THE COUNTY OF GALVESTON

RUFUS G. CROWDER, CPPO, CPPB
PURCHASING AGENT

GWEN MCLAREN, CPPB
ASST. PURCHASING AGENT

COUNTY COURTHOUSE
722 Moody (21st Street)
Fifth (5th) Floor
GALVESTON, TEXAS 77550

July 21, 2020

PROJECT NAME: Gum Bayou Tributary Channel Improvements

SOLICITATION NO: ITB #B201034

RE: ADDENDUM #1

To All Prospective Bidders:

The following information is being provided to aid in preparation of your bid submittal(s):

Question #1: ***It appears that spec 501 is missing. Please advise.***

Response: Spec 501 is attached to this addendum.

Question #2: ***What is the estimated start date of the project?***

Response: Construction is expected to start in late August 2020.

As a reminder, all questions regarding this bid must be submitted in writing to:

Rufus G. Crowder, CPPO CPPB
Galveston County Purchasing Agent
722 Moody, Fifth (5th) Floor
Galveston, Texas 77550
E-mail: purchasing.bids@co.galveston.tx.us

If you have any further questions regarding this bid, please address them to Rufus Crowder, CPPO CPPB, Purchasing Agent, via e-mail at purchasing.bids@co.galveston.tx.us, or contact the Purchasing Department at (409) 770-5371.

Please excuse us for any inconvenience that this may have caused.

Sincerely,

Rufus G. Crowder, CPPO CPPB
Purchasing Agent
Galveston County

ITEM 501

TREE PROTECTION AND TRIMMING

501.1 Description. This item specifies the requirements for the protection and trimming of tree indicated by Galveston County to be preserved.

501.2 Quality Assurance. All tree removing, trimming and work within the tree's drip line shall be performed by or under the supervision of an arborist certified by the International Society of Arboriculture (ISA). The arborist shall indicate the trees that need to be removed, but no removal will be done without prior approval of the Engineer.

Reference standards applicable to this section are:

A. ASTM D2665, "Specification for Poly Vinyl Chloride (PVC), Plastic Drain, Waste and Vent Pipe and Fittings".

B. AWPA Standard U1, " Use Category System: User Specification for Treated Wood"

C. ANSI A300(Part 1), "Tree, Shrub and Other Woody Plant Maintenance – Standard Practices"

501.3 Job Conditions. The contractor shall protect each tree designated to be preserved with a tree protection fence, installed along the outside edge of the tree's canopy. The fencing shall be continuous between posts, shall be pulled taut prior to securing to posts, and shall be firmly attached to the posts with a minimum of 4 wire ties.

All tree protection fencing shall be installed prior to site work or construction activity. The fence shall be placed in a continuous alignment as shown on the tree protection plan or as approved by the Engineer.

Tree protection fencing shall be removed by the contractor unless otherwise directed by the Engineer, at no additional costs, upon completion of all construction activity in each work zone area. Tree protection fencing materials used in the first two work zone areas shall be removed and utilized in subsequent work zone areas. Materials and labor shall be paid for each linear foot of fencing installed in first two work areas. All fencing installed in subsequent work zone areas shall be paid for labor only.

Contractor shall not allow any vehicular traffic, parking of vehicles or stockpiling of excavated material or construction materials within 3-feet of the drip line of trees indicated to be preserved.

Construction equipment may operate within 3-feet of the drip line of a tree when necessary for the performance of indicated work; such operations shall be conducted with special care to avoid damaging the tree.

Water trees indicated to be preserved, as required to maintain their healthy growth during the course of construction operations (per Arborist recommendation).

501.4 Materials. Tree pruning compound shall be waterproof, antiseptic, elastic, and free of kerosene, coal tar, creosote, and other substances harmful to trees.

Topsoil shall be material free of clay, rock or gravel larger than 2-inches in any dimension, debris, waste, vegetation, and other deleterious matter.

Drainage fill shall be selected stone or gravel, graded to pass a 3-inch sieve and retained on a 1-inch sieve.

Physical barriers, if required, shall be constructed from the following material:

A. Wood Components: Number 2 Pine, pressure treated to prevent decay for one year in accordance with the requirements AWPA Standard U1, suitable for Use Category 4B.

B. Fence Material: Orange fence shall be made of high density polyethylene material and shall be minimum 0.6 mm thick weighing minimum of 14 pounds per 100-foot roll and is 4 feet high. Posts shall be made of fiberglass or steel and shall be 6 feet long (minimum).

C. Banding: Stainless steel or varnish coated carbon steel, 3/4-inch wide x 26 gauge.

D. PVC pipe shall conform to ASTM D2665 and be 4-inch o.d., nominal.

501.5 Execution. The Contractor shall protect tree root systems from damage due to noxious materials in solution caused by run-off or spillage during mixing and placement of construction materials, or drainage from stored materials.

The Contractor and/or any of the Contractor's workers shall not park vehicles under trees, nor perform vehicle maintenance under trees.

If required, remove branches from trees indicated to be preserved to clear for new construction. All cuts should be made sufficiently close to the parent limb or trunk without cutting into the branch collar or leaving a protruding stub, so that closure can readily start under normal conditions.

All lateral cuts shall be made back to a lateral that is at least 1/3 the diameter of the parent limb. Clean cuts shall be made at all times. Where directed by the Engineer, extend the pruning operation to restore the natural shape of the entire tree.

Cut branches and roots with sharp pruning instruments. Do not break or chop branches and roots. Paint cuts over 1/2-inch in size with tree pruning compound. Apply black latex paint to all fresh wounds on Oak (Quercus) species immediately after each cut is made.

501.6 Pruning. Pruning shall be completed by ISA (International Society of Arboriculture) certified arborist who has received training in proper pruning techniques. Prior to construction, all deciduous trees indicated to be preserved shall be pruned of new or recent growth to maintain the basic branching form of the trees. Extent of pruning shall be based upon the proximity of pavement to the trunk and the size of tree blockouts and the requirements for construction adjacent to the tree.

Trees having branches which extend to the ground at their outermost limit shall have such branches pruned to a height equal to the height of all vehicles requiring access below or around such trees. Provide minimum of 14 feet and maximum of 18 feet of vertical clearance over proposed street construction. The Contractor shall notify property owner in writing 48 hours prior to trimming or pruning any trees on private property for privately owned trees extended into County right-of-way.

Pruning shall be limited as much as possible to young branches. Care shall be taken to maintain older branches which provide the basic form of the tree.

501.7 Excavation Around Trees. Excavate within the drip line of trees only where indicated. Where trenching for utilities is required within drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots. Smaller roots which interfere with the installation of new work may be cut.

Where excavating for new construction is required within the drip line of trees, hand excavate to minimize damage to the root system. Provide sheeting at excavations if required. Use narrow spading forks and comb soil to expose roots.

Relocate roots in backfill areas wherever possible. If large main lateral roots are encountered, expose beyond excavating limits as required to bend and relocate without breaking. If roots are immediately adjacent to location of new construction and relocation is not practical, cut roots approximately 3-inches back from new construction.

Do not allow exposed roots to dry before permanent backfill is placed. Provide temporary earth cover, or pack with peat moss and wrap with burlap. Water and maintain exposed roots in moist condition and

temporarily support and protect from damage until permanently relocated and covered with earth.

Prune branches to balance loss to root system caused by damage or cutting, per arborist recommendations.

501.8 Grading and Filling Around Trees. Maintain the existing grade within the drip line of trees, unless otherwise indicated.

Where the existing grade is above the new finish grade around trees, carefully hand excavate within the drip line to new finish grade. Cut roots exposed by excavation and provide permanent protection as recommended by the certified arborist.

Where the existing grade is 3-inches or less below new finish grade, use a topsoil fill material. Place the topsoil in a single layer and do not compact. Hand grade to the required elevation.

Where existing grade is more than 6-inches below new finish grade, provide 1-inch, schedule 40 PVC pipe, 6-feet on centers around tree perimeter, at drip line for aeration of the root system.

501.9 Repair of Trees. Remove trees damaged by construction operations as soon as possible to prevent progressive deterioration. Repair work shall be subject to the approval of the Engineer.

Remove and replace dead or damaged trees which are determined by the certified arborist to be incapable of restoration to normal growth status.

501.10 Submittal Requirement. The contractor shall submit the qualifications of ISA certified arborist for Engineer's approval.

501.11 Measurement and Payment. Measurement and payment for tree protection and trimming shall be by the lump sum or by each in accordance with the bid proposal.

Removal of trees shall be paid for as provided in the bid proposal in accordance with Item 102, "Clearing and Grubbing.

Tree protection with barrier (orange fence) shall be measured and paid per each or per linear feet in accordance with bid proposal.

There are line code(s), description(s), and unit(s), for this item.

Note: This specification does require other Standard Specifications.

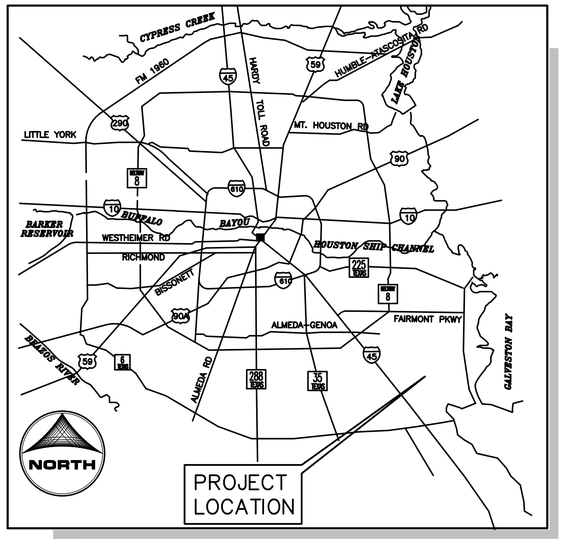
Item 102, Clearing and Grubbing
Item 725, General Source Control

END OF ITEM 501

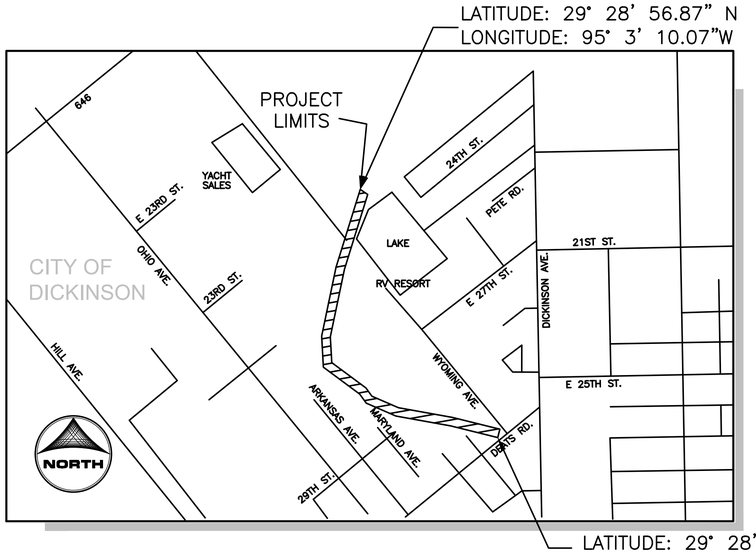
GALVESTON COUNTY, TEXAS
GUM BAYOU TRIBUTARY CHANNEL IMPROVEMENTS

GLO CONTRACT NO. 13-465-000-7974
PROJECT NO. P21473-5
ITB #B201034

JUNE 2020



VICINITY MAP



LOCATION MAP

BEGIN PROJECT– 500–FEET NORTHEAST OF WYOMING AVENUE RIGHT OF WAY
END PROJECT– 50–FEET SOUTHWEST OF THE INTERSECTION OF DEATS ROAD AND WYOMING AVENUE

THE STATE OF TEXAS
COUNTY OF GALVESTON

COUNTY JUDGE - HONORABLE MARK A. HENRY

COMMISIONER PRECINCT 1 - DARRELL APFFEL
COMMISIONER PRECINCT 2 - JOE GIUSTI
COMMISIONER PRECINCT 3 - STEPHEN D. HOLMES
COMMISIONER PRECINCT 4 - KEN CLARK

COUNTY ENGINEER - MICHAEL C. SHANNON, P.E.

SHEET INDEX

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

HRGreen
11011 RICHMOND AVENUE
HOUSTON, TEXAS 77042
713.965.9996
713.965.0044 FAX
Firm No. F-11278

1836 • GENERAL LAND OFFICE • 1836
THE STATE OF TEXAS

1. ALL BACKFILL TO BE PLACED IN ACCORDANCE WITH SPECIFICATION SECTION 02315 EXCAVATING & BACKFILL OR USE 02316 STRUCTURAL EXCAVATING AND BACKFILLING IF REQUIRED AROUND STRUCTURES. MATERIAL TO BE USED AS BACKFILL SHALL CONFORM TO SPECIFICATION SECTION 02314 FILL MATERIAL UNLESS OTHERWISE STATED ON THE PLANS.

2. THE EXCAVATION QUANTITIES SHOWN ARE APPROXIMATE ONLY AND ARE INTENDED TO GIVE A GENERAL INDICATION OF THE AMOUNT OF MATERIAL TO BE EXCAVATED. REFER TO SPECIFICATION 120, SECTION 1.4 FOR MEASUREMENT AND PAYMENT OF EXCAVATION QUANTITIES.

3. IDENTIFY, FENCE AND AVOID ANY WETLAND AREAS BEYOND THE LIMITS OF EXCAVATION.

4. DO NOT DAMAGE TREES AND VEGETATION DESIGNATED BY THE ENGINEER TO REMAIN. INSTALL CONSTRUCTION FENCING TO PROTECT ANY TREES WITHIN THE WORK AREA THAT ARE TO BE PRESERVED.

5. THE ENGINEER WILL DETERMINE THE ACCEPTIBILITY FOR THE REUSE OF STRIPPED VEGETATION AND TOPSOIL. UNACCEPTABLE MATERIAL WILL BE REMOVED AND PAID AS EXCAVATION AND OFF-SITE DISPOSAL. MATERIAL FOUND TO BE ACCEPTABLE FOR REUSE SHALL BE STOCKPILED ON SITE. NO SEPARATE MEASUREMENT AND PAYMENT WILL BE MADE FOR STRIPPING, STOCKPILING AND PLACING MATERIAL FOUND TO BE ACCEPTABLE FOR REUSE. THE COST FOR THIS WORK WILL BE INCIDENTAL TO RELATED PAY ITEMS UNDER SPECIFICATION SECTION 02315 LISTED ON THE UNIT PRICE SCHEDULE.

6. LENGTHS DESIGNATED ON PLANS ARE APPROXIMATE. CONTRACTOR WILL BE RESPONSIBLE FOR FIELD VERIFICATION PRIOR TO ORDERING MATERIALS.

7. ACTIVITIES THAT DISTURB BIRD HABITAT, INCLUDING BUT NOT LIMITED TO CLEARING, GRUBBING AND IMPACTS TO STRUCTURES WHERE MIGRATORY BIRDS MIGHT NEST, SHALL TAKE PLACE ONLY BETWEEN SEPTEMBER 1ST AND MARCH 1ST. IF ANY OF THESE ACTIVITIES ARE REQUIRED BETWEEN THIS TIME FRAME, DO NOT PROCEED UNTIL ENGINEER HAS CONDUCTED A HABITAT SURVEY TO VERIFY ACTIVE MIGRATORY BIRD NESTS ARE NOT PRESENT AND THE ENGINEER HAS PROVIDED WRITTEN AUTHORIZATION TO PROCEED.

ALL UTILITY POWER POLES WITHIN PROPOSED CHANNEL LIMITS SHALL BE PROTECTED IN PLACE UNLESS OTHERWISE NOTED.

TO ARRANGE FOR LINE TO BE TURNED OFF CALL CENTERPOINT ENERGY AT (713)207-2222

NOTICE:
FOR YOUR SAFETY,YOU ARE REQUIRED BY TEXAS LAW TO CALL 811 AT LEAST 48 HOURS BEFORE YOU DIG SO THAT UNDERGROUND LINES CAN BE MARKED. THIS VERIFICATION DOES NOT FULFILL YOUR OBLIGATION TO CALL 811

VERIFICATION OF PRIVATE UTILITY LINES

DATE:

CENTERPOINT ENERGY /NATURAL GAS FACILITIES VERIFICATION ONLY.
(THIS SIGNATURE VERIFIES THAT YOU HAVE SHOWN CNP NATURAL GAS LINES CORRECTLY.
NOT TO BE USED FOR CONFLICT VERIFICATION.)

SIGNATURE VALID FOR SIX MONTHS DATE:

DATE:

CENTERPOINT ENERGY/UNDERGROUND ELECTRICAL FACILITIES VERIFICATION ONLY.
(THIS SIGNATURE VERIFIES THAT EXISTING UNDERGROUND FACILITIES.
(NOT TO BE USED FOR CONFLICT VERIFICATION.)

SIGNATURE VALID FOR SIX MONTHS

UTILITY NOTES

CENTERPOINT ENERGY RESOURCES CORP (GAS)

CAUTION: UNDERGROUND GAS FACILITIES

LOCATIONS OF CENTERPOINT ENERGY MAIN LINES (TO INCLUDE CENTERPOINT ENERGY, INTRASTATE PIPELINE, LLC. WHERE APPLICABLE) ARE SHOWN IN AN APPROXIMATE LOCATION ONLY . SERVICE LINES ARE USUALLY NOT SHOWN IN APPROXIMATE LOCATION. IT DOES NOT IMPLY THAT A CONFLICT ANALYSIS HAS BEEN MADE. THE CONTRACTOR SHALL CONTACT THE UTILITY COORDINATING COMMITTEE AT (713) 223-4567 OR 1800-669-8344 OR 811 A MINIMUM OF 48 HOURS PRIOR TO CONSTRUCTION TO HAVE MAIN AND SERVICE LINES FIELD LOCATED.

- WHEN CENTERPOINT ENERGY PIPE LINE MARKINGS ARE NOT VISIBLE, CALL (713) 945-8036 OR (713) 945-8037 (7:00 A.M. TO 4:30 P.M.) FOR STATUS OF LINE LOCATION REQUEST BEFORE EXCAVATION BEGINS.

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

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

- FOR EMERGENCIES REGARDING GAS LINES CALL (713) 656-3552 OR (713 207-4200).

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

WARNING: OVERHEAD ELECTRICAL LINES

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

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

- 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.

PARTIES RESPONSIBLE FOR THE WORK, INCLUDING CONTRACTORS, ARE LEGALLY 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.

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

AT&T TEXAS/SWBT FACILITIES

1. THE LOCATIONS OF AT&T TEXAS/SWBT FACILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY.

2. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION BEFORE COMMENCING WORK. HE 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.

3. THE CONTRACTOR SHALL CALL 1-800-344-8377 A MINIMUM OF 48 HOURS PRIOR TO CONSTRUCTION TO HAVE UNDERGROUND LINES FIELD LOCATED.

4. WHEN EXCAVATING WITHIN EIGHTEEN INCHES (18") OF THE INDICATED LOCATION 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.

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

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

7. PLEASE CONTACT THE AT&T TEXAS DAMAGE PREVENTION MANAGER MR. ROOSEVELT LEE JR. AT (713)567-4552 OR E-MAIL HIM AT rl7259@att.com, IF THERE ARE QUESTIONS ABOUT BORING OR EXCAVATING NEAR OUR AT&T TEXAS/SWBT FACILITIES.

MAGELLAN PETROLEUM PIPELINE

1. MAGELLAN PETROLEUM PIPELINES EXIST ON THE PROJECT AT APPROXIMATE STATION 14+70. CONTACT MEGELLAN PIPELINE AT 1-800-720-2417 AT LEAST 72 HOURS BEFORE EXCAVATING NEAR THEIR PIPELINE

WATER AND SANITARY SEWER

1. EXISTING 10" SAN. SEWER CROSSES THE CHANNEL AT APPROXIMATE STA. 33+20 THIS LINE IS TO REMAIN IN SERVICE DURING CONSTRUCTION. CONTACT WCID NO. 1, MR KEITH MORGAN AT 281-534-8330 72 HOURS BEFORE EXCAVATING NEAR THE SANITARY SEWER LINE

2. EXISTING 6" WATER LINE CROSSES THE CHANNEL AT APPROXIMATE STA. 33+80 CONTACT WCID NO. 1, MR. KEITH MORGAN AT 281-534-8330 72 HOURS BEFORE EXCAVATING NEAR THE WATER LINE.

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE:
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\2 - General Notes.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

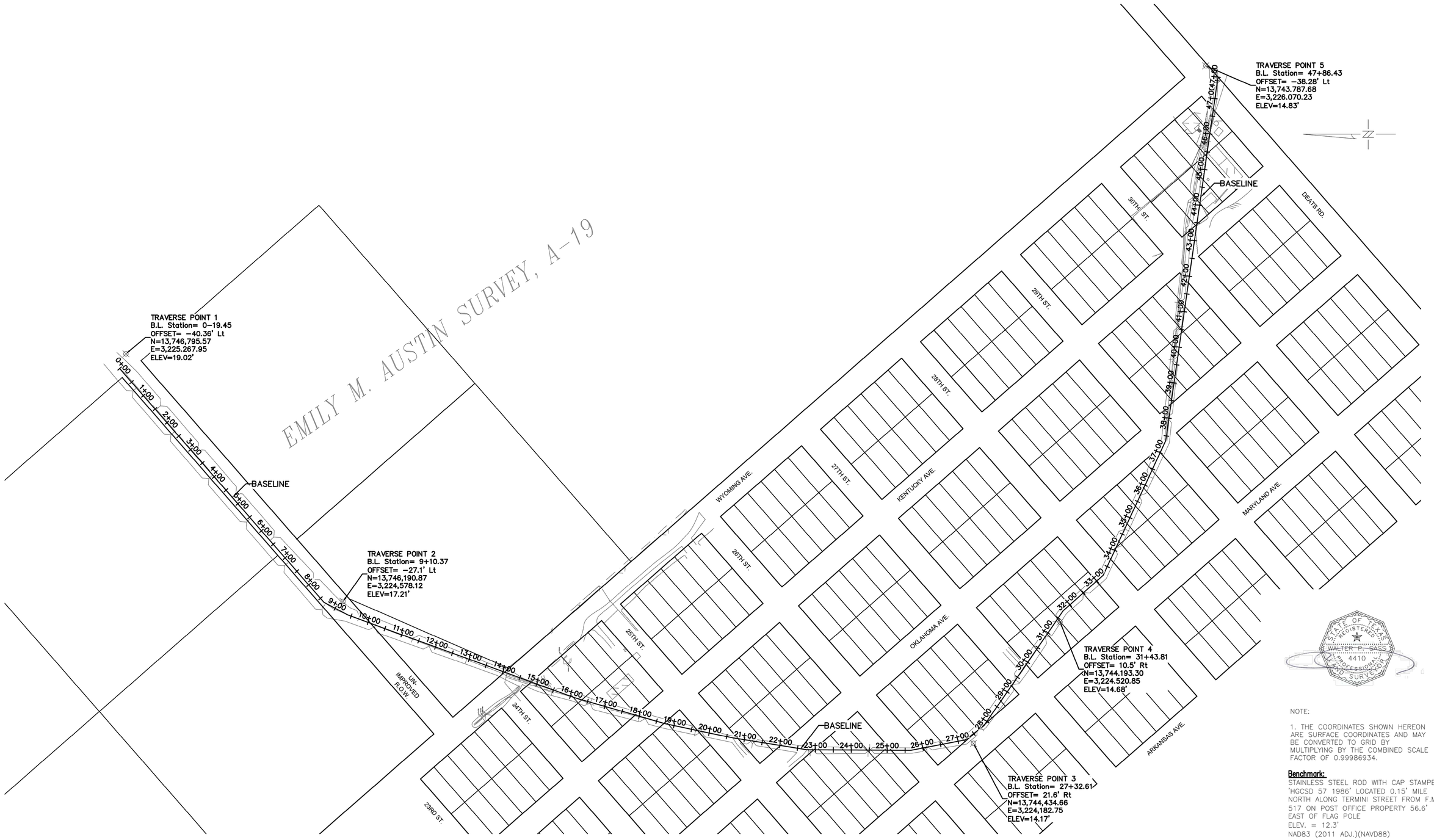
NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
FIRM NO. F-11278
11011 RICHMOND AVENUE, SUITE 200
PH: 713.965.9996
FAX: 713.965.0044

GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

GENERAL NOTES

SHEET NO.
2



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

NOTE:

1. THE COORDINATES SHOWN HEREON ARE SURFACE COORDINATES AND MAY BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.99986934.

