Appendix E Other Supporting Information

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	TX	DAM	Escondido Creek FRS No. 12	BY	SS	DATE	12/10/2024	
YEAR BUILT		1974	DESIGN HAZARD CLASS	L		DRAINAGE AREA	11.64	mi^2
WORK PLAN DATE		1/1/1964	CURRENT HAZARD CLASS	H		DAM HEIGHT	34	ft
sht 1 of 5	CONSEQUENCES OF DAM FAILURE (ver. 2021-01)					NID ID	TX04315	

POTENTIAL DAM FAILURE:

Total Failure Index			151	A

POTENTIAL LOSS OF LIFE:

Maximum Population-at-Risk [PAR]		(number)	144	B
Total Risk Index			4	C

POTENTIAL LOSS OF PROPERTY:

Identify major community affected by breach and rate impact as High (H), Medium (M), Low (L) or None(blank)

Community	Kenedy, TX	(H,M,L,-)	M	D
Number of homes, businesses, major buildings		(number)	88	E

POTENTIAL LIFELINE DISRUPTION:

Water supply, identify community disrupted by dam failure, and estimate number/amount

Municipal sole source		Users	(number)	0	F
Supplemental source		Users	(number)	0	G
Irrigation water		Storage	(Ac-Ft)	0	H

POTENTIAL INFRASTRUCTURE DISRUPTION:

Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number

Major/Interstate	N 5th St	Roads	(number)	1	I
Secondary/County		Roads	(number)		J

POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT:

Describe impacts and rate each as High (H), Medium (M), Low (L), or None (blank)

Threatened & endangered species	Federally and state-listed species with the potential tc	(H,M,L,-)	L	K
Sensitive riparian areas	Riparian areas are present on site.	(H,M,L,-)	L	L
Contaminated reservoir sediment	Area upstream appears to be largely undeveloped pa	(H,M,L,-)	L	M
Wetland and wildlife habitat	Wildlife habitat is present on site. No wetlands are pre	(H,M,L,-)	L	N
Other		(H,M,L,-)		O

POTENTIAL ADVERSE SOCIAL IMPACTS:

Describe impacts and rate each as High (H), Medium (M), Low (L) or None(blank)

Known cultural resources		(H,M,L,-)	L	P
Historic preservation issues		(H,M,L,-)	L	Q
Socially disadvantaged community	Site is located in primarily rural area	(H,M,L,-)	M	R

POTENTIAL ADVERSE ECONOMIC IMPACTS:

Average annual benefits attributed to this dam, updated workplan value	($)	154,092	S
Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)	(I,NC,D)	I	T
Low income families impacted	(number)	16	U

INPUT BY STATE DAM SAFETY AGENCY:

State dam safety order issued for repair, modification, removal issued, Yes(Y), No(N)	(Y,N)	N	V
State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank)	(H,M,L,-)	L	W

OTHER CONSIDERATIONS:

Identify any other considerations and rate as High(H), Medium(M), Low(L) or None(blank)

	(H,M,L,-)		X
	(H,M,L,-)		Y

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	**DAM**	Escondido Creek FRS No. 12	**BY**	SS	**DATE**	12/10/2024

FAILURE & RISK INDEXES

Adopted from Bureau of Reclamation "Risk Based Profile System"
see attached worksheet tab.

LIFE LOSS:

Population-at-Risk [PAR], see NRCS dams inventory definition (number of people)

Estimate PAR for static loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway	144	A
Estimate PAR for hydrologic loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway	22	B
Estimate PAR for seismic loading failure; typically assume water at or above invert of the lowest non-gated spillway (sunny day failure)	2	C

Fatality Rates [FR] from dam breach

Adopted from BuRec "A Procedure for Estimating Loss of Life Caused by Dam Failure" DSO-99-06

see: http://www.usbr.gov/research/dam_safety/documents/dso-99-06.pdf

Flood Severity/Lethality [DV] is the average depth [D] times velocity [V] across flood plain (ft2/sec)

DV= (breach discharge - bank full discharge) / breach floodplain width

Warning Time [T] between failure warning and flood wave at population (minutes)

Flood Severity Understanding [U] of the warning issuer of the likely flooding magnitude

Scenario	Breach Discharge	Bankfull Discharge	Breach Floodplain Width	DV	Warning Time, T	Understanding, U
	(cfs)	(cfs)	(ft)	(ft2/sec)	(minutes)	(N/A or Vague)
Static	37,800	145	2452	15	229	Vague
Hydrologic	25,300	145	2209	11	235	Vague
Seismic	2,400	145	99	23	0	N/A

For DV≥50	T≤60	U=vague	FR=0.04
	T>60		FR=0.03
For DV<50	T≤60	U=vague	FR=0.007
	T>60		FR=0.0003

Estimate FR for static loading failure scenario	0.0003	D
Estimate FR for hydrologic loading failure scenario	0.0003	E
Estimate FR for seismic loading failure scenario	0.007	F

Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index
Static	1	82	82	0.0003	144	4
Hydrologic	*	*	69	0.0003	22	0
Seismic	0.00	#DIV/0!	0	0.007	2	0
		TOTAL=	151		TOTAL=	4

EVALUATION OF POTENTIAL REHABILITATION PROJECTS			
STATE: TX; DAM: Escondido Creek FRS No. 12; BY: SS		DATE	12/10/2024
sht 3 of 5 — STATIC FAILURE INDEX			
PRINCIPAL SPILLWAY SYSTEM (60 points max): (total points)	30		A
Downstream filter or filter zone around conduit (yes=0 or no=10)		10	B
Conduit trench deep (>2d) and narrow (<3d) and steep sideslope (<2:1) (no=0 or yes=10)		0	C
Principal spillway system (inlet, pipe, or outlet) in deteriorated condition (no=0 or yes=10)		0	D
Conduit has seepage cutoff collars or other compaction adverse features (no=0 or yes=10)		10	E
Conduit contains open joints, open cracks, steady seepage (no=0 or yes=10)		0	F
Conduit founded on competent bedrock (yes=0 or no=10)		10	G
Reservoir control gate located at outlet of conduit (no=0 or yes=10)		0	H
RESERVOIR FILLING HISTORY (75 points max): (total points)	10		I
Reservoir has filled to x% of effective height (earth spillway crest minus original streambed)		95	J
(<50%=75 or 51-75%=50 or 76-90%=25 or 91-95%=10 or 96-100%=5 or >100%=0)		10	K
SEEPAGE AND DEFORMATION (85 points max): (total points)	12		L
Seepage carrying fines, or seepage increases with reservoir elevation increases, or sinkholes/jugholes exist in embankment (no=0 or yes=80)		0	M
Large amounts of seepage (no=0 or yes=6)		0	N
Visible and significant slope movement or sloughing (no=0 or yes=6)		0	O
Longitudinal or transverse embankment cracking greater than one foot in depth (no=0 or yes=6)		0	P
Sinkholes/depressions within two times effective height of the dam, either face (no=0 or yes=6)		0	Q
Poor top of dam condition, eroded, trees, rodent holes, settlement (no=0 or yes=6)		6	R
Abnormally wet areas at downstream toe/groin of embankment (no=0 or yes=6)		0	S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)		6	T
FOUNDATION GEOLOGY (41 points max): (total points)	6		U
Highly fractures rock under core (no=0 or treated=3 or untreated=30)		0	V
Karst terrain and soluble rock (gypsum or limestone) (no=0 or treated=3 or untreated=30)		0	W
Collapsible soils (no=0 or treated=3 or untreated=30)		0	X
Significant stress relief fractures in abutments (no=0 or treated=3 or untreated=30)		0	Y
History of underground mining under embankment area (no=0 or treated=3 or untreated=30)		0	Z
Coarse grained and highly permeable soils (no=0 or yes=3)		3	AA
Presence of weak layers/conditions diminishing embankment stability (no=0 or yes=3)		0	AB
Erodible soils (sandy/silty materials) or weakly cemented rock (no=0 or yes=3)		3	AC
Reservoir area prone to landslides that could cause overtopping (no=0 or yes=3)		0	AD
EMBANKMENT DESIGN AND CONSTRUCTION (24 points max): (total points)	16		AE
Filters for core or foundation or compatibility between zones (no=4 or yes=0)		4	AF
Embankment or foundation drainage system (yes=0 or no=4)		4	AG
Erodible core material (sands, silts, dispersive clays) (no=0 or yes=4)		4	AH
Incomplete or no foundation cutoff of shallow permeable layers (no=0 or yes=4)		4	AI
Poorly placed earthfill, inadequate density (no=0 or yes=4)		0	AJ
Gate features to drain reservoir (yes=0 or no=4)		0	AK
EMBANKMENT MONITORING (15 points max): (total points)	8		AL
Instruments (except surficial survey points) installed at dam (yes=0 or no=4)		4	AM
Installed instruments routinely read and evaluated (yes=0 or no=4)		4	AN
Visual inspection of dam by engineer less often than yearly (no=0 or yes=4)		0	AO
Good physical/visual access to downstream groin/toe for inspection (yes=0 or no=4)		0	AP
STATIC FAILURE INDEX: A+I+L+U+AE+AL		82	AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	DAM	Escondido Creek FRS No. 12	BY	SS	DATE	12/10/2024
sht 4 of 5	HYDROLOGIC FAILURE INDEX						ver 2021-01

HYDROLOGIC LOADING:						
Total Spillway Capacity (PS&ES) for 6hr storm [Pfb], Work Plan Tbl 3 (rainfall inches)					17.9	A
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings						
100 year, 6hr rainfall [P100] (inches)					8.23	B
Probable Maximum Precipitation [PMP] (inches)					27.3	C
if Pfb <=	P100	=	8.2	enter 40		
if Pfb =	P100+0.2(PMP-P100)	=	12.0	enter 25		
if Pfb =	P100+0.4(PMP-P100)		15.9	enter 15		
if Pfb =	P100+0.6(PMP-P100)	=	19.7	enter 7		
if Pfb =	P100+0.8(PMP-P100)	=	23.5	enter 3		
if Pfb =>	PMP	=	27.3	enter 1		
Enter interpolated value					10.7	D
HYDROLOGIC UNCERTAINTY:						
Drainage Area [DA] (square miles)					6.1	E
DA<10 enter 1.5 ; 10<DA<20 enter 1.4 ; 20<DA<50 enter 1.3 ; DA=>50 enter 1.2					1.5	F
PIPE SPILLWAY PLUGGING:						
Pipe Diameter [D] (inches)					42.0	G
D<12 enter 1.1; 12<=D<24 enter 1.0; 24<=D enter 0.9					0.9	H
Riser & trash rack type:						
Non-standardized inlet enter 1.1, Open Top riser enter 1.0; Covered or Baffle Top enter 0.9					1.0	I
EARTH SPILLWAY FLOW:						
Earth spillway flow depth [Des] from the spillway crest to top of dam (feet)(10' max)					7.3	J
DAM EROSION RESISTANCE:						
Non-plastic (PI<10) fill enter 2.0 ; Plastic core enter 1.7 ; Overtopping armoring enter 0.8					1.7	K
Vegetal Cover Factor [Cf], see NEH-Part 628-Chapter 51, Earth Spillway Erosion Model.					0.7	L
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8					0.9	M
EARTH SPILLWAY EROSION RESISTANCE:						
Low, can be excavated with hand tools, enter 2.0						
PI>10 and SPT blows<8, PI<10 and SPT blows>8, Kh<0.10, seismic velocity<2000fps						
Moderate, can be excavated with construction equipment, easy ripping, enter 1.2						
PI>10 and SPT blows>8, PI<10 and SPT blows>30, Kh<10, seismic velocity<7000fps						
High, very hard ripping, requires drilling and blasting, enter 0.2						
moderately hard rock, Kh>10, seismic velocity>7000fps					1.2	N
Vegetal Cover Factor [Cf], see NEH-Part 628-Chapter 51, Earth Spillway Erosion Model.					0.7	O
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8					0.9	P
HYDROLOGIC FAILURE INDEX:						
dam overtopping breach: (2)(D)(F)(H)(I)(K)(M)					44	Q
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)					69	R
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300					69	S

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	TX	**DAM**	Escondido Creek FRS No. 12	**BY**	SS	**DATE**	12/10/2024
sht 5 of 5	**SEISMIC FAILURE INDEX**					ver 2021-01	

SEISMIC LOADING:		
Latitude (degrees.decimal)	28.831	A
Longitude (degrees.decimal)	-97.923	B
See "http://https://earthquake.usgs.gov/hazards/interactive/index.php" (MAP LINK)		
PGA [peak ground acceleration] for 2% chance in 50 years, see NSHM maps (%g)	5.64	C
if PGA is less than 10% g, enter 0		
if PGA is between 10% g and 19% g, enter 0.15		
if PGA is between 20% g and 39% g, enter 0.30		
if PGA is between 40% g and 59% g, enter 0.65		
if PGA is greater than 60% g, enter 1.0	0.00	D
FOUNDATION LIQUEFACTION:		
Select the following foundation conditions which best represents the site		
Loose alluvium, lacustrine, loess materials, enter 10		
Bedrock, glacial till, highly clayey materials, enter 5	5	E
EMBANKMENT FREEBOARD FOR FOUNDATION LIQUEFACTION:		
Dam height (ft)	34	F
Freeboard - Elevation difference from top of dam to assumed pool surface (ft)	17.1	G
Freeboard percent of dam height (%)	50	H
if Freeboard is less than 25% of dam height, enter 10		
if Freeboard is 25% to 50% of dam height, enter 5		
if Freeboard is more than 50% of dam height, enter 1	5	I
EMBANKMENT FREEBOARD FOR EMBANKMENT CRACKING:		
Freeboard is less than or equal to 15 feet (no=0 or yes=1)	0	J
EMBANKMENT CRACKING:		
Embankment contains self-healing filter zones (no=4 or yes=0)	4	K
SEISMIC FAILURE INDEX:		
IF E=10, L=(D)(E)(I) ; IF E=5, L=(D)(E)(J+1)(K+1)); but less than 100	0	L

State Conservation Engineer's Signature
concurring with technical content of sheets 2 thru 5

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX		BY	SS	DATE	12/10/24
DAM	Escondido Creek FRS No. 12		CHECKED BY	MW	DATE	12/10/24
YEAR BUILT	1974	DESIGN HAZARD CLASS	L	DRAINAGE AREA	11.64	mi^2
WORK PLAN DATE	1/1/1964	CURRENT HAZARD CLASS	H	DAM HEIGHT	34	ft
sht 1 of 3	STATIC FAILURE SCENARIO (ver. 2013-01)				NID ID	TX04315

Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<2.0 Ft	>=2.0 Ft.			
Mobile Homes	12	2	14	3	6
Seasonal Use RV's				2	
Other					

Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<1.0 Ft	>=1.0 Ft.			
Homes	36	25	61	3	75
Seasonal Use Homes and Cabins	1	0	1	1.5	0
Duplexes				5	
Apartments					
Commercial Buildings	8	3	11	5	15
Schools (In Use)					
Schools (Not in Use)		1	1	10	10
Hospitals					
Other					

Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Road Overflow Depth		Total		
	<1.0 Ft	>=1.0 Ft.			
Main Local Roads and Minor State Highways					
ire Blvd, W Live Oak St, W Butler St, N 4th St,	1	12	13	2	24
t, Hyland Dr, Sunnyside Dr, Comanche St, Crai	3	7	10	2	14
Major State and Minor Federal Highways					
Highway Name(s) or Number(s)				4	
Highway Name(s) or Number(s)				4	
Major Federal and Interstate Highways					
Highway Name(s) or Number(s)				8	
Highway Name(s) or Number(s)				8	
Railroads					
UPSF Freight Traffic Only				3	
Passenger Traffic				20	
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					**144**

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX		BY	SS	DATE	12/10/24
DAM	Escondido Creek FRS No. 12		CHECKED BY	MW	DATE	12/10/24
YEAR BUILT	1974	DESIGN HAZARD CLASS	L	DRAINAGE AREA	11.64	mi^2
WORK PLAN DATE	1/1/1964	CURRENT HAZARD CLASS	H	DAM HEIGHT	34	ft
sht 2 of 3	HYDROLOGIC FAILURE SCENARIO (ver. 2013-01)				NID ID	TX04315

Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<2.0 Ft	>=2.0 Ft.			
Mobile Homes	4	1	5	3	3
Seasonal Use RV's				2	
Other					

Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<1.0 Ft	>=1.0 Ft.			
Homes	2	1	3	3	3
Seasonal Use Homes and Cabins				1.5	
Duplexes				5	
Apartments					
Commercial Buildings	2		2	5	0
Schools (In Use)					
Schools (Not in Use)		1	1	10	10
Hospitals					
Other					

Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Road Overflow Depth		Total		
	<1.0 Ft	>=1.0 Ft.			
Main Local Roads and Minor State Highways					
ate Road, N 5th St ROB, Bellaire Blvd, W Live (	3	2	5	2	4
Comanche St		1	1	2	2
Major State and Minor Federal Highways					
Highway Name(s) or Number(s)				4	
Highway Name(s) or Number(s)				4	
Major Federal and Interstate Highways					
Highway Name(s) or Number(s)				8	
Highway Name(s) or Number(s)				8	
Railroads					
UPSF Freight Traffic Only				3	
Passenger Traffic				20	
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					**22**

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE

STATE	TX		BY	SS	DATE	12/10/24
DAM	Escondido Creek FRS No. 12		CHECKED BY	MW	DATE	12/10/24
YEAR BUILT	1974	DESIGN HAZARD CLASS	L	DRAINAGE AREA	11.64	mi^2
WORK PLAN DATE	1/1/1964	CURRENT HAZARD CLASS	H	DAM HEIGHT	34	ft
sht 3 of 3	SEISMIC FAILURE SCENARIO (ver. 2013-01)				NID ID	TX04315

Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<2.0 Ft	>=2.0 Ft.			
Mobile Homes				3	
Seasonal Use RV's				2	
Other					

Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Inundation Depth Above Natural Ground		Total		
	<1.0 Ft	>=1.0 Ft.			
Homes				3	
Seasonal Use Homes and Cabins				1.5	
Duplexes				5	
Apartments					
Commercial Buildings				5	
Schools (In Use)					
Schools (Not in Use)				10	
Hospitals					
Other					

Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
	Road Overflow Depth		Total		
	<1.0 Ft	>=1.0 Ft.			
Main Local Roads and Minor State Highways					
Bucker Creek Private Road		1	1	2	2
				2	
Major State and Minor Federal Highways					
Highway Name(s) or Number(s)				4	
Highway Name(s) or Number(s)				4	
Major Federal and Interstate Highways					
Highway Name(s) or Number(s)				8	
Highway Name(s) or Number(s)				8	
Railroads					
UPSF Freight Traffic Only				3	
Passenger Traffic				20	
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					**2**

AECOM

Federal and State Listed Threatened and Endangered Species Assessment

Escondido Creek Watershed Floodwater Retarding Structure No. 12 Supplemental Planning Project

Karnes County, Texas

Natural Resources Conservation Service

Project number: 60707508

September 2023

Delivering a better world

Prepared for:

Natural Resources Conservation Service

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Figures

Tables

1. Background

1.1 Project description

AECOM Technical Services, Inc. (AECOM) conducted a federal and state listed threatened and endangered species habitat assessment for the proposed Escondido Creek Watershed Floodwater Retarding Structure (FRS) No. 12 Supplemental Planning Project (Project). The proposed Project is located in Karnes County, approximately 4.7 miles west of Kenedy, Texas (**Appendix A, Figure 1**). A literature search and field investigations were conducted for the Project within a potential impact area encompassing approximately 170 acres (Study Area).

1.2 Purpose

The purpose of this assessment is to comply with Section 9 of the Endangered Species Act (ESA), Chapters 67 and 68 of the Texas Parks and Wildlife (TPW) Code, and Sections 65.171 - 65.176 of Title 31 of the Texas Administrative Code (TAC) to avoid 'take' of federal or state listed threatened or endangered species.

A list of the current United States (U.S.) Fish and Wildlife Service (USFWS) and Texas Parks and Wildlife Department (TPWD) threatened and endangered (T&E) species and their associated habitat requirements are described within this document.

2. Methodology

A literature search was conducted to identify federal and state listed T&E species of concern with the potential to occur within the Study Area. Species lists were accessed through the USFWS's Environmental Conservation Online System (ECOS) Information for Planning and Consultation (IPaC) tool and through TPWD's Rare, Threatened, and Endangered Species list for Karnes County. The literature search also included a review of studies and reports related to the ecology of the area as well as a review of TPWD's Texas Natural Diversity Database (TXNDD), which was obtained via email request. The TXNDD was reviewed on June 20, 2023, to report if any rare and/or listed threatened or endangered species have been previously observed within or adjacent to the Study Area.

Field investigations were conducted on June 13, 2023, to verify previously reviewed information, document the presence of federal and state listed species and/or suitable habitat, and characterize habitat and vegetation types.

3. Regulations

3.1 U.S. Fish and Wildlife Service

3.1.1 Endangered Species Act

USFWS has legislative authority to list and monitor the status of species whose populations are considered to be imperiled. The federal legislative authority for the federal protection of threatened and endangered species issues from the ESA of 1973 and its subsequent amendments. Regulations supporting this Act are codified and regularly updated in Title 50 Code of Federal Regulations (CFR) Sections 17.11 and 17.12.

The ESA process stratifies potential candidates based upon the species' biological vulnerability. Species listed as endangered or threatened by the federal government are provided full protection under the law. This protection not only prohibits the direct possession (take) of a protected wildlife species, but also includes a prohibition of indirect take, such as destruction of habitat. Listed plant species are not protected from take, although it is illegal to collect or maliciously harm them on federal land. The ESA and accompanying regulations provide the necessary authority and incentive for individual states to establish their own regulatory vehicle for the management and protection of threatened and endangered species.

3.1.2 Migratory Bird Treaty Act

USFWS has legislative authority to prohibit, unless permitted by regulations, the kill, capture, collection, possession, buying, selling, trading, or transport of any migratory bird, nest, young, feather, or egg in part or in whole. The Migratory Bird Treaty Act (MBTA) and its subsequent amendments (16 U.S. Code [USC] 703-712) give the federal legislative authority for protection of migratory bird species. Regulations supporting the MBTA are codified and regularly updated in Title 50 CFR Parts 10 and 21.

3.2 Texas Parks and Wildlife Department

TPWD prohibits the take, possession, transportation, or sale of any of the animal or plant species designated by state law as endangered or threatened without the issuance of a permit (per Chapters 67 [Nongame Species] and 68 [Endangered Species] of the TPW Code and Sections 65.171 - 65.176 [Threatened and Endangered Nongame Species] of Title 31 of the TAC. “Take” is defined in the TPW Code as to “collect, hook, net, shoot, or snare, by any means or device, and includes an attempt to take or to pursue in order to take”.

Unlike federally listed species, there is no protection of habitat afforded to species that are only listed by the state.

4. Environmental Setting

Publicly available data was reviewed to identify aquatic features, soil types, and vegetation types within the Study Area. Data resources reviewed included the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD), the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey, USGS 7.5' quadrangle sheets, and recent aerial photography. This data review was used to describe the site-specific information below.

4.1 Land use

The Study Area consisted of an open water reservoir, a dam structure, a well pad, and undeveloped land. Based on the NHD, Bucker Creek, an intermittent stream; two unnamed intermittent streams; and one open water feature, Escondido Creek FRS No. 12 Reservoir, were mapped within the Study Area (USGS 2023). One residential property was identified in the northwestern portion of the Study Area.

4.2 Topography

The USGS 7.5-minute quadrangle map for Lenz, TX displays the topography of the Study Area (**Appendix A, Figure 2**). Topography within the Study Area is shaped by the current reservoir and dam system, as well as Bucker Creek. The surface gradient slopes generally from west-southwest to east-northeast, with the highest elevation located along the northwestern boundary of the Study Area at approximately 360 feet above mean sea level (MSL [National Geodetic Vertical Datum of 1929]). The lowest elevation is located in Bucker Creek near the northeastern boundary of the Study Area at approximately 308 feet above MSL (USGS 1987).

4.3 Soils

According to the USDA NRCS Web Soil Survey Report, the Study Area was mapped as being underlain by 10 soil map units (as shown on **Table 1** below and within **Appendix A, Figure 3**) (USDA NRCS 2021).

Table 1. NRCS Soil Mapping Units

Mapping Unit	Soil Type	Listed as Hydric by NRCS
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	Predominantly Non-hydric
CaA	Clareville clay loam, 0 to 1 percent slopes	No
CoB	Coy clay loam, 1 to 3 percent slopes	Predominantly Non-hydric
MoB	Monteola clay, 1 to 3 percent slopes	Predominantly Non-hydric
MoC	Monteola clay, 3 to 5 percent slopes	No
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	No
SeC	Sarnosa fine sandy loam, 2 to 5 percent slopes	No
ShC	Schattel clay loam, 2 to 5 percent slopes	No
W	Water	No
WaC	Weesatche fine sandy loam, 2 to 5 percent slopes	No

4.4 Vegetation

4.4.1 Historically Mapped and Documented Vegetation Types

According to TPWD’s Ecoregion data, the Study Area falls within the East Central Texas Plains Level 3 Ecoregion and the Southern Post Oak Savanna Level 4 Ecoregion (TPWD 2011).

The Study Area lies within one Land Resource Region (LRR I) and one Major Land Resource Area (MLRA 83A). LRR I denotes the Southwest Plateaus and Plains Range and Cotton Region, and vegetation consists mainly of mesquite and juniper savannas. MLRA 83A is the Northern Rio Grande Plain which can be characterized as areas of grass, cropland, and pasture interspersed with tall, thick shrubs on nearly level and gently rolling hills and valleys. More information on LRR I and MLRA 83A can be read within USDA’s Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, Handbook 296 (NRCS 2022).

According to TPWD’s Ecological Mapping System of Texas (EMST), the vegetation mapped within the Study Area includes Central Texas: Floodplain Live Oak Forest; Central Texas: Floodplain Hardwood Forest; Central Texas: Floodplain Deciduous Shrubland; Central Texas: Floodplain Herbaceous Vegetation; Central Texas: Riparian Herbaceous Vegetation; South

Texas: Clayey Mesquite Mixed Shrubland; South Texas: Clayey Blackbrush Mixed Shrubland; South Texas: Sandy Mesquite Woodland and Shrubland; South Texas: Sandy Mesquite Dense Shrubland; South Texas: Sandy Mesquite Savanna Grassland; Barren; Marsh; Native Invasive: Deciduous Woodland; South Texas: Disturbance Grassland; Row Crops; Urban Low Intensity; and Open Water (**Appendix A, Figure 4**) (Elliot et al 2014).

4.4.2 Existing Conditions

Field investigations documented vegetation types throughout the Study Area. The majority of the Study Area consisted of undeveloped grassland/pasture and riparian woodlands. Common species observed within the tree and sapling/shrub stratum include cedar elm (*Ulmus crassfolia*), sugarberry (*Celtis laevigata*), palo verde (*Parkinsonia aculeata*), mesquite (*Prosopis glandulosa*), and black willow (*Salix nigra*). Common herbaceous species observed within the Study Area include salvia species (Salvia spp.), spotted bee balm (*Monarda punctata*), common sunflower (*Helianthus annuus*), milkweed species (*Asclepias* spp.), prickly pear cactus (*Opuntia engelmannii*), and bermuda grass (*Cynodon dactylon*). Vines observed within the Study Area include grape vine (*Vitis vinifera*). See **Appendix B** for representative photographs of the Study Area.

5. Federal and State Listed T&E Species Review

A literature search and database review were conducted to identify federal and state listed T&E species of concern with the potential to occur within the Study Area. Species lists were accessed through the USFWS ECOS IPaC tool and through TPWD's Rare, Threatened, and Endangered Species of Texas (**Appendix C**). Additionally, the literature search included a review of studies and reports related to the ecology of the area.

One species, the whooping crane (*Grus americana*), was listed by the USFWS and TPWD as federally and state endangered in Karnes County) (USFWS 2023a; TPWD 2023a).

Two species, the piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) were listed as federally and state threatened by the USFWS and TPWD in Karnes County (USFWS 2023a; TPWD 2023a).

One species, the monarch butterfly (*Danaus plexippus*) was listed by the USFWS as federal candidate species in Karnes County. However, candidate species receive no statutory protection under the ESA (USFWS 2023a).

Eight species were listed as only state threatened in Karnes County by TPWD. These include sheep frog (*Hypopachus variolosus*), swallow-tailed kite (*Elanoides forficatus*), white-faced ibis (*Plegadis chihi*), white-tailed hawk (*Buteo albicaudatus*), wood stork (*Mycteria americana*), white-nosed coati (*Nasua narica*), Texas horned lizard (*Phrynosoma cornutum*), and Texas tortoise (*Gopherus berlandieri*) (TPWD 2023a).

One species, the ocelot (*Leopardus pardalis),* was listed by TPWD as only state endangered and one species, the black rail (*Laterallus jamaicensis*) was listed by TPWD as only state threatened in Karnes County, Texas (TPWD 2023a).

A summary of federal and state listed species for Karnes County, their habitat requirements, and suitable habitat determinations are shown in **Table 2**.

Table 2. Listed Threatened and Endangered Species in Karnes County, Texas

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
Amphibians						
Sheep Frog	*Hypopachus variolosus*	NL	T	Terrestrial and aquatic: Predominantly grassland and savanna; largely fossorial in areas with moist microclimates.	Yes	Moist microclimates are present in the Study Area around the aquatic features; therefore, suitable habitat may be present for this species.
Birds						
Black Rail	*Laterallus jamaicensis*	NL**	T	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh; nest usually hidden in marsh grass or at the base of *Salicornia* spp.	No	Species may occur as a migrant/transient; however, marshes are not present within the Study Area. In addition, the Study Area is located outside of this species known breeding range.
Piping Plover	*Charadrius melodus*	T	T	Sand and gravel shores of rivers and lakes. Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore islands.	No	Species may occur as a migrant/transient; however, no sand or gravel shores of rivers or lakes are present within the Study Area.
Red Knot	*Calidris canutus rufa*	T	T	Prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters.	No	Species may occur as a migrant/transient; however, coastal/bay shorelines and mudflats are not present within the Study Area.
Swallow-tailed Kite	*Elanoides forficatus*	NL	T	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees.	No	Species may occur as a migrant/transient; however, the Study Area is located outside of this species known breeding range.

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
White-faced Ibis	*Plegadis chihi*	NL	T	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.	No	Species may occur as a migrant/transient; however, freshwater marshes, sloughs, irrigated rice fields, and brackish habitats are not present within the Study Area.
White-tailed Hawk	*Buteo albicaudatus*	NL	T	Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May.	Yes	Inland prairies and savannas are present in the Study Area; therefore, suitable habitat may be present for this species.
Whooping Crane	*Grus americana*	E	E	Small ponds, marshes, and flooded grain fields for both roosting and foraging. Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.	No	Species may occur as a rare migrant/transient; however, marshes and flooded grain fields are not present within the Study Area.
Wood Stork	*Mycteria americana*	NL	T	Prefers to nest in large tracts of baldcypress (*Taxodium distichum*) or red mangrove (*Rhizophora mangle*); forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.	No	Species may occur as a migrant/transient; however, no large tracts of baldcypress or red mangrove are present within the Study Area. In addition, this species currently does not nest in Texas.

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
Insects						
Monarch Butterfly	*Danaus plexippus*	C	NL	Monarch butterflies are habitat generalists but require milkweed species (*Asclepias* spp.) as larval hosts and a nectar source for adults (TPWD 2016). Monarch butterflies complete a multi-generational migration from Mexico northward starting in Spring. Monarch butterflies fly to Texas from Mexico beginning in March and lay their eggs on milkweed species present in the state. Those monarch butterflies have completed their journey and reproduction. The eggs and resulting larvae present on milkweeds in Texas then use the milkweed as a food source to prepare for metamorphosis to their butterfly form. Those butterflies then mate and continue to lay eggs on milkweed species as they move north for the summer. In the fall, monarch butterflies start moving into the panhandle of Texas during migration to overwintering grounds in Mexico. In Texas, monarch butterflies and their eggs and larvae are present from March-June and September- October (TPWD 2016).	Yes	Milkweed species (*Asclepias spp.*), a host plant for this species, as well as other nectar plants were observed throughout the Study Area. This species is a habitat generalist and suitable habitat may be present throughout the Study Area where nectar plants and/or various species of host plants in the milkweed (*Asclepiadaceae*) family occur.
Mammals						
Ocelot	*Leopardus pardalis*	NL**	E	Restricted to mesquite-thorn scrub and live oak mottes; avoids open areas. Dense mixed brush below four feet; thorny shrublands; dense chaparral thickets; breeds and raises young June-November.	No	No mesquite-thorn scrub, live oak mottes, or dense brush below four feet are present in the Study Area.
White-nosed Coati	*Nasua narica*	NL	T	Woodlands, riparian corridors, and canyons. Most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade.	Yes	Woodlands and riparian corridors are present in the Study Area; therefore, suitable habitat may be present for this species.
Reptiles						
Texas Horned Lizard	*Phrynosoma cornutum*	NL	T	Arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive.	No	No suitable habitat, including sparse vegetation, scattered brush, or scrubby trees in sandy or rocky areas, is present within the Study Area.

Common Name	Scientific Name	Listing Status		Habitat Requirements / Species Description	Suitable Habitat within Study Area	Determination
		Federal	State*			
Texas Tortoise	*Gopherus berlandieri*	NL	T	Terrestrial: Open scrub woods, arid brush, lomas, grass-cactus association; often in areas with sandy well-drained soils. When inactive occupies shallow depressions dug at base of bush or cactus; sometimes in underground burrow or under object. Eggs are laid in nests dug in soil near or under bushes.	No	No suitable habitat, including open scrub woods or arid brush on sandy well-drained soils are present within the Study Area.

NL- Not Listed, T- Threatened, E- Endangered, C-Candidate

Source: USFWS 2023a; TPWD 2023a

**Status as returned in a county specific query, not a statewide listing*

***Species are federally protected; however, are not included on the USFWS IPaC list for the focused Study Area and therefore, not considered as part of the federal analysis within this evaluation.*

Four listed species have the potential to occur within the Study Area: the sheep frog, white-tailed hawk, monarch butterfly, and white-nosed coati. These species are described in further detail below.

Sheep Frog

Suitable habitat for the state threatened sheep frog was identified around the aquatic features that contribute to the presence of moist microhabitats within the Study Area. Based on field investigations, moist microhabitats were abundant surrounding Bucker Creek and an unnamed intermittent stream as they enter the southwestern portion of the Study Area and discharge into the Escondido Creek FRS No. 12 reservoir. Therefore, suitable habitat for the sheep frog may be present within these portions of the Study Area.

White-tailed Hawk

Suitable habitat for the state threatened white-tailed hawk was identified in the grasslands and savannas throughout the Study Area. Based on field investigations, grasslands and savannas are present to the northwest and southeast of the Escondido Creek FRS No. 12 reservoir as well as east of the dam structure within the Study Area. Therefore, suitable habitat for the white-tailed hawk may be present within the Study Area.

Monarch Butterfly

The monarch butterfly is currently considered a candidate species for listing by USFWS and does not yet have federal protection; however, habitat was assessed as a matter of due diligence. Monarch butterflies are habitat generalists but require milkweed species as larval hosts and a nectar source for adults. The presence of milkweed indicates suitable monarch butterfly habitat. In Texas, monarch butterflies and their eggs and larvae are present from March-June and September-October (TPWD 2016). Milkweeds and nectar plants are known to occur along roadsides and in other disturbed and open areas. Milkweed species were observed throughout the Study Area. Therefore, suitable habitat for the monarch butterfly may be present throughout the Study Area where milkweed and nectar plants are present.

White-nosed Coati

Suitable habitat for the state threatened white-nosed coati was identified in the woodland and riparian corridors in the southwestern portion of the Study Area. Based on field investigations, woodlands and riparian corridors were observed along Bucker Creek and an unnamed stream as they enter the southwestern portion of the Study Area. Therefore, suitable habitat for the white-nosed coati may be present within the Study Area.

5.1 TXNDD Element Occurrence Review and Critical Habitat

A review of USFWS Critical Habitat was performed for the vicinity of the Study Area. No critical habitat for federally listed species was mapped within or immediately adjacent to the Study Area (USFWS 2023b).

Additionally, TPWD's TXNDD was reviewed on June 20, 2023 to assess if any rare and/or listed endangered and threatened species have been previously observed within or adjacent to the Study Area. No elements of occurrence (EOs) were reported within the limits of the Study Area. Six EO's for the Texas horned lizard, a state threatened species; two EO's for the Tamaulipan spot-tailed earless lizard (*Holbrookia subcaudalis*); and one EO for the Burridge greenthread (*Thelesperma burridgeanum*) were reported within five miles of the Study Area (**Appendix A, Figure 5**). No other EO's were reported within five miles of the Study Area (TPWD 2023b). The EO records for the Texas horned lizard ranged from 3.9 to 4.7 miles from the Study Area and were primarily identified within the cities of Karnes City and Kenedy.

No recorded EO's for species does not mean that there is an absence of endangered, threatened, or rare species and should not be solely used for presence/absence determinations.

6. Conclusions

This assessment found that suitable habitat for one federal candidate species, the monarch butterfly, is present within the Study Area and that this species may be affected by Project activities. In addition, suitable habitat for three state threatened species including the sheep frog, white-tailed hawk, and white-nosed coati may be found within the Study Area. No additional federal or stated listed T&E species were determined to have suitable habitat within the Study Area and are not likely to be impacted by the proposed Project. Coordination with USFWS and TPWD may be required to avoid potential impacts to protected species and comply with general requirements under federal and state protected species regulations.

No USFWS Critical Habitat was mapped within the Study Area. Additionally, no TXNDD EO's for federal or state listed T&E species were recorded within the Study Area. Six EO's for the Texas horned lizard were recorded between 3.9 and 4.7 miles from the Study Area.

Depending on the timing of construction and amount of tree/shrub clearing required for construction activities, migratory birds could potentially be impacted by the Project. If clearing of trees and shrubs is necessary, then AECOM recommends conducting nest surveys prior to clearing activities. In accordance with the MBTA, construction activities and any vegetation clearing should be conducted outside peak-nesting seasons (March-August) to avoid any adverse effects to migratory birds and their habitats. Should construction and vegetation clearing occur from March through August, active bird nest surveys should be conducted by a biologist no more than 5 days prior to construction.

7. References

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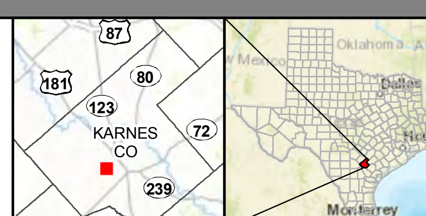
Appendix A Figures

Study Area



Project Location Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N
W E
S

0 200 400
Feet

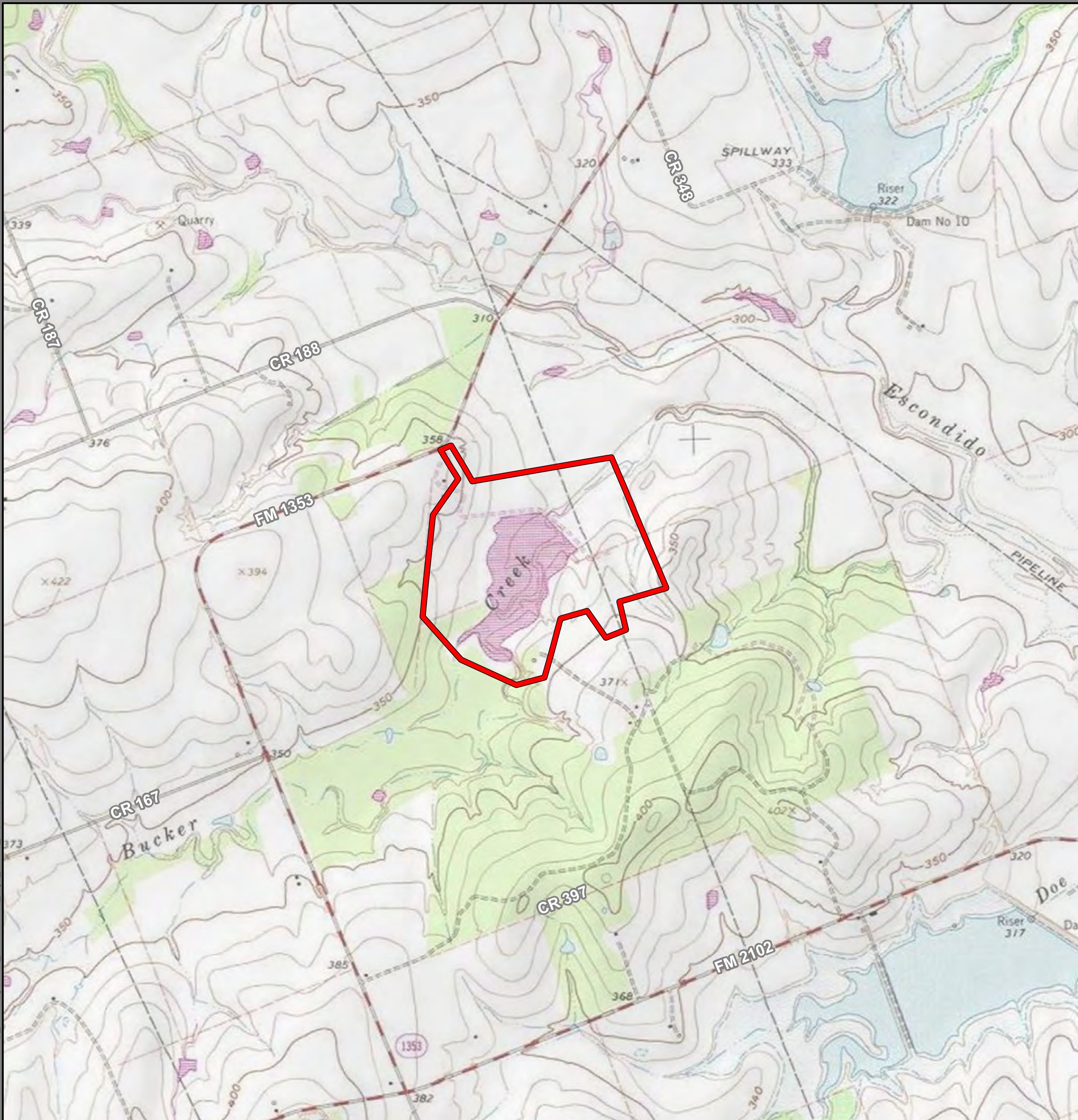
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

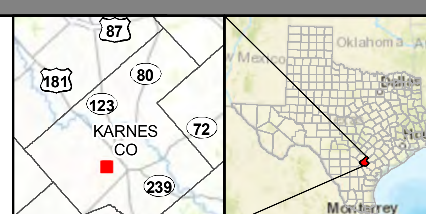
July 2024

Figure 1

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig1_ProjectLocationMap.mxd



Study Area



USGS Topographic Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N
W E
S
0 1000 2000
Feet

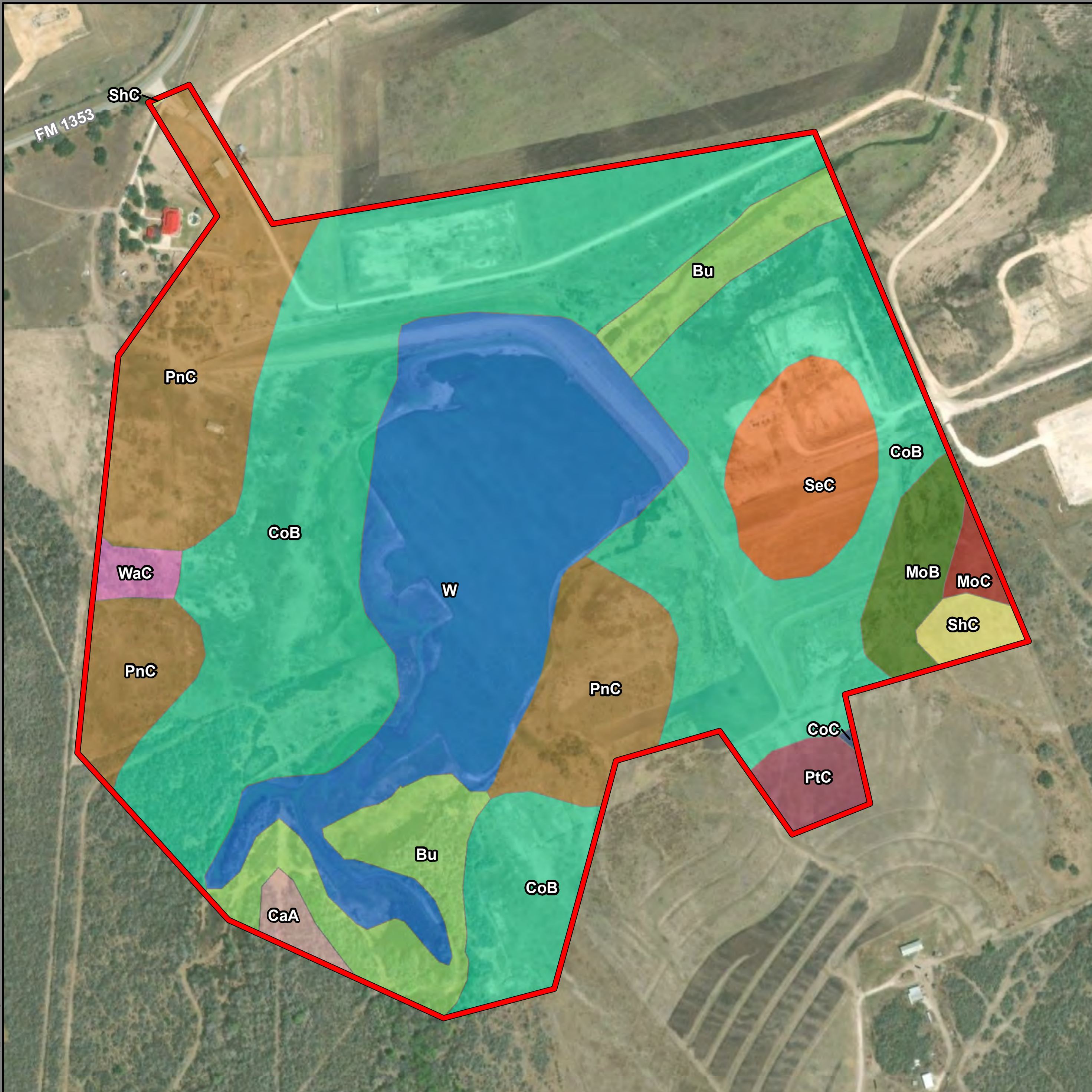
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: USGS 7.5-minute Topographic Maps: Lenz Quadrangle

AECOM

July 2024

Figure 2

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig2_USGS_TopoMap.mxd



Study Area

NRCS Soil Types

- Bu - Buchel clay, 0 to 1 percent slopes, occasionally flooded
- CaA - Clareville clay loam, 0 to 1 percent slopes
- CoB - Coy clay loam, 1 to 3 percent slopes
- CoC - Coy clay loam, 3 to 5 percent slopes
- MoB - Monteola clay, 1 to 3 percent slopes
- MoC - Monteola clay, 3 to 5 percent slopes
- PnC - Pernitas sandy clay loam, 2 to 5 percent slopes
- PtC - Pettus loam, 2 to 5 percent slopes
- SeC - Sarnosa fine sandy loam, 2 to 5 percent slopes
- ShC - Schattel clay loam, 2 to 5 percent slopes
- W - Water
- WaC - Weesatche fine sandy loam, 2 to 5 percent slopes

NRCS Soils Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N W E S

0 200 400
Feet

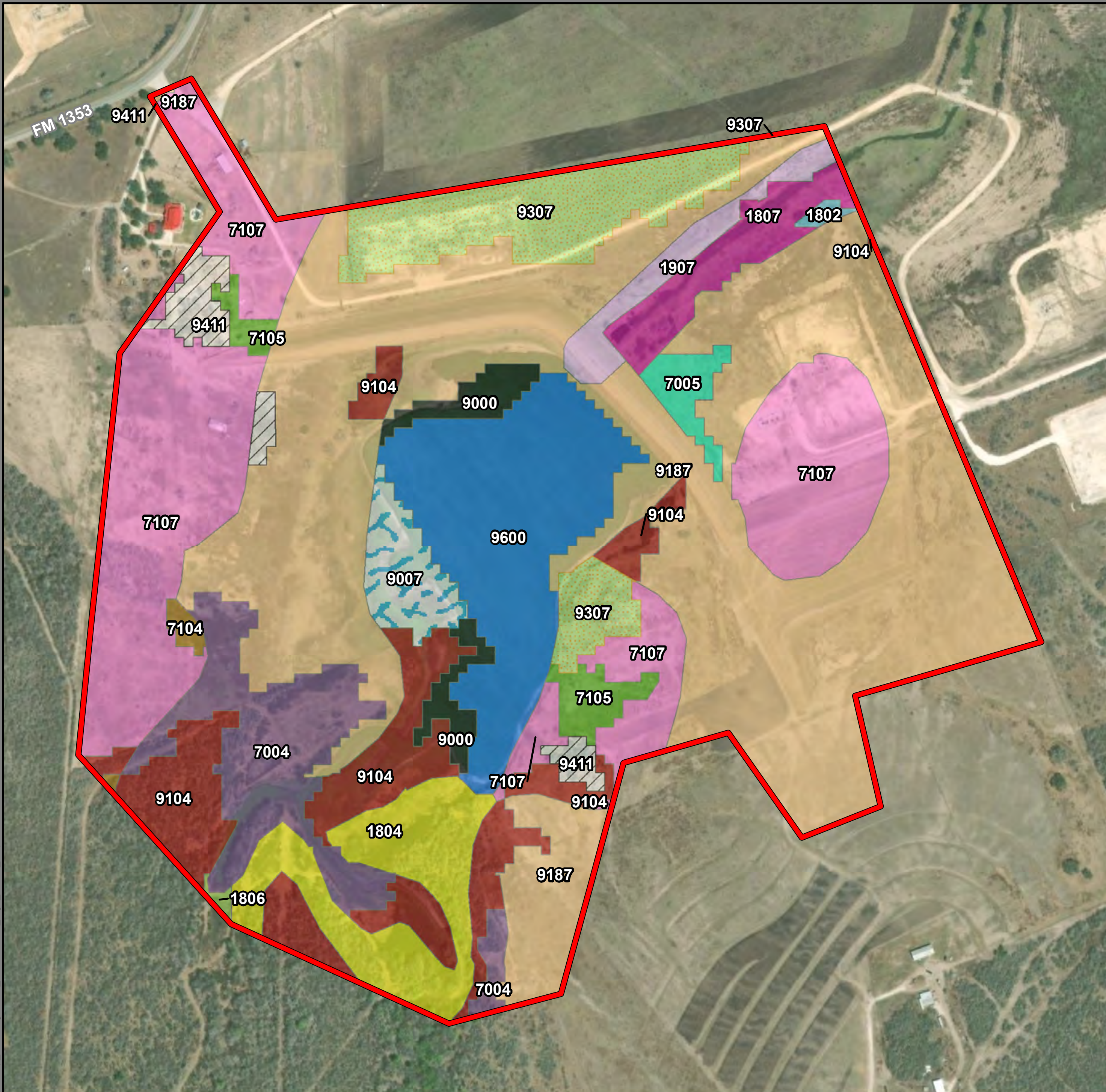
Data Sources: Soils - USDA NRCS 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 3

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig3_NRCS_SoilsMap.mxd



Study Area

EMST Vegetation Types

- 1802 - Central Texas: Floodplain Live Oak Forest
- 1804 - Central Texas: Floodplain Hardwood Forest
- 1806 - Central Texas: Floodplain Deciduous Shrubland
- 1807 - Central Texas: Floodplain Herbaceous Vegetation
- 1907 - Central Texas: Riparian Herbaceous Vegetation
- 7004 - South Texas: Clayey Mesquite Mixed Shrubland
- 7005 - South Texas: Clayey Blackbrush Mixed Shrubland
- 7104 - South Texas: Sandy Mesquite Woodland and Shrubland
- 7105 - South Texas: Sandy Mesquite Dense Shrubland
- 7107 - South Texas: Sandy Mesquite Savanna Grassland
- 9000 - Barren
- 9007 - Marsh
- 9104 - Native Invasive: Deciduous Woodland
- 9187 - South Texas: Disturbance Grassland
- 9307 - Row Crops
- 9411 - Urban Low Intensity
- 9600 - Open Water

Ecological Mapping Systems of Texas (EMST) Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N W E S

0 200 400
Feet

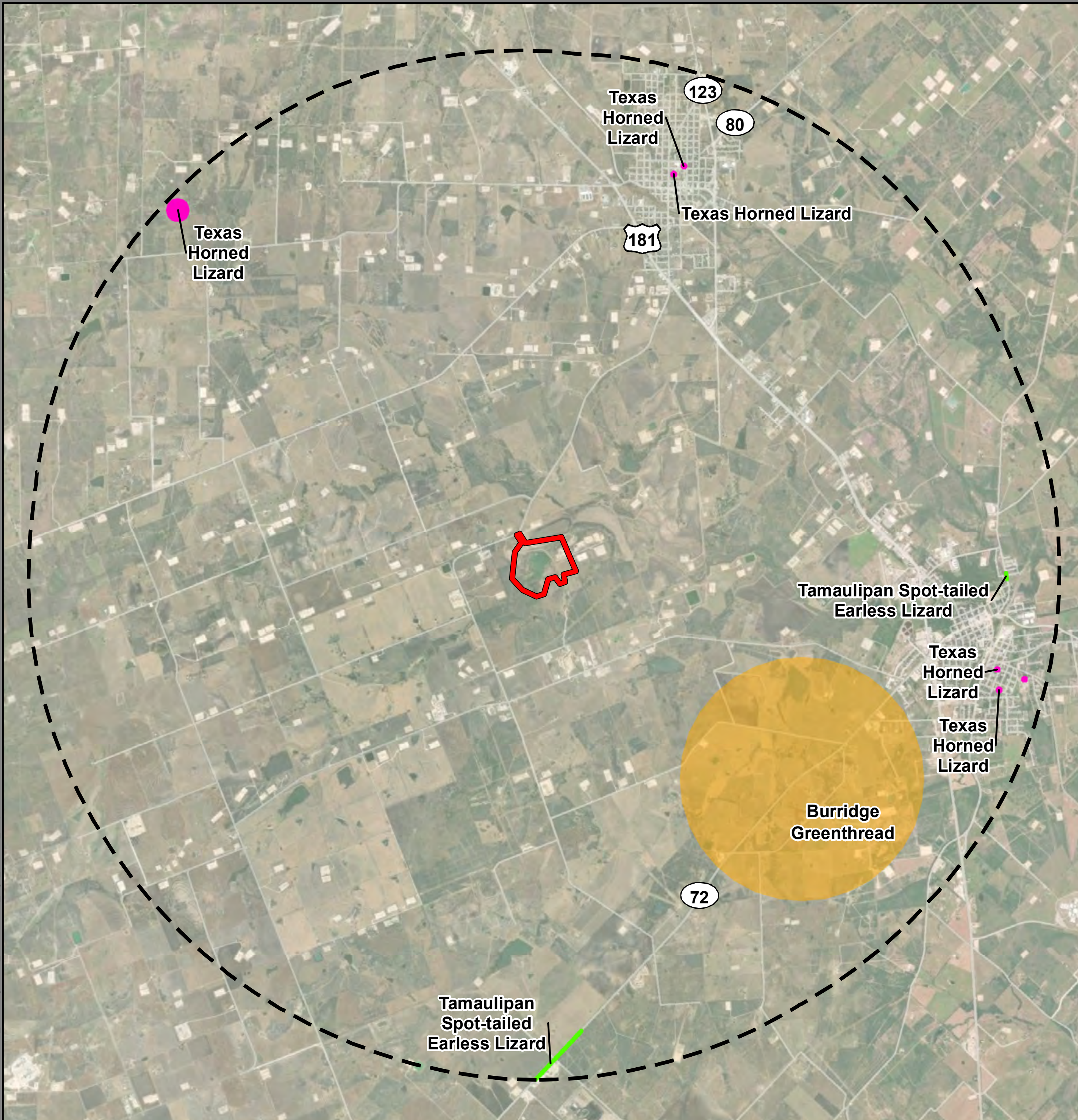
Data Sources: EMST - TPWD 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 4

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig4_EMST_Map.mxd



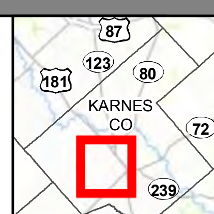
Study Area

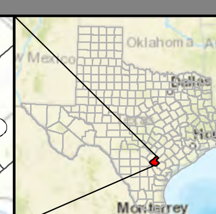
TXNDD Element Occurrence Record

Burridge Greenthread

Tamaulipan Spot-tailed Earless Lizard

Texas Horned Lizard





Texas Natural Diversity Database (TXNDD) Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N W E S

0 0.5 1 1.5
Miles

Data Sources: TXNDD - TPWD 6/26/2023; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 5

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig5_TXNDD_Map.mxd

Appendix B Photographic Log

AECOM | **PHOTOGRAPHIC LOG**

Site Name: Escondido Creek Watershed FRS No. 12	**Site Location:** Karnes County, TX	**Project No.** 60707508

Photo No. 1

Date: 06/14/23

Direction Photo Taken:

Southwest

Description:

View of Escondido Creek Flood Retarding Structure (FRS) No. 12 reservoir and adjacent vegetation in the central portion of the Study Area to the south of the reservoir.

Photo No. 2

Date: 06/13/23

Direction Photo Taken:

Southeast

Description:

View of streams that flow into the Escondido Creek FRS No. 12 reservoir in the southwestern portion of the Study Area.

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Escondido Creek Watershed FRS No. 12	Karnes County, TX	60707508

Photo No. 3

Date: 06/13/23

Direction Photo Taken:

Northeast

Description:

View of Escondido Creek FRS No. 12 reservoir and adjacent land use within the central portion of the Study Area to the west of the reservoir.

Photo No. 4

Date: 06/13/23

Direction Photo Taken:

Southwest

Description:

View of Escondido Creek FRS No. 12 reservoir.

PHOTOGRAPHIC LOG		
Site Name: Escondido Creek Watershed FRS No. 12	**Site Location:** Karnes County, TX	**Project No.** 60707508

Photo No. 5	**Date:** 06/13/23
Direction Photo Taken: Southeast	
Description: View of open pasture on the backside of the Escondido Creek FRS No. 12 dam structure in the southeastern portion of the Study Area. Photo taken from dam structure.	

Photo No. 6	**Date:** 06/13/23
Direction Photo Taken: Southwest	
Description: View of grasslands adjacent to the Escondido Creek FRS No. 12 reservoir in the southeastern portion of the Study Area. Photo taken from dam structure.	

PHOTOGRAPHIC LOG

Site Name: Escondido Creek Watershed FRS No. 12	Site Location: Karnes County, TX	Project No. 60707508

Photo No. 7	Date: 06/13/23
Direction Photo Taken: Northwest	
Description: View of Escondido Creek FRS No. 12 dam structure and reservoir within the Study Area. Photo take from top of dam structure.	

Appendix C Federal and State Database Review

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Karnes County, Texas

Local office

Texas Coastal & Central Plains Esfo

(281) 286-8282
(281) 488-5882

MAILING ADDRESS
17629 El Camino Real, Suite 211
Houston, TX 77058-3051

PHYSICAL ADDRESS
17629 El Camino Real
Houston, TX 77058-3051

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Birds

NAME	STATUS
Piping Plover Charadrius melodus This species only needs to be considered if the following condition applies: • Wind related projects within migratory route. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/6039	Threatened
Rufa Red Knot Calidris canutus rufa Wherever found This species only needs to be considered if the following condition applies: • Wind Related Projects Within Migratory Route There is **proposed** critical habitat for this species. https://ecos.fws.gov/ecp/species/1864	Threatened

Whooping Crane Grus americana — Endangered

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/758

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

Bald & Golden Eagles

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are likely bald eagles present in your project area. For additional information on bald eagles, refer to Bald Eagle Nesting and Sensitivity to Human Activity

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Jul 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

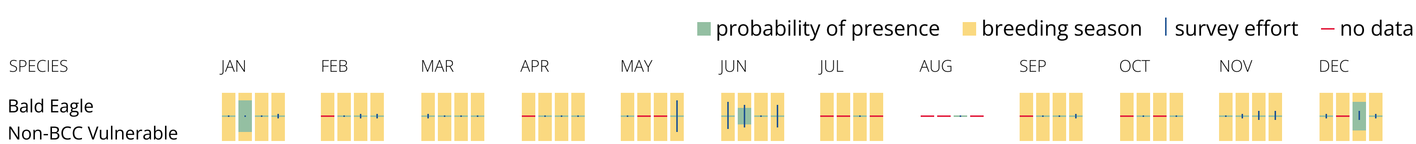
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply). To see a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs of bald and golden eagles in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur. Please contact your local Fish and Wildlife Service Field Office if you have questions.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/ documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Jul 31

Chimney Swift *Chaetura pelagica*
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
Breeds Mar 15 to Aug 25

Lesser Yellowlegs *Tringa flavipes*
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9679
Breeds elsewhere

Little Blue Heron *Egretta caerulea*
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
Breeds Mar 10 to Oct 15

Pectoral Sandpiper *Calidris melanotos*
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
Breeds elsewhere

Prairie Loggerhead Shrike *Lanius ludovicianus excubitorides*
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/8833
Breeds Feb 1 to Jul 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

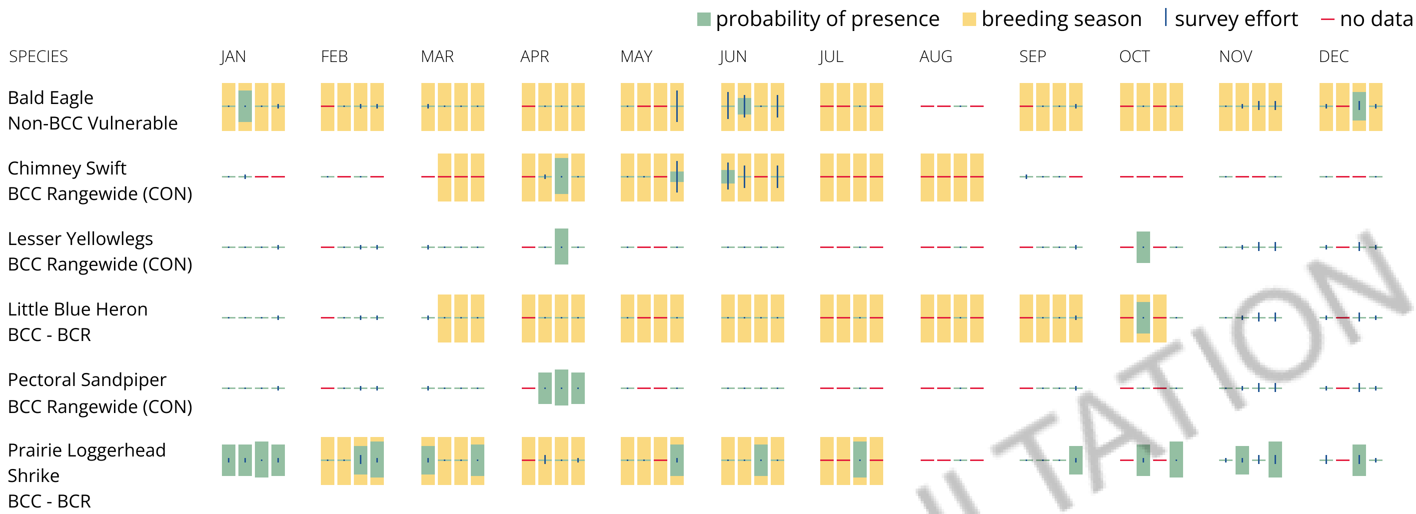
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

PEM1Ah

LAKE

L1UBHh
L2UBFh

RIVERINE

R4SBC

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Last Update: 9/1/2023

KARNES COUNTY

AMPHIBIANS

sheep frog *Hypopachus variolosus*

Terrestrial and aquatic: Predominantly grassland and savanna; largely fossorial in areas with moist microclimates.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S4

Strecker's chorus frog *Pseudacris streckeri*

Terrestrial and aquatic: Wooded floodplains and flats, prairies, cultivated fields and marshes. Likes sandy substrates.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3

Woodhouse's toad *Anaxyrus woodhousii*

Terrestrial and aquatic: A wide variety of terrestrial habitats are used by this species, including forests, grasslands, and barrier island sand dunes. Aquatic habitats are equally varied.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: SU

BIRDS

bald eagle *Haliaeetus leucocephalus*

Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3B,S3N

black rail *Laterallus jamaicensis*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mat of previous years dead grasses; nest usually hidden in marsh grass or at base of Salicornia

Federal Status: T State Status: T SGCN: Y

Endemic: N Global Rank: G3 State Rank: S2

Franklin's gull *Leucophaeus pipixcan*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. This species is only a spring and fall migrant throughout Texas. It does not breed in or near Texas. Winter records are unusual consisting of one or a few individuals at a given site (especially along the Gulf coastline). During migration, these gulls fly during daylight hours but often come down to wetlands, lake shore, or islands to roost for the night.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S2N

KARNES COUNTY

BIRDS

lark bunting *Calamospiza melanocorys*

Overall, it's a generalist in most short grassland settings including ones with some brushy component plus certain agricultural lands that include grain sorghum. Short grasses include sideoats and blue gramas, sand dropseed, prairie junegrass (Koeleria), buffalograss also with patches of bluestem and other mid-grass species. This bunting will frequent smaller patches of grasses or disturbed patches of grasses including rural yards. It also uses weedy fields surrounding playas. This species avoids urban areas and cotton fields.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S4B

mountain plover *Charadrius montanus*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G3 State Rank: S2

piping plover *Charadrius melodus*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore islands. Also spoil islands in the Intracoastal Waterway. Based on the November 30, 1992 Section 6 Job No. 9.1, Piping Plover and Snowy Plover Winter Habitat Status Survey, algal flats appear to be the highest quality habitat. Some of the most important aspects of algal flats are their relative inaccessibility and their continuous availability throughout all tidal conditions. Sand flats often appear to be preferred over algal flats when both are available, but large portions of sand flats along the Texas coast are available only during low-very low tides and are often completely unavailable during extreme high tides or strong north winds. Beaches appear to serve as a secondary habitat to the flats associated with the primary bays, lagoons, and inter-island passes. Beaches are rarely used on the southern Texas coast, where bayside habitat is always available, and are abandoned as bayside habitats become available on the central and northern coast. However, beaches are probably a vital habitat along the central and northern coast (i.e. north of Padre Island) during periods of extreme high tides that cover the flats. Optimal site characteristics appear to be large in area, sparsely vegetated, continuously available or in close proximity to secondary habitat, and with limited human disturbance.

Federal Status: LT State Status: T SGCN: Y

Endemic: N Global Rank: G3 State Rank: S2N

rufa red knot *Calidris canutus rufa*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore. Bolivar Flats in Galveston County, sandy beaches Mustang Island, few on outer coastal and barrier beaches, tidal mudflats and salt marshes.

Federal Status: LT State Status: T SGCN: Y

Endemic: N Global Rank: G4T2 State Rank: S2N

KARNES COUNTY

BIRDS

Sprague's pipit *Anthus spragueii*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Habitat during migration and in winter consists of pastures and weedy fields (AOU 1983), including grasslands with dense herbaceous vegetation or grassy agricultural fields.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G3G4 State Rank: S3N

swallow-tailed kite *Elanoides forficatus*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S2B

western burrowing owl *Athene cunicularia hypugaea*

Open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4T4 State Rank: S2

white-faced ibis *Plegadis chihi*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; currently confined to near-coastal rookeries in so-called hog-wallow prairies. Nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S4B

white-tailed hawk *Buteo albicaudatus*

Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G4G5 State Rank: S4B

whooping crane *Grus americana*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Small ponds, marshes, and flooded grain fields for both roosting and foraging. Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.

Federal Status: LE State Status: E SGCN: Y

Endemic: N Global Rank: G1 State Rank: S1S2N

KARNES COUNTY

BIRDS

wood stork *Mycteria americana*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers to nest in large tracts of baldcypress (Taxodium distichum) or red mangrove (Rhizophora mangle); forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G4 State Rank: SHB,S2N

FISH

river darter *Percina shumardi*

In Texas limited to eastern streams including Red River southward to the Neches River, and a disjunct population in the Guadalupe and San Antonio river systems east of the Balcones Escarpment. Confined to large rivers and lower parts of major tributaries; usually found in deep chutes and riffles where current is swift and bottom composed of coarse gravel or rock.

Federal Status: State Status: SGCN: Y

Endemic: Global Rank: G5 State Rank: S4

INSECTS

Manfreda giant-skipper *Stallingsia maculosus*

Most skippers are small and stout-bodied; name derives from fast, erratic flight; at rest most skippers hold front and hind wings at different angles; skipper larvae are smooth, with the head and neck constricted; skipper larvae usually feed inside a leaf shelter and pupate in a cocoon made of leaves fastened together with silk

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G1 State Rank: S1

MAMMALS

big free-tailed bat *Nyctinomops macrotis*

Habitat data sparse but records indicate that species prefers to roost in crevices and cracks in high canyon walls, but will use buildings, as well; reproduction data sparse, gives birth to single offspring late June-early July; females gather in nursery colonies; winter habits undetermined, but may hibernate in the Trans-Pecos; opportunistic insectivore

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3

cave myotis bat *Myotis velifer*

Colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4G5 State Rank: S2S3

KARNES COUNTY

MAMMALS

eastern red bat *Lasiurus borealis*

Red bats are migratory bats that are common across Texas. They are most common in the eastern and central parts of the state, due to their requirement of forests for foliage roosting. West Texas specimens are associated with forested areas (cottonwoods). Also common along the coastline. These bats are highly mobile, seasonally migratory, and practice a type of "wandering migration". Associations with specific habitat is difficult unless specific migratory stopover sites or wintering grounds are found. Likely associated with any forested area in East, Central, and North Texas but can occur statewide.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G3G4 State Rank: S4

eastern spotted skunk *Spilogale putorius*

Generalist; open fields prairies, croplands, fence rows, farmyards, forest edges & woodlands. Prefer wooded, brushy areas & tallgrass prairies. S.p. ssp. interrupta found in wooded areas and tallgrass prairies, preferring rocky canyons and outcrops when such sites are available.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4 State Rank: S1S3

hoary bat *Lasiurus cinereus*

Hoary bats are highly migratory, high-flying bats that have been noted throughout the state. Females are known to migrate to Mexico in the winter, males tend to remain further north and may stay in Texas year-round. Commonly associated with forests (foliage roosting species) but are found in unforested parts of the state and lowland deserts. Tend to be captured over water and large, open flyways.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G3G4 State Rank: S3

long-tailed weasel *Mustela frenata*

Includes brushlands, fence rows, upland woods and bottomland hardwoods, forest edges & rocky desert scrub. Usually live close to water.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S5

mountain lion *Puma concolor*

Generalist; found in a wide range of habitats statewide. Found most frequently in rugged mountains & riparian zones.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S2S3

northern yellow bat *Lasiurus intermedius*

Occurs mainly along the Gulf Coast but inland specimens are not uncommon. Prefers roosting in spanish moss and in the hanging fronds of palm trees. Common where this vegtation occurs. Found near water and forages over grassy, open areas. Males usually roost solitarily, whereas females roost in groups of several individuals.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S4

KARNES COUNTY

MAMMALS

ocelot *Leopardus pardalis*

Restricted to mesquite-thorn scrub and live-oak mottes; avoids open areas. Dense mixed brush below four feet; thorny shrublands; dense chaparral thickets; breeds and raises young June-November.

Federal Status: LE State Status: E SGCN: Y

Endemic: N Global Rank: G4 State Rank: S1

swamp rabbit *Sylvilagus aquaticus*

Primarily found in lowland areas near water including: cypress bogs and marshes, floodplains, creeks and rivers.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S5

tricolored bat *Perimyotis subflavus*

Forest, woodland and riparian areas are important. Caves are very important to this species.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G3G4 State Rank: S2

western hog-nosed skunk *Conepatus leuconotus*

Habitats include woodlands, grasslands & deserts, to 7200 feet, most common in rugged, rocky canyon country; little is known about the habitat of the ssp. telmalestes

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4 State Rank: S4

western spotted skunk *Spilogale gracilis*

Brushy canyons, rocky outcrops (rimrock) on hillsides and walls of canyons. In semi-arid brushlands in U.S., in wet tropical forests in Mexico. When inactive or bearing young, occupies den in rocks, burrow, hollow log, brush pile, or under building.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S5

white-nosed coati *Nasua narica*

Woodlands, riparian corridors and canyons.Most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade

Federal Status: State Status: T SGCN: Y

Endemic: N Global Rank: G5 State Rank: S1

REPTILES

eastern box turtle *Terrapene carolina*

Terrestrial: Eastern box turtles inhabit forests, fields, forest-brush, and forest-field ecotones. In some areas they move seasonally from fields in spring to forest in summer. They commonly enters pools of shallow water in summer. For shelter, they burrow into loose soil, debris, mud, old stump holes, or under leaf litter. They can successfully hibernate in sites that may experience subfreezing temperatures.

Federal Status: State Status: SGCN: Y

KARNES COUNTY

REPTILES

Endemic: N | Global Rank: G5 | State Rank: S3

slender glass lizard *Ophisaurus attenuatus*

Terrestrial: Habitats include open grassland, prairie, woodland edge, open woodland, oak savannas, longleaf pine flatwoods, scrubby areas, fallow fields, and areas near streams and ponds, often in habitats with sandy soil.

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: G5 | State Rank: S3

Tamaulipan spot-tailed earless lizard *Holbrookia subcaudalis*

Terrestrial: Habitats include moderately open prairie-brushland regions, particularly fairly flat areas free of vegetation or other obstructions (e.g., open meadows, old and new fields, graded roadways, cleared and disturbed areas, prairie savanna, and active agriculture including row crops); also, oak-juniper woodlands and mesquite-prickly pear associations (Axtell 1968, Bartlett and Bartlett 1999).

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: GNR | State Rank: S2

Texas horned lizard *Phrynosoma cornutum*

Terrestrial: Open habitats with sparse vegetation, including grass, prairie, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive. Occurs to 6000 feet, but largely limited below the pinyon-juniper zone on mountains in the Big Bend area.

Federal Status: | State Status: T | SGCN: Y

Endemic: N | Global Rank: G4G5 | State Rank: S3

Texas indigo snake *Drymarchon melanurus erebennus*

Terrestrial: Thornbush-chaparral woodland of south Texas, in particular dense riparian corridors.Can do well in suburban and irrigated croplands. Requires moist microhabitats, such as rodent burrows, for shelter.

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: G5T4 | State Rank: S4

Texas tortoise *Gopherus berlandieri*

Terrestrial: Open scrub woods, arid brush, lomas, grass-cactus association; often in areas with sandy well-drained soils. When inactive occupies shallow depressions dug at base of bush or cactus; sometimes in underground burrow or under object. Eggs are laid in nests dug in soil near or under bushes.

Federal Status: | State Status: T | SGCN: Y

Endemic: N | Global Rank: G4 | State Rank: S2

western box turtle *Terrapene ornata*

Terrestrial: Ornate or western box trutles inhabit prairie grassland, pasture, fields, sandhills, and open woodland. They are essentially terrestrial but sometimes enter slow, shallow streams and creek pools. For shelter, they burrow into soil (e.g., under plants such as yucca) (Converse et al. 2002) or enter burrows made by other species.

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: G5 | State Rank: S3

KARNES COUNTY

REPTILES

PLANTS

Billie's bitterweed *Tetraneuris turneri*

Grasslands on shallow sandy soils and caliche outcrops (Carr 2015).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S3

Burridge greenthread *Thelesperma burridgeanum*

Sandy open areas; Annual; Flowering March-Nov; Fruiting March-June

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G3	State Rank: S3

Drummond's rushpea *Hoffmannseggia drummondii*

Open areas on sandy clay; Perennial

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S3

low spurge *Euphorbia peplidion*

Occurs in a variety of vernally-moist situations in a number of natural regions; Annual; Flowering Feb-April; Fruiting March-April

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G3	State Rank: S3

Welder machaeranthera *Psilactis heterocarpa*

Grasslands , varying from midgrass coastal prairies, and open mesquite-huisache woodlands on nearly level, gray to dark gray clayey to silty soils; known locations mapped on Victoria clay, Edroy clay, Dacosta sandy clay loam over Beaumont and Lissie formations; flowering September-November

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G2G3	State Rank: S2S3

Wright's trichocoronis *Trichocoronis wrightii var. wrightii*

Most records from Texas are historical, perhaps indicating a decline as a result of alteration of wetland habitats; Annual; Flowering Feb-Oct; Fruiting Feb-Sept

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G4T3	State Rank: S2

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Investigation of Potentially Jurisdictional Waters of the United States

Escondido Creek Watershed Floodwater Retarding Structure No. 12 Supplemental Planning Project

Karnes County, Texas

Natural Resources Conservation Service

Project number: 60707508

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Delivering a better world

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1. Introduction

AECOM Technical Services, Inc. (AECOM) conducted an investigation of potentially jurisdictional waters of the United States (U.S.) (WOTUS), including wetlands, for the proposed Escondido Creek Watershed Floodwater Retarding Structure (FRS) No. 12 Supplemental Planning Project (Project). The proposed Project is located in Karnes County, approximately 4.7 miles west of Kenedy, Texas (**Appendix A, Figure 1**). A literature search and field investigations were conducted for the Project within a potential impact area encompassing approximately 173 acres (Study Area).

The purpose of the investigation was to identify and delineate water resources within the Study Area that exhibit characteristics meeting the regulatory definition of WOTUS. These resources were then assessed for their potential to be considered jurisdictional WOTUS subject to regulation by the U.S. Army Corps of Engineers (USACE) Fort Worth District under jurisdiction of Section 404 of the Clean Water Act (CWA).

2. Environmental Setting

Publicly available data was reviewed to identify potentially jurisdictional streams, waterbodies, wetlands, soil types, and vegetation types within the Study Area. Data resources reviewed included the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD), the U.S. Department of Agriculture (USDA) NRCS Web Soil Survey, USGS 7.5' quadrangle sheets, Federal Emergency Management Agency (FEMA) floodplain maps, and recent aerial photography. This data review was used to describe the site-specific information below.

2.1 Land Use

The Study Area consisted of an open water reservoir, a dam structure, a well pad, and undeveloped land. Based on the NHD, Bucker Creek, an intermittent stream; two unnamed intermittent streams; and one open water feature, Escondido Creek FRS No. 12 Reservoir, were mapped within the Study Area (USGS 2023). One residential property was identified in the northwestern portion of the Study Area (**Appendix A, Figure 1)**.

2.2 Topography

The USGS 7.5-minute quadrangle map for Lenz, TX displays the topography of the Study Area (**Appendix A, Figure 2**). Topography within the Study Area is shaped by the current reservoir and dam system, as well as Bucker Creek. The surface gradient slopes generally from west-southwest to east-northeast, with the highest elevation located along the northwestern boundary of the Study Area at approximately 360 feet above mean sea level (MSL [National Geodetic Vertical Datum of 1929]). The lowest elevation is located in Bucker Creek near the northeastern boundary of the Study Area at approximately 308 feet above MSL (USGS 1987).

2.3 Soils

According to the USDA NRCS Web Soil Survey Report, the Study Area was mapped as being underlain by 12 map units (as shown on Table 1 below and within Appendix A, Figure 3) (USDA NRCS 2021).

Table 1. NRCS Soil Mapping Units

Mapping Unit	Soil Type	Listed as Hydric by NRCS
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	Predominantly Non-hydric
CaA	Clareville clay loam, 0 to 1 percent slopes	No
CoB	Coy clay loam, 1 to 3 percent slopes	Predominantly Non-hydric
CoC	Coy clay loam, 3 to 5 percent slopes	No

Mapping Unit	Soil Type	Listed as Hydric by NRCS
MoB	Monteola clay, 1 to 3 percent slopes	Predominantly Non-hydric
MoC	Monteola clay, 3 to 5 percent slopes	No
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	No
PtC	Pettus loam, 2 to 5 percent slopes	No
SeC	Sarnosa fine sandy loam, 2 to 5 percent slopes	No
ShC	Schattel clay loam, 2 to 5 percent slopes	No
W	Water	No
WaC	Weesatche fine sandy loam, 2 to 5 percent slopes	No

2.4 Hydrology

The Study Area lies within the Lower San Antonio watershed (8-Digit Hydrologic Unit Code [HUC] 12100303) and the Headwaters Escondido Creek subwatershed (12-Digit HUC 121003030401).

The USGS NHD was reviewed to gather information on the potential locations of areas that may exhibit characteristics of WOTUS. Bucker Creek, two unnamed streams, and Escondido Creek FRS No. 12 Reservoir were identified by the NHD within the Study Area and are shown on **Appendix A, Figure 4**.

USFWS NWI maps and associated geographic information system (GIS) data were reviewed to gather information on the potential location of areas that may exhibit characteristics of wetlands. According to the NWI data, several features associated with Bucker Creek and Escondido Creek FRS No. 12 Reservoir are located within the Study Area (**Appendix A, Figure 4**). Documented NWI types include Riverine, Intermittent Streambed, Seasonally Flooded (R4SBC); Palustrine, Emergent, Persistent, Temporarily Flooded, Diked/Impounded (PEM1Ah); Lacustrine, Littoral Unconsolidated Bottom, Diked/Impounded (L2UBFh); and Lacustrine, Limnetic, Unconsolidated Bottom, Diked/Impounded (L1UBHh).

2.4.1 Floodplain

Based on a review of the FEMA digital flood insurance rate map (dFIRM) panel number 48255C0375C (effective October 19, 2010), one flood zone designation, Zone A was identified within the Study Area. Zone A is mapped in the throughout the Study Area encompassing the streams above and below the reservoir, and the reservoir area as shown in **Appendix A, Figure 4**.

Zone A includes areas that have a 1% annual chance of flooding and where no depths or base flood elevations have been determined.

2.4.2 Vegetation

Historically Mapped and Documented Vegetation Types

According to TPWD's Ecoregion data, the Study Area falls within the East Central Texas Plains Level 3 Ecoregion and the Southern Post Oak Savanna Level 4 Ecoregion (TPWD 2011).

The Study Area lies within one Land Resource Region (LRR I) and one Major Land Resource Area (MLRA 83A). LRR I denotes the Southwest Plateaus and Plains Range and Cotton Region, and vegetation consists mainly of mesquite and juniper savannas. MLRA 83A is the Northern Rio Grande Plain which can be characterized as areas of grass, cropland, and pasture interspersed with tall, thick shrubs on nearly level and gently rolling hills and valleys. More information on LRR I and MLRA 83A can be read within USDA's Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, Handbook 296 (NRCS 2022).

According to TPWD's Ecological Mapping System of Texas (EMST), the vegetation mapped within the Study Area includes Central Texas: Floodplain Live Oak Forest; Central Texas: Floodplain Hardwood Forest; Central Texas: Floodplain Deciduous Shrubland; Central Texas: Floodplain Herbaceous Vegetation; Central Texas: Riparian Herbaceous Vegetation; South Texas: Clayey Mesquite Mixed Shrubland; South Texas: Clayey Blackbrush Mixed Shrubland; South Texas: Sandy Mesquite Woodland and Shrubland; South Texas: Sandy Mesquite Dense Shrubland; South Texas: Sandy Mesquite Savanna Grassland; Barren; Marsh; Native Invasive: Deciduous Woodland; South Texas: Disturbance Grassland; Row Crops; Urban Low Intensity; and Open Water (**Appendix A, Figure 5** (Elliot et al 2014).

Existing Conditions

Field investigations documented vegetation types throughout the Study Area. The majority of the Study Area consisted of undeveloped grassland/pasture and riparian woodlands. Common species observed within the tree and sapling/shrub stratum include cedar elm (*Ulmus crassfolia*), sugarberry (*Celtis laevigata*), palo verde (*Parkinsonia aculeata*), mesquite (*Prosopis glandulosa*), and black willow (*Salix nigra*). Common herbaceous species observed within the Study Area include salvia (Salvia sp.), spotted bee balm (*Monarda punctata*), common sunflower (*Helianthus annuus*), milkweed (*Asclepias* sp.), prickly pear cactus (*Opuntia engelmannii*), and Bermuda grass (*Cynodon dactylon*). Vines observed within the Study Area include grape vine (*Vitis mustangensis*). See **Appendix B** for representative photographs of the Study Area.

3. Potentially Jurisdictional Waters of the U.S.

3.1 USACE Regulatory Authority

The USACE, acting under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899, regulates certain activities occurring within WOTUS. Under Section 404 of the CWA, authorization must be obtained from the USACE for discharges of dredged and fill material into jurisdictional WOTUS, including wetlands. The USACE's regulatory authority over WOTUS includes jurisdictional determinations and permitting under Section 404 of the CWA. In addition, under Section 10 of the Rivers and Harbors Act of 1899, the USACE regulates any work in or affecting navigable WOTUS (Environmental Protection Agency [EPA], 2015). The proposed project is regulated in accordance with the CWA by the Fort Worth District of the USACE.

3.2 Field Delineation Methodology

In accordance with the pre-2015 regulatory regime and Supreme Court's decision in *Sackett*, the USACE asserts jurisdiction over the following categories of water bodies: 1) traditionally navigable waters (TNWs); 2) wetlands adjacent to TNWs; 3) relatively permanent waters (RPWs) (i.e., waters that typically flow year round or have continuous flow at least seasonally); 4) wetlands adjacent to RPWs; intrastate lakes and ponds; and 5) impoundments of waters. Adjacent means having a continuous surface connection (USACE, 2008; EPA, 2023).

The limit of jurisdiction for non-tidal jurisdictional WOTUS extends to the ordinary high-water mark (OHWM), the limit of adjacent wetlands, or the limit of other special aquatic sites (SAS). SAS include sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes (40 CFR Section 230.10(a)(3) of the CWA). The OHWM is determined by signs of natural lines impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, presence of litter and debris, wracking, vegetation matted down, bent, or absent, sediment sorting, leaf litter disturbed or washed away, scour, deposition, multiple observed flow events, bed and banks, water staining, change in plant community, and/or other appropriate means that consider the characteristics of the surrounding areas.

The USACE's determination of a jurisdictional wetland is based on the wetland criteria of the 1987 Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987), as amended by USACE memoranda dated August 23 and 27, 1991, and March 6, 1992; Questions and Answers to the 1987 Manual (October 7, 1991); and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0, March 2010) (USACE 2010). Wetlands are based on three criteria: hydrophytic vegetation, hydric soils, and wetland hydrology. All three criteria must be present for an area to qualify as a wetland; however, some exceptions can occur in disturbed areas or in newly formed wetlands, where one indicator (such as hydric soils) might be lacking.

Field investigations were conducted on June 13, 2023. AECOM used a Trimble Geo7X Global Positioning System (GPS), capable of sub-meter accuracy, to collect geographically-referenced features, such as OHWMs, wetland boundaries, and soil station data points. The field data was then transferred to GIS software (ESRI ArcMap 10.5) to analyze identified features, calculate areas and lengths, and generate **Appendix A, Figure 6.**

Appendix B contains a detailed photo log showing conditions of each feature as documented within the Study Area.

3.3 Potentially Jurisdictional WOTUS (Non-Wetland)

Escondido Creek FRS No. 12 Reservoir (WB01) is approximately 37.16 acres in areal extent within the Study Area. This reservoir captures hydrologic flow from an unnamed stream and Bucker Creek then discharges below the dam (via spillway) to connect Bucker Creek back to its natural channel bank. Bucker Creek then flows away from the Escondido Creek FRS No. 12 Reservoir in a northeastern direction for approximately one mile before discharging into Escondido Creek, followed by the San Antonio River (a TNW), and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on the NHD, desktop investigations, and field investigations, this is a perennial water feature that maintains year-round flow from groundwater and upstream hydrologic flow. This feature has a significant nexus to a RPW and jurisdictional feature, therefore, can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photo 1** for conditions documented during the field investigation.

Stream 01 (S01) spans approximately 515 linear feet (LF) (0.50 acres in areal extent) within the Study Area. The average OHWM width was approximately 90 feet. OHWM indicators observed include bed and bank, shelving, natural lines impressed on the bank, litter disturbed or washed away, and scour. Stream 01 enters Escondido Creek FRS No. 12 Reservoir, then discharges downstream into Bucker Creek. Bucker Creek leaves Escondido Creek FRS No. 12 Reservoir flowing approximately one mile northeast before discharging into Escondido Creek, followed by the San Antonio River (a TNW), and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on the NHD, desktop investigations, and field investigations, Stream 01 can be considered an intermittent stream as a result of upstream hydrologic contribution, and supplemental rainfall. This feature has a significant nexus to a RPW and jurisdictional feature, therefore, can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 2-3** for conditions documented during the field investigation.

Bucker Creek (S02) upstream of the Escondido Creek FRS No. 12 Reservoir spans approximately 980 LF (3.84 acres in areal extent) within the Study Area. The average OHWM width was approximately 91 feet. Bucker Creek downstream of the Escondido Creek FRS No. 12 spans approximately 985 LF (0.26 acres in areal extent) within the Study Area. The average OHWM width was approximately 8 feet. OHWM indicators observed include bed and bank, shelving, natural lines impressed on the bank, litter disturbed or washed away, and scour. Bucker Creek enters Escondido Creek FRS No. 12 Reservoir, then discharges downstream back into Bucker Creek. Bucker Creek leaves Escondido Creek FRS No. 12 Reservoir flowing approximately one mile northeast before discharging into Escondido Creek, followed by the San Antonio River (a TNW), and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on the NHD, desktop investigations, and field investigations, Bucker Creek can be considered an intermittent stream as a result of ground water, upstream hydrologic contribution, and supplemental rainfall. This feature has a significant nexus to a RPW and jurisdictional feature, therefore, can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 4-5,** and **Photos 7-8** for conditions documented during the field investigation.

Stream 03 (S03) spans approximately 860 LF (0.02 acres in areal extent) within the Study Area. The average OHWM width was approximately one foot. OHWM indicators observed include bed and bank, shelving, natural lines impressed on the bank, litter disturbed or washed away, and scour. Stream 03 enters Bucker Creek downstream of Escondido Creek FRS No. 12 Reservoir outside of the Study Area. Bucker Creek then flows approximately one mile northeast before discharging into Escondido Creek, followed by the San Antonio River (a TNW), and then ultimately discharging into the Gulf of Mexico at the Texas Gulf Coast. Based on NHD, desktop investigations, field investigations, and its downstream connection to a potentially jurisdictional water feature, Stream 03 can be considered an ephemeral stream as a result of only receiving hydrologic flow after rainfall events. This feature has a significant nexus to a RPW and jurisdictional feature, therefore, can be considered potentially jurisdictional per USACE WOTUS classification. Refer to **Appendix B, Photos 6** for conditions documented during the field investigation.

Table 2 below summarizes potentially jurisdictional WOTUS (non-wetlands) within the Study Area.

Table 2. Potentially Jurisdictional WOTUS (Non-Wetlands) within the Study Area

Name	USACE Classification	Flow Regime	Length (LF)	Average Width (feet)	Area within Study Area (acre)
Escondido Creek FRS No. 12 Reservoir (WB01)	Potentially Jurisdictional	Perennial	N/A	N/A	37.16
Stream 01 (S01)	Potentially Jurisdictional	Intermittent	515	90	0.50
Bucker Creek (S02)	Potentially Jurisdictional	Intermittent	1,965	91 / 8	4.10
Stream 03 (S03)	Potentially Jurisdictional	Ephemeral	860	1	0.02
Total			3,340	--	41.78

3.4 Potentially Jurisdictional Wetlands

No potentially jurisdictional wetlands were observed within the Study Area.

3.5 Non-Jurisdictional Features

No potentially non-jurisdictional features were identified within the Study Area.

4. Conclusions

In AECOM's professional opinion, potentially jurisdictional WOTUS identified within the Study Area include Escondido Creek FRS No. 12 Reservoir (WB01), Stream 01 (S01), Bucker Creek/Stream 02 (S02), and Stream 03 (S03).

Based on the findings from data analysis and field investigations, four potentially jurisdictional WOTUS (non-wetland) totaling 3,340 LF (41.78 acres) were identified and mapped within the Study Area (as shown on **Table 3** below, and within **Appendix A, Figure 6**).

Table 3. Potentially Jurisdictional WOTUS within the Study Area

Name	USACE Classification	Flow Regime	Length (LF)	Area within Study Area (acres)
Waterbodies				
Escondido Creek FRS No. 12 Reservoir (WB01)	Potentially Jurisdictional	Perennial	N/A	37.16
Stream 01 (S01)	Potentially Jurisdictional	Intermittent	515	0.50
Bucker Creek (S02)	Potentially Jurisdictional	Intermittent	1,965	4.10
Stream 03 (S03)	Potentially Jurisdictional	Ephemeral	860	0.02
Total			3,340	41.78

These features are subject to regulation by the USACE, Fort Worth District, under Section 404 of the CWA and would require permit authorization if proposed project activities involve the discharge of dredged or fill material into these identified WOTUS.

The USACE is the official regulatory agency to make the final jurisdictional determination of WOTUS and associated wetlands.

5. References

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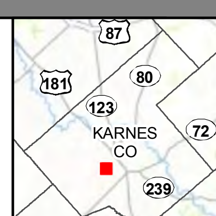
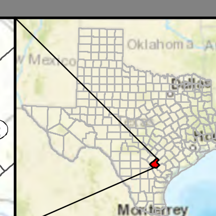
Appendix A Figures

Study Area





Project Location Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N W E S

0 200 400
Feet

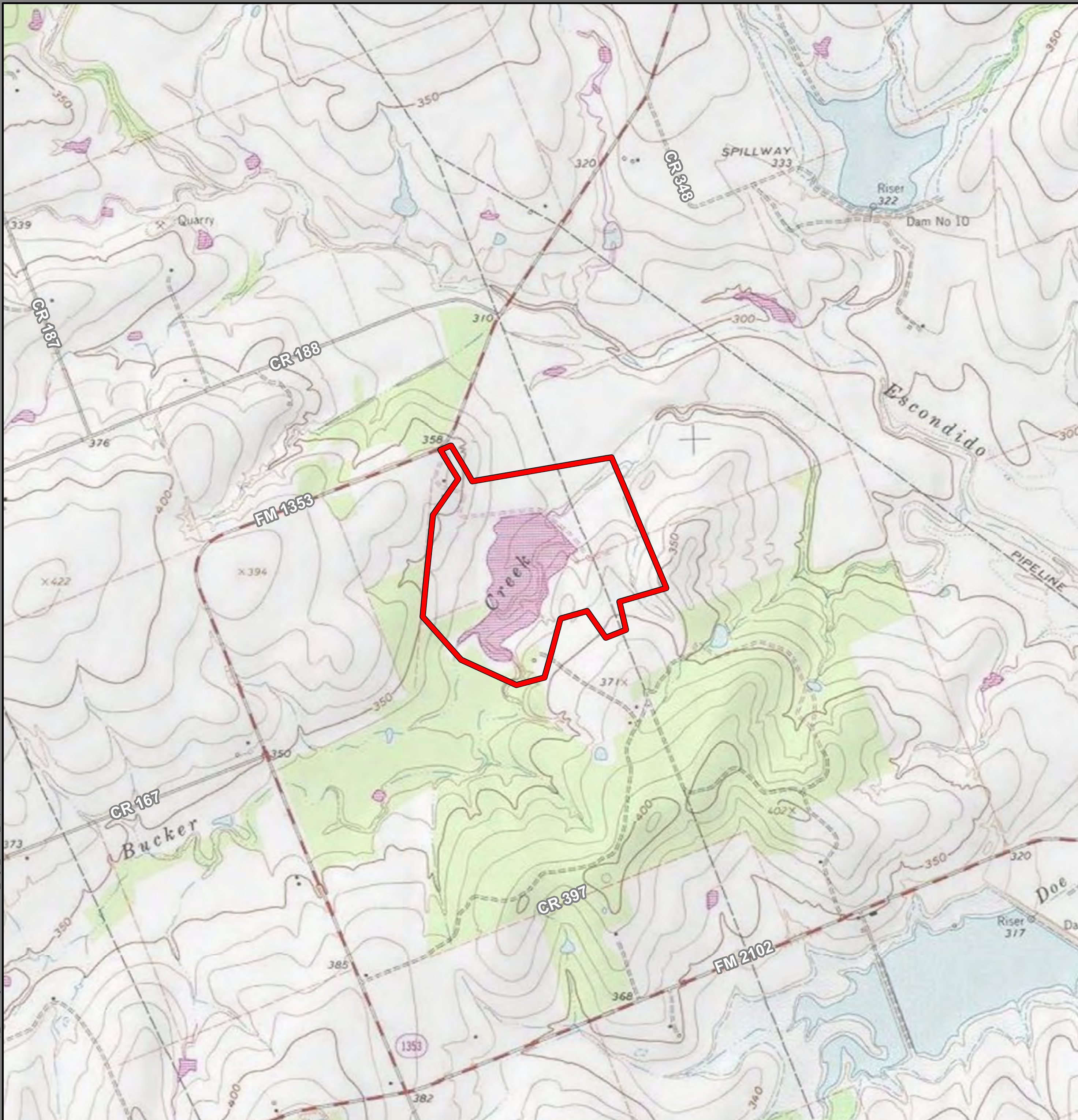
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

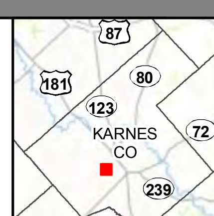
July 2024

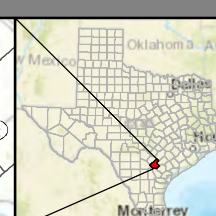
Figure 1

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig1_ProjectLocationMap.mxd



Study Area





USGS Topographic Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

0 1000 2000
Feet

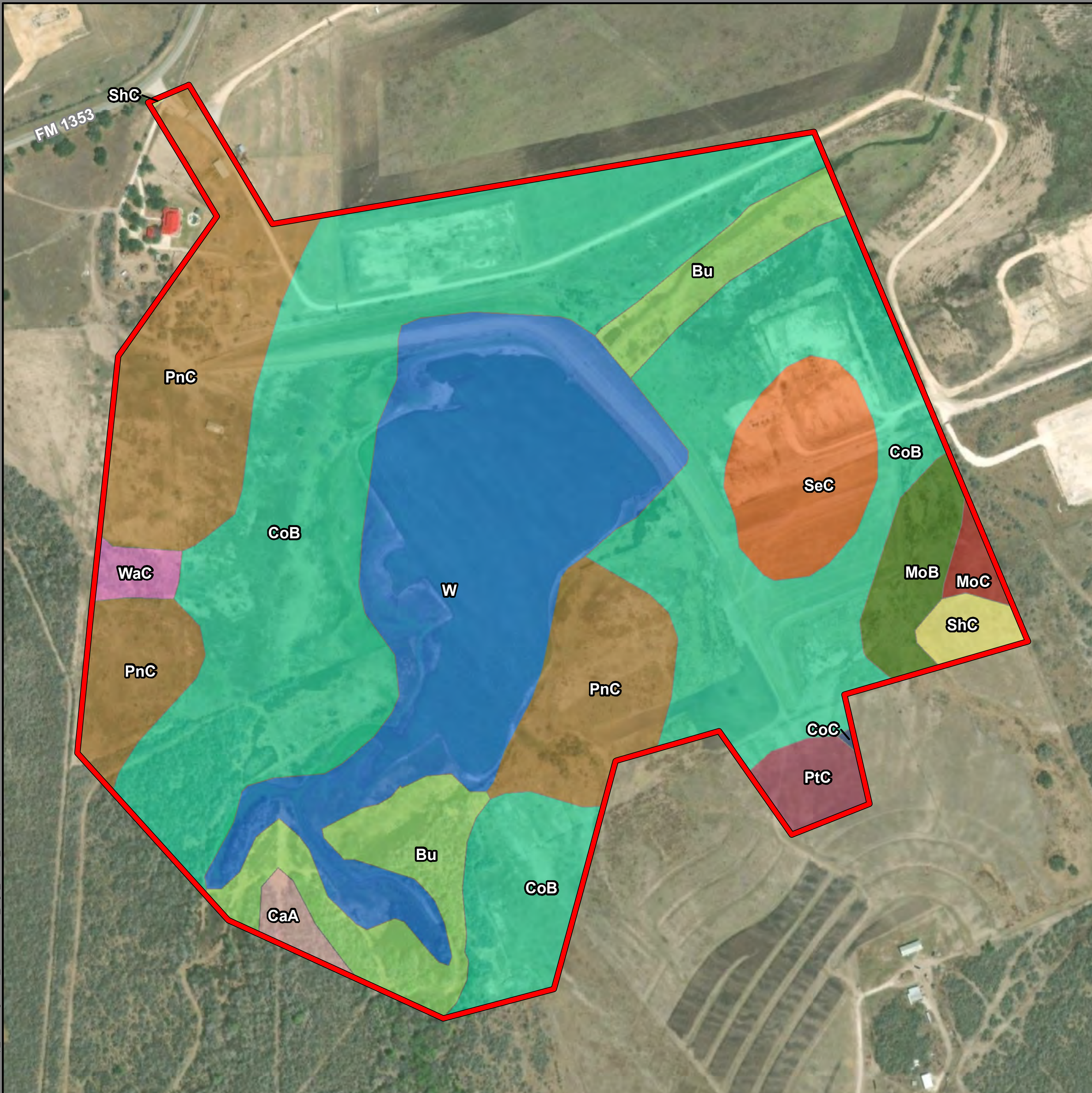
Data Sources: Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: USGS 7.5-minute Topographic Maps: Lenz Quadrangle

AECOM

July 2024

Figure 2

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig2_USGS_TopoMap.mxd



Study Area

NRCS Soil Types

- Bu - Buchel clay, 0 to 1 percent slopes, occasionally flooded
- CaA - Clareville clay loam, 0 to 1 percent slopes
- CoB - Coy clay loam, 1 to 3 percent slopes
- CoC - Coy clay loam, 3 to 5 percent slopes
- MoB - Monteola clay, 1 to 3 percent slopes
- MoC - Monteola clay, 3 to 5 percent slopes
- PnC - Pernitas sandy clay loam, 2 to 5 percent slopes
- PtC - Pettus loam, 2 to 5 percent slopes
- SeC - Sarnosa fine sandy loam, 2 to 5 percent slopes
- ShC - Schattel clay loam, 2 to 5 percent slopes
- W - Water
- WaC - Weesatche fine sandy loam, 2 to 5 percent slopes

NRCS Soils Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N W E S

0 200 400
Feet

Data Sources: Soils - USDA NRCS 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 3

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\T_E\Escondido_Fig3_NRCS_SoilsMap.mxd

Study Area

National Wetlands Inventory (NWI)

Lake

Freshwater Emergent Wetland

National Hydrography Dataset (NHD)

Stream/River: Intermittent

Underground Water Pipeline

Lake/Pond: Perennial

FEMA Flood Zones

A (100-Year Flood Zone)

Author: helen.potter; Document Path: M:\Dallas_GIS\Projects\TSSWCB\EscondidoDams\Map_Docs\Figures\Waters\Escondido_Fig4_HydrologyMap.mxd

Hydrology Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N E S W

0 200 400
Feet

Data Sources: NHD - USGS 2023; NWI - USFWS 2023; Flood Zones - FEMA 2023; Roads - TxDOT 2023
Basemap: Maxar 3/22/2022

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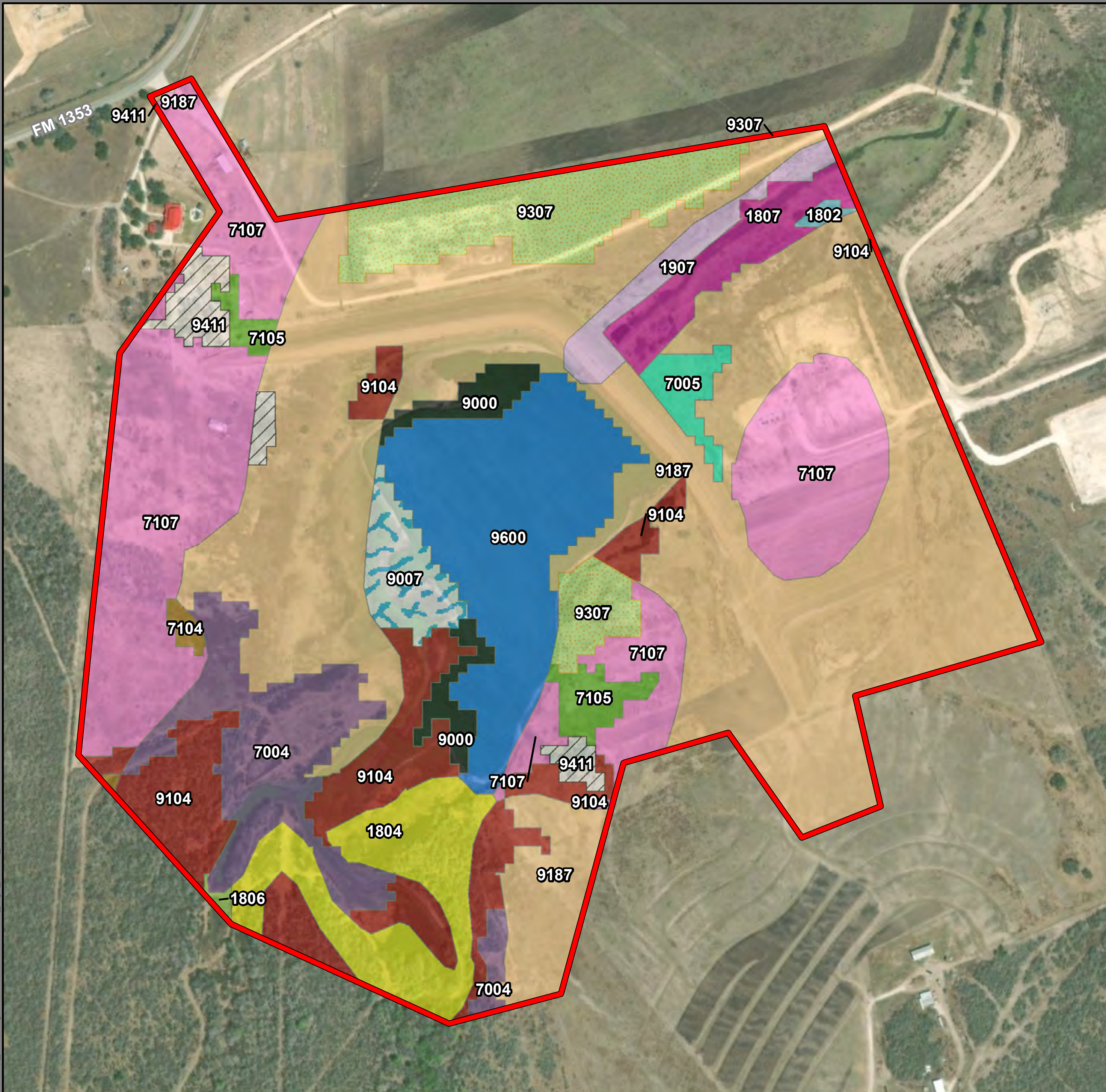
July 2024

Figure 4



Study Area

EMST Vegetation Types

- 1802 - Central Texas: Floodplain Live Oak Forest
- 1804 - Central Texas: Floodplain Hardwood Forest
- 1806 - Central Texas: Floodplain Deciduous Shrubland
- 1807 - Central Texas: Floodplain Herbaceous Vegetation
- 1907 - Central Texas: Riparian Herbaceous Vegetation
- 7004 - South Texas: Clayey Mesquite Mixed Shrubland
- 7005 - South Texas: Clayey Blackbrush Mixed Shrubland
- 7104 - South Texas: Sandy Mesquite Woodland and Shrubland
- 7105 - South Texas: Sandy Mesquite Dense Shrubland
- 7107 - South Texas: Sandy Mesquite Savanna Grassland
- 9000 - Barren
- 9007 - Marsh
- 9104 - Native Invasive: Deciduous Woodland
- 9187 - South Texas: Disturbance Grassland
- 9307 - Row Crops
- 9411 - Urban Low Intensity
- 9600 - Open Water

Ecological Mapping Systems of Texas (EMST) Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas

N
W E
S

0 200 400
Feet

Data Sources: EMST - TPWD 2021; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

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July 2024

Figure 5

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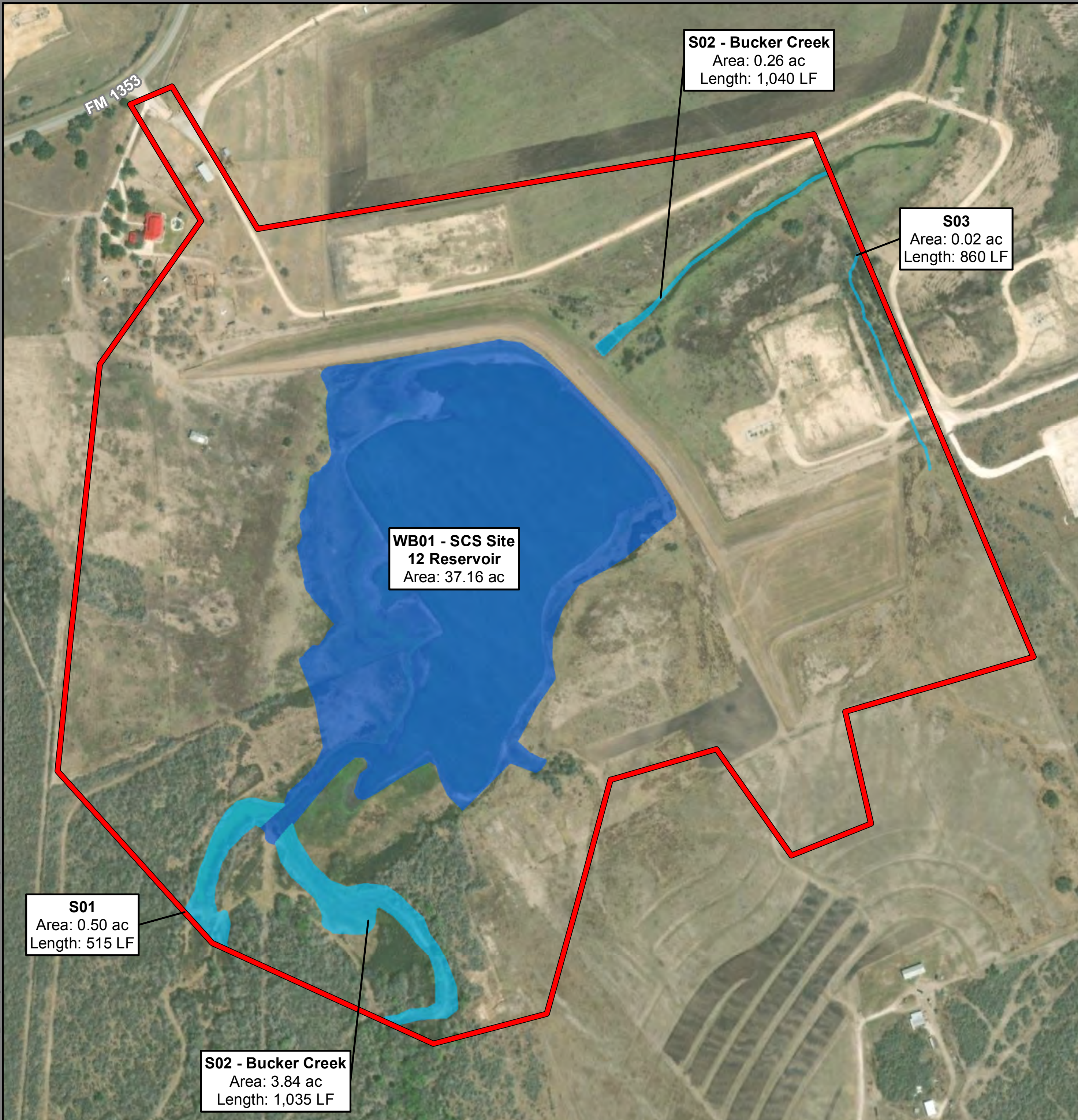
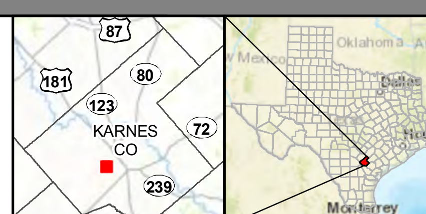
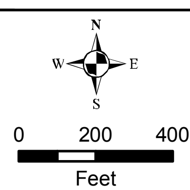


Study Area
Field-Collected Features
Stream
Waterbody
Wetland
Data Point



Potentially Jurisdictional Waters of the U.S. Map

Escondido Creek Watershed FRS No. 12
Karnes County, Texas



Data Sources: AECOM Field Surveys - June, July 2023; Roads - TxDOT 2023; County Boundaries - TIGER 2021
Basemap: Maxar 3/22/2022

AECOM

July 2024

Figure 6

Appendix B Photographic Log

AECOM		PHOTOGRAPHIC LOG
Site Name: Escondido Creek Watershed FRS No. 12	Site Location: Karnes County, TX	Project No. 60707508

Photo No. 1	Date: 06/13/23

Direction Photo Taken:

Southwest

Description:

View of Escondido Creek Flood Retarding Structure (FRS) No. 12 reservoir (WB02) in the central portion of the Study Area.

Photo No. 2	Date: 06/13/23

Direction Photo Taken:

Southeast

Description:

Downstream view of Stream 01 (S01) within the Study Area.

AECOM	PHOTOGRAPHIC LOG

Site Name: Escondido Creek Watershed FRS No. 12	Site Location: Karnes County, TX	Project No. 60707508

Photo No. 3	Date: 06/13/23
Direction Photo Taken: Northeast	
Description: Upstream view of Stream 01 (S01) within the Study Area.	

Photo No. 4	Date: 06/13/23
Direction Photo Taken: Southwest	
Description: Downstream view of Bucker creek/Stream 02 (S02) above the Escondido Creek FRS No. 12 Reservoir within the Study Area.	

Site Name: Escondido Creek Watershed FRS No. 12	Site Location: Karnes County, TX	Project No. 60707508

Photo No.	Date:
5	06/13/23

Direction Photo Taken:

Southeast

Description:

Upstream view of Bucker creek/Stream 02 (S02) above the Escondido Creek FRS No. 12 Reservoir within the Study Area.

Photo No.	Date:
6	06/13/23

Direction Photo Taken:

Southwest

Description:

Upstream view of Stream 03 (S03) within the Study Area.

AECOM

PHOTOGRAPHIC LOG

Site Name: Escondido Creek Watershed FRS No. 12	Site Location: Karnes County, TX	Project No. 60707508

Photo No. 7	Date: 06/13/23
Direction Photo Taken: Southwest	
Description: View of Bucker Creek/Stream 02 (S02) at the outflow of the Escondido Creek FRS No. 12 Reservoir.	

Photo No. 8	Date: 06/13/23
Direction Photo Taken: Northeast	
Description: View of Bucker Creek/Stream 02 (S02) at the outflow of the Escondido Creek FRS No. 12 Reservoir.	

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AECOM

Cultural Resources Survey for the Rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 12, Karnes County, Texas

Prepared by
Steve Ahr
Beth Reed
Gary Hawkins
Joal Houston
Shelley Hartsfield
Ashley Englestead
Tim Wolfe
Albert Fraley

Prepared for
Natural Resources Conservation Service - Texas
San Antonio River Authority

Principal Investigator
Steve Ahr, PhD, RPA

Texas Antiquities Permit No. 31325
October 2024

Cultural Resources Survey for the Rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 12, Karnes County, Texas

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Steve Ahr, PhD, RPA

Texas Antiquities Permit No. 31325

October 2024

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Management Summary

AECOM Technical Services, Inc. (AECOM) conducted a cultural resources survey in support of a Supplemental Watershed Plan for the rehabilitation of the Escondido Creek Watershed Floodwater Retarding Structure No. 12 (FRS 12), located in Karnes County Texas. The project is sponsored by the Natural Resources Conservation Service (NRCS) - Texas, and Sponsoring Local Organizations, including the Karnes-Goliad Soil Water Conservation District, Escondido Watershed District, City of Kenedy, and the San Antonio River Authority. The survey was carried out under Texas Antiquities Permit No. 31325.

The direct Area of Potential Effects (APE) for cultural resources consists of an alternatives evaluation area of 173 acres, which was surveyed through pedestrian walkover supplemented with the excavation of 86 shovel tests. One archeological site (41KA227) containing a low-density historic and prehistoric artifact scatter was identified and recorded during the survey. The field survey also recorded one historic-age resource, which is the FRS 12 dam constructed in 1974. Based on background review and field investigations, both sites are recommended as Not Eligible for listing in the National Register of Historic Places (NRHP) or for designation as State Antiquities Landmarks (SALs).

A geomorphic assessment determined that the APE is not likely to contain deeply buried and/or intact archeological deposits. This conclusion is based on a combination of observations, including the overall geomorphic setting, age and lithology of the soil parent materials, the shallow depths of anticipated construction activities, prior disturbances from dam construction, and a lack of buried archeological materials. No backhoe trenching is recommended.

AECOM recommends that the proposed project should have No Effect on properties included in, or eligible for inclusion in, the NRHP, or that merit designation as SALs. If the dimensions of the project area change, additional archeological and historical investigations may be warranted. In the event that previously undiscovered sites are found during construction, appropriate actions should be taken in accordance with the Prototype Programmatic Agreement between the United States Department of Agriculture, Texas NRCS State Office, and the Texas State Historic Preservation Officer (SHPO), as well as the National Programmatic Agreement among NRCS, the National Conference of SHPOs, and the Advisory Council on Historic Preservation, and NRCS General Manual 420, Part 401 guidance.

If any unmarked prehistoric or historic human remains or burials are encountered at any point during the project, the area of the remains is considered a cemetery under current Texas law and all construction activities must cease immediately to avoid impacting the remains. The Texas Historical Commission must be notified immediately by contacting the Archeology Division at (512) 463-6096. All cemeteries are protected under State law and cannot be disturbed. Further protection is provided in Section 28.03(f) of the Texas Penal Code, which provides that intentional damage or destruction inflicted on a human burial site is a state jail felony.

No artifacts were collected during the survey. Project notes, maps, photographs, and other documentary records were prepared for permanent curation at the Texas Archeological Research Laboratory.

1 Introduction

The Natural Resources Conservation Service (NRCS) – Texas, along with several Sponsoring Local Organizations, including the Karnes-Goliad Soil Water Conservation District (SWCD), Escondido Watershed District, City of Kenedy, and the San Antonio River Authority, are evaluating plans to rehabilitate the Escondido Creek Watershed Floodwater Retarding Structure (FRS) No. 12, located in Karnes County, Texas (**Figure 1**). AECOM Technical Services, Inc. (AECOM) conducted a cultural resources survey in support of a Supplemental Watershed Plan (SWP) for the rehabilitation of FRS 12.

FRS 12 was constructed in 1974 as a low hazard dam on Bucker Creek, a tributary to Escondido Creek, approximately four miles south of Karnes City, Texas. The National Inventory of Dams Identification Number is TX04315 (URS Corporation 2014). The dam is a filled earthen embankment that is 2,667 feet (ft) long with a maximum height of 34 ft. The detention pool is 201.6 acres. The principal spillway is a 42x126-inch drop inlet with 192 ft of 42-inch diameter, concrete-lined steel cylinder pipe. The auxiliary spillway is a vegetated earthen channel 300 ft wide. The existing dam does not meet the current dam design and safety criteria for a High Hazard dam (URS Corporation 2014). The purpose of the rehabilitation would be to mitigate identified dam safety deficiencies associated with the dam's reclassification as a High Hazard dam.

Area of Potential Effects

As defined in 36 Code of Federal Regulations (CFR) 800.16(d), the Area of Potential Effects (APE) is the geographic area within which an undertaking may directly or indirectly cause changes in the character or use of historic properties if such properties exist. The APE is influenced by the scale and nature of the undertaking and may be different for different kinds of effects caused by the undertaking. The direct APE for cultural resources for this project consists of all areas where construction and other potential ground disturbances such as erosion, exposure, or other related factors or activities would occur.

Detailed design plans for structural rehabilitation of FRS 12 are not yet available. However, to meet high hazard criteria, dam rehabilitations typically entail some combination of various modifications, including raising the dam embankment, modifying, or replacing the existing principal spillway, and/or increasing the capacity of the auxiliary spillway.

All potential rehabilitation modifications would take place within a 173-acre Limits of Construction, which is currently considered to be the direct APE for archeological resources (**Figure 2**). Engineering calculations have not yet determined whether the top-of-dam elevation would increase due to any proposed modifications. Should there be a net increase in the maximum pool elevation, then the direct APE and the resulting survey would be adjusted as appropriate to accommodate this change. The project depth of most impacts would be limited to the upper 1 meter (m) of deposits, though if any borrow areas are required on the upland margins they could potentially be excavated to greater depths (e.g., 5 to 10 ft deep).

The indirect APE is the area in which all other impacts may be caused by the implementation of the project and are often those that occur later, or which are farther removed from the immediate project area, including visual, audible, atmospheric, or hydrologic changes. An indirect APE of 600 ft beyond the direct APE was used to assess potential visual effects on historic-age resources and the viewshed.

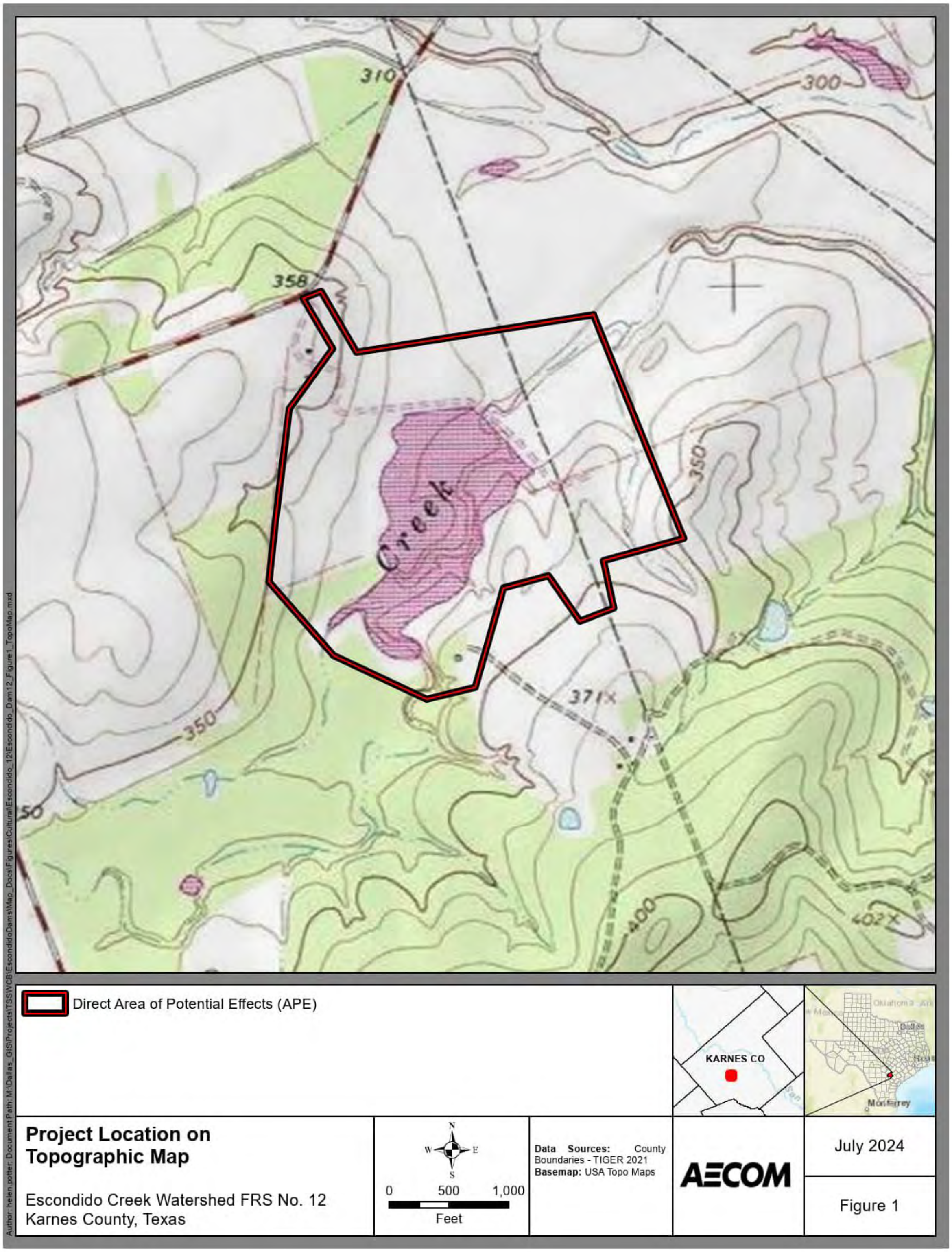

Figure 1. Escondido FRS 12 Project Location

Figure 2. Direct and indirect APE for FRS 4

The SWP will be prepared in accordance with standard engineering principles that comply with NRCS programmatic requirements. In addition, the SWP will be reviewed, concurred, and approved by NRCS, which is the lead federal agency. Consequently, the project falls under the purview of Section 106 of the National Historic Preservation Act of 1966, as amended. In accordance with Advisory Council on Historic Preservation regulations pertaining to the protection of historic properties (36 CFR 800), federal agencies are required to assess the effects of their undertakings on historic properties prior to issuing permits or funding. Historic properties are defined as those properties that are included in, or are eligible for inclusion in, the National Register of Historic Places (NRHP). Therefore, the project is subject to review by the Texas State Historic Preservation Office, which is formally known as the Texas Historical Commission (THC).

United States Army Corps of Engineers (USACE) permitting may also be required for this project. USACE regulations 33 CFR Part 325, Appendix C are the USACE's Regulatory Program's implementing regulations for Section 106 compliance. They provide a process for the review of all proposed USACE permit actions and are commensurate with the level of impacts. For example, a project area includes the entire area of work, including all construction, staging, and access areas, and may be larger than the USACE permit area. The permit area is determined by the USACE, but typically comprises the waters of the U.S. that will be directly affected by the proposed undertaking, and uplands directly affected because of authorizing the work or structures. The USACE evaluates permit applications on a case-by-case basis to determine a project's potential to affect historic properties.

The project will be located on lands owned and/or controlled by the Escondido Watershed District, which is a political subdivision of the State of Texas. As such, it falls within the purview of the Antiquities Code of Texas. Regulations pertaining to the code can be found within Title 13, Part 2, Chapter 26 of the Texas Administrative Code (TAC). The code requires the THC to review actions that have the potential to disturb prehistoric and historic sites within the public domain. The THC issues Antiquities Permits that stipulate the conditions under which survey, discovery, excavation, demolition, restoration, or scientific investigations can occur.

AECOM conducted a cultural resources survey of the APE from September 26 – 28, 2023, and August 8, 2024, under Texas Antiquities Permit No. 31325, requiring approximately 110 person hours to complete. Steve Ahr served as Principal Investigator and was assisted in the field by AECOM archeologists Gary Hawkins, Tim Wolfe, Joal Houston, and Ashley Englestead. AECOM Architectural Historian Beth Reed performed a field survey for aboveground historic resources.

2 Environmental Setting

2.1 Physiography

The project area is within the South Texas Brush Country, located within the greater West Gulf Coastal Plain physiographic province (Gould 1975). This area is dominated by hackberry and elm hardwoods, woodlands of mesquite, and shrublands of blackbrush and fern acacia (Gould 1975). The study area is within the south-central climate region, which is characterized as humid subtropical, with hot summers, and peak precipitation in May and September.

2.2 Topography

The APE is located within the United States Geological Survey (USGS) Lenz, TX topographic quadrangle in Karnes County, Texas. The APE ranges in elevation from 350 ft above mean sea level (amsl) within the upland margins, to approximately 310 ft amsl within the creek/drainage channel.

2.3 Geology

The APE is underlain by the Miocene-age Oakville Sandstone Formation, which is characterized by sandstone, clay, and mud (Bureau of Economic Geology [BEG] 1987). Inset within this formation are Holocene alluvial deposits associated with Bucker Creek (BEG 1987).

2.4 Soils

Ten soil mapping units are present within the APE (**Table 1; Figure 3**). Approximately 70 percent of the soils in the APE are described as having formed in alluvial parent materials on floodplains and terraces, while 10 percent formed in residuum on upland hillslopes (NRCS 2023). The remaining 20 percent of the APE is mapped as water.

Table 1. Soils within the APE

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Pedon	Parent Material
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	7.3	Very deep, very slowly permeable, moderately well drained soils on nearly level floodplains	Ap-A-Bss1-Bss2-Bkss1-Bkss2	Recent (Holocene) Alluvium
CaA	Clareville clay loam, 0 to 1 percent slopes	0.7	Very deep, well drained soils on base slope on draws and drainageways	Ap-A-Bt1-Bt2-Btk-Bk1-Bk2-BCk	Recent (Holocene) Alluvium
CoB	Coy clay loam, 1 to 3 percent slopes	44.7	Very deep, well drained slowly permeable soils on ancient high terraces	Ap-Bt1-Bt2-Btk-Bk-Bky	Ancient Alluvium

Map Unit Symbol	Map Unit Name	Percent of APE	Series Description	Pedon	Parent Material
MoB	Monteola clay, 1 to 3 percent slopes	2.4	Very deep, well drained, very slowly permeable soils on hillslopes	Ap-A-Bss-Bkssy1-Bkssy2-BCkyz	Residuum
MoC	Monteola clay, 3 to 5 percent slopes	0.6	Very deep, well drained, very slowly permeable soils on hillslopes	Ap-A-Bss-Bkssy1-Bkssy2-BCkyz	Residuum
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	16.3	Very deep, well drained, moderately permeable soils on summits, backslopes, and footslopes of low ridges	A-Bt1-Bt2-Bk1-Bk2	Ancient Alluvium
PtC	Pettus loam, 2 to 5 percent slopes	1.4	Very deep, well drained soils on shoulders on hillslopes	A-Bk-BCk1-BCk2	Fluviomarine deposits
SeC	Sarnosa fine sandy loam, 2 to 5 percent slopes	4.5	Very deep, well drained soils on hillslopes	A-Bk1-Bk2-BCk1-BCk2	Residuum
ShC	Schattel clay loam, 2 to 5 percent slopes	1.0	Deep, well drained soils on hillslopes	A-Bw-Bk-Bkyz-Cdkyz	Residuum
W	Water	20.3	N/A	N/A	N/A
WaC	Weesatche fine sandy loam, 2 to 5 percent slopes	0.8	Very deep, well drained, moderately permeable soils on summits, backslopes and footslopes	A-Bt1-Bt2-Bk1-Bk2-BCk	Residuum

Source: (NRCS 2023)

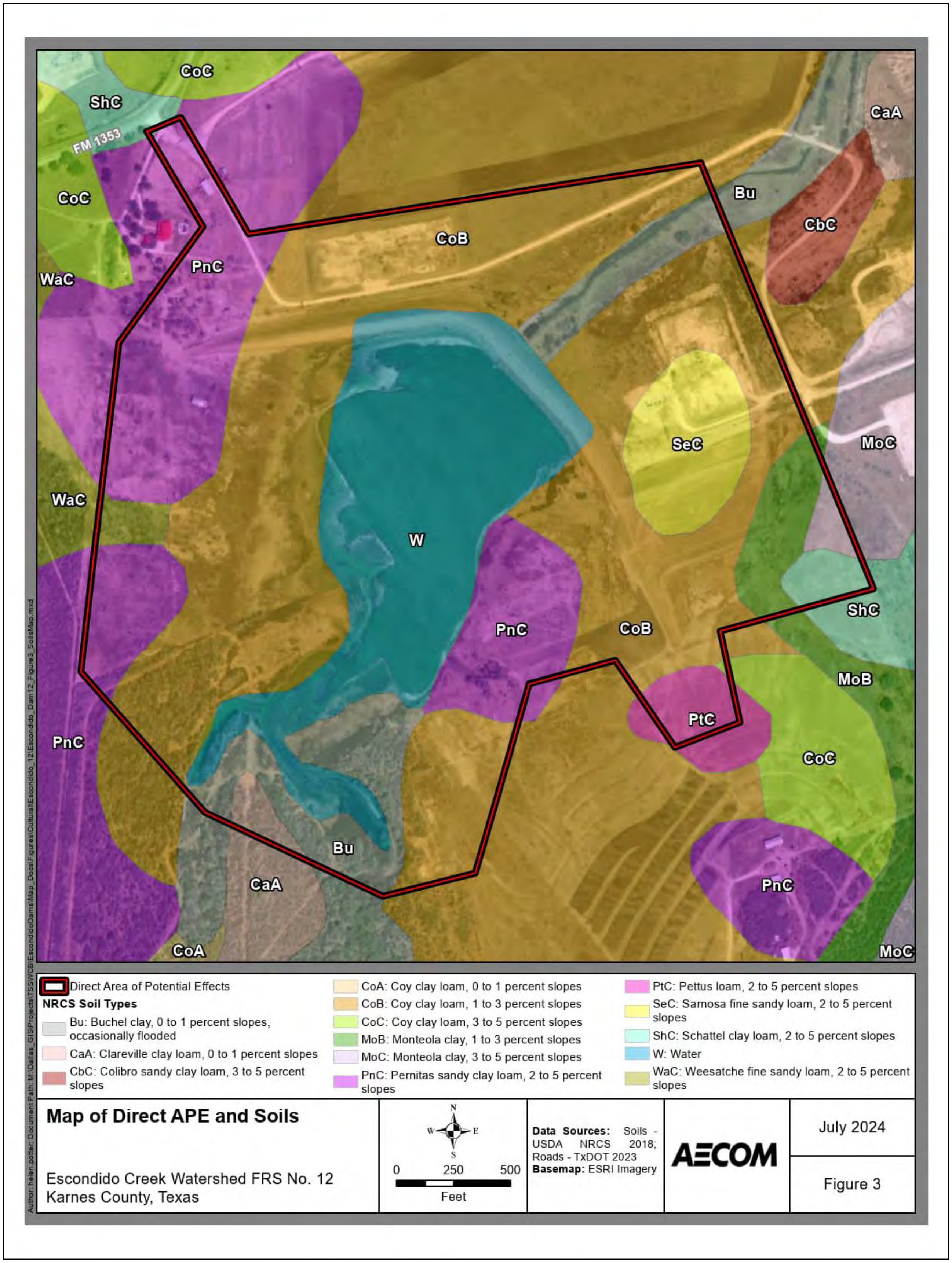

Figure 3. Project soils

3 Cultural History

3.1 Paleoindian Period (11,500 – 8800 Years Before Present [B.P.])

The traditional view of the Paleoindian Period is one that is characterized by small groups of highly mobile hunter-gatherers who hunted mega-fauna such as mammoth, bison, and horse. A more recent interpretation of this period, however, suggests that diverse resources were exploited, including smaller animals, such as turtle, alligator, raccoon, and waterfowl, and a diverse range of plants (Collins 2002, 2004). The defining characteristics of Paleoindian lithic assemblages include lanceolate points with straight or concave bases, scrapers, and notched tools. The earliest part of the Paleoindian Period is represented by Clovis and Folsom cultures, which are identifiable by diagnostic projectile points bearing the same names.

Evidence of big game hunting (e.g., mammoth and bison) is represented by several sites containing Clovis and Folsom spear points (Black 1989; Hester 1995). Few deeply buried and preserved sites from this period have been intensively investigated in south Texas. One notable example includes the Richard Beene Site, located in south San Antonio (Thoms and Mandel 1992; Thoms and Mandel 2007).

3.2 Archaic Period (8800 – 1200 B.P.)

During the Archaic Period, plant food gathering became increasingly important part of overall subsistence in response to increasingly arid climate conditions. This shift is represented archeologically by a wide array of stone tools geared toward plant processing (e.g., grinding implements), and varied projectile point styles. Three subperiods are recognized in south Texas, including the Early Archaic, Middle Archaic, and Late Archaic Periods (Black 1989).

The Early Archaic Period (8800 – 6000 B.P.) is characterized by greater emphasis on exploitation of riverine settings. This period is recognized archeologically by the presence of corner- and basal- notched projectile points (Hester 1995). Early Archaic sites are relatively rare in south Texas, which may be attributed to warmer and drier climates that had been seen previously (Black 1989; Collins 1995). Commonly exploited biomass during this period includes freshwater mussel, deer, rabbit, and antelope (Thoms and Mandel 1992, 2007).

The Middle Archaic Period (6000 – 4000 B.P.) saw a population increase, with a subsistence focused on locally available plants and roots, such as mesquite beans and acacias (Hester 1995). Tortugas, Abasolo, and Carrizo points are diagnostic artifacts for this period (Hester 1995; Turner and Hester 1993). Evidence of prehistoric cemeteries was found at the Bering Sink Hole in Central Texas (Bement 1994) and the Loma Sandia Site in Live Oak County (Taylor and Highley 1995).

The Late Archaic Period (4000 – 1200 B.P.) witnessed continued reliance on hunting along with an increase in gathering. Evidence suggests that cemeteries continued to be used during this time. Bison hunting also took place (Hester 1995), and a wider variety of smaller mammals such as rabbits and rodents may have been exploited with greater intensity, as well as the use of mesquite and acacia. Numerous sites from this period contain large fire-cracked rock features and include seed processing implements such as manos and metates.

3.3 Late Prehistoric Period (1200 – 350 B.P.)

The Late Prehistoric Period is divided into Austin and Toyah phases. During the Austin Phase, the bow and arrow was introduced (Black 1989; Hester 1995; Prewitt 1981). Scallorn arrow points are diagnostic of this period, as well as other side-notched varieties. Use of Clear Fork gouges and bifaces is also common, as well as grinding stones and scrapers, which represents a diverse range of subsistence activities. Deer, freshwater mussels, and snails have been suggested as important food resources during the Austin Phase (Prewitt 1981).

The subsequent Toyah Phase is represented by distinct Perdiz arrow points and other contracting stem varieties. Also commonly found in Toyah sites are bone-tempered pottery, beveled-edge bifacial knives, perforators, and end-scrapers. This artifact assemblage is attributed to widespread deer and bison exploitation (Black 1989; Creel 1991; Dillehay 1974; Hester 1995; Huebner 1991; Johnson 1994; Prewitt 1981). Although Toyah lifeways likely persisted into the earliest historic times, sites from this period are difficult to distinguish from pre-contact sites. Furthermore, ceramics such as Leon Plain were used extensively throughout the Toyah Phase and are similar to historic period Goliad wares (Black 1986, 1989; Hester 1995).

3.4 Historic Period (Post-350 B.P.)

Karnes County is bounded on the north by Wilson County, on the east by Gonzales and DeWitt Counties, on the south by Goliad and Bee counties, and on the west by Atascosa and Live Oak counties. The county seat is Karnes City, which is fifty-two miles southeast of San Antonio. Other communities situated in Karnes County include Kenedy, Runge, Panna Maria, Helena, Czestochowa, Pawelekville, Falls City, Hobson, Ecleto, Gillett, Coy City, and Lenz. Most of the land in the county is prime farmland and major crops include grain sorghum, corn, hay, and vegetables. Livestock includes beef cattle, dairy cattle, and poultry (Long 2023).

During the mid-eighteenth century, the region became the center for ranching activity in the area between San Antonio de Béxar and La Bahía which is now Goliad. The first land grants in present-day Karnes County were issued on April 12, 1758, to Hernández and Luis Antonio Menchaca, who established ranches near the San Antonio River and Cibolo Creek. To protect local ranches from Indian raids a fort was established by the Spanish on Cibolo Creek named Fuerte de Santa Cruz del Cíbolo in approximately 1770, near the site of the present-day community of Czestochowa. In 1783, after repeated Indian attacks, the fort and many ranches were abandoned. By the mid-1780s only six ranches and 85 Spanish settlers remained (Long 2023).

During the early nineteenth century the heirs of the original Hernández and Menchaca ranches divided the land and sold some to other families, including the Veramendi, Cassiano, Flores, Navarro, and Carillo clans. By the 1840s, the first Anglo-American settlers arrived in the region. The first settlement was in 1852, at the site of an earlier Mexican settlement called Alamita, located on a bend of the San Antonio River at the intersection of the Chihuahua Trail and the wagon road from Gonzales to San Patricio. Settlers, led by Thomas Ruckman and Lewis S. Owings founded the community of Helena, which was an important stop between San Antonio and Goliad when a stage line began operation from San Antonio to the coast (Long 2023).

In the 1850s, residents of the area petitioned the state legislature to form a new county from portions of Bexar, Gonzales, DeWitt, Goliad, and San Patricio counties. On February 4, 1854, the legislature established the new county, named Karnes for Texas revolutionary leader Henry Wax Karnes, with Helena as the county seat. In 1854, immigrants from the Upper Silesia area of Poland arrived in Karnes County. Led by Franciscan priest Leopold Moczygemba, they settled the community of Panna Maria. The community, located near the junction of the San Antonio River and Cibolo Creek, was the first Polish colony in the United States. Subsequent groups of Polish immigrants formed communities at Czestochowa and Falls City. The Polish arrivals aided agricultural diversification and planted a wide range of crops, including corn, melons, potatoes, cucumbers, and pumpkins. However, during this period the Karnes County economy remained based on livestock ranching. In 1858, Karnes County tax assessment rolls listed 50,000 cattle, valued at $6 per head, and 2,000 horses worth $2.50 per head (Long 2023).

In 1860, prior to the start of the Civil War, Karnes County had a population of 2,170 and residents voted for secession. Militia companies including the Helena Guards and Escondido Rifles were organized in the county. The Polish settlers formed a unit named the Panna Maria Grays. Following a period of economic decline following the Civil War the economy began to improve during the late 1860s and livestock remained the most key factor of the economy. Beginning in 1866, large numbers of cattle from Karnes County were driven to nearby DeWitt County and then up the Chisholm Trail to railroads and markets in Kansas. By 1882, county tax rolls recorded 7,961 horses and mules, 37,115 cattle, 21,461 sheep, 1,273 goats, and 2,898 hogs, worth a combined $511,099 (Long 2023).

In 1886, the first railroad, the San Antonio and Aransas Pass Railway, arrived in the county. The railroad improved access to markets and attracted new settlers. However, the railroad line did not extend through the town of Helena, the Karnes County seat. As a result, the county seat moved six miles west, to a location along the railroad tracks, and a new town named Karnes City was established. Between 1890 and 1930, the population of Karnes County increased from 3,637 to 23,316. The number of farms in the county also grew during this period. By the turn of the century the principal crops grown in Karnes County included cotton, sorghum, and potatoes. Cotton farming had become particularly important to the county economy during the early twentieth century. Prior to 1900, most Karnes County farmers and ranchers owned their land. By 1930, tenant farmer worked more than half of the county's 2,400 farms. During the early 1930s, the cotton crop was severely diminished due to the boll weevil infestation and the drop in cotton prices as a result of the Great Depression. After 1930 the population of the county declined as tenant farmers left the county (Long 2023).

Since 1950, farming in Karnes County has shifted to larger farms worked by hired laborers. Crops included corn and sorghum, but flax became an important crop after World War II. By 1950, it was the leading crop in the county, with 65,000 acres planted. During the second half of the twentieth century livestock ranching, particularly hogs and sheep, accounted for 86 percent of the agricultural income of Karnes County. Other natural resources present in Karnes County include oil and uranium. During the 1930s, the discovery of oil in the county has contributed to the economy to the present. By 2002, Karnes County had 1,157 farms and ranches covering 474,806 acres. Fifty-six percent of these properties were pastureland for beef cattle and 35 percent was utilized for crops such as hay, wheat, corn, and sorghum (Long 2023).

4 Methods

4.1 Antiquities Permit

A Texas Antiquities Permit application and research design was submitted to the THC prior to fieldwork. The THC approved the application and issued Antiquities Permit No. 31325 on August 17, 2023. Steve Ahr served as Principal Investigator.

4.2 Background Review

Prior to fieldwork, AECOM conducted an archeological background review of the Texas Archeological Sites Atlas (TASA 2023) to identify previously recorded archeological sites, cemeteries, and previous surveys within 1,000 m of the direct APE.

AECOM architectural historian Beth Reed conducted a background review of the Texas Historic Sites Atlas (THSA 2023) and the Texas Department of Transportation's Historic Resources Aggregator (TxDOT 2023) to identify properties listed in, or eligible for listing in, the NRHP, National Historic Landmarks (NHLs), State Antiquities Landmarks (SALs), Recorded Texas Historic Landmarks (RTHLs), and Official Texas Historical Markers (OTHMs) within 1,300 ft of the direct APE. The background reviews also utilized historic aerial photographs and topographic maps.

4.3 Archeological Survey

The objectives of the survey were to identify and record archeological and historic resources within the APE, evaluate their potential for inclusion in the NRHP and for designation as SALs, and determine whether additional investigations were warranted. AECOM conducted an intensive archeological survey of the APE in conformance with the Council of Texas Archeologists (CTA) *Intensive Terrestrial Survey Guidelines*. All work was supervised by AECOM cultural resources staff meeting the United States Secretary of the Interior's *Professional Qualification Standards for Archeology and Historic Preservation* (Title 36 CFR Part 61), and Texas' professional qualification requirements for Principal Investigator (13 TAC 26.4).

All exposed ground surfaces within the direct APE were closely examined for archeological materials. Shovel tests were 30 centimeters (cm) in diameter and were dug in 20-cm levels. In depositional areas, shovel tests were dug either to the bottom of the Holocene deposits, to 80 cm below surface, or to a restrictive layer. In upland areas, shovel tests were dug to subsoil or bedrock. Excavated soils were screened through ¼-inch mesh unless high clay or water content required that they be troweled through. All shovel tests were backfilled upon completion. Shovel testing was precluded in upland or erosional settings with exposed bedrock; on slopes greater than 20 percent; and areas with significant ground disturbance. Except for former well pad areas and the earthen fill embankment and inundated areas, at least one shovel test was excavated for each excluded area to assess the potential for buried deposits and demonstrate the nature and extent of significant ground disturbance. For each shovel test, the location, depth, soil description, and the presence/absence of cultural materials was recorded. The geomorphology of the APE was also assessed by a qualified geoarcheologist to determine whether deeply buried and intact cultural materials could be present and whether deep mechanical prospection (e.g., backhoe trenching) was necessary.

4.4 Site Recording and Assessment

A site was defined by the presence of at least five or more artifacts. Isolated farm/ranch equipment was not considered as sites. According to the CTA's *Intensive Terrestrial Survey Guidelines*, any cultural materials identified during survey greater than 50 years of age were minimally designated as isolated finds. Artifact scatters were delineated as sites through shovel testing and field observations, as outlined in CTA's *Intensive Terrestrial Survey Guidelines*.

In the event of a positive shovel test, additional radials were excavated in a cruciform pattern at intervals no greater than 15 m until two negative shovel tests were found in each direction, or until topographic limits (e.g., landform boundaries, streams) were reached. All sites were photographed from a minimum of two angles. Any cultural features and natural features of interest were also photographed, along with representative overviews. Site boundaries and the locations of all subsurface excavations, cultural features, photographs, individual artifacts or artifact clusters, and other relevant natural or landscape features (e.g., roads, buildings) were recorded with a handheld GPS.

No artifacts were collected during the survey. The quantities of artifacts or estimates of materials in surface scatters were recorded and the locations of artifact concentrations plotted on site maps. Any artifacts from shovel tests or other sub-surface investigations were photographed. Any diagnostic artifacts and a representative sample of non-diagnostic materials from the surface was documented in the field. TexSite forms for all new sites were prepared and submitted to the Texas Archeological Research Laboratory (TARL) for assignment of a permanent trinomial designation.

