

APPENDIX U

HEC-RAS MODEL FOR THE CALCULATION OF THE 500-YEAR AND PMP WATER SURFACE PROFILES ANTECEDENT MOISTURE CONDITION III

HEC-RAS Plan: PMP AMIII River: Ditch A Reach: 5

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Ch W/S (ft)	Max Ch Dpth (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Sta W.S. Lft (ft)	Sta W.S. Rgt (ft)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
5	12674	976.00	3477.00	3478.76	3478.27	1.75	3478.88	0.003056	2.90	327.16	682.56	357.89	355.40	0.46
5	12674	1850.00	3477.00	3479.26	3478.68	2.26	3479.45	0.003167	3.69	291.95	714.24	553.45	422.29	0.49
5	11337	976.00	3469.00	3470.81	3470.81	1.81	3471.39	0.013220	6.21	417.53	566.66	164.80	149.13	0.95
5	11337	1650.00	3469.00	3471.47	3471.46	2.47	3472.26	0.010885	7.39	403.34	580.18	272.35	176.84	0.93
5	10937	976.00	3464.00	3466.24	3466.08	2.24	3466.66	0.010235	5.21	455.99	618.01	188.24	162.01	0.83
5	10937	1850.00	3464.00	3466.72	3466.72	2.72	3467.45	0.013153	6.91	438.39	635.61	273.71	197.22	0.98
5	10288	976.00	3456.00	3457.22	3457.22	1.22	3457.51	0.020477	4.31	374.31	788.29	226.46	419.97	1.03
5	10288	1850.00	3456.00	3457.57	3457.53	1.57	3457.93	0.015410	4.82	339.97	819.21	383.80	479.25	0.95
5	9590	1242.00	3450.00	3451.93	3451.51	1.93	3452.09	0.004969	3.13	389.43	793.60	396.40	404.17	0.56
5	9590	2689.00	3450.00	3452.40	3452.06	2.40	3452.72	0.006338	4.52	345.06	818.68	603.04	473.62	0.67
5	9009	1242.00	3445.00	3446.90	3446.75	1.90	3447.19	0.011195	4.31	416.94	751.61	288.10	334.67	0.82
5	9009	2689.00	3445.00	3447.65		2.65	3447.98	0.007751	4.51	354.62	846.77	596.64	492.15	0.72
5	8130	1242.00	3440.00	3442.03	3441.49	2.03	3442.15	0.003422	2.73	417.16	854.27	455.81	437.11	0.47
5	8130	2689.00	3440.00	3442.50	3442.03	2.50	3442.75	0.004647	4.06	390.07	887.68	674.08	497.59	0.58
5	7717	1242.00	3437.80	3439.01	3439.01	1.21	3439.38	0.018011	4.88	307.18	657.99	254.54	350.81	1.01
5	7717	2689.00	3437.80	3439.74		1.94	3440.11	0.009311	4.84	252.35	723.77	555.05	471.42	0.79
5	7253	1483.00	3435.00	3436.81	3436.18	1.81	3436.89	0.001808	2.29	382.26	946.12	664.88	583.87	0.35
5	7253	5399.00	3435.00	3437.84	3437.06	2.84	3438.13	0.003105	4.42	329.17	997.14	1299.73	667.97	0.51
5	6343	2888.00	3430.00	3431.11	3431.11	1.11	3431.57	0.016513	5.44	724.42	1307.78	531.28	583.36	1.00
5	6343	7144.00	3430.00	3431.94	3431.94	1.94	3432.64	0.012039	6.76	867.41	1534.53	1091.24	867.12	0.94
5	5383	2888.00	3425.00	3426.84	3426.14	1.84	3426.94	0.001869	2.54	660.98	1645.22	1198.09	984.24	0.37
5	5383	7144.00	3425.00	3427.72	3426.80	2.72	3427.91	0.002096	3.65	577.26	1820.07	2169.17	1242.81	0.42
5	4221	3286.00	3420.00	3421.49	3421.49	1.49	3421.84	0.015261	5.39	444.14	1172.66	624.24	728.53	0.97
5	4221	7766.00	3420.00	3422.20	3422.20	2.20	3422.82	0.013358	6.51	293.84	1337.10	1256.74	1043.46	0.97
5	3489	3286.00	3416.00	3417.66	3417.07	2.66	3417.76	0.002329	2.66	-122.29	803.15	1293.45	1025.44	0.40
5	3489	7766.00	3416.00	3418.44	3417.60	3.44	3418.65	0.002671	3.78	-136.55	950.96	2110.92	1087.51	0.46
5	2989	3286.00	3413.80	3414.95	3414.95	1.15	3415.36	0.016461	5.40	47.78	836.22	645.74	788.45	1.09
5	2989	7766.00	3413.80	3415.68	3415.59	1.88	3416.28	0.011352	6.62	-5.70	894.15	1259.21	900.85	0.92
5	2774	3286.00	3409.00	3414.41	3412.71	5.41	3414.50	0.000645	3.37	-418.02	658.08	1773.70	1076.10	0.26
5	2774	7766.00	3409.00	3415.12	3413.54	6.12	3415.31	0.001303	5.22	-438.85	687.85	2554.86	1126.70	0.38
5	2773	Culvert												
5	2734	3286.00	3408.90	3412.71	3412.71	3.81	3413.25	0.004812	7.06	83.74	515.65	665.51	431.91	0.67
5	2734	7766.00	3408.90	3414.37	3414.37	5.47	3414.83	0.003331	7.66	-1467.17	584.55	2185.05	2051.72	0.60
5	1888	3327.00	3408.00	3409.80	3409.14	1.80	3409.92	0.002775	2.72	131.77	1131.73	1225.09	699.96	0.43
5	1888	7894.00	3408.00	3410.58	3409.82	2.59	3410.80	0.002839	3.70	-259.09	1206.15	2224.23	1465.23	0.47
5	1060	3473.00	3402.70	3404.67	3404.67	1.97	3405.20	0.016121	5.85	589.60	1163.09	593.57	573.29	1.01
5	1060	8124.00	3402.70	3405.55	3405.55	2.85	3406.22	0.014413	6.58	460.16	1380.29	1235.07	920.12	1.00

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HEC-RAS Version 3.0.1 Mar 2001
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PROJECT DATA

Project Title: WCS
 Project File : FloodPlain.prj
 Run Date and Time: 3/30/06 9:32:01 AM

Project in English units

PLAN DATA

Plan Title: Plan 38
 Plan File : D:\program files\WCS\FloodPlain.p38

Geometry Title: PMP1-20-04SecRemoved
 Geometry File : D:\program files\WCS\FloodPlain.g04

Flow Title : pmp NOD AMIII
 Flow File : D:\program files\WCS\FloodPlain.f30

Plan Summary Information:

Number of:	Cross Sections =	18	Multiple Openings =	0
	Culverts =	1	Inline Weirs =	0
	Bridges =	0		

Computational Information

Water surface calculation tolerance =	0.01
Critical depth calculaton tolerance =	0.01
Maximum number of interations =	20
Maximum difference tolerance =	0.3
Flow tolerance factor =	0.001

Computation Options

Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: pmp NOD AMIII
 Flow File : D:\program files\WCS\FloodPlain.f30

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Flow Data (cfs)

River	Reach	RS	PF 2	PF 3
Ditch A	5	12674	976	1850
Ditch A	5	9690	1242	2689
Ditch A	5	7253	1483	5399
Ditch A	5	6343	2888	7144
Ditch A	5	4221	3286	7766
Ditch A	5	1888	3327	7864
Ditch A	5	1060	3473	8124

Boundary Conditions

River stream	Reach	Profile	Upstream	Down
Ditch A ritical	5	PF 2	Critical	Cr

GEOMETRY DATA

Geometry Title: PMP1-20-04SecRemoved
 Geometry File : D:\program files\WCS\FloodPlain.g04

CROSS SECTION RIVER: Ditch A
 REACH: 5 RS: 12674

INPUT

Description: Sta. 12674

Station Elevation Data		num=	6						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3482	380	3478	560	3477	635	3478	761	3480
964	3482								

Manning's n Values		num=	3		
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	380	.033	635	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	380	635		1206	1337	1433	.1 .3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3478.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.12	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3478.76	Reach Len. (ft)	1206.00	1337.00	1433.00
Crit W.S. (ft)	3478.27	Flow Area (sq ft)	19.94	320.00	17.95
E.G. Slope (ft/ft)	0.003056	Area (sq ft)	19.94	320.00	17.95
Q Total (cfs)	976.00	Flow (cfs)	25.93	926.74	23.34
Top Width (ft)	355.40	Top Width (ft)	52.84	255.00	47.56

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Vel Total (ft/s)	2.73	Avg. Vel. (ft/s)	1.30	2.90	1.30
Max Chl Dpth (ft)	1.75	Hydr. Depth (ft)	0.38	1.25	0.38
Conv. Total (cfs)	17654.0	Conv. (cfs)	469.0	16762.9	422.1
Length Wtd. (ft)	1336.00	Wetted Per. (ft)	52.85	255.01	47.56
Min Ch El (ft)	3477.00	Shear (lb/sq ft)	0.07	0.24	0.07
Alpha	1.08	Stream Power (lb/ft s)	0.09	0.69	0.09
Frctn Loss (ft)	7.45	Cum Volume (acre-ft)	22.71	137.88	4.08
C & E Loss (ft)	0.05	Cum SA (acres)	24.33	121.69	6.69

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3479.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3479.26	Reach Len. (ft)	1206.00	1337.00	1433.00
Crit W.S. (ft)	3478.68	Flow Area (sq ft)	55.37	448.24	49.84
E.G. Slope (ft/ft)	0.003167	Area (sq ft)	55.37	448.24	49.84
Q Total (cfs)	1850.00	Flow (cfs)	102.99	1654.32	92.69
Top Width (ft)	422.29	Top Width (ft)	88.05	255.00	79.24
Vel Total (ft/s)	3.34	Avg. Vel. (ft/s)	1.86	3.69	1.86
Max Chl Dpth (ft)	2.26	Hydr. Depth (ft)	0.63	1.76	0.63
Conv. Total (cfs)	32873.9	Conv. (cfs)	1830.1	29396.7	1647.1
Length Wtd. (ft)	1334.81	Wetted Per. (ft)	88.06	255.01	79.25
Min Ch El (ft)	3477.00	Shear (lb/sq ft)	0.12	0.35	0.12
Alpha	1.12	Stream Power (lb/ft s)	0.23	1.28	0.23
Frctn Loss (ft)	7.14	Cum Volume (acre-ft)	54.74	234.96	14.97
C & E Loss (ft)	0.06	Cum SA (acres)	51.06	137.20	20.21

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for

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additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 11337

INPUT

Description: Sta. 11337

Station Elevation Data		num= 8							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3477	315	3474	392	3472	435	3470	499	3469
550	3470	591	3472	694	3474				

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	435	.033	550	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	435	550		545 400	332	.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3471.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.58	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3470.81	Reach Len. (ft)	545.00	400.00	332.00
Crit W.S. (ft)	3470.81	Flow Area (sq ft)	7.10	150.94	6.77
E.G. Slope (ft/ft)	0.013220	Area (sq ft)	7.10	150.94	6.77
Q Total (cfs)	976.00	Flow (cfs)	20.14	936.66	19.20
Top Width (ft)	149.13	Top Width (ft)	17.47	115.00	16.66
Vel Total (ft/s)	5.92	Avg. Vel. (ft/s)	2.84	6.21	2.84
Max Chl Dpth (ft)	1.81	Hydr. Depth (ft)	0.41	1.31	0.41
Conv. Total (cfs)	8488.6	Conv. (cfs)	175.2	8146.4	167.0
Length Wtd. (ft)	400.78	Wetted Per. (ft)	17.49	115.02	16.68
Min Ch El (ft)	3469.00	Shear (lb/sq ft)	0.33	1.08	0.33
Alpha	1.06	Stream Power (lb/ft s)	0.95	6.72	0.95
Frctn Loss (ft)	4.64	Cum Volume (acre-ft)	22.34	130.65	3.67
C & E Loss (ft)	0.05	Cum SA (acres)	23.35	116.01	5.64

Warning: The energy equation could not be balanced within the specified number of iterations.
The program selected the water surface that had the least amount of error between computed

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and assumed values.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to

critical depth, the calculated water surface came back below critical depth. This indicates

that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3472.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.79	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3471.47	Reach Len. (ft)	545.00	400.00	332.00
Crit W.S. (ft)	3471.46	Flow Area (sq ft)	23.31	226.83	22.22
E.G. Slope (ft/ft)	0.010885	Area (sq ft)	23.31	226.83	22.22
Q Total (cfs)	1850.00	Flow (cfs)	89.20	1675.75	85.05
Top Width (ft)	176.84	Top Width (ft)	31.66	115.00	30.18
Vel Total (ft/s)	6.79	Avg. Vel. (ft/s)	3.83	7.39	3.83
Max Chl Dpth (ft)	2.47	Hydr. Depth (ft)	0.74	1.97	0.74
Conv. Total (cfs)	17732.1	Conv. (cfs)	855.0	16061.9	815.2
Length Wtd. (ft)	401.47	Wetted Per. (ft)	31.69	115.02	30.22
Min Ch El (ft)	3469.00	Shear (lb/sq ft)	0.50	1.34	0.50
Alpha	1.10	Stream Power (lb/ft s)	1.91	9.90	1.91
Frctn Loss (ft)	4.79	Cum Volume (acre-ft)	53.65	224.60	13.78
C & E Loss (ft)	0.02	Cum SA (acres)	49.40	131.52	18.41

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 10937

INPUT

Description: Sta. 10937

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3470	351	3468	428	3467	465	3466	536	3464
543	3464	609	3466	683	3468	811	3472		

Sta	n Val	Sta	n Val	Sta	n Val
100	.033	428	.033	609	.033

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Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
428	609	729	649	445	.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3466.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.42	Wt. n-Val.		0.033	0.033
W.S. Elev (ft)	3466.24	Reach Len. (ft)	729.00	649.00	445.00
Crit W.S. (ft)	3466.08	Flow Area (sq ft)		187.15	1.10
E.G. Slope (ft/ft)	0.010235	Area (sq ft)		187.15	1.10
Q Total (cfs)	976.00	Flow (cfs)		974.77	1.23
Top Width (ft)	162.01	Top Width (ft)		153.01	9.01
Vel Total (ft/s)	5.18	Avg. Vel. (ft/s)		5.21	1.12
Max Chl Dpth (ft)	2.24	Hydr. Depth (ft)		1.22	0.12
Conv. Total (cfs)	9647.4	Conv. (cfs)		9635.2	12.1
Length Wtd. (ft)	648.87	Wetted Per. (ft)		153.07	9.01
Min Ch El (ft)	3464.00	Shear (lb/sq ft)		0.78	0.08
Alpha	1.01	Stream Power (lb/ft s)		4.07	0.09
Frctn Loss (ft)	9.12	Cum Volume (acre-ft)	22.29	129.10	3.64
C & E Loss (ft)	0.04	Cum SA (acres)	23.25	114.78	5.54

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3467.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.73	Wt. n-Val.		0.033	0.033
W.S. Elev (ft)	3466.72	Reach Len. (ft)	729.00	649.00	445.00
Crit W.S. (ft)	3466.72	Flow Area (sq ft)		264.14	9.57
E.G. Slope (ft/ft)	0.013153	Area (sq ft)		264.14	9.57
Q Total (cfs)	1850.00	Flow (cfs)		1825.01	24.99
Top Width (ft)	197.22	Top Width (ft)		170.61	26.61
Vel Total (ft/s)	6.76	Avg. Vel. (ft/s)		6.91	2.61

Max Chl Dpth (ft)	2.72	FloodPlain.rep Hydr. Depth (ft)	1.55	0.36
Conv. Total (cfs)	16130.8	Conv. (cfs)	15913.0	217.9
Length Wtd. (ft)	647.62	Wetted Per. (ft)	170.68	26.62
Min Ch El (ft)	3464.00	Shear (lb/sq ft)	1.27	0.30
Alpha	1.03	Stream Power (lb/ft s)	8.78	0.77
Frctn Loss (ft)	9.21	Cum Volume (acre-ft)	53.50	222.35
C & E Loss (ft)	0.11	Cum SA (acres)	49.20	130.21
			18.19	

Warning: The energy equation could not be balanced within the specified number of iterations.
The program selected the water surface that had the least amount of error between computed and assumed values.
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 10288

INPUT

Description: Sta. 10288

Station	Elevation	Data	num=	12						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	
100	3464	177	3462	238	3460	298	3458	493	3456	
519	3456	662	3457	778	3457.1	857	3458	903	3460	
947	3462	989	3464							

Manning's n	Values	num=	3							
Sta	n Val	Sta	n Val	Sta	n Val					
100	.033	298	.033	857	.033					

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	298	857		552	598	633	.1
							.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3457.51	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.033	
W.S. Elev (ft)	3457.22	Reach Len. (ft)	552.00	598.00	633.00
Crit W.S. (ft)	3457.22	Flow Area (sq ft)		226.46	
E.G. Slope (ft/ft)	0.020477	Area (sq ft)		226.46	
Q Total (cfs)	976.00	Flow (cfs)		976.00	

		FloodPlain.rep			
Top Width (ft)	413.97	Top Width (ft)		413.97	
Vel Total (ft/s)	4.31	Avg. Vel. (ft/s)		4.31	
Max Chl Dpth (ft)	1.22	Hydr. Depth (ft)		0.55	
Conv. Total (cfs)	6820.4	Conv. (cfs)		6820.4	
Length Wtd. (ft)	598.00	Wetted Per. (ft)		413.98	
Min Ch El (ft)	3456.00	Shear (lb/sq ft)		0.70	
Alpha	1.00	Stream Power (lb/ft s)		3.01	
Frctn Loss (ft)	4.93	Cum Volume (acre-ft)	22.29	126.01	3.64
C & E Loss (ft)	0.04	Cum SA (acres)	23.25	110.56	5.49

