

# **MISSION REACH – LONE STAR SITE EROSION PROJECT: TOEWOOD FOR BANK STABILIZATION**

NATIONAL STREAM CONFERENCE 2022

COLLEN BOWNLOW, PE, CFM, SUAS PILOT  
TAMI NORTON, PE, CFM, PMP, ENV SP



**Committed to Safe, Clean, Enjoyable Creeks and Rivers.**

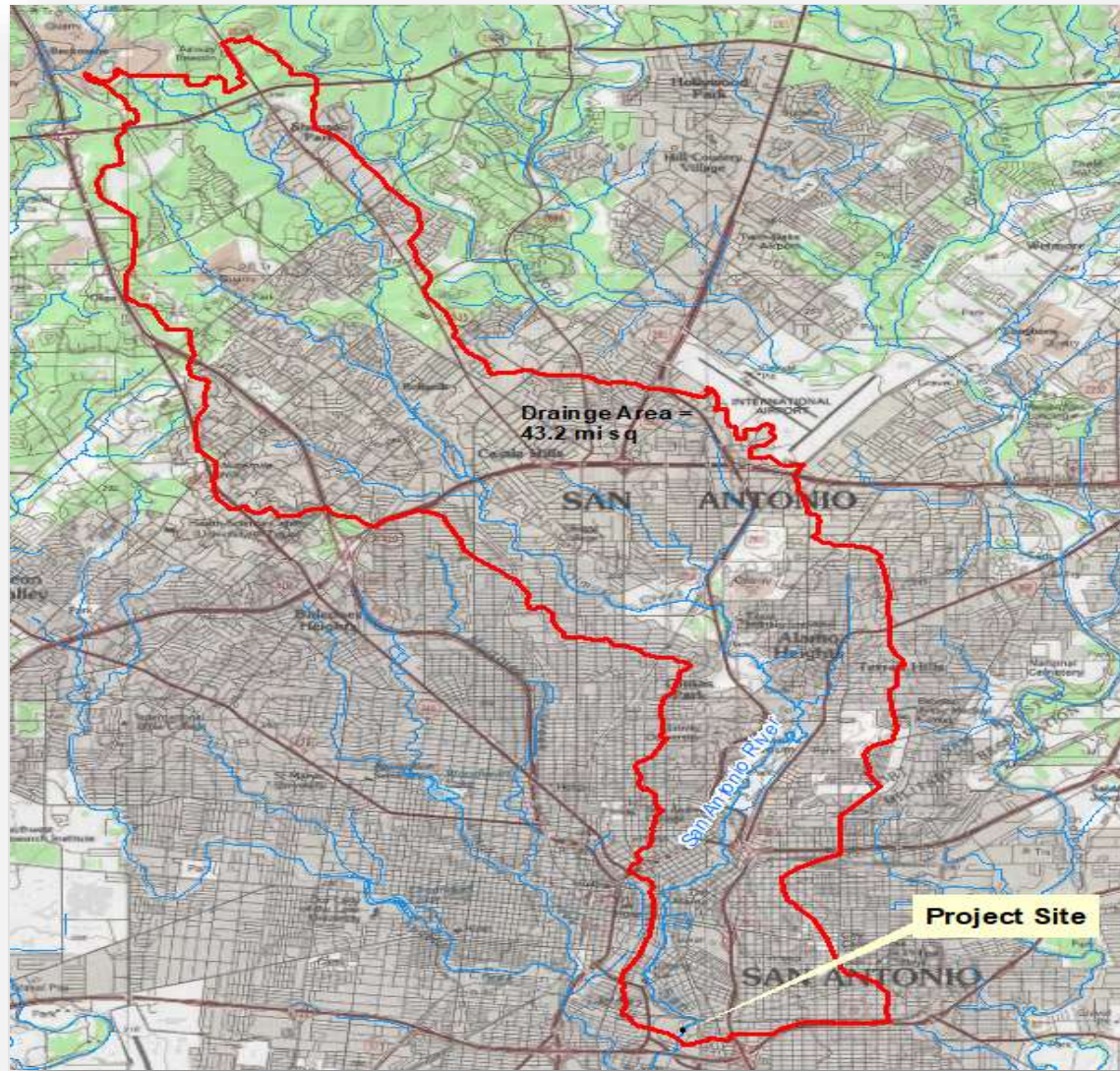
# PROJECT LOCATION





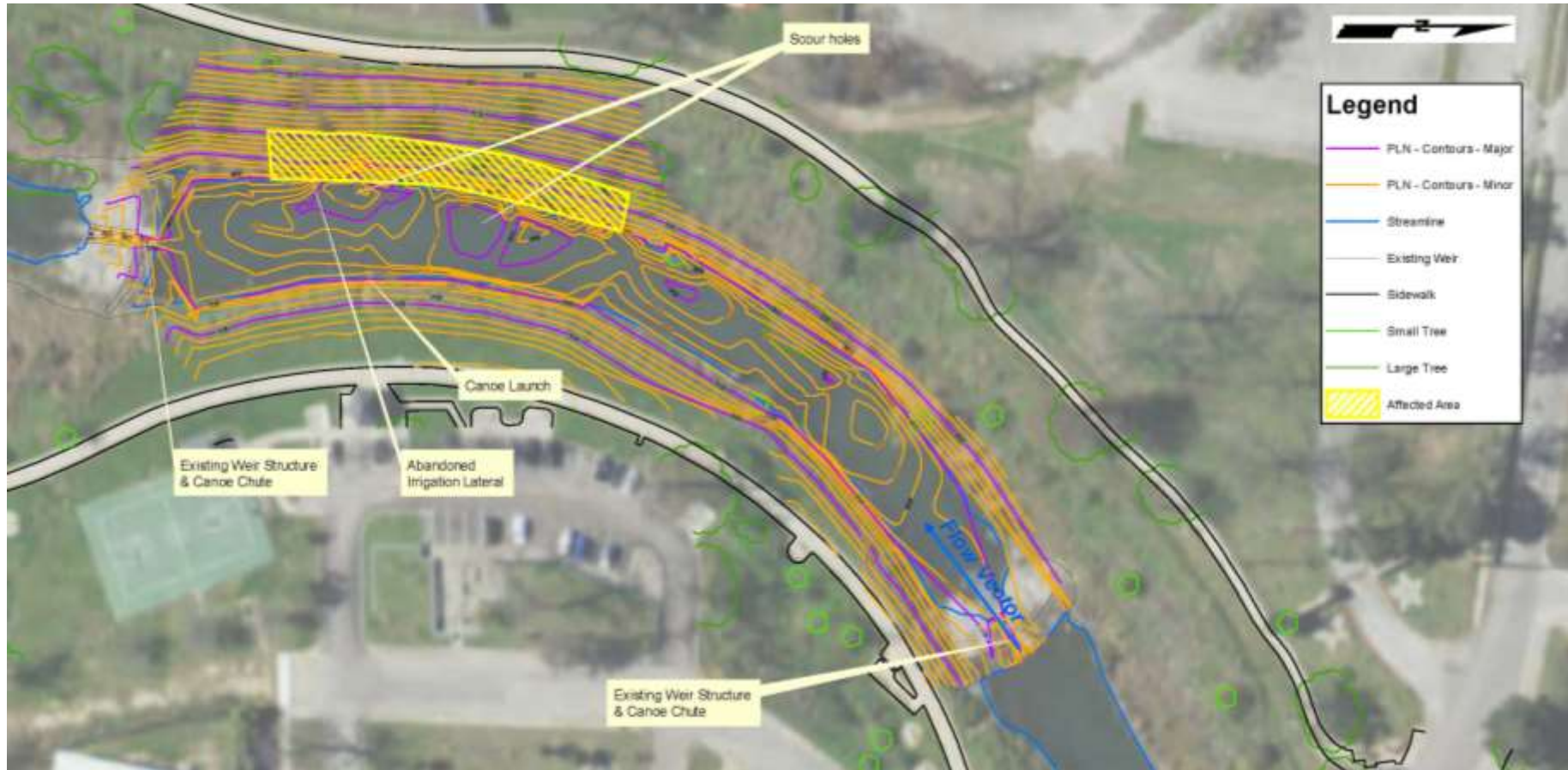