All cultural resources sites were assessed for their eligibility for listing in the NRHP according to the National Register criteria for evaluation (36 CFR Part 60.4 [a-d]), which states that "[t]he quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
b) that are associated with the lives of persons significant in our past; or
c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
d) that have yielded, or may be likely to yield, information important in prehistory or history.

All cultural resource sites were also assessed for SAL eligibility. Under 13 TAC 26.10, an archeological site under the ownership or control of the State of Texas may merit official designation as a SAL if one of the following criteria applies:

1. The site has the potential to contribute to a better understanding of the prehistory and/or history of Texas by the addition of new and important information;
2. The site's archeological deposits and the artifacts within the site are preserved and intact, thereby supporting the research potential or preservation interests of the site;
3. The site possesses unique or rare attributes concerning Texas prehistory and/or history; or
4. The study of the site offers the opportunity to test theories and methods of preservation, thereby contributing to new scientific knowledge.

4.5 Curation

The survey employed a non-collection strategy. Correspondence, field records, and photographs generated during archeological investigations were prepared for permanent curation at TARL.

4.6 Historic Resources Methods

Historic resources refer to any buildings, structures, objects, sites, and potential historic districts that are, or will be, 45 years of age or older at the time of the anticipated project letting date for construction, which currently is estimated to be 2026. Therefore, buildings, structures, objects, sites, or potential historic districts dating to 1981 or earlier were evaluated as historic resources.

A historic resources reconnaissance survey was conducted on October 2, 2023, by AECOM Architectural Historian, Beth Reed. All identified historic-age resources within the indirect APE (i.e., within 600 ft of the direct APE) were identified, documented with digital photography, and evaluated for NRHP eligibility. The condition, materials, alterations, and other features for evaluating significance and integrity of any historic-age resources were noted.

5 Results

5.1 Background Review Results

A review of the TASA (2023) found one archeological survey within 1,000 m of the APE (**Figure 4**). This survey was conducted in 2012 for a Lone Star Natural Gas pipeline (Atlas No. 8500021127). This survey identified archeological site 41KA172, which is located approximately 400 m northeast of FRS 12 and consists of a low-density prehistoric lithic scatter (TASA 2023).

5.2 Survey Results

The APE encompasses a mixture of open pasture, rangeland, industrial use, and natural short and tall grasses and wooded areas (**Figure 5**). Prior disturbances include impacts from the construction of the current earthen dam, the auxiliary spillway, and drainage outlet and impact basin, as well as land clearing, former well pad surfaces, and access roads (**Figures 6-10**).

A total of 86 shovel tests were excavated within the direct APE and revealed shallow (to subsoil) sandy and silty clay loam soils (**Figure 11; Appendix A**). Shovel tests were distributed to avoid inundated area and the most heavily disturbed portions of the project, such as the well pads and the dam structure. Typical ground surface visibility across the APE was about 40 percent.

None of the shovel tests were positive for cultural materials. However, one previously unrecorded archeological site (41KA227) consisting of a surface scatter of historic and prehistoric materials was identified and recorded. One historic-age resource (Historic Site 001), which is the FRS 12 dam, constructed in 1974 was also evaluated during the survey. Each site is discussed and evaluated in the following sections.

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Figure 4. Previous surveys and previously recorded sites within 1,000 m of APE

Figure 5. Overview of northwest corner of APE

Figure 6. Overview of former well pad disturbances within APE

Figure 7. Rock-lined drainage outlet and impact basin

Figure 8. Top of dam embankment

Figure 9. Auxiliary spillway

Figure 10. Dam inlet structure

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Figure 11. Survey Results

Site 41KA227

Archeological site 41KA227 was recorded during the current survey as a historic and prehistoric surface scatter (see **Figure 11; Figure 12**). Based on the distribution of artifacts and former structures identified on historic aerials and topographic maps, the site measures approximately 100 m north-south by 75 m east-west and is on an elevated ridge 65 m east of Bucker Creek at an elevation of 340 ft above mean sea level. Vegetation consisted of sparse woods and short grasses; ground surface visibility was approximately 40 percent. Soils at the site are Coy clay loam, 1 to 3 percent slopes, which formed on ancient, dissected terrace remnants. Heavily dissected ridges and slopes occur immediately west of the site and are eroded to subsoil/bedrock. Other prior disturbances include cattle paths natural weathering, past vegetation clearing, fence lines, and two-track roads. Evidence of livestock was observed on the property and the property appears to currently be used as rangeland.

Site 41KA227 was identified when a light scatter of historic glass, ceramic, metal, and brick were identified on an eroded surface. The surface scatter contained five stamped bricks; 13 metal fragments including wire, nails, a fence nail, rings, and a spring; 31 glass fragments, including colorless, amethyst, amber, opaque, aqua, green, and black glass fragments (**Table 2**); and 15 pieces of undecorated whiteware distributed over an approximately 20x20-m area (**Figures 13-19**). Artifacts date from the late nineteenth through twentieth century. In addition to the historic scatter, four prehistoric lithic flakes and one biface fragment were noted on the surface. No diagnostic prehistoric artifacts or hearth features were observed. The historic scatter was investigated by intensive pedestrian and visual survey, which was supplemented by the excavation of shovel tests to test for the possible presence of subsurface artifacts and to assess the soil/site depth. None of the shovel tests were positive for cultural materials. Shovel tests found soils at the site ranging in depth from 8 to 25 cm and revealed mixed and bioturbated silt loam and sandy loam Ap horizons over a compact, sandy clay Bt (argillic) horizon. The site is bounded by a property fence line and the Bucker Creek bluff to the west, negative shovel tests and property fence line to the north and east, and negative shovel tests and project boundary to the south.

The Karnes County Appraisal District shows that site 41KA227 is situated on Karnes County land parcel #65409 which consists of 214.4 acres. The land is out of an original Texas land grant of 1,476 acres recorded as Abstract 88 to Jackson A. Davis. Davis died at the Battle of Goliad during the Texas Revolution and was entitled to a Goliad 1st land grant by the Republic of Texas after his death. The heirs of Jackson Davis received the land through a Republic of Texas Donation Grant and patented the property on September 9, 1848, under Patent No. 616 (Texas General Land Office Vol. 616, Vol No. 6, Certificate 284). A review of a historic aerial photograph from 1955 (historicaerials.com) and a 1956 USGS topographic map indicates that two possible farmstead related structures and a windmill may have once been present at this site (**Figure 20**). By 1961, the USGS topographic map shows only a single structure at this location, suggesting the other structure and the possible windmill had been removed (**Figure 21**). No structures appear on historic maps or aerial photographs after 1963. No evidence of foundations, slabs, cisterns, water troughs, or indicators of a water well head or windmill supports was identified. It appears that any former structural elements have been completely removed.

Site 41KA227 consists of a low-density late nineteenth through twentieth century artifact scatter which might be associated with two former farmstead related structures and possible windmill that are no longer extant. The former structures appear on topographic maps and aerial photographs from 1955 through 1963, after which they appear to have been completely removed. This site also contains a light lithic scatter containing four chert flakes and a single biface fragment. No prehistoric diagnostic artifacts or features were found. Based on field investigations, an archival search, and review of historic maps and aerial photographs, site 41KA227 does not meet NRHP eligibility requirements, nor does it merit designation as a SAL. The site is not associated with events that have made a significant contribution to the broad patterns of prehistory or history; or are associated with the lives of significant persons in our past; or embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or have yielded or may be likely to yield, information important in history. Furthermore, the site does not have the potential to contribute to a better understanding of the prehistory or history of Texas by the addition of new and important information; the site does not display any archeological deposits that are preserved and intact thereby supporting the research potential or preservation interests of the site; the site does not possess unique or rare attributes concerning Texas prehistory or history; the study of the site does not offer the opportunity to test theories and methods of preservation, thereby contributing to new scientific knowledge; and there is not a high likelihood that vandalism and relic collecting has occurred or could occur, and official landmark designation is not needed to insure maximum legal protection, or alternatively further investigations are not needed to mitigate the effects of vandalism and relic collecting when the site cannot be protected. No further archeological work is recommended at site 41KA227.

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Figure 12. 41KA227 Site Map

Table 2. Historic glass fragments identified at 41KA227

Location	Material / Description	Quantity	Date Range / Diagnostic Characteristics
Surface	Colorless bottle/jar body shards	11	ca. 1875 to present[1]
Surface	Amethyst bottle/jar body shards	6	ca. 1880-1920[2]
Surface	Amber bottle/jar body shards	4	ca. 1860 to present[1]
Surface	Opaque white canning jar lid liner shards	2	ca. 1890-1960[1]
Surface	Aqua bottle/jar body shards	2	ca. 1800-1910[1]
Surface	Green bottle/jar body shard	1	ca. 1860 to present[1]
Surface	“Black” bottle/jar body shard	1	ca. 1870s[1]
Surface	Amethyst mineral bottle; tapered finish/ tapered collar fragment[3]	1	ca. 1880-1920[2]
Surface	Amethyst brandy or wine bottle tapered finish/ring collar fragment[3]	1	ca. 1880-1920[2]
Surface	Amethyst bottle grooved ring finish/collar fragment[3]	1	ca. 1880-1920[2]
Surface	Colorless jar external thread rim fragment	1	ca. 1875 to present[1]

[1]IMACS (1992); [2]Lockhart (2006); [3]SHA (2023)

Figure 13. Site overview of 41KA227, facing north

Figure 14. Stamped bricks from surface at 41KA227

Figure 15. Miscellaneous metal fragments from surface at 41KA227

Figure 16. Glass fragments from 41KA227, including amber, colorless, aqua blue, amethyst, and green glass fragments

Figure 17. Undecorated whiteware fragments from surface at 41KA227

Figure 18. Lithic chert flakes from surface at 41KA227

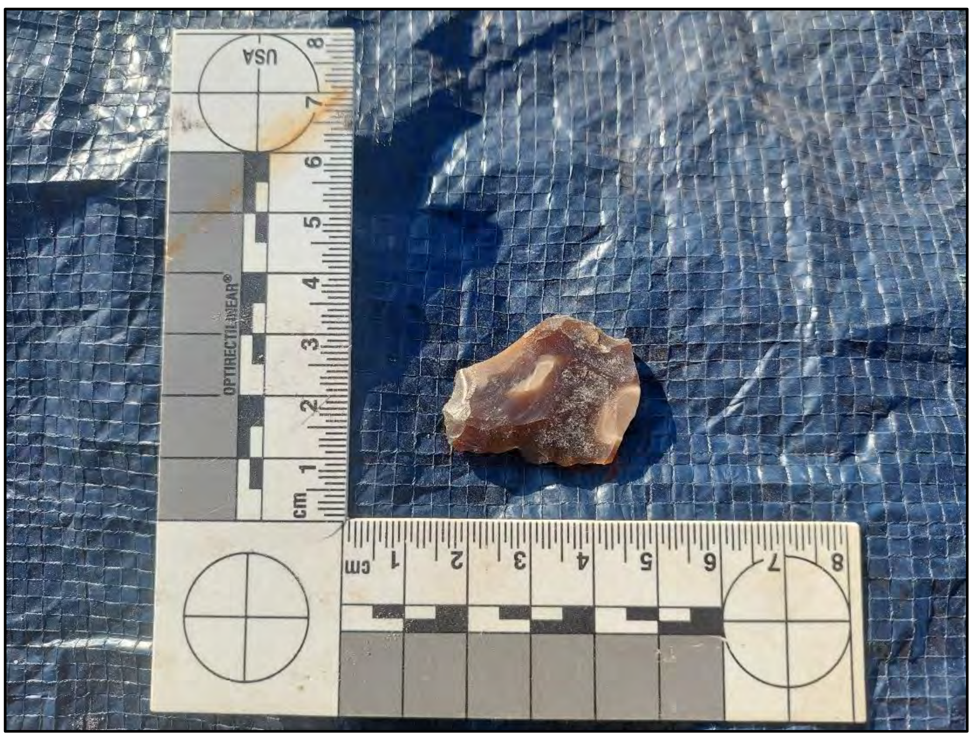

Figure 19. Biface fragment from surface at 41KA227

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Figure 20. 1956 USGS topographic map showing possible former farmstead structures and windmill at 41KA227

Figure 21. 1961 USGS topographic map showing single remaining structure at 41KA227

Historic Site 001

Site 001 consists of the Escondido Creek Watershed FRS No. 12 structure, located on Bucker Creek (see **Figure 11**). The National Inventory of Dams ID number for this dam is TX04315. The site consists of three historic-age resources, Resource 001a, an earthen dam structure, Resource 001b, the principal spillway inlet structure and Resource 001c, the principal spillway outlet drainage pipe. The site was constructed as part of the Escondido Creek Watershed Work Plan under the authority of the Soil Conservation Act of 1935 as implemented by the Watershed Protection item in the Department of Agriculture Appropriation Act of 1954 (URS Corporation 2014). The National Inventory of Dams records a 1974 construction date for Resources 001a-c. Site 001 is situated on an original land grant of 1,476 acres bestowed to Jackson A. Davis as Abstract 88, in File 53 of the Karnes County records. The land was patented by Davis's heirs on September 9, 1848, under Patent No. 616, Patent Volume 6, Certificate 284.

Resource 001a

Resource 001a consists of an earthen-filled embankment dam designed for flood control (**Figure 22**). The resource is grass-covered and measures 2,667 ft in length with an embankment height of 343.3 ft. Resource 001a appears to retain all aspects of integrity. However, the resource is a common example of its type and does not exhibit exceptional architectural or engineering merit, or historical significance and is recommended Not Eligible for NRHP or SAL listing.

Figure 22. View of the top of Resource 001a, looking northwest

Resource 001b

Resource 001b is a Principal Spillway Inlet Riser and functions to convey water so that outflow from the reservoir can be regulated (**Figure 23**). Resource 001b is constructed of concrete and rises from the base of the reservoir on the northeast side. A Principal Spillway Outlet pipe (Resource 001c) extends from the base of the Spillway Inlet structure, beneath the dam and protrudes from the opposite of the dam to serve the Principal Spillway. The structure is open on the top and on the southeast and northwest sides to allow water to enter. Metal bars extend across these openings to limit the entry of debris into the structure. The northeast and southwest sides of the structure are solid concrete. A manual metal gate valve with a turn wheel is present on the west side of the structure to regulate the flow of water into the structure.

Resource 001b appears to retain all aspects of integrity. However, the resource is a common example of its type and does not exhibit exceptional architectural or engineering merit, or historical significance and is recommended Not Eligible for NRHP or SAL listing.

Figure 23. View of Resource 001b, looking northwest

Resource 001c

Resource 001c is a concrete-lined steel cylinder pipe that rests in a concrete cradle support (**Figure 24**). The pipe functions as a Principal Spillway Outlet drainage structure. The outlet structure is used to regulate overflow from the reservoir when water from the reservoir passes through the Principal Inlet Structure (Resource 001b), into the outlet pipe under the dam to empty into the earthen Principal Spillway.

Resource 001c appears to retain all aspects of integrity. However, the resource is a common example of its type and does not exhibit exceptional architectural or engineering merit, or historical significance and is recommended Not Eligible for NRHP or SAL listing.

Figure 24. View of Resource 001c, looking northeast

5.3 Geomorphic Assessment

A geomorphic field assessment was performed to determine whether deeply buried and intact cultural materials may be present in the APE that could be impacted by the project. The assessment evaluated the soil-geomorphic setting and depositional environments, the age and lithology of the soil parent materials, the types of active pedogenic site formation processes, and the anticipated depth of impacts from the project.

The project would take place primarily within areas underlain by the Monteola, Pernitas, Sarnosa, Coy, and Schattel soil series. These soils are on uplands and hillslopes and flank the drainageway sideslopes; they formed in residuum weathered from Miocene-age sandstone, clay, and mud. Shovel tests within these soils that revealed brown (10YR 4/2-4/3) and dark brown (10YR 3/3) sandy loam and sandy clay loam overlying a shallow compacted argillic horizon. These soils tend to be thin (e.g., <30 cm deep), sandy to loam, frequently eroded to clay subsoil, and bioturbated. This was confirmed by numerous shovel tests throughout the APE, which encountered sandy clay Bt subsoil horizons at relatively shallow depths. The well-developed argillic subsurface horizons meet the central requirements of Alfisol classification, wherein weathering and translocation of phyllosilicate clays from upper soil horizons contributes to the Bt horizons in the lower profile (Soil Survey Staff 2010). Depending on local conditions, such as mean annual precipitation and parent materials, the formation of an argillic horizon is time-dependent and can require thousands to tens of thousands of years for such pedogenic features to form (e.g., clay skins, strong prismatic structure, reddish (rubified) soils (Hallmark and Franzmeier 1999). Within the APE these shallow soils have been previously impacted by excavations of the auxiliary spillway during dam construction, as well as other ongoing ranching and industrial activities. Based on the age, genesis, and geomorphic setting of these soils, the potential for buried and intact archeological materials is low.

Buchel and Clareville floodplain soils are described as recent (Holocene) in age and are confined to a shallow, low-gradient erosional drainageway below the dam drainage outlet channel and impact basin, and beneath the current inundation area behind the dam. Shovel tests in drainageway soils below the dam revealed calcareous and shallow (10 to 50 cm deep) grayish brown (10YR 5/2), dark gray (10YR 4/1), and brown (10YR 4/3) silty clay loam and silty clay over compacted clay subsoil. Due to the lack of active sediment deposition and prior disturbances to this disturbed, narrow, and low relief outlet channel, there is no potential for deep artifact burial and preservation. Based on the foregoing observations, it is our assessment that the project is not likely to impact deeply buried and/or intact archeological deposits within the APE. Therefore, no backhoe trenching is recommended.

6 Summary and Recommendations

AECOM conducted a cultural resources survey in support of a Supplemental Watershed Plan for the rehabilitation of the Escondido Creek Watershed FRS 12, within a 173-acre APE, located in Karnes County Texas. The survey was performed under Texas Antiquities Permit No. 31325 and included a 100 percent pedestrian survey supplemented with 86 shovel tests.

One archeological site (41KA227) containing a low-density historic and prehistoric artifact scatter was identified during the survey. The field survey also recorded one historic-age resource site, which is the FRS 12 dam, constructed in 1974. Based on background review and field investigations, both sites are recommended as Not Eligible for listing in the NRHP or designation as SALs.

A geomorphic assessment determined that the project is not likely to impact deeply buried and/or intact archeological deposits within the APE. This conclusion is based on a combination of observations, including the overall geomorphic setting, age and lithology of the soil parent materials, the shallow depths of anticipated construction activities, prior disturbances from dam construction, and a lack of buried archeological materials. No backhoe trenching is recommended for this project.

AECOM recommends that the proposed project should have No Effect on properties included in, or eligible for inclusion in, the NRHP, or that merit designation as SALs, and that construction should proceed without further cultural resources investigations. However, if the dimensions of the project area change, additional archeological and historical investigations may be warranted.

If previously undiscovered sites are found during construction, appropriate actions should be taken in accordance with the Prototype Programmatic Agreement between the United States Department of Agriculture, Texas NRCS State Office, and the Texas SHPO, as well as the National Programmatic Agreement among NRCS, the National Conference of SHPOs, and the Advisory Council on Historic Preservation, and NRCS General Manual 420, Part 401 guidance.

If any unmarked prehistoric or historic human remains or burials are encountered at any point during the project, the area of the remains is considered a cemetery under current Texas law and all construction activities must cease immediately to avoid impacting the remains. The THC must be notified immediately by contacting the Archeology Division at (512) 463-6096. All cemeteries are protected under State law and cannot be disturbed. Further protection is provided in Section 28.03(f) of the Texas Penal Code, which provides that intentional damage or destruction inflicted on a human burial site is a state jail felony.

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APPENDIX A – SHOVEL TEST LOG

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
1	0-20 20-30	10YR 6/3 10YR 6/3	Pale brown Pale brown	Silt loam Silt clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
2	0-20 20-30	10YR 6/3 10YR 6/3	Pale brown Pale brown	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
3	0-8 0-30	10YR 4/2 10YR 4/1	Dark grayish brown Dark gray	Silty clay loam Silty clay	- <2% calcium carbonate	Dry / Compacted; terminated at subsoil
4	0-33	10YR 4/1	Dark gray	Sand loam	-	Terminated at bedrock
5	0-31 31-42	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
6	0-14 14-26	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay loam	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
7	0-4 4-14	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay loam	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
8	0-10 10-20	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay loam Sandy clay	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
9	0-8	10YR 6/2	Light brownish gray	Silty clay loam	-	Terminated at compaction

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
10	0-10	10YR 5/2	Grayish brown	Silty clay loam		Terminated at compaction
11	0-45 45-55	10YR 4/1 10YR 4/1	Dark gray Dark gray	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
12	0-21 21-38	10YR 4/3 10YR 6/3	Brown Pale brown	Silty clay loam Clay loam	- <5% calcium carbonate	Dry/ Compacted; terminated at subsoil
13	0-14	10YR 6/3	Pale brown	Silty clay loam	<1% calcium carbonate	Dry/ Compacted; terminated at subsoil
14	0-17 17-40	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay loam	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
15	0-52 52-63	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
16	0-10 10-20	10YR 6/2 10YR 6/2	Light brownish gray Light brownish gray	Silty clay loam Silty clay	- <1% calcium carbonate	Terminated at compaction
17	0-40 40-50	10YR 4/1 10YR 4/1	Dark gray Dark gray	Silty clay loam Silty clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
18	0-10 10-20	10YR 4/2 10YR 4/1	Dark grayish brown	Silty clay loam	-	Dry/ Compacted;

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
			Dark gray	Silty clay	<1% calcium carbonate	terminated at subsoil
19	0-30 30-40	10YR 4/2 10YR 4/1	Dark grayish brown Dark gray	Silty clay loam Silty clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
20	0-3 3-13	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Clay loam Clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
21	0-40 40-45	10YR 3/2 10YR 4/1	Very dark grayish brown Dark gray	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
22	0-10 10-20	10YR 3/2 10YR 4/1	Very dark grayish brown Dark gray	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
23	0-35 35-50	10YR 4/2 10YR 4/1	Dark grayish brown Dark gray	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
24	0-33 33-44	10YR 4/2 10YR 4/3	Dark grayish brown Brown	Sandy loam Sandy clay loam	<1% calcium carbonate <5% calcium carbonate	Dry/ Compacted; terminated at subsoil
25	0-5 5-10	10YR 3/2 10YR 4/1	Very dark grayish brown Dark gray	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
26	0-40	10YR 2/1	Black	Silty clay loam	-	Dry/ Compacted;

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	40-50	10YR 3/1	Very dark gray	Silty clay	<5% calcium carbonate	Terminated at subsoil
27	0-35 35-45	10YR 4/2 10YR 4/1	Dark grayish brown Dark gray	Silty clay loam Silty clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
28	N/A	N/A	N/A	N/A	N/A	Man Made Levee
29	0-8 8-19	10YR 6/3 10YR 6/1	Pale brown Gray	Silty clay loam Silty clay	- <10% calcium carbonate	Dry/ Compacted; terminated at subsoil
30	0-19 19-33	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy clay loam Clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
31	0-5 5-15	10YR 6/3 10YR 6/3	Pale brown Pale brown	Sandy loam Sandy clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
32	0-10 10-20	10YR 4/1 10YR 4/1	Dark gray Dark gray	Silty clay Silty clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
33	0-19 19-34	10YR 4/2 10YR 4/3	Dark grayish brown Brown	Sandy clay loam Sandy clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
34	0-5 5-25	10YR 3/1 10YR 4/2	Very dark gray Dark grayish brown	Silt loam Silty clay	- <5% calcium carbonate	Dry/ Compacted; terminated at subsoil

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
35	0-20 20-30	10YR 6/3 10YR 6/3	Pale brown Pale brown	Silty clay loam Siltyy clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
36	0-10 10-30	10YR 6/3 10YR 5/1	Pale brown Gray	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
37	0-33 33-46	10YR 4/2 10YR 4/3	Dark grayish brown Brown	Sandy loam Sandy clay loam	<1% calcium carbonate <5% calcium carbonate	Dry/ Compacted; terminated at subsoil
38	0-10 10-30	10YR 6/3 10YR 6/3	Pale brown Pale brown	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
39	0-19 19-36	10YR 4/2 10YR 4/3	Dark grayish brown Brown	Sandy clay loam Sandy clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
40	0-38 38-54	10YR 4/3 10YR 5/3	Brown Brown	Sandy clay Sandy clay loam	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
41	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
42	0-15 15-25	10YR 6/3 10YR 6/3	Pale brown Pale brown	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
43	0-32 32-39	10YR 4/2 10YR 3/1	Dark grayish brown Very dark gray	Sandy loam Sandy clay loam	<1% calcium carbonate <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
44	0-24 24-44	10YR 4/3 10YR 3/2	Brown Very dark grayish brown	Sandy clay loam Clay loam	<1% calcium carbonate <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
45	0-35 35-45	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
46	0-34 34-58	10YR 4/2 10YR 6/2	Dark grayish brown Light brownish gray	Sandy loam Sandy clay loam	<5% calcium carbonate <30% calcium carbonate	Dry/ Compacted; terminated at subsoil
47	0-28 28-46	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay loam	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
48	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
49	0-9 9-36	10YR 4/2 10YR 4/3	Dark grayish brown Brown	Sandy clay loam Sandy clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
50	0-34 34-45	10YR 4/3 10YR 6/3	Brown Pale brown	Sandy loam Sandy loam	<3% calcium carbonate	Dry/ Compacted; terminated at subsoil

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
					<5% calcium carbonate	
51	0-32 32-46	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay loam	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
52	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
53	0-35 35-45	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
54	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Sandy clay Sandy clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
55	0-20 20-30	10YR 4/1 10YR 4/1	Dark gray Dark gray	Sandy clay Sandy clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
56	0-4 4-14	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy clay loam Clay loam	- <5% calcium carbonate	Dry/ Compacted; terminated at subsoil
57	0-26 26-37	10YR 4/3 10YR 5/2	Brown Grayish brown	Sandy clay loam Sandy clay	<2% calcium carbonate <5% calcium carbonate	Dry/ Compacted; terminated at subsoil
58	0-36 36-54	10YR 4/3 10YR 4/2	Brown Dark grayish brown	Sandy loam Sandy clay loam	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
59	0-25 25-35	10YR 4/3 10YR 4/3	Brown Brown	Silty clay Silty clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
60	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
61	0-10	10YR 4/1	Dark gray	Silty loam	<2% calcium carbonate	-
62	0-10	10YR 6/2	Pinkish gray	Sandy loam	<10% caliche	Terminated at caliche
63	0-20 20-32	10YR 3/2 10YR 4/1	Very dark grayish brown Dark gray	Sandy clay Clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
64	0-33 33-42	10YR 4/3 10YR 3/2	Brown Very dark grayish brown	Sandy clay loam Sandy clay	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
65	0-27 27-39	10YR 3/3 10YR 3/2	Dark brown Very dark grayish brown	Sandy clay loam Sandy clay	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
66	0-30 30-40	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
67	0-40 40-50	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
68	0-15 15-25	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
69	0-40 40-50	10YR 4/1 10YR 4/1	Dark gray Dark gray	Silty clay Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
70	0-25 25-35	10YR 3/3 10YR 3/2	Dark brown Very dark grayish brown	Sandy clay loam clay loam	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
71	0-8 8-22	10YR 4/2 10YR 3/2	Dark grayish brown Very dark grayish brown	Sandy clay Sandy clay	- <2% calcium carbonate	Delineation; terminated at subsoil
72	0-30 30-56	10YR 4/3 10YR 3/2	Brown Very dark grayish brown	Sandy clay loam Sandy clay	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
73	0-18 18-37	10YR 3/2 10YR 4/3	Very dark grayish brown Brown	Sandy loam Sandy clay loam	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
74	0-10 10-30	7.5YR 2.5/1 7.5YR 2.5/1	Black Black	Silty clay loam Silty clay	- <1% calcium carbonate	Dry/ Compacted; terminated at subsoil
75	0-19 19-36	10YR 4/3 10YR 3/3	Brown Dark brown	Sandy loam Sandy clay loam	- <2% calcium carbonate	Dry/ Compacted; terminated at subsoil
76	0-39	10YR 4/3	Brown	Sandy loam	-	Dry/ Compacted;

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
	39-49	10YR 3/3	Dark brown	Sandy clay loam	<2% calcium carbonate	terminated at subsoil
77	0-24 24-49	10YR 3/3 10YR 3/2	Dark brown Very dark grayish brown	Sandy clay loam clay loam	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
78	0-34 34-45	10YR 6/3 10YR 5/2	Pale brown Grayish brown	Sandy loam Sandy clay	- <3% calcium carbonate	Dry/ Compacted; terminated at subsoil
79	0-25 25-30	10YR 6/3 10YR 5/2	Pale brown Grayish brown	Sandy loam Sandy clay	-	Dry/ Compacted; terminated at subsoil
80	0-20 20-35	10YR 6/3 10YR 5/2	Pale brown Grayish brown	Sandy loam Sandy clay	-	Dry/ Compacted; terminated at subsoil
81	0-15 15-25	10YR 6/3 10YR 5/2	Pale brown Grayish brown	Sandy loam Sandy clay	-	Dry/ Compacted; terminated at subsoil
82	0-20 20-30	10YR 6/3 10YR 5/2	Pale brown Grayish brown	Sandy loam Sandy clay	-	Dry/ Compacted; terminated at subsoil
E1	0-20	10YR 4/1	Dark gray	Silty loam	-	Delineation; terminated at subsoil
W1	0-10 10-20	10YR 4/3 10YR 3/3	Brown Dark brown	Sandy clay loam Sandy clay	- -	Delineation; terminated at subsoil -
S1	0-25 25-36	10YR 4/3 10YR 3/3	Brown Dark brown	Sandy clay loam Sandy clay	- -- -	Delineation; terminated at subsoil - -

Shovel Test	Depth (cm)	Munsell	Soil Color	Soil Texture	Inclusions	Comments
N1	0-8 8-32	10YR 4/3 10YR 3/3	Brown Dark brown	Sandy clay loam Sandy clay	- -- -	Delineation; terminated at subsoil - -

Ahr, Steven

From: noreply@thc.state.tx.us
Sent: Thursday, January 04, 2024 12:34 PM
To: Ahr, Steven; reviews@thc.state.tx.us
Subject: Archeological Survey for the Rehabilitation of Escondido Creek FRS No. 12

TEXAS HISTORICAL COMMISSION
real places telling real stories

Re: Project Review under Section 106 of the National Historic Preservation Act and/or the Antiquities Code of Texas
THC Tracking #202404232
Date: 01/04/2024
Archeological Survey for the Rehabilitation of Escondido Creek FRS No. 12 (Permit 31325)
Karnes County
Kenedy,TX

Description: Rehabilitation of Escondido Creek Watershed Floodwater Retarding Structure #12

Dear Steven Ahr:
Thank you for your submittal regarding the above-referenced project. This response represents the comments of the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission (THC), pursuant to review under Section 106 of the National Historic Preservation Act and the Antiquities Code of Texas.

The review staff, led by Caitlin Brashear and Mary Galindo, has completed its review and has made the following determinations based on the information submitted for review:

Above-Ground Resources

- No historic properties are present or affected by the project as proposed. However, if historic properties are discovered or unanticipated effects on historic properties are found, work should cease in the immediate area; work can continue where no historic properties are present. Please contact the THC's History Programs Division at 512-463-5853 to consult on further actions that may be necessary to protect historic properties.

Archeology Comments

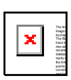
- No historic properties affected. However, if cultural materials are encountered during construction or disturbance activities, work should cease in the immediate area; work can continue where no cultural materials are present. Please contact the THC's Archeology Division at 512-463-6096 to consult on further actions that may be necessary to protect the cultural remains.
- THC/SHPO concurs with information provided.
- This draft report is acceptable. To facilitate review and make project information and final reports available through the Texas Archeological Sites Atlas, we appreciate submission of tagged pdf copies of the final report including one restricted version with all site location information (if applicable), and one public version with all site location information redacted; an online abstract form submitted via the abstract tab on eTRAC; and survey area shapefiles submitted via the shapefile tab on eTRAC. For questions on how to submit these please visit our video training series at: https://www.youtube.com/playlist?list=PLONbbv2pt4cog5t6mCqZVaEAx3d0MkgQC Please note that these steps are required for projects conducted under a Texas Antiquities Permit.

We have the following comments: Prior to submitting the final report, please revise the shovel test table so that it captures the termination reason. In the text of the report it is clear that you terminated shovel tests at subsoil or bedrock, but the table doesn't contain this same information.

We look forward to further consultation with your office and hope to maintain a partnership that will foster effective historic preservation. Thank you for your cooperation in this review process, and for your efforts to preserve the irreplaceable heritage of Texas. If the project changes, or if new historic properties are found, please contact the review staff. If you have any questions concerning our review or if we can be of further assistance, please email the following reviewers: caitlin.brashear@thc.texas.gov, Mary.Galindo@thc.texas.gov.

This response has been sent through the electronic THC review and compliance system (eTRAC). Submitting your project via eTRAC eliminates mailing delays and allows you to check the status of the review, receive an electronic response, and generate reports on your submissions. For more information, visit http://thc.texas.gov/etrac-system.

Sincerely,



for Mark Wolfe, State Historic Preservation Officer
Executive Director, Texas Historical Commission

Please do not respond to this email.

AECOM
13640 Briarwick Drive
Austin, TX 78729
aecom.com

Project name:
Escondido Creek FRS No. 12 SWP-EA,
Karnes County, TX

Project ref:
60707508

To:
Monica Wedo, PE (AECOM)

CC:

Sergio Teran, PG (AECOM)
Charlie Krolikowski, PE (AECOM)

From:
Mariana Jaimes, PE (AECOM)
Lance Finnefrock, PE, GE (AECOM)

Date:
November 16, 2024

Technical Memorandum

Subject: Recommended Geologic Input Parameters for SITES Analysis

1. Project Information

1.1 Project Information

A dam assessment report was prepared in 2014 for Escondido Floodwater Retarding Structure (FRS) No. 12 (Escondido 12) by AECOM. As a result of that study, the dam was reclassified as a high hazard dam. The existing dam does not meet current National Resources Conservation Service (NRCS) criteria for high hazard performance and dam safety standards.

The 2014 assessment included several potential rehabilitation alternatives to meet high hazard performance and safety standards ranging from decommissioning to rehabilitation of the dam. The San Antonio River Authority (River Authority) contracted with AECOM to further evaluate these alternatives and other potential alternatives given review of current conditions in Supplemental Watershed Plan No. V - Environmental Assessment (SWP-EA) which was submitted to the River Authority under separate cover.

1.2 Purpose and Scope

Alternatives evaluations typically require analysis of the existing vegetated auxiliary spillway(s) (ASW) for hydraulic capacity and erodibility/potential breaching during design storm event. Hydraulic analysis and design of vegetated earthen spillways for dams are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event.

The purpose of this memorandum is to provide recommendations for geologic input parameters to be used in hydraulic and erodibility analyses of the existing vegetated ASW channel using SITES software for this project.

2. Site Description

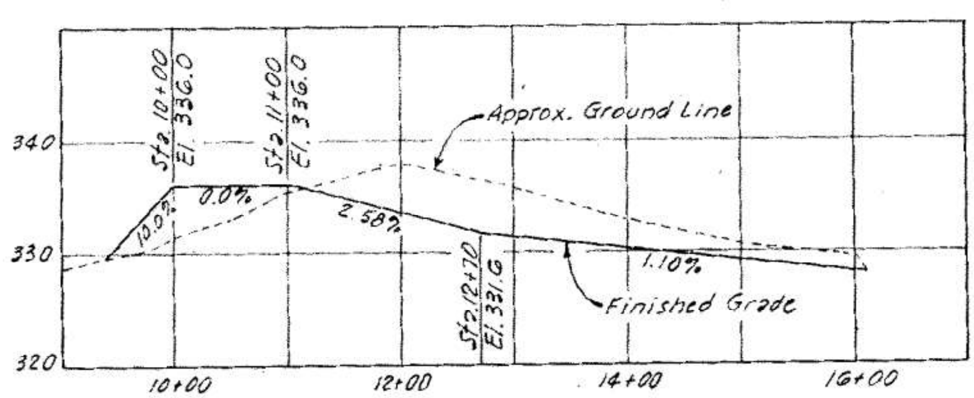
Escondido 12 is located on Bucker Creek, a tributary to Escondido Creek, and a tributary to the San Antonio River, approximately 4.0 miles south of Karnes City, Texas. Global positioning system (GPS) coordinates for the site are latitude 28.830277° and longitude -97.922811°.

Site access is available via an unimproved road off FM 1353, approximately 1 mile northeast of the intersection of FM 1353 and County Road 167 in Karnes County, Texas. Within the site, access is primarily via pastures and unimproved roads. A map of the site is provided as **Figure 1**.

2.1 Existing Dam and Spillway

Escondido 12 was designed and constructed as a low hazard dam in 1974. The dam has an estimated drainage area of approximately 3,904 acres and a total reservoir capacity estimated at 1,844 acre-feet (maximum storage). Escondido 12 was recently reclassified as a high hazard structure and does not meet the current dam design and safety requirements.

According to the as-built drawings, the dam is approximately 34 feet tall at the maximum section and is approximately 2,667 feet long. The crest was built to maximum elevation (El). 343.4* feet in the central portion of the creek valley (including over-build to compensate for post-construction settlement) and tapered to El. 342.2* feet and El. 342.4* feet at the left and right abutments, respectively. The upstream and downstream slopes of the embankment were constructed at an inclination of 2.5H:1V (horizontal:vertical). A 12-foot-wide wave protection berm was constructed on the upstream slope at approximately El. 320.6* feet. A 14-foot-wide berm was constructed on the downstream slope at El. 318.13*. The width of the embankment crest is approximately 14 feet. The dam features a vegetated ASW at the right abutment and a principal spillway (PSW) near the near the original creek alignment. The PSW consists of a drop inlet, four low-level ports with invert El. 322.6* feet, a conduit under the dam, and a rock riprap lined downstream plunge basin. Five (5) anti-seep collars spaced at 24 feet on center are also present.



PROFILE ON ℄ OF EMERGENCY SPILLWAY

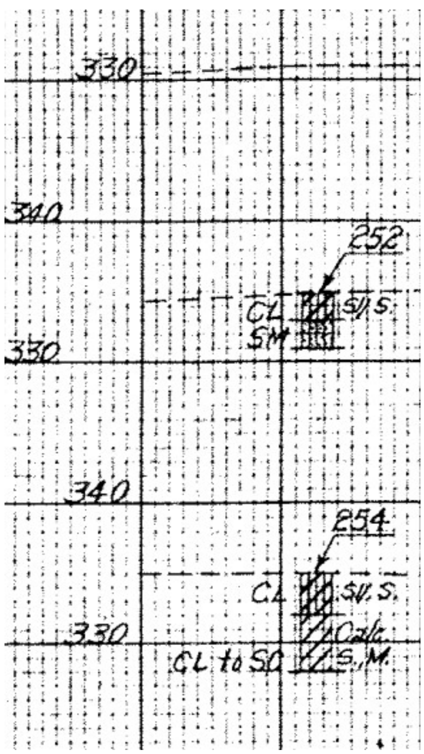
The dam features a vegetated ASW at the right abutment. The existing ASW channel is 300 feet wide and approximately 650 feel long. The ASW crest section is 100 feet long and at Elevation (El.) 336.13* feet according to the North American Vertical Datum of 1988 (NAVD88). The as-built drawings (SCS, 1974) provide limited information on grading of the ASW entrance channel slope, but appears to slope down from the crest at 10% grade in the upstream direction to tie into original ground surface line. The drawings indicate the auxiliary spillway crest

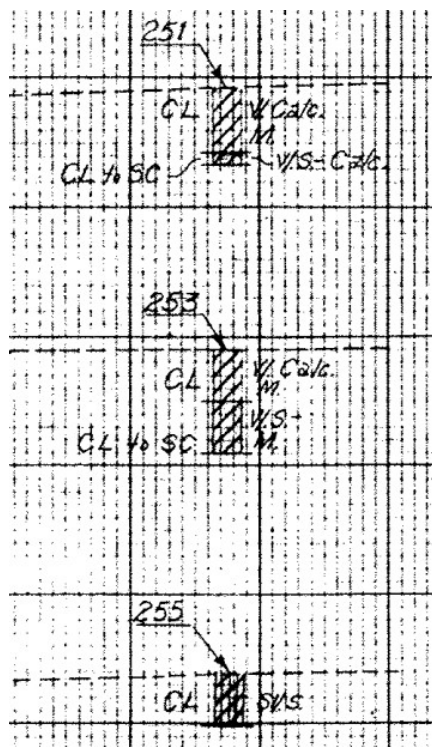
* Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29) and were converted to NAVD88 for the purposes of this report. Conversion from NGVD29 to NAVD88 is +0.134 feet.

was mostly constructed from earthfill having a maximum thickness of about 9.5 feet at the upstream/interior side of the channel. The ASW design is uncommon in that the spillway crest consists of predominantly fill instead of being cut into the abutment, and the earthfill forming the spillway crest is integral with the dam embankment earthfill. The design of the ASW presumably was to provide adequate clearance and soil cover for a pre-existing 18-inch-diameter buried pipeline shown in the as-built drawings that crosses the ASW parallel to the crest.

The fill material source and compaction criteria for the ASW crest was not specified in the as-built drawings (SCS, 1974), but it is likely that material excavated from other areas of the ASW construction were used as the fill source. Further, the 1964 watershed work plan (SCS) indicates that materials excavated from the ASW were suitable for use as fill. Stick logs of borings completed in the ASW during the original GI included in the as-built drawings (SCS, 1974) describe soils in the ASW as interbedded layers of native sandy clays and clayey sands (CL, SC) that are calcareous and very slightly silty.

The ASW exit channel is oriented through the edge of a topographic knoll, where pre-construction ground surface was higher near the middle of the channel and lower at the upstream and downstream ends. The first 170 feet of the exit channel (ASW Sta. 11+00 and Sta. 12+70) was constructed at a 2.58% grade by placing up to 5 feet of earthfill on the interior (dam) side of the channel and excavating up to 5 feet into native clay and sand on the exterior (abutment) side of the channel. at the last 330± feet of the channel was constructed at 1.1% grade to the channel's termination where it ties into original ground surface by excavating to depths ranging from 1 to 4.5 feet which generally decreased going downstream. For reference, the as-built ASW spillway profile is shown in the image below as well as the stick logs provided in the as-built drawings for the auxiliary spillway.





2.2 Spillway Historical Performance

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2013, 2017, and 2021 inspections (TCEQ for San Antonio River Authority, 2013, San Antonio River Authority, 2017 and 2021;) reported that the spillway was in good condition. The most recent inspection report available to AECOM for review was completed in 2021. The 2021 annual inspection (San Antonio River Authority) reported sparse vegetation in some areas of the auxiliary spillway as a result of droughts. No other adverse conditions were noted.

2.3 Proposed Improvements

The prior dam assessment performed at Escondido 12 (AECOM, 2014) offered several alternatives to mitigate identified dam safety deficiencies associated with the reclassification of the dam as a high hazard structure. The alternatives offered included controlled dam breach and decommissioning, relocation of downstream facilities out of the breach impact area, and dam rehabilitation. The proposed improvements to Escondido 12 as part of the rehabilitation option from the 2014 Dam Assessment of Escondido 12, with elevations correct to NAVD88, included:

- Raising the crest elevation (El.) of the dam embankment by approximately 3.8 feet from elevation 342.1 feet to El. 345.9 feet;
- Raising the auxiliary spillway crest 1.5 feet from El. 336.0 feet to El. 337.5 feet;
- Widening the auxiliary spillway crest an additional 200 feet from 300 feet to 500 feet wide;
- Flattening the upstream and downstream embankment slopes from 2.5H:1V (horizontal: vertical) to 3H:1V;
- Replacing the existing 42-inch principal spillway (PSW) conduit with a new 60-inch diameter conduit; and
- Replacing the principal spillway inlet/outlet structures.

The purpose of the SWP-EA (AECOM, 2024) was to further evaluate alternatives, including an alternative for watershed structure rehabilitation of Escondido Creek 12. As a result of this work, the proposed improvements recommended for the high hazard rehabilitation of the dam have been modified to include the following:

- Maintaining the existing 42-inch principal spillway system;
- Installing a new principal spillway system consisting of an inlet tower with crest at elevation 325.1 feet and a 42-inch reinforced concrete pipe (RCP) conduit discharging into an impact basin;
- Installing a 180-foot-wide, five-cycle labyrinth weir structural spillway over the existing embankment with crest set at elevation 338.2 feet and concrete chute discharging into a concrete stilling basin;
- Regrading the inlet and outlet channels of the existing 300-foot-wide vegetated auxiliary spillway and raising the crest by 2.6 feet to elevation 338.7 feet;
- Flattening the downstream embankment slope to 3H:1V;
- Abandoning the existing trench drain in place and installing a new toe drain at the downstream toe;
- Installing rock riprap at the upstream dam embankment slope;
- Raising the top of dam elevation to elevation 345.30 feet (3.1 feet raise); and
- Extending the cutoff trench below the extended dam embankment.

3. Subsurface Information

3.1 Site Geology

Most of the auxiliary spillway and parts of the dam embankment are mapped as underlain by the Catahoula Formation (Oc). The Catahoula Formation is composed of volcanic-clastic deposits interbedded with fluviatile sediments and is further described by Anders (1962) as consisting predominately of tuff, tuffaceous clay, sandy clay, bentonitic clay, and discontinuous lenses of sandstone. According to Chowdhury and Turco (2006), the Catahoula Formation consists of approximately 60 percent volcanic material and 30 percent sandstone. The formation has local thickness of approximately 350 feet (Brown et. al, 1975). A map of the site is provided as **Figure 1**.

Alluvium (Qal) of the Holocene Epoch is mapped downstream of the principal spillway, along the banks of Bucker Creek, and along the central portion of the dam embankment. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Alluvium deposits are typically organized as point bars, natural levees, stream channels, or backswamps.

The Miocene-aged Oakville Sandstone (designated as "Mo") is mapped near the dam abutments. This formation is geologically older than the Catahoula Formation and is, therefore, identified in areas of higher elevations along the dam site. The Oakville Sandstone Formation consists of sandstone and clay with thickness of 300 to 500 feet (Adams et. al 1981; Baker 1979). Per the geologic map, the sandstone intervals are described as thickly bedded, medium grained, and calcareous with some crossbedding while the clay intervals are described as yellow-gray and calcareous. Anders (1962) describes the Oakville Sandstone as cross-bedded medium to fine grained sand and sandstone and sandy, ashy, and bentonitic clay beds with the base of the Oakville dipping gulfward at an average of 85 feet per mile. The Oakville Sandstone contains fossil wood, chert, and quartz gravels, with some vertebrate fossils and reworked Cretaceous invertebrate fossils (Adams et. al 1981; Baker 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is montmorillonite with variable amounts of kaolinite and subordinate illite.

It should be noted that while recent geologic mapping appears to suggest that the ASW of Escondido 12 is underlain by the Catahoula Formation, the original classification of the site subsurface as the Oakville Sandstone Formation is maintained here forth because the resolution of available geologic maps is not considered sufficient, without further studies which presently are not included in AECOM's scope of work, to allow for precise differentiation between the two formations.

3.2 Soil Maps

The NRCS Survey database (NRCS, 2023) was examined to identify near-surface soil mapping of the site (i.e., approximately upper 7 feet). The mapped soil types in the vicinity of the dam are largely described as Alluvium/Residuum resulting from in-place weathering of the parent bedrock. The Alluvium is generally mapped south-southwest (upstream) of the site within the low-lying areas of the valley, at the southern section of the ASW, and north (downstream) of the dam. Residuum is mapped along the northern segment of the ASW and east of the dam embankment. Note that the ASW was excavated approximately 0.5 foot to 5 feet along the centerline for over 500 feet of the ASW channel removing surficial soils.

It should also be noted that while the NRCS soil survey mapping shows both alluvium and residuum within the ASW channel, it does not include fill. The discrepancy between the as-built drawings location of fill and the NRCS soil survey mapping could partially be due to the resolution of the NRCS soil survey mapping influenced by the fact that, as discussed in Section 2.1, the fill material reported was likely sourced from excavations of the ASW channel which could have rendered it roughly indistinguishable (visual-manually) from the native soils.

3.3 Previous Investigations

3.3.1 Soil Conservation Service – 1954 Work Plan, 1964 Work Plan, and As-Built Drawings

The original work plan for Escondido Creek Watershed (SCS, 1954) was developed with the goal of providing flood protection to agricultural lands in the watershed. The 1954 work plan included, but was not limited to, the implementation of 11 floodwater retarding structures all of which were completed in 1957 (SCS, 1964). The 1964 Escondido Creek Watershed Work Plan was developed to provide additional structural measures needed to protect the City of Kenedy and it included the construction of 2 additional floodwater retarding structures, Escondido Creek 12 and Escondido Creek 13, and 0.7 miles of channel improvements (SCS, 1964).

A preliminary geologic investigation of Escondido Creek 12 was completed by the SCS prior to construction of the existing dam, which included surface observations of valley slopes, alluvium, channel banks, exposed geologic formations, and hand auger borings (SCS, 1964). Detailed geologic dam site investigations were made at the 11 sites previously built in the Escondido Creek Watershed and the findings of these investigations along with structure performances were used to inform the proposed design of the two new sites, including that of Escondido Creek 12.

The 1964 Work Plan (SCS, 1964) describes the foundation of the Escondido Creek Watershed dams (including Escondido Creek 12) as consisting primarily of 6 to 12 feet of sandy clay with some clayey and silty sands which are underlain by clays, sands, and sandstones of the Oakville formation. The Oakville formation is further described as containing interbedded silts and clays as well as sand. In addition, the original Watershed Work Plan (SCS, 1954) states that chalk and caliche outcrops are expected to occur on the surface, especially on the tops of hills. Valley slopes were described as principally residual silty clays and sandy clays underlain by beds of clay and sand. The Work Plan included generalized preliminary recommendations for dam design planning. One particular concern was for exposure of sand beds in ASW cuts which were anticipated to be very susceptible to erosion; thus, the 1964 Work Plan (SCS) indicated that spillways of dams built in the Escondido Watershed should be vegetated as soon as possible following construction.

The as-built drawings for Escondido Creek 12 (SCS, 1974) indicate an additional geologic investigation was performed as part of the original dam design. The drawings provide subsurface profiles of the site with boring “stick” logs from the pre-construction investigation with generalized soil types. The investigation consisted of the following:

- 15 borings along the dam centerline (Hole Nos. 1 through 15);
- 5 borings along the principal spillway alignment (Hole Nos. 301 through 303 and Holes Nos. 351 and 352);
- 5 borings along the auxiliary spillway (Hole Nos. 251 through 255);
- 4 borings along the original stream channel (Hole Nos. 451 through 454);
- 17 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 167); and
- 5 borings along the proposed downstream toe of the dam (Hole Nos. 601 through 605);

The complete investigation report containing the Escondido Creek 12 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1973 by the SCS were the only data from the final design geologic investigation available to AECOM and were used to develop a generalized understanding of the subsurface conditions at Escondido Creek 12. Based on this documentation, the existing dam foundation consist of calcareous, medium stiff to stiff, sandy, lean to fat clays (CL, CH) and clayey sands (SC) followed by sandstone described in the geological stick logs as poorly cemented with trace coarse particles with thicknesses of up to 6 inches and interbedded layers of claystone and caliche (indurated calcium carbonate deposits).

The sandstone bedrock was described as having hardness classification of Hd 2 to Hd 3 according to the legacy SCS classification system (SCS, 1974). Sandstone was encountered at depths as shallow as 9 feet below the ground surface (bgs) in centerline borehole No. 4, and at a maximum depth of 20 feet bgs in centerline borehole No. 10. Sandstone bedrock was not encountered in centerline boreholes Nos. 12 through 15 located in the right side of the lower creek valley and valley walls towards the right abutment.

The as-built drawings indicate that the embankment was to be constructed as a zoned earthfill comprised by fine-grained materials. Moderately plastic, silty to sandy clays (CL) and slightly to moderately plastic, very sandy clays (CL) are prescribed in the as-built drawings for the interior Zone 1 of the embankment. The original drawings indicate a maximum allowable particle size of 6 inches for the embankment fill material which was to be placed in uncompacted lifts of 9-inch maximum thickness and be compacted to at least 95% maximum dry density per ASTM D-698. The moisture content prescribed for compaction of the fill material was not legible in the as-built drawings, but seem to indicate above-optimum moisture criteria.

A 4-foot-thick earth blanket was prescribed on the exterior of the dam embankment overlying the Zone 1 materials. This earth blanket zone was specified to consist of the least plastic and least dispersive materials available in accordance with Section 10 of Construction Specification item 23 (not available to AECOM for review). An 18-inch-thick layer of rock riprap was installed on the upstream slope between approximately El. 326.6[*] and El. 320.6[*].

Based on review of Escondido Creek 12 as-built drawings and the available geologic stick logs of borings in the ASW, the spillway channel invert included fills sections with maximum thickness of 9.5 feet thick and excavated sections with a maximum depth of about 5 feet below original grade. The data suggest excavations would have exposed lean clay to sandy lean clay (CL), clayey sand (SC), and some sandy silt (SM) with varying amounts of calcareous material at the channel invert and exterior cut slope of the channel. Earthfill was used to construct the crest section and the upper-left portion of the spillway channel (i.e., where the original grade was less than about El. 334 feet).

No in-situ testing or laboratory testing results on recovered soil and/or rock samples from the original investigation were available to AECOM for review.

Groundwater was identified in several of the original borings drilled typically between 300 and 315 feet in elevation. Groundwater levels may vary over time and may have significant impact on potential auxiliary spillway modifications.

It should be noted that while recent geologic mapping appears to suggest that the ASW of Escondido 12 is underlain by the Catahoula formation, the original classification of the site subsurface as the Oakville formation is maintained here forth because the resolution of available geologic maps is not considered sufficient, without further studies which presently are not included in AECOM's scope of work, to allow for precise differentiation between the two formations.

3.3.2 NRCS – 2021 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on August 5, 2021, by the River Authority as part of the routine dam safety inspections. The inspection identified several deep animal burrows along the dam embankment as well as surface cracking on the downstream slope. Sparse vegetation, aeration activity, and evidence of wind erosion along the dam embankment were also highlighted during the inspection.

Undesirable vegetation was observed near the PSW conduit support cradle and its removal was advised. The PSW and ASW were noted as being in good condition. The ASW was noted as having generally good vegetative cover with some sparse areas. Photographs in the inspection report depicted good vegetative coverage with native grasses throughout the dam.

The 2021 inspection concluded that Escondido 12 was performing as designed and no immediate safety concerns were reported. However, due to urban encroachment and updated TCEQ hydraulic criteria, Escondido 12 qualifies for assistance through the watershed rehabilitation program intended to bring this dam to safety standard for high hazard dams.

3.4 AECOM Preliminary Geologic Investigation

AECOM conducted a preliminary GI of the site to support hydraulic evaluation of the auxiliary spillway and alternatives analysis for the SWP-EA. The GI was conducted June of 2023 in general accordance with the approved Field Investigation and Testing Plan submitted to the River Authority prior to field mobilization. Geologic investigation of the existing ASW was performed to develop recommended geologic input parameters for SITES erodibility analysis. The ASW investigation included four (4) geotechnical test borings in the existing channel designated as 201-23 through 204-23. Boring locations are shown in **Figure 1**. Borings logs, boring locations, and detailed discussion of procedures, findings, and interpretations from the geologic investigation are provided in the preliminary Geologic Investigation Report (GIR) (AECOM, 2024a) prepared as part of the scope of this project.

[*] Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29). Conversion to NAVD88 is +0.134 feet.

Laboratory testing was performed on select samples recovered from the existing auxiliary spillway. Testing included natural moisture content, natural unit weight, Atterberg limits, sieve and hydrometer, unconfined compression (UC) testing, and dispersion testing including crumb and double hydrometer. A summary of the laboratory test methods and results is provided in the Preliminary Soil Mechanics Report (SMR) (AECOM, 2024b).

3.4.1 Generalized Subsurface Stratigraphy

Subsurface conditions encountered in the borings were generally consistent with the published geology, the stick logs included on the as-built drawings (SCS, 1974), and the geological descriptions provided in the Escondido Watershed Workplan (SCS, 1964). The borings encountered interbedded clays, silts, and sands generally overlying interbedded clays. The generalized stratigraphy identified included soils of alluvial and residual origin which were identified in the upper 4 to 6 feet of the borings drilled along the ASW. Below the Alluvium/Residuum stratum, the stratigraphy identified at Escondido 12 included the Oakville Sandy Clay layer from approximately 6 to 15 feet in depth followed by Oakville Sand and Clayey Sand between the approximate depths of 15 and 25 feet and a second clayey stratum, the Oakville Clay, at depths roughly greater than 25 feet. As discussed in Section 3.1, the original classification of the site subsurface as the Oakville Formation, rather than Catahoula Formation, is maintained for the purposes of this memorandum.

A geologic profile of the field data along the existing ASW profile is presented in **Figure 2**. The geologic profile was extended for the proposed auxiliary spillway widening as presented in **Figure 3**, with the existing ground surface and proposed ground surface being updated to reflect the alignment of the proposed widening. The profiles illustrate abridged boring logs indicating field USCS classification, pocket penetrometer values, SPT N-values, and measured groundwater levels (as applicable). For the purposes of spillway erodibility analysis, the following generalized subsurface stratigraphy was assigned for the ASW channel:

1. Existing Fill
2. Alluvium/Residuum
3. Oakville Sandy Clays
4. Oakville Silty and Clayey Sands
5. Oakville Clays

Soils of alluvial and/or residual origin were identified in the upper 4 to 6 feet of the borings drilled along the ASW of Escondido 12. Per the NRCS Websoil Survey, the location of borings 201-23 and 202-23 are mapped as alluvium whereas the locations of borings 203-23 and 204-23 are mapped as residuum. While soils encountered in the upper portion of borings 201-23 and 204-23 were visually similar, there was inconsistency in the remaining borings drilled along the ASW. Additionally, the effects of previous cut/fill grading in the spillway as part of original construction further complicated interpretation of near-surface stratigraphy. As a result, soils of alluvial and/or residual origin identified in the upper 4 to 6 feet were grouped into a single stratum (Alluvium/ Residuum) for ease of evaluating spillway erodibility. The Alluvium/Residuum layer was described as very stiff to hard, grayish brown to black, lean to fat clay (CL, CH) with sand, organics, trace gravel, and calcareous inclusions.

In addition to the NRCS soil survey mapped areas of Alluvium and Residuum within the ASW channel, the as-built drawings (SCS, 1974) indicate that fill material was placed between approximately ASW Sta. 9+45 and Sta. 12+00 to form the ASW approach, part of the ASW crest, and a portion of the ASW channel. While the boreholes drilled as part of this investigation did not conclusively indicate the presence of fill material in the ASW (boring 202-23 was offset to the right side of the spillway where the fill tapers out) the stratigraphy considered in SITES analyses conservatively models fill material along the left inside edge of the ASW, where the existing fill has greatest thickness. Index properties and estimated strength of the fill material used, specified as slightly to moderately plastic, silty, sandy to very sandy clays (CL), were not included in the historical documentation available to AECOM for review; however, it is possible that materials excavated from the ASW channel were used as fill. The 1964 Watershed Work Plan (SCS) corroborates this interpretation by highlighting that lean clays (CL) and clayey to silty sands (SC, SM) excavated from the ASW were suitable for use as fill. However, in absence of formal test results for the fill material used and due to the fact that compacted fill material generally presents different density and strength than native soils, because of the lack of long-term environmental exposure, the existing fill was treated as a separate material from the Alluvium/Residuum layer in analysis.

The geologic investigation encountered Oakville Sandy Clays in each of the borings drilled at depths of about 4 to 6 feet bgs. This unit generally extended to depths of approximately 15 feet bgs. Soil in this stratum were described in the field as light brown to yellowish brown, sandy lean to fat clays (CL, CH) with trace iron oxide staining and gravel. The clayey soils in this stratum were generally calcareous (with reactions to hydrochloric acid ranging from weak to strong), very stiff to hard, and dry to moist.

The Oakville Silty and Clayey Sands was typically present in the depth interval between 14 and 28 feet bgs and were characterized as clayey to silty sands (SC, SM) with alternating clayey seams. The sandy soils in this stratum were generally pale to yellowish brown, fine to medium grained, dense to very dense, and varied from dry to moist. In boring 204-23, Oakville sandstone was identified below approximately El. 316 feet; however, no recovery was achieved in the cores attempted. The lack of recovery could possibly be indicative of poorly-indurated bedrock and/or high degrees of weathering of the bedrock into sandy materials such as those observed in this stratum in the other nearby borings drilled during the field GI.

The Oakville Clays were encountered below the Oakville Silty and Clayey Sands depths ranging from about 16 to 28 feet bgs(roughly below El. 305 to 310 feet). This stratum was encountered in borings 201-23 through 203-23; boring 204-23 was terminated just above El. 310 feet and did not encounter the Oakville Clays. Soils encountered in this stratum were described as stiff to hard, moist, fat clay (CH) with medium to coarse grained sand, calcareous gravel, iron oxide staining, and mostly weak to moderate reaction to hydrochloric acid.

3.4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were added to boring(s) in which rock coring was attempted but levels were not measured. Boreholes were backfilled with cement bentonite grout at the end of drilling; as a result, subsequent delayed water level readings were not recorded.

The preliminary geologic investigation did not include the installation of piezometers for monitoring groundwater levels over time. It should be noted that groundwater levels may vary over time and may have a significant impact on potential dam modifications.

4. Geotechnical Analysis of Auxiliary Spillway Erodibility

4.1 Analysis Methodology

Development of recommended material parameters for SITES analysis was performed according to the guidance provided in the *National Engineering Handbook, 210-VI-NEH, Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index* (NRCS, 2001) and the accompanying *DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons* (NRCS, 2011).

The primary SITES input parameter is the empirical headcut erodibility index (K_h). The K_h is calculated based on Equation 1:

$$K_h = M_S \cdot K_b \cdot K_d \cdot J_S \qquad [Equation\ 1]$$

where:

M_s = material strength number of the earth material

K_b = block or particle size number

K_d = discontinuity or interparticle bond shear strength number

J_s = relative ground structure number

For soil-like materials, the program also requires representative soil index properties as input parameters. The index properties used directly in the SITES model include the following parameters:

- USCS Soil Type
- Dry Unit Weight, γ_{dry} (pounds-per-cubic-foot, pcf)
- Plasticity Index, PI
- Clay Fraction, CF (% finer than 0.002 millimeter diameter)
- Representative Diameters, D_{75} and D_{50} (millimeters [mm])

Note that for the representative particle size, the D_{75} is typically used for soil-like materials, and D_{50} is typically used for rock-like materials.

4.2 Material Parameters Development

Development of estimated Kh was completed using the two reference documents cited above for the Alluvium/Residuum, the Oakville Sandy Clays, and Oakville Clays assuming each of the parameters except Ms are held constant and equal to 1.0. The Kh estimation procedure for cohesionless soil was followed for the Oakville Silty and Clayey Sands based on the same reference documents. The estimated Kh of the Existing Fill was conservatively developed based on the estimated Kh value for the Alluvium/ Residuum layer and refined based on experience with similar materials.

Materials considered in the evaluation included those encountered beginning near the proposed finished-grade elevation of the ASW channel surface and extending down below the valley bottom elevation at the downstream exit channel. Material parameters were developed for each of the generalized strata units described previously, as well as for potential proposed fill material from on-site sources that may be needed with proposed rehabilitation spillway modifications. In summary, these included the following:

1) Alluvium/Residuum
2) Existing Fill
3) Oakville Sandy Clays
4) Oakville Silty and Clayey Sands
5) Oakville Clays
6) Proposed Fill (ASW excavation borrow)

Representative values for each stratum were selected on an approximate best fit between the 33^{rd} and 50^{th} percentile values, as is consistent with typical geotechnical engineering practice.

4.2.1 Index Properties

Results of laboratory testing performed as part of the current Preliminary GIR and Preliminary SMR prepared by AECOM for this project were used to evaluate index properties of the various materials. The laboratory test results summary for the ASW borings is provided in the Preliminary SMR (AECOM, 2024). A tabulated summary of the minimum, maximum, and average test data values for each general stratum is provided in **Table 1.**

The D_{75} has been summarized in a graph by depth in **Attachment 2**. Note that D_{75} is typically used in analysis of soil-like materials and D_{50} is typically used for rock-like materials. The D_{50} is not presented since all materials encountered were considered to behave like soils.

Plots of γ_{dry}, CF, LL, PI, Su, UCS, N_{60}, and D_{75}, versus depth, annotated to illustrate the selected representative values, are provided in **Attachment 2**. The selected representative values pertinent to the SITES analysis are also summarized in **Table 2**. Recommended values were developed based on results of laboratory index tests from the 2023 investigation and experience with similar materials.

In absence of formal specification of the fill material used and due to the fact that compacted fill material generally presents different density and strength than native soils, because of the lack of long-term environmental exposure, index and strength properties of the existing fill were conservatively estimated based on testing results of samples recovered from the Oakville Sandy Clays and Oakville Clayey and Silty Sands which were assumed to be similar to the material that may have been used to form the Existing Fill.

4.2.2 Material Strength Number, Ms

Estimates of Ms are based on relative density for cohesionless soils (i.e., PI≤10 per NRCS 2001), and unconfined compressive strength for both cohesive soils (i.e., PI > 10) and rock materials. Typical ranges of Ms are presented in tabular format in NRCS 2001 and 2011 correlated with SPT and relative density for cohesionless soils; with SPT, consistency, unconfined compressive strength (UCS), undrained shear strength (Su), and liquidity index (LI) for cohesive soils; and with UCS and field strength tests for rock.

The Ms values for cohesionless soils and rock are estimated predominantly using the methods in NRCS (2001). The Ms (=Kh) values for cohesive soils were estimated by comparing results from both methods in NRCS (2001) and NRCS (2011) and using engineering judgment to select recommended values. See **Attachment 2** for the plots used to sub-divide the generalized strata and develop representative values (note the undrained shear strength from laboratory unconfined compression testing was given the heaviest weighting). The two methods used for developing Kh are presented in **Attachment 3**. Note, only the undrained strength computed from correlation with the Liquidity Index is used for the NRCS 2011 method. Supporting calculations for the Ms value are also provided in **Attachment 3**.

Plots of Su, N_{60}, Su, Pocket Penetrometer, and γ_{dry} data versus depth, with representative values also plotted, are provided in **Attachment 3**. Calculations for the derived Ms values are provided in **Attachment 3**. Discussion of Ms development for each of the various geologic strata is provided in the following subsections.

The Alluvium/Residuum, Oakville Sandy Clays, and Oakville Clays were considered “cohesive” soil for the purposes of estimating the Ms parameter, whereas the Oakville Silty and Clayey Sands stratum was conservatively treated as “cohesionless” soil in analyses although the PI was generally greater than 10. The material designated as Proposed Fill was obtained from samples collected in the upper 5 feet of the borings drilled which primarily classified as lean and fat clays (CL, CH), and thus was also considered as “cohesive” soil. While the Proposed Fill would have similar gradation and plasticity as the in-situ soils, the fill will be excavated and recompacted in the field during construction which will change the density and strength properties from that of the natural in-place material. As such, the proposed fill material was analyzed as a separate layer.

It is noted that NRCS (2001) Table 52-3 indicates that soils with SPT blow counts greater than 30 bpf or UCS greater than 625 kPa (13,053 psf) should be treated as rock (NRCS, 2001). While many of the SPT values in the Oakville Sandy Clay and the Oakville Clay strata exceeded 30 bpf, the laboratory UCS values indicate the material is borderline and should still be considered soil like in analysis. Similarly, the Oakville Clayey and Silty Sands stratum was also considered soil-like due to the interbedded nature of the soils identified in the field. For all materials, engineering judgement was applied to the results based on published ranges in Chapter 52 (NRCS 2001), and the final selected Kh values were adjusted accordingly. As discussed in following paragraphs, all other parameters were equal to 1.0 so the only value that affected Kh was the Ms number.

The field SPT N-values were corrected to equivalent 60% hammer efficiency (N_{60}) based on the hammer energy calibration report provided by the driller. While an SPT hammer energy calibration report was not available, the driller provided a hammer energy calibration report for the Texas Cone Penetrometer hammer on the same drill rig which indicated 89% hammer efficiency. Based on AECOM’s experience, an energy correction of 80% hammer efficiency is typical for SPT autohammers like that used on this project, and thus 80% efficiency was adopted for analysis.

Alluvium/Residuum

SITES parameters for this unit were estimated using several methods including the results of 4 field standard penetration tests correlated to an estimated Su value, correlations from liquidity indices (LI) to estimate Su, and 4 unconfined compression tests (UC). Greater weight was given to the UC tests and LI correlation methods. The liquidity indices were used as a check to correlate the strength of the soils in a saturated state.

The NRCS 2011 Appendix 52D method was used as a check on the Su values, which correlates Su with the LI of saturated clay. Reference **Attachment 3** to see Su values for comparison of the two procedures, and the calculated MS values for NRCS 2001.

Oakville Sandy Clays

SITES parameters for the Oakville Sandy Clays were estimated using several methods including the results of 7 field standard penetration tests correlated to an estimated Su value, correlations from LI to estimate Su, and 4 UC tests. The use of the liquidity indices was used as a check to correlate the strength of the soils in a saturated state.

Oakville Silty and Clayey Sands

The Oakville Silty and Clayey Sands were considered cohesionless soil in analyses, and SITES parameters were estimated primarily based on the results of 7 standard penetration tests and 1 UC strength test.

Oakville Clays

SITES parameters for this unit were estimated based on the results of 6 field standard penetration tests, which were correlated to obtain an estimated Su value, correlations from liquidity indices and 2 UC tests. The use of the liquidity indices was used as a check to correlate the strength of the soils in a saturated state.

Proposed Fill (ASW Borrow)

The Ms value for Proposed Fill materials is typically estimated by performing laboratory UC or UU tests on remolded samples compacted to target moisture content and density that simulate typical values of earthfill construction compaction specifications. It is common to conservatively remold samples to the minimum acceptable density and upper range of allowable moisture content (i.e., 95% of maximum dry density and +2% of optimum moisture relative to Standard Proctor energy as determined by ASTM D698). However, insufficient quantity of material was available to complete the remolded strength tests. Consequently, the strength of the Proposed Fill was estimated based on experience from prior projects for similar soils remolded to similar moisture/density, informed by the maximum dry density and optimum moisture content from site-specific Standard Proctor test results and 4 UC test results in the Alluvium/Residuum layer. The Ms values was then estimated from the assumed strength value.

4.2.3 Block or particle size number, Kb

The value of K_b is 1.0 for each analysis case per NRCS 2001 and NRCS 2011. The Alluvium/Residuum, Oakville Sandy Clay, Oakville Clay, and Proposed Fill (collectively referred to as the “clayey layers”) are considered as “massive, unjointed cohesive” soil materials. The Oakville Silty and Clayey Sands (referred to as the “sandy layer” herein) were considered a cohesionless soil where the average particle size diameter is less than 0.1 meters.

4.2.4 Discontinuity / Interparticle Bond Shear Strength Number, Kd

According to NRCS 2001, the value of K_d is estimated based on the tangent of the residual friction angle (ϕ'_r) of the soil, which can be estimated by correlation with values of LL and CF using the following formulas:

$$\text{For} \leq 20\% \text{ clay,} \quad \phi'_r = 169.58\,(LL)^{-0.4925} \quad [52\text{–}7]$$

$$\text{For } 25 - 45\% \text{ clay,} \quad \phi'_r = 329.56\,(LL)^{-0.7100} \quad [52\text{–}8]$$

$$\text{For} \geq 50\,\% \text{ clay,} \quad \phi'_r = 234.73\,(LL)^{-0.6655} \quad [52\text{–}9]$$

Plots of LL and CF versus depth, with interpreted lower and upper bounds, are provided in **Attachment 3**.

Based on feedback received from NRCS geologists at the NDCSMC (email dated April 7, 2020), the method presented in NRCS 2001 has often produced overly conservative values for K_d. The email indicated that internal NRCS guidance is to assume K_d = 1.0 for soil-like materials. This assumption is supported by McCook (2005) and the Draft Appendix 52D (NRCS, 2011). Consequently, K_d = 1.0 was adopted for all materials since they are considered "soil-like".

4.2.5 Relative Ground Structure Number, Js

The value of J_S is 1.0 per NRCS 2001. The clayey layers are considered as "cohesive" materials, while the sandy layer is considered a "cohesionless" material.

4.2.6 Adjustment for High-Plasticity, Blocky Soils

The Draft Appendix 52D (NRCS 2011) and McCook (2005) cautions that very stiff, high-plasticity fat clays (CH) with plastic limits (PL) > 25 often have blocky or fissured secondary structure and such deposits may be more erodible than indicated by the unconfined compressive strength on intact samples typically used to obtain the Ms value. While the document states that no case history is available, interim guidance is to apply a reduction factor of 0.5 to the calculated Ms and thus Kh value.

The Alluvium/Residuum layer had PL values ranging from 14 to 21 (average 18). The Oakville Sandy Clays had PL values ranging from 14 to 26 (average 19). The Oakville Clays had PL values ranging from 19 to 24 (average 21). Fissures were noted for borings 201-23 and 203-23, and these were typically infilled with calcium. However, due to the lack of fissures being noted on the other borings, and the PL for the site being generally below the threshold, the blocky soil reduction factor was not applied to the Kh values for any of the clayey layers of soil identified.

4.3 Recommendations

Recommended parameters for SITES analyses are presented in **Table 2**. Supporting calculations are provided in **Attachment 3**. Based on the assumption stated herein, the estimated K_h ranges of unfavorable and favorable values for the existing ASW are as follows:

- Proposed Fill (ASW Excavation Borrow): Kh = 0.10
- Existing Fill Kh = 0.10
- Alluvium / Residuum: Kh = 0.20
- Oakville Sandy Clays: Kh = 0.20
- Oakville Silty and Clayey Sands: Kh = 0.20
- Oakville Clays: Kh = 0.30

The recommended values for the cohesive soil-like materials are generally in agreement with those recommended for stiff to very stiff cohesive soils according to the typical range of values below (from NRCS 2011):

Table 52D–3 Values shown in NEH628.52 relating saturated consistency to unconfined compressive strength

Relative density	Description	SPT	q_u, lb/ft^2	M_s
Very soft	• Exudes between fingers when squeezed in hand	< 2	< 835	< 0.02
Soft	• Easily molded with fingers • Point of geologic pick easily pushed into shaft of handle	2–4	835–1,670	0.02–0.05
Firm	• Penetrated several centimeters by thumb with moderate pressure • Molded by fingers with some pressure	4–8	1,670–3,130	0.05–0.10
Stiff	• Indented by thumb with great effort • Point of geologic pick can be pushed in up to 1 centimeter • Very difficult to mold with fingers • Just penetrated with hand spade	8–15	3,130–6,265	0.10–0.20
Very stiff	• Indented only by thumbnail • Slight indentation by pushing point of geologic pick • Requires hand pick for excavation	15–30	> 6,265	0.20–0.45

The recommended Kh value for sand and sandstone is also in agreement with those recommended for dense cohesionless soils (Table 52D-2 from NRCS 2011, shown below).

It should be noted that part of the existing ASW, including the crest section, was built on fill material which makes it significantly more susceptible to erosion. In the event of spillway activation, headcut erosion could advance from the downstream end of channel towards the upstream section and reach the existing fill in which case severe erosion of the dam embankment could ensue. As a result, cutting (rather than filling) of the ASW deeper than the existing condition is the preferred rehabilitation design approach for Escondido 12.

Table 52D–2 Material strength number, M_s for cohesionless soil

Relative density	Description	SPT	M_s
Very loose	• Particles loosely packed • High percentage of voids • Very easily dislodged by hand • Matrix crumbles easily when scraped with point of geologic pick • Raveling often occurs on excavated faces	< 5	< 0.02
Loose	• Particles loosely packed • Some resistance to being dislodged by hand • Large number of voids • Matrix shows low resistance to penetration by point of geologic pick	5–10	0.02–0.05
Medium dense	• Particles closely packed • Difficult to dislodge individual particles by hand • Voids less apparent • Matrix has considerable resistance to penetration by point of geologic pick	10–30	0.05–0.10
Dense	• Particles very closely packed and occasionally very weakly cemented • Cannot dislodge individual particles by hand • The mass has very high resistance to penetration by point of geologic pick • Requires many blows of geologic pick to dislodge particles	30–50	0.10–0.20
Very dense	• Particles very densely packed and usually cemented together • Mass has high resistance to repeated blows of geologic pick • Requires power tools for excavation	> 50	0.20–0.45

(210–VI–NEH, draft, October 2011) 52D–9

5. Limitations

This memorandum was prepared by AECOM using the degree of care and skill ordinarily exercised under similar circumstances by responsible engineers and geologists practicing in the same general location. No other warranty or representation, either expressed or implied, is made as to the findings and professional advice in this memorandum.

The opinions and conclusions contained in this memorandum are based on interpretations of limited subsurface information. Soil and geologic conditions can vary greatly between or beyond the exploration sites, and different conditions may be found during subsequent investigations.

The conclusions and recommendations contained herein are based in part upon information provided by others (including the NRCS) and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information provided to AECOM has not been independently verified by AECOM, unless otherwise stated.

There is no intention that this memorandum addresses any environmental issues (for example, environmentally affected soil or groundwater, or historic site uses) related to this site. Such evaluations are outside the scope of this work and should be addressed in separate studies.

6. References

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7. Attachments

TABLES

Table 1. Summary of Laboratory Test Data by Stratum for Borings in Existing ASW Channel [1]

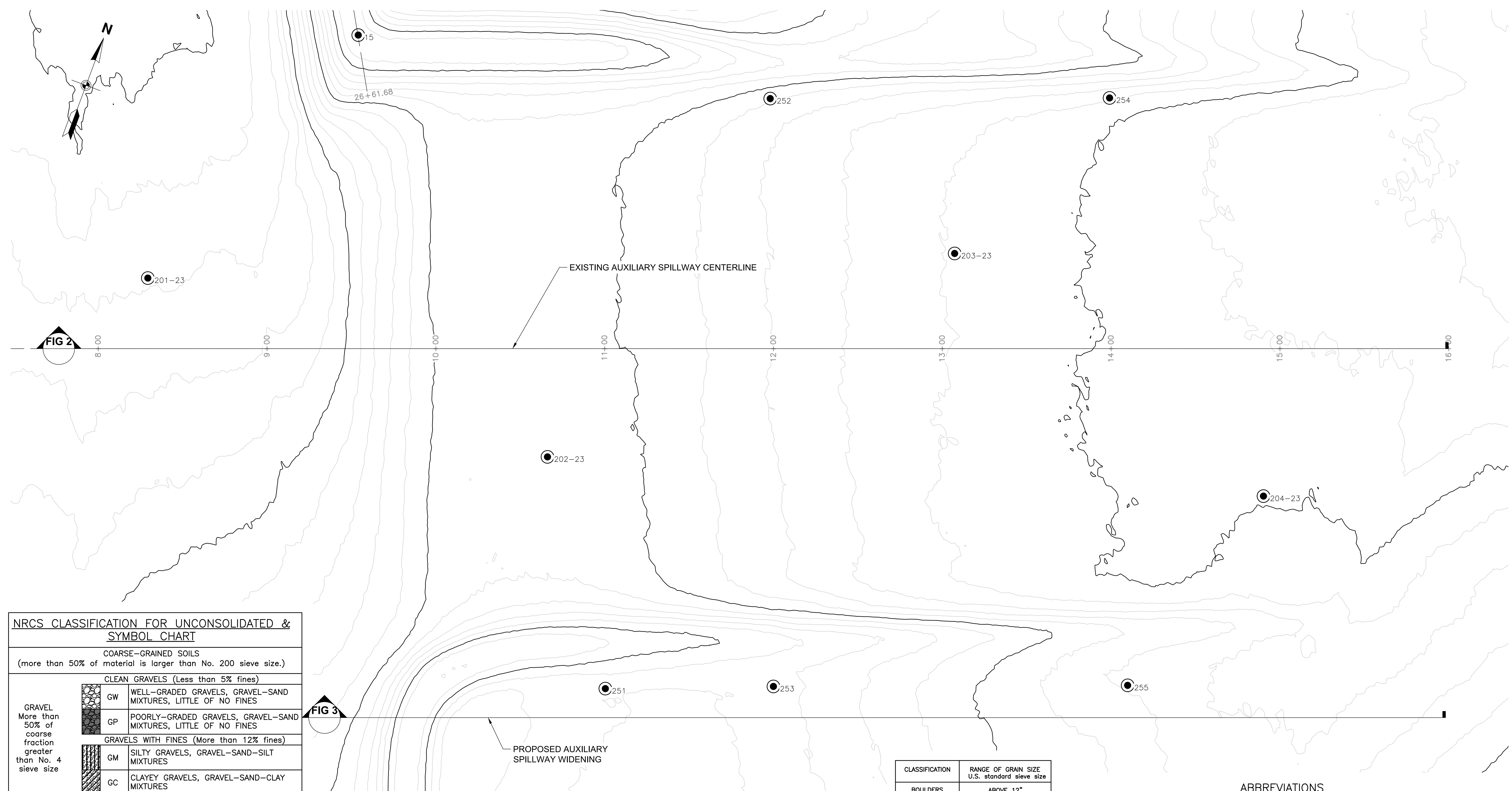
Stratum Description (USCS)	Thick-ness (ft)	USCS	N_{60} (bpf) [2]	Pocket Pen. (tsf)	Undrained Shear Strength, S_u (psf)	Unconfined Compressive Strength, UCS (psf)	Dry Unit Weight (pcf)	LL	PI	LI	Fines (%)	CF (%)	D_{75} (mm)	Crumb
Alluvium/Residuum	0-6	CL, CH	8 - 12 (11)	2.25 - 4.5 (3.8)	2,196 - 19,159 (7,789)	4,392 - 38,318 (15,578)	92 - 118 (107)	28 - 64 (49)	14 - 44 (31)	-0.40 to +0.36 (-0.03)	50 - 87 (70)	22	0.072 - 0.185 (0.115)	1
Oakville Sandy Clays	6-15	CL	16 - 120 (47)	2.25 - 4.5 (4.1)	1,970 - 8,490 (5,441)	3,940 - 16,980 (10,882)	82 - 121 (110)	29 - 77 (46)	11 - 51 (27)	-0.46 to +0.18 (-0.06)	50 - 86 (67)	24 - 36	0.075 - 0.185 (0.128)	1 – 4 (3)
Oakville Silty and Clayey Sands	15 – 25	SP, SC, SM	40 - 107 (80)	0.75 - 4.5 (2.3)	---[3]	---[3]	---[3]	31 - 38 (35)	15 - 23 (19)	-0.60 to +0.57 (-0.08)	16 - 54 (33)	---[3]	0.15 - 0.358 (0.25)	---[3]
Oakville Clays	25+	CH	25 - 61 (42)	4.25 - 4.5 (4.5)	290 - 8,446	580 - 16,891	86 - 105 (97)	55 - 63 (59)	32 - 44 (38)	-0.10 to +0.23 (+0.04)	45 - 91 (76)	22 - 26	0.046 - 0.352 (0.158)	2 – 3
Proposed Fill (ASW Borrow)	TBD	CH	---[3]	---[3]	---[3]	---[3]	---[3]	31 - 72 (47)	17 - 51 (30)	-0.82 to -0.41 (-0.64)	41 - 73 (57)	15 - 53 (28)	---[3]	1 – 1 (1)

Notes:
(1) Format of reported values is Minimum – Maximum (Average). Average value not reported when two or fewer results are available.
(2) Raw SPT N-values converted to N_{60} based on 80% hammer efficiency.
(3) “---” No test results available from current ASW borings.

Table 2. Recommended Material Parameters for SITES Analysis of Existing ASW

SITES inputs	Proposed Fill (ASW Borrow)	Existing Fill	Alluvium/Residuum	Oakville – Sandy Clays	Oakville – Clayey & Silty Sands	Oakville - Clays
USCS - Soil Type (Predominant)	CL - Lean Clay	CL - Lean Clay	CH - Fat clay	CL - Lean Clay	SC – Clayey Sand	CH - fat clay
PI – Representative	30	15	30	21	17	38
LL – Representative	45	30	50	38	32	58
Dry Density (lbs/ft3) – Representative	92	97	100	115	90	102
Kh – Representative	0.10	0.10	0.20	0.20	0.20	0.30
Clay % – Representative	25	17	24	24	5	24
Rep. Diam. D_{75} (mm) – Representative	0.06	0.11	0.085	0.12	0.22	0.05
Rep. Diam. D_{75} (in) – Representative	0.002	0.004	0.003	0.005	0.009	0.002
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---	---	---

FIGURES



PLAN

0 15 30 60
SCALE IN FEET

NRCS CLASSIFICATION FOR UNCONSOLIDATED & SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
CLEAN GRAVELS (Less than 5% fines)		
GRAVEL More than 50% of coarse fraction greater than No. 4 sieve size	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
GRAVELS WITH FINES (More than 12% fines)		
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
CLEAN SAND (Less than 5% fines)		
SAND More than 50% of coarse fraction smaller than No. 4 sieve size	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
	SP	POORLY-GRADED SANDS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
SAND WITH FINES (More than 12% fines)		
	SM	SILTY SAND, SAND-SILT MIXTURE
	SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS (more than 50% of material is smaller than No. 200 sieve size.)		
SILTS & CLAYS Liquid limit less than 50%	ML	INORGANIC SILTS WITH SLIGHT PLASTICITY
	CL	INORGANIC CLAY WITH LOW OR MEDIUM PLASTICITY, LEAN CLAY
SILTS & CLAYS Liquid limit Greater than 50%	MH	INORGANIC SILTS WITH ELASTICITY
	CH	INORGANIC CLAY WITH HIGH PLASTICITY, FAT CLAY.

NRCS CLASSIFICATION FOR CONSOLIDATED & SYMBOL CHART

- Low Plasticity Clay
- High Plasticity Clay
- Poorly Graded Sand
- Clayey Sand
- Silty Sand
- Fine to Coarse Grained Sand
- Poorly Graded Sand with Clay

OTHER SYMBOLS

- HOLE LOGGED ONLY
- STRIKE AND DIP
- HOLE SAMPLED
- PIT OR TRENCH

CLASSIFICATION	RANGE OF GRAIN SIZE U.S. standard sieve size
BOULDERS	ABOVE 12"
COBBLES	12" TO 3"
GRAVEL Course Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200
SILT & CLAY	Below No. 200

TEST HOLE NUMBERING SYSTEM

	COMBINA-TION RIG	POWER AUGER	HAND BORINGS	TRENCH OR PIT EXCAVA-TIONS	NATURAL OUTCROPS, STREAMBANKS, AND GULLIES
CENTERLINE OF DAM	1-49	51-99	1001-1099	2001-2099	3001-3099
BORROW AREA	101-149	151-199	1101-1199	2101-2199	3101-3199
AUXILIARY SPILLWAY	201-249	251-299	1201-1299	2201-2299	3201-3299
PRINCIPAL SPILLWAY	301-349	351-399	1301-1399	2301-2399	3301-3399
STREAM CHANNELS	401-449	451-499	1401-1499	2401-2499	3401-3499
EXPLORATORY BORINGS	501-549	551-599	1501-1599	—	—
FOUNDATION DRAIN	601-649	651-699	1601-1699	2601-2699	3601-3699
MISCELLANEOUS	701-749	751-799	1701-1799	2701-2799	3701-3799

ABBREVIATIONS

Ang.	ANGULAR
B.	BEDDED OR BEDDING
Bld.	BOULDERS (> 12")
Calc.	CALCAREOUS
Cali.	CALICHE
Carb.	CARBONATE
Cav.	CAVITIES
Cmt.	CEMENTED
Ch.	CHALK OR CHALKY
C	CLAY, CLAYEY
Cse.	COARSE
Cbl.	COBBLES (3" - 12")
Cpt.	COMPACT
Con.	CONCRETIONS
Cng.	CONGLOMERATE
Cs.	CLAYSTONE
C.T.	CAVED TO
Xln.	CRYSTALLINE
Ds.	DENSE
Dip.	DIPPING
D.S.	DOWNSTREAM
Fe. Stn.	Iron Stains
Flg.	FLAGSTONE OR FLAGGY
Fn.	FINE
Frm.	FIRM
Frac.	FRACTURED
Frg.	FRAGMENTS
Fri.	FRIABLE
Grn.	GRAIN
G	GRAVEL, GRAVELLY
Gyp.	GYPSEOUS
Hd.	ROCK HARDNESS
H.	HIGHLY
Int.	INTERBEDDED
Lam.	LAMINATED
Lay.	LAYER OR LAYERS
Len.	LENS OR LENSES
Lig.	LIGNITE
Ls.	LIMESTONE
Lse.	LOOSE
Ma.	MARL, OR MARLY
Mas.	MASSIVE
Mat.	MATRIX
Med.	MEDIUM
Mic.	MICACEOUS
Mod.	MODERATELY
Nod.	NODULE OR NODULAR
N.R.	NO RECOVERY
O	ORGANIC
Part.	PARTINGS
Peb.	PEBBLE
Per.	PERMEABLE
Po.	POORLY
P.	POORLY GRADED
Rdd.	ROUNDED
S	SAND, SANDY
Ss.	SANDSTONE
Sat.	SATURATED
Sh.	SHALE, OR SHALY
Sl/.	SLIGHTLY
Slo.	SLOWLY
M	SILT, SILTY
Sft.	SOFT
Sl.	SOME
Stf.	STIFF
Str.	STREAKS
T.	THIN
T.B.	THIN - BEDDED
Tuff.	TUFFACEOUS
U.A.D.	UNABLE TO AUGER DEEPER
U.D.B.D.	UNABLE TO DRY BARREL DEEPER
U.E.D.	UNABLE TO EXCAVATE DEEPER
U.S.	UPSTREAM
Var.	VARIABLE
V/.	VERY
Vug.	VUGULAR
Wtr.	WATER LEVEL AS ENCOUNTERED DURING DRILLING PROCESS
W	WELL GRADED
W/.	WITH
Wea.	WEATHERED
▼____	(DATE) STATIC WATER LEVEL

DRAWN ME DATE 9/5/23
CHECKED MJ DATE 9/5/23
APPROVED LF DATE 9/5/23

PLAN OF GEOLOGIC INVESTIGATIONS

FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 3

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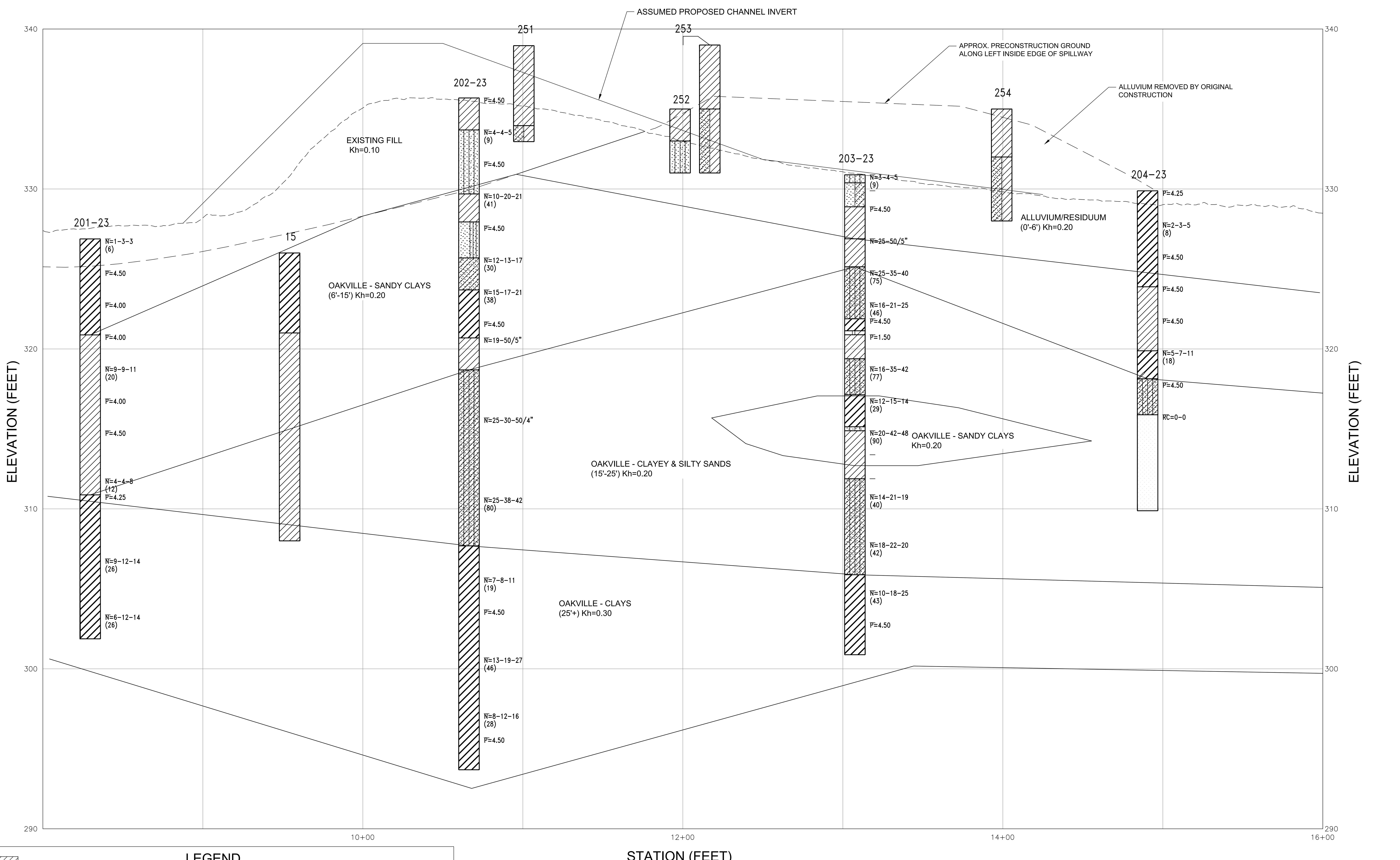

LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Poorly Graded Sand
- Clayey Sand
- Silty Sand
- Fine to Coarse Grained Sand
- Poorly Graded Sand with Clay
- — Sample Top Depth
- N= SPT blows per 6" increment (N-value, bpf)
- P= Pocket Penetrometer (tsf)
- RC= Core Recovery (%) - RQD (%)
- Water Level at Time Drilling, or as Shown
- Water Level at End of Drilling, or as Shown
- Water Level After 24 Hours, or as Shown

HORIZ. 0' 30' 60'
VERT. 0' 3' 6'
SCALE IN FEET

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
MCLENNAN COUNTY, TEXAS

DRAWN	ME	DATE	9/5/23
CHECKED	MJ	DATE	9/5/23
APPROVED	LF	DATE	9/5/23

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 3

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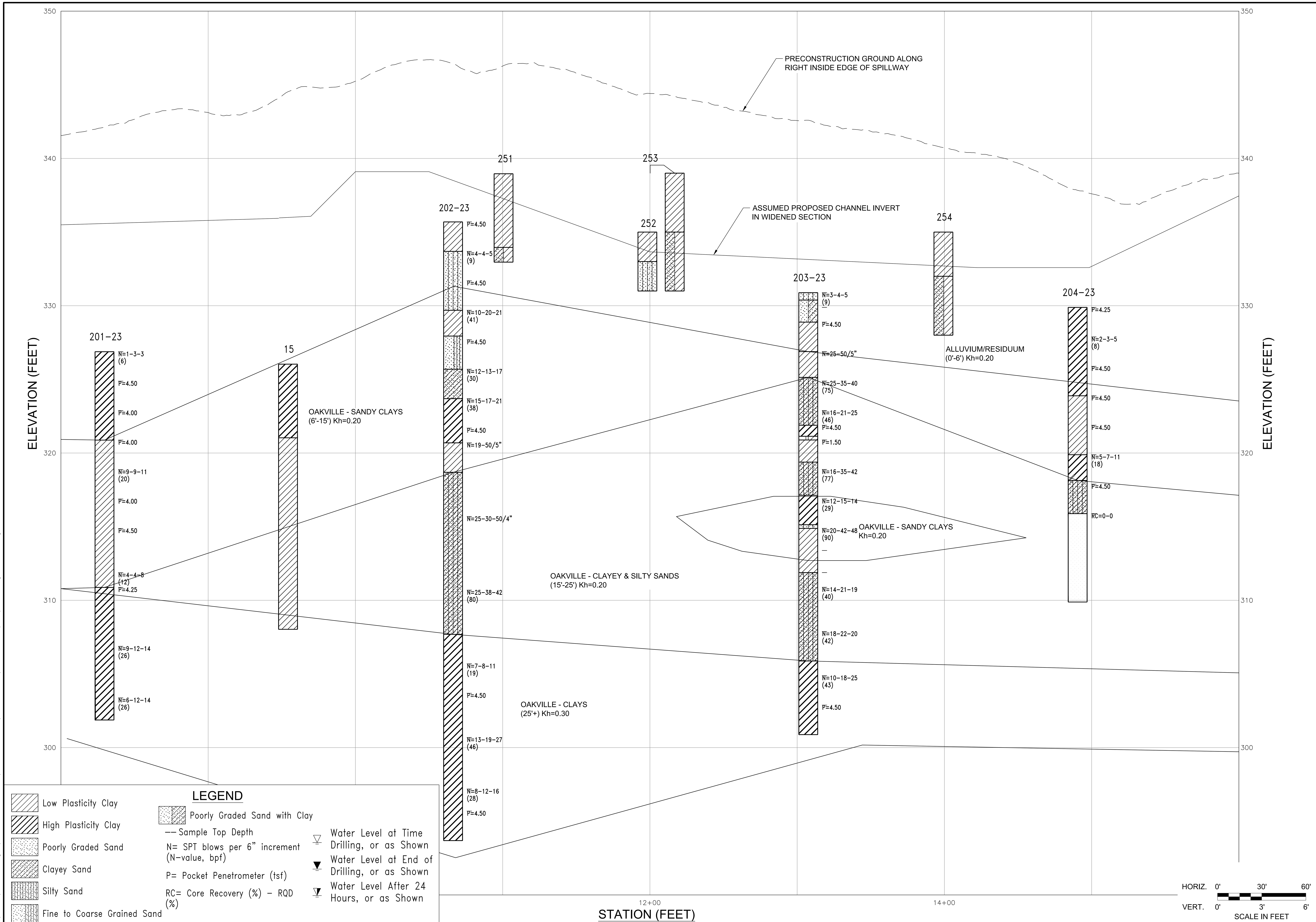

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DRAWN ME DATE 9/5/23
CHECKED MJ DATE 9/5/23
APPROVED LF DATE 9/5/23

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY
FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
MCLENNAN COUNTY, TEXAS

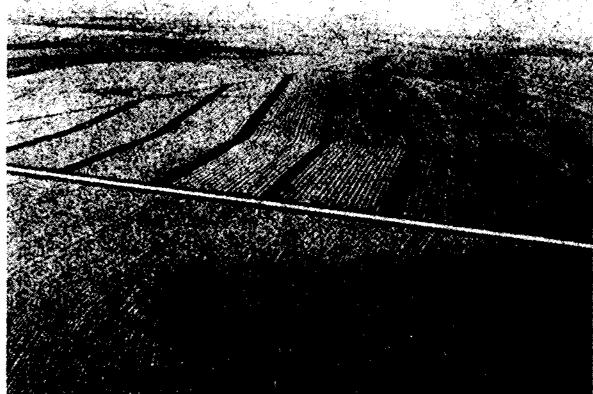
AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 3 OF 3

ATTACHMENT 1.

AS-BUILT DRAWINGS



SOIL CONSERVATION SERVICE

FLOODWATER RETARDING DAM NO. 12
ESCONDIDO CREEK WATERSHED PROJECT
IN
KARNES COUNTY, TEXAS

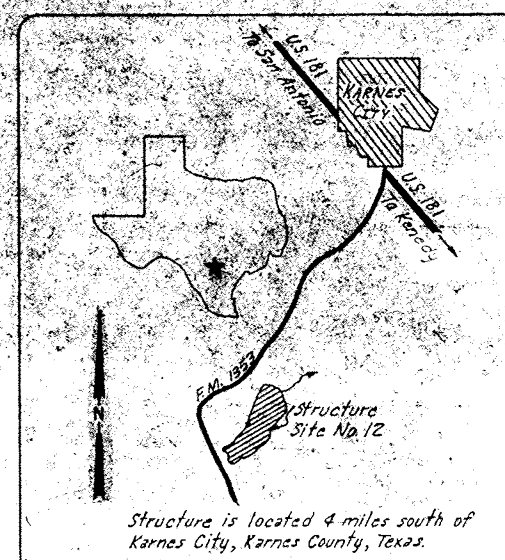
DRAINAGE AREA	3,904 ACRES
TOTAL STORAGE	1,844 AC. FT.
HEIGHT OF DAM	34 FEET
VOLUME OF FILL	~~164,520~~ 168,192 CU. YDS.

SPONSORED BY
KARNES - GOLIAD SOIL AND WATER CONSERVATION DISTRICT
ESCONDIDO WATERSHED DISTRICT
CITY OF KENEDY
SAN ANTONIO RIVER AUTHORITY
COOPERATING WITH
SOIL CONSERVATION SERVICE
OF THE
U.S. DEPARTMENT OF AGRICULTURE
1974

CONSTRUCTION DRAWINGS APPROVED
Gene C. Vittetoe, [illegible] 4-9-74
STATE CONSERVATION ENGINEER, S.C.S. DATE
TEMPLE, TEXAS

INDEX OF DRAWINGS

SHEET NO.	TITLE
1	GENERAL PLAN OF RESERVOIR
2	PLAN OF EMBANKMENT AND SPILLWAYS
3 - 4	PRINCIPAL SPILLWAY- PLAN AND SECTION
5	PIPE DETAILS
6	PRINCIPAL SPILLWAY INLET
7 - 8	STEEL PLACEMENT-PRINCIPAL SPILLWAY INLET
9	TRASH RACK, SLIDE GATE, PIPE CANTILEVER SUPPORT DETAILS
10	FENCE DETAILS
11 - 13	PLANS AND PROFILES FOR GEOLOGIC INVESTIGATIONS



Structure is located 4 miles south of Karnes City, Karnes County, Texas.

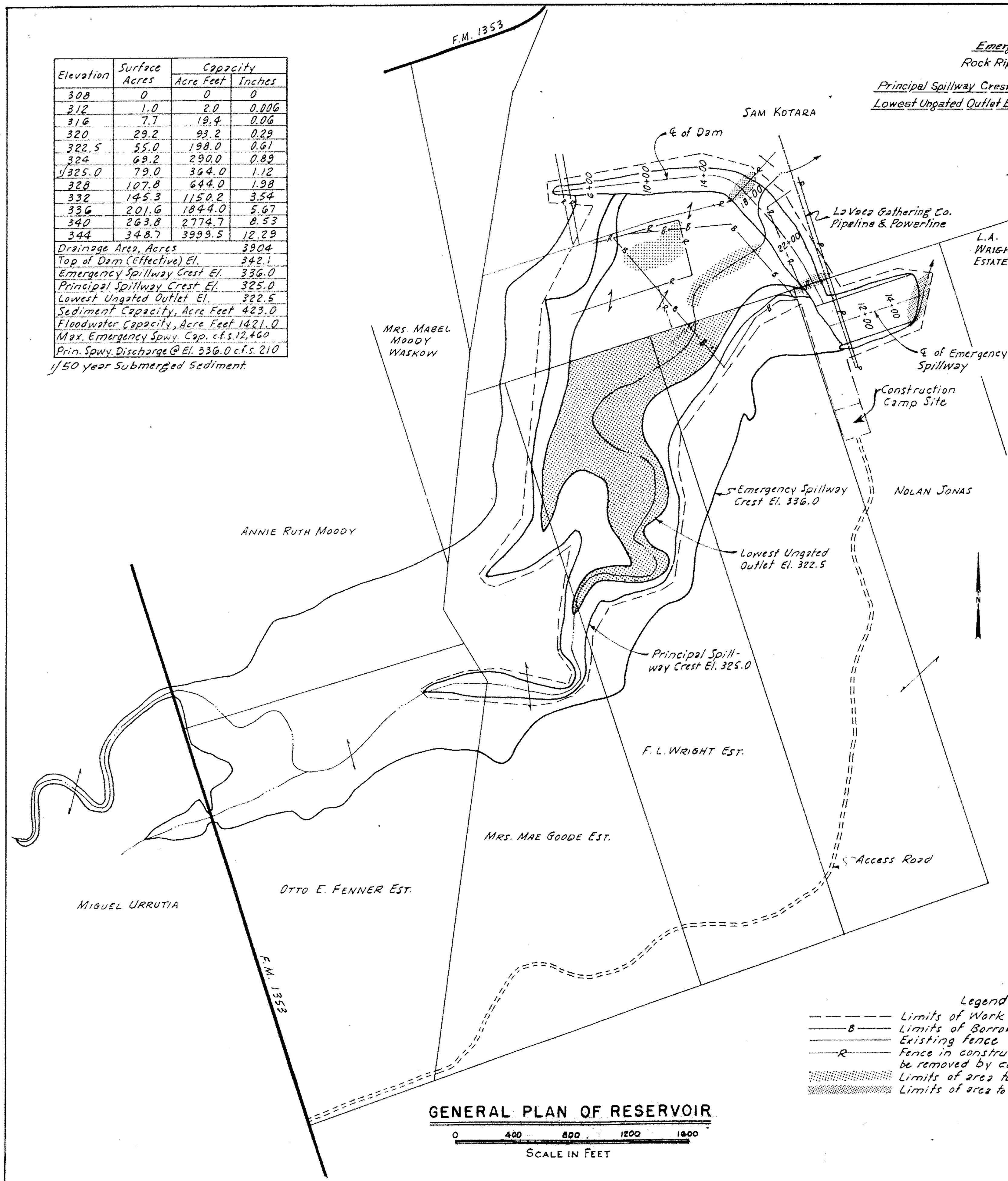
VICINITY MAP

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

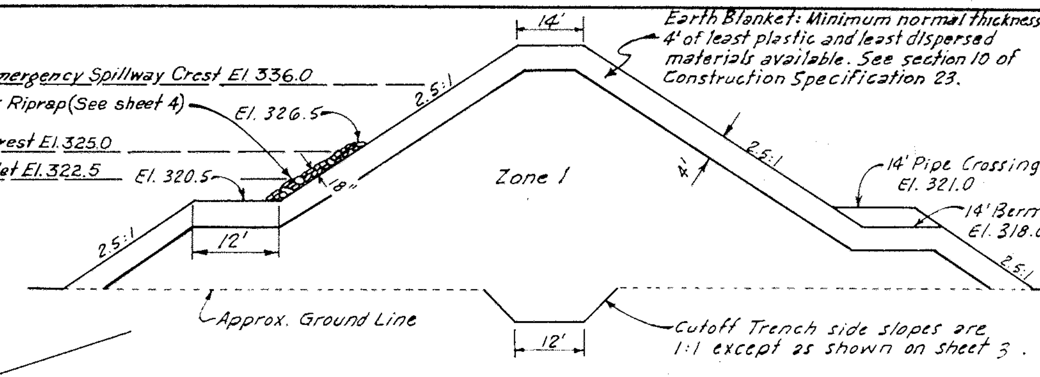
Drawing No.
4-E-33,763

Elevation	Surface Acres	Capacity	
		Acre Feet	Inches
308	0	0	0
312	1.0	2.0	0.006
316	7.7	19.4	0.06
320	29.2	93.2	0.29
322.5	55.0	198.0	0.61
324	69.2	290.0	0.89
1/325.0	79.0	364.0	1.12
328	107.8	644.0	1.98
332	145.3	1150.2	3.54
336	201.6	1844.0	5.67
340	263.8	2774.7	8.53
344	348.7	3999.5	12.29
Drainage Area, Acres			3904
Top of Dam (Effective) El.			342.1
Emergency Spillway Crest El.			336.0
Principal Spillway Crest El.			325.0
Lowest Ungated Outlet El.			322.5
Sediment Capacity, Acre Feet			423.0
Floodwater Capacity, Acre Feet			1421.0
Max. Emergency Spwy. Cap. c.f.s.			12,460
Prin. Spwy. Discharge @ El. 336.0 c.f.s.			210

1/50 year Submerged Sediment.



GENERAL PLAN OF RESERVOIR



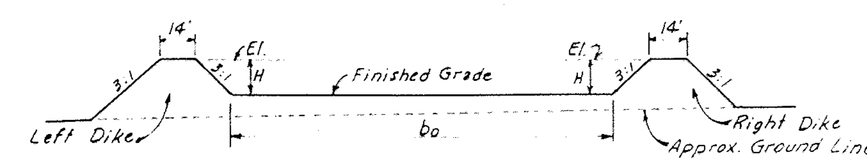
TYPICAL SECTION

Note: Place the least plastic soils to the outside of the Embankment and the more plastic soils to the inside.

MATERIALS PLACEMENT DATA

Embankment Zone No. 1/	Type or Unified Classification	Field Control Test		Placement and Compaction Requirements					
		ASTM Test		Max. Allowable Particle Size	Max Uncompacted Layer Thickness	Specified Compaction Class	Min. Dry Density, Percent of Field Test Max. Dry Density	Moisture Limits, Relative to Field Test Optimum %	
		Number	Method					From	To
1	CL; Moderately Plastic, Silty, Sandy Clay	D-698	A or B	6"	9"	A	95	1	[illegible]
1	CL; Slightly to Mod. Plastic Silty, Very Sandy Clay	D-698	A or B	6"	9"	A	95	Opt.	[illegible]

ZONED EMBANKMENT DATA



Left Dike: From Embankment to Sta. 11+00, El. 342.3
Sta. 11+00 to Sta. 12+00 is a transition section.
Sta. 12+00 to Sta. 12+50, H = 4.0 feet.
Sta. 12+50 to Sta. 13+00 dike shall transition from section of dike to section of diversion.

Right Dike: From approx. Sta. 7+00 to Sta. 11+00, El. 342.3
Sta. 11+00 to Sta. 11+50 is a transition section.
Sta. 11+50 (H = 4.0 ft.) to Sta. 12+00, dike shall transition from section of dike to section of diversion.

Bottom Width: Approx. Sta. 9+10 to Sta. 10+00, bo = variable
Sta. 10+00 to approx. Sta. 15+00, bo = 300 ft.
Approx. Sta. 15+00 to approx. Sta. 16+10, bo = variable

Material forming dikes and transition sections shall be placed and paid for as "Earth Fill, Embankment." See Materials Placement Data and Construction Specification 23.

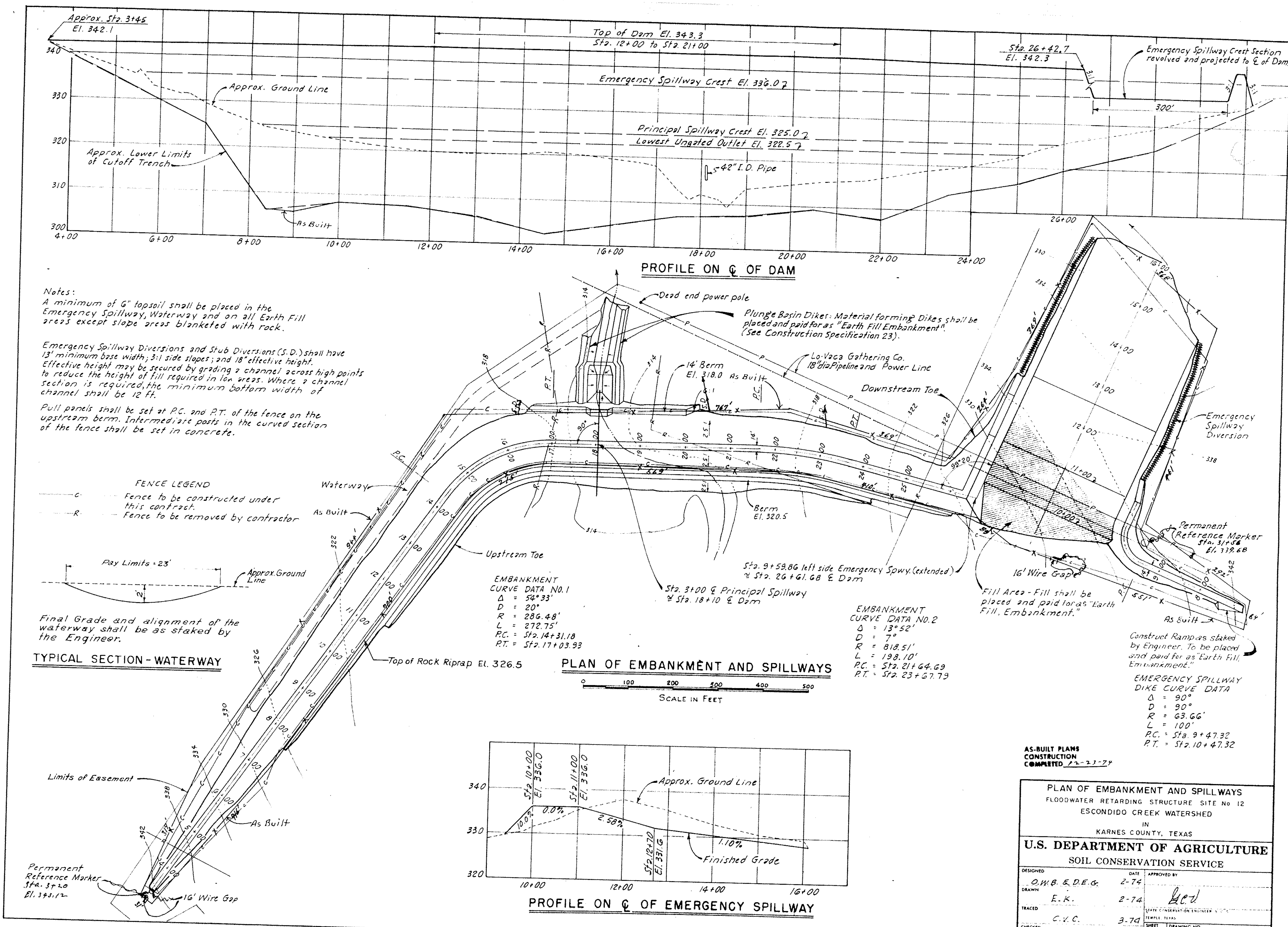
TYPICAL SECTION - EMERGENCY SPILLWAY

NO CHANGE IN PLANS

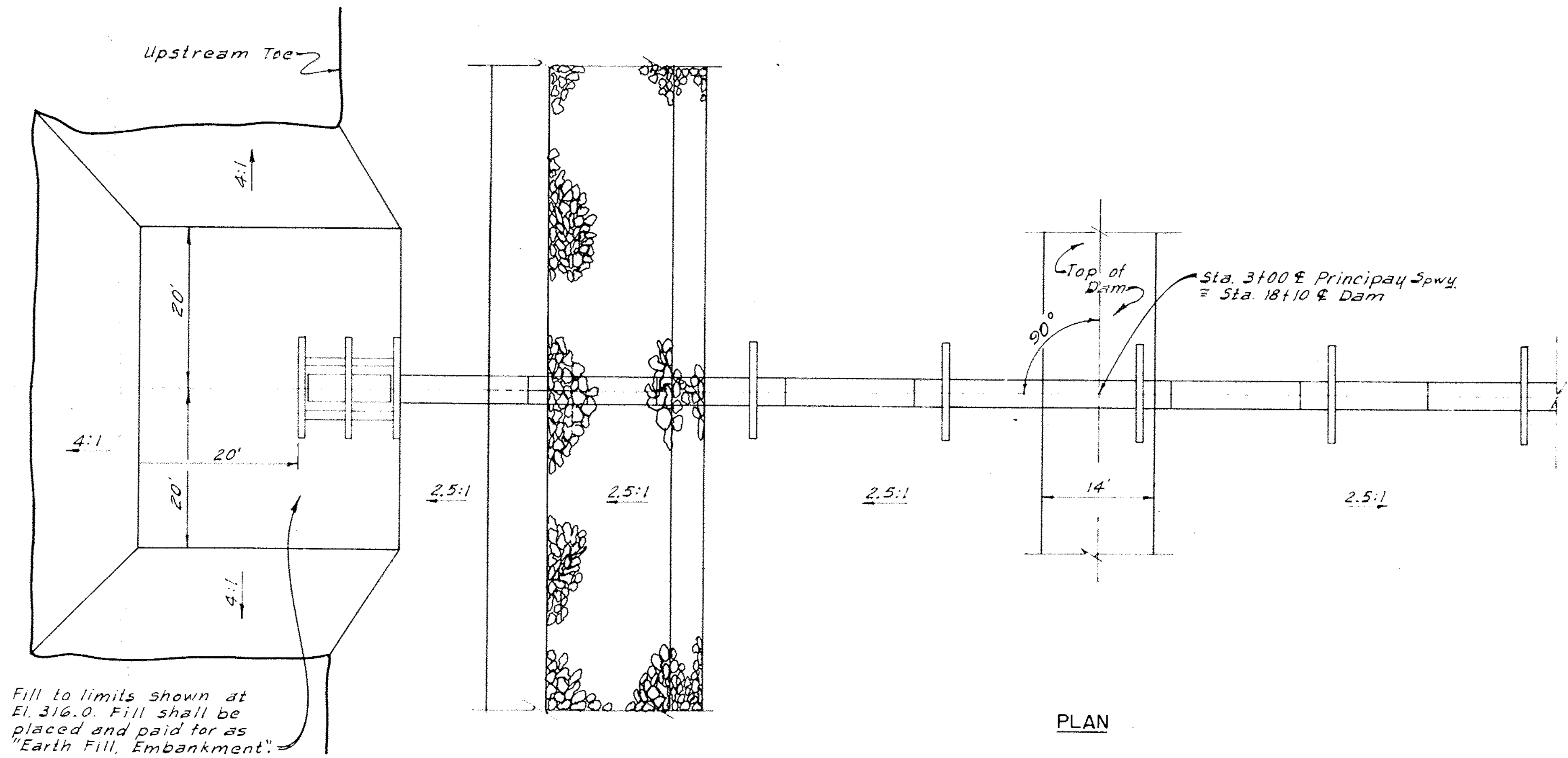
AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74

GENERAL PLAN OF RESERVOIR FLOODWATER RETARDING STRUCTURE SITE No. 12 ESCONDIDO CREEK WATERSHED IN KARNES COUNTY, TEXAS			
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
DESIGNED O.W.B. & D.E.G.	DATE 2-74	APPROVED BY	
DRAWN E.K.	2-74	STATE CONSERVATION ENGINEER S.C.S. TEMPLE, TEXAS	
TRACED C.V.C.	3-74		
CHECKED M.D.K. & D.E.G.	3-74	SHEET No. 1 of 13	DRAWING NO. 4-E-33,763

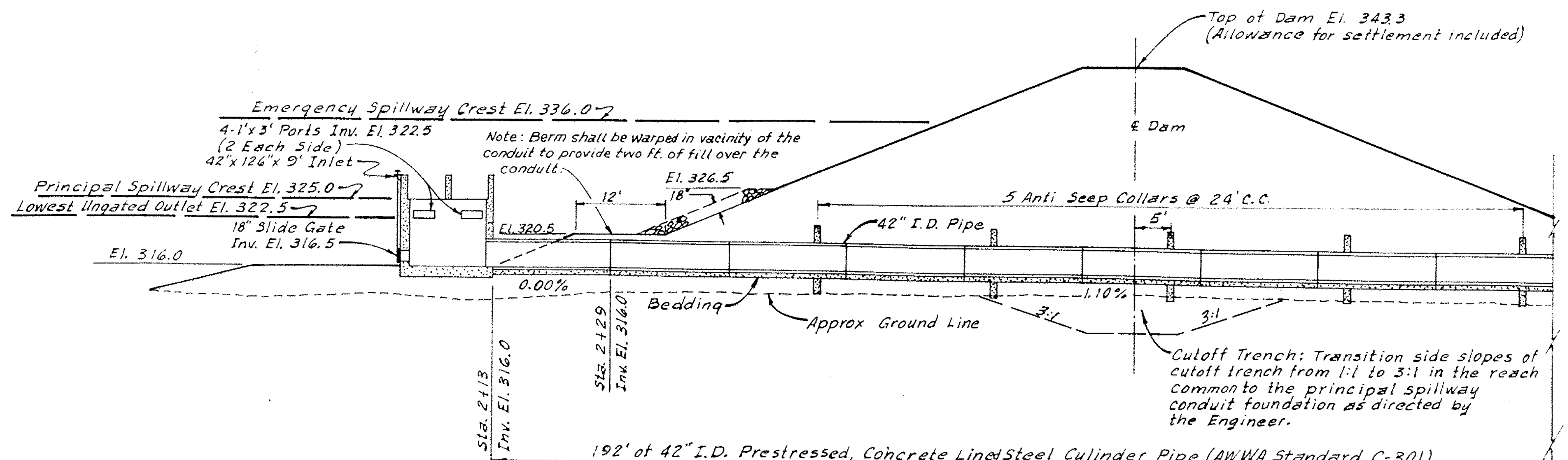
SCS-ENG-314 (Rev. 7-71)



Approx. Sta. 3+45
El. 342.1
Top of Dam El. 343.3
Sta. 12+00 to Sta. 21+00
Sta. 26+42.7
El. 342.3
Emergency Spillway Crest Section revolved and projected to ℄ of Dam.
Emergency Spillway Crest El. 336.0
Approx. Ground Line
300'
Principal Spillway Crest El. 325.0
Lowest Ungated Outlet El. 322.5
Approx. Lower Limits of Cutoff Trench
42" I.D. Pipe
As Built
340
330
320
310
300
4+00
6+00
8+00
10+00
12+00
14+00
16+00
18+00
20+00
22+00
24+00
26+00
PROFILE ON ℄ OF DAM
Notes:
A minimum of 6" topsoil shall be placed in the Emergency Spillway, Waterway and on all Earth Fill areas except slope areas blanketed with rock.
Emergency Spillway Diversions and Stub Diversions (S.D.) shall have 13' minimum base width; 3:1 side slopes; and 18" effective height. Effective height may be secured by grading a channel across high points to reduce the height of fill required in low areas. Where a channel section is required, the minimum bottom width of channel shall be 12 ft.
Pull panels shall be set at P.C. and P.T. of the fence on the upstream berm. Intermediate posts in the curved section of the fence shall be set in concrete.
FENCE LEGEND
—C— Fence to be constructed under this contract.
—R— Fence to be removed by contractor
Pay Limits = 23'
Approx. Ground Line
2'
Final Grade and alignment of the waterway shall be as staked by the Engineer.
TYPICAL SECTION - WATERWAY
Dead end power pole
Plunge Basin Dikes: Material forming Dikes shall be placed and paid for as "Earth Fill Embankment". (See Construction Specification 23).
Lo-Vaca Gathering Co. 18" dia. Pipeline and Power Line
14' Berm
El. 318.0 As Built
Downstream Toe
Emergency Spillway Diversion
Waterway
As Built
Berm
El. 320.5
Upstream Toe
Permanent Reference Marker
Sta. 31+56
El. 339.68
Sta. 9+59.86 left side Emergency Spwy. (extended) ≅ Sta. 26+61.68 ℄ Dam
16' Wire Gap
Fill Area - Fill shall be placed and paid for as "Earth Fill, Embankment."
Sta. 3+00 ℄ Principal Spillway ≅ Sta. 18+10 ℄ Dam
As Built
Construct Ramps as staked by Engineer. To be placed and paid for as "Earth Fill, Embankment."
EMBANKMENT CURVE DATA NO. 1
Δ = 54°33'
D = 20°
R = 286.48'
L = 272.75'
P.C. = Sta. 14+31.18
P.T. = Sta. 17+03.93
EMBANKMENT CURVE DATA NO. 2
Δ = 13°52'
D = 7°
R = 818.51'
L = 198.10'
P.C. = Sta. 21+64.69
P.T. = Sta. 23+67.79
EMERGENCY SPILLWAY DIKE CURVE DATA
Δ = 90°
D = 90°
R = 63.66'
L = 100'
P.C. = Sta. 9+47.32
P.T. = Sta. 10+47.32
Top of Rock Riprap El. 326.5
PLAN OF EMBANKMENT AND SPILLWAYS
0 100 200 300 400 500
SCALE IN FEET
Limits of Easement
As Built
Permanent Reference Marker
Sta. 3+20
El. 343.12
16' Wire Gap
Sta. 10+00 El. 336.0
Sta. 11+00 El. 336.0
Approx. Ground Line
10.0%
0.0%
2.58%
1.10%
Sta. 12+70 El. 331.6
Finished Grade
340
330
320
10+00
12+00
14+00
16+00
PROFILE ON ℄ OF EMERGENCY SPILLWAY
AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74
PLAN OF EMBANKMENT AND SPILLWAYS
FLOODWATER RETARDING STRUCTURE SITE No 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
DESIGNED O.W.B. & D.E.G. 2-74
DRAWN E.K. 2-74
TRACED C.V.C. 3-74
CHECKED
APPROVED BY
STATE CONSERVATION ENGINEER
TEMPLE, TEXAS
SHEET
DRAWING NO.



PLAN



SECTION
PRINCIPAL SPILLWAY

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74
NO CHANGE IN PLANS

PRINCIPAL SPILLWAY—PLAN AND SECTION
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

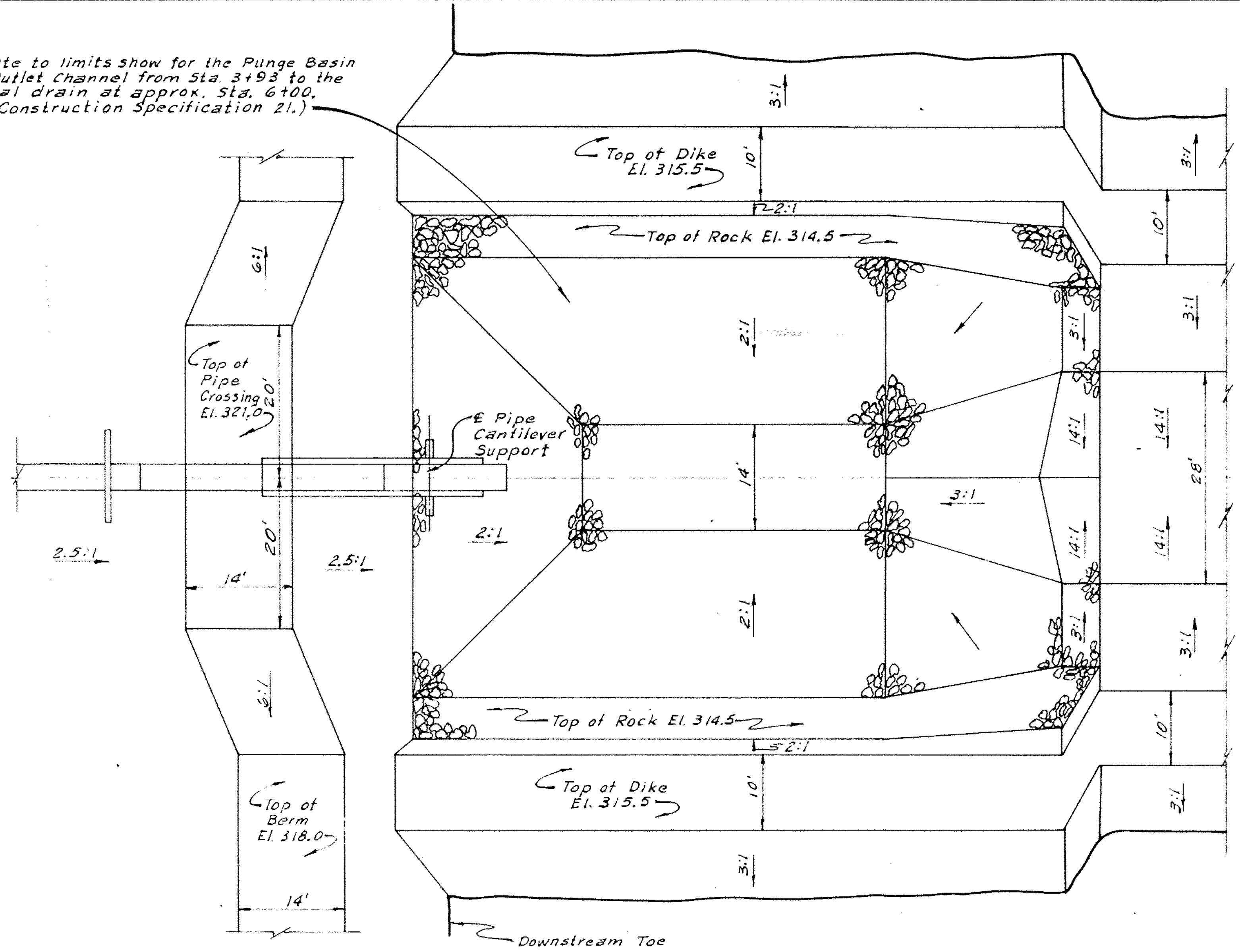
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED O.W.B. & DE.G.	DATE 2-74	APPROVED BY
DRAWN E.K.	2-74	[signature] STATE CONSERVATION ENGINEER S.C.S. TEMPLE, TEXAS
TRACED T.D.S.	3-74	
CHECKED R.L.K. & DE.G.	3-74	SHEET No. 3 of 13 — DRAWING NO 4-E-33,763

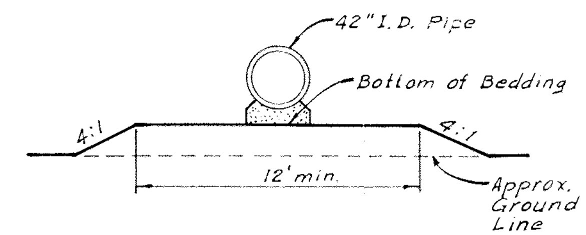
GRADATION OF ROCK RIPRAP	
Size of Rock	% Smaller by Weight
250 lbs	100
75 lbs	40-60
8 lbs	5-10

Rock Riprap for the upstream face of the dam and rock for lining the plunge basin shall have the above gradation.

Approximately 5% by weight shall be spalls fines and rock chips. The least dimension of an individual rock fragment shall not be less than one third the greatest dimension of the fragment.

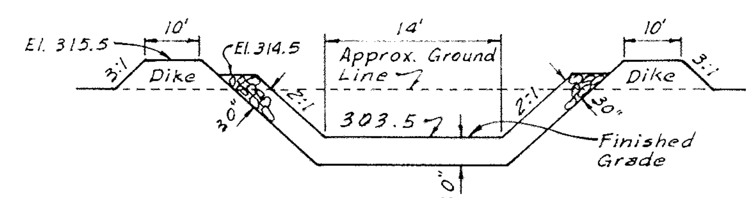


PLAN

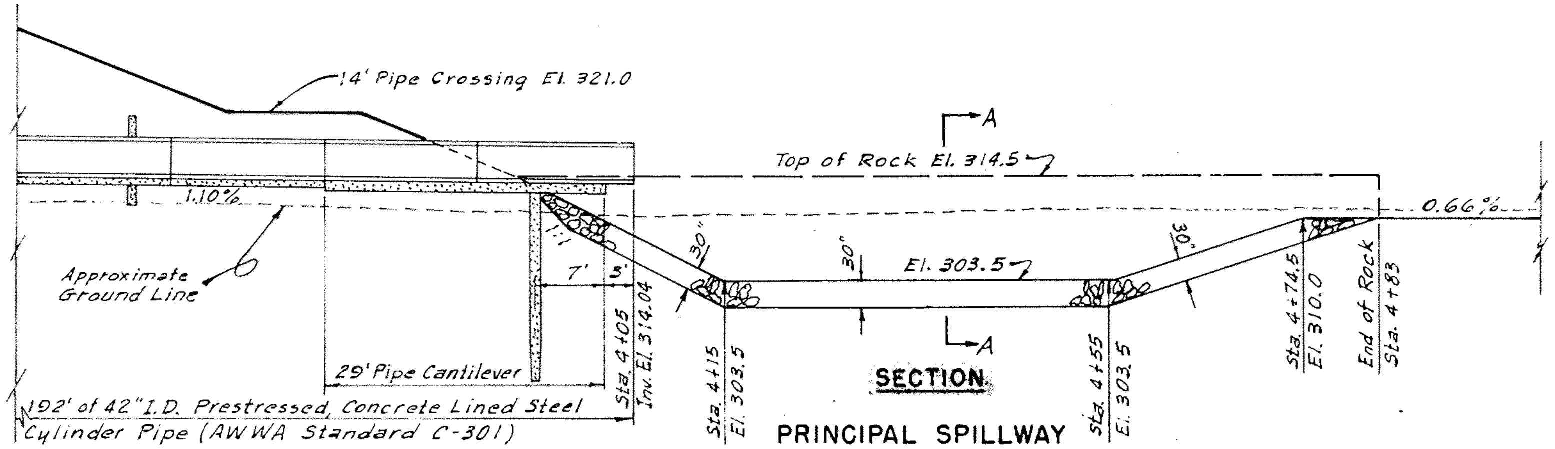


Fill to bottom of bedding, see Construction Specification 23. Prior to placing fill material around the completed conduit, the exposed earth surfaces shall be reworked as necessary and to the depth necessary to remove all cracks caused by weathering and to establish or restore the density and moisture requirements specified for that type of material.

TYPICAL CONDUIT FOUNDATION



SECTION A-A



SECTION
PRINCIPAL SPILLWAY

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

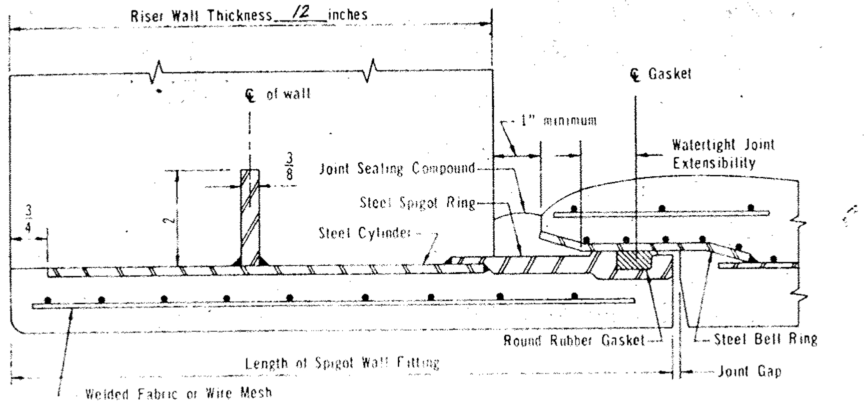
NO CHANGE IN PLANS

PRINCIPAL SPILLWAY—PLAN AND SECTION
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

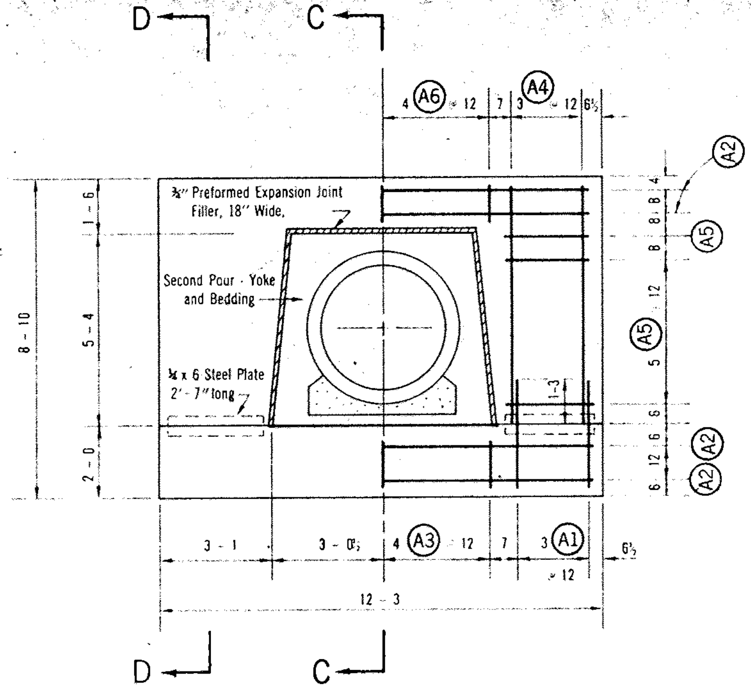
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED O.W.B & D.E.G.	DATE 2-74	APPROVED BY GCV
DRAWN E.K.	2-74	STATE CONSERVATION ENGINEER S.C.S.
TRACED T.D.S.	3-74	TEMPLE, TEXAS
CHECKED R.L.K. & D.E.G.	3-74	SHEET No. 4 of 13 — DRAWING NO. 4-E-33,763

SCS-ENG-314 (Rev. 7-71)

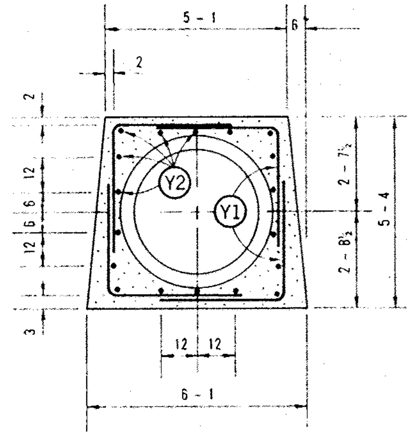


DETAIL A



DETAIL OF ANTI-SEEP COLLAR

Yoke steel not shown.



DETAIL OF ANTI-SEEP COLLAR YOKE

STEEL SCHEDULE						
Anti-seep Collar and Yoke, 5 Required.						
Mark	Size	Quantity per Collar	Length	Type	Total Quantity	Total Length
A_1	4	6	3 - 0	1	30	90-0
A_2	4	4	11 - 9	1	20	235-0
A_3	4	7	1 - 6	1	35	52-6
A_4	4	6	6 - 7	1	30	197-6
A_5	4	12	2 - 7	1	60	155-0
A_6	4	7	1 - 0	1	35	35-0
Y_1	4	12	6 - 2	21	60	370-0
Y_2	4	18	1 - 2	1	90	105-0

QUANTITIES

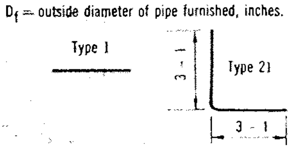
Concrete	Cu. Yds.
Anti-seep Collar including Yoke	
* Each	2.8842
Total	14.4
Bedding	
** Per Lineal Foot of Bedding	0.0989
Total (.0989)(152.5) + .38 c.y.	15.5
Steel	**Pounds**
Anti-seep Collar including Yoke	828.3

Concrete quantities are based on an outside diameter of pipe of 49.25 inches. Steel quantities do not change with outside diameter of pipe.

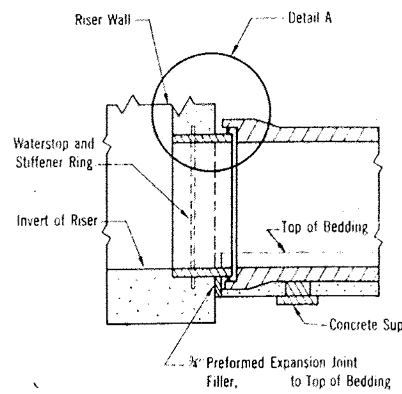
* This quantity is given by
$2.831 - 0.0003030 (D_f + 51)(D_f - 51)$ cu. yds

** This quantity is given by
$0.0977 - 0.0007 (D_f - 51)$ cu. yds

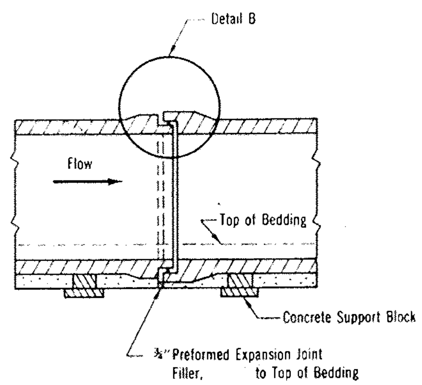
D_f = outside diameter of pipe furnished, inches.



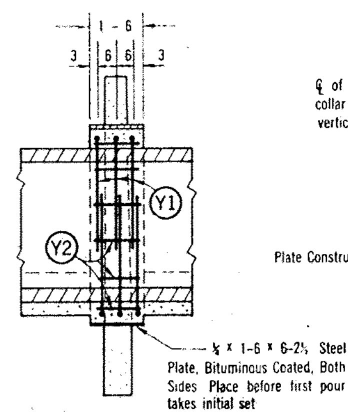
BAR TYPES



DETAIL OF SPIGOT WALL FITTING

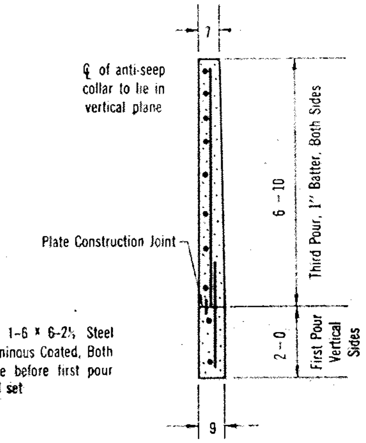


DETAIL OF PIPE JOINT

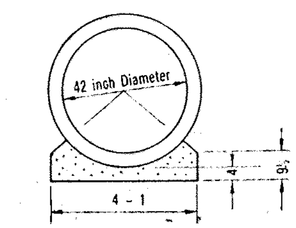


SECTION C-C

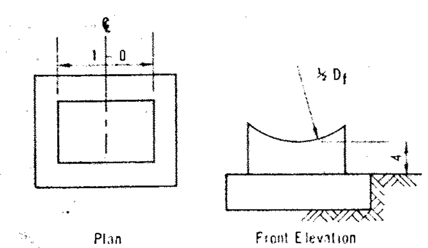
Anti-seep collar steel not shown.



SECTION D-D



DETAIL OF BEDDING

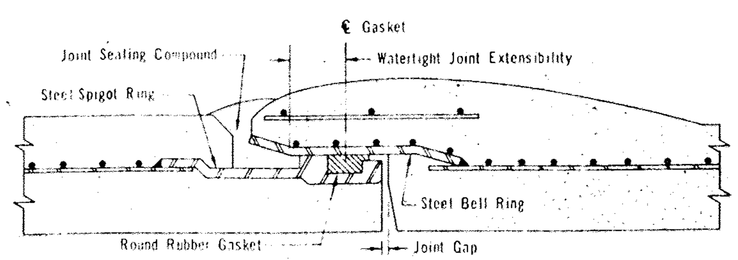


SUGGESTED SUPPORT BLOCKS

Sufficient blocks shall be provided to support the pipe to the required line and grade. The Contractor shall determine the number and size of blocks required. Wedges may be used as an alternate.

NO CHANGE IN PLANS

AS-BUILT PLANS CONSTRUCTION COMPLETED 12-27-74



DETAIL B

JOINT REQUIREMENTS

Length of Pipe Section	Minimum Joint Length	Minimum Joint Limiting Angle	
feet	inches	radians	degrees
16	2.5	0.01878	1.07

For pipe length other than shown, joint requirements will be determined by the Engineer.

Where pipes of different length are connected, adjoining pipes shall meet the requirements of the longer pipe.

Prior to delivery of pipe, the pipe joint detail proposed for use shall be submitted to the Engineer for approval.

STRENGTH REQUIREMENTS

Inside Diameter of Pipe	Internal Load	External Load	
	Hydrostatic Pressure	Minimum 3-Edge Bearing Strength in Pounds per Lineal Foot of Pipe	
		Applicable Standard Specification	
		AWWA C-301	AWWA C-300
	Head of Water	Load to produce 0.001 inch crack one foot long	Load to produce 0.01 inch crack one foot long
inches	feet		
42	50	10,500	

The outside diameter of pipe assumed in design is 49.25 inches. Where the pipe furnished has an outside diameter greater than assumed in design, the three-edge bearing strength of the pipe furnished must not be less than the specified three-edge bearing strength multiplied by the ratio of the outside diameter of the pipe furnished to the outside diameter assumed in design.

Joint length equals watertight joint extensibility plus joint gap.

The pipe shall be drawn together so that the maximum joint gap does not exceed ⅜ inch for pipe laid on a straight line. For cambered pipe or pipe laid on a curved line, the joint gap at the closest point shall not exceed ⅜ inch.