Warning: The energy equation could not be balanced within the specified number of iterations.
The

program used critical depth for the water surface and continued on with the calculations.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3457.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.		0.033	
W.S. Elev (ft)	3457.57	Reach Len. (ft)	552.00	598.00	633.00
Crit W.S. (ft)	3457.53	Flow Area (sq ft)		383.80	
E.G. Slope (ft/ft)	0.015410	Area (sq ft)		383.80	
Q Total (cfs)	1850.00	Flow (cfs)		1850.00	
Top Width (ft)	479.25	Top Width (ft)		479.25	
Vel Total (ft/s)	4.82	Avg. Vel. (ft/s)		4.82	
Max Chl Dpth (ft)	1.57	Hydr. Depth (ft)		0.80	
Conv. Total (cfs)	14902.9	Conv. (cfs)		14902.9	
Length Wtd. (ft)	597.95	Wetted Per. (ft)		479.26	
Min Ch El (ft)	3456.00	Shear (lb/sq ft)		0.77	

Alpha	1.00	FloodPlain.rep Stream Power (lb/ft s)	3.71		
Frctn Loss (ft)	5.20	Cum Volume (acre-ft)	53.50	217.52	13.61
C & E Loss (ft)	0.01	Cum SA (acres)	49.20	125.36	18.06

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 9690

INPUT

Description: Sta. 9690

Station Elevation Data		num=	8						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3454.5	202	3454	381	3452	632	3450	638	3450
799	3452	897	3454	1010	3458				

Manning's n Values		num=	3		
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	381	.033	799	.033

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
381	799	639 681	658	.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3452.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.		0.033	
W.S. Elev (ft)	3451.93	Reach Len. (ft)	639.00	681.00	658.00
Crit W.S. (ft)	3451.51	Flow Area (sq ft)		396.40	
E.G. Slope (ft/ft)	0.004969	Area (sq ft)		396.40	
Q Total (cfs)	1242.00	Flow (cfs)		1242.00	
Top Width (ft)	404.17	Top Width (ft)		404.17	
Vel Total (ft/s)	3.13	Avg. Vel. (ft/s)		3.13	
Max Chl Dpth (ft)	1.93	Hydr. Depth (ft)		0.98	
Conv. Total (cfs)	17619.0	Conv. (cfs)		17619.0	
Length Wtd. (ft)	681.00	Wetted Per. (ft)		404.19	
Min Ch El (ft)	3450.00	Shear (lb/sq ft)		0.30	
Alpha	1.00	Stream Power (lb/ft s)		0.95	
Frctn Loss (ft)	4.88	Cum Volume (acre-ft)	22.29	121.74	3.64
C & E Loss (ft)	0.01	Cum SA (acres)	23.25	104.94	5.49

FloodPlain rep

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3452.72	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3452.40	Reach Len. (ft)	639.00	681.00	658.00
Crit W.S. (ft)	3452.06	Flow Area (sq ft)	7.22	591.87	3.95
E.G. Slope (ft/ft)	0.006338	Area (sq ft)	7.22	591.87	3.95
Q Total (cfs)	2689.00	Flow (cfs)	8.87	2675.27	4.86
Top Width (ft)	473.62	Top Width (ft)	35.94	418.00	19.68
Vel Total (ft/s)	4.46	Avg. Vel. (ft/s)	1.23	4.52	1.23
Max Chl Dpth (ft)	2.40	Hydr. Depth (ft)	0.20	1.42	0.20
Conv. Total (cfs)	33777.0	Conv. (cfs)	111.4	33604.5	61.0
Length Wtd. (ft)	680.91	Wetted Per. (ft)	35.95	418.02	19.68
Min Ch El (ft)	3450.00	Shear (lb/sq ft)	0.08	0.56	0.08
Alpha	1.02	Stream Power (lb/ft s)	0.10	2.53	0.10
Frctn Loss (ft)	4.76	Cum Volume (acre-ft)	53.46	210.83	13.59
C & E Loss (ft)	0.00	Cum SA (acres)	48.97	119.21	17.91

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A REACH: 5 RS: 9009

INPUT

Description: Sta. 9009

Station Elevation Data		num=		9					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3452	203	3450	325	3448	492	3446	596	3445
637	3446	892	3448	1007	3450	1124	3452		

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	325	.033	892	.033

Bank Sta:		Right		Lengths:		FloodPlain.rep		Coeff Contr.		Expan.	
Left	Right	Left	Channel	Right							
325	892	898	879	794				.1		.3	

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3447.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.033	
W.S. Elev (ft)	3446.90	Reach Len. (ft)	898.00	879.00	794.00
Crit W.S. (ft)	3446.75	Flow Area (sq ft)		288.10	
E.G. Slope (ft/ft)	0.011195	Area (sq ft)		288.10	
Q Total (cfs)	1242.00	Flow (cfs)		1242.00	
Top Width (ft)	334.67	Top Width (ft)		334.67	
Vel Total (ft/s)	4.31	Avg. Vel. (ft/s)		4.31	
Max Chl Dpth (ft)	1.90	Hydr. Depth (ft)		0.86	
Conv. Total (cfs)	11738.3	Conv. (cfs)		11738.3	
Length Wtd. (ft)	879.00	Wetted Per. (ft)		334.70	
Min Ch El (ft)	3445.00	Shear (lb/sq ft)		0.60	
Alpha	1.00	Stream Power (lb/ft s)		2.59	
Frctn Loss (ft)	4.99	Cum Volume (acre-ft)	22.29	116.39	3.64
C & E Loss (ft)	0.05	Cum SA (acres)	23.25	99.17	5.49

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3447.96	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.		0.033	
W.S. Elev (ft)	3447.65	Reach Len. (ft)	898.00	879.00	794.00
Crit W.S. (ft)		Flow Area (sq ft)		596.64	
E.G. Slope (ft/ft)	0.007751	Area (sq ft)		596.64	
Q Total (cfs)	2689.00	Flow (cfs)		2689.00	
Top Width (ft)	492.15	Top Width (ft)		492.15	
Vel Total (ft/s)	4.51	Avg. Vel. (ft/s)		4.51	

Max Chl Dpth (ft)	2.65	FloodPlain.rep Hydr. Depth (ft)	1.21		
Conv. Total (cfs)	30543.4	Conv. (cfs)	30543.4		
Length Wtd. (ft)	878.86	Wetted Per. (ft)	492.18		
Min Ch El (ft)	3445.00	Shear (lb/sq ft)	0.59		
Alpha	1.00	Stream Power (lb/ft s)	2.64		
Frctn Loss (ft)	5.19	Cum Volume (acre-ft)	53.40	201.54	13.56
C & E Loss (ft)	0.02	Cum SA (acres)	48.71	112.09	17.77

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
 REACH: 5 RS: 8130

INPUT									
Description: Sta. 8130									
Station Elevation Data num= 8									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3448	303	3444	419	3442	654	3440	663	3440
852	3442	995	3444	1104	3446				

Manning's n Values num= 3					
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	419	.033	852	.033

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
419	852	399	413	456	.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3442.15	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.12	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3442.03	Reach Len. (ft)	399.00	413.00	456.00
Crit W.S. (ft)	3441.49	Flow Area (sq ft)	0.03	455.74	0.04
E.G. Slope (ft/ft)	0.003422	Area (sq ft)	0.03	455.74	0.04
Q Total (cfs)	1242.00	Flow (cfs)	0.00	1241.99	0.01
Top Width (ft)	437.11	Top Width (ft)	1.84	433.00	2.27
Vel Total (ft/s)	2.72	Avg. Vel. (ft/s)	0.17	2.73	0.17
Max Chl Dpth (ft)	2.03	Hydr. Depth (ft)	0.02	1.05	0.02
Conv. Total (cfs)	21233.1	Conv. (cfs)	0.1	21232.9	0.1
Length Wtd. (ft)	413.00	Wetted Per. (ft)	1.84	433.02	2.27
Min Ch El (ft)	3440.00	Shear (lb/sq ft)	0.00	0.22	0.00

Alpha	1.00	FloodPlain.rep Stream Power (lb/ft s)	0.00	0.61	0.00
Frctn Loss (ft)	2.74	Cum Volume (acre-ft)	22.29	108.88	3.63
C & E Loss (ft)	0.03	Cum SA (acres)	23.23	91.42	5.47

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3442.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.25	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3442.50	Reach Len. (ft)	399.00	413.00	456.00
Crit W.S. (ft)	3442.03	Flow Area (sq ft)	7.21	657.97	8.89
E.G. Slope (ft/ft)	0.004647	Area (sq ft)	7.21	657.97	8.89
Q Total (cfs)	2689.00	Flow (cfs)	8.77	2669.41	10.82
Top Width (ft)	497.59	Top Width (ft)	28.93	433.00	35.66
Vel Total (ft/s)	3.99	Avg. Vel. (ft/s)	1.22	4.06	1.22
Max Chl Dpth (ft)	2.50	Hydr. Depth (ft)	0.25	1.52	0.25
Conv. Total (cfs)	39445.5	Conv. (cfs)	128.7	39158.1	158.7
Length Wtd. (ft)	413.06	Wetted Per. (ft)	28.93	433.02	35.67
Min Ch El (ft)	3440.00	Shear (lb/sq ft)	0.07	0.44	0.07
Alpha	1.03	Stream Power (lb/ft s)	0.09	1.79	0.09
Frctn Loss (ft)	2.64	Cum Volume (acre-ft)	53.33	188.88	13.47
C & E Loss (ft)	0.01	Cum SA (acres)	48.41	102.76	17.44

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 7717

INPUT
Description: Sta 7717
Station Elevation Data num= 8

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Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3442	233	3440	383	3438	492	3437.8	510	3438
657	3439	747	3440	879	3442				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
100	.033	233	.033	747	.033

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan..

	233	747		444	464	510	.1	.3
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CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3439.38	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.		0.033	
W.S. Elev (ft)	3439.01	Reach Len. (ft)	444.00	464.00	510.00
Crit W.S. (ft)	3439.01	Flow Area (sq ft)		254.54	
E.G. Slope (ft/ft)	0.018011	Area (sq ft)		254.54	
Q Total (cfs)	1242.00	Flow (cfs)		1242.00	
Top Width (ft)	350.81	Top Width (ft)		350.81	
Vel Total (ft/s)	4.88	Avg. Vel. (ft/s)		4.88	
Max Chl Dpth (ft)	1.21	Hydr. Depth (ft)		0.73	
Conv. Total (cfs)	9254.5	Conv. (cfs)		9254.5	
Length Wtd. (ft)	464.16	Wetted Per. (ft)		350.82	
Min Ch El (ft)	3437.80	Shear (lb/sq ft)		0.82	
Alpha	1.00	Stream Power (lb/ft s)		3.98	
Frctn Loss (ft)	1.77	Cum Volume (acre-ft)	22.29	105.52	3.63
C & E Loss (ft)	0.09	Cum SA (acres)	23.22	87.70	5.46

Warning: The energy equation could not be balanced within the specified number of iterations.
The

program used critical depth for the water surface and continued on with the calculations.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #PF 3

FloodPlain.rep

E.G. Elev (ft)	3440.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.		0.033	
W.S. Elev (ft)	3439.74	Reach Len. (ft)	444.00	464.00	510.00
Crit W.S. (ft)		Flow Area (sq ft)		555.05	
E.G. Slope (ft/ft)	0.009311	Area (sq ft)		555.05	
Q Total (cfs)	2689.00	Flow (cfs)		2689.00	
Top Width (ft)	471.42	Top Width (ft)		471.42	
Vel Total (ft/s)	4.84	Avg. Vel. (ft/s)		4.84	
Max Chl Dpth (ft)	1.94	Hydr. Depth (ft)		1.18	
Conv. Total (cfs)	27866.5	Conv. (cfs)		27866.5	
Length Wtd. (ft)	464.62	Wetted Per. (ft)		471.44	
Min Ch El (ft)	3437.80	Shear (lb/sq ft)		0.68	
Alpha	1.00	Stream Power (lb/ft s)		3.32	
Frctn Loss (ft)	1.95	Cum Volume (acre-ft)	53.30	183.13	13.43
C & E Loss (ft)	0.02	Cum SA (acres)	48.28	98.47	17.25

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 7253

INPUT

Description: Sta. 7253

Station Elevation Data		num=	9						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3438	109	3438.7	321	3438	424	3436	668	3435
906	3436	1005	3438	1200	3440	1365	3442		

Manning's n Values		num=	3		
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	424	.033	906	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	424	906		756	910	980	
						.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3436.89	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.08	Wt. n-Val.	0.033	0.033	0.033

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W.S. Elev (ft)	3436.81	Reach Len. (ft)	756.00	910.00	980.00
Crit W.S. (ft)	3436.16	Flow Area (sq ft)	16.92	631.68	16.26
E.G. Slope (ft/ft)	0.001808	Area (sq ft)	16.92	631.68	16.26
Q Total (cfs)	1483.00	Flow (cfs)	17.73	1448.22	17.05
Top Width (ft)	563.87	Top Width (ft)	41.74	482.00	40.12
Vel Total (ft/s)	2.23	Avg. Vel. (ft/s)	1.05	2.29	1.05
Max Chl Dpth (ft)	1.81	Hydr. Depth (ft)	0.41	1.31	0.41
Conv. Total (cfs)	34880.8	Conv. (cfs)	417.1	34062.8	400.9
Length Wtd. (ft)	909.65	Wetted Per. (ft)	41.75	482.00	40.13
Min Ch El (ft)	3435.00	Shear (lb/sq ft)	0.05	0.15	0.05
Alpha	1.04	Stream Power (lb/ft s)	0.05	0.34	0.05
Frctn Loss (ft)	5.28	Cum Volume (acre-ft)	22.21	100.80	3.54
C & E Loss (ft)	0.04	Cum SA (acres)	23.01	83.27	5.22

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3438.13	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3437.84	Reach Len. (ft)	756.00	910.00	980.00
Crit W.S. (ft)	3437.06	Flow Area (sq ft)	87.30	1128.51	83.91
E.G. Slope (ft/ft)	0.003105	Area (sq ft)	87.30	1128.51	83.91
Q Total (cfs)	5399.00	Flow (cfs)	207.28	4992.50	199.22
Top Width (ft)	667.97	Top Width (ft)	94.83	482.00	91.14
Vel Total (ft/s)	4.15	Avg. Vel. (ft/s)	2.37	4.42	2.37
Max Chl Dpth (ft)	2.84	Hydr. Depth (ft)	0.92	2.34	0.92
Conv. Total (cfs)	96891.5	Conv. (cfs)	3719.8	89596.3	3575.3
Length Wtd. (ft)	909.03	Wetted Per. (ft)	94.85	482.00	91.16
Min Ch El (ft)	3435.00	Shear (lb/sq ft)	0.18	0.45	0.18
Alpha	1.07	Stream Power (lb/ft s)	0.42	2.01	0.42

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Frctn Loss (ft)	5.45	Cum Volume (acre-ft)	52.85	174.16	12.94
C & E Loss (ft)	0.04	Cum SA (acres)	47.79	93.39	16.72

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 6343

INPUT

Description: Sta. 6343

Station Elevation Data		num=		9					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3434	346	3433	663	3432	732	3431	860	3430.2
981	3430	1273	3430	1320	3431.5	1566	3432		

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	663	.033	1320	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	663	1320		767 980	1051	.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3431.57	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.		0.033	
W.S. Elev (ft)	3431.11	Reach Len. (ft)	767.00	980.00	1051.00
Crit W.S. (ft)	3431.11	Flow Area (sq ft)		531.26	
E.G. Slope (ft/ft)	0.016513	Area (sq ft)		531.26	
Q Total (cfs)	2888.00	Flow (cfs)		2888.00	
Top Width (ft)	583.36	Top Width (ft)		583.36	
Vel Total (ft/s)	5.44	Avg. Vel. (ft/s)		5.44	
Max Chl Dpth (ft)	1.11	Hydr. Depth (ft)		0.91	
Conv. Total (cfs)	22474.4	Conv. (cfs)		22474.4	
Length Wtd. (ft)	979.58	Wetted Per. (ft)		583.38	
Min Ch El (ft)	3430.00	Shear (lb/sq ft)		0.94	
Alpha	1.00	Stream Power (lb/ft s)		5.10	
Frctn Loss (ft)	4.10	Cum Volume (acre-ft)	22.06	88.65	3.36
C & E Loss (ft)	0.11	Cum SA (acres)	22.64	72.14	4.77

Warning: The energy equation could not be balanced within the specified number of iterations.
 The program used critical depth for the water surface and continued on with the calculations.
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
 Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.
 Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3432.64	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.70	Wt. n-Val.		0.033	0.033
W.S. Elev (ft)	3431.94	Reach Len. (ft)	767.00	980.00	1051.00
Crit W.S. (ft)	3431.94	Flow Area (sq ft)		1044.47	46.77
E.G. Slope (ft/ft)	0.012039	Area (sq ft)		1044.47	46.77
Q Total (cfs)	7144.00	Flow (cfs)		7060.30	83.70
Top Width (ft)	867.12	Top Width (ft)		652.59	214.53
Vel Total (ft/s)	6.55	Avg. Vel. (ft/s)		6.76	1.79
Max Chl Dpth (ft)	1.94	Hydr. Depth (ft)		1.60	0.22
Conv. Total (cfs)	65111.0	Conv. (cfs)		64348.1	762.9
Length Wtd. (ft)	979.22	Wetted Per. (ft)		652.62	214.53
Min Ch El (ft)	3430.00	Shear (lb/sq ft)		1.20	0.16
Alpha	1.05	Stream Power (lb/ft s)		8.13	0.29
Frctn Loss (ft)	4.09	Cum Volume (acre-ft)	52.09	151.46	11.47
C & E Loss (ft)	0.15	Cum SA (acres)	46.97	81.54	13.28

Warning: The energy equation could not be balanced within the specified number of iterations.
 The program selected the water surface that had the least amount of error between computed and assumed values.
 Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less

than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to

critical depth, the calculated water surface came back below critical depth. This indicates

that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 5363

INPUT

Description: Sta. 5363

Station Elevation Data		num=		10	
Sta	Elev	Sta	Elev	Sta	Elev
100	3432	282	3430	550	3428
1097	3425	1476	3426	1877	3428
				1966	3428
				2160	3430