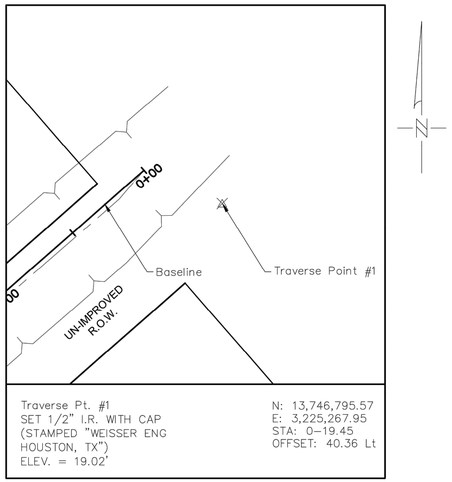
Benchmark:
STAINLESS STEEL ROD WITH CAP STAMPED 'HGCSD 57 1986' LOCATED 0.15' MILE NORTH ALONG TERMINI STREET FROM F.M. 517 ON POST OFFICE PROPERTY 56.6' EAST OF FLAG POLE
ELEV. = 12.3'
NAD83 (2011 ADJ.)(NAVD88)

NO.	REVISIONS	DATE	NAME
	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\3-4 SURVEY CONTROL MAPS.dwg		

GALVESTON COUNTY
ENGINEERING DEPARTMENT

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

PROJECT TITLE:	GUM BAYOU
DRAWN BY: D.G.	SURVEY CONTROL
CK'D BY: J.C.M./L.Y.	SHEET DESCRIPTION: OVERALL MAP
SCALE: N.T.S.	SHEET NO: 03
DATE: 09/05/14	APPROVED BY:



Traverse Pt. #1
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HOUSTON, TX")
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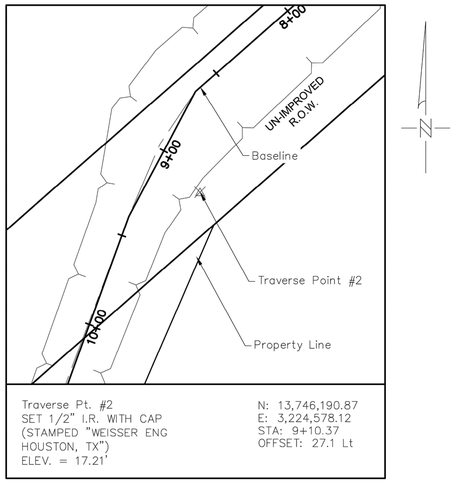
STA: 0-19.45
OFFSET: 40.36 Lt



Traverse Pt. #2
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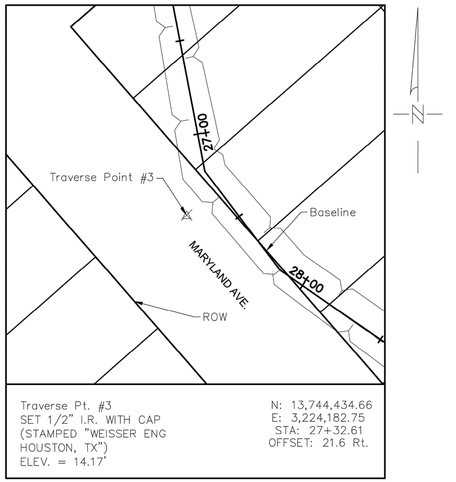
STA: 9+10.37
OFFSET: 27.1 Lt



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HOUSTON, TX")
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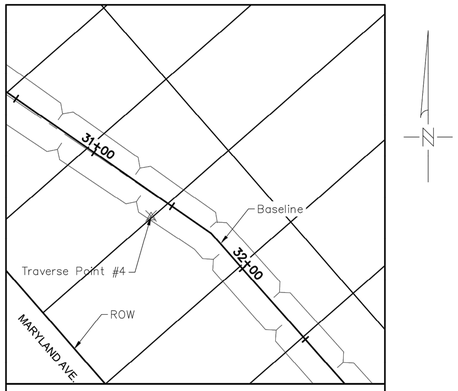
OFFSET: 21.6 Rt.



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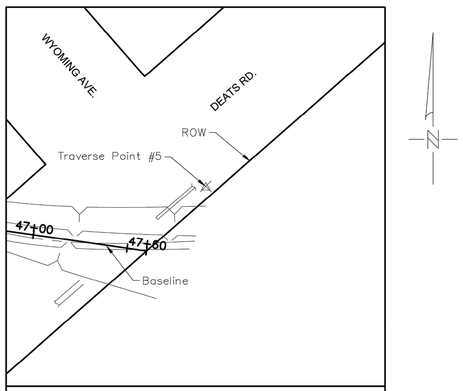
OFFSET: 10.5 Rt



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HOUSTON, TX")
ELEV. = 14.83'

N: 13,743,787.68
E: 3,226,070.23
STA: 47+86.43
OFFSET: 38.28 Lt

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

NOTE:

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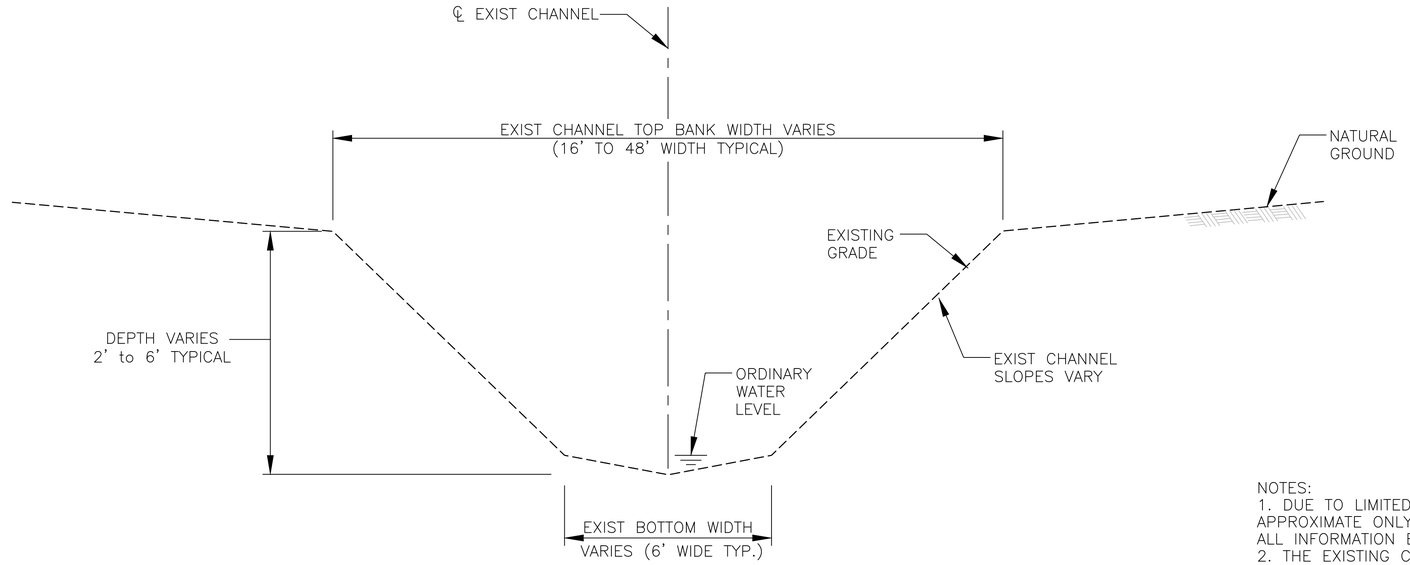
NO.	REVISIONS	DATE	NAME
	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\3-4 SURVEY CONTROL MAPS.dwg		

GALVESTON COUNTY
ENGINEERING DEPARTMENT

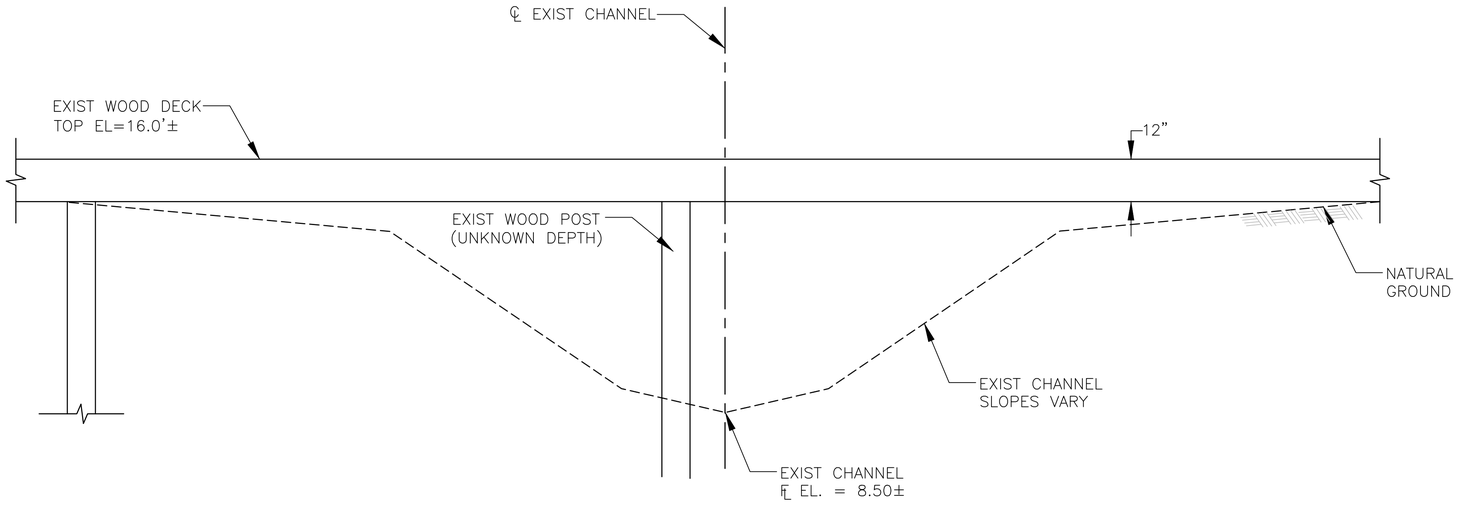
WEISSER
Engineering Co.
19500 Park Row, Suite 100
Houston, Texas 77084
(281) 579 - 7300
www.WeisserEng.com
T.B.P.E.R. #F-88 T.B.P.L.S. #100518-00

PROJECT TITLE:	GUM BAYOU
DRAWN BY: D.G.	SURVEY CONTROL
CK'D BY: J.C.M./L.Y.	SHEET DESCRIPTION: MAP
SCALE: 1"=40'	DETAILS
DATE: 09/05/14	APPROVED BY:
	SHEET NO: 04



NOTES:
1. DUE TO LIMITED SURVEY INFORMATION DIMENSIONS SHOWN ARE APPROXIMATE ONLY. THE CONTRACTOR SHOULD FIELD VERIFY ALL INFORMATION BEFORE BEGINNING CONSTRUCTION.
2. THE EXISTING CHANNEL IS NOT LOCATED IN AN EXISTING RIGHT OF WAY AND ACTUAL DIMENSIONS MAY VARY.

TYPICAL SECTION STA. 0+00 TO STA. 45+91



TYPICAL SECTION STA. 45+91 TO STA. 46+70

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

N.T.S.

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE: 3/24/2016 8:35:05 AM
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\5 EXISTING TYPICAL SECTIONS.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
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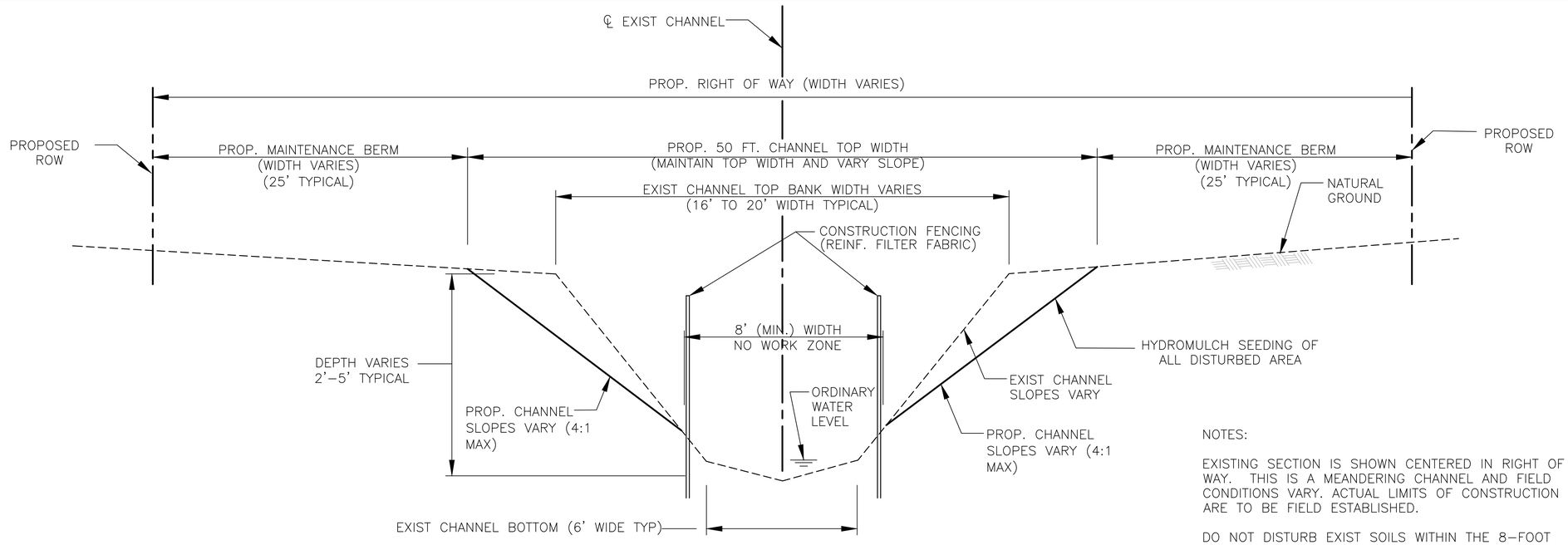
PH: 713.965.9996
FAX: 713.965.0044

GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

EXISTING TYPICAL SECTIONS

SHEET NO.
5

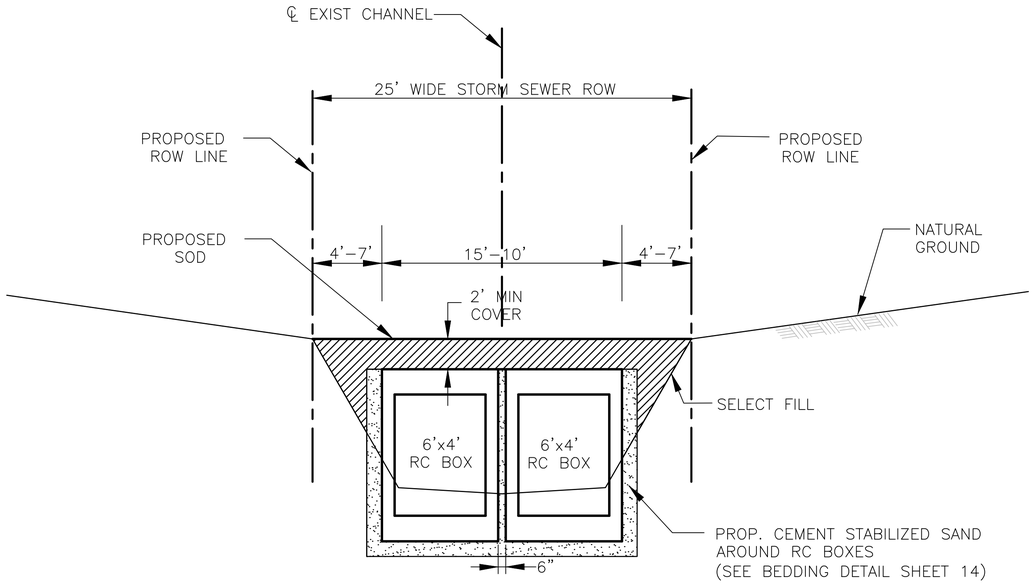


TYPICAL SECTION STA. 14+00 TO STA: 44+20

NOTES:

EXISTING SECTION IS SHOWN CENTERED IN RIGHT OF WAY. THIS IS A MEANDERING CHANNEL AND FIELD CONDITIONS VARY. ACTUAL LIMITS OF CONSTRUCTION ARE TO BE FIELD ESTABLISHED.

DO NOT DISTURB EXIST SOILS WITHIN THE 8–FOOT WIDE NO WORK ZONE AREA PROVIDE A SMOOTH, DRIVABLE SURFACE ON MAINTENANCE BERMS USING ON–SITE FILL MATERIAL.



TYPICAL SECTION STA. 44+20 TO 46+70

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED PROFESSIONAL ENGINEER
06/25/2020

N.T.S.

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APPROVED:	SS	JOB NUMBER:	85130016
CAD DATE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100		
CAD FILE:	submittal\6 – Proposed Typical Sections.dwg		

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GUM BAYOU TRIBUTARY CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

PROPOSED TYPICAL SECTIONS

SHEET NO. 6

LOT 100

LOT 101

LOT 102 & THE NORTH 1/2 OF LOT 103
STARSHIP NORTH BEAUMONT, L.P.
F.C. NO. 2012070148
O.P.R.R.P.G.C.

BEGIN PROJECT
STA 8+90
LATITUDE: 29° 28' 56.87" N
LONGITUDE: 95° 3' 10.07"W

EAST ROW

6' NO WORK ZONE

BEGIN LEFT SIDE SLOPE
STABILIZATION STA. 9+00

25' BERM

50' CHANNEL

100' ROW

MATCH LINE STA. 10+00 (SEE SHEET 8)

DITCH TOP OF
BANK LEFT

DITCH CENTERLINE

DITCH BASELINE

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00

100' ROW

50'

50'

DITCH TOP OF
BANK RIGHT

WEST ROW

BEGIN RIGHT SIDE SLOPE
STABILIZATION STA. 8+90

LOT 78

CALLED 39.970 ACRES
REPUBLIC WASTE SERVICES OF TEXAS II, LLC.
F.C. NO. 9863815
O.P.R.R.P.G.C.

LOT 80

LOT 79

NO WORK IN THIS AREA – EXISTING CHANNEL TO REMAIN

0 20 40 80

26
22
18
14
10
6
2

TOP OF BANK RIGHT

EXISTING ROW LEFT

EXISTING ROW RIGHT

TOP OF BANK LEFT

EXISTING
CHANNEL FLOWLINE

MATCH LINE STA. 10+00 (SEE SHEET 8)

0+00 2+00 4+00 6+00 8+00 10+00

STATE OF TEXAS
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06/25/2020

DRAWN BY:	EBS
APPROVED:	SS
CAD DATE:	6/29/2020 2:38:20 PM
CAD FILE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\7 PLAN AND PROFILE SHEET 1 OF 5.dwg
JOB DATE:	2015
JOB NUMBER:	85130016

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NO.	DATE	BY	REVISION DESCRIPTION

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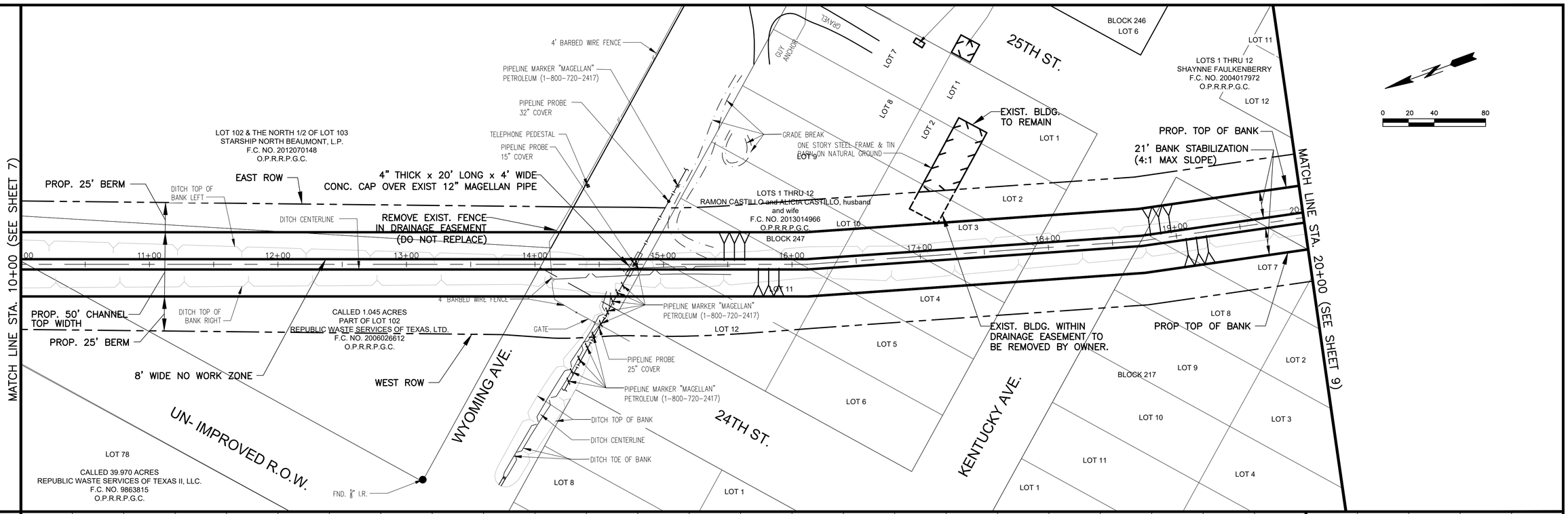
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

PLAN AND PROFILE SHEETS
FROM STA. 0+00 TO STA. 10+00
(SHEET 1 OF 5)

SHEET NO.
7

Xrefs: xgt-1-dh01; xgt-1-dh01_grid; xca-base; xct-desig



Xrefs: xgt-1-dh01; xgt-1-dh01_grid; xcs-base; xct-desig

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APPROVED:	SS
CAD DATE:	7/1/2020 4:31:31 PM
CAD FILE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\8 PLAN AND PROFILE SHEET 2 OF 5.dwg
JOB DATE:	2015
JOB NUMBER:	85130016

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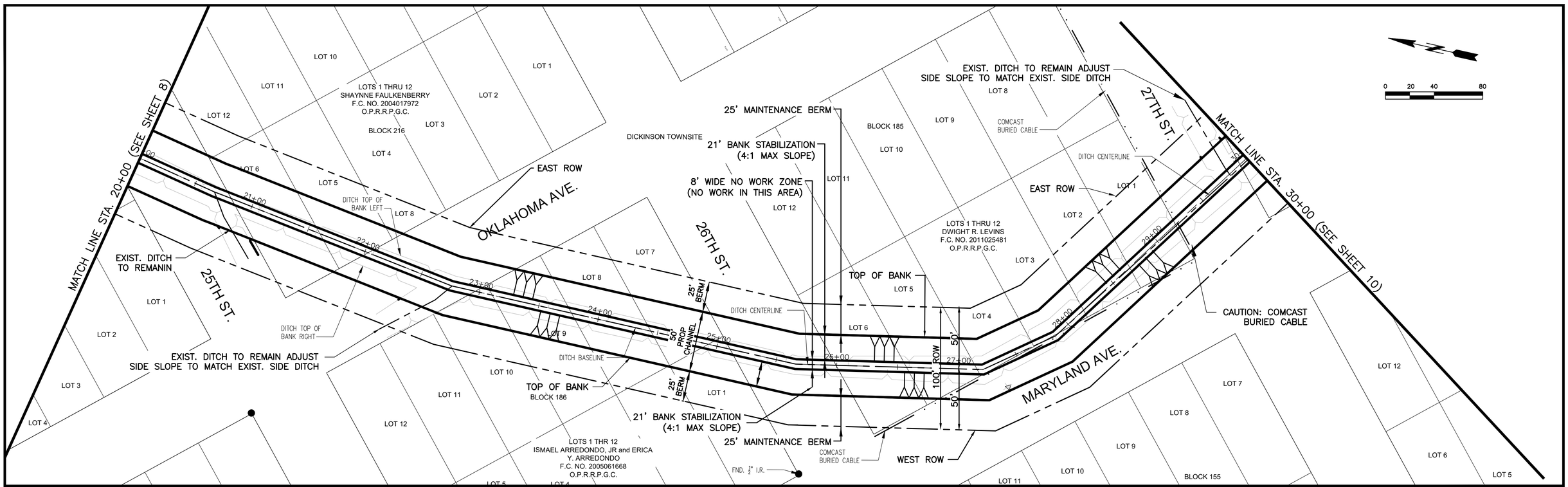
GUM BAYOU TRIBUTARY CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

PLAN AND PROFILE SHEETS
FROM STA. 10+00 TO STA. 20+00
(SHEET 2 OF 5)

SHEET NO.
8



STATE OF TEXAS
STEPHEN A. SPARKS
68994
REGISTERED PROFESSIONAL ENGINEER
06/25/2020

DRAWN BY: EBS	JOB DATE: 2015	BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"	
APPROVED: SS	JOB NUMBER: 85130016	IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.	
CAD DATE: 6/6/2016 3:23:34 PM			
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\9 PLAN AND PROFILE SHEET 3 OF 5.dwg			