STANDARD CONDUIT DETAILS	
FOR REINFORCED CONCRETE PRESSURE PIPE PRINCIPAL SPILLWAY	
STANDARD DWG. NO. ES- 5042-BE	
DATE 2-70	SHEET 1 OF 1

Rev. 7-6-72
Rev. 6-19-71

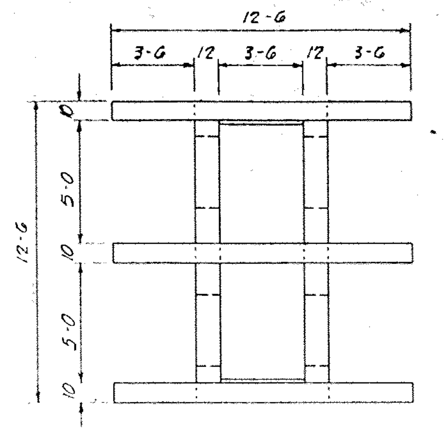
PIPE DETAILS
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Name	Date
Designed	O. W. B. & D.E.G.	2-74
Drawn	E. K.	2-74
Traced	L. S.	3-74
Checked	R.L.K. & D.E.G.	3-74

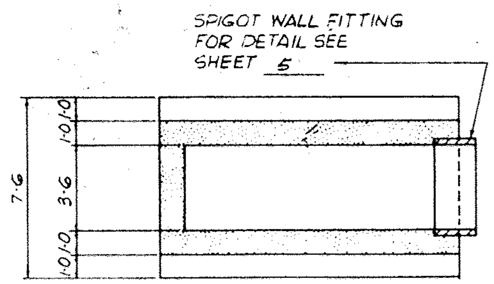
Approved by: G.C.V. — State Conservation Engineer, S.C.S., Temple, Texas

Sheet No. 5 of 13 — Drawing No. 4-E-33,763



TOP PLAN

For detail of trashrack angles and grating see sheet 9



SECTION A-A

STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	6	13	7-0	1	–	–	91-0
B2	6	8	12-0	1	–	–	96-0
B3	7	44	11-2	21	3-8	7-6	491-4
B4	6	8	12-0	1	–	–	96-0
B5	6	12	7-0	1	–	–	84-0
B6	6	2	2-10	1	–	–	5-8
B7	6	4	8-5	21	1-0	7-5	33-8
B8	6	4	8-5	21	1-0	7-5	33-8
B9	6	14	8-5	21	1-0	7-5	117-10
B10	6	2	8-5	21	1-0	7-5	16-10
B11	6	14	11-2	1	–	–	156-4
B12	6	4	4-2	1	–	–	16-8
B13	6	20	10-8	21	3-7	7-1	213-4
B14	6	4	8-2	21	1-1	7-1	32-8
B15	6	4	7-10	21	0-9	7-1	31-4
B16	6	6	7-7	21	0-6	7-1	45-6
B17	6	2	9-2	21	2-1	7-1	18-4
B18	6	2	2-[illegible]	1	–	–	5-6
B19	6	2	2-10	1	–	–	5-8

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
T1	6	12	4-2	1			50-0
T2	6	8	7-10	1			62-8
T3	6	16	4-4	1			69-4
T4	6	8	7-10	1			62-8
T5	5	12	11-6	1			138-0
T6	5	2	4-2	1			8-4
T7	5	28	10-4	21	3-5	6-11	289-4
T8	5	2	6-6	1			13-0
T9	5	2	8-6	1			17-0
T10	5	2	10-6	1			21-0
T11	5	22	12-2	1			267-8
T12	5	12	8-6	19	3-9	4-9	102-0
T13	5	8	4-10	1			38-8
T14	5	8	5-10	1			46-8
T15	5	8	6-10	1			54-8
T16	5	2	6-10	1			13-8
T17	5	2	9-6	1			19-0
T18	5	6	3-2	1			19-0
T19	5	8	7-10	1			62-8
T20	5	4	6-4	1			25-4
T21	5	4	5-1	1			20-4
T22	5	4	3-3	21	1-7	1-8	13-0
T23	5	4	4-6	21	1-7	2-11	18-0
T24	5	4	5-8	21	1-7	4-1	22-8

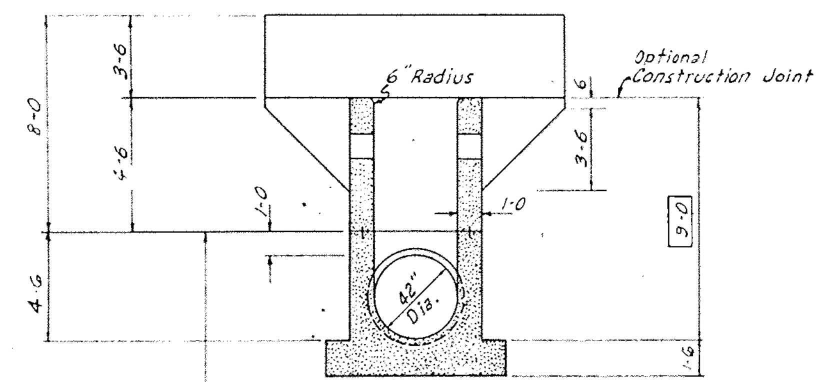
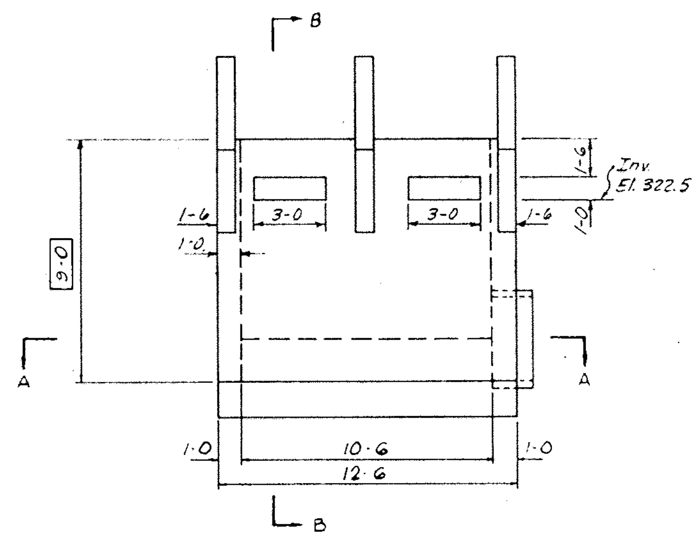


PLATE CONSTRUCTION JOINT FOR DETAIL SEE SHEET 9

SECTION B-B



SIDEWALL ELEVATION

NO CHANGE IN PLANS

AS-BUILT PLANS
CONSTRUCTION
COMPLETED 12-23-74

QUANTITIES

STEEL

#5 BARS	1210-0	1262 LBS
#6 BARS	1346-0	2022 LBS
#7 BARS	491-4	1004 LBS
		4288 LBS

CONCRETE - 21.4 = 21.4 CU. YDS.

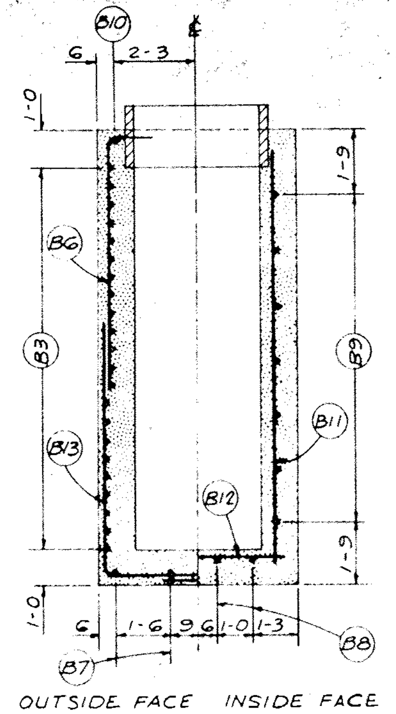
STANDARD OPEN RISER	
STANDARD DWG. NO. ES-3142-1010R	
DATE 9-67	SHEET 1 OF 3
ADAPTED FROM	
STANDARD COVERED RISER	
DESIGN CONSTANTS f'_c = 4000 psi, f_c = 1600 psi, n = 8, f_s = 20,000 psi	
STANDARD DWG. NO. ES-3042-2015R	
DATE 8-66	SHEET 1 OF 4

Special

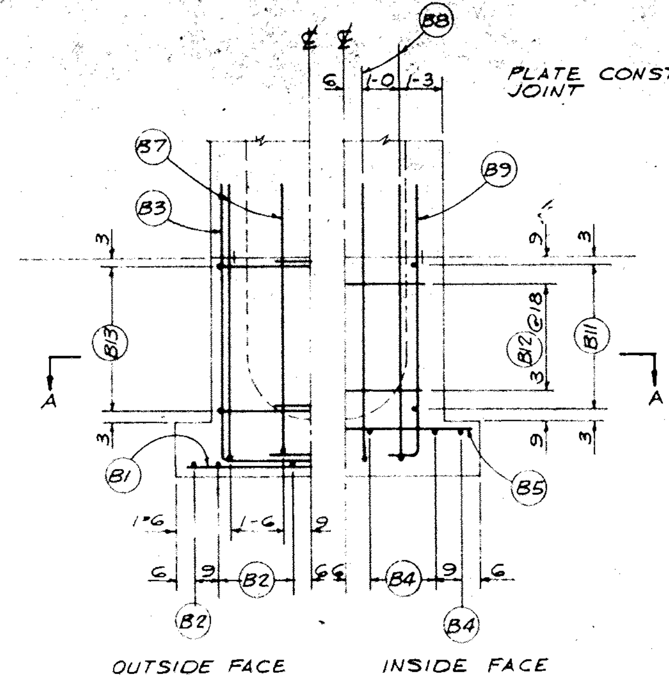
PRINCIPAL SPILLWAY INLET
FLOODWATER RETARDING STRUCTURE, SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

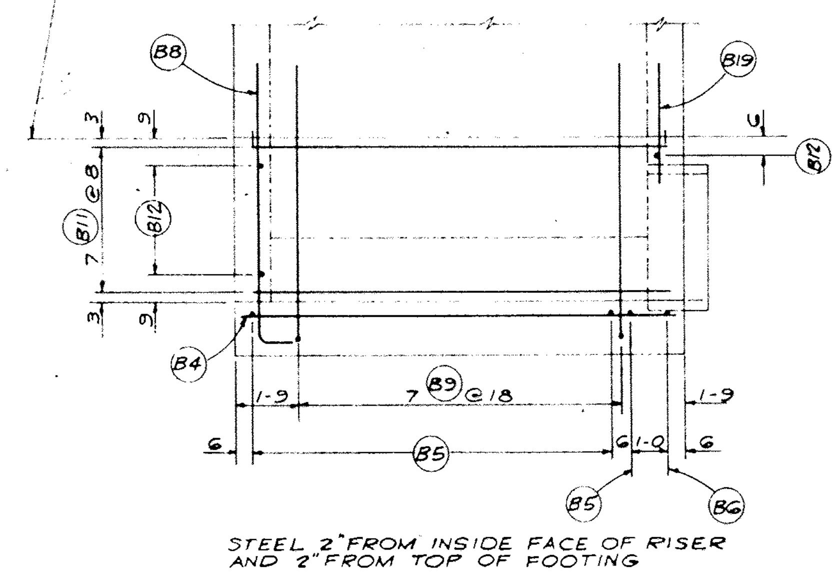
		Date	
Designed	O. W. B. & D.E.G.	2-74	Approved by [signature] STATE CONSERVATION ENGINEER, S. C. S. TEMPLE, TEXAS
Drawn	E. K.	2-74	
Traced	L. S.	3-74	Sheet No. 6 of 13
Checked	R.L.K. & D.E.G.	3-74	Drawing No 4-E-33,763



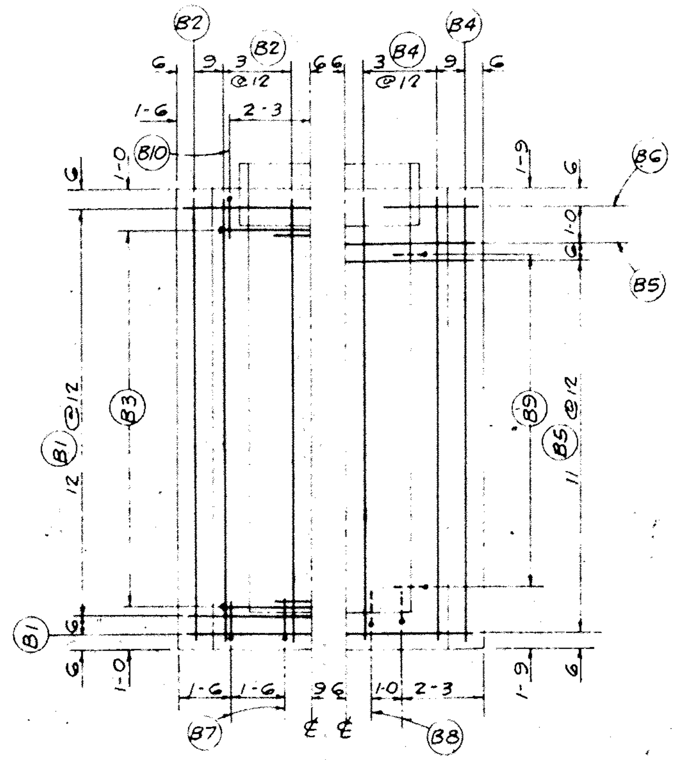
SECTION A-A



UPSTREAM ELEVATION

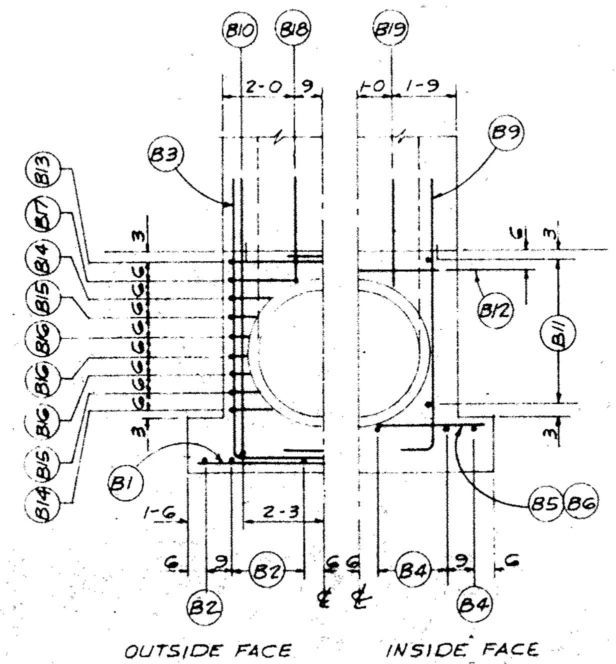


SIDEWALL ELEVATION

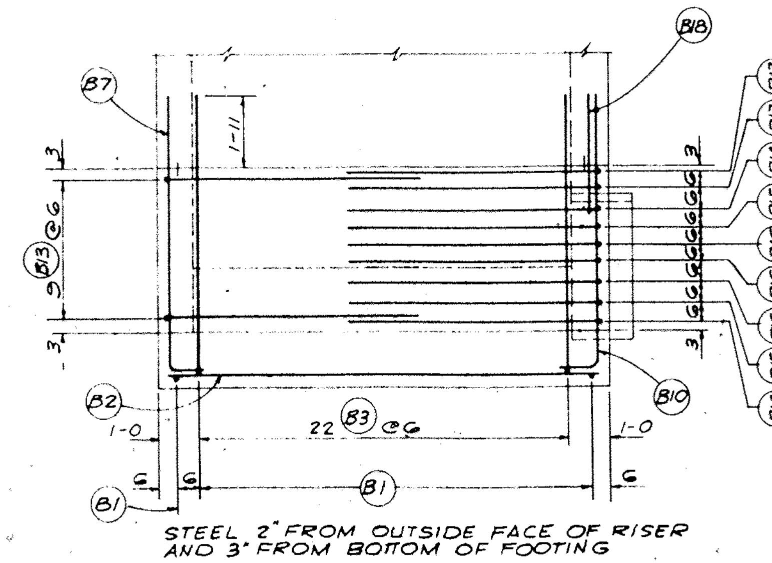


Steel 3" From Bottom of Footing
Steel 2" From Top of Footing

FOOTING PLAN



DOWNSTREAM ELEVATION



SIDEWALL ELEVATION

STANDARD OPEN RISER	
STANDARD DWG. NO. ES-3142-1010 R	
DATE 9-67	SHEET 2 OF 3
ADAPTED FROM	
STANDARD COVERED RISER	
DESIGN CONSTANTS f'c = 4000 psi, n = 8	fc = 1600 psi, fs = 20,000 psi
STANDARD DWG. NO. ES-3042-2015R	
DATE 8-66	SHEET 2 OF 4

Special

0 2 4 6
SCALE IN FEET

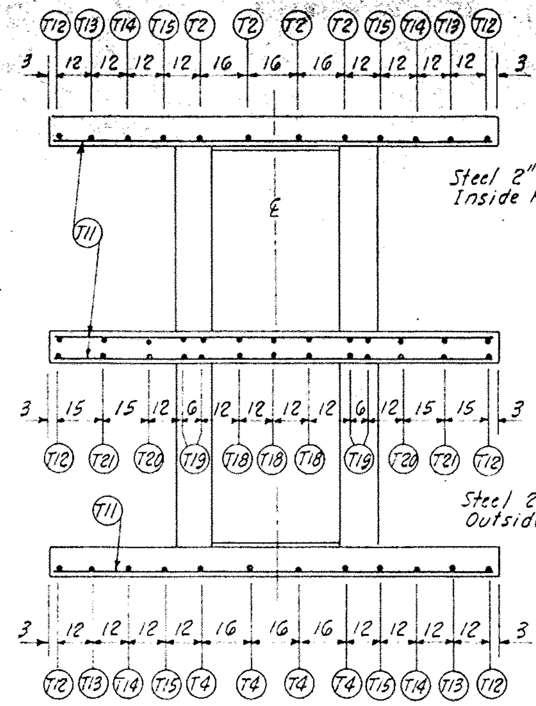
NO CHANGE IN PLANS

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

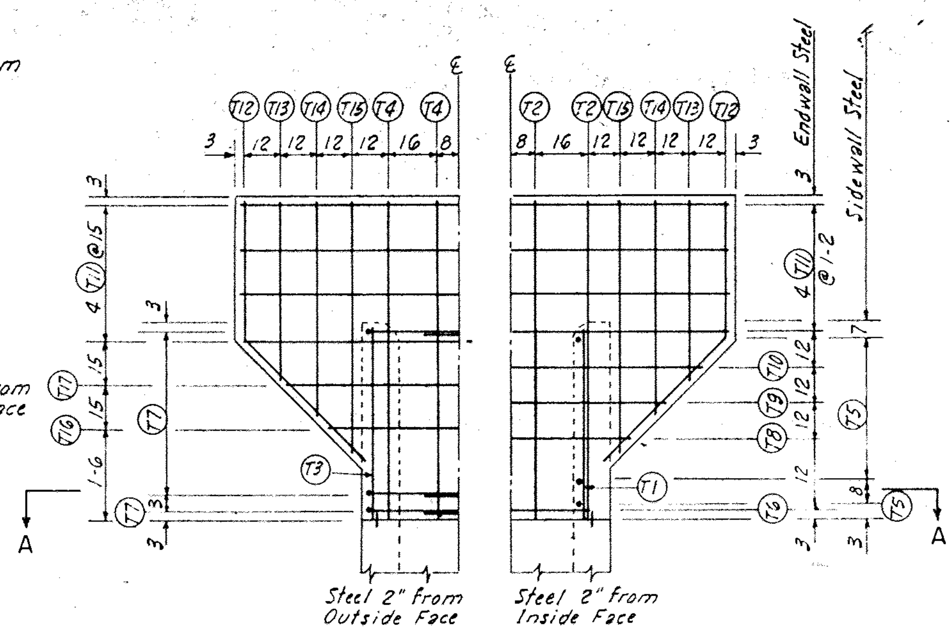
STEEL PLACEMENT-PRINCIPAL SPILLWAY INLET
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

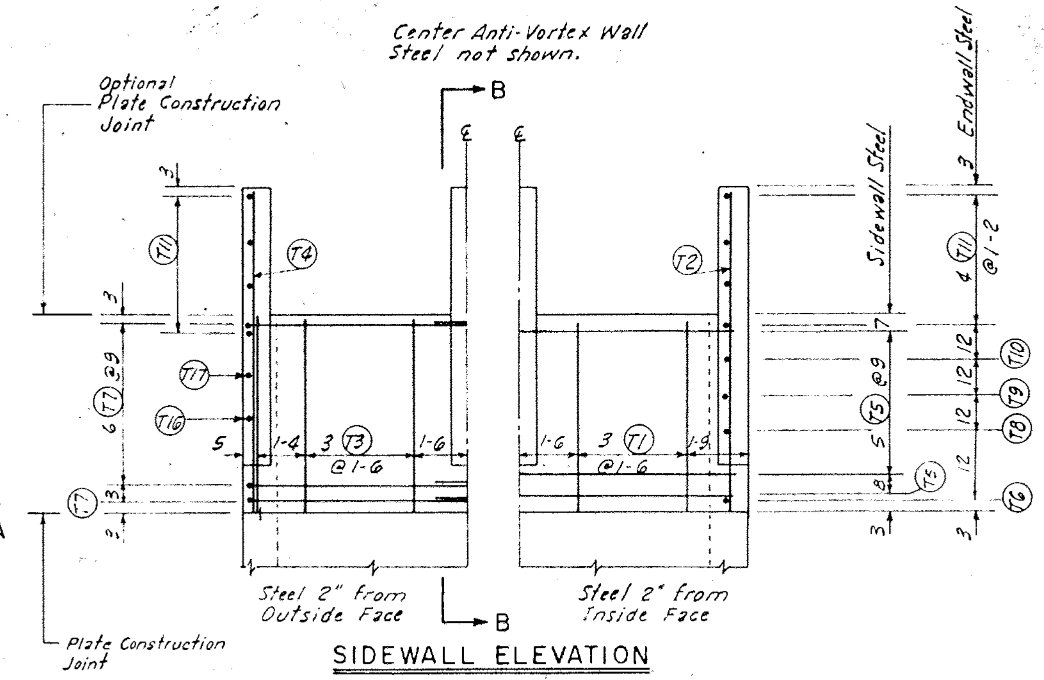
		Date	
Designed	O.W.B. & D.E.G.	2-74	Approved by
Drawn	E.K.	2-74	STATE CONSERVATION ENGINEER S.C.S. TEMPLE, TEXAS
Traced	L.S.	3-74	Sheet No. 7 of 13
Checked	R.L.K. & D.E.G.	3-74	Drawing No. 4-E-33,763



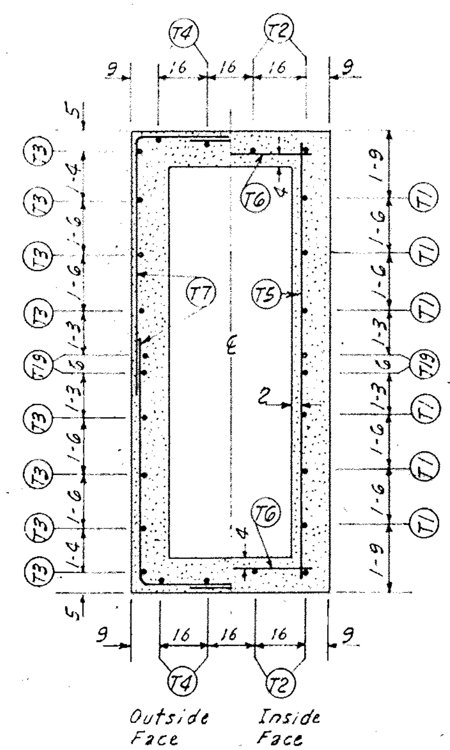
ANTI-VORTEX WALL PLAN



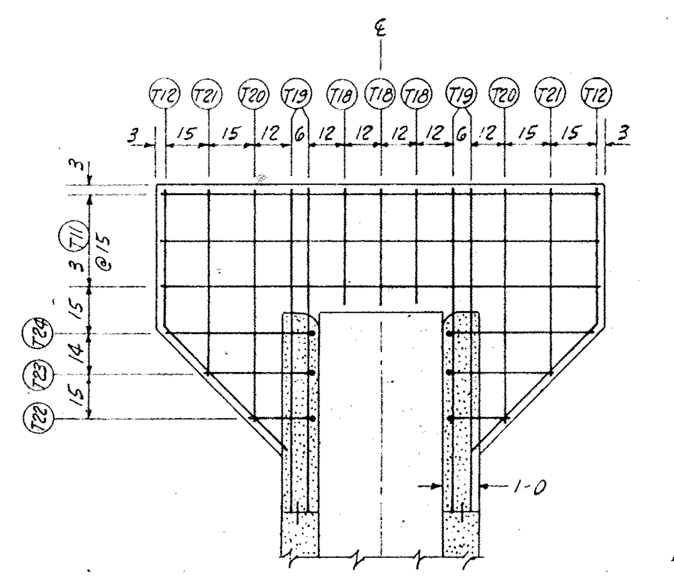
ENDWALL ELEVATION



SIDEWALL ELEVATION



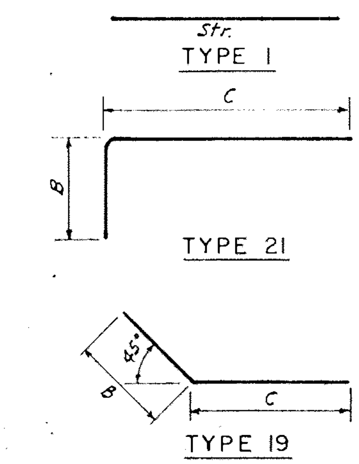
SECTION A-A



CENTER ANTI-VORTEX WALL ELEVATION

(Steel Identical Both Faces)

SECTION B-B



BAR TYPES

0 1 2 3 4 5 6
SCALE IN FEET

NOTE:
1. BAR DIMENSIONS ARE OUT TO OUT OF BAR
2. RADIUS OF BENDS
= 3 BAR DIAMETERS FOR SIZES ≤ #7
= 4 BAR DIAMETERS FOR #8
3. THE 2" AND 3" DISTANCES FROM SPECIFIED CONCRETE SURFACES ARE CLEAR DISTANCES.
4. CUT OR DEFLECT STEEL TO CLEAR PORTS.

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

NO CHANGE IN PLANS

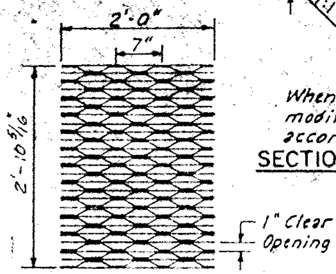
STEEL PLACEMENT-PRINCIPAL SPILLWAY INLET
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	O.W.B. E.D.E.G.	2-74	Approved by
Drawn	E.K.	2-74	STATE CONSERVATION ENGINEER, S.C.S.
Traced	L.S.	3-74	TEMPLE, TEXAS
Checked	R.L.K. E.D.E.G.	3-74	Sheet No 8 of 13 — Drawing No 4-E-33,763

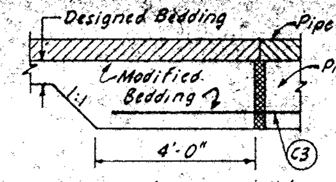
Special

STANDARD OPEN RISER	
DESIGN CONSTANTS	f'_c = 4000 psi f_c = 1600 psi n = 8 f_s = 20,000 psi
STANDARD DWG. NO.	ES-3142-1010 R
DATE 4-67	SHEET 3 OF 3



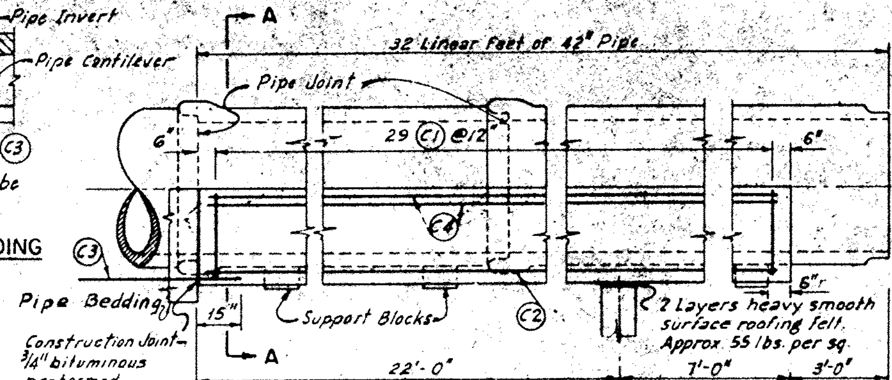
Grating: Galvanized steel; pattern as shown; bearing bars 1"x 3/16"; min. weight 9.0 lbs. per sq.ft. Fasten to supporting angles with clips as shown. Not less than 3 clips on each side of each panel. 4 panels required.

GRATING

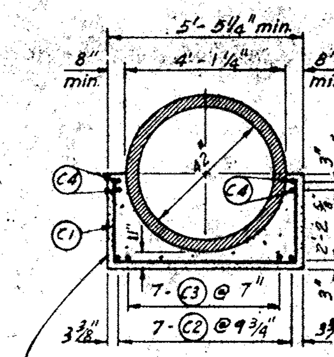


When used, bedding shall be modified as shown to accommodate C3 bars.

SECTION-MODIFIED BEDDING

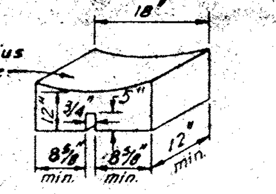


PIPE CANTILEVER



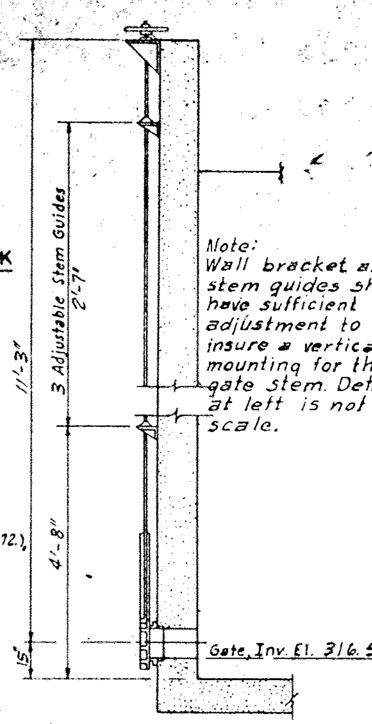
Note: Sides of Pipe Cantilever to be formed with lumber or metal.

SECTION A-A



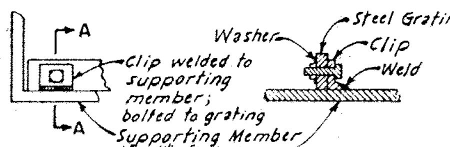
CANTILEVER SUPPORT BLOCK

18" Moderate Duty Slide Gate (Type MMS-1), Class 50-10, square opening, spigot back frame and bronze seating surface. Lifting mechanism shall include a 1 1/8" dia. stainless steel rising type gate stem, adjustable stem guides and wall brackets; and a 14" dia. handwheel lift with bronze lift nut (ball or roller bearings not required). Stainless steel for gate stem shall be Type 302, 303 or 304. (See Construction Specification 71 and Material Specification 512.)



The Slide Gate shall be centered in the upstream wall of the riser. Set anchor bolts to fit gate, stem guides and wall bracket furnished.

SLIDE GATE

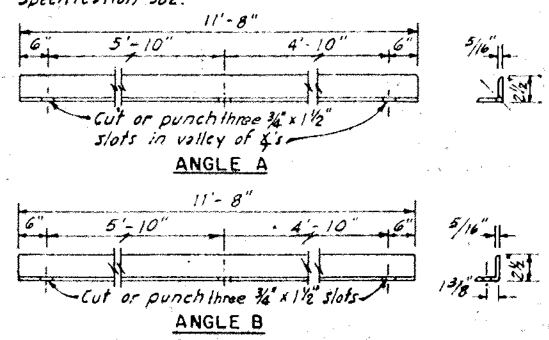


CLIP DETAILS

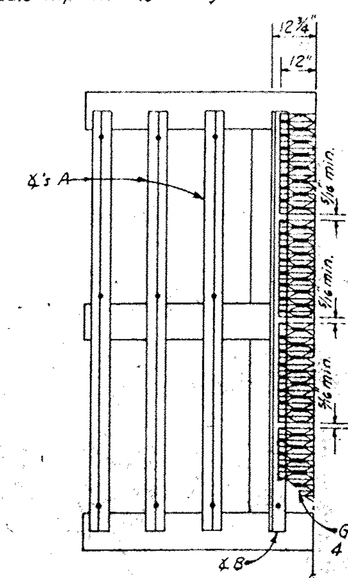
(Acceptable alternate to above clip detail is saddle clip with 3/8"x 1 1/4" galvanized bolts.)

SCHEDULE OF MATERIALS FOR TRASH RACK			
Item	Quan.	Length	Total Feet
2 1/2"x 2 1/2"x 5/16" Angle A	16	11'-8"	186'-8"
3/4" I.D. Pipe Sleeve	54	10"	45'-0"
5/8" Angle Bolt A, w/washers & nuts	48	21"	
2 1/2"x 2 1/2"x 5/16" Angle B	2	11'-8"	23'-4"
5/8" Angle Bolt B, w/washers & nuts	6	20"	
Grating Panels	4		

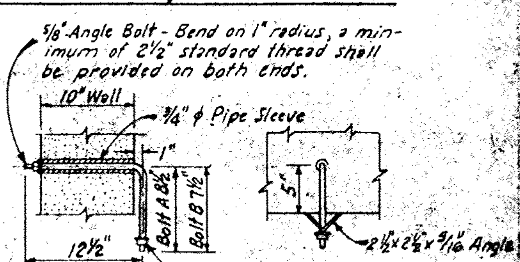
All parts of the trash rack shall be galvanized. See Construction Specification 81 and Material Specification 582.



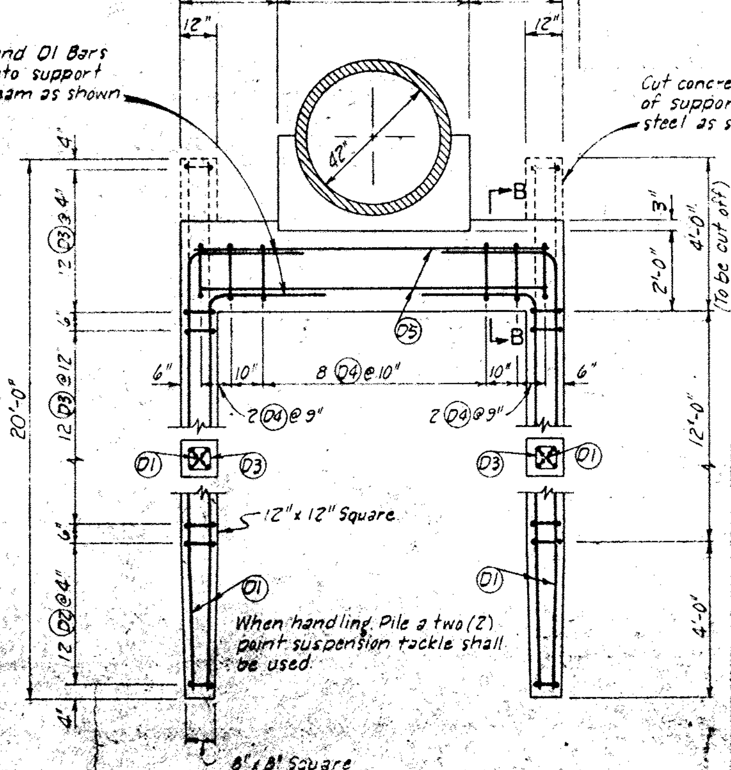
DETAIL OF ANGLES FOR TRASH RACK



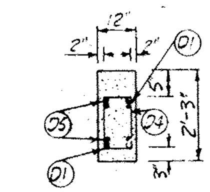
HALF PLAN



DETAIL A



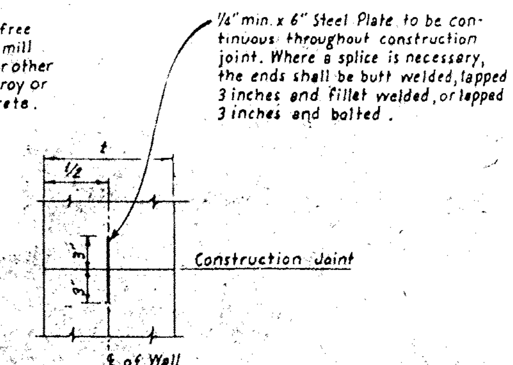
ELEVATION



SECTION B-B

The 20' Piles are to be driven approx. 14' below the bottom of the support beam and cut flush with the bottom of the beam. See Construction Specification 13 for minimum penetration and bearing capacity.

Note: Shear Plate shall be free from dirt, oil, grease, paint, mill scale, loose or thick rust, or other coating which might destroy or reduce its bond with concrete.



DETAIL OF SHEAR PLATE CONSTRUCTION JOINT

PIPE CANTILEVER SUPPORT

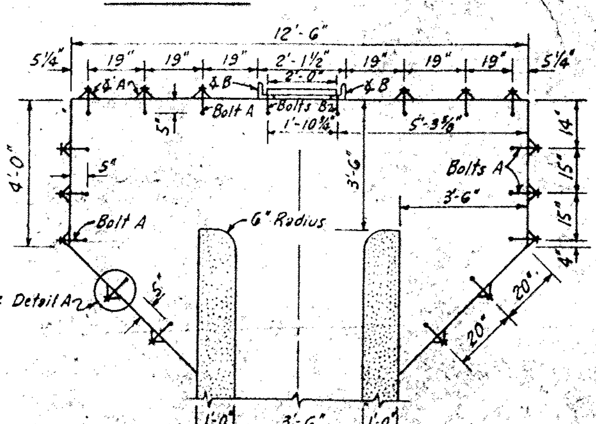
For Typical Bar Types Refer To A.C.I. Standard 315

No.	Location	Qty.	Length	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
C1	Pipe Cantilever	29	10-2	294-10	4	S-10		2-7	5-0	2-7						
C2	" "	7	28-6	199-6	4	Str.										
C3	" "	7	5-0	35-0	4	"										
C4	" "	4	28-6	114-0	8	"										
Total Steel in Pipe Cantilever (Size 4) = 529'-4" = 353.59 lbs.																
" " " " (Size 8) = 114'-0" = 304.38 lbs.																
Total Steel = 657.97 lbs.																
Total Reinforced Concrete in Pipe Cantilever = 10.23 cu. yds.																
D1	Pile	8	19-6	156-0	8	Str.										
D2	~~Pile~~	24	2-8 Ave.	64-0	3	T1	0-4	0-4 to 0-8	0-4 to 0-8	0-4 to 0-8	0-4 to 0-8		0-4			
D3	Pile	48	3-6	168-0	3	T1	0-5	0-8	0-8	0-8	0-8		0-5			
D4	Beam	12	5-4	64-0	4	T1	0-5	0-8	1-7	0-8	1-7		0-5			
D5	Beam	4	9-6	38-0	8	Str.										
Total Steel in Beam (Size 4) = 64'-0" = 42.75 lbs.																
Total Steel in Beam (Size 8) = 38'-0" = 101.46 lbs.																
Total Steel in Beam = 144.21 lbs.																
Total Reinforced Concrete in Beam = 0.78 cu. yds.																

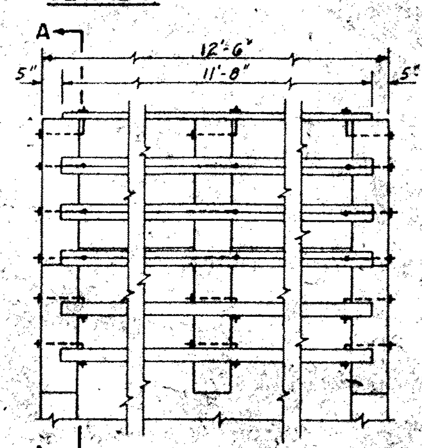
Note: All concrete shall equal or exceed class 4000

AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74

NO CHANGE IN PLANS



SECTION A-A



SIDE ELEVATION

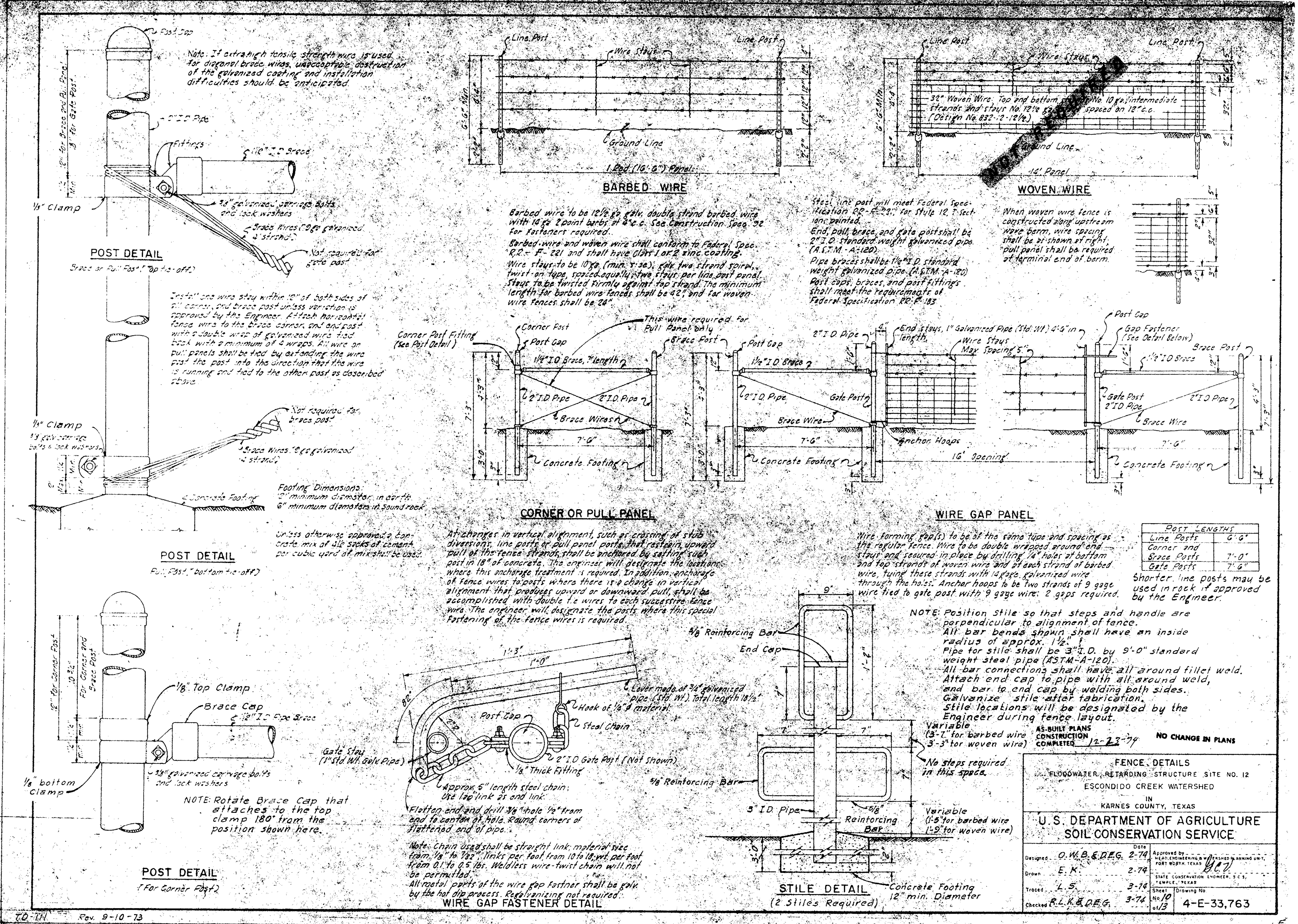
TRASH RACK

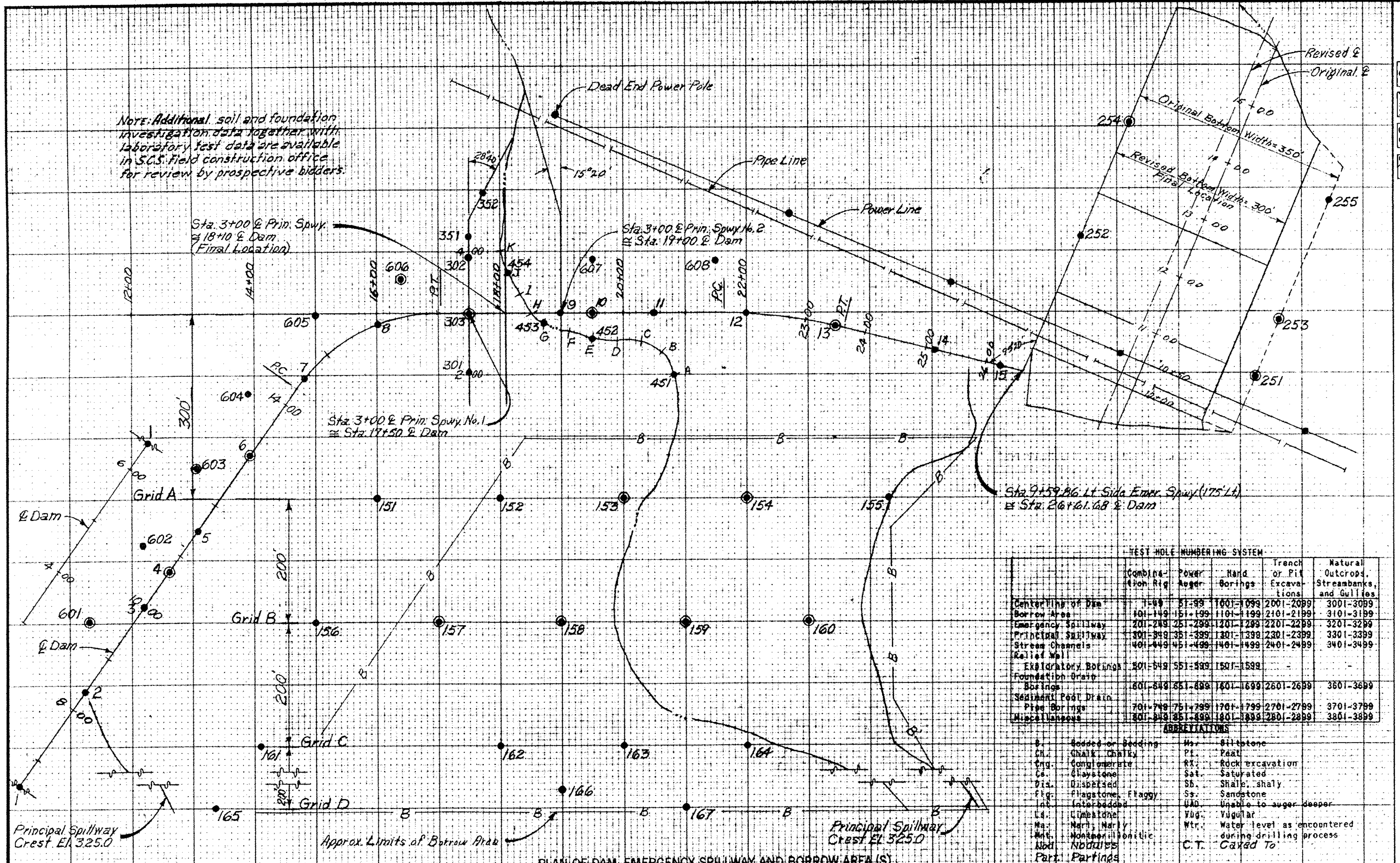
TRASH RACK, SLIDE GATE, AND PIPE CANTILEVER SUPPORT DETAILS
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date		
Designed	O. W. B. E.D.E.G.	2-74	Approved by	
Drawn	E. K.	2-74		
Traced	L. S.	3-74	Sheet No.	Drawing No.
Checked	R.L.K. E.D.E.G.	3-74	9 of 13	4-E-33,763

42" Pipe W/Cantilever and Slide Gate


Post Cap
Note: If extra high tensile strength wire is used for diagonal brace wires, unacceptable destruction of the galvanized coating and installation difficulties should be anticipated.
2" I.D. Pipe
Fittings
1 1/2" I.D. Brace
1/8" Clamp
3/8" galvanized carriage bolts and lock washers
Brace Wires (9 ga galvanized 4 strand)
Not required for gate post
POST DETAIL
Brace or Pull Post ("Top tie-off")
Install one wire stay within 12" of both sides of all corner, and brace post unless variation is approved by the Engineer. Attach horizontal fence wire to the brace corner, and end post with a double wrap of galvanized wire tied back with a minimum of 4 wraps. All wire on pull panels shall be tied by extending the wire past the post into the direction that the wire is running and tied to the other post as described above.
1/8" Clamp
3/8" galvanized carriage bolts & lock washers
Not required for brace post
Brace Wires (9 ga galvanized 4 strand)
Concrete Footing
Footing Dimensions:
12" minimum diameter in earth.
6" minimum diameter in sound rock.
Unless otherwise approved a concrete mix of 4 1/2 sacks of cement per cubic yard of mix shall be used.
POST DETAIL
Pull Post ("bottom tie-off")
1/8" Top Clamp
Brace Cap
1 1/2" I.D. Pipe Brace
1/8" bottom Clamp
3/8" galvanized carriage bolts and lock washers
NOTE: Rotate Brace Cap that attaches to the top clamp 180° from the position shown here.
POST DETAIL
(For Corner Post)
Line Post
Wire Stays
Ground Line
1 Rod (16'-6") Panel
BARBED WIRE
Barbed wire to be 12 1/2 ga galv. double strand barbed wire with 14 ga 2 point barbs at 4" c.c. See Construction Spec. 92 for fasteners required.
Barbed wire and woven wire shall conform to Federal Spec. RR-F-221 and shall have Class 1 or 2 zinc coating.
Wire stays to be 10 ga (min. size), galv. two strand spiral twist-on type, spaced equally, two stays per line post panel. Stays to be twisted firmly against top strand. The minimum length for barbed wire fences shall be 42", and for woven wire fences shall be 24".
Steel line post will meet Federal Specification RR-F-221, for Style 12, T Section painted.
End, pull, brace, and gate post shall be 2" I.D. standard weight galvanized pipe (A.S.T.M.-A-120).
Pipe braces shall be 1 1/2" I.D. standard weight galvanized pipe (A.S.T.M.-A-120).
Post caps, braces, and post fittings shall meet the requirements of Federal Specification RR-F-183.
Line Post
Wire Stays
32" Woven Wire: Top and bottom strands No. 10 ga, intermediate strands and stays No. 12 1/2 ga, stays spaced on 12" c.c.
Ground Line
14' Panel
WOVEN WIRE
When woven wire fence is constructed along upstream wave berm, wire spacing shall be as shown at right; pull panel shall be required at terminal end of berm.
Corner Post Fitting (See Post Detail)
Corner Post
Post Cap
This wire required for Pull Panel only
Brace Post
1 1/2" I.D. Brace, 7' length
2" I.D. Pipe
Brace Wires
Concrete Footing
CORNER OR PULL PANEL
At changes in vertical alignment, such as crossing of stub diversions, line posts or pull panel posts that restrain upward pull of the fence strands shall be anchored by setting such post in 18" of concrete. The engineer will designate the locations where this anchorage treatment is required. In addition, anchorage of fence wires to posts where there is a change in vertical alignment that produces upward or downward pull shall be accomplished with double tie wires to each successive fence wire. The engineer will designate the posts where this special fastening of the fence wires is required.
2" I.D. Pipe
End stays, 1" Galvanized Pipe (Std. Wt.) 4'-6" in length
Wire Stays Max. Spacing 5'
Post Cap
1 1/2" I.D. Brace
Gate Post
Brace Wire
Anchor Hoops
16' Opening
Concrete Footing
Gap Fastener (See Detail Below)
Brace Post
Gate Post 2" I.D. Pipe
WIRE GAP PANEL
Wire forming gap(s) to be of the same type and spacing as the regular fence. Wire to be double wrapped around end stays and secured in place by drilling 1/4" holes at bottom and top strands of woven wire and at each strand of barbed wire, tying these strands with 14 gage galvanized wire through the holes. Anchor hoops to be two strands of 9 gage wire tied to gate post with 9 gage wire. 2 gaps required.
POST LENGTHS
Line Posts 6'-6"
Corner and Brace Posts 7'-0"
Gate Posts 7'-6"
Shorter line posts may be used in rock if approved by the Engineer.
Lever made of 3/4" galvanized pipe (Std. Wt.) Total length 18 1/2"
Hook of 1/4" Ø material
Steel Chain
Post Cap
Gate Stay (1" Std. Wt. Galv. Pipe)
2" I.D. Gate Post (Not Shown)
1/8" Thick Fitting
Approx. 5" length steel chain; use lap link as end link.
Flatten end and drill 3/8" hole 1/2" from end to center of hole. Round corners of flattened end of pipe.
Note: Chain used shall be straight link; material size from 1/8" to 7/32", links per foot from 10 to 18, wt. per foot from 0.1 to 0.5 lbs. Weldless wire-twist chain will not be permitted.
All metal parts of the wire gap fastener shall be galv. by the hot dip process. Regalvanizing not required.
WIRE GAP FASTENER DETAIL
5/8" Reinforcing Bar
End Cap
5/8" Reinforcing Bar
3" I.D. Pipe
5/8" Reinforcing Bar
Concrete Footing 12" min. Diameter
STILE DETAIL
(2 Stiles Required)
NOTE: Position stile so that steps and handle are perpendicular to alignment of fence.
All bar bends shown shall have an inside radius of approx. 1 1/2".
Pipe for stile shall be 3" I.D. by 9'-0" standard weight steel pipe (ASTM-A-120).
All bar connections shall have all around fillet weld.
Attach end cap to pipe with all around weld, and bar to end cap by welding both sides.
Galvanize stile after fabrication.
Stile locations will be designated by the Engineer during fence layout.
Variable (3'-7" for barbed wire, 3'-3" for woven wire)
No steps required in this space.
Variable (1'-5" for barbed wire, 1'-9" for woven wire)
AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74
NO CHANGE IN PLANS
FENCE DETAILS
FLOODWATER RETARDING STRUCTURE SITE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed O.W.B. & D.E.G. 2-74
Drawn E.K. 2-74
Traced L.S. 3-74
Checked R.L.K. & D.E.G. 3-74
Approved by HEAD, ENGINEERING & WATERSHED PLANNING UNIT, FORT WORTH, TEXAS
STATE CONSERVATION ENGINEER, S.C.S., TEMPLE, TEXAS
Sheet No. 10 of 13
Drawing No. 4-E-33,763
TO-TH Rev. 9-10-73



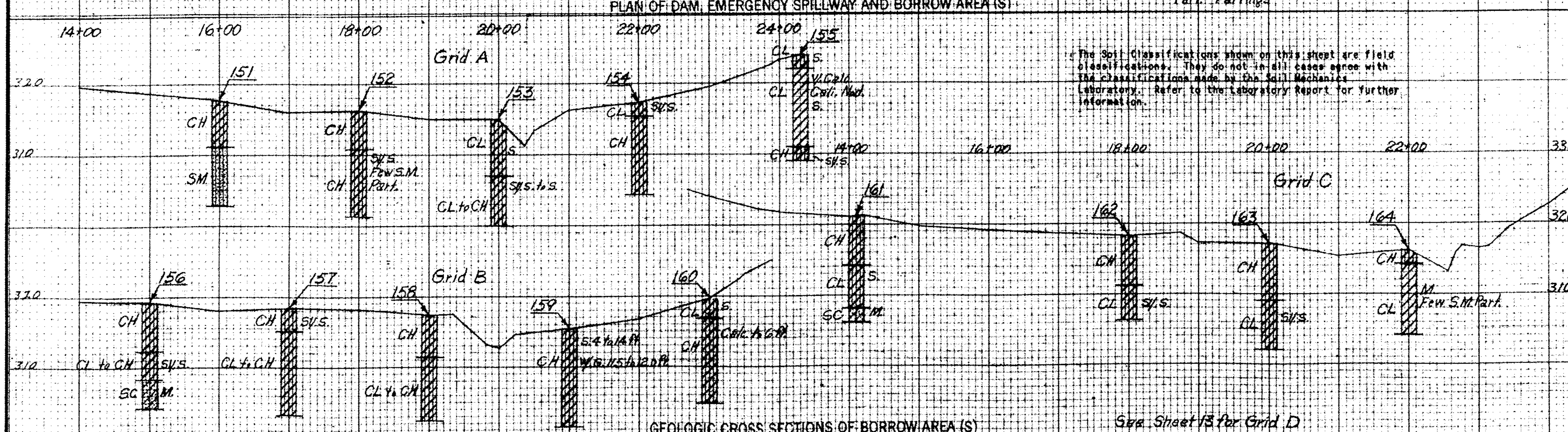
TEST HOLE NUMBERING SYSTEM

	Combination Rig	Power Auger	Hand Borings	Trench or Pit Excavations	Natural Outcrops, Streambanks, and Gullies
Centerline of Dam	1-49	51-99	1001-1099	2001-2099	3001-3099
Borrow Area	101-149	151-199	1101-1199	2101-2199	3101-3199
Emergency Spillway	201-249	251-299	1201-1299	2201-2299	3201-3299
Principal Spillway	301-349	351-399	1301-1399	2301-2399	3301-3399
Stream Channels	401-449	451-499	1401-1499	2401-2499	3401-3499
Relief Well Exploratory Borings	501-549	551-599	1501-1599	-	-
Foundation Drain Borings	601-649	651-699	1601-1699	2601-2699	3601-3699
Sediment Pool Drain Pipe Borings	701-749	751-799	1701-1799	2701-2799	3701-3799
Miscellaneous	801-849	851-899	1801-1899	2801-2899	3801-3899

ABBREVIATIONS

B.	Bedded or Bedding	Ms.	Siltstone
Ch.	Chalk, Chalky	Pt.	Peat
Cng.	Conglomerate	RX.	Rock excavation
Cs.	Claystone	Sat.	Saturated
Dis.	Dispersed	Sh.	Shale, shaly
Flg.	Flagstone, Flaggy	Ss.	Sandstone
Int.	Interbedded	UAD.	Unable to auger deeper
Ls.	Limestone	Vug.	Vugular
Ma.	Marl, Marly	Wtr.	Water level as encountered during drilling process
Mnt.	Montmorillonitic		
Nod.	Nodules	C.T.	Caved To
Part.	Partings		

The Soil Classifications shown on this sheet are field classifications. They do not in all cases agree with the classifications made by the Soil Mechanics Laboratory. Refer to the Laboratory Report for further information.



LEGEND

SYMBOLS

UNCONSOLIDATED MATERIAL

gravel; sand; silt; clay; cobbles, boulders
gravel, sandy; sand, gravelly; silt, gravelly; clay, gravelly; peat or muck
gravel, silty; sand, silty; silt, sandy; clay, sandy
gravel, clayey; sand, clayey; silt, clayey; clay, silty

CONSOLIDATED MATERIAL

Sedimentary Rocks

Conglomerate Cng.; shale sh.; limestone ls.; coal
breccia brc.; siltstone Ms.; dolomite dol.; gypsum gyp.
sandstone ss.; marl; chalk Ch.; chert cht.

Metamorphic Rocks: gneiss; schist; quartzite; slate; marble; soapstone talc serpentine

Igneous Rocks: intrusive; extrusive; pyroclastic

Undifferentiated

Other Symbols

● hole logged only; strike and dip
◉ hole sampled; pit or trench

ABBREVIATIONS

ang.	angular	lam.	laminated	G	gravel, gravelly
bld.	boulders (> 12")	lse.	loose	S	sand, sandy
calc.	calcareous	mas.	massive	M	silt, silty
cali.	caliche	med.	medium	C	clay, clayey
cav.	cavities	mic.	micaceous	O	organic
cmt.	cemented	mod.	moderately	W	well graded
cse.	coarse	n. r.	no recovery	P	poorly graded
cbl.	cobbles (3"-12")	per.	permeable		
cpt.	Compact	po.	poorly		
con.	concretions	rdd.	rounded		
xln.	crystalline	sl/.	slightly		
ds.	dense	sft.	soft		
dip.	dipping	s/.	some		
d.s.	downstream	slo.	slowly		
fn.	fine	stf.	stiff		
frm.	firm	t.b.	thin-bedded		
frac.	fractured	tuff.	tuffaceous		
frg.	fragments	u.s.	upstream		
fri.	friable	var.	variable		
grn.	grain	v/.	very		
gyp.	gypseous	w/.	with		
hd.	hard	wea.	weathered		
h.	highly	w.l.	(date) static water level		

~~TEST HOLE NUMBERING SYSTEM~~

~~Centerline of dam~~	~~1-99~~	~~Stream channel~~	~~401-499~~
~~Borrow area~~	~~101-199~~	~~Relief wells~~	~~501-599~~
~~Emergency spillway~~	~~201-299~~		~~601-699~~
~~Centerline of outlet structure~~	~~301-399~~		~~701-799~~

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

GW	Well graded gravels; gravel-sand mixtures
GP	Poorly graded gravels
GM	Silty gravels; gravel-sand-silt mixtures
GC	Clayey gravels; gravel-sand-clay mixtures
SW	Well graded sands; sand-gravel mixtures
SP	Poorly graded sands
SM	Silty sand
SC	Clayey sands; sand-clay mixtures
ML	Silts with liquid limit of 50 or less
MH	Silts with liquid limit above 50
CL	Clays with liquid limit of 50 or less
CH	Clays with liquid limit above 50
OL	Organic silts and clays with liquid limit of 50 or less
OH	Organic silts and clays with liquid limit above 50

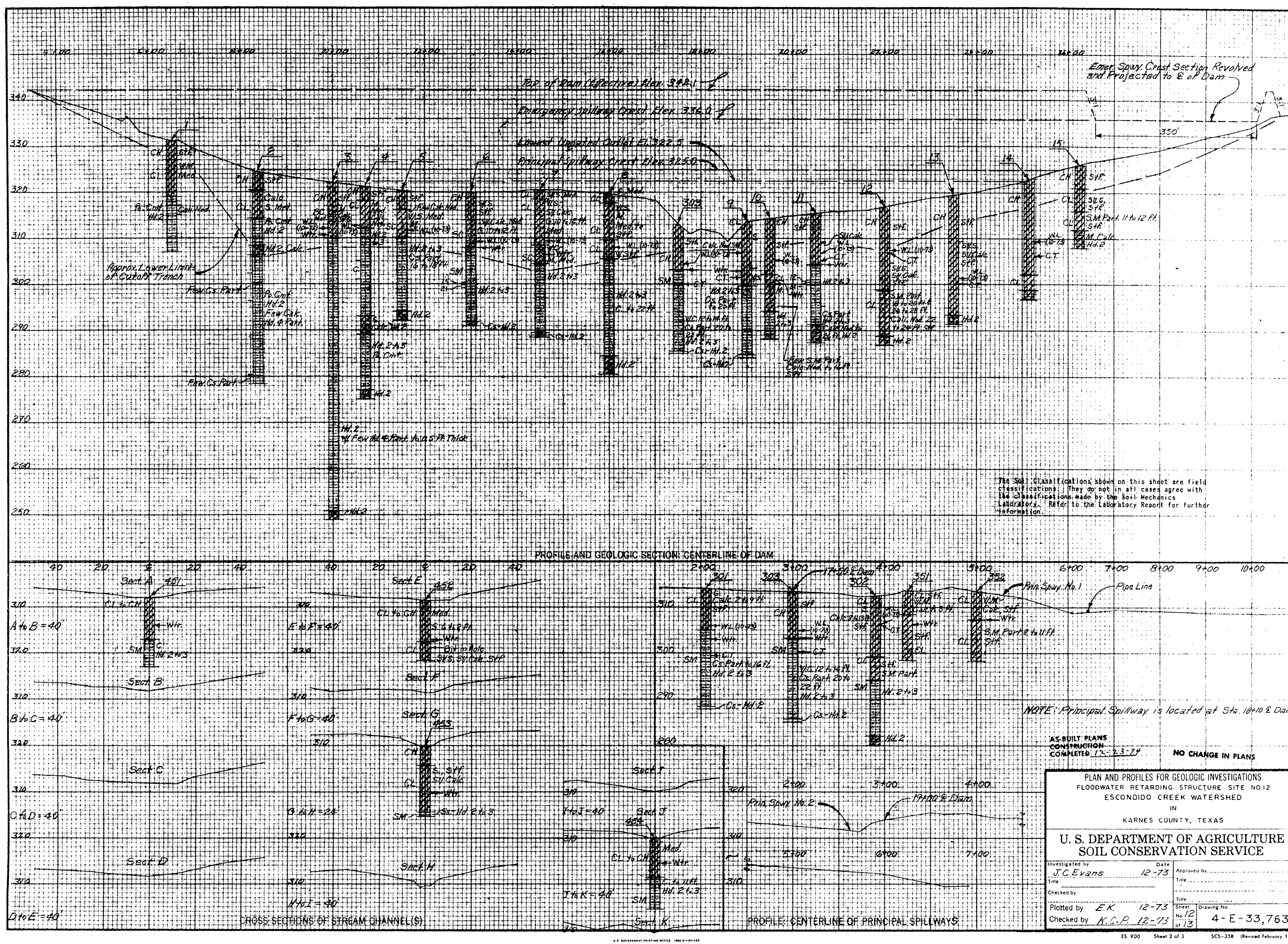
Revised February 1963

AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74 **NO CHANGE IN PLANS**

PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
FLOODWATER RETARDING STRUCTURE SITE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Investigated by J. C. Evans	Date 12-73	Approved by	
Title		Title	
Checked by		Title	
Plotted by E.K.	12-73	Sheet No. 11 of 13	Drawing No. 4-E-33,763
Checked by K.C.P.	12-73		



NOTE: Principal Spillway is located at Sta. 18+10 ℄ Dam

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

NO CHANGE IN PLANS

PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
FLOODWATER RETARDING STRUCTURE SITE NO. 12
ESCONDIDO CREEK WATERSHED
IN
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U. S. DEPARTMENT OF AGRICULTURE
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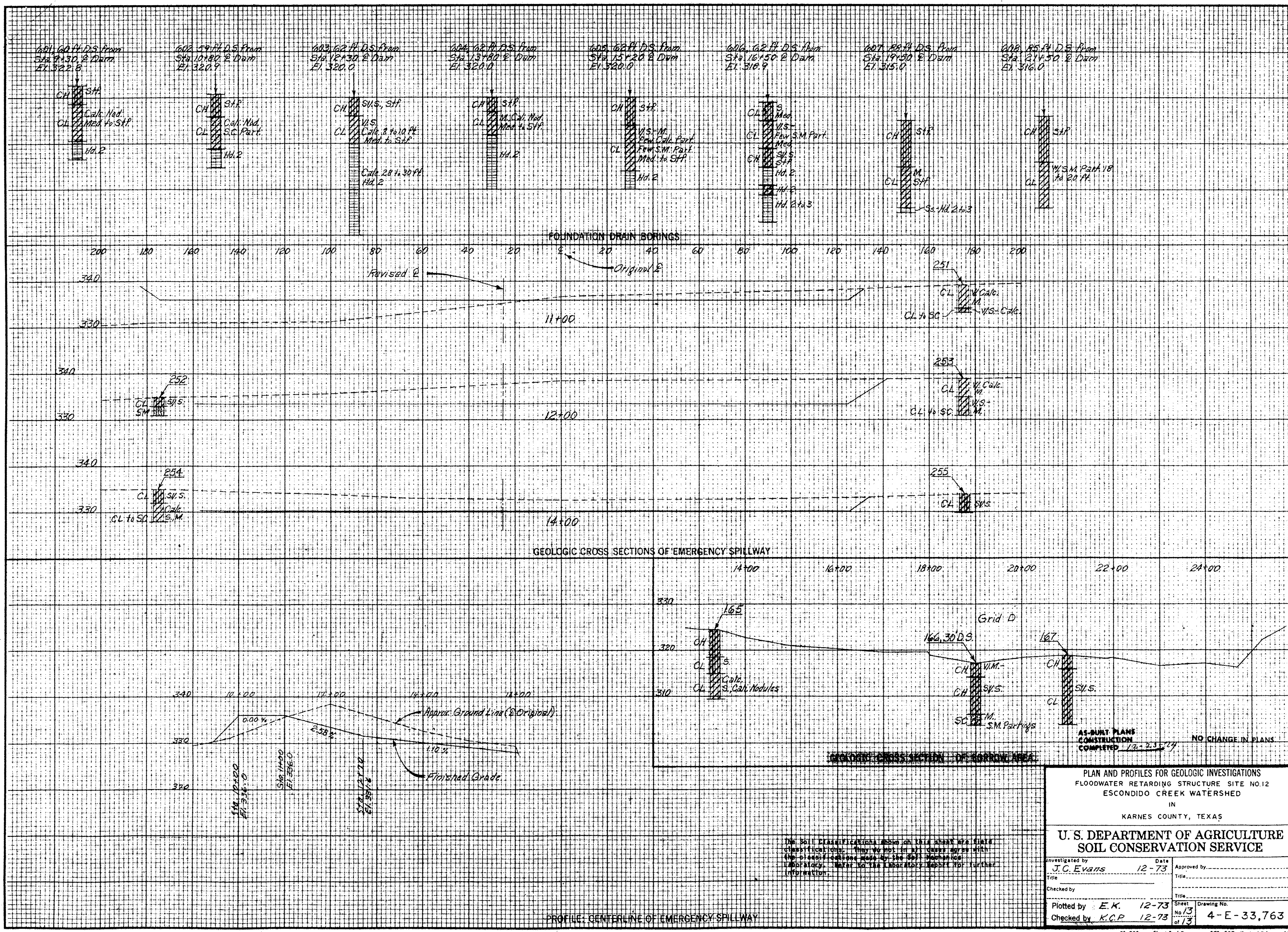
Investigated by J. C. Evans	Date 12-73	Approved by
Title		Title
Checked by		Title
Plotted by E.K.	12-73	Sheet No. 12 of 13
Checked by K.C.P.	12-73	Drawing No. 4-E-33,763



PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
FLOODWATER RETARDING STRUCTURE SITE NO.12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

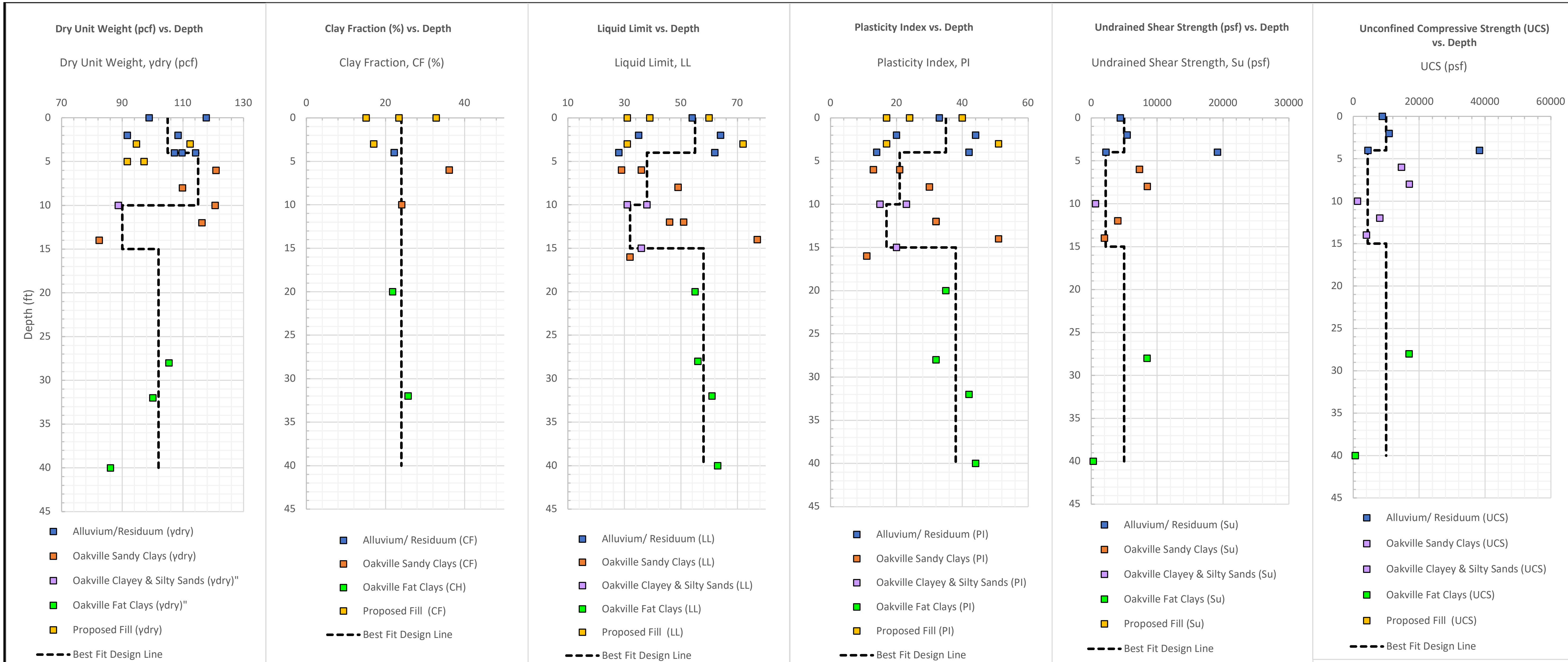
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Investigated by J.C. Evans	Date 12-73	Approved by	
Title		Title	
Checked by		Title	
Plotted by E.K.	12-73	Sheet No 13 of 13	Drawing No. 4-E-33,763
Checked by K.C.P.	12-73		

ES 900 Sheet 3 of 3 SCS-35C (Revised February 1963)

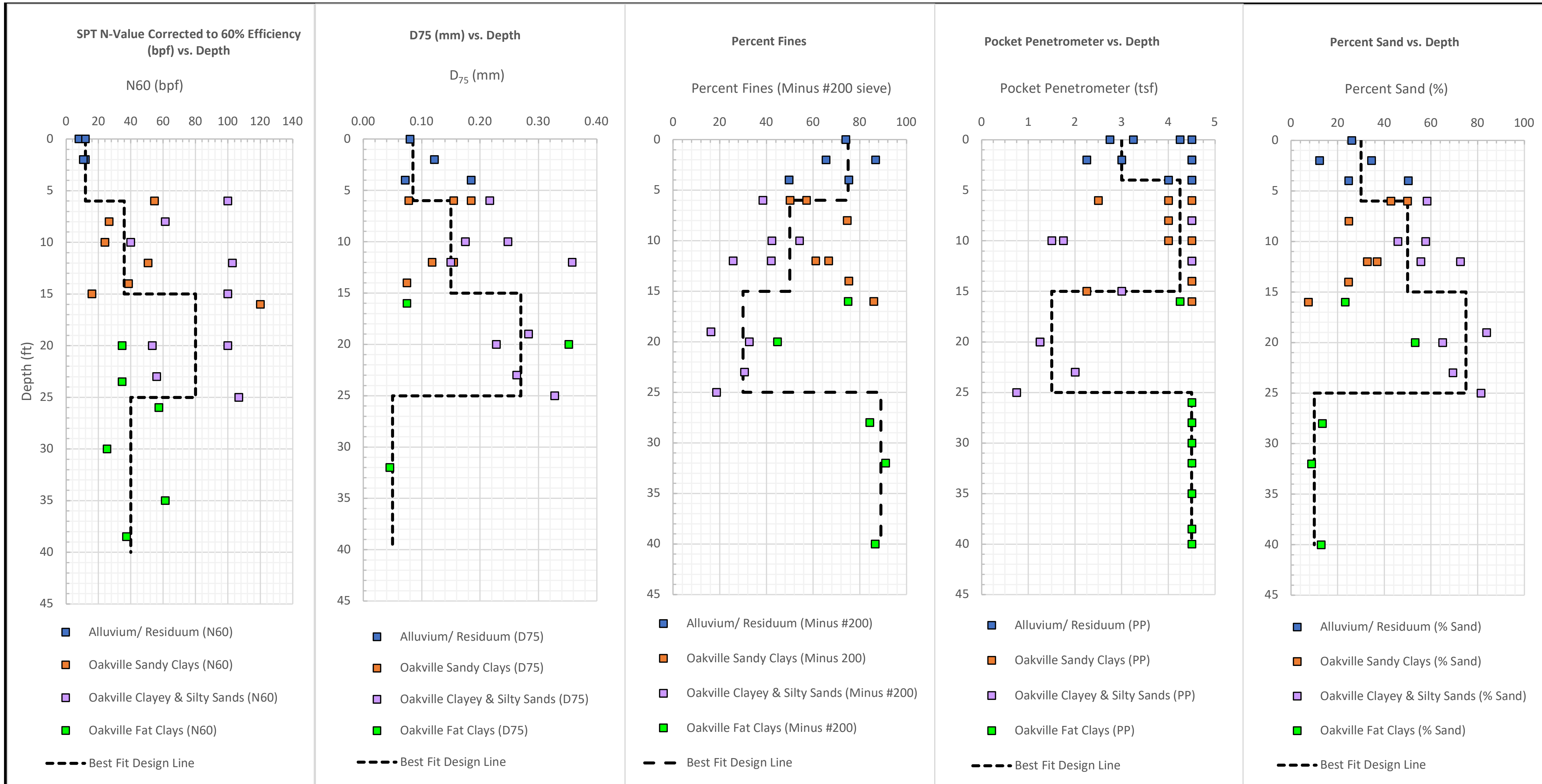
ATTACHMENT 2.

LABORATORY TEST DATA PLOTS FOR ASW BORINGS



San Antonio River Authority Escondido FRS No. 12 SWP-EA	Project No. 60707508
Geotechnical Laboratory Testing Summary Plots	

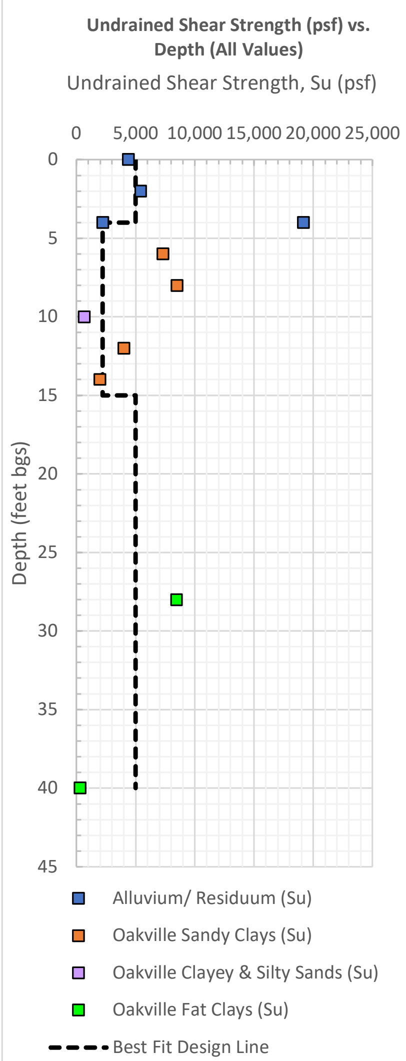
AECOM | April 2024 | Attachment No. 2

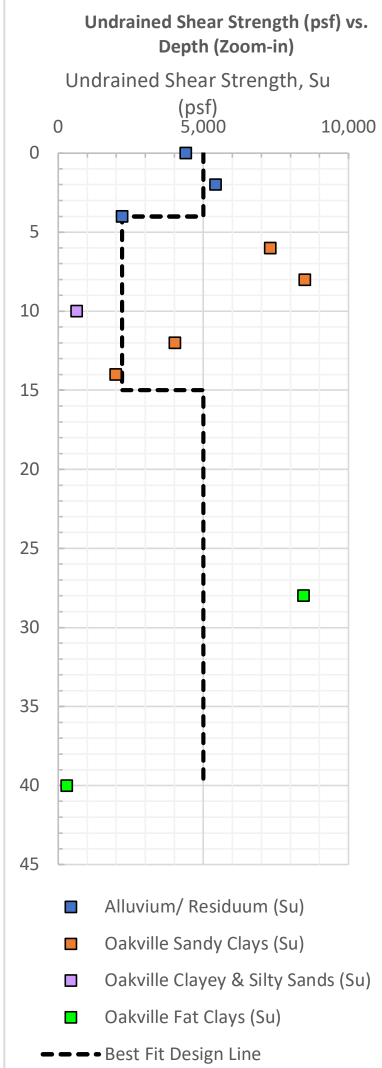


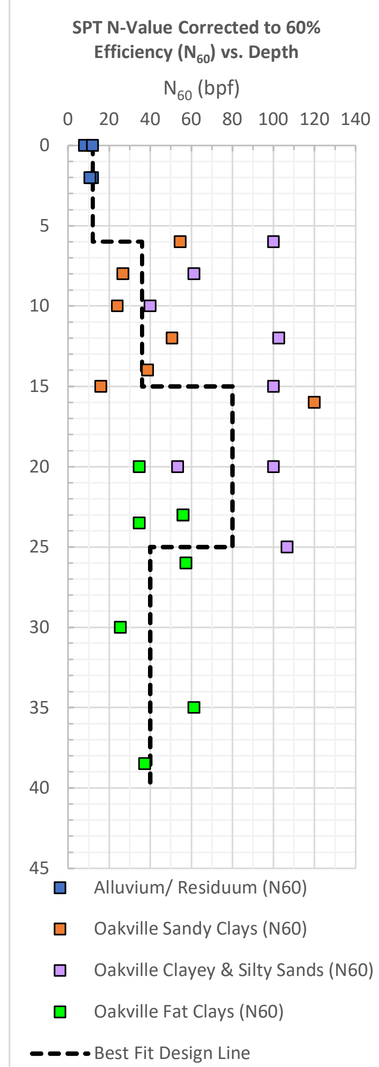
San Antonio River Authority Escondido FRS No. 12 SWP-EA		Project No. 60707508
Geotechnical Laboratory Testing Summary Plots		
AECOM	April 2024	Attachment No. 2

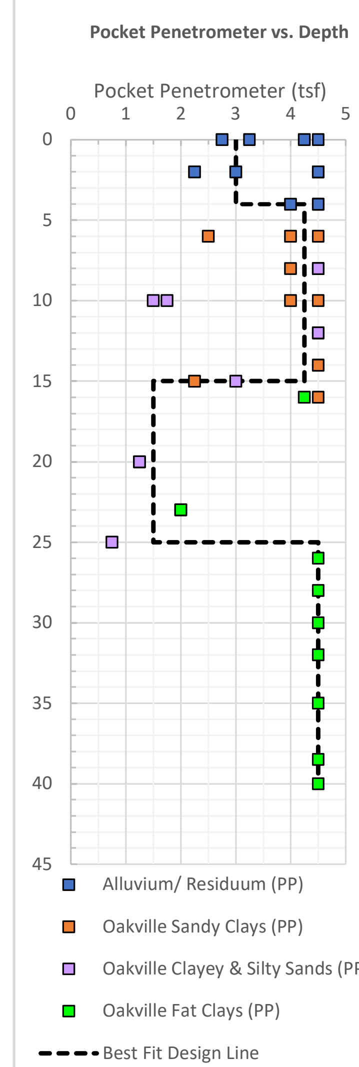
ATTACHMENT 3.

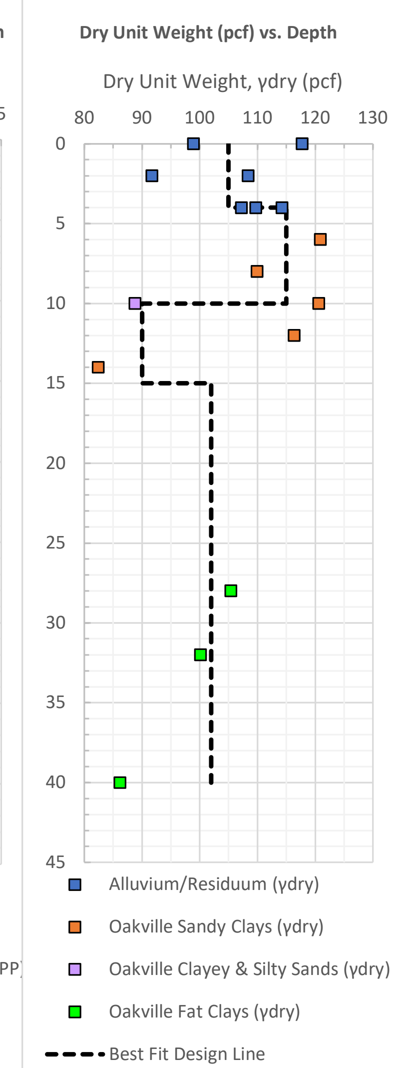
HEADCUT ERODIBILITY INDEX (Kh) CALCULATIONS











Best Fit Design Line

Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
0	5000	12	3	105
4	5000	12	3	105
4	2200	12	4.25	115
6	2200	12	4.25	115
6	2200	36	4.25	115
10	2200	36	4.25	115
10	2200	36	4.25	90
15	2200	36	4.25	90
15	5000	80	1.5	90
15	5000	80	1.5	102
25	5000	80	1.5	102
25	5000	40	4.5	102
30	5000	40	4.5	102
30	5000	40	4.5	102
40	5000	40	4.5	102

Estimated Kh Values

Depth(ft)	From Su1[1]	From Su2[2]	From N60[3]	From N60[4]	From PP1[1]	From PP1[2]	Avg
0	0.49	0.35	0.17	---	0.29	0.20	0.30
4	0.49	0.35	0.17	---	0.29	0.20	0.30
4	0.21	0.14	0.17	---	0.415	0.29	0.25
6	0.21	0.14	0.17	---	0.415	0.29	0.25
6	0.21	0.14	---	0.13	0.415	0.29	0.24
10	0.21	0.14	---	0.13	0.415	0.29	0.24
10	---	---	---	0.13	---	---	0.13
15	---	---	---	0.13	---	---	0.13
15	0.49	0.35	1.16	---	0.14	0.09	0.45
25	0.49	0.35	1.16	---	0.14	0.09	0.45
25	0.49	0.35	0.58	---	0.44	0.31	0.43
30	0.49	0.35	0.58	---	0.44	0.31	0.43

[1] Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4

[2] Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3

[3] Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3

[4] Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2

Residuum - Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	UC (natural moisture)		
		WCn (%)	DDn (pcf)	Su (psf)
201-23	2	35.6	91.7	5410
201-23	6	13.3	120.9	7300
202-23	4	13.6	109.7	2200
203-23	10	27.8	88.7	630
204-23	0	22.1	98.9	4390
204-23	4	14.5	114.2	19160
204-23	8	15.7	109.9	8490
	Average	20.4	104.9	6,797

San Antonio River Authority Escondido FRS No. 12 SWP-EA		Project No. 60707508
Parameters for Kh Development		
AECOM	April 2024	Attachment No. 3

Attachment 3
Estimate of Kh for Cohesive Soils
Escondido 12, Karnes, County, TX

*Red values denote assumed values when lab values not available

																						NEH Part 628, Chapter 52 Correlation					NEH Part 628, Appendix 52D Correlation					
Boring ID	Top (ft bgs)	Bottom (ft bgs)	Sample ID	Stratum	Field USCS	Lab USCS	w-n (%)	DD (pcf)	TD (pcf)	Gravel (%)	Sand (%)	Fines (%)	Clay (%)	LL	PL	PI	Gs*	Test Type	$\varepsilon_{failure}$ (%)	Su (psf)	Blocky Clay Correction?	UCS (psf)	UCS (kPa)	UCS (Mpa)	Ms	Kh-adj	w-sat (%)	LI-n	LI-sat	Su-sat (psf)	Kh	Kh-adj
LEFT AUXILIARY SPILLWAY																																
201-23	0	1.5	SS-1	Alluvium/ Residuum	CH		19.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	2	3	ST-2	Alluvium/ Residuum	CH	CH	36.0	91.7	124.7	0.0	34.5	65.5		64	20	44	2.62	UC	1.6	5,410	NO	10,820	518	0.52	0.38	0.38	29.9	0.36	0.22	1,837	0.11	0.11
	4	6	P-3	Alluvium/ Residuum	CH		14.0	107.2	122.2				22.2				2.62				NO	-	-	-	-	-	20.0	-	-	-	-	-
	6	8	ST-4	Oakville - Sandy Clays	CL	CL	13.3	120.9	137.1	0.0	42.8	57.2		36	15	21	2.62	UC	3.9	8,176	NO	16,352	783	0.78	0.60	0.60	13.4	-0.08	-0.07	4,000	0.45	0.45
	8	9.5	SS-5	Oakville - Sandy Clays	CL		10.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	10	12	P-6	Oakville - Sandy Clays	CL		12.0	120.6	135.1				24.1				2.62				NO	-	-	-	-	-	13.6	-	-	-	-	-
	12	14	ST-7	Oakville - Sandy Clays	CL	CL	15.0	116.3	133.8	2.0	36.9	61.1		46	14	32	2.62	UC	7.26	4,010	NO	8,020	384	0.38	0.27	0.27	15.5	0.03	0.05	3,407	0.40	0.40
	15	16	SS-8A	Oakville - Sandy Clays	CL		41.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	16	16.5	SS-8B	Oakville - Gray Clay (CH)	CH-SW		14.0			1.7	23.2	75.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	20	21.5	SS-9	Oakville - Gray Clay (CH)	CH	CH	18.0			2.1	53.2	44.7	21.8	55	20	35	2.62				NO	-	-	-	-	-	-	-0.06	-	-	0.45	0.45
	23.5	25	SS-10	Oakville - Gray Clay (CH)	CH	CH	21.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	0	2	P-1	Alluvium/ Residuum	CH		12.0	117.7	131.8								2.62				NO	-	-	-	-	-	14.8	-	-	-	-	-
	2	3.5	SS-2	Alluvium/ Residuum	CH		13.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	ST-3	Alluvium/ Residuum	CH	SC	13.6	109.7	124.6	0.0	50.3	49.7		28	14	14	2.62	UC	3.8	2,464	NO	4,928	236	0.24	0.16	0.16	18.7	-0.03	0.34	1,245	0.45	0.45
	6	7.5	SS-4	Oakville - Sandy Clays	ML	CL	10.0			0.0	49.9	50.1		29	16	13	2.62				NO	-	-	-	-	-	-	-0.46	-	-	0.45	0.45
	8	10	P-5	Oakville - Sandy Clays	SP-SM		7.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	10	11.5	SS-6	Oakville - Clayey & Silty Sands (SC-SM)	SP-SM	SC	7.0			0.0	57.7	42.3		31	16	15	2.62				NO	-	-	-	-	-	-	-0.60	-	-	0.45	0.45
	12	13.5	SS-7	Oakville - Sandy Clays	CH	CH	19.0			0.6	32.7	66.7		51	19	32	2.62				NO	-	-	-	-	-	-	0.00	-	-	0.45	0.45
	14	15	ST-8	Oakville - Sandy Clays	SM		40.0	82.0	114.8	0.1	24.6	75.3					2.62	UC	2.11	1,970	NO	3,940	189	0.19	0.13	0.13	37.9	-	-	-	-	-
	15	16.5	SS-9	Oakville - Clayey & Silty Sands (SC-SM)	CH		12.0							36	16	20	2.62				NO	-	-	-	-	-	-	-0.20	-	-	0.45	0.45
	20	21.5	SS-10	Oakville - Clayey & Silty Sands (SC-SM)	SP		7.0			2.4	65.0	32.7					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	25	26.5	SS-11	Oakville - Clayey & Silty Sands (SC-SM)	SP		8.0			0.0	81.4	18.6					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	30	31.5	SS-12	Oakville - Gray Clay (CH)	CH		23.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	32	33	P-13	Oakville - Gray Clay (CH)	CH	CH	22.0	100.1	122.1	0.2	8.8	91.0	25.7	61	19	42	2.62				NO	-	-	-	-	-	24.2	0.07	0.12	2,611	0.34	0.34
	35	36.5	SS-14	Oakville - Gray Clay (CH)	CH		18.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	38.5	40	SS-15	Oakville - Gray Clay (CH)	CH		25.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	40	42	ST-16	Oakville - Gray Clay (CH)	CH	CH	29.0	86.0	110.9	0.6	12.9	86.6		63	19	44	2.62	UC	4.33	290	NO	580	28	0.03	0.02	0.02	34.4	0.23	0.35	1,190	0.18	0.18
203-23	0	1.5	SS-1	Alluvium/ Residuum	CH		13.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	2	4	P-2	Alluvium/ Residuum	SP-SC	CL	7.0	108.4	116.0	1.1	12.2	86.8		35	15	20	2.62				NO	-	-	-	-	-	19.4	-0.40	0.22	1,867	0.45	0.45
	4	5.5	SS-3	Alluvium/ Residuum	CL		9.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	6	7.5	SS-4	Oakville - Sandy Clays	SP		5.0			3.2	58.3	38.5					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	8	9.5	SS-5	Oakville - Clayey & Silty Sands (SC-SM)	SP		13.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	10	11	ST-6	Oakville - Clayey & Silty Sands (SC-SM)	SM	CL	28.0	89.0	113.9	0.0	45.8	54.2		38	15	23	2.62	UC	4.62	630	NO	1,260	60	0.06	0.04	0.04	31.9	0.57	0.74	311	0.06	0.06
	12	13.5	SS-7	Oakville - Clayey & Silty Sands (SC-SM)	SP		10.0			1.7	72.6	25.8					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	14	15.5	SS-8	Oakville - Clayey & Silty Sands (SC-SM)	CH		29.0							77	26	51	2.62				NO	-	-	-	-	-	-	0.06	-	-	0.35	0.35
	16	17.5	SS-9	Oakville - Sandy Clays	SM	CL	23.0			6.6	7.4	86.0		32	21	11	2.62				NO	-	-	-	-	-	-	0.18	-	-	0.22	0.22
	17.5	18	ST-10	Oakville - Sandy Clays	SM		24.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	19	20	P-11	Oakville - Clayey & Silty Sands (SC-SM)	SP-SM		6.0			0.0	83.8	16.2					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	20	21.5	SS-12	Oakville - Clayey & Silty Sands (SC-SM)	SP		10.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	23	24.5	SS-13	Oakville - Clayey & Silty Sands (SC-SM)	SP		21.0			0.0	69.4	30.6					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	26	27.5	SS-14	Oakville - Clayey & Silty Sands (SC-SM)	CH		19.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	28	30	ST-15	Oakville - Gray Clay (CH)	CH	CH	20.7	105.4	127.3	2.3	13.4	84.3		56	24	32	2.62	UC	6.5	9,453	NO	18,906	905	0.91	0.70	0.70	21.0	-0.10	-0.09	4,000	0.45	0.45
204-23	0	2	ST-1	Oakville - Gray Clay (CH)	CH	CH	22.0	98.9	120.6	0.0	26.0	74.0		54	21	33	2.62	UC	3.51	4,390	NO	8,780	420	0.42	0.30	0.30	24.9	0.03	0.12	2,647	0.40	0.40
	2	3.5	SS-2	Alluvium/ Residuum	CH		21.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	ST-3	Alluvium/ Residuum	CH	CH	14.5	114.2	130.8	0.0	24.7	75.3		62	20	42	2.62	UC	7.7	21,459	NO	42,918	2,055	2.05	1.71	1.71	16.5	-0.13	-0.08	4,000	0.45	0.45
	6	8	P-4	Alluvium/ Residuum	CH								36.1				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	8	10	ST-5	Oakville - Sandy Clays	CH	CL	16.0	109.9	127.5	0.6	24.8	74.6		49	19	30	2.62	UC	1.63	8,490	NO	16,980	813	0.81	0.62	0.62	18.6	-0.10	-0.01	4,000	0.45	0.45
	10	11.5	SS-6	Oakville - Sandy Clays	CH		21.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	12	13.5	P-7	Oakville - Sandy Clays	SP-SM		13.0			2.3	55.7	42.1					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
				Oakville - Clayey & Silty Sands (SC-SM)																												
																	MIN			**290**						**0.02**			**MIN**	**311**	**0.06**	**0.06**
																	MAX			**21,459**						**1.71**			**MAX**	**4,000**	**0.45**	**0.45**
																	AVG			**6,067**						**0.45**			**AVG**	**2,593**	**0.37**	**0.37**

Preliminary Geologic Investigation Report

Escondido Floodwater Retarding Structure No. 12
Karnes County, Texas

Task Order No. 8 (C230128)
Project Reference: San Antonio River Authority MSA Contract C210002
AECOM Project number: 60707508

November 2024

Quality information

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1. Introduction

1.1 Project Overview

Escondido Creek Flood Retarding Structure (FRS) No. 12 (Escondido 12), National Inventory of Dams (NID) identification number TX04315, was built by the Soil Conservation Service (presently known as the National Resources Conservation Service, NRCS) as a single purpose, low hazard flood retaining structure in 1974. Escondido 12 was constructed as a homogeneous earthen embankment with the primary purposes of watershed protection and flood prevention.

Construction of Escondido 12 was sponsored by the following Sponsoring Local Organizations (SLOs): Karnes-Goliad Soil Conservation District, the Escondido Watershed District, the City of Kennedy, and the San Antonio River Authority (the River Authority). Escondido 12 is currently owned, operated, and maintained by the SLOs. The NRCS provide periodic inspections of the dam.

A 2014 Dam Assessment Report prepared by URS (now AECOM) concluded that although the dam was originally built as low hazard, it is presently reclassified as high hazard since the existing principal spillway does not meet the 100-year storm drawdown requirements which, in the event of the 100-year storm, would result in activation of the auxiliary spillway (ASW). Additionally, the probable maximum precipitation would cause the auxiliary spillway to flow at depths that exceed reservoir capacity, and which would result in overtopping of the dam, leading to a breach in either the ASW or the embankment. Breach studies indicate that 43 structures and a local road (North 5th Street) are at risk in the event of catastrophic breach of Escondido 12 (AECOM, 2014). As a result, Escondido 12 was reclassified as high hazard.

The River Authority contracted with AECOM Technical Services, Inc., (AECOM) to further evaluate the potential remediation measures offered in the 2014 assessment of Escondido 12 (AECOM, 2014) as well as to investigate additional potential alternatives based on review of current site conditions. The results of these evaluations will be compiled in a Supplemental Watershed Plan and Environmental Assessment (SWP-EA) to be submitted under separate cover. The geotechnical investigations described in this Preliminary Geologic Investigation Report (GIR) are intended to support the evaluations required for completion of the SWP-EA.

1.2 Proposed Construction

The prior dam assessment performed at Escondido 12 (AECOM, 2014) offered several alternatives to mitigate identified dam safety deficiencies associated with the reclassification of the dam as a high hazard structure. The alternatives offered included controlled dam breach and decommissioning, relocation of downstream facilities out of the breach impact area, and dam rehabilitation. The proposed improvements to Escondido 12 as part of the rehabilitation option from the 2014 Dam Assessment of Escondido 12, with elevations correct to NAVD88, included:

- Raising the crest elevation (El.) of the dam embankment by approximately 3.8 feet from elevation 342.1 feet to El. 345.9 feet;
- Raising the auxiliary spillway crest 1.5 feet from El. 336.0 feet to El. 337.5 feet;
- Widening the auxiliary spillway crest an additional 200 feet from 300 feet to 500 feet wide;
- Flattening the upstream and downstream embankment slopes from 2.5H:1V (horizontal: vertical) to 3H:1V;
- Replacing the existing 42-inch principal spillway (PSW) conduit with a new 60-inch-diameter conduit; and

- Replacing the principal spillway inlet/outlet structures.

The purpose of the SWP-EA (AECOM, 2024) was to further evaluate alternatives, including an alternative for watershed structure rehabilitation of Escondido Creek 12. As a result of this work, the proposed improvements recommended for the high hazard rehabilitation of the dam have been modified to include the following:

- Maintaining the existing 42-inch principal spillway system;
- Installing a new principal spillway system consisting of an inlet tower with crest at elevation 325.1 feet and a 42-inch reinforced concrete pipe (RCP) conduit discharging into an impact basin;
- Installing a 180-foot-wide, five-cycle labyrinth weir structural spillway over the existing embankment with crest set at elevation 338.2 feet and concrete chute discharging into a concrete stilling basin;
- Regrading the inlet and outlet channels of the existing 300-foot-wide vegetated auxiliary spillway and raising the crest by 2.6 feet to elevation 338.7 feet;
- Flattening the downstream embankment slope to 3H:1V;
- Abandoning the existing trench drain in place and installing a new toe drain at the downstream toe;
- Installing rock riprap at the upstream dam embankment slope;
- Raising the top of dam elevation to elevation 345.30 feet (3.1 feet raise); and
- Extending the cutoff trench below the extended dam embankment.

1.3 Purpose and Scope of Work

AECOM was contracted to perform a site-specific field Preliminary Geologic Investigation (GI) of the auxiliary spillway and prepare a Preliminary Geologic Investigation Report (GIR) of the findings and interpretations. The purpose of the GI is to collect geologic and geotechnical data that can be used to support assessments of the existing dam and proposed aspects of dam rehabilitation design, including:

- Erodibility of the existing vegetated auxiliary spillway (ASW) channel for use in SITES analysis.
- Subsurface stratigraphy, groundwater conditions, and soil/rock characteristics in the ASW channel.
- Preliminary borrow source evaluation for re-use of material from potential excavations in the ASW channel.

Also included in AECOM's scope is soil mechanics laboratory testing on select soil and rock samples recovered during the GI, and preparation of a preliminary Soil Mechanics Report (SMR), which will be issued under separate cover.

1.4 Authorization

This Preliminary GIR was prepared by AECOM for the River Authority in accordance with the Project Scope of Work for the SWP-EA for Escondido FRS No. 12, Karnes County, Texas which was authorized as part of Task Order No. 8 (C230128) on April 12, 2023, and performed under the terms and conditions of IDIQ Contract No C210002 effective August 3, 2020.

2. Site Description

2.1 Site Location

Escondido 12 is located on Bucker Creek, a tributary to Escondido Creek, approximately 4.0 miles south of Karnes City, Texas. Global positioning system (GPS) coordinates for the site are latitude 28.830277° and longitude -97.922811°.

Site access is available via an unpaved dirt road off FM 1353, approximately 0.7 miles southeast of the intersection of CFM 1353 and County Road 167 in Karnes City, Texas. Within the site, access is primarily via pastures and unimproved roads. A vicinity map of the site is provided as **Figure 1**.

2.2 Existing Dam and Spillways

Escondido FRS 12 was designed and constructed as a low hazard dam in 1974. The dam has an estimated drainage area of approximately 3,904 acres and a total reservoir storage capacity estimated at 1,844 acre-feet (maximum storage). Escondido 12 was recently reclassified as a high hazard structure and does not meet the current dam design and safety requirements.

According to the as-built drawings, the dam is approximately 34 feet tall at the maximum section and 2,667 feet long. The dam alignment crosses the main channel of the original creek tributary at approximate dam centerline station (STA.) 18+50. The embankment crest was built to maximum elevation (El). 343.3 feet in the central portion of the creek valley (including over-build to compensate for post-construction settlement) and tapered to El. 342.1 and El. 342.3 at the left and right abutments, respectively.

The upstream and downstream slopes of the embankment were constructed at an inclination of 2.5H:1V (horizontal:vertical). The width of the embankment crest is approximately 14 feet. A 12-foot-wide wave protection berm was constructed on the upstream slope. A 14-foot-wide berm was constructed on the downstream slope with top El. 318.13*. The embankment features an excavated cutoff trench under the centerline with 12-foot bottom width and 1H:1V side slopes. The cutoff trench depth varies considerably with maximum depth of about 18 feet below pre-construction ground surface, but it generally terminates at about El. 304 to El. 310 in the lower creek valley and the bottom gradually tapers upward towards each of the abutments. The cutoff trench appears to terminate mostly in siltstone or sandstone bedrock to the left of the original creek centerline and terminates in fat clay to the right of the creek.

As-built drawings indicate the dam consists of a zoned earthfill embankment. The embankment is shown to include an exterior earthfill blanket measuring about 4-feet in thickness (normal to slope) specified to consist of the “least plastic and least dispersive materials available” with a reference to the construction specifications which were not available to AECOM for review. The remaining interior zone of the dam was designated as “Zone 1” and specified to be constructed from slightly to moderately plastic, sandy to very sandy lean clay (CL) from on-site borrow sources. The as-built drawings contain a note specifying that the least plastic soils be placed in the exterior of the embankment and more plastic soils be placed in the interior zones.

The existing principal spillway (PSW) consisting of a concrete inlet riser, conduit under the dam with cantilevered discharge end, and a rock riprap lined plunge pool. The riser has crest at El. 325.13*, four ungated low inlet ports at El. 322.63*, and a gated low-level outlet at El. 316.63* with 18-inch-square slide gate. The PSW conduit consists of 42-inch-diameter prestressed concrete lined steel cylinder pipe with an unreinforced concrete cradle and 5 concrete anti-seep collars.

* Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29). Conversion to NAVD88 is +0.134 feet.

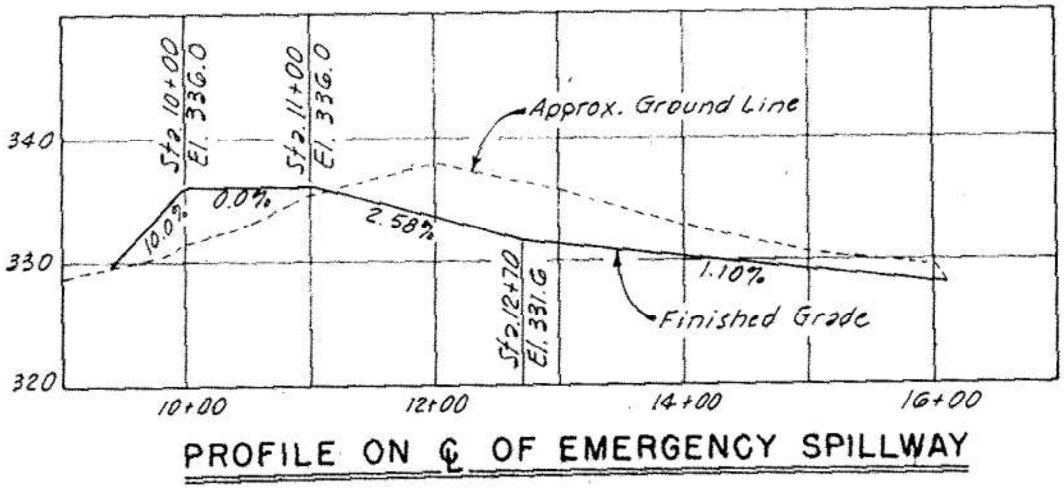
The riser and conduit were generally constructed on about 1.5 to 3 feet of earthfill, and a maximum of 8 feet of earthfill under the conduit associated with the embankment core trench. The cantilevered discharge end section of the conduit is supported by a reinforced concrete grade beam connected to two 20-foot-long, 12-inch-square reinforced concrete piles with tapered tips.

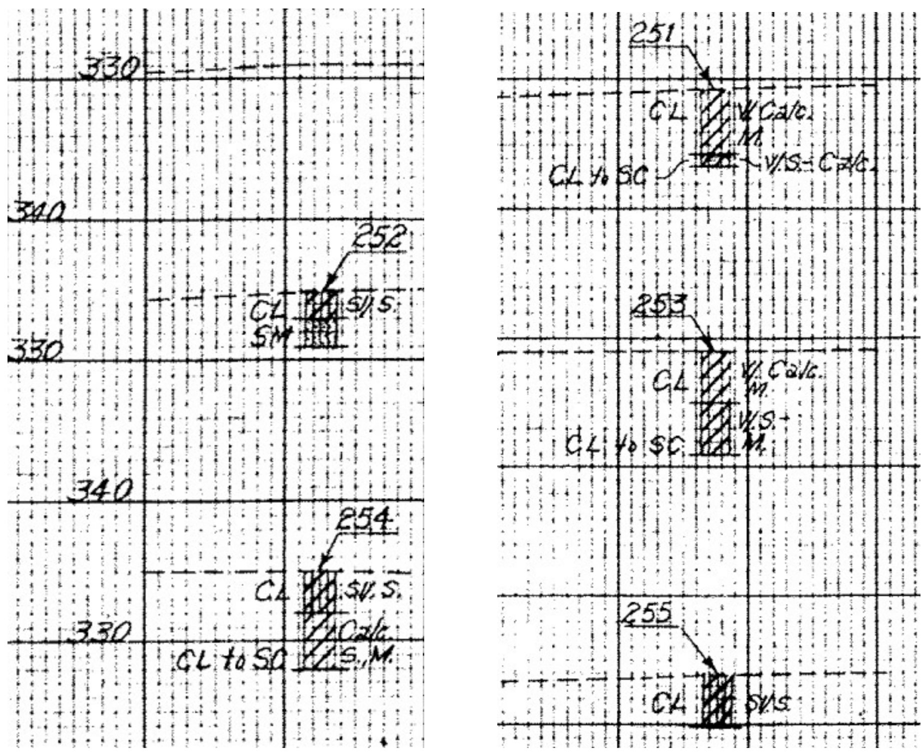
The dam features a vegetated ASW at the right abutment. The existing ASW channel is 300 feet wide and approximately 650 feet long. The ASW crest section is 100 feet long and at Elevation (El.) 336.13* feet according to the North American Vertical Datum of 1988 (NAVD88). The as-built drawings (SCS, 1974) provide limited information on grading of the ASW entrance channel slope but appears to slope down from the crest at 10% grade in the upstream direction to tie into original ground surface line. The drawings indicate the auxiliary spillway crest was mostly constructed from earthfill having a maximum thickness of about 9.5 feet at the upstream/interior side of the channel. The ASW design is uncommon in that the spillway crest consists of predominantly fill instead of being cut into the abutment, and the earthfill forming the spillway crest is integral with the dam embankment earthfill. The design of the ASW presumably was to provide adequate clearance and soil cover for a pre-existing 18-inch-diameter buried pipeline shown in the as-built drawings that crosses the ASW parallel to the crest.

The fill material source and compaction criteria for the ASW crest was not specified in the as-built drawings (SCS, 1974), but it is likely that material excavated from other areas of the ASW construction were used as the fill source. Further, the 1964 watershed work plan (SCS) indicates that materials excavated from the ASW were suitable for use as fill. Stick logs of borings completed in the ASW during the original GI included in the as-built drawings (SCS, 1974) describe soils in the ASW as interbedded layers of native sandy clays and clayey sands (CL, SC) that are calcareous and very slightly silty.

The ASW exit channel is oriented through the edge of a topographic knoll, where pre-construction ground surface was higher near the middle of the channel and lower at the upstream and downstream ends. The first 170 feet of the exit channel (ASW Sta. 11+00 and Sta. 12+70) was constructed at a 2.58% grade by placing up to 5 feet of earthfill on the interior (dam) side of the channel and excavating up to 5 feet into native clay and sand on the exterior (abutment) side of the channel. The last 330± feet of the channel was constructed at 1.1% grade to the channel's termination, where it ties into the original ground surface from excavating to depths ranging from 1 to 4.5 feet, which generally decreased going downstream. For reference, the as-built ASW spillway profile is shown in the image below as well as the stick logs provided in the as-built drawings for the auxiliary spillway.

The left side of the dam features a 23-foot-wide by 2-foot-deep "waterway" channel. The waterway begins at the downstream toe of the dam near the left abutment and continues along the downstream toe for about 700 feet until it diverges to discharge into the PSW plunge basin.





2.3 Historical Performance of Spillway

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The most recent inspection report available to AECOM for review was completed in 2021. The 2021 annual inspection (San Antonio River Authority) reported that the spillway was in good condition. This inspection also noted sparse vegetation in some areas of the auxiliary spillway as a result of droughts. No other adverse conditions were noted.

2.4 Physiography

Per the Physiographic Map of Texas (Wermund, 1996), Karnes County is located within the Interior Coastal Plains of the Gulf Coastal Plains of South Texas. The Interior Coastal Plain physiographic province consists of alternating beds of resistant uncemented sands among weaker shales that erode into long, sandy ridges, resulting in topography that is characterized by parallel ridges and valleys. Bedrock types are generally unconsolidated sands and muds. The regional bedding is tilted toward the Gulf of Mexico at approximately 2 degrees, with fault systems that trend nearly parallel to the coastline.

The interior coastal plain vegetation varies from pine and hardwood forests in East Texas, and moving to the West and South, tree density declines, with pines disappearing altogether in Central Texas, and eventually turns into vegetation of chaparral brush and sparse grasses along the southwest boundary.

2.5 Geology

Published geologic mapping indicates most of the auxiliary spillway and parts of the dam embankment are mapped as underlain by the Catahoula formation (Oc). The Catahoula Formation is composed of volcanic-clastic deposits interbedded with fluviatile sediments and is further described by Anders (1962) as consisting predominately of tuff, tuffaceous clay, sandy clay, bentonitic clay, and discontinuous lenses of sandstone. According to Chowdhury and Turco (2006), the Catahoula Formation consists of approximately 60 percent volcanic material and 30 percent sandstone. The formation has local thickness of approximately 350 feet (Brown et. al, 1975). A geologic map of the site is provided as **Figure 2**.

Alluvium (Qal) of the Holocene Epoch is mapped downstream of the principal spillway, along the banks of Bucker Creek, and along the central portion of the dam embankment. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Alluvium deposits in Central Texas are typically organized as point bars, natural levees, stream channels, and backswamps.

The Miocene-aged Oakville Sandstone (Mo) is mapped near the dam abutments. This formation is geologically older than the Catahoula formation and is, therefore, identified in areas of higher elevations along the dam site. The Oakville Sandstone formation consists of sandstone and clay with thickness of 300 to 500 feet (Adams et. al 1981 and Baker 1979). Per the geologic map, the sandstone intervals are described as thickly bedded, medium grained, and calcareous with some crossbedding while the clay intervals are described as yellow-gray and calcareous. Anders (1962) describes the Oakville Sandstone as cross-bedded medium to fine grained sand and sandstone and sandy, ashy, and bentonitic clay beds with the base of the Oakville dipping gulfward at an average of 85 feet per mile. The Oakville Sandstone contains fossil wood, chert, and quartz gravels, with some vertebrate fossils and reworked Cretaceous invertebrate fossils (Adams et. al 1981 and Baker 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is montmorillonite with variable amounts of kaolinite and subordinate illite.

2.5.1 Soil Mapping

The NRCS Websoil Survey database (NRCS, 2023) was examined to identify near-surface soils mapping of the site (i.e., approximately upper 7 feet). The Websoil Survey report and data are provided in **Appendix A**.

The mapped soil units in the vicinity of Escondido 12 are described as alluvium and residuum resulting from in-place weathering of the underlying sandstone and mudstone parent bedrock.

Alluvium is generally mapped throughout the majority of the site including to the southeast (upstream) of the site within the low-lying areas of the valley and north (downstream) of the dam embankment. In contrast, residuum is less predominant and identified only in the northern half of the ASW and east of the ASW channel.

The alluvium mapped in the vicinity of the Escondido 12 consists primarily of the Coy series soil unit (CoB) and is described as calcareous clayey alluvium derived from mudstone. CoB soils are typically identified on terrace summits, shoulders, backslopes, and side slopes and are generally well drained with very low to moderately high ability to transmit water.

The residuum mapped on-site includes the Monteola and Sarnosa series, both of which are derived from Oakville sandstone deposits. Mapped residuum soil units in the investigation area are described below:

- Monteola (MoB): Calcareous clayey residuum weathered from sandstone and shale. Typically identified on slopes (i.e. back, foot, toe, and base slopes), MoB soils are described as well drained with very low to moderately low ability to transmit water.
- Sarnosa (SeC): Loamy residuum weathered from calcareous sandstone typically identified on shoulders, back slopes, and side slopes. Described as well drained with moderately high to high ability to transmit water.

Typical index and physical properties for the soil units mapped at Escondido 12 are summarized in the table below.

Series	Type	USCS Classification	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing No. 200 Sieve (Fines Content)
Coy Series (CoB)	Alluvium	CL, CH	38 - 69	18 - 44	64 - 93
Sarnosa (SeC)	Residuum	SC-SM, SC	15 - 34	2 - 16	29 - 48
Monteola (MoB)	Residuum	CH	50 - 75	25 - 48	66 - 93

2.5.2 Structural Geology

The site is located near several prominent structural geologic features. Most broadly, the site lies within the northwestern edge of the Gulf of Mexico Basin (Ewing and Lopez, 1991). Other structural features are within the Gulf of Mexico Basin.

The Luling Fault Zone - referred to as the combined Luling-Mexia-Talco (LMT) Fault Zone as well – is located to the north of the site according to Figure 9 from Woodruff and McBride (1979) included as **Figure 3**. The LMT strikes approximately northeast in the area near the site in the area of southern and southeastern Texas near the updip limit of Tertiary deposits (Hosman 1996). The LMT then continues to extend into the northeastern corner of Texas where the trend turns eastward. The LMT runs parallel to the Balcones Fault Zone (BFZ), with the BFZ being just to the north and west of the LMT. The two fault zones are characterized by large Cretaceous to Tertiary normal faults with throws over 100 feet. (Collins et al. 1992). The belt of faults is likely associated with the sinking of the Gulf Coast geosyncline, which is to the southeast of the site, generally running parallel to the coast where associated smaller faults with the downthrown side of the normal faults in the direction of the Gulf Basin marking extension along the margin of the Gulf Coastal Basin (Collins et al., 1992; Hosman, 1996). The LMT is a system of en-echelon grabens several miles across and normal faults. The faulting has been reported as being active throughout the Cenozoic era, including the present day (Hosman, 1996).

The site also lies on the southwestern side of the San Marcos Arch. The San Marcos Arch is described as a southeast trending are of lesser subsidence than surrounding areas during the Mesozoic and Cenozoic eras (Ewing, 1999). The Arch comes off the Llano uplift in central Texas towards the Gulf of Mexico and effectively separates the Rio Grande Salt basin in the southwest from the Houston Salt basin in the northeast (Bodziak et al., 2014). During the early Cretaceous period, carbonate platforms occupied the area and were responsible for several depositions, particularly the site directly overlies the deeper Edwards (Stuart City) shelf margin and the Sligo Shelf Margin (Rendall, 2017). The deposition of the margins later influenced the Eagle Ford shale deposition, which is an important shale play for extraction of hydrocarbons (Bodziak et al., 2014). The deeper deposited Eagle Ford shale and surrounding geologic units (Buda Limestone below and Austin Chalk above) has most recently been a focus on studies relative to anthropogenic fault rupture (McKeighan, 2022). Additional discussion is provided in Faulting and Seismicity.

2.5.3 Faulting

Published geologic fault maps (see Figure 3 from Woodruff and McBride (1979) referenced above) indicate several regional faults with northeast-southwest trending normal faults. Most of these faults are rooted in the deeper subsurface at depths of 3,200 to 13,000 ft (Veerbek et al 1979). **Figure 4** was published from the faulting data from the Bureau of Economic Geology (University of Texas) and shows several faults located within about 11 miles to the north and west of the site. In addition to these faults, a recent publication (McKeighan, 2022) mapped several deep fault zones in the Eagle Ford shale play region in the vicinity of Escondido 12 (see **Figure 5**); these include the Karnes Trough Fault Zone (KTFZ), Northern Live Oak Fault Zone (NLOFZ), and the Southern Karnes County (SKC). As shown in **Figure 5**, the Escondido 12 site is approximately 3 miles northwest of the SKC, and the KTFZ and NLOFZ are located about 8.5 miles to the north-northwest and about 6 miles to the southwest, respectively.

McKeighan describes the KTFZ region as being 82 miles long, being bounded by large faults on the northern and southern flank, having a total of 75 parallel to sub parallel striking faults, and being mapped within the Buda Formation horizon. Dip is 51 degrees with an average length of 4.3 miles and an average throw of 167 ft. The SKC is also noted as having 49 faults mapped in the Buda Formation and runs parallel approximately 12.4 miles south of the KTFZ and extends 45 miles SW to NE (56-degree strike). Dip for the SKC is also 51 degrees with an average length of 2.5 miles and average throw of 80 feet. These individual faults are not in the Quaternary Faults and Folds database because of the age of the formation they are in (Buda formation is part of the lower Cretaceous). The faults were primarily considered inactive before the introduction of oil and gas production but have recently become active due to induced seismicity resulting from hydraulic fracturing operations (McKeighan 2022).

According to the U.S. Quaternary Faults and Folds Database, no Quaternary-active faults are present at the project site. The USGS database indicates the nearest quaternary-active faults are the Gulf-margin normal faults system. This system is considered as the “latest Quaternary” (active within the last 15,000 years) and consists of a compilation of numerous individual unmapped faults. The faults are decoupled from the underlying crust and assigned as Class B structures due to their low seismicity (Wheeler, 1999). The system is a belt of mostly seaward-facing normal faults that borders the northern Gulf of Mexico in westernmost Florida, southwestern Alabama, southern Mississippi, all of Louisiana and southernmost Arkansas, and eastern and southern Texas (Ewing and Lopez, 1991). The Gulf Coast faults are divided into four groups due to the large number of faults within this fault group and in order to better represent regional differences. The Texas portion of the Gulf-margin normal faults dips 0º - 90º to the southeast and northwest and display long term slip rate of less than 0.2 mm/year.

Based on the definition presented in TR-210-60 (NRCS, 2019a), faults associated with the KTFZ and SKC zones could be considered “active faults” due to recent induced seismicity resulting from hydraulic fracturing operations. However, published literature has not identified any surface expression from these faults resulting from the induced seismic events – that is, the faults are not visible at the surface even after an earthquake event.

The Quaternary Faults and Folds Database does not identify other active faults or fault zones within 100 miles of the project site.

2.5.4 Seismicity

As required by the current TR-210-60 (2019a), a map of recent and historic earthquakes within a 100-kilometer (approximately 62-mile) radius of the site is provided in **Figure 6** Earthquakes are presented in terms of Moment Magnitude (M), which may have been estimated from historic earthquakes (United States Geological Survey [USGS] and University of Texas Institute for Geophysics [UTIG] et al. 2013). Most recorded earthquakes within the area of interest were of relatively low magnitude with M≤4. The strongest recorded earthquake in the area of interest occurred in 2011 in northwestern Karnes County, about 13 miles west-southwest of the site, with Magnitude 4.8. Three additional earthquakes (one in 1993 with M = 4.3 and two in 2023 and 2018 with both M = 4.0) were also recorded in Karnes County to the north and/or west of the site.

Prior to conducting the current field investigation, a screening-level analysis was performed to evaluate the potential need for special field investigation procedures to characterize seismic hazards (e.g., liquefaction, cyclic softening, potential for seismic loading). The screening procedure was conducted according to Table 2-5 of the *National Engineering Handbook (NEH), Part 631, Chapter 2, Engineering Geologic Investigations* (Natural Resources Conservation Service [NRCS] 2012a) which is based on the peak ground acceleration (PGA) corresponding to a seismic event with a 2% probability of exceedance in 50 years.

Seismic hazard data for the site were obtained from the online USGS National Seismic Hazards Mapping Tool. Based on the deaggregation of seismic hazard, the PGA for a site underlain by "rock" (i.e., B-C boundary where the shear-wave velocity in the upper 30 meters of depth, V_{s30}, is approximately 2,500 feet per second) is 0.028g for the 2% in 50 year earthquake event (2,475-year return period). The deaggregation data are provided in **Appendix B**. Based on Table 2-5 of NEH, Part 631, Chapter 2 (NRCS 2012a) all dams regardless of hazard class or height with a PGA less than 0.10g for the 2,475-year event do not require additional seismic evaluation. Therefore, additional seismic evaluation (including, but not limited to, liquefaction potential as discussed in Chapter 2 NRCS 2012a) was not completed prior to the investigation.

Given the dam's recent reclassification as a high hazard structure, there may be a potential for loss of life from dam failure at permanent pool, in which case Table 2-6 of the NEH, Part 631, Chapter 2 (NRCS, 2012a) indicates a seismic event with 0.5% exceedance probability in 50 years (10,000-year return period) would govern. For reference, the PGA for the 10,000-year event is 0.075g for a site underlain by rock using similar approach as described in the paragraph above.

For design-level evaluations of seismic hazard, analyses of site seismicity should be conducted in accordance with the current TR-210-60 (NRCS, 2019). This analysis includes an evaluation of the design PGA based on the seismic site class and consequences of seismic failure of the dam at normal pool level. A hydrological analysis is typically needed to evaluate the consequence of seismic failure for a normal pool dam breach, which differs from the dam hazard class which is typically defined based on a flood pool dam breach. Additionally, note that the design PGA requires adjustment from the "rock" site PGAs reported above to account for the damping or amplification caused by the actual soil conditions underlying the site. Additional recommendations are presented in **Section 5.1**.

2.5.5 Expansive Clays

As anticipated for Central Texas, the project site is located in an area with high predominance of expansive soils. Expansive soils exhibit significant shrink and swell behavior with fluctuations in moisture content. Accordingly, soils with moderate to very high shrink-swell potential are anticipated to underlie the site. This risk was noted in the 1954 and 1964 SCS Watershed Work

Plans which stated that the clays identified were highly montmorillonitic and should only be used in the central sections of the embankment. This is consistent with the description of the primary geologic formations (Catahoula and Oakville) as being composed of volcanic ash and bentonitic materials.

2.5.6 Dispersive Clays

No visible evidence of dispersive clays, such as characteristic erosion patterns that result in badland topography, for example, were noted during the site inspection.

2.5.7 Karst Hazard

The Oakville Sandstone and Catahoula formation are not susceptible to long-term dissolution, a chemical process that produces karst conditions. Accordingly, karst and soluble rock beneath the site are not anticipated.

2.6 Previous Investigations

2.6.1 Soils Conservation Service – 1954 Work Plan, 1964 Work Plan, and As-Built Drawings

The original work plan for Escondido Creek Watershed (SCS, 1954) was developed with the goal of providing flood protection to agricultural lands in the watershed. The 1954 work plan included, but was not limited to, the implementation of 11 floodwater retarding structures all of which were completed in 1957 (SCS, 1964). The 1964 Escondido Creek Watershed Work Plan was developed to provide additional structural measures needed to protect the City of Kenedy and it included the construction of 2 additional floodwater retarding structures, Escondido Creek 12 and Escondido Creek 13, and 0.7 miles of channel improvements (SCS, 1964).

A preliminary geologic investigation of Escondido Creek 12 was completed by the SCS prior to construction of the existing dam, which included surface observations of valley slopes, alluvium, channel banks, exposed geologic formations, and hand auger borings (SCS, 1964). Detailed geologic dam site investigations were made at the 11 sites previously built in the Escondido Creek Watershed and the findings of these investigations along with structure performances were used to inform the proposed design of the two new sites, including that of Escondido Creek 12.

The 1964 Work Plan (SCS, 1964) describes the foundation of the Escondido Creek Watershed dams (including Escondido Creek 12) as consisting primarily of 6 to 12 feet of sandy clay with some clayey and silty sands which are underlain by clays, sands, and sandstones of the Oakville formation. The Oakville formation is further described as containing interbedded silts and clays as well as sand. In addition, the original Watershed Work Plan (SCS, 1954) states that chalk and caliche outcrops are expected to occur on the surface, especially on the tops of hills. Valley slopes were described as principally residual silty clays and sandy clays underlain by beds of clay and sand. The Work Plan included generalized preliminary recommendations for dam design planning. One particular concern was for exposure of sand beds in ASW cuts which were anticipated to be very susceptible to erosion; thus, the 1964 Work Plan (SCS) indicated that spillways of dams built in the Escondido Watershed should be vegetated as soon as possible following construction.

The as-built drawings for Escondido Creek 12 (SCS, 1974) indicate an additional geologic investigation was performed as part of the original dam design. The drawings provide subsurface profiles of the site with boring “stick” logs from the pre-construction investigation with generalized soil types. The investigation consisted of the following:

- 15 borings along the dam centerline (Hole Nos. 1 through 15);

- 5 borings along the principal spillway alignment (Hole Nos. 301 through 303 and Holes Nos. 351 and 352);
- 5 borings along the auxiliary spillway (Hole Nos. 251 through 255);
- 4 borings along the original stream channel (Hole Nos. 451 through 454);
- 17 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 167); and
- 5 borings along the proposed downstream toe of the dam (Hole Nos. 601 through 605);

The complete investigation report containing the Escondido Creek 12 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1973 by the SCS were the only data from the final design geologic investigation available to AECOM and were used to develop a generalized understanding of the subsurface conditions at Escondido Creek 12. Based on this documentation, the existing dam foundation consist of calcareous, medium stiff to stiff, sandy, lean to fat clays (CL, CH) and clayey sands (SC) followed by sandstone described in the geological stick logs as poorly cemented with trace coarse particles with thicknesses of up to 6 inches and interbedded layers of claystone and caliche (indurated calcium carbonate deposits).

The sandstone bedrock was described as having hardness classification of Hd 2 to Hd 3 according to the legacy SCS classification system (SCS, 1974). Sandstone was encountered at depths as shallow as 9 feet below the ground surface (bgs) in centerline borehole No. 4, and at a maximum depth of 20 feet bgs in centerline borehole No. 10. Sandstone bedrock was not encountered in centerline boreholes Nos. 12 through 15 located in the right side of the lower creek valley and valley walls towards the right abutment.

The as-built drawings indicate that the embankment was to be constructed as a zoned earthfill comprised by fine-grained materials. Moderately plastic, silty to sandy clays (CL) and slightly to moderately plastic, very sandy clays (CL) are prescribed in the as-built drawings for the interior Zone 1 of the embankment. The original drawings indicate a maximum allowable particle size of 6 inches for the embankment fill material which was to be placed in uncompacted lifts of 9-inch maximum thickness and be compacted to at least 95% maximum dry density per ASTM D-698. The moisture content prescribed for compaction of the fill material was not legible in the as-built drawings but seem to indicate above-optimum moisture criteria.

A 4-foot-thick earth blanket was prescribed on the exterior of the dam embankment overlying the Zone 1 materials. This earth blanket zone was specified to consist of the least plastic and least dispersive materials available in accordance with Section 10 of Construction Specification item 23 (not available to AECOM for review). An 18-inch-thick layer of rock riprap was installed on the upstream slope between approximately El. 326.6* and El. 320.6*.

Based on review of Escondido Creek 12 as-built drawings and the available geologic stick logs of borings in the ASW, the spillway channel invert included fill sections with maximum thickness of 9.5 feet thick and excavated sections with a maximum depth of about 5 feet below original grade. The data suggest excavations would have exposed lean clay to sandy lean clay (CL), clayey sand (SC), and some sandy silt (SM) with varying amounts of calcareous material at the channel invert and exterior cut slope of the channel. Earthfill was used to construct the crest section and the upper-left portion of the spillway channel (i.e., where the original grade was less than about El. 334 feet).

* Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29). Conversion to NAVD88 is +0.134 feet.

No in-situ testing or laboratory testing results on recovered soil and/or rock samples from the original investigation were available to AECOM for review.

Groundwater was identified in several of the original borings drilled typically between 300 and 315 feet in elevation. Groundwater levels may vary over time and may have significant impact on potential auxiliary spillway modifications.

It should be noted that while recent geologic mapping appears to suggest that the ASW of Escondido 12 is underlain by the Catahoula formation, the original classification of the site subsurface as the Oakville formation is maintained here forth because the resolution of available geologic maps is not considered sufficient, without further studies which presently are not included in AECOM's scope of work, to allow for precise differentiation between the two formations.

2.6.2 NRCS – 2021 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on August 5, 2021, by the River Authority as part of the routine dam safety inspections. The inspection identified several deep animal burrows along the dam embankment as well as surface cracking on the downstream slope. Sparse vegetation, aeration activity, and evidence of wind erosion along the dam embankment were also highlighted during the inspection.

Undesirable vegetation was observed near the PSW conduit support cradle and its removal was advised. The PSW and ASW were noted as being in good condition. The ASW was noted as having generally good vegetative cover with some sparse areas.

Photographs in the inspection report depicted good vegetative coverage with native grasses throughout the dam.

The 2021 inspection concluded that Escondido Creek 12 was performing as designed and no immediate safety concerns were reported. However, due to urban encroachment and updated TCEQ hydraulic criteria, the inspection noted that Escondido Creek 12 qualifies for assistance through the watershed rehabilitation program intended to bring this dam to safety standard for high hazard dams.

3. Field Geologic Investigation

3.1 Geologic Reconnaissance

A limited geologic reconnaissance was conducted by an AECOM geologist on June 16, 2023. The limited reconnaissance included prior desktop review of available data (aerial photos, topography, geologic maps, etc.), and walk-over of the dam site to document surficial geologic features and to identify any visual evidence of adverse dam performance, particularly along the ASW channel. The limited geologic reconnaissance was intended to aid in erodibility analyses of the ASW and to supplement preliminary feasibility studies of potential use of on-site borrow sources for possible rehabilitation purposes.

No surface evidence of slope instability (slumps, sloughs, scarps) was identified along the dam embankment slopes during the walk-over. The embankment cracking noted in prior inspections was not observed by AECOM, but matted grass from recent mowing on the embankment may have concealed such features. However, animal burrows and rut marks were noted along the embankment crest and upstream slope of the embankment. No areas of excessive wetness or changes to vegetative growth as a result of excess and/or flowing water resulting from seepage through and/or underneath the dam were observed. No erosion features typical of dispersive soils (e.g., jugholes or “badlands” surface erosion) were observed during the site visit or through review of available satellite aerial imagery (Google Earth Pro). Adequate vegetative cover was observed throughout the site. Review of aerial images available on Google Earth Pro dating back to 1995 indicate that significant changes to the dam site have mostly been associated with the development of the field adjacent to the right dam abutment in 2012 for the ongoing oil and gas operation found onsite. This operation appears to have expanded in 2018 to include additional well pads further east and downstream of the ASW channel and north of the downstream slope near the left abutment of the dam. Based on the historic aerials available, reservoir storage appears to periodically reach levels lower than the intake tower base including in 2008, 2012, and 2014.

3.2 Geologic Investigation Summary

Four (4) geotechnical test borings designated as 201-23 through 204-23 were drilled in the ASW channel located generally along the ASW centerline. The borehole locations are shown in **Figure 7** with depths summarized in **Table 1**.

The purposes of these borings were to support the characterization of the ASW subsurface conditions, including identification of potential for dispersive/erodible soils, characterization of the depth to bedrock for excavatability purposes, and development of estimates of headcut erodibility indices and other index properties for SITES analysis of the ASW. It is noted that the rehabilitation alternative presented in the 2014 dam assessment (URS, 2014) consisting of a 200-foot-widening of the ASW channel (required to limit headcutting that would otherwise breach the spillway crest) was developed based on assumed input parameters from historical data only. The proposed ASW widening was assumed to be feasible because the model showed the ASW to not breach during design flow event. However, site-specific investigation was needed to confirm the selected input parameters and modelling results to fully validate the feasibility of this alternative. Consequently, the geologic investigation presented herein included geotechnical test borings with in-situ testing and soil sampling. Laboratory testing on representative samples of each geologic stratum including index testing (moisture content, density, Atterberg limits, sieve analysis with hydrometer), dispersion testing, and unconfined compression testing were performed to develop refined estimates of the SITES analysis input parameters; refer to SMR for description of test methods and presentation of results (AECOM, 2024a);

A secondary purpose of the borings was to aid in evaluation of the suitability of materials from possible excavations in the auxiliary spillway for use as borrow source for earthfill. Bulk samples were collected from auger cuttings and subjected to laboratory testing including index properties, moisture-density relationship (Standard Proctor compaction), and engineering properties on remolded samples (shear strength, etc.) for the purpose of rehabilitation fill suitability evaluation.

3.3 Staking, Utility Locates, and Survey

All boring locations were staked in the field by the AECOM geologist as part of the limited field geologic reconnaissance. Global Positioning System (GPS) coordinates were obtained by handheld unit by the AECOM field representative at the time of drilling. The final drilled locations were at approximately the same locations staked during the site visit.

Texas One Call (811) utility location service was contacted prior to drilling or ground disturbing activities. The utility locates did not identify the presence of buried utilities in close proximity to the boring locations. The local sponsors were responsible for notifying property owners affected by the field investigation.

3.4 Test Borings

3.4.1 Drilling and Sampling Methods

Drilling was performed by Texas Geobore, who was subcontracted by Arias & Associates, Inc. (Arias) of San Antonio, Texas, under subcontract to AECOM. An AECOM geologist (AECOM Site Supervisor) was present on site full-time during the field GI. The AECOM Site Supervisor was responsible for monitoring subcontractor drilling and sampling activities, classifying soil/rock samples, packaging samples, and preparing handwritten logs of borings. Arias transported soil/rock samples to their geotechnical testing laboratory. A truck mounted rig (Mobile B57) was used for the investigation.

Soil test borings were advanced through unconsolidated (soil-like) materials using a 3 7/8-inch Polycrystalline Diamond Compact (PDC) drill bit and air-rotary drilling methods. Soil samples were collected in 2-foot intervals in the upper 15 feet and at 5-foot intervals thereafter until practical refusal or the planned termination depth was reached, whichever happened first. Rock coring was attempted in one of the borings, but no rock core recovery was achieved at Escondido 12 due to the weakly-indurated consistency of the sandstone. Primary sampling methods utilized as listed below; detailed sampling methodology is provided in the Field Investigation Plan (AECOM, 2023).

- Standard Penetration Test (SPT) split spoon sampler in general accordance with ASTM D1586 (ASTM Standard D1586 2018).
- Shelby Tubes (laboratory extruded) in accordance with ASTM D1587-08(2012)e.1, *Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soil*.
- Push tubes (field extruded) generally consisting of Shelby tube samplers requiring field extrusion of samples. Push tube sampling was conducted according to ASTM D1587.
- Bulk Samples consisting of large-volume bag samples were collected from auger cuttings in borings located in the auxiliary spillway, for the purposes of evaluating the suitability of excavated soils for use as borrow source.
- Rock core sampling was attempted in accordance with ASTM D5079, *Standard Practices for Preserving and Transporting Rock Core Samples* but was unsuccessful in recovering core samples.

The number of blows required to advance the split spoon barrel sampler a depth of 18 inches was counted for each 6-inch interval. The number of blows required to drive the sampler the last 12 inches is referred to as the “N-value” and was reported in units of blows-per-foot. Practical refusal conditions were generally considered to be 50 blows or greater per 6 or less inches of penetration with an SPT split spoon sampler. An automatic trip hammer was used for the field investigation. While an SPT hammer energy calibration report was not available, the driller provided a hammer energy calibration report for the Texas Cone Penetrometer hammer on the same drill rig which indicated 89% hammer efficiency. Based on AECOM’s experience, an energy correction of 80% hammer efficiency is typical for SPT automatic hammers such as the one used on this project; thus, 80% efficiency was adopted for analysis. The energy calibration report is provided for reference in **Appendix C**.

Sampling with 4.5-inch OD, thin-wall Shelby tubes (ASTM Standard D1587) was performed in select intervals of fine-grained soils to collect relatively undisturbed samples for advanced laboratory testing using a conventional open tube push sampler.

Bulk samples were collected from auger cuttings at the surface for the purposes of evaluating borrow source suitability from potential spillway excavation and to allow laboratory testing on remolded samples. Rock coring methods were employed to advance boring 204-23 to termination depth. Rock was sampled continuously in 5-foot runs using NQ size, double tube core barrel (NQ2) wireline coring techniques. The NQ2 coring produced 2-inch diameter core samples from a 3.5-inch diameter excavation. The core bit used was a diamond impregnated bit specifically manufactured for hard rock drilling. Note that only one core run was attempted and was unsuccessful in recovering any sample.

3.4.2 Borehole Logging and Sample Preservation

An AECOM geologist provided full-time monitoring of field drilling and sampling activities. The geologist prepared field boring logs, classified soil and rock samples in the field, and labeled and packaged soil and rock samples for transport.

Each soil sample was classified in the field based on the observed texture and plasticity in general accordance with the USCS and NRCS guidelines. Pocket penetrometer testing was performed on the exposed end of Shelby tube samples. Logs of the borings are provided in **Appendix D**. The USCS classifications presented on the logs generally correspond to the field classifications (ASTM D2488) but were modified in some cases based on further review of samples and laboratory test results to present the laboratory-based classifications (ASTM D2487). The final boring logs include index test results tabulated at the corresponding depth from the laboratory testing program.

Disturbed soil samples were placed in plastic bags to minimize moisture loss and labeled for subsequent identification and testing. Shelby tube samples were sealed with plastic end caps secured with electrical tape and were labeled for subsequent identification in the laboratory.

Following completion of the field investigation, Arias transported the soil and rock samples to their laboratory in San Antonio, Texas. An AECOM Professional Engineer reviewed the field borings logs and photos of the recovered rock core samples. An inventory of samples is provided in **Table 2**.

3.4.3 Groundwater Measurements

Groundwater was not encountered at any of the boring locations at the time of drilling or prior to backfilling. A summary of groundwater measurements at the time of drilling is provided in **Table 1**. The geologic investigation did not include the installation of piezometers for monitoring stabilized groundwater levels over time.

3.4.4 Borehole Backfilling

Test holes were abandoned by backfilling with cement-bentonite grout mixture (5% bentonite by weight of cement) placed by tremie methods from the bottom of the drill hole to the ground surface. Unusually high grout takes were not observed during backfilling.

3.5 Laboratory Testing

Soil and rock samples retrieved from the borings were packaged in the field to minimize moisture loss and were transported by Arias to their geotechnical laboratory in San Antonio, Texas. Based on the AECOM Professional Engineer’s review, select soil and rock samples were identified for further classification, description, and testing. Laboratory test assignments for select samples were developed by AECOM and the results are presented in the Preliminary SMR under separate cover.

4. Subsurface Conditions

The following subsections discuss soil stratigraphy and subsurface conditions encountered during the geologic investigation.

4.1 Generalized Stratigraphy

A geologic subsurface profile of the ASW is presented in **Appendix F**. The profile illustrates the existing ground surface (from LIDAR data) and abridged boring (stick) logs indicating field USCS classification, pocket penetrometer values, SPT N-values, rock core recovery, and rock quality designation (RQD).

Subsurface conditions encountered in the borings were generally consistent with published geology, the stick logs included on the as-built drawings (SCS, 1974), and the geological descriptions provided in the Escondido Watershed Workplan (SCS, 1964). The borings encountered interbedded clays, silts, and sands generally overlying interbedded clays. The generalized stratigraphy in descending order below ground surface, included the following:

1. Existing Fill (Discussed in Section 2.2 and 2.6)
2. Alluvium/Residuum
3. Oakville Sandy Clays
4. Oakville Silty and Clayey Sands
5. Oakville Clays

According to the as-built drawings (SCS, 1974), up to 9.5 feet of earthfill material was placed within the ASW channel to construct the crest section and interior (left) part of the exit channel between approximately ASW Sta. 9+45 and Sta. 12+00. While the boreholes drilled as part of this investigation did not conclusively indicate the presence of fill material in the ASW (boring 202-23 was offset to the right side of the spillway where the fill tapers out), the estimated limits of the existing fill material is shown on the interpreted subsurface stratigraphy shown in **Appendix F**. While the index properties and compaction criteria for the existing earthfill material in the ASW were not specified in the as-built drawings, it is likely the existing fill materials consist of compacted clayey soils obtained from required excavations made to construct the remainder of the ASW channel. The 1964 Watershed Work Plan (SCS) corroborates this interpretation by highlighting that lean clays (CL) and clayey to silty sands (SC, SM) excavated from the ASW were suitable for use as fill.

Note that the NRCS soil survey mapping shows both alluvium and residuum within the auxiliary spillway (ASW) channel but does not include fill. The discrepancy between the as-built drawings location of fill and the NRCS soil survey mapping could partially be due to the relatively large-scale resolution of the soil survey mapping, and the the fact that the existing fill material was likely sourced from excavations of the ASW channel which could have rendered it visually indistinguishable from the native soils.

Similarly, while an attempt was made in this report to distinguish between the alluvium and residuum units, the large-scale resolution of the NRCS soil survey mapping and limited number of boreholes drilled during this study did not provide sufficient information to differentiate the depositional origin of these materials. As a result, no distinction was made between the alluvium and residuum.

4.1.1 Alluvium/Residuum

Soils of alluvial and/or residual origin were identified in the upper 9 to 6 feet of the borings drilled along the ASW of Escondido 12. Per the NRCS Websoil Survey, the location of borings 201-23 and 202-23 are mapped as alluvium whereas the locations of borings 203-23 and 204-23 are mapped as residuum. While soils encountered in the upper portion of borings 201-23 and 204-23 were visually similar, there was inconsistency in the remaining borings drilled along the ASW. Additionally, the effects of previous cut/fill grading in the spillway as part of original construction further complicated interpretation of near-surface stratigraphy. As a result, soils of alluvial and/or residual origin identified in the upper 4 to 6 feet were grouped into a single stratum (Alluvium/ Residuum) for ease of evaluating spillway erodibility.

The present field GI encountered very stiff to hard, black fat clay (CH) with sand, organics, and calcareous inclusions which are interpreted as alluvial in origin in the upper 4 to 6 feet of borings 201-23 and 204-23. Pocket penetrometer readings of 2.25 to over 4.5 tsf were recorded. Ground surface elevation at both of these boring locations is presently lower than El. 330 feet. Boring 201-23 is located upstream of the ASW control section whereas boring 204-23 was drilled near the right training berm of the ASW channel.

The upper 4 to 6 feet of borings 202-23 and 203-23 encountered soils described in the field as stiff to hard, grayish brown lean to fat clays (CL, CH) with calcareous inclusions, organics, and trace gravel along with loose to dense, pale brown, calcareous clayey to silty sands (SC, SC/SM). Pocket penetrometer readings varied from 2.75 tsf to more than 4.5 tsf. It is possible that the near-surface soils encountered in these borings are representative of residuum resulting from in-place weathering of the Oakville Sandstone, since 1) the Oakville is described as a formation of interbedded sands, sandstones, and clays; and 2) residuum is anticipated to be present in higher elevations of the ASW including portions of the spillway crest section (possibly re-deposited as existing fill material) and right/middle portions of the ASW channel near where borings 202-23 and 203-23 were drilled. However, additional data would be necessary to confirm this distinction.

4.1.2 Oakville Sandy Clays

The geologic investigation encountered Oakville Sandy Clays in each of the borings drilled at depths of about 4 to 6 feet bgs. This unit generally extended to depths of approximately 15 feet bgs. Soil in this stratum were described in the field as light brown to yellowish brown, sandy lean to fat clays (CL, CH) with trace iron oxide staining and gravel. The clayey soils in this stratum were generally calcareous (with reactions to hydrochloric acid ranging from weak to strong), very stiff to hard, and dry to moist.

4.1.3 Oakville Silty and Clayey Sands

The Oakville Silty and Clayey Sands unit was identified underlying the Oakville Sandy Clays in all borings completed except for boring 201-23 which was drilled upstream of the ASW control section. The Oakville Silty and Clayey Sands was typically present in the depth interval between 14 and 28 feet bgs and were characterized as clayey to silty sands (SC, SM) with alternating clayey seams. The sandy soils in this stratum were generally pale to yellowish brown, fine to medium grained, dense to very dense, and varied from dry to moist. In boring 204-23, Oakville sandstone was identified below approximately El. 316 feet; however, no recovery was achieved in the cores attempted. The lack of recovery could possibly be indicative of poorly-indurated bedrock and/or high degrees of weathering of the bedrock into sandy materials such as those observed in this stratum in the other nearby borings drilled during the field GI.

It should be noted that some of the sandy samples recovered from this stratum were classified in the field by the AECOM geologist as poorly graded sands (SP); however, classifications shown in the boring logs were modified to clayey to silty sands (SC, SM) in light of laboratory index testing results including those of sieve analyses, hydrometer, and clay fraction testing.

4.1.4 Oakville Clays

The Oakville Clays were encountered below the Oakville Silty and Clayey Sands depths ranging from about 16 to 28 feet bgs(roughly below El. 305 to 310 feet). This stratum was encountered in borings 201-23 through 203-23; boring 204-23 was terminated just above El. 310 feet and did not encounter the Oakville Clays. Soils encountered in this stratum were described as stiff to hard, moist, fat clay (CH) with medium to coarse grained sand, calcareous gravel, iron oxide staining, and mostly weak to moderate reaction to hydrochloric acid.

Further description of the stratigraphy at specific locations of the project site are provided in the following sections.

4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were added to boring(s) in which rock coring was attempted but levels were not measured. Boreholes were backfilled with cement bentonite grout at the end of drilling; as a result, subsequent delayed water level readings were not recorded.

It should be noted that groundwater levels may vary over time and may have a significant impact on potential dam modifications.

4.3 Auxiliary Spillway

Borings 201-23 through 204-23 were drilled along the centerline on the auxiliary spillway. The existing ground surface elevation in the vicinity of the borings ranged from approximately 327 to 336 feet. Note that original construction of the ASW involved placement of up to 9.5 feet of earthfill within some areas of the channel footprint and with excavation of 0.5 foot to 5 feet in other areas of the channel. The borings were drilled to depths of 20 to 42 feet bgs. Groundwater was not encountered at the time of drilling in the borings completed.

The stratigraphy identified in the field included approximately 4 to 6 feet of Alluvium / Residuum overlying an alternating sequence of fine- and coarse-grained subunits of the Oakville Sandstone formation. The Alluvium / Residuum was described as stiff to hard, moist, grayish brown and black lean to fat clay (CL, CH) with sand, organics, trace grave, and calcareous inclusions. SPT N-values were relatively consistent in the Alluvium and Residuum stratum, ranging from 6 to 9 bpf (average of 8 bpf), and generally increased with depth. It should be noted that one instance of SPT refusal (N value of 50/5”) was identified at approximately 4 feet bgs in boring 203-23. The refusal likely resulted from identification of a transitional zone between the clayey materials and the underlying sands which may have had some degree of cementation. Pocket penetrometer readings in recovered samples ranged from 2.25 tsf to more than 4.5 tsf with average reading of 3.8 tsf. Although existing fill materials are indicated in the spillway channel by the as-built drawings, the locations of the borings and mixed soil types in the upper portion of borings 202-23 and 203-23 did not allow for conclusive identification of fill in the present GI.

Intact bedrock, defined as SPT and/or auger refusal, was not encountered in any of the borings drilled; however, three distinct zones of alternating clayey and sandy subunits of the Oakville Sandstone formation were identified below the Alluvium / Residuum in each of borings.

The upper zone was Oakville Sandy Clays which was encountered at 4 to 6 feet bgs and extended to about 15 feet bgs in the borings drilled. Soils in this stratum were described as light yellowish brown clayey to silty sands (SC, SM) with SPT N-values ranging from 12 to 90 bpf (average N-value of approximately 35 bpf). It should be noted that SPT refusal (N-value of 50 bpf or greater with 6 or less inches of penetration) was identified at approximately 15 feet bgs in boring 202-23. Refusal likely resulted from identification of a zone of cemented clayey sands, typical of the geologic unit mapped at Escondido 12. Borehole advancement and additional SPT testing proceeded without issue at deeper depths following the sampler refusal.

