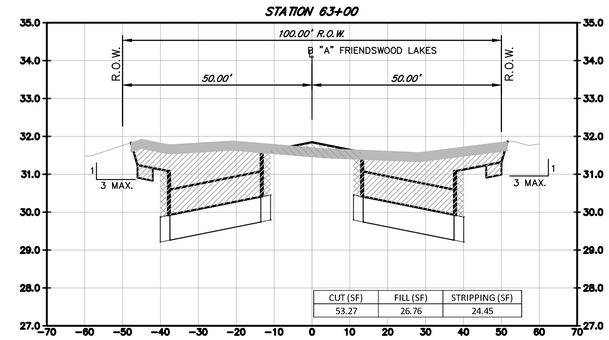
DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET CS03



CUT (SF)	FILL (SF)	STRIPPING (SF)
60.99	25.87	24.32



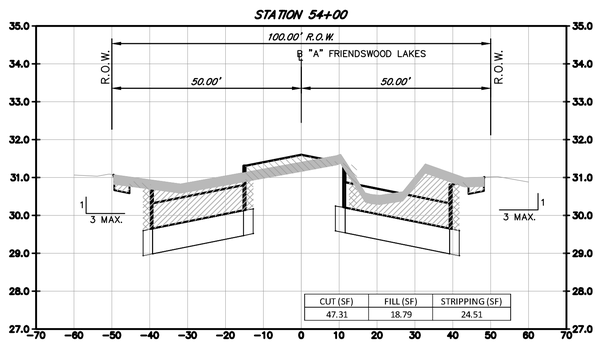
CUT (SF)	FILL (SF)	STRIPPING (SF)
65.03	18.06	24.50



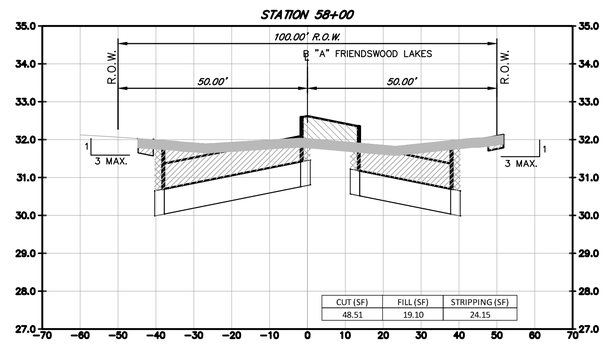
CUT (SF)	FILL (SF)	STRIPPING (SF)
53.27	26.76	24.45

LEGEND

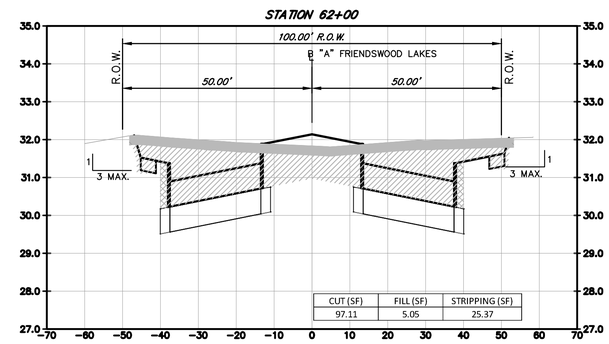
- 3" STRIPPING
- EMBANKMENT AREA
- ROADWAY EXCAVATION



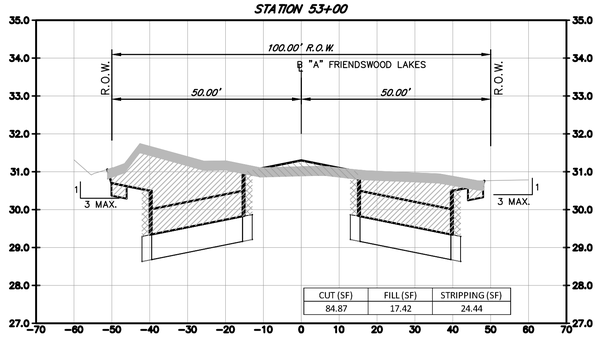
CUT (SF)	FILL (SF)	STRIPPING (SF)
47.31	18.79	24.51