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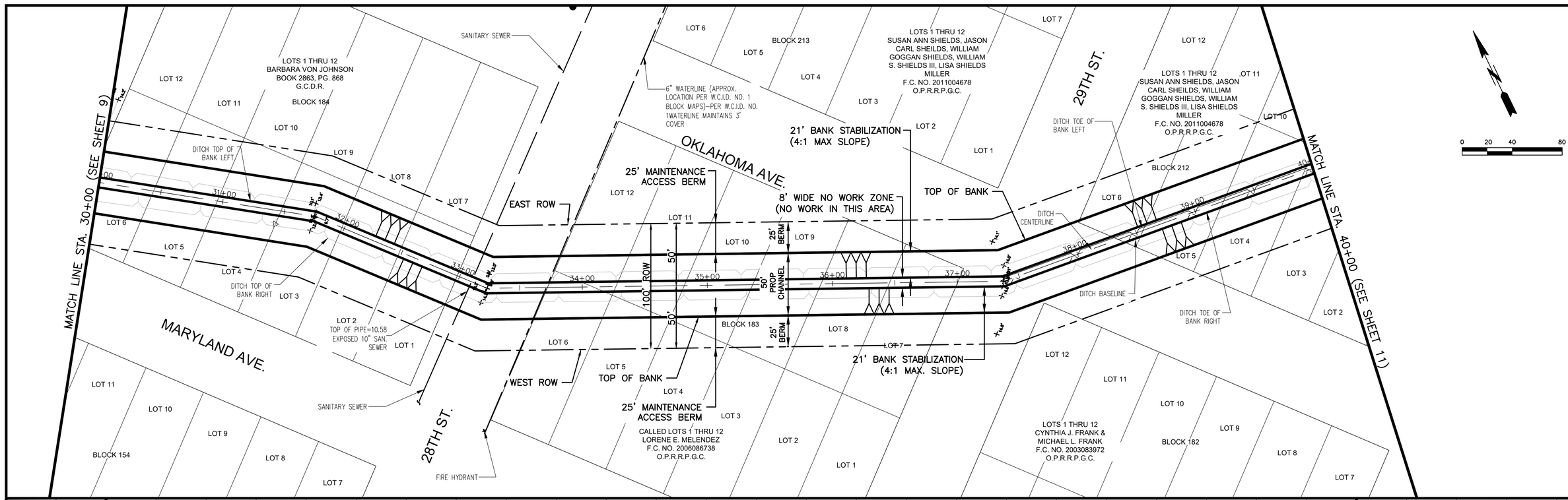
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

PLAN AND PROFILE SHEETS
FROM STA. 20+00 TO STA. 30+00
(SHEET 3 OF 5)

SHEET NO.
9

Xrefs: xgl-1-dh01; xgl-1-dh01_grid; xcs-base; xcl-desig



STATE OF TEXAS
STEPHEN A. SPARKS
68994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

DRAWN BY: EBS	JOB DATE: 2015	BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.	
APPROVED: SS	JOB NUMBER: 85130016		
CAD DATE: 6/29/2020 2:38:18 PM			
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\10 PLAN AND PROFILE SHEET 4 OF 5.dwg			

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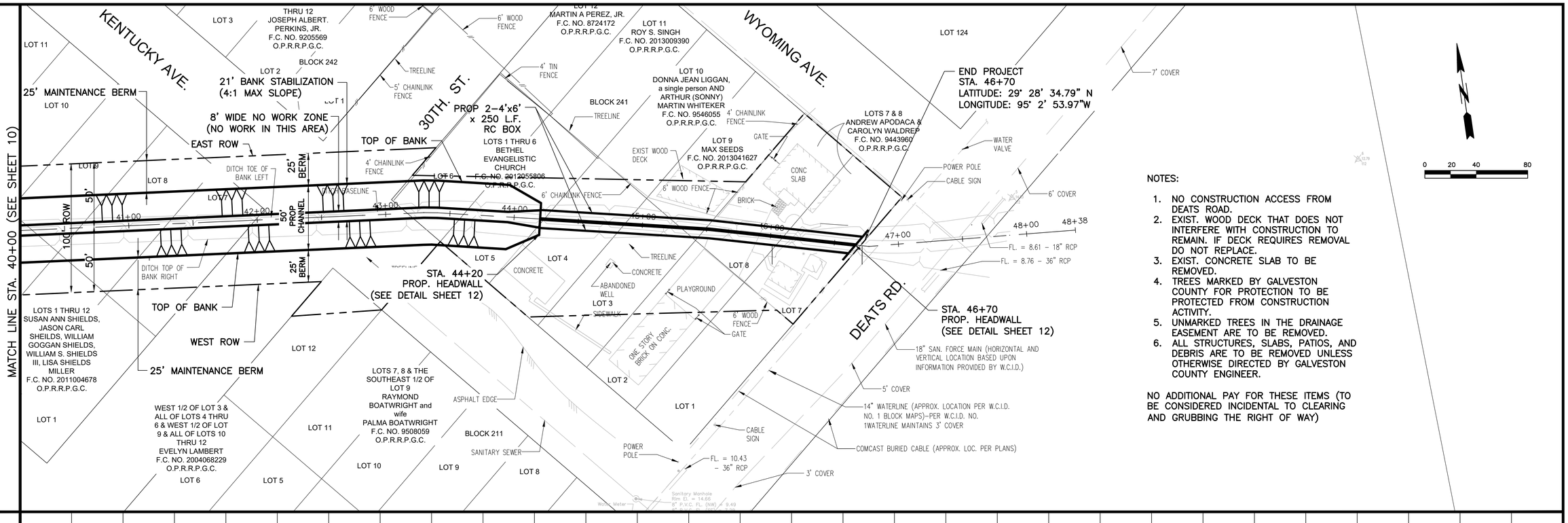
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

PLAN AND PROFILE SHEETS
FROM STA. 30+00 TO STA. 40+00
(SHEET 4 OF 5)

SHEET NO.
10

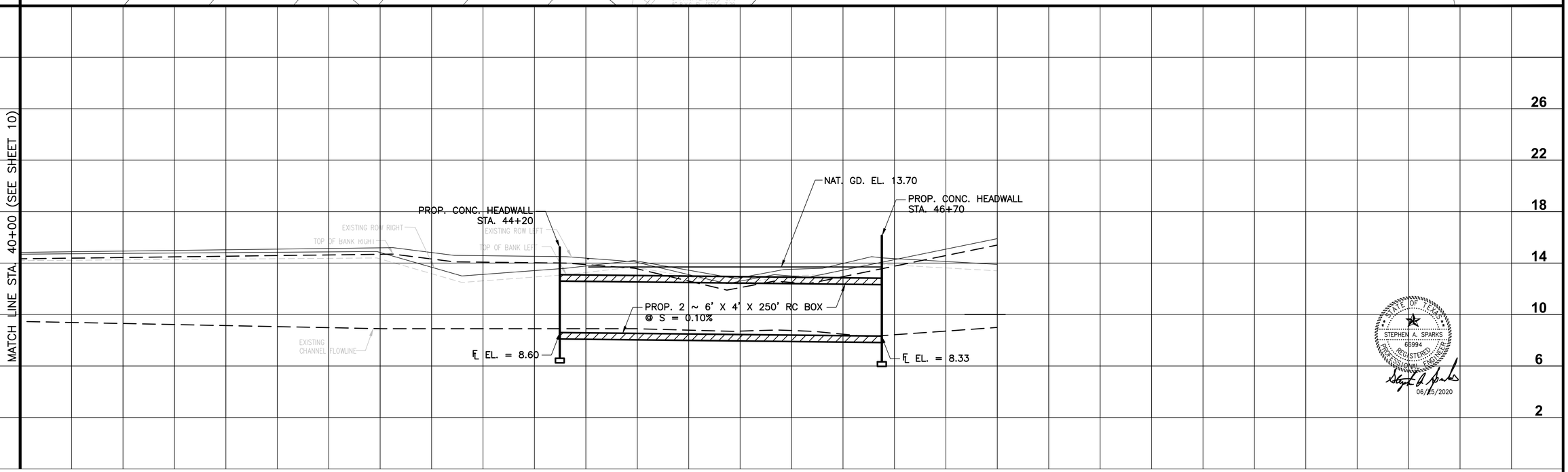
Xrefs: xgl-1-dh01; xgl-1-dh01_grid; xcs-base; xcl-desig



NOTES:

1. NO CONSTRUCTION ACCESS FROM DEATS ROAD.
2. EXIST. WOOD DECK THAT DOES NOT INTERFERE WITH CONSTRUCTION TO REMAIN. IF DECK REQUIRES REMOVAL DO NOT REPLACE.
3. EXIST. CONCRETE SLAB TO BE REMOVED.
4. TREES MARKED BY GALVESTON COUNTY FOR PROTECTION TO BE PROTECTED FROM CONSTRUCTION ACTIVITY.
5. UNMARKED TREES IN THE DRAINAGE EASEMENT ARE TO BE REMOVED.
6. ALL STRUCTURES, SLABS, PATIOS, AND DEBRIS ARE TO BE REMOVED UNLESS OTHERWISE DIRECTED BY GALVESTON COUNTY ENGINEER.

NO ADDITIONAL PAY FOR THESE ITEMS (TO BE CONSIDERED INCIDENTAL TO CLEARING AND GRUBBING THE RIGHT OF WAY)



STATE OF TEXAS
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PROFESSIONAL
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06/25/2020

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CAD FILE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\11 PLAN AND PROFILE SHEET 5 OF 5.dwg		

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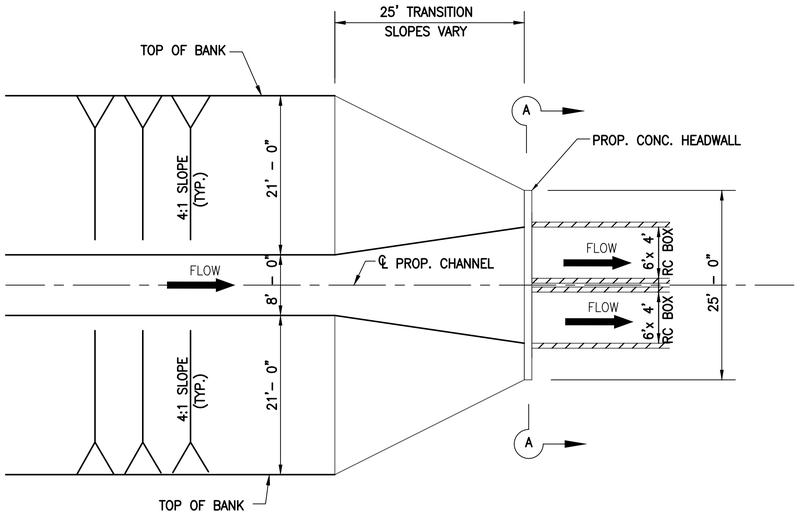
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

PLAN AND PROFILE SHEETS
FROM STA. 40+00 TO END
(SHEET 5 OF 5)

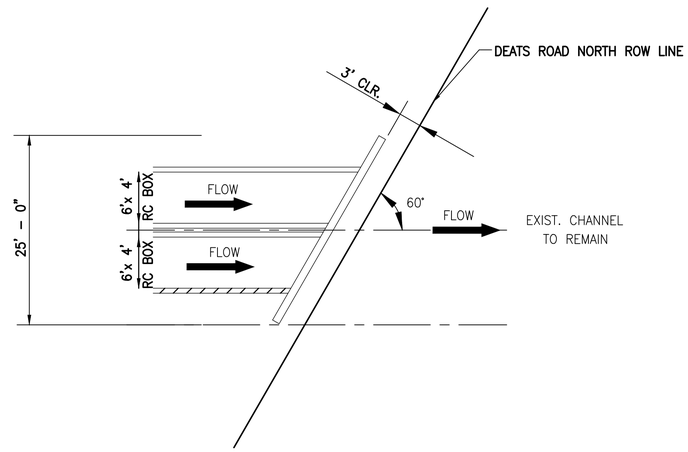
SHEET NO.
11

Xrefs: xgt-1-dh01; xgt-1-dh01_grid; xcs-base; xct-desig



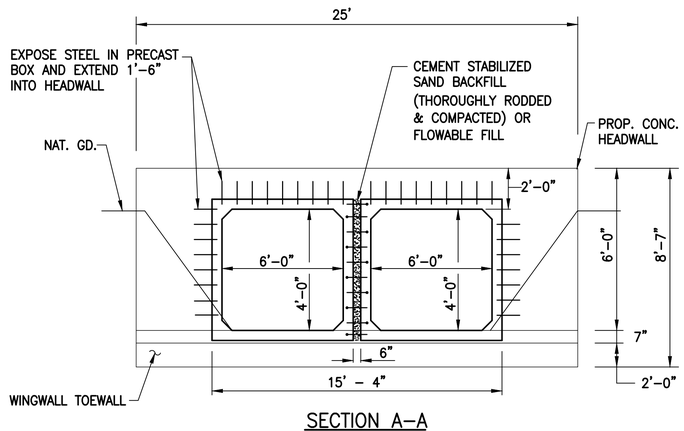
HEADWALL & CHANNEL TRANSITION DETAIL
AT STA. 44+40

SCALE: 1"= 20'



HEADWALL DETAIL
AT STA. 46+70

SCALE: 1"= 20'



SECTION A-A
TYPICAL TOEWALL & SLOPE PAVING DETAIL
FOR 6' x 4' CONC. BOX

NOTE: SEE SHEET 13 FOR HEADWALL REINFORCING SIZE AND DIMENSIONS

STATE OF TEXAS
STEPHEN A. SPARKS
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REGISTERED
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06/25/2020

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CAD FILE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\12 BOX CULVERT LAYOUT SHEET.dwg		

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GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

BOX CULVERT HEADWALL LAYOUT SHEET

SHEET NO.
12

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TABLE OF DIMENSIONS & REINFORCING STEEL
(Wings for One Structure End)

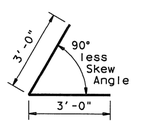
Dimensions					Variable Reinforcing				Estimated ④ Quantities per ft of Wing (2-Wings)		Estimated Quantities per ft of Toewall (1-Toewall)	
					Bars J1		Bars J2					
Maximum Wingwall Height Hw	W	X	Y	Z	Size	Spa	Size	Spa	Reinf (LB/Ft)	Conc (CY/Ft)	Reinf (LB/Ft)	Conc (CY/Ft)
2'-6"	2'-10"	10"	1'- 0"	7"	#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)

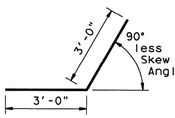
Bar	Size	No.	Spa
D1	#6	~	1'-0"
D2	#6	~	1'-0"
E1	#4	~	1'-0"
F	#4	~	1'-0"
G	#6	~	8"
M1	#4	4	~
P	#4	~	1'-0"
V	#4	~	1'-0"

TABLE OF TOEWALL REINFORCING

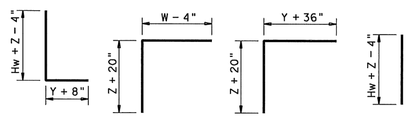
Bar	Size	No	Spa
J3	#4	~	1'-0"
M2	#4	2	~
E2	#4	~	1'-0"



BARS D1



BARS D2



BARS J1 BARS J2 BARS J3 BARS V

WING DIMENSION CALCULATIONS:

Formulas: (All values are in Feet)

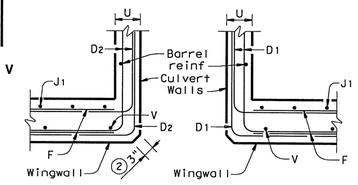
Hw = H + T + C
Lw = (Hw) (SL) ÷ Cosine θ for Ty PW-1
= (Hw - 1') (SL) ÷ Cosine θ for Ty PW-2 and Hw ≥ 4'
= (Hw - 0.5') (SL) ÷ Cosine θ for Ty PW-2 and Hw < 4'

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

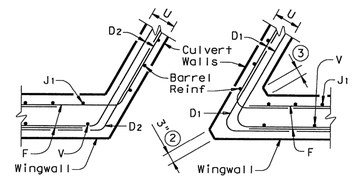
For Precast culverts:
Ltw = [(N) (2 U + S) + (N - 1) (0.5')] ÷ Cosine θ
Total Wingwall Area (Two Wings ~ SF)
= (2) (Hw) (Lw) for Ty PW-1
= (2) (Hw) (Lw) - 6 SF for Ty PW-2 and Hw ≥ 4'
= (2) (Hw) (Lw) - 1.5 SF for Ty PW-2 and Hw < 4'

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

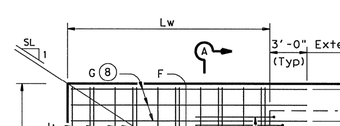
See applicable box culvert standard for S, H, T and U values.



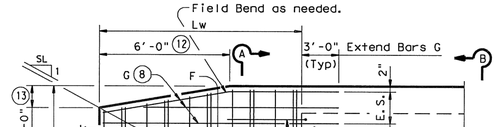
SECTION C-C



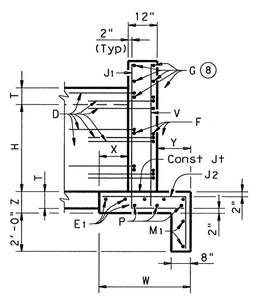
SECTION C-C



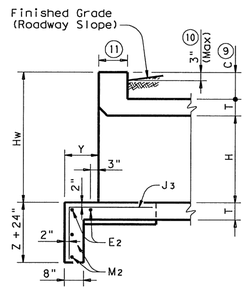
PARTIAL ELEVATION - PW-1



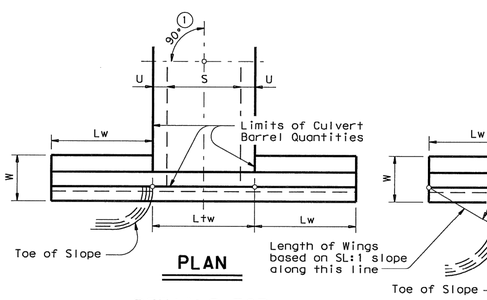
PARTIAL ELEVATION - PW-2



SECTION A-A
(Showing Wing Reinf)

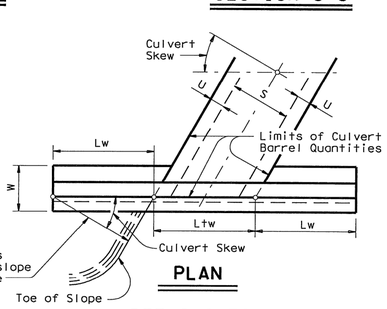


SECTION B-B
(Showing Wing Reinf)



PLAN

DETAILS FOR NON-SKEWED BOX CULVERTS



PLAN

DETAILS FOR SKEWED BOX CULVERTS
(Showing 30° Skew)

1. Skew Angle = 0°
2. At discharge end, chamfer may be ¾".
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. Bars G equally spaced at 8" maximum, place as shown. Provide at least two pair 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, bicycle rail or curbs taller than 1'-0", refer to ECD standard. For structures with T6 bridge rail, refer to T6-CM standard. For structures with traffic rail, other than T6, refer to RAC standard.
10. For vehicle safety, the following requirements must be met:
    - For structures without bridge rail, curbs cannot project more than 3" above finished grade.
    - For structures with bridge rail, build 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'-0" typical when RAC standard is referenced elsewhere in the plans.
12. 3'-0" for Hw < 4'.
13. 6" for Hw < 4'.

GENERAL NOTES:
Designed in accordance with AASHTO LRFD Bridge Design Specifications.
Provide Class "C" Concrete (f'c = 3,600 psi Min) and Grade 60 reinforcing steel.
Provide 1 ½" Min clear cover to reinforcing steel.
Depth of toewalls for wingwalls and culverts may be reduced or eliminated when founded on solid rock, when directed by the Engineer.
See BCS sheet for wingwall type and additional dimensions and information.
The quantities for concrete and reinforcing steel resulting from the formulas given on this sheet are for the Contractor's information only.

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.

Texas Department of Transportation
Bridge Division

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

PW

FILE: pwstde01.dgn	DN: CAF	CK: CAT	DW: TxDOT	CK: CAF
©TxDOT February 2010	DISTRICT	FEDERAL AID PROJECT		SHEET
REVISIONS 11-10: Reinforcing Quantities. 01-12: PW-1 & PW-2.	COUNTY	CONTROL	SECT	JOB	HIGHWAY

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

LEVELS DISPLAYED ACC:

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE:
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\13 TxDOT Parallel Wing Detail.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

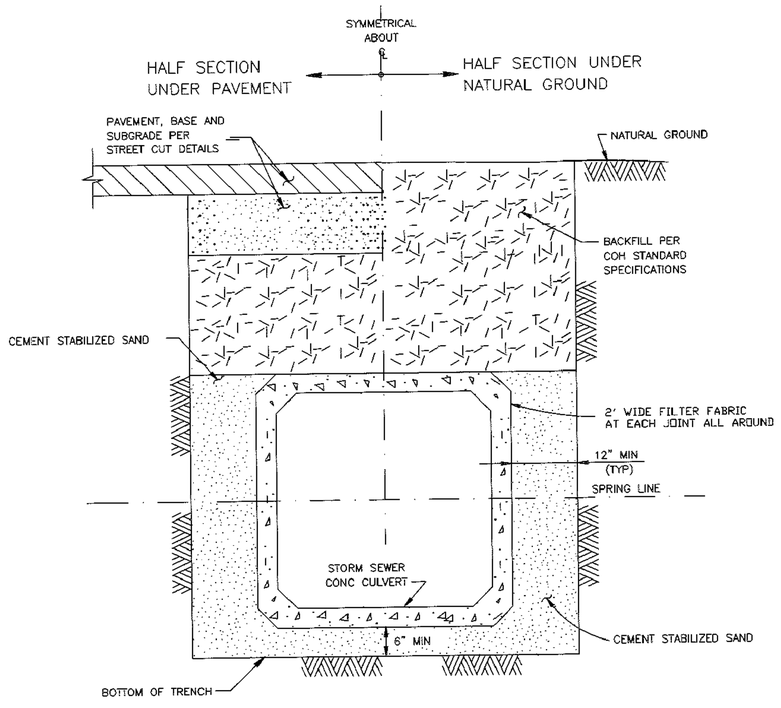
NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
FIRM NO. F-11278
11011 RICHMOND AVENUE, SUITE 200
PH: 713.965.9996
FAX: 713.965.0044

GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

CONCRETE WINGWALLS WITH PARALLEL WINGS FOR BOX CULVERTS TYPES PW-1 AND PW-2 (TXDOT STANDARD)

SHEET NO.
13



NOTES:

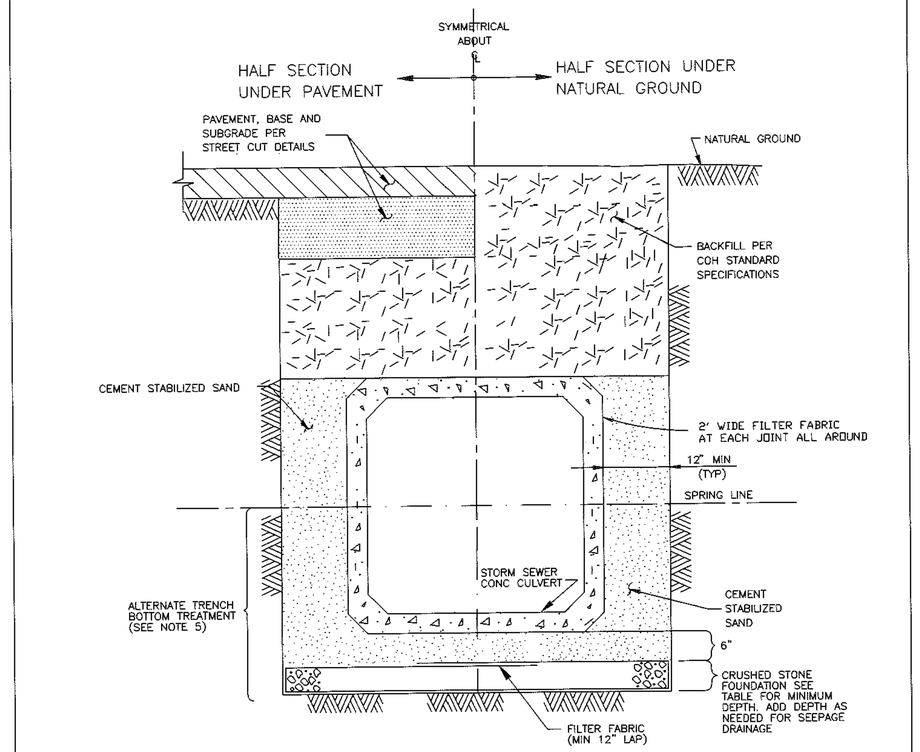
1. WHERE MULTIPLE BOX SEWERS ARE USED IN THE SAME TRENCH, MIN OUTSIDE TO OUTSIDE BOX SEWER SEPARATION SHALL BE 6".
2. SUBGRADE AND PAVEMENT PER STREET CUT DETAILS - 02951

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
ENGINEERING, CONSTRUCTION AND REAL ESTATE DIVISION

PRECAST CONCRETE BOX
STORM SEWER BEDDING AND BACKFILL
FOR DRY STABLE TRENCH
(NOT TO SCALE)

APPROVED BY:	APPROVED BY:
CITY ENGINEER	DIRECTOR OF PUBLIC WORKS AND ENGINEERING
EFF DATE: OCT-01-2002	DWG NO: 02317-05

COH



NOTES:

1. WHERE MULTIPLE BOX SEWERS ARE USED IN THE SAME TRENCH, MIN OUTSIDE TO OUTSIDE BOX SEWER SEPARATION SHALL BE 6".
2. ALTERNATE TRENCH BOTTOM TREATMENT MAY BE USED AS APPROVED BY THE CITY ENGINEER AND AS PAID FOR IN THE PROPOSAL.