# BACKGROUND & OVERVIEW

- DA = 43.2 mi<sup>2</sup>
- Mission Reach
- FEMA floodplain
- Bank Erosion
- 250-LF Toewood





# PRE-PROJECT CONDITIONS



# PRE-PROJECT CONDITIONS

4/26/2018



**Committed to Safe, Clean, Enjoyable Creeks and Rivers.**



# PRE-PROJECT CONDITIONS

4/26/2018



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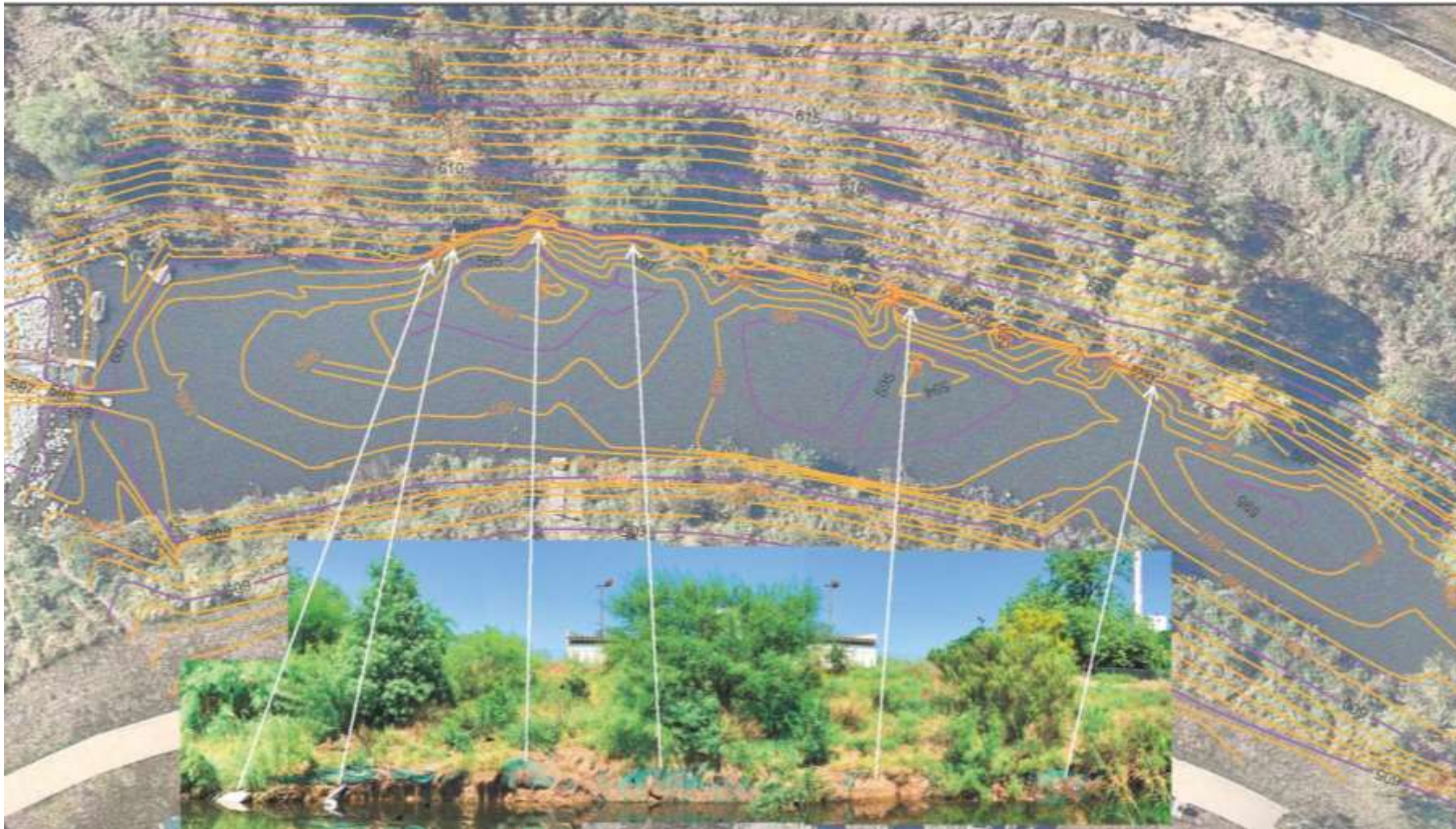