Manning's n Values

num=		3	
Sta	n Val	Sta	n Val
100	.033	742	.033
		1476	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	742	1476		1199 1142	713	.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3426.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3426.84	Reach Len. (ft)	1199.00	1142.00	713.00
Crit W.S. (ft)	3426.14	Flow Area (sq ft)	34.19	1092.49	71.41
E.G. Slope (ft/ft)	0.001869	Area (sq ft)	34.19	1092.49	71.41
Q Total (cfs)	2888.00	Flow (cfs)	37.45	2772.35	78.21
Top Width (ft)	984.24	Top Width (ft)	81.02	734.00	169.22
Vel Total (ft/s)	2.41	Avg. Vel. (ft/s)	1.10	2.54	1.10
Max Chl Dpth (ft)	1.84	Hydr. Depth (ft)	0.42	1.49	0.42
Conv. Total (cfs)	66802.9	Conv. (cfs)	866.1	64127.7	1809.0
Length Wtd. (ft)	1137.41	Wetted Per. (ft)	81.03	734.00	169.22
Min Ch El (ft)	3425.00	Shear (lb/sq ft)	0.05	0.17	0.05
Alpha	1.07	Stream Power (lb/ft s)	0.05	0.44	0.05
Frctn Loss (ft)	4.97	Cum Volume (acre-ft)	21.76	70.38	2.50
C & E Loss (ft)	0.03	Cum SA (acres)	21.93	57.32	2.73

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Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3427.91	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3427.72	Reach Len. (ft)	1199.00	1142.00	713.00
Crit W.S. (ft)	3426.80	Flow Area (sq ft)	141.35	1732.59	295.22
E.G. Slope (ft/ft)	0.002096	Area (sq ft)	141.35	1732.59	295.22
Q Total (cfs)	7144.00	Flow (cfs)	263.09	6331.42	549.49
Top Width (ft)	1242.81	Top Width (ft)	164.74	734.00	344.07
Vel Total (ft/s)	3.29	Avg. Vel. (ft/s)	1.86	3.65	1.86
Max Chl Dpth (ft)	2.72	Hydr. Depth (ft)	0.86	2.36	0.86
Conv. Total (cfs)	156056.6	Conv. (cfs)	5747.0	138306.4	12003.2
Length Wtd. (ft)	1129.22	Wetted Per. (ft)	164.75	734.00	344.08
Min Ch El (ft)	3425.00	Shear (lb/sq ft)	0.11	0.31	0.11
Alpha	1.13	Stream Power (lb/ft s)	0.21	1.13	0.21
Frctn Loss (ft)	5.04	Cum Volume (acre-ft)	50.85	120.22	7.34
C & E Loss (ft)	0.04	Cum SA (acres)	45.52	65.94	6.54

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 4221

INPUT

Description: Sta. 4221

Station Elevation Data		num= 12							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3423	341	3422	544	3421	640	3420	669	3420
753	3420.2	829	3420	837	3420	1030	3421	1320	3422
1407	3423	1497	3424						

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	544	.033	1407	.033

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Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	544	1407		749	732	843	.1 .3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3421.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.	0.033	0.033	
W.S. Elev (ft)	3421.49	Reach Len. (ft)	749.00	732.00	843.00
Crit W.S. (ft)	3421.49	Flow Area (sq ft)	24.56	599.68	
E.G. Slope (ft/ft)	0.015261	Area (sq ft)	24.56	599.68	
Q Total (cfs)	3286.00	Flow (cfs)	53.64	3232.36	
Top Width (ft)	728.53	Top Width (ft)	99.86	628.66	
Vel Total (ft/s)	5.26	Avg. Vel. (ft/s)	2.18	5.39	
Max Chl Dpth (ft)	1.49	Hydr. Depth (ft)	0.25	0.95	
Conv. Total (cfs)	26599.8	Conv. (cfs)	434.2	26165.6	
Length Wtd. (ft)	737.24	Wetted Per. (ft)	99.87	628.67	
Min Ch El (ft)	3420.00	Shear (lb/sq ft)	0.23	0.91	
Alpha	1.03	Stream Power (lb/ft s)	0.51	4.90	
Frctn Loss (ft)	3.55	Cum Volume (acre-ft)	20.95	48.20	1.91
C & E Loss (ft)	0.10	Cum SA (acres)	19.44	39.46	1.35

Warning: The energy equation could not be balanced within the specified number of iterations.
The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3422.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.033	0.033	
W.S. Elev (ft)	3422.20	Reach Len. (ft)	749.00	732.00	843.00

		FloodPlain.rep			
Crit W.S. (ft)	3422.20	Flow Area (sq ft)	146.05	1110.69	
E.G. Slope (ft/ft)	0.013358	Area (sq ft)	146.05	1110.69	
Q Total (cfs)	7766.00	Flow (cfs)	530.65	7235.35	
Top Width (ft)	1043.46	Top Width (ft)	250.36	793.10	
Vel Total (ft/s)	6.18	Avg. Vel. (ft/s)	3.63	6.51	
Max Chl Dpth (ft)	2.20	Hydr. Depth (ft)	0.58	1.40	
Conv. Total (cfs)	67192.6	Conv. (cfs)	4591.3	62601.3	
Length Wtd. (ft)	737.87	Wetted Per. (ft)	250.37	793.11	
Min Ch El (ft)	3420.00	Shear (lb/sq ft)	0.49	1.17	
Alpha	1.06	Stream Power (lb/ft s)	1.77	7.61	
Frctn Loss (ft)	3.76	Cum Volume (acre-ft)	46.89	82.95	4.92
C & E Loss (ft)	0.12	Cum SA (acres)	39.81	45.93	3.73

Warning: The energy equation could not be balanced within the specified number of iterations.
The program selected the water surface that had the least amount of error between computed and assumed values.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 3489

INPUT

Description: Sta. 3489

Station Elevation Data		num= 22							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-286	3420	-138	3418.5	-126	3418	-104	3416	-91	3415.5
-76	3416	-21	3417	100	3417	258	3416.5	299	3416
309	3415	318	3416	405	3416	422	3416	539	3416.4
581	3416.2	642	3416.4	744	3416	830	3416	918	3418
1068	3420	1159	3421						

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
-286	.033	539	.033	918	.033

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
539	918	464	500	457	.1	.3	

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3417.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.033	0.033	
W.S. Elev (ft)	3417.66	Reach Len. (ft)	464.00	500.00	457.00
Crit W.S. (ft)	3417.07	Flow Area (sq ft)	800.11	493.34	
E.G. Slope (ft/ft)	0.002329	Area (sq ft)	800.11	493.34	
Q Total (cfs)	3286.00	Flow (cfs)	1973.59	1312.41	
Top Width (ft)	1025.44	Top Width (ft)	661.29	364.15	
Vel Total (ft/s)	2.54	Avg. Vel. (ft/s)	2.47	2.66	
Max Chl Dpth (ft)	2.66	Hydr. Depth (ft)	1.21	1.35	
Conv. Total (cfs)	68095.7	Conv. (cfs)	40898.7	27197.0	
Length Wtd. (ft)	481.91	Wetted Per. (ft)	661.50	364.17	
Min Ch El (ft)	3416.00	Shear (lb/sq ft)	0.18	0.20	
Alpha	1.00	Stream Power (lb/ft s)	0.43	0.52	
Frctn Loss (ft)	2.37	Cum Volume (acre-ft)	13.86	39.02	1.91
C & E Loss (ft)	0.03	Cum SA (acres)	12.90	31.12	1.35

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3418.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3418.44	Reach Len. (ft)	464.00	500.00	457.00
Crit W.S. (ft)	3417.60	Flow Area (sq ft)	1318.41	785.27	7.24
E.G. Slope (ft/ft)	0.002671	Area (sq ft)	1318.41	785.27	7.24
Q Total (cfs)	7766.00	Flow (cfs)	4790.13	2969.74	6.14
Top Width (ft)	1087.51	Top Width (ft)	675.55	379.00	32.96
Vel Total (ft/s)	3.68	Avg. Vel. (ft/s)	3.63	3.78	0.85
Max Chl Dpth (ft)	3.44	Hydr. Depth (ft)	1.95	2.07	0.22
Conv. Total (cfs)	150271.6	Conv. (cfs)	92688.7	57464.2	118.7

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Length Wtd. (ft)	480.92	Wetted Per. (ft)	675.78	379.02	32.96
Min Ch El (ft)	3416.00	Shear (lb/sq ft)	0.33	0.35	0.04
Alpha	1.01	Stream Power (lb/ft s)	1.18	1.31	0.03
Frctn Loss (ft)	2.33	Cum Volume (acre-ft)	34.30	67.02	4.85
C & E Loss (ft)	0.04	Cum SA (acres)	31.85	36.08	3.41

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 2989

INPUT

Description: Sta. 2989

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-31	3416	59	3414.8	170	3414.8	196	3414	436	3413.8
613	3414	651	3414	700	3414	747	3414	761	3414
841	3415.01	920	3416	976	3418	1067	3420		

Sta	n Val	Sta	n Val	Sta	n Val
-31	.033	436	.033	841	.033

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
436	841	317	215	.3	.5

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3415.36	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.41	Wt. n-Val.	0.033	0.033	
W.S. Elev (ft)	3414.95	Reach Len. (ft)	317.00	215.00	172.00
Crit W.S. (ft)	3414.95	Flow Area (sq ft)	283.67	362.07	
E.G. Slope (ft/ft)	0.016461	Area (sq ft)	283.67	362.07	
Q Total (cfs)	3286.00	Flow (cfs)	1329.43	1956.57	
Top Width (ft)	788.45	Top Width (ft)	388.22	400.22	
Vel Total (ft/s)	5.09	Avg. Vel. (ft/s)	4.69	5.40	
Max Chl Dpth (ft)	1.15	Hydr. Depth (ft)	0.73	0.90	
Conv. Total (cfs)	25611.5	Conv. (cfs)	10361.7	15249.8	
Length Wtd. (ft)	255.96	Wetted Per. (ft)	388.24	400.23	
Min Ch El (ft)	3413.80	Shear (lb/sq ft)	0.75	0.93	

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Alpha	1.01	Stream Power (lb/ft s)	3.52	5.02	
Frctn Loss (ft)	0.46	Cum Volume (acre-ft)	8.09	34.11	1.91
C & E Loss (ft)	0.16	Cum SA (acres)	7.31	26.73	1.35

Warning: The energy equation could not be balanced within the specified number of iterations.
The

program selected the water surface that had the least amount of error between computed and assumed values.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3416.28	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.61	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3415.68	Reach Len. (ft)	317.00	215.00	172.00
Crit W.S. (ft)	3415.59	Flow Area (sq ft)	585.43	656.09	17.70
E.G. Slope (ft/ft)	0.011352	Area (sq ft)	585.43	656.09	17.70
Q Total (cfs)	7766.00	Flow (cfs)	3383.66	4341.55	40.79
Top Width (ft)	900.85	Top Width (ft)	442.70	405.00	53.15
Vel Total (ft/s)	6.17	Avg. Vel. (ft/s)	5.78	6.62	2.30
Max Chl Dpth (ft)	1.88	Hydr. Depth (ft)	1.32	1.62	0.33
Conv. Total (cfs)	72888.6	Conv. (cfs)	31757.7	40748.1	382.9
Length Wtd. (ft)	263.06	Wetted Per. (ft)	442.72	405.01	53.15
Min Ch El (ft)	3413.80	Shear (lb/sq ft)	0.94	1.15	0.24
Alpha	1.03	Stream Power (lb/ft s)	5.42	7.60	0.54
Frctn Loss (ft)	0.76	Cum Volume (acre-ft)	24.16	58.75	4.72
C & E Loss (ft)	0.20	Cum SA (acres)	25.89	31.58	2.96

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
 REACH: 5 RS: 2774

INPUT

Description: Sta. 2774 Upstream of culverts

Station	Elevation	Data	num=	18
Sta	Elev	Sta	Elev	Sta Elev Sta Elev Sta Elev
-453	3416	-437	3415	-405 3414 -289 3413.8 -13 3413.8
100	3413.8	175	3413.8	204 3412 261 3412 298 3411.2
402	3410.9	437	3410	469 3409 491 3409 511 3410
560	3412	641	3414	725 3416

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
-453	.033	437	.033
		511	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	437	511		40	40	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-888	F		
888	F		

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3414.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3414.41	Reach Len. (ft)	40.00	40.00	40.00
Crit W.S. (ft)	3412.71	Flow Area (sq ft)	1115.26	374.10	284.35
E.G. Slope (ft/ft)	0.000645	Area (sq ft)	1115.26	374.10	284.35
Q Total (cfs)	3286.00	Flow (cfs)	1522.17	1259.45	504.38
Top Width (ft)	1076.10	Top Width (ft)	855.02	74.00	147.08
Vel Total (ft/s)	1.85	Avg. Vel. (ft/s)	1.36	3.37	1.77
Max Chl Dpth (ft)	5.41	Hydr. Depth (ft)	1.30	5.06	1.93
Conv. Total (cfs)	129409.2	Conv. (cfs)	59946.0	49599.6	19863.6
Length Wtd. (ft)	40.00	Wetted Per. (ft)	855.10	74.04	147.15
Min Ch El (ft)	3409.00	Shear (lb/sq ft)	0.05	0.20	0.08
Alpha	1.66	Stream Power (lb/ft s)	0.07	0.68	0.14
Frctn Loss (ft)		Cum Volume (acre-ft)	3.00	32.29	1.35
C & E Loss (ft)		Cum SA (acres)	2.78	25.56	1.06

Warning: The cross section had to be extended vertically during the critical depth calculations.

Warning: The parabolic search method failed to converge on critical depth. The program will try the

cross section slice/secant method to find critical depth.

CROSS SECTION OUTPUT Profile #PF 3

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	3415.31				
Vel Head (ft)	0.20	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3415.12	Reach Len. (ft)	40.00	40.00	40.00
Crit W.S. (ft)	3413.54	Flow Area (sq ft)	1729.17	426.55	399.14
E.G. Slope (ft/ft)	0.001303	Area (sq ft)	1729.17	426.55	399.14
Q Total (cfs)	7766.00	Flow (cfs)	4422.39	2227.79	1115.82
Top Width (ft)	1126.70	Top Width (ft)	875.85	74.00	176.85
Vel Total (ft/s)	3.04	Avg. Vel. (ft/s)	2.56	5.22	2.80
Max Chl Dpth (ft)	6.12	Hydr. Depth (ft)	1.97	5.76	2.26
Conv. Total (cfs)	215162.4	Conv. (cfs)	122525.4	61722.5	30914.5
Length Wtd. (ft)	40.00	Wetted Per. (ft)	875.94	74.04	176.93
Min Ch El (ft)	3409.00	Shear (lb/sq ft)	0.16	0.47	0.18
Alpha	1.37	Stream Power (lb/ft s)	0.41	2.45	0.51
Frctn Loss (ft)		Cum Volume (acre-ft)	15.74	56.08	3.90
C & E Loss (ft)		Cum SA (acres)	21.09	30.40	2.50

CULVERT RIVER: Ditch A
 REACH: 5 RS: 2773

INPUT

Description:

Distance from Upstream XS = 8

Deck/Roadway Width = 24

Weir Coefficient = 3

Upstream Deck/Roadway Coordinates

num= 6

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
26	3413.8				100	3413.8				402	3412.7			
500	3412.8				600	3413.9				700	3415.7			

Upstream Bridge Cross Section Data

Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-453	3416	-437	3415	-405	3414	-289	3413.8	-13	3413.8
100	3413.8	175	3413.8	204	3412	261	3412	298	3411.2
402	3410.9	437	3410	469	3409	491	3409	511	3410
560	3412	641	3414	725	3416				

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-453	.033	437	.033	511	.033

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	437	511	.3		.5

Ineffective Flow num= 2

FloodPlain.rep

Sta L Sta R Elev Permanent
 -888 F
 888 F

Downstream Deck/Roadway Coordinates

num= 6

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
26	3413.8				100	3413.8				402	3412.7			
500	3412.8				600	3413.9				700	3415.7			

Downstream Bridge Cross Section Data

Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-1721	3416	-1410	3414	26	3413.8	100	3412.4	155	3412
299	3411.4	349	3410	387	3408.9	391.4	3408.9	395.8	3408.9
400.2	3408.9	404.6	3408.9	409	3408.9	434	3410	487	3412
568	3414	658	3416						

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-1721	.033	349	.033	434	.033

Bank Sta: Left Right Coeff Contr. Expan.
 349 434 .3 .5

Ineffective Flow num= 2
 Sta L Sta R Elev Permanent

-888 F
 888 F

Upstream Embankment side slope = 3 horiz. to 1.0 vertical
 Downstream Embankment side slope = 3 horiz. to 1.0 vertical
 Maximum allowable submergence for weir flow = .95
 Elevation at which weir flow begins = 3412.7
 Energy head used in spillway design =
 Spillway height used in design =
 Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span
 Culvert #1 Pipe Arch 1.833 2.43
 FHWA Chart # 34- 18 inch corner radius; Corrugated metal
 FHWA Scale # 1 - 90 Degree headwall
 Solution Criteria = Highest U.S. EG

Culvert Upstrm Dist	Length	n Value	Entrance Loss Coef	Exit Loss Coef
1	39	.024	.5	1

Number of Barrels = 6

Upstream Elevation = 3409

Centerline Stations

Sta.	Sta.	Sta.	Sta.	Sta.	Sta.
469	473.4	477.8	482.2	486.6	491

Downstream Elevation = 3408.9

Centerline Stations

Sta.	Sta.	Sta.	Sta.	Sta.	Sta.
387	391.4	395.8	400.2	404.6	409

CROSS SECTION RIVER: Ditch A
 REACH: 5 RS: 2734

INPUT

Description: Sta. 2734 Downstream of culverts

Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-1721	3416	-1410	3414	26	3413.8	100	3412.4	155	3412
299	3411.4	349	3410	387	3408.9	391.4	3408.9	395.8	3408.9

FloodPlain.rep

400.2	3408.9	404.6	3408.9	409	3408.9	434	3410	487	3412
568	3414	658	3416						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-1721	.033	349	.033	434	.033

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

	349	434	745	846	1015	.3	.5
--	-----	-----	-----	-----	------	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-888	F		
888	F		

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3413.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.55	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3412.71	Reach Len. (ft)	745.00	846.00	1015.00
Crit W.S. (ft)	3412.71	Flow Area (sq ft)	275.89	288.99	100.64
E.G. Slope (ft/ft)	0.004812	Area (sq ft)	275.89	288.99	100.64
Q Total (cfs)	3286.00	Flow (cfs)	884.51	2040.31	361.18
Top Width (ft)	431.91	Top Width (ft)	265.26	85.00	81.65
Vel Total (ft/s)	4.94	Avg. Vel. (ft/s)	3.21	7.06	3.59
Max Chl Dpth (ft)	3.81	Hydr. Depth (ft)	1.04	3.40	1.23
Conv. Total (cfs)	47371.8	Conv. (cfs)	12751.3	29413.6	5206.9
Length Wtd. (ft)	841.72	Wetted Per. (ft)	265.28	85.04	81.70
Min Ch El (ft)	3408.90	Shear (lb/sq ft)	0.31	1.02	0.37
Alpha	1.44	Stream Power (lb/ft s)	1.00	7.21	1.33
Frctn Loss (ft)	3.01	Cum Volume (acre-ft)	2.36	31.99	1.17
C & E Loss (ft)	0.22	Cum SA (acres)	2.27	25.49	0.95