CULVERT SIZE (FT)	FOUNDATION DEPTH (IN)
3' x 2' TO 6' x 6'	12
6' x 6' AND LARGER	18

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
ENGINEERING, CONSTRUCTION AND REAL ESTATE DIVISION

PRECAST CONCRETE BOX
STORM SEWER BEDDING AND
BACKFILL FOR WET STABLE TRENCH
(NOT TO SCALE)

APPROVED BY:	APPROVED BY:
CITY ENGINEER	DIRECTOR OF PUBLIC WORKS AND ENGINEERING
EFF DATE: OCT-01-2002	DWG NO: 02317-06

COH

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE:
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\14 RC BOX BEDDING AND BACKFILL DETAIL.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
FIRM NO. F-11278
11011 RICHMOND AVENUE, SUITE 200
PH: 713.965.9996
FAX: 713.965.0044

GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

STORM SEWER BEDDING AND BACKFILL DETAILS

SHEET NO.
14

STA. 14+00
BEGIN 50 FT.
CHANNEL TOP WIDTH

STA. 13+50 BEGIN CHANNEL IMPROVEMENTS TRANSITION TO MATCH EXIST. CHANNEL

LOT 102 & THE NORTH 1/2 OF LOT 103
STARSHIP NORTH BEAUMONT, L.P.
F.C. NO. 2012070148
O.P.R.R.P.G.C.

EAST ROW

DITCH TOP OF BANK LEFT

DITCH CENTERLINE

FLOW

DITCH TOP OF BANK RIGHT

TFA

CALLED 1.045 ACRES
PART OF LOT 102
REPUBLIC WASTE SERVICES OF TEXAS, LTD.
F.C. NO. 2006026612
O.P.R.R.P.G.C.

SC-1

WEST ROW

UN- IMPROVED R.O.W.

LOT 78

CALLED 39.970 ACRES
REPUBLIC WASTE SERVICES OF TEXAS II, LLC.
F.C. NO. 9863815

FND. 8" I.R.

WYOMING AVE.

4' BARBED WIRE FENCE

PIPELINE MARKER "MAGELLAN" PETROLEUM (1-800-720-2417)

PIPELINE PROBE 32" COVER

TELEPHONE PEDESTAL

PIPELINE PROBE 15" COVER

GUY ANCHOR

GRAVEL

GRADE BREAK

ONE STORY STEEL FRAME & TIN BARN ON NATURAL GROUND

8' WIDE NO WORK ZONE
(NO WORK IN THIS AREA)

LOTS 1 THRU 12
RAMON CASTILLO and ALICIA CASTILLO, husband and wife
F.C. NO. 2013014966
O.P.R.R.P.G.C.

BLOCK 247

4' BARBED WIRE FENCE

GATE

PIPELINE MARKER "MAGELLAN" PETROLEUM (1-800-720-2417)

PIPELINE PROBE 25" COVER

PIPELINE MARKER "MAGELLAN" PETROLEUM (1-800-720-2417)

DITCH TOP OF BANK

DITCH CENTERLINE

DITCH TOE OF BANK

24TH ST.

LOT 8

LOT 1

LOT 6

BLOCK 246
LOT 6

25TH ST.

PROP. 25' BERM

PROP. EAST ROW

EXIST. BLDG. TO REMAIN

PROP. TOP OF BANK

21' BANK STABILIZATION
(4:1 MAX SLOPE)

LOTS 1 THRU 12
SHAYNNE FAULKENBERRY
F.C. NO. 2004017972
O.P.R.R.P.G.C.

MATCH LINE STA. 20+00

PROP. 50' CHANNEL TOP WIDTH

PROP. TOP OF BANK

PROP. 25' BERM

KENTUCKY AVE.

BLOCK 217

LOT 9

LOT 10

LOT 11

LOT 2

LOT 3

LOT 4

LOT 7

LOT 8

0 20 40 80

LEGEND

- RFB — REINFORCED FILTER FABRIC BARRIER
- TFA — TEMPORARY FUEL AREA
- SC-1 — STABILIZED CONSTRUCTION ACCESS
- CONSTRUCTION ACCESS MATERIAL
- CTW — CONCRETE TRUCK WASHOUT AREA
- RFD-TYPE — ROCK FILTER DAM
- IPB — INLET PROTECTION BARRIER
- FLOW — FLOW ARROW

NOTE:

INSTALL, MAINTAIN AND REMOVE REINFORCED FILTER FABRIC BARRIER ALONG BOTH OF THE DESIGNATED NO WORK ZONE.

MATCH LINE STA. 20+00

MATCH LINE STA. 30+00

OKLAHOMA AVE.

25TH ST.

26TH ST.

27TH ST.

MARYLAND AVE.

DITCH TOP OF BANK LEFT

DITCH CENTERLINE

DITCH BASELINE

DITCH TOP OF BANK RIGHT

FLOW

SC-1

COMCAST BURIED CABLE

LOTS 1 THRU 12
SHAYNNE FAULKENBERRY
F.C. NO. 2004017972
O.P.R.R.P.G.C.

BLOCK 216

DICKINSON TOWNSITE

LOTS 1 THRU 12
DWIGHT R. LEVINS
F.C. NO. 2011025481
O.P.R.R.P.G.C.

BLOCK 185

BLOCK 186

BLOCK 155

LOT 1 LOT 2 LOT 3 LOT 4 LOT 5 LOT 6 LOT 7 LOT 8 LOT 9 LOT 10 LOT 11 LOT 12

0 20 40 80

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED PROFESSIONAL ENGINEER
06/25/2020

DRAWN BY:	EBS	JOB DATE:	2015
APPROVED:	SS	JOB NUMBER:	85130016
CAD DATE:	6/22/2020 1:06:39 PM		
CAD FILE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\15 STORM WATER PPP1.dwg		

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

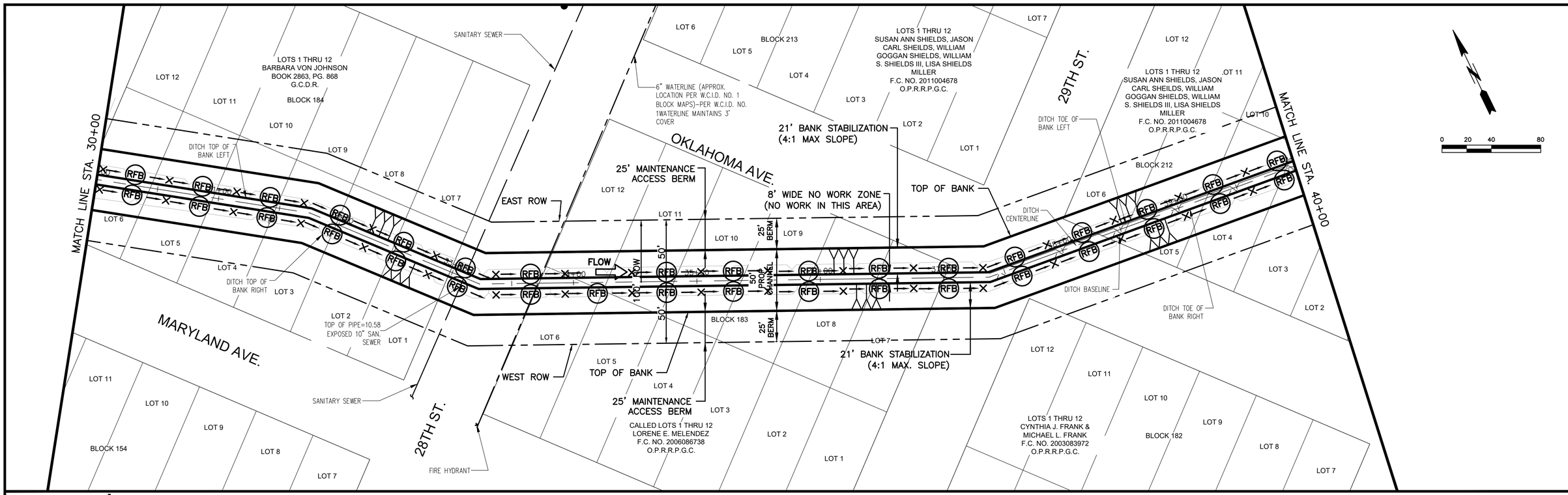
HRGreen
FIRM NO. F-11278
11011 RICHMOND AVENUE, SUITE 200
PH: 713.965.9996
FAX: 713.965.0044

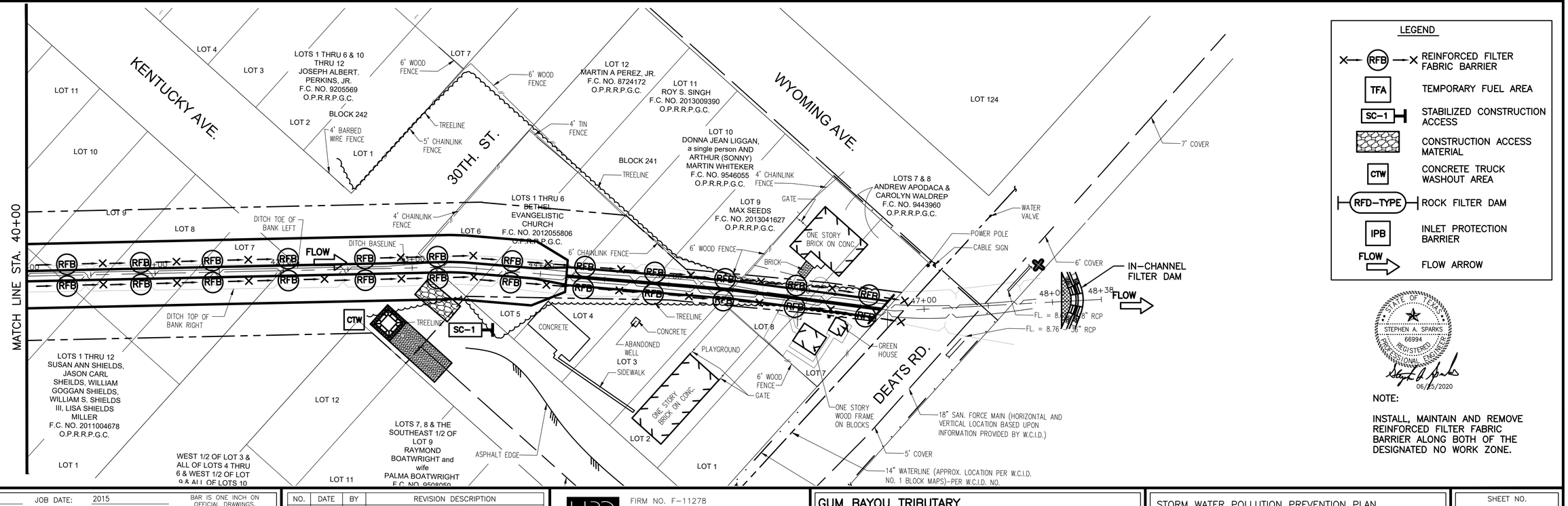
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

STORM WATER POLLUTION PREVENTION PLAN
FROM STA. 10+00 TO STA. 30+00
(SHEET 1 OF 2)

SHEET NO.
15

Xrefs: xgt-1-dh01; xgt-1-dh01_grid; xcs-base; xct-desig





LEGEND

- RFB — REINFORCED FILTER FABRIC BARRIER
- TFA — TEMPORARY FUEL AREA
- SC-1 — STABILIZED CONSTRUCTION ACCESS
- CONSTRUCTION ACCESS MATERIAL
- CTW — CONCRETE TRUCK WASHOUT AREA
- RFD–TYPE — ROCK FILTER DAM
- IPB — INLET PROTECTION BARRIER
- FLOW — FLOW ARROW

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED PROFESSIONAL ENGINEER
06/25/2020

NOTE:

INSTALL, MAINTAIN AND REMOVE REINFORCED FILTER FABRIC BARRIER ALONG BOTH OF THE DESIGNATED NO WORK ZONE.

DRAWN BY:	EBS	JOB DATE:	2015
APPROVED:	SS	JOB NUMBER:	85130016
CAD DATE:	6/22/2020 1:06:50 PM		
CAD FILE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\16 STORM WATER PPP2.dwg		

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

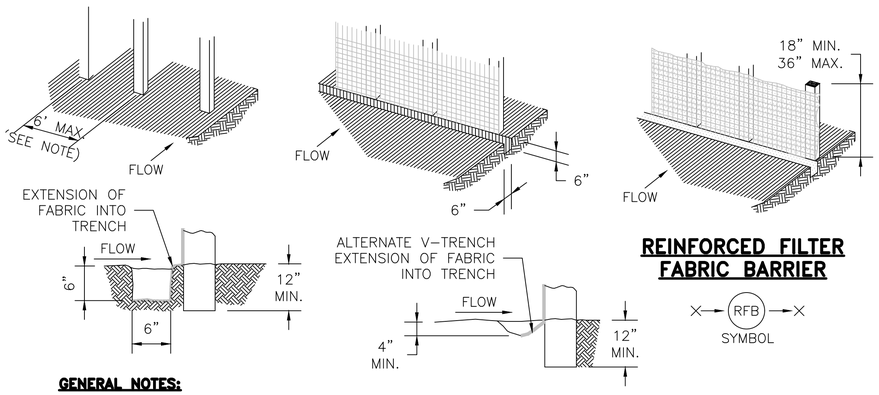
HRGreen
FIRM NO. F-11278
11011 RICHMOND AVENUE, SUITE 200
PH: 713.965.9996
FAX: 713.965.0044

GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

STORM WATER POLLUTION PREVENTION PLAN
FROM STA. 30+00 TO STA. 40+00

SHEET NO.
16

Xrefs: xgl-1-dh01; xgl-1-dh01_grid; xcs-base; xcl-desig

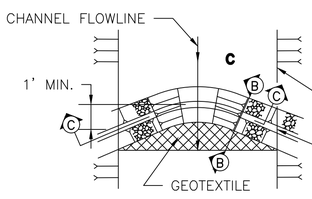


REINFORCED FILTER FABRIC BARRIER

RFB
SYMBOL

GENERAL NOTES:

1. SECURELY FASTEN MESH FENCING TO POSTS WITH STAPLES OR TIE WIRES.
2. SECURELY FASTEN FILTER FABRIC TO MESH FENCING.
3. WHEN TWO SECTIONS OF FILTER FABRIC ADJOIN EACH OTHER, OVERLAP 6 INCHES AT A POST, FOLD TOGETHER, AND ATTACH TO A POST.
4. REMOVE SEDIMENT DEPOSITS WHEN SILT REACHES ONE-THIRD OF THE HEIGHT OF THE FENCE IN DEPTH.



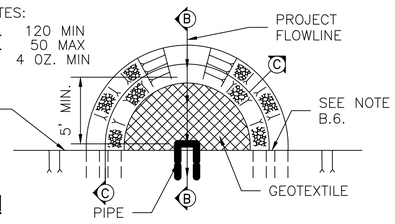
IN-CHANNEL FILTER DAM PLAN

GEOTEXTILE NOTES:

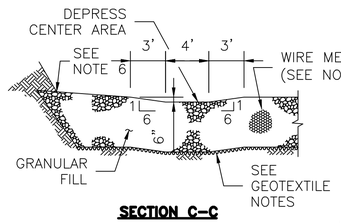
MIN. AOS	SIEVE NO.	120 MIN
MAX. AOS	SIEVE NO.	50 MAX
WEIGHT	OZ/SY	4 OZ. MIN

FILTER DAM

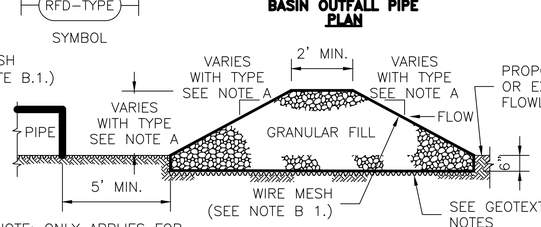
RFD-TYPE
SYMBOL



FILTER DAM AT DETENTION BASIN OUTFALL PIPE PLAN



SECTION C-C



SECTION B-B

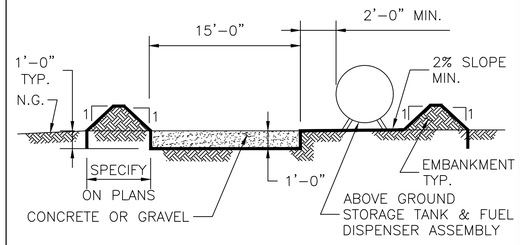
NOTE: ONLY APPLIES FOR DETENTION BASIN OUTFALL PIPE PROTECTION.

A. TYPES OF FILTER DAMS

1. TYPE 1 (NON-REINFORCED)
   a. HEIGHT – 18-24 INCHES. MEASURE VERTICALLY FROM EXISTING GROUND TO TOP OF FILTER DAM.
   b. TOP WIDTH – 2 FEET (MINIMUM)
   c. SLOPES – 2:1 (MAXIMUM).
2. TYPE 2 (REINFORCED).
   a. HEIGHT – 18-36 INCHES. MEASURE VERTICALLY FROM EXISTING GROUND TO TOP OF FILTER DAM.
   b. TOP WIDTH – 2 FEET (MINIMUM).
   c. SLOPES – 2:1 (MAXIMUM).
3. TYPE 3 (REINFORCED)
   a. HEIGHT – 36-48 INCHES. MEASURE VERTICALLY FROM EXISTING GROUND TO TOP OF FILTER DAM.
   b. TOP WIDTH – 2 FEET (MINIMUM).
   c. SLOPES – 3:1 (MAXIMUM).
4. TYPE 4 (GABION)
   a. HEIGHT – 30 INCHES (MINIMUM). MEASURE VERTICALLY FROM EXISTING GROUND TO TOP OF FILTER DAM.
   b. TOP WIDTH – 2 FEET (MINIMUM).
5. TYPE 5. AS SHOWN ON THE PLANS.

B. CONSTRUCT FILTER DAMS ACCORDING TO THE FOLLOWING CRITERIA UNLESS SHOWN OTHERWISE ON THE PLANS.

1. TYPE 2 AND 3 FILTER DAMS: SECURE WITH 20 GAUGE GALVANIZED WOVEN WIRE MESH WITH 1 INCH DIAMETER HEXAGONAL OPENINGS.
2. PLACE GRANULAR FILL ON THE WIRE MESH TO HEIGHT AND SLOPES SHOWN ON PLANS OR AS SPECIFIED BY THE ENGINEER.
   a. 3-5 INCHES FOR ROCK FILTER DAM TYPES 1, 2 AND 4.
   b. 4-8 INCHES FOR ROCK FILTER DAM TYPE REFER TO GRANULAR FILL IN SPECIFICATION SECTION No. 02378 RIPRAP AND GRANULAR FILL.
3. FOLD WIRE MESH AT UPSTREAM SIDE OVER GRANULAR FILL AND TIGHTLY SECURED TO ITSELF ON THE DOWNSTREAM SIDE USING WIRE TIES OR HOG RINGS.
4. IN STREAMS: SECURE OR STAKE MESH TO STREAM BED PRIOR TO AGGREGATE PLACEMENT.
5. SEE HCFCD SPECIFICATION SECTION NO. 02364-FILTER DAMS.
6. EMBED ONE FOOT MINIMUM INTO SLOPE AND RAISE ONE FOOT HIGHER THAN CENTER OF DEPRESSED AREA AT SLOPE.

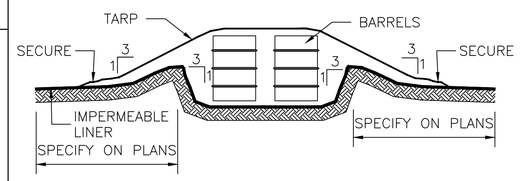


ABOVE GROUND TEMP. VEHICLE & EQUIPMENT FUELING AREA WITH TANK

TFA
SYMBOL

GENERAL NOTES:

1. THE SIZE OF TANK FOUNDATION AREA DEPENDS ON THE SIZE OF ABOVE GROUND STORAGE TANK AND DISPENSER ASSEMBLY.
2. PROVIDE A MINIMUM SLOPE OF 2 % TOWARD THE SUMP PIT.
3. INSTALL IMPERMEABLE LINER AS PER MANUFACTURER'S RECOMMENDATIONS.

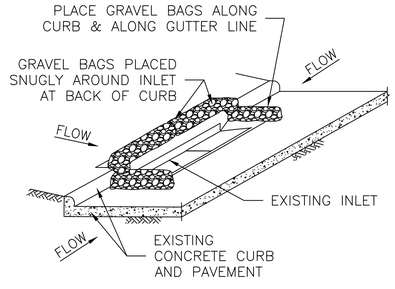


BARREL STORAGE AREA

BSA
SYMBOL

GENERAL NOTES:

1. ALTERNATIVELY, STORE BARRELS IN AN ENCLOSED BUILDING OR SHED.
2. INSTALL IMPERMEABLE LINER AS PER MANUFACTURER'S RECOMMENDATIONS. 60 mil MINIMUM.
3. CONSTRUCT BERMED AREA WITH VOLUME GREATER THAN OR EQUAL TO 110% VOLUME OF BARRELS.

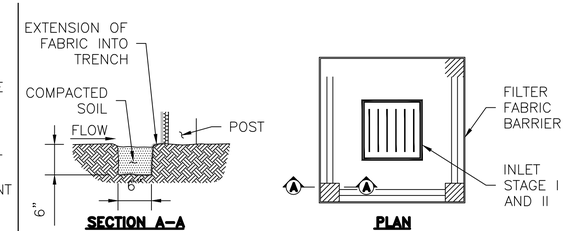


INLET PROTECTION BARRIERS FOR STAGE II INLETS

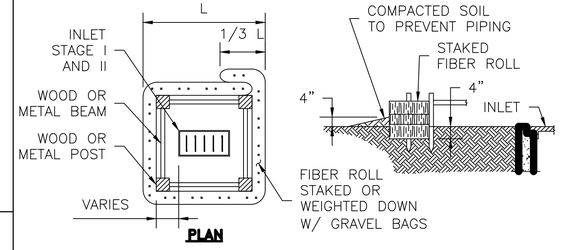
IPB-II
SYMBOL

GENERAL NOTES:

1. REMOVE SEDIMENT DEPOSIT WHEN THE SEDIMENT HAS ACCUMULATED TO ONE-THIRD THE HEIGHT OF THE BARRIER.
2. GRAVEL BAGS SHALL NOT BLOCK THROAT OF INLET UNLESS DIRECTED BY ENGINEER.



INLET PROTECTION BARRIER WITH REINFORCED FILTER FABRIC



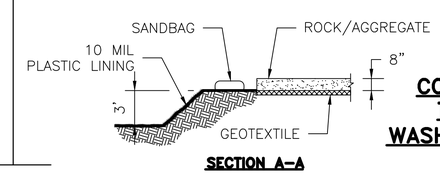
INLET PROTECTION BARRIER WITH FILTER ROLLS

GENERAL NOTES:

1. FIBER ROLLS WILL BE UTILIZED ONLY WHEN SITE CONDITIONS DO NOT PERMIT THE USE OF FILTER FABRIC BARRIER, AND AS APPROVED BY THE ENGINEER.

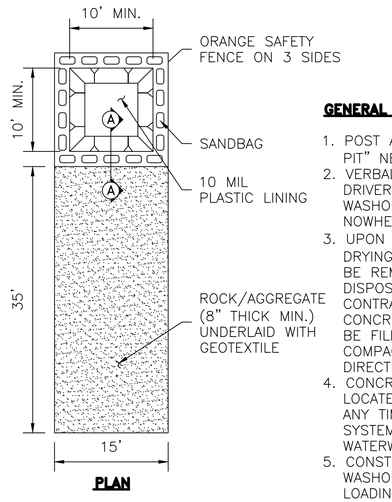
INLET PROTECTION BARRIERS FOR STAGE I INLETS

IPB
SYMBOL



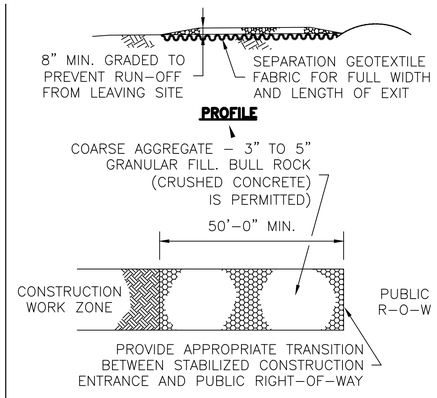
CONCRETE TRUCK WASHOUT AREA

CTW
SYMBOL



GENERAL NOTES:

1. POST A SIGN READING "CONCRETE WASHOUT PIT" NEXT TO THE PIT.
2. VERBALLY INSTRUCT THE CONCRETE TRUCK DRIVERS WHERE THE PIT IS AND TO WASHOUT THEIR TRUCKS IN THE PIT AND NOWHERE ELSE.
3. UPON THE CONCRETE SETTING UP (CURING, DRYING OUT), THE CONCRETE WASTE SHALL BE REMOVED FROM THE PROJECT SITE AND DISPOSED OF PROPERLY BY THE CONTRACTOR. AFTER REMOVAL OF THE CONCRETE WASTE, THE WASHOUT PIT SHALL BE FILLED WITH CLEAN FILL MATERIAL AND COMPACTED TO IN-SITU CONDITIONS, OR AS DIRECTED BY THE PROJECT SPECIFICATIONS.
4. CONCRETE WASHOUT PITS SHALL NOT BE LOCATED DIRECTLY ADJACENT TO, NOR AT ANY TIME DRAIN INTO THE STORM SEWER SYSTEM OR ANY OTHER SWALE, DITCH, OR WATERWAY.
5. CONSTRUCT ENTRY ROAD AND BOTTOM OF WASHOUT AREA TO SUPPORT EXPECTED LOADINGS FROM TRUCKS EQUIPMENT.