# PRE-PROJECT CONDITIONS



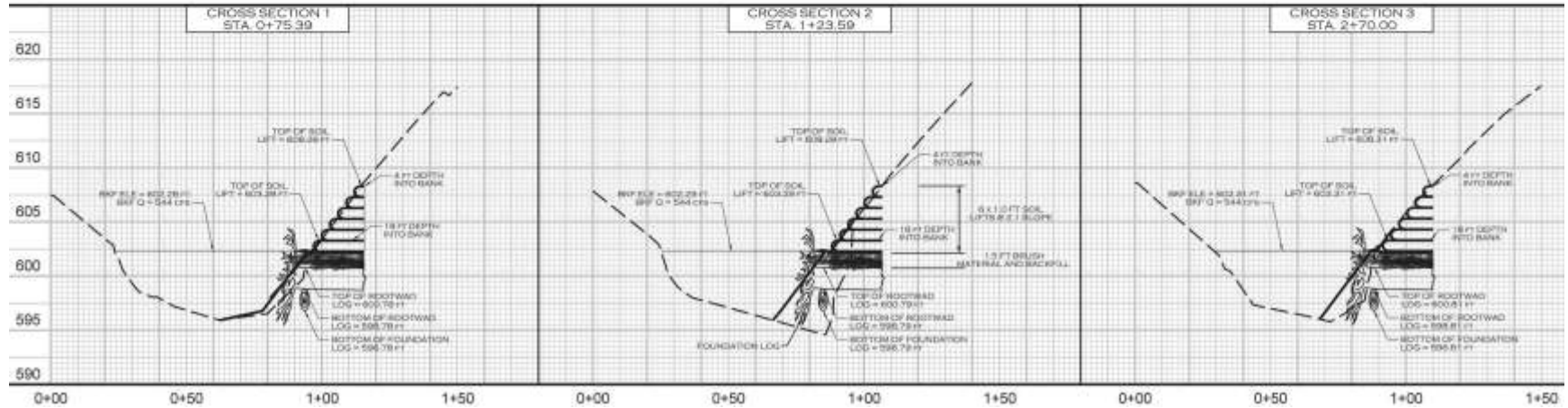
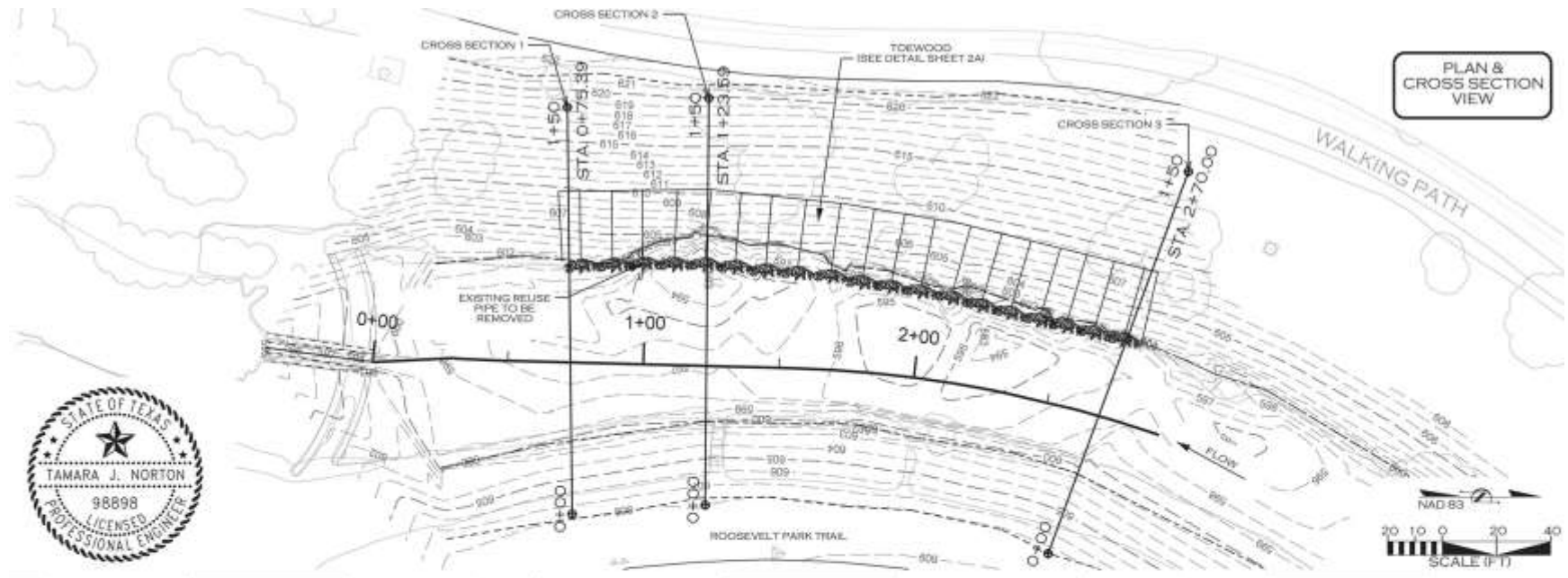