Warning: The energy equation could not be balanced within the specified number of iterations.
The program selected the water surface that had the least amount of error between computed and assumed values.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Warning: The parabolic search method failed to converge on critical depth. The program will

try the

cross section slice/secant method to find critical depth.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3414.83	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3414.37	Reach Len. (ft)	745.00	846.00	1015.00
Crit W.S. (ft)	3414.37	Flow Area (sq ft)	1462.63	430.11	292.31
E.G. Slope (ft/ft)	0.003331	Area (sq ft)	1462.63	430.11	292.31
Q Total (cfs)	7766.00	Flow (cfs)	3290.35	3293.62	1182.03
Top Width (ft)	2051.72	Top Width (ft)	1816.17	85.00	150.55
Vel Total (ft/s)	3.55	Avg. Vel. (ft/s)	2.25	7.66	4.04
Max Chl Dpth (ft)	5.47	Hydr. Depth (ft)	0.81	5.06	1.94
Conv. Total (cfs)	134550.1	Conv. (cfs)	57007.1	57063.8	20479.3
Length Wtd. (ft)		Wetted Per. (ft)	1816.21	85.04	150.61
Min Ch El (ft)	3408.90	Shear (lb/sq ft)	0.17	1.05	0.40
Alpha	2.34	Stream Power (lb/ft s)	0.38	8.06	1.63
Frctn Loss (ft)		Cum Volume (acre-ft)	14.28	55.69	3.58
C & E Loss (ft)		Cum SA (acres)	19.86	30.32	2.35

Warning: The energy equation could not be balanced within the specified number of iterations.
The

program used critical depth for the water surface and continued on with the calculations.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 1888

INPUT

Description: Sta. 1888

Station Elevation Data		num= 10							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-775	3412	-41	3410	81	3410	100	3410.2	110	3410
331	3408	532	3408	690	3408	1180	3410	1268	3412

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
-775	.033	100	.033	1180	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	100	1180		305	828	980	
						.1	.3

CROSS SECTION OUTPUT Profile #PF 2

FloodPlain.rep

E.G. Elev (ft)	3409.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.		0.033	
W.S. Elev (ft)	3409.80	Reach Len. (ft)	305.00	828.00	980.00
Crit W.S. (ft)	3409.14	Flow Area (sq ft)		1225.09	
E.G. Slope (ft/ft)	0.002775	Area (sq ft)		1225.09	
Q Total (cfs)	3327.00	Flow (cfs)		3327.00	
Top Width (ft)	999.96	Top Width (ft)		999.96	
Vel Total (ft/s)	2.72	Avg. Vel. (ft/s)		2.72	
Max Chl Dpth (ft)	1.80	Hydr. Depth (ft)		1.23	
Conv. Total (cfs)	63158.9	Conv. (cfs)		63158.9	
Length Wtd. (ft)	828.00	Wetted Per. (ft)		999.97	
Min Ch El (ft)	3408.00	Shear (lb/sq ft)		0.21	
Alpha	1.00	Stream Power (lb/ft s)		0.58	
Frctn Loss (ft)	4.67	Cum Volume (acre-ft)		17.28	
C & E Loss (ft)	0.04	Cum SA (acres)		14.95	

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross

section. This may indicate the need for additional cross sections.

Note: Hydraulic jump has occurred between this cross section and the previous upstream section.

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3410.80	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.033	0.033	0.033
W.S. Elev (ft)	3410.59	Reach Len. (ft)	305.00	828.00	980.00
Crit W.S. (ft)	3409.82	Flow Area (sq ft)	146.69	2069.78	7.77
E.G. Slope (ft/ft)	0.002839	Area (sq ft)	146.69	2069.78	7.77
Q Total (cfs)	7864.00	Flow (cfs)	193.76	7661.94	8.30
Top Width (ft)	1465.23	Top Width (ft)	359.09	1080.00	26.15
Vel Total (ft/s)	3.54	Avg. Vel. (ft/s)	1.32	3.70	1.07
Max Chl Dpth (ft)	2.59	Hydr. Depth (ft)	0.41	1.92	0.30

Conv. Total (cfs)	147583.8	FloodPlain.rep Conv. (cfs)	3636.3	143791.8	155.7
Length Wtd. (ft)	821.74	Wetted Per. (ft)	359.09	1080.02	26.15
Min Ch El (ft)	3408.00	Shear (lb/sq ft)	0.07	0.34	0.05
Alpha	1.07	Stream Power (lb/ft s)	0.10	1.26	0.06
Frctn Loss (ft)	4.53	Cum Volume (acre-ft)	0.51	31.41	0.09
C & E Loss (ft)	0.05	Cum SA (acres)	1.26	19.01	0.29

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

Note: Hydraulic jump has occurred between this cross section and the previous upstream section.

CROSS SECTION RIVER: Ditch A
REACH: 5 RS: 1060

INPUT

Description: Sta. 1060

Station Elevation Data		num= 6							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	3408	394	3406	879	3402.7	909	3402.7	1206	3405
1523	3406								

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
100	.033	394	.033	1523	.033

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	394	1523		60	60	.1	.3

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	3405.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.53	Wt. n-Val.		0.033	
W.S. Elev (ft)	3404.67	Reach Len. (ft)			
Crit W.S. (ft)	3404.67	Flow Area (sq ft)		593.57	
E.G. Slope (ft/ft)	0.016121	Area (sq ft)		593.57	
Q Total (cfs)	3473.00	Flow (cfs)		3473.00	
Top Width (ft)	573.29	Top Width (ft)		573.29	
Vel Total (ft/s)	5.85	Avg. Vel. (ft/s)		5.85	
Max Chl Dpth (ft)	1.97	Hydr. Depth (ft)		1.04	
Conv. Total (cfs)	27353.4	Conv. (cfs)		27353.4	
Length Wtd. (ft)		Wetted Per. (ft)		573.31	

FloodPlain.rep

Min Ch El (ft)	3402.70	Shear (lb/sq ft)	1.04
Alpha	1.00	Stream Power (lb/ft s)	6.10
Frctn Loss (ft)		Cum Volume (acre-ft)	
C & E Loss (ft)		Cum SA (acres)	

CROSS SECTION OUTPUT Profile #PF 3

E.G. Elev (ft)	3406.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.67	Wt. n-Val.		0.033	
W.S. Elev (ft)	3405.55	Reach Len. (ft)			
Crit W.S. (ft)	3405.55	Flow Area (sq ft)		1235.07	
E.G. Slope (ft/ft)	0.014413	Area (sq ft)		1235.07	
Q Total (cfs)	8124.00	Flow (cfs)		8124.00	
Top Width (ft)	920.12	Top Width (ft)		920.12	
Vel Total (ft/s)	6.58	Avg. Vel. (ft/s)		6.58	
Max Chl Dpth (ft)	2.85	Hydr. Depth (ft)		1.34	
Conv. Total (cfs)	67669.9	Conv. (cfs)		67669.9	
Length Wtd. (ft)		Wetted Per. (ft)		920.14	
Min Ch El (ft)	3402.70	Shear (lb/sq ft)		1.21	
Alpha	1.00	Stream Power (lb/ft s)		7.94	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

SUMMARY OF MANNING'S N VALUES

River:Ditch A

Reach	River Sta.	n1	n2	n3
5	12674	.033	.033	.033
5	11337	.033	.033	.033
5	10937	.033	.033	.033
5	10288	.033	.033	.033
5	9690	.033	.033	.033
5	9009	.033	.033	.033
5	8130	.033	.033	.033
5	7717	.033	.033	.033
5	7253	.033	.033	.033

		FloodPlain.rep		
5	6343	.033	.033	.033
5	5363	.033	.033	.033
5	4221	.033	.033	.033
5	3489	.033	.033	.033
5	2989	.033	.033	.033
5	2774	.033	.033	.033
5	2773	Culvert		
5	2734	.033	.033	.033
5	1888	.033	.033	.033
5	1060	.033	.033	.033

SUMMARY OF REACH LENGTHS

River: Ditch A

Reach	River Sta..	Left	Channel	Right
5	12674	1206	1337	1433
5	11337	545	400	332
5	10937	729	649	445
5	10288	552	598	633
5	9690	639	681	658
5	9009	898	879	794
5	8130	399	413	456
5	7717	444	464	510
5	7253	756	910	980
5	6343	767	980	1051
5	5363	1199	1142	713
5	4221	749	732	843
5	3489	464	500	457
5	2989	317	215	172
5	2774	40	40	40
5	2773	Culvert		
5	2734	745	846	1015
5	1888	305	828	980
5	1060	60	60	60

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Ditch A

Reach	River Sta..	Contr..	Expan..
5	12674	.1	.3
5	11337	.1	.3
5	10937	.1	.3
5	10288	.1	.3
5	9690	.1	.3
5	9009	.1	.3
5	8130	.1	.3
5	7717	.1	.3
5	7253	.1	.3
5	6343	.1	.3
5	5363	.1	.3
5	4221	.1	.3
5	3489	.1	.3
5	2989	.3	.5
5	2774	.3	.5
5	2773	Culvert	

		FloodPlain.rep
5	2734	.3 .5
5	1888	.1 .3
5	1060	.1 .3

Profile Output Table - Standard Table 1

Reach lope /ft)	Vel (ft/s)	River Sta Chnl Flow Area (sq ft)	Q Total Top Width (ft)	Min Ch El Froude # Chl (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. S (ft)
5		12674	976.00	3477.00	3478.76	3478.27	3478.88	0.00
3056	2.90	357.89	355.40	0.46				
5		12674	1850.00	3477.00	3479.26	3478.68	3479.45	0.00
3167	3.69	553.45	422.29	0.49				
5		11337	976.00	3469.00	3470.81	3470.81	3471.39	0.01
3220	6.21	164.80	149.13	0.95				
5		11337	1850.00	3469.00	3471.47	3471.46	3472.26	0.01
0885	7.39	272.36	176.84	0.93				
5		10937	976.00	3464.00	3466.24	3466.08	3466.66	0.01
0235	5.21	188.24	162.01	0.83				
5		10937	1850.00	3464.00	3466.72	3466.72	3467.45	0.01
3153	6.91	273.71	197.22	0.98				
5		10288	976.00	3456.00	3457.22	3457.22	3457.51	0.02
0477	4.31	226.46	413.97	1.03				
5		10288	1850.00	3456.00	3457.57	3457.53	3457.93	0.01
5410	4.82	383.80	479.25	0.95				
5		9690	1242.00	3450.00	3451.93	3451.51	3452.09	0.00
4969	3.13	396.40	404.17	0.56				
5		9690	2689.00	3450.00	3452.40	3452.06	3452.72	0.00
6338	4.52	603.04	473.62	0.67				
5		9009	1242.00	3445.00	3446.90	3446.75	3447.19	0.01
1195	4.31	288.10	334.67	0.82				
5		9009	2689.00	3445.00	3447.65		3447.96	0.00
7751	4.51	596.64	492.15	0.72				
5		8130	1242.00	3440.00	3442.03	3441.49	3442.15	0.00
3422	2.73	455.81	437.11	0.47				
5		8130	2689.00	3440.00	3442.50	3442.03	3442.75	0.00
4647	4.06	674.08	497.59	0.58				
5		7717	1242.00	3437.80	3439.01	3439.01	3439.38	0.01
8011	4.88	254.54	350.81	1.01				
5		7717	2689.00	3437.80	3439.74		3440.11	0.00
9311	4.84	555.05	471.42	0.79				
5		7253	1483.00	3435.00	3436.81	3436.16	3436.89	0.00
1808	2.29	664.86	563.87	0.35				
5		7253	5399.00	3435.00	3437.84	3437.06	3438.13	0.00

				FloodPlain.rep				
3105	4.42	1299.73	667.97	0.51				
5		6343	2888.00	3430.00	3431.11	3431.11	3431.57	0.01
6513	5.44	531.26	583.36	1.00				
5		6343	7144.00	3430.00	3431.94	3431.94	3432.64	0.01
2039	6.76	1091.24	867.12	0.94				
5		5363	2888.00	3425.00	3426.84	3426.14	3426.94	0.00
1869	2.54	1198.09	984.24	0.37				
5		5363	7144.00	3425.00	3427.72	3426.80	3427.91	0.00
2096	3.65	2169.17	1242.81	0.42				
5		4221	3286.00	3420.00	3421.49	3421.49	3421.94	0.01
5261	5.39	624.24	728.53	0.97				
5		4221	7766.00	3420.00	3422.20	3422.20	3422.82	0.01
3358	6.51	1256.74	1043.46	0.97				
5		3489	3286.00	3416.00	3417.66	3417.07	3417.76	0.00
2329	2.66	1293.45	1025.44	0.40				
5		3489	7766.00	3416.00	3418.44	3417.60	3418.65	0.00
2671	3.78	2110.92	1087.51	0.46				
5		2989	3286.00	3413.80	3414.95	3414.95	3415.36	0.01
6461	5.40	645.74	788.45	1.00				
5		2989	7766.00	3413.80	3415.68	3415.59	3416.28	0.01
1352	6.62	1259.21	900.85	0.92				
5		2774	3286.00	3409.00	3414.41	3412.71	3414.50	0.00
0645	3.37	1773.70	1076.10	0.26				
5		2774	7766.00	3409.00	3415.12	3413.54	3415.31	0.00
1303	5.22	2554.86	1126.70	0.38				
5		2773	Culvert					
5		2734	3286.00	3408.90	3412.71	3412.71	3413.25	0.00
4812	7.06	665.51	431.91	0.67				
5		2734	7766.00	3408.90	3414.37	3414.37	3414.83	0.00
3331	7.66	2185.05	2051.72	0.60				
5		1888	3327.00	3408.00	3409.80	3409.14	3409.92	0.00
2775	2.72	1225.09	999.96	0.43				
5		1888	7864.00	3408.00	3410.59	3409.82	3410.80	0.00
2839	3.70	2224.23	1465.23	0.47				
5		1060	3473.00	3402.70	3404.67	3404.67	3405.20	0.01
6121	5.85	593.57	573.29	1.01				
5		1060	8124.00	3402.70	3405.55	3405.55	3406.22	0.01
4413	6.58	1235.07	920.12	1.00				

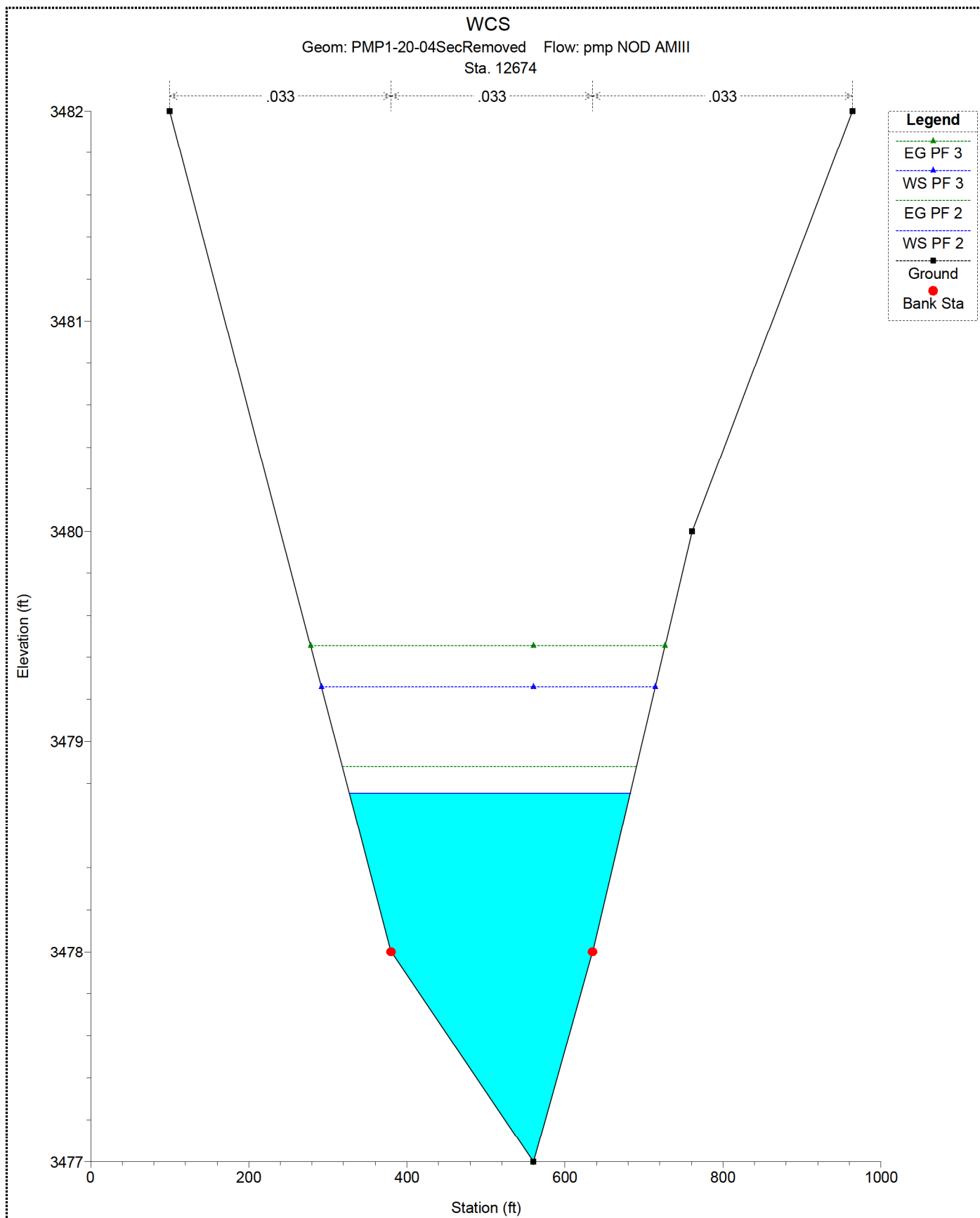
Profile Output Table - Report Standard Table 1