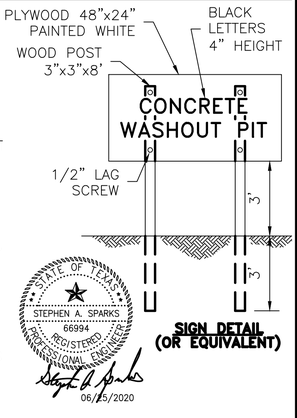


STABILIZED CONSTRUCTION ACCESS

SC-1
SYMBOL

GENERAL NOTES:

1. MINIMUM LENGTH IS AS SHOWN ON CONSTRUCTION DRAWINGS OR 50 FEET, WHICHEVER IS MORE.
2. CONSTRUCT AND MAINTAIN CONSTRUCTION EXIT WITH CONSTANT WIDTH ACROSS ITS LENGTH, INCLUDING ALL POINTS OF INGRESS OR EGRESS.
3. UNLESS SHOWN ON THE CONSTRUCTION DRAWINGS, STABILIZATION FOR OTHER AREAS WILL HAVE THE SAME AGGREGATE THICKNESS AND WIDTH REQUIREMENTS AS THE STABILIZED CONSTRUCTION EXIT.
4. WHEN SHOWN ON THE CONSTRUCTION DRAWINGS, WIDEN OR LENGTHEN STABILIZED AREA TO ACCOMMODATE A TRUCK WASHING AREA. PROVIDE OUTLET SEDIMENT TRAP FOR THE TRUCK WASHING AREA.
5. PROVIDE PERIODIC TOP DRESSING WITH ADDITIONAL COARSE AGGREGATE TO MAINTAIN THE REQUIRED DEPTH OR WHEN SURFACE BECOMES PACKED WITH MUD.
6. PERIODICALLY TURN AGGREGATE TO EXPOSE A CLEAN DRIVING SURFACE.
7. MINIMUM 14' WIDTH FOR ONE WAY TRAFFIC AND 20' WIDTH FOR TWO WAY TRAFFIC.



SIGN DETAIL (OR EQUIVALENT)

DRAWN BY:	EBS	JOB DATE:	2015
APPROVED:	SS	JOB NUMBER:	85130016
CAD DATE:	6/22/2020 1:07:04 PM		
CAD FILE:	\\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\17 STORM WATER POLLUTION PREVENTION PLAN DETAILS.dwg		

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

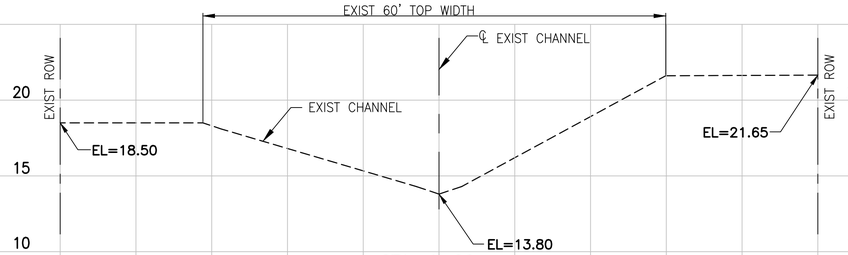
NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
FIRM NO. F-11278
11011 RICHMOND AVENUE, SUITE 200
PH: 713.965.9996
FAX: 713.965.0044

GUM BAYOU TRIBUTARY CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

STORM WATER POLLUTION PREVENTION PLAN DETAILS

SHEET NO. 17



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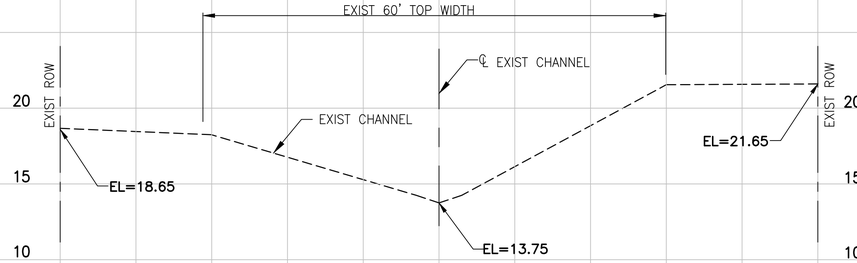
FILL = 0 SF

STA. 1+00

CUT VOL = 0 CY
FILL VOL = 0 CY



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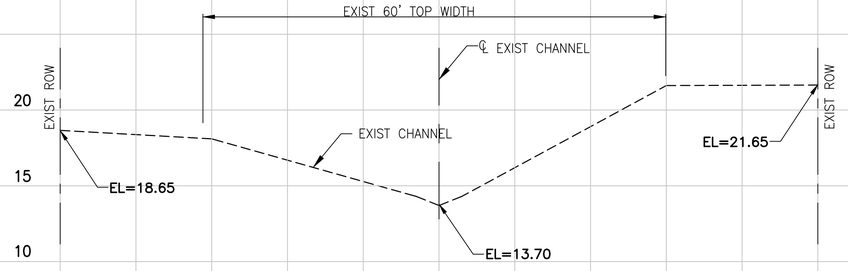
FILL = 0 SF

STA. 2+00

CUT VOL = 0 CY
FILL VOL = 0 CY



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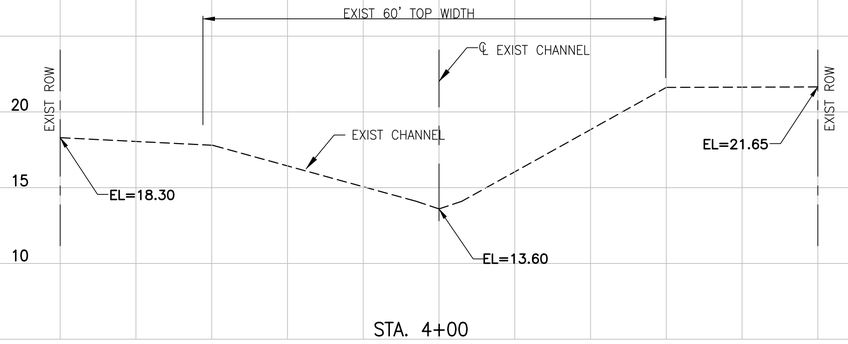
FILL = 0 SF

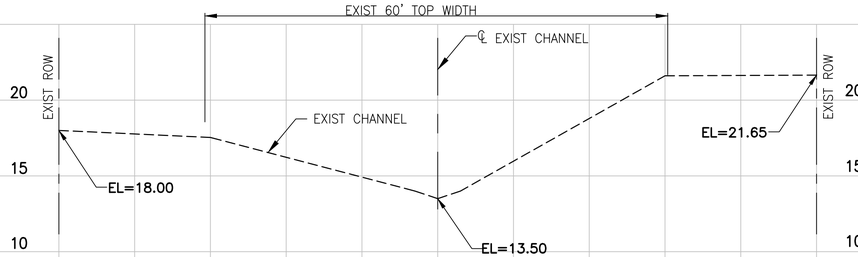
STA. 3+00

CUT VOL = 0 CY
FILL VOL = 0 CY



CUT = 0 SF
FILL = 0 SF

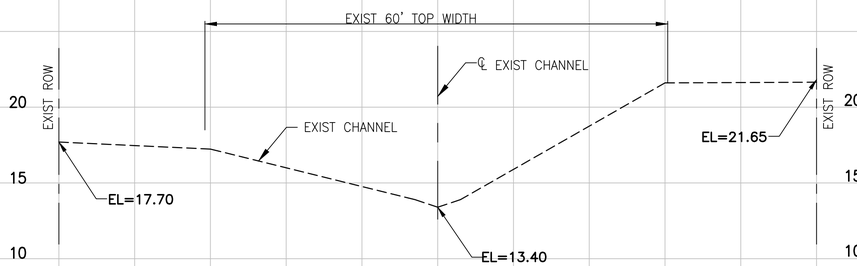
STA. 4+00



CUT = 0 SF
FILL = 0 SF

STA. 5+00

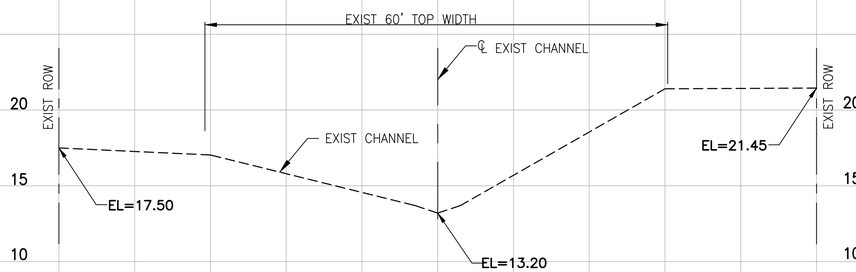
CUT VOL = 0 CY
FILL VOL = 0 CY



CUT = 0 SF
FILL = 0 SF

STA. 6+00

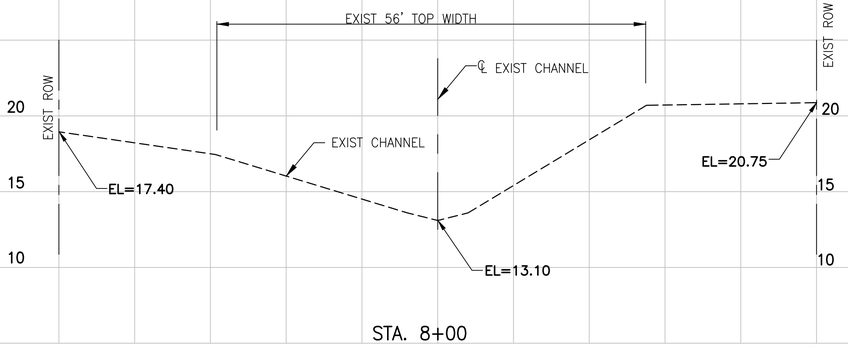
CUT VOL = 0 CY
FILL VOL = 0 CY



CUT = 0 SF
FILL = 0 SF

STA. 7+00

CUT VOL = 0 CY
FILL VOL = 0 CY



CUT = 0 SF
FILL = 0 SF

SHEET TOTAL:
TOTAL CUT = 0 C.Y.
TOTAL FILL = 0 C.Y.

STA. 8+00

50 40 30 20 10 0 10 20 30 40 50

NOTE: ALL CROSS SECTIONS ARE LOOKING DOWNSTREAM

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

SCALE:
FULL – 1"=10' HZ/VT
HALF – 1"=20' HZ/VT

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE: 6/22/2020 1:07:24 PM
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\18 CROSS SECTION STA 1+00 TO STA 8+00.dwg

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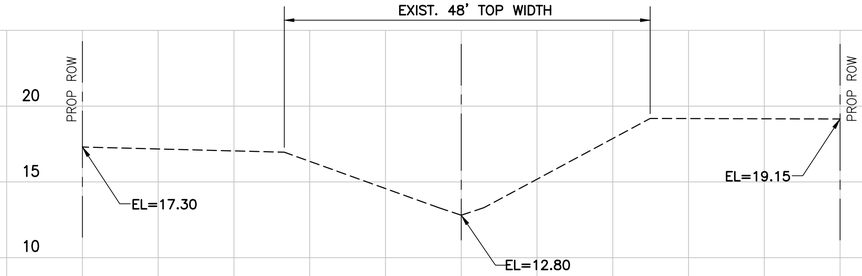
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

CROSS SECTIONS
CROSS SECTION STA 1+00 TO STA 8+00

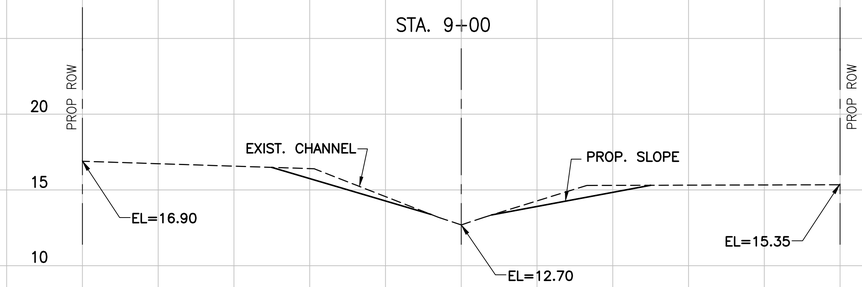
SHEET NO.
18



STA. 9+00

CUT = 0 SF
FILL = 0 SF

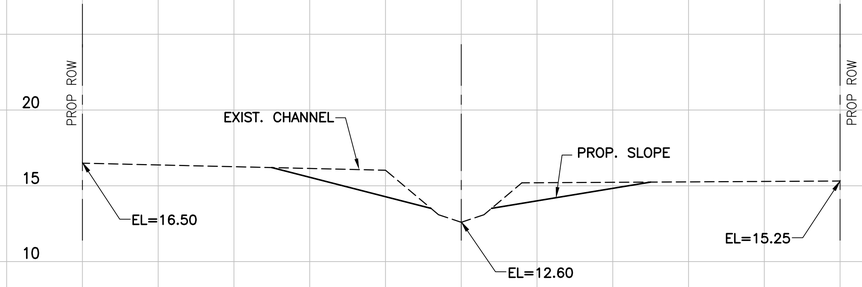
CUT VOL. = 30 CY
FILL VOL. = 0 CY



STA. 10+00

CUT = 16 SF
FILL = 0 SF

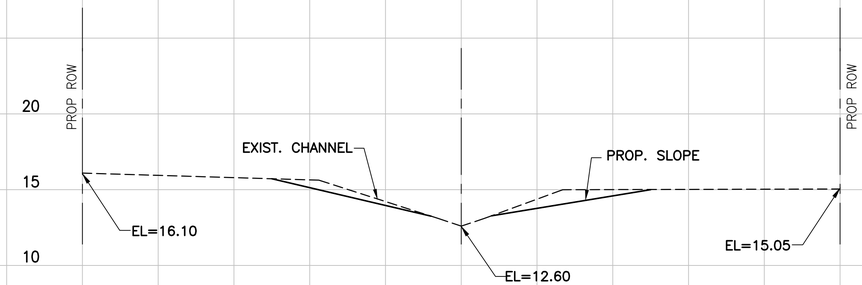
CUT VOL. = 93 CY
FILL VOL. = 0 CY



STA. 11+00

CUT = 34 SF
FILL = 0 SF

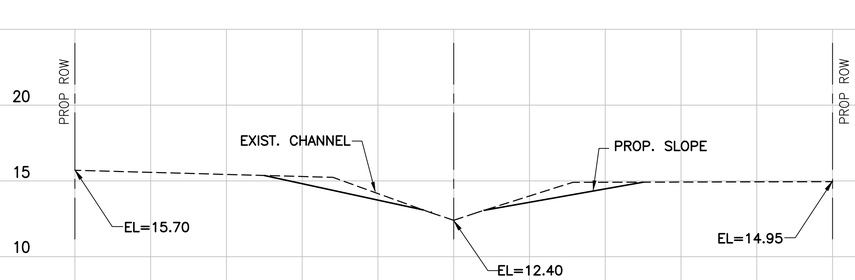
CUT VOL. = 100 CY
FILL VOL. = 0 CY



STA. 12+00

CUT = 20 SF
FILL = 0 SF

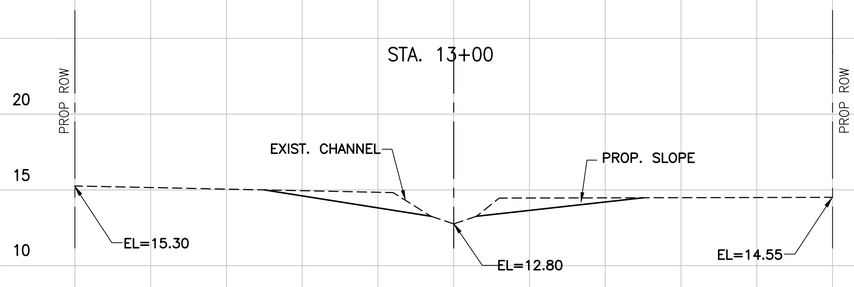
CUT VOL. = 74 CY
FILL VOL. = 0 CY



STA. 13+00

CUT = 20 SF
FILL = 0 SF

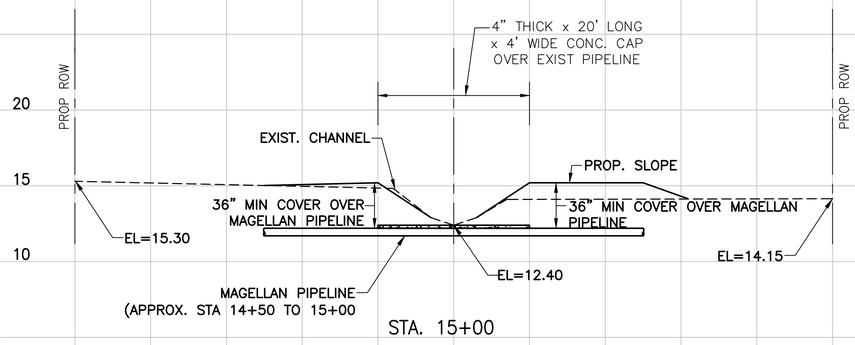
CUT VOL. = 83 CY
FILL VOL. = 0 CY



STA. 14+00

CUT = 25 SF
FILL = 0 SF

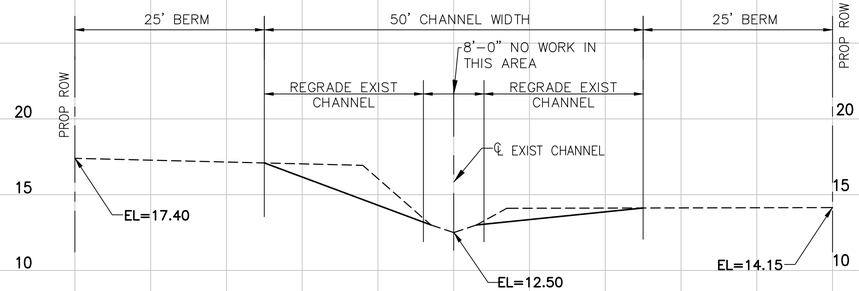
CUT VOL = 91 CY
FILL VOL = 0 CY



STA. 15+00

CUT = 24 SF
FILL = 0 SF

CUT VOL. = 174 CY
FILL VOL. = 0 CY



STA. 16+00

CUT = 70 SF
FILL = 0 SF

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

SHEET TOTAL:
TOTAL CUT = 645 C.Y.
TOTAL FILL = 0 C.Y.

SCALE:
FULL – 1"=10' H/ 5' V
HALF – 1"=20' H/ 10' V

50 40 30 20 10 0 10 20 30 40 50

NOTE: ALL SECTIONS ARE LOOKING DOWNSTREAM

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE: 6/22/2020 5:45:12 PM
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\19 CROSS SECTION STA 9+00 TO STA 16+00.dwg

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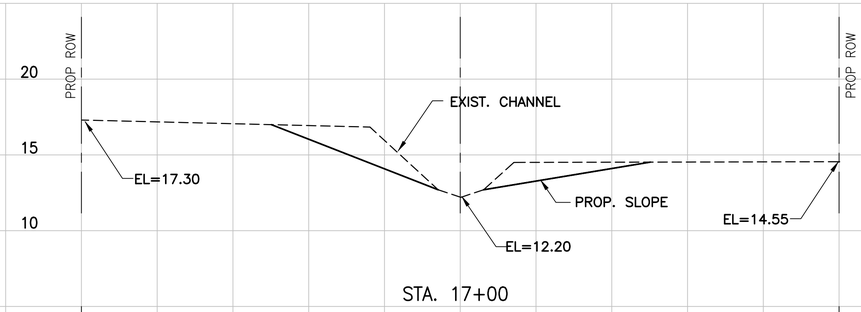
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

CROSS SECTIONS
CROSS SECTION STA 9+00 TO STA 16+00

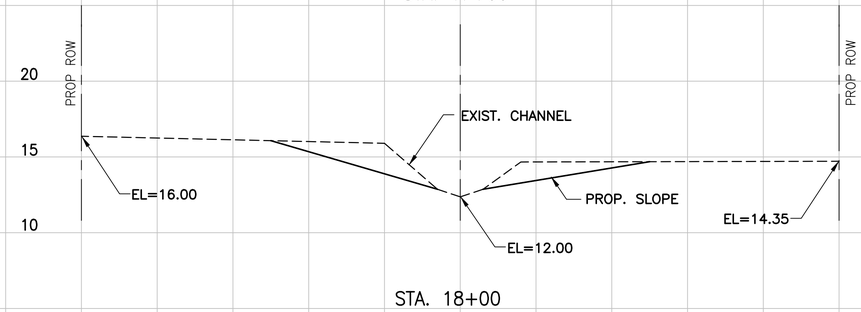
SHEET NO.
19



STA. 17+00

CUT VOL. = 209 CY
FILL VOL. = 0 CY

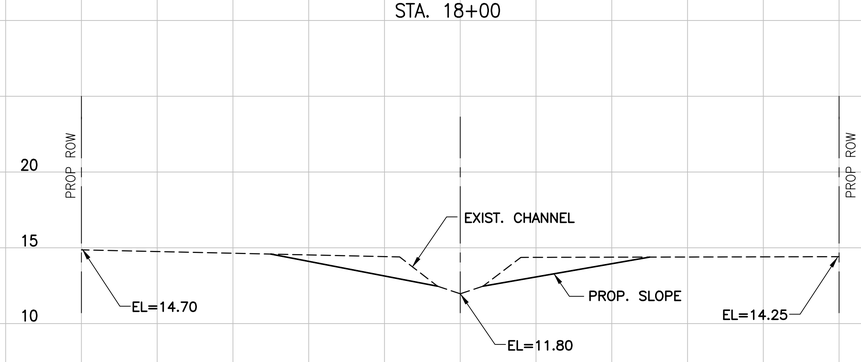
CUT = 43 SF
FILL = 0 SF



STA. 18+00

CUT VOL. = 122 CY
FILL VOL. = 0 CY

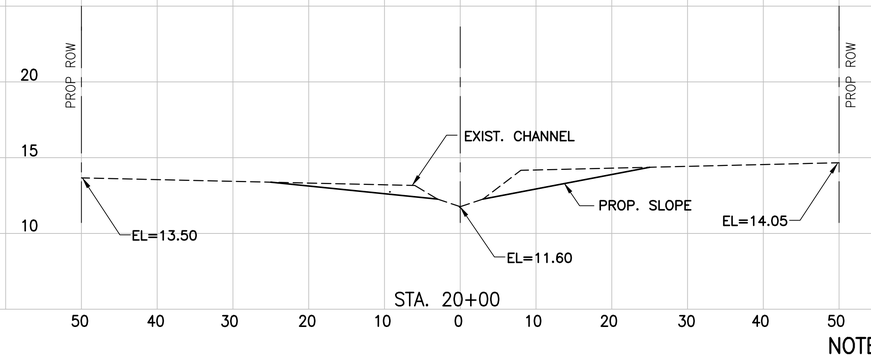
CUT = 23 SF
FILL = 0 SF



STA. 19+00

CUT VOL. = 102 CY
FILL VOL. = 0 CY

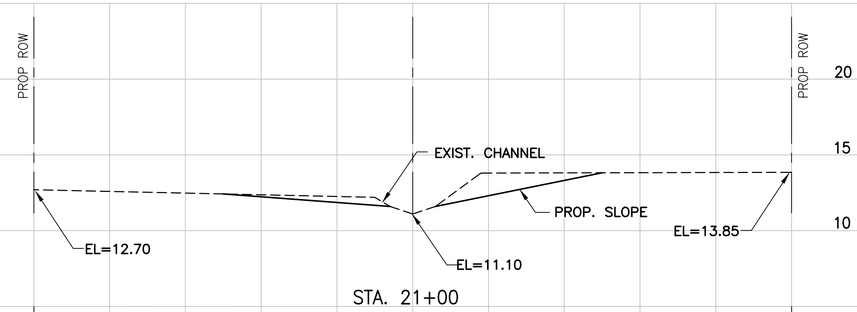
CUT = 32 SF
FILL = 0 SF



STA. 20+00

CUT VOL. = 89 CY
FILL VOL. = 0 CY

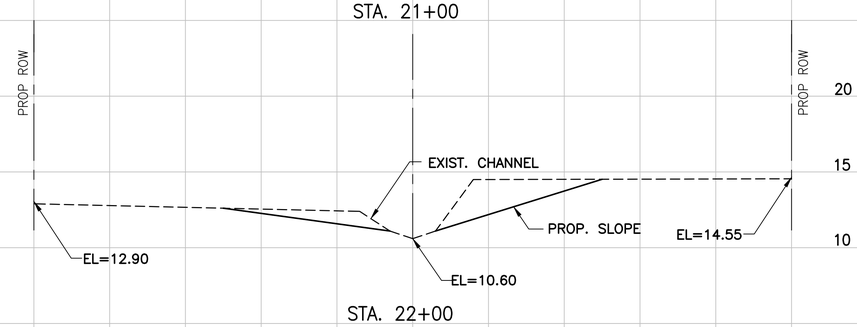
CUT = 24 SF
FILL = 0 SF



STA. 21+00

CUT VOL. = 118 CY
FILL VOL. = 0 CY

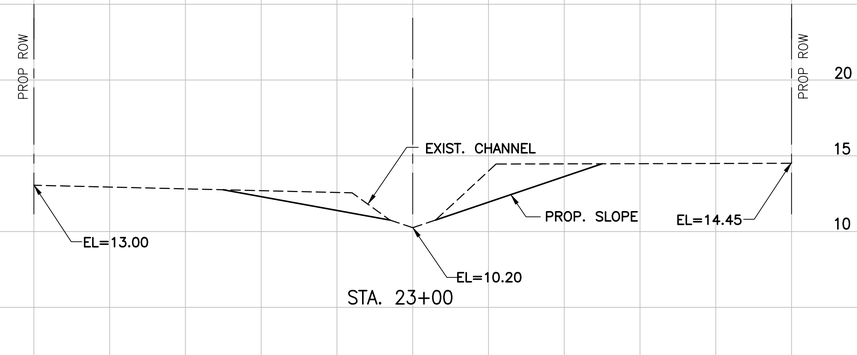
CUT = 24 SF
FILL = 0 SF



STA. 22+00

CUT VOL. = 150 CY
FILL VOL. = 0 CY

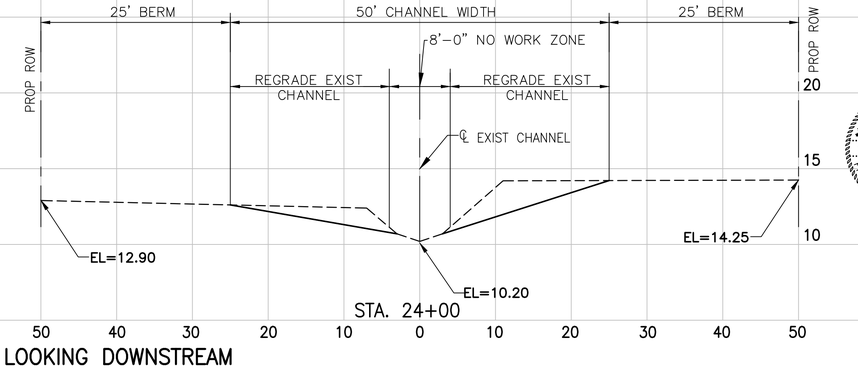
CUT = 40 SF
FILL = 0 SF



STA. 23+00

CUT VOL. = 150 CY
FILL VOL. = 0 CY

CUT = 41 SF
FILL = 0 SF



STA. 24+00

CUT VOL. = 150 CY
FILL VOL. = 0 CY

CUT = 40 SF
FILL = 0 SF

50 40 30 20 10 0 10 20 30 40 50

NOTE: ALL CROSS SECTIONS ARE LOOKING DOWNSTREAM

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

SHEET TOTAL:
TOTAL CUT = 894 C.Y.
TOTAL FILL = 0 C.Y.