# PRE-PROJECT CONDITIONS

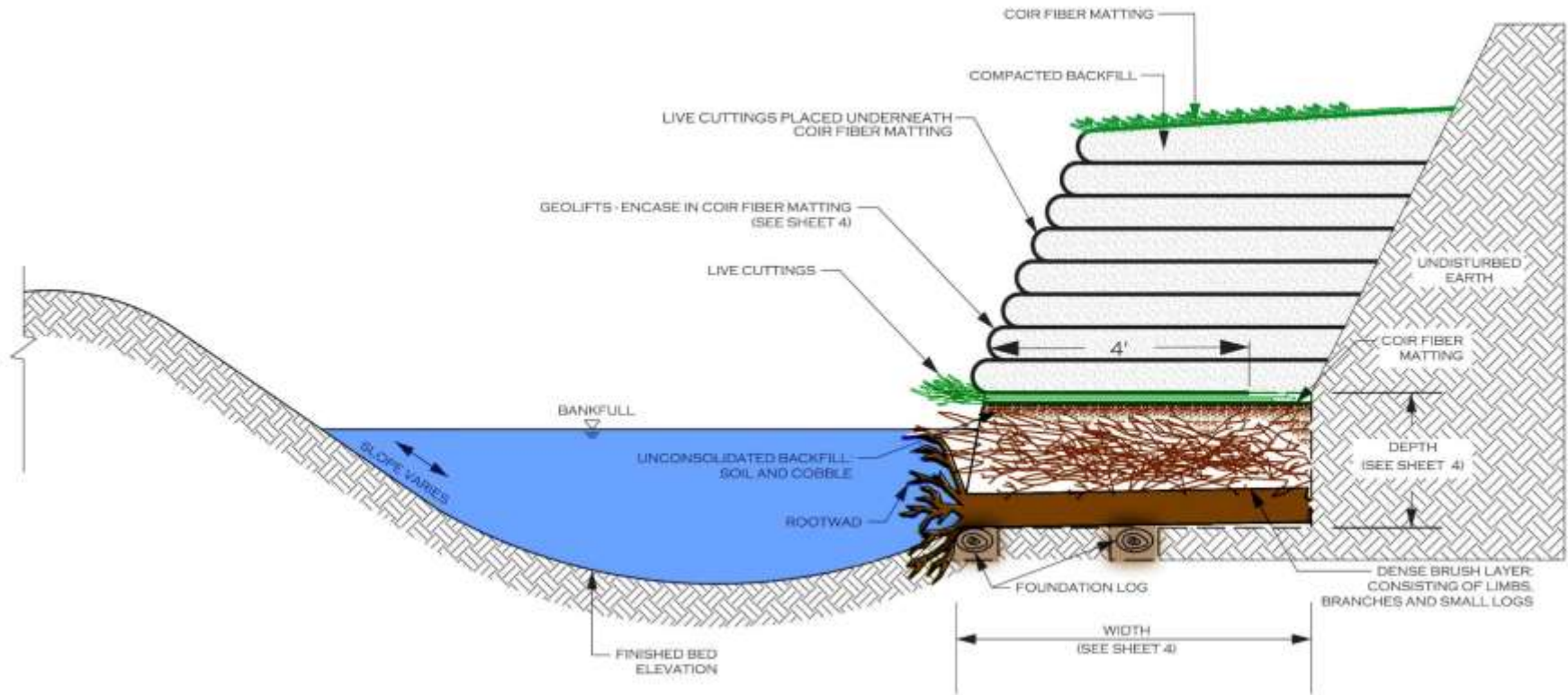




# ORIGINAL DESIGN

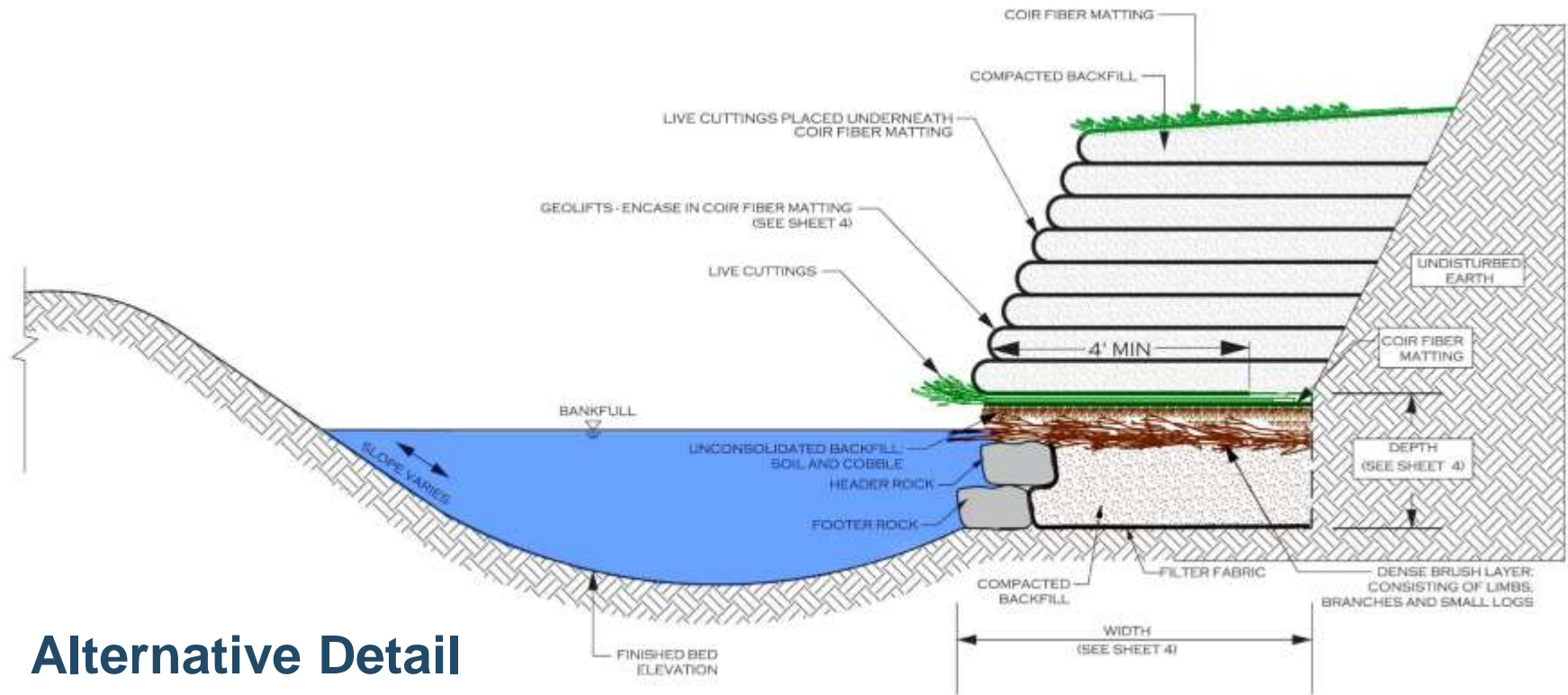


# ORIGINAL DESIGN – TOEWOOD/GEOLIFT





# ORIGINAL DESIGN – ROCK TOE/GEOLIFT



Alternative Detail

# ORIGINAL DESIGN – PLANT SELECTION

## TREES & SHRUBS

All trees species shall be planted during the dormant season (late November - early March) for San Antonio, Texas, to ensure optimal growth.