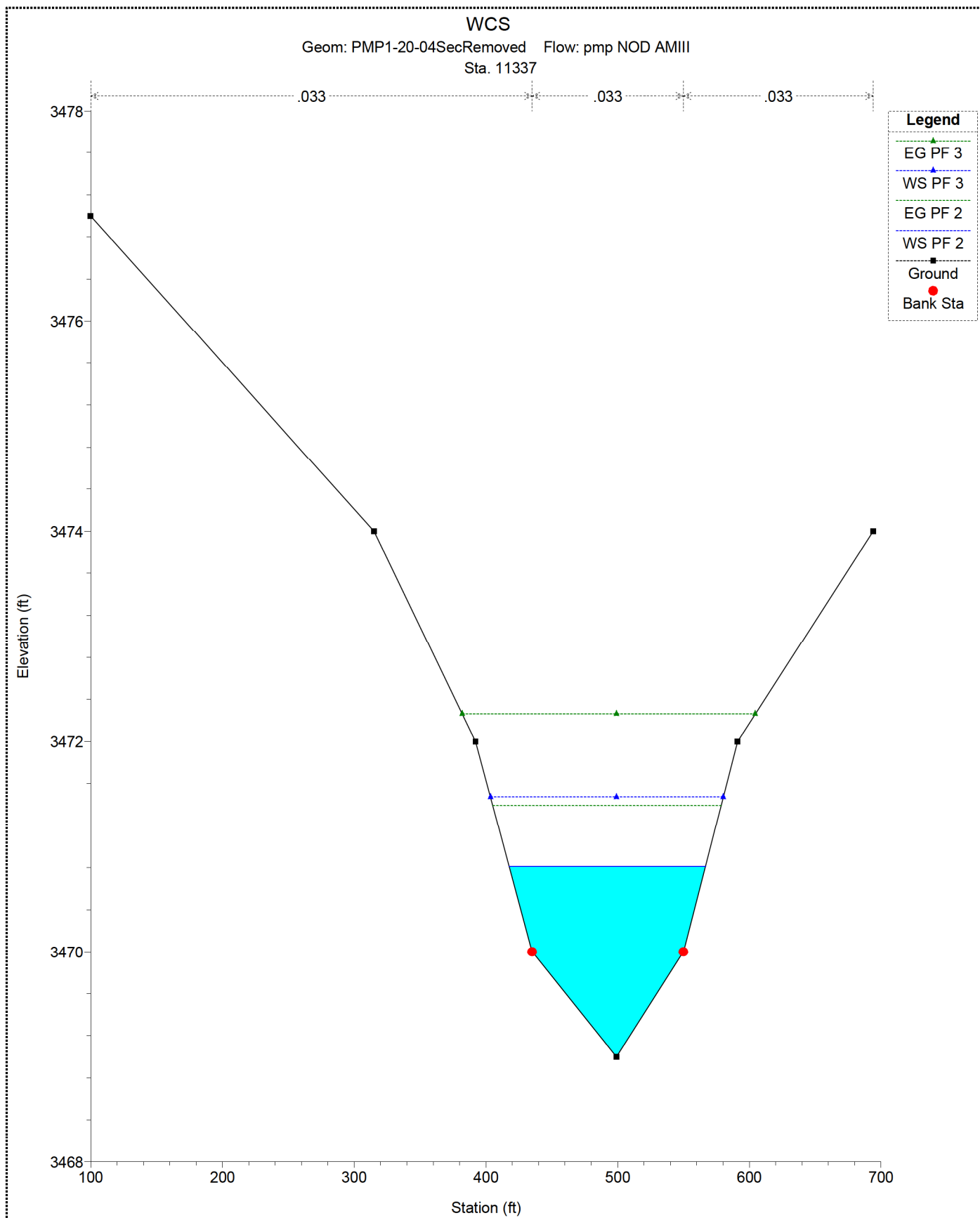
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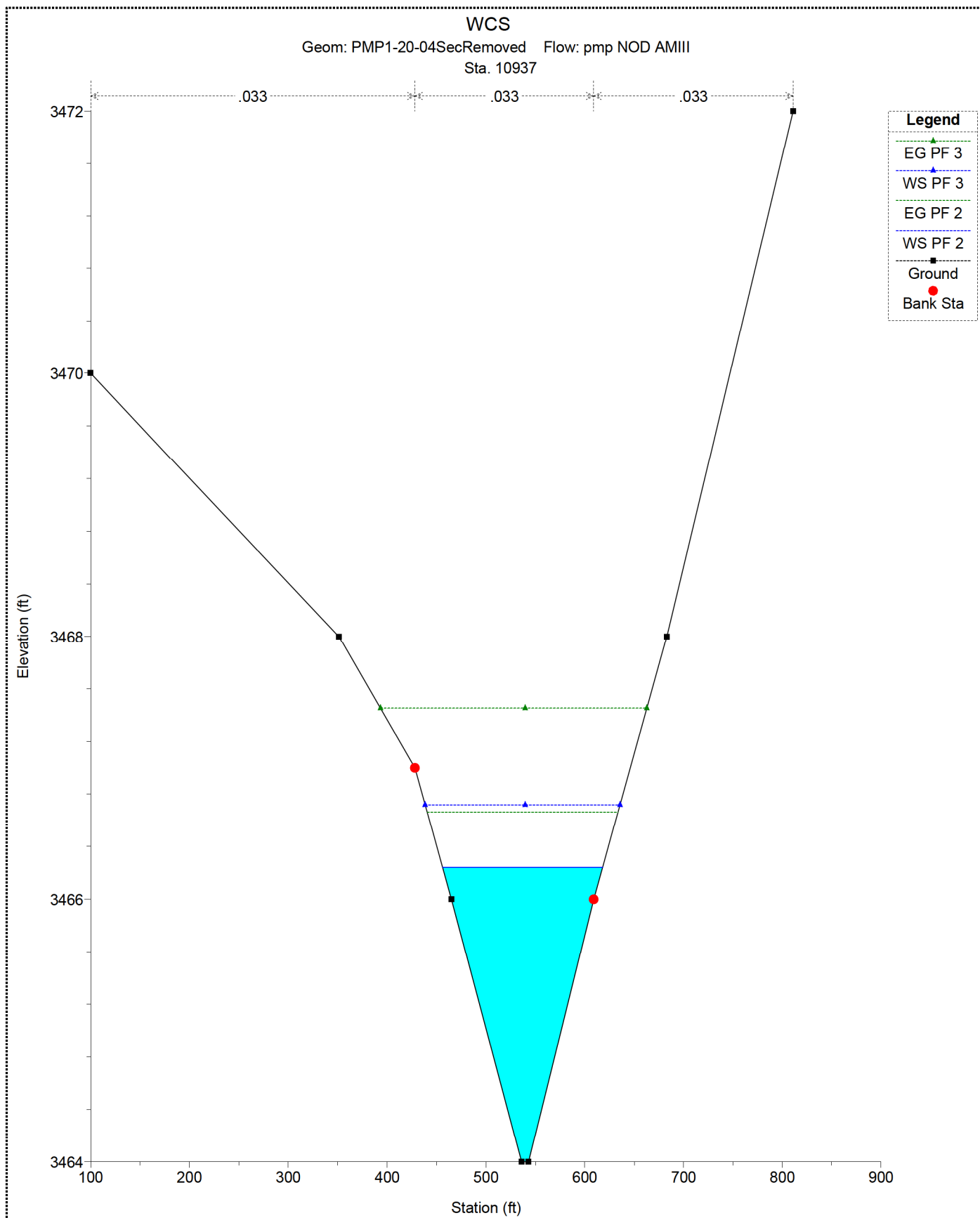
Reach	River Sta	Q Total	Min Ch El	W.S.	Elev	Crit W.S.	Max Chl Dpth	E.G
Elev	E.G. Slope	Sta W.S. Lft	Sta W.S. Rgt	Flow Area	Top Width	Froude #	Chl	
(ft)	(ft/ft)	(cfs)	(ft)	(ft)	(sq ft)	(ft)	(ft)	
5	12674	976.00	3477.00	3478.76	3478.27	1.75	3	
478.88	0.003056	327.16	682.56	357.89	355.40		0.46	
5	12674	1850.00	3477.00	3479.26	3478.68	2.26	3	
479.45	0.003167	291.95	714.24	553.45	422.29		0.49	
5	11337	976.00	3469.00	3470.81	3470.81	1.81	3	
471.39	0.013220	417.53	566.66	164.80	149.13		0.95	
5	11337	1850.00	3469.00	3471.47	3471.46	2.47	3	
472.26	0.010885	403.34	580.18	272.36	176.84		0.93	
5	10937	976.00	3464.00	3466.24	3466.08	2.24	3	
466.66	0.010235	455.99	618.01	188.24	162.01		0.83	
5	10937	1850.00	3464.00	3466.72	3466.72	2.72	3	
467.45	0.013153	438.39	635.61	273.71	197.22		0.98	
5	10288	976.00	3456.00	3457.22	3457.22	1.22	3	
457.51	0.020477	374.31	788.29	226.46	413.97		1.03	
5	10288	1850.00	3456.00	3457.57	3457.53	1.57	3	
457.93	0.015410	339.97	819.21	383.80	479.25		0.95	
5	9690	1242.00	3450.00	3451.93	3451.51	1.93	3	
452.09	0.004969	389.43	793.60	396.40	404.17		0.56	
5	9690	2689.00	3450.00	3452.40	3452.06	2.40	3	
452.72	0.006338	345.06	818.68	603.04	473.62		0.67	
5	9009	1242.00	3445.00	3446.90	3446.75	1.90	3	
447.19	0.011195	416.94	751.61	288.10	334.67		0.82	
5	9009	2689.00	3445.00	3447.65		2.65	3	
447.96	0.007751	354.62	846.77	596.64	492.15		0.72	
5	8130	1242.00	3440.00	3442.03	3441.49	2.03	3	

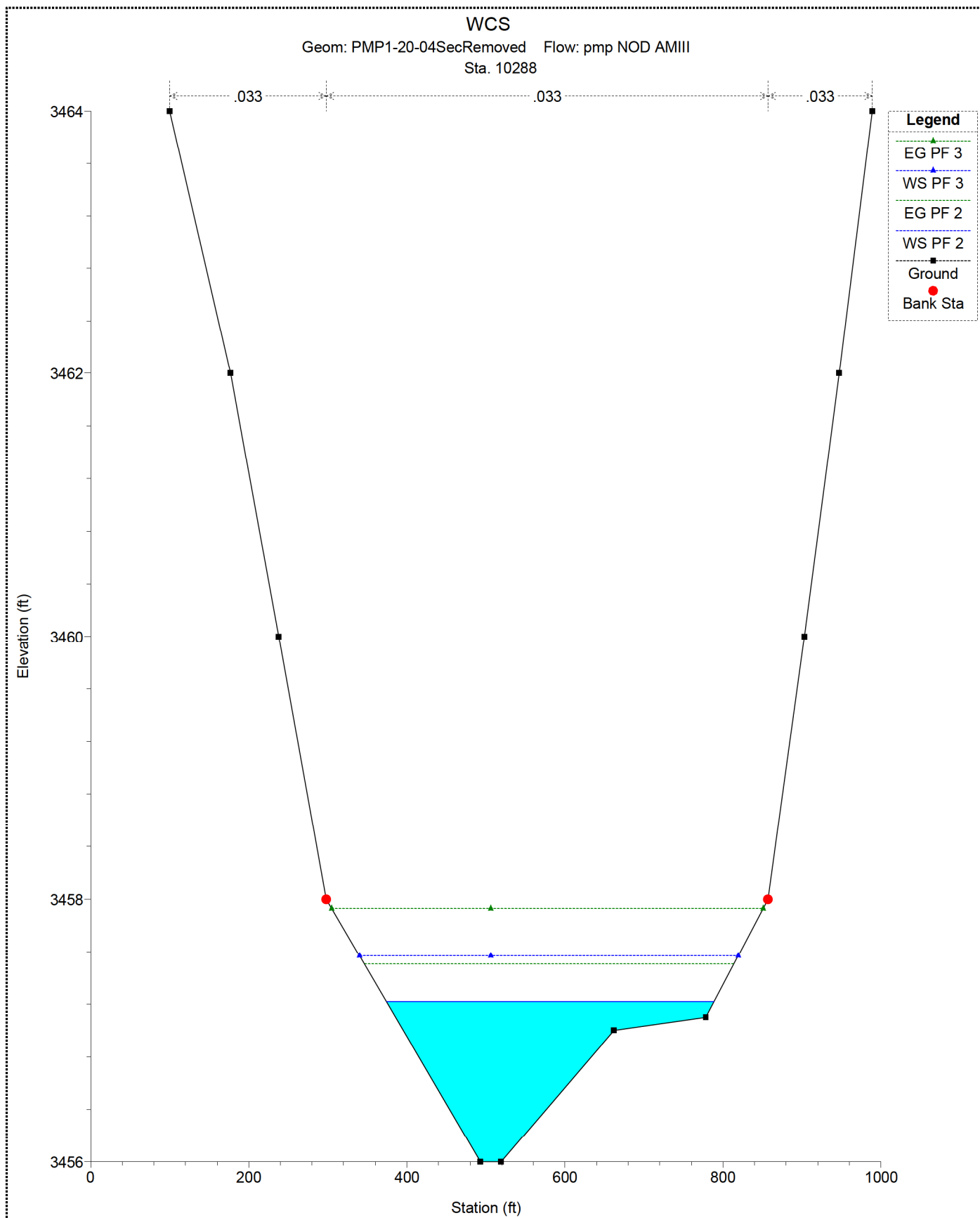
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442.15	0.003422	2.73	417.16	854.27	455.81	437.11		0.47	
5	8130		2689.00	3440.00	3442.50	3442.03		2.50	3
442.75	0.004647	4.06	390.07	887.66	674.08	497.59		0.58	
5	7717		1242.00	3437.80	3439.01	3439.01		1.21	3
439.38	0.018011	4.88	307.18	657.99	254.54	350.81		1.01	
5	7717		2689.00	3437.80	3439.74			1.94	3
440.11	0.009311	4.84	252.35	723.77	555.05	471.42		0.79	
5	7253		1483.00	3435.00	3436.81	3436.16		1.81	3
436.89	0.001808	2.29	382.26	946.12	664.86	563.87		0.35	
5	7253		5399.00	3435.00	3437.84	3437.06		2.84	3
438.13	0.003105	4.42	329.17	997.14	1299.73	667.97		0.51	
5	6343		2888.00	3430.00	3431.11	3431.11		1.11	3
431.57	0.016513	5.44	724.42	1307.78	531.26	583.36		1.00	
5	6343		7144.00	3430.00	3431.94	3431.94		1.94	3
432.64	0.012039	6.76	667.41	1534.53	1091.24	867.12		0.94	
5	5363		2888.00	3425.00	3426.84	3426.14		1.84	3
426.94	0.001869	2.54	660.98	1645.22	1198.09	984.24		0.37	
5	5363		7144.00	3425.00	3427.72	3426.80		2.72	3
427.91	0.002096	3.65	577.26	1820.07	2169.17	1242.81		0.42	
5	4221		3286.00	3420.00	3421.49	3421.49		1.49	3
421.94	0.015261	5.39	444.14	1172.66	624.24	728.53		0.97	
5	4221		7766.00	3420.00	3422.20	3422.20		2.20	3
422.82	0.013358	6.51	293.64	1337.10	1256.74	1043.46		0.97	
5	3489		3286.00	3416.00	3417.66	3417.07		2.66	3
417.76	0.002329	2.66	-122.29	903.15	1293.45	1025.44		0.40	
5	3489		7766.00	3416.00	3418.44	3417.60		3.44	3
418.65	0.002671	3.78	-136.55	950.96	2110.92	1087.51		0.46	
5	2989		3286.00	3413.80	3414.95	3414.95		1.15	3
415.36	0.016461	5.40	47.78	836.22	645.74	788.45		1.00	