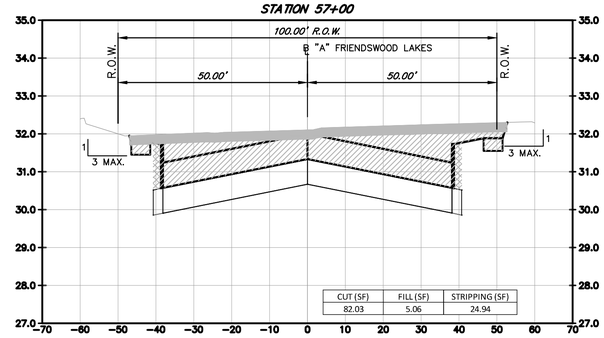
CUT (SF)	FILL (SF)	STRIPPING (SF)
48.51	19.10	24.15



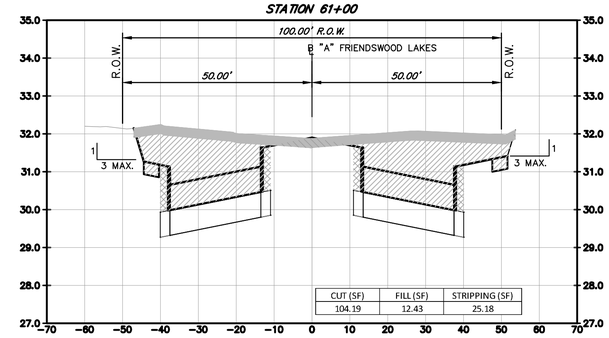
CUT (SF)	FILL (SF)	STRIPPING (SF)
97.11	5.05	25.37



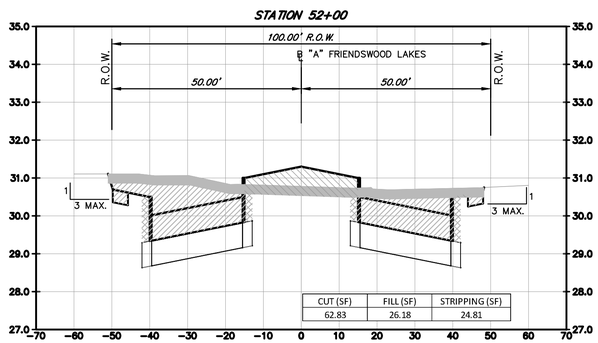
CUT (SF)	FILL (SF)	STRIPPING (SF)
84.87	17.42	24.44



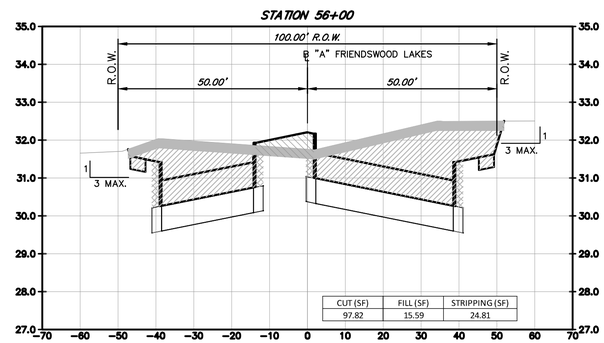
CUT (SF)	FILL (SF)	STRIPPING (SF)
82.03	5.06	24.94



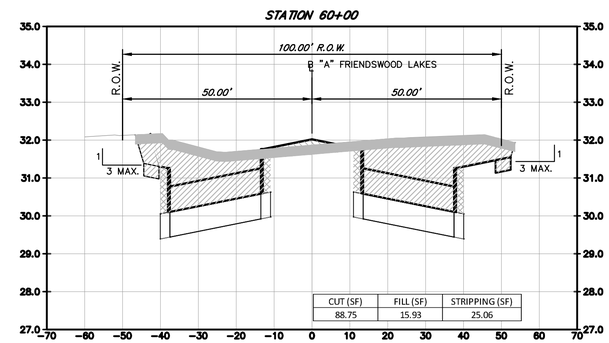
CUT (SF)	FILL (SF)	STRIPPING (SF)
104.19	12.43	25.18