### Zone 1 - Riparian Upland (Trees)

Riparian upland species shall be planted in the areas designated on the plans and according to the details, technical specifications, and the container and height requirements shown below. Containerized species shall be planted at an overall density of **48 trees/acre (30' x 30' spacing)**. It is understood that commercial availability may dictate which species can be used at the time of planting. **At a minimum, the Contractor must use at least 4 of the species listed below.** Any changes must be approved by the Engineer.

Scientific Name	Common Name	Acceptable Container <sup>1</sup>	Acceptable Height (ft) <sup>1</sup>	Wetland Indicator Status
<i>Carya illinoensis</i>	Pecan	#5, #7, #10	4	FAC
<i>Celtis laevigata</i>	Hackberry	#5, #7, #10	4	FAC
<i>Cercis canadensis</i>	Texas Redbud	#3, #5	4	UPL
<i>Fraxinus velutina</i>	Arizona ash	#3, #7, #10	5 to 6	FAC
<i>Ilex vomitoria</i>	Yaupon Holly	#3, #5	4	FAC
<i>Rhus rubra</i>	Red mulberry	#5, #7, #10	4	FACU
<i>Populus deltoides</i>	Cottonwood	#3, #7, #10	5 to 6	FAC
<i>Quercus macrocarpa</i>	Bur oak	#3, #7, #10	5 to 6	FACU
<i>Unguaris speciosa</i>	Mexican Buckeye	#3, #5	4	NI

<sup>1</sup> - The American Standard for Nursery Stock (ANSI Z60.1)

Total Trees Needed for Zone 1 **18**

### Zone 2 - Upper Stream Bank (Trees)

Upper stream bank species shall be planted in the areas designated on the plans and according to the details, technical specifications, and the container and height requirements shown below. Containerized species shall be planted at an overall density of **194 trees/acre (20' x 20' spacing)**. It is understood that commercial availability may dictate which species can be used at the time of planting. **At a minimum, the Contractor must use at least 4 of the species listed below.** Any changes must be approved by the Engineer.

Scientific Name	Common Name	Acceptable Container <sup>1</sup>	Acceptable Height (ft) <sup>1</sup>	Wetland Indicator Status
<i>Celtis laevigata</i>	Hackberry	#5, #7, #10	4	FAC
<i>Fraxinus pennsylvanica</i>	Green ash	#3, #7, #10	5 to 6	FAC
<i>Ilex decidua</i>	Possumhaw	#3, #5	4	FAC
<i>Juglans nigra</i>	Black Walnut	#5, #7, #10	4	FACU
<i>Populus deltoides</i>	Cottonwood	#3, #7, #10	5 to 6	FAC
<i>Prunus mexicana</i>	Mexican Plum	#3, #5	4	NI
<i>Quercus macrocarpa</i>	Bur oak	#3, #7, #10	5 to 6	FACU
<i>Salix nigra</i>	Black willow	#3, #5	4	FACW
<i>Ulmus americana</i>	American elm	#3, #7, #10	5 to 6	FAC
<i>Ulmus crassifolia</i>	Cedar elm	#5, #7, #10	4	FAC

<sup>1</sup> - The American Standard for Nursery Stock (ANSI Z60.1)

Total Trees Needed for Zone 2 **18**

### Zone 3 - Lower Stream Bank to Water's Edge (Trees)

Lower stream bank to water's edge species shall be planted in the areas designated on the plans and according to the details, technical specifications, and the container and height requirements shown below. Containerized species shall be planted at an overall density of **194 trees/acre (20' x 20' spacing)**. It is understood that commercial availability may dictate which species can be used at the time of planting. **At a minimum, the Contractor must use at least 1 of the species listed below.** Any changes must be approved by the Engineer.

Scientific Name	Common Name	Acceptable Container <sup>1</sup>	Acceptable Height (ft) <sup>1</sup>	Wetland Indicator Status
<i>Populus deltoides</i>	Cottonwood	#3, #7, #10	5 to 6	FAC
<i>Quercus macrocarpa</i>	Bur oak	#3, #7, #10	5 to 6	FACU
<i>Salix nigra</i>	Black Willow	#3, #5	4	FACW
<i>Taxodium distichum</i>	Bald Cypress	#7, #10, #15	5 to 6	OBL
<i>Ulmus americana</i>	American elm	#3, #7, #10	5 to 6	FAC

<sup>1</sup> - The American Standard for Nursery Stock (ANSI Z60.1)

Total Trees Needed for Zone 3 **2**

### LIVE CUTTINGS (TOE WOOD PROTECTION STRUCTURE)

All live cutting species shall be harvested and planted during the dormant season (late November - early March) for San Antonio, Texas, to ensure optimal growth.

### Zone 3 - Lower Stream Bank to Water's Edge (Live Cuttings)

Live cuttings will be installed in the locations shown on the plans and according to the toewood details and technical specifications. Live cuttings shall be comprised of equal quantities of the species listed and follow the length and diameter criteria shown below.