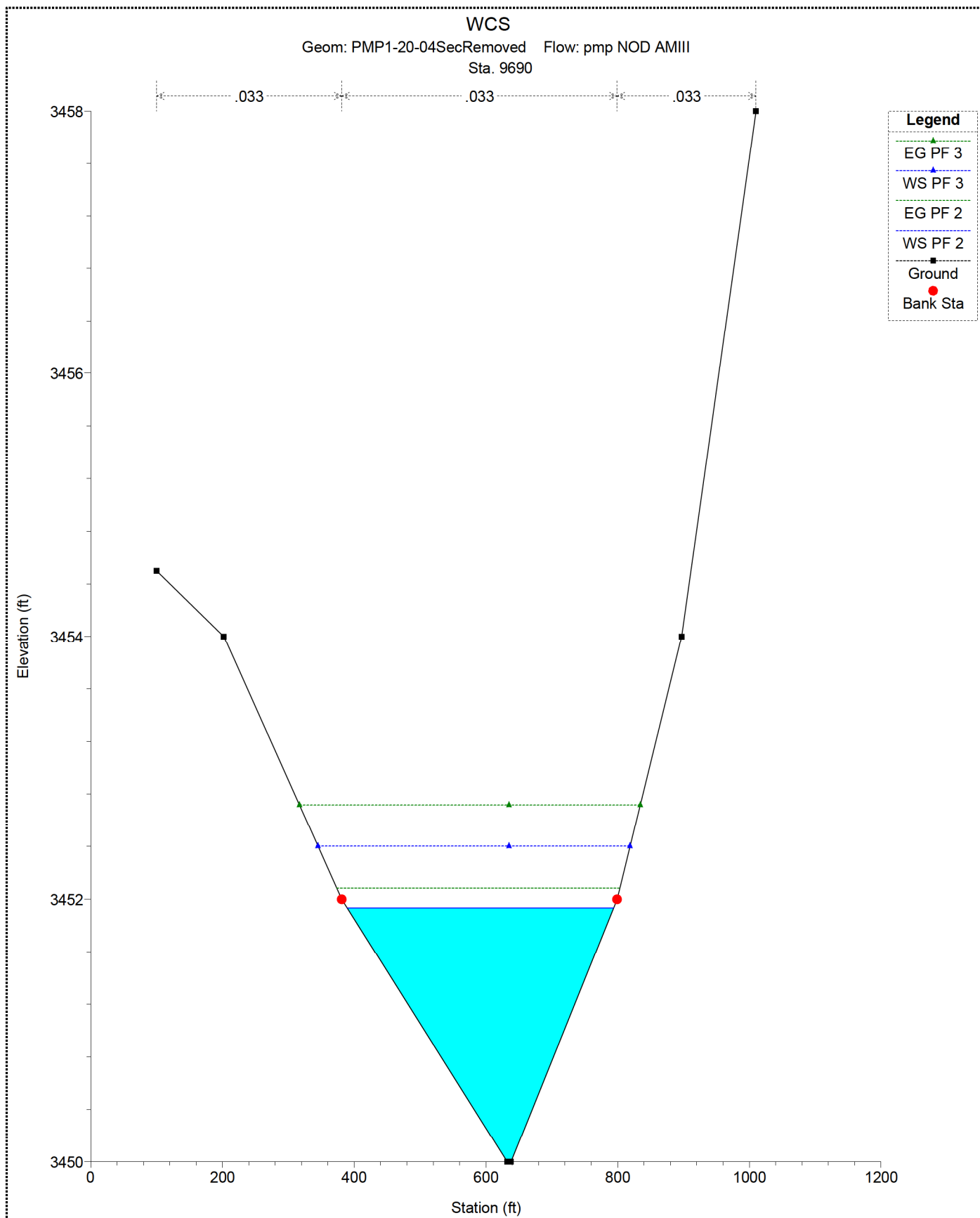
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5	2989		7766.00	3413.80	3415.68	3415.59	1.88	3	
416.28	0.011352	6.62	-6.70	894.15	1259.21	900.85		0.92	
5	2774		3286.00	3409.00	3414.41	3412.71	5.41	3	
414.50	0.000645	3.37	-418.02	658.08	1773.70	1076.10		0.26	
5	2774		7766.00	3409.00	3415.12	3413.54	6.12	3	
415.31	0.001303	5.22	-438.85	687.85	2554.86	1126.70		0.38	
5	2773		Culvert						
5	2734		3286.00	3408.90	3412.71	3412.71	3.81	3	
413.25	0.004812	7.06	83.74	515.65	665.51	431.91		0.67	
5	2734		7766.00	3408.90	3414.37	3414.37	5.47	3	
414.83	0.003331	7.66	-1467.17	584.55	2185.05	2051.72		0.60	
5	1888		3327.00	3408.00	3409.80	3409.14	1.80	3	
409.92	0.002775	2.72	131.77	1131.73	1225.09	999.96		0.43	
5	1888		7864.00	3408.00	3410.59	3409.82	2.59	3	
410.80	0.002839	3.70	-259.09	1206.15	2224.23	1465.23		0.47	
5	1060		3473.00	3402.70	3404.67	3404.67	1.97	3	
405.20	0.016121	5.85	589.80	1163.09	593.57	573.29		1.01	
5	1060		8124.00	3402.70	3405.55	3405.55	2.85	3	
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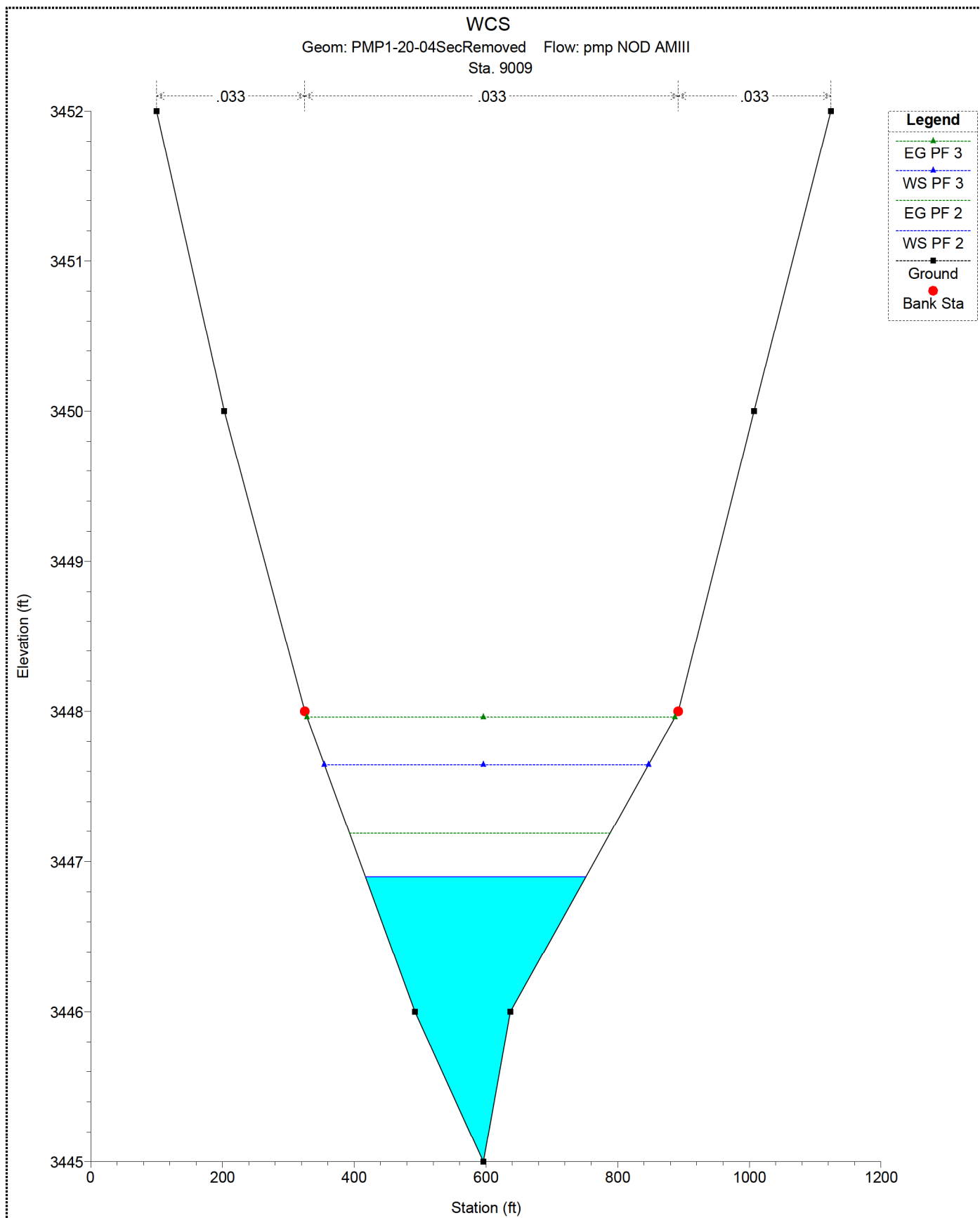