The middle zone was the Oakville Silty and Clayey Sands which was present between the depth intervals of 14 and 28 feet bgs in borings 202-23 and 203-23. The Oakville Silty and Clayey Sands were composed primarily of clayey to silty sands (SC-SM) which were described in the field as dense to very dense, dry to moist, pale to yellowish brown, fine to medium grained with alternating clayey seams. Recorded SPT N-values ranged from 30 to 80 bpf with average of 56 bpf. It should be noted that this stratum was not encountered in boring 201-23. In boring 204-23, this stratum was classified in the field as sandstone based on mapped local geology; however, rock core recovery was insufficient for manual-visual or laboratory testing confirmation.

The lower zone was the Oakville Clays which was encountered approximately below elevations 305 to 310 feet in borings 201-23 through 203-23. Boring 204-23 was terminated near El. 310 feet and, therefore, did not encounter this stratum. High plasticity clayey soils (CH) primarily described as pinkish gray to gray, moist, stiff to hard, with medium to coarse grained sand and calcareous gravel form this stratum. Pocket penetrometer readings were typically greater than 4.5 tsf with a single reading of 4.25 tsf recorded in this layer. SPT N-values ranged between 19 bpf and 46 bpf with average of 31 bpf. Boreholes 201-23 through 203-23 were terminated in this stratum.

5. Interpretations and Conclusions

5.1 Seismic Characterization

Seismic site characterization was performed according to the guidance in TR-210-60 (NRCS 2019a) and Part 302 – Interim Guidance for Seismic Hazard Data Collection and Evaluation for the Planning and Design of NRCS Structures (NRCS 2021). The document specifies that conventional seismic analysis be performed for sites with PGA equal to or exceeding 0.07g for the seismic event associated with the dam's consequence of seismic failure. The consequence of seismic failure is defined as failure of the dam at normal pool conditions (not at flood pool conditions like the dam's hazard potential classification), and thus additional dam breach analysis at normal pool conditions will be required for final design to determine the applicable earthquake return period for design.

Because this dam is designated as high hazard, the consequence of seismic hazard for planning evaluations was conservatively taken to be the same as the dam's hazard potential classification (worst case). Accordingly, the design earthquake for a dam with high consequence of seismic failure is the 0.5% probability of exceedance in 50-year event (10,000-year return period) may be appropriate for preliminary design-level evaluations. Based on a deaggregation of seismic hazard using the online USGS National Seismic Hazards Mapping Tool, the PGA for a "rock" site (B/C boundary) for the 10,000-year event is 0.075g. The deaggregation output from the USGS website is provided in **Appendix B**.

The PGA obtained from the USGS National Seismic Hazards Mapping Tool is for general Site Class B/C (rock, Vs30 equals 2,500 feet per second). The mapped Class B/C PGA was corrected to site-specific conditions following 210-NI-Part 302 Interim Guidance for Seismic Hazards (NRCS, 2021). Based on the weighted average N-values of the soil borings, the site class was determined to be Site Class D. The PGA amplification factor for Site Class D of 1.6 was used to calculate the adjusted PGA per NRCS (2021). Therefore, the resulting design peak ground acceleration, PGA_{Design}, is 0.119g.

The resulting PGA_{Design} is greater than 0.07g, and therefore future studies for rehabilitation final design may be needed to evaluate the potential for loss of shear strength due to liquefaction or cyclic failure of the foundation and embankment soils and related effects (e.g., seismic deformation and/or slope instability) as noted in TR-201-60 (NRCS 2019a). Alternatively, additional hydrologic analysis for a dam breach at normal pool conditions may allow reduction in the consequence of seismic hazard to either significant consequence (governed by the 2,500-year seismic event) or low consequence (governed by the 1,000-year seismic event) and corresponding reduction in the design PGA. Additionally, future studies may determine if the site classifies as one with limited loss of strength (i.e. well-built embankment dam on rock or dense soil) which is exempt from seismic analysis per TR-210-60. The current investigation was limited in scope to only the auxiliary spillway, and as such, cannot determine if the site would classify as one with the potential for significant or limited loss of strength.

5.2 Auxiliary Spillway

The existing footprint of the auxiliary spillway is underlain by a significant thickness of earthfill materials at the ASW crest (up to 9.5 feet), and unconsolidated natural materials elsewhere in cut sections of the spillway consisting primarily of alluvium and/or residuum. Residual sandy clays resulting from weathering of the Oakville Sandstone formation are anticipated at depths of about 4 to 6 feet below existing grade and extent to approximately 15 feet bgs. Groundwater was not encountered and is not anticipated within depths of at least 20 to 40 feet bgs. Uniform vegetative cover was generally observed throughout the existing auxiliary spillway.

Preliminary hydraulic evaluation developed as part of the present SWP-EA has identified potential rehabilitation alternatives which include either a proposed raise of the crest of the existing ASW by several feet with additional earthfill and widening the channel, or installing a 350-foot-wide RCC structural spillway which would replace the existing ASW (to be decommissioned). Detailed design recommendations for these alternatives or additional alternatives should be provided under a final design level SMR, which is outside of AECOM's current scope of work. In addition, a final design level GI and GIR will be necessary to support design of any rehabilitation or decommission alternatives considered.

For planning purposes, a minimum depth of stripping of about 1 foot would be needed to remove topsoil and vegetation in areas requiring earthfill. In addition, AECOM has assumed the excavation depth will be no greater than 5 feet below the existing spillway channel invert, but likely will instead include several feet of fill based on the current alternatives being considered. Excavations up to 5 feet deep below the existing channel invert elevation are not expected to encounter bedrock or groundwater. Accordingly, general excavation quantities will likely be classified as “common excavation” (except as noted).

Rehabilitation of the auxiliary spillway should include the re-establishment of robust vegetative cover following construction to improve spillway performance and reduce flows through the channel in case of ASW activation. Moreover, regular management of the ASW vegetative cover should be performed to prevent the growth of woody vegetation such as trees and shrubs which can disrupt flow in the channel (due to turbulence, for example). Design specifications should indicate types of grass seed that are well-suited to the local climate, and which will minimize soil exposure to erosion caused by rainfall, surface runoff, and spillway flows. Recommendations on material and placement criteria should be provided in a final design SMR, currently outside of AECOM's scope of work for this project.

Special consideration may be needed for rehabilitation design of the existing auxiliary spillway since the existing earthfill comprising the spillway crest is integrated with the dam embankment fill. Earthfill materials often have a lower resistance to erosion than comparable natural soil materials due to depositional age. Based on the current spillway design, potential initiation of erosion within the auxiliary spillway channel in the vicinity of the crest would have limited resistance to progressive erosion into the adjacent embankment fill. Channel armoring in critical areas or cutoff walls could be considered to improve the erosion resistance of the spillway channel and adjacent embankment.

5.2.1 Headcut Erodibility Index

Hydraulic analysis and design of vegetated earthen or rock spillways are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event. SITES input values include USCS soil type, soil dry unit weight, plasticity index, clay fraction, representative diameters D75 and D50, and the empirical headcut erodibility index (Kh).

Development of recommended material parameters for SITES analysis was performed according to the guidance provided in the *National Engineering Handbook, 210-VI-NEH, Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index* (NRCS, 2001) and the accompanying *DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons* (NRCS, 2011). SITES parameters presented herein were estimated based on field visual classification, SPT N-values, pocket penetrometer readings, available laboratory test data, NRCS Websoil Survey data, past experience, and professional judgement.

Materials considered in the evaluation included those encountered beginning near the proposed finished-grade elevation of the ASW channel surface and extending down below the valley bottom elevation at the downstream exit channel. Material parameters were developed for each of the generalized strata units described previously, as well as for potential proposed fill material from on-site sources that may be needed with proposed rehabilitation spillway modifications. In summary, these included the following material layers:

1) Proposed Fill (ASW Borrow)
2) Existing Fill
3) Alluvium/Residuum
4) Oakville Sandy Clays
5) Oakville Clayey & Silty Sands
6) Oakville Fat Clays

Representative values of SITES input parameters for each stratum were selected on an approximate best fit between the 33rd and 50th percentile measured values, as is consistent with typical geotechnical engineering practice. Recommended parameters for preliminary analysis are presented in **Table 3**. Supporting calculations are provided in **Appendix G**.

The materials were considered to be soil-like in analyses for estimating the value of Kh. The Alluvium/Residuum, Oakville Sandy Clays, and Oakville Clays were considered as cohesive soils in analysis, and the Kh values were estimated using several methods including correlations with standard penetration tests N-values, correlations with liquidity index (LI), and results of laboratory unconfined compression (UC) tests presented in the SMR (AECOM, 2024). The Oakville Silty and Clayey Sands were considered cohesionless soil in analysis, and the Kh value was estimated primarily based on correlation with standard penetration test N-values and a single UC strength test.

Estimates of the Kh for the Proposed Fill material (in this case assumed to be derived from the potential ASW excavation borrow source) are typically developed by performing laboratory UC or UU tests on remolded samples compacted to target moisture content and density that simulate typical values of earthfill construction compaction specifications. It is common to conservatively remold samples to the minimum acceptable density and near the upper range of allowable moisture content (i.e., 95% of maximum dry density and +2% of optimum moisture relative to Standard Proctor energy as determined by ASTM D698). As such, the range of Kh values were estimated based on results of 4 UC tests on representative composite samples from auger cuttings collected at the surface for each of the borings drilled and remolded to target moisture and density in the lab. Results are contained in the SMR (AECOM, 2024).

Subsurface profiles illustrating the recommended stratigraphy for SITES analysis are contained in **Appendix G**.

5.3 Earth Embankment Fill Sources

An evaluation of potential on-site borrow sources is provided in this section.

5.3.1 Required Excavations in the Auxiliary Spillway

Borings drilled in the ASW channel indicate the presence of 6 to 15 feet of unconsolidated clayey soils that may be suitable as a borrow sources for possible embankment fill. Sandy lean to fat clays (CL, CH) and clayey to silty sands (SC, SC-SM) with varying amounts of calcareous inclusions were identified between the existing ground surface and depths of up to approximately 15 feet below existing grade. Clayey to silty sands (SC to SM) were also identified between approximately 15 and 25 feet bgs. Because excavations (if any) would likely remain above the water table (not encountered in any of the borings), dewatering is not anticipated to be required.

Classification testing, as well as engineering properties testing on remolded bulk samples (designated as G-1 and G-2 in each of the borings) from the ASW borings, were performed as part of the laboratory investigation and presented in the preliminary SMR (AECOM, 2024) to confirm suitability of these materials, particularly as it concerns to dispersion potential. Refer to the SMR for additional information regarding borrow suitability.

The estimated volume of cuts and fills is the responsibility of the project civil designer. Once this information is available, AECOM can provide guidance on estimated proportion of available borrow materials in proposed excavations. In addition, AECOM can then evaluate the need for additional borrow sources that may be required. It should be noted, however, that rehabilitation alternatives requiring a raise of the dam embankment would likely require identification of additional borrow sources to meet anticipated quantities since only minimal ASW excavation is presently planned under the leading rehabilitation alternatives developed as part of the SWP-EA.

5.3.2 Other On-site Borrow Sources

Desktop review of the topography in the vicinity of Escondido 12 suggests a shallow borrow area may be feasible upstream of the embankment within the reservoir. Review of available aerial imagery (Google Earth Pro) indicates the possible borrow area measures approximately 450 feet by 500 feet in plan and is located to the right of the existing reservoir, immediately upstream of the existing ASW entry. AECOM recommends that all borrow areas within the basin be located at least 200 feet upstream of the upstream toe of the embankment. Review of aerial images indicates the reservoir level has historically been low at times, which may facilitate access to potential borrow areas upstream of the dam around the reservoir and reduce the need for dewatering activities during construction.

According to the original workplan (SCS, 1964), an abundance of alluvial sandy clays and clayey sands were available within the sediment pool for use as borrow. In addition, the 1964 workplan (SCS) notes that materials excavated from the original ASW profile as well as other locally available materials classified as CL, SC, or SM per the USCS were suitable for use in the embankment. Stick boring logs contained in the as-built drawings (SCS, 1974) describe the upstream borrow area as composed primarily of lean to fat clays (CL, CH) with some silty to clayey sand (SM, SC) partings. In addition, calcareous inclusions such as caliche and trace gravel were identified with no indication of proportions. The clay layers described in the stick logs had thicknesses of 12 to 15 feet. Bedrock was not encountered, and groundwater levels were not shown on the plans.

Available data suggests suitable materials for earthfill may be available in this possible borrow source. However, additional geologic investigation and soil mechanics testing will be needed as part of final rehabilitation design to confirm the suitability of this possible borrow source.

5.4 Dispersive Soils

No visual evidence of dispersive soil erosion was identified during AECOM's site reconnaissance or in prior inspection reports. As indicated by laboratory testing for the current investigation presented in the SMR (AECOM, 2024), the majority of tested samples were classified as non-dispersive or probably not dispersive. However, one of the samples from the auxiliary spillway at a depth of 14 feet bgs had an elevated crumb and double-hydrometer test result suggesting possibly dispersive classification.

While no test data from the original investigation (SCS, 1973) was available to AECOM for review, a note in the as-builts drawings prescribing the "least dispersed" clays be placed in the exterior zone of the embankment suggests that testing on some samples may have indicated possibly dispersive soils in the proposed earthfill sources (e.g., dedicated borrow source and/or material from required excavations).

Consequently, final design investigations for dam rehabilitation options should include additional sampling and dispersion testing to further evaluate the risk of dispersive soils. Additionally, further sampling in the auxiliary spillway with confirmatory pinhole testing may be warranted since the possibly dispersive test result in the current investigation was performed on a sample obtained from this area. Moreover, the configuration of the auxiliary spillway crest in relation to the dam embankment (i.e., integrated earthfill) presents an added risk of erosion which could be exacerbated if dispersive soils are present.

6. Limitations

This report was prepared by AECOM using the degree of care and skill ordinarily exercised under similar circumstances by responsible engineers and geologists practicing in the same general location. No other warranty or representation, either expressed or implied, is made as to the findings and professional advice in this report.

The opinions, conclusions, and recommendations contained in this report are based on the field observations and subsurface explorations, laboratory tests, and present understanding of the proposed improvements. The findings in this report are believed to describe site conditions to the extent practical given the scope of the investigation. However, this investigation, like all such investigations, can directly explore subsurface conditions only at the boring locations within the site. Soil and geologic conditions can vary greatly between or beyond the exploration sites, and different conditions may be found during subsequent investigations or project construction.

The conclusions and recommendations contained herein are based in part upon information provided by others (including our subcontractors) and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information provided to AECOM has not been independently verified by AECOM, unless otherwise stated.

There is no intention that this report addresses environmental issues (for example, environmentally affected soil or groundwater, or historic site uses) related to this site. Such evaluations are outside the scope of this work and should be addressed in separate studies by appropriate professionals. In the event that changes are made to the nature, design, or location of the proposed construction layout or design criteria, the conclusions and recommendations presented herein should not be considered valid, unless and until AECOM reviews the changes and addresses their impact to the recommendations provided.

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TABLES

Table 1. Summary of Borings

Test Hole No.	Estimated [1] [2] Ground Elev. (ft)	Northing (ft) [3]	Easting (ft) [3]	Total Depth (ft)	Depth to Bedrock (ft)	Bedrock Elevation (ft) [2]	Groundwater Depth at Time of Drilling (ft)	Drill Hole Completion [4]
201-23	326.89	13486741	2313680	25.0	NE [3]	--	NE [3]	Cement-Bentonite Grout backfill
202-23	335.69	13486724	2313938	42.0	NE [3]	--	NE [3]	Cement-Bentonite Grout backfill
203-23	330.90	13486921	2314122	30.0	NE [3]	--	NE [3]	Cement-Bentonite Grout backfill
204-23	329.91	13486850	2314344	20.0	NE [3]	--	NE [3]	Cement-Bentonite Grout backfill

Notes:

(1) Ground elevation estimated from LiDAR contours (https://datagateway.nrcs.usda.gov/GDGOrder.aspx)
(2) Elevations reported with respect to NAVD88 datum.
(3) GPS coordinates from Google Earth Pro converted to North American Datum of 1983 (NAD83) using ArcGIS software.
(4) Grout mix: 3 bags (90 lb/ bag) of Portland cement and 3/4 bag (50 lb/bag) of bentonite.
(5) NE- Not Encountered

Table 2. Sample Inventory

Boring ID	Top Depth (ft)	Bottom Depth (ft)	Sample ID	Sample Type	Recovery (inch)	Field Classification	Laboratory Classification
201-23	0	1.5	SS-1	Split-Spoon	10	CH	--
"	2	3	ST-2	Shelby Tube	12	CH	CH
"	4	6	P-3	Push Tube	10.5	CH	--
"	6	8	ST-4	Shelby Tube	21	CL	CL
"	8	9.5	SS-5	Split-Spoon	13.5	CL	--
"	10	12	P-6	Push Tube	12	CL	--
"	12	14	ST-7	Shelby Tube	22	CL	CL
"	15	16	SS-8A	Split-Spoon	12	CL	--
"	16	16.5	SS-8B	Split-Spoon	6	CH and SW	--
"	20	21.5	SS-9	Split-Spoon	16	CH	CH
"	23.5	25	SS-10	Split-Spoon	16	CH	CH
"	0	3	G-1	Bulk	--	Mixed	--
"	3	5	G-2	Bulk	--	Mixed	--
202-23	0	2	P-1	Push Tube	16.5	CH	--
"	2	2.5	SS-2	Split-Spoon	14	CH	--
"	4	6	ST-3	Shelby Tube	17.5	CH	SC
"	6	7.5	SS-4	Split-Spoon	18	ML	CL
"	8	10	P-5	Push Tube	12.5	SP-SM	--
"	10	11.5	SS-6	Split-Spoon	18	SP-SM	SC
"	12	13.5	SS-7	Split-Spoon	17	CH	CH
"	14	15	ST-8	Shelby Tube	9.5	SM	--
"	15	16.5	SS-9	Split-Spoon	11	CH	--
"	20	21.5	SS-10	Split-Spoon	12.5	SP	--
"	25	26.5	SS-11	Split-Spoon	11	SP	--
"	30	31.5	SS-12	Split-Spoon	16	CH	--
"	32	33	P-13	Push Tube	12	CH	CH
"	35	36.5	SS-14	Split-Spoon	17.5	CH	--
"	38.5	40	SS-15	Split-Spoon	18	CH	--
"	40	42	ST-16	Shelby Tube	21.5	CH	CH
"	0	3	B-1	Bulk	--	Mixed	--
"	3	5	B-2	Bulk	--	Mixed	--
203-23	0	0.5	SS-1A	Split-Spoon	6	CH	--
"	0.5	1	SS-1B	Split-Spoon	9	SP-SC	--
"	2	4	P-2	Push Tube	10	SP-SC	CL
"	4	5.5	SS-3	Split-Spoon	10	CL	--
"	6	7.5	SS-4	Split-Spoon	14	SP	--
"	8	9	SS-5A	Split-Spoon	12	SP	--
"	9	9.5	SS-5B	Split-Spoon	6	CH	--
"	10	11	ST-6	Shelby Tube	6.5	SM	CL
"	12	13.5	SS-7	Split-Spoon	10	SP	--

"	14	15.5	SS-8	Split-Spoon	18	CH	--
"	16	17.5	SS-9	Split-Spoon	15	SM	CL
"	17.5	18	ST-10	Shelby Tube	2	SM	--
"	19	20	P-11	Push Tube	15.5	SP	--
"	20	21.5	SS-12	Split-Spoon	17	SP	--
"	23	24.5	SS-13	Split-Spoon	17	SP	--
"	26	27.5	SS-14	Split-Spoon	18	CH	--
"	28	30	ST-15	Shelby Tube	21	CH	CH
"	0	3	B-1	Bulk	--	Mixed	--
"	3	5	B-2	Bulk	--	Mixed	--
204-23	0	2	ST-1	Shelby Tube	13	CH	CH
"	2	3.5	SS-2	Split-Spoon	14	CH	--
"	4	6	ST-3	Shelby Tube	13	CH	CH
"	6	8	P-4	Push Tube	14	CH	
"	8	10	ST-5	Shelby Tube	16	CH	CL
"	10	11.5	SS-6	Split-Spoon	16	CH	--
"	12	13.5	P-7	Push Tube	10	SP-SM	--
"	14	20	RC-1	Rock Core	0	Sandstone	--
"	0	3	G-1	Bulk	--	Mixed	--
"	3	5	G-2	Bulk	--	Mixed	--

Table 3. Recommended Parameters for SITES Analysis of Existing ASW

SITES inputs	Proposed Fill (ASW Borrow)	Existing Fill	Alluvium/Residuum	Oakville – Sandy Clays	Oakville – Clayey & Silty Sands	Oakville - Clays
USCS - Soil Type (Predominant)	CL - Lean Clay	CL - Lean Clay	CH - Fat clay	CL - Lean Clay	SC – Clayey Sand	CH - Fat Clay
PI	30	15	30	21	17	38
LL	45	30	50	38	32	58
Dry Density (lbs/ft3)	92	97	100	115	90	102
Kh	0.10	0.10	0.20	0.20	0.20	0.3
Clay %	25	17	24	24	5	24
D_{75} (mm)	0.06	0.11	0.085	0.12	0.22	0.05
D_{75} (in)	0.002	0.004	0.003	0.005	0.009	0.002
D_{50} (mm)	---	---	---	---	---	---
D_{50} (in)	---	---	---	---	---	---

FIGURES

Figure 1. Site Vicinity Map

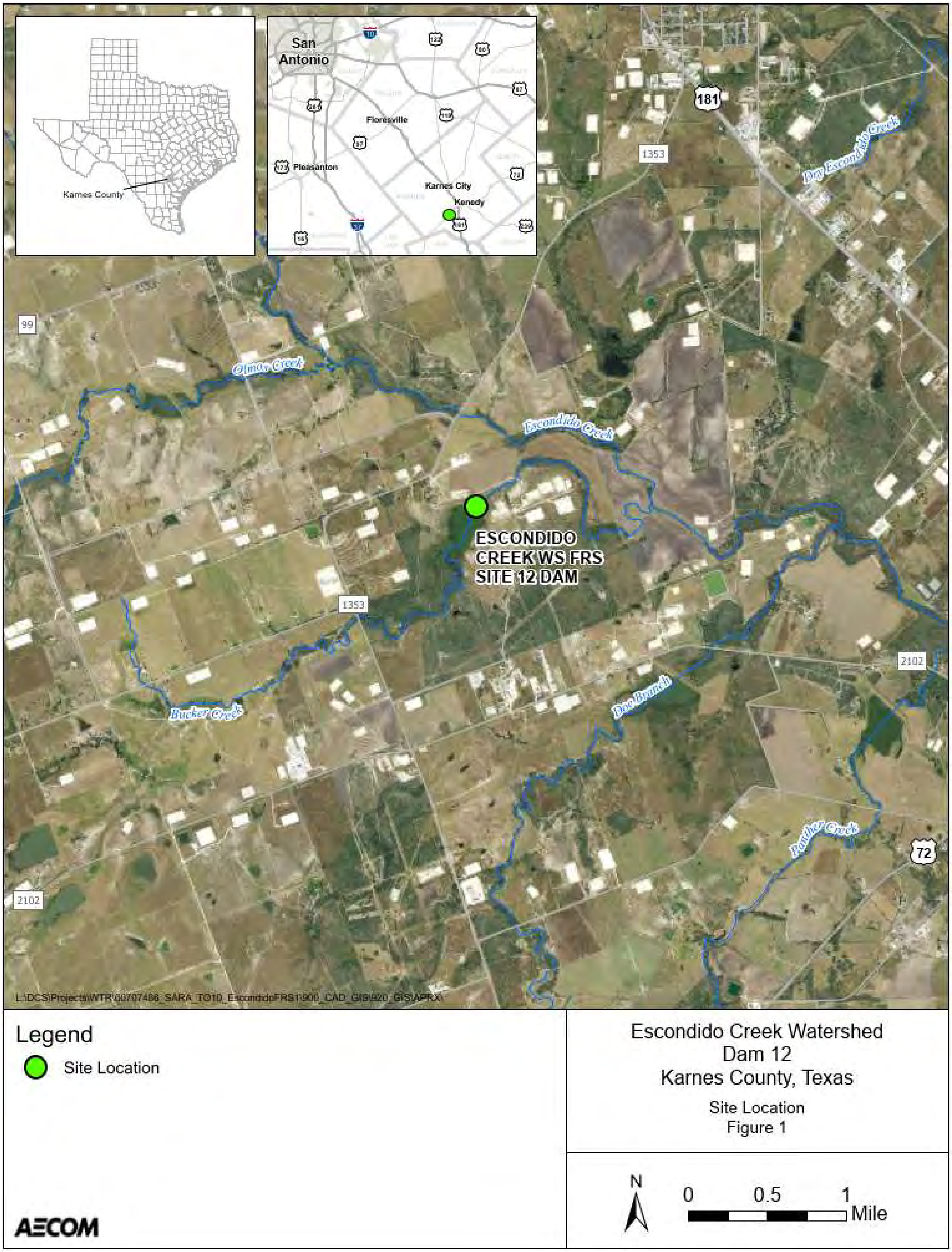


Figure 2. Geologic Map (Brown et al., 1975)

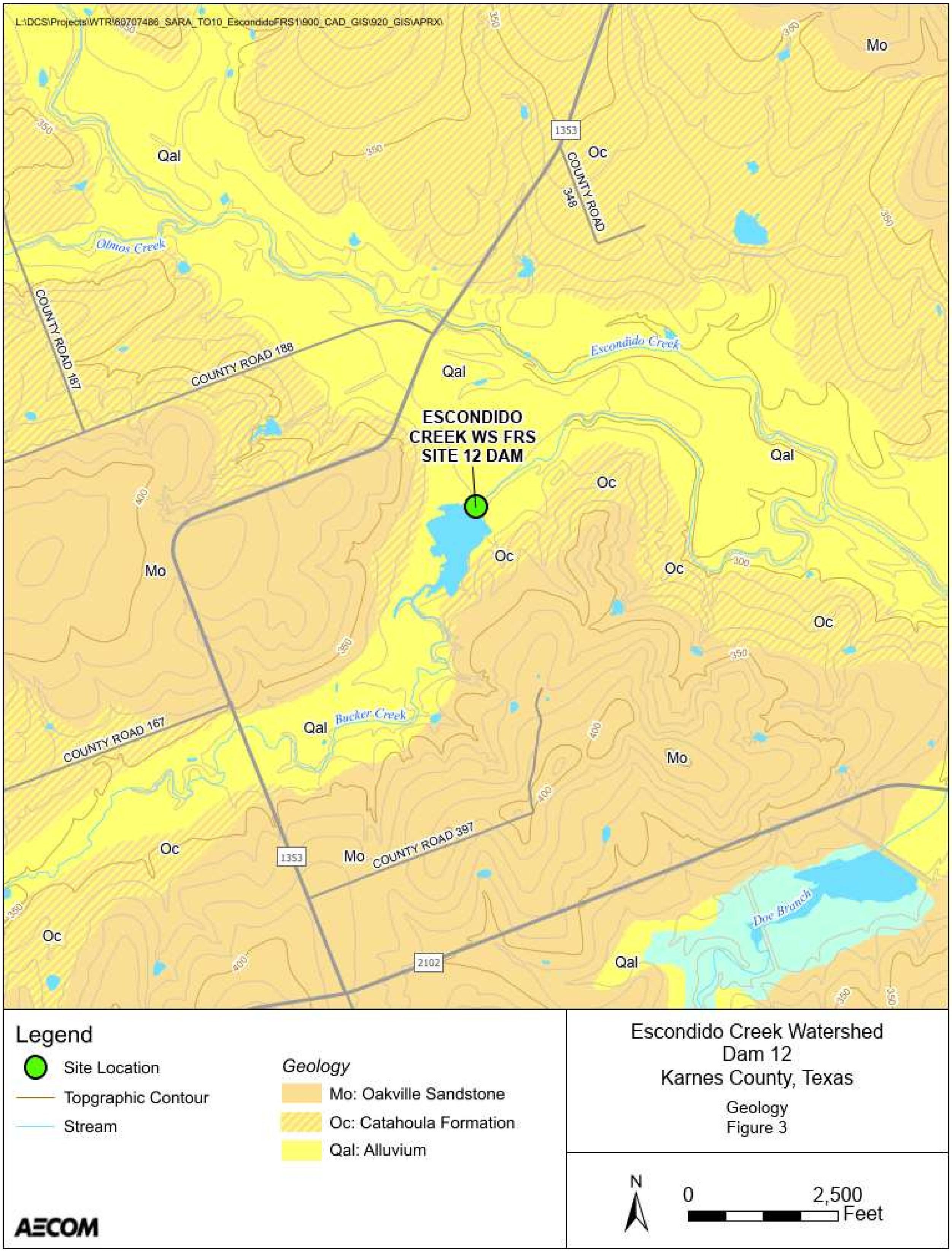
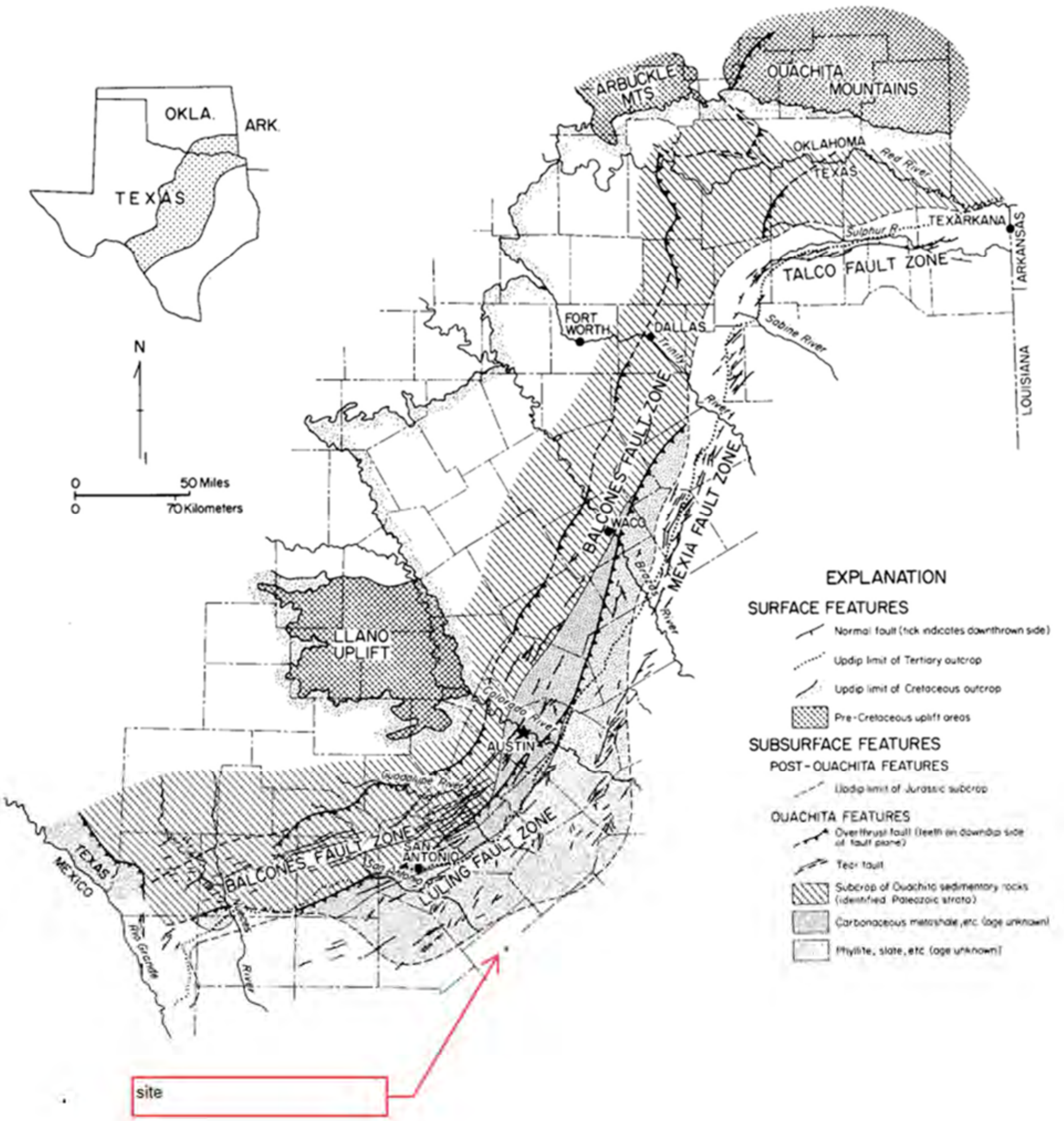


Figure 3. Regional Tectonic Features from Woodruff and McBride (1979)



Regional tectonic features (modified from Flawn and others, 1961, and Sellards and Hendricks, 1946).

Figure 4. Mapped Faults from Bureau of Economic Geology (University of Texas)

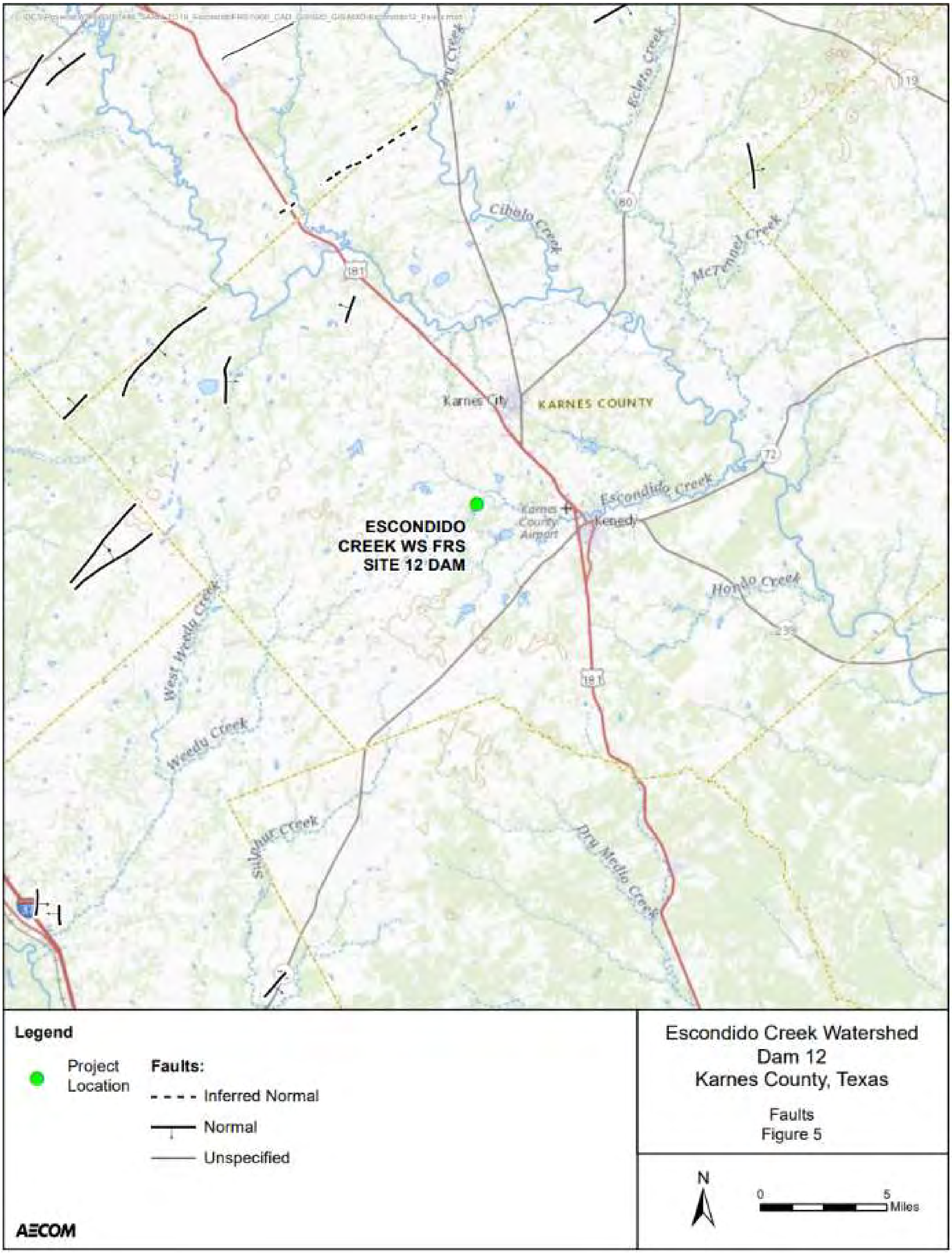


Figure 5. Regional Faults from McKeighan Thesis 2022

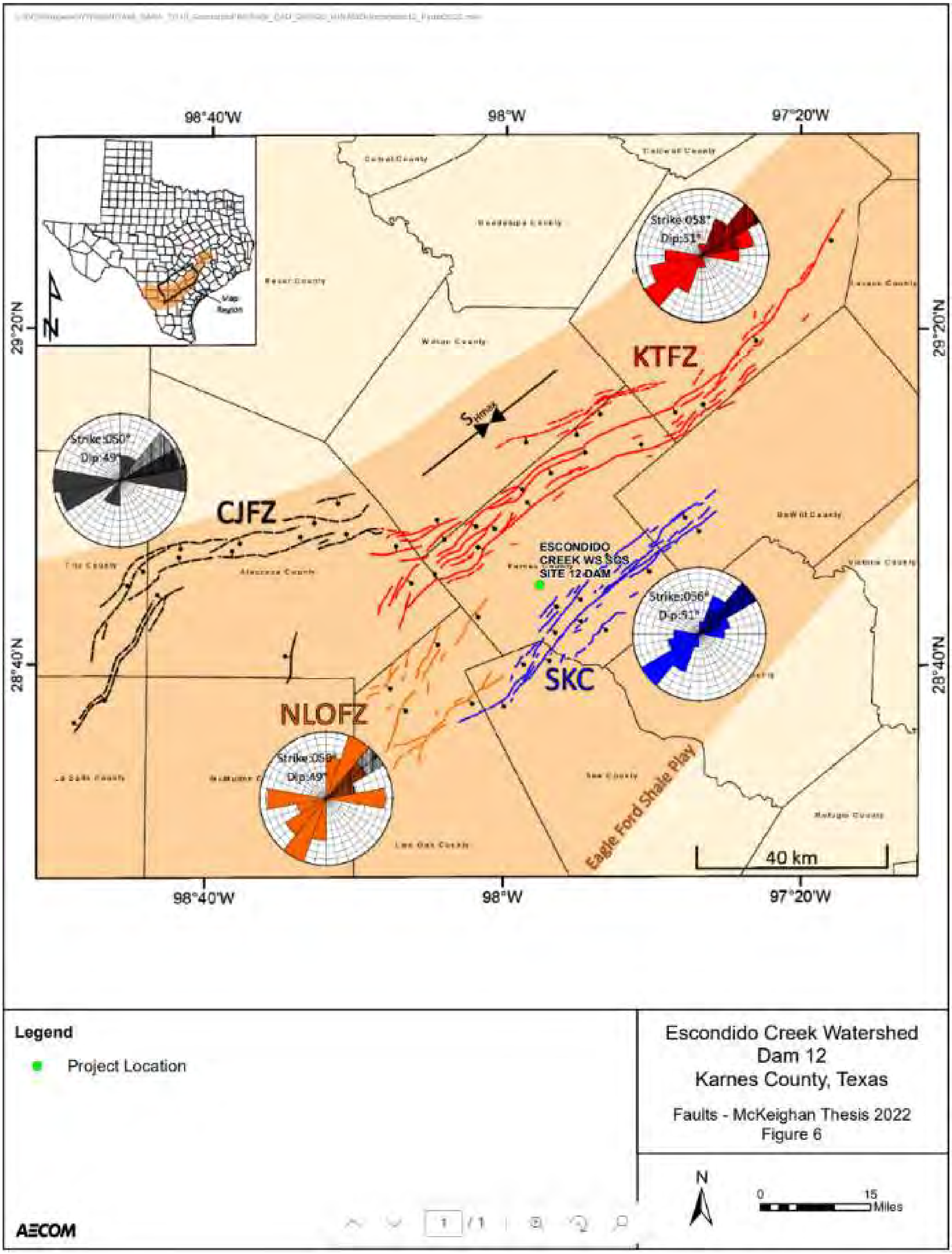


Figure 6. Recent and Historic Earthquakes

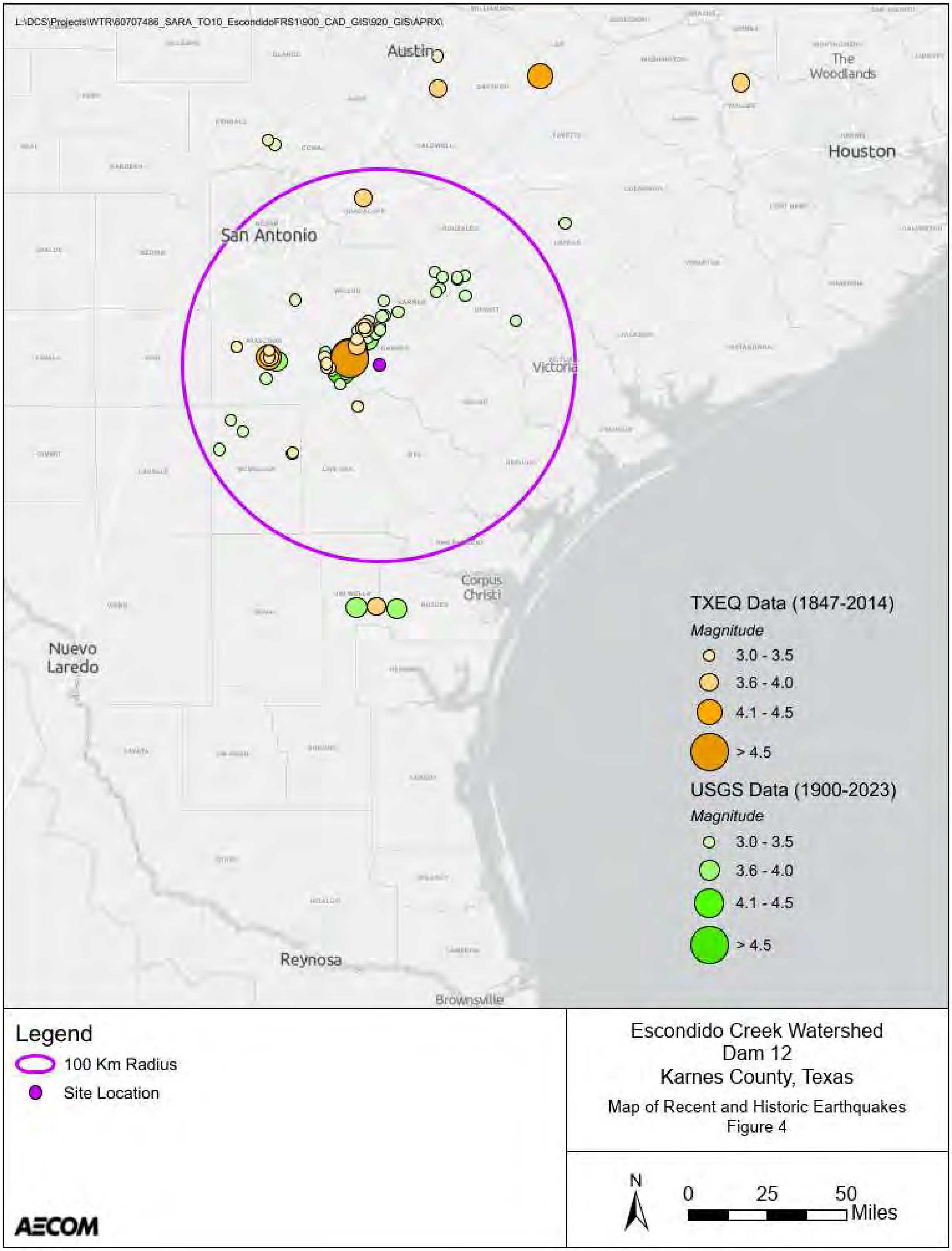
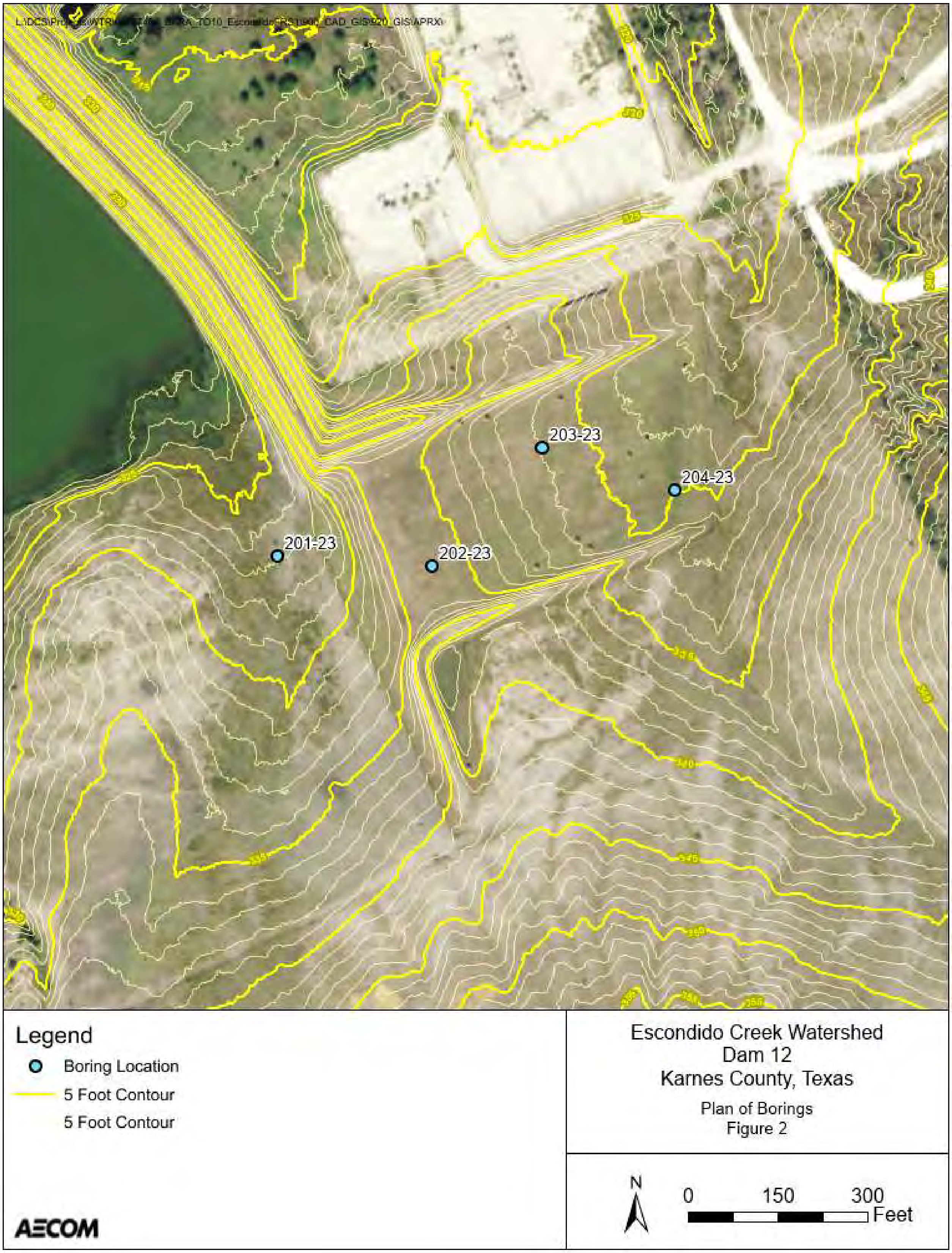
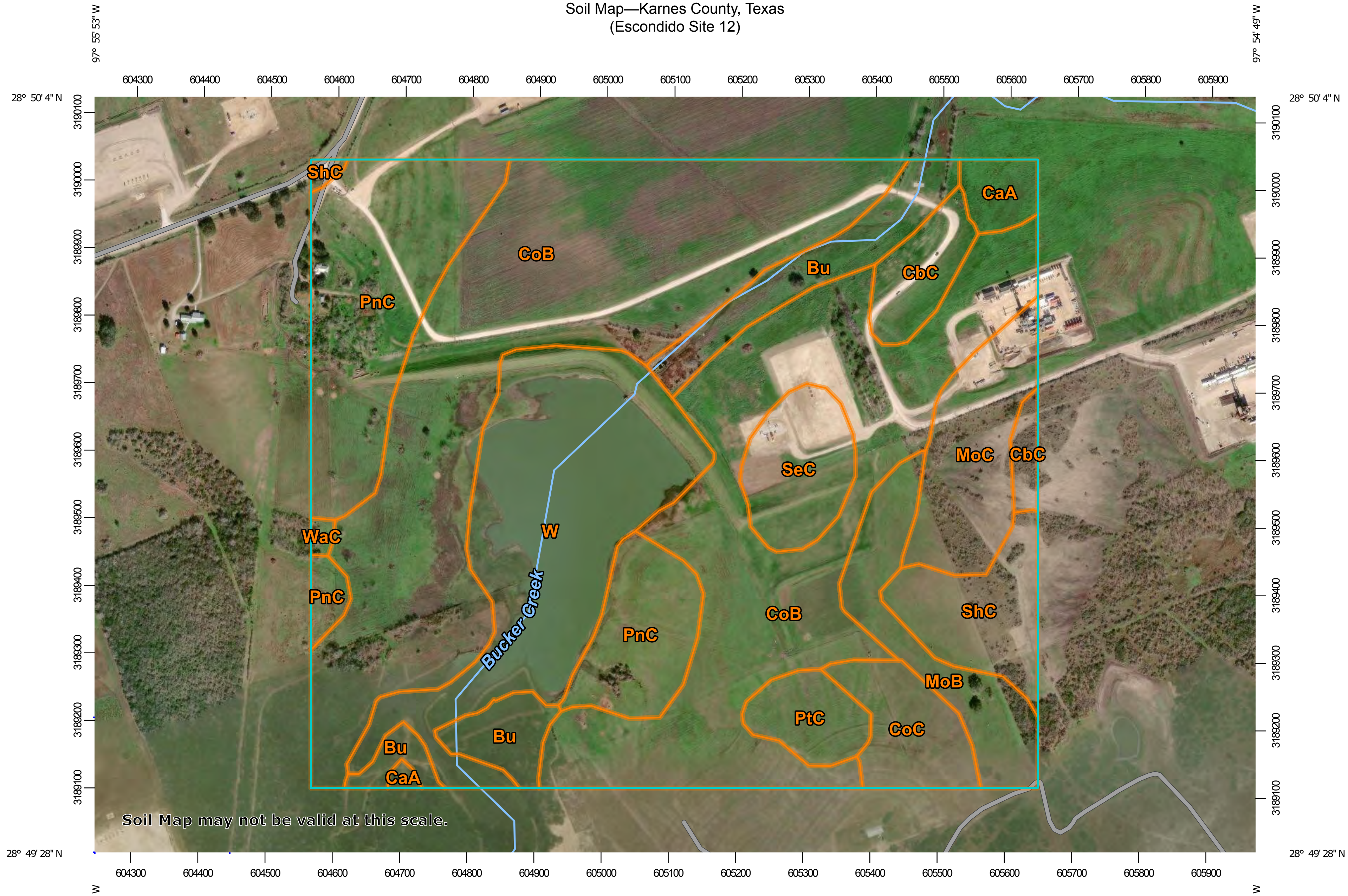


Figure 7. Plan of Borings

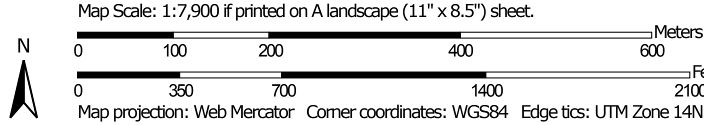


Appendix A NRCS Websoil Survey Data

Soil Map—Karnes County, Texas
(Escondido Site 12)



Map Scale: 1:7,900 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 23, 2013—Oct 29, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Bu	Buchel clay, 0 to 1 percent slopes, occasionally flooded	13.4	5.3%
CaA	Clareville clay loam, 0 to 1 percent slopes	3.1	1.2%
CbC	Colibro sandy clay loam, 3 to 5 percent slopes	6.4	2.6%
CoB	Coy clay loam, 1 to 3 percent slopes	109.9	44.0%
CoC	Coy clay loam, 3 to 5 percent slopes	6.9	2.8%
MoB	Monteola clay, 1 to 3 percent slopes	9.9	4.0%
MoC	Monteola clay, 3 to 5 percent slopes	11.6	4.6%
PnC	Pernitas sandy clay loam, 2 to 5 percent slopes	32.3	12.9%
PtC	Pettus loam, 2 to 5 percent slopes	4.7	1.9%
SeC	Sarnosa fine sandy loam, 2 to 5 percent slopes	7.8	3.1%
ShC	Schattel clay loam, 2 to 5 percent slopes	9.1	3.7%
W	Water	34.2	13.7%
WaC	Weesatche fine sandy loam, 2 to 5 percent slopes	0.4	0.2%
Totals for Area of Interest		**249.7**	**100.0%**

Karnes County, Texas

WaC—Weesatche fine sandy loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t8c0
Elevation: 100 to 400 feet
Mean annual precipitation: 27 to 36 inches
Mean annual air temperature: 70 to 74 degrees F
Frost-free period: 275 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Weesatche and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Weesatche

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Calcareous loamy residuum weathered from sandstone

Typical profile

A - 0 to 11 inches: fine sandy loam
Bt - 11 to 36 inches: sandy clay loam
Bk - 36 to 56 inches: sandy clay loam
BCk - 56 to 80 inches: fine sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R083AY023TX - Sandy Loam
Hydric soil rating: No

Minor Components

Pernitas

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Parrita

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY004TX - Shallow Sandy Loam
Hydric soil rating: No

Olmedo

Percent of map unit: 1 percent
Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083CY002TX - Shallow Ridge
Hydric soil rating: No

Goliad

Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083AY026TX - Eastern Clay Loam

Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

PnC—Pernitas sandy clay loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2s663
Elevation: 150 to 800 feet
Mean annual precipitation: 28 to 36 inches
Mean annual air temperature: 70 to 74 degrees F
Frost-free period: 270 to 295 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pernitas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pernitas

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous loamy alluvium derived from sandstone

Typical profile

A - 0 to 7 inches: sandy clay loam
Bt - 7 to 21 inches: sandy clay loam
Btk - 21 to 33 inches: sandy clay loam
Bk - 33 to 80 inches: sandy clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R083AY019TX - Gray Sandy Loam
Hydric soil rating: No

Minor Components

Pettus

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083AY003TX - Gravelly Ridge
Hydric soil rating: No

Olmedo

Percent of map unit: 3 percent
Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083CY002TX - Shallow Ridge
Hydric soil rating: No

Colibro

Percent of map unit: 3 percent
Landform: Stream terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY019TX - Gray Sandy Loam
Hydric soil rating: No

Coy

Percent of map unit: 1 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY026TX - Eastern Clay Loam

Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

Bu—Buchel clay, 0 to 1 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: 2sf5c
Elevation: 40 to 450 feet
Mean annual precipitation: 25 to 32 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 275 to 290 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Buchel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buchel

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous clayey alluvium

Typical profile

A - 0 to 16 inches: clay
Bss1 - 16 to 42 inches: clay
Bss2 - 42 to 60 inches: clay
Bkss - 60 to 80 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: OccasionalNone
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to moderately saline (0.5 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: R083AY009TX - Clayey Bottomland
Hydric soil rating: No

Minor Components

Sinton

Percent of map unit: 7 percent
Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY013TX - Loamy Bottomland
Hydric soil rating: No

Odem

Percent of map unit: 5 percent
Landform: Natural levees
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R150AY534TX - Loamy Bottomland
Hydric soil rating: No

Meguin

Percent of map unit: 2 percent
Landform: Flood plains on river valleys
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY013TX - Loamy Bottomland
Hydric soil rating: No

Unnamed, hydric

Percent of map unit: 1 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R083AY009TX - Clayey Bottomland
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

MoB—Monteola clay, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t12l
Elevation: 120 to 570 feet
Mean annual precipitation: 27 to 37 inches
Mean annual air temperature: 70 to 72 degrees F
Frost-free period: 260 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Monteola and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monteola

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, footslope, toeslope
Landform position (three-dimensional): Base slope
Microfeatures of landform position: Circular gilgai
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Calcareous clayey residuum weathered from sandstone and shale

Typical profile

A - 0 to 12 inches: clay
Bss - 12 to 26 inches: clay
Bkss - 26 to 50 inches: clay
BCky - 50 to 80 inches: clay

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to moderately saline (0.5 to 10.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0

Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: R083BY017TX - Blackland
Hydric soil rating: No

Minor Components

Coy

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Schattel

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY016TX - Saline Clay Loam
Hydric soil rating: No

Pernitas

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Unnamed, hydric

Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

ShC—Schattel clay loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: dcd0
Elevation: 250 to 650 feet
Mean annual precipitation: 26 to 32 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 265 to 295 days
Farmland classification: Not prime farmland

Map Unit Composition

Schattel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Schattel

Setting

Landform: Ridges
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Clayey residuum

Typical profile

H1 - 0 to 5 inches: clay loam
H2 - 5 to 55 inches: clay
H3 - 55 to 80 inches: clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Gypsum, maximum content: 30 percent
Maximum salinity: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R083AY016TX - Saline Clay Loam
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 15 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

CbC—Colibro sandy clay loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: dcbm
Elevation: 250 to 500 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 240 to 270 days
Farmland classification: Farmland of statewide importance, if irrigated

Map Unit Composition

Colibro and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Colibro

Setting

Landform: Ridges on stream terraces
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Convex, concave
Parent material: Calcareous loamy alluvium

Typical profile

H1 - 0 to 17 inches: sandy clay loam
H2 - 17 to 56 inches: sandy clay loam
H3 - 56 to 80 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 70 percent
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: R083AY019TX - Gray Sandy Loam
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 20 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

PtC—Pettus loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: dccr
Elevation: 200 to 500 feet
Mean annual precipitation: 23 to 33 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 275 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Pettus and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pettus

Setting

Landform: Ridges, interfluves
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous loamy fluviomarine deposits

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 18 inches: gravelly loam
H3 - 18 to 28 inches: very gravelly loam
H4 - 28 to 80 inches: very gravelly loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 65 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B
Ecological site: R083AY005TX - Shallow
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 15 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

SeC—Sarnosa fine sandy loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2wt07
Elevation: 100 to 550 feet
Mean annual precipitation: 29 to 37 inches
Mean annual air temperature: 70 to 72 degrees F
Frost-free period: 270 to 290 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sarnosa and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sarnosa

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy residuum weathered from calcareous sandstone

Typical profile

A - 0 to 16 inches: fine sandy loam
Bk - 16 to 52 inches: fine sandy loam
BCk - 52 to 80 inches: fine sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: R083AY019TX - Gray Sandy Loam
Hydric soil rating: No

Minor Components

Pernitas

Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Colibro

Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083AY019TX - Gray Sandy Loam
Hydric soil rating: No

Shiner

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083AY002TX - Shallow Ridge
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

CaA—Clareville clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2ymrw
Elevation: 180 to 580 feet
Mean annual precipitation: 26 to 32 inches
Mean annual air temperature: 69 to 72 degrees F
Frost-free period: 270 to 300 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Clareville and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clareville

Setting

Landform: Drainageways, flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 10 inches: clay loam
Bt - 10 to 43 inches: clay loam
Bk - 43 to 64 inches: clay loam
BCk - 64 to 80 inches: loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 2s

Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Minor Components

Sinton

Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY013TX - Loamy Bottomland
Hydric soil rating: No

Weesatche

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY023TX - Sandy Loam
Hydric soil rating: No

Miguel

Percent of map unit: 3 percent
Landform: Low hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R083AY024TX - Tight Sandy Loam
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

CoB—Coy clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2wvwd
Elevation: 100 to 600 feet
Mean annual precipitation: 26 to 35 inches
Mean annual air temperature: 70 to 72 degrees F
Frost-free period: 270 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Coy and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coy

Setting

Landform: Terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous clayey alluvium derived from mudstone

Typical profile

Ap - 0 to 6 inches: clay loam
Bt - 6 to 25 inches: clay
Btk - 25 to 40 inches: clay
Bk - 40 to 80 inches: clay

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Minor Components

Pernitas

Percent of map unit: 6 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Schattel

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083AY016TX - Saline Clay Loam
Hydric soil rating: No

Monteola

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: R083BY017TX - Blackland
Hydric soil rating: No

Tiocano

Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R083AY007TX - Lakebed
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

CoC—Coy clay loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2wvwt
Elevation: 100 to 600 feet
Mean annual precipitation: 28 to 35 inches
Mean annual air temperature: 70 to 71 degrees F
Frost-free period: 270 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Coy and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coy

Setting

Landform: Terraces
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous clayey alluvium derived from mudstone

Typical profile

Ap - 0 to 6 inches: clay loam
Bt - 6 to 25 inches: clay
Btk - 25 to 40 inches: clay
Bk - 40 to 80 inches: clay

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R083AY026TX - Eastern Clay Loam
Hydric soil rating: No

Minor Components

Schattel

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083AY016TX - Saline Clay Loam
Hydric soil rating: No

Pernitas

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Monteola

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: R083BY017TX - Blackland
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Karnes County, Texas

MoC—Monteola clay, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t12r
Elevation: 100 to 550 feet
Mean annual precipitation: 27 to 37 inches
Mean annual air temperature: 70 to 72 degrees F
Frost-free period: 260 to 295 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Monteola and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monteola

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous clayey residuum weathered from sandstone and shale

Typical profile

A - 0 to 12 inches: clay
Bss - 12 to 26 inches: clay
Bkss - 26 to 50 inches: clay
BCky - 50 to 80 inches: clay

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to moderately saline (0.5 to 10.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: R083BY017TX - Blackland
Hydric soil rating: No

Minor Components

Schattel

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083AY016TX - Saline Clay Loam
Hydric soil rating: No

Pernitas

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R083CY019TX - Gray Sandy Loam
Hydric soil rating: No

Fashing

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R083AY002TX - Shallow Ridge
Hydric soil rating: No

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H
Bu—Buchel clay, 0 to 1 percent slopes, occasionally flooded														
Buchel	85	D	0-16	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	93-97-100	92-96-100	80-95-100	75-90-100	52-66-82	26-38-44
			16-42	Silty clay, clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-95-95	55-69-83	30-40-48
			42-60	Clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-95-95	53-75-81	29-46-48
			60-80	Clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-93-95	54-69-79	29-41-48
CaA—Clareville clay loam, 0 to 1 percent slopes														
Clareville	90	C	0-10	Clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	97-98-100	96-98-100	87-95-100	59-67-78	37-45-55	17-25-32
			10-43	Clay loam, clay, sandy clay	CH	A-7-6	0- 0- 0	0- 0- 0	96-98-100	96-98-100	88-96-100	64-72-81	51-53-61	29-30-37
			43-64	Clay loam, clay, sandy clay, sandy clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	97-98-100	96-98-100	86-96-100	61-73-83	46-53-61	25-30-37
			64-80	Clay loam, loam, sandy clay loam	CL	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	92-98-100	91-98-100	77-94-100	51-68-78	28-35-44	9-15-22

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
CbC—Colibro sandy clay loam, 3 to 5 percent slopes														
Colibro	80	A	0-17	Sandy clay loam	CL	A-4, A-6	0- 0- 0	0- 3- 5	95-98-100	95-98-100	85-93-100	60-75-90	29-35-40	9-15-20
			17-56	Loam, sandy clay loam, fine sandy loam	CL, SC	A-4, A-6	0- 0- 0	0- 3- 5	95-98-100	95-98-100	85-90-95	40-55-70	28-34-39	9-14-19
			56-80	Loam, sandy loam, loamy sand	SM	A-2-4, A-4	0- 0- 0	0- 3- 5	90-95-100	65-80-95	60-78-95	15-30-45	0-15 -30	NP-4 -7
CoB—Coy clay loam, 1 to 3 percent slopes														
Coy	85	C	0-6	Clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	88-99-100	64-74-78	38-50-56	18-25-29
			6-25	Clay, clay loam, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	84-99-100	67-81-93	44-59-69	20-32-44
			25-40	Clay, clay loam, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	84-99-100	67-81-93	43-58-68	20-32-44
			40-80	Clay loam, clay, silty clay, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	86-99-100	68-81-88	40-55-65	18-31-39

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
CoC—Coy clay loam, 3 to 5 percent slopes														
Coy	90	C	0-6	Clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	88-99-100	64-74-78	38-50-56	18-25-29
			6-25	Clay, clay loam, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	84-99-100	67-81-93	44-59-69	20-32-44
			25-40	Clay, clay loam, sandy clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	99-100-100	98-100-100	84-99-100	67-81-93	43-58-68	20-32-44
			40-80	Clay, silty clay, sandy clay, clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	86-99-100	68-81-88	40-55-65	18-31-39
MoB—Monteola clay, 1 to 3 percent slopes														
Monteola	90	D	0-12	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-100-100	93-100-100	85-99-100	70-82-90	55-59-62	36-38-40
			12-26	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	95-100-100	94-100-100	83-99-100	69-83-93	55-61-75	36-40-48
			26-50	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	97-99-100	94-98-100	83-97-100	69-81-93	50-59-73	27-38-48
			50-80	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	91-96-100	90-96-100	80-95-100	66-80-93	50-59-73	25-37-48

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
MoC—Monteola clay, 3 to 5 percent slopes														
Monteola	90	D	0-12	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-100-100	93-100-100	85-99-100	70-82-90	55-59-62	36-38-40
			12-26	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	95-100-100	94-100-100	83-99-100	69-83-93	55-61-75	36-40-48
			26-50	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	97-99-100	94-98-100	83-97-100	69-81-93	50-59-73	27-38-48
			50-80	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	91-96-100	90-96-100	80-95-100	66-80-93	50-59-73	25-37-48
PnC—Pernitas sandy clay loam, 2 to 5 percent slopes														
Pernitas	85	B	0-7	Sandy clay loam	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	98-100-100	90-95-100	44-48-57	32-37-48	9-15-22
			7-21	Sandy clay loam, clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	97-99-100	97-99-100	83-92-100	50-58-70	30-39-53	11-18-29
			21-33	Sandy clay, sandy clay loam, clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	96-99-100	96-99-100	81-91-99	50-58-65	31-41-49	12-19-26
			33-80	Clay loam, sandy clay loam	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	93-97-100	92-97-100	75-85-93	42-50-57	27-35-43	8-14-21

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
PtC—Pettus loam, 2 to 5 percent slopes														
Pettus	85	B	0-10	Loam	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	80-90-100	75-85-95	55-74-92	40-53-65	27-35-43	11-16-21
			10-18	Gravelly loam, gravelly sandy clay loam, very gravelly sandy clay loam	CL, GC, SC	A-2-6, A-6, A-7-6	0- 0- 0	0- 5- 10	35-60-85	25-50-75	20-40-60	15-35-55	27-35-43	11-16-21
			18-28	Very gravelly loam, very gravelly sandy clay loam, cobbly sandy clay loam	CL, GC, SC	A-2-6, A-6	0- 3- 5	0-10- 20	30-55-80	20-48-75	15-43-70	15-38-60	25-30-35	10-14-18
			28-80	Very gravelly loam, very gravelly sandy clay loam	CL, GC, SC	A-2-6, A-6	0- 0- 0	0- 5- 10	50-73-95	35-58-80	30-50-70	26-41-56	25-30-35	10-14-18
SeC—Sarnosa fine sandy loam, 2 to 5 percent slopes														
Sarnosa	90	A	0-16	Fine sandy loam	SC-SM, SC, SM	A-2-4, A-4, A-6	0- 0- 0	0- 0- 0	97-100-100	95-100-100	80-93-97	30-40-44	15-25-29	2-8 -11
			16-52	Loam, sandy clay loam, fine sandy loam	SC-SM, SC, SM	A-2-4, A-4, A-6	0- 0- 0	0- 0- 0	97-99-100	94-98-100	80-92-100	29-39-48	15-25-34	2-9 -16
			52-80	Sandy clay loam, fine sandy loam, loam	SC-SM, SC, SM	A-2-4, A-4, A-6	0- 0- 0	0- 0- 0	96-99-100	92-98-100	78-91-100	29-39-49	15-23-31	2-6 -16

Engineering Properties–Karnes County, Texas														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
ShC—Schattel clay loam, 2 to 5 percent slopes														
Schattel	85	C	0-5	Clay loam	CL	A-6, A-7-6	0- 0- 0	0- 1- 1	96-98-100	96-98-100	70-85-100	55-68-80	36-42-48	16-21-25
			5-55	Clay, clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	96-98-100	96-98-100	70-85-100	65-80-95	43-53-62	21-29-36
			55-80	Clay, silty clay, clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	96-98-100	96-98-100	65-83-100	60-78-95	48-59-70	27-38-48
WaC—Weesatche fine sandy loam, 2 to 5 percent slopes														
Weesatche	85	B	0-11	Fine sandy loam	SC-SM, SC	A-2-4, A-4, A-6	0- 0- 0	0- 0- 0	90-93-100	89-93-100	77-87-97	28-35-41	21-27-30	6-8 -14
			11-36	Sandy clay loam, clay loam	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	89-93-100	88-92-100	79-90-100	41-50-64	30-37-46	11-19-26
			36-56	Clay loam, sandy clay loam	CL, SC	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	90-93-100	89-92-100	78-90-100	43-54-64	23-31-43	9-16-22
			56-80	Loam, sandy clay loam, fine sandy loam	CL, SC	A-4, A-6	0- 0- 0	0- 0- 0	90-93-100	89-93-100	76-83-100	40-45-60	23-28-39	9-10-18

Data Source Information

Soil Survey Area: Karnes County, Texas
Survey Area Data: Version 19, Aug 24, 2022

Appendix B Seismicity Data

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (4.2.0)

Latitude

Decimal degrees

28.828406

Longitude

Decimal degrees, negative values for western longitudes

-97.921891

Site Class

Spectral Period

Peak Ground Acceleration

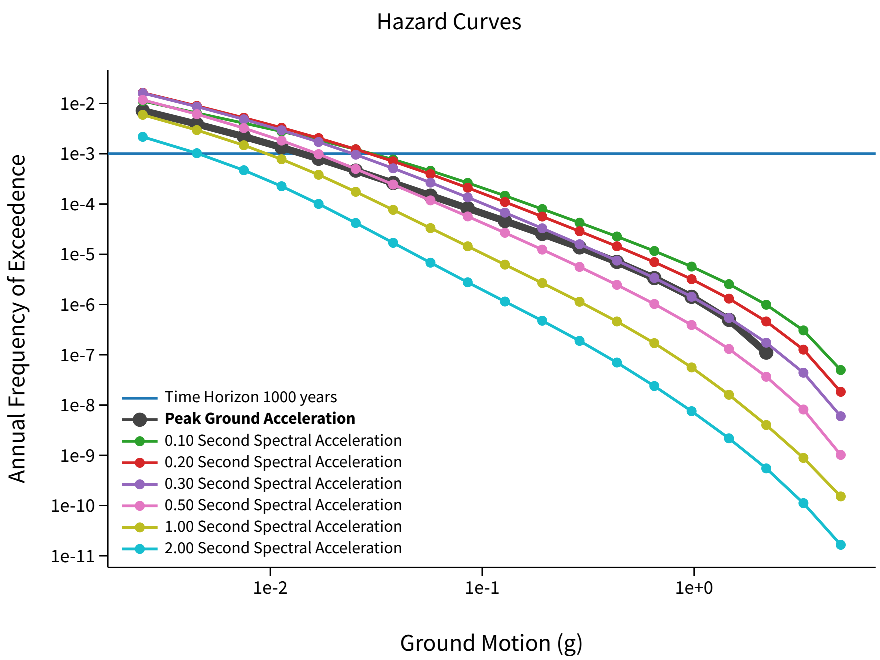
Time Horizon

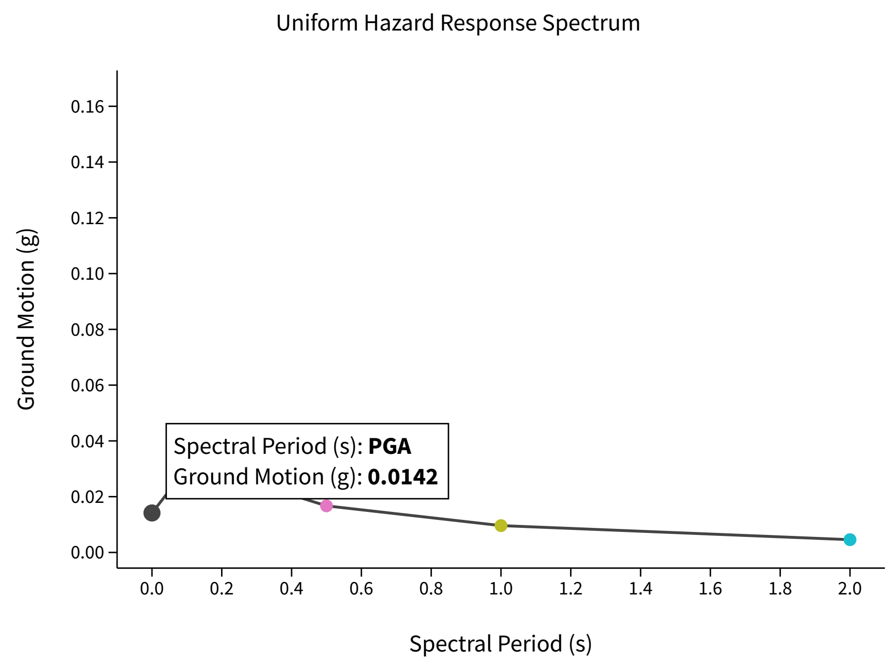
Return period in years

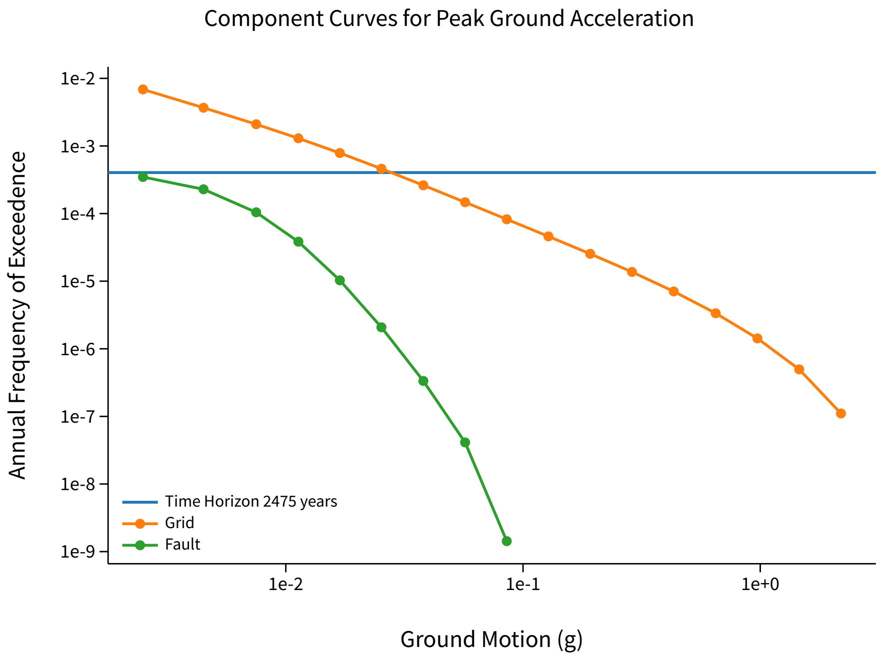
1000

760 m/s (B/C boundary)

Hazard Curve





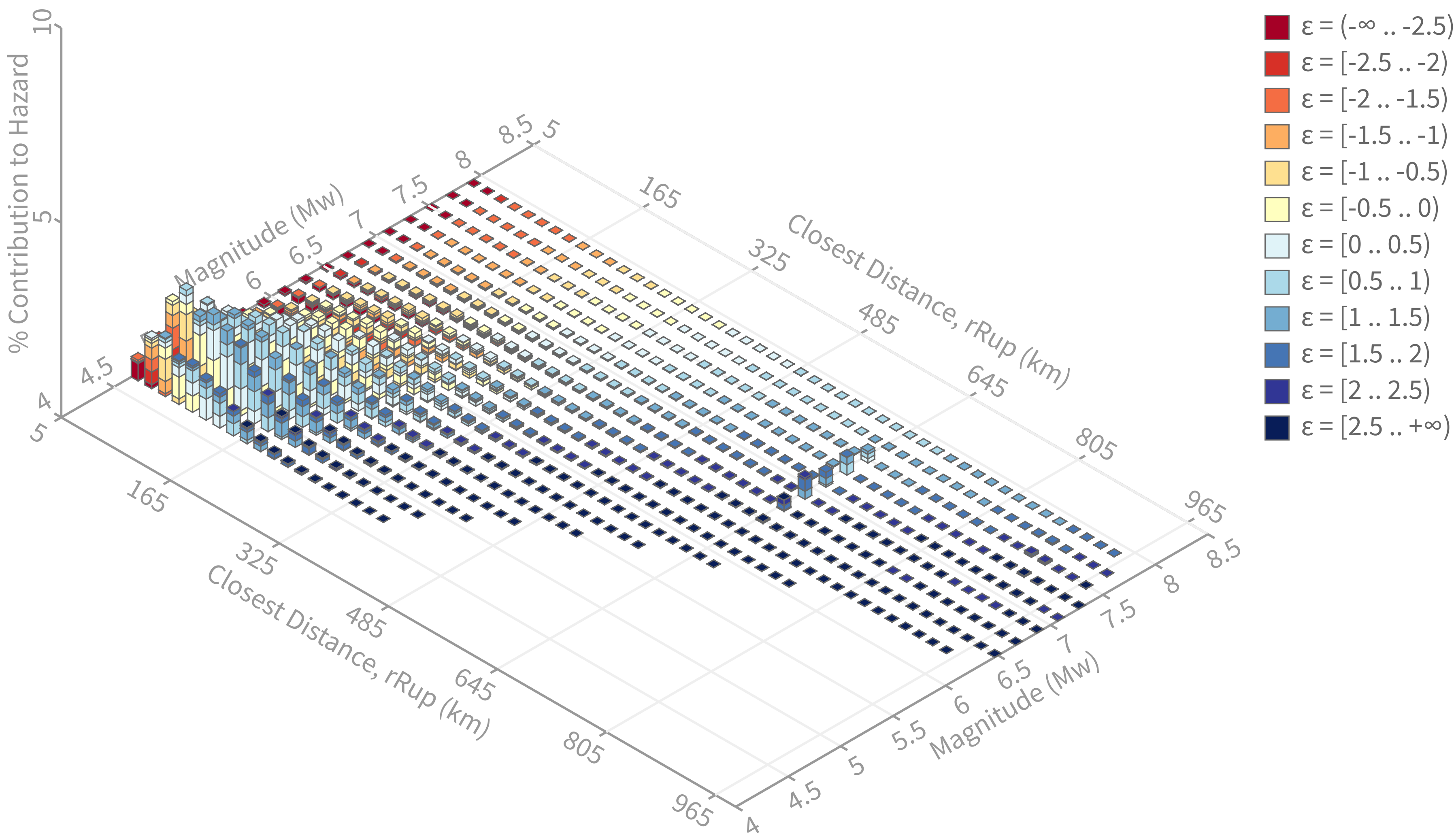


View Raw Data

Deaggregation

Component

Total



% Contribution to Hazard
10
5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Magnitude (Mw)
165
325
485
645
805
965
Closest Distance, rRup (km)
ε = (-∞ .. -2.5)
ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 1000 yrs
Exceedance rate: 0.001 yr^{-1}
PGA ground motion: 0.014159668 g

Recovered targets

Return period: 996.86977 yrs
Exceedance rate: 0.0010031401 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 3.71 %

Mean (over all sources)

m: 5.52
r: 156.98 km
ε_0: -0.31 σ

Mode (largest m-r bin)

m: 4.9
r: 50.13 km
ε_0: -0.79 σ
Contribution: 2.41 %

Mode (largest m-r-ε_0 bin)

m: 4.9
r: 88.94 km
ε_0: -0.24 σ
Contribution: 0.95 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)

ε5: [-0.5 .. 0.0)

ε6: [0.0 .. 0.5)

ε7: [0.5 .. 1.0)

ε8: [1.0 .. 1.5)

ε9: [1.5 .. 2.0)

ε10: [2.0 .. 2.5)

ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							25.34
SSCn Fixed Smoothing Zone 2 (opt)	Grid							25.22
USGS Adaptive Smoothing Zone 2 (opt)	Grid							16.96
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							16.86
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							3.14
USGS Adaptive Smoothing Zone 1 (opt)	Grid							3.08
SSCn Fixed Smoothing Zone 1 (opt)	Grid							3.03
USGS Fixed Smoothing Zone 1 (opt)	Grid							2.97
SSCn Meers Full Rupture	Fault							1.34
Meers CEUS - SSC		654.77	7.12	1.30	98.300°W	34.709°N	356.97	1.34

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (4.2.0)

Latitude

Decimal degrees

28.828406

Longitude

Decimal degrees, negative values for western longitudes

-97.921891

Site Class

Spectral Period

Peak Ground Acceleration

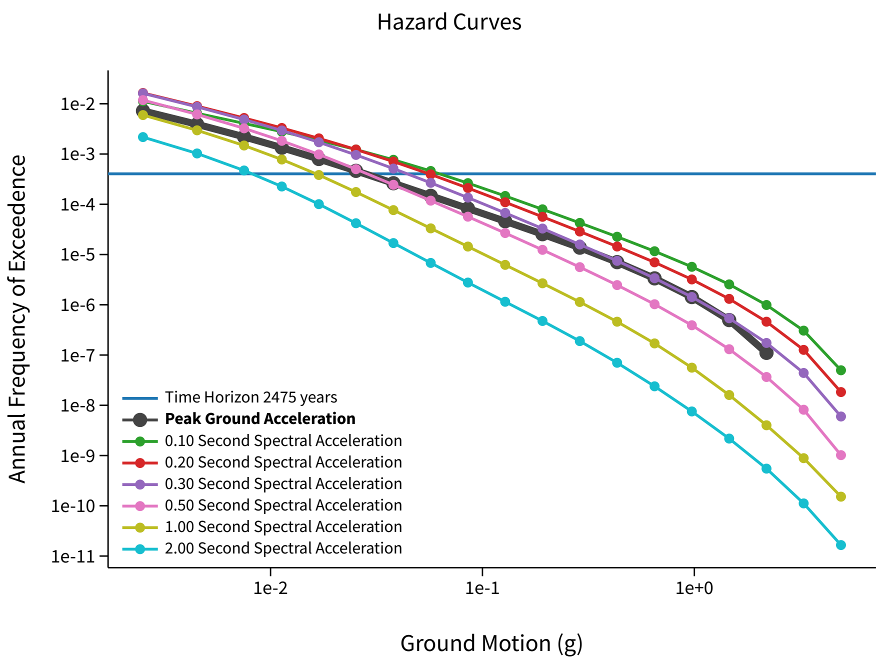
Time Horizon

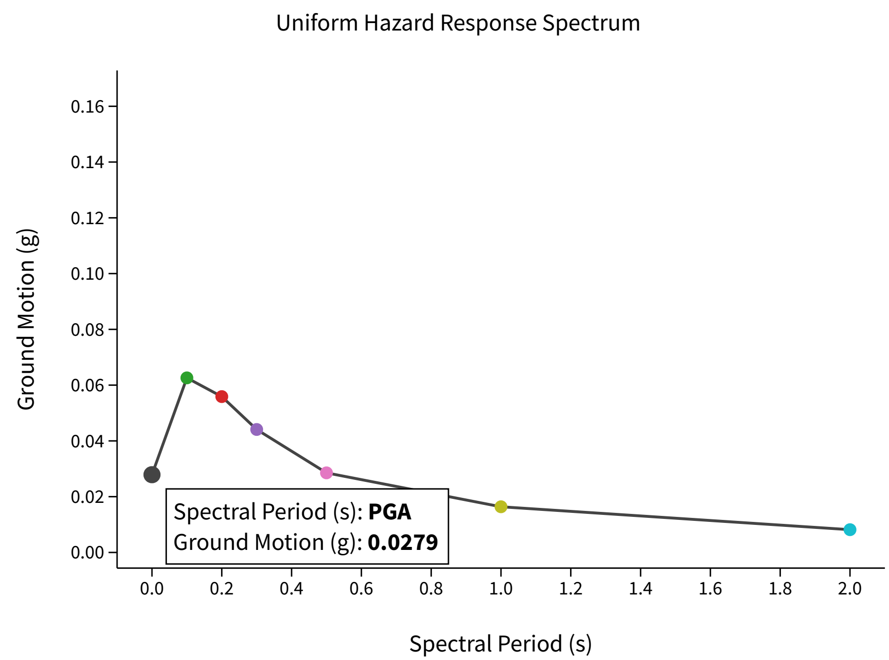
Return period in years

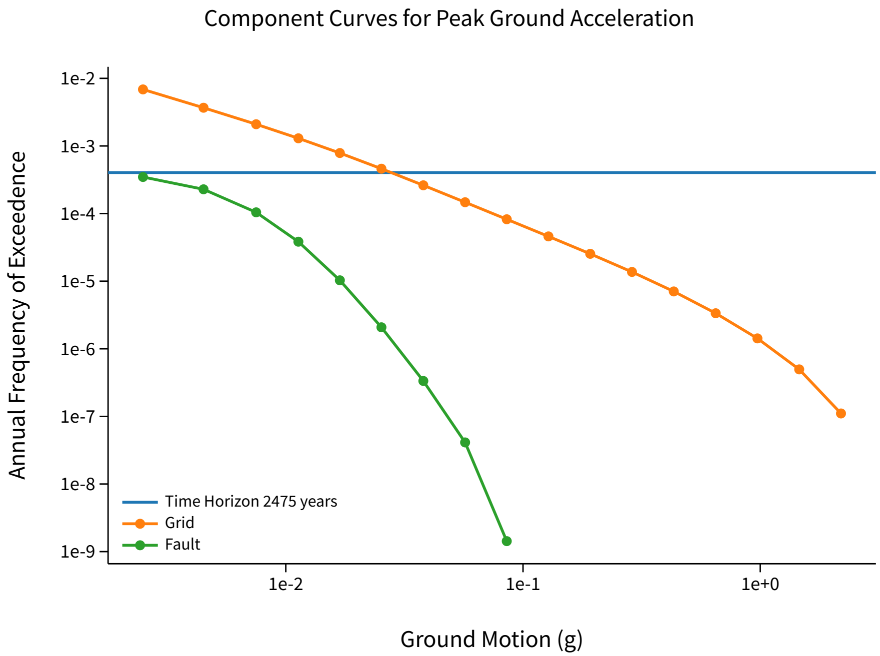
2475

760 m/s (B/C boundary)

Hazard Curve





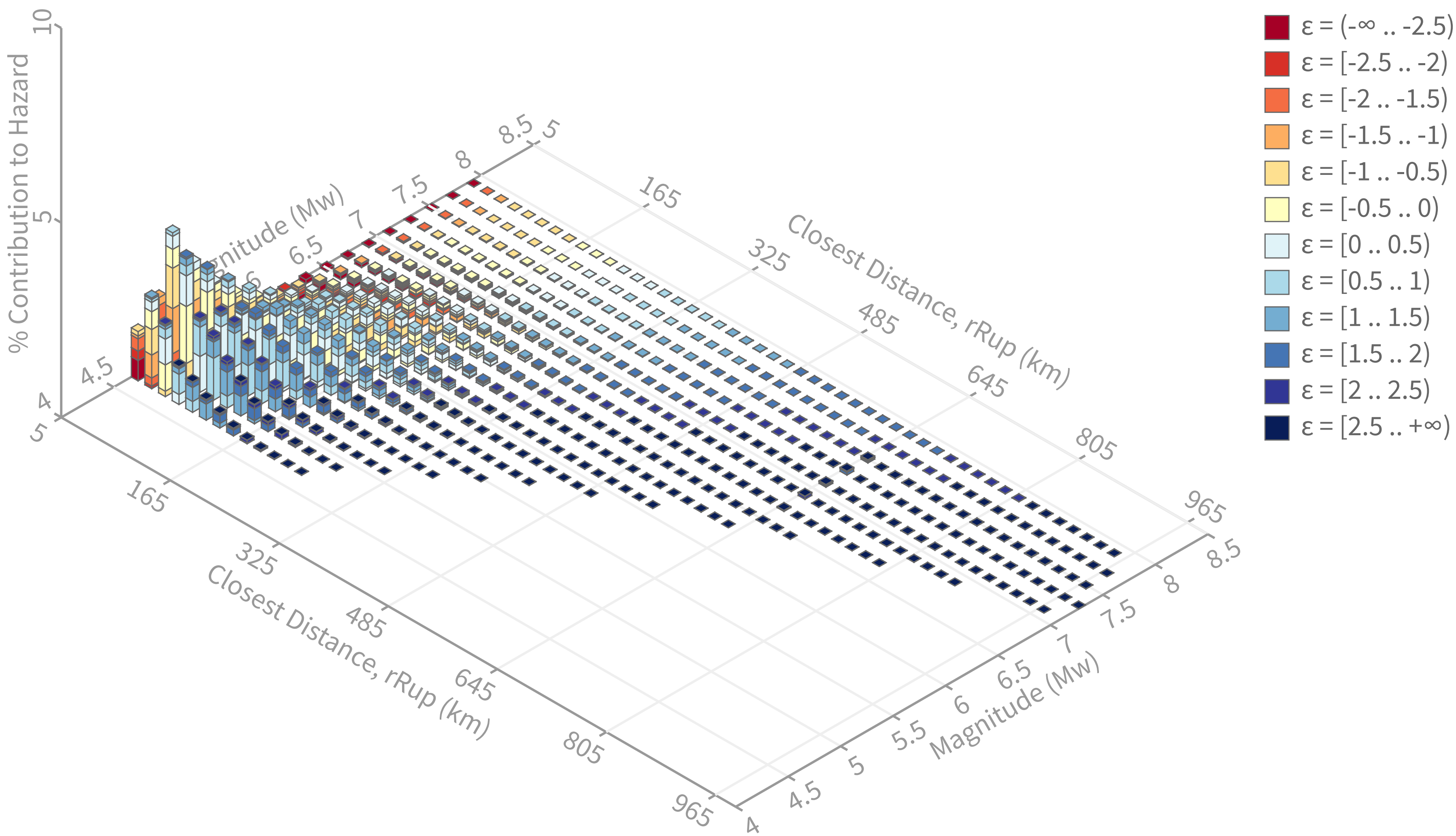


View Raw Data

Deaggregation

Component

Total



% Contribution to Hazard
10
5
Closest Distance, rRup (km)
165
325
485
645
805
965
Magnitude (Mw)
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
ε = (-∞ .. -2.5)
ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.027883672 g

Recovered targets

Return period: 2470.9507 yrs
Exceedance rate: 0.00040470252 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 2.68 %

Mean (over all sources)

m: 5.55
r: 104.99 km
ε_0: -0.2 σ

Mode (largest m-r bin)

m: 4.9
r: 30.94 km
ε_0: -0.91 σ
Contribution: 3.69 %

Mode (largest m-r-ε_0 bin)

m: 4.9
r: 49.11 km
ε_0: -0.23 σ
Contribution: 1.46 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)

ε5: [-0.5 .. 0.0)

ε6: [0.0 .. 0.5)

ε7: [0.5 .. 1.0)

ε8: [1.0 .. 1.5)

ε9: [1.5 .. 2.0)

ε10: [2.0 .. 2.5)

ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							27.39
PointSourceFinite: -97.922, 29.121		32.60	5.19	-1.20	97.922°W	29.121°N	0.00	1.26
PointSourceFinite: -97.922, 29.211		42.42	5.24	-0.77	97.922°W	29.211°N	0.00	1.15
PointSourceFinite: -97.922, 29.076		27.70	5.17	-1.49	97.922°W	29.076°N	0.00	1.11
PointSourceFinite: -97.922, 29.166		37.51	5.22	-0.96	97.922°W	29.166°N	0.00	1.10
PointSourceFinite: -97.922, 29.256		47.34	5.27	-0.60	97.922°W	29.256°N	0.00	1.08
SSCn Fixed Smoothing Zone 2 (opt)	Grid							27.36
PointSourceFinite: -97.922, 29.121		32.60	5.19	-1.20	97.922°W	29.121°N	0.00	1.26
PointSourceFinite: -97.922, 29.211		42.42	5.24	-0.77	97.922°W	29.211°N	0.00	1.15
PointSourceFinite: -97.922, 29.076		27.70	5.17	-1.49	97.922°W	29.076°N	0.00	1.11
PointSourceFinite: -97.922, 29.166		37.51	5.22	-0.96	97.922°W	29.166°N	0.00	1.10
PointSourceFinite: -97.922, 29.256		47.34	5.27	-0.60	97.922°W	29.256°N	0.00	1.08
USGS Adaptive Smoothing Zone 2 (opt)	Grid							17.70
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							17.68
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							2.32
USGS Adaptive Smoothing Zone 1 (opt)	Grid							2.31
SSCn Fixed Smoothing Zone 1 (opt)	Grid							2.22
USGS Fixed Smoothing Zone 1 (opt)	Grid							2.20

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (4.2.0)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

28.828406

Time Horizon

Return period in years

10000

Longitude

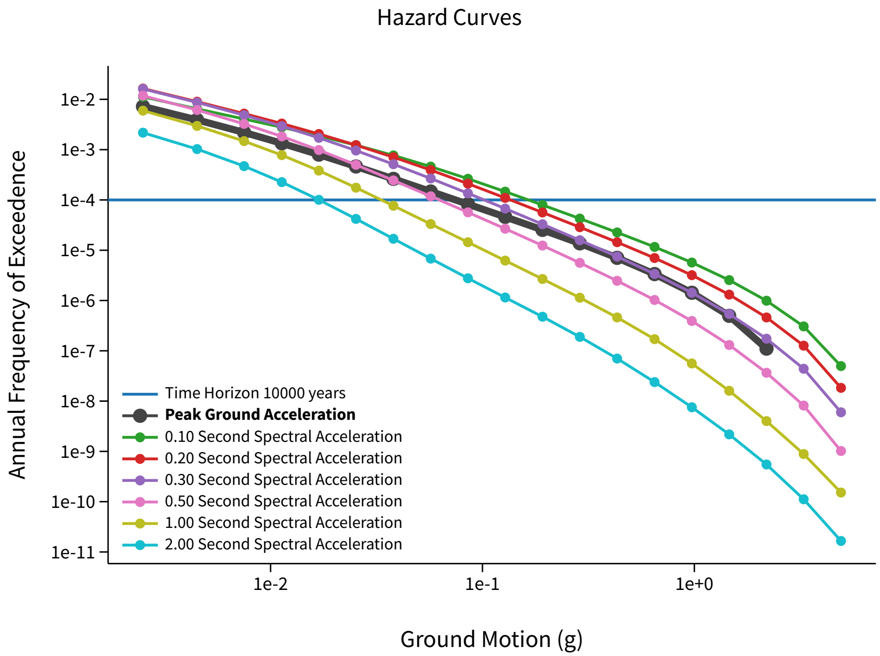
Decimal degrees, negative values for western longitudes

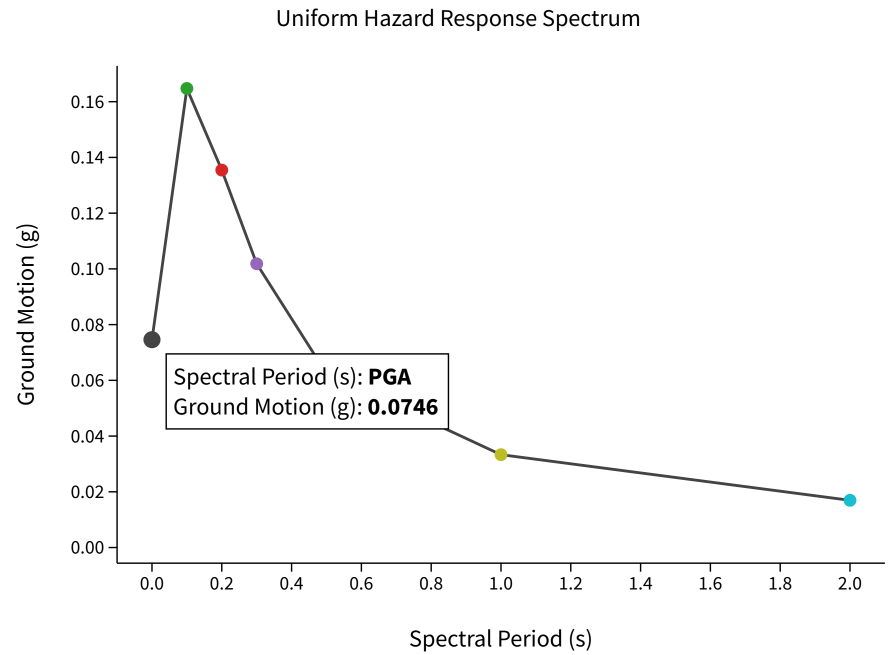
-97.921891

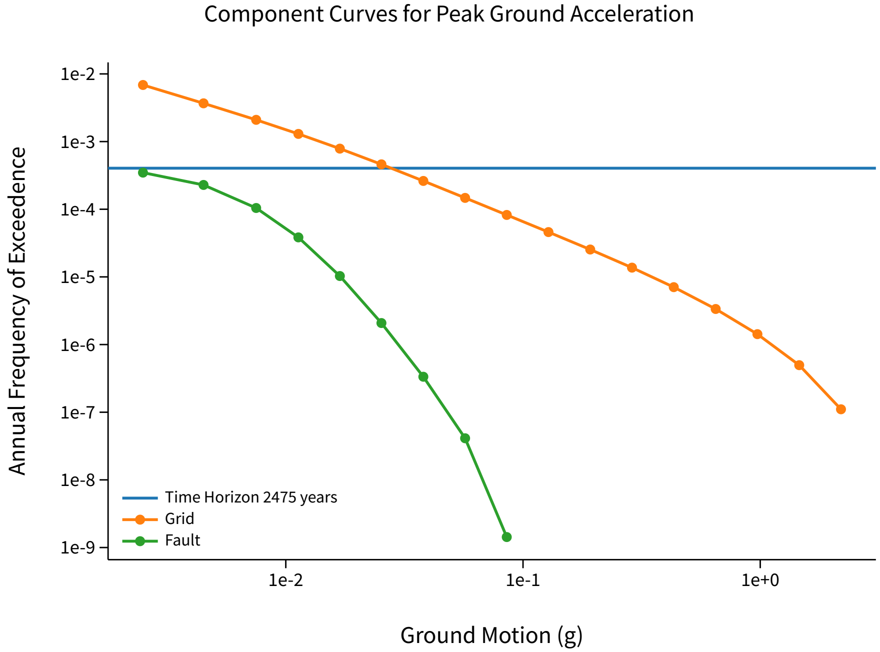
Site Class

760 m/s (B/C boundary)

Hazard Curve





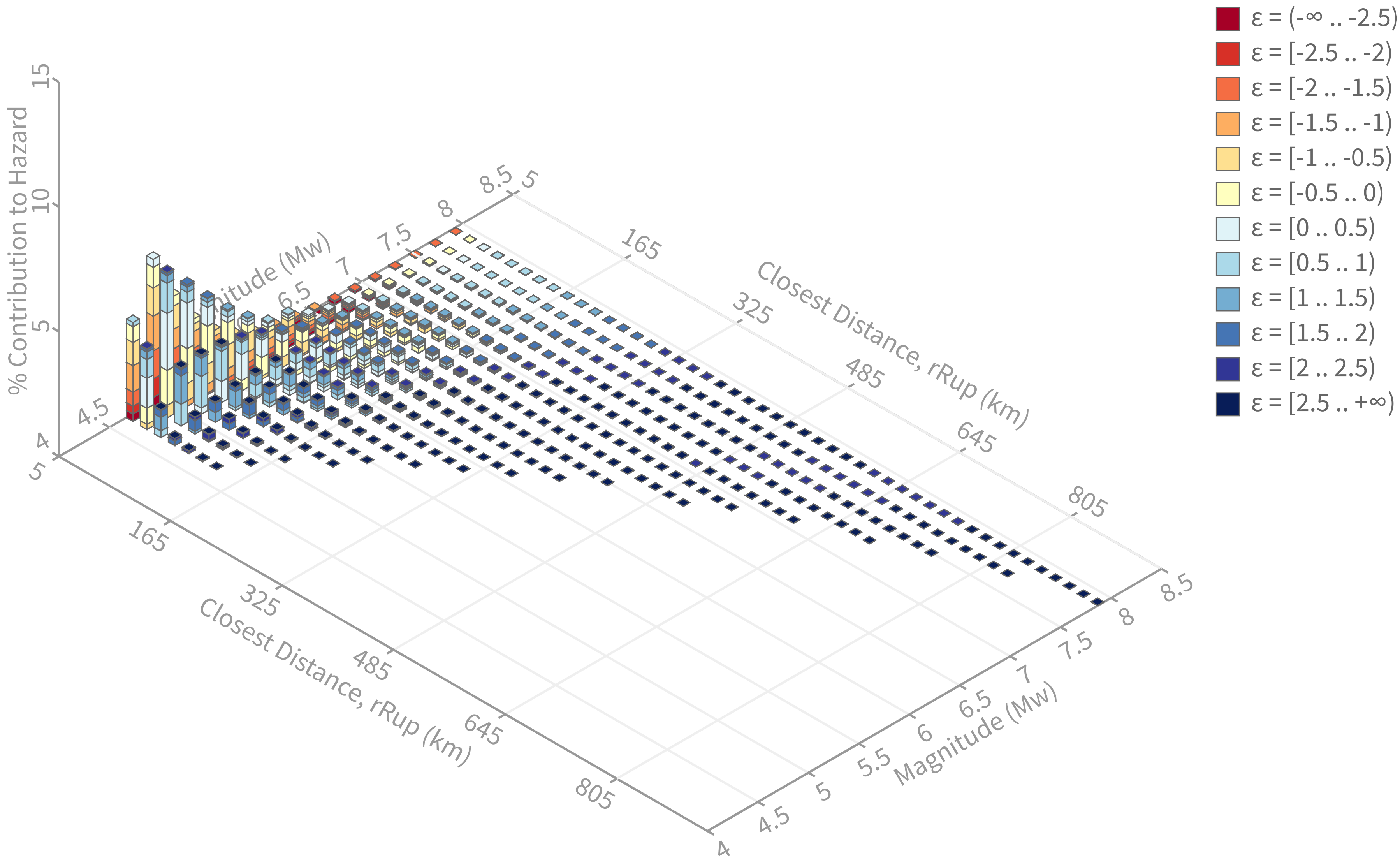


View Raw Data

Deaggregation

Component

Total



% Contribution to Hazard
Closest Distance, rRup (km)
Magnitude (Mw)
ε = (-∞ .. -2.5)
ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 10000 yrs
Exceedance rate: 0.0001 yr^{-1}
PGA ground motion: 0.074588711 g

Recovered targets

Return period: 9998.0132 yrs
Exceedance rate: 0.00010001987 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 1.54 %

Mean (over all sources)

m: 5.59
r: 57.97 km
ε_0: -0.13 σ

Mode (largest m-r bin)

m: 4.9
r: 13.44 km
ε_0: -1.3 σ
Contribution: 6.02 %

Mode (largest m-r-ε_0 bin)

m: 4.9
r: 30.91 km
ε_0: 0.24 σ
Contribution: 2.28 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)

ε5: [-0.5 .. 0.0)

ε6: [0.0 .. 0.5)

ε7: [0.5 .. 1.0)

ε8: [1.0 .. 1.5)

ε9: [1.5 .. 2.0)

ε10: [2.0 .. 2.5)

ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							28.98
PointSourceFinite: -97.922, 28.986		17.95	5.19	-1.06	97.922°W	28.986°N	0.00	2.42
PointSourceFinite: -97.922, 29.076		27.53	5.29	-0.40	97.922°W	29.076°N	0.00	2.39
PointSourceFinite: -97.922, 29.121		32.34	5.34	-0.18	97.922°W	29.121°N	0.00	2.32
PointSourceFinite: -97.922, 28.941		13.28	5.16	-1.58	97.922°W	28.941°N	0.00	2.17
PointSourceFinite: -97.922, 29.031		22.72	5.24	-0.69	97.922°W	29.031°N	0.00	1.77
PointSourceFinite: -97.922, 29.166		37.16	5.40	-0.00	97.922°W	29.166°N	0.00	1.74
PointSourceFinite: -97.922, 29.211		41.96	5.46	0.14	97.922°W	29.211°N	0.00	1.60
PointSourceFinite: -97.922, 29.256		46.75	5.53	0.26	97.922°W	29.256°N	0.00	1.33
PointSourceFinite: -97.922, 28.896		8.91	5.14	-2.25	97.922°W	28.896°N	0.00	1.23
PointSourceFinite: -97.922, 29.301		51.53	5.59	0.36	97.922°W	29.301°N	0.00	1.08
SSCn Fixed Smoothing Zone 2 (opt)	Grid							28.98
PointSourceFinite: -97.922, 28.986		17.95	5.19	-1.06	97.922°W	28.986°N	0.00	2.42
PointSourceFinite: -97.922, 29.076		27.53	5.29	-0.40	97.922°W	29.076°N	0.00	2.39
PointSourceFinite: -97.922, 29.121		32.34	5.34	-0.18	97.922°W	29.121°N	0.00	2.32
PointSourceFinite: -97.922, 28.941		13.28	5.16	-1.58	97.922°W	28.941°N	0.00	2.17
PointSourceFinite: -97.922, 29.031		22.72	5.24	-0.69	97.922°W	29.031°N	0.00	1.77
PointSourceFinite: -97.922, 29.166		37.16	5.40	-0.00	97.922°W	29.166°N	0.00	1.74
PointSourceFinite: -97.922, 29.211		41.96	5.46	0.14	97.922°W	29.211°N	0.00	1.60
PointSourceFinite: -97.922, 29.256		46.75	5.53	0.26	97.922°W	29.256°N	0.00	1.33
PointSourceFinite: -97.922, 28.896		8.91	5.14	-2.25	97.922°W	28.896°N	0.00	1.23
PointSourceFinite: -97.922, 29.301		51.53	5.59	0.36	97.922°W	29.301°N	0.00	1.08
USGS Adaptive Smoothing Zone 2 (opt)	Grid							18.68
PointSourceFinite: -97.922, 29.121		32.34	5.34	-0.18	97.922°W	29.121°N	0.00	1.61
PointSourceFinite: -97.922, 28.986		17.95	5.19	-1.06	97.922°W	28.986°N	0.00	1.58
PointSourceFinite: -97.922, 29.076		27.53	5.29	-0.40	97.922°W	29.076°N	0.00	1.54
PointSourceFinite: -97.922, 28.941		13.28	5.16	-1.58	97.922°W	28.941°N	0.00	1.52
PointSourceFinite: -97.922, 29.031		22.72	5.24	-0.69	97.922°W	29.031°N	0.00	1.25
PointSourceFinite: -97.922, 29.211		41.96	5.46	0.14	97.922°W	29.211°N	0.00	1.11
SSCn Adaptive Smoothing Zone 2 (opt)	Grid							18.68
PointSourceFinite: -97.922, 29.121		32.34	5.34	-0.18	97.922°W	29.121°N	0.00	1.61
PointSourceFinite: -97.922, 28.986		17.95	5.19	-1.06	97.922°W	28.986°N	0.00	1.58

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
PointSourceFinite: -97.922, 29.076		27.53	5.29	-0.40	97.922°W	29.076°N	0.00	1.54
PointSourceFinite: -97.922, 28.941		13.28	5.16	-1.58	97.922°W	28.941°N	0.00	1.52
PointSourceFinite: -97.922, 29.031		22.72	5.24	-0.69	97.922°W	29.031°N	0.00	1.25
PointSourceFinite: -97.922, 29.211		41.96	5.46	0.14	97.922°W	29.211°N	0.00	1.11
SSCn Adaptive Smoothing Zone 1 (opt)	Grid							1.18
USGS Adaptive Smoothing Zone 1 (opt)	Grid							1.18
SSCn Fixed Smoothing Zone 1 (opt)	Grid							1.12
USGS Fixed Smoothing Zone 1 (opt)	Grid							1.12

Appendix C Hammer Energy Calibration Report

Jesus E Garcia
Texas Geo Bore Drilling LLC
100 Little Elm Way
Hutto, TX 78634

October 23, 2020

Re: Energy Measurement for Dynamic Penetrometers
Texas Cone Penetrometer (TCP)
Hutto, TX

GRL Job No. 2055075-1

Dear Mr. Garcia:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for four of Texas Geo Bore Drilling LLC's drill rigs located in Hutto, Texas. Four automatic hammer systems were monitored during Texas Cone Penetrometer (TCP) tests. Calibration testing summarized in this report was conducted on October 17, 2020.

The purpose in collecting the TCP energy measurements was to compute the energy transfer efficiency for four drill rig hammers. To meet this objective, an 8G Model, Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

TEST SEQUENCE

Using an instrumented AW-J rod, energy measurements were made at various sample depths for the drill rigs. For the rigs identified by serial number (SN) 90024, 668-10 and 172555, dynamic measurements were obtained for sample depths ranging from 10.0 feet to 31.5 feet. For the rig identified by NO SN, dynamic measurements were obtained for sample depths ranging from 8.5 feet to 30.0. Each sample depth consisted of energy measurements taken across 18 inches of driving. The drill rigs are summarized below.

Table 1: Calibrated Rig

TCP Rig	Serial Number
MOBILE B57	90024
GARDENER DENVER 1000	668-10
CME 55	172555
MOBILE B57	NO SN

ENERGY TRANSFER MEASUREMENTS

An 8G model Pile Driving Analyzer was used to take measurements of strain and acceleration. The strain and acceleration signals were conditioned and converted to force and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were also digitally stored for subsequent analysis.

The maximum energy transferred to the rod (EMX) was calculated by integrating both the force and velocity records over time as follows:

$$EMX = \int F(t)V(t)dt$$

Where:

F(t) = the force at time *t*
V(t) = the velocity at time *t*

The energy transfer ratio or efficiency is computed by dividing EMX by the theoretical TCP hammer energy of 340 lb-ft (computed from the product of the hammer weight, assumed to be the standard 170 lbs, and the fall height, assumed to be 2.0 ft). The TCP N values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where:

e_m = the measured transfer ratio (ETR)
N_m = the measured TCP “N” value

CONCLUSIONS

The tables below present a summary of the average transferred energy and the energy transfer ratio for each drill rig at each sample depth calculated using the EMX equation. Included in the tables are also average values of the hammer operating rate, maximum impact force and maximum velocity of the rod. The overall performance, which represents the average of data from all sample depths for each rig/rod type is also shown. Complete information, including the maximum, minimum and standard deviation for each sampling depth, is included in Appendix B.

As indicated in the tables in Appendix B, the average energy transfer ratio (ETR) from individual sample depths are summarized below.

Table 2: TCP transfer efficiency ranges and hammer operating rate

TCP Rig (*Serial Number*)	Overall Transfer Efficiency Range	Average Overall Transfer Efficiency	Average Hammer Operating Rate
MOBILE B57 (SN 90024)	83.7 – 92.0%	88%	45
GARDENER DENVER 1000 (SN 668-10)	82.2 – 89.7%	86%	44
CME 55 (SN 172555)	89.7 – 101.8%	97%	46
MOBILE B57 (NO SN)	82.2 – 95.1%	89%	49

N_{60} values presented in Appendix B do not account for any required corrections such as overburden or rod length.

CONCLUDING REMARKS

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Respectfully,
GRL ENGINEERS, INC.

Brandon Phetteplace, P.E.
Senior Engineer
TBPE Registration No. F-11426

Appendix A

Introduction to SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \left[E_m / (0.6E_r)\right] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_{o}^{t} F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_{o}^{t} F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v\,/\,c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Appendix B
TCP Results

MOBILE B57 (SN 90024)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
13.83	**30-50-0**	10.00	11.50	**50**	**73**	28	11.8	32.9	284	340	83.7
18.83	**42-50-0**	15.00	16.50	**50**	**73**	33	11.0	43.7	287	340	84.5
24.83	**0-50-0**	20.00	21.50	**50**	**73**	35	12.4	46.9	307	340	90.4
28.83	**3-50-0**	25.00	26.50	**50**	**73**	34	13.4	46.8	306	340	90.1
33.83	**3-50-0**	30.00	31.50	**50**	**73**	37	13.3	52.4	313	340	92.0
					Overall Average Values:	34	12.4	44.6	300	340	88.1
					Standard Deviation:	3	1.0	7.3	13	0	3.9
					Overall Maximum Value:	39	14.0	52.9	322	340	94.8
					Overall Minimum Value:	25	10.3	1.9	252	340	74.0

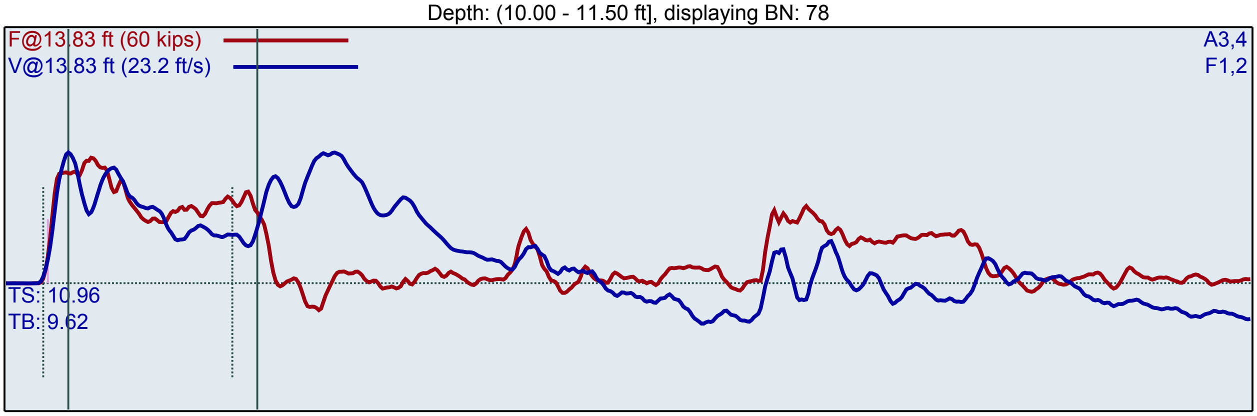
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 13.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 78



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	30	10.02	31	13.5	1.9	289	340	85.1
2	30	10.03	32	13.3	29.8	314	340	92.3
3	30	10.05	31	12.8	29.0	280	340	82.3
4	30	10.07	31	12.4	29.9	273	340	80.3
5	30	10.08	31	12.4	30.1	262	340	77.2
6	30	10.10	31	12.6	30.8	270	340	79.3
7	30	10.12	31	13.0	33.0	280	340	82.3
8	30	10.13	31	13.1	33.0	302	340	88.8
9	30	10.15	31	13.7	33.0	273	340	80.2
10	30	10.17	31	13.1	32.4	274	340	80.7
11	30	10.18	32	13.0	33.1	288	340	84.8
12	30	10.20	30	12.8	33.0	290	340	85.2
13	30	10.22	30	13.0	33.1	289	340	84.9
14	30	10.23	31	13.1	32.7	288	340	84.8
15	30	10.25	31	13.2	33.0	300	340	88.2
16	30	10.27	29	12.9	33.0	294	340	86.5
17	30	10.28	29	12.5	33.0	323	340	94.9
18	30	10.30	29	12.5	32.9	297	340	87.5
19	30	10.32	29	12.5	32.8	294	340	86.4
20	30	10.33	29	12.6	32.9	299	340	88.1
21	30	10.35	31	13.2	32.1	273	340	80.4
22	30	10.37	31	12.9	33.0	286	340	84.2
23	30	10.38	31	12.9	33.0	296	340	87.1
24	30	10.40	30	12.3	33.0	299	340	88.0
25	30	10.42	29	12.3	33.0	302	340	88.9
26	30	10.43	29	12.6	33.0	303	340	89.1
27	30	10.45	32	12.8	32.4	278	340	81.7
28	30	10.47	31	12.4	33.0	286	340	84.1

29	30	10.48	31	12.3	33.0	288	340	84.7
30	30	10.50	29	12.5	32.9	297	340	87.2
31	50	10.51	29	12.5	32.9	294	340	86.5
32	50	10.52	28	12.3	32.7	290	340	85.4
33	50	10.53	30	12.5	32.9	283	340	83.2
34	50	10.54	30	12.2	32.4	283	340	83.2
35	50	10.55	30	12.6	33.0	294	340	86.4
36	50	10.56	29	12.1	33.0	289	340	85.0
37	50	10.57	28	12.2	33.0	297	340	87.3
38	50	10.58	30	12.2	32.5	280	340	82.4
39	50	10.59	30	12.1	32.9	290	340	85.2
40	50	10.60	30	12.3	32.9	298	340	87.6
41	50	10.61	28	11.8	33.0	286	340	84.1
42	50	10.62	27	11.4	33.0	278	340	81.7
43	50	10.63	29	11.9	32.5	272	340	79.9
44	50	10.64	29	11.9	33.0	284	340	83.6
45	50	10.65	30	12.0	33.0	294	340	86.5
46	50	10.66	27	11.2	33.1	284	340	83.5
47	50	10.67	30	12.2	33.0	296	340	87.1
48	50	10.68	29	12.0	32.5	281	340	82.8
49	50	10.69	29	11.7	33.1	290	340	85.2
50	50	10.70	29	11.8	33.0	295	340	86.8
51	50	10.71	30	12.2	32.9	303	340	89.3
52	50	10.72	27	11.4	33.0	291	340	85.6
53	50	10.73	29	11.9	32.6	274	340	80.7
54	50	10.74	28	11.8	33.2	282	340	82.8
55	50	10.75	29	11.8	33.1	294	340	86.4
56	50	10.76	28	11.7	33.1	277	340	81.4
57	50	10.77	25	11.2	33.0	288	340	84.7
58	50	10.78	29	11.4	32.4	256	340	75.4
59	50	10.79	28	11.7	33.1	277	340	81.5
60	50	10.80	28	11.7	33.0	290	340	85.3
61	50	10.81	30	12.0	33.0	303	340	89.0
62	50	10.82	25	10.6	32.9	279	340	82.1
63	50	10.83	27	11.3	32.6	252	340	74.0
64	50	10.84	28	11.8	33.0	283	340	83.2
65	50	10.85	28	11.6	33.0	278	340	81.9
66	50	10.86	30	12.0	33.0	290	340	85.2
67	50	10.87	25	10.5	33.0	281	340	82.6
68	50	10.88	26	10.7	33.0	280	340	82.4
69	50	10.89	28	11.7	33.0	280	340	82.3
70	50	10.90	30	11.8	32.7	275	340	81.0
71	50	10.91	29	12.1	32.9	275	340	80.9
72	50	10.92	27	11.5	33.0	289	340	84.9
73	50	10.93	26	11.2	33.0	287	340	84.4
74	50	10.94	26	11.2	32.9	292	340	85.9
75	50	10.95	30	11.9	32.3	269	340	79.1
76	50	10.96	29	11.9	32.9	281	340	82.8
77	50	10.97	29	11.6	32.9	271	340	79.7
78	50	10.98	29	11.8	32.9	282	340	82.9
79	50	10.99	29	12.1	32.8	297	340	87.3
80	50	11.00	27	11.5	32.9	290	340	85.3
		Average	28	11.8	32.9	284	340	83.7
		Std Dev	1	0.5	0.2	10	0	3.0
		Maximum	30	12.6	33.2	303	340	89.3
		Minimum	25	10.5	32.3	252	340	74.0

N-value: 50

Sample Interval Time: 145.02 seconds.

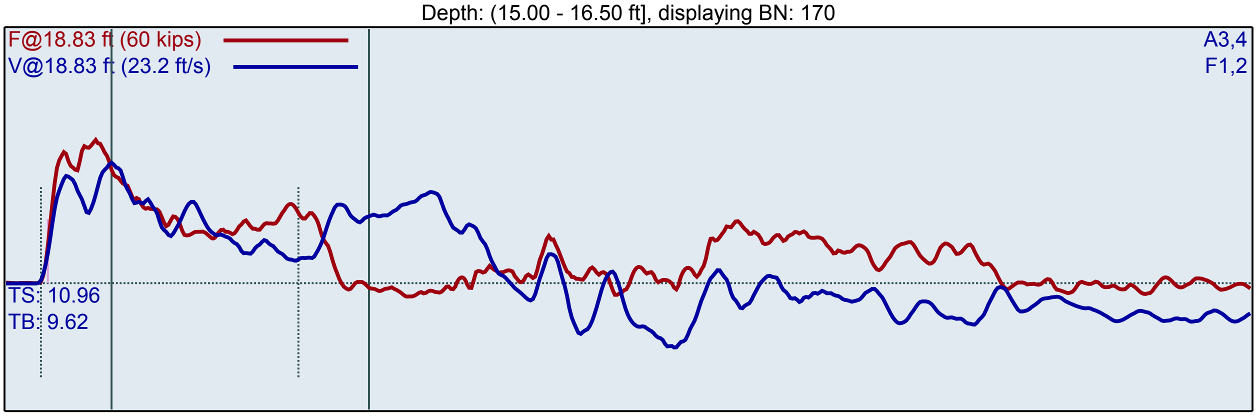
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 18.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 170



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
81	42	15.01	34	14.2	1.9	290	340	85.3
82	42	15.02	34	13.8	37.8	298	340	87.5
83	42	15.04	34	12.9	43.5	299	340	88.0
84	42	15.05	35	12.7	43.7	302	340	88.7
85	42	15.06	34	12.5	43.4	298	340	87.6
86	42	15.07	35	12.8	44.7	300	340	88.2
87	42	15.08	35	12.7	45.7	300	340	88.1
88	42	15.10	35	13.0	45.8	297	340	87.4
89	42	15.11	34	12.7	45.4	297	340	87.3
90	42	15.12	35	12.5	45.2	296	340	87.1
91	42	15.13	34	12.6	44.9	294	340	86.4
92	42	15.14	34	12.7	45.0	297	340	87.3
93	42	15.15	34	12.6	44.6	298	340	87.7
94	42	15.17	33	12.4	44.6	293	340	86.3
95	42	15.18	33	12.3	44.3	294	340	86.4
96	42	15.19	33	12.1	44.1	289	340	85.0
97	42	15.20	32	12.0	44.1	292	340	86.0
98	42	15.21	32	11.9	43.8	289	340	85.1
99	42	15.23	32	11.9	43.6	294	340	86.4
100	42	15.24	32	12.0	43.5	292	340	85.8
101	42	15.25	32	11.6	43.1	288	340	84.7
102	42	15.26	31	11.6	42.9	283	340	83.2
103	42	15.27	32	12.1	42.7	293	340	86.0
104	42	15.29	32	12.0	42.7	290	340	85.3
105	42	15.30	32	12.1	43.6	291	340	85.7
106	42	15.31	32	11.9	45.8	293	340	86.1
107	42	15.32	32	11.9	46.6	293	340	86.1
108	42	15.33	32	11.7	46.5	295	340	86.9
109	42	15.35	33	11.9	46.6	301	340	88.4
110	42	15.36	33	12.1	46.3	301	340	88.4
111	42	15.37	33	12.1	46.1	301	340	88.5

112	42	15.38	33	12.0	46.1	299	340	87.8
113	42	15.39	33	11.7	45.9	301	340	88.6
114	42	15.40	32	11.4	45.8	293	340	86.0
115	42	15.42	33	11.7	45.8	299	340	87.9
116	42	15.43	33	11.7	45.6	297	340	87.2
117	42	15.44	33	11.7	45.6	299	340	87.8
118	42	15.45	33	11.8	45.5	298	340	87.5
119	42	15.46	33	11.8	45.4	297	340	87.2
120	42	15.48	33	11.8	45.4	300	340	88.1
121	42	15.49	33	11.9	45.2	297	340	87.4
122	42	15.50	33	12.0	45.0	299	340	88.1
123	50	15.51	33	11.9	45.0	303	340	89.0
124	50	15.52	33	11.8	45.1	295	340	86.9
125	50	15.53	33	11.8	44.8	295	340	86.8
126	50	15.54	33	11.7	44.7	295	340	86.8
127	50	15.55	33	11.8	44.7	297	340	87.5
128	50	15.56	33	11.7	44.6	297	340	87.3
129	50	15.57	33	11.4	44.5	292	340	86.0
130	50	15.58	33	11.1	44.5	292	340	85.9
131	50	15.59	33	10.9	44.2	292	340	85.9
132	50	15.60	33	10.7	44.4	282	340	82.9
133	50	15.61	33	10.5	44.1	283	340	83.3
134	50	15.62	33	10.3	43.9	283	340	83.4
135	50	15.63	33	10.7	43.8	287	340	84.5
136	50	15.64	33	10.5	43.9	292	340	85.8
137	50	15.65	33	10.6	43.8	289	340	85.0
138	50	15.66	34	10.8	43.6	294	340	86.4
139	50	15.67	33	10.7	43.6	291	340	85.5
140	50	15.68	33	10.7	43.6	286	340	84.2
141	50	15.69	33	10.6	43.5	282	340	83.0
142	50	15.70	33	11.1	43.5	287	340	84.5
143	50	15.71	33	11.0	43.4	284	340	83.5
144	50	15.72	33	11.1	43.1	286	340	84.1
145	50	15.73	33	11.1	43.0	287	340	84.4
146	50	15.74	32	11.1	43.3	284	340	83.6
147	50	15.75	33	11.0	43.3	285	340	83.7
148	50	15.76	32	10.9	43.3	280	340	82.5
149	50	15.77	33	11.1	43.1	285	340	83.9
150	50	15.78	33	11.1	43.1	284	340	83.6
151	50	15.79	32	11.0	43.2	284	340	83.4
152	50	15.80	33	11.0	43.0	287	340	84.4
153	50	15.81	34	10.9	42.8	288	340	84.8
154	50	15.82	33	10.9	42.7	283	340	83.3
155	50	15.83	33	10.9	42.6	282	340	82.9
156	50	15.84	33	10.7	42.5	283	340	83.2
157	50	15.85	33	10.8	42.5	283	340	83.4
158	50	15.86	33	10.9	42.5	284	340	83.5
159	50	15.87	33	10.6	42.3	283	340	83.1
160	50	15.88	33	10.9	42.1	284	340	83.6
161	50	15.89	32	11.2	41.9	283	340	83.2
162	50	15.90	32	11.0	41.8	281	340	82.6
163	50	15.91	32	11.2	41.7	281	340	82.6
164	50	15.92	32	11.1	41.7	284	340	83.7
165	50	15.93	33	11.1	44.1	290	340	85.2
166	50	15.94	33	11.1	45.4	286	340	84.0
167	50	15.95	33	11.1	45.5	289	340	85.1
168	50	15.96	33	11.2	45.7	290	340	85.2
169	50	15.97	33	10.9	45.5	289	340	85.0
170	50	15.98	34	10.9	45.9	287	340	84.4
171	50	15.99	33	10.9	45.7	286	340	84.1
172	50	16.00	33	11.0	45.8	290	340	85.3

Average	33	11.0	43.7	287	340	84.5
Std Dev	0	0.4	1.1	5	0	1.5
Maximum	34	11.9	45.9	303	340	89.0
Minimum	32	10.3	41.7	280	340	82.5

N-value: 50

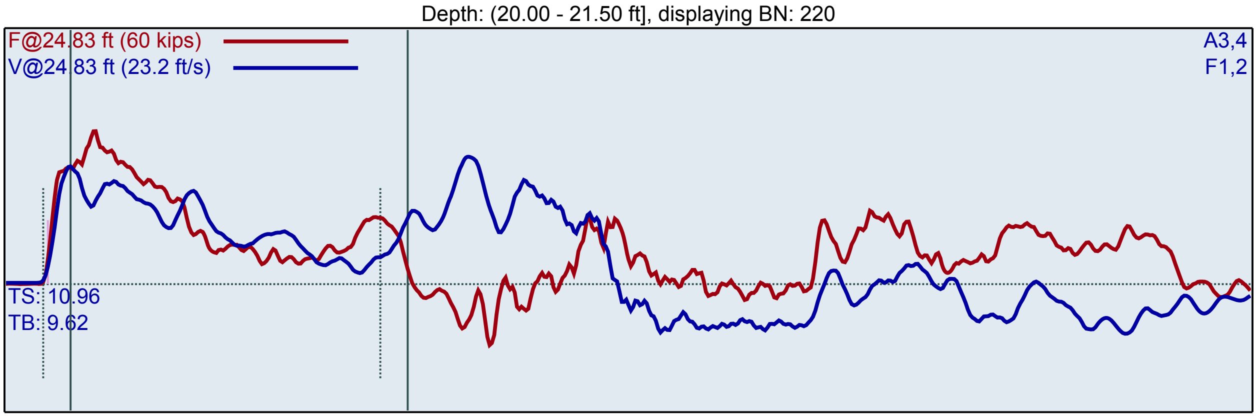
Sample Interval Time: 123.80 seconds.

Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 24.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
173	50	20.51	33	13.3	1.9	287	340	84.3
174	50	20.52	34	12.3	34.0	288	340	84.8
175	50	20.53	34	11.9	34.8	297	340	87.3
176	50	20.54	35	12.2	39.5	310	340	91.2
177	50	20.55	35	12.0	45.7	307	340	90.4
178	50	20.56	35	11.9	46.0	302	340	88.7
179	50	20.57	35	11.9	46.3	301	340	88.4
180	50	20.58	35	11.9	48.7	304	340	89.5
181	50	20.59	36	12.1	48.7	316	340	92.9
182	50	20.60	35	12.1	49.0	303	340	89.2
183	50	20.61	36	11.9	48.9	301	340	88.7
184	50	20.62	35	12.4	49.1	309	340	90.8
185	50	20.63	35	12.7	48.8	317	340	93.3
186	50	20.64	35	12.7	48.8	310	340	91.3
187	50	20.65	35	12.6	49.0	309	340	90.9
188	50	20.66	35	12.8	49.0	315	340	92.7
189	50	20.67	35	12.7	49.0	310	340	91.0
190	50	20.68	35	12.8	49.0	311	340	91.4
191	50	20.69	35	13.0	48.8	315	340	92.6
192	50	20.70	35	13.0	48.9	313	340	92.0
193	50	20.71	36	13.1	49.0	312	340	91.8
194	50	20.72	36	13.2	48.8	314	340	92.3
195	50	20.73	36	13.2	48.9	311	340	91.5
196	50	20.74	36	13.2	48.8	314	340	92.4
197	50	20.75	36	13.2	49.0	314	340	92.3
198	50	20.76	36	13.1	48.6	308	340	90.7
199	50	20.77	36	13.0	48.9	305	340	89.8
200	50	20.78	36	13.0	48.6	310	340	91.1
201	50	20.79	37	12.9	48.9	309	340	90.7
202	50	20.80	36	12.9	48.7	307	340	90.4
203	50	20.81	36	13.0	48.6	313	340	91.9

204	50	20.82	37	13.0	48.8	312	340	91.9
205	50	20.83	36	12.8	48.9	310	340	91.3
206	50	20.84	36	12.7	48.7	312	340	91.8
207	50	20.85	36	12.8	48.7	312	340	91.7
208	50	20.86	36	12.5	48.6	311	340	91.3
209	50	20.87	35	12.4	48.7	309	340	90.8
210	50	20.88	36	12.2	48.8	310	340	91.2
211	50	20.89	35	12.1	48.7	303	340	89.0
212	50	20.90	35	12.2	48.8	304	340	89.5
213	50	20.91	35	12.1	48.8	304	340	89.4
214	50	20.92	36	11.9	48.8	304	340	89.4
215	50	20.93	36	11.9	48.8	302	340	88.9
216	50	20.94	34	11.5	48.6	294	340	86.5
217	50	20.95	35	11.7	48.9	312	340	91.9
218	50	20.96	35	11.6	48.7	303	340	89.2
219	50	20.97	35	11.5	48.7	302	340	88.8
220	50	20.98	36	11.5	48.7	315	340	92.5
221	50	20.99	36	11.1	48.5	306	340	90.1
222	50	21.00	36	11.1	48.9	305	340	89.8
		Average	35	12.4	46.9	307	340	90.4
		Std Dev	1	0.6	7.1	6	0	1.9
		Maximum	37	13.3	49.1	317	340	93.3
		Minimum	33	11.1	1.9	287	340	84.3

N-value: 50

Sample Interval Time: 61.80 seconds.

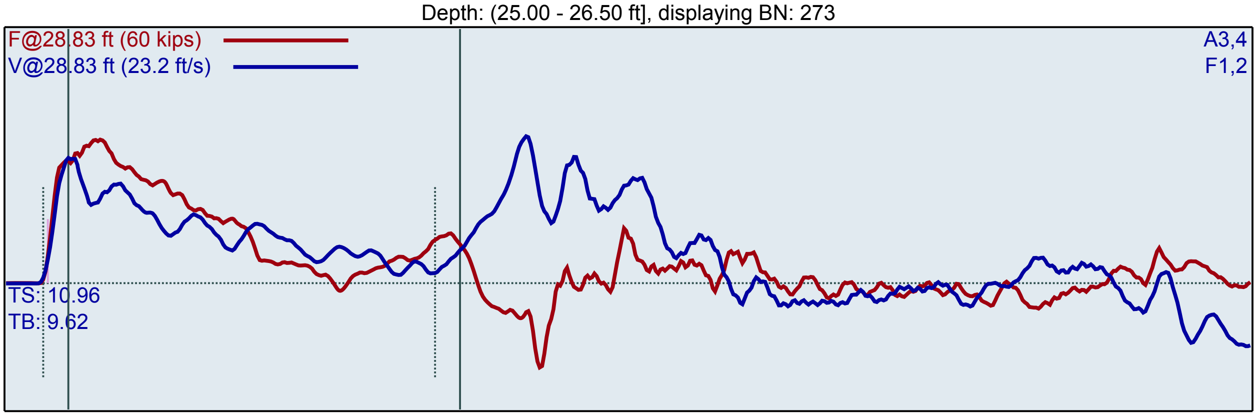
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 28.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 273



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
223	3	25.17	33	13.5	1.9	282	340	82.9
224	3	25.33	33	13.5	33.8	288	340	84.7
225	3	25.50	33	13.4	38.6	289	340	85.0
226	50	25.51	32	13.3	38.8	288	340	84.7
227	50	25.52	32	13.2	39.0	279	340	82.0
228	50	25.53	33	13.4	38.8	286	340	84.2
229	50	25.54	33	13.7	41.5	299	340	87.8
230	50	25.55	33	13.6	46.7	296	340	86.9
231	50	25.56	33	13.7	47.2	302	340	88.9
232	50	25.57	34	13.7	47.4	305	340	89.6
233	50	25.58	34	13.7	47.3	303	340	89.1
234	50	25.59	34	13.6	47.8	302	340	88.7
235	50	25.60	34	13.5	47.6	309	340	90.8
236	50	25.61	33	13.4	47.5	301	340	88.6
237	50	25.62	34	13.6	47.8	308	340	90.6
238	50	25.63	34	13.6	47.5	310	340	91.1
239	50	25.64	34	13.6	47.3	309	340	90.8
240	50	25.65	34	13.6	47.6	310	340	91.3
241	50	25.66	35	13.7	47.5	313	340	92.0
242	50	25.67	34	13.5	47.5	303	340	89.1
243	50	25.68	35	13.7	47.5	312	340	91.8
244	50	25.69	34	13.4	47.4	302	340	88.7
245	50	25.70	34	13.4	47.4	303	340	89.1
246	50	25.71	34	13.5	47.7	308	340	90.5
247	50	25.72	35	13.5	47.5	310	340	91.3
248	50	25.73	34	13.5	47.4	308	340	90.6
249	50	25.74	34	13.5	47.5	308	340	90.5
250	50	25.75	34	13.5	47.6	308	340	90.6
251	50	25.76	34	13.3	47.4	303	340	89.1
252	50	25.77	34	13.5	47.4	307	340	90.4
253	50	25.78	34	13.3	47.4	303	340	89.1

254	50	25.79	34	13.4	47.6	308	340	90.5
255	50	25.80	34	13.4	47.4	309	340	91.0
256	50	25.81	34	13.3	47.4	303	340	89.0
257	50	25.82	34	13.4	47.4	306	340	89.9
258	50	25.83	34	13.5	47.7	312	340	91.8
259	50	25.84	35	13.5	47.5	309	340	91.0
260	50	25.85	34	13.4	47.4	305	340	89.6
261	50	25.86	34	13.4	47.5	311	340	91.4
262	50	25.87	34	13.3	47.5	309	340	90.8
263	50	25.88	33	13.2	47.4	310	340	91.3
264	50	25.89	33	13.1	47.6	308	340	90.6
265	50	25.90	33	13.1	47.4	306	340	90.1
266	50	25.91	33	13.3	47.2	312	340	91.8
267	50	25.92	32	13.3	47.3	307	340	90.4
268	50	25.93	33	13.2	47.5	314	340	92.4
269	50	25.94	34	13.3	47.4	316	340	93.1
270	50	25.95	33	13.3	47.4	317	340	93.4
271	50	25.96	33	13.2	47.4	311	340	91.5
272	50	25.97	33	13.2	47.5	309	340	91.0
273	50	25.98	34	13.3	47.4	311	340	91.5
274	50	25.99	34	13.2	47.4	312	340	91.7
275	50	26.00	33	13.3	47.5	313	340	92.1
		Average	34	13.4	46.8	306	340	90.1
		Std Dev	1	0.2	2.2	7	0	2.1
		Maximum	35	13.7	47.8	317	340	93.4
		Minimum	32	13.1	38.8	279	340	82.0

N-value: 50

Sample Interval Time: 67.60 seconds.

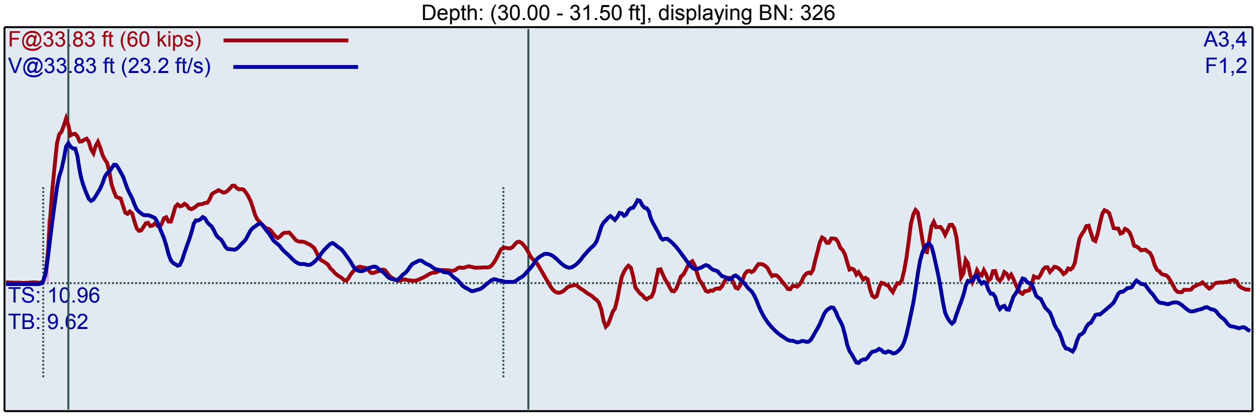
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 33.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (30.00 - 31.50 ft], displaying BN: 326



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
277	3	30.33	36	13.4	46.3	325	340	95.7
278	3	30.50	36	13.3	47.3	324	340	95.4
279	50	30.51	36	13.3	48.5	301	340	88.6
280	50	30.52	37	13.4	51.5	314	340	92.2
281	50	30.53	37	13.1	52.1	315	340	92.6
282	50	30.54	37	13.4	52.4	312	340	91.8
283	50	30.55	36	13.3	52.5	311	340	91.6
284	50	30.56	37	13.3	52.4	311	340	91.4
285	50	30.57	37	13.1	52.5	300	340	88.4
286	50	30.58	37	13.5	52.4	317	340	93.3
287	50	30.59	37	13.2	52.4	305	340	89.7
288	50	30.60	37	13.4	52.6	311	340	91.4
289	50	30.61	37	13.4	52.7	320	340	94.1
290	50	30.62	37	13.2	52.4	313	340	92.0
291	50	30.63	37	13.4	52.6	310	340	91.2
292	50	30.64	38	13.4	52.7	317	340	93.3
293	50	30.65	38	13.2	52.3	307	340	90.3
294	50	30.66	38	13.1	52.8	307	340	90.3
295	50	30.67	37	13.3	52.4	310	340	91.2
296	50	30.68	38	13.3	52.7	313	340	92.1
297	50	30.69	38	13.1	52.4	308	340	90.6
298	50	30.70	38	13.3	52.6	315	340	92.5
299	50	30.71	38	13.3	52.5	316	340	92.8
300	50	30.72	38	13.3	52.2	311	340	91.6
301	50	30.73	37	13.4	52.6	315	340	92.8
302	50	30.74	37	13.4	52.7	311	340	91.4
303	50	30.75	38	13.3	52.4	310	340	91.3
304	50	30.76	38	13.4	52.8	318	340	93.5
305	50	30.77	37	13.4	52.5	315	340	92.7
306	50	30.78	37	13.6	52.4	316	340	92.9
307	50	30.79	37	13.5	52.4	322	340	94.8

308	50	30.80	37	13.6	52.7	319	340	93.8
309	50	30.81	36	13.6	52.6	311	340	91.3
310	50	30.82	36	13.7	52.6	320	340	94.0
311	50	30.83	37	13.1	52.3	310	340	91.1
312	50	30.84	38	13.1	52.6	309	340	90.7
313	50	30.85	38	13.2	52.5	316	340	92.9
314	50	30.86	38	12.9	52.3	316	340	92.9
315	50	30.87	37	13.3	52.5	310	340	91.3
316	50	30.88	37	13.5	52.4	310	340	91.2
317	50	30.89	36	13.7	52.3	314	340	92.2
318	50	30.90	36	13.8	52.1	311	340	91.6
319	50	30.91	36	14.0	52.6	315	340	92.6
320	50	30.92	37	13.5	52.6	313	340	92.1
321	50	30.93	37	13.8	52.8	315	340	92.6
322	50	30.94	38	13.3	52.2	318	340	93.6
323	50	30.95	38	12.9	52.7	319	340	93.7
324	50	30.96	38	12.8	52.7	309	340	91.0
325	50	30.97	39	12.9	52.4	313	340	92.1
326	50	30.98	39	12.7	52.2	310	340	91.3
327	50	30.99	38	12.8	52.9	310	340	91.3
328	50	31.00	39	13.0	52.4	316	340	92.9
		Average	37	13.3	52.4	313	340	92.0
		Std Dev	1	0.3	0.6	4	0	1.3
		Maximum	39	14.0	52.9	322	340	94.8
		Minimum	36	12.7	48.5	300	340	88.4

N-value: 50

Sample Interval Time: 58.55 seconds.

GARDENER DENVER 1000 (SN 668-10)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
17.50	**25-50-0**	10.00	11.50	**50**	**72**	51	13.2	40.0	279	340	82.2
22.50	**11-50-0**	15.00	16.50	**50**	**72**	50	12.4	40.2	280	340	82.3
27.50	**2-50-0**	20.00	21.50	**50**	**72**	50	12.8	43.9	304	340	89.5
32.50	**3-50-0**	25.00	26.50	**50**	**72**	51	12.8	47.6	303	340	89.0
37.50	**2-50-0**	30.00	31.50	**50**	**72**	52	12.7	50.3	305	340	89.7
					Overall Average Values:	51	12.8	44.4	294	340	86.5
					Standard Deviation:	1	0.4	6.3	14	0	4.3
					Overall Maximum Value:	55	13.6	56.7	324	340	95.3
					Overall Minimum Value:	47	11.6	21.9	265	340	77.8

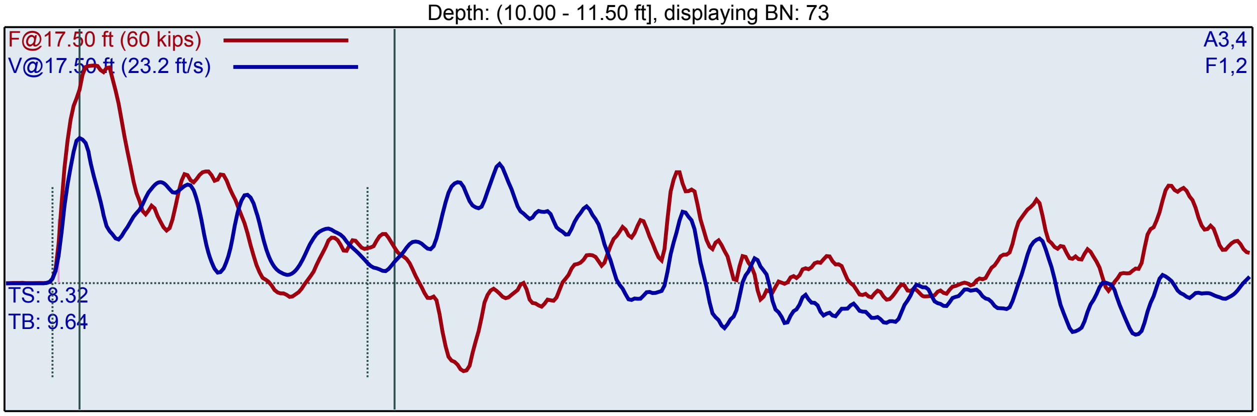
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 17.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 73



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	25	10.02	41	10.8	1.9	232	340	68.4
2	25	10.04	45	12.3	21.9	250	340	73.4
3	25	10.06	46	12.2	22.3	253	340	74.4
4	25	10.08	47	12.6	22.9	258	340	76.0
5	25	10.10	47	12.5	27.4	261	340	76.8
6	25	10.12	47	12.4	31.2	256	340	75.3
7	25	10.14	48	12.9	33.0	262	340	77.1
8	25	10.16	48	12.9	34.2	265	340	77.9
9	25	10.18	48	12.7	32.0	261	340	76.7
10	25	10.20	48	12.5	29.9	258	340	76.0
11	25	10.22	49	12.8	34.8	265	340	78.0
12	25	10.24	49	12.6	39.8	264	340	77.5
13	25	10.26	49	12.6	35.8	262	340	77.1
14	25	10.28	48	12.5	30.6	258	340	75.9
15	25	10.30	49	12.7	31.8	266	340	78.2
16	25	10.32	49	12.4	39.6	269	340	79.1
17	25	10.34	50	12.8	41.8	277	340	81.5
18	25	10.36	49	12.6	41.6	273	340	80.4
19	25	10.38	50	13.1	38.6	275	340	80.8
20	25	10.40	50	13.0	35.6	274	340	80.6
21	25	10.42	51	13.2	39.0	282	340	82.9
22	25	10.44	51	13.1	43.4	281	340	82.5
23	25	10.46	52	13.2	43.7	283	340	83.2
24	25	10.48	51	13.2	42.6	279	340	82.2
25	25	10.50	51	13.1	41.7	279	340	82.1
26	50	10.51	52	13.2	40.7	282	340	82.8
27	50	10.52	51	13.2	39.7	282	340	82.8
28	50	10.53	51	13.1	39.0	278	340	81.9

29	50	10.54	52	13.1	38.4	283	340	83.2
30	50	10.55	51	13.2	37.1	278	340	81.9
31	50	10.56	51	13.2	36.2	276	340	81.3
32	50	10.57	51	13.2	36.0	278	340	81.8
33	50	10.58	51	13.2	36.4	279	340	82.0
34	50	10.59	51	13.3	37.5	282	340	83.1
35	50	10.60	51	13.2	37.7	279	340	82.2
36	50	10.61	51	13.3	37.4	281	340	82.6
37	50	10.62	51	13.3	37.2	286	340	84.1
38	50	10.63	50	13.2	36.7	279	340	81.9
39	50	10.64	51	13.1	36.5	275	340	80.8
40	50	10.65	51	13.2	36.9	276	340	81.2
41	50	10.66	50	13.2	36.7	277	340	81.4
42	50	10.67	50	12.9	35.8	276	340	81.1
43	50	10.68	50	13.1	35.1	271	340	79.8
44	50	10.69	50	12.9	34.4	266	340	78.2
45	50	10.70	50	13.0	33.0	268	340	78.8
46	50	10.71	51	13.0	32.9	270	340	79.5
47	50	10.72	51	13.2	37.6	278	340	81.8
48	50	10.73	50	13.3	38.7	271	340	79.8
49	50	10.74	50	12.9	36.0	267	340	78.5
50	50	10.75	50	12.9	32.1	265	340	77.8
51	50	10.76	51	13.1	34.9	275	340	80.9
52	50	10.77	51	13.1	43.4	279	340	82.0
53	50	10.78	51	13.1	46.0	279	340	82.0
54	50	10.79	51	13.1	46.3	280	340	82.5
55	50	10.80	52	13.2	46.1	282	340	83.0
56	50	10.81	52	13.3	45.5	280	340	82.5
57	50	10.82	51	13.2	44.9	278	340	81.6
58	50	10.83	51	13.2	44.3	282	340	82.9
59	50	10.84	51	13.3	44.0	285	340	83.9
60	50	10.85	51	13.2	44.1	284	340	83.5
61	50	10.86	51	13.3	43.9	282	340	83.1
62	50	10.87	51	13.3	44.1	286	340	84.2
63	50	10.88	51	13.3	44.0	284	340	83.4
64	50	10.89	51	13.3	44.0	283	340	83.2
65	50	10.90	51	13.2	43.6	286	340	84.0
66	50	10.91	51	13.3	43.4	286	340	84.1
67	50	10.92	51	13.2	43.4	285	340	83.7
68	50	10.93	51	13.1	43.0	284	340	83.6
69	50	10.94	51	13.0	42.9	282	340	83.0
70	50	10.95	51	13.2	42.6	287	340	84.4
71	50	10.96	51	13.1	42.5	283	340	83.1
72	50	10.97	51	13.1	41.9	285	340	83.7
73	50	10.98	51	13.1	41.6	283	340	83.1
74	50	10.99	51	13.1	41.5	283	340	83.2
75	50	11.00	51	13.2	41.7	282	340	83.0
		Average	51	13.2	40.0	279	340	82.2
		Std Dev	1	0.1	4.0	5	0	1.6
		Maximum	52	13.3	46.3	287	340	84.4
		Minimum	50	12.9	32.1	265	340	77.8

N-value: 50

Sample Interval Time: 118.96 seconds.