SCALE:
FULL – 1"=10' H/ 5' V
HALF – 1"=20' H/ 10'V

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE: 6/22/2020 5:46:57 PM
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\20 CROSS SECTION STA 17+00 TO STA 24+00.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
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NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
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11011 RICHMOND AVENUE, SUITE 200
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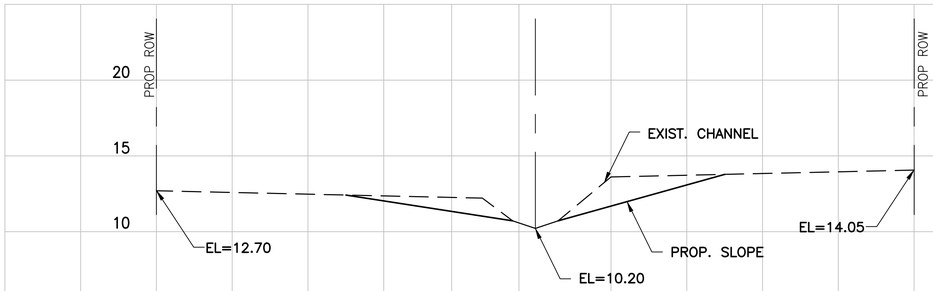
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

CROSS SECTIONS
CROSS SECTION STA 17+00 TO STA 24+00

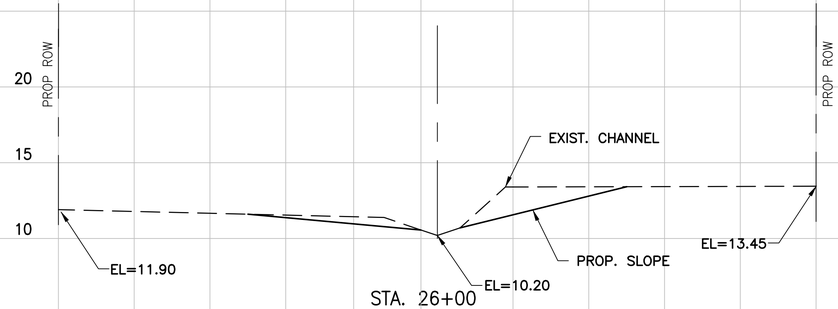
SHEET NO.
20



STA. 25+00

CUT VOL = 137 CY
FILL VOL = 0 CY

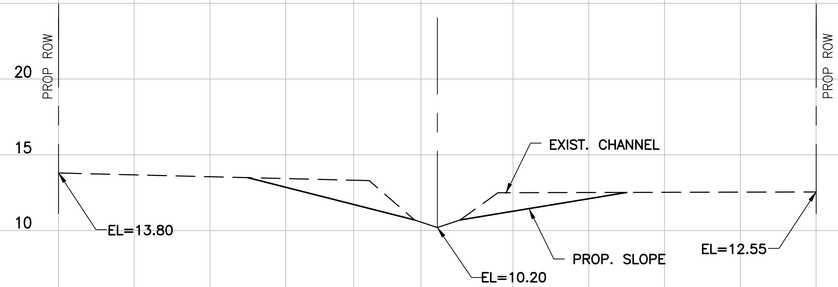
CUT = 34 SF
FILL = 0 SF



STA. 26+00

CUT VOL = 115 CY
FILL VOL = 0 CY

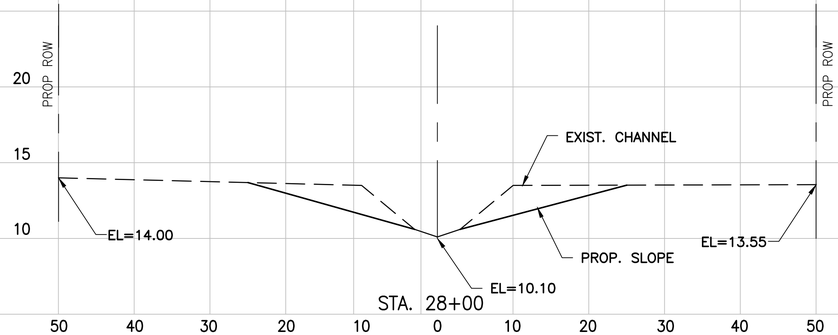
CUT = 28 SF
FILL = 0 SF



STA. 27+00

CUT VOL = 116 CY
FILL VOL = 0 CY

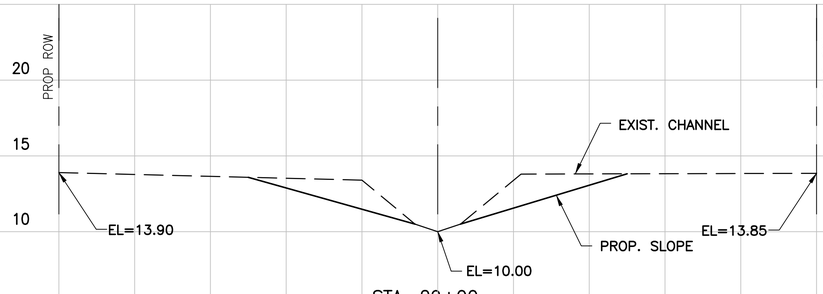
CUT = 35 SF
FILL = 0 SF



STA. 28+00

CUT VOL = 144 CY
FILL VOL = 0 CY

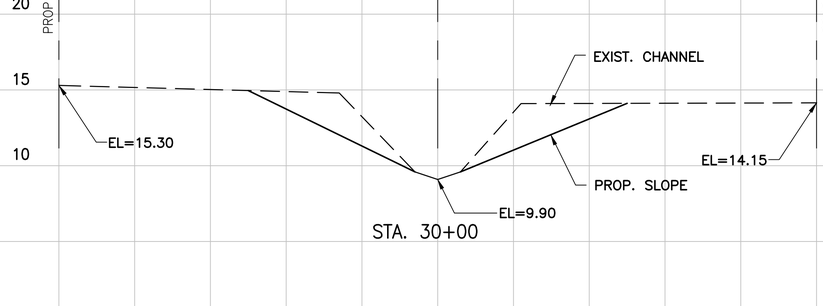
CUT = 43 SF
FILL = 0 SF



STA. 29+00

CUT VOL = 161 CY
FILL VOL = 0 CY

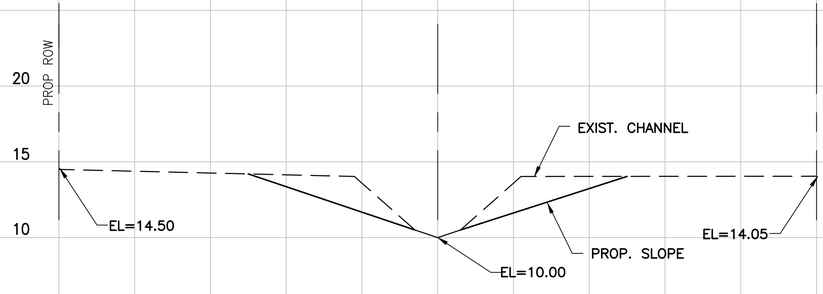
CUT = 44 SF
FILL = 0 SF



STA. 30+00

CUT VOL = 196 CY
FILL VOL = 0 CY

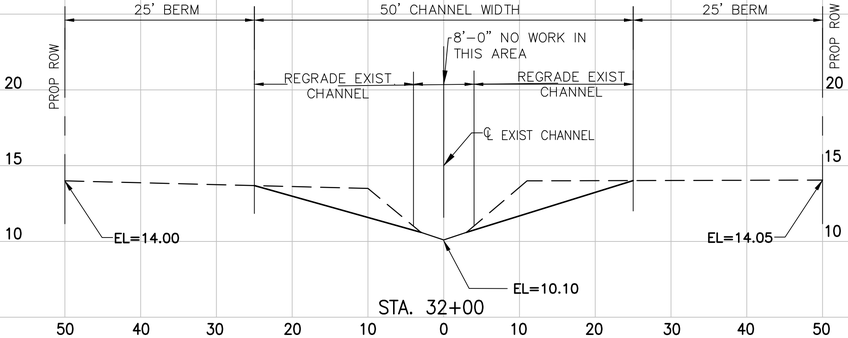
CUT = 62 SF
FILL = 0 SF



STA. 31+00

CUT VOL = 204 CY
FILL VOL = 0 CY

CUT = 48 SF
FILL = 0 SF



STA. 32+00

CUT VOL = 172 CY
FILL VOL = 0 CY

CUT = 45 SF
FILL = 0 SF

STATE OF TEXAS
STEPHEN A. SPARKS
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REGISTERED PROFESSIONAL ENGINEER
06/25/2020

SHEET TOTAL:
TOTAL CUT = 1396 C.Y.
TOTAL FILL = 0 C.Y.

50 40 30 20 10 0 10 20 30 40 50

SCALE:
FULL - 1"=10' H/ 5' V
HALF - 1"=20' H/ 5' V

NOTE: ALL CROSS SECTIONS ARE LOOKING DOWNSTREAM

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE: 6/22/2020 5:48:05 PM
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\21 CROSS SECTION STA 25+00 TO STA 32+00.dwg

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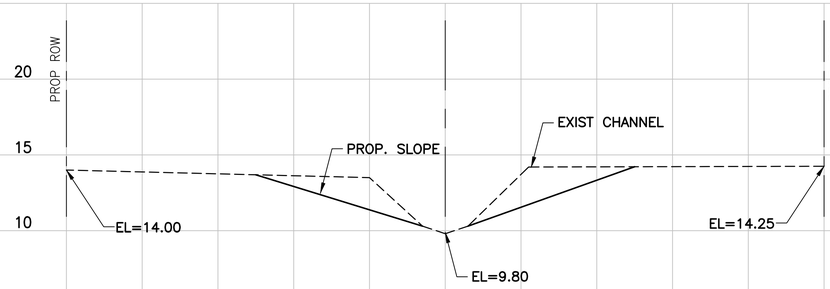
FAX: 713.965.0044

GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

CROSS SECTIONS
CROSS SECTION STA 25+00 TO STA 32+00

SHEET NO.
21

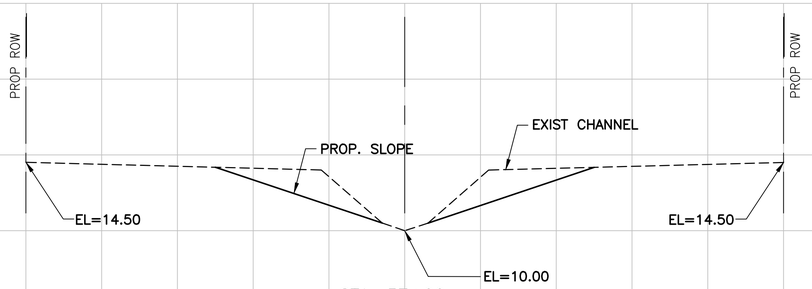


STA. 33+00

CUT VOL = 178 CY
FILL VOL = 0 CY

CUT = 51 SF
FILL = 0 SF

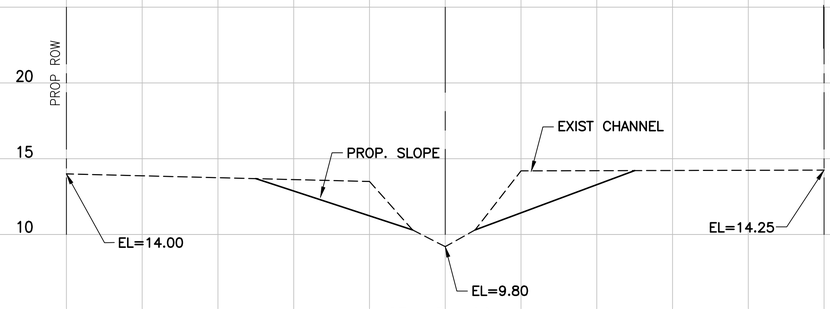
CUT VOL = 192 CY
FILL VOL = 0 CY



STA. 37+00

CUT = 48 SF
FILL = 0 SF

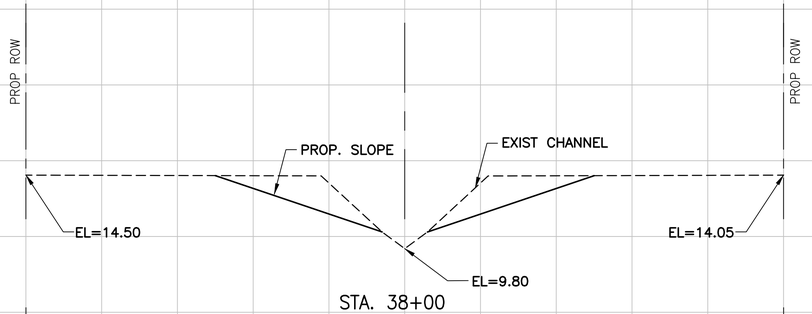
CUT VOL = 185 CY
FILL VOL = 0 CY



STA. 34+00

CUT = 53 SF
FILL = 0 SF

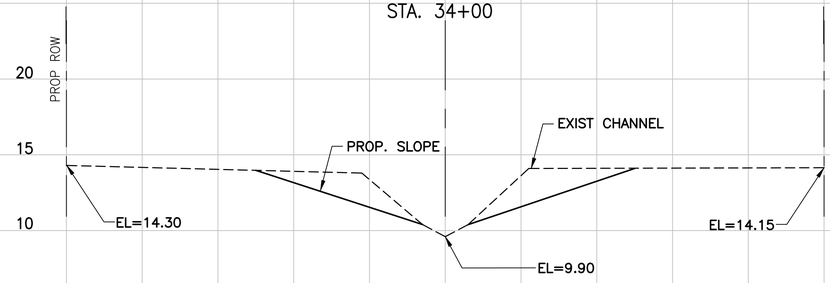
CUT VOL = 189 CY
FILL VOL = 0 CY



STA. 38+00

CUT = 52 SF
FILL = 0 SF

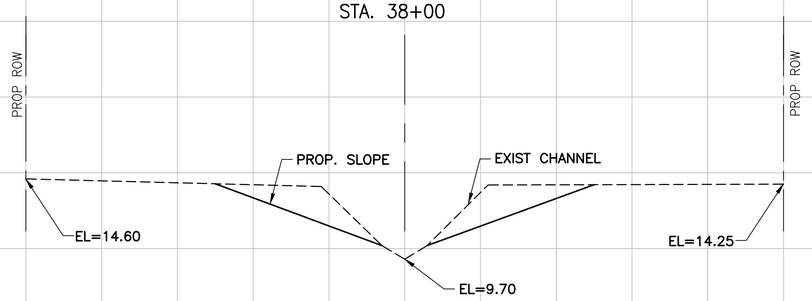
CUT VOL = 198 CY
FILL VOL = 0 CY



STA. 35+00

CUT = 49 SF
FILL = 0 SF

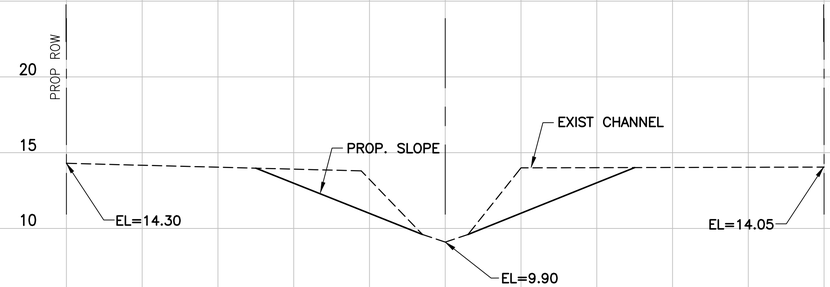
CUT VOL = 206 CY
FILL VOL = 0 CY



STA. 39+00

CUT = 55 SF
FILL = 0 SF

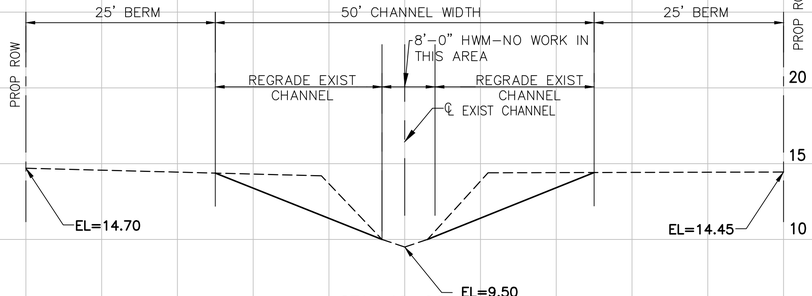
CUT VOL = 211 CY
FILL VOL = 0 CY



STA. 36+00

CUT = 62 SF
FILL = 0 SF

CUT VOL = 203 CY
FILL VOL = 0 CY



STA. 40+00

CUT = 59 SF
FILL = 0 SF

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

SHEET TOTAL:
TOTAL CUT = 1563 C.Y.
TOTAL FILL = 0 C.Y.

SCALE:
FULL – 1"=10' HZ/VT
HALF – 1"=20' HZ/VT

50 40 30 20 10 0 10 20 30 40 50

NOTE: ALL CROSS SECTIONS ARE LOOKING DOWNSTREAM

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE: 6/22/2020 5:49:15 PM
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\22 CROSS SECTION STA 33+00 TO STA 40+00.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

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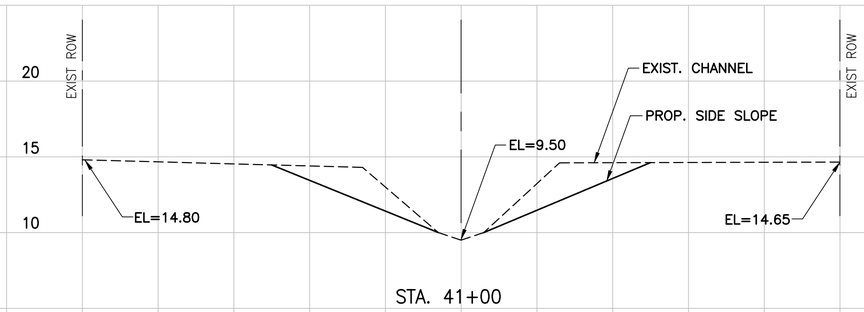
GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

CROSS SECTIONS
CROSS SECTION STA 33+00 TO STA 40+00

SHEET NO.
22

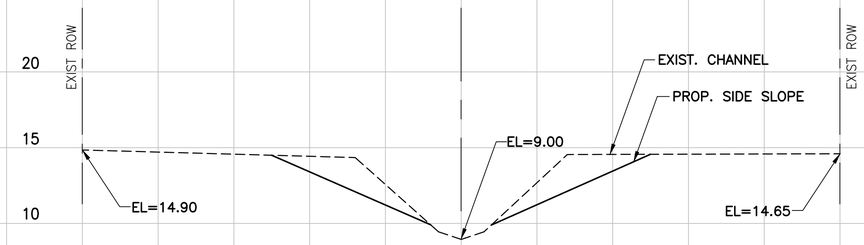


STA. 41+00

CUT VOL = 157 CY
FILL VOL = 0 CY

CUT = 26 SF
FILL = 0 SF

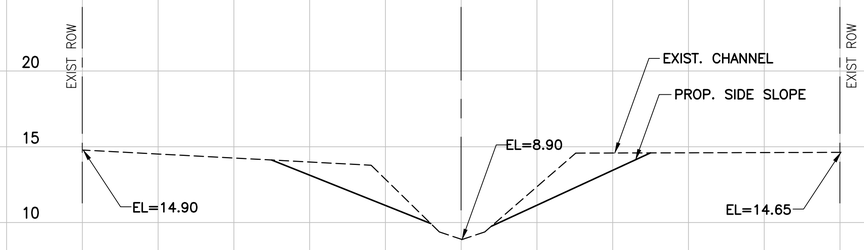
CUT VOL = 139 CY
FILL VOL = 0 CY



STA. 42+00

CUT = 49 SF
FILL = 0 SF

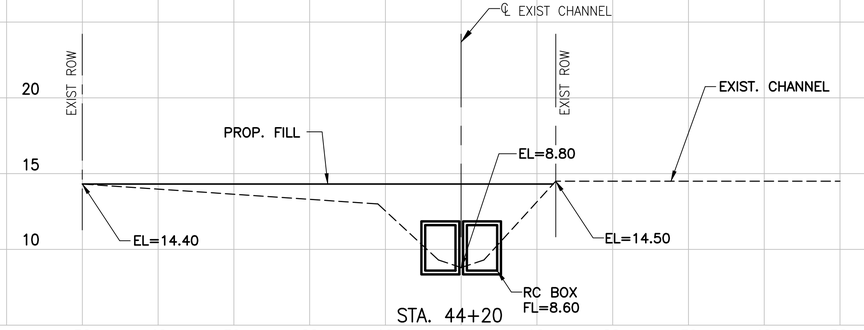
CUT VOL = 180 CY
FILL VOL = 0 CY



STA. 43+00

CUT = 48 SF
FILL = 0 SF

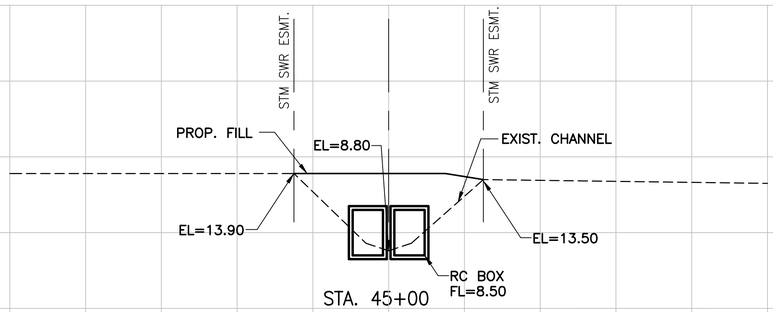
CUT VOL = 89 CY
FILL VOL = 0 CY



STA. 44+20

CUT = 209 SF
FILL = 0 SF

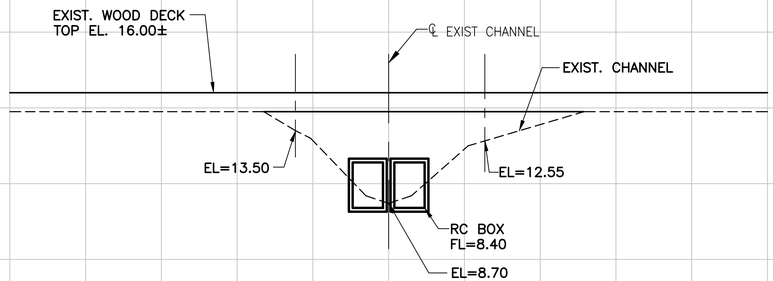
CUT VOL = 145 CY
FILL VOL = 0 CY



STA. 45+00

CUT = 0 SF
FILL = 0 SF

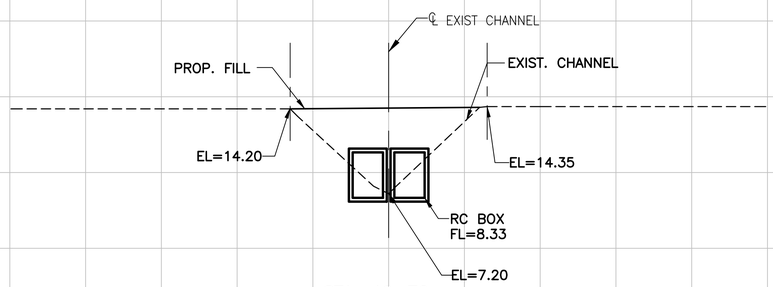
CUT VOL = 0 CY
FILL VOL = 0 CY



STA. 46+00

CUT = 0 SF
FILL = 0 SF

CUT VOL = 0 CY
FILL VOL = 0 CY



STA. 46+70

CUT = 0 SF
FILL = 0 SF

SHEET TOTAL:
TOTAL CUT = 753 C.Y.
TOTAL FILL = 0 C.Y.