CUT (SF)	FILL (SF)	STRIPPING (SF)
62.83	26.18	24.81



CUT (SF)	FILL (SF)	STRIPPING (SF)
97.82	15.59	24.81



CUT (SF)	FILL (SF)	STRIPPING (SF)
88.75	15.93	25.06

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

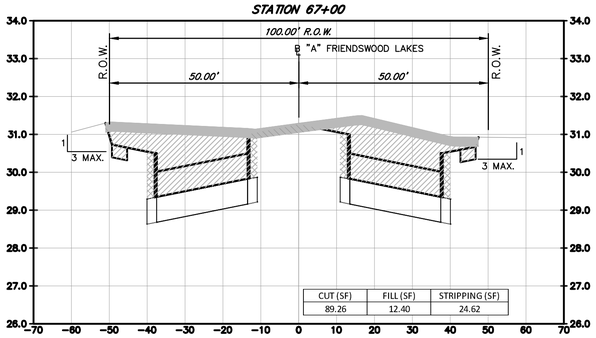
CROSS-SECTIONS
STA. 52+00 TO STA. 63+00

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS
1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET CS04

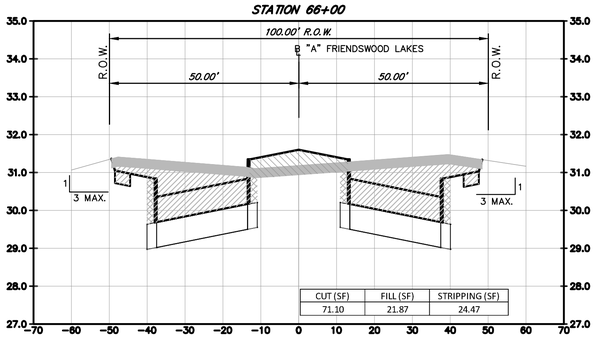
F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\Xreference\C3D_Data\FW-Model-CrossSec.dwg May 27, 2020-10:48am Terra Associates Inc., Thanh Dao

STATION 67+00



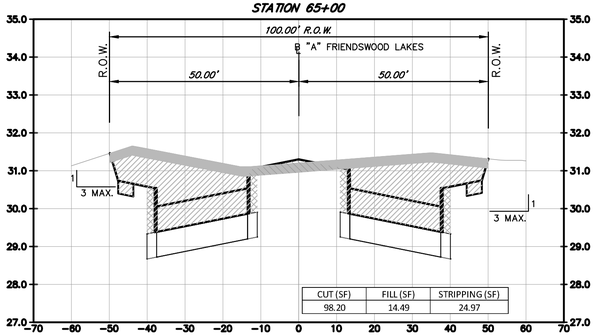
CUT (SF)	FILL (SF)	STRIPPING (SF)
89.26	12.40	24.62

STATION 66+00



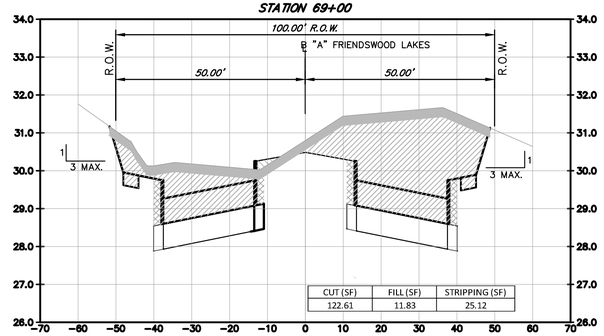
CUT (SF)	FILL (SF)	STRIPPING (SF)
71.10	21.87	24.47

STATION 65+00



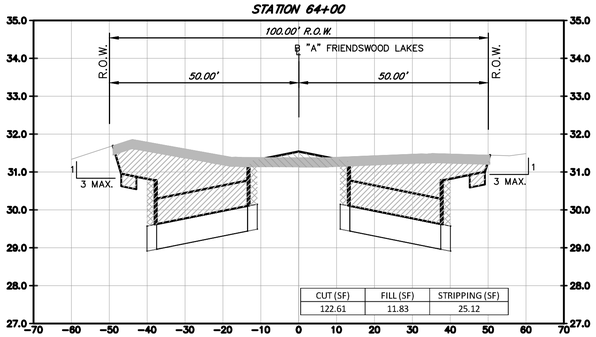
CUT (SF)	FILL (SF)	STRIPPING (SF)
98.20	14.49	24.97