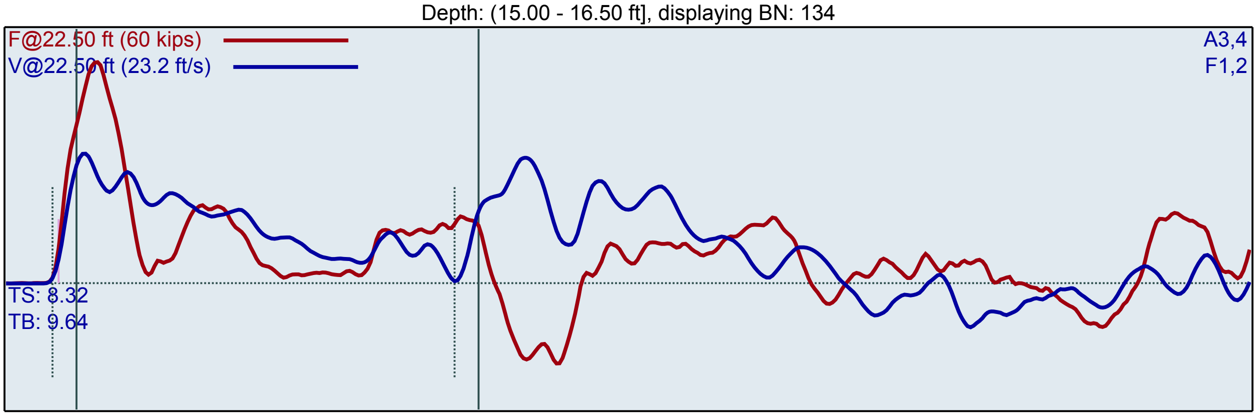
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 22.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 134



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
77	11	15.09	42	11.8	5.5	239	340	70.4
78	11	15.14	45	12.7	19.7	256	340	75.3
79	11	15.18	45	12.9	19.8	256	340	75.3
80	11	15.23	46	13.0	20.0	257	340	75.7
81	11	15.27	46	12.9	20.7	259	340	76.1
82	11	15.32	46	12.7	21.6	256	340	75.2
83	11	15.36	47	12.9	22.9	260	340	76.5
84	11	15.41	47	12.4	28.1	263	340	77.2
85	11	15.45	47	12.5	35.1	264	340	77.5
86	11	15.50	47	12.3	29.8	258	340	75.8
87	50	15.51	48	12.4	34.5	270	340	79.3
88	50	15.52	48	12.6	43.3	277	340	81.4
89	50	15.53	48	12.5	45.5	274	340	80.5
90	50	15.54	47	12.2	41.4	266	340	78.1
91	50	15.55	47	12.4	35.2	268	340	78.7
92	50	15.56	49	12.9	38.9	294	340	86.5
93	50	15.57	48	12.5	43.1	276	340	81.1
94	50	15.58	48	12.8	44.2	276	340	81.3
95	50	15.59	48	13.1	43.4	277	340	81.5
96	50	15.60	49	13.1	42.5	277	340	81.4
97	50	15.61	48	12.9	42.4	277	340	81.4
98	50	15.62	49	13.0	42.6	278	340	81.7
99	50	15.63	49	12.9	42.6	279	340	82.0
100	50	15.64	49	13.0	42.2	277	340	81.4
101	50	15.65	49	13.0	42.2	279	340	82.1
102	50	15.66	49	12.8	42.0	276	340	81.1
103	50	15.67	49	13.1	41.9	277	340	81.3
104	50	15.68	49	13.2	42.0	279	340	82.1
105	50	15.69	49	13.2	42.1	276	340	81.1
106	50	15.70	49	13.2	42.4	275	340	80.9
107	50	15.71	49	13.0	42.6	277	340	81.4

108	50	15.72	49	13.1	42.2	283	340	83.1
109	50	15.73	50	13.0	42.5	281	340	82.8
110	50	15.74	49	13.0	42.2	280	340	82.4
111	50	15.75	50	12.8	41.4	279	340	82.0
112	50	15.76	50	12.8	41.4	279	340	82.1
113	50	15.77	50	12.7	41.6	282	340	82.9
114	50	15.78	51	12.7	41.5	285	340	83.7
115	50	15.79	51	12.6	41.7	283	340	83.3
116	50	15.80	51	12.4	41.4	277	340	81.4
117	50	15.81	51	12.3	40.5	280	340	82.3
118	50	15.82	52	12.3	39.3	279	340	82.1
119	50	15.83	52	12.0	38.2	280	340	82.3
120	50	15.84	52	11.9	37.7	279	340	82.1
121	50	15.85	52	12.0	38.0	278	340	81.8
122	50	15.86	53	12.1	39.7	285	340	83.9
123	50	15.87	52	12.0	40.2	277	340	81.5
124	50	15.88	52	11.6	39.1	278	340	81.8
125	50	15.89	52	11.9	37.0	281	340	82.7
126	50	15.90	52	11.6	36.4	271	340	79.8
127	50	15.91	52	11.9	38.4	291	340	85.5
128	50	15.92	52	11.6	40.4	283	340	83.1
129	50	15.93	51	11.6	35.9	280	340	82.4
130	50	15.94	52	11.8	31.7	287	340	84.4
131	50	15.95	53	11.8	37.8	296	340	87.0
132	50	15.96	53	11.8	44.2	294	340	86.5
133	50	15.97	52	11.6	41.2	286	340	84.1
134	50	15.98	52	11.7	31.4	279	340	82.0
135	50	15.99	52	11.8	33.4	290	340	85.2
136	50	16.00	52	11.6	36.2	287	340	84.3
		Average	50	12.4	40.2	280	340	82.3
		Std Dev	2	0.5	3.2	6	0	1.8
		Maximum	53	13.2	45.5	296	340	87.0
		Minimum	47	11.6	31.4	266	340	78.1

N-value: 50

Sample Interval Time: 98.41 seconds.

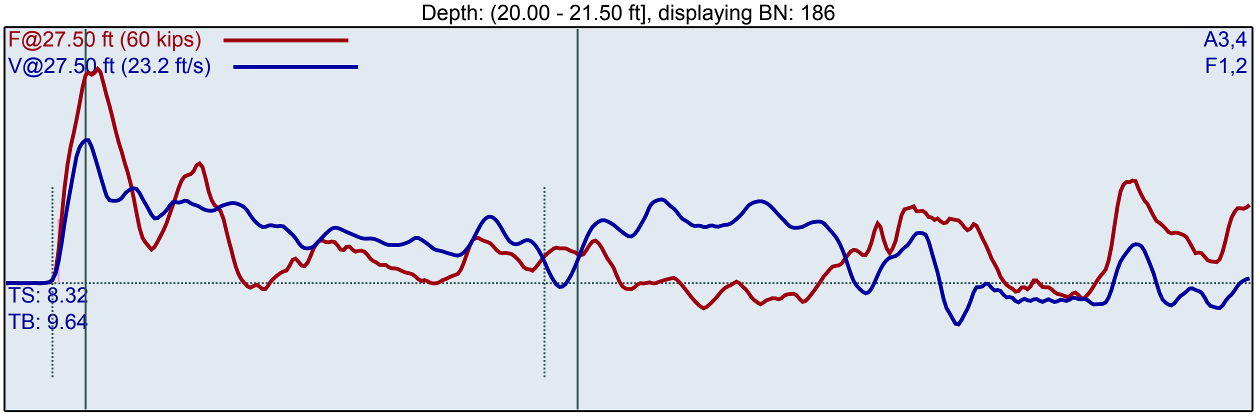
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 27.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (20.00 - 21.50 ft], displaying BN: 186



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
137	2	20.25	47	12.0	1.9	277	340	81.5
138	2	20.50	49	12.0	20.8	302	340	88.7
139	50	20.51	49	11.9	21.9	271	340	79.6
140	50	20.52	50	12.2	28.0	283	340	83.4
141	50	20.53	51	12.7	39.9	293	340	86.1
142	50	20.54	50	12.5	41.7	293	340	86.2
143	50	20.55	49	12.1	34.3	279	340	82.0
144	50	20.56	50	12.8	31.4	295	340	86.7
145	50	20.57	51	13.2	39.1	315	340	92.5
146	50	20.58	49	12.9	38.8	290	340	85.4
147	50	20.59	49	12.9	32.5	286	340	84.2
148	50	20.60	48	13.1	31.5	296	340	87.1
149	50	20.61	50	13.0	35.5	293	340	86.2
150	50	20.62	48	12.8	36.9	286	340	84.2
151	50	20.63	49	12.7	35.8	288	340	84.7
152	50	20.64	47	12.4	31.5	284	340	83.7
153	50	20.65	49	12.7	30.1	287	340	84.3
154	50	20.66	49	12.8	37.5	301	340	88.6
155	50	20.67	49	13.0	41.0	304	340	89.3
156	50	20.68	49	12.8	41.6	293	340	86.2
157	50	20.69	48	12.6	33.9	286	340	84.0
158	50	20.70	49	12.7	33.3	287	340	84.3
159	50	20.71	50	12.9	44.9	309	340	90.9
160	50	20.72	52	13.2	48.8	310	340	91.2
161	50	20.73	51	12.9	50.1	309	340	90.9
162	50	20.74	51	12.8	50.7	302	340	88.7
163	50	20.75	51	12.9	50.8	310	340	91.2
164	50	20.76	51	12.8	50.8	309	340	91.0
165	50	20.77	51	12.9	50.5	315	340	92.7
166	50	20.78	50	12.9	50.7	322	340	94.6
167	50	20.79	51	12.9	50.8	318	340	93.6

168	50	20.80	51	12.8	51.0	315	340	92.6
169	50	20.81	50	12.7	50.2	313	340	92.2
170	50	20.82	50	12.7	49.4	310	340	91.2
171	50	20.83	51	12.6	49.2	311	340	91.5
172	50	20.84	51	12.6	49.6	313	340	92.2
173	50	20.85	51	12.8	50.3	312	340	91.7
174	50	20.86	51	12.9	50.2	324	340	95.3
175	50	20.87	51	12.7	49.9	315	340	92.7
176	50	20.88	51	12.9	49.6	317	340	93.2
177	50	20.89	50	12.9	49.8	316	340	92.9
178	50	20.90	50	13.0	50.4	316	340	93.0
179	50	20.91	51	13.0	50.4	319	340	93.8
180	50	20.92	49	12.7	50.4	313	340	92.2
181	50	20.93	50	12.9	50.3	317	340	93.1
182	50	20.94	50	12.7	50.1	313	340	92.1
183	50	20.95	50	12.9	49.3	314	340	92.4
184	50	20.96	50	13.0	49.2	312	340	91.7
185	50	20.97	50	12.8	49.4	309	340	90.8
186	50	20.98	50	13.0	50.4	321	340	94.4
187	50	20.99	50	12.8	50.7	312	340	91.7
188	50	21.00	50	12.7	50.8	314	340	92.2
		Average	50	12.8	43.9	304	340	89.5
		Std Dev	1	0.2	8.1	13	0	3.9
		Maximum	52	13.2	51.0	324	340	95.3
		Minimum	47	11.9	21.9	271	340	79.6

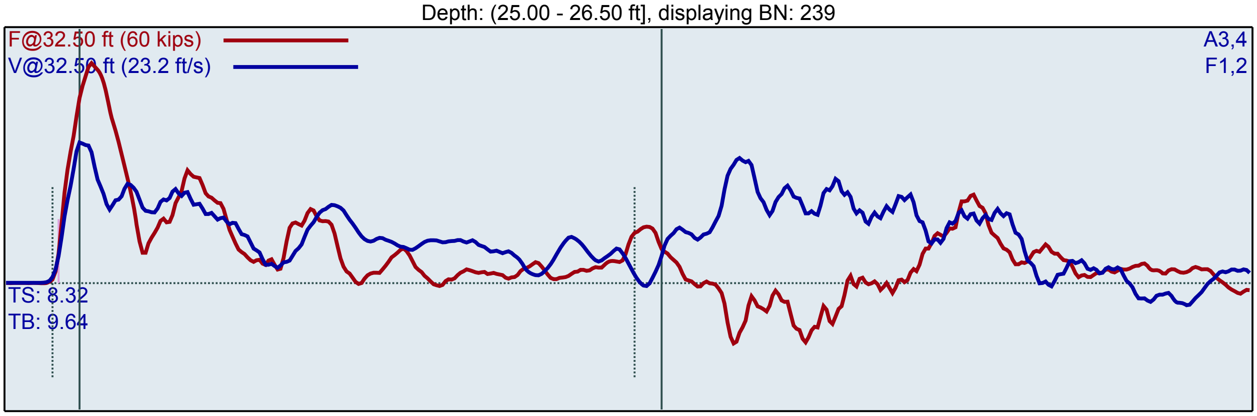
N-value: 50

Sample Interval Time: 74.25 seconds.

Texas Geo Bore Drilling 10.17.20 TCP 10-11.5
CM Interval start: 10/17/2020
TCP

AR: 1.45 in^2 SP: 0.492 k/ft3
LE: 32.50 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (25.00 - 26.50 ft], displaying BN: 239



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1
A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
189	3	25.17	49	12.9	1.9	284	340	83.6
190	3	25.33	48	13.1	21.1	283	340	83.3
191	3	25.50	48	13.7	30.6	289	340	85.1
192	50	25.51	51	13.1	41.1	286	340	84.1
193	50	25.52	50	13.1	41.9	285	340	83.7
194	50	25.53	51	13.1	42.6	291	340	85.6
195	50	25.54	51	13.3	44.0	301	340	88.4
196	50	25.55	51	13.0	43.0	288	340	84.7
197	50	25.56	51	13.1	40.9	300	340	88.4
198	50	25.57	49	13.2	41.8	295	340	86.8
199	50	25.58	50	13.3	47.1	304	340	89.3
200	50	25.59	49	13.1	48.9	298	340	87.8
201	50	25.60	49	13.0	47.6	297	340	87.3
202	50	25.61	49	13.4	46.6	301	340	88.5
203	50	25.62	49	13.6	46.7	304	340	89.5
204	50	25.63	50	13.3	48.1	308	340	90.7
205	50	25.64	50	13.6	49.8	307	340	90.2
206	50	25.65	50	13.1	50.3	307	340	90.2
207	50	25.66	50	12.9	50.1	296	340	87.1
208	50	25.67	48	12.9	45.7	292	340	85.8
209	50	25.68	49	12.7	40.1	290	340	85.4
210	50	25.69	49	13.0	41.6	296	340	87.1
211	50	25.70	51	12.9	46.1	295	340	86.9
212	50	25.71	50	12.8	46.7	299	340	88.1
213	50	25.72	50	12.8	47.2	298	340	87.6
214	50	25.73	48	12.8	47.7	298	340	87.6
215	50	25.74	50	12.7	48.6	299	340	88.0
216	50	25.75	50	12.8	50.0	301	340	88.4
217	50	25.76	50	12.9	50.0	303	340	89.0
218	50	25.77	49	12.7	50.2	306	340	89.9
219	50	25.78	50	12.7	50.2	302	340	88.8

220	50	25.79	50	12.5	49.8	297	340	87.2
221	50	25.80	50	12.6	49.2	303	340	89.0
222	50	25.81	51	12.4	49.0	302	340	88.8
223	50	25.82	51	12.6	49.2	311	340	91.6
224	50	25.83	50	12.7	49.4	302	340	88.9
225	50	25.84	51	12.6	49.4	307	340	90.3
226	50	25.85	52	12.5	49.8	306	340	90.0
227	50	25.86	52	12.6	49.5	306	340	90.0
228	50	25.87	51	12.7	49.6	309	340	90.9
229	50	25.88	52	12.5	49.3	310	340	91.2
230	50	25.89	52	12.6	49.4	312	340	91.8
231	50	25.90	51	12.7	49.4	306	340	89.9
232	50	25.91	52	12.6	50.2	307	340	90.2
233	50	25.92	52	12.8	49.8	314	340	92.2
234	50	25.93	52	12.6	49.4	305	340	89.8
235	50	25.94	52	12.6	49.7	313	340	92.1
236	50	25.95	51	12.7	49.7	313	340	92.1
237	50	25.96	52	12.7	49.7	316	340	92.8
238	50	25.97	52	12.7	49.7	312	340	91.7
239	50	25.98	52	12.7	49.8	311	340	91.4
240	50	25.99	52	12.5	49.4	307	340	90.4
241	50	26.00	52	12.6	47.3	311	340	91.5
		Average	51	12.8	47.6	303	340	89.0
		Std Dev	1	0.3	3.0	7	0	2.2
		Maximum	52	13.6	50.3	316	340	92.8
		Minimum	48	12.4	40.1	285	340	83.7

N-value: 50

Sample Interval Time: 68.03 seconds.

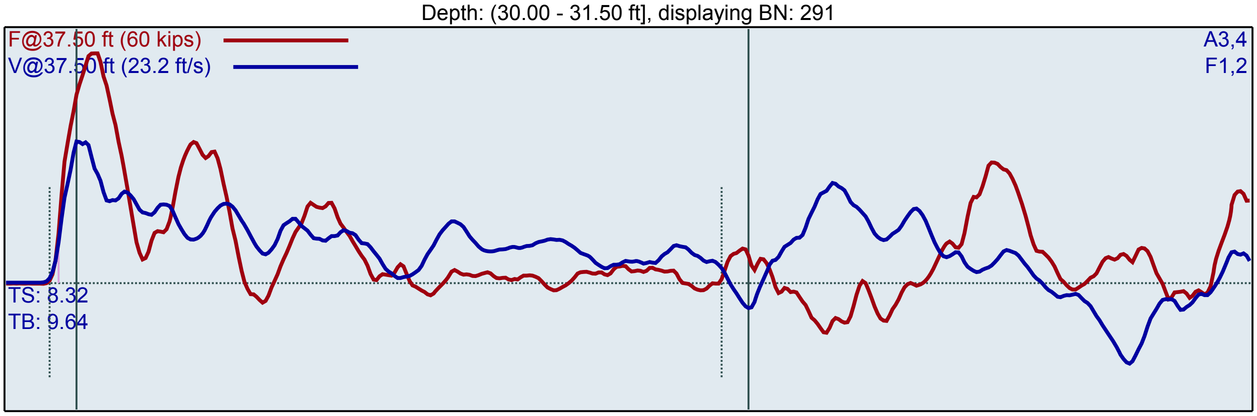
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 37.50 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (30.00 - 31.50 ft], displaying BN: 291



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
242	2	30.25	48	12.0	1.9	298	340	87.8
243	2	30.50	49	12.6	20.8	292	340	85.9
244	50	30.51	49	12.6	28.0	285	340	83.8
245	50	30.52	50	13.0	42.6	300	340	88.2
246	50	30.53	50	12.8	47.7	304	340	89.4
247	50	30.54	50	12.8	51.5	302	340	88.9
248	50	30.55	50	12.6	52.1	303	340	89.1
249	50	30.56	51	12.6	52.3	300	340	88.2
250	50	30.57	51	12.6	51.5	301	340	88.6
251	50	30.58	51	12.4	51.3	296	340	87.2
252	50	30.59	51	12.8	50.8	306	340	90.0
253	50	30.60	51	12.8	51.3	302	340	88.7
254	50	30.61	52	12.6	52.3	301	340	88.4
255	50	30.62	52	12.8	52.7	306	340	89.9
256	50	30.63	51	12.5	52.0	302	340	88.9
257	50	30.64	52	12.6	51.5	295	340	86.9
258	50	30.65	52	12.6	51.6	303	340	89.2
259	50	30.66	52	12.7	51.8	305	340	89.7
260	50	30.67	51	12.5	52.3	297	340	87.4
261	50	30.68	52	12.5	52.7	305	340	89.7
262	50	30.69	52	12.6	55.6	307	340	90.3
263	50	30.70	52	12.7	56.7	314	340	92.3
264	50	30.71	52	12.6	55.1	304	340	89.5
265	50	30.72	51	12.4	47.9	293	340	86.2
266	50	30.73	52	12.7	45.5	299	340	88.1
267	50	30.74	52	12.8	48.6	301	340	88.4
268	50	30.75	53	12.8	45.8	303	340	89.0
269	50	30.76	53	12.4	47.2	302	340	88.7
270	50	30.77	53	12.7	49.2	307	340	90.3
271	50	30.78	52	12.6	49.4	304	340	89.5
272	50	30.79	54	12.9	49.6	312	340	91.6

273	50	30.80	53	12.8	49.7	306	340	90.1
274	50	30.81	53	12.7	49.5	308	340	90.7
275	50	30.82	54	13.0	49.5	313	340	92.1
276	50	30.83	54	12.8	49.9	308	340	90.5
277	50	30.84	54	12.8	50.3	311	340	91.6
278	50	30.85	53	12.8	50.3	307	340	90.2
279	50	30.86	54	12.8	50.3	310	340	91.2
280	50	30.87	53	12.9	50.5	310	340	91.1
281	50	30.88	54	12.7	50.4	308	340	90.7
282	50	30.89	54	12.9	50.6	311	340	91.5
283	50	30.90	54	12.8	51.0	310	340	91.3
284	50	30.91	54	12.9	51.7	308	340	90.7
285	50	30.92	54	12.8	51.5	307	340	90.4
286	50	30.93	54	12.8	51.2	309	340	90.9
287	50	30.94	53	12.7	51.8	306	340	90.1
288	50	30.95	55	12.7	51.1	313	340	92.1
289	50	30.96	54	12.6	51.2	306	340	90.0
290	50	30.97	54	12.6	51.7	307	340	90.3
291	50	30.98	54	12.8	52.1	312	340	91.9
292	50	30.99	54	12.7	52.1	308	340	90.6
293	50	31.00	54	12.8	52.0	308	340	90.6
		Average	52	12.7	50.3	305	340	89.7
		Std Dev	1	0.1	4.0	6	0	1.6
		Maximum	55	13.0	56.7	314	340	92.3
		Minimum	49	12.4	28.0	285	340	83.8

N-value: 50

Sample Interval Time: 63.07 seconds.

CME 55 (SN 172555)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
13.83	**15-17-16**	10.00	11.50	**33**	**53**	36	18.7	47.6	333	340	98.0
18.83	**1-50-0**	15.00	16.50	**50**	**80**	34	18.0	39.9	305	340	89.7
23.83	**1-50-0**	20.00	21.50	**50**	**80**	34	19.0	47.2	331	340	97.3
27.83	**40-50-0**	25.00	26.50	**50**	**80**	37	18.1	47.2	337	340	99.1
32.83	**2-50-0**	30.00	31.50	**50**	**80**	37	18.5	50.0	346	340	101.8
					Overall Average Values:	36	18.5	46.3	330	340	97.1
					Standard Deviation:	1	0.5	3.5	17	0	5.0
					Overall Maximum Value:	40	19.3	50.7	364	340	107.1
					Overall Minimum Value:	33	17.1	37.7	281	340	82.7

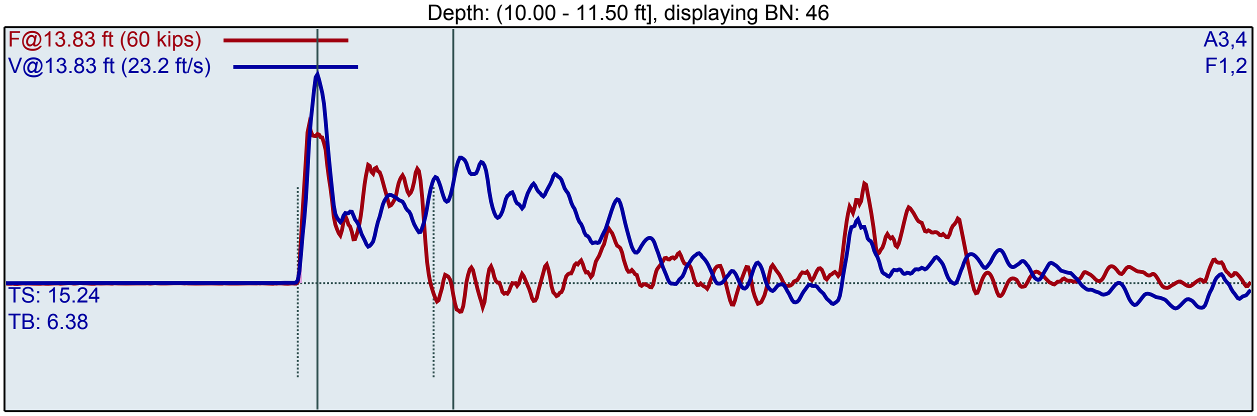
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 13.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 46



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	15	10.03	34	17.7	1.9	282	340	82.9
2	15	10.07	38	18.9	44.6	321	340	94.3
3	15	10.10	38	18.9	47.4	338	340	99.3
4	15	10.13	39	19.0	48.1	336	340	98.8
5	15	10.17	39	19.1	48.2	339	340	99.6
6	15	10.20	39	18.9	48.1	324	340	95.2
7	15	10.23	37	18.7	48.3	342	340	100.6
8	15	10.27	37	18.6	48.1	342	340	100.5
9	15	10.30	37	18.5	47.6	336	340	98.9
10	15	10.33	36	18.4	47.3	326	340	96.0
11	15	10.37	38	18.6	47.6	343	340	101.0
12	15	10.40	37	18.3	47.7	331	340	97.4
13	15	10.43	37	18.3	47.3	315	340	92.8
14	15	10.47	37	18.4	47.6	324	340	95.2
15	15	10.50	37	18.3	47.4	317	340	93.2
16	17	10.53	36	18.1	47.6	322	340	94.6
17	17	10.56	37	18.6	47.8	326	340	95.9
18	17	10.59	36	18.4	47.5	328	340	96.4
19	17	10.62	36	18.4	47.2	319	340	93.8
20	17	10.65	36	18.3	47.5	318	340	93.6
21	17	10.68	36	18.4	47.7	327	340	96.2
22	17	10.71	37	18.6	47.7	335	340	98.6
23	17	10.74	37	18.7	47.6	332	340	97.8
24	17	10.76	36	18.6	47.6	328	340	96.3
25	17	10.79	36	18.7	47.5	324	340	95.3
26	17	10.82	36	18.5	47.4	323	340	95.1
27	17	10.85	36	18.5	47.6	322	340	94.8
28	17	10.88	36	18.5	47.7	321	340	94.4

29	17	10.91	36	18.9	47.7	328	340	96.4
30	17	10.94	37	19.0	47.7	332	340	97.8
31	17	10.97	35	18.7	47.5	321	340	94.4
32	17	11.00	36	19.0	47.3	335	340	98.6
33	16	11.03	35	18.7	47.7	332	340	97.5
34	16	11.06	35	18.7	47.5	335	340	98.5
35	16	11.09	35	18.6	47.8	338	340	99.5
36	16	11.13	36	18.7	47.6	334	340	98.3
37	16	11.16	36	18.7	47.6	331	340	97.5
38	16	11.19	37	18.7	47.4	334	340	98.2
39	16	11.22	36	18.8	47.6	341	340	100.3
40	16	11.25	36	18.8	47.4	337	340	99.1
41	16	11.28	37	18.9	47.8	343	340	101.0
42	16	11.31	37	19.0	47.6	348	340	102.2
43	16	11.34	38	19.0	47.5	349	340	102.6
44	16	11.38	37	18.9	47.7	337	340	99.1
45	16	11.41	38	19.0	47.8	351	340	103.3
46	16	11.44	37	18.9	47.7	353	340	103.7
47	16	11.47	37	19.0	48.0	352	340	103.6
48	16	11.50	37	19.0	47.8	343	340	100.9
		Average	36	18.7	47.6	333	340	98.0
		Std Dev	1	0.2	0.2	10	0	2.9
		Maximum	38	19.0	48.0	353	340	103.7
		Minimum	35	18.1	47.2	318	340	93.6

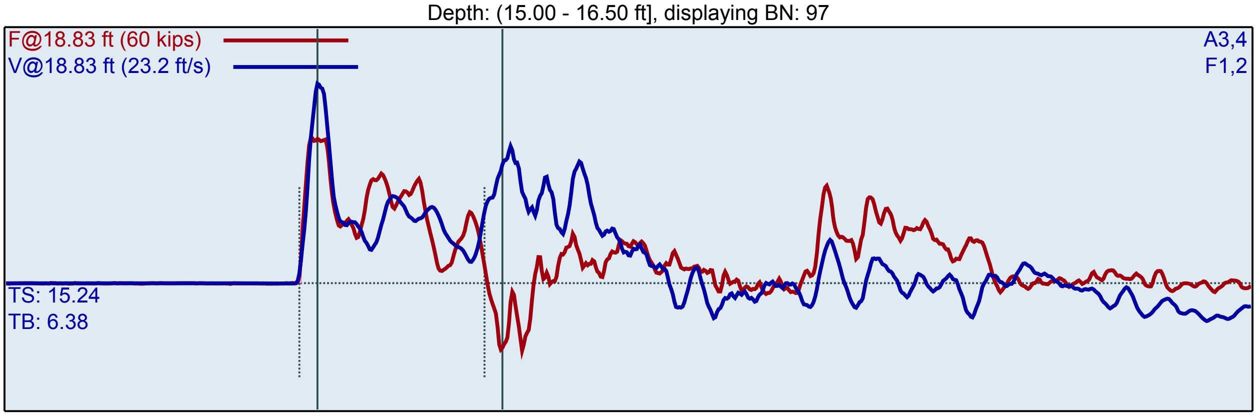
N-value: 33

Sample Interval Time: 59.25 seconds.

Texas Geo Bore Drilling 10.17.20 TCP 10.0-11.5
CM Interval start: 10/17/2020
TCP

AR: 1.45 in^2 SP: 0.492 k/ft3
LE: 18.83 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (15.00 - 16.50 ft], displaying BN: 97



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1
A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
49	1	15.50	35	17.4	1.9	370	340	108.8
50	50	15.51	35	18.0	37.7	337	340	99.1
51	50	15.52	35	18.1	38.9	336	340	98.8
52	50	15.53	35	18.2	39.3	333	340	97.9
53	50	15.54	36	18.2	39.6	338	340	99.3
54	50	15.55	35	18.1	39.7	339	340	99.7
55	50	15.56	35	18.0	39.7	336	340	98.8
56	50	15.57	35	18.2	39.9	334	340	98.2
57	50	15.58	34	17.8	39.9	290	340	85.2
58	50	15.59	34	17.9	39.9	290	340	85.4
59	50	15.60	34	17.9	39.8	321	340	94.4
60	50	15.61	34	17.6	39.7	285	340	83.9
61	50	15.62	34	17.9	39.7	289	340	84.9
62	50	15.63	34	17.8	39.6	291	340	85.6
63	50	15.64	34	17.6	39.7	287	340	84.4
64	50	15.65	33	17.4	39.6	281	340	82.7
65	50	15.66	34	17.9	39.6	289	340	84.9
66	50	15.67	34	18.0	39.8	293	340	86.3
67	50	15.68	34	18.0	39.7	297	340	87.3
68	50	15.69	35	18.1	39.9	298	340	87.6
69	50	15.70	34	18.0	39.8	299	340	87.8
70	50	15.71	34	17.7	39.8	298	340	87.5
71	50	15.72	34	17.9	39.9	301	340	88.5
72	50	15.73	34	18.0	39.8	297	340	87.4
73	50	15.74	35	17.9	40.2	295	340	86.9
74	50	15.75	35	18.2	40.1	299	340	87.8
75	50	15.76	35	18.1	40.0	296	340	87.0
76	50	15.77	35	18.1	40.0	303	340	89.0
77	50	15.78	35	18.2	40.2	300	340	88.3
78	50	15.79	35	18.0	40.2	316	340	93.0
79	50	15.80	34	18.2	40.2	299	340	87.9

80	50	15.81	34	18.3	39.9	291	340	85.6
81	50	15.82	34	17.9	40.2	289	340	84.9
82	50	15.83	34	17.9	40.1	292	340	86.0
83	50	15.84	34	18.0	40.3	310	340	91.0
84	50	15.85	34	18.1	40.1	298	340	87.5
85	50	15.86	34	18.1	40.0	288	340	84.7
86	50	15.87	34	18.1	40.4	286	340	84.1
87	50	15.88	34	17.9	40.3	288	340	84.7
88	50	15.89	34	18.0	40.4	308	340	90.7
89	50	15.90	34	18.0	40.3	310	340	91.2
90	50	15.91	34	18.1	40.4	295	340	86.6
91	50	15.92	33	17.9	40.0	304	340	89.4
92	50	15.93	34	18.3	40.5	300	340	88.4
93	50	15.94	34	17.9	40.2	307	340	90.4
94	50	15.95	34	18.0	40.2	313	340	92.2
95	50	15.96	34	18.1	40.2	318	340	93.4
96	50	15.97	34	18.1	40.1	323	340	94.9
97	50	15.98	34	18.1	40.1	322	340	94.6
98	50	15.99	34	18.1	40.2	299	340	88.1
99	50	16.00	35	18.3	40.1	352	340	103.5
		Average	34	18.0	39.9	305	340	89.7
		Std Dev	0	0.2	0.4	17	0	5.1
		Maximum	36	18.3	40.5	352	340	103.5
		Minimum	33	17.4	37.7	281	340	82.7

N-value: 50

Sample Interval Time: 75.14 seconds.

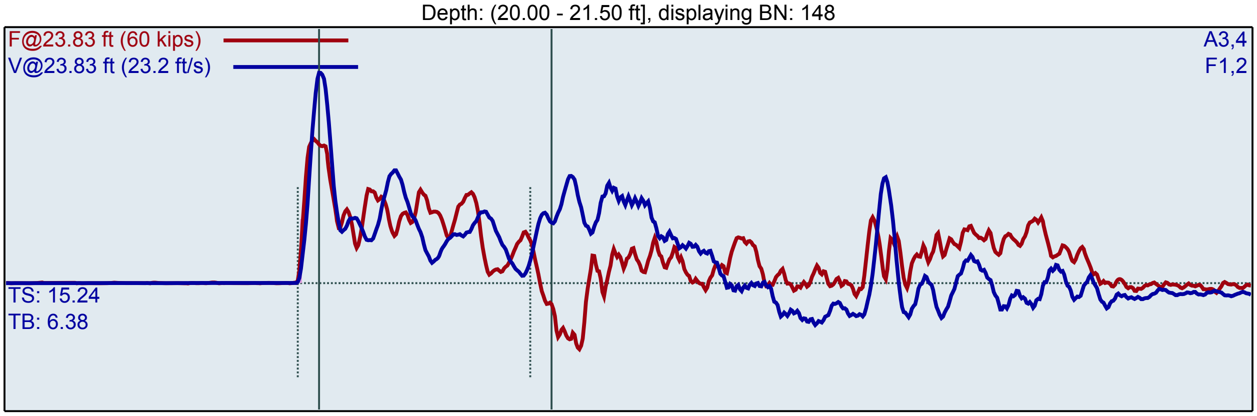
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 23.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (20.00 - 21.50 ft], displaying BN: 148



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
100	1	20.50	35	17.8	1.9	350	340	103.0
101	50	20.51	35	18.2	44.4	324	340	95.3
102	50	20.52	35	18.5	46.8	330	340	97.0
103	50	20.53	35	18.6	46.9	329	340	96.8
104	50	20.54	35	18.8	47.0	331	340	97.3
105	50	20.55	35	18.6	46.9	327	340	96.2
106	50	20.56	34	18.8	47.1	329	340	96.9
107	50	20.57	34	18.6	47.2	326	340	96.0
108	50	20.58	34	18.7	47.2	327	340	96.1
109	50	20.59	34	18.9	47.1	326	340	95.7
110	50	20.60	34	18.8	47.3	325	340	95.6
111	50	20.61	34	18.7	47.2	327	340	96.1
112	50	20.62	34	18.8	47.4	324	340	95.4
113	50	20.63	34	18.8	47.3	326	340	95.9
114	50	20.64	34	18.8	47.3	326	340	95.9
115	50	20.65	34	18.9	47.4	326	340	95.9
116	50	20.66	34	18.7	47.3	322	340	94.8
117	50	20.67	34	18.9	47.2	330	340	97.2
118	50	20.68	34	18.8	47.3	327	340	96.1
119	50	20.69	34	18.8	47.2	328	340	96.3
120	50	20.70	34	18.9	47.3	330	340	97.0
121	50	20.71	34	18.9	47.2	334	340	98.3
122	50	20.72	34	18.8	47.2	326	340	96.0
123	50	20.73	34	19.1	47.1	335	340	98.7
124	50	20.74	34	19.0	47.2	330	340	97.0
125	50	20.75	34	19.0	47.0	332	340	97.7
126	50	20.76	34	19.0	47.1	335	340	98.5
127	50	20.77	34	18.9	47.3	328	340	96.5
128	50	20.78	34	19.0	47.4	331	340	97.2
129	50	20.79	34	19.2	47.2	336	340	98.8
130	50	20.80	34	19.1	47.5	328	340	96.5

131	50	20.81	34	19.3	47.2	339	340	99.7
132	50	20.82	34	19.3	47.4	331	340	97.5
133	50	20.83	34	19.2	47.4	337	340	99.0
134	50	20.84	34	19.3	47.5	332	340	97.7
135	50	20.85	34	19.2	47.8	330	340	97.1
136	50	20.86	34	19.2	47.5	333	340	98.0
137	50	20.87	34	19.2	47.5	334	340	98.2
138	50	20.88	34	19.3	47.5	329	340	96.9
139	50	20.89	34	19.2	47.4	336	340	98.8
140	50	20.90	34	19.1	47.4	330	340	97.1
141	50	20.91	34	19.3	47.0	338	340	99.4
142	50	20.92	34	19.3	47.3	339	340	99.7
143	50	20.93	34	19.2	47.1	332	340	97.6
144	50	20.94	34	19.2	47.2	338	340	99.5
145	50	20.95	34	19.2	47.3	331	340	97.3
146	50	20.96	34	19.2	47.5	333	340	97.8
147	50	20.97	34	19.2	47.0	338	340	99.3
148	50	20.98	34	19.1	47.3	332	340	97.7
149	50	20.99	34	19.3	47.2	334	340	98.2
150	50	21.00	34	19.3	47.2	334	340	98.1
		Average	34	19.0	47.2	331	340	97.3
		Std Dev	0	0.3	0.4	4	0	1.2
		Maximum	35	19.3	47.8	339	340	99.7
		Minimum	34	18.2	44.4	322	340	94.8

N-value: 50

Sample Interval Time: 66.18 seconds.

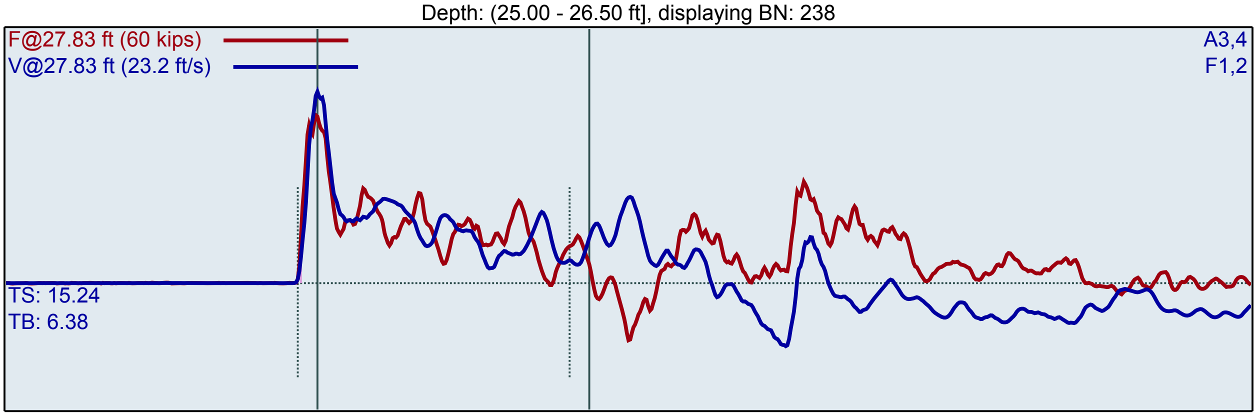
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

10.0-11.5
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 27.83 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 238



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
151	40	25.01	34	18.1	61.8	323	340	94.9
152	40	25.03	36	18.1	39.9	329	340	96.9
153	40	25.04	36	18.5	40.8	343	340	100.8
154	40	25.05	37	18.4	41.5	342	340	100.7
155	40	25.06	36	18.5	41.4	330	340	97.1
156	40	25.08	36	18.4	41.5	338	340	99.4
157	40	25.09	37	17.9	42.2	344	340	101.2
158	40	25.10	38	17.3	42.1	331	340	97.2
159	40	25.11	37	18.0	42.3	337	340	99.2
160	40	25.13	39	16.9	42.1	339	340	99.6
161	40	25.14	39	17.7	43.7	344	340	101.2
162	40	25.15	37	18.5	46.7	350	340	102.9
163	40	25.16	39	17.4	47.1	341	340	100.4
164	40	25.18	39	17.8	46.3	347	340	102.1
165	40	25.19	38	18.0	47.1	346	340	101.8
166	40	25.20	38	18.0	47.4	338	340	99.4
167	40	25.21	38	18.1	46.6	345	340	101.6
168	40	25.23	38	18.2	47.0	337	340	99.2
169	40	25.24	38	18.1	47.4	339	340	99.8
170	40	25.25	37	18.2	47.4	336	340	98.9
171	40	25.26	37	18.3	47.1	342	340	100.5
172	40	25.28	39	17.7	46.7	333	340	97.9
173	40	25.29	38	18.1	47.1	329	340	96.8
174	40	25.30	38	18.3	47.5	337	340	99.2
175	40	25.31	38	18.1	47.8	332	340	97.7
176	40	25.33	39	17.9	46.9	328	340	96.3
177	40	25.34	39	18.3	47.3	335	340	98.5
178	40	25.35	39	18.0	47.1	330	340	96.9
179	40	25.36	38	18.2	47.0	333	340	98.0
180	40	25.38	39	18.3	47.5	330	340	96.9
181	40	25.39	39	18.3	47.3	343	340	100.8

182	40	25.40	39	18.1	47.1	333	340	98.0
183	40	25.41	39	18.3	46.9	336	340	98.9
184	40	25.43	39	18.2	47.3	334	340	98.4
185	40	25.44	39	18.3	47.2	337	340	99.1
186	40	25.45	38	18.0	47.0	329	340	96.9
187	40	25.46	39	18.1	2.5	336	340	98.8
188	40	25.48	38	18.2	45.1	336	340	98.7
189	40	25.49	38	18.3	46.7	338	340	99.4
190	40	25.50	37	18.4	47.5	342	340	100.5
191	50	25.51	37	18.6	47.6	334	340	98.4
192	50	25.52	36	18.6	47.8	337	340	99.0
193	50	25.53	36	18.8	47.3	346	340	101.7
194	50	25.54	36	18.9	47.3	348	340	102.4
195	50	25.55	37	18.6	47.4	339	340	99.7
196	50	25.56	36	18.5	47.4	335	340	98.4
197	50	25.57	36	18.5	47.2	336	340	98.9
198	50	25.58	36	18.4	47.3	330	340	97.1
199	50	25.59	36	18.3	46.7	332	340	97.7
200	50	25.60	36	18.3	47.2	333	340	98.0
201	50	25.61	36	18.2	46.9	324	340	95.4
202	50	25.62	36	18.4	46.5	336	340	98.9
203	50	25.63	36	18.4	47.6	332	340	97.6
204	50	25.64	36	18.7	47.2	339	340	99.6
205	50	25.65	37	18.6	46.9	341	340	100.4
206	50	25.66	36	18.6	46.6	340	340	100.1
207	50	25.67	36	18.5	46.9	334	340	98.2
208	50	25.68	36	18.5	47.1	335	340	98.4
209	50	25.69	36	18.4	46.6	336	340	98.9
210	50	25.70	36	18.3	47.0	336	340	98.9
211	50	25.71	36	18.3	46.9	335	340	98.5
212	50	25.72	36	18.4	47.1	336	340	98.8
213	50	25.73	36	18.6	47.2	341	340	100.3
214	50	25.74	36	18.4	47.1	333	340	98.0
215	50	25.75	37	18.2	46.5	338	340	99.5
216	50	25.76	37	18.4	47.1	345	340	101.4
217	50	25.77	37	18.2	47.6	339	340	99.8
218	50	25.78	37	18.1	47.3	337	340	99.1
219	50	25.79	37	18.2	47.5	339	340	99.7
220	50	25.80	37	18.2	47.1	339	340	99.8
221	50	25.81	37	18.1	47.1	331	340	97.5
222	50	25.82	37	18.2	47.1	339	340	99.7
223	50	25.83	37	18.3	47.7	339	340	99.6
224	50	25.84	37	18.1	47.0	336	340	98.8
225	50	25.85	38	18.0	47.3	336	340	98.8
226	50	25.86	37	18.0	47.4	333	340	97.8
227	50	25.87	37	18.0	46.9	333	340	98.0
228	50	25.88	37	17.8	47.4	335	340	98.5
229	50	25.89	37	17.8	47.6	336	340	98.9
230	50	25.90	38	17.6	47.1	335	340	98.6
231	50	25.91	38	17.5	47.0	331	340	97.4
232	50	25.92	38	17.5	47.0	337	340	99.2
233	50	25.93	39	17.5	47.8	343	340	100.7
234	50	25.94	38	17.2	47.6	335	340	98.5
235	50	25.95	39	17.1	47.0	334	340	98.3
236	50	25.96	39	17.3	47.5	339	340	99.7
237	50	25.97	39	17.3	47.2	335	340	98.6
238	50	25.98	39	17.3	47.4	340	340	100.0
239	50	25.99	40	17.3	47.5	345	340	101.6
240	50	26.00	40	17.2	47.4	346	340	101.8

Average	37	18.1	47.2	337	340	99.1
Std Dev	1	0.5	0.3	4	0	1.3
Maximum	40	18.9	47.8	348	340	102.4
Minimum	36	17.1	46.5	324	340	95.4

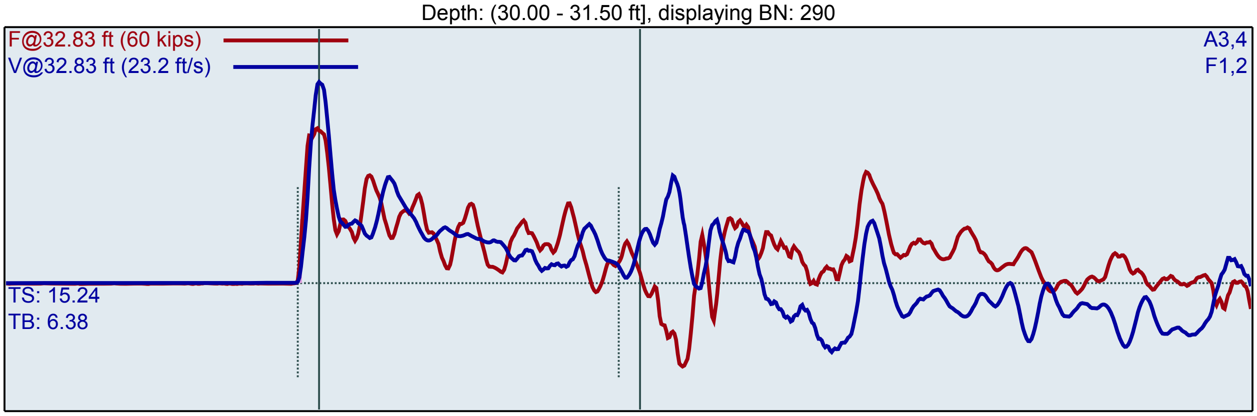
N-value: 50

Sample Interval Time: 137.90 seconds.

Texas Geo Bore Drilling 10.17.20 TCP 10.0-11.5
CM Interval start: 10/17/2020
TCP

AR: 1.45 in^2 SP: 0.492 k/ft3
LE: 32.83 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (30.00 - 31.50 ft], displaying BN: 290



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1
A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
241	2	30.25	34	18.3	1.9	344	340	101.1
242	2	30.50	36	18.6	47.2	361	340	106.2
243	50	30.51	37	19.0	48.3	355	340	104.5
244	50	30.52	36	18.6	49.8	347	340	102.0
245	50	30.53	37	18.8	50.0	352	340	103.7
246	50	30.54	37	18.8	49.8	351	340	103.2
247	50	30.55	37	18.9	50.4	351	340	103.4
248	50	30.56	37	18.9	49.8	350	340	103.1
249	50	30.57	37	18.8	49.8	346	340	101.8
250	50	30.58	37	18.9	49.7	345	340	101.5
251	50	30.59	37	18.7	49.9	346	340	101.9
252	50	30.60	37	18.9	50.1	346	340	101.8
253	50	30.61	37	18.7	49.8	343	340	100.8
254	50	30.62	37	18.8	49.9	345	340	101.6
255	50	30.63	37	18.8	50.0	346	340	101.8
256	50	30.64	37	18.7	49.9	345	340	101.4
257	50	30.65	37	18.9	50.0	343	340	100.8
258	50	30.66	37	18.7	49.9	344	340	101.2
259	50	30.67	37	18.8	50.5	348	340	102.4
260	50	30.68	38	19.1	50.0	364	340	107.1
261	50	30.69	37	18.7	50.1	347	340	102.1
262	50	30.70	38	18.9	49.7	352	340	103.4
263	50	30.71	37	18.8	50.1	350	340	102.9
264	50	30.72	37	18.8	49.9	346	340	101.8
265	50	30.73	37	18.6	50.0	350	340	103.0
266	50	30.74	37	18.7	49.9	347	340	102.1
267	50	30.75	37	18.6	50.2	348	340	102.3
268	50	30.76	37	18.7	50.2	354	340	104.0
269	50	30.77	37	18.5	49.9	354	340	104.2
270	50	30.78	37	18.4	50.3	352	340	103.4
271	50	30.79	37	18.4	50.2	353	340	103.7

272	50	30.80	37	18.3	50.1	350	340	103.0
273	50	30.81	36	18.2	50.0	348	340	102.2
274	50	30.82	37	18.3	49.9	342	340	100.7
275	50	30.83	36	18.3	50.0	349	340	102.5
276	50	30.84	37	18.4	50.4	348	340	102.2
277	50	30.85	36	18.3	50.7	345	340	101.6
278	50	30.86	36	18.3	50.3	346	340	101.9
279	50	30.87	36	18.3	50.3	346	340	101.7
280	50	30.88	36	18.3	50.1	336	340	98.8
281	50	30.89	36	18.2	50.0	339	340	99.8
282	50	30.90	36	18.4	50.1	345	340	101.5
283	50	30.91	36	18.3	49.8	347	340	102.0
284	50	30.92	36	18.2	50.0	340	340	100.1
285	50	30.93	36	18.2	49.5	341	340	100.3
286	50	30.94	36	18.1	49.8	337	340	99.2
287	50	30.95	36	18.1	49.9	334	340	98.3
288	50	30.96	36	18.2	50.2	339	340	99.7
289	50	30.97	36	18.1	49.9	336	340	98.9
290	50	30.98	36	18.2	50.0	340	340	99.9
291	50	30.99	36	18.1	49.9	337	340	99.1
292	50	31.00	36	18.1	49.9	343	340	100.8
		Average	37	18.5	50.0	346	340	101.8
		Std Dev	1	0.3	0.3	6	0	1.7
		Maximum	38	19.1	50.7	364	340	107.1
		Minimum	36	18.1	48.3	334	340	98.3

N-value: 50

Sample Interval Time: 61.25 seconds.

MOBILE B57 (NO SN)

Summary of TCP Test Results

Project: Texas Geo Bore Drilling 10.17.20 TCP, Test Date: 10/17/2020

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ER ft-lb	Average ETR %
11.41	**18-19-18**	8.50	10.00	**37**	**55**	33	12.2	50.3	302	340	88.9
16.41	**1-50-0**	13.50	15.00	**50**	**74**	31	13.3	50.0	280	340	82.2
21.41	**10-50-0**	18.50	20.00	**50**	**74**	35	13.3	48.4	304	340	89.4
26.41	**2-50-0**	23.50	25.00	**50**	**74**	34	13.4	47.4	312	340	91.8
31.41	**2-50-0**	28.50	30.00	**50**	**74**	34	13.5	48.4	323	340	95.1
					Overall Average Values:	33	13.2	48.8	304	340	89.5
					Standard Deviation:	2	0.8	2.9	17	0	5.0
					Overall Maximum Value:	36	15.3	51.8	357	340	105.0
					Overall Minimum Value:	26	11.0	8.2	263	340	77.3

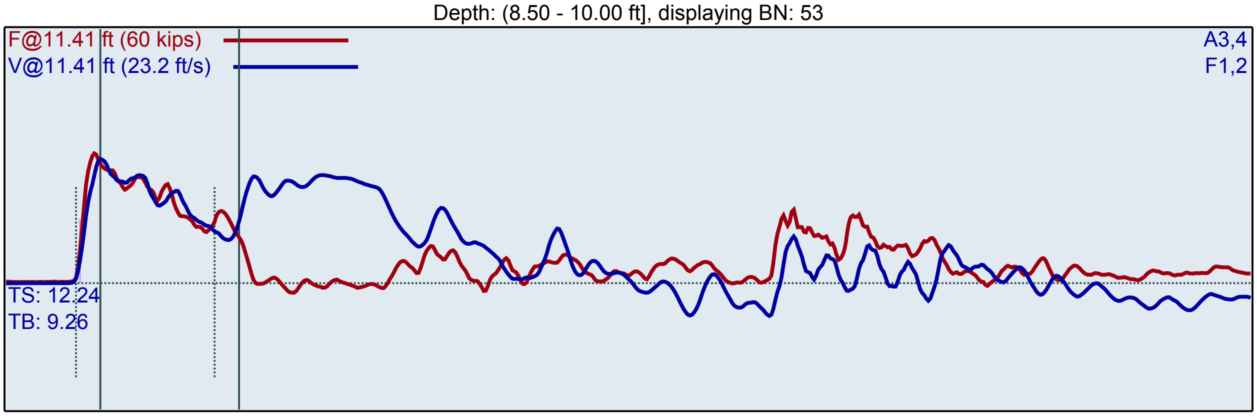
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 11.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (8.50 - 10.00 ft], displaying BN: 53



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
1	18	8.53	34	13.4	1.9	283	340	83.3
2	18	8.56	35	13.0	50.7	298	340	87.8
3	18	8.58	35	12.8	51.8	286	340	84.2
4	18	8.61	35	13.1	51.8	297	340	87.4
5	18	8.64	35	12.9	51.6	294	340	86.6
6	18	8.67	35	13.1	51.7	293	340	86.2
7	18	8.69	35	12.9	51.6	297	340	87.2
8	18	8.72	35	13.0	51.4	301	340	88.5
9	18	8.75	35	13.2	51.6	314	340	92.5
10	18	8.78	35	13.0	51.4	305	340	89.8
11	18	8.81	36	13.2	51.8	314	340	92.3
12	18	8.83	35	13.2	51.7	321	340	94.3
13	18	8.86	36	13.2	51.8	313	340	92.0
14	18	8.89	35	13.0	51.5	303	340	89.2
15	18	8.92	35	13.0	51.5	307	340	90.2
16	18	8.94	36	13.0	51.6	306	340	89.9
17	18	8.97	35	13.1	51.3	305	340	89.8
18	18	9.00	35	13.0	6.3	299	340	88.1
19	19	9.03	35	12.9	50.3	306	340	90.1
20	19	9.05	35	12.9	51.5	303	340	89.0
21	19	9.08	36	13.1	51.6	315	340	92.6
22	19	9.11	36	13.0	51.5	305	340	89.8
23	19	9.13	35	13.1	51.4	304	340	89.3
24	19	9.16	35	12.9	51.3	298	340	87.6
25	19	9.18	36	13.0	51.1	306	340	90.0
26	19	9.21	35	12.9	51.3	301	340	88.5
27	19	9.24	35	12.9	51.1	301	340	88.6
28	19	9.26	36	12.9	51.0	299	340	87.9

29	19	9.29	36	12.9	51.2	307	340	90.4
30	19	9.32	35	12.7	50.7	298	340	87.6
31	19	9.34	36	13.0	51.1	310	340	91.2
32	19	9.37	36	12.8	50.8	296	340	87.2
33	19	9.39	32	11.6	50.9	304	340	89.4
34	19	9.42	33	12.0	50.6	303	340	89.2
35	19	9.45	33	12.0	50.5	305	340	89.8
36	19	9.47	32	12.0	50.9	298	340	87.6
37	19	9.50	33	11.9	50.1	305	340	89.7
38	18	9.53	33	11.8	50.1	305	340	89.8
39	18	9.56	33	12.0	50.1	303	340	89.1
40	18	9.58	33	12.0	49.9	298	340	87.7
41	18	9.61	33	11.9	49.7	305	340	89.8
42	18	9.64	31	11.8	49.8	304	340	89.4
43	18	9.67	33	12.2	49.3	309	340	90.8
44	18	9.69	33	12.2	49.7	303	340	89.0
45	18	9.72	33	12.0	49.7	300	340	88.3
46	18	9.75	34	12.1	49.0	298	340	87.7
47	18	9.78	33	12.2	49.6	304	340	89.3
48	18	9.81	33	11.8	49.7	301	340	88.5
49	18	9.83	31	11.5	49.4	301	340	88.5
50	18	9.86	31	11.6	48.9	307	340	90.3
51	18	9.89	31	11.3	49.6	302	340	89.0
52	18	9.92	30	11.2	49.2	286	340	84.2
53	18	9.94	30	11.3	48.9	300	340	88.3
54	18	9.97	30	11.0	49.2	300	340	88.1
55	18	10.00	29	11.0	49.3	289	340	85.1
		Average	33	12.2	50.3	302	340	88.9
		Std Dev	2	0.6	0.8	5	0	1.5
		Maximum	36	13.1	51.6	315	340	92.6
		Minimum	29	11.0	48.9	286	340	84.2

N-value: 37

Sample Interval Time: 72.28 seconds.

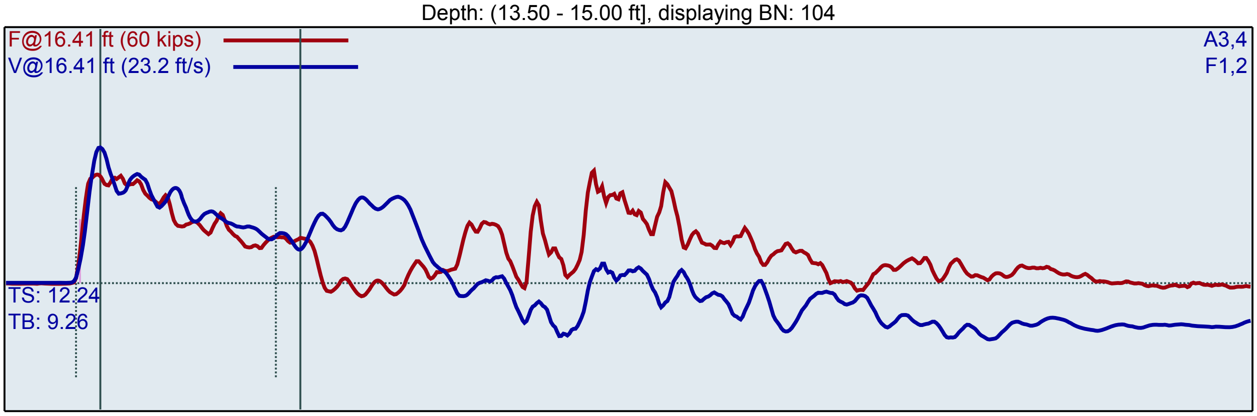
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 16.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (13.50 - 15.00 ft], displaying BN: 104



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
57	50	14.01	35	14.4	51.5	311	340	91.6
58	50	14.02	34	13.5	51.8	311	340	91.4
59	50	14.03	34	13.1	51.8	312	340	91.9
60	50	14.04	33	12.6	51.8	283	340	83.1
61	50	14.05	33	12.3	51.6	283	340	83.4
62	50	14.06	34	13.0	51.8	318	340	93.6
63	50	14.07	34	13.3	51.2	282	340	83.0
64	50	14.08	32	13.0	51.7	276	340	81.0
65	50	14.09	32	12.3	51.3	277	340	81.5
66	50	14.10	30	11.8	51.6	269	340	79.2
67	50	14.11	28	12.5	50.5	276	340	81.3
68	50	14.12	30	12.4	51.3	278	340	81.9
69	50	14.13	34	13.1	51.2	283	340	83.1
70	50	14.14	33	14.6	50.6	288	340	84.7
71	50	14.15	34	13.7	51.4	285	340	83.8
72	50	14.16	32	14.4	50.9	279	340	82.1
73	50	14.17	33	13.6	51.0	278	340	81.8
74	50	14.18	33	13.5	50.4	279	340	82.2
75	50	14.19	34	13.7	50.7	281	340	82.7
76	50	14.20	33	13.5	50.4	282	340	83.0
77	50	14.21	32	14.8	49.5	285	340	83.8
78	50	14.22	33	13.8	51.1	279	340	82.1
79	50	14.23	32	14.5	48.7	285	340	83.8
80	50	14.24	31	14.8	50.6	281	340	82.7
81	50	14.25	29	14.7	49.6	281	340	82.7
82	50	14.26	30	15.3	49.4	286	340	84.0
83	50	14.27	33	13.6	49.6	286	340	84.1
84	50	14.28	32	13.6	49.3	283	340	83.1
85	50	14.29	33	13.2	50.0	277	340	81.5
86	50	14.30	33	14.4	48.8	289	340	85.0
87	50	14.31	34	13.3	50.0	279	340	81.9

88	50	14.32	29	14.2	49.4	272	340	80.1
89	50	14.33	29	14.7	48.7	282	340	82.8
90	50	14.34	28	14.2	49.4	273	340	80.3
91	50	14.35	27	13.3	49.4	271	340	79.6
92	50	14.36	28	13.7	48.8	273	340	80.3
93	50	14.37	28	13.6	49.1	272	340	79.9
94	50	14.38	28	13.5	48.7	279	340	82.1
95	50	14.39	27	13.4	49.5	265	340	78.0
96	50	14.40	27	13.1	48.7	271	340	79.7
97	50	14.41	28	12.8	48.3	272	340	80.0
98	50	14.42	27	12.3	49.1	267	340	78.5
99	50	14.43	29	11.8	48.4	269	340	79.2
100	50	14.44	30	11.2	48.6	267	340	78.6
101	50	14.45	31	11.8	48.4	272	340	79.9
102	50	14.46	27	11.5	48.5	263	340	77.3
103	50	14.47	26	12.1	48.3	269	340	79.1
104	50	14.48	26	12.3	48.6	267	340	78.5
105	50	14.49	28	11.2	48.5	266	340	78.2
106	50	14.50	29	12.3	48.3	269	340	79.1
		Average	31	13.3	50.0	280	340	82.2
		Std Dev	3	1.0	1.2	12	0	3.5
		Maximum	35	15.3	51.8	318	340	93.6
		Minimum	26	11.2	48.3	263	340	77.3

N-value: 50

Sample Interval Time: 58.94 seconds.

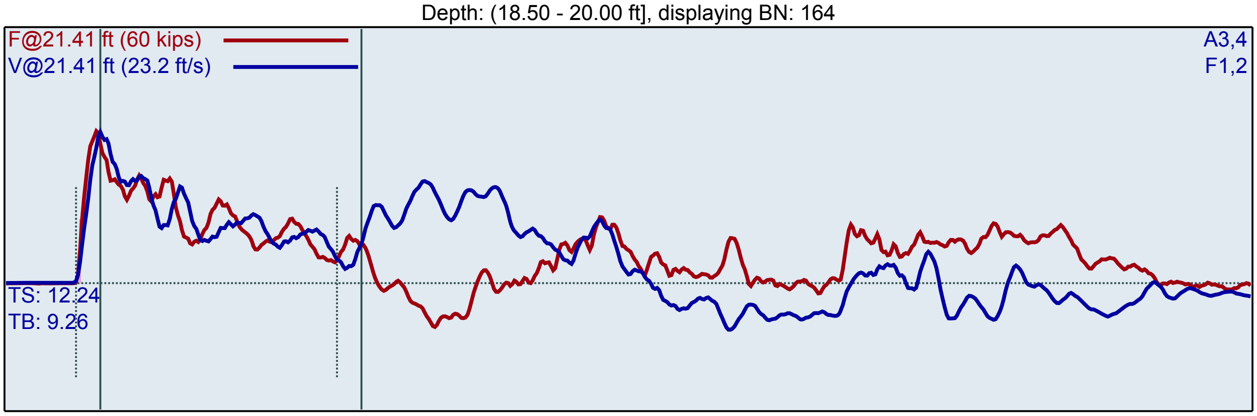
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 21.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (18.50 - 20.00 ft], displaying BN: 164



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
108	10	18.60	35	13.7	50.2	317	340	93.1
109	10	18.65	35	13.5	51.1	321	340	94.5
110	10	18.70	35	13.5	50.6	312	340	91.8
111	10	18.75	35	13.4	50.5	311	340	91.3
112	10	18.80	36	13.8	50.1	310	340	91.2
113	10	18.85	35	13.7	49.8	311	340	91.5
114	10	18.90	36	13.6	50.0	308	340	90.6
115	10	18.95	35	13.5	49.8	312	340	91.8
116	10	19.00	36	13.6	50.0	312	340	91.8
117	50	19.01	29	12.8	49.7	307	340	90.4
118	50	19.02	32	11.9	49.6	298	340	87.7
119	50	19.03	36	13.8	48.8	321	340	94.3
120	50	19.04	36	13.9	49.5	317	340	93.1
121	50	19.05	34	13.2	49.2	309	340	91.0
122	50	19.06	31	11.6	49.3	302	340	88.7
123	50	19.07	31	11.4	49.1	299	340	87.9
124	50	19.08	32	11.9	49.2	300	340	88.3
125	50	19.09	32	12.3	49.1	302	340	89.0
126	50	19.10	31	11.8	48.8	300	340	88.3
127	50	19.11	32	11.9	48.8	298	340	87.6
128	50	19.12	34	13.3	48.8	312	340	91.7
129	50	19.13	35	13.5	48.7	312	340	91.8
130	50	19.14	35	13.5	48.9	309	340	90.8
131	50	19.15	35	13.5	48.9	306	340	89.9
132	50	19.16	35	13.6	48.2	311	340	91.4
133	50	19.17	35	13.7	49.1	304	340	89.5
134	50	19.18	35	13.1	49.0	291	340	85.7
135	50	19.19	35	13.5	47.8	308	340	90.7
136	50	19.20	35	13.3	48.7	300	340	88.4
137	50	19.21	35	13.5	48.3	299	340	87.9
138	50	19.22	35	13.5	49.1	297	340	87.2

139	50	19.23	35	13.2	48.0	297	340	87.3
140	50	19.24	35	13.6	48.3	308	340	90.6
141	50	19.25	35	13.6	48.4	302	340	88.9
142	50	19.26	35	13.5	48.1	301	340	88.4
143	50	19.27	35	13.6	48.5	304	340	89.5
144	50	19.28	35	13.4	48.0	299	340	87.9
145	50	19.29	35	13.4	49.0	294	340	86.5
146	50	19.30	35	13.8	47.3	320	340	94.1
147	50	19.31	35	13.6	48.3	302	340	88.7
148	50	19.32	36	13.7	47.9	309	340	90.8
149	50	19.33	35	13.5	48.5	301	340	88.7
150	50	19.34	35	13.3	48.1	299	340	87.9
151	50	19.35	36	13.6	47.7	303	340	89.0
152	50	19.36	35	13.6	48.3	302	340	88.9
153	50	19.37	35	13.7	48.0	311	340	91.5
154	50	19.38	35	13.5	47.9	299	340	88.1
155	50	19.39	36	13.8	47.7	314	340	92.4
156	50	19.40	34	13.5	48.5	289	340	85.0
157	50	19.41	35	13.6	47.5	302	340	88.9
158	50	19.42	36	13.6	47.9	305	340	89.8
159	50	19.43	35	13.3	48.4	297	340	87.3
160	50	19.44	35	13.4	47.5	301	340	88.5
161	50	19.45	35	13.3	47.9	300	340	88.1
162	50	19.46	35	13.4	47.8	302	340	88.9
163	50	19.47	36	13.6	47.1	308	340	90.5
164	50	19.48	36	13.7	48.1	309	340	90.9
165	50	19.49	36	13.7	47.7	310	340	91.3
166	50	19.50	35	13.2	47.7	299	340	87.9
		Average	35	13.3	48.4	304	340	89.4
		Std Dev	2	0.6	0.6	7	0	1.9
		Maximum	36	13.9	49.7	321	340	94.3
		Minimum	29	11.4	47.1	289	340	85.0

N-value: 50

Sample Interval Time: 71.52 seconds.

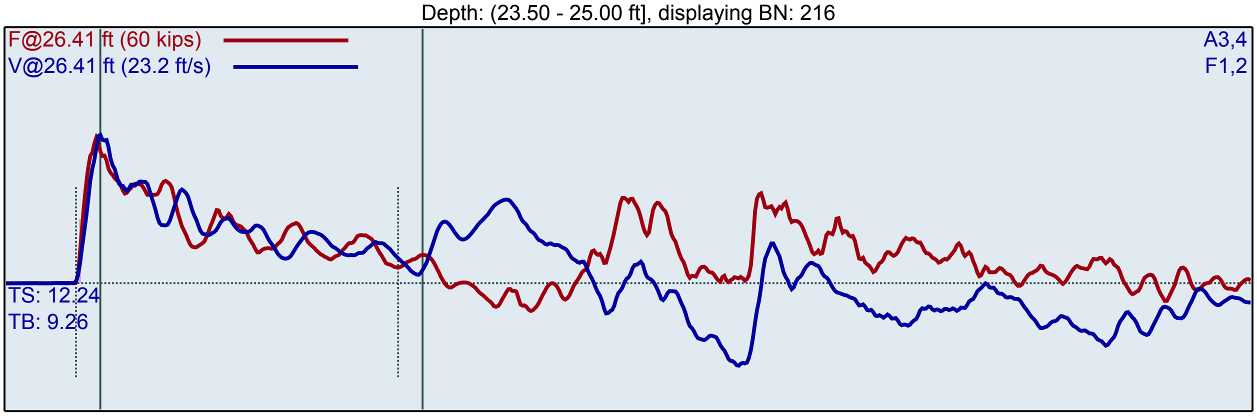
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 26.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (23.50 - 25.00 ft], displaying BN: 216



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ER ft-lb	ETR %
167	2	23.75	34	14.7	1.9	315	340	92.7
168	2	24.00	34	13.1	50.1	354	340	104.2
169	50	24.01	34	13.3	50.8	316	340	93.1
170	50	24.02	35	13.4	50.8	316	340	92.9
171	50	24.03	35	13.4	50.2	317	340	93.1
172	50	24.04	35	13.2	50.4	314	340	92.3
173	50	24.05	35	13.3	49.9	320	340	94.0
174	50	24.06	34	13.1	49.7	318	340	93.5
175	50	24.07	35	13.3	49.9	319	340	94.0
176	50	24.08	35	13.6	49.7	325	340	95.6
177	50	24.09	35	13.6	49.4	318	340	93.6
178	50	24.10	35	13.4	49.0	317	340	93.1
179	50	24.11	35	13.3	49.0	316	340	93.1
180	50	24.12	35	13.3	48.8	317	340	93.3
181	50	24.13	35	13.9	48.8	320	340	94.1
182	50	24.14	34	14.0	48.1	320	340	94.2
183	50	24.15	34	13.9	48.9	313	340	92.0
184	50	24.16	34	13.2	47.7	312	340	91.8
185	50	24.17	35	13.3	48.2	313	340	92.0
186	50	24.18	35	13.6	48.1	319	340	93.8
187	50	24.19	34	13.5	48.4	317	340	93.2
188	50	24.20	32	12.4	48.3	307	340	90.4
189	50	24.21	35	13.5	47.6	320	340	94.2
190	50	24.22	35	13.4	48.5	317	340	93.1
191	50	24.23	34	13.4	48.1	314	340	92.4
192	50	24.24	35	13.4	48.2	314	340	92.2
193	50	24.25	34	13.2	48.2	306	340	89.9
194	50	24.26	34	13.9	47.5	315	340	92.7
195	50	24.27	33	12.9	48.1	314	340	92.3
196	50	24.28	34	13.7	48.0	314	340	92.3
197	50	24.29	34	14.2	48.0	313	340	92.2

198	50	24.30	34	13.2	47.6	312	340	91.8
199	50	24.31	34	13.4	47.2	320	340	94.2
200	50	24.32	34	13.7	48.5	315	340	92.6
201	50	24.33	33	13.2	47.7	307	340	90.2
202	50	24.34	34	13.5	47.0	314	340	92.4
203	50	24.35	35	13.5	47.4	315	340	92.6
204	50	24.36	35	13.5	47.9	311	340	91.5
205	50	24.37	35	13.5	47.5	311	340	91.4
206	50	24.38	34	13.3	47.7	303	340	89.0
207	50	24.39	34	13.0	46.9	301	340	88.6
208	50	24.40	35	13.2	47.3	300	340	88.2
209	50	24.41	35	13.5	46.8	305	340	89.6
210	50	24.42	34	13.0	47.2	301	340	88.4
211	50	24.43	35	13.3	46.8	303	340	89.0
212	50	24.44	34	13.1	47.1	299	340	88.1
213	50	24.45	34	13.2	46.5	307	340	90.2
214	50	24.46	33	13.1	47.5	296	340	87.1
215	50	24.47	34	14.0	46.4	311	340	91.4
216	50	24.48	34	13.4	47.1	303	340	89.0
217	50	24.49	34	13.2	8.2	307	340	90.3
218	50	24.50	34	12.9	48.7	308	340	90.5
		Average	34	13.4	47.4	312	340	91.8
		Std Dev	1	0.3	5.7	7	0	1.9
		Maximum	35	14.2	50.8	325	340	95.6
		Minimum	32	12.4	8.2	296	340	87.1

N-value: 50

Sample Interval Time: 69.46 seconds.

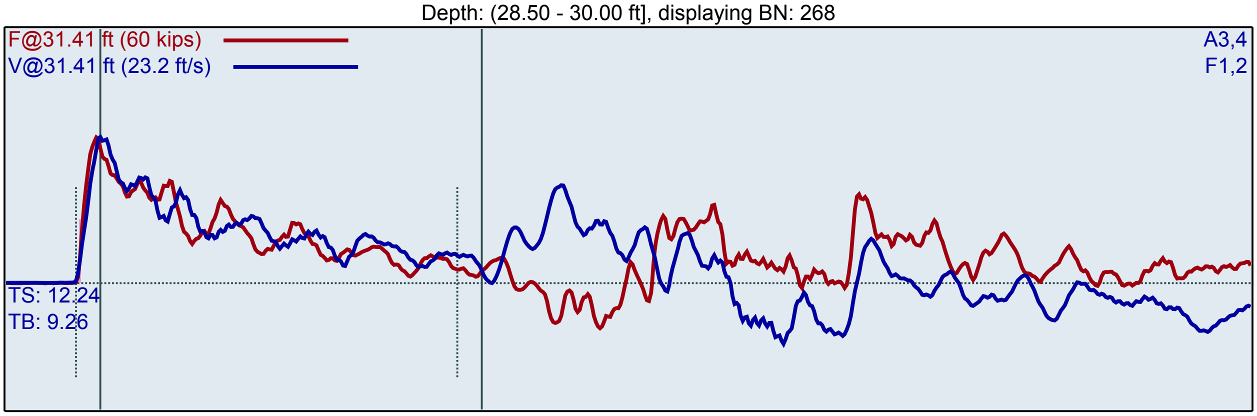
Texas Geo Bore Drilling 10.17.20 TCP
CM
TCP

8.5-10
Interval start: 10/17/2020

AR: 1.45 in^2
LE: 31.41 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (28.50 - 30.00 ft], displaying BN: 268



F1 : [256NWJ1] 213.44 PDICAL (1) FF1
F2 : [256NWJ2] 211.56 PDICAL (1) FF1

A3 (PR): [K11547] 377 mv/6.4v/5000g (1) VF1
A4 (PR): [K11546] 403 mv/6.4v/5000g (1) VF1

BL#	BC	LP	FMX	VMX	BPM	EFV	ER	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	ft-lb	%
220	2	29.00	33	16.1	58.1	319	340	93.9
221	50	29.01	34	13.3	49.5	321	340	94.6
223	50	29.03	34	13.4	50.4	318	340	93.4
224	50	29.04	34	13.2	50.5	314	340	92.4
225	50	29.05	33	13.3	50.4	321	340	94.3
226	50	29.06	34	13.6	49.9	339	340	99.8
227	50	29.07	34	13.5	50.2	324	340	95.2
228	50	29.08	35	13.7	49.8	330	340	96.9
229	50	29.09	35	13.6	49.9	324	340	95.3
230	50	29.10	34	13.6	49.5	327	340	96.1
231	50	29.11	34	13.9	49.9	333	340	98.1
232	50	29.12	34	13.6	49.5	335	340	98.4
233	50	29.13	35	13.7	49.4	332	340	97.7
234	50	29.14	35	13.6	49.5	325	340	95.6
235	50	29.15	35	13.8	48.5	329	340	96.7
236	50	29.16	35	13.6	49.5	323	340	95.0
237	50	29.17	35	13.7	48.0	330	340	97.0
238	50	29.18	35	13.8	48.4	334	340	98.2
239	50	29.19	35	13.7	49.3	321	340	94.3
240	50	29.20	35	13.7	47.9	327	340	96.3
241	50	29.21	34	14.0	47.9	357	340	105.0
242	50	29.22	35	13.9	48.4	331	340	97.2
243	50	29.23	35	13.6	47.9	327	340	96.1
244	50	29.24	35	13.6	48.4	325	340	95.5
245	50	29.25	35	13.6	48.5	318	340	93.7
246	50	29.26	34	13.8	47.7	329	340	96.7
247	50	29.27	34	13.6	48.2	325	340	95.7
248	50	29.28	35	13.5	47.9	312	340	91.9
249	50	29.29	35	13.7	47.7	324	340	95.4
250	50	29.30	35	13.7	48.2	322	340	94.7
251	50	29.31	35	13.6	47.6	322	340	94.8

252	50	29.32	35	13.8	47.4	328	340	96.5
253	50	29.33	35	13.9	47.7	330	340	96.9
254	50	29.34	35	13.6	47.5	337	340	99.3
255	50	29.35	35	13.7	48.2	327	340	96.2
256	50	29.36	34	13.4	47.8	318	340	93.5
257	50	29.37	35	13.6	47.3	328	340	96.6
258	50	29.38	34	13.2	48.2	314	340	92.3
259	50	29.39	34	12.9	47.3	312	340	91.7
260	50	29.40	34	13.2	47.8	318	340	93.6
261	50	29.41	33	12.9	48.1	312	340	91.8
262	50	29.42	34	13.1	47.4	313	340	92.2
263	50	29.43	33	12.9	47.3	310	340	91.2
264	50	29.44	33	13.0	47.4	314	340	92.2
265	50	29.45	33	12.6	47.8	305	340	89.6
266	50	29.46	33	13.0	47.6	310	340	91.2
267	50	29.47	34	13.4	46.9	320	340	94.2
268	50	29.48	34	13.3	47.2	318	340	93.5
269	50	29.49	34	13.3	47.5	314	340	92.5
270	50	29.50	34	13.2	47.1	312	340	91.7
		Average	34	13.5	48.4	323	340	95.1
		Std Dev	1	0.3	1.0	9	0	2.7
		Maximum	35	14.0	50.5	357	340	105.0
		Minimum	33	12.6	46.9	305	340	89.6

N-value: 49

Sample Interval Time: 61.96 seconds.

Appendix D Boring Logs

D.1 Key to Terms and Descriptions

PROJECT NAME: Escondido FRS 12	DATES DRILLED: 6/14/2023 - 6/16/2023	TEST HOLE LEGEND
PROJECT NO: 60707508	NUMBER OF HOLES DRILLED: 4	PAGE 1 OF 1
LOCATION: Karnes City, TX	TOTAL LENGTH DRILLED (ft): 117	

DEPTH (ft)	SOIL SAMPLES: SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (%)	STRATIGRAPHY	MATERIAL DESCRIPTION AND REMARKS	LITHOLOGY	ROCK CORE: BOX NUMBER	RUN NUMBER	RECOVERY (%)	RQD (%)	FRACTURES PER FOOT
1	2	3	4	5	6	7	8	9	10	11	12	13

COLUMN DESCRIPTIONS

1 **Depth:** Depth in feet below the ground surface.

2 **Sample Symbol:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

3 **Sample Type and Number:** Indicates the type of sampler used and identification number.

4 **Blow Counts:** Number of blows required to advance sampler each 6-inch interval, or length noted, using a 140-lb hammer falling 30-inches. N-value reported for SPT samples.

5 **Recovery:** Percentage of driven soil sample length actually recovered.

6 **Stratigraphy:** Abbreviation for soil depositional environment of rock formation name.

7 **Material Description and Remarks:** Description of material encountered; may include density/consistency, moisture, color, material type, grain size and other remarks.

8 **Lithology:** Graphic depiction of soil material or rock type encountered; typical symbols are explained below..

9 **Box Number:** Indicates core sample box number.

10 **Run Number:** Indicates core sample run number.

11 **Recovery:** Percentage of core run length actually recovered.

12 **RQD:** Rock Quality Designation; Percentage of intact rock core (pieces of sound core greater than 100 millimeters or about 4 inches long) in each core run.

13 **Fractures per Foot:** Approximate number of rock core fractures per foot.

TYPICAL SOIL MATERIAL GRAPHIC SYMBOLS

- High Plasticity Clay
- Low Plasticity Clay
- Silty Clay (half silt, half clay)
- Clayey Sand
- Silty clayey SAND
- Silty Sand
- Poorly-graded Sand with clay
- Poorly-graded Sand

TYPICAL ROCK MATERIAL GRAPHIC SYMBOLS

- Sandstone

TYPICAL SAMPLER GRAPHIC SYMBOLS

- P: TX Push Tube
- RC: Rock Core
- SS: Split Spoon
- ST: Shelby Tube

WATER LEVEL LEGEND

- Water Level at Time of Drilling, or as Shown
- Water Level at End of Drilling, or as Shown
- Water Level After 24 Hours, or as Shown

Recovered Sample Length — Driven Sample Length

ABBREVIATIONS

ATD: At Time of Drilling
NR: No Recovery
NA: Not Applicable
bgs: Below Ground Surface

MINOR SOIL TYPE(s)

"trace" When the soil type's percentage is estimated, using visual/manual procedures, to be between 1 and 15 percent of the total sample.

"with" When the soil type's percentage is estimated, using visual/manual procedures, to be greater than 15 percent and less than 30 percent of the total sample.

"y" When the soil type's percentage is estimated, using visual/manual procedures, to be greater than 30 percent of the total sample.

Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

D.2 Boring Logs

PROJECT NAME: Escondido FRS 12	**DATES DRILLED:** 6/16/23 - 6/16/23	**LOG NO: 201-23**
PROJECT NO: 60707508	**SURFACE ELEVATION (ft):** 326.89	PAGE 1 OF 2 AECOM
LOCATION: Karnes City, TX	**TOTAL DEPTH (ft):** 25	

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran & T. Jackson
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Air Rotary, NQ2 Rock Coring	**AT END OF DRILLING** ---	**HOLE LOCATION:** 130 ft upstream of ASW crest
BIT SIZE/TYPE: 3 7/8" Air Rotary, NQ2 Rock Coring	**AFTER DRILLING** ---	**LATITUDE (deg) or NORTHING (ft):** 28.828406 (deg) 13486740.7(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg) or EASTING (ft):** -97.921891 (deg) 2313679.6(ft)

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	LABORATORY TESTING RESULTS: Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
	0	SS 1	1-3-3 (6)	3.25	56	Very stiff, moist, black, sandy CLAY, with organics, trace iron oxide staining, 3 to 5% sand, 2 to 3% calcareous inclusions, weak reaction to HCl, (CH), [ALLUVIUM/ RESIDUUM] - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs	19		60	40	0	35	65	33
325		ST 2		4.5+	100	- 2 ft: Weak reaction to HCl observed	36	124.7	64	44	0	34	66	
						- 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs								
	5	P 3		4.0	58	- 4 ft: Becomes dark brown, strong reaction to HCl observed	14	122.2			0	38	62	22
320		ST 4		4.0	88	Very stiff, dry, light brown, sandy CLAY, with calcerous fissures and inclusions, strong reaction to HCl, (CL), [OAKVILLE]	13.3	137.1	36	21	0	43	57	
		SS 5	9-9-11 (20)	4.0	75	- 8 ft: Pinkish gray, increase in calcareous fissures and inclusions to 6 to 8% , trace iron oxide staining, becoming sandier, fine to medium grained sand, 8 to 10% sand, strong reaction to HCl observed	10							
	10	P 6		4.0	50	- 10 ft: Weak reaction to HCl observed	12	135.1			0	41	59	24
315		ST 7		4.5+	92		15	133.8	46	32	2	37	61	
	15	SS 8A	4-4-8 (12)	2.25	100		41							
		SS 8B		4.25		Stiff, moist, pinkish gray, sandy CLAY, with fine to coarse calcareous gravel, weak reaction to HCl, (CH), [OAKVILLE]	14				2	23	75	
310	20													

(Continued Next Page)

PROJECT NAME: Escondido FRS 12	**DATES DRILLED:** 6/16/23 - 6/16/23	**LOG NO: 201-23**
PROJECT NO: 60707508	**SURFACE ELEVATION (ft):** 326.89	PAGE 2 OF 2 AECOM
LOCATION: Karnes City, TX	**TOTAL DEPTH (ft):** 25	

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
	20		SS 9	9-12-14 (26)		89	Stiff, moist, pinkish gray, sandy CLAY, with fine to coarse calcareous gravel, weak reaction to HCl, (CH), [OAKVILLE] *(continued)* - 20 ft: Becomes hard, pale brown with trace iron oxide staining, 8 to 10% calcareous gravel, moderate reaction to HCl		18		55	35	2	53	45	22
305																
	25		SS 10	6-12-14 (26)		89	- 23.5 ft: Mottled, 5 to 8% iron bearing minerals, trace organics, weak reaction to HCl observed		21							

Bottom of hole at 25.0 feet. Grout mix: 60 lbs of bentonite, 100 lbs of portland cement, and 150 gal of water. Approximately 35 gal of grout used to backfill hole.

PROJECT NAME: Escondido FRS 12	**DATES DRILLED:** 6/16/23 - 6/16/23	**LOG NO: 202-23**
PROJECT NO: 60707508	**SURFACE ELEVATION (ft):** 335.69	AECOM
LOCATION: Karnes City, TX	**TOTAL DEPTH (ft):** 42	

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran & T. Jackson
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Air Rotary, NQ2 Rock Coring	**AT END OF DRILLING** ---	**HOLE LOCATION:** 100 ft downstream of ASW crest
BIT SIZE/TYPE: 3 7/8" Air Rotary, NQ2 Rock Coring	**AFTER DRILLING** ---	**LATITUDE (deg) or NORTHING (ft):** 28.828354 (deg) 13486724.1(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg) or EASTING (ft):** -97.921084 (deg) 2313938.4(ft)

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
335	0	P 1		4.5+	69	Stiff, dry, dark grayish brown, CLAY, with SAND, with 2 to 3% calcareous inclusions, iron oxide staining, organics in upper portion of sample, strong reaction to HCl, (CL), [ALLUVIUM/ RESIDUUM] - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs	12	131.8	39	24	5	34	61	23
		SS 2	4-4-5 (9)	3 4.5+	78	Loose, dry, light grayish brown, silty SAND, with large calcareous inclusions, gravel up to 7 mm in diameter, strong reaction to HCl, (SM), [ALLUVIUM/ RESIDUUM] - 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs	13							
									31	17	0	53	47	17
							14	124.6	28	14	0	50	50	
330	5	ST 3		4.5+	73									
		SS 4	10-20-21 (41)	2.5	100	Very stiff to hard, moist, brown, sandy CLAY, with 10 to 15% calcareous inclusions, fine to medium grained sand, strong reaction to HCl, (CL), [OAKVILLE]	10		29	13	0	50	50	
		P 5		4.5	52	Medium dense, dry, light yellowish brown, SAND, with SILT, fine to medium grained with calcium carbonate filled veins, strong reaction to HCl, (SP-SM), [OAKVILLE]	7							
325	10	SS 6	12-13-17 (30)	1.75 4.5	100	Loose to medium dense, moist, light yellowish brown, clayey SAND, with 2 to 3% calcareous inclusions at 11 to 11.5 ft, weak reaction to HCl, (SC), [OAKVILLE]	7		31	15	0	58	42	
		SS 7	15-17-21 (38)	4.5+	94	Hard, moist, brown, sandy CLAY, with medium to coarse grained sand stringers, calcareous gravel up to 10 mm, trace iron oxide staining, 5% calcareous inclusions, mottled, weak reaction to HCl, (CH), [OAKVILLE]	19		51	32	0	33	67	25
	15	ST 8		4.5+	79		40	114.8			0	25	75	
320		SS 9	19-50/5"	3	61	Very stiff to hard, dry, light brown, sandy CLAY, with alternating layers of sandy fat clay (CH), strong reaction to HCl, (CL), [OAKVILLE]	12		36	20				
	20					Dense to very dense, dry, light brownish gray, silty to clayey SAND, calcareous, fine to medium grained with trace clayey stringers, strong reaction to HCl, (SC-SM), [OAKVILLE]								

(Continued Next Page)

PROJECT NAME: Escondido FRS 12	**DATES DRILLED:** 6/16/23 - 6/16/23	**LOG NO: 202-23**
PROJECT NO: 60707508	**SURFACE ELEVATION (ft):** 335.69	AECOM
LOCATION: Karnes City, TX	**TOTAL DEPTH (ft):** 42	

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
315	20	SS 10	25-30-50/4"	1.25	69	Dense to very dense, dry, light brownish gray, silty to clayey SAND, calcareous, fine to medium grained with trace clayey stringers, strong reaction to HCl, (SC-SM), [OAKVILLE] *(continued)*	7				2	65	33	
310	25	SS 11	25-38-42 (80)	.75	61	- 25 ft: No clay observed, trace calcareous sand, no significant reaction to HCl observed	8				0	81	19	
						Hard, moist, gray, CLAY, with 3 to 8% iron oxide minerals, trace iron oxide staining, 5 to 8% calcareous gravel, occasional sand stringers, medium to coarse grained sand, strong reaction to HCl, (CH), [OAKVILLE]								
305	30	SS 12	7-8-11 (19)	4.5+	89		23							
		P 13		4.5+	100		22	122.1	61	42	0	9	91	
300	35	SS 14	13-19-27 (46)	4.5+	97	- 35 ft: Some yellow mottling observed	18							
		SS 15	8-12-16 (28)	4.5+	100		25							
295	40	ST 16		4.5+	90		29	110.9	63	44	0	13	87	

Bottom of hole at 42.0 feet. Approximately 50 gal of grout used to backfill hole.

PROJECT NAME: Escondido FRS 12	**DATES DRILLED:** 6/15/23 - 6/15/23	**LOG NO: 203-23**
PROJECT NO: 60707508	**SURFACE ELEVATION (ft):** 330.90	PAGE 1 OF 2
LOCATION: Karnes City, TX	**TOTAL DEPTH (ft):** 30	AECOM

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran & T. Jackson
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Air Rotary, NQ2 Rock Coring	**AT END OF DRILLING** ---	**HOLE LOCATION:** 350 ft downstream of ASW crest
BIT SIZE/TYPE: 3 7/8" Air Rotary, NQ2 Rock Coring	**AFTER DRILLING** ---	**LATITUDE (deg) or NORTHING (ft):** 28.828891 (deg) 13486921.1(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg) or EASTING (ft):** -97.920503 (deg) 2314122.4(ft)

ELEVATION (ft)	DEPTH (ft)	SOIL SAMPLES: SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
330	0	SS 1A SS 1B	3-4-5 (9)	2.75	83	Loose, dry, very dark grayish brown, silty SAND, with trace organics, approximately 15% calcareous sand, strong reaction to HCl, (SM), [ALLUVIUM/ RESIDUUM] - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs	13		31	17	0	59	41	15
		P 2		4.5+	42	Loose, dry, pale brown, SAND, with CLAY, fine grained, with medium plasticity fines, calcareous inclusions, strong reaction to HCl, (SP-SC), [ALLUVIUM/ RESIDUUM]	7	116	35	20	1	12	87	
	5	SS 3	25-50/5"		56	Hard, dry, pale brown, CLAY, with approximately 8 to 10 % calcareous inclusions, trace organics, strong reaction to HCl, (CL), [ALLUVIUM/ RESIDUUM] - 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs	9							
325						Hard, dry, light yellowish brown, CLAY, with SAND, with calcareous inclusions, fine sand stringers, (CL), [OAKVILLE]								
		SS 4	25-35-40 (75)		78	Very dense, dry, pale yellow, silty to clayey SAND, calcareous, very fine to fine grained, with very strong reaction to HCl, (SC-SM), [OAKVILLE]	5				3	58	39	
		SS 5A SS 5B	16-21-25 (46)	4.5	100	Hard, dry, brown, CLAY, with 3 to 5% sand, iron oxide stained fissures, no significant reaction to HCl, (CH), [OAKVILLE]	13							
320	10	ST 6		1.5	54	Stiff, dry, light yellowish brown, sandy CLAY, to sandy SILT, fine to medium grained with low plasticity fines, strong reaction to HCl, (CL-ML), [OAKVILLE]	28	113.9	38	23	0	46	54	
						Stiff, dry, light yellowish brown, sandy CLAY, with no reaction to HCl, (CL), [OAKVILLE]								
		SS 7	16-35-42 (77)		56	Very dense, dry, pale brown, clayey to silty SAND, fine to medium grained, thinly laminated, with iron oxide staining, (SC-SM), [OAKVILLE]	10				2	72	26	
	15	SS 8	12-15-14 (29)	4.5+	100	Hard, moist, light brown, CLAY, mottled, with chert gravel up to 7 mm in diameter, trace iron oxide staining, weak reaction to HCl, (CH), [OAKVILLE]	29		77	51				31
315		SS 9	20-42-48 (90)	4.5+ 3.5	83	Very dense, moist, pale brown, silty SAND, with trace iron minerals, (SM), [OAKVILLE]	23		32	11	7	7	86	
						Hard to stiff, moist, pale brown, CLAY, (CL), [OAKVILLE]								
		ST 10			33		24							
	20	P 11			100		6				0	84	16	

(Continued Next Page)

ELEVATION (ft)	DEPTH (ft)	SAMPLE SYMBOL	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	STRATIGRAPHY	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
	20															
310			SS 12	14-21-19 (40)	1.25	94	Dense, moist, light yellowish brown, clayey to silty SAND, fine to medium grained, with weak HCl reaction, (SC-SM), [OAKVILLE] *(continued)*		10							
			SS 13	18-22-20 (42)	2.0	94	- 23 ft: Clay stringers, weak to no reaction to HCl observed		21				0	69	31	
305	25		SS 14	10-18-25 (43)	4.5+	100	Hard, moist, pinkish gray, CLAY, with sand, calcareous gravel up to 10 mm in diameter, 3 to 5% iron oxide staining and iron minerals, weak reaction to HCl, (CH), [OAKVILLE]		19							
	30		ST 15		4.5+	88	- 28 ft: Becomes light brown, trace iron oxide minerals, weak reaction to HCl observed				56	32	2	14	84	

Bottom of hole at 30.0 feet. Approximately 40 gal of grout used to backfill hole.

PROJECT NAME: Escondido FRS 12	**DATES DRILLED:** 6/14/23 - 6/14/23	**LOG NO: 204-23** PAGE 1 OF 1 AECOM
PROJECT NO: 60707508	**SURFACE ELEVATION (ft):** 329.91	
LOCATION: Karnes City, TX	**TOTAL DEPTH (ft):** 20	

DRILL COMPANY / DRILLER: Texas Geobore / Chris Garcia	**GROUNDWATER LEVELS:**	**LOGGED BY:** Sergio Teran & T. Jackson
DRILL EQUIP: B-57 Mobile	**AT TIME OF:** --- Not Encountered	**CHECKED BY:** Charlie Krolikowski
DRILL METHOD: Air Rotary, NQ2 Rock Coring	**AT END OF DRILLING** ---	**HOLE LOCATION:** 540 ft downstream of ASW crest
BIT SIZE/TYPE: 3 7/8" Air Rotary, NQ2 Rock Coring	**AFTER DRILLING** ---	**LATITUDE (deg) or NORTHING (ft):** 28.828691 (deg) 13486850.3(ft)
CASING DEPTH (ft bgs): N/A	**COMPLETION:** Cement Bentonite Grout	**LONGITUDE (deg) or EASTING (ft):** -97.919813 (deg) 2314344(ft)

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE AND NUMBER	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	RECOVERY (%)	MATERIAL DESCRIPTION AND REMARKS	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	GRAVEL (%)	SAND (%)	FINES - Passing No. 200 Sieve (%)	CLAY - Passing 2 microns (%)
	0	ST ST-1		4.25	54	Hard, moist, black, CLAY, with SAND, with approximately 10% organics, weak reaction to HCl, (CH), [ALLUVIUM/ RESIDUUM] - 0 ft: Bulk sample G-1 collected from 0 to 3 ft bgs	22	120.7	54	33	0	26	74	
		SS SS-2	2-3-5 (8)	2.25	78	- 2 ft: Becomes very stiff with trace iron oxide staining, weak reaction to HCl	21							
						- 3 ft: Bulk sample G-2 collected from 3 to 5 ft bgs			72	51	0	27	73	53
325	5	ST ST-3		4.5+	54	- 4 ft: Becomes dry and dark gray with 3 to 5% calcareous inclusions			62	42	0	25	75	
		P P-4		4.5+	58	Hard, dry, grayish brown, CLAY, with SAND, with 5 to 8% calcareous inclusions, mottled, strong reaction to HCl, (CL), [OAKVILLE]					0	30	70	36
		ST ST-5		4.5+	67	- 8 ft: Becomes moist, 2 to 3% iron oxide staining observed	16	127.5	49	30	0	25	75	
320	10	SS SS-6	5-7-11 (18)	4.5+	89	Hard, dry, grayish brown, CLAY, with calcareous inclusions up to 6 mm, (CH), [OAKVILLE]	21							
		P P-7		4.5+	42	Medium dense, moist, pale brown, clayey to silty SAND, fine to coarse grained, with 10 to 12% calcareous inclusions, non-plastic fines, strong reaction to HCl, (SC-SM), [OAKVILLE]	13				2	56	42	
315	15	RC 1			0	SANDSTONE: - 14 ft to 20 ft: No recovery								
310	20													

Bottom of hole at 20.0 feet.

Appendix E Sample Photographs

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
1	6/16/23

Description:

Boring: 201-23. SS-1.
Depths: 0-1.5 ft.

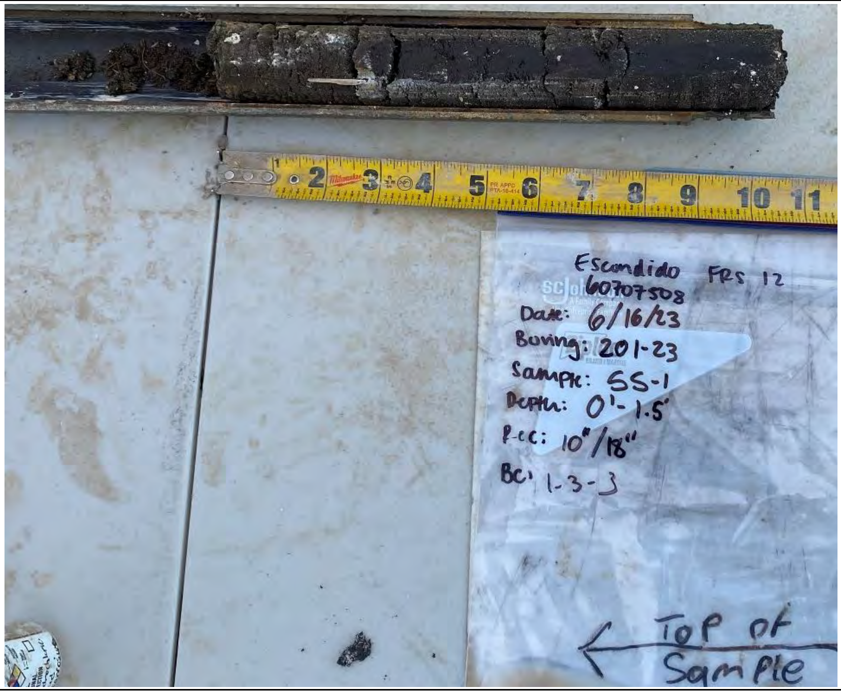


Photo No.	Date:
2	6/16/23

Description:

Boring: 201-23. ST-2.
Depths: 2-3 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
3	6/16/23

Description:

Boring: 201-23. P-3.
Depths: 4-6 ft.

Photo No.	Date:
4	6/16/23

Description:

Boring 201-23. ST-4.
Depths: 6-8 ft.

AECOM		PHOTOGRAPHIC LOG
Client Name: San Antonio River Authority	**Site Location:** Escondido FRS No. 12: Karnes County, TX	**Project No.** 60707508

Photo No.	**Date:**
5	6/16/23

Description:

Boring 201-23. SS-5.
Depths: 8-9.5 ft.

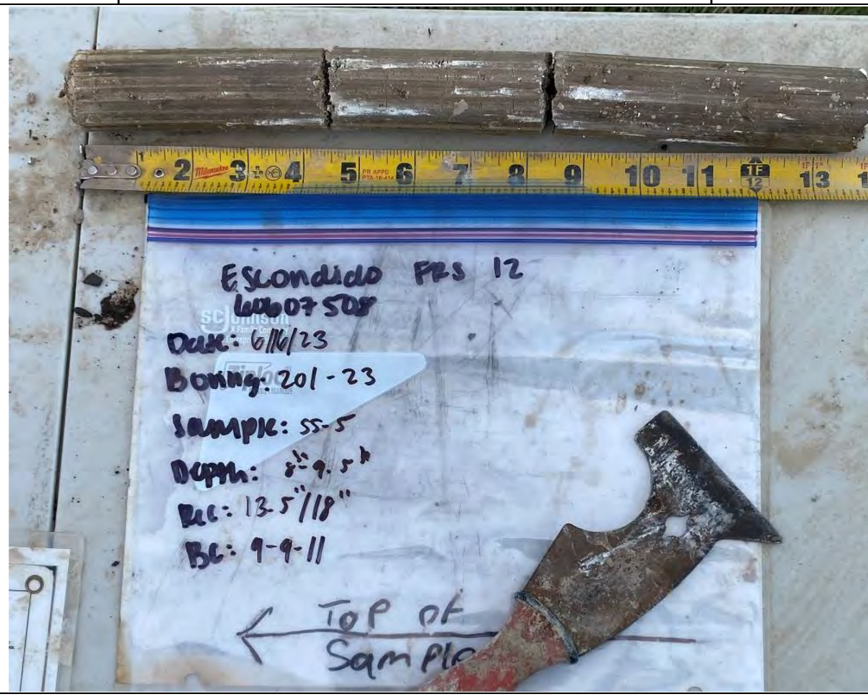
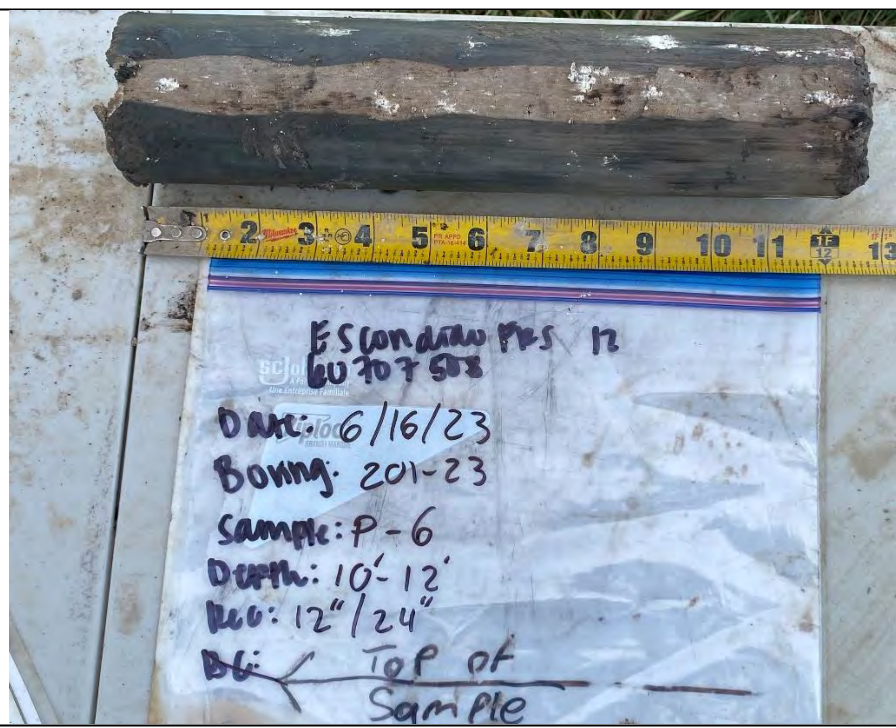


Photo No.	**Date:**
6	6/16/23

Description:

Boring 201-23. P-6.
Depths: 10-12 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
7	6/16/23

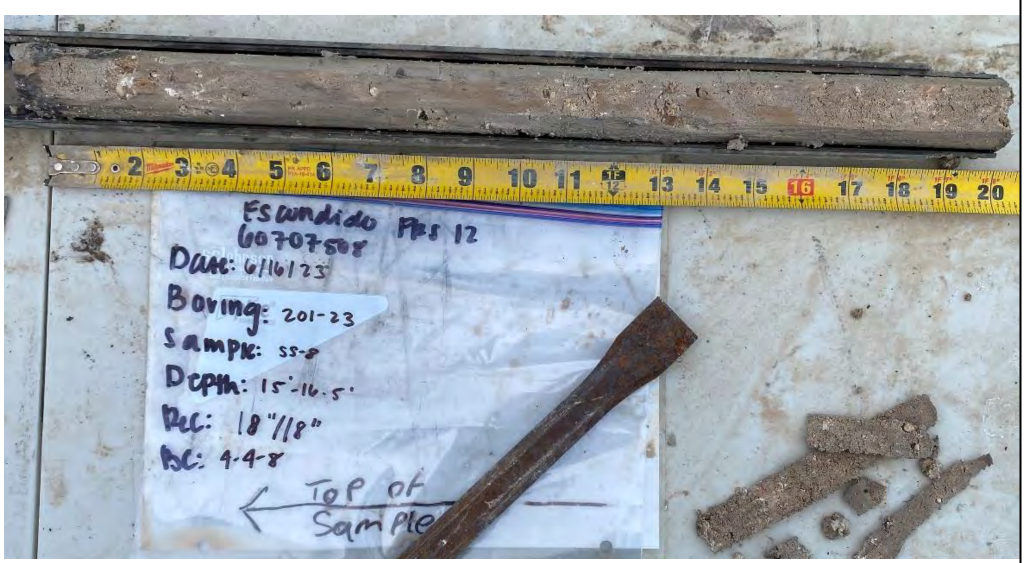
Description:

Boring 201-23. ST-7.
Depths: 12-14 ft.

Photo No.	Date:
8	6/16/23

Description:

Boring 201-23. SS-8.
Depths: 15-16.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
9	6/16/23

Description:

Boring 201-23. SS-9.
Depths: 20-21.5 ft.

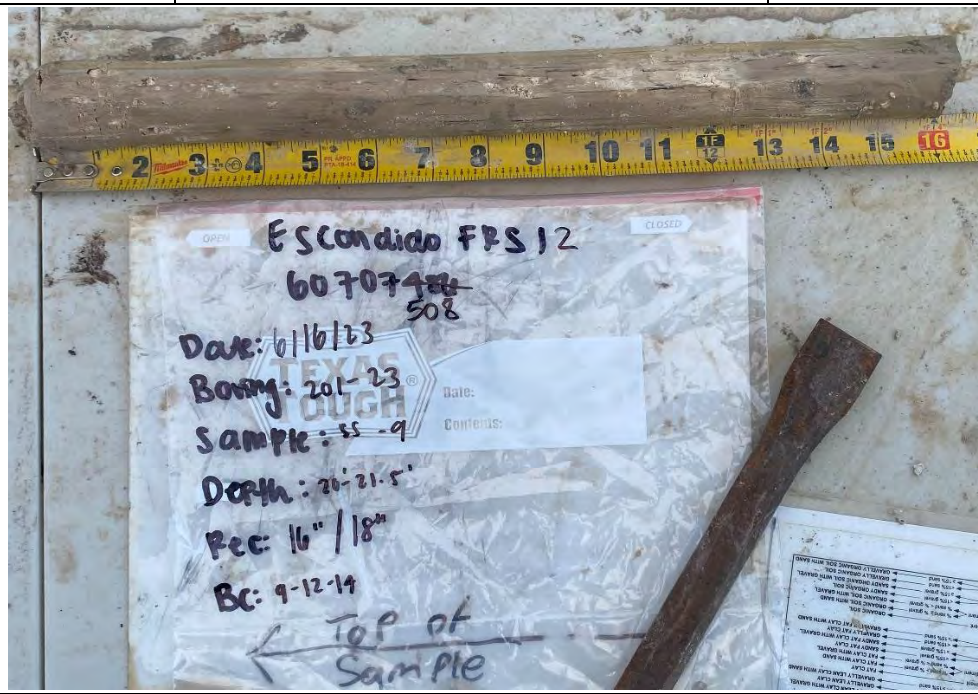


Photo No.	Date:
10	6/16/23

Description:

Boring 201-23. SS-10.
Depths: 23.5-25 ft.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
1	6/16/23

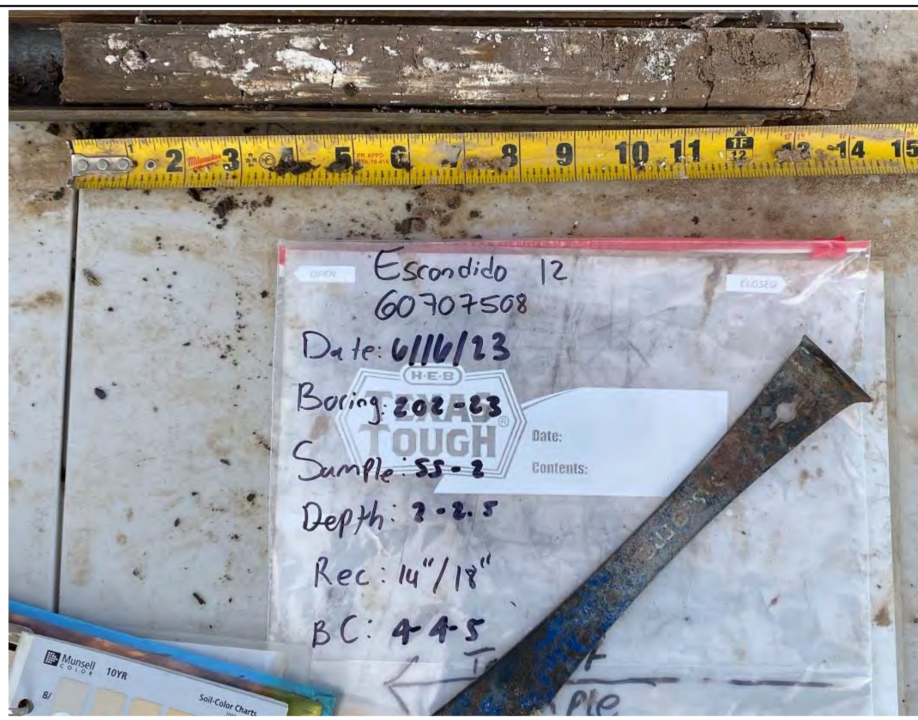
Description:

Boring: 202-23. P-1.
Depths: 0-2 ft.

Photo No.	Date:
2	6/16/23

Description:

Boring: 202-23. SS-2.
Depths: 2-2.5 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
3	6/16/23

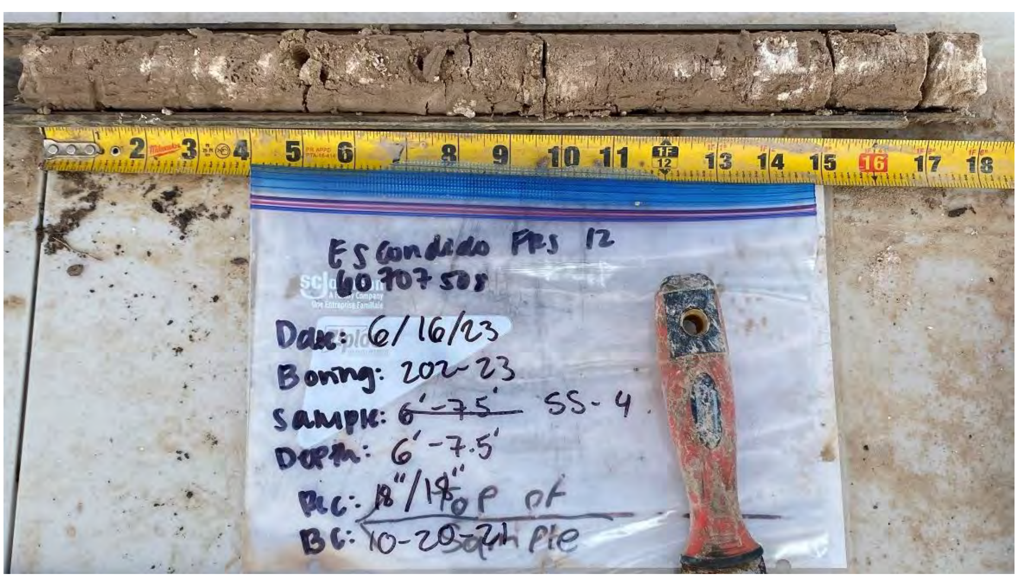
Description:

Boring: 202-23. ST-3.
Depths: 4-6 ft.

Photo No.	Date:
4	6/16/23

Description:

Boring 202-23. SS-4.
Depths: 6-7.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
5	6/16/23

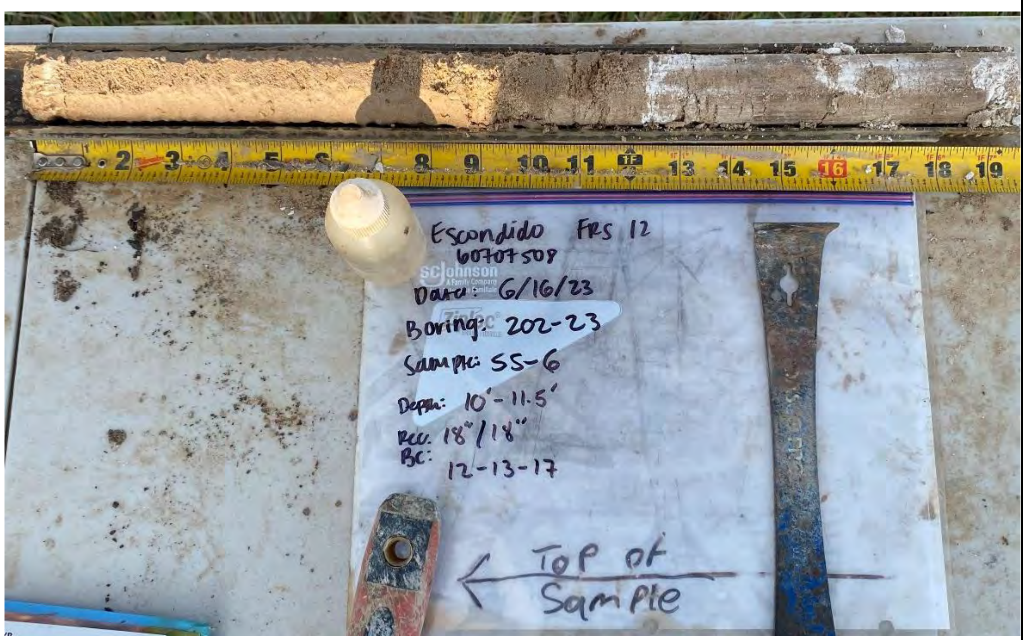
Description:

Boring 202-23. P-5.
Depths: 8-10 ft.

Photo No.	Date:
6	6/16/23

Description:

Boring 202-23. SS-6.
Depths: 10-11.5 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No. 7 **Date:** 6/16/23

Description:

Boring 202-23. SS-7.
Depths: 12-13.5 ft.

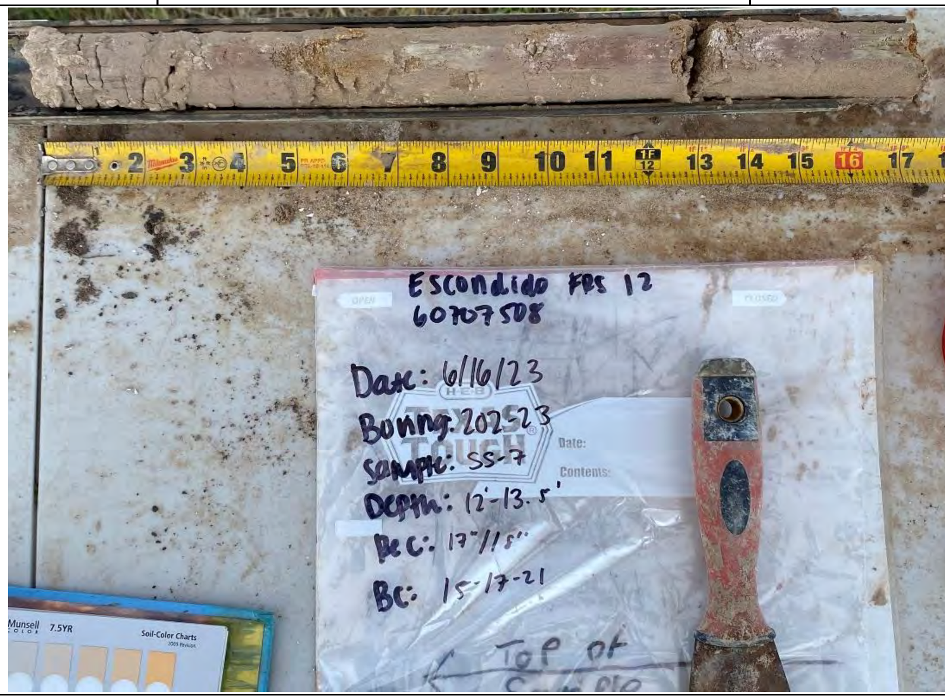


Photo No. 8 **Date:** 6/16/23

Description:

Boring 202-23. ST-8.
Depths: 14-15 ft.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
9	6/16/23

Description:

Boring 202-23. SS-9.
Depths: 15-16.5 ft.

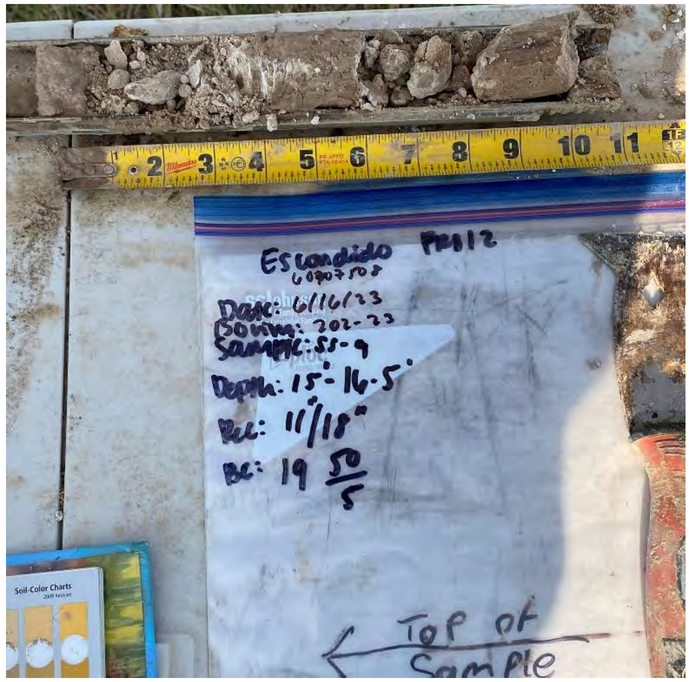


Photo No.	Date:
10	6/16/23

Description:

Boring 202-23. SS-10.
Depths: 20-21.5 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
11	6/16/23

Description:

Boring 202-23. SS-11.
Depths: 25-26.5 ft.

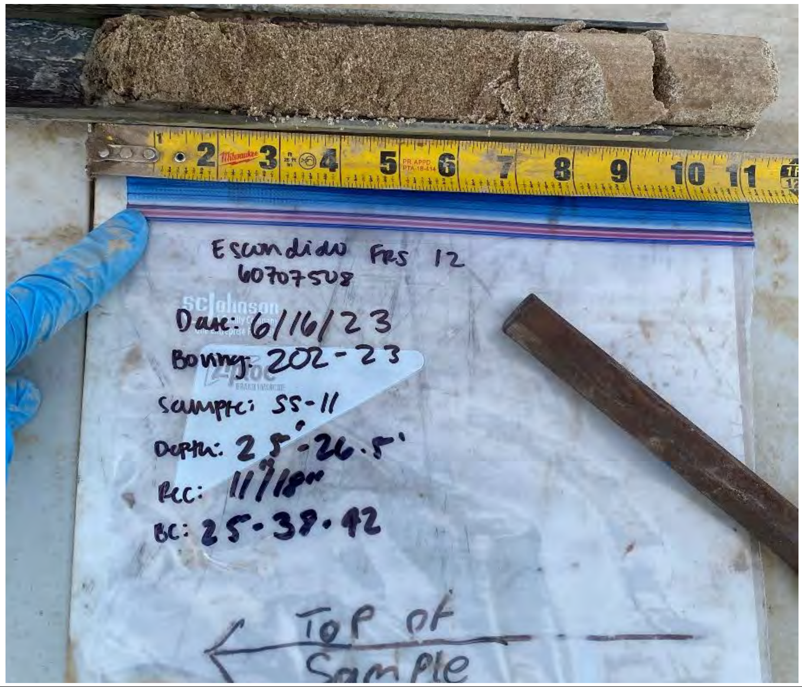


Photo No.	Date:
12	6/16/23

Description:

Boring 202-23. SS-12.
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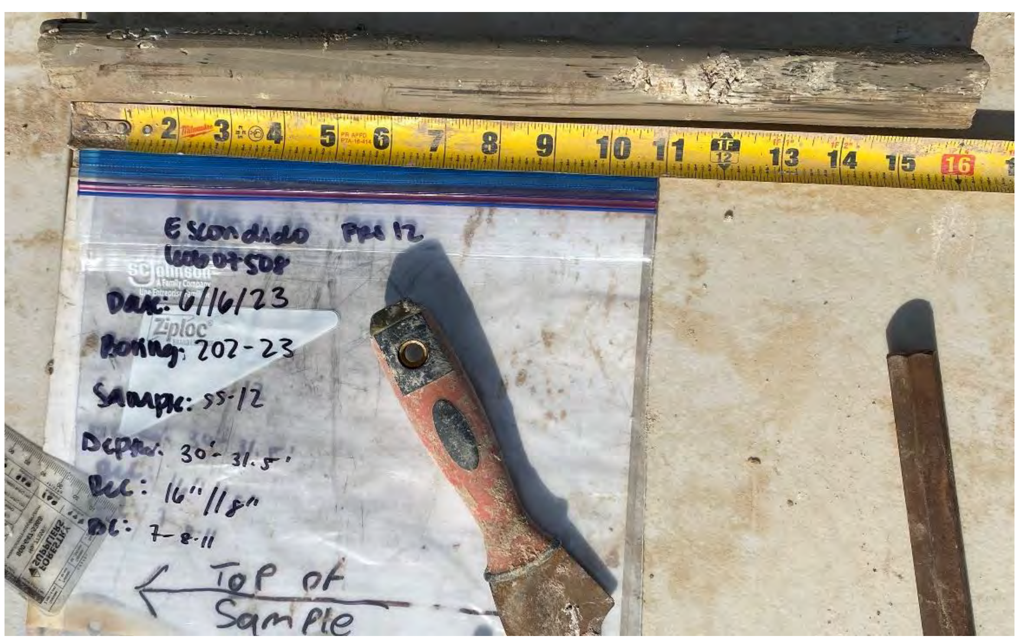


AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
13	6/16/23

Description:

Boring 202-23. ST-13.
Depths: 32-33 ft.

Photo No.	Date:
14	6/16/23

Description:

Boring 202-23. SS-14.
Depths: 35-36.5 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No. 15 **Date:** 6/16/23

Description:

Boring 202-23. ST-15.
Depths: 38.5-40 ft.

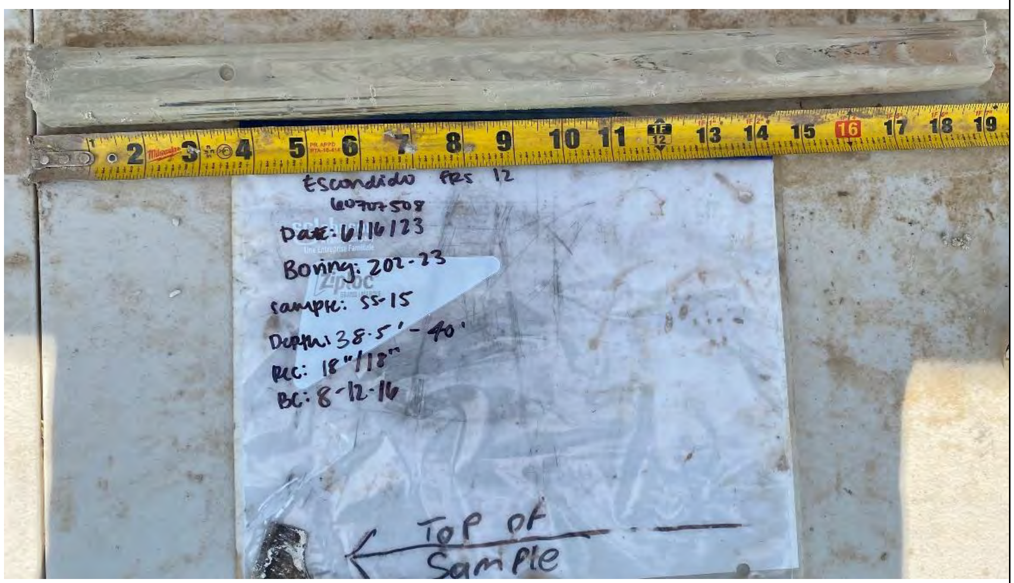


Photo No. 16 **Date:** 6/16/23

Description:

Boring 202-23. ST-16.
Depths: 40-42 ft.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
1	6/15/23

Description:

Boring: 203-23. SS-1.
Depths: 0-1.5 ft.

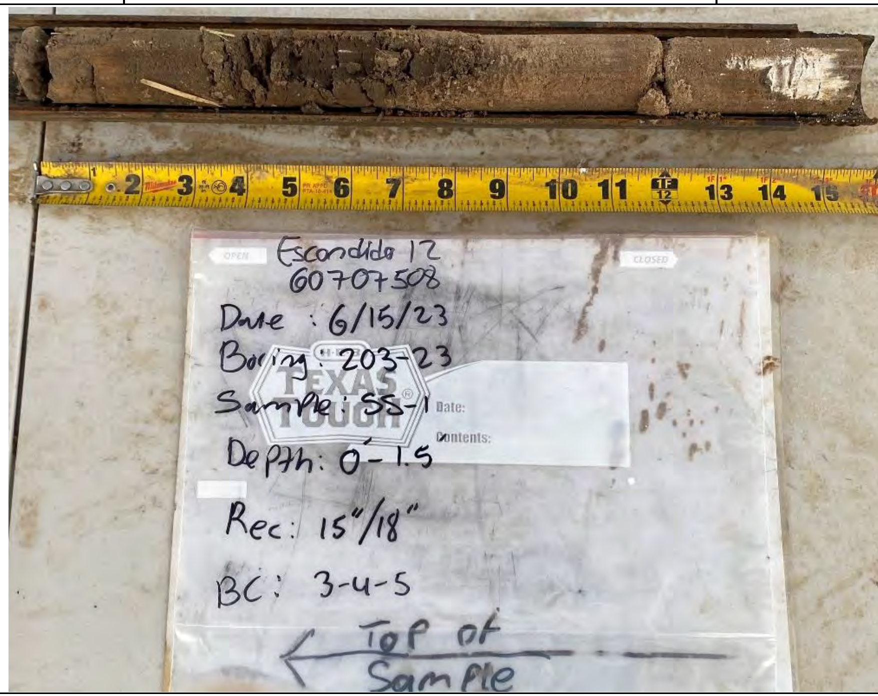
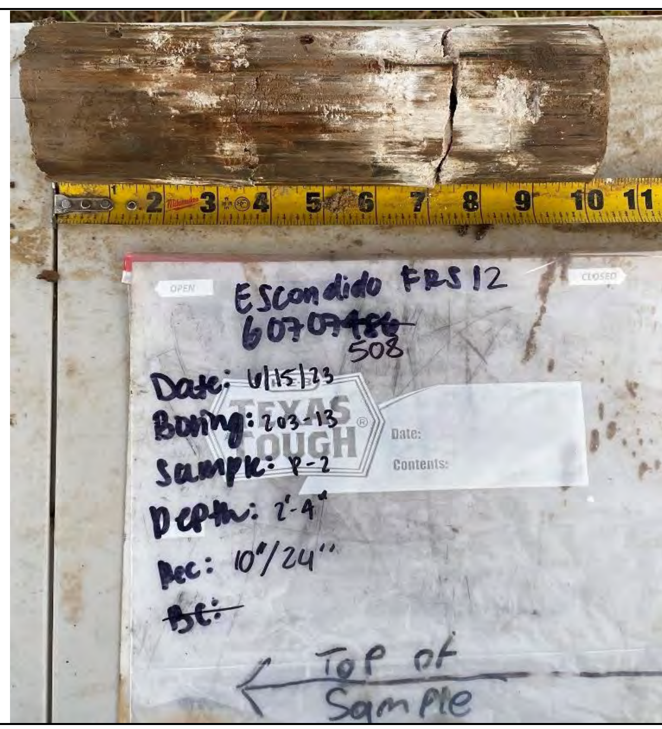


Photo No.	Date:
2	6/15/23

Description:

Boring: 203-23. P-2.
Depths: 2-4 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
3	6/15/23

Description:

Boring: 203-23. SS-3.
Depths: 4-5.5 ft.

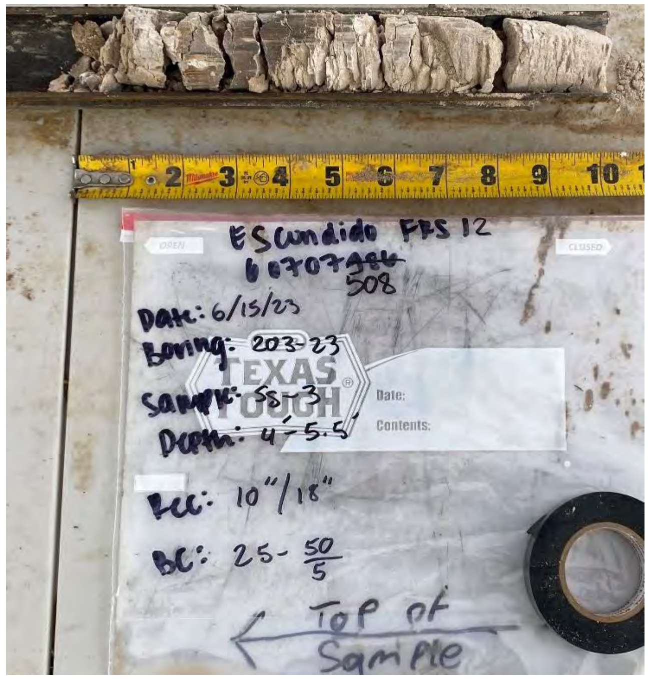
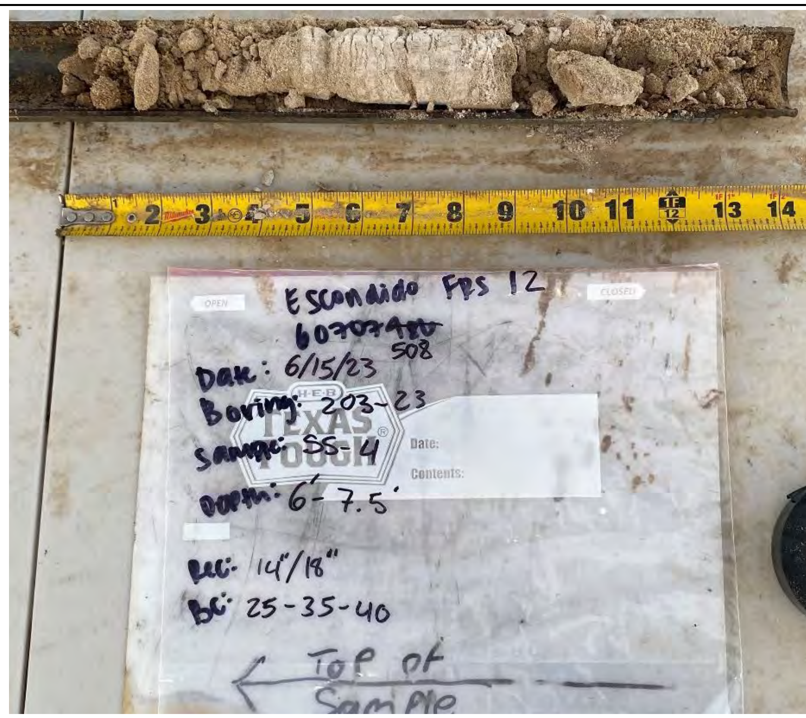


Photo No.	Date:
4	6/15/23

Description:

Boring 203-23. SS-4.
Depths: 6-7.5 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
5	6/15/23

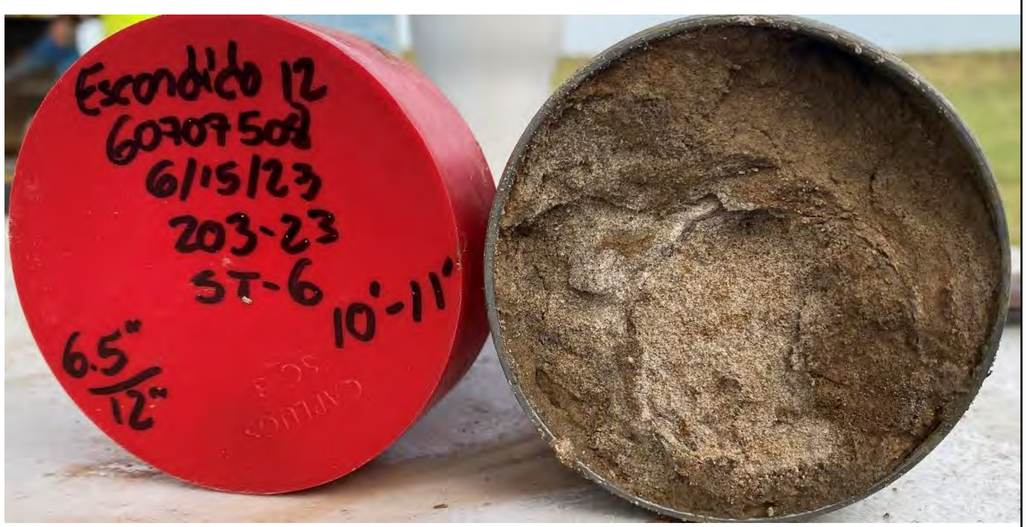
Description:

Boring 203-23. SS-5.
Depths: 8-9.5 ft.

Photo No.	Date:
6	6/15/23

Description:

Boring 203-23. ST-6.
Depths: 10-11 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
7	6/15/23

Description:

Boring 203-23. SS-7.
Depths: 12-13.5 ft.

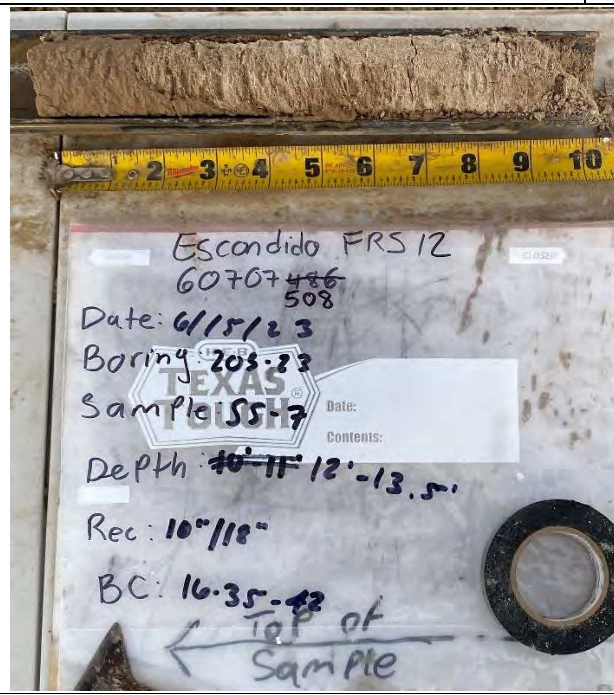
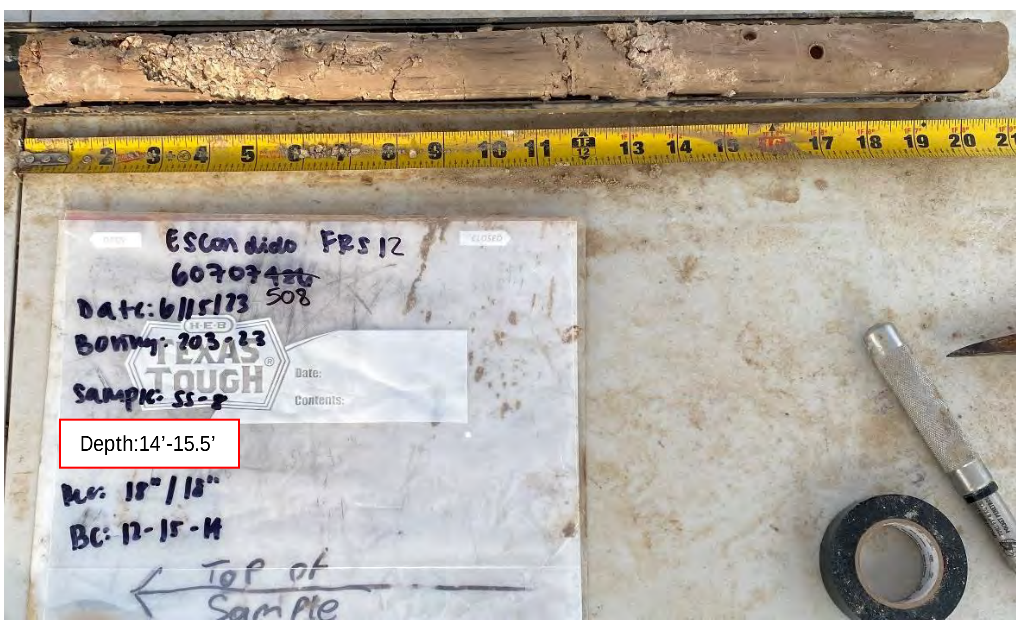


Photo No.	Date:
8	6/15/23

Description:

Boring 203-23. SS-8.
Depths: 14-15.5 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
9	6/15/23

Description:

Boring 203-23. SS-9.
Depths: 16-17.5 ft.

Photo No.	Date:
10	6/15/23

Description:

Boring 203-23. ST-10.
Depths: 17.5-18 ft.
Rec: 2”/6”

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
11	6/15/23

Description:

Boring 203-23. P-11.
Depths: 19-20 ft.

*Sample was field extruded and logged as P-11 after sample was identified as loose silty sand (SM).

Photo No.	Date:
12	6/15/23

Description:

Boring 203-23. SS-12.
Depths: 20-21.5 ft.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
13	6/15/23

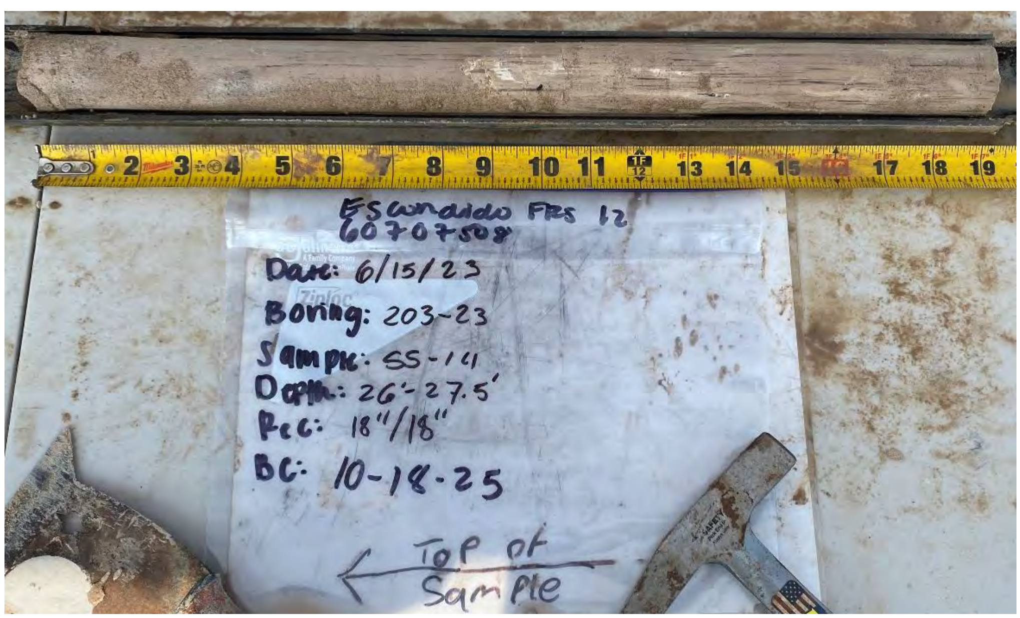
Description:

Boring 203-23. SS-13.
Depths: 23-24.5 ft.

Photo No.	Date:
14	6/15/23

Description:

Boring 203-23. SS-14.
Depths: 26-27.5 ft.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
15	6/15/23

Description:

Boring 203-23. ST-15.
Depths: 28-30 ft.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
1	6/14/23

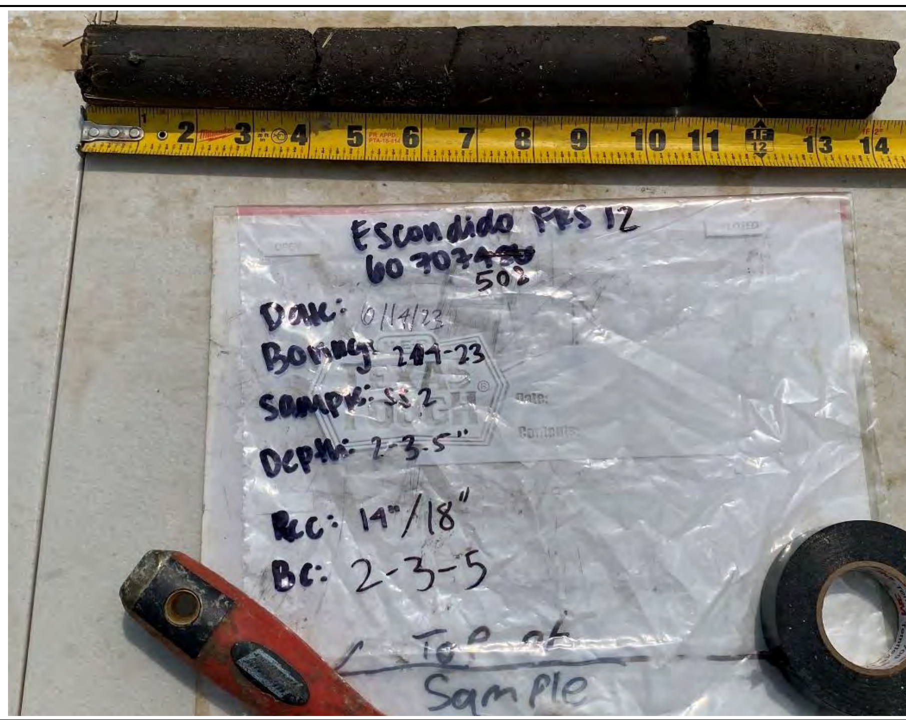
Description:

Boring: 204-23. ST-1.
Depths: 0-2 ft.