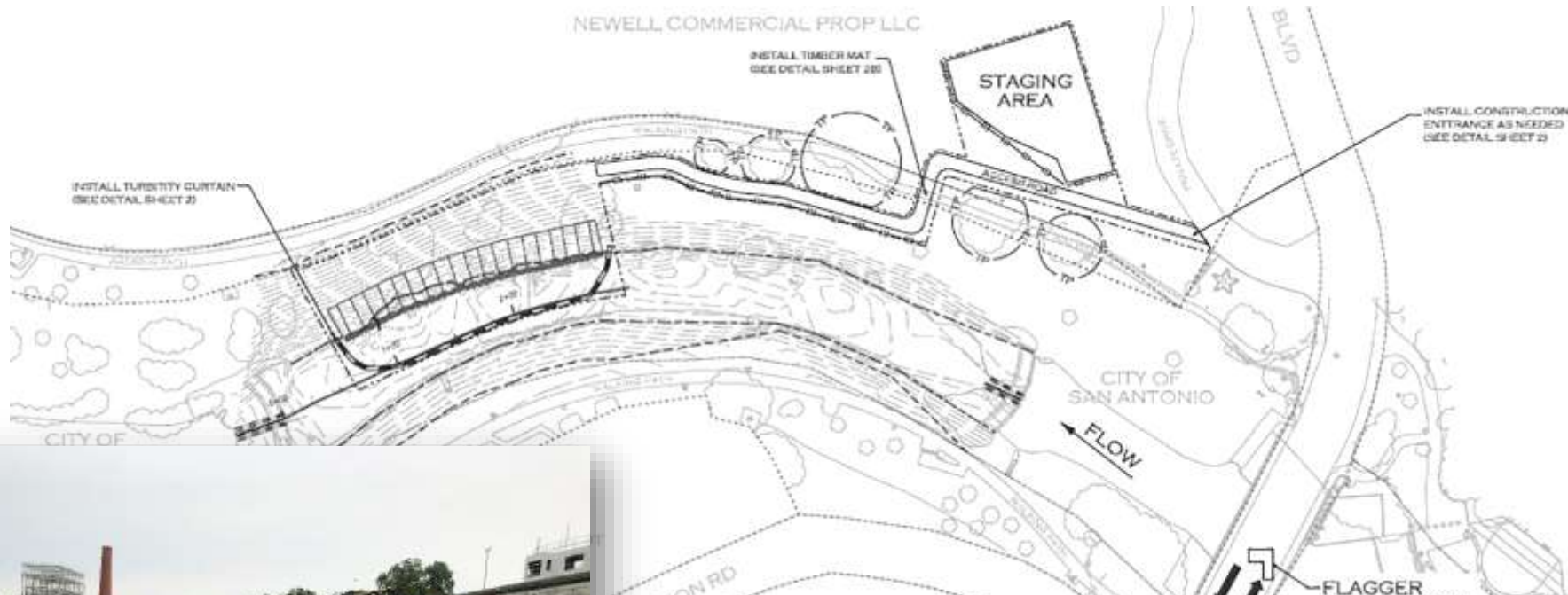
Scientific Name	Common Name	Cutting Length (ft)	Cutting Diameter (in)	Toewood Length (ft)	Toewood Layers	Quantity	Wetland Indicator Status
<i>Cephalanthus occidentalis</i>	Button bush	5 to 10	1 to 2.5	225	6	3,500	OBL
<i>Cornus drummondii</i>	Roughleaf dogwood					3,500	FAC
<i>Salix nigra</i>	Black Willow					3,500	FACW
<i>Sambucus nigra</i>	Common Elderberry					3,500	FAC

Total Live Cuttings Needed for Zone 3 **14,000**





# EROSION CONTROL PLAN



## Turbidity Curtain:

- Fabric shall be reinforced PVC coated fabric with rip-stop & yellow in color.
- The minimum net buoyancy shall be 6 inch / 15cm – 13 lb/ft/19.2 kg/m.
- Floatation shall be 6 inches square and of EPS marine quality.
- Load carrying components shall consist of fabric & 3/16-inch galvanized steel chain with 3,000 lb. break strength.
- The ballast shall be 0.41 lb. per foot galvanized chain.
- Connections shall be made with laced grommets or chain to chain.
- Minimum curtain depth shall be 5 ft.



# ORIGINAL DESIGN - EEOCC

July 16, 2019

## Lone Star Site Erosion Project

Unit Number	Tech. Spec. Section Number	Unit Description	Unit of Measure	Estimated Quantity	Unit Price	Total Price
1	107	Construction stakeout	LS	1	\$967.50	\$967.50
3	107	Mobilization (assume 5% of project cost)	LS	1	\$6,758.43	\$6,758.43
4	200/301	Tree Protection and Safety Fence	LF	760	\$2.00	\$1,520.00
5	301	Clearing & Grubbing	AC	0.40	\$4,000.00	\$1,600.00
6	302	Excavation	LS	1	\$32,940.00	\$32,940.00
		Cut	CY	1830	--	--
		Fill	CY	1250	--	--
		Balance	CY	580	--	--
7	500	Toewood with Geolift - TW	LF	225	\$400.00	\$90,000.00
	500	Foundation Logs	EA	28	--	--
	500	Rootwads	EA	29	--	--
	200	Coir Fiber Matting	SY	3350	--	--
	401	Live Cuttings - Lower Stream Bank - Zone 3	STEMS	14000	--	--
8	200	Temporary Construction Entrance	EA	1	\$2,500.00	\$2,500.00
9	200	Timber Mat	EA	1	\$75.00	\$75.00
10	200	Silt Fence	LF	255	\$2.50	\$637.50
11	200	Coir Fiber Matting	SY	120	\$4.50	\$540.00
12	200	Turbidity Curtain	LF	260	\$8.25	\$2,145.00
13	400	Temporary Seeding	AC	0.78	\$500.00	\$387.50
14	400	Permanent Seeding - Riparian Upland - Zone 1	AC	0.62	\$1,000.00	\$620.00
15	400	Permanent Seeding - Upper Stream Bank - Zone 2	AC	0.15	\$1,200.00	\$180.00
16	400	Permanent Seeding - Lower Stream Bank - Zone 3	AC	0.005	\$1,200.00	\$6.00
17	401	Trees - Riparian Upland - Zone 1	EA	18	\$35.00	\$630.00
18	401	Trees - Upper Stream Bank - Zone 2	EA	10	\$35.00	\$350.00
19	401	Trees - Lower Stream Bank - Zone 3	EA	2	\$35.00	\$70.00
<b>TOTAL BID PRICE ESTIMATE</b>					<b>\$141,926.93</b>	
<i>Cost/LF</i>					<i>\$ 630.79</i>	





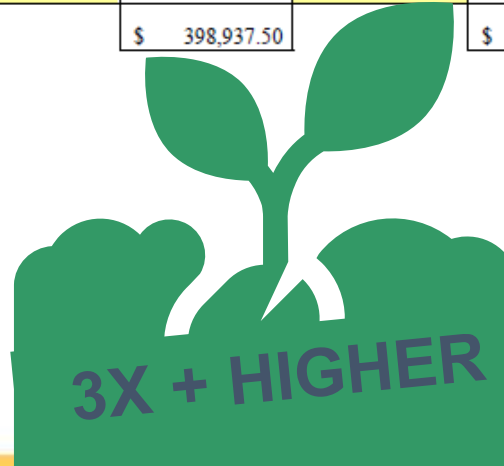
# BIDS

RFB # 00136  
 DATE: 11/21/2019 at 11:00 AM  
 Description: Lone Star Erosion Repair Construction