STATION 69+00



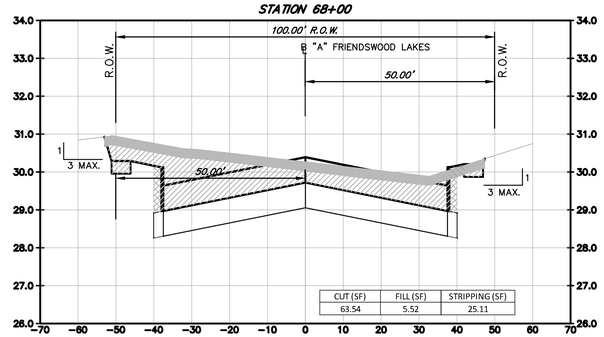
CUT (SF)	FILL (SF)	STRIPPING (SF)
122.61	11.83	25.12

STATION 64+00



CUT (SF)	FILL (SF)	STRIPPING (SF)
122.61	11.83	25.12

STATION 68+00



CUT (SF)	FILL (SF)	STRIPPING (SF)
63.54	5.52	25.11

LEGEND

- 3" STRIPPING
- EMBANKMENT AREA
- ROADWAY EXCAVATION

STATE OF TEXAS
A.G.A.N. NANAYAKKARA
115913
LICENSED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

CROSS-SECTIONS
STA. 64+00 TO END

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H, 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET CS05

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\Xreference\C3D_Data\FW-Model-CrossSec.dwg May 27, 2020-10:48am Terra Associates Inc., Thanh Dao

F:\Clients\0600-Galveston County\0600-1901 Friendswood Lake Blvd\Drawings\Xreference\C3D_Data\FW-Model-CrossSec.dwg May 27, 2020-10:48am Terra Associates Inc., Thanh Dao

FRIENDSWOOD LAKES BLVD EARTHWORK QUANTITIES WORKSHEET

	Cross Sectional Areas			Average Cross Sectional Areas			Distance Between Stations	Volumes		
Station	Roadway Excavation [SF]	Embankment Area [SF]	3" Stripping [SF]	Average Total Roadway Excavation [SF]	Average Embankment Area [SF]	Average 3" Stripping [SF]	Distance Between Stations [FT]	ITEM 110 ROADWAY EXCAVATION [CY] - *PAY*	STRIPPING [CY]	ROADWAY EMBANKMENT [CY]
	AR	***BR***	***CR***	***FR***	***GR***	***HR***	***KR***	***LR***	***MR***	***QR***
ROADWAY										
16+00	11.01	33.28	16.78							
				5.74	63.43	18.66	100	21	69	235
17+00	0.46	93.57	20.54							
				6.00	105.93	19.66	100	22	73	392
18+00	11.55	118.29	18.77							
				13.06	135.27	12.96	100	48	48	501
19+00	14.58	152.25	7.15							
				7.29	107.31	10.45	100	27	39	397
20+00	0.01	62.37	13.74							
				1.06	113.23	16.41	100	4	61	419
21+00	2.12	164.08	19.07							
				1.35	164.29	18.45	100	5	68	608
22+00	0.57	164.50	17.84							
				1.05	153.55	18.47	100	4	68	569
23+00	1.54	142.60	19.10							
				5.42	131.15	24.11	100	20	89	486
24+00	9.30	119.70	29.12							
				6.91	167.15	29.41	100	26	109	619
25+00	4.52	214.60	29.70							
				2.26	214.24	28.52	100	8	106	793
26+00	0.01	213.87	27.33							
				0.39	231.69	28.72	100	1	106	858
27+00	0.78	249.50	30.11							
				2.16	240.40	30.13	100	8	112	890
28+00	3.54	231.30	30.16							
				1.98	234.05	29.98	100	7	111	867
29+00	0.43	236.80	29.80							
				0.24	210.66	29.31	100	1	109	780
30+00	0.05	184.52	28.83							
				0.53	149.57	28.53	100	2	106	554
31+00	1.00	114.62	28.23							
				5.93	87.51	27.98	100	22	104	324
32+00	10.85	60.40	27.73							
				27.50	52.42	27.90	100	102	103	194
33+00	44.15	44.44	28.08							
				33.66	48.71	28.29	100	125	105	180
34+00	23.18	52.98	28.50							
				47.84	38.45	27.65	100	177	102	142
35+00	72.51	23.92	26.81							
				101.22	16.75	27.05	100	375	100	62
36+00	129.93	9.59	27.29							
				168.21	9.69	26.51	100	623	98	36
37+00	206.48	9.79	25.73							
				154.16	10.91	25.27	100	571	94	40
38+00	101.84	12.03	24.81							
				53.89	38.02	24.96	100	200	92	141
39+00	5.94	64.01	25.11							
				2.97	143.32	26.98	100	11	100	531
40+00	0.01	222.64	28.86							
				0.01	189.27	27.69	100	0	103	701
41+00	0.01	155.90	26.52							
				3.95	86.21	25.90	100	15	96	319
42+00	7.90	16.53	25.28							
				27.15	24.12	24.88	100	101	92	89
43+00	46.41	31.71	24.48							
				39.26	35.56	24.73	100	145	92	132
44+00	32.12	39.40	24.98							
				27.33	28.57	25.30	100	101	94	106
45+00	22.54	17.74	25.62							
				39.62	19.64	25.11	100	147	93	73
46+00	56.71	21.53	24.60							
				67.13	18.65	24.55	100	249	91	69