Photo No.	Date:
2	6/14/23

Description:

Boring: 204-23. SS-2.
Depths: 2-3.5 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
3	6/14/23

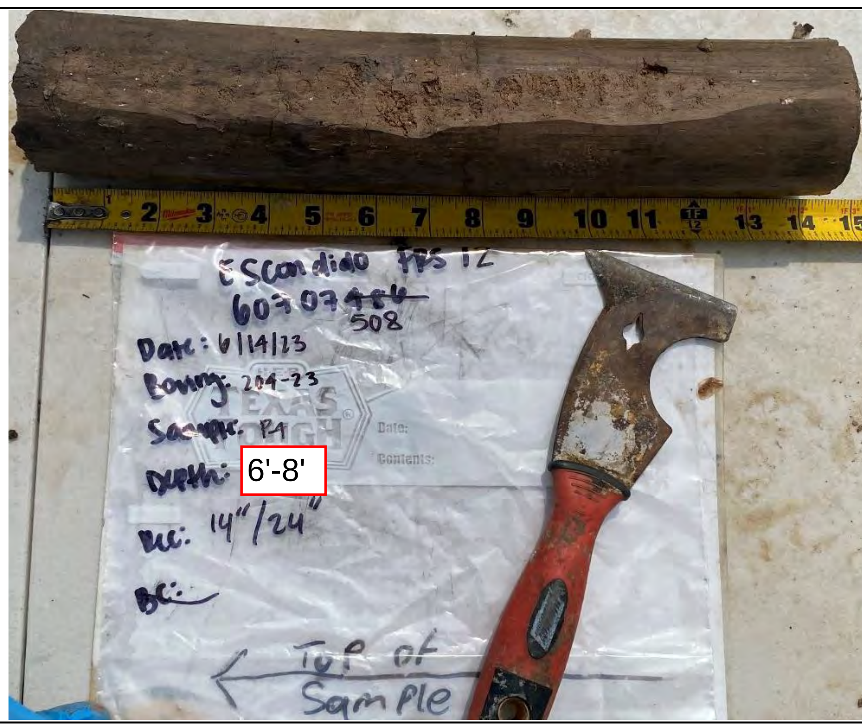
Description:

Boring: 204-23. ST-3.
Depths: 4-6 ft.

Photo No.	Date:
4	6/14/23

Description:

Boring 204-23. P-4.
Depths: 6-8 ft.



PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
5	6/14/23

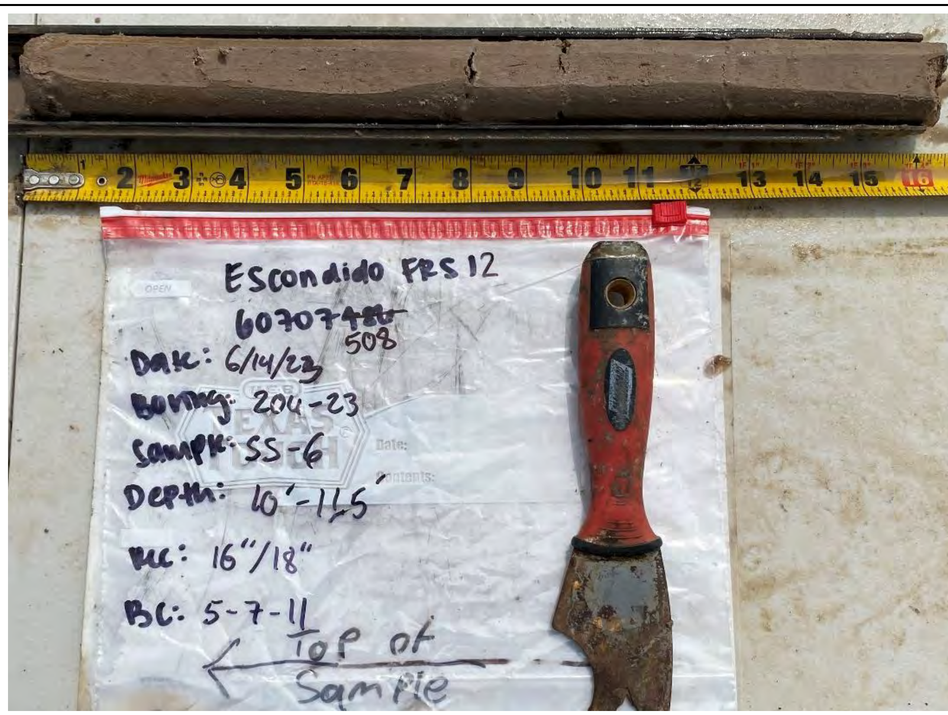
Description:

Boring 204-23. ST-5.
Depths: 8-10 ft.

Photo No.	Date:
6	6/14/23

Description:

Boring 204-23. SS-6.
Depths: 10-11.5 ft.



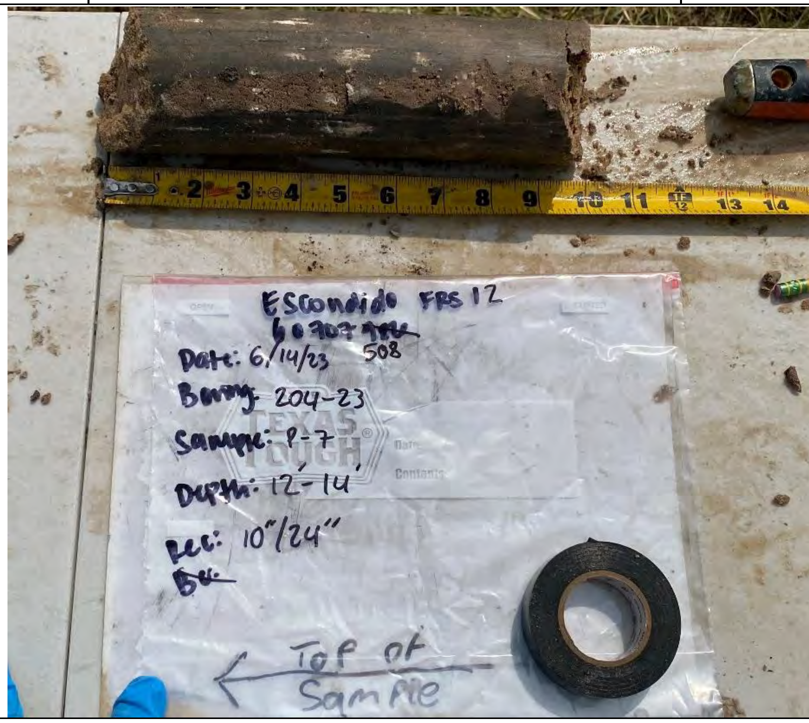
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
San Antonio River Authority	Escondido FRS No. 12: Karnes County, TX	60707508

Photo No.	Date:
7	6/14/23

Description:

Boring 204-23. P-7.
Depths: 12-14 ft.



Appendix F Geologic Profile

PLAN OF GEOLOGIC INVESTIGATIONS

FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

PLAN

0 15 30 60
SCALE IN FEET

NRCS CLASSIFICATION FOR UNCONSOLIDATED & SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
	CLEAN GRAVELS (Less than 5% fines)	
GRAVEL More than 50% of coarse fraction greater than No. 4 sieve size	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	GRAVELS WITH FINES (More than 12% fines)	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	CLEAN SAND (Less than 5% fines)	
SAND More than 50% of coarse fraction smaller than No. 4 sieve size	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
	SP	POORLY-GRADED SANDS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
	SAND WITH FINES (More than 12% fines)	
	SM	SILTY SAND, SAND-SILT MIXTURE
	SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS (more than 50% of material is smaller than No. 200 sieve size.)		
SILTS & CLAYS Liquid limit less than 50%	ML	INORGANIC SILTS WITH SLIGHT PLASTICITY
	CL	INORGANIC CLAY WITH LOW OR MEDIUM PLASTICITY, LEAN CLAY
SILTS & CLAYS Liquid limit Greater than 50%	MH	INORGANIC SILTS WITH ELASTICITY
	CH	INORGANIC CLAY WITH HIGH PLASTICITY, FAT CLAY.

NRCS CLASSIFICATION FOR CONSOLIDATED & SYMBOL CHART

- Low Plasticity Clay
- High Plasticity Clay
- Poorly Graded Sand
- Clayey Sand
- Silty Sand
- Fine to Coarse Grained Sand
- Poorly Graded Sand with Clay

OTHER SYMBOLS

- HOLE LOGGED ONLY
- STRIKE AND DIP
- HOLE SAMPLED
- PIT OR TRENCH

CLASSIFICATION	RANGE OF GRAIN SIZE U.S. standard sieve size
BOULDERS	ABOVE 12"
COBBLES	12" TO 3"
GRAVEL Course Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200
SILT & CLAY	Below No. 200

TEST HOLE NUMBERING SYSTEM

	COMBINA-TION RIG	POWER AUGER	HAND BORINGS	TRENCH OR PIT EXCAVA-TIONS	NATURAL OUTCROPS, STREAMBANKS, AND GULLIES
CENTERLINE OF DAM	1-49	51-99	1001-1099	2001-2099	3001-3099
BORROW AREA	101-149	151-199	1101-1199	2101-2199	3101-3199
AUXILIARY SPILLWAY	201-249	251-299	1201-1299	2201-2299	3201-3299
PRINCIPAL SPILLWAY	301-349	351-399	1301-1399	2301-2399	3301-3399
STREAM CHANNELS	401-449	451-499	1401-1499	2401-2499	3401-3499
EXPLORATORY BORINGS	501-549	551-599	1501-1599	—	—
FOUNDATION DRAIN	601-649	651-699	1601-1699	2601-2699	3601-3699
MISCELLANEOUS	701-749	751-799	1701-1799	2701-2799	3701-3799

ABBREVIATIONS

Ang.	ANGULAR
B.	BEDDED OR BEDDING
Bld.	BOULDERS (> 12")
Calc.	CALCAREOUS
Cali.	CALICHE
Carb.	CARBONATE
Cav.	CAVITIES
Cmt.	CEMENTED
Ch.	CHALK OR CHALKY
C	CLAY, CLAYEY
Cse.	COARSE
Cbl.	COBBLES (3" - 12")
Cpt.	COMPACT
Con.	CONCRETIONS
Cng.	CONGLOMERATE
Cs.	CLAYSTONE
C.T.	CAVED TO
Xln.	CRYSTALLINE
Ds.	DENSE
Dip.	DIPPING
D.S.	DOWNSTREAM
Fe. Stn.	Iron Stains
Flg.	FLAGSTONE OR FLAGGY
Fn.	FINE
Frm.	FIRM
Frac.	FRACTURED
Frg.	FRAGMENTS
Fri.	FRIABLE
Grn.	GRAIN
G	GRAVEL, GRAVELLY
Gyp.	GYPSEOUS
Hd.	ROCK HARDNESS
H.	HIGHLY
Int.	INTERBEDDED
Lam.	LAMINATED
Lay.	LAYER OR LAYERS
Len.	LENS OR LENSES
Lig.	LIGNITE
Ls.	LIMESTONE
Lse.	LOOSE
Ma.	MARL, OR MARLY
Mas.	MASSIVE
Mat.	MATRIX
Med.	MEDIUM
Mic.	MICACEOUS
Mod.	MODERATELY
Nod.	NODULE OR NODULAR
N.R.	NO RECOVERY
O	ORGANIC
Part.	PARTINGS
Peb.	PEBBLE
Per.	PERMEABLE
Po.	POORLY
P.	POORLY GRADED
Rdd.	ROUNDED
S	SAND, SANDY
Ss.	SANDSTONE
Sat.	SATURATED
Sh.	SHALE, OR SHALY
Sl/.	SLIGHTLY
Slo.	SLOWLY
M	SILT, SILTY
Sft.	SOFT
Sl.	SOME
Stf.	STIFF
Str.	STREAKS
T.	THIN
T.B.	THIN - BEDDED
Tuff.	TUFFACEOUS
U.A.D.	UNABLE TO AUGER DEEPER
U.D.B.D.	UNABLE TO DRY BARREL DEEPER
U.E.D.	UNABLE TO EXCAVATE DEEPER
U.S.	UPSTREAM
Var.	VARIABLE
V/.	VERY
Vug.	VUGULAR
Wtr.	WATER LEVEL AS ENCOUNTERED DURING DRILLING PROCESS
W	WELL GRADED
W/.	WITH
Wea.	WEATHERED
▼	(DATE) STATIC WATER LEVEL

DRAWN	ME	DATE	9/5/23
CHECKED	MJ	DATE	9/5/23
APPROVED	LF	DATE	9/5/23

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 3

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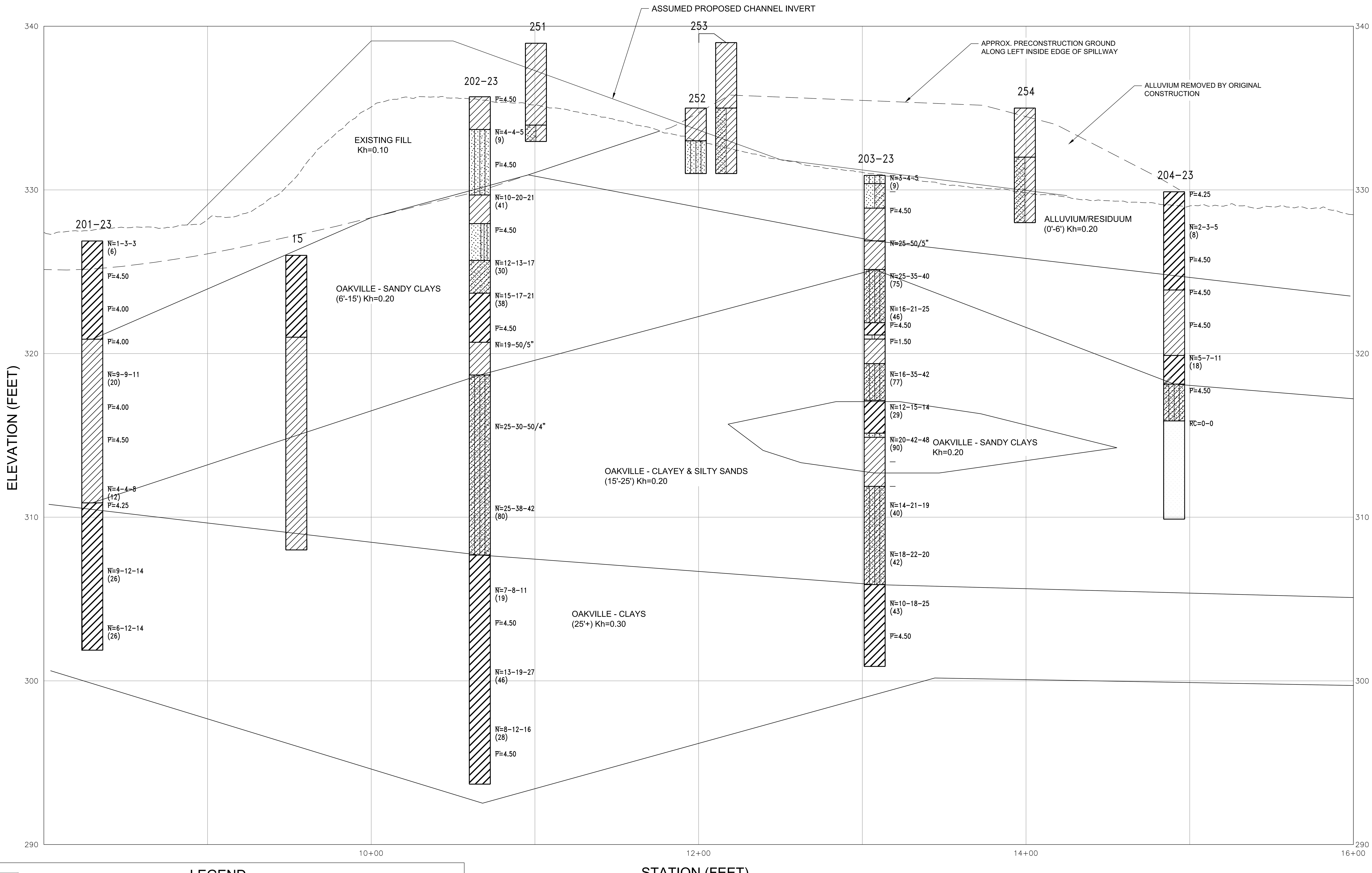

LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Poorly Graded Sand
- Clayey Sand
- Silty Sand
- Fine to Coarse Grained Sand
- Poorly Graded Sand with Clay
- — Sample Top Depth
- N= SPT blows per 6" increment (N-value, bpf)
- P= Pocket Penetrometer (tsf)
- RC= Core Recovery (%) – RQD (%)
- Water Level at Time Drilling, or as Shown
- Water Level at End of Drilling, or as Shown
- Water Level After 24 Hours, or as Shown

HORIZ. 0' 30' 60'
VERT. 0' 3' 6'
SCALE IN FEET

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DRAWN ME DATE 9/5/23
CHECKED MJ DATE 9/5/23
APPROVED LF DATE 9/5/23

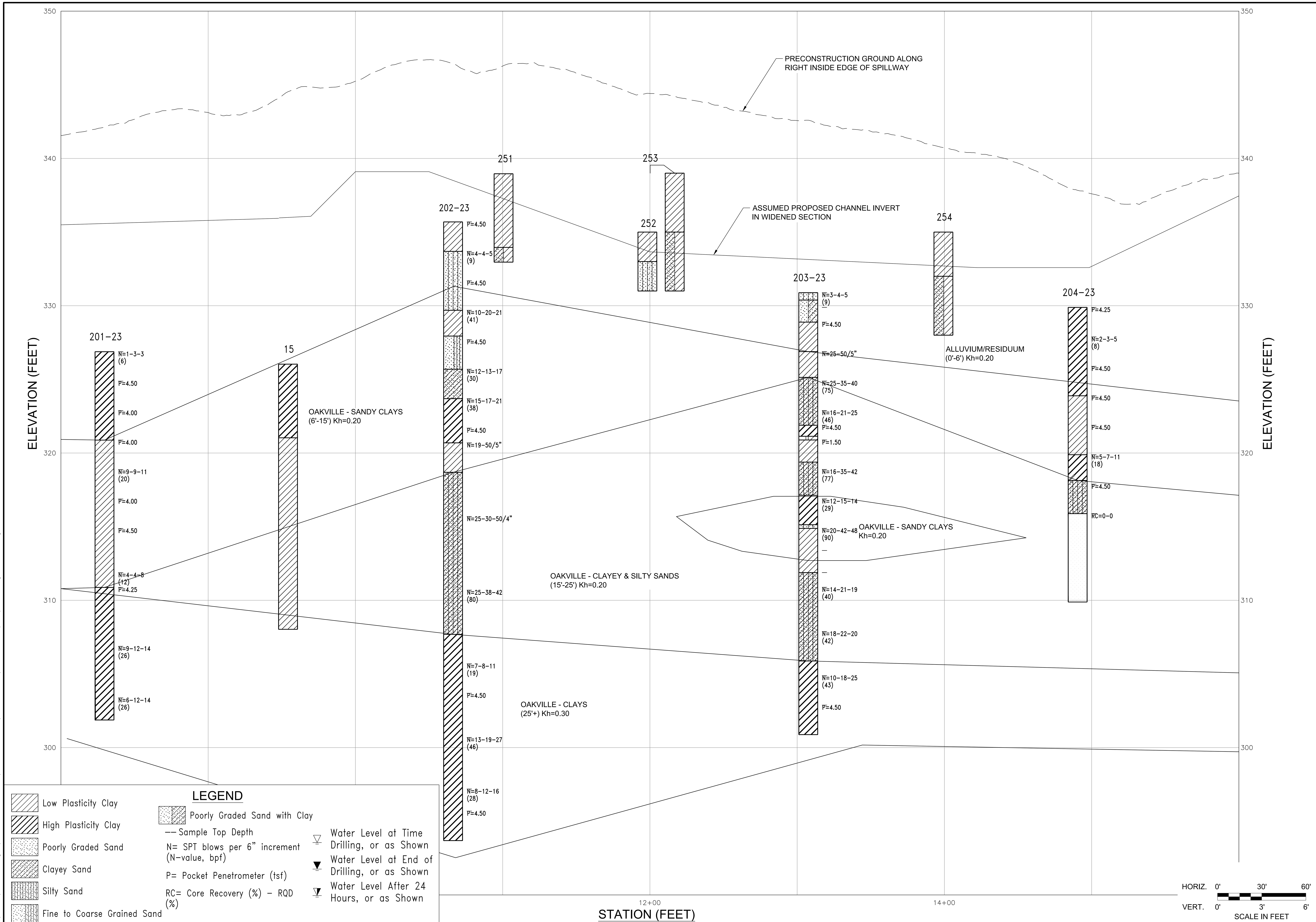
GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
MCLENNAN COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 3



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DRAWN ME DATE 9/5/23
CHECKED MJ DATE 9/5/23
APPROVED LF DATE 9/5/23

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
MCLENNAN COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 3 OF 3

Appendix G Headcut Erodibility Index Calculations

AECOM
13640 Briarwick Drive
Austin, TX 78729
aecom.com

Project name:
Escondido Creek FRS No. 12 SWP-EA,
Karnes County, TX

Project ref:
60707508

To:
Monica Wedo, PE (AECOM)

CC:

Sergio Teran, PG (AECOM)
Charlie Krolikowski, PE (AECOM)

From:
Mariana Jaimes, PE (AECOM)
Lance Finnefrock, PE, GE (AECOM)

Date:
November 16, 2024

Technical Memorandum

Subject: **Recommended Geologic Input Parameters for SITES Analysis**

1. Project Information

1.1 Project Information

A dam assessment report was prepared in 2014 for Escondido Floodwater Retarding Structure (FRS) No. 12 (Escondido 12) by AECOM. As a result of that study, the dam was reclassified as a high hazard dam. The existing dam does not meet current National Resources Conservation Service (NRCS) criteria for high hazard performance and dam safety standards.

The 2014 assessment included several potential rehabilitation alternatives to meet high hazard performance and safety standards ranging from decommissioning to rehabilitation of the dam. The San Antonio River Authority (River Authority) contracted with AECOM to further evaluate these alternatives and other potential alternatives given review of current conditions in Supplemental Watershed Plan No. V - Environmental Assessment (SWP-EA) which was submitted to the River Authority under separate cover.

1.2 Purpose and Scope

Alternatives evaluations typically require analysis of the existing vegetated auxiliary spillway(s) (ASW) for hydraulic capacity and erodibility/potential breaching during design storm event. Hydraulic analysis and design of vegetated earthen spillways for dams are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event.

The purpose of this memorandum is to provide recommendations for geologic input parameters to be used in hydraulic and erodibility analyses of the existing vegetated ASW channel using SITES software for this project.

2. Site Description

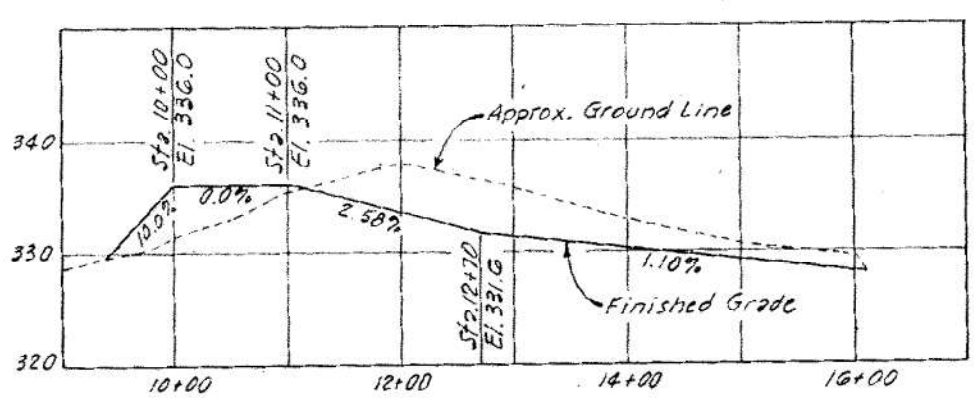
Escondido 12 is located on Bucker Creek, a tributary to Escondido Creek, and a tributary to the San Antonio River, approximately 4.0 miles south of Karnes City, Texas. Global positioning system (GPS) coordinates for the site are latitude 28.830277° and longitude -97.922811°.

Site access is available via an unimproved road off FM 1353, approximately 1 mile northeast of the intersection of FM 1353 and County Road 167 in Karnes County, Texas. Within the site, access is primarily via pastures and unimproved roads. A map of the site is provided as **Figure 1**.

2.1 Existing Dam and Spillway

Escondido 12 was designed and constructed as a low hazard dam in 1974. The dam has an estimated drainage area of approximately 3,904 acres and a total reservoir capacity estimated at 1,844 acre-feet (maximum storage). Escondido 12 was recently reclassified as a high hazard structure and does not meet the current dam design and safety requirements.

According to the as-built drawings, the dam is approximately 34 feet tall at the maximum section and is approximately 2,667 feet long. The crest was built to maximum elevation (El). 343.4* feet in the central portion of the creek valley (including over-build to compensate for post-construction settlement) and tapered to El. 342.2* feet and El. 342.4* feet at the left and right abutments, respectively. The upstream and downstream slopes of the embankment were constructed at an inclination of 2.5H:1V (horizontal:vertical). A 12-foot-wide wave protection berm was constructed on the upstream slope at approximately El. 320.6* feet. A 14-foot-wide berm was constructed on the downstream slope at El. 318.13*. The width of the embankment crest is approximately 14 feet. The dam features a vegetated ASW at the right abutment and a principal spillway (PSW) near the near the original creek alignment. The PSW consists of a drop inlet, four low-level ports with invert El. 322.6* feet, a conduit under the dam, and a rock riprap lined downstream plunge basin. Five (5) anti-seep collars spaced at 24 feet on center are also present.



PROFILE ON ℄ OF EMERGENCY SPILLWAY

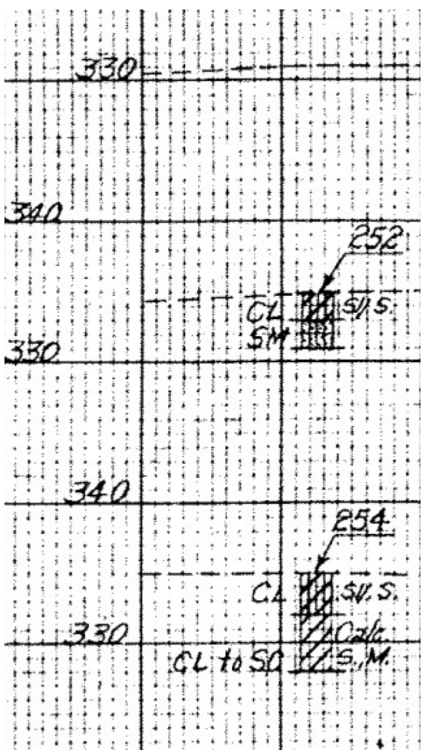
The dam features a vegetated ASW at the right abutment. The existing ASW channel is 300 feet wide and approximately 650 feel long. The ASW crest section is 100 feet long and at Elevation (El.) 336.13* feet according to the North American Vertical Datum of 1988 (NAVD88). The as-built drawings (SCS, 1974) provide limited information on grading of the ASW entrance channel slope, but appears to slope down from the crest at 10% grade in the upstream direction to tie into original ground surface line. The drawings indicate the auxiliary spillway crest

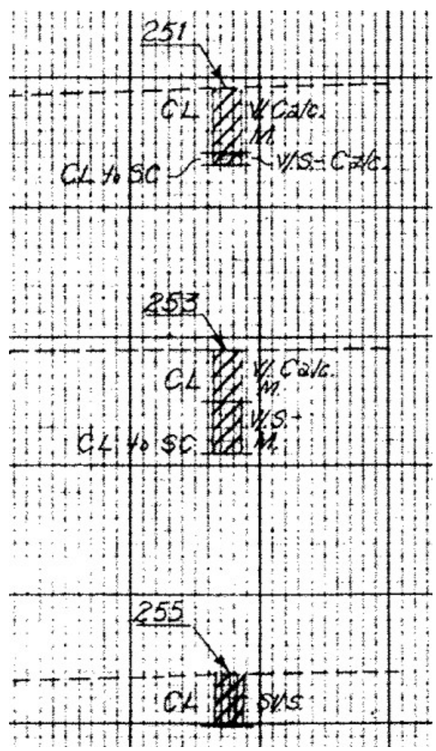
* Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29) and were converted to NAVD88 for the purposes of this report. Conversion from NGVD29 to NAVD88 is +0.134 feet.

was mostly constructed from earthfill having a maximum thickness of about 9.5 feet at the upstream/interior side of the channel. The ASW design is uncommon in that the spillway crest consists of predominantly fill instead of being cut into the abutment, and the earthfill forming the spillway crest is integral with the dam embankment earthfill. The design of the ASW presumably was to provide adequate clearance and soil cover for a pre-existing 18-inch-diameter buried pipeline shown in the as-built drawings that crosses the ASW parallel to the crest.

The fill material source and compaction criteria for the ASW crest was not specified in the as-built drawings (SCS, 1974), but it is likely that material excavated from other areas of the ASW construction were used as the fill source. Further, the 1964 watershed work plan (SCS) indicates that materials excavated from the ASW were suitable for use as fill. Stick logs of borings completed in the ASW during the original GI included in the as-built drawings (SCS, 1974) describe soils in the ASW as interbedded layers of native sandy clays and clayey sands (CL, SC) that are calcareous and very slightly silty.

The ASW exit channel is oriented through the edge of a topographic knoll, where pre-construction ground surface was higher near the middle of the channel and lower at the upstream and downstream ends. The first 170 feet of the exit channel (ASW Sta. 11+00 and Sta. 12+70) was constructed at a 2.58% grade by placing up to 5 feet of earthfill on the interior (dam) side of the channel and excavating up to 5 feet into native clay and sand on the exterior (abutment) side of the channel. at the last 330± feet of the channel was constructed at 1.1% grade to the channel's termination where it ties into original ground surface by excavating to depths ranging from 1 to 4.5 feet which generally decreased going downstream. For reference, the as-built ASW spillway profile is shown in the image below as well as the stick logs provided in the as-built drawings for the auxiliary spillway.





2.2 Spillway Historical Performance

The auxiliary spillway is not known to have previously activated to convey flow from the reservoir. The 2013, 2017, and 2021 inspections (TCEQ for San Antonio River Authority, 2013, San Antonio River Authority, 2017 and 2021;) reported that the spillway was in good condition. The most recent inspection report available to AECOM for review was completed in 2021. The 2021 annual inspection (San Antonio River Authority) reported sparse vegetation in some areas of the auxiliary spillway as a result of droughts. No other adverse conditions were noted.

2.3 Proposed Improvements

The prior dam assessment performed at Escondido 12 (AECOM, 2014) offered several alternatives to mitigate identified dam safety deficiencies associated with the reclassification of the dam as a high hazard structure. The alternatives offered included controlled dam breach and decommissioning, relocation of downstream facilities out of the breach impact area, and dam rehabilitation. The proposed improvements to Escondido 12 as part of the rehabilitation option from the 2014 Dam Assessment of Escondido 12, with elevations correct to NAVD88, included:

- Raising the crest elevation (El.) of the dam embankment by approximately 3.8 feet from elevation 342.1 feet to El. 345.9 feet;
- Raising the auxiliary spillway crest 1.5 feet from El. 336.0 feet to El. 337.5 feet;
- Widening the auxiliary spillway crest an additional 200 feet from 300 feet to 500 feet wide;
- Flattening the upstream and downstream embankment slopes from 2.5H:1V (horizontal: vertical) to 3H:1V;
- Replacing the existing 42-inch principal spillway (PSW) conduit with a new 60-inch diameter conduit; and
- Replacing the principal spillway inlet/outlet structures.

The purpose of the SWP-EA (AECOM, 2024) was to further evaluate alternatives, including an alternative for watershed structure rehabilitation of Escondido Creek 12. As a result of this work, the proposed improvements recommended for the high hazard rehabilitation of the dam have been modified to include the following:

- Maintaining the existing 42-inch principal spillway system;
- Installing a new principal spillway system consisting of an inlet tower with crest at elevation 325.1 feet and a 42-inch reinforced concrete pipe (RCP) conduit discharging into an impact basin;
- Installing a 180-foot-wide, five-cycle labyrinth weir structural spillway over the existing embankment with crest set at elevation 338.2 feet and concrete chute discharging into a concrete stilling basin;
- Regrading the inlet and outlet channels of the existing 300-foot-wide vegetated auxiliary spillway and raising the crest by 2.6 feet to elevation 338.7 feet;
- Flattening the downstream embankment slope to 3H:1V;
- Abandoning the existing trench drain in place and installing a new toe drain at the downstream toe;
- Installing rock riprap at the upstream dam embankment slope;
- Raising the top of dam elevation to elevation 345.30 feet (3.1 feet raise); and
- Extending the cutoff trench below the extended dam embankment.

3. Subsurface Information

3.1 Site Geology

Most of the auxiliary spillway and parts of the dam embankment are mapped as underlain by the Catahoula Formation (Oc). The Catahoula Formation is composed of volcanic-clastic deposits interbedded with fluviatile sediments and is further described by Anders (1962) as consisting predominately of tuff, tuffaceous clay, sandy clay, bentonitic clay, and discontinuous lenses of sandstone. According to Chowdhury and Turco (2006), the Catahoula Formation consists of approximately 60 percent volcanic material and 30 percent sandstone. The formation has local thickness of approximately 350 feet (Brown et. al, 1975). A map of the site is provided as **Figure 1**.

Alluvium (Qal) of the Holocene Epoch is mapped downstream of the principal spillway, along the banks of Bucker Creek, and along the central portion of the dam embankment. The Alluvium is comprised by floodplain deposits consisting of various proportions of clay, silt, sand, gravel, and abundant organic matter. Alluvium deposits are typically organized as point bars, natural levees, stream channels, or backswamps.

The Miocene-aged Oakville Sandstone (designated as “Mo”) is mapped near the dam abutments. This formation is geologically older than the Catahoula Formation and is, therefore, identified in areas of higher elevations along the dam site. The Oakville Sandstone Formation consists of sandstone and clay with thickness of 300 to 500 feet (Adams et. al 1981; Baker 1979). Per the geologic map, the sandstone intervals are described as thickly bedded, medium grained, and calcareous with some crossbedding while the clay intervals are described as yellow-gray and calcareous. Anders (1962) describes the Oakville Sandstone as cross-bedded medium to fine grained sand and sandstone and sandy, ashy, and bentonitic clay beds with the base of the Oakville dipping gulfward at an average of 85 feet per mile. The Oakville Sandstone contains fossil wood, chert, and quartz gravels, with some vertebrate fossils and reworked Cretaceous invertebrate fossils (Adams et. al 1981; Baker 1979). Per Adams (1981), the most abundant clay mineral in the Oakville is montmorillonite with variable amounts of kaolinite and subordinate illite.

It should be noted that while recent geologic mapping appears to suggest that the ASW of Escondido 12 is underlain by the Catahoula Formation, the original classification of the site subsurface as the Oakville Sandstone Formation is maintained here forth because the resolution of available geologic maps is not considered sufficient, without further studies which presently are not included in AECOM’s scope of work, to allow for precise differentiation between the two formations.

3.2 Soil Maps

The NRCS Survey database (NRCS, 2023) was examined to identify near-surface soil mapping of the site (i.e., approximately upper 7 feet). The mapped soil types in the vicinity of the dam are largely described as Alluvium/Residuum resulting from in-place weathering of the parent bedrock. The Alluvium is generally mapped south-southwest (upstream) of the site within the low-lying areas of the valley, at the southern section of the ASW, and north (downstream) of the dam. Residuum is mapped along the northern segment of the ASW and east of the dam embankment. Note that the ASW was excavated approximately 0.5 foot to 5 feet along the centerline for over 500 feet of the ASW channel removing surficial soils.

It should also be noted that while the NRCS soil survey mapping shows both alluvium and residuum within the ASW channel, it does not include fill. The discrepancy between the as-built drawings location of fill and the NRCS soil survey mapping could partially be due to the resolution of the NRCS soil survey mapping influenced by the fact that, as discussed in Section 2.1, the fill material reported was likely sourced from excavations of the ASW channel which could have rendered it roughly indistinguishable (visual-manually) from the native soils.

3.3 Previous Investigations

3.3.1 Soil Conservation Service – 1954 Work Plan, 1964 Work Plan, and As-Built Drawings

The original work plan for Escondido Creek Watershed (SCS, 1954) was developed with the goal of providing flood protection to agricultural lands in the watershed. The 1954 work plan included, but was not limited to, the implementation of 11 floodwater retarding structures all of which were completed in 1957 (SCS, 1964). The 1964 Escondido Creek Watershed Work Plan was developed to provide additional structural measures needed to protect the City of Kenedy and it included the construction of 2 additional floodwater retarding structures, Escondido Creek 12 and Escondido Creek 13, and 0.7 miles of channel improvements (SCS, 1964).

A preliminary geologic investigation of Escondido Creek 12 was completed by the SCS prior to construction of the existing dam, which included surface observations of valley slopes, alluvium, channel banks, exposed geologic formations, and hand auger borings (SCS, 1964). Detailed geologic dam site investigations were made at the 11 sites previously built in the Escondido Creek Watershed and the findings of these investigations along with structure performances were used to inform the proposed design of the two new sites, including that of Escondido Creek 12.

The 1964 Work Plan (SCS, 1964) describes the foundation of the Escondido Creek Watershed dams (including Escondido Creek 12) as consisting primarily of 6 to 12 feet of sandy clay with some clayey and silty sands which are underlain by clays, sands, and sandstones of the Oakville formation. The Oakville formation is further described as containing interbedded silts and clays as well as sand. In addition, the original Watershed Work Plan (SCS, 1954) states that chalk and caliche outcrops are expected to occur on the surface, especially on the tops of hills. Valley slopes were described as principally residual silty clays and sandy clays underlain by beds of clay and sand. The Work Plan included generalized preliminary recommendations for dam design planning. One particular concern was for exposure of sand beds in ASW cuts which were anticipated to be very susceptible to erosion; thus, the 1964 Work Plan (SCS) indicated that spillways of dams built in the Escondido Watershed should be vegetated as soon as possible following construction.

The as-built drawings for Escondido Creek 12 (SCS, 1974) indicate an additional geologic investigation was performed as part of the original dam design. The drawings provide subsurface profiles of the site with boring “stick” logs from the pre-construction investigation with generalized soil types. The investigation consisted of the following:

- 15 borings along the dam centerline (Hole Nos. 1 through 15);
- 5 borings along the principal spillway alignment (Hole Nos. 301 through 303 and Holes Nos. 351 and 352);
- 5 borings along the auxiliary spillway (Hole Nos. 251 through 255);
- 4 borings along the original stream channel (Hole Nos. 451 through 454);
- 17 borings in a borrow area located in the present-day reservoir (Holes No. 151 through 167); and
- 5 borings along the proposed downstream toe of the dam (Hole Nos. 601 through 605);

The complete investigation report containing the Escondido Creek 12 boring logs and summary text was not available to AECOM for review. Stick logs resulting from the original geologic investigation completed in 1973 by the SCS were the only data from the final design geologic investigation available to AECOM and were used to develop a generalized understanding of the subsurface conditions at Escondido Creek 12. Based on this documentation, the existing dam foundation consist of calcareous, medium stiff to stiff, sandy, lean to fat clays (CL, CH) and clayey sands (SC) followed by sandstone described in the geological stick logs as poorly cemented with trace coarse particles with thicknesses of up to 6 inches and interbedded layers of claystone and caliche (indurated calcium carbonate deposits).

The sandstone bedrock was described as having hardness classification of Hd 2 to Hd 3 according to the legacy SCS classification system (SCS, 1974). Sandstone was encountered at depths as shallow as 9 feet below the ground surface (bgs) in centerline borehole No. 4, and at a maximum depth of 20 feet bgs in centerline borehole No. 10. Sandstone bedrock was not encountered in centerline boreholes Nos. 12 through 15 located in the right side of the lower creek valley and valley walls towards the right abutment.

The as-built drawings indicate that the embankment was to be constructed as a zoned earthfill comprised by fine-grained materials. Moderately plastic, silty to sandy clays (CL) and slightly to moderately plastic, very sandy clays (CL) are prescribed in the as-built drawings for the interior Zone 1 of the embankment. The original drawings indicate a maximum allowable particle size of 6 inches for the embankment fill material which was to be placed in uncompacted lifts of 9-inch maximum thickness and be compacted to at least 95% maximum dry density per ASTM D-698. The moisture content prescribed for compaction of the fill material was not legible in the as-built drawings, but seem to indicate above-optimum moisture criteria.

A 4-foot-thick earth blanket was prescribed on the exterior of the dam embankment overlying the Zone 1 materials. This earth blanket zone was specified to consist of the least plastic and least dispersive materials available in accordance with Section 10 of Construction Specification item 23 (not available to AECOM for review). An 18-inch-thick layer of rock riprap was installed on the upstream slope between approximately El. 326.6* and El. 320.6*.

Based on review of Escondido Creek 12 as-built drawings and the available geologic stick logs of borings in the ASW, the spillway channel invert included fills sections with maximum thickness of 9.5 feet thick and excavated sections with a maximum depth of about 5 feet below original grade. The data suggest excavations would have exposed lean clay to sandy lean clay (CL), clayey sand (SC), and some sandy silt (SM) with varying amounts of calcareous material at the channel invert and exterior cut slope of the channel. Earthfill was used to construct the crest section and the upper-left portion of the spillway channel (i.e., where the original grade was less than about El. 334 feet).

No in-situ testing or laboratory testing results on recovered soil and/or rock samples from the original investigation were available to AECOM for review.

Groundwater was identified in several of the original borings drilled typically between 300 and 315 feet in elevation. Groundwater levels may vary over time and may have significant impact on potential auxiliary spillway modifications.

It should be noted that while recent geologic mapping appears to suggest that the ASW of Escondido 12 is underlain by the Catahoula formation, the original classification of the site subsurface as the Oakville formation is maintained here forth because the resolution of available geologic maps is not considered sufficient, without further studies which presently are not included in AECOM's scope of work, to allow for precise differentiation between the two formations.

3.3.2 NRCS – 2021 Routine Dam Safety Inspection

A visual inspection of the dam was conducted on August 5, 2021, by the River Authority as part of the routine dam safety inspections. The inspection identified several deep animal burrows along the dam embankment as well as surface cracking on the downstream slope. Sparse vegetation, aeration activity, and evidence of wind erosion along the dam embankment were also highlighted during the inspection.

Undesirable vegetation was observed near the PSW conduit support cradle and its removal was advised. The PSW and ASW were noted as being in good condition. The ASW was noted as having generally good vegetative cover with some sparse areas. Photographs in the inspection report depicted good vegetative coverage with native grasses throughout the dam.

The 2021 inspection concluded that Escondido 12 was performing as designed and no immediate safety concerns were reported. However, due to urban encroachment and updated TCEQ hydraulic criteria, Escondido 12 qualifies for assistance through the watershed rehabilitation program intended to bring this dam to safety standard for high hazard dams.

3.4 AECOM Preliminary Geologic Investigation

AECOM conducted a preliminary GI of the site to support hydraulic evaluation of the auxiliary spillway and alternatives analysis for the SWP-EA. The GI was conducted June of 2023 in general accordance with the approved Field Investigation and Testing Plan submitted to the River Authority prior to field mobilization. Geologic investigation of the existing ASW was performed to develop recommended geologic input parameters for SITES erodibility analysis. The ASW investigation included four (4) geotechnical test borings in the existing channel designated as 201-23 through 204-23. Boring locations are shown in **Figure 1**. Borings logs, boring locations, and detailed discussion of procedures, findings, and interpretations from the geologic investigation are provided in the preliminary Geologic Investigation Report (GIR) (AECOM, 2024a) prepared as part of the scope of this project.

* Elevations from the as-built drawings and the 2014 dam assessment are from the National Geodetic Vertical Datum of 1929 (NGVD29). Conversion to NAVD88 is +0.134 feet.

Laboratory testing was performed on select samples recovered from the existing auxiliary spillway. Testing included natural moisture content, natural unit weight, Atterberg limits, sieve and hydrometer, unconfined compression (UC) testing, and dispersion testing including crumb and double hydrometer. A summary of the laboratory test methods and results is provided in the Preliminary Soil Mechanics Report (SMR) (AECOM, 2024b).

3.4.1 Generalized Subsurface Stratigraphy

Subsurface conditions encountered in the borings were generally consistent with the published geology, the stick logs included on the as-built drawings (SCS, 1974), and the geological descriptions provided in the Escondido Watershed Workplan (SCS, 1964). The borings encountered interbedded clays, silts, and sands generally overlying interbedded clays. The generalized stratigraphy identified included soils of alluvial and residual origin which were identified in the upper 4 to 6 feet of the borings drilled along the ASW. Below the Alluvium/Residuum stratum, the stratigraphy identified at Escondido 12 included the Oakville Sandy Clay layer from approximately 6 to 15 feet in depth followed by Oakville Sand and Clayey Sand between the approximate depths of 15 and 25 feet and a second clayey stratum, the Oakville Clay, at depths roughly greater than 25 feet. As discussed in Section 3.1, the original classification of the site subsurface as the Oakville Formation, rather than Catahoula Formation, is maintained for the purposes of this memorandum.

A geologic profile of the field data along the existing ASW profile is presented in **Figure 2**. The geologic profile was extended for the proposed auxiliary spillway widening as presented in **Figure 3**, with the existing ground surface and proposed ground surface being updated to reflect the alignment of the proposed widening. The profiles illustrate abridged boring logs indicating field USCS classification, pocket penetrometer values, SPT N-values, and measured groundwater levels (as applicable). For the purposes of spillway erodibility analysis, the following generalized subsurface stratigraphy was assigned for the ASW channel:

1. Existing Fill
2. Alluvium/Residuum
3. Oakville Sandy Clays
4. Oakville Silty and Clayey Sands
5. Oakville Clays

Soils of alluvial and/or residual origin were identified in the upper 4 to 6 feet of the borings drilled along the ASW of Escondido 12. Per the NRCS Websoil Survey, the location of borings 201-23 and 202-23 are mapped as alluvium whereas the locations of borings 203-23 and 204-23 are mapped as residuum. While soils encountered in the upper portion of borings 201-23 and 204-23 were visually similar, there was inconsistency in the remaining borings drilled along the ASW. Additionally, the effects of previous cut/fill grading in the spillway as part of original construction further complicated interpretation of near-surface stratigraphy. As a result, soils of alluvial and/or residual origin identified in the upper 4 to 6 feet were grouped into a single stratum (Alluvium/ Residuum) for ease of evaluating spillway erodibility. The Alluvium/Residuum layer was described as very stiff to hard, grayish brown to black, lean to fat clay (CL, CH) with sand, organics, trace gravel, and calcareous inclusions.

In addition to the NRCS soil survey mapped areas of Alluvium and Residuum within the ASW channel, the as-built drawings (SCS, 1974) indicate that fill material was placed between approximately ASW Sta. 9+45 and Sta. 12+00 to form the ASW approach, part of the ASW crest, and a portion of the ASW channel. While the boreholes drilled as part of this investigation did not conclusively indicate the presence of fill material in the ASW (boring 202-23 was offset to the right side of the spillway where the fill tapers out) the stratigraphy considered in SITES analyses conservatively models fill material along the left inside edge of the ASW, where the existing fill has greatest thickness. Index properties and estimated strength of the fill material used, specified as slightly to moderately plastic, silty, sandy to very sandy clays (CL), were not included in the historical documentation available to AECOM for review; however, it is possible that materials excavated from the ASW channel were used as fill. The 1964 Watershed Work Plan (SCS) corroborates this interpretation by highlighting that lean clays (CL) and clayey to silty sands (SC, SM) excavated from the ASW were suitable for use as fill. However, in absence of formal test results for the fill material used and due to the fact that compacted fill material generally presents different density and strength than native soils, because of the lack of long-term environmental exposure, the existing fill was treated as a separate material from the Alluvium/Residuum layer in analysis.

The geologic investigation encountered Oakville Sandy Clays in each of the borings drilled at depths of about 4 to 6 feet bgs. This unit generally extended to depths of approximately 15 feet bgs. Soil in this stratum were described in the field as light brown to yellowish brown, sandy lean to fat clays (CL, CH) with trace iron oxide staining and gravel. The clayey soils in this stratum were generally calcareous (with reactions to hydrochloric acid ranging from weak to strong), very stiff to hard, and dry to moist.

The Oakville Silty and Clayey Sands was typically present in the depth interval between 14 and 28 feet bgs and were characterized as clayey to silty sands (SC, SM) with alternating clayey seams. The sandy soils in this stratum were generally pale to yellowish brown, fine to medium grained, dense to very dense, and varied from dry to moist. In boring 204-23, Oakville sandstone was identified below approximately El. 316 feet; however, no recovery was achieved in the cores attempted. The lack of recovery could possibly be indicative of poorly-indurated bedrock and/or high degrees of weathering of the bedrock into sandy materials such as those observed in this stratum in the other nearby borings drilled during the field GI.

The Oakville Clays were encountered below the Oakville Silty and Clayey Sands depths ranging from about 16 to 28 feet bgs(roughly below El. 305 to 310 feet). This stratum was encountered in borings 201-23 through 203-23; boring 204-23 was terminated just above El. 310 feet and did not encounter the Oakville Clays. Soils encountered in this stratum were described as stiff to hard, moist, fat clay (CH) with medium to coarse grained sand, calcareous gravel, iron oxide staining, and mostly weak to moderate reaction to hydrochloric acid.

3.4.2 Groundwater

Groundwater was not encountered at the time of drilling in any of the borings. Drilling fluids were added to boring(s) in which rock coring was attempted but levels were not measured. Boreholes were backfilled with cement bentonite grout at the end of drilling; as a result, subsequent delayed water level readings were not recorded.

The preliminary geologic investigation did not include the installation of piezometers for monitoring groundwater levels over time. It should be noted that groundwater levels may vary over time and may have a significant impact on potential dam modifications.

4. Geotechnical Analysis of Auxiliary Spillway Erodibility

4.1 Analysis Methodology

Development of recommended material parameters for SITES analysis was performed according to the guidance provided in the *National Engineering Handbook, 210-VI-NEH, Part 628, Chapter 52, Field Procedures Guide for the Headcut Erodibility Index* (NRCS, 2001) and the accompanying *DRAFT Appendix 52D, Erodibility Parameter Selection for Soil Material Horizons* (NRCS, 2011).

The primary SITES input parameter is the empirical headcut erodibility index (K_h). The K_h is calculated based on Equation 1:

$$K_h = M_S \cdot K_b \cdot K_d \cdot J_S \qquad [Equation\ 1]$$

where:

M_s = material strength number of the earth material

K_b = block or particle size number

K_d = discontinuity or interparticle bond shear strength number

J_s = relative ground structure number

For soil-like materials, the program also requires representative soil index properties as input parameters. The index properties used directly in the SITES model include the following parameters:

- USCS Soil Type
- Dry Unit Weight, γ_{dry} (pounds-per-cubic-foot, pcf)
- Plasticity Index, PI
- Clay Fraction, CF (% finer than 0.002 millimeter diameter)
- Representative Diameters, D_{75} and D_{50} (millimeters [mm])

Note that for the representative particle size, the D_{75} is typically used for soil-like materials, and D_{50} is typically used for rock-like materials.

4.2 Material Parameters Development

Development of estimated Kh was completed using the two reference documents cited above for the Alluvium/Residuum, the Oakville Sandy Clays, and Oakville Clays assuming each of the parameters except Ms are held constant and equal to 1.0. The Kh estimation procedure for cohesionless soil was followed for the Oakville Silty and Clayey Sands based on the same reference documents. The estimated Kh of the Existing Fill was conservatively developed based on the estimated Kh value for the Alluvium/ Residuum layer and refined based on experience with similar materials.

Materials considered in the evaluation included those encountered beginning near the proposed finished-grade elevation of the ASW channel surface and extending down below the valley bottom elevation at the downstream exit channel. Material parameters were developed for each of the generalized strata units described previously, as well as for potential proposed fill material from on-site sources that may be needed with proposed rehabilitation spillway modifications. In summary, these included the following:

1) Alluvium/Residuum
2) Existing Fill
3) Oakville Sandy Clays
4) Oakville Silty and Clayey Sands
5) Oakville Clays
6) Proposed Fill (ASW excavation borrow)

Representative values for each stratum were selected on an approximate best fit between the 33rd and 50th percentile values, as is consistent with typical geotechnical engineering practice.

4.2.1 Index Properties

Results of laboratory testing performed as part of the current Preliminary GIR and Preliminary SMR prepared by AECOM for this project were used to evaluate index properties of the various materials. The laboratory test results summary for the ASW borings is provided in the Preliminary SMR (AECOM, 2024). A tabulated summary of the minimum, maximum, and average test data values for each general stratum is provided in **Table 1.**

The D_{75} has been summarized in a graph by depth in **Attachment 2**. Note that D_{75} is typically used in analysis of soil-like materials and D_{50} is typically used for rock-like materials. The D_{50} is not presented since all materials encountered were considered to behave like soils.

Plots of γ_{dry}, CF, LL, PI, Su, UCS, N_{60}, and D_{75}, versus depth, annotated to illustrate the selected representative values, are provided in **Attachment 2**. The selected representative values pertinent to the SITES analysis are also summarized in **Table 2**. Recommended values were developed based on results of laboratory index tests from the 2023 investigation and experience with similar materials.

In absence of formal specification of the fill material used and due to the fact that compacted fill material generally presents different density and strength than native soils, because of the lack of long-term environmental exposure, index and strength properties of the existing fill were conservatively estimated based on testing results of samples recovered from the Oakville Sandy Clays and Oakville Clayey and Silty Sands which were assumed to be similar to the material that may have been used to form the Existing Fill.

4.2.2 Material Strength Number, Ms

Estimates of Ms are based on relative density for cohesionless soils (i.e., PI≤10 per NRCS 2001), and unconfined compressive strength for both cohesive soils (i.e., PI > 10) and rock materials. Typical ranges of Ms are presented in tabular format in NRCS 2001 and 2011 correlated with SPT and relative density for cohesionless soils; with SPT, consistency, unconfined compressive strength (UCS), undrained shear strength (Su), and liquidity index (LI) for cohesive soils; and with UCS and field strength tests for rock.

The Ms values for cohesionless soils and rock are estimated predominantly using the methods in NRCS (2001). The Ms (=Kh) values for cohesive soils were estimated by comparing results from both methods in NRCS (2001) and NRCS (2011) and using engineering judgment to select recommended values. See **Attachment 2** for the plots used to sub-divide the generalized strata and develop representative values (note the undrained shear strength from laboratory unconfined compression testing was given the heaviest weighting). The two methods used for developing Kh are presented in **Attachment 3**. Note, only the undrained strength computed from correlation with the Liquidity Index is used for the NRCS 2011 method. Supporting calculations for the Ms value are also provided in **Attachment 3**.

Plots of Su, N_{60}, Su, Pocket Penetrometer, and γ_{dry} data versus depth, with representative values also plotted, are provided in **Attachment 3**. Calculations for the derived Ms values are provided in **Attachment 3**. Discussion of Ms development for each of the various geologic strata is provided in the following subsections.

The Alluvium/Residuum, Oakville Sandy Clays, and Oakville Clays were considered “cohesive” soil for the purposes of estimating the Ms parameter, whereas the Oakville Silty and Clayey Sands stratum was conservatively treated as “cohesionless” soil in analyses although the PI was generally greater than 10. The material designated as Proposed Fill was obtained from samples collected in the upper 5 feet of the borings drilled which primarily classified as lean and fat clays (CL, CH), and thus was also considered as “cohesive” soil. While the Proposed Fill would have similar gradation and plasticity as the in-situ soils, the fill will be excavated and recompacted in the field during construction which will change the density and strength properties from that of the natural in-place material. As such, the proposed fill material was analyzed as a separate layer.

It is noted that NRCS (2001) Table 52-3 indicates that soils with SPT blow counts greater than 30 bpf or UCS greater than 625 kPa (13,053 psf) should be treated as rock (NRCS, 2001). While many of the SPT values in the Oakville Sandy Clay and the Oakville Clay strata exceeded 30 bpf, the laboratory UCS values indicate the material is borderline and should still be considered soil like in analysis. Similarly, the Oakville Clayey and Silty Sands stratum was also considered soil-like due to the interbedded nature of the soils identified in the field. For all materials, engineering judgement was applied to the results based on published ranges in Chapter 52 (NRCS 2001), and the final selected Kh values were adjusted accordingly. As discussed in following paragraphs, all other parameters were equal to 1.0 so the only value that affected Kh was the Ms number.

The field SPT N-values were corrected to equivalent 60% hammer efficiency (N_{60}) based on the hammer energy calibration report provided by the driller. While an SPT hammer energy calibration report was not available, the driller provided a hammer energy calibration report for the Texas Cone Penetrometer hammer on the same drill rig which indicated 89% hammer efficiency. Based on AECOM’s experience, an energy correction of 80% hammer efficiency is typical for SPT autohammers like that used on this project, and thus 80% efficiency was adopted for analysis.

Alluvium/Residuum

SITES parameters for this unit were estimated using several methods including the results of 4 field standard penetration tests correlated to an estimated Su value, correlations from liquidity indices (LI) to estimate Su, and 4 unconfined compression tests (UC). Greater weight was given to the UC tests and LI correlation methods. The liquidity indices were used as a check to correlate the strength of the soils in a saturated state.

The NRCS 2011 Appendix 52D method was used as a check on the Su values, which correlates Su with the LI of saturated clay. Reference **Attachment 3** to see Su values for comparison of the two procedures, and the calculated MS values for NRCS 2001.

Oakville Sandy Clays

SITES parameters for the Oakville Sandy Clays were estimated using several methods including the results of 7 field standard penetration tests correlated to an estimated Su value, correlations from LI to estimate Su, and 4 UC tests. The use of the liquidity indices was used as a check to correlate the strength of the soils in a saturated state.

Oakville Silty and Clayey Sands

The Oakville Silty and Clayey Sands were considered cohesionless soil in analyses, and SITES parameters were estimated primarily based on the results of 7 standard penetration tests and 1 UC strength test.

Oakville Clays

SITES parameters for this unit were estimated based on the results of 6 field standard penetration tests, which were correlated to obtain an estimated Su value, correlations from liquidity indices and 2 UC tests. The use of the liquidity indices was used as a check to correlate the strength of the soils in a saturated state.

Proposed Fill (ASW Borrow)

The Ms value for Proposed Fill materials is typically estimated by performing laboratory UC or UU tests on remolded samples compacted to target moisture content and density that simulate typical values of earthfill construction compaction specifications. It is common to conservatively remold samples to the minimum acceptable density and upper range of allowable moisture content (i.e., 95% of maximum dry density and +2% of optimum moisture relative to Standard Proctor energy as determined by ASTM D698). However, insufficient quantity of material was available to complete the remolded strength tests. Consequently, the strength of the Proposed Fill was estimated based on experience from prior projects for similar soils remolded to similar moisture/density, informed by the maximum dry density and optimum moisture content from site-specific Standard Proctor test results and 4 UC test results in the Alluvium/Residuum layer. The Ms values was then estimated from the assumed strength value.

4.2.3 Block or particle size number, Kb

The value of K_b is 1.0 for each analysis case per NRCS 2001 and NRCS 2011. The Alluvium/Residuum, Oakville Sandy Clay, Oakville Clay, and Proposed Fill (collectively referred to as the “clayey layers”) are considered as “massive, unjointed cohesive” soil materials. The Oakville Silty and Clayey Sands (referred to as the “sandy layer” herein) were considered a cohesionless soil where the average particle size diameter is less than 0.1 meters.

4.2.4 Discontinuity / Interparticle Bond Shear Strength Number, Kd

According to NRCS 2001, the value of K_d is estimated based on the tangent of the residual friction angle (ϕ'_r) of the soil, which can be estimated by correlation with values of LL and CF using the following formulas:

For ≤ 20% clay, $\phi'_r = 169.58\,(LL)^{-0.4925}$ [52–7]
For 25 – 45% clay, $\phi'_r = 329.56\,(LL)^{-0.7100}$ [52–8]
For ≥ 50 % clay, $\phi'_r = 234.73\,(LL)^{-0.6655}$ [52–9]

Plots of LL and CF versus depth, with interpreted lower and upper bounds, are provided in **Attachment 3**.

Based on feedback received from NRCS geologists at the NDCSMC (email dated April 7, 2020), the method presented in NRCS 2001 has often produced overly conservative values for K_d. The email indicated that internal NRCS guidance is to assume $K_d = 1.0$ for soil-like materials. This assumption is supported by McCook (2005) and the Draft Appendix 52D (NRCS, 2011). Consequently, $K_d = 1.0$ was adopted for all materials since they are considered "soil-like".

4.2.5 Relative Ground Structure Number, Js

The value of J_S is 1.0 per NRCS 2001. The clayey layers are considered as "cohesive" materials, while the sandy layer is considered a "cohesionless" material.

4.2.6 Adjustment for High-Plasticity, Blocky Soils

The Draft Appendix 52D (NRCS 2011) and McCook (2005) cautions that very stiff, high-plasticity fat clays (CH) with plastic limits (PL) > 25 often have blocky or fissured secondary structure and such deposits may be more erodible than indicated by the unconfined compressive strength on intact samples typically used to obtain the Ms value. While the document states that no case history is available, interim guidance is to apply a reduction factor of 0.5 to the calculated Ms and thus Kh value.

The Alluvium/Residuum layer had PL values ranging from 14 to 21 (average 18). The Oakville Sandy Clays had PL values ranging from 14 to 26 (average 19). The Oakville Clays had PL values ranging from 19 to 24 (average 21). Fissures were noted for borings 201-23 and 203-23, and these were typically infilled with calcium. However, due to the lack of fissures being noted on the other borings, and the PL for the site being generally below the threshold, the blocky soil reduction factor was not applied to the Kh values for any of the clayey layers of soil identified.

4.3 Recommendations

Recommended parameters for SITES analyses are presented in **Table 2**. Supporting calculations are provided in **Attachment 3**. Based on the assumption stated herein, the estimated K_h ranges of unfavorable and favorable values for the existing ASW are as follows:

- Proposed Fill (ASW Excavation Borrow): Kh = 0.10
- Existing Fill Kh = 0.10
- Alluvium / Residuum: Kh = 0.20
- Oakville Sandy Clays: Kh = 0.20
- Oakville Silty and Clayey Sands: Kh = 0.20
- Oakville Clays: Kh = 0.30

The recommended values for the cohesive soil-like materials are generally in agreement with those recommended for stiff to very stiff cohesive soils according to the typical range of values below (from NRCS 2011):

Table 52D–3 Values shown in NEH628.52 relating saturated consistency to unconfined compressive strength

Relative density	Description	SPT	q_u, lb/ft^2	M_s
Very soft	• Exudes between fingers when squeezed in hand	< 2	< 835	< 0.02
Soft	• Easily molded with fingers • Point of geologic pick easily pushed into shaft of handle	2–4	835–1,670	0.02–0.05
Firm	• Penetrated several centimeters by thumb with moderate pressure • Molded by fingers with some pressure	4–8	1,670–3,130	0.05–0.10
Stiff	• Indented by thumb with great effort • Point of geologic pick can be pushed in up to 1 centimeter • Very difficult to mold with fingers • Just penetrated with hand spade	8–15	3,130–6,265	0.10–0.20
Very stiff	• Indented only by thumbnail • Slight indentation by pushing point of geologic pick • Requires hand pick for excavation	15–30	> 6,265	0.20–0.45

The recommended Kh value for sand and sandstone is also in agreement with those recommended for dense cohesionless soils (Table 52D-2 from NRCS 2011, shown below).

It should be noted that part of the existing ASW, including the crest section, was built on fill material which makes it significantly more susceptible to erosion. In the event of spillway activation, headcut erosion could advance from the downstream end of channel towards the upstream section and reach the existing fill in which case severe erosion of the dam embankment could ensue. As a result, cutting (rather than filling) of the ASW deeper than the existing condition is the preferred rehabilitation design approach for Escondido 12.

Table 52D–2 Material strength number, M_s for cohesionless soil

Relative density	Description	SPT	M_s
Very loose	• Particles loosely packed • High percentage of voids • Very easily dislodged by hand • Matrix crumbles easily when scraped with point of geologic pick • Raveling often occurs on excavated faces	< 5	< 0.02
Loose	• Particles loosely packed • Some resistance to being dislodged by hand • Large number of voids • Matrix shows low resistance to penetration by point of geologic pick	5–10	0.02–0.05
Medium dense	• Particles closely packed • Difficult to dislodge individual particles by hand • Voids less apparent • Matrix has considerable resistance to penetration by point of geologic pick	10–30	0.05–0.10
Dense	• Particles very closely packed and occasionally very weakly cemented • Cannot dislodge individual particles by hand • The mass has very high resistance to penetration by point of geologic pick • Requires many blows of geologic pick to dislodge particles	30–50	0.10–0.20
Very dense	• Particles very densely packed and usually cemented together • Mass has high resistance to repeated blows of geologic pick • Requires power tools for excavation	> 50	0.20–0.45

(210–VI–NEH, draft, October 2011) 52D–9

5. Limitations

This memorandum was prepared by AECOM using the degree of care and skill ordinarily exercised under similar circumstances by responsible engineers and geologists practicing in the same general location. No other warranty or representation, either expressed or implied, is made as to the findings and professional advice in this memorandum.

The opinions and conclusions contained in this memorandum are based on interpretations of limited subsurface information. Soil and geologic conditions can vary greatly between or beyond the exploration sites, and different conditions may be found during subsequent investigations.

The conclusions and recommendations contained herein are based in part upon information provided by others (including the NRCS) and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information provided to AECOM has not been independently verified by AECOM, unless otherwise stated.

There is no intention that this memorandum addresses any environmental issues (for example, environmentally affected soil or groundwater, or historic site uses) related to this site. Such evaluations are outside the scope of this work and should be addressed in separate studies.

6. References

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7. Attachments

TABLES

Table 1. Summary of Laboratory Test Data by Stratum for Borings in Existing ASW Channel [1]

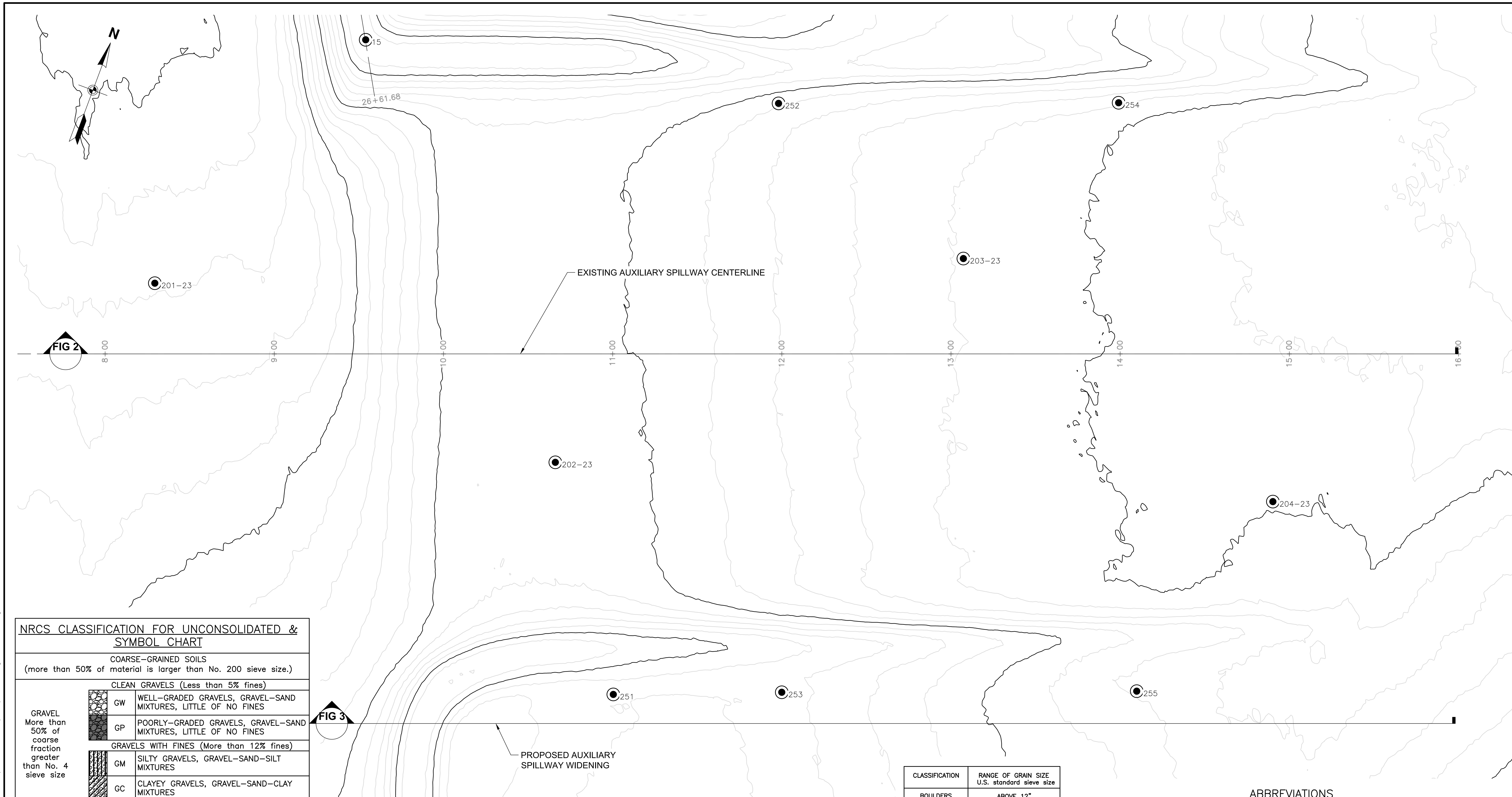
Stratum Description (USCS)	Thick-ness (ft)	USCS	N_{60} (bpf) [2]	Pocket Pen. (tsf)	Undrained Shear Strength, S_u (psf)	Unconfined Compressive Strength, UCS (psf)	Dry Unit Weight (pcf)	LL	PI	LI	Fines (%)	CF (%)	D_{75} (mm)	Crumb
Alluvium/Residuum	0-6	CL, CH	8 - 12 (11)	2.25 - 4.5 (3.8)	2,196 - 19,159 (7,789)	4,392 - 38,318 (15,578)	92 - 118 (107)	28 - 64 (49)	14 - 44 (31)	-0.40 to +0.36 (-0.03)	50 - 87 (70)	22	0.072 - 0.185 (0.115)	1
Oakville Sandy Clays	6-15	CL	16 - 120 (47)	2.25 - 4.5 (4.1)	1,970 - 8,490 (5,441)	3,940 - 16,980 (10,882)	82 - 121 (110)	29 - 77 (46)	11 - 51 (27)	-0.46 to +0.18 (-0.06)	50 - 86 (67)	24 - 36	0.075 - 0.185 (0.128)	1 – 4 (3)
Oakville Silty and Clayey Sands	15 – 25	SP, SC, SM	40 - 107 (80)	0.75 - 4.5 (2.3)	---[3]	---[3]	---[3]	31 - 38 (35)	15 - 23 (19)	-0.60 to +0.57 (-0.08)	16 - 54 (33)	---[3]	0.15 - 0.358 (0.25)	---[3]
Oakville Clays	25+	CH	25 - 61 (42)	4.25 - 4.5 (4.5)	290 - 8,446	580 - 16,891	86 - 105 (97)	55 - 63 (59)	32 - 44 (38)	-0.10 to +0.23 (+0.04)	45 - 91 (76)	22 - 26	0.046 - 0.352 (0.158)	2 – 3
Proposed Fill (ASW Borrow)	TBD	CH	---[3]	---[3]	---[3]	---[3]	---[3]	31 - 72 (47)	17 - 51 (30)	-0.82 to -0.41 (-0.64)	41 - 73 (57)	15 - 53 (28)	---[3]	1 – 1 (1)

Notes:
(1) Format of reported values is Minimum – Maximum (Average). Average value not reported when two or fewer results are available.
(2) Raw SPT N-values converted to N_{60} based on 80% hammer efficiency.
(3) "---" No test results available from current ASW borings.

Table 2. Recommended Material Parameters for SITES Analysis of Existing ASW

SITES inputs	Proposed Fill (ASW Borrow)	Existing Fill	Alluvium/Residuum	Oakville – Sandy Clays	Oakville – Clayey & Silty Sands	Oakville - Clays
USCS - Soil Type (Predominant)	CL - Lean Clay	CL - Lean Clay	CH - Fat clay	CL - Lean Clay	SC – Clayey Sand	CH - fat clay
PI – Representative	30	15	30	21	17	38
LL – Representative	45	30	50	38	32	58
Dry Density (lbs/ft3) – Representative	92	97	100	115	90	102
Kh – Representative	0.10	0.10	0.20	0.20	0.20	0.30
Clay % – Representative	25	17	24	24	5	24
Rep. Diam. D_{75} (mm) – Representative	0.06	0.11	0.085	0.12	0.22	0.05
Rep. Diam. D_{75} (in) – Representative	0.002	0.004	0.003	0.005	0.009	0.002
Rep. Diam. D_{50} (mm) – Representative	---	---	---	---	---	---
Rep. Diam. D_{50} (in) – Representative	---	---	---	---	---	---

FIGURES



NRCS CLASSIFICATION FOR UNCONSOLIDATED & SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
CLEAN GRAVELS (Less than 5% fines)			
GRAVEL More than 50% of coarse fraction greater than No. 4 sieve size		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
		GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
GRAVELS WITH FINES (More than 12% fines)			
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
CLEAN SAND (Less than 5% fines)			
SAND More than 50% of coarse fraction smaller than No. 4 sieve size		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
		SP	POORLY-GRADED SANDS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES
SAND WITH FINES (More than 12% fines)			
		SM	SILTY SAND, SAND-SILT MIXTURE
		SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS (more than 50% of material is smaller than No. 200 sieve size.)			
SILTS & CLAYS Liquid limit less than 50%		ML	INORGANIC SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAY WITH LOW OR MEDIUM PLASTICITY, LEAN CLAY
SILTS & CLAYS Liquid limit Greater than 50%		MH	INORGANIC SILTS WITH ELASTICITY
		CH	INORGANIC CLAY WITH HIGH PLASTICITY, FAT CLAY.

NRCS CLASSIFICATION FOR CONSOLIDATED & SYMBOL CHART

Low Plasticity Clay	Fine to Coarse Grained Sand
High Plasticity Clay	Poorly Graded Sand with Clay
Poorly Graded Sand	
Clayey Sand	
Silty Sand	

OTHER SYMBOLS

HOLE LOGGED ONLY — STRIKE AND DIP

HOLE SAMPLED — PIT OR TRENCH

PLAN

0 15 30 60

SCALE IN FEET

CLASSIFICATION	RANGE OF GRAIN SIZE U.S. standard sieve size
BOULDERS	ABOVE 12"
COBBLES	12" TO 3"
GRAVEL Course Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200
SILT & CLAY	Below No. 200

TEST HOLE NUMBERING SYSTEM

	COMBINATION RIG	POWER AUGER	HAND BORINGS	TRENCH OR PIT EXCAVATIONS	NATURAL OUTCROPS, STREAMBANKS, AND GULLIES
CENTERLINE OF DAM	1-49	51-99	1001-1099	2001-2099	3001-3099
BORROW AREA	101-149	151-199	1101-1199	2101-2199	3101-3199
AUXILIARY SPILLWAY	201-249	251-299	1201-1299	2201-2299	3201-3299
PRINCIPAL SPILLWAY	301-349	351-399	1301-1399	2301-2399	3301-3399
STREAM CHANNELS	401-449	451-499	1401-1499	2401-2499	3401-3499
EXPLORATORY BORINGS	501-549	551-599	1501-1599	—	—
FOUNDATION DRAIN	601-649	651-699	1601-1699	2601-2699	3601-3699
MISCELLANEOUS	701-749	751-799	1701-1799	2701-2799	3701-3799

ABBREVIATIONS

Ang.	ANGULAR	Int.	INTERBEDDED	M	SILT, SILTY
B.	BEDDED OR BEDDING	Lam.	LAMINATED	Sft.	SOFT
Bld.	BOULDERS (> 12")	Lay.	LAYER OR LAYERS	Sl.	SOME
Calc.	CALCAREOUS	Len.	LENS OR LENSES	Stf.	STIFF
Cali.	CALICHE	Lig.	LIGNITE	Str.	STREAKS
Carb.	CARBONATE	Ls.	LIMESTONE	T.	THIN
Cav.	CAVITIES	Lse.	LOOSE	T.B.	THIN - BEDDED
Cmt.	CEMENTED	Ma.	MARL, OR MARLY	Tuff.	TUFFACEOUS
Ch.	CHALK OR CHALKY	Mas.	MASSIVE	U.A.D.	UNABLE TO AUGER DEEPER
C	CLAY, CLAYEY	Mat.	MATRIX	U.D.B.D.	UNABLE TO DRY BARREL DEEPER
Cse.	COARSE	Med.	MEDIUM	U.E.D.	UNABLE TO EXCAVATE DEEPER
Cbl.	COBBLES (3" - 12")	Mic.	MICACEOUS	U.S.	UPSTREAM
Cpt.	COMPACT	Mod.	MODERATELY	Var.	VARIABLE
Con.	CONCRETIONS	Nod.	NODULE OR NODULAR	V/.	VERY
Cng.	CONGLOMERATE	N.R.	NO RECOVERY	Vug.	VUGULAR
Cs.	CLAYSTONE	O	ORGANIC	Wtr.	WATER LEVEL AS ENCOUNTERED DURING DRILLING PROCESS
C.T.	CAVED TO	Part.	PARTINGS	W	WELL GRADED
Xln.	CRYSTALLINE	Peb.	PEBBLE	W/.	WITH
Ds.	DENSE	Per.	PERMEABLE	Wea.	WEATHERED
Dip.	DIPPING	Po.	POORLY	▽	(DATE) STATIC WATER LEVEL
D.S.	DOWNSTREAM	P.	POORLY GRADED		
Fe. Stn.	Iron Stains	Rdd.	ROUNDED		
Flg.	FLAGSTONE OR FLAGGY	S	SAND, SANDY		
Fn.	FINE	Ss.	SANDSTONE		
Frm.	FIRM	Sat.	SATURATED		
Frac.	FRACTURED	Sh.	SHALE, OR SHALY		
Frg.	FRAGMENTS	Sl/.	SLIGHTLY		
Fri.	FRIABLE	Slo.	SLOWLY		
Grn.	GRAIN				
G	GRAVEL, GRAVELLY				
Gyp.	GYPSEOUS				
Hd.	ROCK HARDNESS				
H.	HIGHLY				

DRAWN ME DATE 9/5/23

CHECKED MJ DATE 9/5/23

APPROVED LF DATE 9/5/23

PLAN OF GEOLOGIC INVESTIGATIONS

FLOODWATER RETARDING STRUCTURE NO. 12

ESCONDIDO CREEK WATERSHED

IN

KARNES COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 1 OF 3

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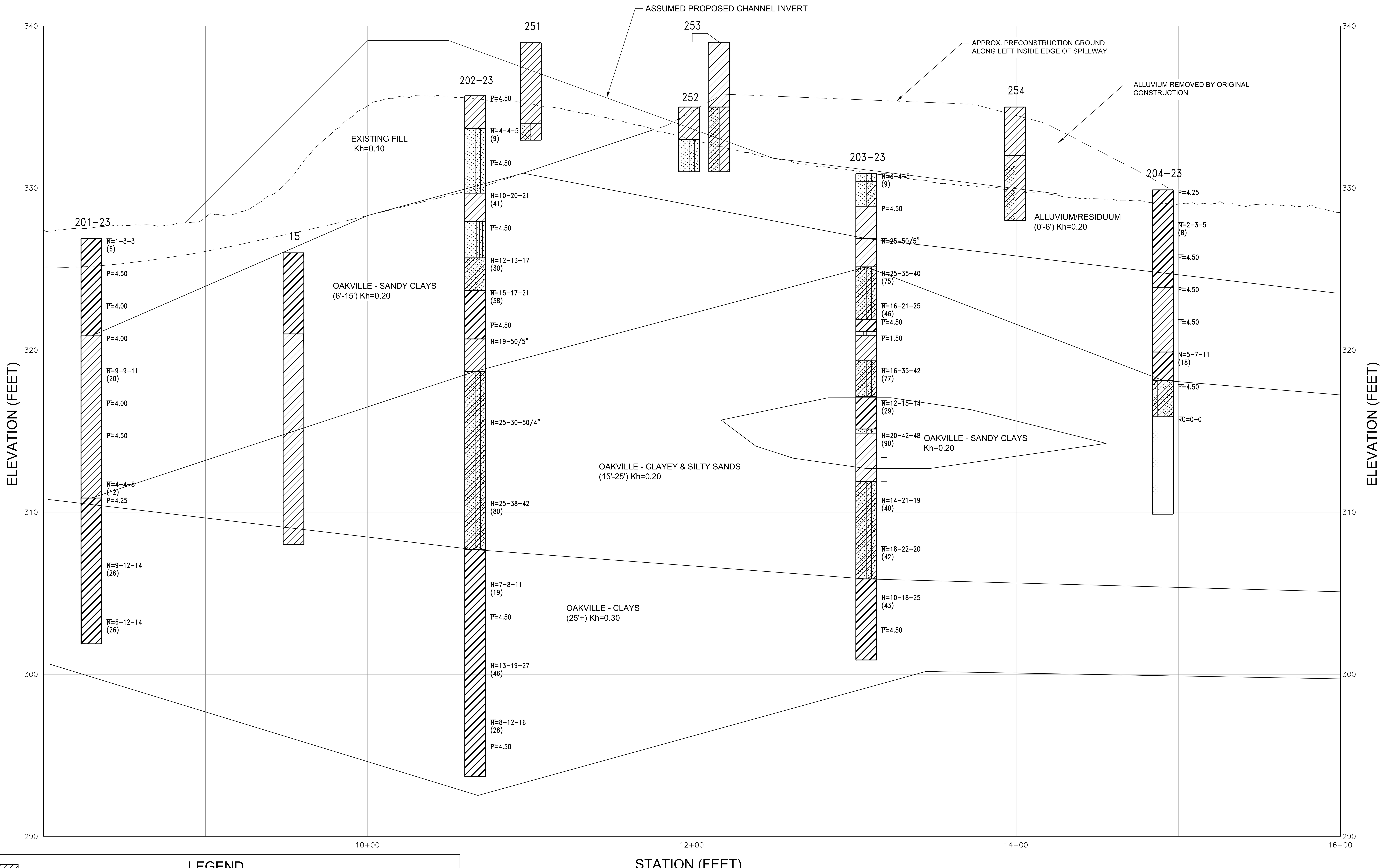

LEGEND

- Low Plasticity Clay
- High Plasticity Clay
- Poorly Graded Sand
- Clayey Sand
- Silty Sand
- Fine to Coarse Grained Sand
- Poorly Graded Sand with Clay
- — Sample Top Depth
- N= SPT blows per 6" increment (N-value, bpf)
- P= Pocket Penetrometer (tsf)
- RC= Core Recovery (%) – RQD (%)
- Water Level at Time Drilling, or as Shown
- Water Level at End of Drilling, or as Shown
- Water Level After 24 Hours, or as Shown

HORIZ. 0' 30' 60'
VERT. 0' 3' 6'
SCALE IN FEET

DRAWN ME DATE 9/5/23
CHECKED MJ DATE 9/5/23
APPROVED LF DATE 9/5/23

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
MCLENNAN COUNTY, TEXAS

AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 2 OF 3

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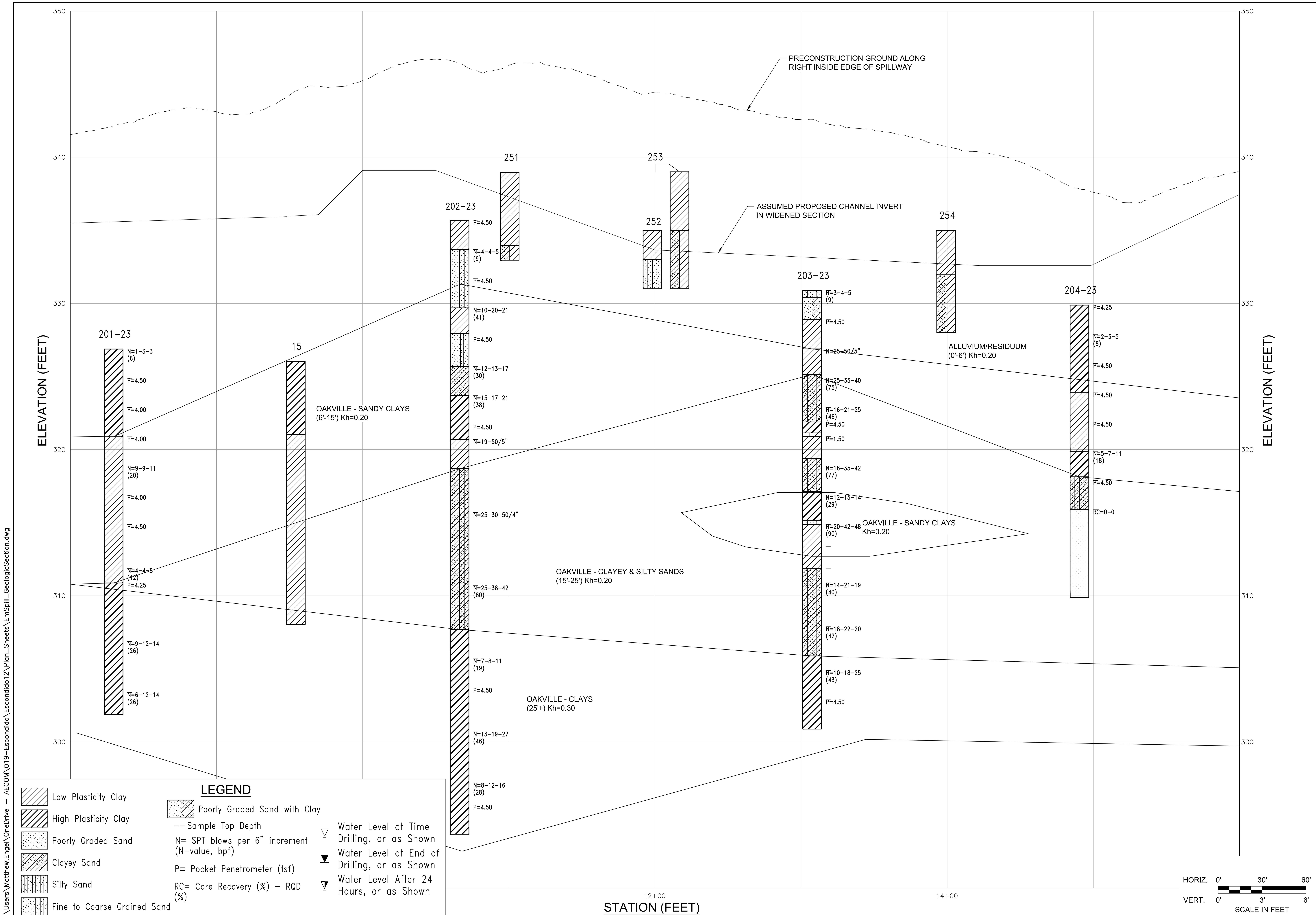


DRAWN ME DATE 9/5/23
CHECKED MJ DATE 9/5/23
APPROVED LF DATE 9/5/23

GEOLOGIC PROFILE OF AUXILIARY SPILLWAY

FLOODWATER RETARDING STRUCTURE NO. 12
ESCONDIDO CREEK WATERSHED
IN
MCLENNAN COUNTY, TEXAS

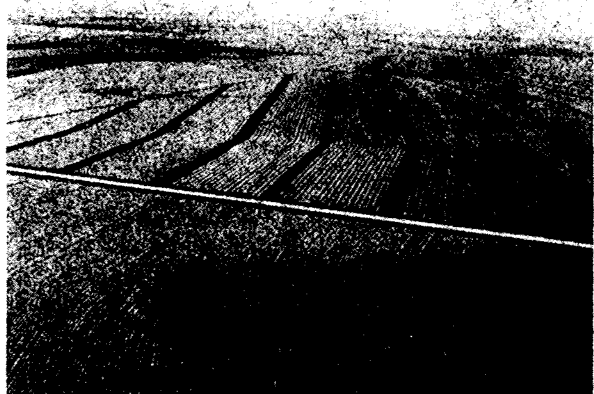
AECOM

CAD FILE NAME: GEOLOGIC PROFILES.DWG

SHEET NO. 3 OF 3

ATTACHMENT 1.

AS-BUILT DRAWINGS



SOIL CONSERVATION SERVICE

FLOODWATER RETARDING DAM NO. 12
ESCONDIDO CREEK WATERSHED PROJECT
IN
KARNES COUNTY, TEXAS

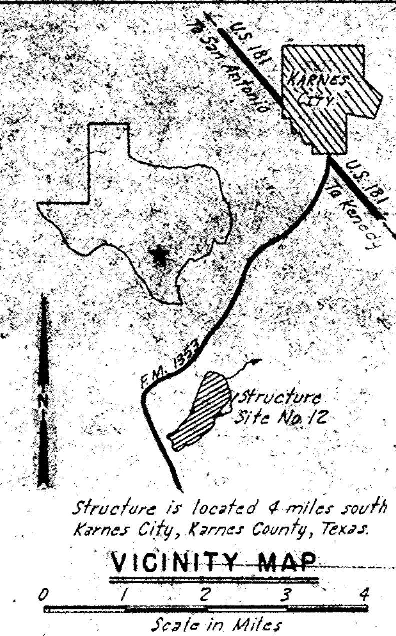
DRAINAGE AREA	3,904	ACRES
TOTAL STORAGE	1,844	AC. FT.
HEIGHT OF DAM	34	FEET
VOLUME OF FILL	~~164,520~~ 168,192	CU. YDS.

SPONSORED BY
KARNES - GOLIAD SOIL AND WATER CONSERVATION DISTRICT
ESCONDIDO WATERSHED DISTRICT
CITY OF KENEDY
SAN ANTONIO RIVER AUTHORITY
COOPERATING WITH
SOIL CONSERVATION SERVICE
OF THE
U.S. DEPARTMENT OF AGRICULTURE
1974

CONSTRUCTION DRAWINGS APPROVED
Gene C. Vittetoe, (Wood) 4-9-74
STATE CONSERVATION ENGINEER, S.C.S. DATE
TEMPLE, TEXAS

I N D E X O F D R A W I N G S

SHEET NO.	TITLE
1	GENERAL PLAN OF RESERVOIR
2	PLAN OF EMBANKMENT AND SPILLWAYS
3 - 4	PRINCIPAL SPILLWAY- PLAN AND SECTION
5	PIPE DETAILS
6	PRINCIPAL SPILLWAY INLET
7 - 8	STEEL PLACEMENT-PRINCIPAL SPILLWAY INLET
9	TRASH RACK, SLIDE GATE, PIPE CANTILEVER SUPPORT DETAILS
10	FENCE DETAILS
11 - 13	PLANS AND PROFILES FOR GEOLOGIC INVESTIGATIONS



Structure is located 4 miles south of Karnes City, Karnes County, Texas.

VICINITY MAP

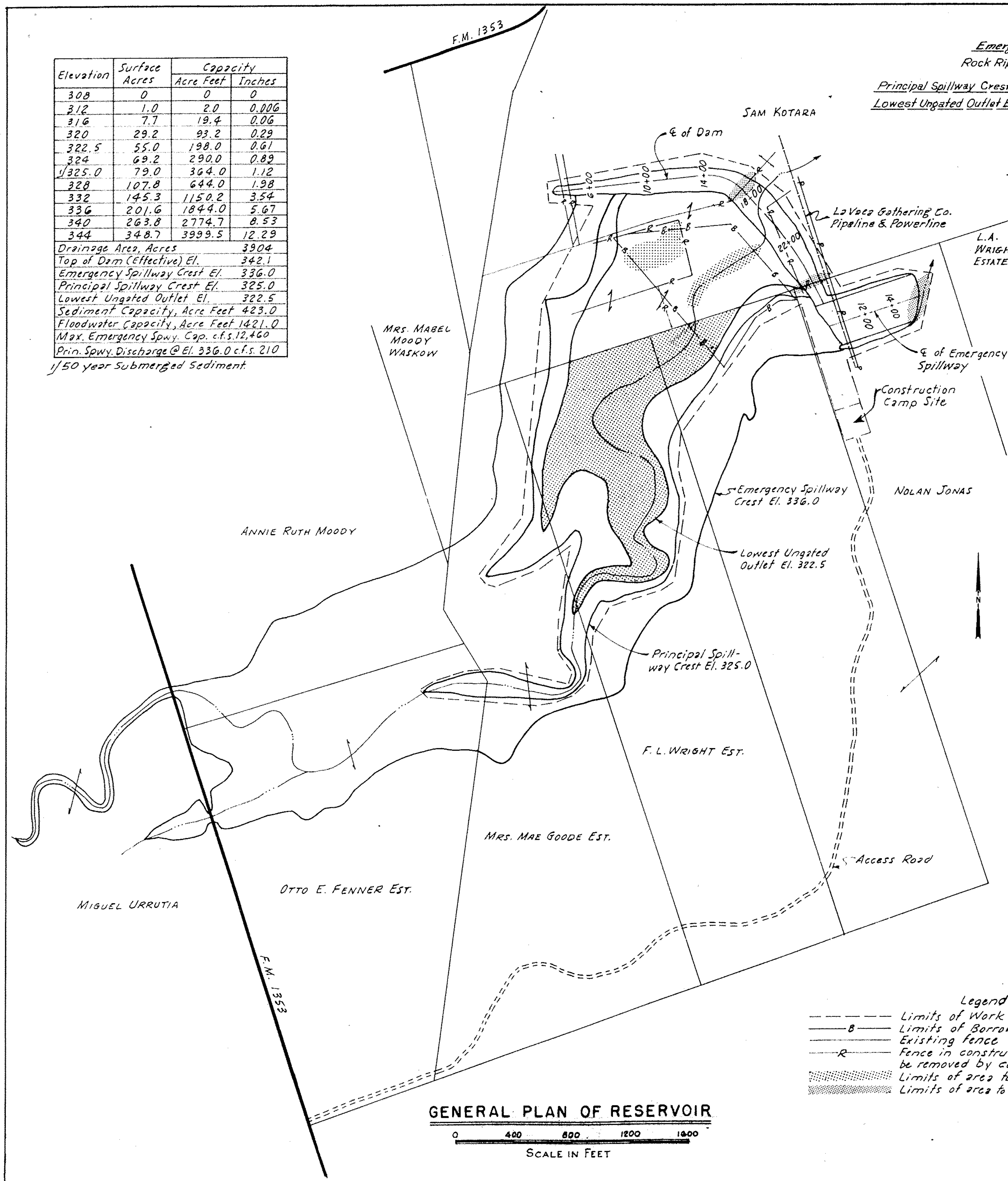
AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

Drawing No.
4-E-33,763

Elevation	Surface Acres	Capacity Acre Feet	Capacity Inches
308	0	0	0
312	1.0	2.0	0.006
316	7.7	19.4	0.06
320	29.2	93.2	0.29
322.5	55.0	198.0	0.61
324	69.2	290.0	0.89
1/325.0	79.0	364.0	1.12
328	107.8	644.0	1.98
332	145.3	1150.2	3.54
336	201.6	1844.0	5.67
340	263.8	2774.7	8.53
344	348.7	3999.5	12.29

Drainage Area, Acres	3904
Top of Dam (Effective) El.	342.1
Emergency Spillway Crest El.	336.0
Principal Spillway Crest El.	325.0
Lowest Ungated Outlet El.	322.5
Sediment Capacity, Acre Feet	423.0
Floodwater Capacity, Acre Feet	1421.0
Max. Emergency Spwy. Cap. c.f.s.	12,460
Prin. Spwy. Discharge @ El. 336.0 c.f.s.	210

1/50 year Submerged Sediment.



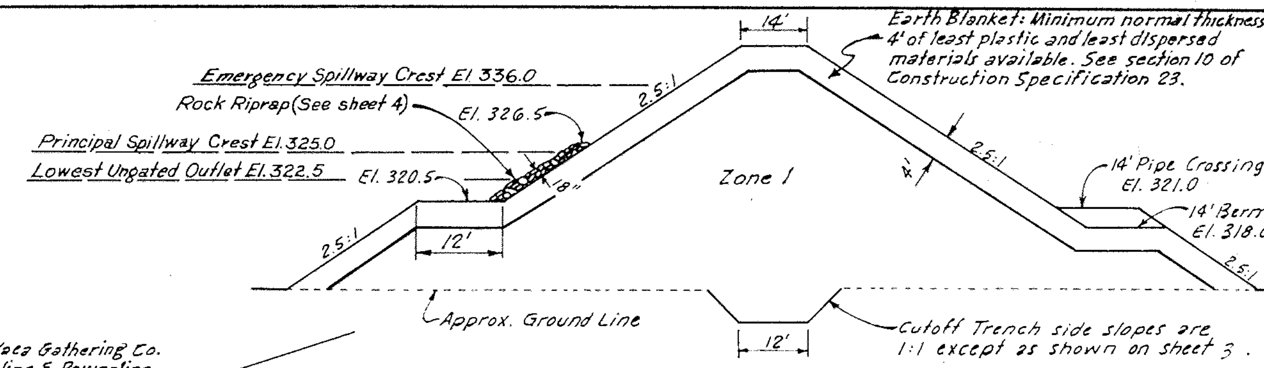
Legend

- — — — Limits of Work Area
- —B— Limits of Borrow Area
- Existing Fence
- —R— Fence in construction area to be removed by contractor.
- Limits of area to be cleared
- Limits of area to be cleared and grubbed.

GENERAL PLAN OF RESERVOIR

0 400 800 1200 1600

Scale in Feet



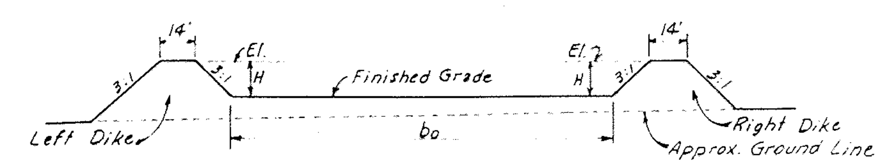
TYPICAL SECTION

Note: Place the least plastic soils to the outside of the Embankment and the more plastic soils to the inside.

MATERIALS PLACEMENT DATA

Embankment Zone No. 1/	Type or Unified Classification	Field Control Test: ASTM Test Number	Field Control Test: ASTM Test Method	Placement and Compaction Requirements: Max. Allowable Particle Size	Max Uncompacted Layer Thickness	Specified Compaction Class	Min. Dry Density, Percent of Field Test Max. Dry Density	Moisture Limits, Relative to Field Test Optimum %: From	To
1	CL; Moderately Plastic, Silty, Sandy Clay	D-698	A or B	6"	9"	A	95	1	[illegible]
1	CL; Slightly to Mod. Plastic Silty, Very Sandy Clay	D-698	A or B	6"	9"	A	95	Opt.	[illegible]

ZONED EMBANKMENT DATA



Left Dike: From Embankment to Sta. 11+00, El. 342.3
Sta. 11+00 to Sta. 12+00 is a transition section.
Sta. 12+00 to Sta. 12+50, H = 4.0 feet.
Sta. 12+50 to Sta. 13+00 dike shall transition from section of dike to section of diversion.

Right Dike: From approx. Sta. 7+00 to Sta. 11+00, El. 342.3
Sta. 11+00 to Sta. 11+50 is a transition section.
Sta. 11+50 (H = 4.0 ft.) to Sta. 12+00, dike shall transition from section of dike to section of diversion.

Bottom Width: Approx. Sta. 9+10 to Sta. 10+00, bo = variable
Sta. 10+00 to approx. Sta. 15+00, bo = 300 ft.
Approx. Sta. 15+00 to approx. Sta. 16+10, bo = variable

Material forming dikes and transition sections shall be placed and paid for as "Earth Fill, Embankment." See Materials Placement Data and Construction Specification 23.

TYPICAL SECTION - EMERGENCY SPILLWAY

GENERAL PLAN OF RESERVOIR
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

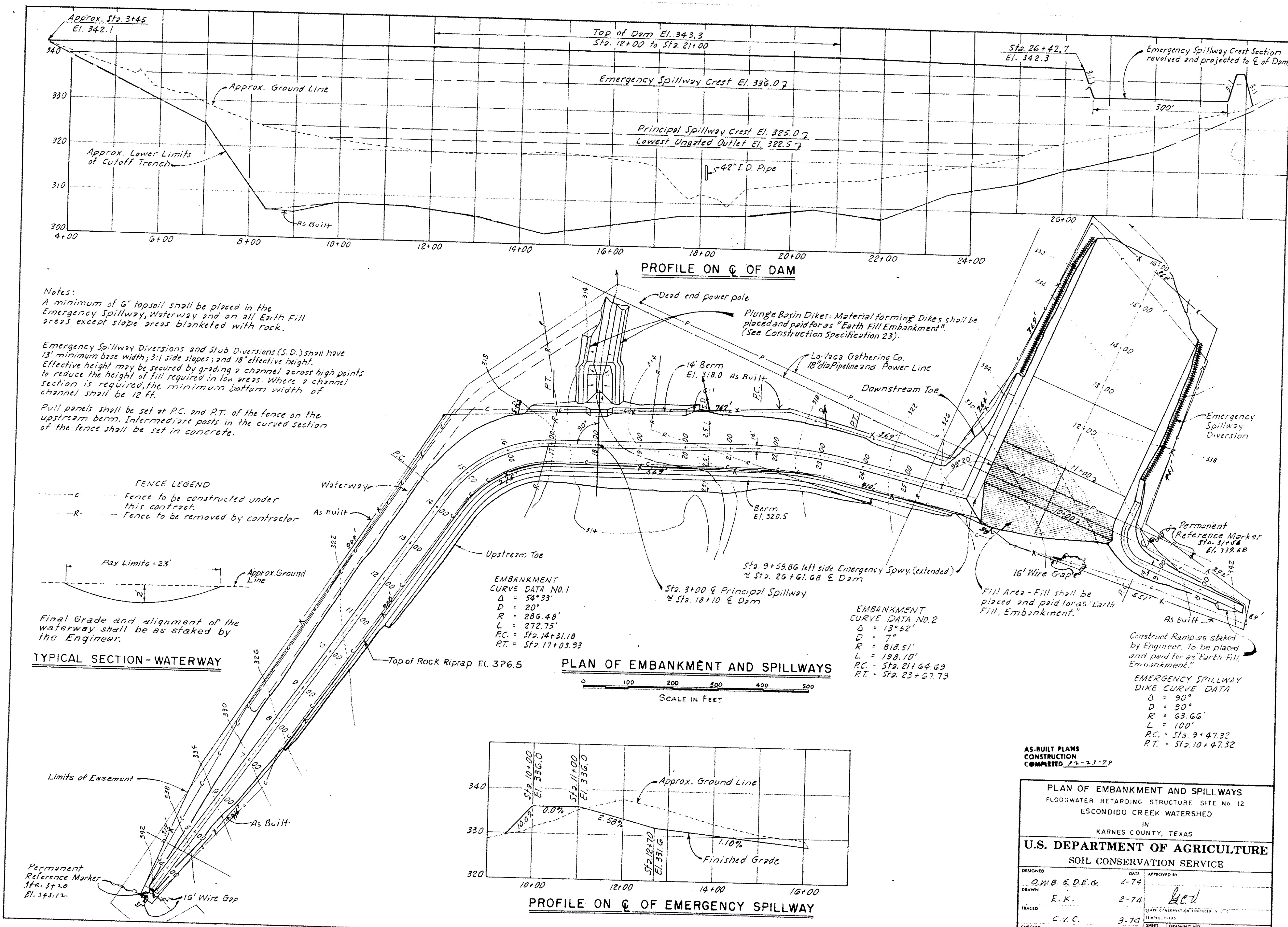
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

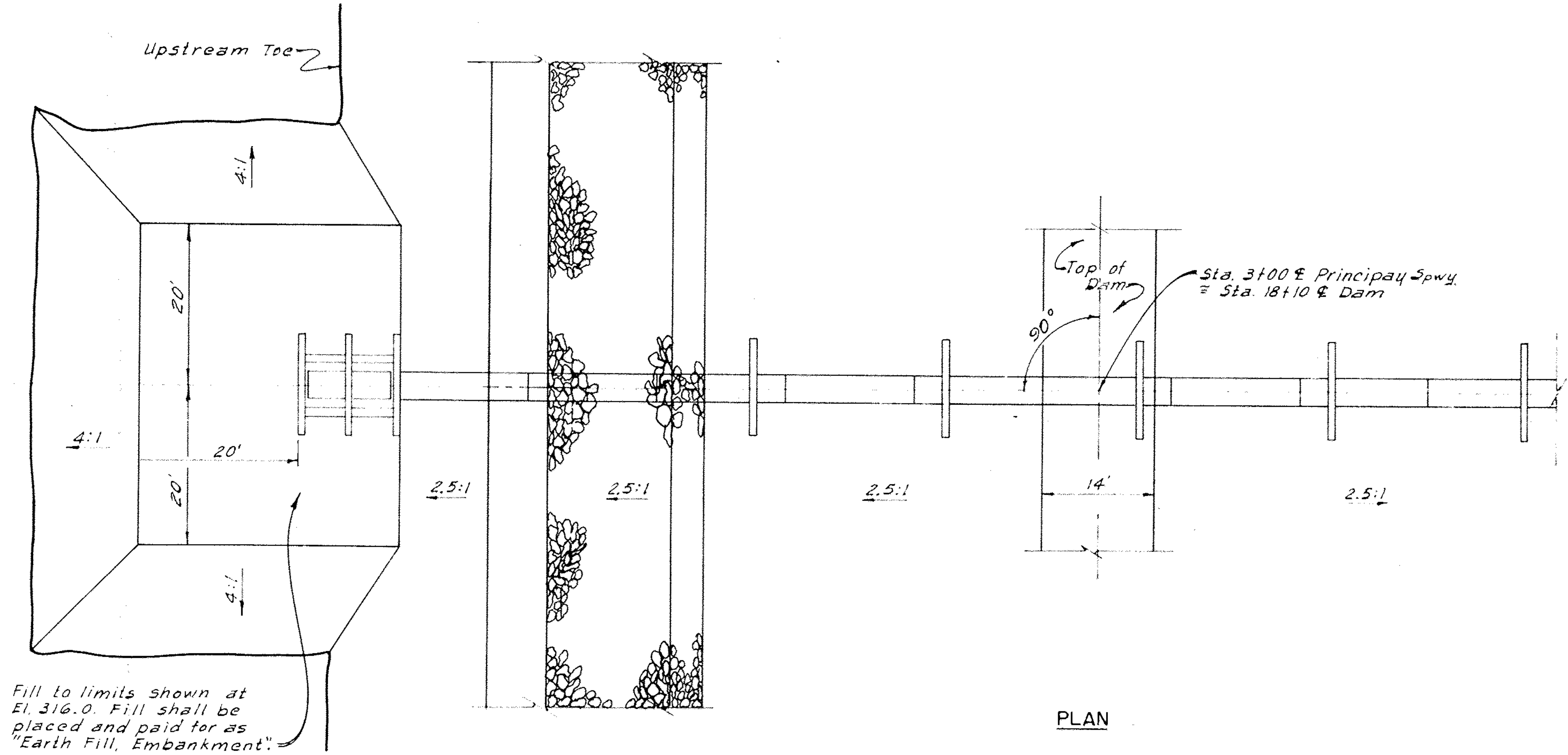
NO CHANGE IN PLANS

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

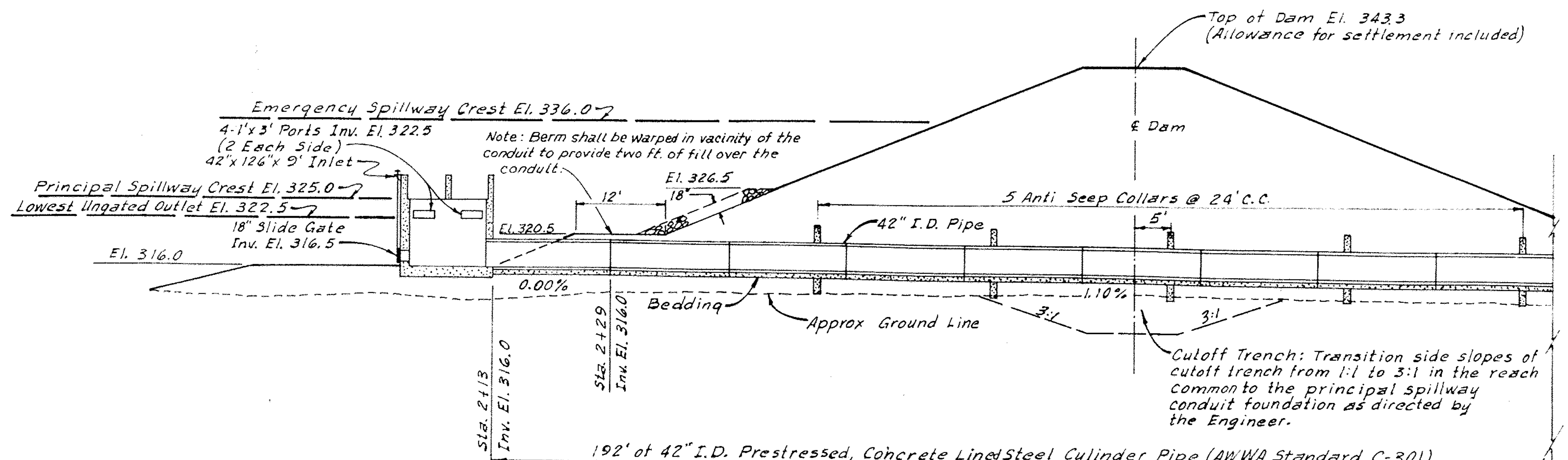
DESIGNED O.W.B. & D.E.G.	DATE 2-74	APPROVED BY Gcd — STATE CONSERVATION ENGINEER S.C.S. TEMPLE, TEXAS
DRAWN E.K.	2-74	
TRACED C.V.C.	3-74	
CHECKED M.D.K. & D.E.G.	3-74	SHEET No. 1 of 13 — DRAWING NO. 4-E-33,763

SCS-ENG-314 (Rev. 7-71)


Approx. Sta. 3+45
El. 342.1
Top of Dam El. 343.3
Sta. 12+00 to Sta. 21+00
Sta. 26+42.7
El. 342.3
Emergency Spillway Crest Section revolved and projected to ℄ of Dam.
Approx. Ground Line
Emergency Spillway Crest El. 336.0
300'
Principal Spillway Crest El. 325.0
Lowest Ungated Outlet El. 322.5
Approx. Lower Limits of Cutoff Trench
42" I.D. Pipe
As Built
340
330
320
310
300
4+00
6+00
8+00
10+00
12+00
14+00
16+00
18+00
20+00
22+00
24+00
26+00
PROFILE ON ℄ OF DAM
Notes:
A minimum of 6" topsoil shall be placed in the Emergency Spillway, Waterway and on all Earth Fill areas except slope areas blanketed with rock.
Emergency Spillway Diversions and Stub Diversions (S.D.) shall have 13' minimum base width; 3:1 side slopes; and 18" effective height. Effective height may be secured by grading a channel across high points to reduce the height of fill required in low areas. Where a channel section is required, the minimum bottom width of channel shall be 12 ft.
Pull panels shall be set at P.C. and P.T. of the fence on the upstream berm. Intermediate posts in the curved section of the fence shall be set in concrete.
Dead end power pole
Plunge Basin Dikes: Material forming Dikes shall be placed and paid for as "Earth Fill Embankment". (See Construction Specification 23).
Lo-Vaca Gathering Co. 18" dia. Pipeline and Power Line
14' Berm
El. 318.0 As Built
Downstream Toe
Emergency Spillway Diversion
FENCE LEGEND
—C— Fence to be constructed under this contract.
—R— Fence to be removed by contractor
Waterway
As Built
Berm
El. 320.5
Upstream Toe
Permanent Reference Marker
Sta. 31+56
El. 339.68
Pay Limits = 23'
Approx. Ground Line
2'
Final Grade and alignment of the waterway shall be as staked by the Engineer.
TYPICAL SECTION - WATERWAY
EMBANKMENT CURVE DATA NO. 1
Δ = 54° 33'
D = 20°
R = 286.48'
L = 272.75'
P.C. = Sta. 14+31.18
P.T. = Sta. 17+03.93
Sta. 3+00 ℄ Principal Spillway ≅ Sta. 18+10 ℄ Dam
Sta. 9+59.86 left side Emergency Spwy. (extended) ≅ Sta. 26+61.68 ℄ Dam
16' Wire Gap
Fill Area - Fill shall be placed and paid for as "Earth Fill, Embankment."
As Built
EMBANKMENT CURVE DATA NO. 2
Δ = 13° 52'
D = 7°
R = 818.51'
L = 198.10'
P.C. = Sta. 21+64.69
P.T. = Sta. 23+67.79
Construct Ramps as staked by Engineer. To be placed and paid for as "Earth Fill Embankment."
EMERGENCY SPILLWAY DIKE CURVE DATA
Δ = 90°
D = 90°
R = 63.66'
L = 100'
P.C. = Sta. 9+47.32
P.T. = Sta. 10+47.32
Top of Rock Riprap El. 326.5
PLAN OF EMBANKMENT AND SPILLWAYS
0 100 200 300 400 500
SCALE IN FEET
Limits of Easement
As Built
Permanent Reference Marker
Sta. 3+20
El. 343.12
16' Wire Gap
Sta. 10+00 El. 336.0
Sta. 11+00 El. 336.0
Approx. Ground Line
10.0% 0.0%
2.58%
Sta. 12+70 El. 331.6
1.10%
Finished Grade
340
330
320
10+00
12+00
14+00
16+00
PROFILE ON ℄ OF EMERGENCY SPILLWAY
AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74
PLAN OF EMBANKMENT AND SPILLWAYS
FLOODWATER RETARDING STRUCTURE SITE No 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
DESIGNED O.W.B. & D.E.G. 2-74
DRAWN E.K. 2-74
TRACED C.V.C. 3-74
CHECKED
APPROVED BY
STATE CONSERVATION ENGINEER
TEMPLE, TEXAS
SHEET
DRAWING NO.



PLAN



SECTION
PRINCIPAL SPILLWAY

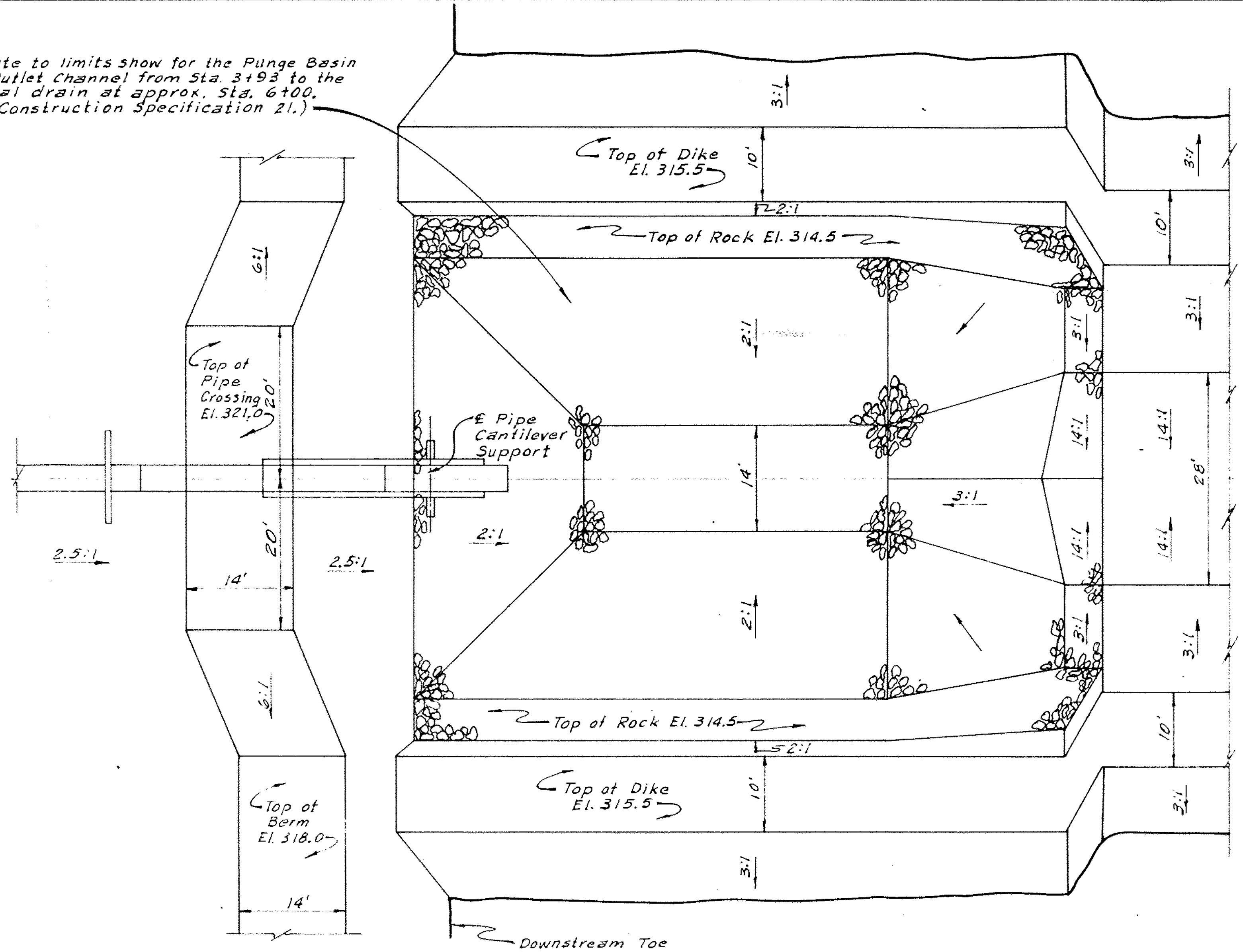
AS-BUILT PLANS
CONSTRUCTION
COMPLETED 12-23-74 NO CHANGE IN PLANS

PRINCIPAL SPILLWAY—PLAN AND SECTION
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

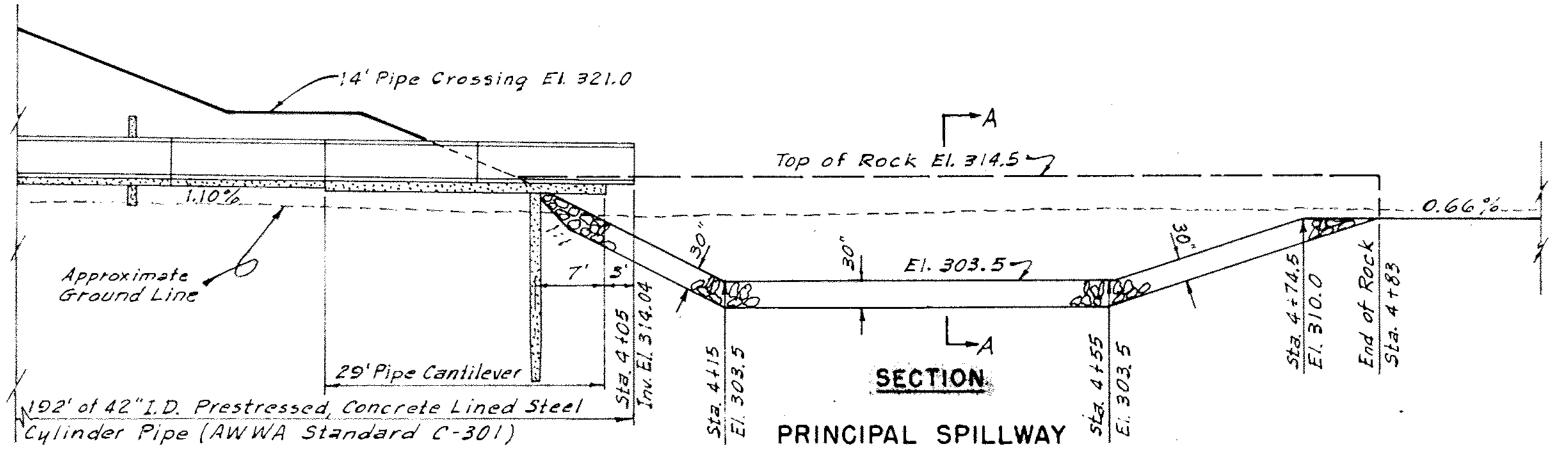
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED O. W. B. & DE. G.	DATE 2-74	APPROVED BY	
DRAWN E. K.	2-74		
TRACED T. D. S.	3-74	STATE CONSERVATION ENGINEER S.C.S. TEMPLE, TEXAS	
CHECKED R. L. K. & DE. G.	3-74	SHEET No. 3 of 13	DRAWING NO 4-E-33,763

Excavate to limits show for the Punge Basin and Outlet Channel from Sta. 3+93 to the natural drain at approx. Sta. 6+00. (See Construction Specification 21.)



PLAN



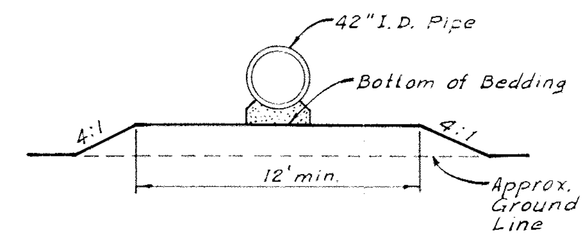
SECTION

PRINCIPAL SPILLWAY

GRADATION OF ROCK RIPRAP	
Size of Rock	% Smaller by Weight
250 lbs	100
75 lbs	40-60
8 lbs	5-10

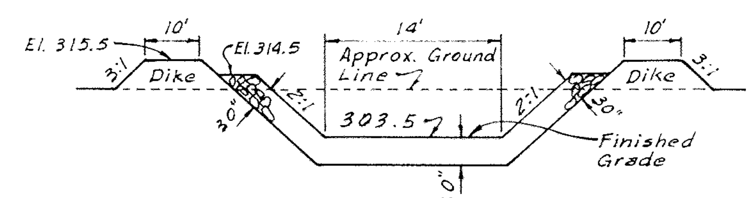
Rock Riprap for the upstream face of the dam and rock for lining the plunge basin shall have the above gradation.

Approximately 5% by weight shall be spalls fines and rock chips. The least dimension of an individual rock fragment shall not be less than one third the greatest dimension of the fragment.



Fill to bottom of bedding, see Construction Specification 23. Prior to placing fill material around the completed conduit, the exposed earth surfaces shall be reworked as necessary and to the depth necessary to remove all cracks caused by weathering and to establish or restore the density and moisture requirements specified for that type of material.

TYPICAL CONDUIT FOUNDATION



SECTION A-A

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

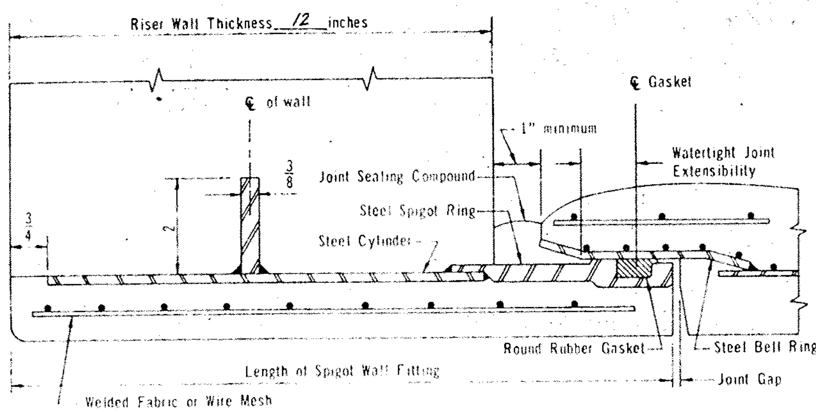
NO CHANGE IN PLANS

PRINCIPAL SPILLWAY—PLAN AND SECTION
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

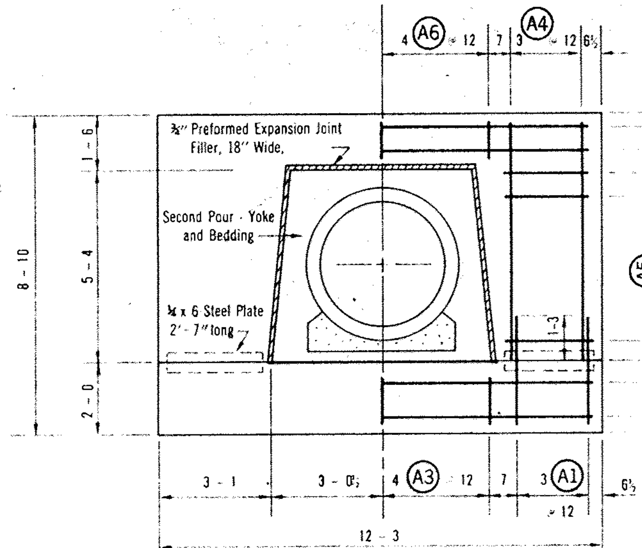
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED O.W.B. & D.E.G.	DATE 2-74	APPROVED BY GCV
DRAWN E.K.	2-74	STATE CONSERVATION ENGINEER S.C.S. TEMPLE, TEXAS
TRACED T.D.S.	3-74	SHEET No. 4 of 13
CHECKED R.L.K. & D.E.G.	3-74	DRAWING NO. 4-E-33,763

SCS-ENG-314 (Rev. 7-71)

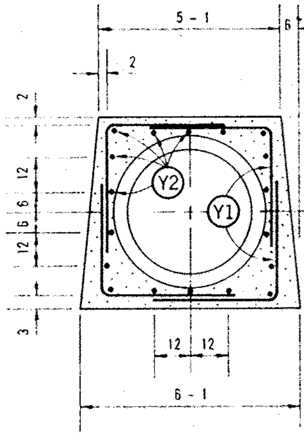


DETAIL A



DETAIL OF ANTI-SEEP COLLAR

Yoke steel not shown.



DETAIL OF ANTI-SEEP COLLAR YOKE

STEEL SCHEDULE

Anti-seep Collar and Yoke, 5 Required.

Mark	Size	Quantity per Collar	Length	Type	Total Quantity	Total Length
A_1	4	6	3 - 0	1	30	90-0
A_2	4	4	11 - 9	1	20	235-0
A_3	4	7	1 - 6	1	35	52-6
A_4	4	6	6 - 7	1	30	197-6
A_5	4	12	2 - 7	1	60	155-0
A_6	4	7	1 - 0	1	35	35-0
Y_1	4	12	6 - 2	21	60	370-0
Y_2	4	18	1 - 2	1	90	105-0

QUANTITIES

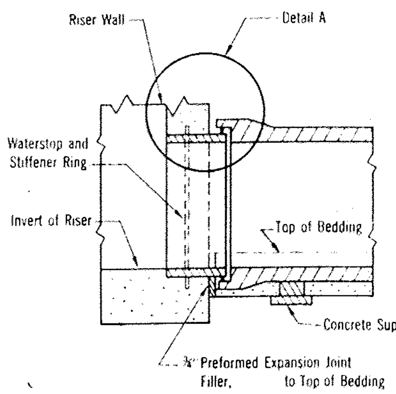
Concrete	Cu. Yds.
Anti-seep Collar including Yoke	
* Each,	2.8842
Total	14.4
Bedding	
** Per Lineal Foot of Bedding	0.0989
Total (.0989)(152.5) + .38 c.y.	15.5
Steel	**Pounds**
Anti-seep Collar including Yoke	828.3

Concrete quantities are based on an outside diameter of pipe of 49.25 inches. Steel quantities do not change with outside diameter of pipe.

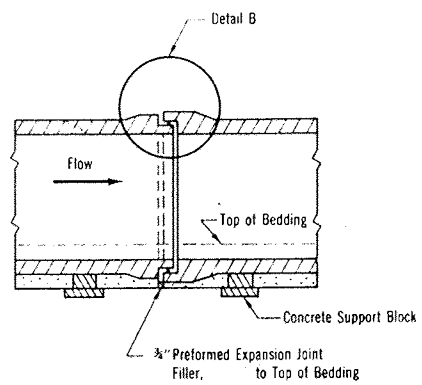
* This quantity is given by
$2.831 - 0.0003030 (D_f + 51)(D_f - 51)$ cu. yds

** This quantity is given by
$0.0977 - 0.0007 (D_f - 51)$ cu. yds

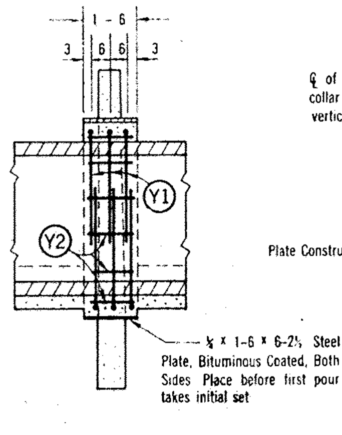
D_f = outside diameter of pipe furnished, inches.



DETAIL OF SPIGOT WALL FITTING

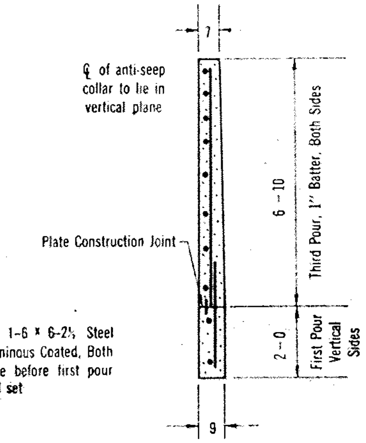


DETAIL OF PIPE JOINT

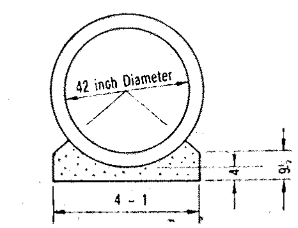


SECTION C-C

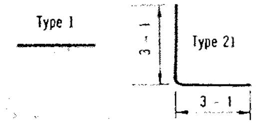
Anti-seep collar steel not shown.



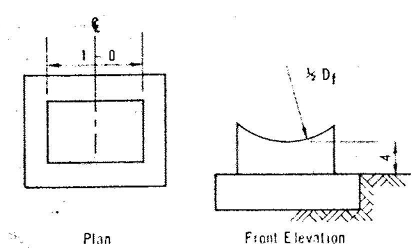
SECTION D-D



DETAIL OF BEDDING



BAR TYPES

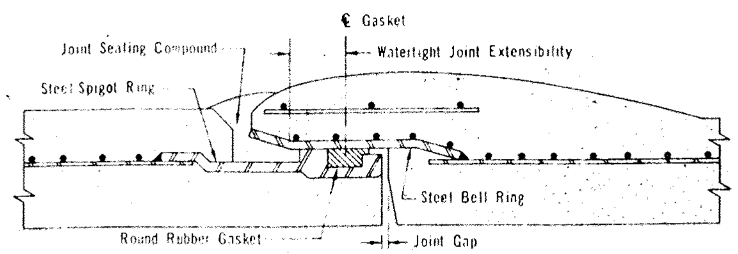


SUGGESTED SUPPORT BLOCKS

Sufficient blocks shall be provided to support the pipe to the required line and grade. The Contractor shall determine the number and size of blocks required. Wedges may be used as an alternate.

NO CHANGE IN PLANS

AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74



DETAIL B

JOINT REQUIREMENTS

Length of Pipe Section	Minimum Joint Length	Minimum Joint Limiting Angle	
feet	inches	radians	degrees
16	2.5	0.01878	1.07

For pipe length other than shown, joint requirements will be determined by the Engineer.

Where pipes of different length are connected, adjoining pipes shall meet the requirements of the longer pipe.

Prior to delivery of pipe, the pipe joint detail proposed for use shall be submitted to the Engineer for approval.

STRENGTH REQUIREMENTS

Inside Diameter of Pipe	Internal Load	External Load	
	Hydrostatic Pressure	Minimum 3-Edge Bearing Strength in Pounds per Lineal Foot of Pipe	
		Applicable Standard Specification	
		AWWA C-301	AWWA C-300
	Head of Water	Load to produce 0.001 inch crack one foot long	Load to produce 0.01 inch crack one foot long
inches	feet		
42	50	10,500	

The outside diameter of pipe assumed in design is 49.25 inches. Where the pipe furnished has an outside diameter greater than assumed in design, the three-edge bearing strength of the pipe furnished must not be less than the specified three-edge bearing strength multiplied by the ratio of the outside diameter of the pipe furnished to the outside diameter assumed in design.

Joint length equals watertight joint extensibility plus joint gap.

The pipe shall be drawn together so that the maximum joint gap does not exceed ⅜ inch for pipe laid on a straight line. For cambered pipe or pipe laid on a curved line, the joint gap at the closest point shall not exceed ⅜ inch.

STANDARD CONDUIT DETAILS
FOR
REINFORCED CONCRETE PRESSURE PIPE
PRINCIPAL SPILLWAY

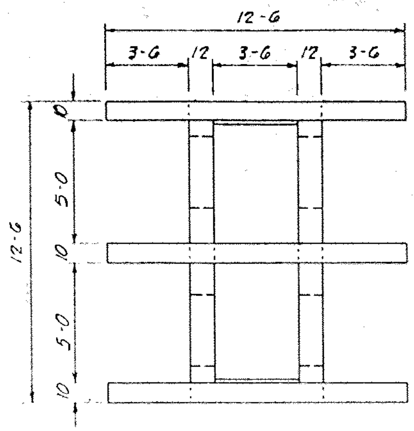
STANDARD DWG. NO.	ES- 5042-BE
DATE 2-70	SHEET 1 OF 1

Rev. 7-6-72
Rev. 6-19-71

PIPE DETAILS
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

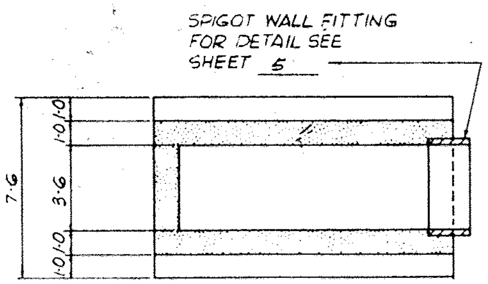
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	Approved by
Designed O. W. B. & D.E.G.	2-74	
Drawn E. K.	2-74	G.C.V. STATE CONSERVATION ENGINEER S.C.S. TEMPLE, TEXAS
Traced L. S.	3-74	
Checked R.L.K. & D.E.G.	3-74	Sheet No 5 of 13 — Drawing No 4-E-33,763



For detail of trashrack angles and grating see sheet 9

TOP PLAN



SECTION A-A

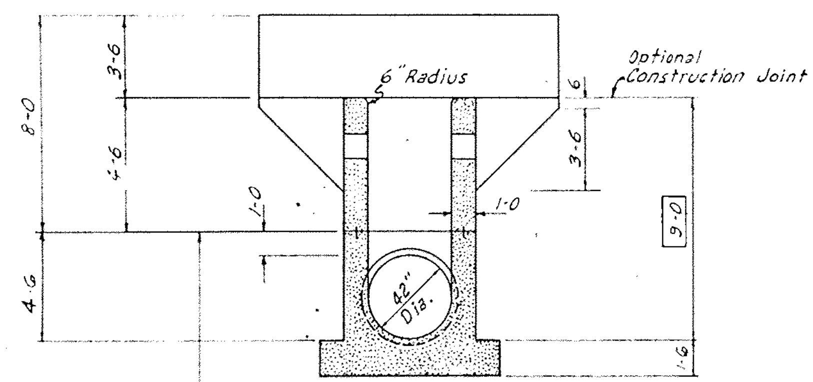
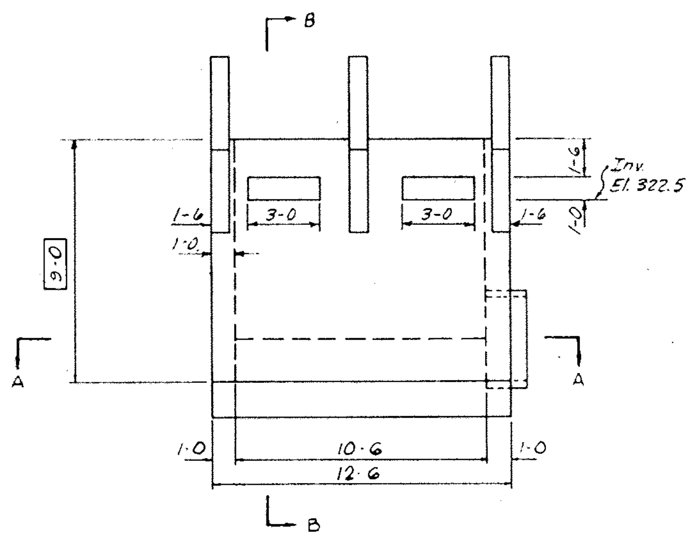


PLATE CONSTRUCTION JOINT. FOR DETAIL SEE SHEET 9

SECTION B-B



SIDEWALL ELEVATION

STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	6	13	7-0	1	-	-	91-0
B2	6	8	12-0	1	-	-	96-0
B3	7	44	11-2	21	3-8	7-6	491-4
B4	6	8	12-0	1	-	-	96-0
B5	6	12	7-0	1	-	-	84-0
B6	6	2	2-10	1	-	-	5-8
B7	6	4	8-5	21	1-0	7-5	33-8
B8	6	4	8-5	21	1-0	7-5	33-8
B9	6	14	8-5	21	1-0	7-5	117-10
B10	6	2	8-5	21	1-0	7-5	16-10
B11	6	14	11-2	1	-	-	156-4
B12	6	4	4-2	1	-	-	16-8
B13	6	20	10-8	21	3-7	7-1	213-4
B14	6	4	8-2	21	1-1	7-1	32-8
B15	6	4	7-10	21	0-9	7-1	31-4
B16	6	6	7-7	21	0-6	7-1	45-6
B17	6	2	9-2	21	2-1	7-1	18-4
B18	6	2	2-[illegible]	1	-	-	5-6
B19	6	2	2-10	1	-	-	5-8

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
T1	6	12	4-2	1			50-0
T2	6	8	7-10	1			62-8
T3	6	16	4-4	1			69-4
T4	6	8	7-10	1			62-8
T5	5	12	11-6	1			138-0
T6	5	2	4-2	1			8-4
T7	5	28	10-4	21	3-5	6-11	289-4
T8	5	2	6-6	1			13-0
T9	5	2	8-6	1			17-0
T10	5	2	10-6	1			21-0
T11	5	22	12-2	1			267-8
T12	5	12	8-6	19	3-9	4-9	102-0
T13	5	8	4-10	1			38-8
T14	5	8	5-10	1			46-8
T15	5	8	6-10	1			54-8
T16	5	2	6-10	1			13-8
T17	5	2	9-6	1			19-0
T18	5	6	3-2	1			19-0
T19	5	8	7-10	1			62-8
T20	5	4	6-4	1			25-4
T21	5	4	5-1	1			20-4
T22	5	4	3-3	21	1-7	1-8	13-0
T23	5	4	4-6	21	1-7	2-11	18-0
T24	5	4	5-8	21	1-7	4-1	22-8

NO CHANGE IN PLANS

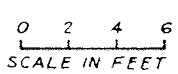
AS-BUILT PLANS
CONSTRUCTION
COMPLETED 12-23-74

QUANTITIES

STEEL

#5 BARS	1210-0	1262 LBS
#6 BARS	1346-0	2022 LBS
#7 BARS	491-4	1004 LBS
		4288 LBS

CONCRETE - 21.4 = 21.4 CU. YDS.