50 40 30 20 10 0 10 20 30 40 50

NOTE: ALL CROSS SECTIONS ARE LOOKING DOWNSTREAM

PROJECT TOTALS

SHEET	CUT	FILL
18	0	0
19	645	0
20	894	0
21	1396	0
22	1563	0
23	753	0
TOTAL	5251 CY	270 CY

STATE OF TEXAS
STEPHEN A. SPARKS
66994
REGISTERED
PROFESSIONAL ENGINEER
06/25/2020

SCALE:
FULL – 1"=10' H/5' V
HALF – 1"=20' H/10' V

DRAWN BY: EBS JOB DATE: 2015
APPROVED: SS JOB NUMBER: 85130016
CAD DATE: 6/22/2020 5:57:56 PM
CAD FILE: \\HRGHUS\Data\85130016 Gum Bayou\CAD\100 submittal\23 CROSS SECTION STA 41+00 TO STA 47+00.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

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GUM BAYOU TRIBUTARY
CHANNEL IMPROVEMENTS
GALVESTON COUNTY, TEXAS

CROSS SECTIONS
CROSS SECTION STA 41+00 TO STA 46+70

SHEET NO.
23

GEOTECHNICAL INVESTIGATION
Proposed GUM Bayou Tributary Channel Improvements
Near Dickinson Avenue and Deats Road
Galveston County, Texas

Reported to:
Dannenbaum Engineering
Houston, Texas

Prepared by:
Geoscience Engineering and Testing, Inc.
Houston, Texas

PROJECT NO: 13G22402/A
(Supersedes February 10, 2014 Report)

March 2014

GEOSCIENCE
ENGINEERING & TESTING, INC.

405 E. 20th Street
Houston, Texas 77008
713.861.9700
713.861.4477 Fax

HOUSTON DALLAS SAN ANTONIO NEW ORLEANS

March 17, 2014
(Supersedes February 10, 2014 Report)

Dannenbaum Engineering
3100 West Alabama Street
Houston, Texas 77098

Attention: Mr. Larry S. Marr, P.E.

Reference: Geotechnical Investigation
Proposed GUM Bayou Tributary Channel Improvements
Near Dickinson Avenue and Deats Road
Galveston County, Texas
GETI NO: 13G22402/A

Dear Mr. Marr:

GEOSCIENCE ENGINEERING & TESTING, INC. is pleased to submit this report for the above referenced project. This study was authorized by you on November 20, 2013. This report briefly describes the procedures employed in our investigation and presents the conclusions and recommendations of our studies.

We appreciate the opportunity to work with you on this phase of the project. If you have any question concerning this report or require additional information, please contact us.

With Kindest Regards,

Lakshman K. Dontha, M.Sc., E.I.T.
Staff Engineer

03.17.2014

Ronald L. Dilly, Ph.D., P.E.
Principal Engineer

STATE OF TEXAS
RONALD L. DILLY
111371
LICENSED PROFESSIONAL ENGINEER

F-4802

Copies Submitted: (1)

I. INTRODUCTION

Geoscience Engineering and Testing, Inc. (GETI) hereby submits this report of geotechnical investigation of subsurface conditions at the site of the Proposed GUM Bayou Tributary Channel Improvements, Galveston County, Texas. GETI's investigation was authorized by Mr. Larry S. Marr, P.E. with Dannenbaum Engineering on November 20, 2013.

The purpose of the geotechnical investigation was to determine the subsurface soil conditions at the site of the proposed GUM Bayou Tributary Channel Improvements, Galveston County, Texas in the region of the Dickinson Avenue and Deats Road intersection with particular reference to the recommendations for channel improvement and channel foundation structures for the channel north of Deats Road.

II. SUBSURFACE EXPLORATION

1. General

This report presents the results of our soil exploration and analysis for the proposed GUM Bayou Tributary Channel Improvements located in Galveston County, Texas in the proximity of Dickinson Avenue and Deats Road intersection.

Scope of this investigation included a reconnaissance of the immediate site, the subsurface exploration, field and laboratory testing, an engineering analysis and evaluation of the subsurface materials. The purpose of this subsurface exploration and analysis was to determine soil profile components, the engineering characteristics of the subsurface materials and to provide criteria for use by design engineers in preparing designs for channel improvements.

The exploration and analysis of the subsurface conditions reported herein are considered in sufficient detail and scope to form a reasonable basis for the recommendations. The recommendations submitted are based on the available soil information and the preliminary design details furnished by Mr. Larry S. Marr, P.E. with Dannenbaum Engineering. Any revision in plans for the proposed GUM Bayou Tributary Channel Improvements, Galveston County, Texas from those enumerated in this report should be brought to the attention of the soil engineer, to determine if changes in the recommendations are required. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the soil engineer.

2. Description of the Site

The site of the proposed GUM Bayou Tributary Channel Improvements in, upon which this subsurface exploration has been made, is located near Dickinson Avenue and Deats Road Galveston County, Texas. The region around the site was developed with an existing structures and roads; the remaining area of the site is gently sloping and covered with grass. The surface soils were soft clay at the time of drilling operation.

3. Field Investigation

The field investigation, which was completed on December 11, 2013, was to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, drilling the exploratory borings and recovering the representative soil samples. Due to presence of existing structures and somewhat limited accessibility, soil test borings were drilled in the area accessible to drill rig.

The subsurface soil conditions were explored by advancing and sampling four (4) soil borings. The soil boring B-1 through B-4 was drilled to a depth of ten (10) feet below the existing bank surface along the banks of the GUM Bayou Tributary Channel. The approximate soil boring locations are shown on the attached soil Boring Plan, Plate No. 1. The existing channel is accentuated on this plate.

Sample depth and description of soil classification (based on the Unified Soil Classification System) are presented on the Soil Boring Logs, Plate Nos. 2 and 5. Keys to terms and symbols used on the soil boring logs are shown on Plate No. 6.

The soil borings were of two-inch nominal diameter. Both relatively undisturbed and disturbed soil samples were obtained at two (2) feet intervals continuously to a depth of ten (10) feet. The soil borings were performed with a drilling rig equipped with rotary head conventional solid-stem augers were used to advance the holes. Representative disturbed or undisturbed soil samples were obtained employing thin-walled sampling procedures in accordance with ASTM D-1587. The obtained soil samples were extruded from the tube and visually classified in the field. Soil samples were identified according to the boring number and depth and wrapped in aluminum foil and polyethylene plastic wrapping bags to prevent moisture loss and disturbance. All of the samples were transported to our geotechnical laboratory for examination, testing and analysis. All borings were backfilled after final water readings were obtained with the soil cuttings accumulated during the drilling operation unless noted otherwise on the soil boring logs.

3.1 Field Strength Tests

During the field boring operation, samples of the cohesive soil from the thin-walled tube were frequently tested in compression by use of a calibrated soil penetrometer to aid in determining the strength of the soil.

3.2 Water Level Measurement

The information in this report summarizes conditions as found on the date the borings were drilled. Groundwater was not encountered during the drilling operation. Long-term monitoring of the groundwater level was beyond the scope of this study. It should be noted that the groundwater table may be expected to fluctuate with environmental variations such as frequency and magnitude of rainfall and the time of the year when construction begins.

4. Surface Fault

A surface fault investigation is beyond the scope of this investigation. It should be noted that the coastal plains in this region has a complex geology, which included active surface faulting.

5. Laboratory Testing

In addition to the field investigation, a supplemental laboratory investigation was conducted to ascertain additional pertinent engineering characteristics of the subsurface materials necessary in analyzing their behavior under the proposed loading conditions. During the laboratory investigation all field soil samples from the boring were examined and classified by a soil engineer. Laboratory tests were then performed on selected soil samples in order to evaluate and determine the physical and engineering properties of the soils in accordance with the prescribed ASTM standards and methods. The following laboratory tests were performed:

LABORATORY TEST	TEST STANDARD
Moisture Content of Soils	ASTM D 2216
Moisture Content and In Situ Dry Density of Soils	ASTM D 2937
Unconfined Compressive Strength of Cohesive Soils	ASTM D 2166
Liquid Limit, Plastic Limit, and Plasticity Index of Soils	ASTM D 4318

Strength properties of the soils were determined by means of unconfined compression tests performed on undisturbed samples. The type and number of the laboratory tests performed for this investigation are:

DESCRIPTIONS	No. of Test	DESCRIPTIONS	No. of Test
Hand Penetrometer Test	15	Dry Density Test	4
Moisture Content Test	20	Unconfined Compressive Test	4
Atterberg Limits	10		

The tests noted above were performed to establish the index properties and to aid in the proper classification of the subsurface soils. The test results are shown on the soil boring logs and are presented on Plate Nos. 2 through 5.

III. GENERAL DESCRIPTION OF SUBSURFACE MATERIALS

The specific subsurface stratigraphy as determined by the field exploration is shown in detail on the soil boring logs herein. However, the stratigraphy can be generalized as follow:

STRATUM NUMBER	RANGE OF DEPTH, Ft.	SOIL DESCRIPTION
I A	0' – 6'	Dark gray FAT CLAY (CH)*
I B	0' – 4'	Dark gray LEAN CLAY WITH SAND (CL)* (encountered in boring B-4 only)
II A	6' – 10'	Soft to stiff, dark gray and light brown FAT CLAY (CH)*
II B	4' – 10'	Soft to stiff, dark gray and light brown LEAN CLAY WITH SAND (CL)* (encountered in boring B-4 only)

* Classification is in accordance with the Unified Soil Classification System

Laboratory tests results for the soils indicate that the Liquid Limits are ranging from 35 to 72, the Plasticity Indices (P.I.) ranging from 19 to 45, and moistures contents from 19 to 36 percent.

Swell Potential

Based on plasticity index results, the lean clay and fat clay subsoil are characterized as having a moderate to very high shrink/swell potential.

When the moisture content of these types of soils increases, the volume increases; conversely, when the moisture content of these types of soils decreases, the soil volume decreases. The volume changes can result in foundation movement and stresses.

IV. CHANNEL IMPROVEMENT AND FOUNDATION RECOMMENDATIONS

1. Foundations and Risks

Many lightly loaded foundations are designed and constructed based on economics, risks, soil type, foundation shape and structural loading. Many times, due to economic considerations, higher risks are accepted in foundation design. It should be noted that some levels of risk are associated with all types of foundations. Foundations must be stiffened in the areas where expansive soils are present.

2. Channel Improvement

Plate 1, shows a plan view of the existing channel as it relates to the scope of this geotechnical investigation. The outer channel bank is generally subject to erosion; whereas, the inner channel bank is generally subject to deposition. (Erosion of outer the banks of channels is associated with increased water velocity; whereas, deposition in channels is function of a number of factors that include, water velocity and particle size of suspended load or bed load). Erosion of a channel bed or watercourse bed is defined as scour. Channel erosion can be controlled by numerous methods. Riprap is recognized as providing erosion control. Concerning erosion, the hydraulic aspects of the water velocity and volume in the channel are beyond the scope of this report. Water levels and velocity are a function of intensity of rainfall, frequency of rainfall, area of the drainage basin, channel profile, channel cross section, channel material, etc.

Slope of Channel Bank - The estimated channel embankment slope based on reported Texas Department of Transportation[1] experience to maintain a factor of safety of 1.3 for the long-term (drained) condition is: 4(H):1(V) for embankment soil profiles that correspond to boring B-2; and 3.5(H):1(V) for embankment soil profiles that correspond to borings B-1, B-3; and B-4. A global slope stability analysis is beyond the scope of this report.

A slope of 4(H):1(V) for the channel embankment is recommended and is satisfactory and for the encountered soils. This slope provides for channel maintenance.

Erosion Susceptibility – The Verland (Ve) soil series is shown in this geographic area[2]. The erosion susceptibility of the encountered soil can be characterized as "average" based on USDA,[3] reported K factors (an index that quantifies the relative susceptibility of the soil to sheet and rill erosion) for the Verland (Ve) soil series. This soil series corresponds to CL and CH soils based on the unified classification system. Dispersive clay commonly has low to medium plasticity and commonly classifies as a CL; and is generalized as more susceptible to erosion than fat clay. The potential for erosion susceptibility is reduced when permeability is reduced. The permeability of a compacted fat clay (CH) or lean clay (CL) can be characterized as nearly impervious and seepage is essentially nonexistent (unless desiccation cracking occurs).

---

[1] *Geotechnical Manual*, Texas Department of Transportation, August 2006.
[2] *http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx*
[3] *Soil Survey of Galveston County, Texas*, USDA Soil Conservation Service

Based on dispersion characteristics of fat clay in the Houston gulf coast region, the dispersive potential of the encountered fat clay is generalized as low. In relation to the fat clay, the lean clay with sand is more likely to have a higher dispersive potential. Borings B-1 through B-3 correspond to fat clay; whereas, boring B-4 corresponds to sandy lean clay. To minimize the erosion and dispersion potential, soils should be compacted to minimize permeability and seepage. Compaction of clay soil at a moisture content slightly wet of optimum reduces permeability in relation to compaction at lower moisture contents.

Existing bank soils should be scarified and recompacted to 95% of ASTM D698 to minimize susceptibility to erosion. Turf should be established to further reduce soil erosion. HCFCD specification section 02921 provides guidance for defining turf establishment.[4] Additional guidance for turf establishment is provided by TxDOT Item 162, sodding for erosion control, and TxDOT item 163, seeding for erosion control.[5]

3. Channel Bank and Bed Protection

Hydraulic features of the channel are influenced by the shape and material of channel, and the channel profile. Determining the water levels and velocities for the channel is beyond the scope of this report, i.e. intensity of rainfall, frequency of rainfall, area of the drainage basin, channel profile, channel cross section, channel material, etc. The water level and velocity in the channel are used in defining regions where scour and erosion are likely to occur.

In regions along the channel bank were the hydraulic flow conditions do not create an erosion concern, the bank should be sodded, seeded, or a mulch and tackifier used for erosion control. Additional erosion protection can be achieved with geotextile fabrics in conjunction with swales and interceptor and outfall structures that channel and direct storm water into the channel. Harris County Flood Control District provides details and construction requirements for concrete lining with weep holes, and interceptor structures, and storm sewer and riprap details.[4]

4. Regions of the Channel that Require Rip Rap Protection

For the Proposed GUM Bayou Tributary Channel Improvements project, areas along the bank may require riprap (due to hydraulic aspects associated with resulting runoff calculations, conveyance configuration, and conveyance hydraulic computations). Dry Protection Stone Riprap and Concrete Riprap are effective in providing bank erosion protection.

4.1 Dry Protection Stone Riprap

Based on Federal Highway Administration (FHA) Hydraulics Engineering literature entitled "Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance" riprap revetment is a means of providing erosion protection. Prior to placing stone riprap the channel slope and bed must be shaped. The stripped soil and cut soil should be scarified, and recompacted to 95% of ASTM D698. Soft soils should be undercut and replaced with compacted sandy clay structural select fill. The channel bed must be undercut to provide for the subsequently described "toed down" requirement for dry

[4] *2005 Standard Specifications and Detail Sheets*, Harris County Flood Control District.
[5] Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, adopted by the Texas Department of Transportation, June 1, 2004

protection stone riprap. FHA recommends a minimum freeboard, of 2 feet between design high water level and top of riprap revetment.

Riprap for bank protection requirements should correspond to Texas Department of Transportation June 01, 2004 Standard Specification Item 432 entitled "RIPRAP". A dry protection stone riprap should provide satisfactory service. TxDOT Item 432 protection dry stone riprap requires:

1. A filter fabric is used on the slope and toe to create a barrier between the stone and soil. Riprap is placed on a filter fabric defined by TxDOT Departmental Materials Specification DMS – 6200 FILTER FABRIC, Type 2 filter fabric requirements for weight, permittivity, tensile strength, apparent opening size, elongation, and trapezoidal tear. The length of the filter fabric should run and down the slope, with 2 feet overlap, with nails or pins spaced at a maximum of 10 feet along the seams.

2. Riprap is required to be toed down below the toe of the bank depth to a minimum depth of two (2) times the embankment riprap thickness. (FHA requires that the riprap be toed down below the toe of the bank depth to depth of anticipated long-term bed degradation plus toe scour.)

3. The width of the riprap toe is defined as two (2) times the embankment riprap thickness.

4. Prior to placing the riprap, stone bedding should be placed that meets the "Protection Riprap Bedding Material Gradation Requirements".

5. Place dry protection stone riprap that meets the requirements for "In-Place Protection Riprap Gradation Requirements" defined as a function of the embankment riprap thickness. The minimum embankment riprap thickness is twelve (12) inches; whereas, the maximum is defined as thirty (30) inches.

For the Proposed GUM Bayou Tributary Channel Improvements project, a minimum embankment riprap thickness of twelve (12) inches should be satisfactory in most cases for areas along the bank that may require riprap (due to hydraulic aspects associated with resulting runoff calculations, conveyance configuration, and conveyance hydraulic computations).

4.2 Concrete Riprap (Slope Paving)

Prior to placing concrete riprap the channel slope and bed must be shaped and groomed. The soil should be stripped, exposed soils scarified, and recompacted to 95% of ASTM D698. The moisture content should range -1% to +3% of optimum moisture. Soft soils should be undercut and replaced with compacted sandy clay structural select fill. The channel bed must be undercut to provide for the subsequently described "toe" requirement for anchorage.

For concrete riprap (slope paving) anchorage, GETI recommends a toe wall be placed along the bank toe and a top of bank wall be placed along the bank at the top of the slope. The toe wall and top of bank wall should be placed in undisturbed clay at a minimum depth of 2 feet below existing or final grade, whichever is deeper. The wall depths may be increased to provide greater passive resistance to sliding and/or overturning if necessary.

For this project, a minimum concrete riprap (slope paving) thickness of five (5) inches recommended, with consideration given to clear cover of reinforcing steel. Concrete Riprap (slope paving) must be

designed to have sufficient resistance against overturning and sliding. For a defined slope of 4(H):1(V), the stability of the concrete riprap (slope paving) is not a concern provided a toe bank wall and top of bank wall are used. (Steeper slopes would require analysis of stability considering at least six different force systems including, forward active pressure, backward passive earth reaction, the soil bearing pressure, the base shear resistance, the weights of the earth (or other materials) masses, and the weight of the slope paving itself. Future surcharge loads should also be considered as a force acting on the slope paving. Design of a concrete riprap (slope paving) should include consideration of factor of safety against overturning, maximum soil pressure under the base, and factor of safety against sliding. If the concrete riprap (slope paving) will have a slope backfill condition, the active force will not be horizontal. The magnitude and location of the resultant active force by the backfill should be determined by the structural engineer based on the final configuration of the slope paving and backfill slope, if applicable.)

Sand should be used as bedding under (and behind) the concrete riprap (slope paving). This sand should classified as well graded sands, poorly graded sands or clayey sands with Group Symbols SW, SP or SC according to ASTM D 2487 are recommended for this purpose.

Drainage for Concrete Riprap (Slope Paving)

As previously stated no ground water was encountered. However, groundwater could have a considerable influence on lateral earth pressures against the slope paving structure. GETI recommends that measures be taken to minimize the possibility of build-up of hydrostatic pressure behind the slope paving by installing adequate drainage at the base along the slope paving with weep holes through the concrete riprap (slope paving).

To reduce the potential for erosion due to storm water ingress at the top of the slope embankment, high strength woven geotextiles designed and manufactured for erosion control are recommended for placement along the top region of the embankment. With erosion control geotextiles in conjunction with swales and interceptor and outfall structures that channel and direct storm water into the channel, the recommended compacted sand backfill facilitates the collection of seepage water for weep hole drainage.

Sand should be used as bedding under (and behind) the concrete riprap (slope paving). The backfill sand is defined as SW, SP or SC according to ASTM D 2487. A geotextile fabric is recommended at the boundary between the clay and the backfill sand. This geotextile fabric must provide an effective boundary between the two soil types while permitting the passage of seepage water from clay to sand. We recommend a woven geotextile fabric with an ASTM D-4751 Apparent Opening Size (AOS) Sieve No. of 40 be placed between the two soil types.

A weep hole system is defined in the "Concrete Channel Lining Details" appearing in the 2005 Harris County Flood Control District (HCFCD) "Standard Specifications and Detail Sheets". This specification detail sheet defines weep hole system materials and illustrates construction requirements for channel lining. Using HCFCD Type B weep hole system as a guide we recommend the following for concrete riprap (slope paving) weep holes:

- 4-inch diameter SCH. 40 PVC pipe should be placed to provide positive drainage for weep holes. A hardware cloth with defined minimum and maximum openings of 1/8 and 1/4 inch, respectively, should be placed over the end of the pipe in contact with drain gravel.

- Drain gravel gradation criteria of 100%, 70-100%, 20-90%, 0-60%, and 0% passing should be respectively applied to 1 inch, 3/4 inch, 3/8 inch, No. 4, and No. 8 sieves.

- Drain gravel should be encapsulated in a non-woven geotextile filter fabric with defined Apparent Opening Size (AOS) criteria. The non-woven geotextile filter fabric requirements are a minimum AOS Sieve No. of 100 and a maximum AOS Sieve No. of 70, and a minimum weight of 6.0 oz./sq.yd.

We recommend that the weep holes not exceed a 10 ft. center-to-center longitudinal spacing along the full length of concrete riprap (slope paving). In all regions, toe weep holes should be placed a vertical distance of 1 ft. above the base of the toe along the full length of concrete riprap (slope paving). In regions where the bank height is between 8 ft. to 10 ft. above the base of the toe, additional weep holes should be placed a vertical distance of 5 ft. above the toe with a longitudinal spacing of that does not exceed 10 ft.

Strength, Reinforcement, and Joints for Concrete Riprap (Slope Paving)

Concrete Riprap (Slope Paving) for bank protection requirements should correspond to Texas Department of Transportation June 01, 2004 Standard Specification Item 432 entitled "RIPRAP". A 5 (five) inch minimum (concrete riprap) slope paving thickness should be satisfactory considering clear cover requirements for reinforcing steel; In-lieu-of the minimum 28-day design compressive strength of f'_c = 2,000 psi (Class B for riprap concrete) reported by Texas Department of Transportation June 01, 2004 Standard Specification Item 421, GETI recommends a minimum 28-day design compressive strength of f'_c = 3,000 psi. Reinforcement should consist of No. 3 bars placed at 18 inches on center in each direction.

Expansion joints are recommended where new concrete construction joins or abuts any type of existing structure. Expansion joints should be sealed to protect the integrity of the concrete riprap (slope paving system). When concrete placements exceed lengths of 75 ft., expansion joints are also recommended. (Expansive characteristics of concrete may further be reduced through the use of a concrete mixture with a limestone coarse aggregate constituent.) The concrete slope paving should have transverse construction and/or contraction (control) joints. The recommended joint spacing is 10 ft. This spacing facilitates the recommended longitudinal weep hole spacing of 10 ft., where the weep holes can be located midway between transverse slope paving joints. Contraction (or control) joints should be obtained by notching the concrete riprap (slope paving) 1/3 of the concrete depth. A notch depth of 1.7 inch corresponds to a 5 (five) inch slab depth. Joints should be sealed to protect the concrete riprap (slope paving) system. (The use of "waterstops" would improve the joint system integrity by assuring that the water drains through the weep holes. Although there are some exceptions, construction joints are generally required for waterstops.)

4.3 Retaining Wall

GETI understands that retaining walls may be used to reduce impact to right-of-way acquisition.

Should a retaining wall be placed in the region just north of Deats Road, based on Boring B-2 soil properties and strength parameters in the region of Deats Road, the base of the footing could be supported on firm fat clay at a depth of 8.0 feet below existing bank grade. The footing for a retaining wall in this area, or any area, must be below the scour depth and anticipated long-term bed degradation. (The depth of scour and long-term bed degradation is beyond the scope this report.)