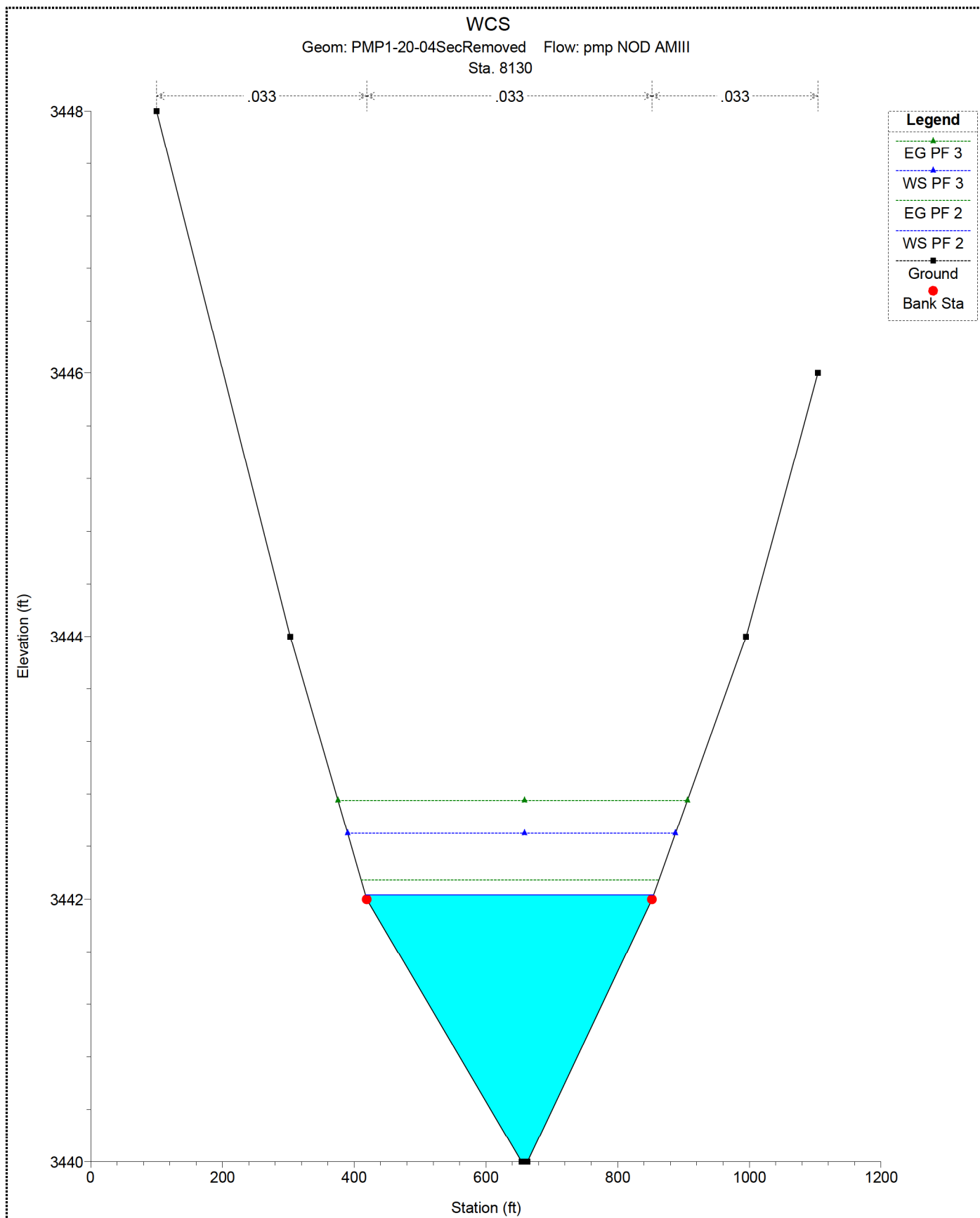


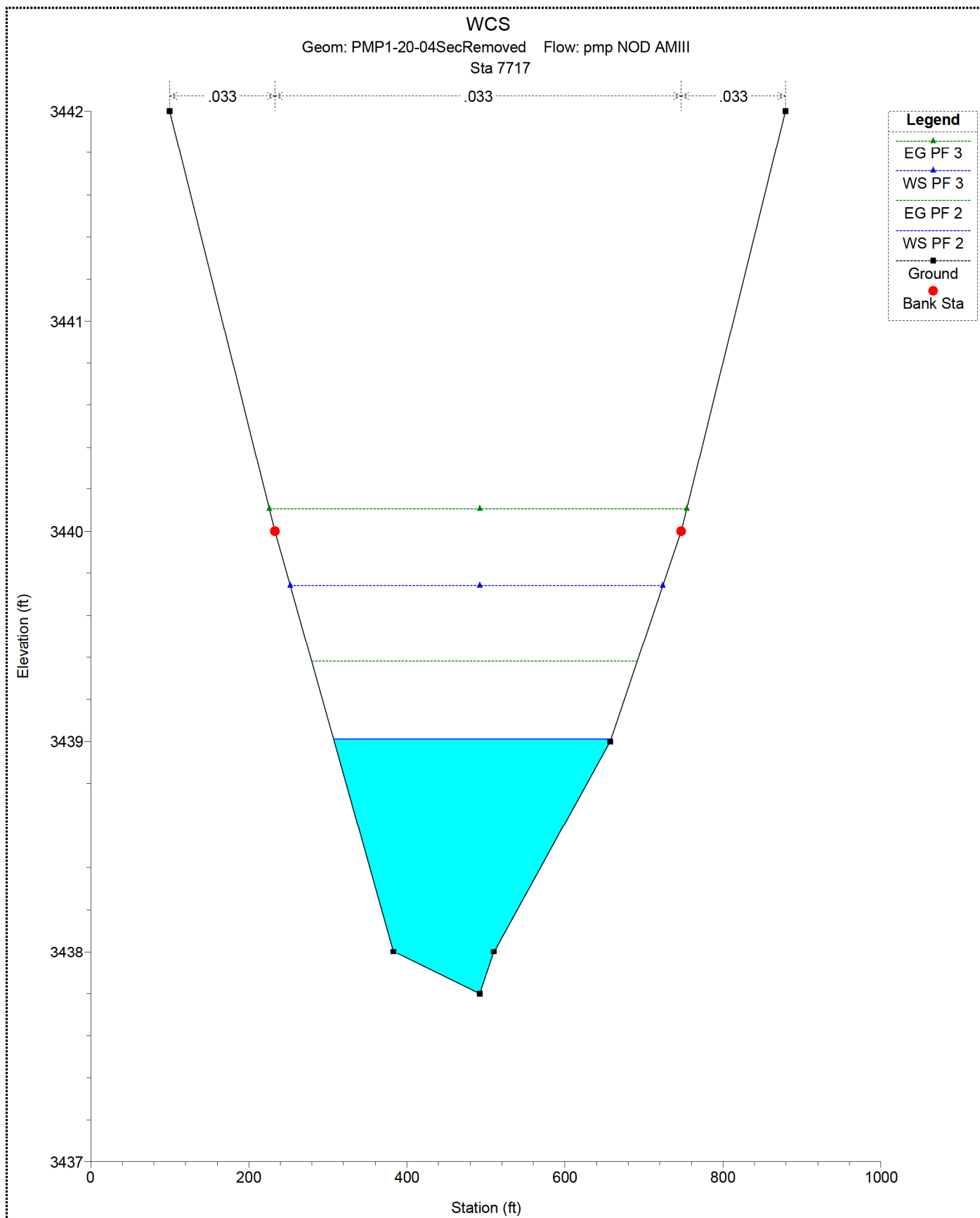


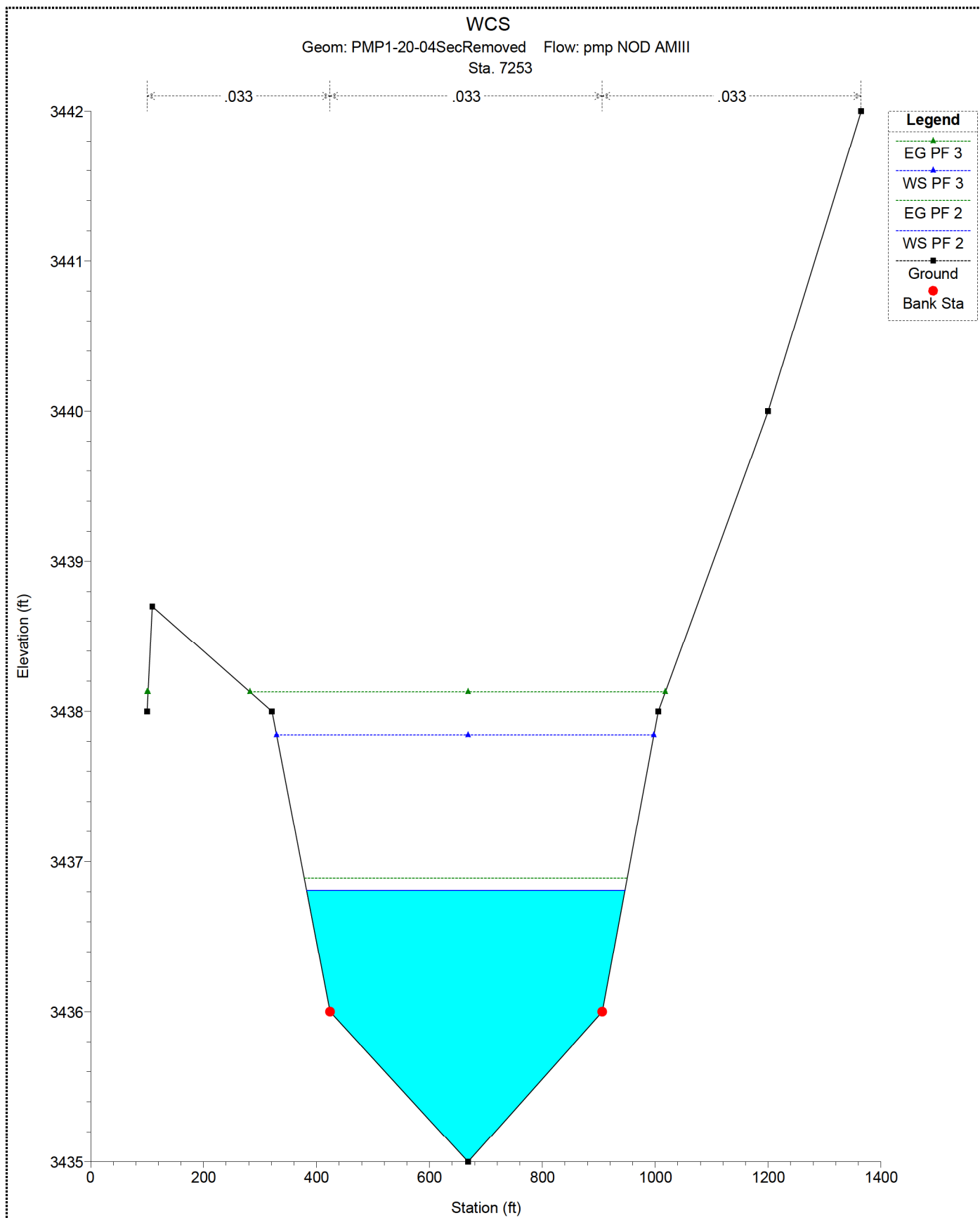


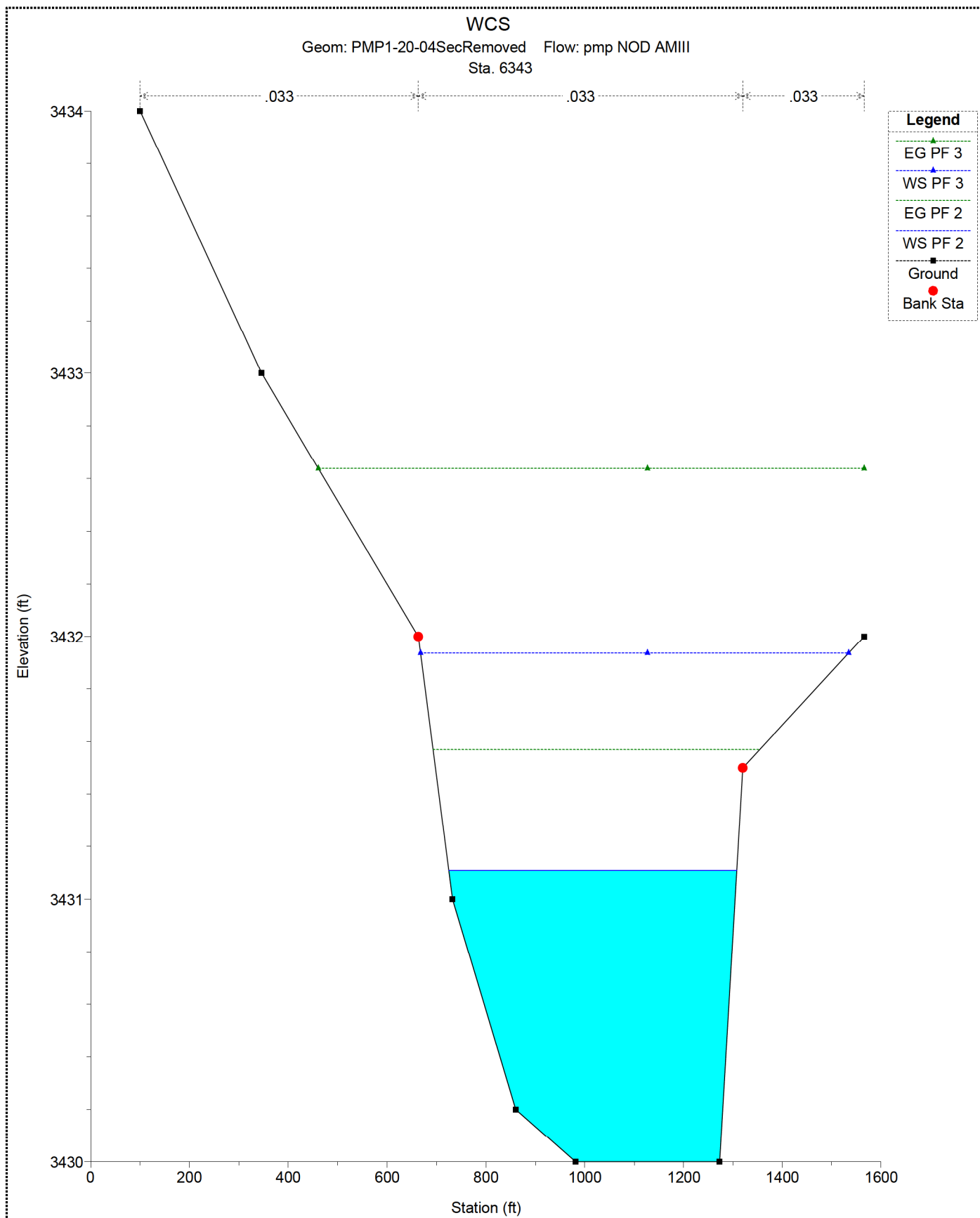


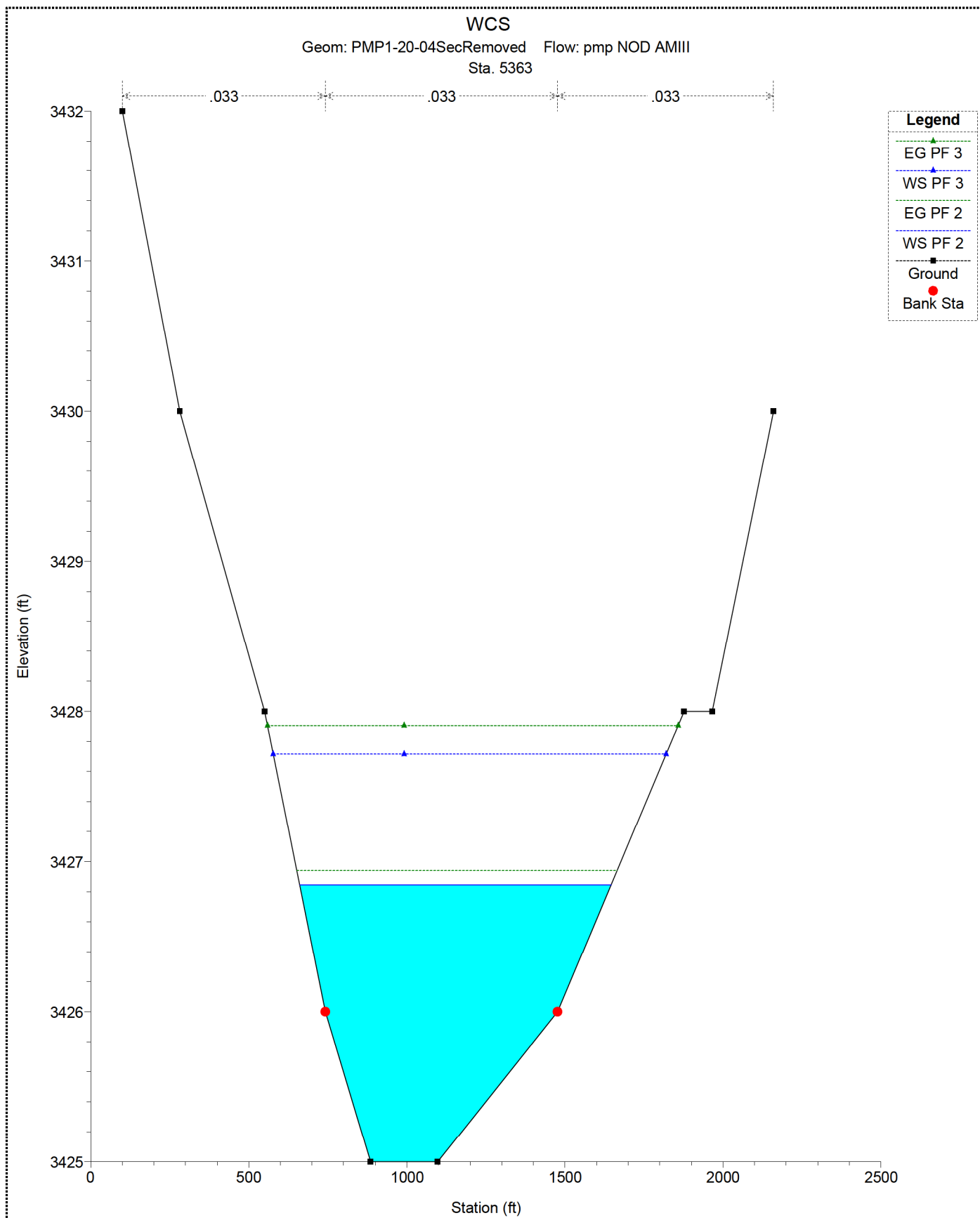


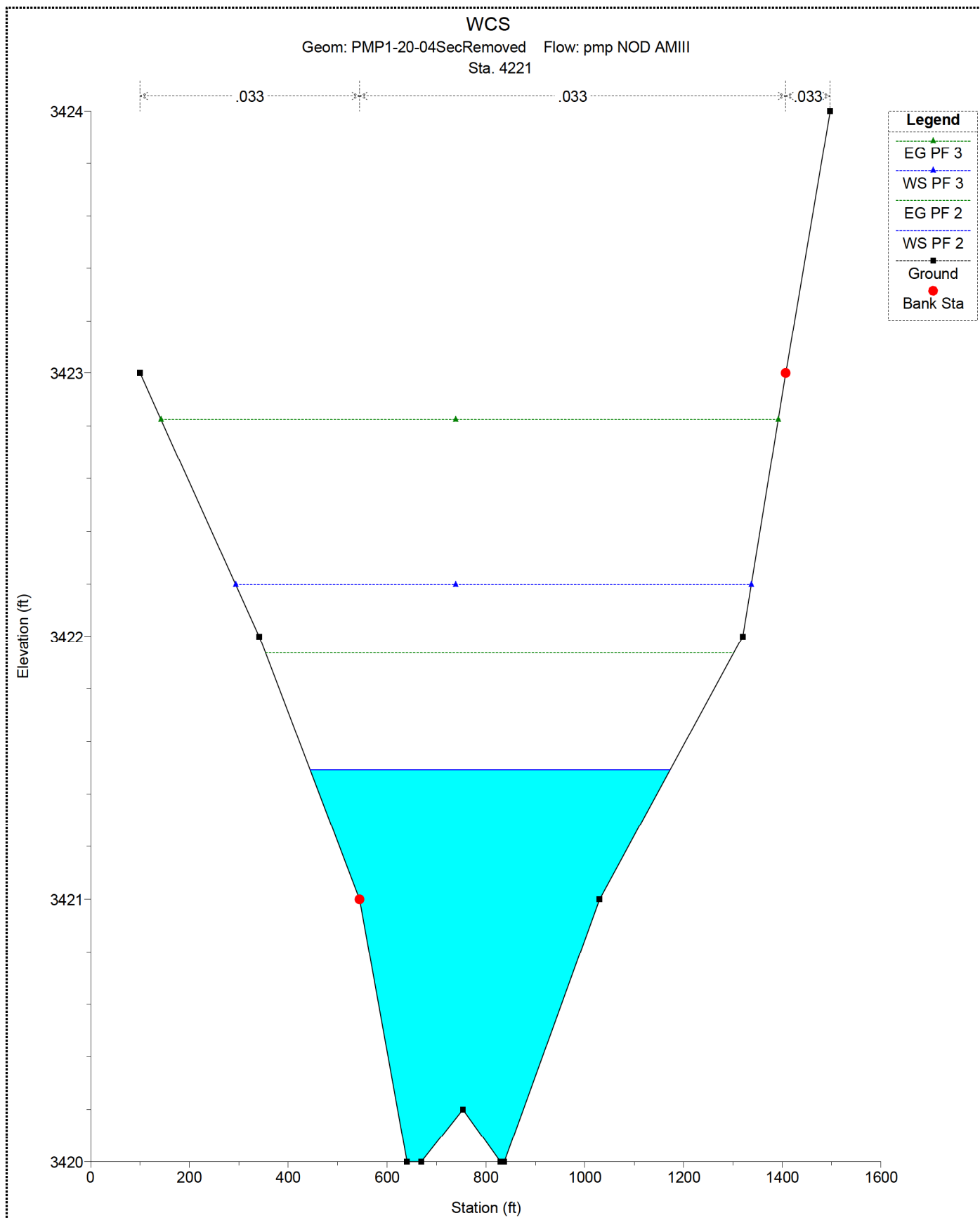