				Vendor:					
				Contractor 1		Contractor 2		Contractor 3	
Principle Place of Business:				San Antonio, TX		Schertz, TX		Carrollton, GA	
No.	Qty.	UOM	DESCRIPTION	Unit Price	Total	Unit Price	Total	Unit Price	Total
200	225	LF	Silt Fence	\$ 4.50	\$ 1,012.50	\$ 1.80	\$ 405.00	\$ 3.45	\$ 776.25
200	120	SY	Coir Fiber Matting	\$ 8.00	\$ 960.00	\$ 5.00	\$ 600.00	\$ 8.50	\$ 1,020.00
200	260	LF	Turbidity Curtain	\$ 23.00	\$ 5,980.00	\$ 59.50	\$ 15,470.00	\$ 38.40	\$ 9,984.00
400	0.78	AC	Temporary Seeding	\$ 3,000.00	\$ 2,340.00	\$ 10,540.00	\$ 8,221.20	\$ 2,184.00	\$ 1,703.52
400	0.62	AC	Permanent Seeding - Riparian Upland-Zone 1	\$ 9,500.00	\$ 5,890.00	\$ 7,340.00	\$ 4,550.80	\$ 2,648.00	\$ 1,641.76
400	0.15	AC	Permanent Seeding - Upper Stream Bank - Zone 2	\$ 9,500.00	\$ 1,425.00	\$ 12,390.00	\$ 1,858.50	\$ 3,455.00	\$ 518.25
400	0.005	AC	Permanent Seeding - Lower Stream Bank - Zone 3	\$ 9,500.00	\$ 47.50	\$ 140,000.00	\$ 700.00	\$ 3,830.00	\$ 19.15
401	18	EA	Trees - Riparian Upland - Zone 1	\$ 475.00	\$ 8,550.00	\$ 258.00	\$ 4,644.00	\$ 245.00	\$ 4,410.00
401	10	EA	Trees - Upper Stream Bank - Zone 2	\$ 475.00	\$ 4,750.00	\$ 258.00	\$ 2,580.00	\$ 245.00	\$ 2,450.00
401	2	EA	Trees - Lower Stream Bank - Zone 3	\$ 475.00	\$ 950.00	\$ 258.00	\$ 516.00	\$ 275.00	\$ 550.00
				\$ 398,937.50		\$ 467,114.50		\$ 594,270.00	

I certify that the above is a true and accurate tabulation of bids received at 11:00 a.m., 11/21/2019 for the Lone Star Erosion Repair Construction

▪ **EEOC = \$141,926**



# REDESIGN

- **Floodplain Permitting issue along entire Mission Reach (prior to project)**
- **SARA conducted Manning's n-value exercise to determine max roughness allowed on banks**
- **EPR told to reduce live cuttings from 14,000 stems to 60**
- **Geolift on top of toewood no longer an option**



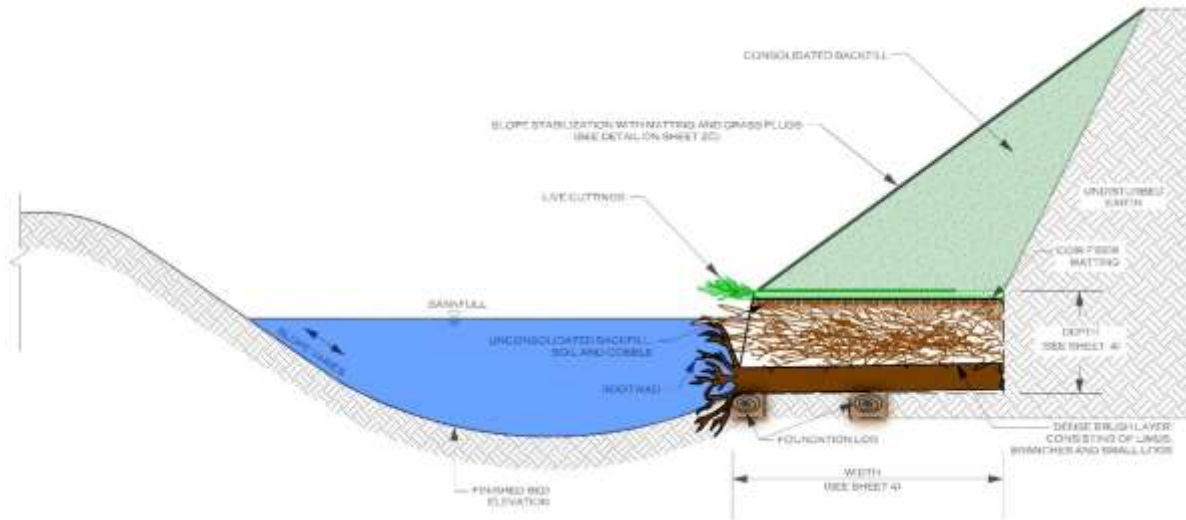


# REDESIGN – TOEWOOD WITH GRASS PLUGS

## Slope Stabilization with Matting & Grass Plugs



SEE COIR FIBER MATTING DETAIL (THIS SHEET) FOR ANCHORING TYPES AND TRENCHING METHODS.  
FOR GRASS PLUG VEGETATION SELECTION



# REDESIGN – PLANTINGS

## VEGETATION SELECTION

### PERMANENT SEEDING

All permanent permanent seed mixes shall be planted within the growing season period for San Antonio, TX (March 5 - November 23), to ensure optimal growth.

#### Zone 1 - Riparian Upland (Permanent Seeding)

This permanent seed mixture shall be planted in all disturbed areas as specified on the plans as Zone 1. This permanent seed mixture shall be applied with temporary seed, as defined in the construction specifications. This permanent seed shall be applied at a rate of 12 lbs/acre.

Scientific Name	Common Name	Species %	Wetland Indicator Status
<b>Grasses</b>			
<i>Andropogon gerardii</i>	Big bluestem	11.5	FACU
<i>Elymus canadensis</i>	Prairie wildrye	10.0	FACU
<i>Eragrostis trichodes</i>	Sand lovegrass	10.0	NI
<i>Panicum virgatum</i>	Switchgrass	10.0	FAC
<i>Schizachyrium scoparium</i>	Lirde bluestem	11.0	FACU
<i>Sorghastrum nutans</i>	Indiangrass	10.0	FACU
<b>Forbs</b>			
<i>Asclepias tuberosa</i>	Butterflyweed	7.5	NI
<i>Coreopsis basilis</i>	Golden-wave	7.5	NI
<i>Coreopsis lanceolata</i>	Lanceleaf coreopsis	7.5	FACU
<i>Rudbeckia hirta</i>	Black-eyed Susan	7.5	FACU
<i>Salvia farinacea</i>	Mealy blue sage	7.5	NI

Total Permanent Seeding Area - Zone 1 0.68 acre(s)

### GRASS PLUGS

#### Zone 2 - Upper Stream Bank (Permanent Grass Plugs)

This permanent grass mixture shall be planted as plugs in the area specified as Zone 2 on the plan. This permanent seed mixture shall be planted according to the percentages shown below and the planting guidelines (spacing, depth, etc.) outlined by the grass plug supplier.