Should retaining walls be placed in the regions corresponding to Boring B-1, B-3 or B-4, soil properties and strength parameters for these respective borings show that in the region of B-1 the base of the retaining wall should be 8.0 feet below existing bank grade supported on firm fat clay, in the region of B-3 the base of the

retaining wall should be 8.0 feet below existing bank grade supported on stiff fat clay, and in the region of B-4 the base of the retaining wall should be 8.0 feet below existing bank grade supported on firm lean clay. In each case, the footing for a retaining wall should be below the scour depth and anticipated long-term bed degradation. (The depth of scour and long-term bed degradation is beyond the scope this report.)

The estimated allowable bearing capacity for a retaining wall base bearing on firm clay, c = 750 psf, at a depth of 8.0 feet below existing grade is estimated to be:

Dead Load Only:	1200 psf
Total (dead and live):	1800 psf

For the above allowable bearing capacities, a factor of safety of 3 was applied for the estimated Dead Load Only capacity, and a factor of safety of 2 was applied for the estimated Total (dead and live) capacity. Resistance against sliding of the footing base on clay based on soil cohesion, c, of 750 psf may be defined as cB, lb./ft. along the wall length, where B is defined as the footing width.

The proposed wall should be designed to resist lateral earth pressures. The use of active, at-rest, or passive lateral earth pressures depends on the amount of horizontal movement that can occur along the wall height.

GETI understands that the retaining wall is likely to be subjected to a hydraulic load from storm water in the channel resulting in a wall displacement towards the retained soil and passive earth pressure stresses are exerted on the wall and retained soil. Whereas, without the channel hydraulic load, the wall displacement is away from the retained soil, and the soil and wall will be subjected to an active pressure stresses. Initially, compacted clay and compacted sand backfill subjects the wall to at least the at-rest earth pressure.

The wall should be designed for additional lateral loads due to surcharge and live loads. Drainage systems (weep holes and/or collector drains) should be provided near or at the base of wall to collect and remove groundwater and prevent a buildup of hydrostatic pressure on the wall. If provisions to prevent accumulation of water behind the walls are not provided, the wall should be designed to resist the full hydrostatic head in addition to the lateral earth pressures as outlined.

Retaining Wall Lateral Earth Pressure

The wall should be designed to resist the lateral earth pressures. The use of active or at rest earth pressures depends on the amount of horizontal movement that can occur along the wall height. The wall may be designed for active earth pressures, if the top of the wall is not rigidly restrained, and can deflect at the top as the soil expands. If the wall is restrained at the top, the at-rest earth pressure values should be used.

For compacted clay and compacted sand backfill, the wall should be designed to resist at least the at-rest earth pressure. The passive earth pressure values apply when the wall movement compresses the soil. The wall should be designed for additional lateral loads due to surcharge and live loads. The following formulae can be used to design a wall subjected to lateral soil pressure and hydrostatic pressure.

$$P_o = \Upsilon' K_o h + \Upsilon_w h_w + q K_o, \text{ for At Rest Condition}$$
$$P_a = \Upsilon' K_a h + \Upsilon_w h_w + q K_a, \text{ for Active Condition}$$

where:

Υ_{sat}	= saturated unit weight of soil, say 128 lbs./ft^3
Υ_w	= unit weight of water, 62.4 lbs./ft^3
Υ'	= effective unit weight (Υ_{sat} - Υ_w)
h	= wall height, ft.
h_w	= height of water behind the wall, ft.
q	= Surcharge load lbs/sq. ft.
K	= Lateral earth pressure coefficients

Values for Horizontal Backfill Lateral Earth Pressure Coefficients, K, are subsequently provided in the table below.

Estimated Lateral Earth Pressure Coefficients for Horizontal Backfill

Type of Properly Compacted Backfill Behind the Retaining System and Soil Parameters	Active Condition	At-Rest Condition	Passive Condition
Sandy Clay (CL) soils free of organics, other deleterious materials and with a liquid limit less than 35 and a plasticity index of 10 to 20. Unit weight of 125 pcf, Friction Angle of 25^0	0.41	1.00	2.46
Clayey Sands (SC) or Silty Sands free of organics and other deleterious materials. Unit weight of 125 pcf, Effective Friction Angle of 30^0	0.33	0.50	3.00
Silty Sand (SM) or Silty Clayey Sand (SC-SM) containing no more than 10% fines, free of organics and other deleterious materials. Unit weight of 125 pcf, Effective Friction Angle of 35^0	0.27	0.43	3.69

Note: Values provided assume that the materials are compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D 698), within two percentage points of the optimum moisture content

Retaining Wall Drainage

Swales and interceptor and outfall structures that collect and direct water into the channel can be effective in reducing hydrostatic pressure on the wall. To further reduce the potential for erosion due to storm water ingress at the top of the wall, high strength woven geotextiles designed and manufactured for erosion control can be placed along the top region of the wall. Weep holes and collector drains should be used to reduce the hydrostatic pressure behind the wall.

Drainage systems (weep holes and/or collector drains) should be provided near or at the base of wall to collect and remove groundwater and prevent a buildup of hydrostatic pressure on the wall. If provisions to prevent accumulation of water behind the walls are not provided, the wall should be designed to resist the full hydrostatic head in addition to the lateral earth pressures as outlined. The drainage behind the wall is regulated by providing (collector drains) perforated pipes along the back face of the wall at the bottom of the stem and weep holes.

5. Box Culvert(s)

GETI understands that box culverts may be used to reduce impact to right-of-way acquisition.

Based on Boring B-2 with soil properties and strength parameters in the region of Deats Road, the base of the box culvert footing could be supported on firm clay at a depth of 8.0 feet below the existing bank grade. The base of the box culvert should be below the scour depth of anticipated long-term bed degradation plus toe scour. The estimated allowable bearing capacity for the box culvert bearing on soil at a depth of 8.0 feet below existing bank grade is estimated to be:

Dead Load Only:	1200 psf
Total (dead and live):	1800 psf

For the above allowable bearing capacities, a factor of safety of 3 was applied for the reported Dead Load Only capacity, and a factor of safety of 2 was applied for the reported Total (dead and live) capacity.

The cut subgrade area supporting box culverts should be proof-rolled with a 15-ton roller, or other equivalent suitable equipment as approved by the engineer. The proof-rolling serves to compact surficial soils and to detect any soft or loose zones. Any soils deflecting excessively under moving loads should be undercut to firm soils and re-compacted. The proof-rolling operations should be observed by an experienced geotechnician

Texas Department of Transportation June 01, 2004 Standard Specification Item 462 entitled "Box Culverts and Storm Drains." provides guidance for placing concrete box culverts; and Item 400 entitled "Excavation and Backfill for Structures" provides guidance for cement stabilized sand embedment and backfill. The cut grade supporting the box culverts should be undercut at least 4 in. and backfilled with cement stabilized sand to support the box(s) at the required grade. The cement stabilized sand should be used as backfill between box culverts and between culverts and excavated bank soil.

The cement-stabilized sand should contain clean aggregate (sand), water, and a minimum of 7% hydraulic cement based on the dry weight of the aggregate, in accordance with Tex-120-E. Use clean sand as aggregate for cement-stabilized backfill unless otherwise shown on the plans. The cement-stabilized sand should be compacted to 95% of ASTM D558. The cement stabilized sand should be placed using maximum of eight (8) inch loose lift and compacted to a minimum of 95 percent of the maximum dry density as per ASTM D558. The moisture content should be with slightly less than optimum moisture.

Sandy clay structural select fill material should be placed on top of the box culverts. The minimum cover amount for construction loads should be in excess of 3 (three) feet.[6] The Structural Select fill material should be placed in maximum of eight (8) inch loose lift and compacted to a minimum of 95 percent of the maximum dry density as per ASTM D-698. The moisture content should be with -1% to +3% of optimum moisture.

Box Culvert Riprap Apron

A riprap apron should be placed at the box culvert(s) outlet to protect the channel and culverts from erosion. Based on Federal Highway Administration (FHA) Hydraulics Engineering literature entitled "Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance"

[6] American Concrete Pipe Association

these aprons do not dissipate significant energy except through increased roughness for a short distance, and they serve to spread the flow helping to transition to the natural drainage way or to sheet flow where no natural drainage way exists. Hydraulic aspects are beyond the scope of the report. The key design elements of the riprap apron are the riprap size as well as the length, width, and depth of the apron.

At a box culvert outlet the channel grade should be undercut a minimum of two feet for placing riprap. Hydraulics aspects may define the depth and length of the riprap apron. The previously described TxDOT Departmental Materials Specification DMS – 6200 FILTER FABRIC, Type 2 filter fabric and TxDOT Item 432 dry protection stone riprap should provide satisfactory service.

V. GENERAL CONSTRUCTION CONSIDERATIONS

1. Site Preparation

We recommend that the site and soil conditions that may be used in the structural design of the foundation elements (i.e., retaining walls, toe walls, etc.) be verified by the engineer's site visit after all of the earthwork and site preparation has been completed prior to the concrete placement.

2. Structural Fill and Subgrade Preparation for supporting Foundation Elements

It is recommended that the subgrade and fill be prepared as follow:

2.1 The area should be stripped to suitable depth to remove any top soil and miscellaneous fill material. All soft or loose soils should be removed and replaced with select fill materials.

2.2 The natural subgrade should be scarified to a minimum depth of six (6) inches. The scarified soils should then be recompacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor Density Test (ASTM-D 698). The moisture content should range -1% to +3% of optimum moisture.

2.3 The Structural Select fill should consist of a clean Sandy Clay with Liquid Limit less than 35 and a Plasticity Index (P.I.) between 10 and 20.

2.4 The Structural Select fill material should be placed in maximum of eight (8) inch loose lift and compacted to a minimum of 95 percent of the maximum dry density as per ASTM D-698. The moisture content should be with -1% to +3% of optimum moisture.

3. Surface Drainage

To reduce the potential for erosion due to storm water ingress into the soil at the top of the channel slope embankment, high strength woven geotextiles designed and manufactured for erosion control should be placed along the top region of the embankment. With effective drainage swales and interceptor and outfall structures that channel and direct storm water into the channel and erosion control geotextiles, erosion is less likely to occur to concrete foundation elements.

4. Vegetation Control

HCFCD specification section 02921 provides guidance for defining turf establishment for controlling erosion. TxDOT Item 162 provides guidance for using sod for erosion control, and TxDOT Item 163, provides for using seeding for erosion control.

To minimize the possible movement of foundation elements (retaining walls, toe walls, and concrete riprap) that may be distressed due to tree root systems we recommend trees not to be closer than half the canopy diameter of the mature tree from the foundation elements, typically a minimum of 20 feet.

VI. DISCLAIMER

The information and recommendation contained in the report summarized condition found at the site of the proposed GUM Bayou Tributary Channel Improvements, Galveston County, Texas specified and on the date the field exploration was completed. The attached soil boring logs are a true representation of the soils encountered at the stratigraphy as found during the field exploration and drilling of the subject site.

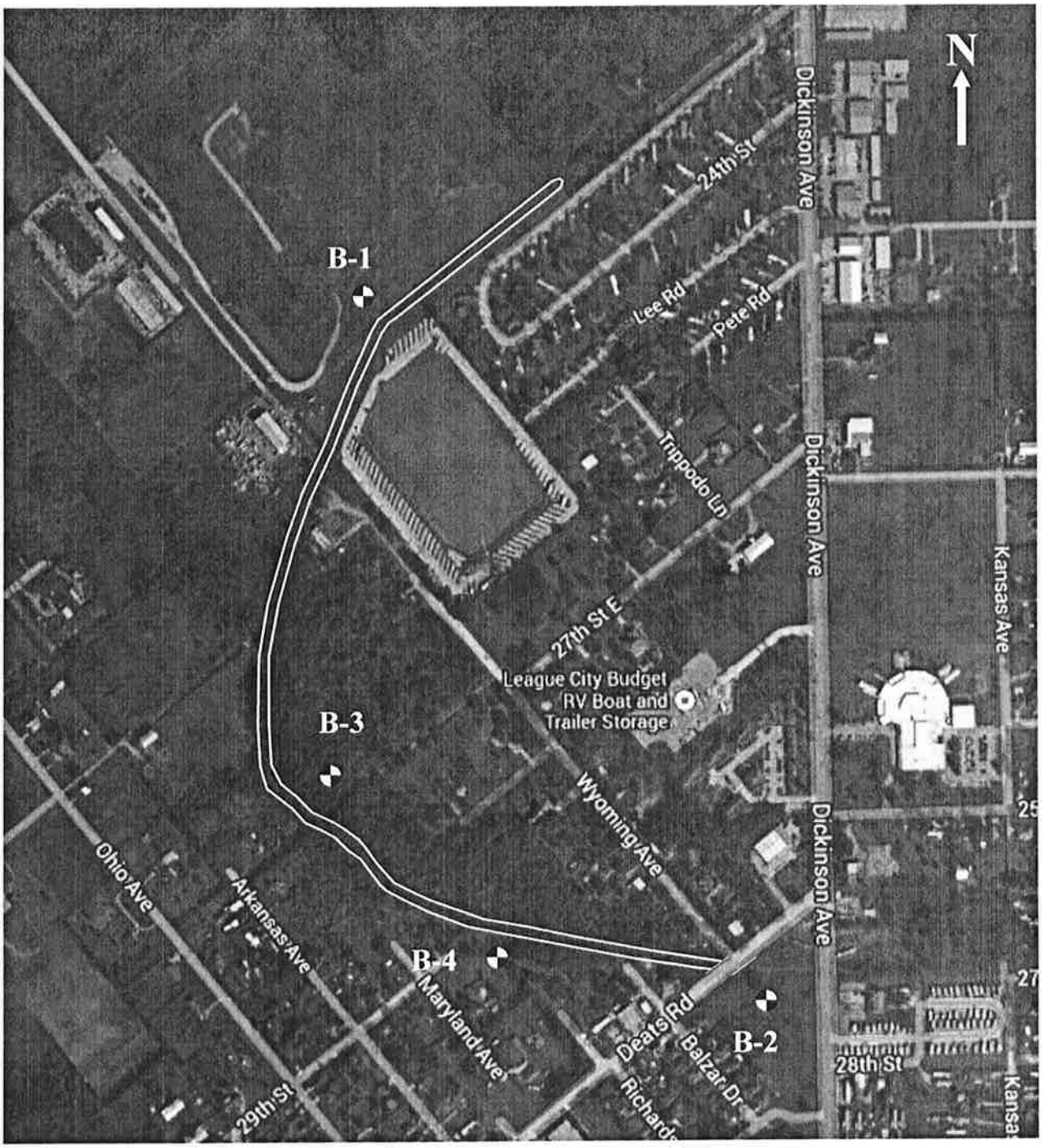
Reasonable variations from the subsurface information presented in this report are assumed. If conditions encountered during construction are significantly different than those presented in this report, GETI should be notified immediately.

The report was prepared for the sole and exclusive use by our client, based on specific and limited objectives. All reports, boring logs, field data, laboratory test results, and other documents prepared by GETI as instruments of service shall remain the property of GETI. Reuse of these documents is not permitted without written approval by GETI. GETI assumes no responsibility or obligation for the unauthorized use of this report by other parties and for purposes beyond the stated project objectives and work limitations.

In addition, the construction process may itself alter site soil conditions. Therefore, experienced geotechnical personnel should observe and document the construction procedures and all conditions encountered. We recommend that the owner retain Geoscience Engineering and Testing, Inc. to provide this service as well as the construction material and testing and inspection required during the construction phase of the project.

We would welcome the opportunity to discuss our recommendation with you and hope we may have the opportunity to provide any additional studies or service to complete this project. The following illustrations are attached and complete this report:

ILLUSTRATIONS	PLATE NUMBERS
Boring Location Plan	1
Boring Logs	2-5
Symbols and Terms used on Boring Logs	6



Approximate Boring Locations

NOT TO SCALE

LOCATION
Proposed GUM Bayou Tributary
Channel Improvements
Near Dickinson Avenue & Deats Road
Galveston County, Texas
GETI NO.: 13G22402/A

PLATE NO. 1

PROJECT: **Proposed GUM Bayou Tributary Channel Improvements**
Near Dickinson Avenue and Deats Road
Galveston County, Texas

CLIENT: **Dannenbaum Engineering**
Houston, Texas

BORING NO.: **B-1** DEPTH: **10'**

PROJECT NO. 13G22402/A DATE: December 11, 2013

Water was not encountered **during drilling operation**

DRILLING METHOD (S)

Continuous Flight Auger & Intermittent Sampling

Legend

Fat Clay | Lean Clay / Silty Clay | Silty Sand / Sandy Silt

Fill | Clayey Sand | Silty Clayey Sand

FIELD DATA							LABORATORY DATA							
DEPTH (FEET)	SOIL SYMBOL	SAMPLES	N: BLOWS/FT	T: INCHES/100 BLOWS	P: TONS/SQ FT	RQD: PERCENT	MOISTURE CONTENT (%)	DRY DENSITY POUNDS/CU. FT	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	SHEAR STRENGTH (TSF)	DESCRIPTION OF STRATUM
0			B				29		54	23	31			Dark gray FAT CLAY (CH)
			B				36							-moist from 0' to 6'
5			B				31							
			P=0.25				24		51	22	29	87		Soft, dark gray and light brown FAT CLAY (CH)
			P=0.75				21	110					1.00	-firm from 8' to 10'
10														
15														
20														
25														
30														

N- STANDARD PENETRATION TEST RESISTANCE
T- TXDOT CONE PENETRATION RESISTANCE
P- POCKET PENETROMETER RESISTANCE
R- PERCENTAGE OF ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

GEOSCIENCE ENGINEERING & TESTING, INC

PLATE NO. 2

PROJECT: **Proposed GUM Bayou Tributary Channel Improvements**
Near Dickinson Avenue and Deats Road
Galveston County, Texas

CLIENT: **Dannenbaum Engineering**
Houston, Texas

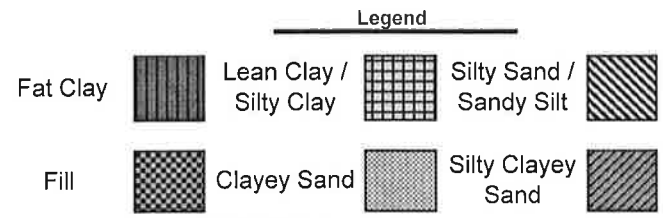
BORING NO.: **B-2** DEPTH: **10'**

PROJECT NO. 13G22402/A DATE: December 11, 2013

Water was not encountered **during drilling operation**

DRILLING METHOD (S)

Continuous Flight Auger & Intermittent Sampling



DEPTH (FEET)	SOIL SYMBOL	SAMPLES	N: BLOWS/FT	T: INCHES/100 BLOWS	P: TONS/SQ FT	RQD: PERCENT	MOISTURE CONTENT (%)	DRY DENSITY POUNDS/CU. FT	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	SHEAR STRENGTH (TSF)	DESCRIPTION OF STRATUM
			B				24							Dark gray FAT CLAY (CH)
			P=0.75				27		72	27	45	89		-firm below 2'
5			P=1.0				26	96					0.9	
			P=0.75				27							Firm, dark gray and light brown FAT CLAY (CH)
			P=0.75				27		66	26	40			
10														
15														
20														
25														
30														

N- STANDARD PENETRATION TEST RESISTANCE
T- TXDOT CONE PENETRATION RESISTANCE
P- POCKET PENETROMETER RESISTANCE
R- PERCENTAGE OF ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

GEOSCIENCE ENGINEERING & TESTING, INC

PLATE NO. 3

PROJECT: **Proposed GUM Bayou Tributary Channel Improvements**
Near Dickinson Avenue and Deats Road
Galveston County, Texas

CLIENT: **Dannenbaum Engineering**
Houston, Texas

BORING NO.: **B-3** DEPTH: **10'**

PROJECT NO. 13G22402/A DATE: December 11, 2013

Water was not encountered **during drilling operation**

DRILLING METHOD (S)

Continuous Flight Auger & Intermittent Sampling

Legend

Fat Clay | Lean Clay / Silty Clay | Silty Sand / Sandy Silt

Fill | Clayey Sand | Silty Clayey Sand

FIELD DATA							LABORATORY DATA							
DEPTH (FEET)	SOIL SYMBOL	SAMPLES	N: BLOWS/FT	T: INCHES/100 BLOWS	P: TONS/SQ FT	RQD: PERCENT	MOISTURE CONTENT (%)	DRY DENSITY POUNDS/CU. FT	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	SHEAR STRENGTH (TSF)	DESCRIPTION OF STRATUM
0			B				21		54	23	31	87		Dark gray FAT CLAY (CH)
			P=1.5				23		61	25	37			-stiff below 2'
5			P=1.5				23							
			P=1.0				23							Stiff, Dark gray and light brown FAT CLAY (CH)
			P=1.25				22	103	57	23	34		0.55	
10														
15														
20														
25														
30														

N- STANDARD PENETRATION TEST RESISTANCE
T- TXDOT CONE PENETRATION RESISTANCE
P- POCKET PENETROMETER RESISTANCE
R- PERCENTAGE OF ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

GEOSCIENCE ENGINEERING & TESTING, INC

PLATE NO. 4

PROJECT: **Proposed GUM Bayou Tributary Channel Improvements**
Near Dickinson Avenue and Deats Road
Galveston County, Texas

CLIENT: **Dannenbaum Engineering**
Houston, Texas

BORING NO.: **B-4** DEPTH: **10'**

PROJECT NO. 13G22402/A DATE: December 11, 2013

Water was not encountered **during drilling operation**

DRILLING METHOD (S)

Continuous Flight Auger & Intermittent Sampling

Legend

Fat Clay | Lean Clay / Silty Clay | Silty Sand / Sandy Silt

Fill | Clayey Sand | Silty Clayey Sand

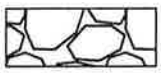
FIELD DATA							LABORATORY DATA							
DEPTH (FEET)	SOIL SYMBOL	SAMPLES	N: BLOWS/FT	T: INCHES/100 BLOWS	P: TONS/SQ FT	RQD: PERCENT	MOISTURE CONTENT (%)	DRY DENSITY POUNDS/CU. FT	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	SHEAR STRENGTH (TSF)	DESCRIPTION OF STRATUM
			P=1.0				19							Firm, dark gray LEAN CLAY WITH SAND (CL)
			P=0.5				20		35	16	19			
5			P=0.25				22		45	18	27	80		Soft, dark gray and light brown LEAN CLAY WITH SAND (CL)
			P=0.5				21		45	18	27			-firm from 6' to 10'
			P=0.75				19	107					0.95	
10														
15														
20														
25														
30														

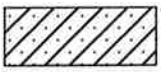
N- STANDARD PENETRATION TEST RESISTANCE
T- TXDOT CONE PENETRATION RESISTANCE
P- POCKET PENETROMETER RESISTANCE
R- PERCENTAGE OF ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

GEOSCIENCE ENGINEERING & TESTING, INC

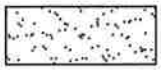
PLATE NO. 5

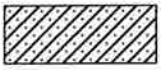
KEY TO SOIL CLASSIFICATIO AND SYMBOLS

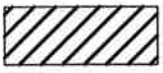
 Gravel (GW, GP, GM, GC)

 Clayey Sand (SC)

 Sandy Silt (ML)

 Sand (SW, SP)

 Clayey Silt (ML)

 Silty or Sandy Clay (CL)

 Silty Sand (SM)

 Silt (ML)

 Clay (CH)

CONSISTENCY OF COHESIVE SOILS

Description	Shear Strength KSF	Penetration Resistance Blows/ Ft
Very Soft	Less than 0.25	0 - 2
Soft	0.25 - 0.5	2 - 4
Firm	0.5 - 1.00	4 - 8
Stiff	1.00 - 2.00	8 - 15
VeryStiff	2.00 - 4.00	15 - 30
Hard	Greater than 4.00	>30

RELATIVE DENSITY OF COHESIONLESS SOILS

Description	Penetration Resistance Blows / Ft	Relative Density %
Very Loose	0 - 4	0 - 15
Loose	4 - 10	15 - 35
Medium dense	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very Dense	>50	85 - 100

Soil Structure

CALCAREOUS NODULES	-- Nodules of Calcium Carbonate
FERROUS NODULES	-- Nodules of Ferrous Material
SLICKENSIDED	-- Having inclined planes of weakness that are slick and glossy
BLOCKY	-- Having inclined planes of weakness that are frequent and rectangular in pattern
LAMINATED	-- Composed of thin layers of varying soil type and texture
FISSURERD	-- Containing shrinkage cracks frequently filled with fine sand
INTERBEDDED	-- Composed of alternate layers of different soil types

 Shelby Tube Sample

 Standard Penetration Test

 Auger or Wash Sample

 No Recovery

GROUNDWATER

 (24 hOurs) - Water Level after drilling (time increment after drilling)

 - Free Water observed during drilling

FAILURE DESCRIPTION (COMPRESSION TEST)

B - Bulge
S - Shear
M/S - Multiple Shear

SLS - Failure surface occuring along slickensided plane
SAS - Failure surface occuring along or in sand seam
SS - Failure surface occuring in or along other secondary structure such as calcareous pockets

PLATE NO: 6