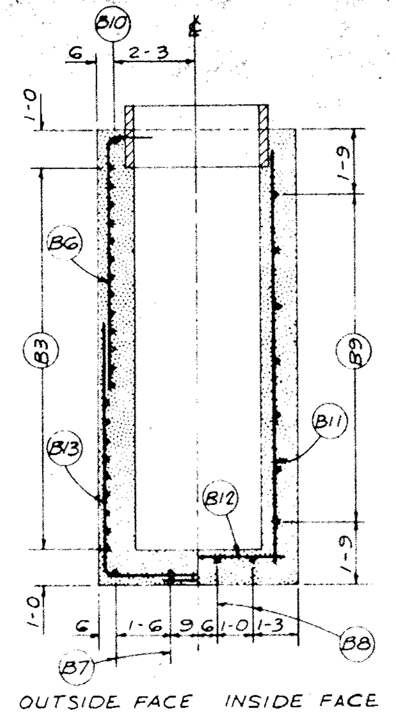
STANDARD OPEN RISER	
STANDARD DWG. NO. ES-3142-1010R	
DATE 9-67	SHEET 1 OF 3
ADAPTED FROM	
STANDARD COVERED RISER	
DESIGN CONSTANTS $f'_c = 4000$ psi, $n = 8$, $f_c = 1600$ psi, $f_s = 20{,}000$ psi	
STANDARD DWG. NO. ES-3042-2015R	
DATE 8-66	SHEET 1 OF 4

Special

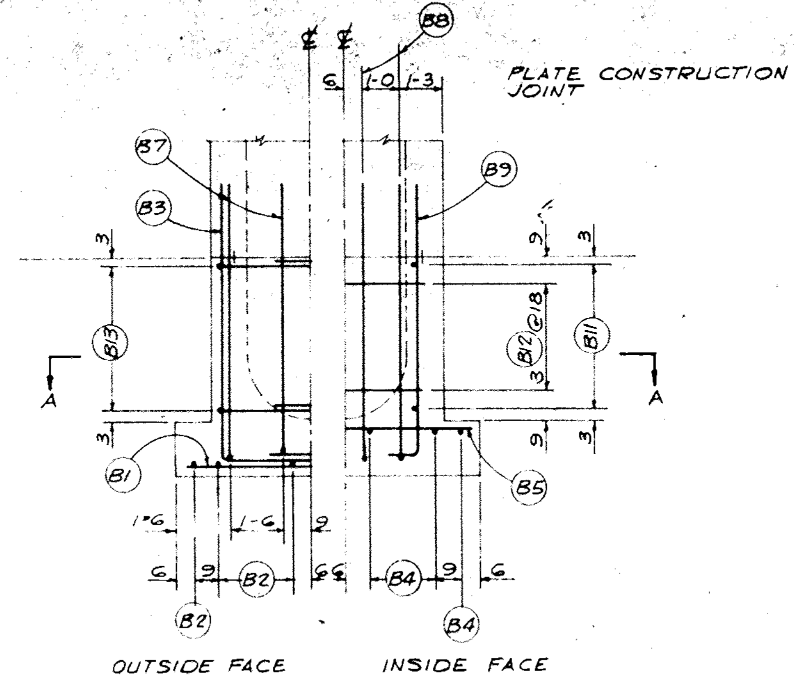
PRINCIPAL SPILLWAY INLET
FLOODWATER RETARDING STRUCTURE, SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

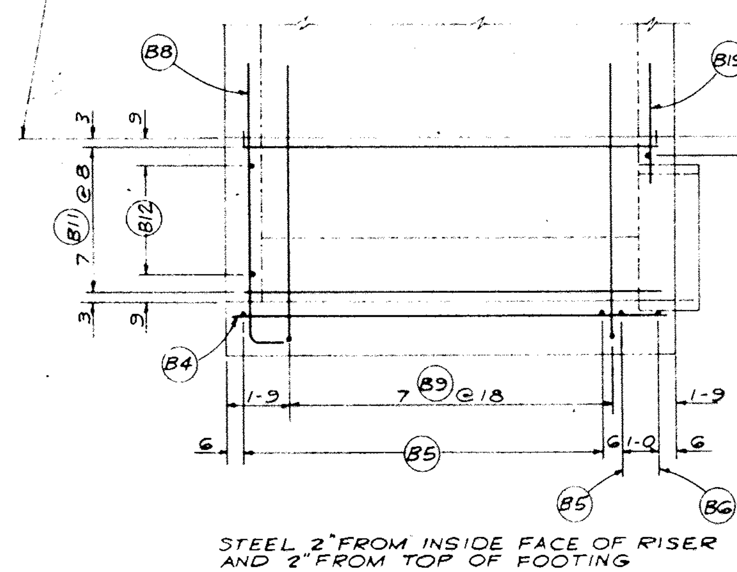
		Date	
Designed	O. W. B. & D.E.G.	2-74	Approved by [signature] STATE CONSERVATION ENGINEER, S.C.S. TEMPLE, TEXAS
Drawn	E. K.	2-74	
Traced	L. S.	3-74	Sheet No. 6 of 13
Checked	R.L.K. & D.E.G.	3-74	Drawing No. 4-E-33,763



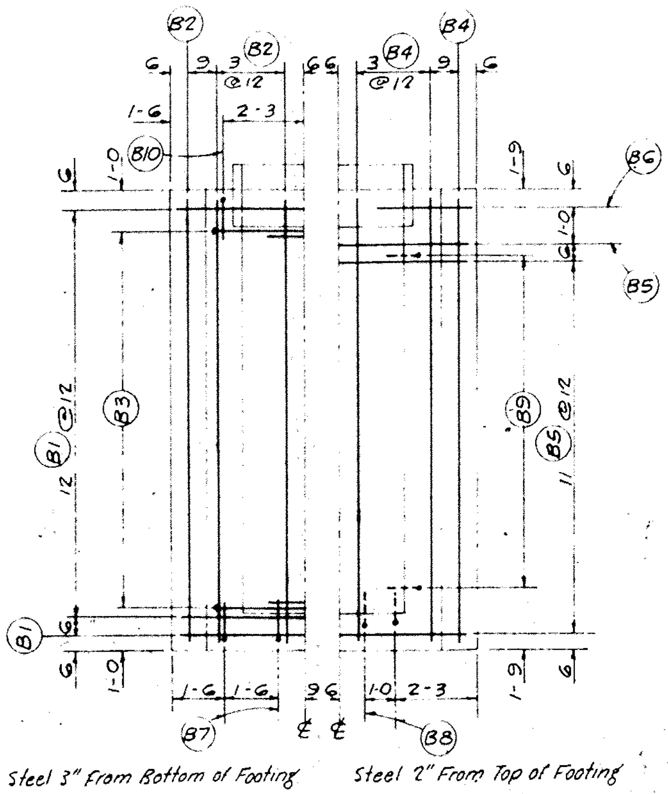
SECTION A-A



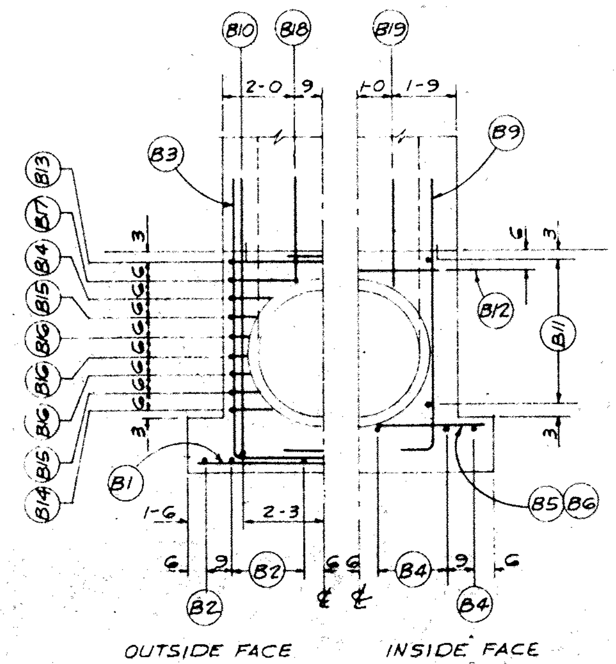
UPSTREAM ELEVATION



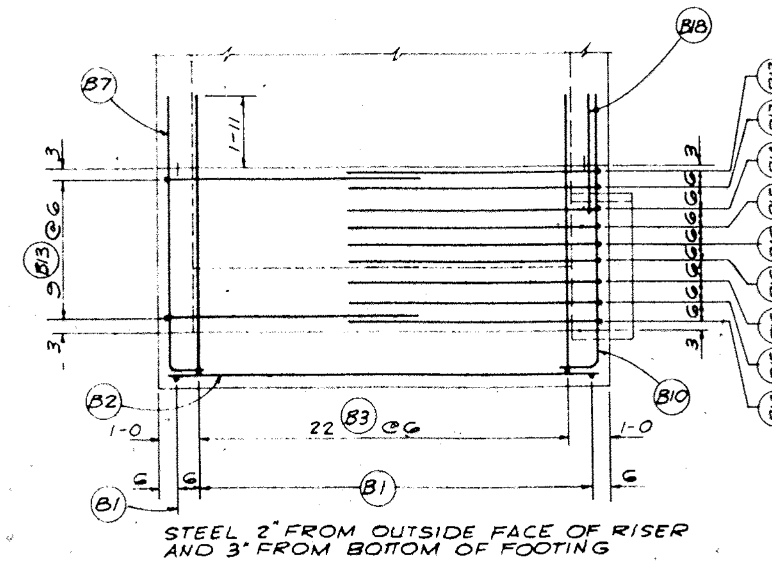
SIDEWALL ELEVATION



FOOTING PLAN



DOWNSTREAM ELEVATION



SIDEWALL ELEVATION

STANDARD OPEN RISER	
STANDARD DWG. NO. ES-3142-1010 R	
DATE 9-67	SHEET 2 OF 3
ADAPTED FROM	
STANDARD COVERED RISER	
DESIGN CONSTANTS f'_c = 4000 psi, n = 8, f_c = 1600 psi, f_s = 20,000 psi	
STANDARD DWG. NO. ES-3042-2015R	
DATE 8-66	SHEET 2 OF 4

Special

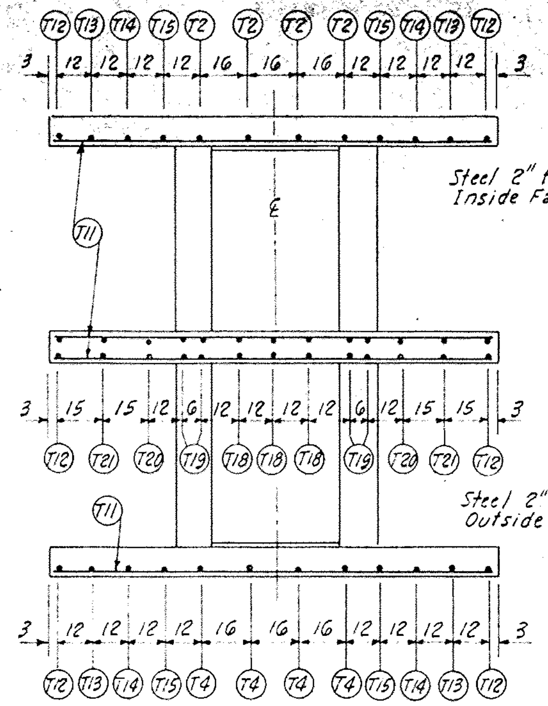
NO CHANGE IN PLANS

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

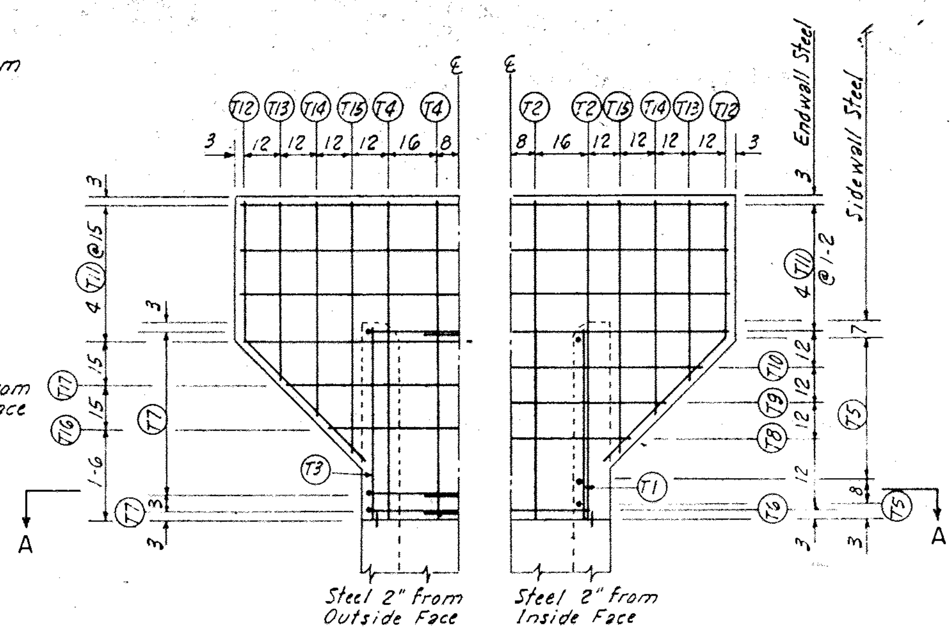
STEEL PLACEMENT-PRINCIPAL SPILLWAY INLET
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

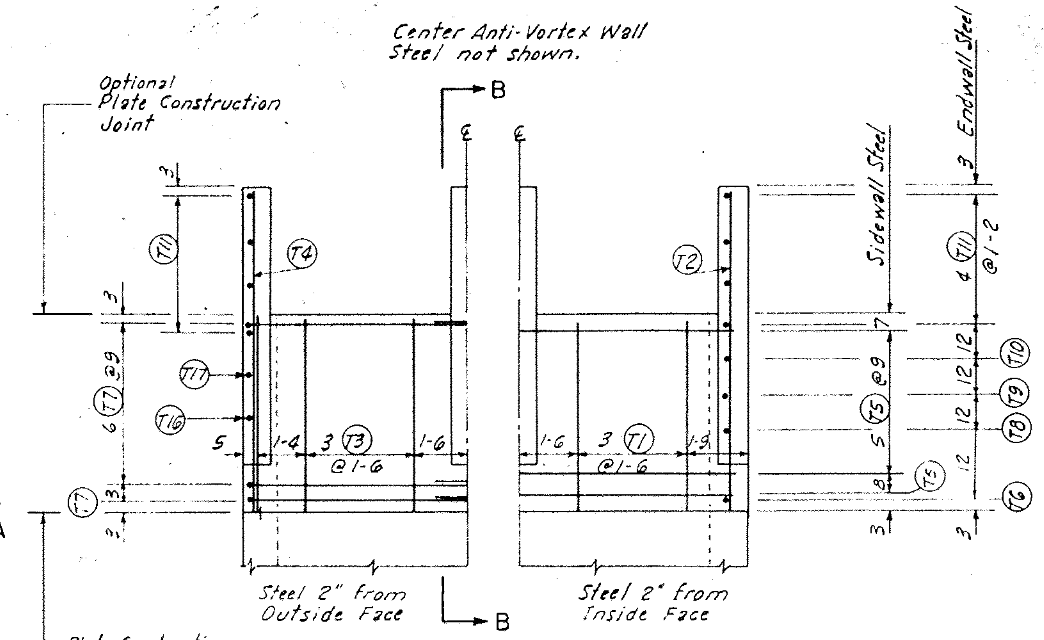
Designed O.W.B. E.D.E.G.	2-74	Approved by GCV, STATE CONSERVATION ENGINEER, TEMPLE, TEXAS
Drawn E.K.	2-74	
Traced L.S.	3-74	Sheet No. 7 of 13
Checked R.L.K. & D.E.G.	3-74	Drawing No. 4-E-33,763



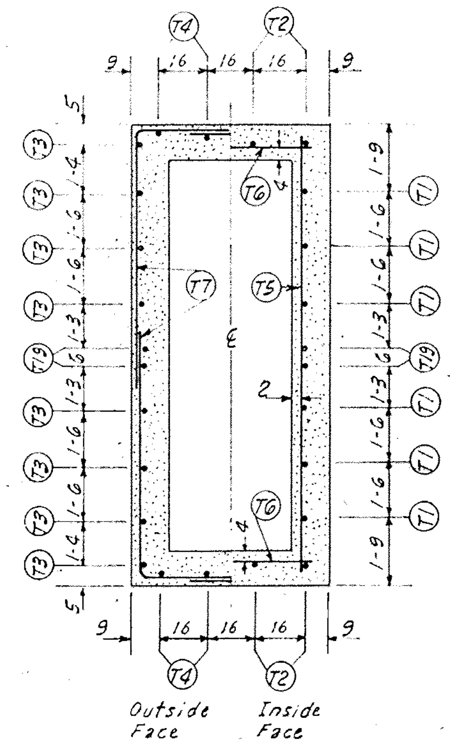
ANTI-VORTEX WALL PLAN



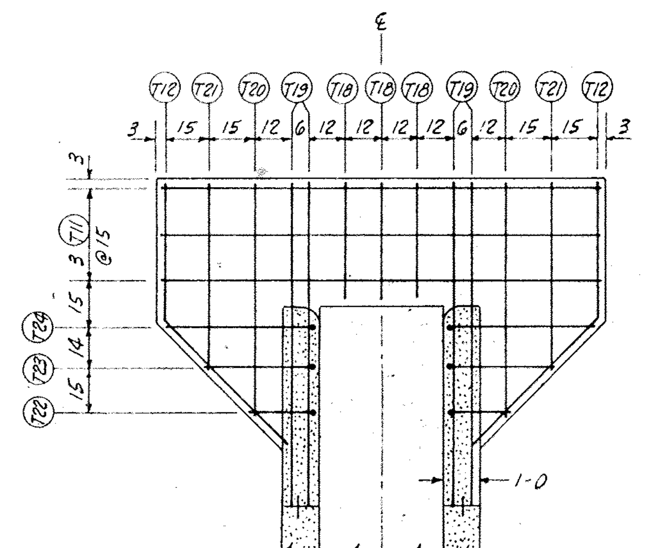
ENDWALL ELEVATION



SIDEWALL ELEVATION



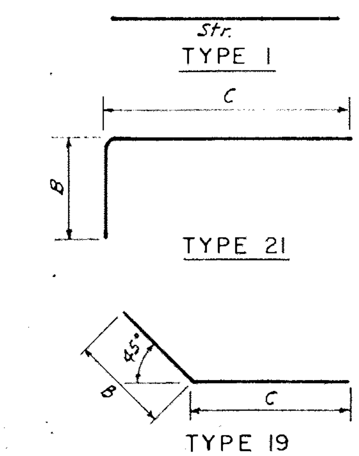
SECTION A-A



CENTER ANTI-VORTEX WALL ELEVATION

(Steel Identical Both Faces)

SECTION B-B



BAR TYPES

0 1 2 3 4 5 6
SCALE IN FEET

NOTE:
1. BAR DIMENSIONS ARE OUT TO OUT OF BAR
2. RADIUS OF BENDS
= 3 BAR DIAMETERS FOR SIZES ≤ #7
= 4 BAR DIAMETERS FOR #8
3. THE 2" AND 3" DISTANCES FROM SPECIFIED CONCRETE SURFACES ARE CLEAR DISTANCES.
4. CUT OR DEFLECT STEEL TO CLEAR PORTS.

AS-BUILT PLANS
CONSTRUCTION COMPLETED 12-23-74

NO CHANGE IN PLANS

STEEL PLACEMENT-PRINCIPAL SPILLWAY INLET
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNCS COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	O.W.B. E.D.E.G.	2-74
Drawn	E.K.	2-74
Traced	L.S.	3-74
Checked	R.L.K. E.D.E.G.	3-74

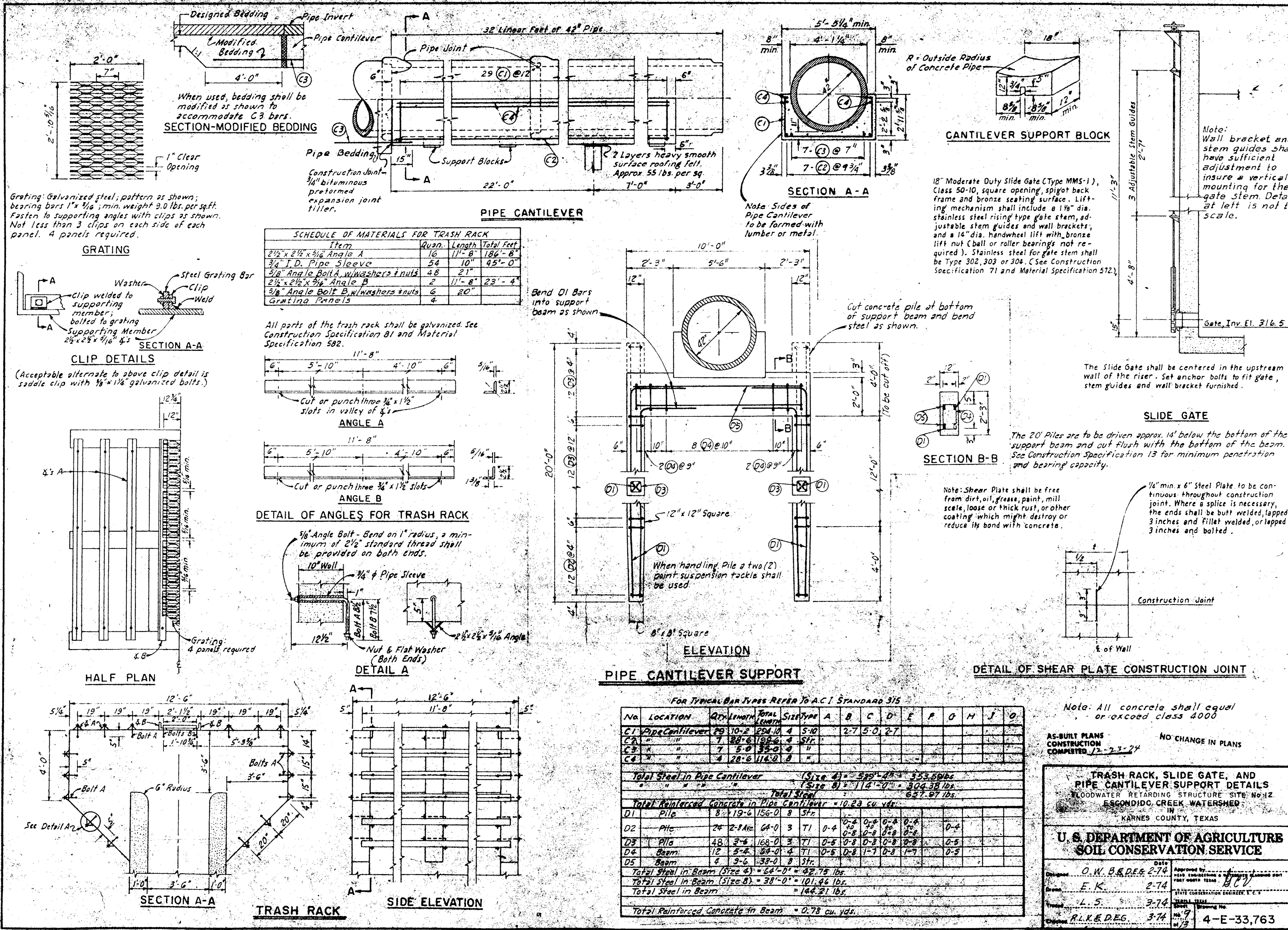
Approved by [signature]
STATE CONSERVATION ENGINEER, S.C.S.
TEMPLE, TEXAS

Sheet No. 8 of 13 — Drawing No. 4-E-33,763

Special

STANDARD OPEN RISER

DESIGN CONSTANTS	f'_c = 4000 psi, f_c = 1600 psi, n = 8, f_s = 20,000 psi
STANDARD DWG. NO.	ES-3142-1010 R
DATE 4-67	SHEET 3 OF 3



SCHEDULE OF MATERIALS FOR TRASH RACK			
Item	Quan.	Length	Total Feet
2 1/2" x 2 1/2" x 5/16" Angle A	16	11'-8"	186'-8"
3/4" I.D. Pipe Sleeve	54	10"	45'-0"
5/8" Angle Bolt A, w/washers & nuts	48	21"	
2 1/2" x 2 1/2" x 5/16" Angle B	2	11'-8"	23'-4"
5/8" Angle Bolt B, w/washers & nuts	6	20"	
Grating Panels	4		

FOR TYPICAL BAR TYPES REFER TO A.C.I. STANDARD 315

No.	LOCATION	QTY.	LENGTH	TOTAL LENGTH	SIZE	TYPE	A	B	C	D	E	F	G	H	J	O
C1	Pipe Cantilever	29	10-2	294-10	4	S-10		2-7	5-0	2-7						
C2	" "	7	28-6	199-6	4	Str.										
C3	" "	7	5-0	35-0	4	"										
C4	" "	4	28-6	114-0	8	"										
Total Steel in Pipe Cantilever (Size 4) = 529'-4" = 353.59 lbs.																
" " " " " (Size 8) = 114'-0" = 304.38 lbs.																
Total Steel = 657.97 lbs.																
Total Reinforced Concrete in Pipe Cantilever = 10.23 cu. yds.																
D1	Pile	8	19-6	156-0	8	Str.										
D2	~~Pile~~	24	2-8 Ave.	64-0	3	T1	0-4	0-4 to 0-8	0-4 to 0-8	0-4 to 0-8	0-4 to 0-8		0-4			
D3	Pile	48	3-6	168-0	3	T1	0-5	0-8	0-8	0-8	0-8		0-5			
D4	Beam	12	5-4	64-0	4	T1	0-5	0-8	1-7	0-8	1-7		0-5			
D5	Beam	4	9-6	38-0	8	Str.										
Total Steel in Beam (Size 4) = 64'-0" = 42.75 lbs.																
Total Steel in Beam (Size 8) = 38'-0" = 101.46 lbs.																
Total Steel in Beam = 144.21 lbs.																
Total Reinforced Concrete in Beam = 0.78 cu. yds.																

AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74

NO CHANGE IN PLANS

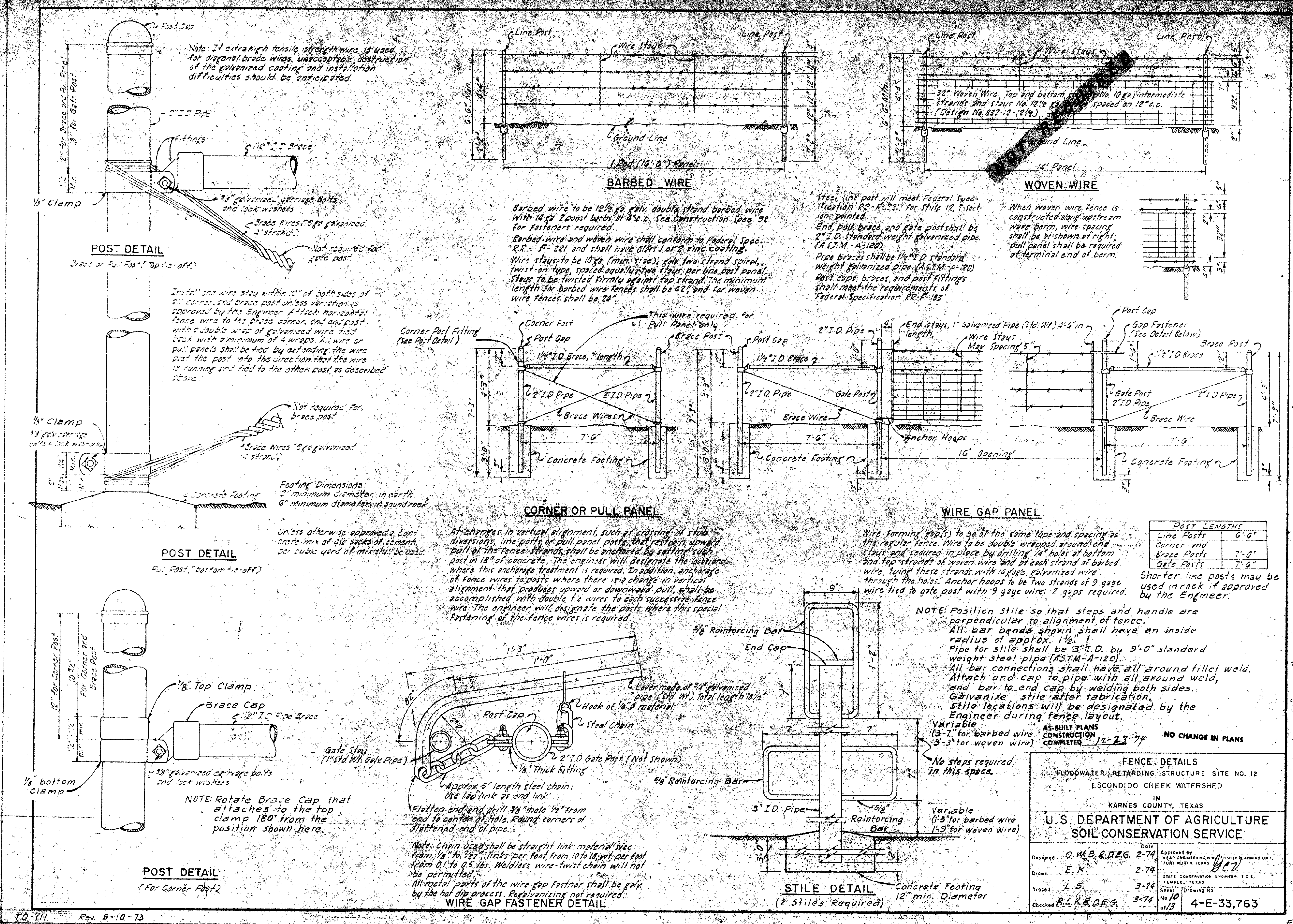
TRASH RACK, SLIDE GATE, AND PIPE CANTILEVER SUPPORT DETAILS
FLOODWATER RETARDING STRUCTURE SITE No. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

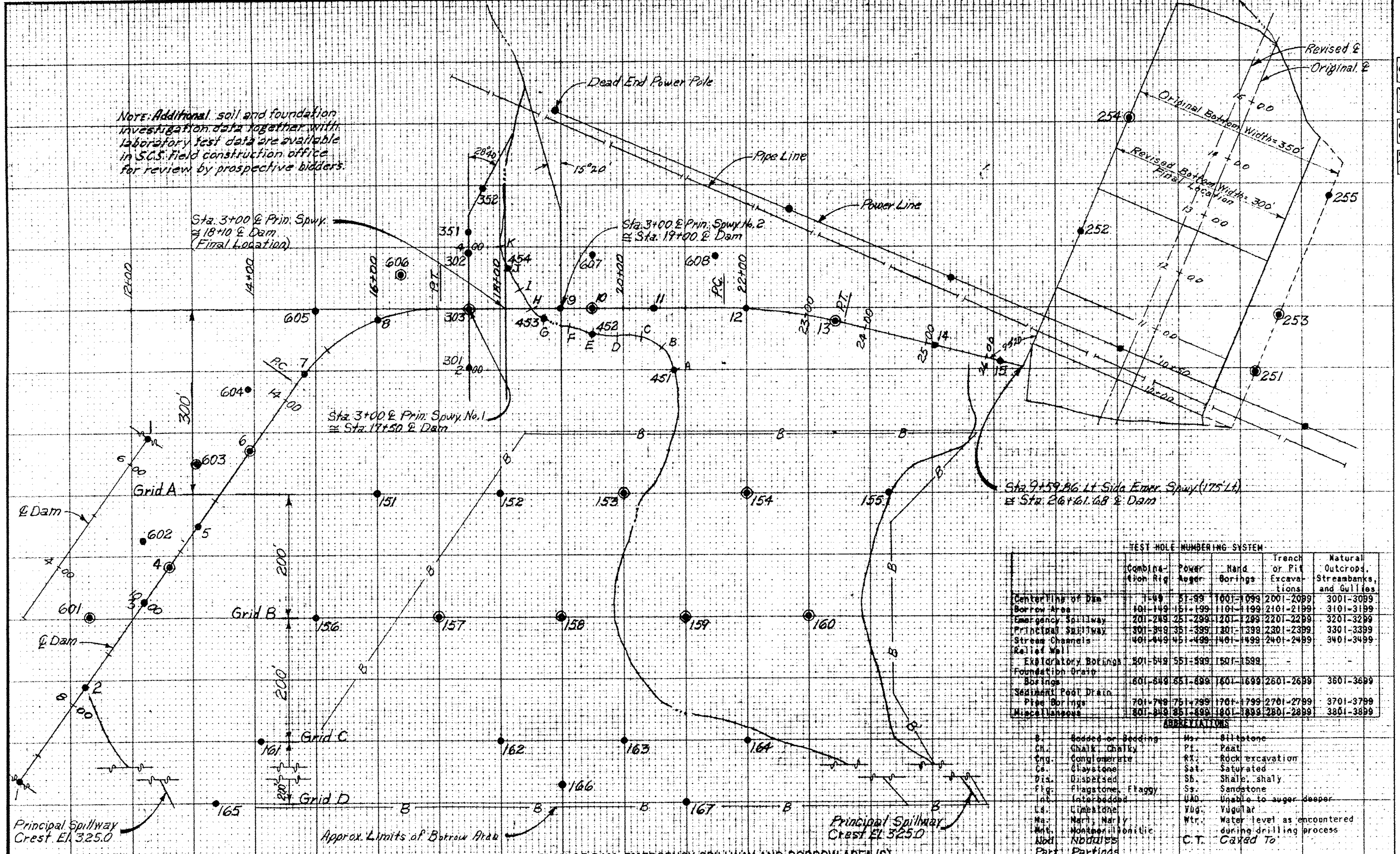
Designed O.W.B. & D.E.G. 2-74
Drawn E.K. 2-74
Traced L.S. 3-74
Checked R.L.K. & D.E.G. 3-74
Approved by ... STATE CONSERVATION ENGINEER, S.C.S.
Sheet No. 9 of 13
Drawing No. 4-E-33,763

TD-383 1-73 11-73

42" Pipe W/Cantilever and Slide Gate



Post Cap
Note: If extra high tensile strength wire is used for diagonal brace wires, unacceptable destruction of the galvanized coating and installation difficulties should be anticipated.
2" I.D. Pipe
Fittings
1/2" I.D. Brace
1/8" Clamp
3/8" galvanized carriage bolts and lock washers
Brace Wires (9 ga galvanized 4 strands)
Not required for gate post
POST DETAIL
Brace or Pull Post ("top tie-off")
Install one wire stay within 12" of both sides of all corner, end brace post unless variation is approved by the Engineer. Attach horizontal fence wire to the brace corner, end end post with a double wrap of galvanized wire tied back with a minimum of 4 wraps. All wire on pull panels shall be tied by extending the wire past the post into the direction that the wire is running and tied to the other post as described above.
1/4" Clamp
3/8" galv carriage bolts & lock washers
Not required for brace post
Brace Wires (9 ga galvanized 4 strands)
Concrete Footing
Footing Dimensions: 12" minimum diameter in earth. 6" minimum diameter in sound rock.
Unless otherwise approved a concrete mix of 4 1/2 sacks of cement per cubic yard of mix shall be used.
POST DETAIL
Pull Post ("bottom tie-off")
Line Post
Wire Stays
Ground Line
1 Rod (16'-6") Panel
BARBED WIRE
Barbed wire to be 12 1/2 ga galv. double strand barbed wire with 14 ga 2 point barbs at 4" c.c. See Construction Spec. 32 for fasteners required.
Barbed wire and woven wire shall conform to Federal Spec. RR-F-221 and shall have Class 1 or 2 zinc coating.
Wire stays to be 10 ga. (min. size), galv. two strand spiral twist-on type, spaced equally, two stays per line post panel. Stays to be twisted firmly against top strand. The minimum length for barbed wire fences shall be 42" and for woven wire fences shall be 24".
Steel line post will meet Federal Specification RR-F-221, for Style 12, T-Section painted.
End, pull, brace, and gate post shall be 2" I.D. standard weight galvanized pipe (A.S.T.M.-A-120).
Pipe braces shall be 1 1/2" I.D. standard weight galvanized pipe (A.S.T.M.-A-120).
Post caps, braces, and post fittings shall meet the requirements of Federal Specification RR-F-183.
32" Woven Wire: Top and bottom strands No. 10 ga, intermediate strands and stays No. 12 1/2 ga, stays spaced on 12" c.c. (Design No. 832-12-12 1/2)
Ground Line
14' Panel
WOVEN WIRE
When woven wire fence is constructed along upstream wave berm, wire spacing shall be as shown at right; pull panel shall be required at terminal end of berm.
Corner Post Fitting (See Post Detail)
Corner Post
Post Cap
This wire required for Pull Panel only
Brace Post
1 1/2" I.D. Brace, 7' length
2" I.D. Pipe
Brace Wires
Concrete Footing
CORNER OR PULL PANEL
At changes in vertical alignment, such as crossing of stub diversions, line posts or pull panel posts that restrain upward pull of the fence strands shall be anchored by setting such post in 18" of concrete. The engineer will designate the locations where this anchorage treatment is required. In addition, anchorage of fence wires to posts where there is a change in vertical alignment that produces upward or downward pull, shall be accomplished with double tie wires to each successive fence wire. The engineer will designate the posts where this special fastening of the fence wires is required.
End stays, 1" Galvanized Pipe (Std. Wt.) 4'-6" in length
Wire Stays Max. Spacing 5'
Gate Post
Brace Wire
Anchor Hoops
16' Opening
Gap Fastener (See Detail Below)
Gate Post 2" I.D. Pipe
WIRE GAP PANEL
Wire forming gap(s) to be of the same type and spacing as the regular fence. Wire to be double wrapped around end stays and secured in place by drilling 1/4" holes at bottom and top strands of woven wire and at each strand of barbed wire, tying these strands with 14 gage galvanized wire through the holes. Anchor hoops to be two strands of 9 gage wire tied to gate post with 9 gage wire. 2 gaps required.
POST LENGTHS
Line Posts 6'-6"
Corner and Brace Posts 7'-0"
Gate Posts 7'-6"
Shorter line posts may be used in rock if approved by the Engineer.
1/8" Top Clamp
Brace Cap
1/2" I.D. Pipe Brace
3/8" galvanized carriage bolts and lock washers
1/8" bottom Clamp
NOTE: Rotate Brace Cap that attaches to the top clamp 180° from the position shown here.
POST DETAIL
(For Corner Post)
Lever made of 3/4" galvanized pipe (Std. Wt.) Total length 18 1/2"
Hook of 1/4" Ø material
Steel Chain
Post Cap
Gate Stay (1" Std Wt. Galv Pipe)
2" I.D. Gate Post (Not Shown)
1/8" Thick Fitting
Approx 5" length steel chain; Use lap link as end link.
Flatten end and drill 3/8" hole 1/2" from end to center of hole. Round corners of flattened end of pipe.
Note: Chain used shall be straight link; material size from 1/8" to 1/32", links per foot from 10 to 18, wt. per foot from 0.1 to 0.5 lbs. Weldless wire-twist chain will not be permitted.
All metal parts of the wire gap fastener shall be galv. by the hot dip process. Regalvanizing not required.
WIRE GAP FASTENER DETAIL
5/8" Reinforcing Bar
End Cap
3" I.D. Pipe
Reinforcing Bar
Concrete Footing 12" min. Diameter
STILE DETAIL
(2 Stiles Required)
NOTE: Position stile so that steps and handle are perpendicular to alignment of fence.
All bar bends shown shall have an inside radius of approx. 1 1/2".
Pipe for stile shall be 3" I.D. by 9'-0" standard weight steel pipe (ASTM-A-120).
All bar connections shall have all around fillet weld.
Attach end cap to pipe with all around weld, and bar to end cap by welding both sides.
Galvanize stile after fabrication.
Stile locations will be designated by the Engineer during fence layout.
Variable (3'-7" for barbed wire 3'-3" for woven wire)
No steps required in this space.
Variable (1'-5" for barbed wire 1'-9" for woven wire)
AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74
NO CHANGE IN PLANS
FENCE DETAILS
FLOODWATER RETARDING STRUCTURE SITE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed O.W.B. & D.E.G. 2-74
Drawn E.K. 2-74
Traced L.S. 3-74
Checked R.L.K. & D.E.G. 3-74
Approved by HEAD, ENGINEERING & WATERSHED PLANNING UNIT, FORT WORTH, TEXAS
STATE CONSERVATION ENGINEER, S.C.S., TEMPLE, TEXAS
Sheet No 10 of 13
Drawing No 4-E-33,763
TO-TH Rev. 9-10-73



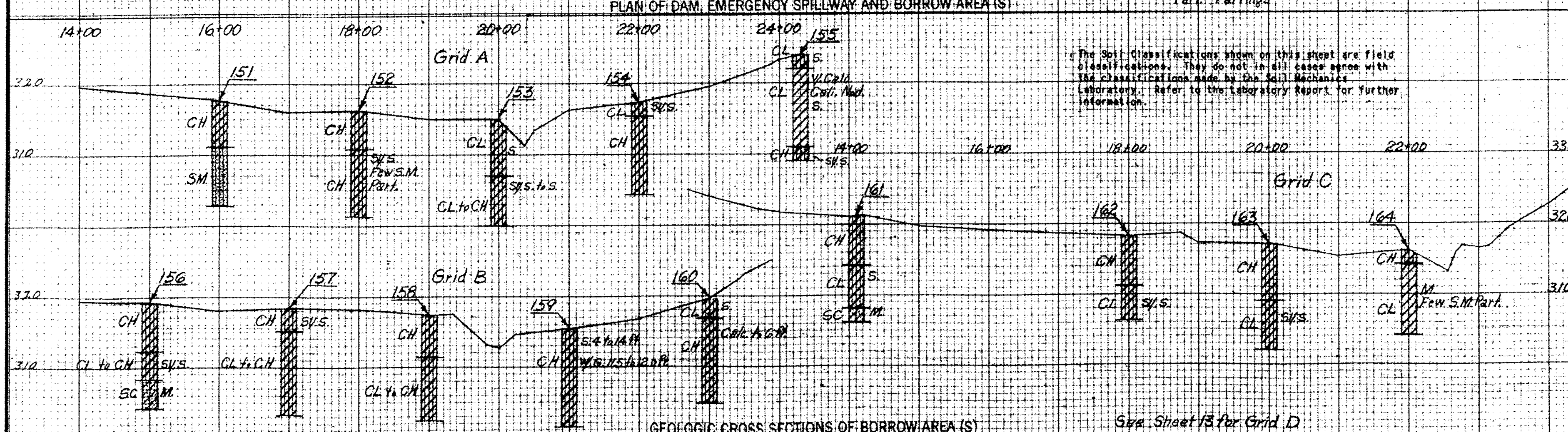
TEST HOLE NUMBERING SYSTEM

	Combination Rig	Power Auger	Hand Borings	Trench or Pit Excavations	Natural Outcrops, Streambanks, and Gullies
Centerline of Dam	1-49	51-99	1001-1099	2001-2099	3001-3099
Borrow Area	101-149	151-199	1101-1199	2101-2199	3101-3199
Emergency Spillway	201-249	251-299	1201-1299	2201-2299	3201-3299
Principal Spillway	301-349	351-399	1301-1398	2301-2399	3301-3399
Stream Channels	401-449	451-499	1401-1499	2401-2499	3401-3499
Relief Well Exploratory Borings	501-549	551-599	1501-1599	-	-
Foundation Drain Borings	601-649	651-699	1601-1699	2601-2699	3601-3699
Sediment Pool Drain Pipe Borings	701-749	751-799	1701-1799	2701-2799	3701-3799
Miscellaneous	801-849	851-899	1801-1899	2801-2899	3801-3899

ABBREVIATIONS

B.	Bedded or Bedding	Ms.	Siltstone
Ch.	Chalk, Chalky	Pt.	Peat
Cng.	Conglomerate	RX.	Rock excavation
Cs.	Claystone	Sat.	Saturated
Dis.	Dispersed	Sh.	Shale, shaly
Flg.	Flagstone, Flaggy	Ss.	Sandstone
Int.	Interbedded	UAD.	Unable to auger deeper
Ls.	Limestone	Vug.	Vugular
Ma.	Marl, Marly	Wtr.	Water level as encountered during drilling process
Mnt.	Montmorillonitic		
Nod.	Nodules	C.T.	Caved To
Part.	Partings		

The Soil Classifications shown on this sheet are field classifications. They do not in all cases agree with the classifications made by the Soil Mechanics Laboratory. Refer to the Laboratory Report for further information.



See Sheet 13 for Grid D

LEGEND

SYMBOLS

UNCONSOLIDATED MATERIAL

gravel; sand; silt; clay; cobbles, boulders
gravel, sandy; sand, gravelly; silt, gravelly; clay, gravelly; peat or muck
gravel, silty; sand, silty; silt, sandy; clay, sandy
gravel, clayey; sand, clayey; silt, clayey; clay, silty

CONSOLIDATED MATERIAL

Sedimentary Rocks

Conglomerate Cng.; shale sh.; limestone ls.; coal
breccia brc.; siltstone Ms.; dolomite dol.; gypsum gyp.
sandstone ss.; marl; chalk Ch.; chert cht.

Metamorphic Rocks: gneiss; schist; quartzite; slate; marble; soapstone talc serpentine

Igneous Rocks: intrusive; extrusive; pyroclastic

Undifferentiated

Other Symbols

● hole logged only; strike and dip
◉ hole sampled; pit or trench

ABBREVIATIONS

ang.	angular	lam.	laminated	G	gravel, gravelly
bld.	boulders (> 12")	lse.	loose	S	sand, sandy
calc.	calcareous	mas.	massive	M	silt, silty
cali.	caliche	med.	medium	C	clay, clayey
cav.	cavities	mic.	micaceous	O	organic
cmt.	cemented	mod.	moderately	W	well graded
cse.	coarse	n. r.	no recovery	P	poorly graded
cbl.	cobbles (3"-12")	per.	permeable		
cpt.	Compact	po.	poorly		
con.	concretions	rdd.	rounded		
xln.	crystalline	sl/.	slightly		
ds.	dense	sft.	soft		
dip.	dipping	s/.	some		
d.s.	downstream	slo.	slowly		
fn.	fine	stf.	stiff		
frm.	firm	t.b.	thin-bedded		
frac.	fractured	tuff.	tuffaceous		
frg.	fragments	u.s.	upstream		
fri.	friable	var.	variable		
grn.	grain	v/.	very		
gyp.	gypseous	w/.	with		
hd.	hard	wea.	weathered		
h.	highly	w.l.	(date) static water level		

~~TEST HOLE NUMBERING SYSTEM~~

~~Centerline of dam~~	~~1-99~~	~~Stream channel~~	~~401-499~~
~~Borrow area~~	~~101-199~~	~~Relief wells~~	~~501-599~~
~~Emergency spillway~~	~~201-299~~		~~601-699~~
~~Centerline of outlet structure~~	~~301-399~~		~~701-799~~

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

GW	Well graded gravels; gravel-sand mixtures
GP	Poorly graded gravels
GM	Silty gravels; gravel-sand-silt mixtures
GC	Clayey gravels; gravel-sand-clay mixtures
SW	Well graded sands; sand-gravel mixtures
SP	Poorly graded sands
SM	Silty sand
SC	Clayey sands; sand-clay mixtures
ML	Silts with liquid limit of 50 or less
MH	Silts with liquid limit above 50
CL	Clays with liquid limit of 50 or less
CH	Clays with liquid limit above 50
OL	Organic silts and clays with liquid limit of 50 or less
OH	Organic silts and clays with liquid limit above 50

Revised February 1963

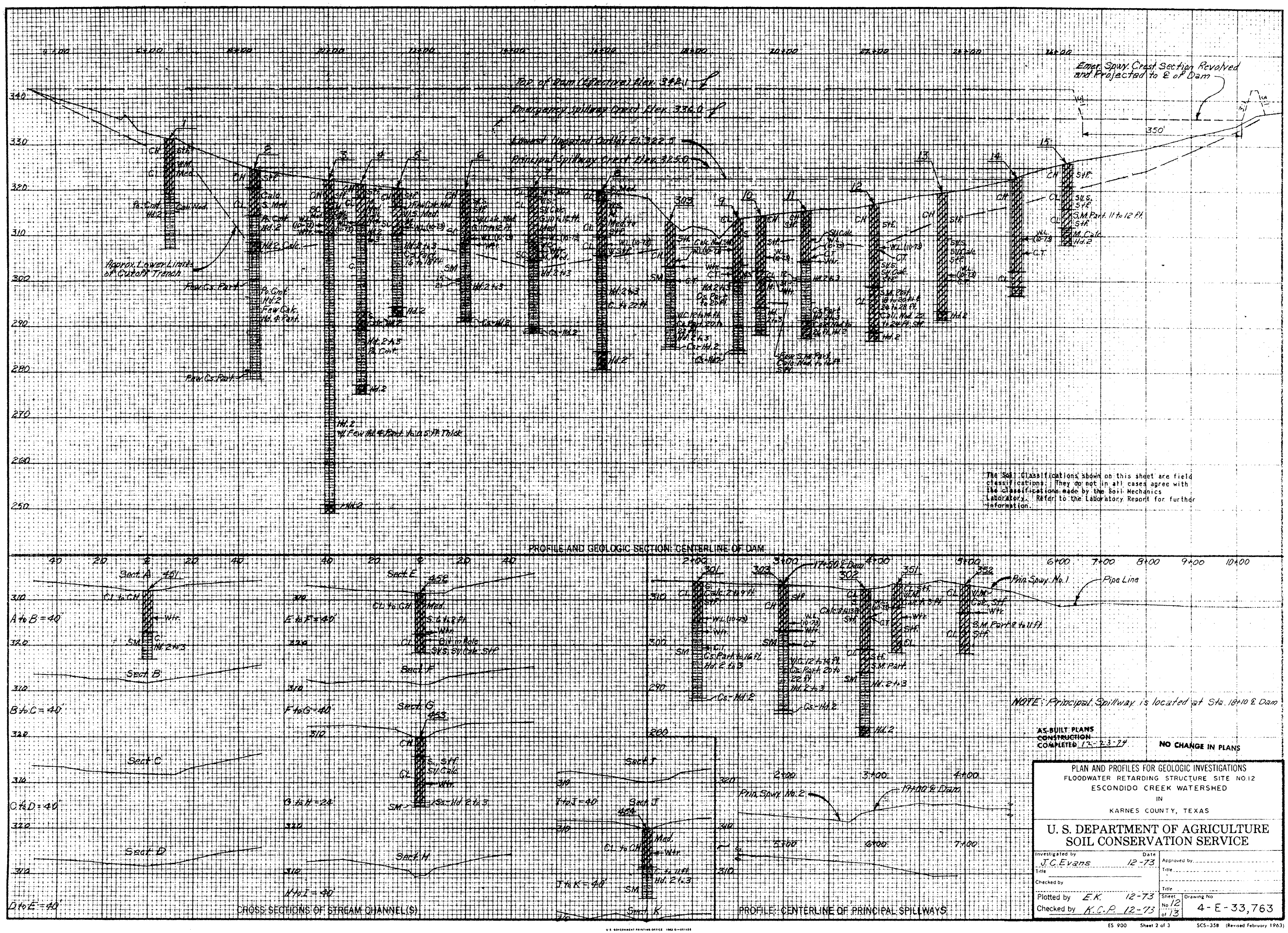
AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74

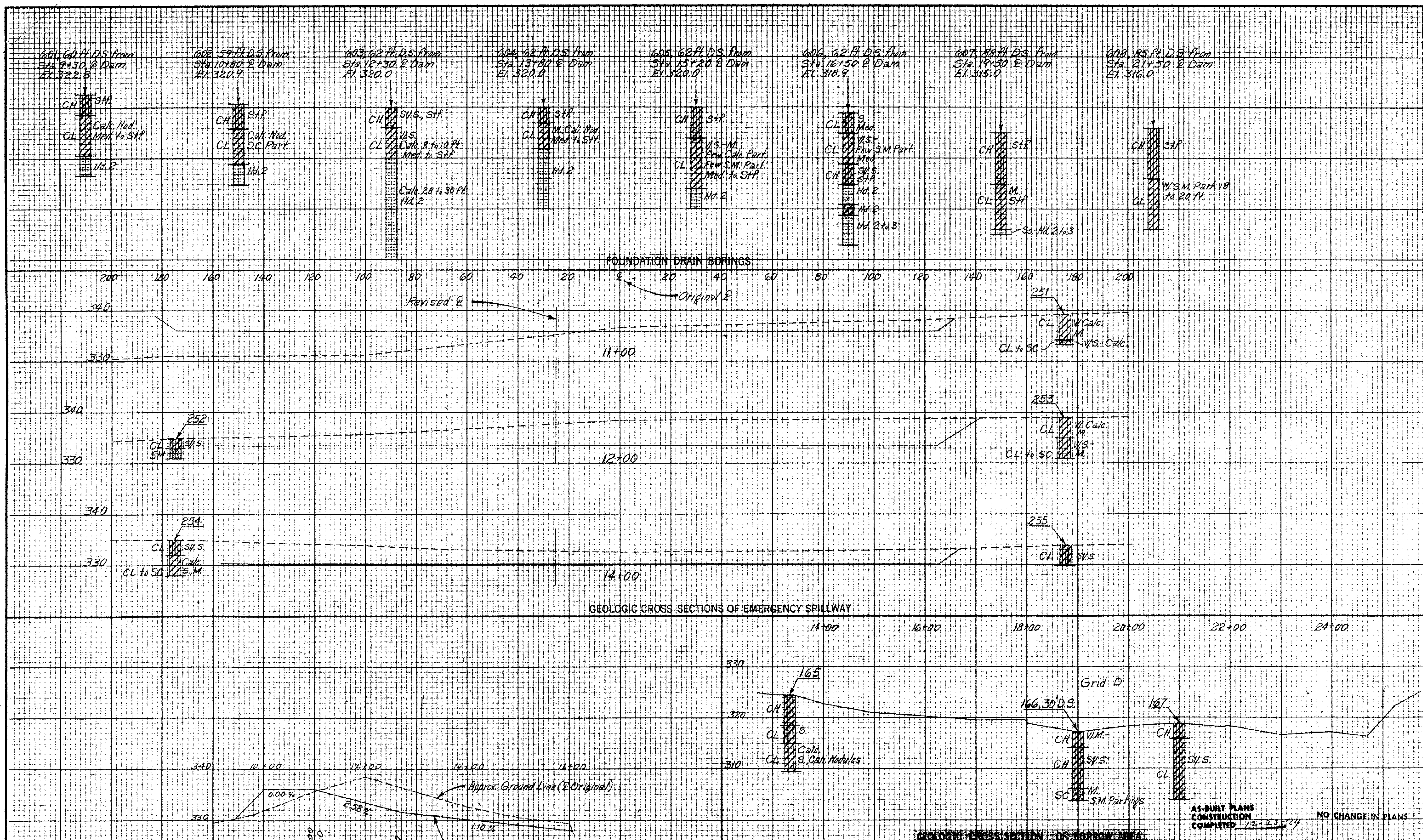
NO CHANGE IN PLANS

PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
FLOODWATER RETARDING STRUCTURE SITE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Investigated by J. C. Evans	Date 12-73	Approved by
Title		Title
Checked by		Title
Plotted by E. K.	12-73	Sheet No. 11 of 13
Checked by K. C. P.	12-73	Drawing No. 4-E-33,763


PROFILE AND GEOLOGIC SECTION: CENTERLINE OF DAM
Top of Dam (Effective) Elev. 342.1
Emergency Spillway Crest Elev. 336.0
Lowest Ungated Outlet El. 322.5
Principal Spillway Crest Elev. 325.0
Emer. Spwy. Crest Section Revolved and Projected to ℄ of Dam
350'
Approx. Lower Limits of Cutoff Trench
The Soil Classifications shown on this sheet are field classifications. They do not in all cases agree with the classifications made by the Soil Mechanics Laboratory. Refer to the Laboratory Report for further information.
CROSS SECTIONS OF STREAM CHANNEL(S)
PROFILE: CENTERLINE OF PRINCIPAL SPILLWAYS
Prin. Spwy. No. 1
Pipe Line
Prin. Spwy. No. 2
19+00 ℄ Dam
17+50 ℄ Dam
NOTE: Principal Spillway is located at Sta. 18+10 ℄ Dam
AS-BUILT PLANS CONSTRUCTION COMPLETED 12-23-74
NO CHANGE IN PLANS
PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
FLOODWATER RETARDING STRUCTURE SITE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Investigated by J.C. Evans Date 12-73
Plotted by E.K. 12-73
Checked by K.C.P. 12-73
Sheet No. 12 of 13
Drawing No. 4-E-33,763
ES 900 Sheet 2 of 3 SCS-358 (Revised February 1963)



The Soil Classifications shown on this sheet are field classifications. They do not in all cases agree with the classifications made by the Soil Mechanics Laboratory. Refer to the Laboratory Report for further information.

PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
FLOODWATER RETARDING STRUCTURE SITE NO. 12
ESCONDIDO CREEK WATERSHED
IN
KARNES COUNTY, TEXAS

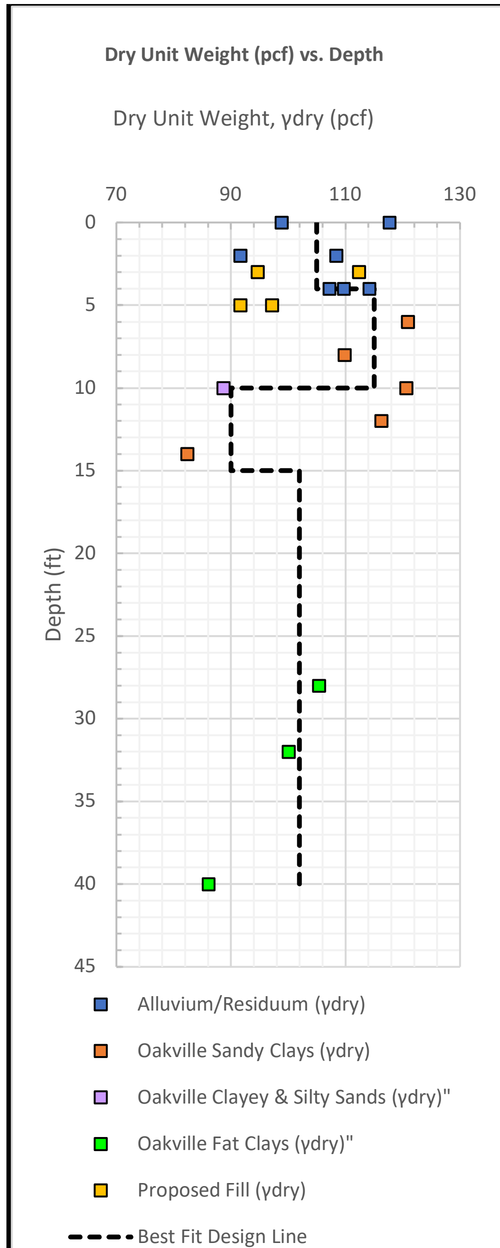
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

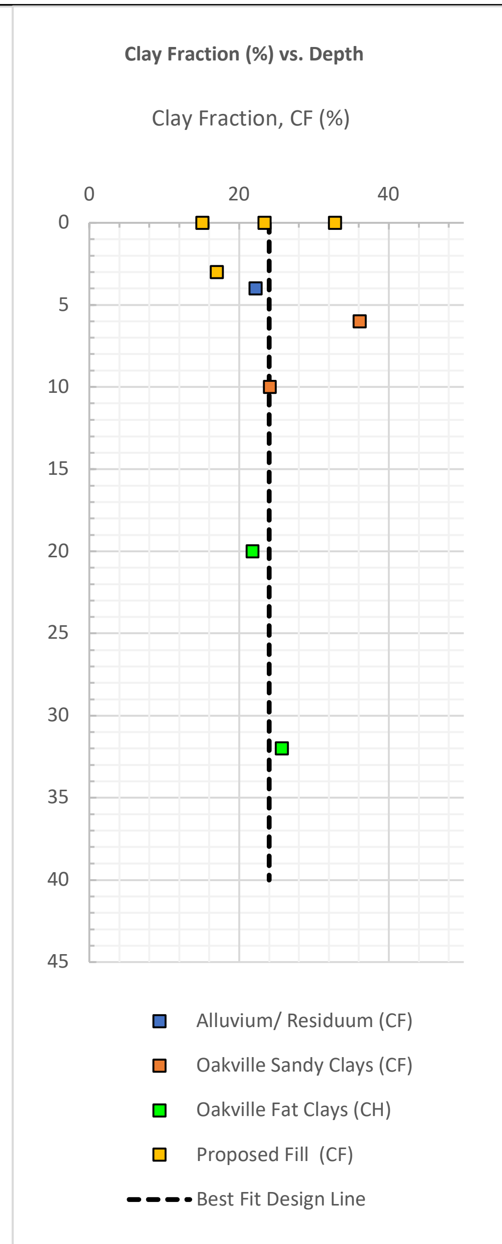
Investigated by J.C. Evans	Date 12-73	Approved by
Title		Title
Checked by		Title
Plotted by E.K.	12-73	Sheet No. 13 of 13
Checked by K.C.P.	12-73	Drawing No. 4-E-33,763

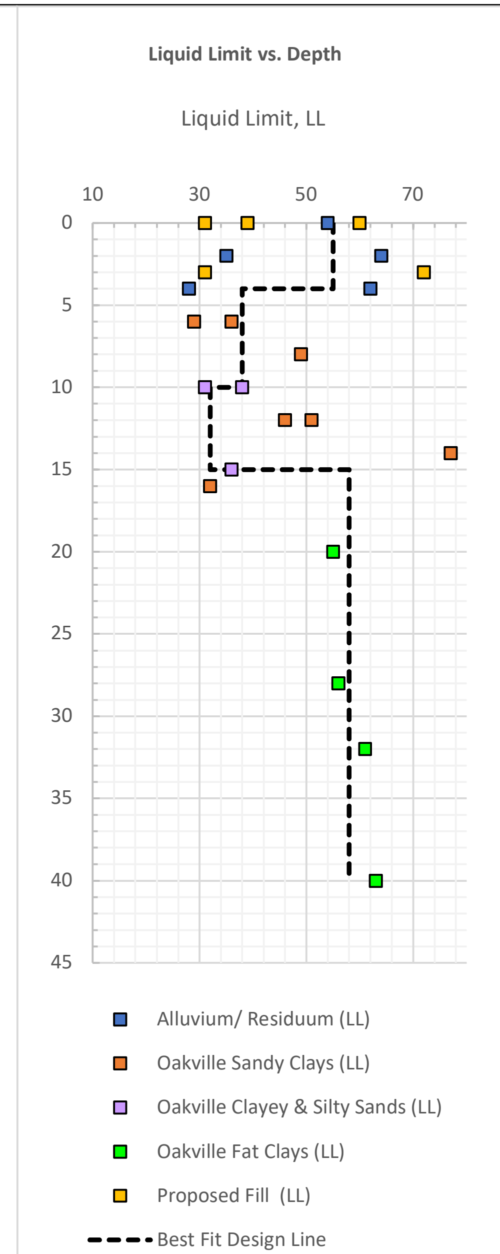
ES 900 Sheet 3 of 3 SCS-35C (Revised February 1963)

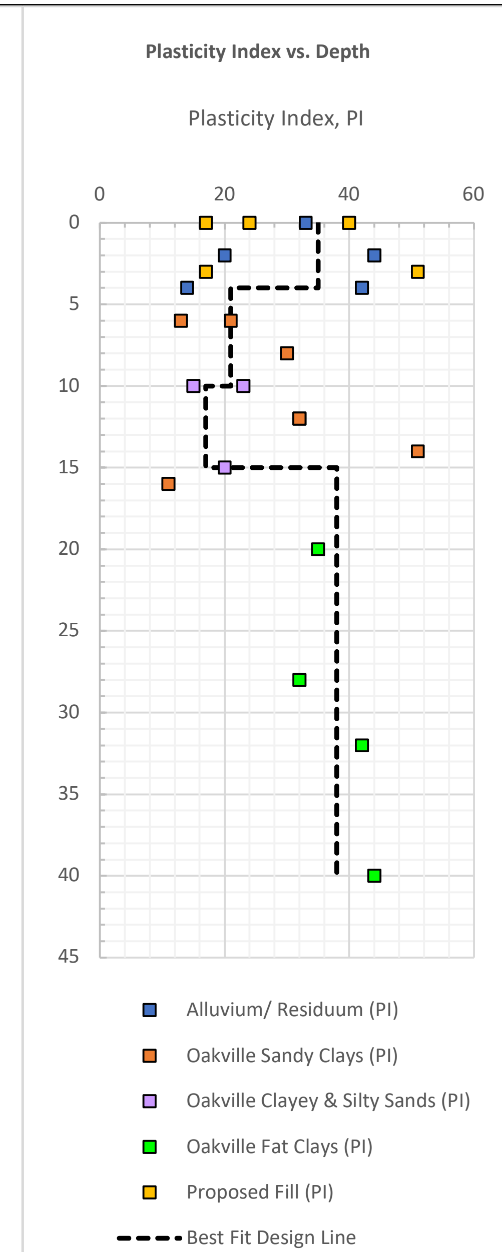
ATTACHMENT 2.

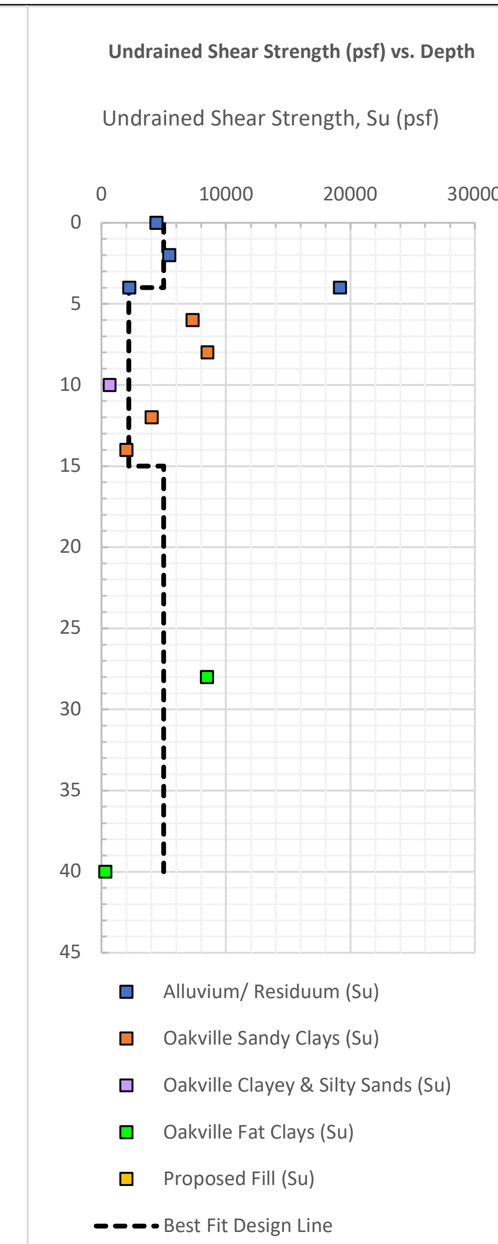
LABORATORY TEST DATA PLOTS FOR ASW BORINGS

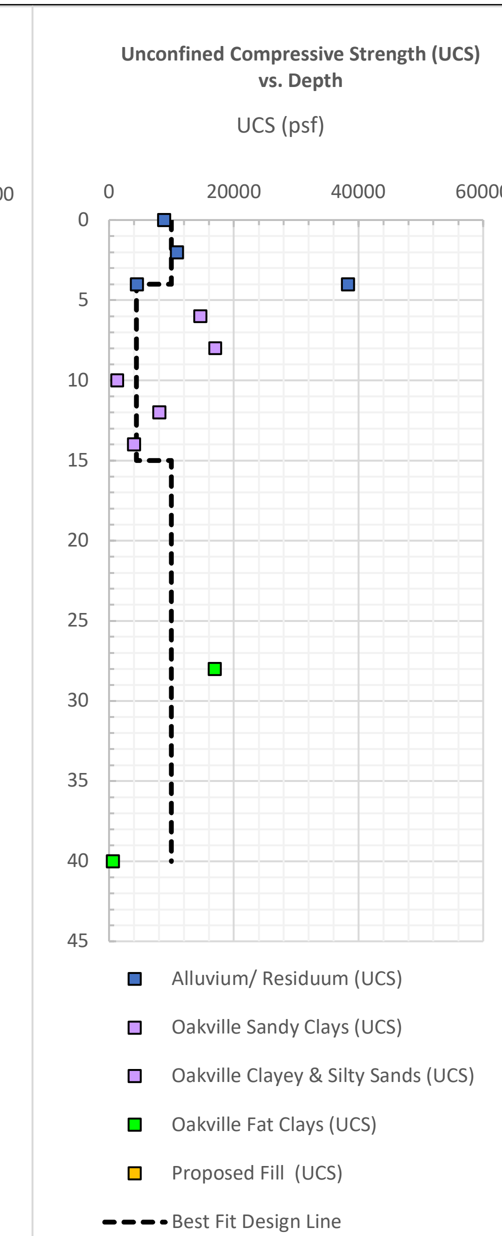




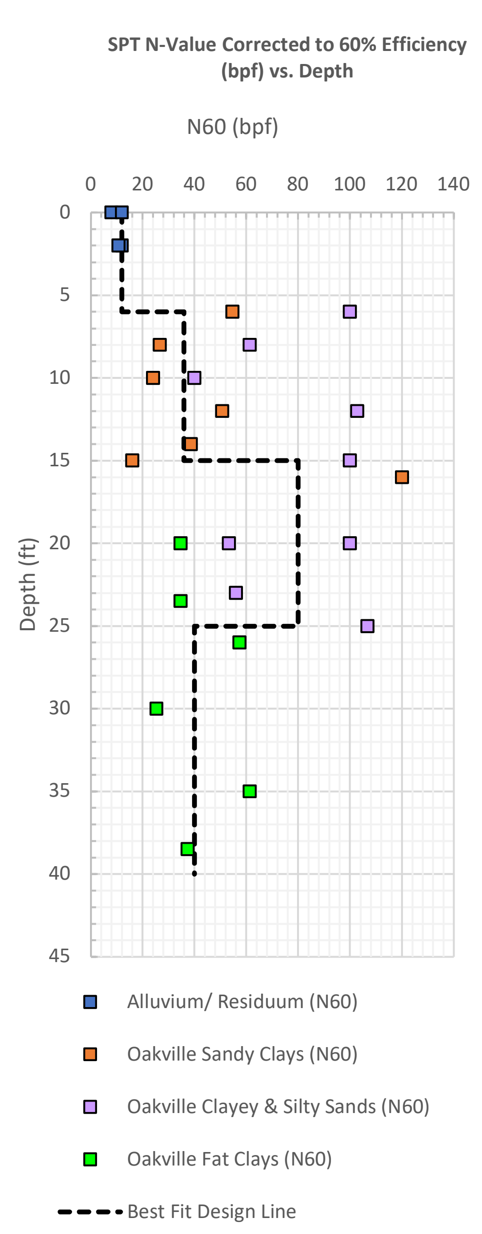


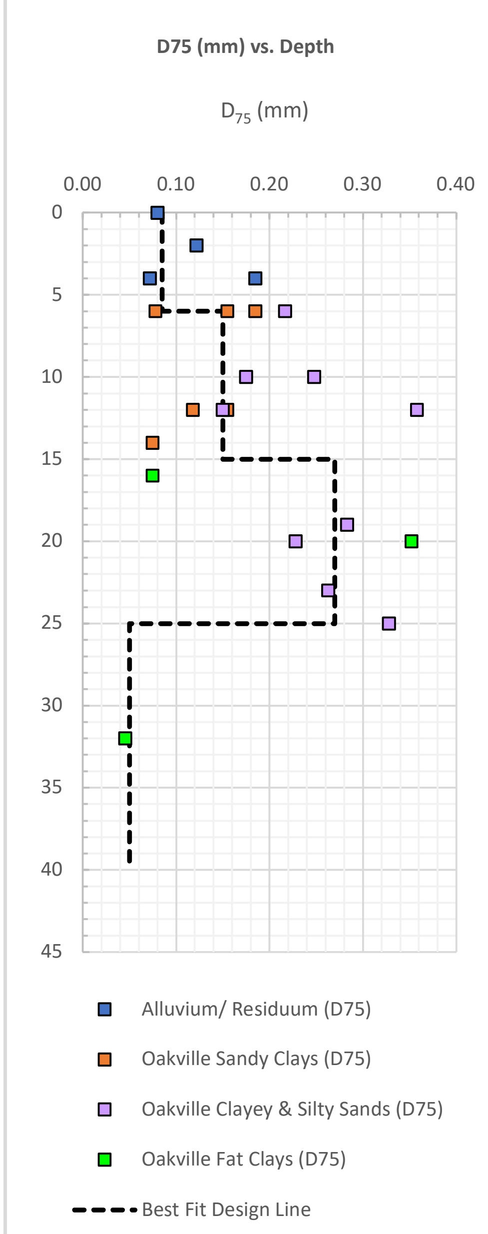


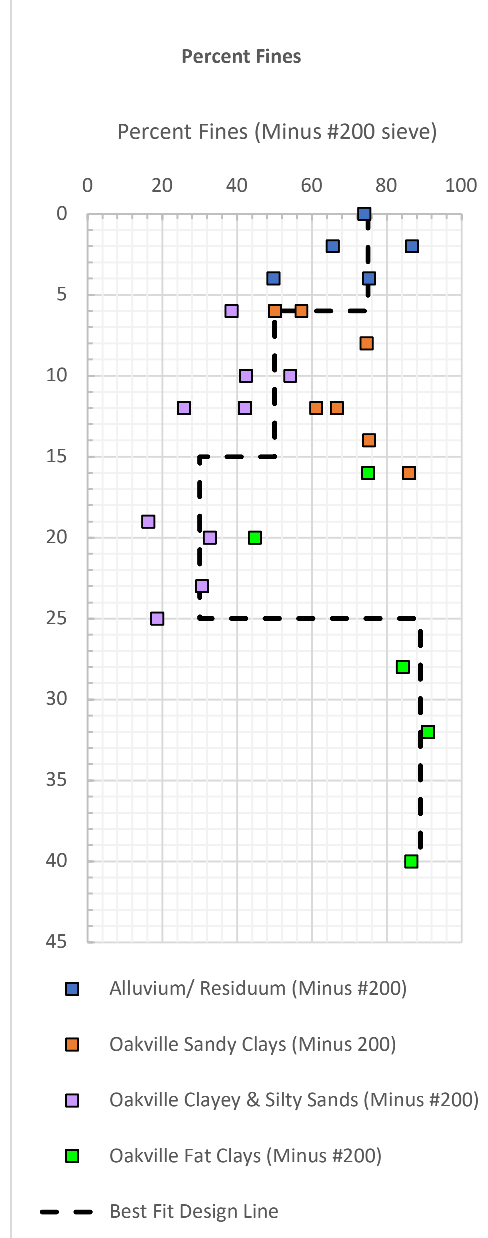


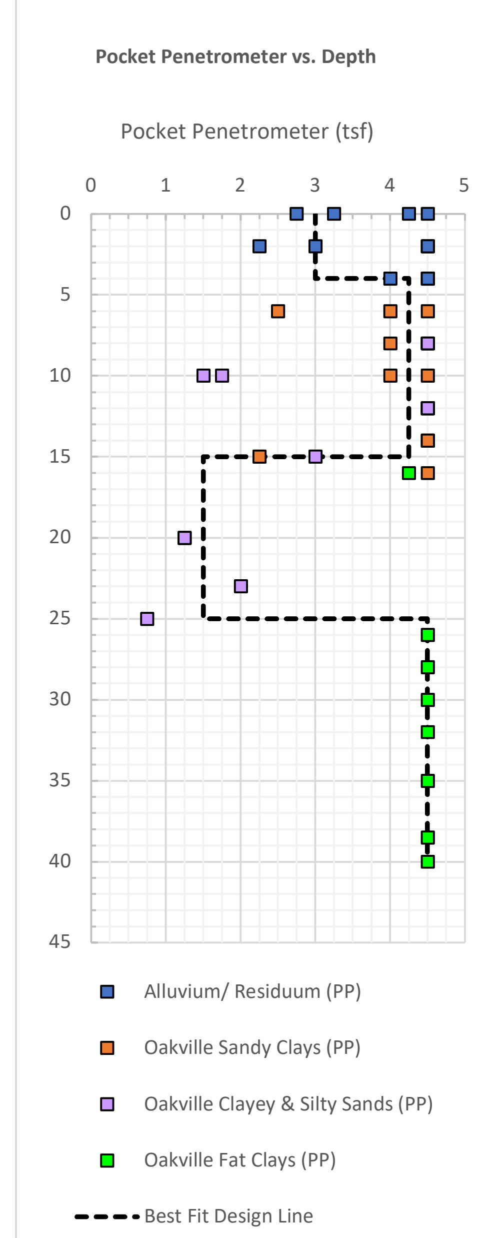


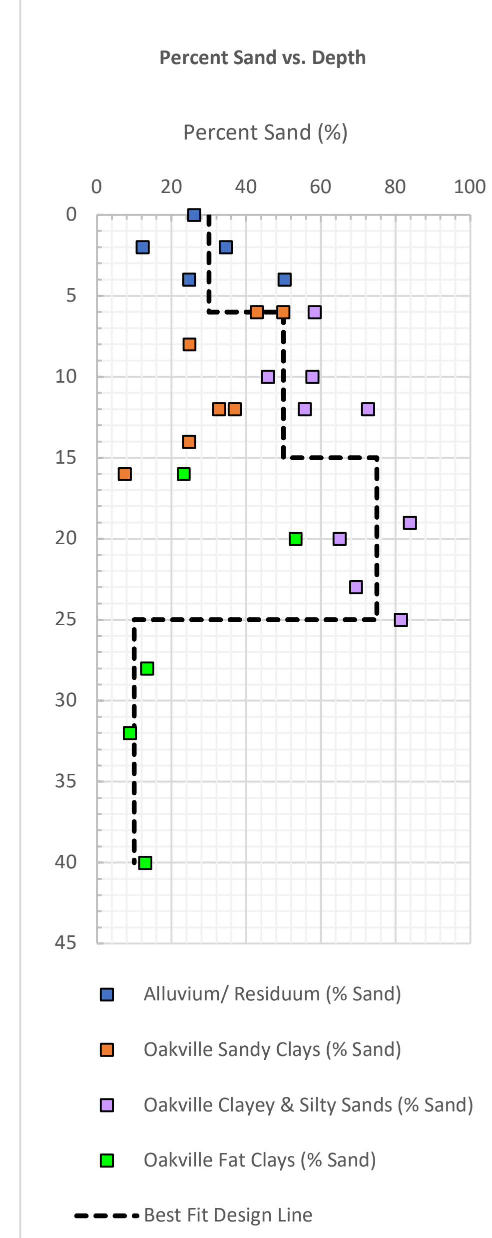
San Antonio River Authority Escondido FRS No. 12 SWP-EA		Project No. 60707508
Geotechnical Laboratory Testing Summary Plots		
AECOM	April 2024	Attachment No. 2







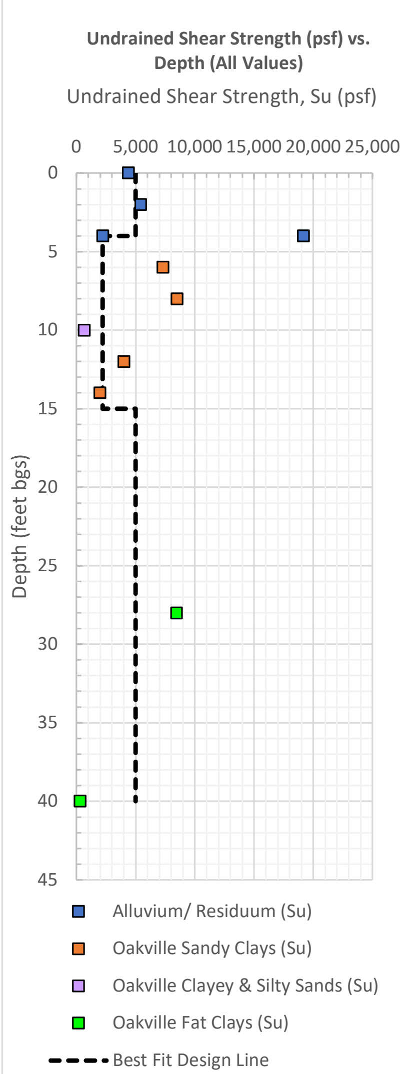


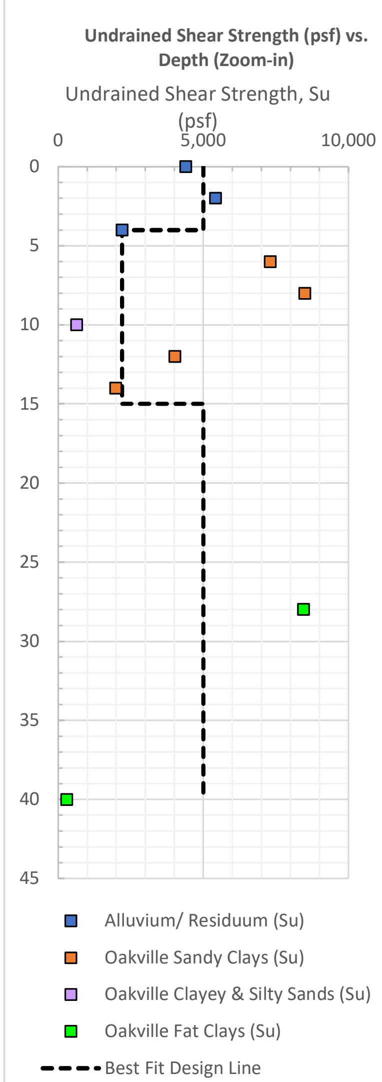


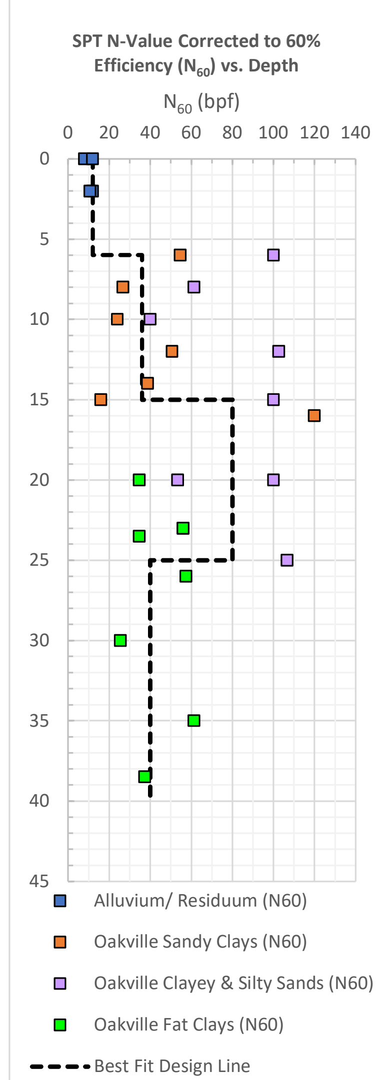
San Antonio River Authority Escondido FRS No. 12 SWP-EA		Project No. 60707508
Geotechnical Laboratory Testing Summary Plots		
AECOM	April 2024	Attachment No. 2

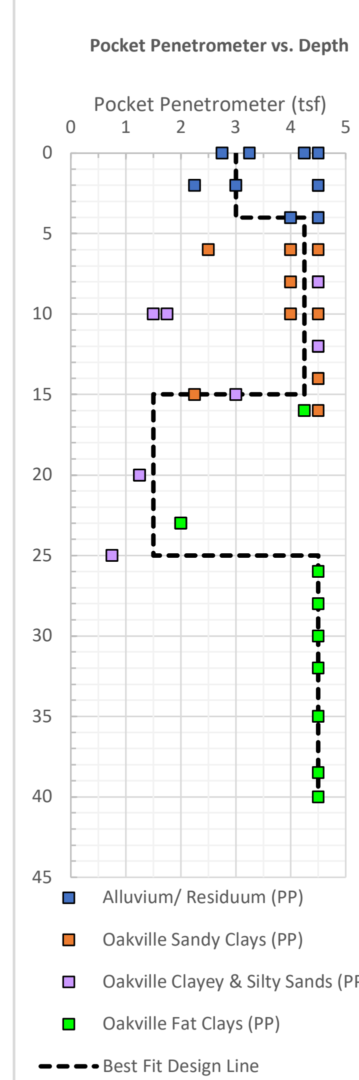
ATTACHMENT 3.

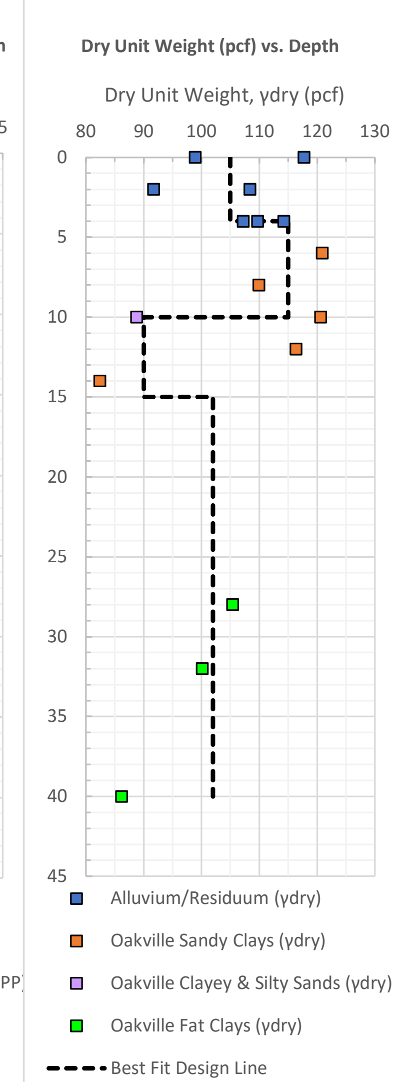
HEADCUT ERODIBILITY INDEX (Kh) CALCULATIONS











Best Fit Design Line

Depth(ft)	Su (psf)	N60 (bpf)	PP (tsf)	DD (pcf)
0	5000	12	3	105
4	5000	12	3	105
4	2200	12	4.25	115
6	2200	12	4.25	115
6	2200	36	4.25	115
10	2200	36	4.25	115
10	2200	36	4.25	90
15	2200	36	4.25	90
15	5000	80	1.5	90
15	5000	80	1.5	102
25	5000	80	1.5	102
25	5000	40	4.5	102
30	5000	40	4.5	102
30	5000	40	4.5	102
40	5000	40	4.5	102

Estimated Kh Values

Depth(ft)	From Su1[1]	From Su2[2]	From N60[3]	From N60[4]	From PP1[1]	From PP1[2]	Avg
0	0.49	0.35	0.17	---	0.29	0.20	0.30
4	0.49	0.35	0.17	---	0.29	0.20	0.30
4	0.21	0.14	0.17	---	0.415	0.29	0.25
6	0.21	0.14	0.17	---	0.415	0.29	0.25
6	0.21	0.14	---	0.13	0.415	0.29	0.24
10	0.21	0.14	---	0.13	0.415	0.29	0.24
10	---	---	---	0.13	---	---	0.13
15	---	---	---	0.13	---	---	0.13
15	0.49	0.35	1.16	---	0.14	0.09	0.45
25	0.49	0.35	1.16	---	0.14	0.09	0.45
25	0.49	0.35	0.58	---	0.44	0.31	0.43
30	0.49	0.35	0.58	---	0.44	0.31	0.43

(1) Regression of Kh vs. Su from NRCS NEH Ch 52, Draft Appendix 52D, Table 52D-4
(2) Regression of Ms(=Kh) vs UCS (=Su*2) from NRCS NEH CH 52, Table 52-3
(3) Regression of Ms(=Kh) vs SPT N-value from NRCS NEH CH 52, Table 52-3
(4) Regression of Ms(=Kh) from SPT N60 vs. IDM from NRCS NEH CH 52, Table 52-2

Residuum - Summary of Lab Strength Tests (Upper 10' of profile)

Boring ID	Depth (ft)	UC (natural moisture)		
		WCn (%)	DDn (pcf)	Su (psf)
201-23	2	35.6	91.7	5410
201-23	6	13.3	120.9	7300
202-23	4	13.6	109.7	2200
203-23	10	27.8	88.7	630
204-23	0	22.1	98.9	4390
204-23	4	14.5	114.2	19160
204-23	8	15.7	109.9	8490
	Average	20.4	104.9	6,797

San Antonio River Authority Escondido FRS No. 12 SWP-EA		Project No. 60707508
Parameters for Kh Development		
AECOM	April 2024	Attachment No. 3

Attachment 3
Estimate of Kh for Cohesive Soils
Escondido 12, Karnes, County, TX

*Red values denote assumed values when lab values not available

																						NEH Part 628, Chapter 52 Correlation					NEH Part 628, Appendix 52D Correlation					
Boring ID	Top (ft bgs)	Bottom (ft bgs)	Sample ID	Stratum	Field USCS	Lab USCS	w-n (%)	DD (pcf)	TD (pcf)	Gravel (%)	Sand (%)	Fines (%)	Clay (%)	LL	PL	PI	Gs*	Test Type	$\varepsilon_{failure}$ (%)	Su (psf)	Blocky Clay Correction?	UCS (psf)	UCS (kPa)	UCS (Mpa)	Ms	Kh-adj	w-sat (%)	LI-n	LI-sat	Su-sat (psf)	Kh	Kh-adj
LEFT AUXILIARY SPILLWAY																																
201-23	0	1.5	SS-1	Alluvium/ Residuum	CH		19.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	2	3	ST-2	Alluvium/ Residuum	CH	CH	36.0	91.7	124.7	0.0	34.5	65.5		64	20	44	2.62	UC	1.6	5,410	NO	10,820	518	0.52	0.38	0.38	29.9	0.36	0.22	1,837	0.11	0.11
	4	6	P-3	Alluvium/ Residuum	CH		14.0	107.2	122.2				22.2				2.62				NO	-	-	-	-	-	20.0	-	-	-	-	-
	6	8	ST-4	Oakville - Sandy Clays	CL	CL	13.3	120.9	137.1	0.0	42.8	57.2		36	15	21	2.62	UC	3.9	8,176	NO	16,352	783	0.78	0.60	0.60	13.4	-0.08	-0.07	4,000	0.45	0.45
	8	9.5	SS-5	Oakville - Sandy Clays	CL		10.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	10	12	P-6	Oakville - Sandy Clays	CL		12.0	120.6	135.1				24.1				2.62				NO	-	-	-	-	-	13.6	-	-	-	-	-
	12	14	ST-7	Oakville - Sandy Clays	CL	CL	15.0	116.3	133.8	2.0	36.9	61.1		46	14	32	2.62	UC	7.26	4,010	NO	8,020	384	0.38	0.27	0.27	15.5	0.03	0.05	3,407	0.40	0.40
	15	16	SS-8A	Oakville - Sandy Clays	CL		41.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	16	16.5	SS-8B	Oakville - Gray Clay (CH)	CH-SW		14.0			1.7	23.2	75.0					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	20	21.5	SS-9	Oakville - Gray Clay (CH)	CH	CH	18.0			2.1	53.2	44.7	21.8	55	20	35	2.62				NO	-	-	-	-	-	-	-0.06	-	-	0.45	0.45
	23.5	25	SS-10	Oakville - Gray Clay (CH)	CH	CH	21.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
202-23	0	2	P-1	Alluvium/ Residuum	CH		12.0	117.7	131.8								2.62				NO	-	-	-	-	-	14.8	-	-	-	-	-
	2	3.5	SS-2	Alluvium/ Residuum	CH		13.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	ST-3	Alluvium/ Residuum	CH	SC	13.6	109.7	124.6	0.0	50.3	49.7		28	14	14	2.62	UC	3.8	2,464	NO	4,928	236	0.24	0.16	0.16	18.7	-0.03	0.34	1,245	0.45	0.45
	6	7.5	SS-4	Oakville - Sandy Clays	ML	CL	10.0			0.0	49.9	50.1		29	16	13	2.62				NO	-	-	-	-	-	-	-0.46	-	-	0.45	0.45
	8	10	P-5	Oakville - Sandy Clays	SP-SM		7.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	10	11.5	SS-6	Oakville - Clayey & Silty Sands (SC-SM)	SP-SM	SC	7.0			0.0	57.7	42.3		31	16	15	2.62				NO	-	-	-	-	-	-	-0.60	-	-	0.45	0.45
	12	13.5	SS-7	Oakville - Sandy Clays	CH	CH	19.0			0.6	32.7	66.7		51	19	32	2.62				NO	-	-	-	-	-	-	0.00	-	-	0.45	0.45
	14	15	ST-8	Oakville - Sandy Clays	SM		40.0	82.0	114.8	0.1	24.6	75.3					2.62	UC	2.11	1,970	NO	3,940	189	0.19	0.13	0.13	37.9	-	-	-	-	-
	15	16.5	SS-9	Oakville - Clayey & Silty Sands (SC-SM)	CH		12.0							36	16	20	2.62				NO	-	-	-	-	-	-	-0.20	-	-	0.45	0.45
	20	21.5	SS-10	Oakville - Clayey & Silty Sands (SC-SM)	SP		7.0			2.4	65.0	32.7					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	25	26.5	SS-11	Oakville - Clayey & Silty Sands (SC-SM)	SP		8.0			0.0	81.4	18.6					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	30	31.5	SS-12	Oakville - Gray Clay (CH)	CH		23.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	32	33	P-13	Oakville - Gray Clay (CH)	CH	CH	22.0	100.1	122.1	0.2	8.8	91.0	25.7	61	19	42	2.62				NO	-	-	-	-	-	24.2	0.07	0.12	2,611	0.34	0.34
	35	36.5	SS-14	Oakville - Gray Clay (CH)	CH		18.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	38.5	40	SS-15	Oakville - Gray Clay (CH)	CH		25.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	40	42	ST-16	Oakville - Gray Clay (CH)	CH	CH	29.0	86.0	110.9	0.6	12.9	86.6		63	19	44	2.62	UC	4.33	290	NO	580	28	0.03	0.02	0.02	34.4	0.23	0.35	1,190	0.18	0.18
203-23	0	1.5	SS-1	Alluvium/ Residuum	CH		13.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	2	4	P-2	Alluvium/ Residuum	SP-SC	CL	7.0	108.4	116.0	1.1	12.2	86.8		35	15	20	2.62				NO	-	-	-	-	-	19.4	-0.40	0.22	1,867	0.45	0.45
	4	5.5	SS-3	Alluvium/ Residuum	CL		9.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	6	7.5	SS-4	Oakville - Sandy Clays	SP		5.0			3.2	58.3	38.5					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	8	9.5	SS-5	Oakville - Clayey & Silty Sands (SC-SM)	SP		13.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	10	11	ST-6	Oakville - Clayey & Silty Sands (SC-SM)	SM	CL	28.0	89.0	113.9	0.0	45.8	54.2		38	15	23	2.62	UC	4.62	630	NO	1,260	60	0.06	0.04	0.04	31.9	0.57	0.74	311	0.06	0.06
	12	13.5	SS-7	Oakville - Clayey & Silty Sands (SC-SM)	SP		10.0			1.7	72.6	25.8					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	14	15.5	SS-8	Oakville - Clayey & Silty Sands (SC-SM)	CH		29.0							77	26	51	2.62				NO	-	-	-	-	-	-	0.06	-	-	0.35	0.35
	16	17.5	SS-9	Oakville - Sandy Clays	SM	CL	23.0			6.6	7.4	86.0		32	21	11	2.62				NO	-	-	-	-	-	-	0.18	-	-	0.22	0.22
	17.5	18	ST-10	Oakville - Sandy Clays	SM		24.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	19	20	P-11	Oakville - Clayey & Silty Sands (SC-SM)	SP-SM		6.0			0.0	83.8	16.2					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	20	21.5	SS-12	Oakville - Clayey & Silty Sands (SC-SM)	SP		10.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	23	24.5	SS-13	Oakville - Clayey & Silty Sands (SC-SM)	SP		21.0			0.0	69.4	30.6					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	26	27.5	SS-14	Oakville - Clayey & Silty Sands (SC-SM)	CH		19.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	28	30	ST-15	Oakville - Gray Clay (CH)	CH	CH	20.7	105.4	127.3	2.3	13.4	84.3		56	24	32	2.62	UC	6.5	9,453	NO	18,906	905	0.91	0.70	0.70	21.0	-0.10	-0.09	4,000	0.45	0.45
204-23	0	2	ST-1	Oakville - Gray Clay (CH)	CH	CH	22.0	98.9	120.6	0.0	26.0	74.0		54	21	33	2.62	UC	3.51	4,390	NO	8,780	420	0.42	0.30	0.30	24.9	0.03	0.12	2,647	0.40	0.40
	2	3.5	SS-2	Alluvium/ Residuum	CH		21.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	4	6	ST-3	Alluvium/ Residuum	CH	CH	14.5	114.2	130.8	0.0	24.7	75.3		62	20	42	2.62	UC	7.7	21,459	NO	42,918	2,055	2.05	1.71	1.71	16.5	-0.13	-0.08	4,000	0.45	0.45
	6	8	P-4	Alluvium/ Residuum	CH								36.1				2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	8	10	ST-5	Oakville - Sandy Clays	CH	CL	16.0	109.9	127.5	0.6	24.8	74.6		49	19	30	2.62	UC	1.63	8,490	NO	16,980	813	0.81	0.62	0.62	18.6	-0.10	-0.01	4,000	0.45	0.45
	10	11.5	SS-6	Oakville - Sandy Clays	CH		21.0										2.62				NO	-	-	-	-	-	-	-	-	-	-	-
	12	13.5	P-7	Oakville - Sandy Clays	SP-SM		13.0			2.3	55.7	42.1					2.62				NO	-	-	-	-	-	-	-	-	-	-	-
				Oakville - Clayey & Silty Sands (SC-SM)																												
																	MIN			**290**						**0.02**			**MIN**	**311**	**0.06**	**0.06**
																	MAX			**21,459**						**1.71**			**MAX**	**4,000**	**0.45**	**0.45**
																	AVG			**6,067**						**0.45**			**AVG**	**2,593**	**0.37**	**0.37**

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November 16, 2024

Wayne Tschirhart, P.E., PMP
San Antonio River Authority
600 East Euclid
San Antonio, Texas 78212

Preliminary Soil Mechanics Report

Escondido Creek Floodwater Retarding Structure No. 12 SWP-EA, Karnes County, TX

This Preliminary Soil Mechanics Report (SMR) provides a summary of geotechnical laboratory testing results on samples recovered during the field geologic investigation for Escondido Creek FRS No. 12 (Escondido 12). The field geologic investigation is documented in the Preliminary Geologic Investigation Report (GIR) (AECOM, 2024) under separate cover.

The purpose of this Preliminary SMR is to present and discuss the results of the laboratory testing. Geotechnical engineering analyses of the dam embankment or ancillary structures or engineering recommendations for dam rehabilitation are beyond the scope of this Preliminary SMR, and will need to be addressed during final design under separate authorization.

This report was prepared by AECOM for the San Antonio River Authority (River Authority) in accordance with the Project Scope of Work for the SWP-EA for Escondido FRS No. 12, Karnes County, Texas which was authorized as part of Task Order No. 8 (C230128) on April 12, 2023, and performed under the terms and conditions of IDIQ Contract No. C210002 effective August 3, 2020.

<u>Testing Summary and Results</u>

Laboratory testing performed on select samples recovered from the geologic investigation included index properties, dispersion potential, corrosion potential, compressive strength, and laboratory moisture-density relationship (Proctor) testing according to the following standard test methods:

- Moisture content (ASTM D2216)
- Atterberg Limit (ASTM D4318)
- Sieve analysis (ASTM D6913)
- Wash #200 sieve (D1140)
- Hydrometer (ASTM D7928)
- Dry unit weight (ASTM D7263)
- Unconfined compression – Soil (ASTM D2166)
- Crumb test (ASTM D6572)
- Double hydrometer (ASTM D4221)
- Pinhole test (ASTM D4647)
- Standard Proctor moisture-density (ASTM D698)

The preliminary GIR characterized the subsurface conditions according to the generalized stratigraphy listed below (descending order relative to depth). The discussion of results and referenced laboratory summary tables presented in the following paragraphs of this report denote the interpreted stratum to which each sample belongs.

- Alluvium/Residuum
- Existing Fill
- Oakville Sandy Clays
- Oakville Clayey and Silty Sands
- Oakville Clays

Published geologic mapping indicates the Catahoula Formation underlies Escondido 12. However, the original classification, according to the 1964 Watershed Work Plan (SCS, 1964), of the site subsurface as the Oakville Sandstone Formation was maintained for the purposes of the present geologic investigation because the resolution of available geologic maps is not considered sufficient, without further studies which presently are not included in AECOM's scope of work, to allow for precise differentiation between the two formations. The Oakville Sandstone is described as being composed of interbedded sand and clay layers which is consistent with the findings of this investigation.

Index Testing

The results of index tests are summarized for each stratum in **Table 1**. The results indicate the following:

1. The Alluvium / Residuum generally classifies as lean clay (CL) with an average liquid limit (LL) of 49 and average plasticity index (PI) of 31.

2. The Oakville Sandy Clays classify as lean clay (CL) with average LL of 46 and average PI of 27.

3. The Oakville Clayey and Silty Sands classify as clayey sand (SC) with average LL of 35 and average PI of 19.

4. The Oakville Clays generally classify as fat clay (CH) with average LL of 59 and average PI of 38.

Index properties and estimated strength of the Existing Fill, specified as slightly- to moderately-plastic silty, sandy clay (CL), were not reported in the historical documentation available to AECOM for review; however, as previously discussed, it is likely that materials excavated from the ASW channel were used as fill. The 1964 Watershed Work Plan (SCS, 1964) corroborates this interpretation by highlighting that lean clays (CL) and clayey to silty sands (SC, SM) excavated from the ASW were suitable for use as fill.

Strength Testing

A summary of the strength tests is provided in **Table 2**. Strength testing included 11 unconfined compression (UC) tests on relativey undisturbed Shelby tube samples to estimate the strength of in-situ materials. UC tests were performed on samples of all strata identified as show below:

- Alluvium/Residuum: 4 UC Tests
- Oakville Sandy Clays: 4 UC Tests
- Oakville Clayey and Silty Sands: 1 UC Test
- Oakville Clays: 2 UC Tests

The resulting undrained shear strengths (Su) on relatively undisturbed samples generally ranged from 1,970 to 19,159 psf (average 6,818 psf), which are consistent with very stiff to hard cohesive soils. The exceptions are two tests with unexpectedly low Su values of 290 psf and 630 psf (i.e., soft and medium stiff cohesive soils) performed on a sample of the Oakville Clays obtained from a depth of 40 feet below the ground surface (bgs) and from a sample recovered from the Oakville Clayey and Silty Sands at a depth of 10 feet bgs, respectively. The low result on the sample from the Oakville Clays was obtained from a test performed on a sample which had pocket penetrometer reading of 4.5+ tsf (i.e., hard cohesive soil), which suggests possible sample defects (e.g., cracks, fissures, etc.) may have contributed the relatively lower UC strength. Post-test photographs of the samples were not available from the testing laboratory to confirm the presence of suspected sample defect. The second low result, obtained in a sample recovered in the Oakville Clayey and Silty Sands, was described in the field as silty sand (SM) and had pocket penetrometer reading of 1.5 tsf. However, this sample was classified by the testing laboratory as a lean clay (CL) and was found to have 54% fines and 46% sand content; thus, it is possible that the low result obtained is either a result of the shear behavior which, in this case, was controlled by the sand fraction of the sample rather than its plastic fines fraction or a result of possible sample defects.

The strength of the Proposed Fill is typically estimated by performing laboratory UC tests or unconsolidated undrained (UU) triaxial tests on remolded samples compacted to target moisture content and density that simulate typical values of earthfill construction compaction specifications. It is common to conservatively remold samples to the minimum acceptable density and upper range of allowable moisture content (i.e., 95% of maximum dry density and +2% of optimum moisture relative to Standard Proctor energy as determined by ASTM D698). However, sufficient quantity of material was not available to complete the remolded strength tests. Consequently, the strength of the Proposed Fill was estimated based on experience from prior projects for similar soils remolded to similar moisture/density, informed by the maximum dry density and optimum moisture content from site-specific Standard Proctor test results and the 4 UC test results in the Alluvium/Residuum layer.

Moisture-Density Testing (Standard Proctor)

The results of Standard Proctor testing on four bulk samples collected from the upper 5 feet of the spillway channel are summarized in **Table 3**. The purpose of this testing was to evaluate the moisture-density relationships of materials that may be excavated and re-used as earthfill material for potential rehabilitation improvements (e.g., include spillway channel grading).

Dispersion Testing

The dispersion test results summary is provided in **Table 4**, and includes comparison of results from crumb, double-hydrometeter, and pinhole test methods where available.

Two samples in the Alluvium/Residuum classified as highly dispersive based on the crumb test (both classified as Grade 4). Two pinhole tests and one double-hydrometer test were completed on these samples and resulted in non-dispersive classifications (ND1 in both pinhole tests and 1.8% dispersion in the double-hydrometer; thus, below the 30% general treshold for dispersion). Additionally, one sample identified at 14 feet bgs in the Oakville Sandy Clays, also classified as highly dispersive based on the crumb test (Grade 4). A double-hydrometer was performed on this sample of the Oakville Sandy Clays and resulted in 45.8% dispersion suggesting possibly dispersive behavior. Additional testing could be considered to more accurately assess the dispersion potential of soils in this zone. However, the materials at this depth do not crop out/daylight into the spillway channel or creek due to the spilway's relatively flat topography and minimal elevation change. Additionally, because of the horizontally-bedded soils encountered at this location and the fact that potential excavations are not anticipated to exceed depths greater than approximately 5 feet bgs, subsequent confirmatory testing was not performed as part of this investigation.

Two additional samples, both from boring 201-23, resulted in Grade 3 (dispersive) in the crumb test. The first was recovered from the Oakville Sandy Clays and a confirmatory double-hydrometer was performed which resulted in 15.5% dispersion thus classifying it as non-dispersive. The second crumb test Grade 3 was reported on a sample of the Oakville Clays which was recovered from approximately 20 bgs; additional testing was not conducted since potential excavations are not anticipated to reach depths greater than approximately 5 feet bgs, and the potentially-erosive spillway flows should not affect soils at such great depth below the spillway channel invert.

Corrosivity Testing

Corrosivity testing was completed on three of the composite bulk samples representative of the borrow material under consideration for use in a potential dam rehabilitation. In addition, corrosivity testing was also conducted on one sample recovered from approximately 8 feet bgs in boring 202-23, in the Oakville Sandy Clays. The corrosivity assessment performed included the test methods listed below, and results are reported as minimum – maximum (average). Published thresholds for aggressive (corrosive) soil generally include electrical resistivity values less than 2,000 ohm-cm, soluble sulfate contents greater than 200 ppm, and soluble chloride contents greater than 100 ppm. Based on the results below, site soils should be considered aggressive with respect to potential corrosion of buried concrete and metal.

Bulk Samples: Includes auger cuttings from approximately the upper 5 feet of the Alluvium/Residuum in borings 201-23 through 203-23.

- pH analysis (ASTM G51): 7.0 – 7.8 (7.3)
- Electrical resistivity (ASTM G187): 730 – 1,230 ohm-cm
- Soluble Sulfates (ASTM C1580): 100 – 1,200 (385) ppm
- Soluble Chlorides (ASTM D512): 100 – 140 (125) ppm
- Reduction/Oxidation (ASTM G200) 2.4 – 3.8 (3.1) mV

Note that not enough sample material was available from the bulk samples collected to perform all of the assigned corrosivity related tests. As a result, resistivity tests were completed in samples recovered from approximately 0 to 2 feet bgs in borings 201-23 and 202-23 and were omitted in boring 203-23.

Oakville Sandy Clays: Boring 202-23, Sample P-5, recovered from approximately between 8 and 10 feet bgs.

- pH analysis (ASTM G51): 7.3
- Electrical resistivity (ASTM G187): Not Tested
- Soluble Sulfates (ASTM C1580): 120 ppm
- Soluble Chlorides (ASTM D512): 120 ppm
- REDOX 2.9 mV

Borrow Assessment

Based on the test results presented above, excavations in the ASW are likely to produce a suitable borrow source of earthfill for an embankment raise and/or spillway grading. However, the presence of some higher plasticity (high-PI) clays may require relatively flat embankment slopes to maintain slope stability. Lime treatment of the high-PI clays could be considered if steeper slopes are desired, since the sulfate contents are within a range that is unlikely to pose issues with chemical amendment that would induce heaving or swelling (less than 3,000 ppm). Note that the corrosivity test results (specifically sulfate content and chloride content) indicates the proposed fill could be corrosive to buried metal and concrete, and corrosion protection measures may need to be considered for such elements in final design for dam rehabilitation.

Note that additional on-site borrow sources may be needed to provide a sufficient volume of required earthfill for proposed dam rehabilitation alternatives. Sampling and testing of other candidate borrow areas were not performed as part of this scope.

Conclusions and Recommendations

Several crumb test and one double hydrometer test results on samples of the Alluvium/Residuum and Oakville Sandy Clays indicated potentially dispersive soils. However, confirmatory pinhole testing indicated two of the Grade 4 crumb test samples classified as non-dispersive (ND1), suggetsing that crumb testing of site soils may not be a reliable indivator of soil dispersion. Final design investigations for dam rehabilitation should perform additional sampling and confirmatory testing using pinhole or double-hydrometer methods to further evaluate the potential for dispersive soils at the site. Dispersive soils are highly erodible when subjected to surface water flows (e.g. auxiliary spillway), and present an elevated risk of internal erosion (“piping”) when subjected to seepage flows.

Samples of existing embankment or foundation materials were not collected during the geologic investigation, and thus no testing of these materials were conducted. Sampling and testing of these materials should be performed as part of final design investigations for dam rehabilitation.

Additional on-site borrow sources may need to be identified, sampled, and tested as part of final dseign investigations to provide a sufficient volume of earthfill required for dam rehabilitation alternatives.

Limitations

This report was prepared by AECOM using the degree of care and skill ordinarily exercised under similar circumstances by responsible engineers and geologists practicing in the same general location. No other warranty or representation, either expressed or implied, is made as to the findings and professional advice in this report.

The opinions, conclusions, and recommendations contained in this report are based on the field observations and subsurface explorations, laboratory tests, and present understanding of the proposed improvements. The findings in this report are believed to describe site conditions to the extent practical given the scope of the investigation. However, this investigation, like all such investigations, can directly explore subsurface conditions only at the boring locations within the site. Soil and geologic conditions can vary greatly between or beyond the exploration sites, and different conditions may be found during subsequent investigations or project construction.

The conclusions and recommendations contained herein are based in part upon information provided by others (including our subcontractors) and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information provided to AECOM has not been independently verified by AECOM, unless otherwise stated.

There is no intention that this report addresses any environmental issues (for example, environmentally-affected soil or groundwater, or historic site uses) related to this site. Such evaluations are outside the scope of this work and should be addressed in separate studies. In the event that changes are made to the nature, design, or location of the proposed construction layout or design criteria, the conclusions and recommendations presented herein should not be considered valid, unless AECOM has reviewed the changes and addresses their impact to the recommendations provided.

AECOM

Closure

AECOM appreciates the opportunity to be of service to the River Authority on this project. Should you have any questions concerning this Preliminary SMR, or if we may be of further service, please contact Mariana Jaimes, Charles Krolikowski, or Lance Finnefrock.

Yours Sincerely,

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Attachments:

Table 1	Index Test Summary
Table 2	Soil Strength Testing Summary
Table 3	Proposed Fill Strength Testing Summary
Table 4	Dispersion Test Summary
Attachment 1	Laboratory Test Results

Table 1 – Index Test Results Summary [1]

Stratum Description (USCS) [5]	Thickness (feet)	USCS	Dry Unit Weight (pcf)	LL	PI	LI	Fines Content (%)	CF (%)
Alluvium/Residuum	0 - 6	CL, CH	92 - 118 (107)	28 - 64 (49)	14 - 44 (31)	-0.40 to +0.36 (-0.03)	50 - 87 (70)	22
Oakville Sandy Clays	6 - 15	CL	82 - 121 (110)	29 - 77 (46)	11 - 51 (27)	-0.46 to +0.18 (-0.06)	50 - 86 (67)	24 - 36
Oakville Silty and Clayey Sands	15 - 25	SP, SC, SM	---[2]	31 - 38 (35)	15 - 23 (19)	-0.60 to +0.57 (-0.08)	16 - 54 (33)	---[2]
Oakville Clays	25+	CH	86 - 105 (97) [4]	55 - 63 (59)	32 - 44 (38)	-0.10 to +0.23 (+0.04)	45 - 91 (76)	22 - 26
Proposed Fill (ASW Borrow) [3]	TBD	CH	---[2]	31 - 72 (47)	17 - 51 (30)	-0.82 to -0.41 (-0.64)	41 - 73 (57)	15 - 53 (28)

Notes:

(1) Format of reported values is Minimum – Maximum (Average). Average value not reported when two or fewer results are available.
(2) "---" No test results available from current ASW borings.
(3) Proposed Fill materials collected from the upper 5± feet of the ASW channel.
(4) Reported results reflect the maximum dry density from Standard Proctor testing.
(5) As discussed in "Testing Summary and Results", the existing fill was not encountered in the borings drilled during the field GI and index properties were not assessed as part of this Preliminary SMR.

Table 2 – Soil Strength Testing Summary

Boring ID	Depth (feet)		Stratum	Field USCS	Lab USCS	LL	PI	Percent Passing No. 200 Sieve (%)	UC Test (Relatively undisturbed sample at natural moisture)		
	Top	Bottom							Moisture Content (%)	Dry Unit Weight (pcf)	Undrained Shear Strength, Su (psf)
201-23	2	3	Alluvium/Residuum	CH	CH	64	44	66	36	91.7	5,410
201-23	6	8	Oakville Sandy Clays	CL	CL	36	21	57	13	120.9	7,294
201-23	12	14	Oakville Sandy Clays	CL	CL	46	32	61	15	116.3	4,010
202-23	4	6	Alluvium/Residuum	CH	SC	28	14	50	14	109.7	2,196
202-23	14	15	Oakville Sandy Clays	SM	NT	NT	NT	75	40	82.4	1,970
202-23	40	42	Oakville Clays	CH	CH	63	44	87	29	86.1	290
203-23	10	11	Oakville Clayey & Silty Sands	SM	CL	38	23	54	28	88.7	630
203-23	28	30	Oakville Clays	CH	CH	56	32	84	21	105.4	8,446
204-23	0	2	Alluvium/Residuum	CH	CH	56	33	74	22	98.9	4,390
204-23	4	6	Alluvium/Residuum	CH	CH	62	42	75	15	114.2	19,159
204-23	8	10	Oakville Sandy Clays	CH	CL	49	30	75	16	109.9	8,490
					Average	**32**	**32**	**69**	**23**	**102**	**5,662**

Notes:

1. NT: Sample(s) not tested.

Table 3 – Proposed Fill Standard Proctor Test Summary

Boring ID	Depth (feet)	Stratum	LL	PI	Percent Passing No. 200 Sieve (%)	Standard Proctor	
						Opt. Water Content (%)	Max Dry Density (pcf)
201-23	0-3	Alluvium/Residuum	60	40	64.6	22.6	94.7
202-23	3-5	Alluvium/Residuum	31	17	46.8	21.4	97.2
203-23	0-3	Alluvium/Residuum	31	17	41.1	13.4	112.4
204-23	3-5	Alluvium/Residuum	72	51	Not Tested	24.4	91.7
Average			**48.5**	**31.3**	**50.8**	**20.5**	**99.0**

Table 4 – Dispersion Test Summary

Boring ID	Depth (feet)	Stratum	USCS	Dispersion		
				Crumb Test	Double Hydrometer	Pinhole
201-23	0	Alluvium/Residuum	Bulk	-	12.3	-
201-23	4	Alluvium/Residuum	CH	1	9.4	-
201-23	10	Oakville Sandy Clays	CL	3	15.5	-
201-23	20	Oakville Clays	SC	3	-	-
202-23	0	Alluvium/Residuum	Bulk	1	-	-
202-23	3	Alluvium/Residuum	Bulk	4	1.8	ND1
202-23	6	Oakville Sandy Clays	CL	2	-	-
202-23	12	Oakville Sandy Clays	CH	1	6.4	-
202-23	32	Oakville Clays	CH	1	8.0	-
203-23	0	Alluvium/Residuum	Bulk	4	-	ND1
203-23	4	Oakville Sandy Clays	CL	4	45.8	-
203-23	14	Oakville Sandy Clays	CH	1	14.2	-
204-23	0	Alluvium/Residuum	Bulk	1	10.1	-
204-23	6	Oakville Sandy Clays	CH	1	-	-
204-23	10	Oakville Sandy Clays	CH	1	4.3	-

AECOM

Attachment 1 – Laboratory Test Results

142 Chula Vista, San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

September 18, 2023, **Revision 1, November 10, 2023**
Arias Job No. 2023-136

Via Email: lance.finnefrock@aecom.com

Mr. Lance Finnefrock, P.E., G.E
AECOM
13640 Briarwick Drive, Suite 200
Austin, TX 78729

RE: Geotechnical Data Report
Escondido Creek Watershed FRS No. 12
Karnes County, TX

Project Information

We understand that AECOM is assisting SARA with the Improvement of existing dam. A geotechnical study is needed to aid in the evaluation of the dam. As a part of the proposed improvements, Arias performed Laboratory Testing study for Dam 12 in Karnes County, Texas. The boring numbers, locations, depths and laboratory tests were provided/assigned by AECOM.

Please note, the signed and sealed data report was submitted on September 18, 2023. However, we are submitting an updated report including the results of the additional requested tests. This report will supersede the reports submitted prior to November 10, 2023.

Purpose

The purpose of this Memorandum was to:

- perform geotechnical borings at the project site,
- conduct laboratory testing on recovered soil samples, and
- present the results of the laboratory test data in this memo.

SOIL BORINGS

Four (4) borings were drilled at locations staked by AECOM. Drilling was performed in general accordance with ASTM D1586 and D1587 sampling techniques. A truck-mounted drill rig using hollow stem augers together with the sampling tools noted were used to secure the subsurface soil samples and the borehole grouted following the completion of borings.

AECOM field logger directed the sampling efforts, visually classified recovered samples and logged the borings on-site. Additionally, Arias's field technician was present during the entire drilling operation and transported the samples to the laboratory after the completion of drilling.

LABORATORY TESTING

Laboratory testing was performed on the retrieved samples. The laboratory tests were assigned by AECOM and were performed in accordance with the American Society for Testing and Materials (ASTM). Additional pinhole and double hydrometer tests were performed, as requested and the results are included in the Appendix.

Remaining soil samples recovered from this exploration will be routinely discarded following submittal of this report. The following tests were performed in accordance with the ASTM guidelines:

- Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216)
- Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (ASTM D4318)
- Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing (ASTM D1140)
- Standard Test Methods for Laboratory Determination of Density and Unit Weight of Soil Specimens (ASTM D7263)
- Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854).
- Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils (ASTM D2974)
- Standard Test Method for Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)
- Standard Test Methods for Determining Dispersive Characteristics of Clayey Soils by the Crumb Test (ASTM D6572)
- Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM D6913)
- Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis (ASTM D7928)
- Standard Test Method for Dispersive Characteristics of Clay Soil by Double Hydrometer (ASTM D6913, D7928, & ASTM D4221)
- Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing (ASTM G51)
- Standard Test Method for Measurement of Oxidation-Reduction Potential (ORP) of Soil (ASTM G200)
- Standard Test Methods for Chloride Ion In Water (ASTM D512)
- Standard Test Method for Water-Soluble Sulfate in Soil (ASTM C1580)
- Standard Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method (ASTM G187)
- Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (ASTM D698)
- Standard Test Methods for Identification and Classification of Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

The summary of the results is appended with this letter.

Sincerely,

11/10/2023

ARIAS & Associates, Inc.
TBPE Registration No: F-32

MARK J. O'CONNOR
79252

Sandeep K. Malla, E.I.T.
Geotechnical Engineer

Mark O'Connor, P.E.
Senior Geotechnical Engineer

LABORATORY TEST SUMMARY

PROJECT: Escondido FRS No. 12
PROJECT LOCATION: South of Karnes City, Texas
AECOM / JOB NO.: 60707508
PROJECT MANAGER: L. Finnefrock

Provided by AECOM				D4318			D1140	D2216	D7263	D6913	D854	D6913 & D7928	D2974	D2166	D2850	D6572	D4647	D4221	G51	G200	D152	C1580	G187	D698	
		DEPTH (feet)		INDEX TESTS										SOIL STRENGTH TESTS		DISPERSION**			CORROSIVITY SUITE					BULK TESTS (STANDARD PROCTOR)**	
BORING No.	SAMPLE No.	Top	Bottom	ATTERBERG LIMITS (3 pt)**			Wash #200 SIEVE**	MOISTURE CONTENT	DRY UNIT WEIGHT	SIEVE THROUGH #200	SPECIFIC GRAVITY	SIEVE + HYDROMETER	ORGANIC CONTENT	UNCONFINED COMPRESSION**	UU TRIAXIAL	CRUMB TEST**	PINHOLE TEST	DISP. OF CLAY BY DOUBLE HYDRO.**	pH	REDOX	CHLORIDE	SULFATE	RESISTIVITY	Maximum Dry Density**	Optimum Moisture Content**
				LL	PL	PI	%	%	pcf				%	tsf		Grade	Classification	% Dispersion		milivolts	mg/kg	ppm	ohms-cm	lb/ft^3	%
201-23	SS-1	0.0	1.5					19					3.8										730		
	ST-2	2.0	3.0	64	20	44	65	36	91.7					5.41											
	P-3	4.0	6.0					14	107.2				3.3			Grade 1		9.4							
	ST-4	6.0	8.0	36	15	21	57							7.3											
	SS-5	8.0	9.5					10																	
	P-6	10.0	12.0	*		*		12	120.6							Grade 3		15.5							
	ST-7	12.0	14.0	46	14	32	61							4.01	--										
	SS-8A	15.0	16.0					41																	
	SS-8B	16.0	16.5				75	14		**															
	SS-9	20.0	21.5	55	20	35	45	18				**				Grade 3									
	SS-10	23.5	25.0					21																	
	G-1	0.0	3.0	60	20	40					2.613		3.3			*		12.3	7.8	3.76	140	1200	*	94.7	22.6
	G-2	3.0	5.0																						
202-23	P-1	0.0	2.0					12	117.7														1230		
	SS-2	2.0	3.5					13																	
	ST-3	4.0	6.0	28	14	14	50							2.2	--										
	SS-4	6.0	7.5	29	16	13	50	10								Grade 1									
	P-5	8.0	10.0					7		**									7.3	2.92	120	120			
	SS-6	10.0	11.5	31	16	15	42	7		**															
	SS-7	12.0	13.5	51	19	32	67	19								Grade 4	ND1	1.8							
	ST-8	14.0	15.0				75	40	82					1.97											
	SS-9	15.0	16.5	36	16	20		12																	
	SS-10	20.0	21.5				33	7																	
	SS-11	25.0	26.5				19	8		**															
	SS-12	30.0	31.5					23																	
	P-13	32.0	33.0	61	19	42	91	22	100.1			**				Grade 2									
	SS-14	35.0	36.5					18																	
	SS-15	38.5	40.0					25																	
	ST-16	40.0	42.0	63	19	44	87	29	86					0.29											
	G-1	0.0	3.0	39	15	24					2.611		2.1	--		Grade 1		6.4	7	3.54	140	120	*	*	*
	G-2	3.0	5.0	31	14	17					2.616		1.4	--		Grade 1		8	7.1	2.86	100	120	*	97.2	21.4

LABORATORY TEST SUMMARY

PROJECT: Escondido FRS No. 12
PROJECT LOCATION: South of Karnes City, Texas
AECOM / JOB NO.: 60707508
PROJECT MANAGER: L. Finnefrock

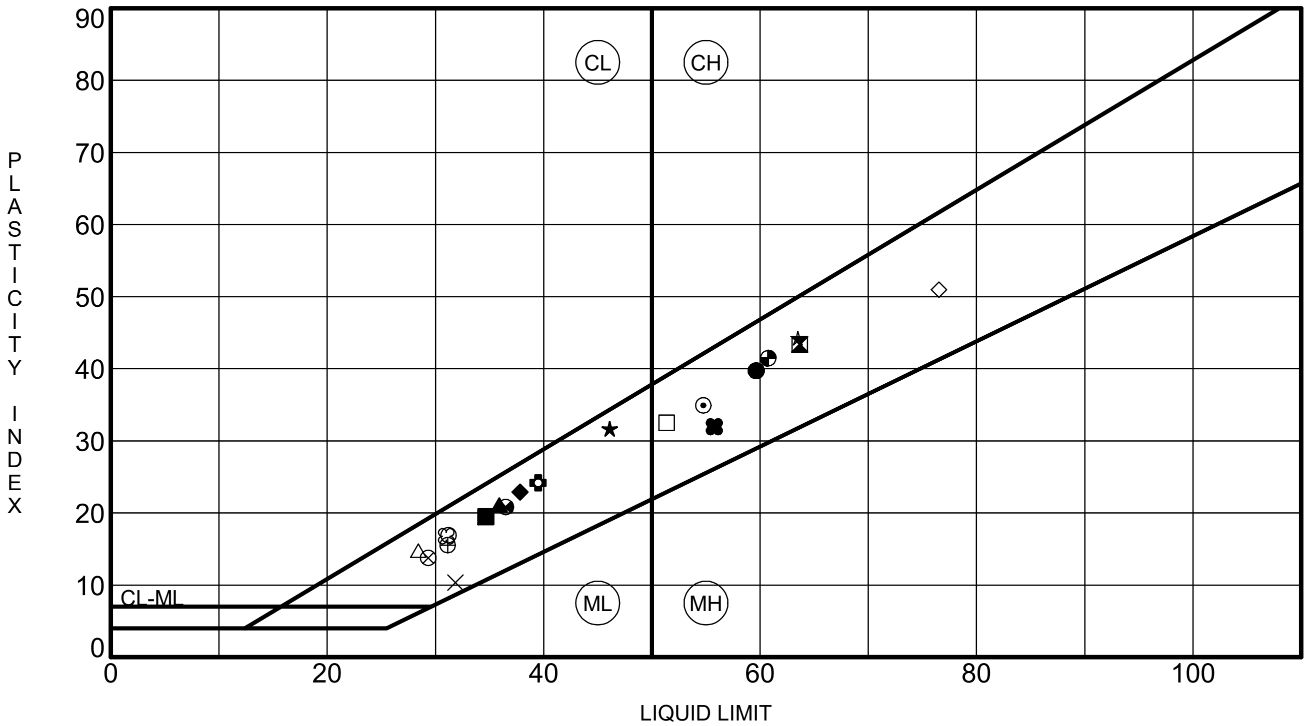
Provided by AECOM				D4318			D1140	D2216	D7263	D6913	D854	D6913 & D7928	D2974	D2166	D2850	D6572	D4647	D4221	G51	G200	D152	C1580	G187	D698	
		DEPTH (feet)		INDEX TESTS										SOIL STRENGTH TESTS		DISPERSION**			CORROSIVITY SUITE					BULK TESTS (STANDARD PROCTOR)**	
BORING No.	SAMPLE No.	Top	Bottom	ATTERBERG LIMITS (3 pt)**			Wash #200 SIEVE**	MOISTURE CONTENT	DRY UNIT WEIGHT	SIEVE THROUGH #200	SPECIFIC GRAVITY	SIEVE + HYDROMETER	ORGANIC CONTENT	UNCONFINED COMPRESSION**	UU TRIAXIAL	CRUMB TEST**	PINHOLE TEST	DISP. OF CLAY BY DOUBLE HYDRO.**	pH	REDOX	CHLORIDE	SULFATE	RESISTIVITY	Maximum Dry Density**	Optimum Moisture Content**
				LL	PL	PI	%	%	pcf				%	tsf		Grade	Classification	% Dispersion		milivolts	mg/kg	ppm	ohms-cm	lb/ft^3	%
203-23	SS-1	0.0	1.5					13																	
	P-2	2.0	4.0	35	15	20	87	7	108.4	**															
	SS-3	4.0	5.5					9								Grade 4	ND1								
	SS-4	6.0	7.5				38	5		**															
	SS-5	8.0	9.5					13																	
	ST-6	10.0	11.0	38	15	23	54	28	89					0.63											
	SS-7	12.0	13.5				26	10		**															
	SS-8	14.0	15.5	77	26	51		29								Grade 4		45.8							
	SS-9	16.0	17.5	32	21	11	86	23		**															
	ST-10	17.5	18.0					24																	
	P-11	19.0	20.0				16	6		**															
	SS-12	20.0	21.5					10																	
	SS-13	23.0	24.5				31	21		**															
	SS-14	26.0	27.5					19																	
	ST-15	28.0	30.0	56	24	32	84							8.44											
	G-1	0.0	3.0	31	14	17					2.649			--		Grade 1		14.2	7.2	2.42	120	100	*	112.4	13.4
	G-2	3.0	5.0																						
204-23	ST-1	0.0	2.0	54	21	33	74	22	98.9					4.39											
	SS-2	2.0	3.5					21																	
	ST-3	4.0	6.0	62	20	42	75							19.16											
	P-4	6.0	8.0													Grade 1		10.1							
	ST-5	8.0	10.0	49	19	30	75	16	109.9					8.49	--										
	SS-6	10.0	11.5					21								Grade 1									
	P-7	12.0	13.5				42	13	107.5	**															
	G-1	0.0	3.0								2.639			--		Grade 1		4.3							
	G-2	3.0	5.0	72	21	51																		91.7	24.4

* Not Sufficient Material

** See Attached Graph

-- not enough sample to run UC/ was not possbile to meet given criteria to run UU, and cancled as per direction.

ATTERBERG LIMIT RESULTS



Boring	Depth	LL	PL	PI	Fines	Classification
● 201-23	1.5	60	20	40		G-1, Bulk Sample 0'-3', Redox=3.76mV
⧗ 201-23	2.0	64	20	44	65	SANDY FAT CLAY (CH)
▲ 201-23	6.0	36	15	21	57	SANDY LEAN CLAY (CL)
★ 201-23	12.0	46	14	32	61	SANDY LEAN CLAY (CL)
⊙ 201-23	20.0	55	20	35	45	CLAYEY SAND (SC)
✿ 202-23	1.5	39	15	24		G-1, Bulk Sample 0'-3'; Redox=3.54mV
○ 202-23	3.0	31	14	17		G-2, Bulk Sample 3'-5'; Redox=2.86mV
△ 202-23	4.0	28	14	14	50	CLAYEY SAND (SC)
⊗ 202-23	6.0	29	16	13	50	SANDY LEAN CLAY (CL)
⊕ 202-23	10.0	31	16	15	42	CLAYEY SAND (SC)
□ 202-23	12.0	51	19	32	67	SANDY FAT CLAY (CH)
◉ 202-23	15.0	36	16	20		
◕ 202-23	32.0	61	19	42	91	FAT CLAY (CH)
☆ 202-23	40.0	63	19	44	87	FAT CLAY (CH)
✿ 203-23	1.5	31	14	17		G-1, Bulk Sample 0'-3'; Redox=2.42mV
■ 203-23	2.0	35	15	20	87	LEAN CLAY (CL)
◆ 203-23	10.0	38	15	23	54	SANDY LEAN CLAY (CL)
◇ 203-23	14.0	77	26	51		
× 203-23	16.0	32	21	11	86	LEAN CLAY (CL)
✖ 203-23	28.0	56	24	32	84	FAT CLAY with SAND (CH)

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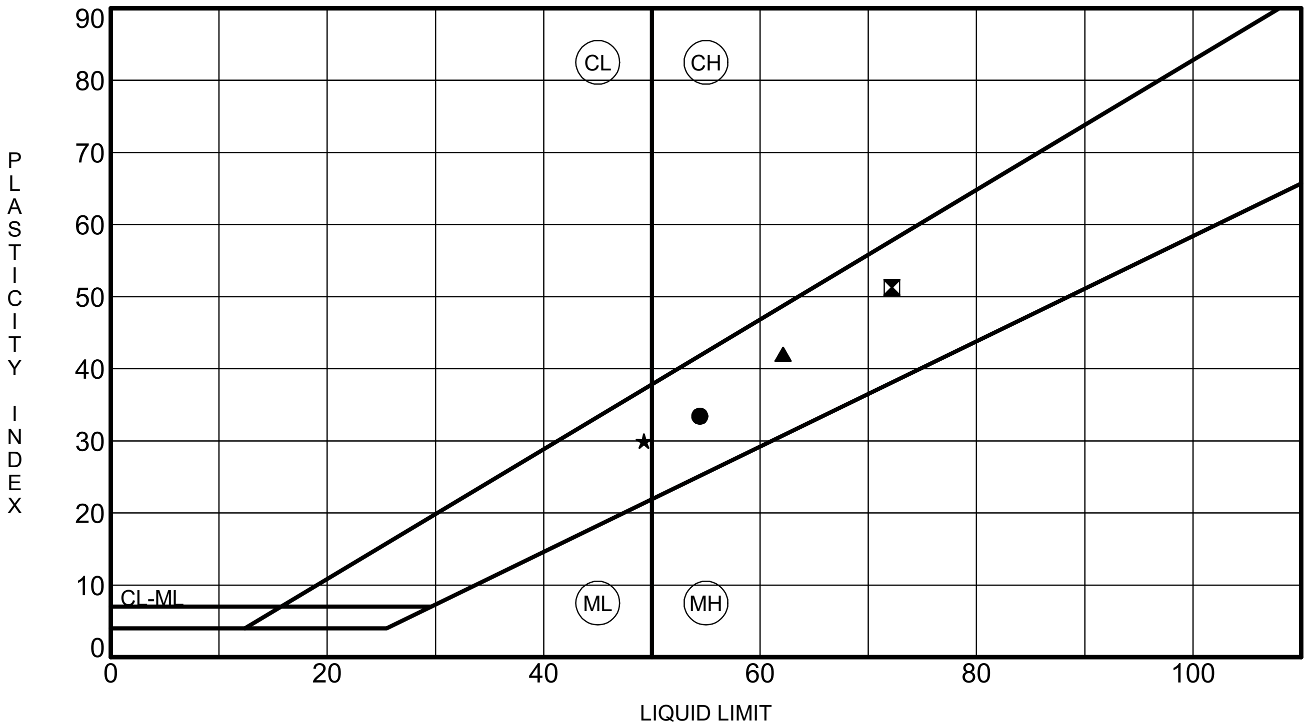
ATTERBERG LIMITS RESULTS

Project:

Location: See Boring Location Plan

Job No.: Escondido 12



	Boring	Depth	LL	PL	PI	Fines	Classification
●	**204-23**	**0.0**	**54**	**21**	**33**	**74**	**FAT CLAY with SAND (CH)**
⧗	**204-23**	**3.0**	**72**	**21**	**51**		**G-2, Bulk Sample 3'-5'**
▲	**204-23**	**4.0**	**62**	**20**	**42**	**75**	**FAT CLAY with SAND (CH)**
★	**204-23**	**8.0**	**49**	**19**	**30**	**75**	**LEAN CLAY with SAND (CL)**

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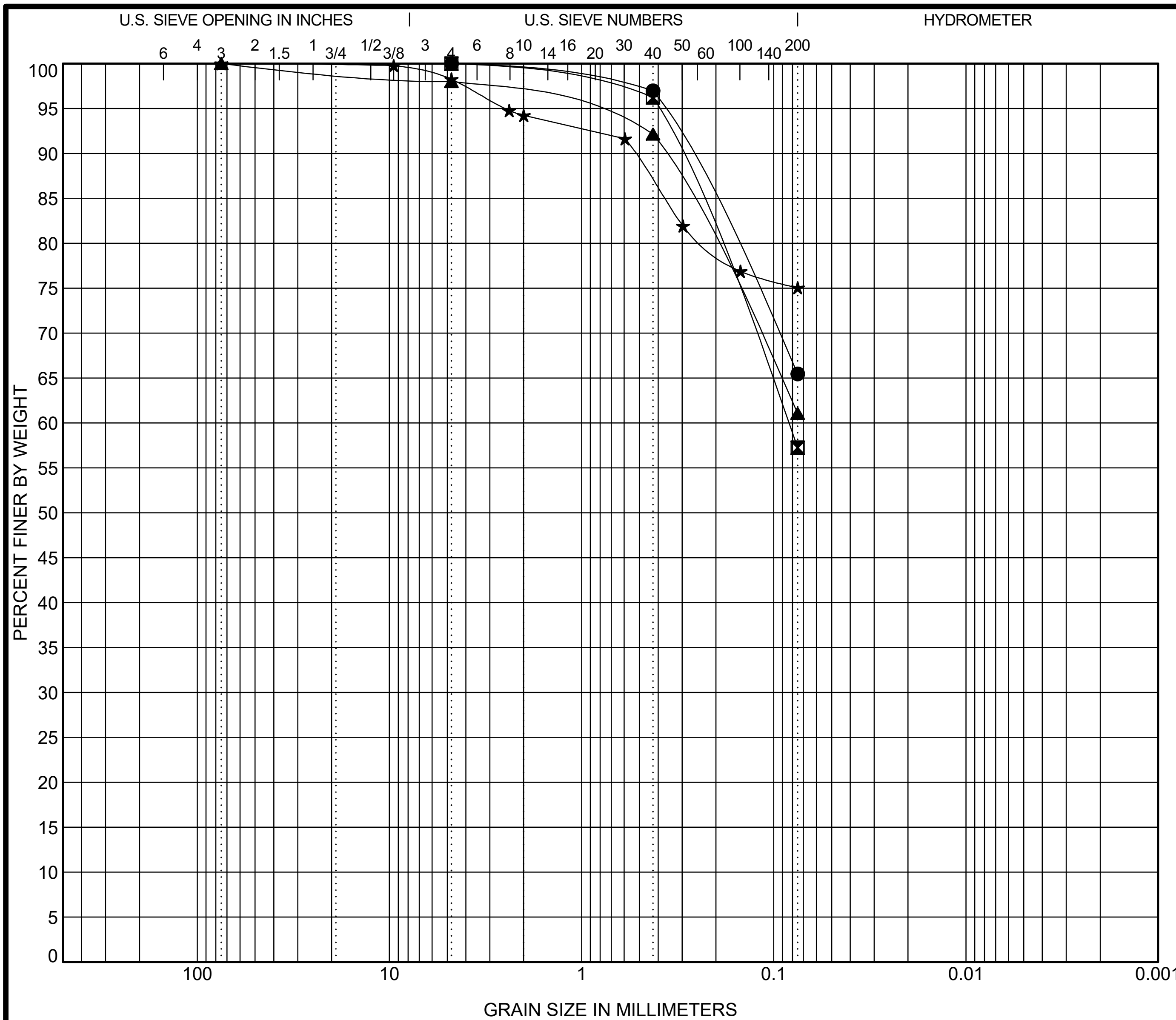
ATTERBERG LIMITS RESULTS

Project:

Location: See Boring Location Plan

Job No.: Escondido 12

GRAIN SIZE DISTRIBUTION CURVE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**201-23**		**2.0**	**SANDY FAT CLAY (CH)**	**64**	**20**	**44**		
⧗	**201-23**		**6.0**	**SANDY LEAN CLAY (CL)**	**36**	**15**	**21**		
▲	**201-23**		**12.0**	**SANDY LEAN CLAY (CL)**	**46**	**14**	**32**		
★	**201-23**		**15.0**						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**201-23**	**2.0**	**4.75**				**0.0**	**34.5**	**65.5**	
⧗	**201-23**	**6.0**	**4.75**	**0.085**			**0.0**	**42.8**	**57.2**	
▲	**201-23**	**12.0**	**75**				**2.0**	**36.9**	**61.1**	
★	**201-23**	**15.0**	**75**				**1.7**	**23.2**	**75.0**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

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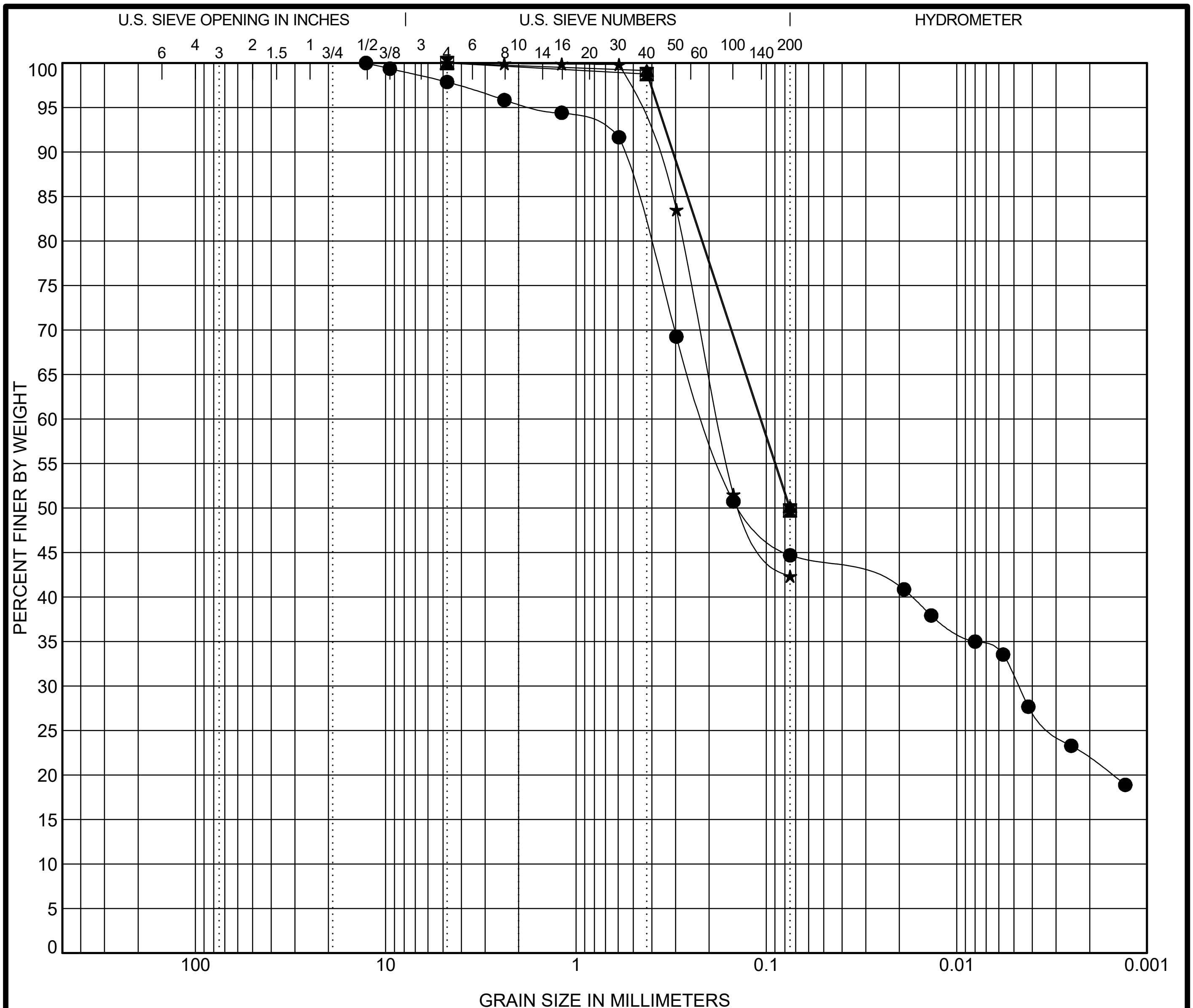
GRAIN SIZE DISTRIBUTION

Project:

Location: See Boring Location Plan

Job No.: Escondido 12



Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
● **201-23**		**20.0**	**CLAYEY SAND (SC)**	**55**	**20**	**35**		
⊠ **202-23**		**4.0**	**CLAYEY SAND (SC)**	**28**	**14**	**14**		
▲ **202-23**		**6.0**	**SANDY LEAN CLAY (CL)**	**29**	**16**	**13**		
★ **202-23**		**10.0**	**CLAYEY SAND (SC)**	**31**	**16**	**15**		

Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **201-23**	**20.0**	**12.7**	**0.21**	**0.005**		**2.1**	**53.2**	**22.9**	**21.8**
⊠ **202-23**	**4.0**	**4.75**	**0.108**			**0.0**	**50.3**	**49.7**	
▲ **202-23**	**6.0**	**4.75**	**0.106**			**0.0**	**49.9**	**50.1**	
★ **202-23**	**10.0**	**4.76**	**0.179**			**0.0**	**57.7**	**42.3**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

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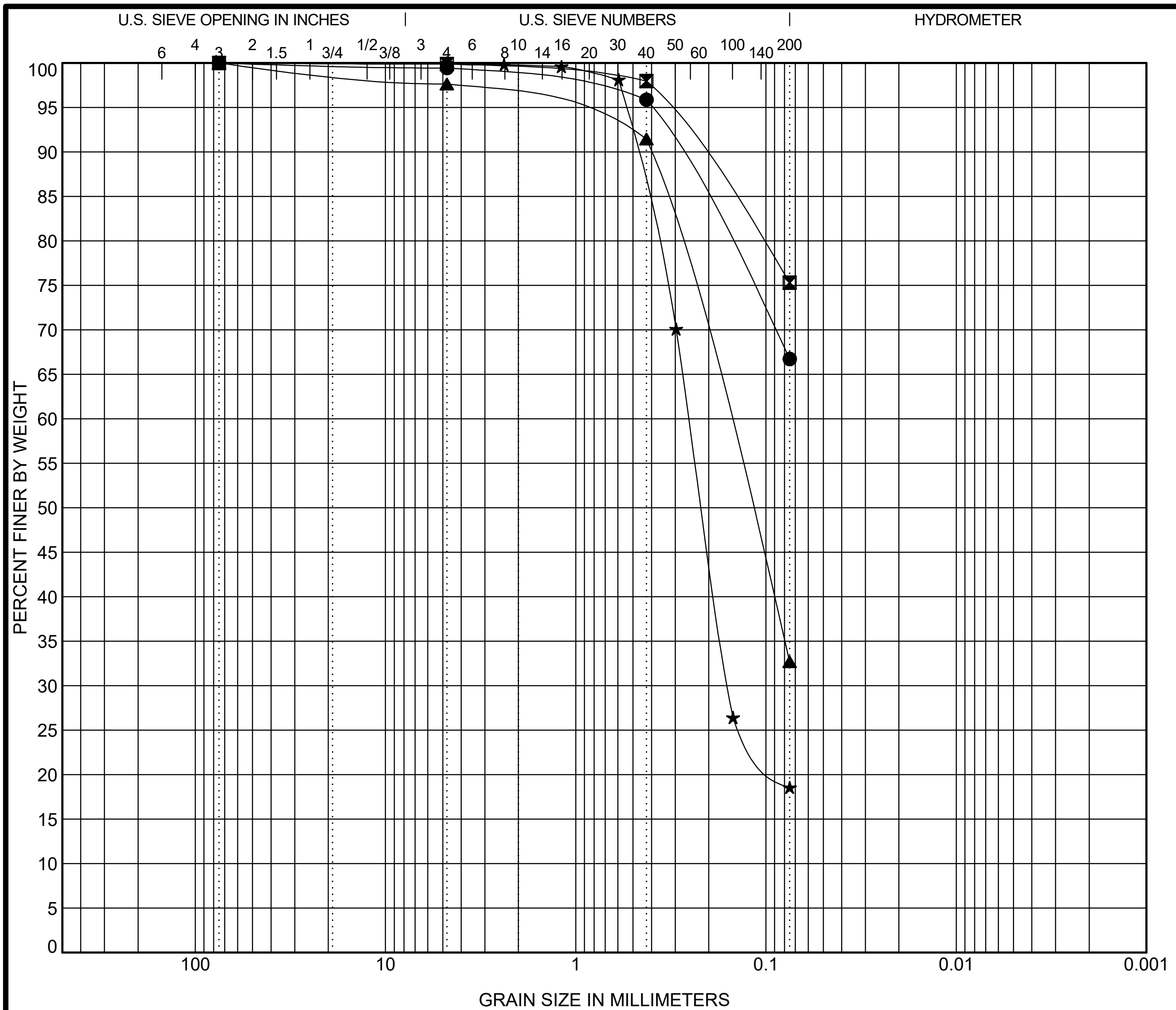
GRAIN SIZE DISTRIBUTION

Project:

Location: See Boring Location Plan

Job No.: Escondido 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**202-23**		**12.0**	**SANDY FAT CLAY (CH)**	**51**	**19**	**32**		
⧗	**202-23**		**14.0**						
▲	**202-23**		**20.0**						
★	**202-23**		**25.0**						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**202-23**	**12.0**	**75**				**0.6**	**32.7**	**66.7**	
⧗	**202-23**	**14.0**	**75**				**0.1**	**24.6**	**75.3**	
▲	**202-23**	**20.0**	**75**	**0.168**			**2.4**	**65.0**	**32.7**	
★	**202-23**	**25.0**	**4.76**	**0.253**	**0.158**		**0.0**	**81.4**	**18.6**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

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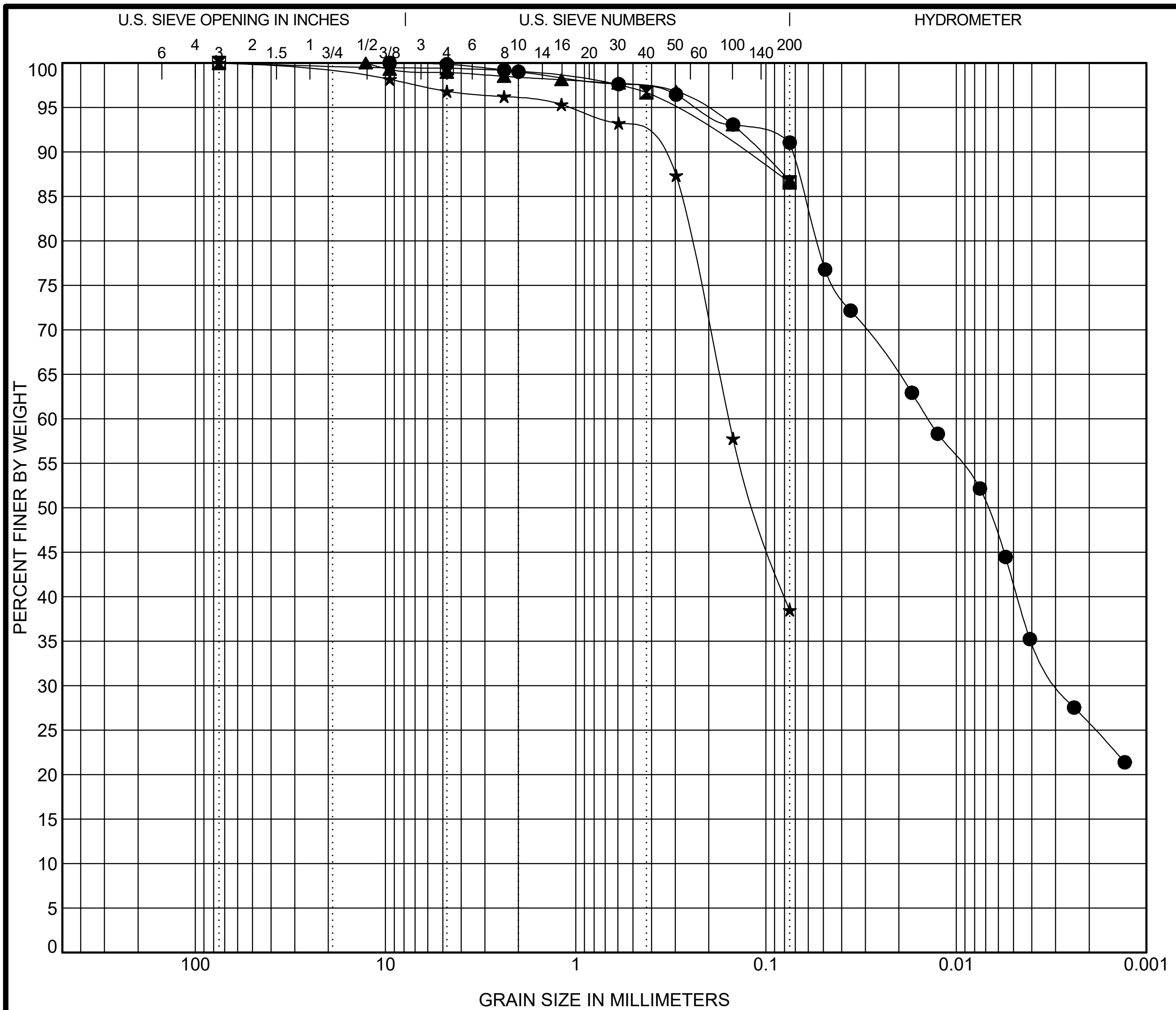
GRAIN SIZE DISTRIBUTION

Project:

Location: See Boring Location Plan

Job No.: Escondido 12



	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**202-23**		**32.0**	**FAT CLAY (CH)**	**61**	**19**	**42**		
⧗	**202-23**		**40.0**	**FAT CLAY (CH)**	**63**	**19**	**44**		
▲	**203-23**		**2.0**	**LEAN CLAY (CL)**	**35**	**15**	**20**		
★	**203-23**		**6.0**						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**202-23**	**32.0**	**9.51**	**0.014**	**0.003**		**0.2**	**8.8**	**65.3**	**25.7**
⧗	**202-23**	**40.0**	**75**				**0.6**	**12.9**	**86.6**	
▲	**203-23**	**2.0**	**12.7**				**1.1**	**12.2**	**86.8**	
★	**203-23**	**6.0**	**75**	**0.157**			**3.2**	**58.3**	**38.5**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

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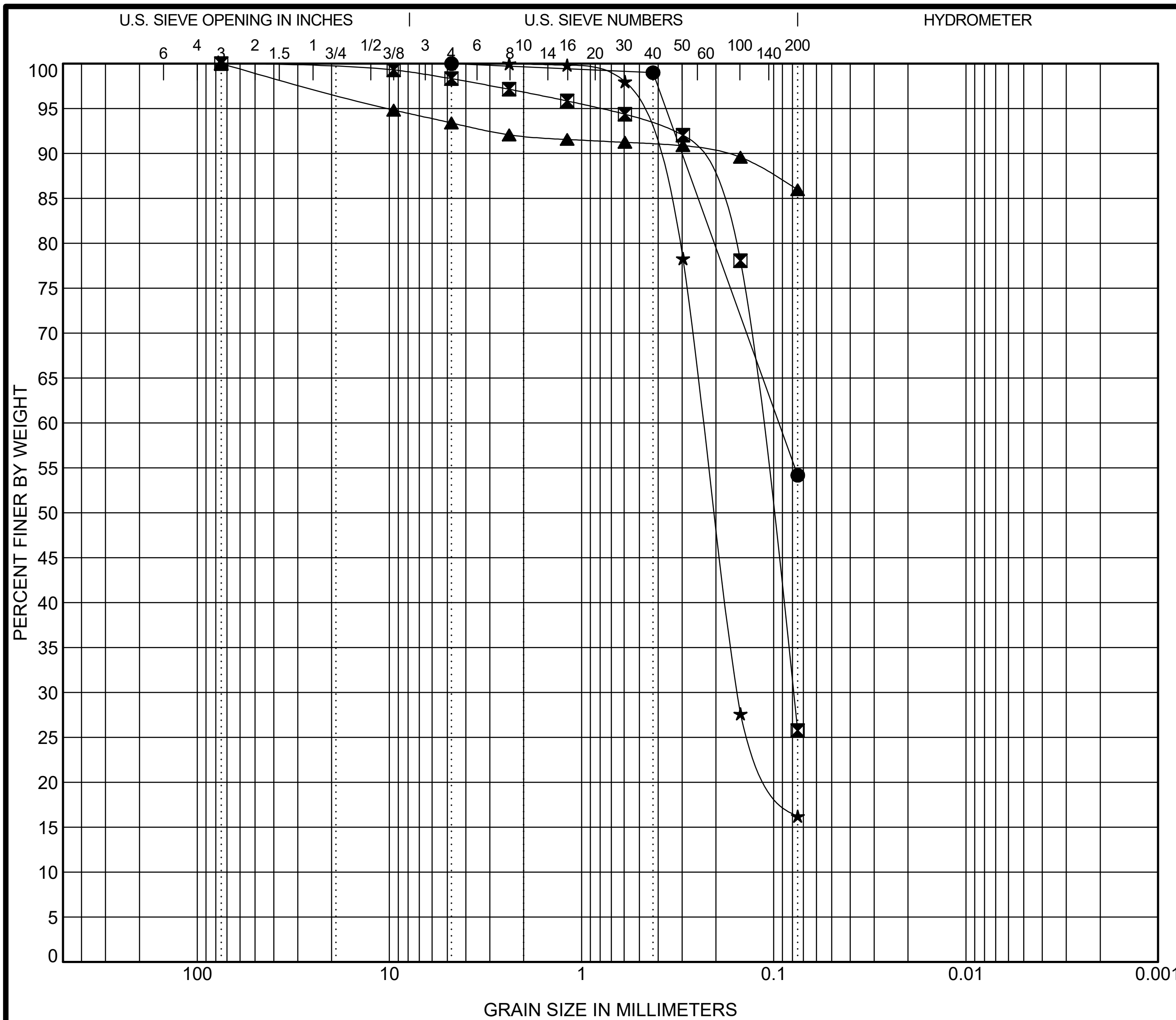
GRAIN SIZE DISTRIBUTION

Project:

Location: See Boring Location Plan

Job No.: Escondido 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**203-23**		**10.0**	**SANDY LEAN CLAY (CL)**	**38**	**15**	**23**		
⊠	**203-23**		**12.0**						
▲	**203-23**		**16.0**	**LEAN CLAY (CL)**	**32**	**21**	**11**		
★	**203-23**		**19.0**						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**203-23**	**10.0**	**4.75**	**0.094**			**0.0**	**45.8**	**54.2**	
⊠	**203-23**	**12.0**	**75**	**0.118**	**0.079**		**1.7**	**72.6**	**25.8**	
▲	**203-23**	**16.0**	**75**				**6.6**	**7.4**	**86.0**	
★	**203-23**	**19.0**	**4.76**	**0.232**	**0.154**		**0.0**	**83.8**	**16.2**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

GRAIN SIZE DISTRIBUTION

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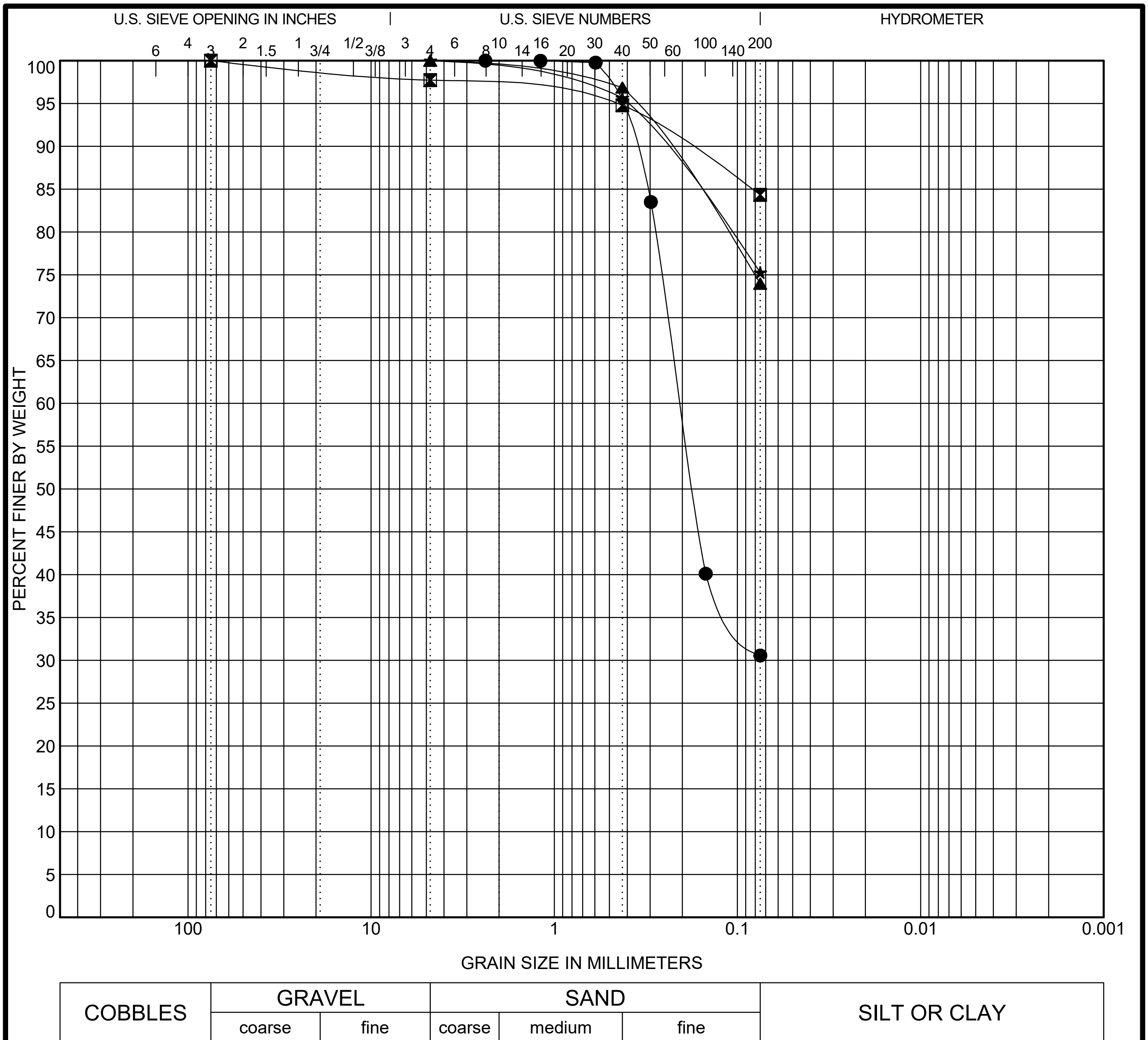
Project:

Location: See Boring Location Plan

Job No.: Escondido 12



Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
● 203-23		23.0						
⧗ 203-23		28.0	**FAT CLAY with SAND (CH)**	56	24	32		
▲ 204-23		0.0	**FAT CLAY with SAND (CH)**	54	21	33		
★ 204-23		4.0	**FAT CLAY with SAND (CH)**	62	20	42		

Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 203-23	23.0	2.38	0.204			0.0	69.4	30.6	
⧗ 203-23	28.0	75				2.3	13.4	84.3	
▲ 204-23	0.0	4.75				0.0	26.0	74.0	
★ 204-23	4.0	4.75				0.0	24.7	75.3	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

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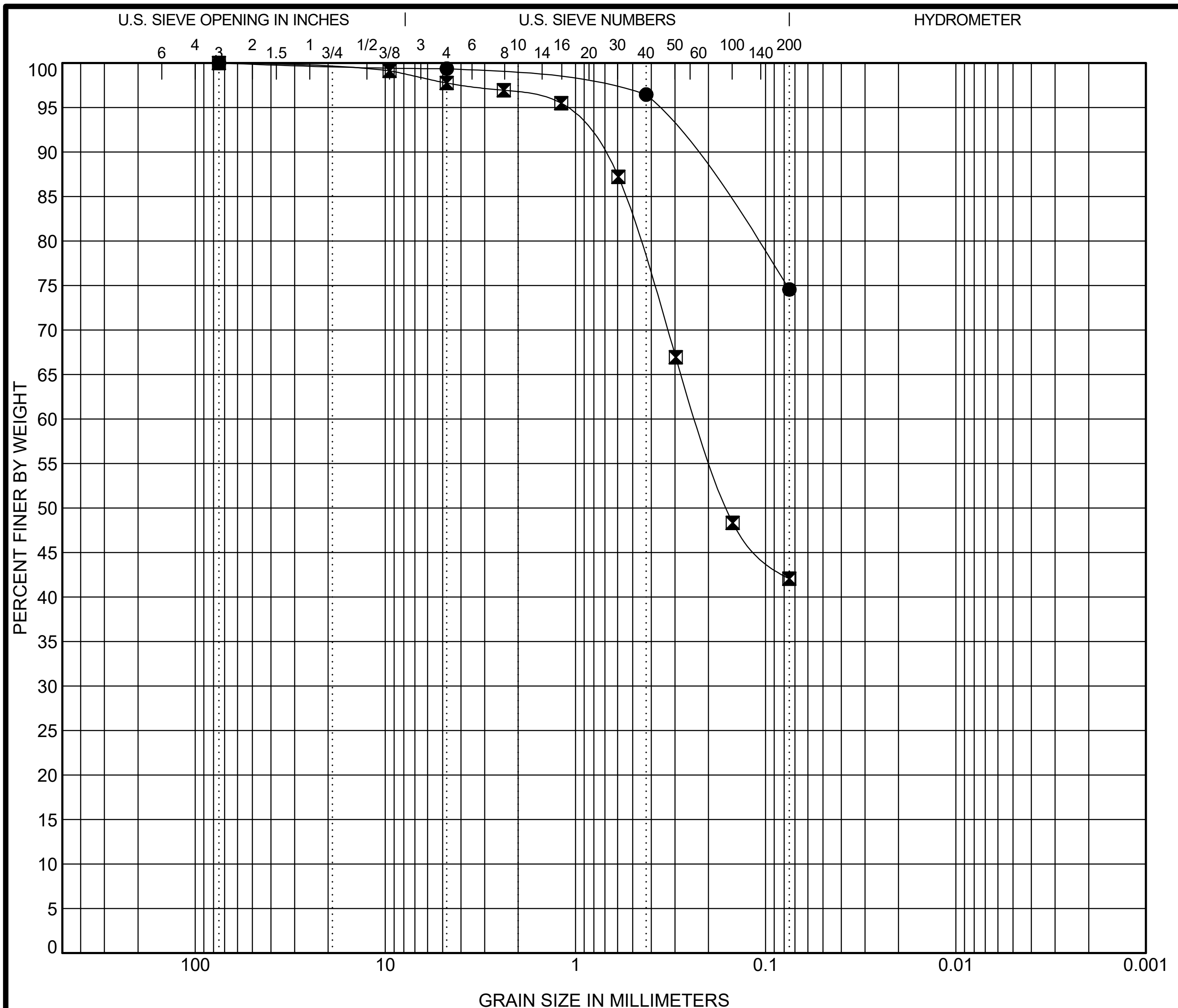
GRAIN SIZE DISTRIBUTION

Project:

Location: See Boring Location Plan

Job No.: Escondido 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**204-23**		**8.0**	**LEAN CLAY with SAND (CL)**	**49**	**19**	**30**		
⧗	**204-23**		**12.0**						

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**204-23**	**8.0**	**75**				**0.6**	**24.8**	**74.6**	
⧗	**204-23**	**12.0**	**75**	**0.23**			**2.3**	**55.7**	**42.1**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

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GRAIN SIZE DISTRIBUTION

Project:

Location: See Boring Location Plan

Job No.: Escondido 12

Arias Geoprofessionals

UNCONFINED COMPRESSTION TEST RESULTS

142 Chula Vista Dr., San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

Unconfined Compressive Strength Test
ASTM D2166

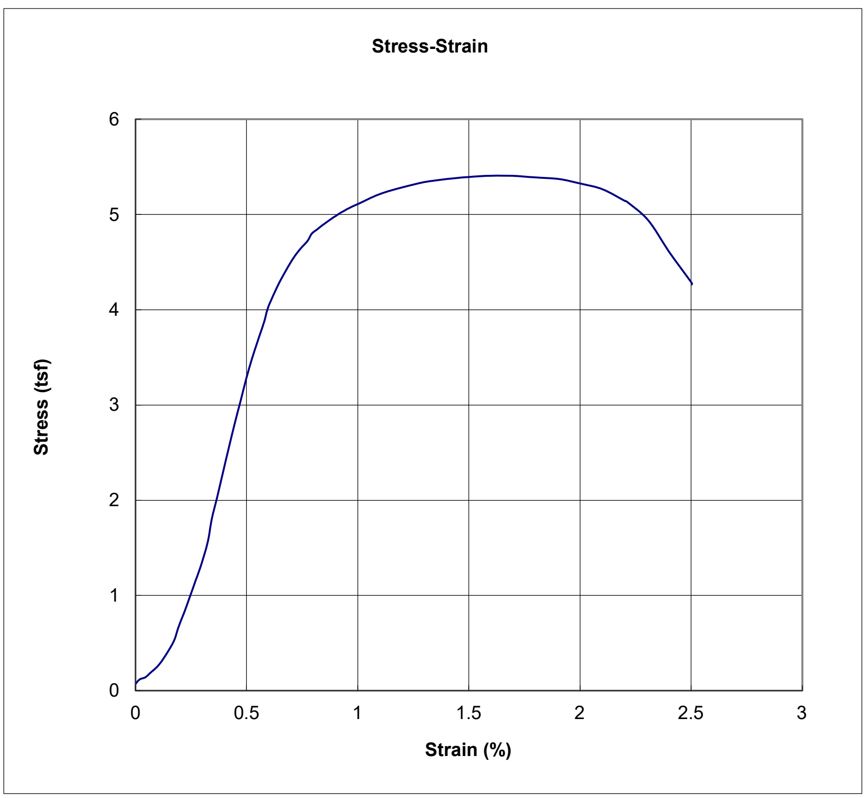
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 12
Kenedy, TX

Project Number: 2023-136
Date of Test:

Specimen and Testing Details

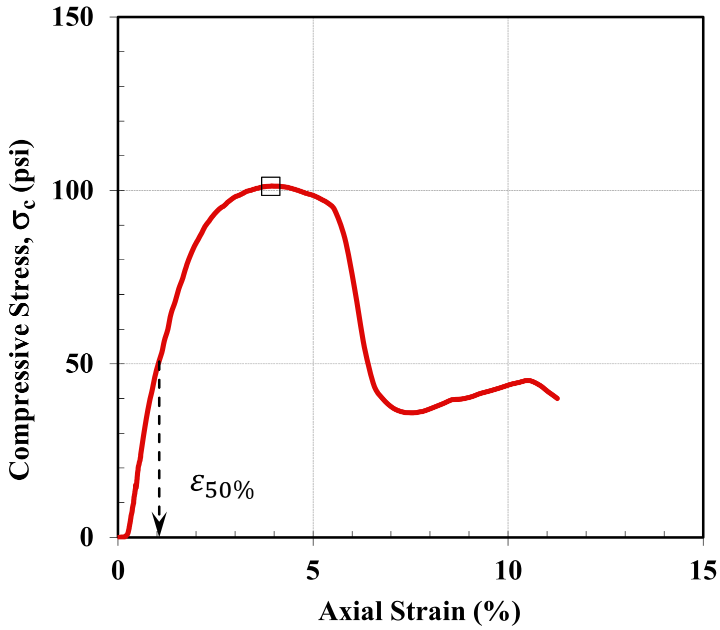
Borehole		201-23
Depth (ft)		2 - 3
Sample Date		7/20/2023
Soil Type		SANDY FAT CLAY (CH)
Specimen Height	inch	5.54
Specimen Diameter	inch	2.77
Moisture Content	%	35.6
Dry Density	pcf	91.7
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.60
Failure Stress	tsf	5.41



Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client:	Arias & Associates, Inc.	Alpine Project No.:	2307258
Project Name:	Escondido FRS No.12 (PN: 2023-136)	Test Date:	08/10/23
Sample ID:	201-23, ST-4 (6-8 ft)	Tested By:	T.D.