FRIENDSWOOD LAKES BLVD EARTHWORK QUANTITIES WORKSHEET

	Cross Sectional Areas			Average Cross Sectional Areas			Distance Between Stations	Volumes		
Station	Roadway Excavation [SF]	Embankment Area [SF]	3" Stripping [SF]	Average Total Roadway Excavation [SF]	Average Embankment Area [SF]	Average 3" Stripping [SF]	Distance Between Stations [FT]	ITEM 110 ROADWAY EXCAVATION [CY] - *PAY*	STRIPPING [CY]	ROADWAY EMBANKMENT [CY]
	AR	***BR***	***CR***	***FR***	***GR***	***HR***	***KR***	***LR***	***MR***	***QR***
ROADWAY										
47+00	77.56	15.77	24.50							
				76.85	20.38	24.55	100	285	91	75
48+00	76.15	25.00	24.60							
				73.32	25.68	24.97	100	272	92	95
49+00	70.50	26.36	25.35							
				44.31	21.17	25.52	100	164	95	78
50+00	18.12	15.99	25.69							
				26.37	26.95	25.19	100	98	93	100
51+00	34.61	37.91	24.69							
				48.72	32.05	24.75	100	180	92	119
52+00	62.83	26.18	24.81							
				73.85	21.80	24.63	100	274	91	81
53+00	84.87	17.42	24.44							
				66.09	18.11	24.47	100	245	91	67
54+00	47.31	18.79	24.51							
				54.15	22.33	24.41	100	201	90	83
55+00	60.99	25.87	24.32							
				79.40	20.73	24.56	100	294	91	77
56+00	97.82	15.59	24.81							
				89.93	10.33	24.87	100	333	92	38
57+00	82.03	5.06	24.94							
				65.27	12.08	24.54	100	242	91	45
58+00	48.51	19.10	24.15							
				56.77	18.58	24.32	100	210	90	69
59+00	65.03	18.06	24.50							
				76.89	16.99	24.78	100	285	92	63
60+00	88.75	15.93	25.06							
				96.47	14.18	25.12	100	357	93	53
61+00	104.19	12.43	25.18							
				100.65	8.74	25.27	100	373	94	32
62+00	97.11	5.05	25.37							
				90.98	10.36	25.11	100	337	93	38
63+00	84.85	15.67	24.85							
				87.83	15.96	24.87	100	325	92	59
64+00	90.82	16.25	24.88							
				94.51	15.37	24.93	100	350	92	57
65+00	98.20	14.49	24.97							
				84.65	18.18	24.72	100	314	92	67
66+00	71.10	21.87	24.47							
				80.18	17.14	24.54	100	297	91	63
67+00	89.26	12.40	24.62							
							Roadway Totals:	**8,602**	**4,669**	**13,470**

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY A.G.A.N. NANAYAKKARA, P.E. 115913

ON MAY 27, 2020

REV.NO.	DESCRIPTION	DATE	APP.

FRIENDSWOOD LAKES BLVD
STONEY LAKE DR TO WEST BLVD

EARTH WORK QUANTITIES

TERRA ASSOCIATES, INC.
CONSULTING ENGINEERS
LANDSCAPE ARCHITECTS

1445 N. LOOP WEST – SUITE 450
HOUSTON, TEXAS 77008
713-993-0333
TBPE Registration No.: F-003832

DRAWN BY: T.D.	SCALE: 1" = 20' H 1" = 2' V	PROJECT No. 0600-1901 CONTRACT: 1
CHECKED BY: AGN	DATE: MAY, 2020	SHEET CS06