Scientific Name	Common Name	Type	Species %
<i>Bouteloua dactyloides</i>	Buffalograss	Plug	50.0
<i>Bouteloua gracilis</i>	Blue Grama	Plug	50.0

Total Permanent Seeding Area - Zone 2 0.30 acre(s)

### TREES & SHRUBS

All trees species shall be planted during the dormant season (late November - early March) for San Antonio, Texas, to ensure optimal growth.

#### Zone 1 - Riparian Upland (Trees)

Riparian upland species shall be planted in the areas designated on the plans and according to the details, technical specifications, and the container and height requirements shown below. Containerized species shall be planted at an overall density of 48 trees/acre (30' x 30' spacing). It is understood that commercial availability may dictate which species can be used at the time of planting. At a minimum, the Contractor must use at least 4 of the species listed below. Any changes must be approved by the Engineer.

Scientific Name	Common Name	Acceptable Container <sup>1</sup>	Acceptable Height (ft) <sup>1</sup>	Wetland Indicator Status
<i>Carya illinoensis</i>	Pecan	#5, #7, #10	4	FAC
<i>Celtis laevigata</i>	Hackberry	#5, #7, #10	4	FAC
<i>Cercis canadensis</i>	Texas Redbud	#3, #5	4	UPL
<i>Fraxinus velutina</i>	Arizona ash	#3, #7, #10	5 to 6	FAC
<i>Ilex vomitoria</i>	Yaupon Holly	#3, #5	4	FAC
<i>Morus rubra</i>	Red mulberry	#1, #7, #10	4	FACU
<i>Populus deltoides</i>	Cottonwood	#3, #7, #10	5 to 6	FAC
<i>Quercus macrocarpa</i>	Bur oak	#3, #7, #10	5 to 6	FACU
<i>Ulmus americana</i>	Mexican Buckeye	#3, #5	4	NI

<sup>1</sup> - The American Standard for Nursery Stock (ANSI Z60.1)

Total Trees Needed for Zone 1 18

### LIVE CUTTINGS (TOE WOOD PROTECTION STRUCTURE)

All live cutting species shall be harvested and planted during the dormant season (late November - early March) for San Antonio, Texas, to ensure optimal growth. A survival rate of 50% is assumed for the Live Cuttings following installation.

#### Zone 3 - Live Cuttings within Toe Wood Structure

Live cuttings will be installed in the locations shown on the plans and according to the toewood details and technical specifications. Live cuttings shall be comprised of equal quantities of the species listed and follow the length and diameter criteria shown below. Install 1 live cutting every 2-feet in the location shown on the detail.

Scientific Name	Common Name	Cutting Length (ft)	Cutting Diameter (in)	Toewood Length (ft)	Toewood Layers	Quantity	Wetland Indicator Status
<i>Cephalanthus occidentalis</i>	Burton bush	5 to 10	1 to 2.5	225	1	30	OBL
<i>Cornus drummondii</i>	Roughleaf dogwood					30	FAC
<i>Salix nigra</i>	Black Willow					30	FACW
<i>Sambucus nigra</i>	Common Elderberry					30	FAC

Total Live Cuttings Needed for Zone 3 120

- Originally 14,000 cuttings





# CONSTRUCTION

- SARA sourced pecan trees for the toewood from property at Truehart Ranch
- Live cuttings from Mission Reach
- Contractor didn't order grass plugs until week before planting....weren't available. Had to find a substitute. Caused delay.
- Construction began on 4/21/2020 (COVID) and finished on 8/27/2020 (5 months for 250-LF of toewood)
- Contractor inexperienced, interesting construction methods



# CONSTRUCTION

APRIL 7, 2020





# CONSTRUCTION

APRIL 24, 2020



# CONSTRUCTION

APRIL 24, 2020



**Committed to Safe, Clean, Enjoyable Creeks and Rivers.**



# CONSTRUCTION

APRIL 29, 2020



**Committed to Safe, Clean, Enjoyable Creeks and Rivers.**

# CONSTRUCTION

APRIL 29, 2020





# CONSTRUCTION



MAY 6, 2020



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# CONSTRUCTION

MAY 6, 2020



**Committed to Safe, Clean, Enjoyable Creeks and Rivers.**



# CONSTRUCTION

MAY 6, 2020



# CONSTRUCTION



MAY 20, 2020





# CONSTRUCTION

MAY 20, 2020



# CONSTRUCTION



JULY 15, 2020





# CONSTRUCTION



# CONSTRUCTION

JULY 15, 2020





# CONSTRUCTION COMPLETED

AUGUST 27, 2020



Committed to Safe, Clean, Enjoyable Creeks and Rivers.

# 1 MONTH POST CONSTRUCTION

September 24, 2020



**Committed to Safe, Clean, Enjoyable Creeks and Rivers.**



# 2 YRS – POST CONSTRUCTION



July 15, 2022



# CONSTRUCTION

- **Drone Footage**





# POST CONSTRUCTION

- **Native sedge growing too fast**
- **Stopped irrigation to slow growth**
- **Contractor and SARA worked on removal plan**
- **Several mid bank floods, but no major ones**



# HIGHLIGHTS/LESSONS LEARNED

- **Unexpected design changes**
- **NCD techniques still ‘new’ to area**
- **Texas is expensive – plan for higher bids due to inexperienced contractors**
- **Vegetation – availability of species**
- **COVID changed construction oversight schedule – reduced time on site, relied on client photos/calls, etc.**
- **Turbidity curtain worked ‘ok’**
- **Maintenance**





# Questions & Answers



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## **MISSION REACH – LONE STAR SITE EROSION PROJECT: TOEWOOD FOR BANK STABILIZATION**

NATIONAL STREAM CONFERENCE 2022