Initial Conditions	
Avg. Diameter (in)	2.77
Avg. Height, H_0 (in)	5.67
Avg. Water Content (%)	13.3
Total Unit Weight, γ_{total} (pcf)	137.1
Dry Unit Weight, γ_{dry} (pcf)	120.9
Void Ratio, e_0	0.38
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	3.9
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	1.1
Unconfined Compressive Strength, q_u (psi)	101.3
Undrained Shear Strength, S_u (tsf)	3.65

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.

(a) After Test

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

142 Chula Vista Dr., San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

Unconfined Compressive Strength Test
ASTM D2166

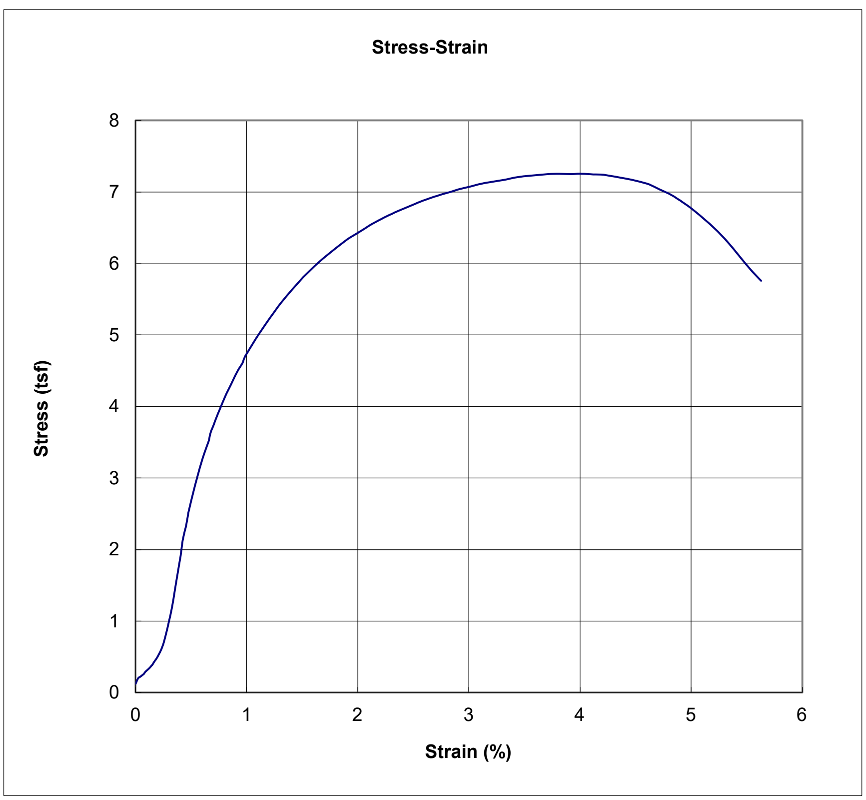
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 12
Kenedy, TX

Project Number: 2023-136
Date of Test:

Specimen and Testing Details

Borehole		201-23
Depth (ft)		12 - 14
Sample Date		7/20/2023
Soil Type		FAT CLAY (CH)
Specimen Height	inch	5.56
Specimen Diameter	inch	2.77
Moisture Content	%	15
Dry Density	pcf	116.31
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	7.26
Failure Stress	tsf	4.01

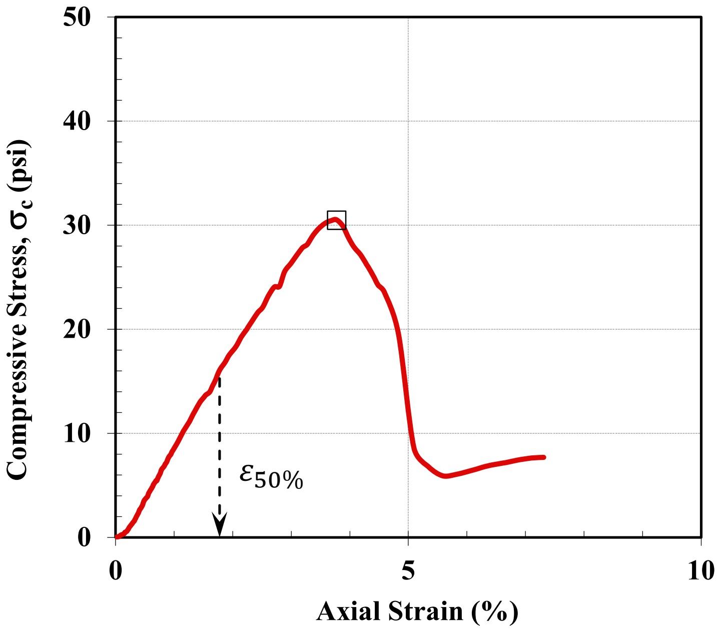


Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, ST-3 (4-6 ft)

Alpine Project No.: 2307258
Test Date: 08/10/23
Tested By: T.D.



Initial Conditions	
Avg. Diameter (in)	2.78
Avg. Height, H_0 (in)	5.68
Avg. Water Content (%)	13.6
Total Unit Weight, γ_{total} (pcf)	124.7
Dry Unit Weight, γ_{dry} (pcf)	109.7
Void Ratio, e_0	0.52
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	3.8
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	1.8
Unconfined Compressive Strength, q_u (psi)	30.5
Undrained Shear Strength, S_u (tsf)	1.10

(a) After Test

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.

Cheng-Wei Chen, Ph.D. 08/12/23
Reviewed By / Date

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Unconfined Compressive Strength Test
ASTM D2166

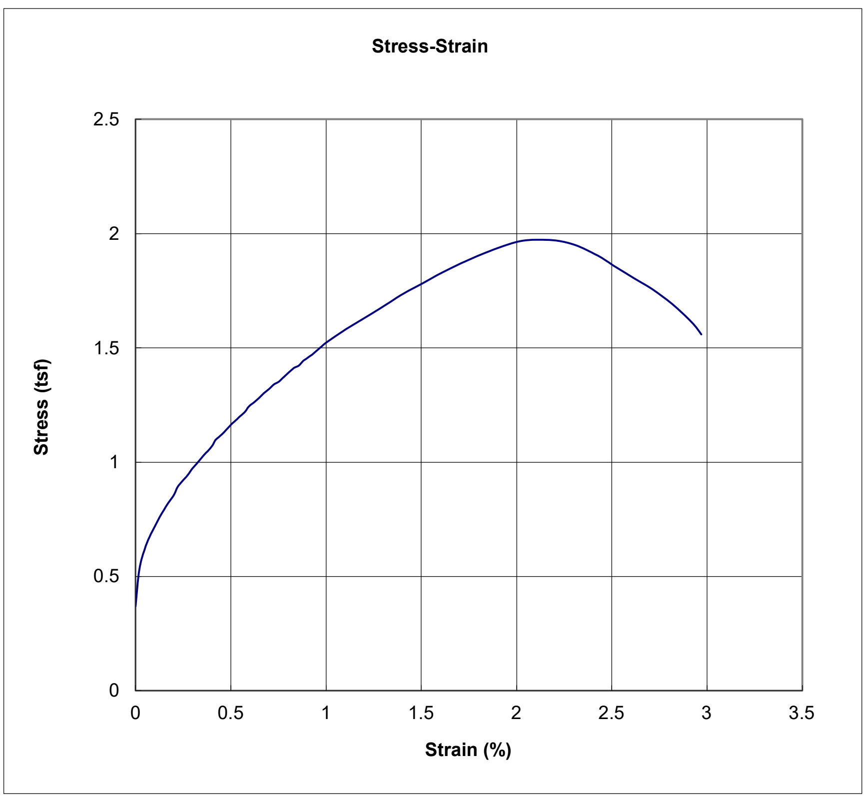
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 12
Kenedy, TX

Project Number: 2023-136
Date of Test:

Specimen and Testing Details

Borehole		202-23
Depth (ft)		14 - 16
Sample Date		7/20/2023
Soil Type		LEAN CLAY (CL)
Specimen Height	inch	5.51
Specimen Diameter	inch	2.74
Moisture Content	%	39.6
Dry Density	pcf	82.43
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	2.11
Failure Stress	tsf	1.97



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Unconfined Compressive Strength Test
ASTM D2166

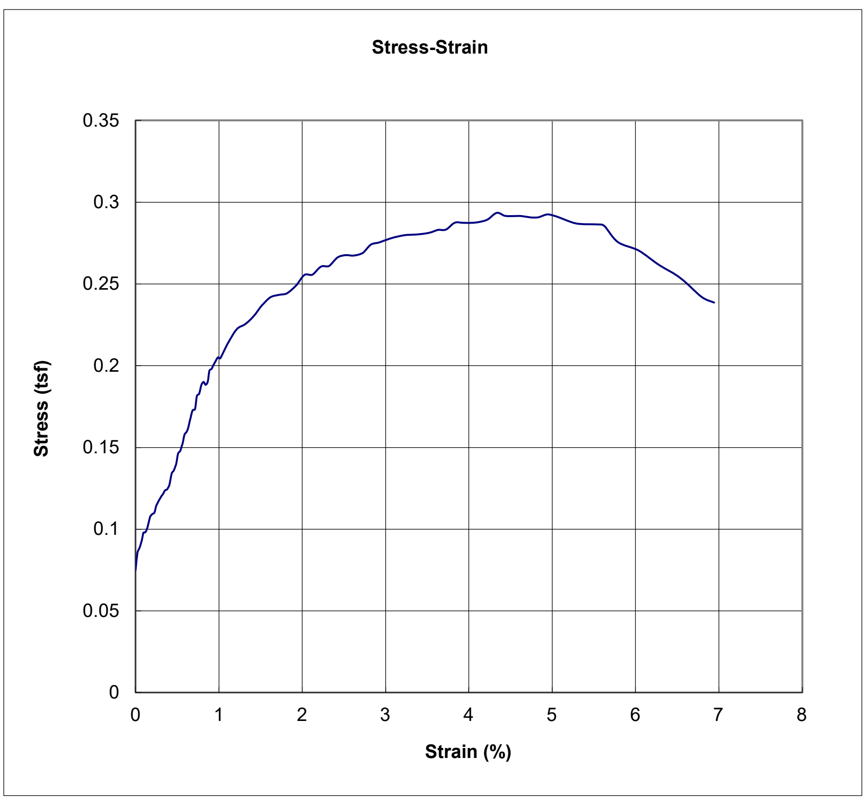
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 12
Kenedy, TX

Project Number: 2023-136
Date of Test:

Specimen and Testing Details

Borehole		202-23
Depth (ft)		40 - 42
Sample Date		7/20/2023
Soil Type		FAT CLAY (CH)
Specimen Height	inch	5.51
Specimen Diameter	inch	2.78
Moisture Content	%	28.6
Dry Density	pcf	86.13
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	4.33
Failure Stress	tsf	0.29



ARIAS
142 Chula Vista Dr., San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

Unconfined Compressive Strength Test
ASTM D2166

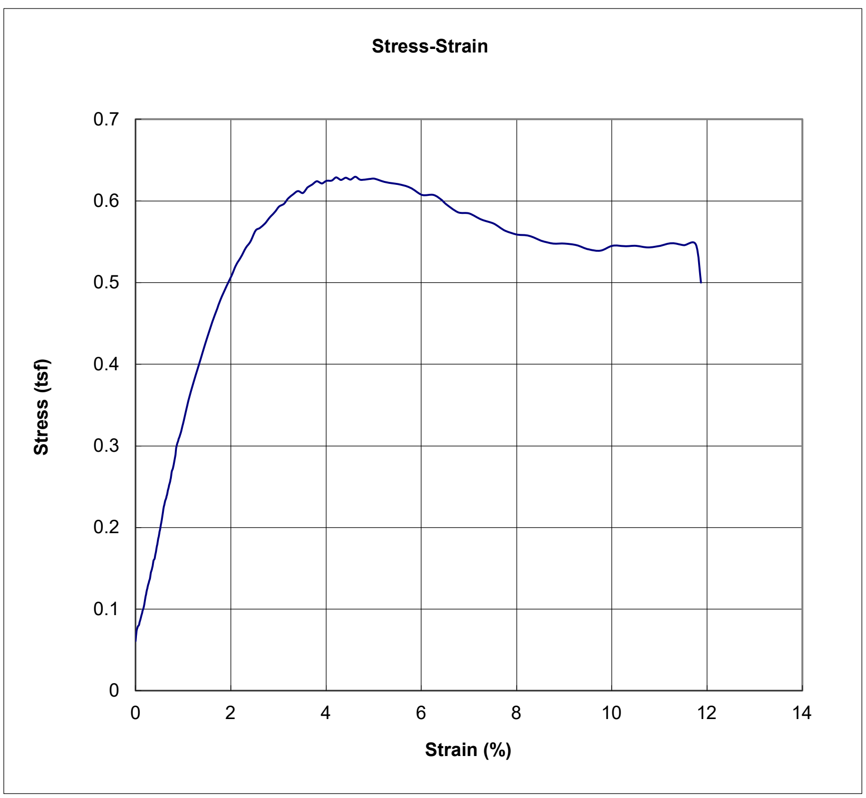
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 12
Kenedy, TX

Project Number: 2023-136
Date of Test:

Specimen and Testing Details

Borehole		203-23
Depth (ft)		10 - 11
Sample Date		7/20/2023
Soil Type		FAT CLAY (CH)
Specimen Height	inch	4.69
Specimen Diameter	inch	2.86
Moisture Content	%	27.8
Dry Density	pcf	88.74
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	4.62
Failure Stress	tsf	0.63



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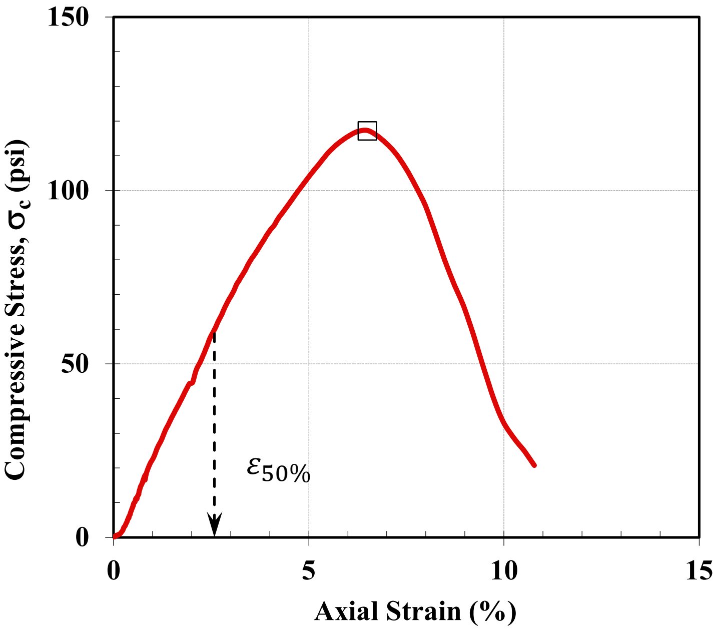
Hutto, TX 78634
Tel: (512) 387-1287

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 203-23, ST-15 (28-30 ft)

Alpine Project No.: 2307258
Test Date: 08/10/23
Tested By: T.D.

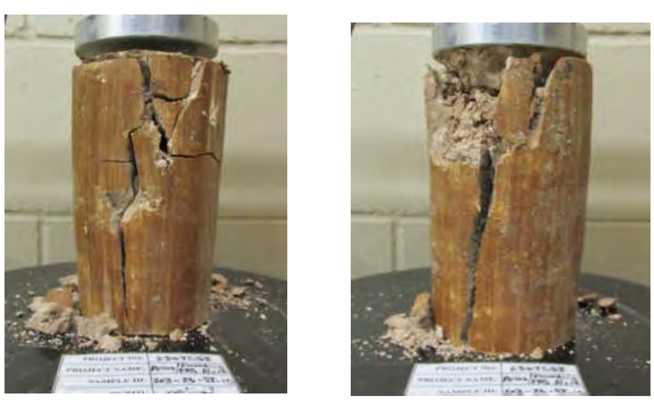


Initial Conditions	
Avg. Diameter (in)	2.76
Avg. Height, H_0 (in)	5.67
Avg. Water Content (%)	20.7
Total Unit Weight, γ_{total} (pcf)	127.3
Dry Unit Weight, γ_{dry} (pcf)	105.4
Void Ratio, e_0	0.59
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	6.5
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	2.6
Unconfined Compressive Strength, q_u (psi)	117.3
Undrained Shear Strength, S_u (tsf)	4.22

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.



(a) After Test

Cheng-Wei Chen, Ph.D. 08/12/23
Reviewed By / Date

142 Chula Vista Dr., San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

Unconfined Compressive Strength Test
ASTM D2166

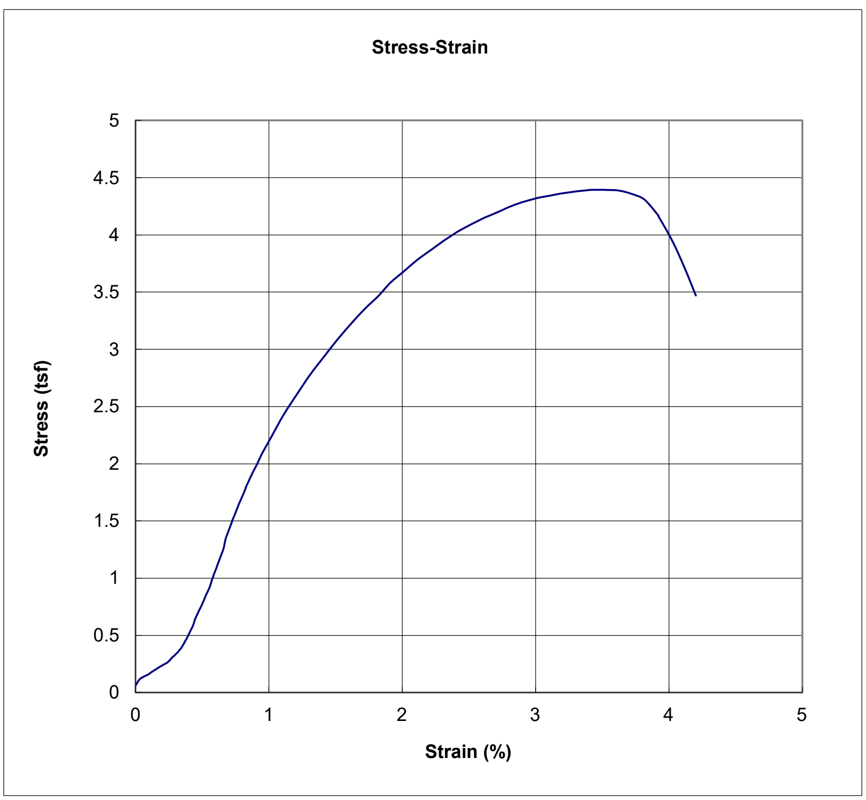
Customer: AECOM
8860 5^{TH} Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 12
Kenedy, TX

Project Number: 2023-136
Date of Test:

Specimen and Testing Details

Borehole		204-23
Depth (ft)		0 - 2
Sample Date		7/20/2023
Soil Type		FAT CLAY with SAND (CH)
Specimen Height	inch	5.59
Specimen Diameter	inch	2.85
Moisture Content	%	22.1
Dry Density	pcf	98.89
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	3.51
Failure Stress	tsf	4.39



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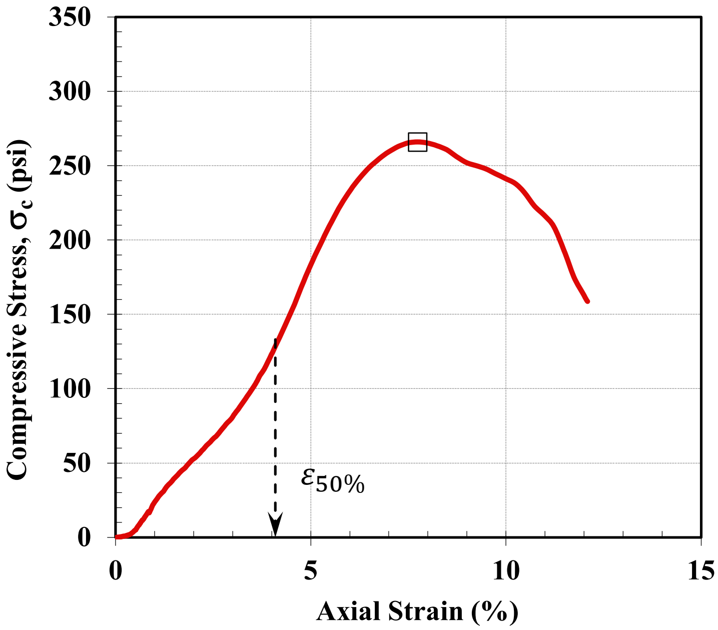
Hutto, TX 78634
Tel: (512) 387-1287

Unconfined Compressive Strength of Cohesive Soil (ASTM D2166)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 204-23, ST-3 (4-6 ft)

Alpine Project No.: 2307258
Test Date: 08/10/23
Tested By: T.D.



Initial Conditions	
Avg. Diameter (in)	2.80
Avg. Height, H_0 (in)	5.69
Avg. Water Content (%)	14.5
Total Unit Weight, γ_{total} (pcf)	130.8
Dry Unit Weight, γ_{dry} (pcf)	114.2
Void Ratio, e_0	0.46
Specific Gravity (Assumed)	2.68

Rate of Axial Strain (%/ min)	1.0

Stresses at Failure	
Axial Strain at Failure (%)	7.7
Axial Strain at 50% of q_u, $\varepsilon_{50\%}$	4.1
Unconfined Compressive Strength, q_u (psi)	266.1
Undrained Shear Strength, S_u (tsf)	9.58

(a) After Test

Note: Failure was determined at the maximum compressive stress or stress at 15 % axial strain, whenever is obtained first.

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Reviewed By / Date

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Unconfined Compressive Strength Test
ASTM D2166

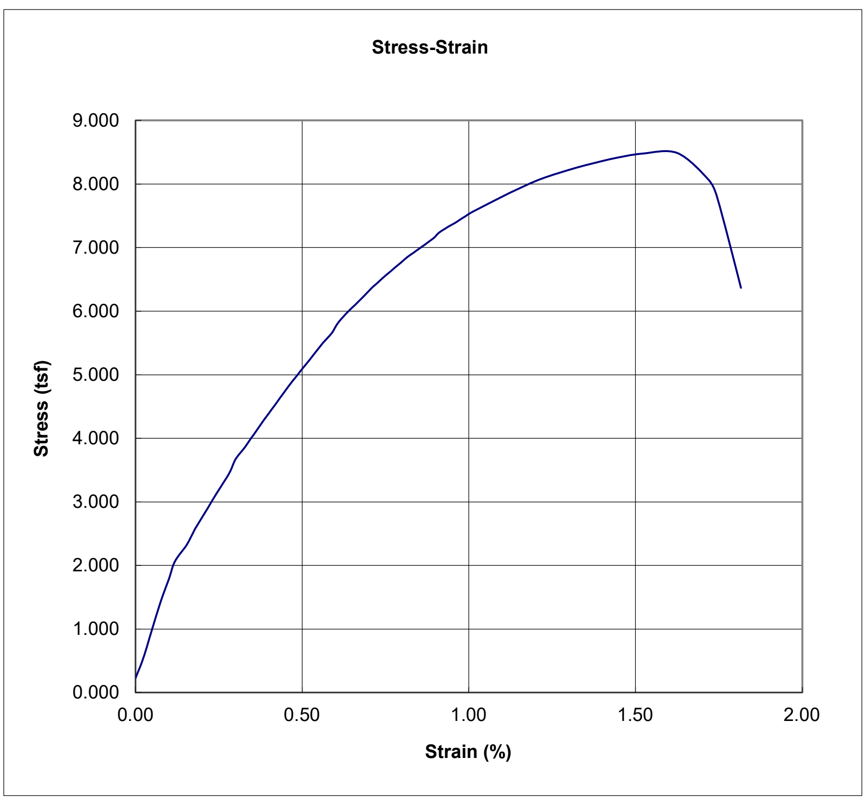
Customer: AECOM
8860 5TH Ave, Suite 600
Portland, Oregon 97204

Project: Escondido FRS 12
Kenedy, TX

Project Number: 2023-136
Date of Test:

Specimen and Testing Details

Borehole		204-23
Depth (ft)		8 - 10
Sample Date		7/20/2023
Soil Type		FAT CLAY (CH)
Specimen Height	inch	5.59
Specimen Diameter	inch	2.87
Moisture Content	%	15.7
Dry Density	pcf	109.89
Confining Pressure	psi	0
Membrane Correction Used?	Y/N	N
Axial Strain	%	1.63
Failure Stress	tsf	8.49



CRUMB TEST RESULTS

Alpine Engineering Services, LLC
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Tel: (512) 387-1287

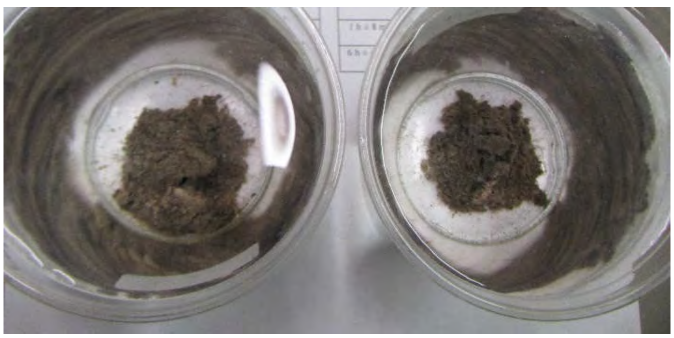
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)

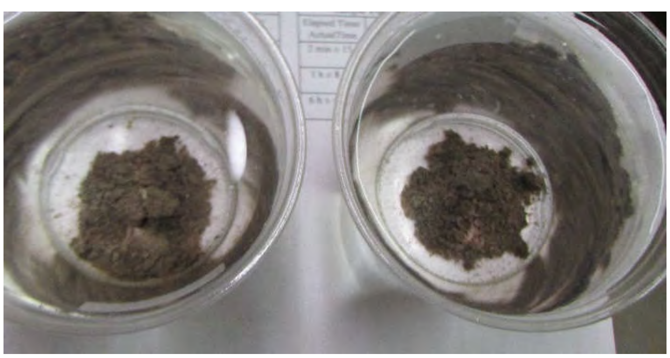
Alpine Project No.: 2307258
Test Date: 08/08/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, P-3 (4-6 ft)	2 minutes	19.1	1	Non-dispersive
	1 hour	19.3	1	Non-dispersive
	6 hours	19.3	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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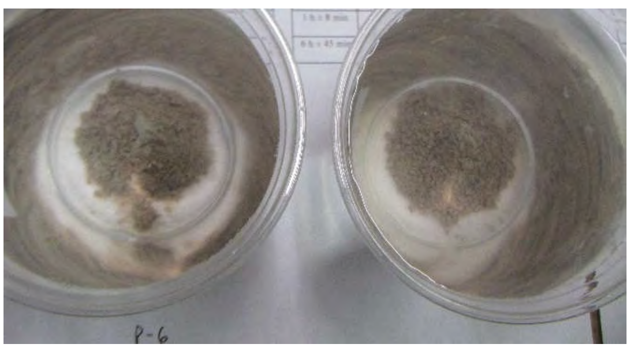
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12
(PN: 2023-136)

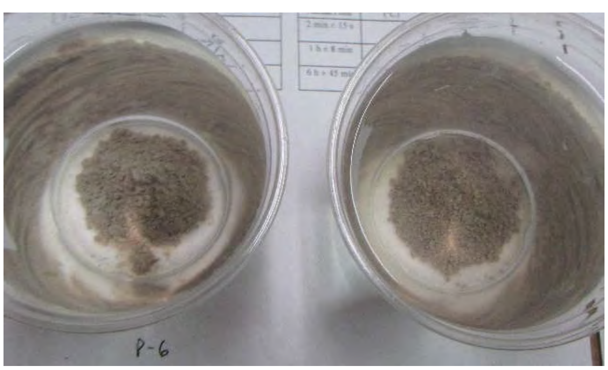
Alpine Project No.: 2307258
Test Date: 08/08/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, P-6 (10-12 ft)	2 minutes	19.2	2	Intermediate
	1 hour	19.3	3	Dispersive
	6 hours	19.3	3	Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

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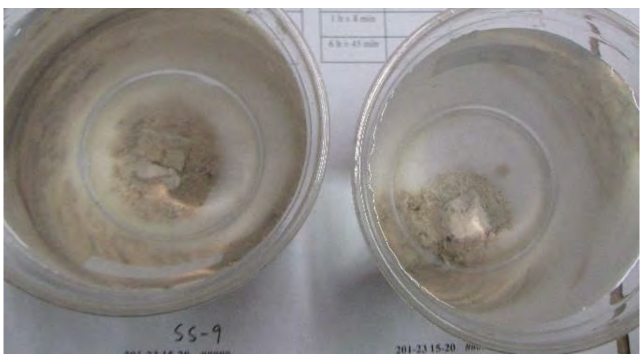
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)

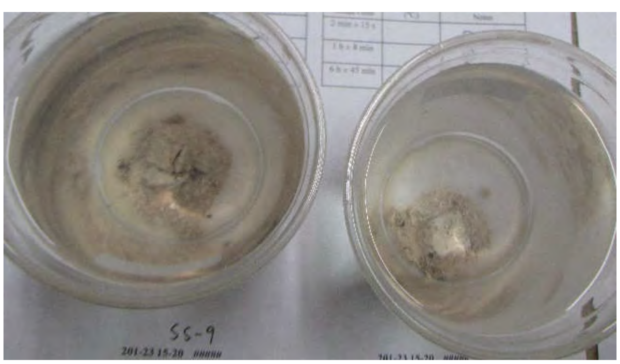
Alpine Project No.: 2307258
Test Date: 08/08/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
201-23, SS-9 (20-21.5 ft)	2 minutes	19.3	2	Intermediate
	1 hour	19.4	2	Intermediate
	6 hours	19..5	3	Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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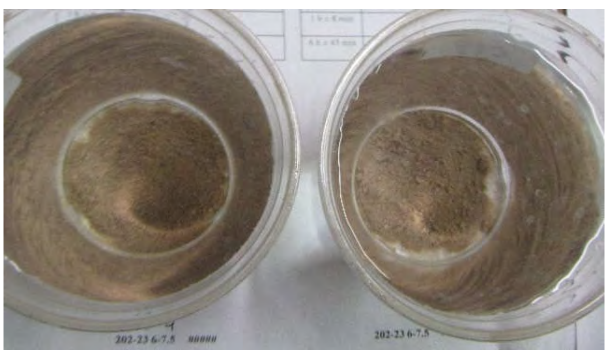
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)

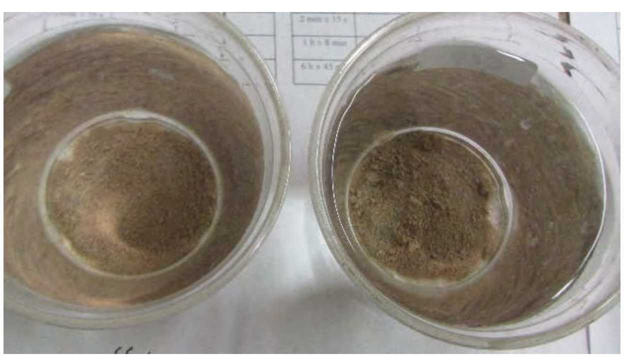
Alpine Project No.: 2307258
Test Date: 08/08/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, SS-4 (6-7.5 ft)	2 minutes	19.3	1	Non-dispersive
	1 hour	19.4	1	Non-dispersive
	6 hours	19.6	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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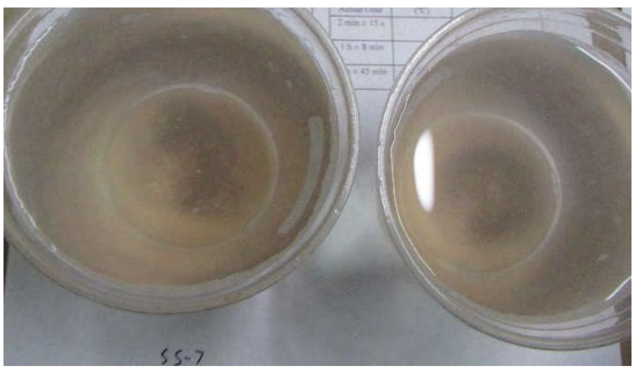
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)

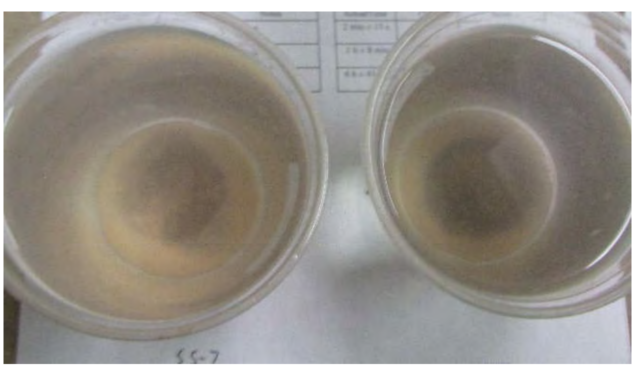
Alpine Project No.: 2307258
Test Date: 08/08/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, SS-7 (12-13.5 ft)	2 minutes	21.3	4	Highly Dispersive
	1 hour	21.5	4	Highly Dispersive
	6 hours	21.9	4	Highly Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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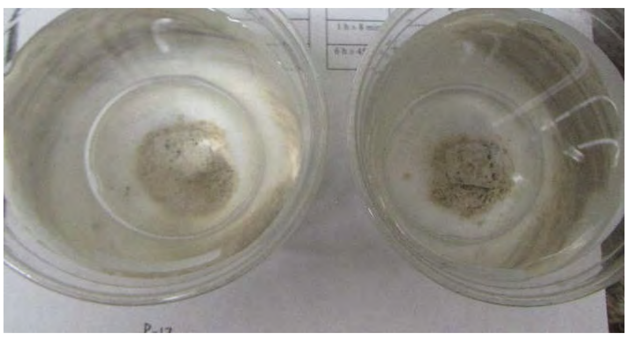
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12
(PN: 2023-136)

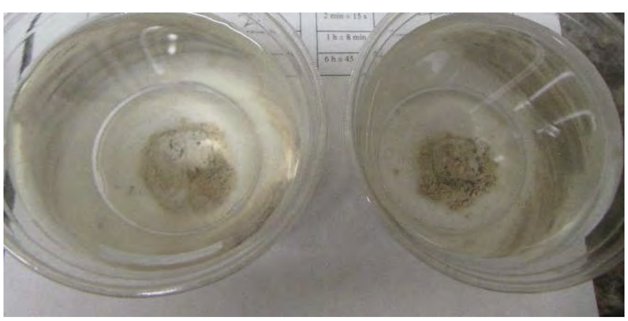
Alpine Project No.: 2307258
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, P-13 (32-33 ft)	2 minutes	21.7	2	Intermediate
	1 hour	22.0	2	Intermediate
	6 hours	22.4	2	Intermediate

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.

Project Name: Escondido FRS No.12 (PN: 2023-136)

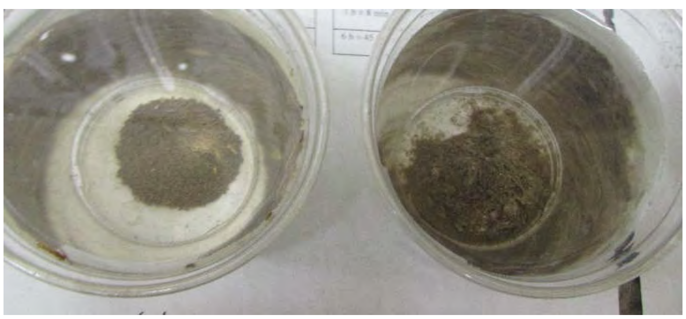
Alpine Project No.: 2307258

Test Date: 08/09/23

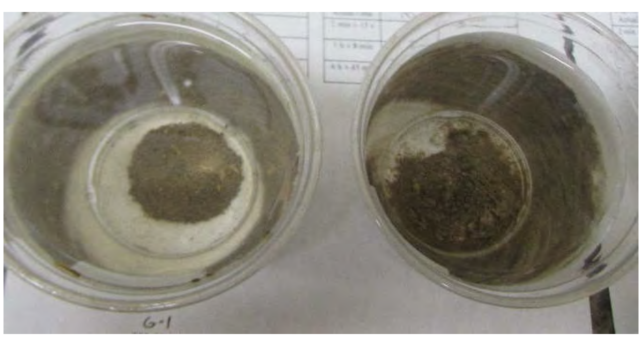
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, G1 (0-3 ft)	2 minutes	21.7	1	Non-dispersive
	1 hour	22.0	1	Non-dispersive
	6 hours	22.4	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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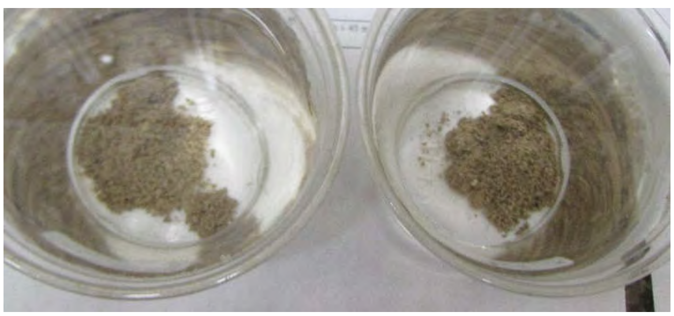
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12
(PN: 2023-136)

Alpine Project No.: 2307258
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
202-23, G2 (3-5 ft)	2 minutes	21.7	1	Non-dispersive
	1 hour	22.0	1	Non-dispersive
	6 hours	22.4	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading

(b) Photo taken at 6 hours reading

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Reviewed By / Date

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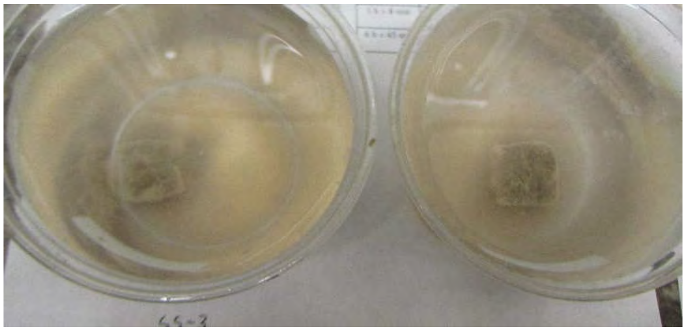
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)

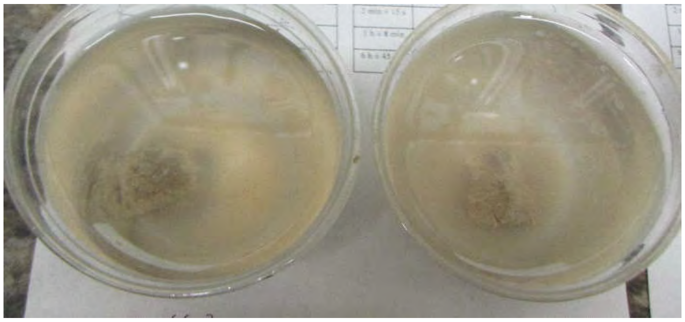
Alpine Project No.: 2307258
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, SS-3 (4-5.5 ft)	2 minutes	21.4	3	Dispersive
	1 hour	22.0	4	Highly Dispersive
	6 hours	22.4	4	Highly Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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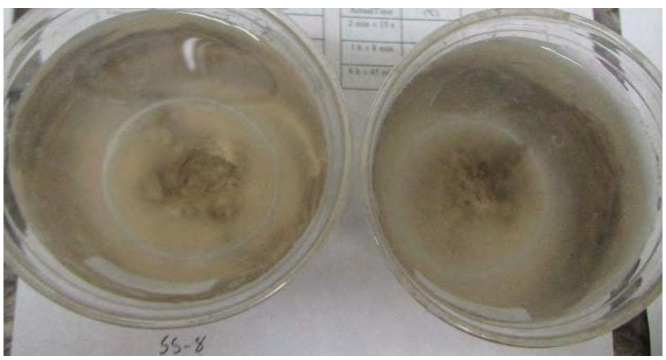
Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)

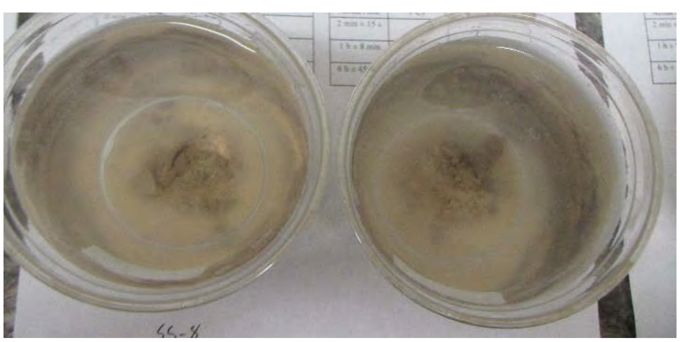
Alpine Project No.: 2307258
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, SS-8 (14-15.5 ft)	2 minutes	21.4	2	Intermediate
	1 hour	22.0	4	Highly Dispersive
	6 hours	22.4	4	Highly Dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

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Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.

Project Name: Escondido FRS No.12 (PN: 2023-136)

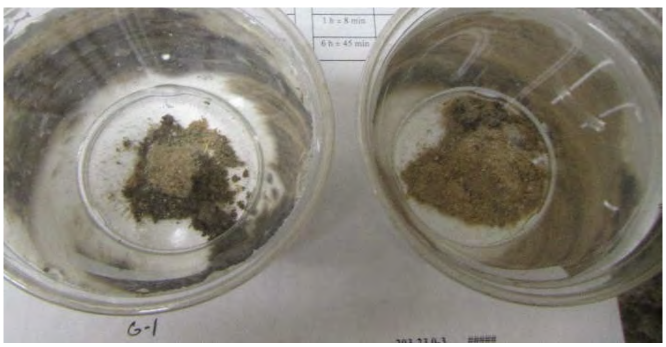
Alpine Project No.: 2307258

Test Date: 08/09/23

Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
203-23, G1 (0-3 ft)	2 minutes	21.5	1	Non-dispersive
	1 hour	21.9	1	Non-dispersive
	6 hours	22.7	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading

(b) Photo taken at 6 hours reading

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Crumb Test for Dispersibility of Clayey Soils (ASTM D6572, Method A)

Client: Arias & Associates, Inc.

Project Name: Escondido FRS No.12 (PN: 2023-136)

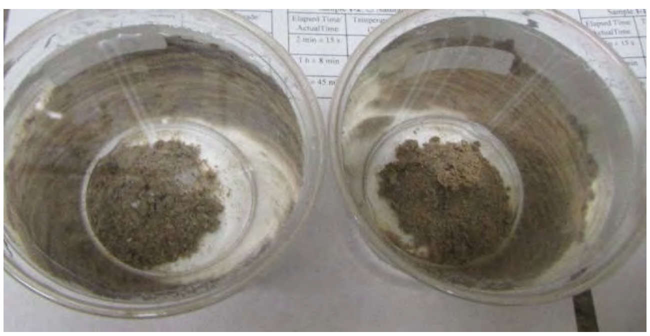
Alpine Project No.: 2307258

Test Date: 08/09/23

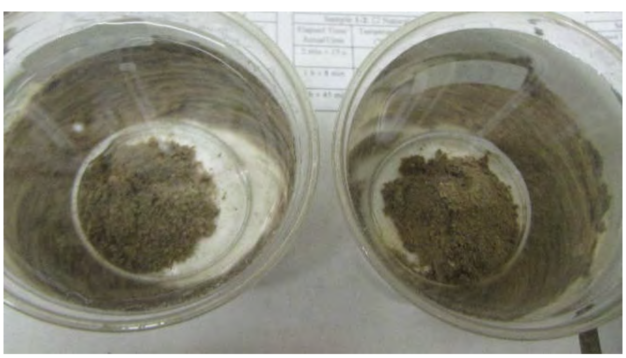
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, P-4 (6-8 ft)	2 minutes	21.5	1	Non-dispersive
	1 hour	21.9	1	Non-dispersive
	6 hours	21.7	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12
(PN: 2023-136)

Alpine Project No.: 2307258
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, SS-6 (10-11.5 ft)	2 minutes	21.5	1	Non-dispersive
	1 hour	21.9	1	Non-dispersive
	6 hours	22.7	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.

(a) Photo taken at 1 hour reading

(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

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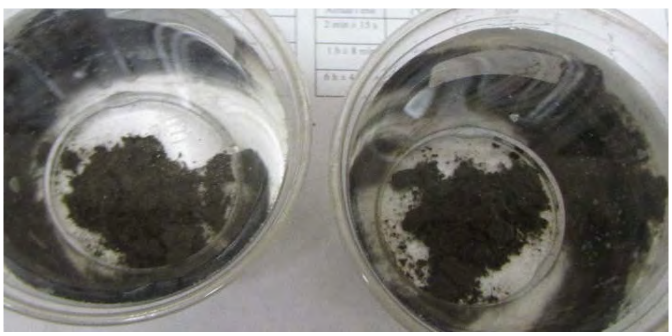
Crumb Test for Dispersibility of Clayey Soils
(ASTM D6572, Method A)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12
(PN: 2023-136)

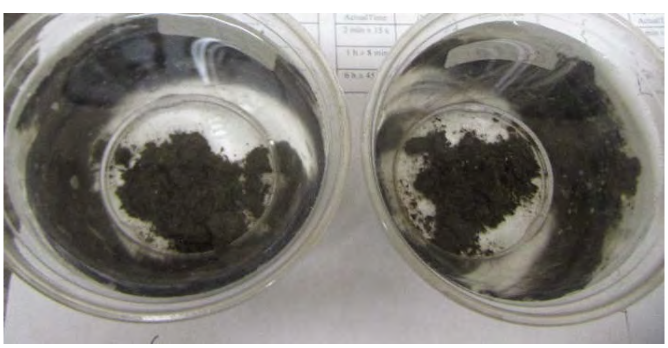
Alpine Project No.: 2307258
Test Date: 08/09/23
Tested By: C.M.

Borehole/ Sample ID	Elapsed Time	Temp. °C	Grade	Dispersive Classification
204-23, G1 (0-3 ft)	2 minutes	21.5	1	Non-dispersive
	1 hour	21.9	1	Non-dispersive
	6 hours	22.3	1	Non-dispersive

*Natural soil crumbs (Method A) tested at as-received water content in distilled water.



(a) Photo taken at 1 hour reading



(b) Photo taken at 6 hours reading

Cheng-Wei Chen, Ph.D. 08/12/23

Reviewed By / Date

PINHOLE TEST RESUTLS

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, SS-7 (12-13.5 ft)

Alpine Project No.: 2307258
Test Date: 11/01/23
Tested By: C.M.
Type of Pinhole Test: Method A

Note 1: Specimen remolded to 105.0 pcf dry density at 19.0 % water content.

Water Content of Specimen: 19.2%
Specimen Dry Unit Weight: 105.2 pcf
Distilled Water Used: ☒ Yes ☐ No

Head (in)	Flow		Flow Rate (*ml/sec*)	Turbidity from Visual						Completely Clear Top Down	Comments
	ml.	*sec.*		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		
2	58	180	0.3						√		Minimal flow at 2 in. head
2	56	180	0.3						√		
7	35	60	0.6						√		Minimal flow at 7 in. head
7	36	60	0.6						√	√	
7	36	60	0.6						√	√	
15	58	60	1.0						√	√	Minimal flow at 15 in. head
15	58	60	1.0						√	√	
15	59	60	1.0						√	√	
40	56	30	1.9						√	√	
40	56	30	1.9						√	√	

Note 2: Hole size after test ≤ 1.0 mm

Classification:	ND1, Nondispersive Clay

Cheng-Wei Chen, Ph.D. 11/02/23

Reviewed By / Date

Alpine Engineering Services, LLC
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Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 203-23, SS-3 (4-5.5 ft)

Alpine Project No.: 2307258
Test Date: 10/31/23
Tested By: C.M.
Type of Pinhole Test: Method A

Note 1: Specimen remolded to 110.0 pcf dry density at 9.0 % water content.

Water Content of Specimen: 8.8%
Specimen Dry Unit Weight: 110.5 pcf
Distilled Water Used: ☒ Yes ☐ No

Head (in)	Flow		Flow Rate (*ml/sec*)	Turbidity from Visual						Completely Clear Top Down	Comments
	ml.	*sec.*		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		
2	18	300	0.1						√		Minimal flow at 2 in. head
2	18	300	0.1						√		
7	39	120	0.3						√	√	Minimal flow at 7 in. head
7	38	120	0.3						√	√	
7	39	120	0.3						√	√	
15	58	120	0.5						√	√	Minimal flow at 15 in. head
15	58	120	0.5						√	√	
15	59	120	0.5						√	√	
40	78	60	1.3						√	√	
40	79	60	1.3						√	√	

Note 2: Hole size after test ≤ 1.0 mm

Classification:	ND1, Nondispersive Clay

Cheng-Wei Chen, Ph.D. 11/02/23
Reviewed By / Date

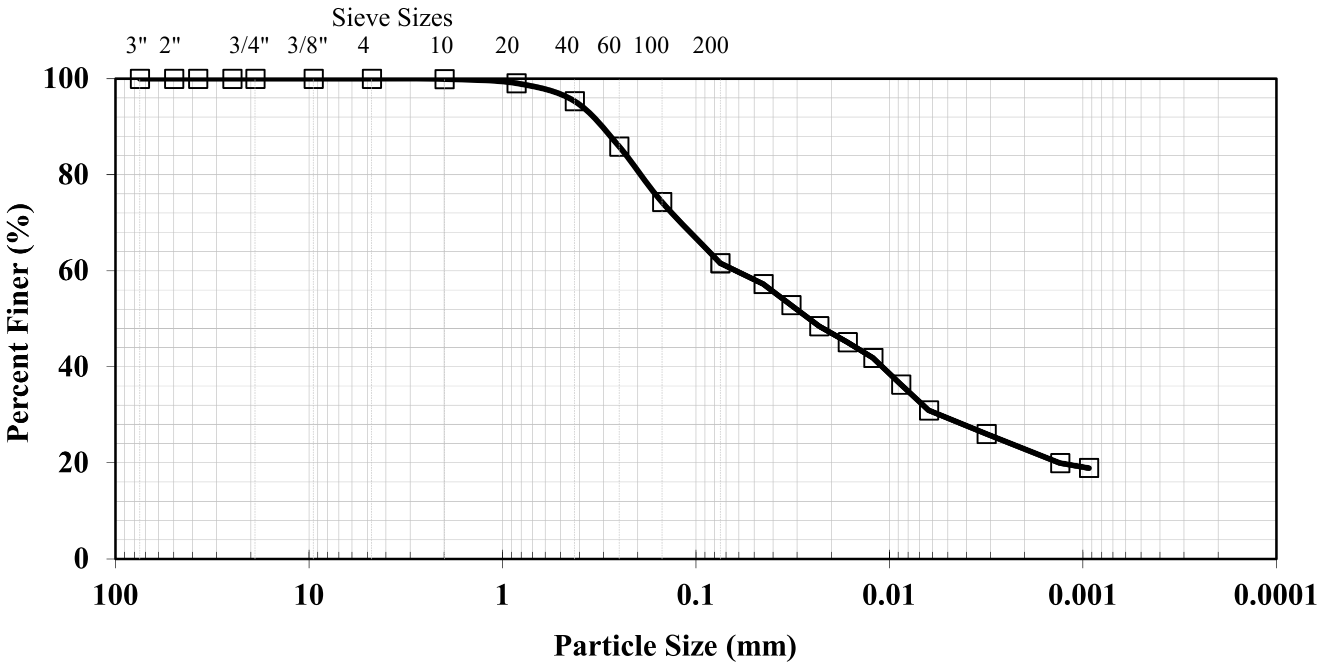
HYDROMETER TEST RESULTS

Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 201-23, P-3 (4-6 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 μm)	99.1
No. 40 (425 μm)	95.3
No. 60 (250 μm)	85.9
No. 100 (150 μm)	74.3
No. 200 (75 μm)	61.6

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0450 mm	57.2
0.0322 mm	52.8
0.0231 mm	48.4
0.0165 mm	45.1
0.0122 mm	41.8
0.0087 mm	36.3
0.0063 mm	30.9
0.0032 mm	26.0
0.0013 mm	19.9
0.0009 mm	18.9

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m, 2\,\mu m, d}$ (%) = 22.2

D60 (mm)	0.064
D30 (mm)	0.006
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Alpine Engineering Services, LLC
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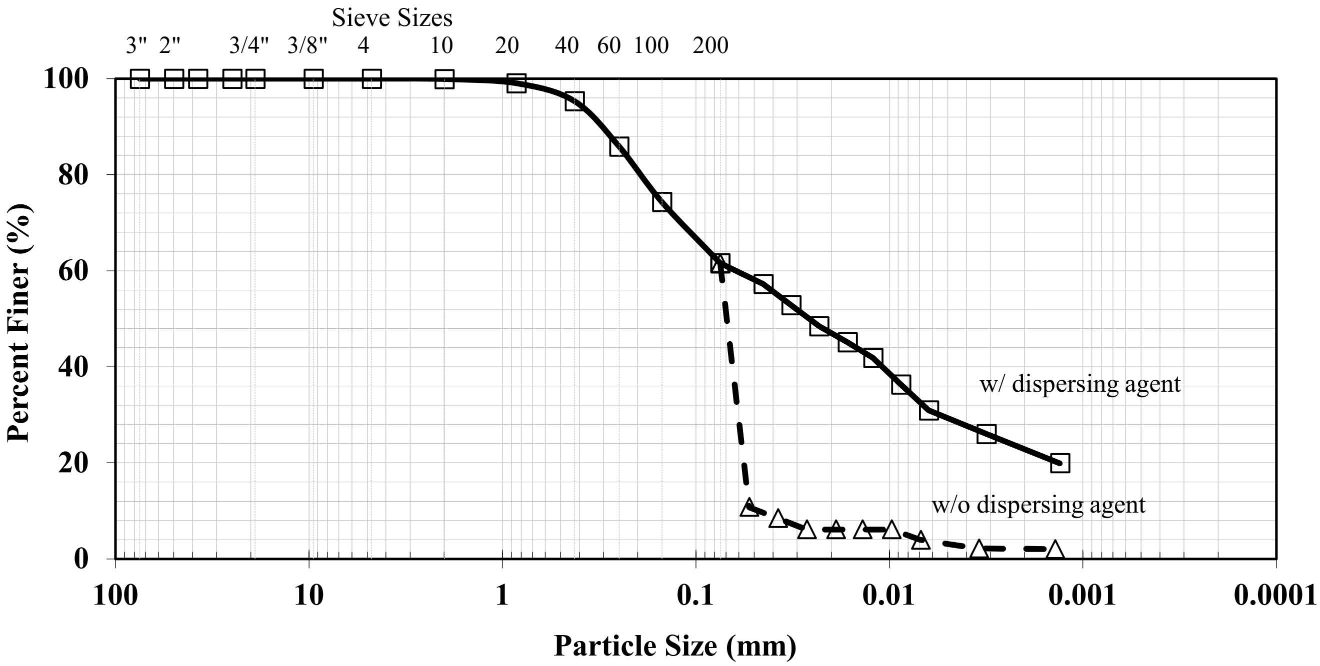
Tel: (512) 387-1287

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 201-23, P-3 (4-6 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 µm)	99.1
No. 40 (425 µm)	95.3
No. 60 (250 µm)	85.9
No. 100 (150 µm)	74.3
No. 200 (75 µm)	61.6

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0532 mm	10.8
0.0377 mm	8.5
0.0267 mm	6.1
0.0189 mm	6.1
0.0138 mm	6.1
0.0098 mm	6.1
0.0069 mm	4.0
0.0034 mm	2.2
0.0014 mm	2.1

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 2.1

% Dispersion = 9.4

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

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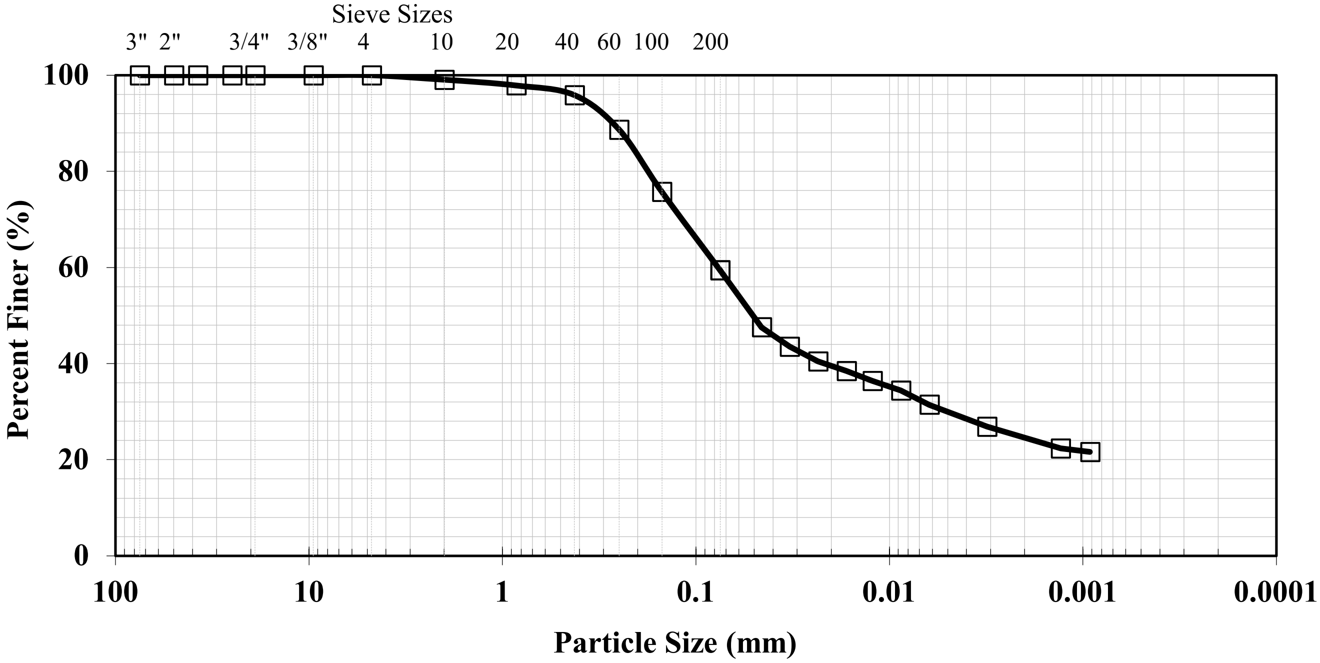
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 201-23, P-6 (10-12 ft)

Alpine Project No.: 2307258
Test Date: 08/03/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.1
No. 20 (850 µm)	97.9
No. 40 (425 µm)	95.9
No. 60 (250 µm)	88.7
No. 100 (150 µm)	75.7
No. 200 (75 µm)	59.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0458 mm	47.5
0.0328 mm	43.5
0.0234 mm	40.5
0.0167 mm	38.4
0.0123 mm	36.4
0.0087 mm	34.4
0.0062 mm	31.4
0.0031 mm	26.9
0.0013 mm	22.3
0.0009 mm	21.6

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m, 2\mu m, d}$ (%) = 24.1

D60 (mm)	0.078
D30 (mm)	0.005
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/14/23
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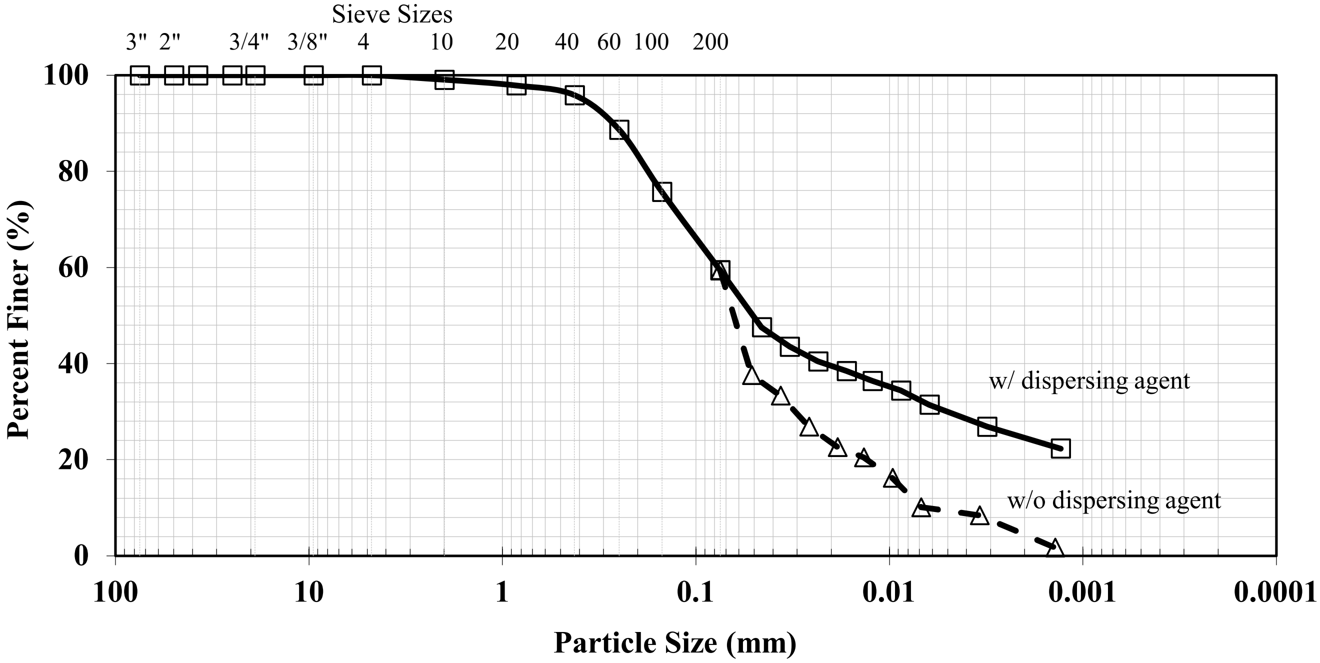
Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 201-23, P-6 (10-12 ft)

Alpine Project No.: 2307258
Test Date: 08/03/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.1
No. 20 (850 µm)	97.9
No. 40 (425 µm)	95.9
No. 60 (250 µm)	88.7
No. 100 (150 µm)	75.7
No. 200 (75 µm)	59.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0515 mm	37.6
0.0366 mm	33.3
0.0261 mm	26.9
0.0185 mm	22.6
0.0136 mm	20.5
0.0096 mm	16.2
0.0069 mm	10.1
0.0034 mm	8.4
0.0014 mm	1.7

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 3.7

% Dispersion = 15.5

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/14/23
Reviewed By / Date

Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Alpine Engineering Services, LLC
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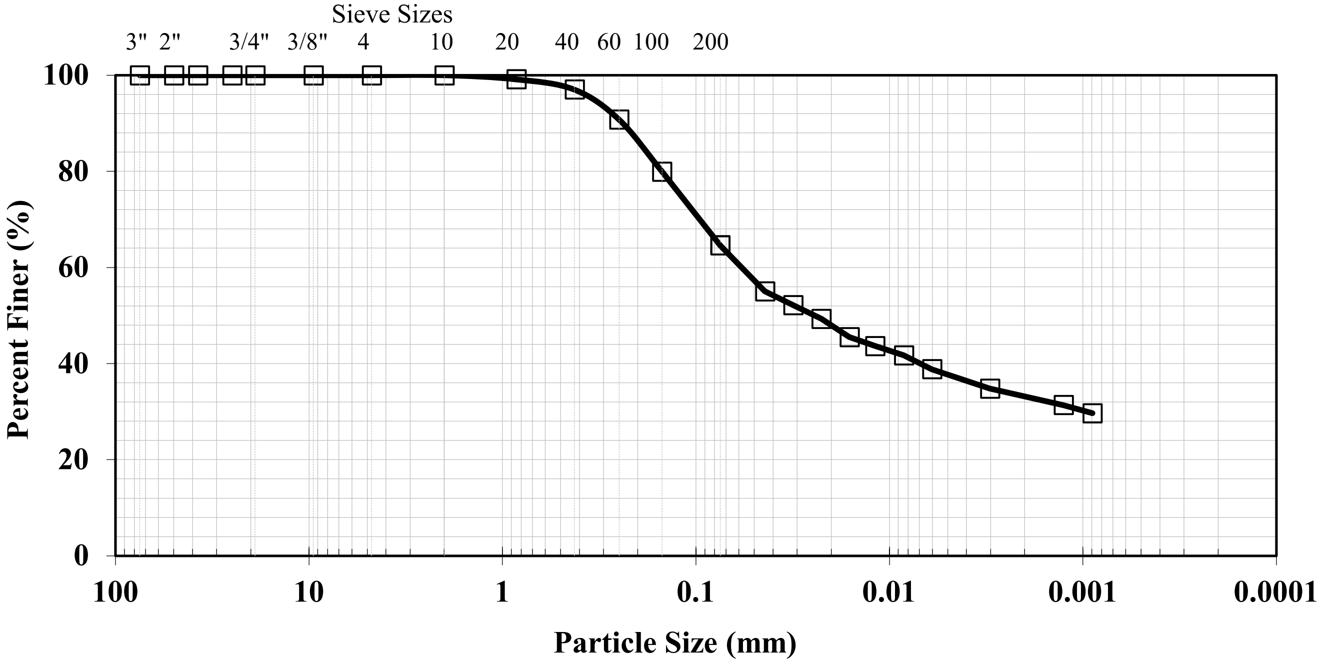
Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 201-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 µm)	99.2
No. 40 (425 µm)	97.0
No. 60 (250 µm)	90.8
No. 100 (150 µm)	80.0
No. 200 (75 µm)	64.6

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0440 mm	55.0
0.0315 mm	52.2
0.0225 mm	49.3
0.0161 mm	45.5
0.0119 mm	43.6
0.0084 mm	41.7
0.0060 mm	38.8
0.0030 mm	34.8
0.0013 mm	31.4
0.0009 mm	29.7

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 32.8

D60 (mm)	0.060
D30 (mm)	0.001
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Alpine Engineering Services, LLC
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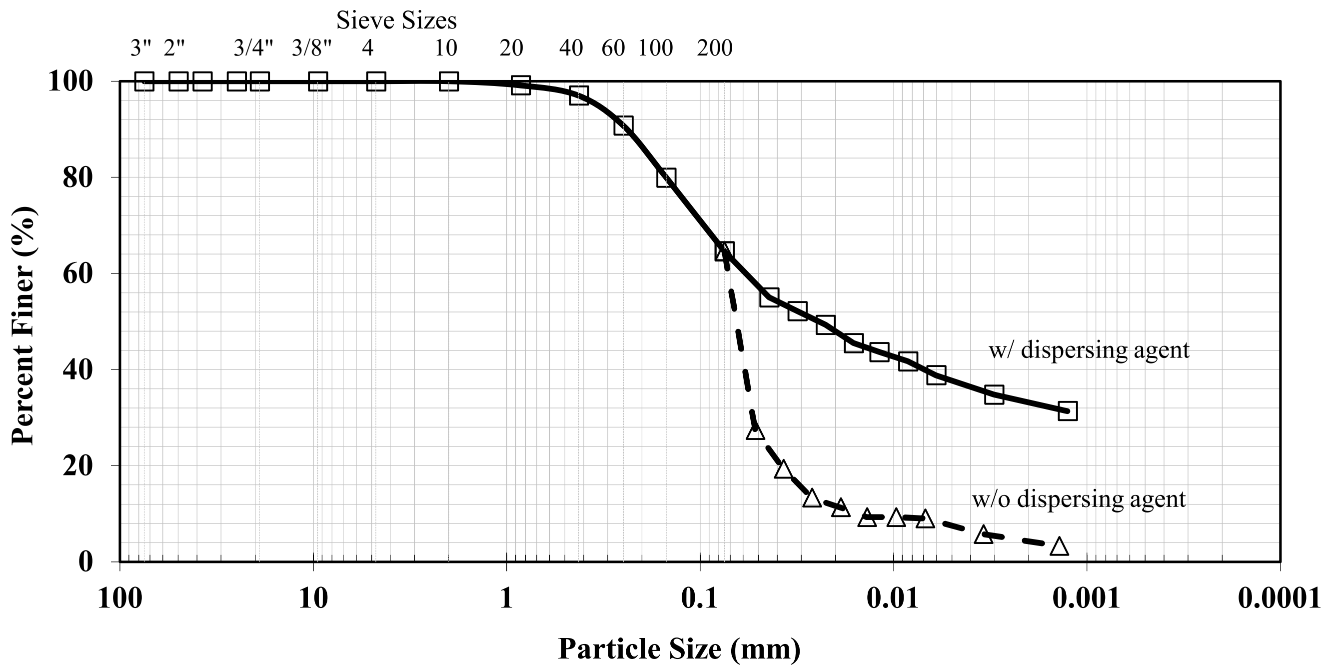
Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 201-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 µm)	99.2
No. 40 (425 µm)	97.0
No. 60 (250 µm)	90.8
No. 100 (150 µm)	80.0
No. 200 (75 µm)	64.6

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0520 mm	27.4
0.0371 mm	19.4
0.0264 mm	13.3
0.0187 mm	11.3
0.0137 mm	9.3
0.0097 mm	9.3
0.0069 mm	9.0
0.0034 mm	5.8
0.0014 mm	3.3

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 4.0

% Dispersion = 12.3

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/15/23
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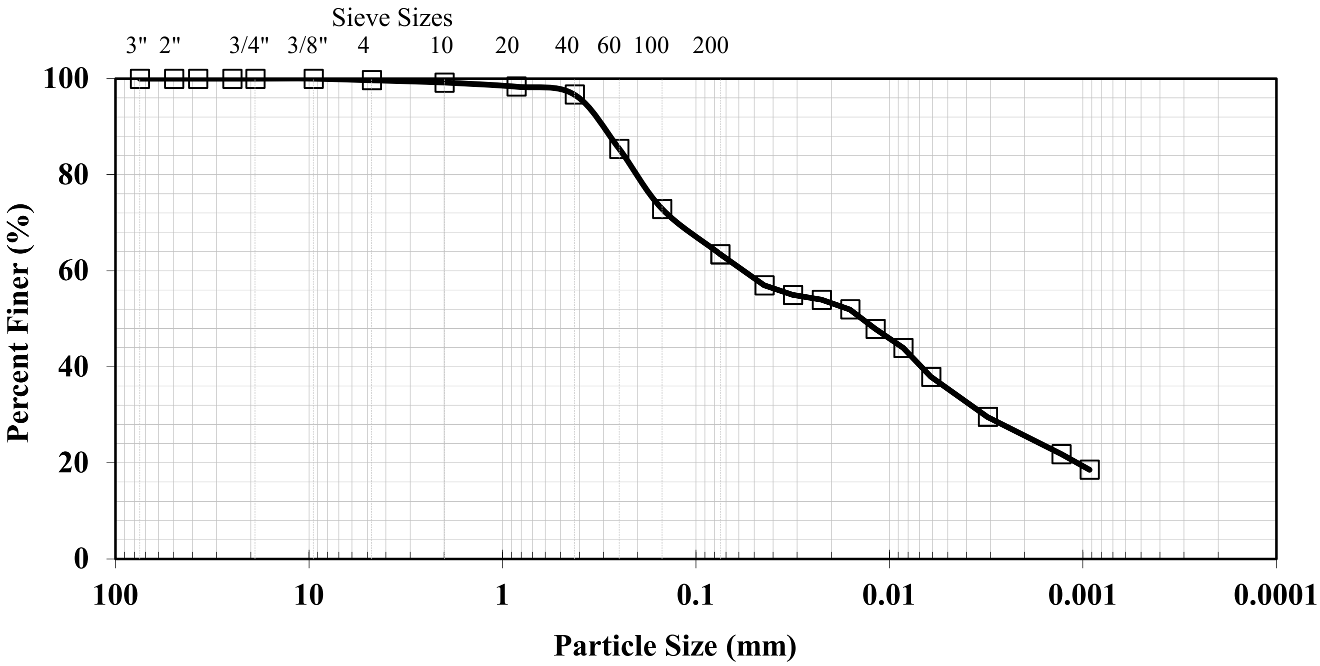
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, SS-7 (12-13.5 ft)

Alpine Project No.: 2307258
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.7
No. 10 (2.0 mm)	99.2
No. 20 (850 µm)	98.4
No. 40 (425 µm)	96.7
No. 60 (250 µm)	85.4
No. 100 (150 µm)	72.9
No. 200 (75 µm)	63.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0444 mm	57.0
0.0316 mm	55.0
0.0225 mm	54.0
0.0160 mm	51.9
0.0118 mm	47.9
0.0085 mm	43.9
0.0061 mm	38.0
0.0031 mm	29.6
0.0013 mm	21.8
0.0009 mm	18.6

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 24.8

D60 (mm)	0.059
D30 (mm)	0.003
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

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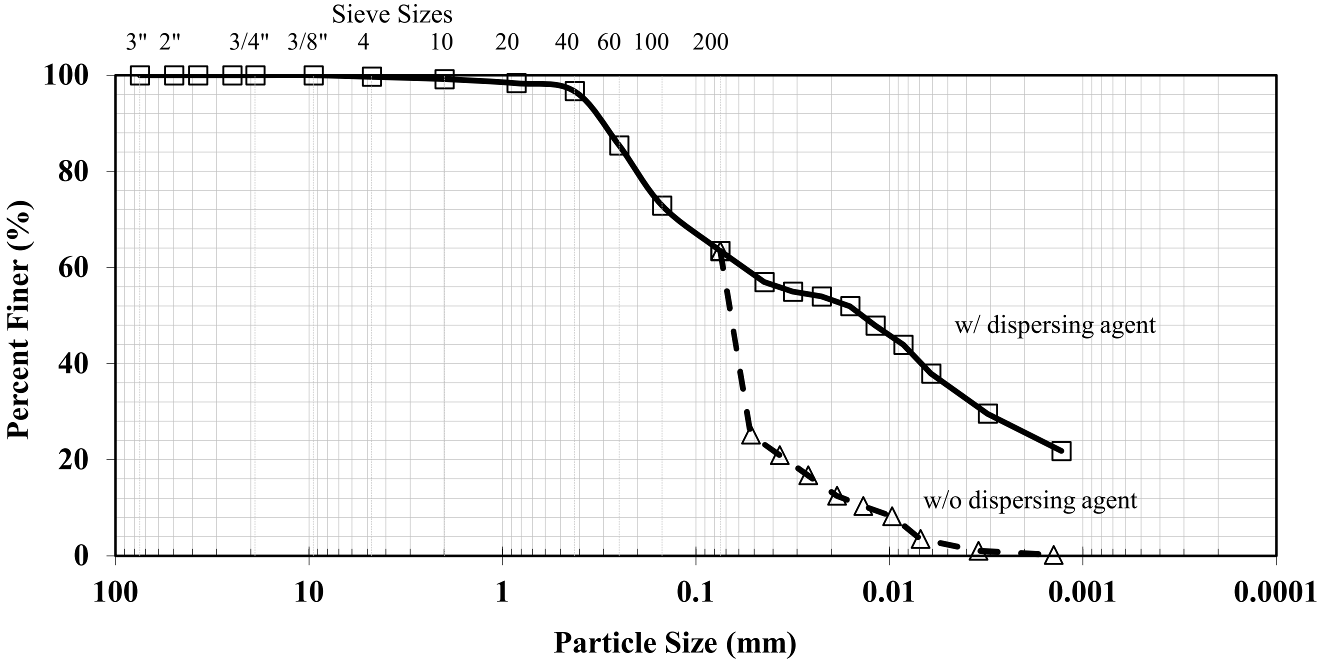
Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, SS-7 (12-13.5 ft)

Alpine Project No.: 2307258
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.7
No. 10 (2.0 mm)	99.2
No. 20 (850 µm)	98.4
No. 40 (425 µm)	96.7
No. 60 (250 µm)	85.4
No. 100 (150 µm)	72.9
No. 200 (75 µm)	63.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0521 mm	25.2
0.0370 mm	21.0
0.0263 mm	16.7
0.0187 mm	12.5
0.0137 mm	10.3
0.0097 mm	8.2
0.0069 mm	3.5
0.0035 mm	1.0
0.0014 mm	0.2

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 0.4

% Dispersion = 1.8

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

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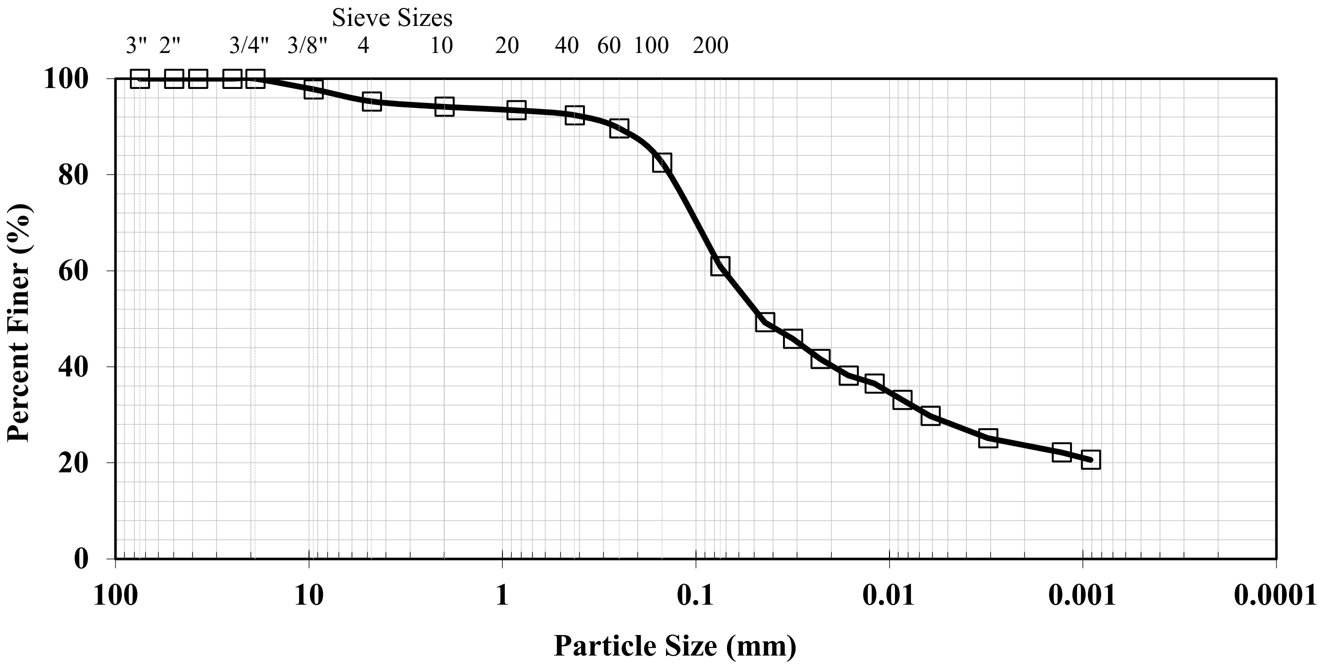
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	97.8
No. 4 (4.75 mm)	95.3
No. 10 (2.0 mm)	94.2
No. 20 (850 µm)	93.4
No. 40 (425 µm)	92.4
No. 60 (250 µm)	89.7
No. 100 (150 µm)	82.6
No. 200 (75 µm)	60.9

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0441 mm	49.3
0.0316 mm	45.9
0.0228 mm	41.6
0.0163 mm	38.2
0.0120 mm	36.5
0.0086 mm	33.1
0.0061 mm	29.8
0.0031 mm	25.2
0.0013 mm	22.2
0.0009 mm	20.7

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m, 2 \mu m, d}$ (%) = 23.4

D60 (mm)	0.072
D30 (mm)	0.006
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

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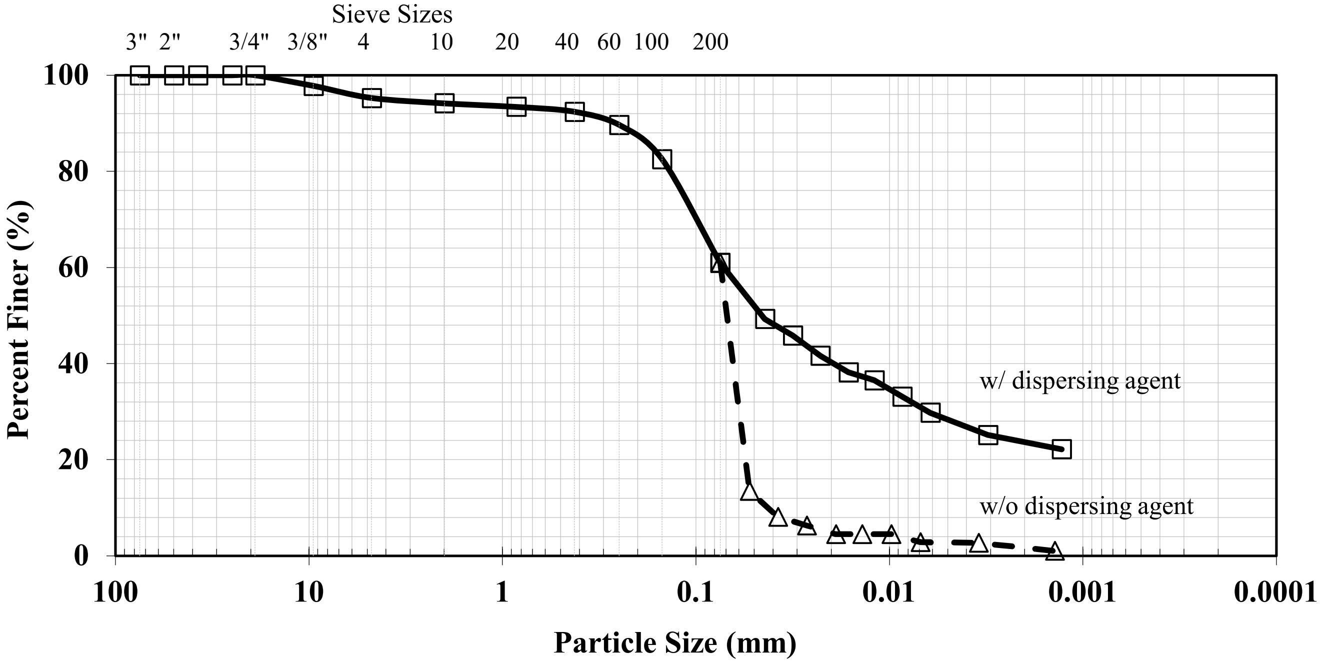
Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	97.8
No. 4 (4.75 mm)	95.3
No. 10 (2.0 mm)	94.2
No. 20 (850 µm)	93.4
No. 40 (425 µm)	92.4
No. 60 (250 µm)	89.7
No. 100 (150 µm)	82.6
No. 200 (75 µm)	60.9

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0529 mm	13.5
0.0377 mm	8.1
0.0267 mm	6.3
0.0189 mm	4.5
0.0138 mm	4.5
0.0098 mm	4.5
0.0069 mm	2.8
0.0035 mm	2.7
0.0014 mm	1.0

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 1.5

% Dispersion = 6.4

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

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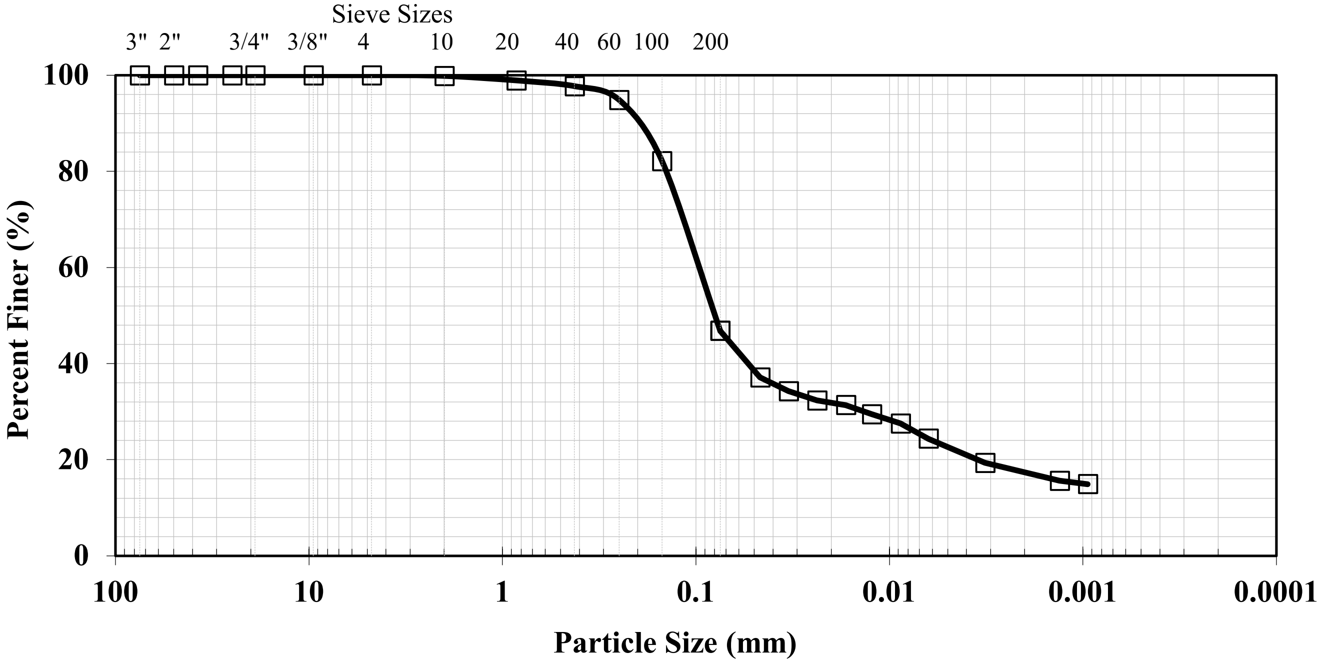
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, G2 (3-5 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 µm)	98.9
No. 40 (425 µm)	97.7
No. 60 (250 µm)	94.8
No. 100 (150 µm)	82.1
No. 200 (75 µm)	46.8

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0466 mm	37.1
0.0333 mm	34.2
0.0237 mm	32.3
0.0168 mm	31.4
0.0123 mm	29.5
0.0088 mm	27.5
0.0063 mm	24.4
0.0032 mm	19.4
0.0013 mm	15.6
0.0009 mm	14.9

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 17.0

D60 (mm)	0.103
D30 (mm)	0.014
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

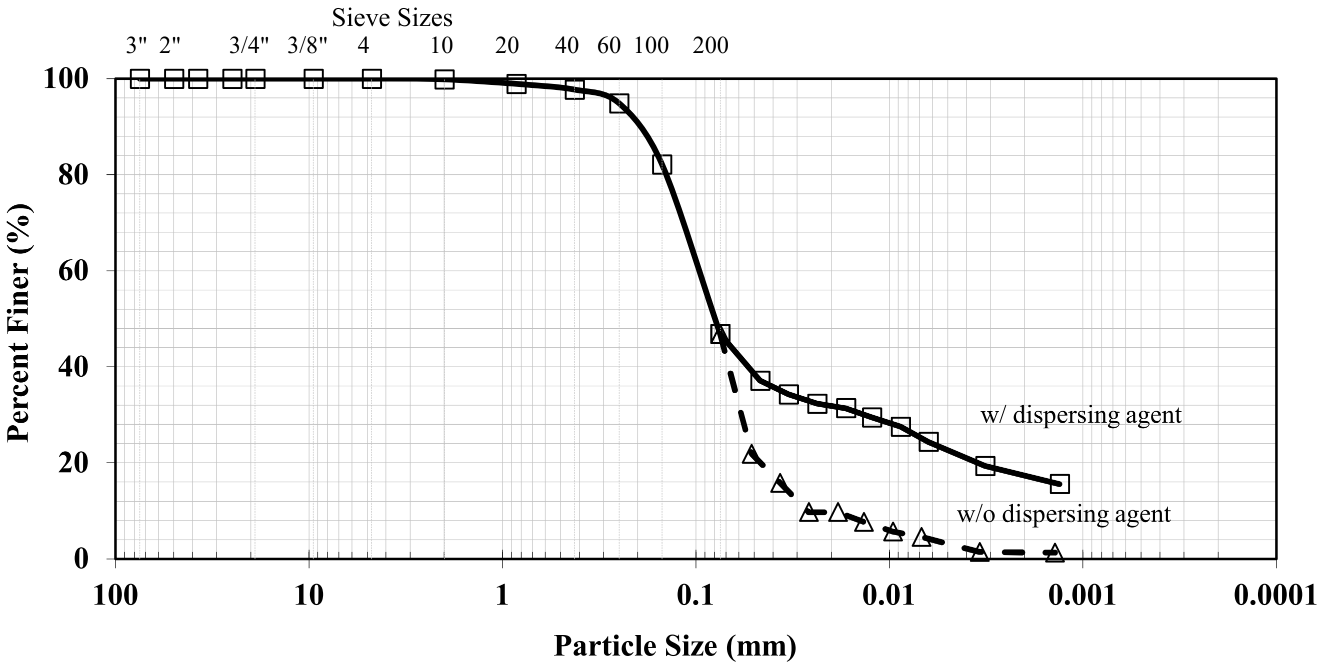
Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 202-23, G2 (3-5 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 µm)	98.9
No. 40 (425 µm)	97.7
No. 60 (250 µm)	94.8
No. 100 (150 µm)	82.1
No. 200 (75 µm)	46.8

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0516 mm	21.9
0.0368 mm	15.8
0.0262 mm	9.7
0.0185 mm	9.7
0.0136 mm	7.7
0.0096 mm	5.7
0.0068 mm	4.6
0.0034 mm	1.5
0.0014 mm	1.3

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 1.4

% Dispersion = 8.0

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

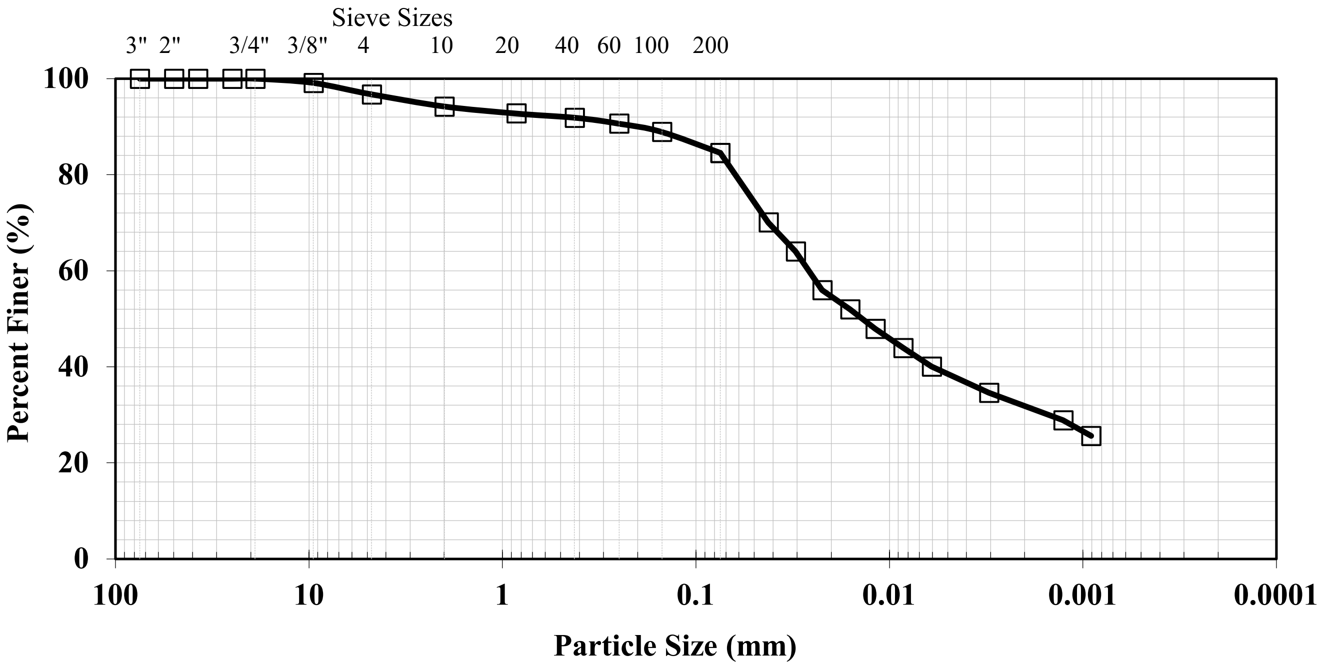
Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 203-23, SS-8 (14-15.5 ft)

Alpine Project No.: 2307258
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	99.1
No. 4 (4.75 mm)	96.7
No. 10 (2.0 mm)	94.2
No. 20 (850 µm)	92.8
No. 40 (425 µm)	91.9
No. 60 (250 µm)	90.6
No. 100 (150 µm)	88.9
No. 200 (75 µm)	84.5

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0423 mm	70.0
0.0306 mm	64.0
0.0223 mm	56.0
0.0160 mm	52.0
0.0118 mm	47.9
0.0085 mm	43.9
0.0061 mm	40.0
0.0031 mm	34.6
0.0013 mm	28.9
0.0009 mm	25.6

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m, 2\mu m, d}$ (%) = 31.2

D60 (mm)	0.026
D30 (mm)	0.002
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

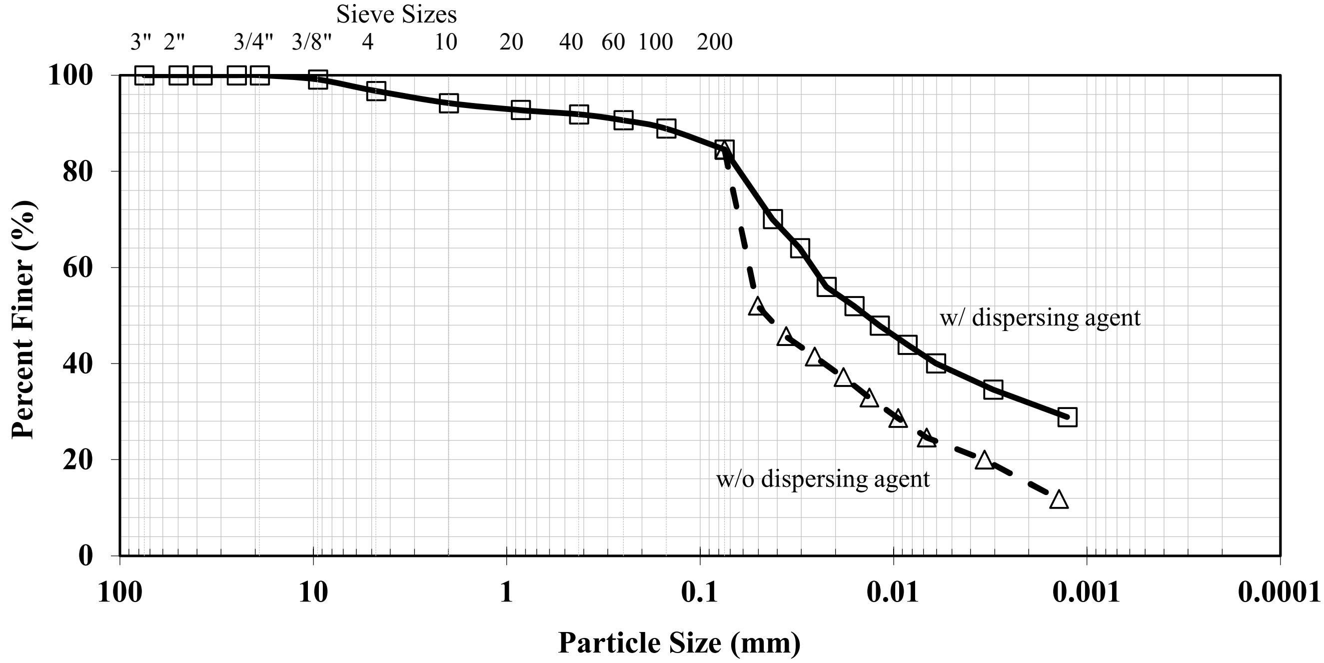
Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 203-23, SS-8 (14-15.5 ft)

Alpine Project No.: 2307258
Test Date: 10/16/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	99.1
No. 4 (4.75 mm)	96.7
No. 10 (2.0 mm)	94.2
No. 20 (850 µm)	92.8
No. 40 (425 µm)	91.9
No. 60 (250 µm)	90.6
No. 100 (150 µm)	88.9
No. 200 (75 µm)	84.5

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0506 mm	52.1
0.0361 mm	45.7
0.0256 mm	41.4
0.0182 mm	37.2
0.0134 mm	32.9
0.0095 mm	28.7
0.0068 mm	24.6
0.0034 mm	20.0
0.0014 mm	11.8

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 14.3

% Dispersion = 45.8

Note 2: The % dispersion is between 30 to 50 % - The soil is probably intermediate dispersiveness.

Cheng-Wei Chen, Ph.D. 10/23/23
Reviewed By / Date

Alpine Engineering Services, LLC
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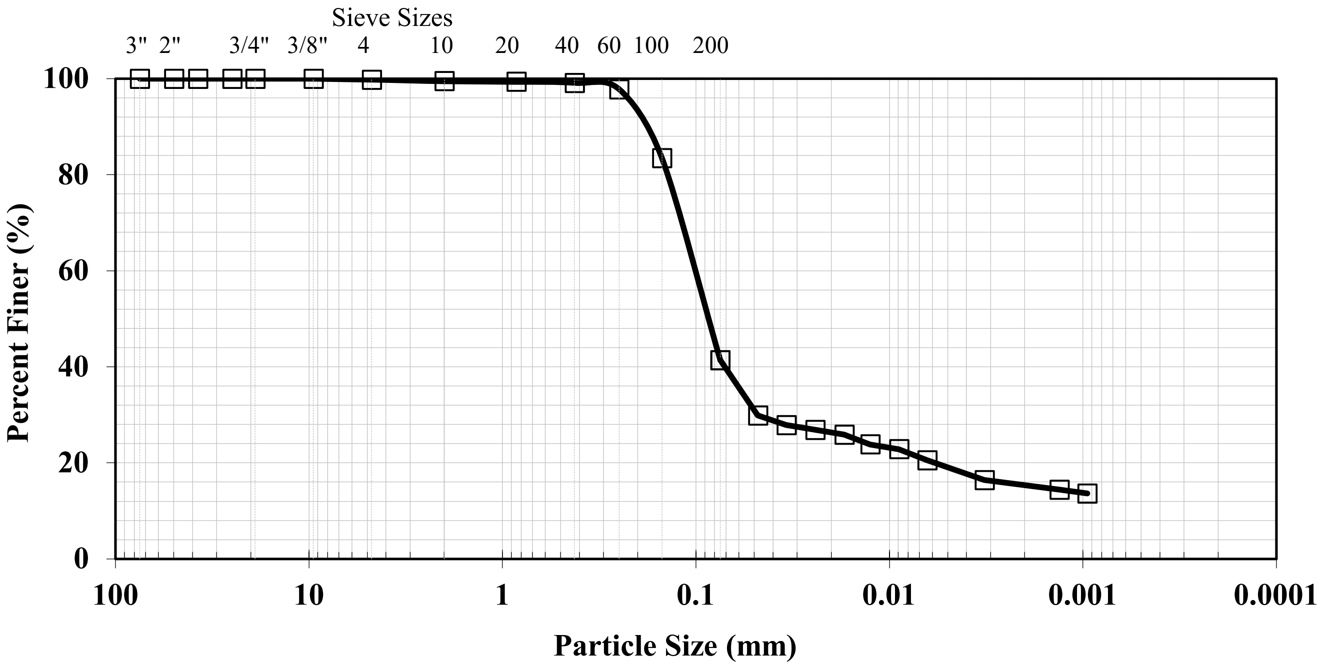
Particle-Size Distribution & Hydrometer Analysis for Soils (ASTM D6913 & D7928)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 203-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.8
No. 10 (2.0 mm)	99.5
No. 20 (850 μm)	99.4
No. 40 (425 μm)	99.1
No. 60 (250 μm)	97.8
No. 100 (150 μm)	83.4
No. 200 (75 μm)	41.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0479 mm	29.9
0.0341 mm	27.9
0.0242 mm	26.9
0.0172 mm	25.9
0.0126 mm	23.9
0.0089 mm	22.8
0.0064 mm	20.5
0.0032 mm	16.4
0.0013 mm	14.4
0.0010 mm	13.6

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m, 2 \mu m, d}$ (%) = 15.1

D60 (mm)	0.108
D30 (mm)	0.048
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

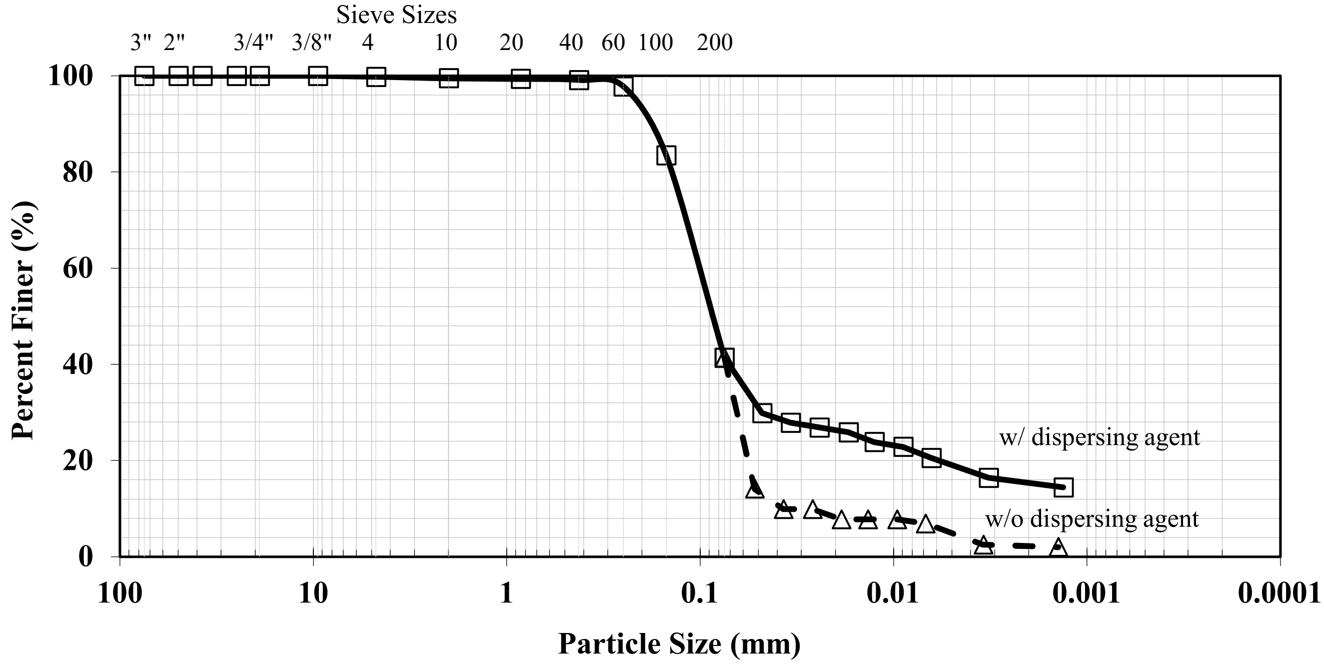
Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 203-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.8
No. 10 (2.0 mm)	99.5
No. 20 (850 µm)	99.4
No. 40 (425 µm)	99.1
No. 60 (250 µm)	97.8
No. 100 (150 µm)	83.4
No. 200 (75 µm)	41.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0522 mm	14.1
0.0371 mm	9.9
0.0262 mm	9.9
0.0186 mm	7.7
0.0136 mm	7.7
0.0096 mm	7.7
0.0068 mm	6.9
0.0034 mm	2.5
0.0014 mm	2.0

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 2.1

% Dispersion = 14.2

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Particle-Size Distribution
& Hydrometer Analysis for Soils
(ASTM D6913 & D7928)

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
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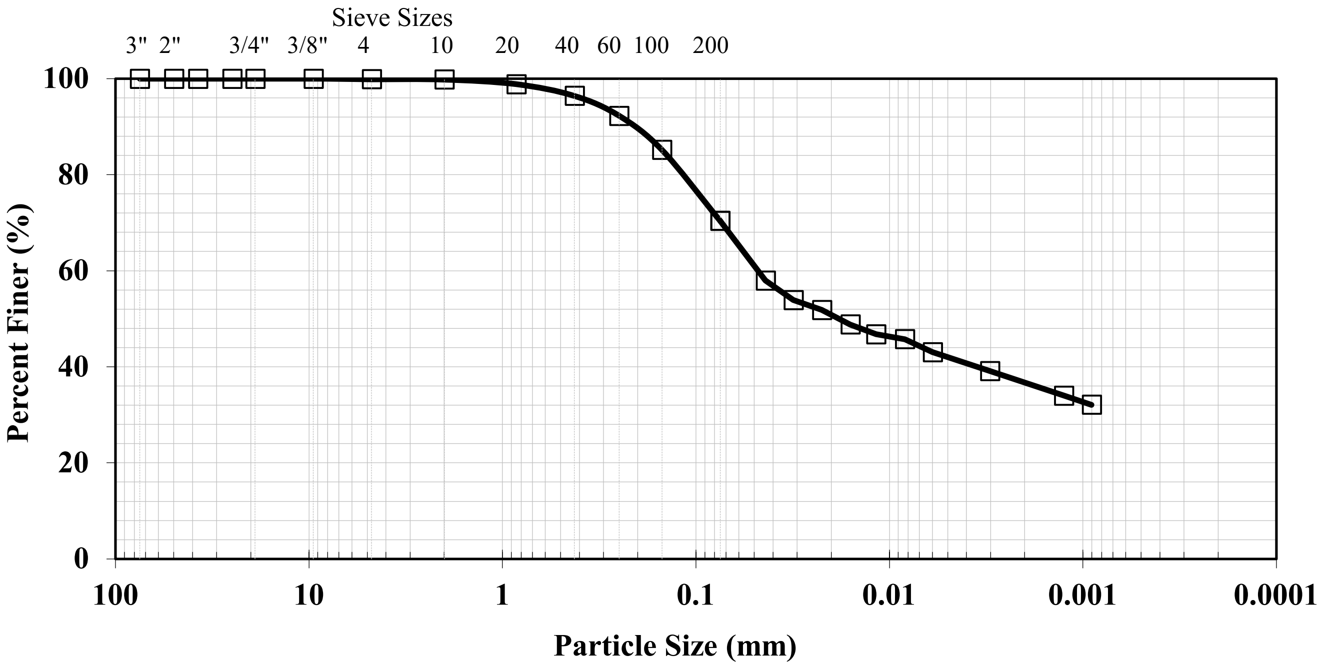
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 204-23, P-4 (6-8 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.9
No. 10 (2.0 mm)	99.8
No. 20 (850 µm)	98.8
No. 40 (425 µm)	96.4
No. 60 (250 µm)	92.3
No. 100 (150 µm)	85.2
No. 200 (75 µm)	70.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0437 mm	58.0
0.0314 mm	53.9
0.0223 mm	51.9
0.0160 mm	48.8
0.0117 mm	46.8
0.0083 mm	45.8
0.0060 mm	43.0
0.0030 mm	39.1
0.0013 mm	34.0
0.0009 mm	32.1

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 36.1

D60 (mm)	0.049
D30 (mm)	- -
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Particle-Size Distribution
& Double Hydrometer Analysis for Soils
(ASTM D6913 & D4221)

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
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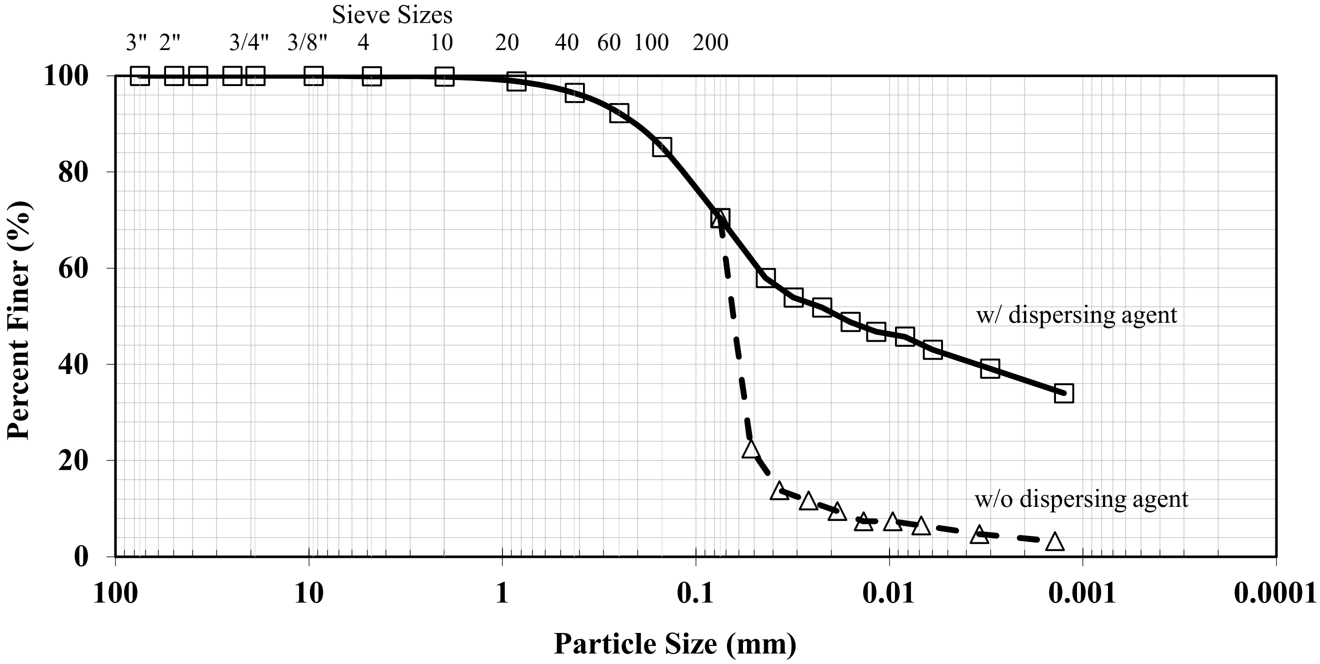
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 204-23, P-4 (6-8 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.9
No. 10 (2.0 mm)	99.8
No. 20 (850 μm)	98.8
No. 40 (425 μm)	96.4
No. 60 (250 μm)	92.3
No. 100 (150 μm)	85.2
No. 200 (75 μm)	70.4

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0519 mm	22.4
0.0371 mm	13.8
0.0263 mm	11.7
0.0186 mm	9.5
0.0136 mm	7.3
0.0096 mm	7.3
0.0069 mm	6.5
0.0034 mm	4.7
0.0014 mm	3.2

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,nd}$ (%) = 3.6

% Dispersion = 10.1

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

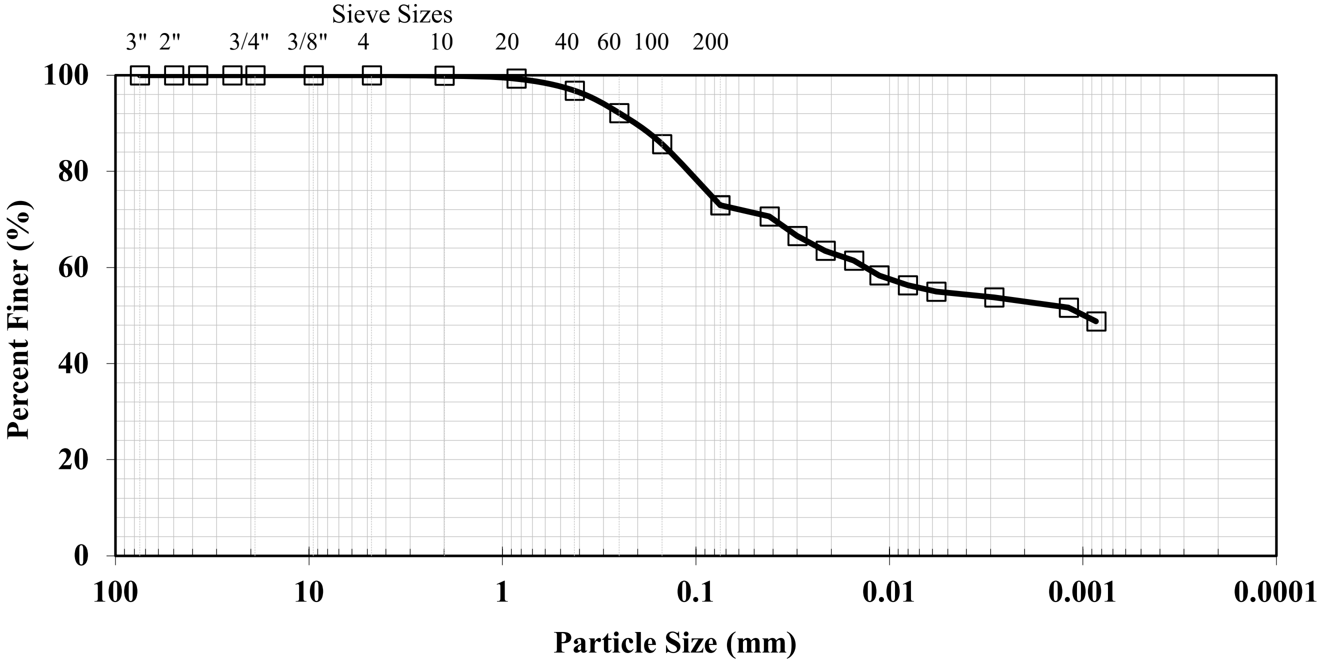
Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Particle-Size Distribution
& Hydrometer Analysis for Soils
(ASTM D6913 & D7928)

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 204-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 µm)	99.3
No. 40 (425 µm)	96.8
No. 60 (250 µm)	92.1
No. 100 (150 µm)	85.7
No. 200 (75 µm)	73.0

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.0418 mm	70.6
0.0300 mm	66.5
0.0215 mm	63.5
0.0153 mm	61.4
0.0113 mm	58.3
0.0080 mm	56.3
0.0057 mm	54.9
0.0029 mm	53.8
0.0012 mm	51.6
0.0009 mm	48.8

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\,2\,\mu m,\,d}$ (%) = 52.7

D60 (mm)	0.013
D30 (mm)	- -
D10 (mm)	- -

Coeff. of Uniformity, Cu : - -
Coeff. of Curvature, Cc : - -

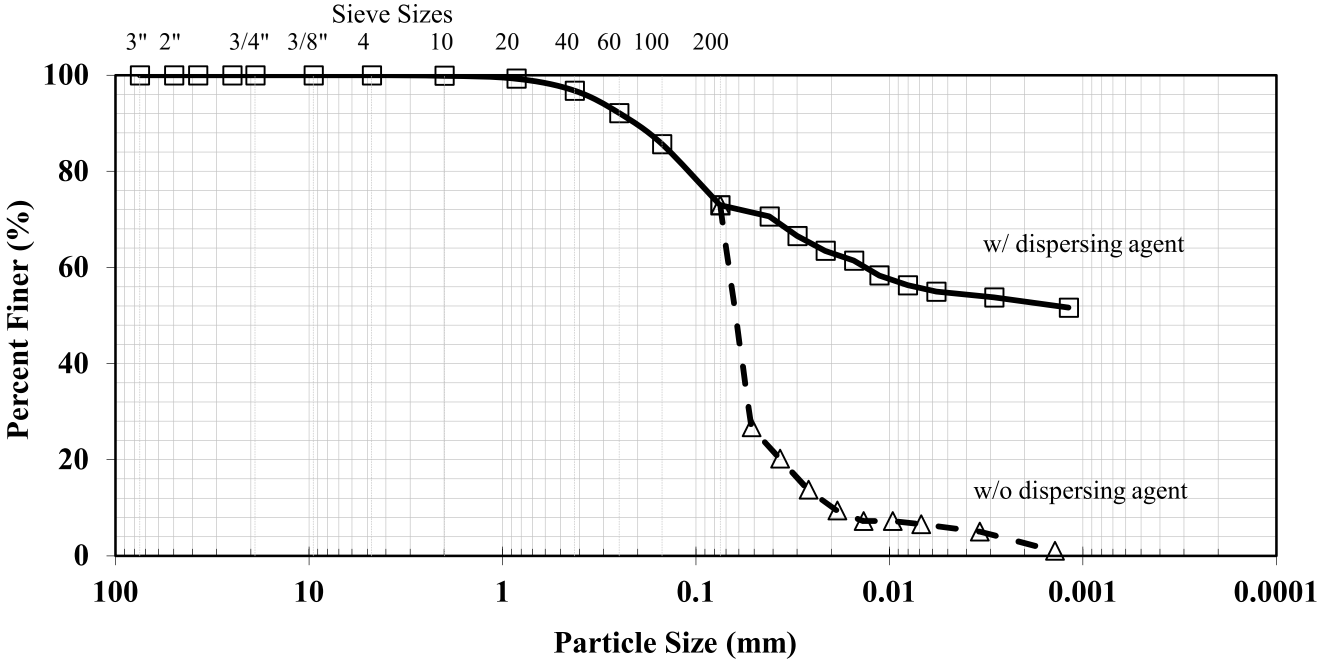
Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

Alpine Engineering Services, LLC
105 Tradesmen Drive, Suite B
Hutto, TX 78634
Tel: (512) 387-1287

Particle-Size Distribution & Double Hydrometer Analysis for Soils (ASTM D6913 & D4221)

Client: Arias & Associates, Inc.
Project Name: Escondido FRS No.12 (PN: 2023-136)
Sample ID: 204-23, G1 (0-3 ft)

Alpine Project No.: 2307258
Test Date: 08/02/23
Tested By: T.D.



Particle-Size Distribution	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	99.9
No. 20 (850 µm)	99.3
No. 40 (425 µm)	96.8
No. 60 (250 µm)	92.1
No. 100 (150 µm)	85.7
No. 200 (75 µm)	73.0

w/o Dispersing Agent	
Particle Size	Percent Passing (%)
0.0517 mm	26.7
0.0368 mm	20.2
0.0262 mm	13.7
0.0186 mm	9.4
0.0137 mm	7.2
0.0097 mm	7.2
0.0069 mm	6.6
0.0034 mm	5.1
0.0014 mm	1.1

Note 1: Specific gravity was assumed to be 2.68, sample was prepared moist.

$N_{m,\, 2\,\mu m,\, nd}$ (%) = 2.2

% Dispersion = 4.3

Note 2: The % dispersion is less than 30 % - The soil is nondispersive.

Cheng-Wei Chen, Ph.D. 08/15/23
Reviewed By / Date

STANDARD PROCTOR TEST RESULTS

142 Chula Vista, San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

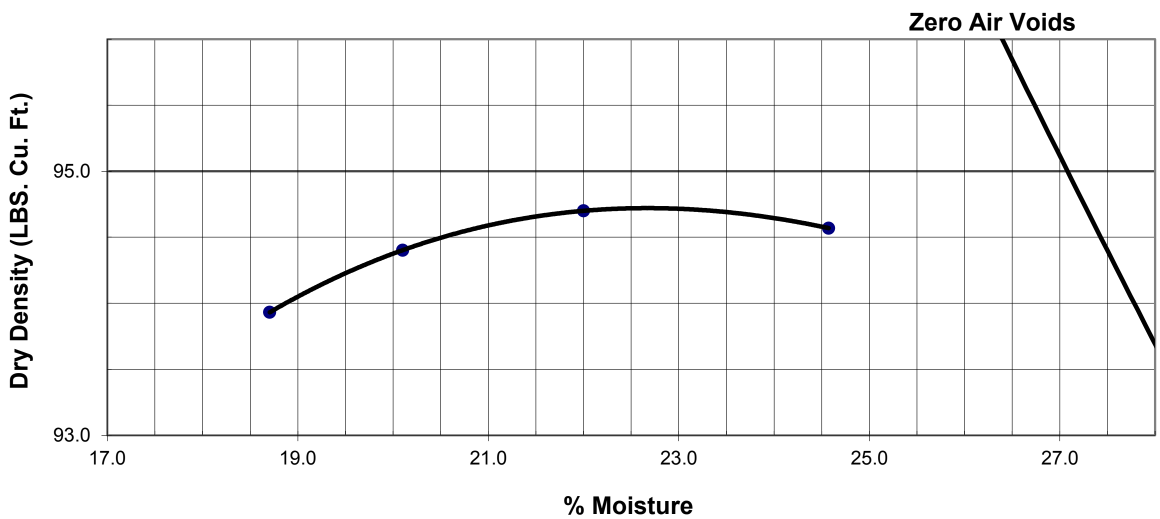
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Escondido FRS 12

Report Date: August 8, 2023 **Arias Report No.:** 2023-136

Soil Description: Fat Clay
Material Origin: 201-23, Bulk 1 0'-3'
Date Sampled: July 16, 2023
Sampled By: Evan Martinez
Test Method: ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool
Application:
Comments:

Test results for sample I.D.:	23-0841
Maximum Dry Density(lb/ft3):	94.7
Optimum Moisture Content (%):	22.6
Liquid Limit:	60
Plasticity Index:	40
(Estimated) Specific Gravity:	2.6



Respectfully Submitted,
Arias & Associates, Inc

142 Chula Vista, San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

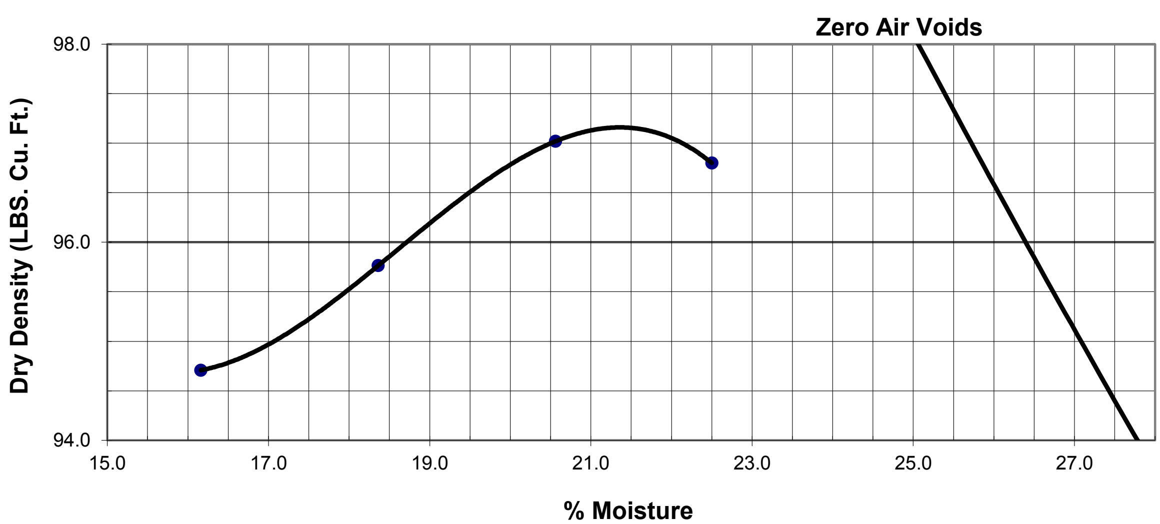
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Escondido FRS 12

Report Date: August 8, 2023 **Arias Report No.:** 2023-136

Soil Description:	Lean Clay
Material Origin:	202-23, Bulk 2 3'-5'
Date Sampled:	July 16, 2023
Sampled By:	Evan Martinez
Test Method:	ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool
Application:	
Comments:	

Test results for sample I.D.:	23-0842
Maximum Dry Density(lb/ft3):	97.2
Optimum Moisture Content (%):	21.4
Liquid Limit:	31
Plasticity Index:	17
(Estimated) Specific Gravity:	2.6



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

142 Chula Vista, San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

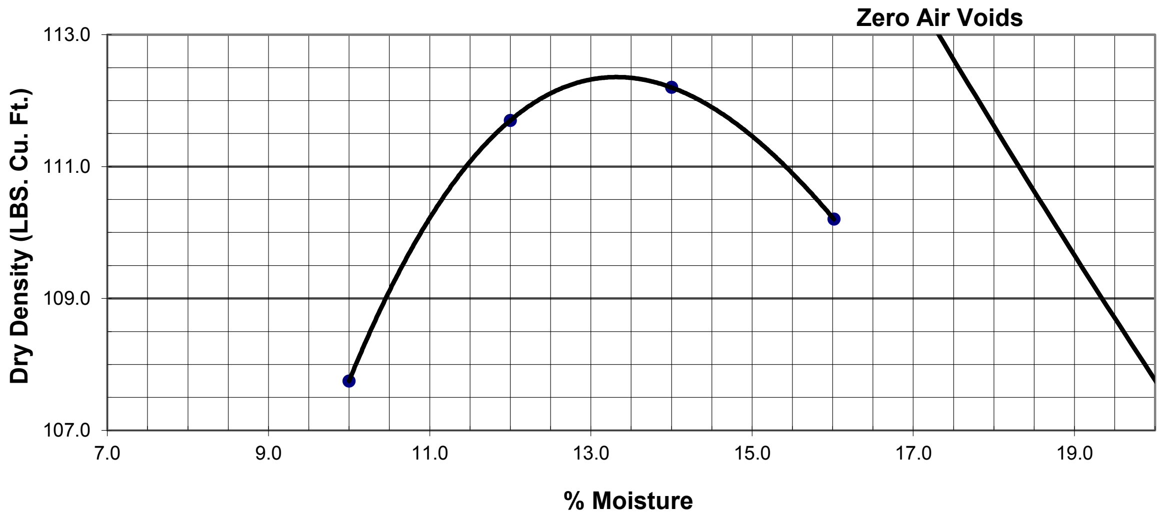
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Escondido FRS 12

Report Date: August 8, 2023 **Arias Report No.:** 2023-136

Soil Description: Lean Clay
Material Origin: 203-23 Bulk 1 0'-3'
Date Sampled: July 14, 2023
Sampled By: Evan Martinez
Test Method: ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool
Application:
Comments:

Test results for sample I.D.: 23-0843
Maximum Dry Density(lb/ft3): 112.4
Optimum Moisture Content (%): 13.4
Liquid Limit: 31
Plasticity Index: 17
(Estimated) Specific Gravity: 2.65



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

142 Chula Vista, San Antonio, Texas 78232 • Phone: (210) 308-5884 • Fax: (210) 308-5886

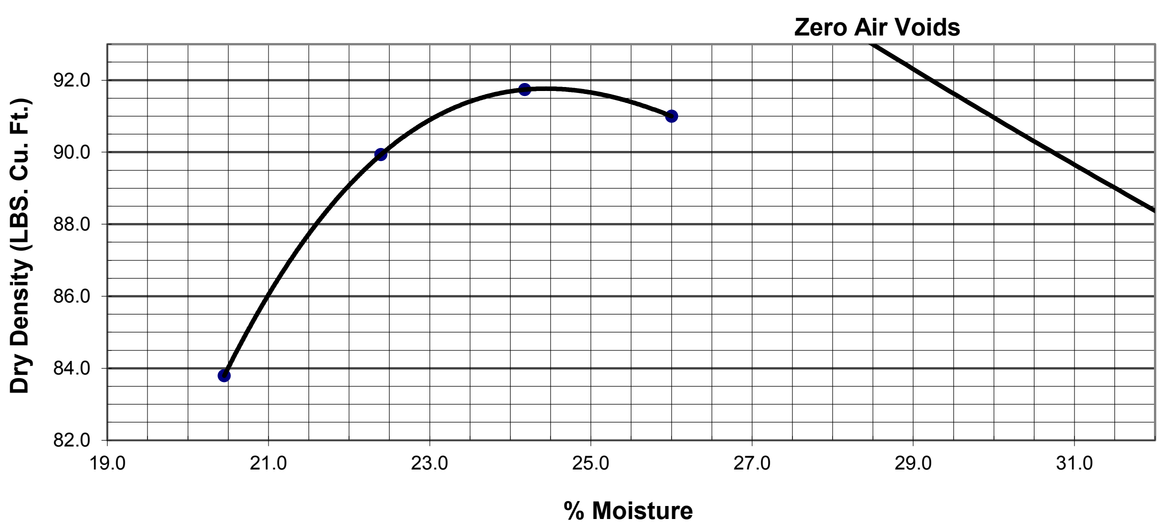
Moisture Density Relationship Test Report

Customer: AECOM **Project:** Escondido FRS 12

Report Date: August 8, 2023 **Arias Report No.:** 2023-136

Soil Description:	Fat Clay
Material Origin:	204-23, Bulk 2 3'-5'
Date Sampled:	July 16, 2023
Sampled By:	Evan Martinez
Test Method:	ASTM D698 Method B: Moist, Mechanical, ASTM D4318: Wet, Hand-rolled, Manual Liquid Limit, Metal Grooving Tool
Application:	
Comments:	

Test results for sample I.D.:	23-0844
Maximum Dry Density(lb/ft3):	91.7
Optimum Moisture Content (%):	24.4
Liquid Limit:	72
Plasticity Index:	51
(Estimated) Specific Gravity:	2.6



Respectfully Submitted,
Arias & Associates, Inc
TBPE Registration No: F-32

CHLORIDE & REDOX RESULTS

ALAMO ANALYTICAL LABORATORIES, LTD.

Date: 04-Aug-23

Analytical Results Report

CLIENT: Arias & Associates
Lab Order: 2307097
Project: 2023 - 136 Escondido FRS 12 (Kenedy Dam)

Alamo Lab ID	Client ID	Collection Date	Analyses	Matrix	Result	MDL	PQL	Units	DF	Qua
TestName: CHLORIDE			**Date Analyzed** 8/1/2023 9:40:00 AM					Initials: YK		
2307097-01A	201 - 23 G1 (0 - 3)	6/16/2023	Chloride	Solid	140	2.57	5	mg/Kg	1	
2307097-02A	202 - 23 P5 (8 - 10)	6/16/2023	Chloride	Solid	120	2.57	5	mg/Kg	1	
2307097-03A	202 - 23 G1 (0 - 3)	6/16/2023	Chloride	Solid	140	2.57	5	mg/Kg	1	
2307097-04A	202 - 23 G2 (3 - 5)	6/16/2023	Chloride	Solid	100	2.57	5	mg/Kg	1	
2307097-05A	203 - 23 G1 (0 - 3)	6/16/2023	Chloride	Solid	120	2.57	5	mg/Kg	1	
TestName: OXIDATION-REDUCTION POTENTIAL			**Date Analyzed** 8/1/2023 2:30:00 PM					Initials: YK		
2307097-01A	201 - 23 G1 (0 - 3)	6/16/2023	Oxidation-Reduction Potential	Solid	3.76	0	-180.	millivolts	1	
2307097-02A	202 - 23 P5 (8 - 10)	6/16/2023	Oxidation-Reduction Potential	Solid	2.92	0	-180.	millivolts	1	
2307097-03A	202 - 23 G1 (0 - 3)	6/16/2023	Oxidation-Reduction Potential	Solid	3.54	0	-180.	millivolts	1	
2307097-04A	202 - 23 G2 (3 - 5)	6/16/2023	Oxidation-Reduction Potential	Solid	2.86	0	-180.	millivolts	1	
2307097-05A	203 - 23 G1 (0 - 3)	6/16/2023	Oxidation-Reduction Potential	Solid	2.42	0	-180.	millivolts	1	

H Holding times for preparation or analysis excceeded; J - Analyte detected below quanititation limits

* Non-NELAP Standards ** Sub Contracted

Approved by: Reddy Gosala, Laboratory Direc

Report of Laboratory Analysis