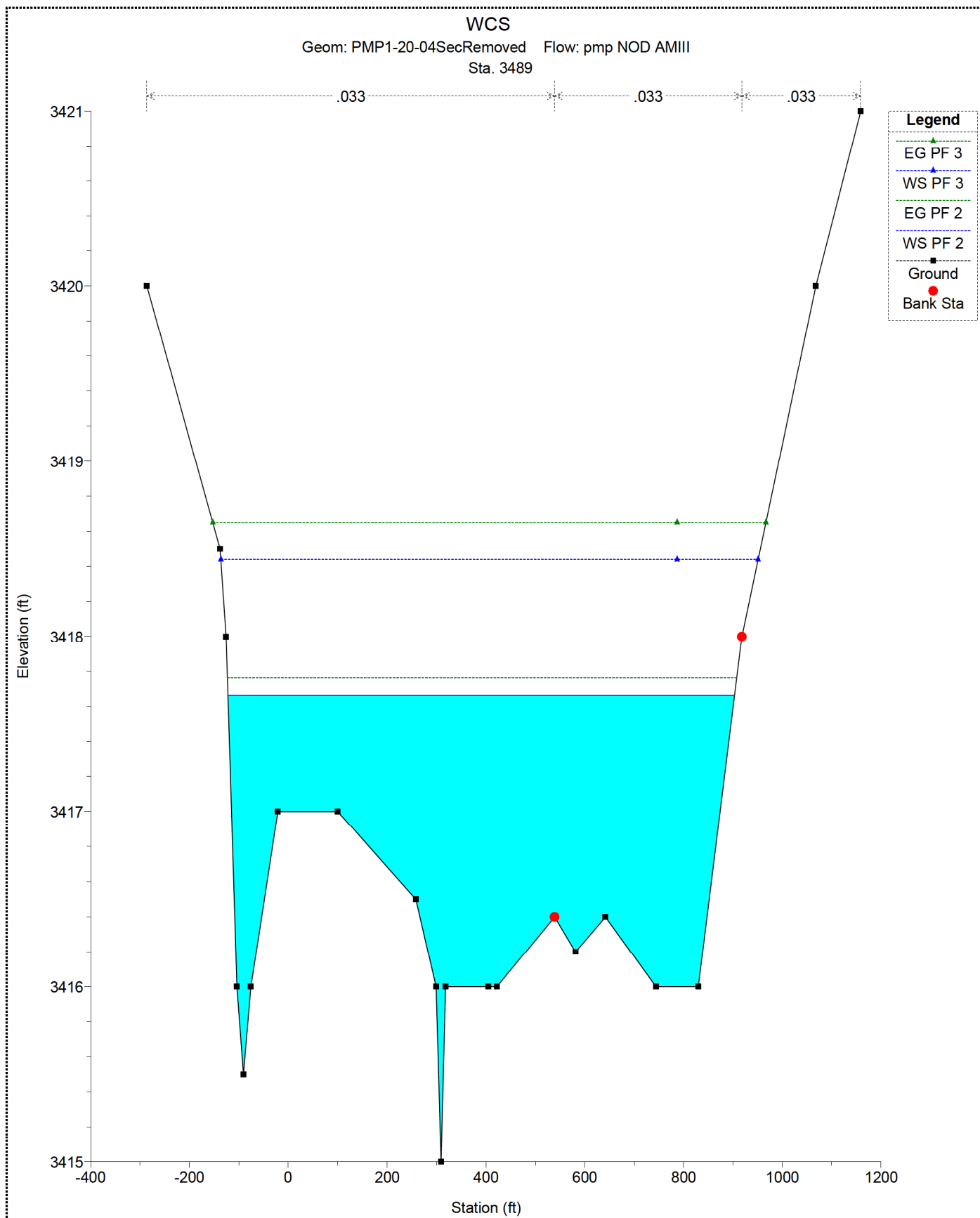


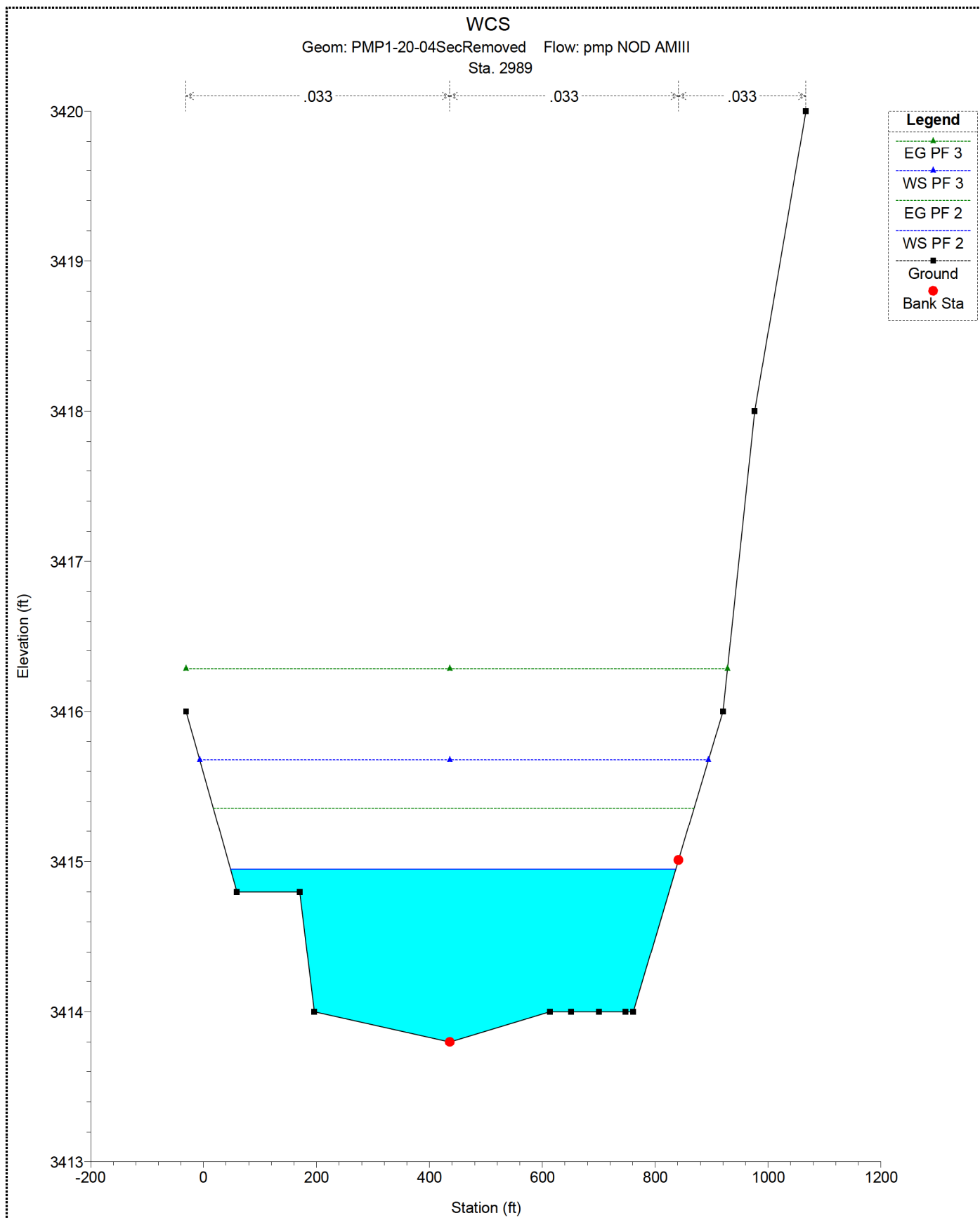


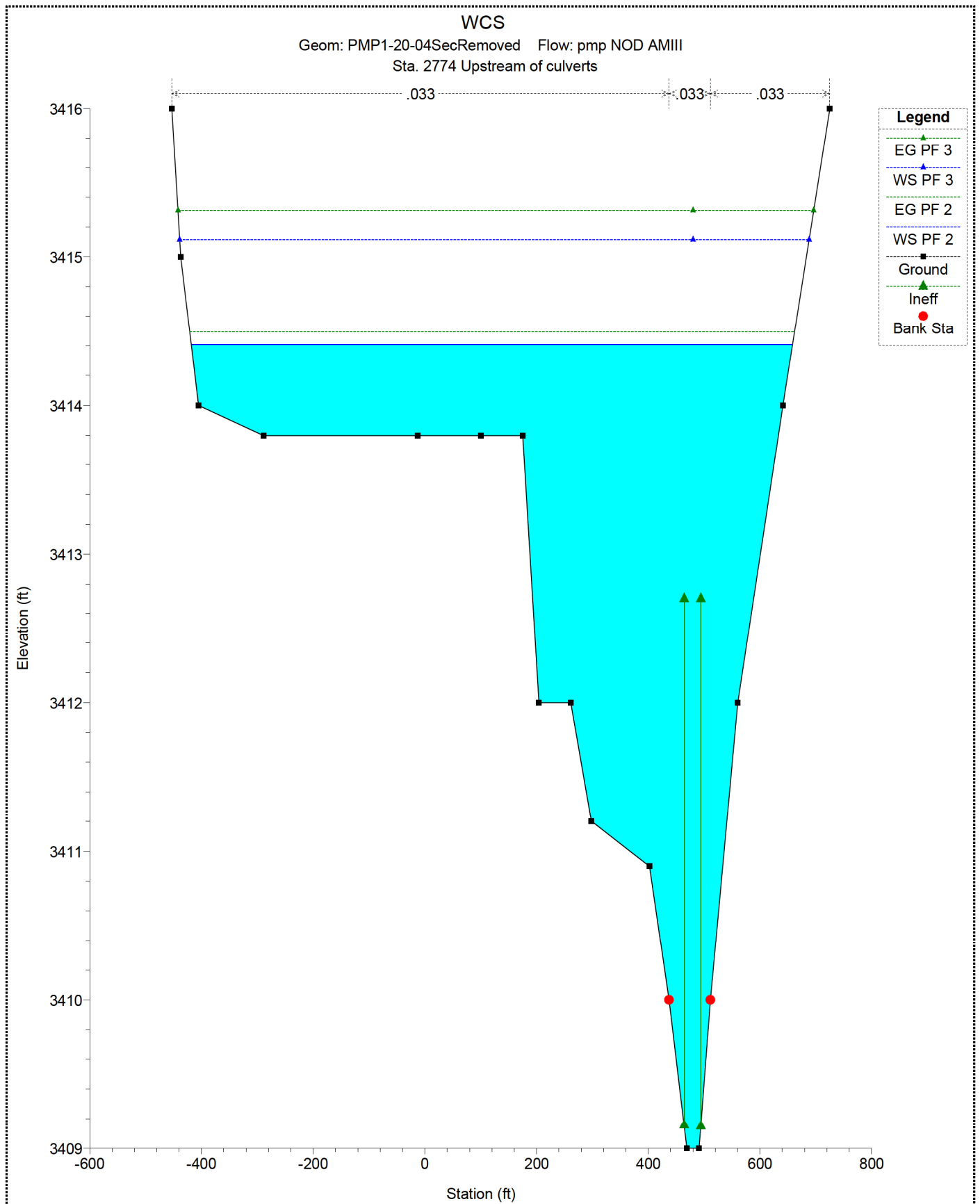


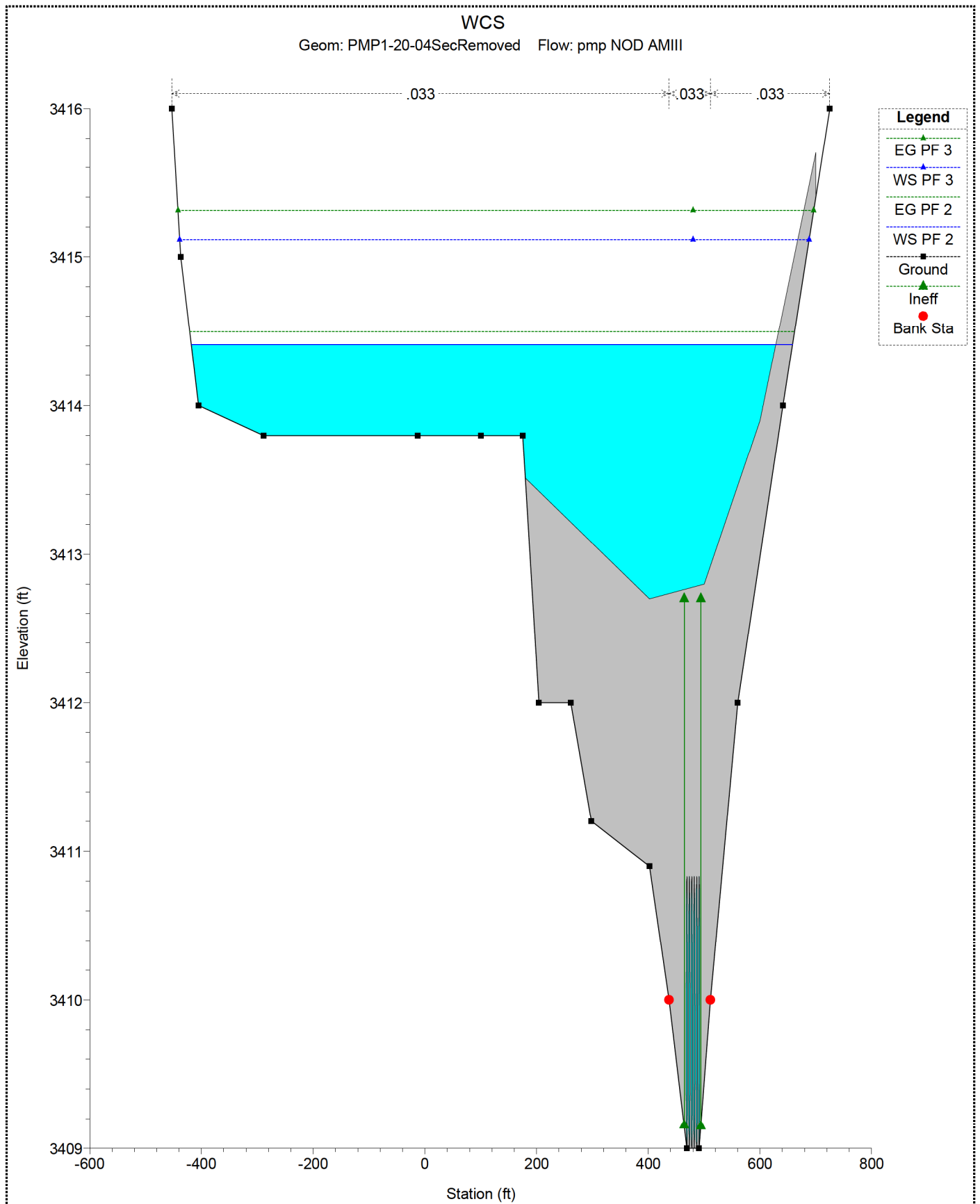


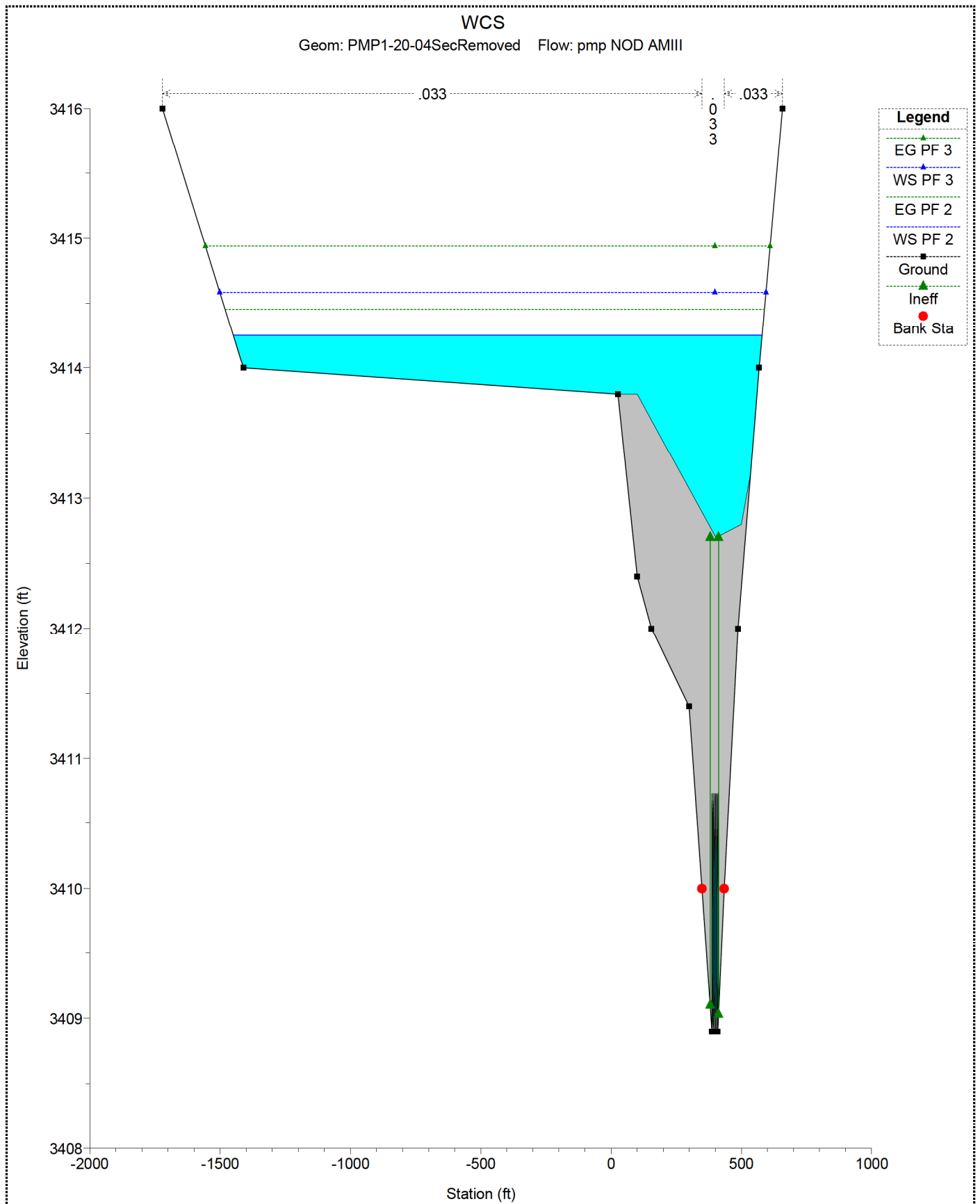


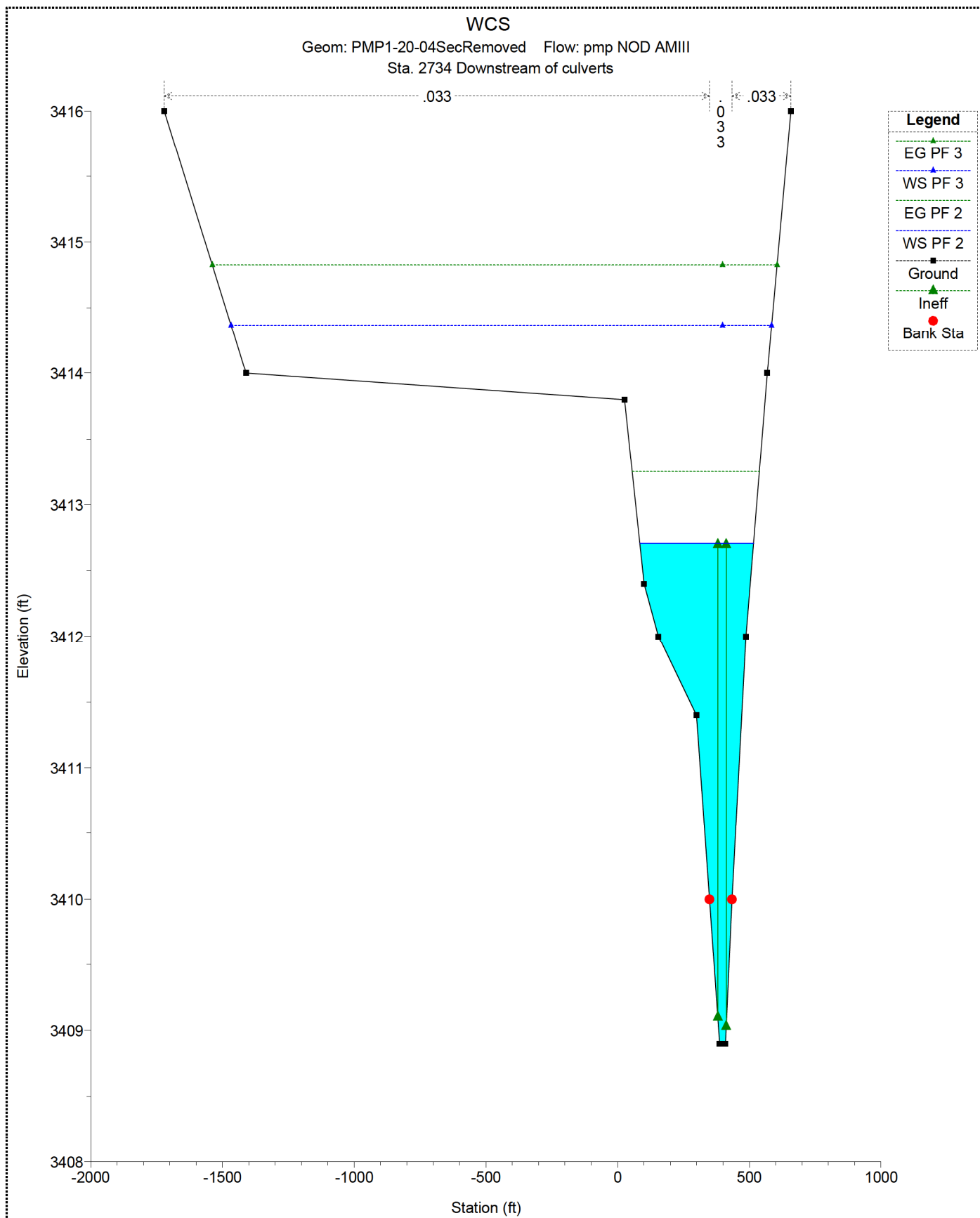


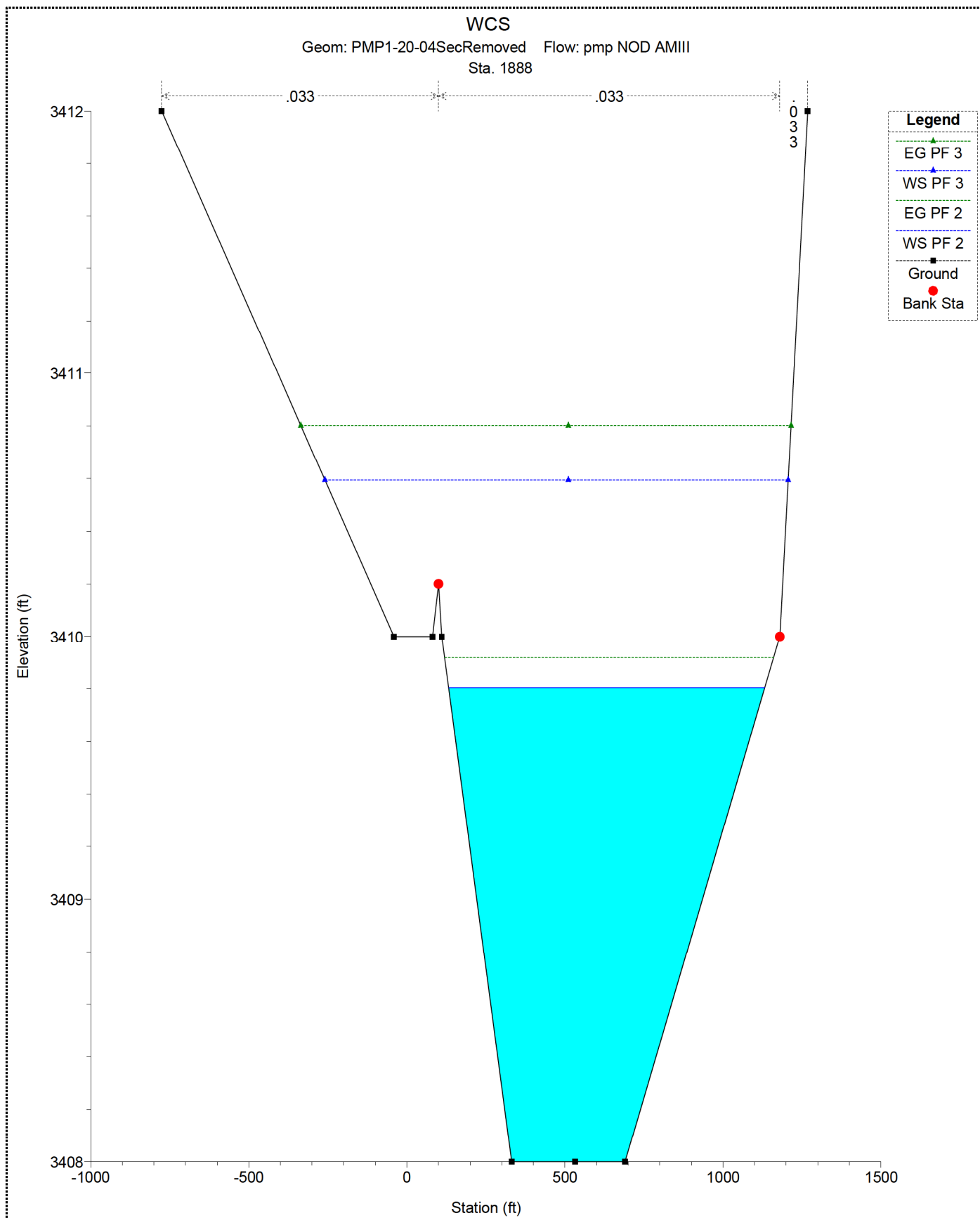


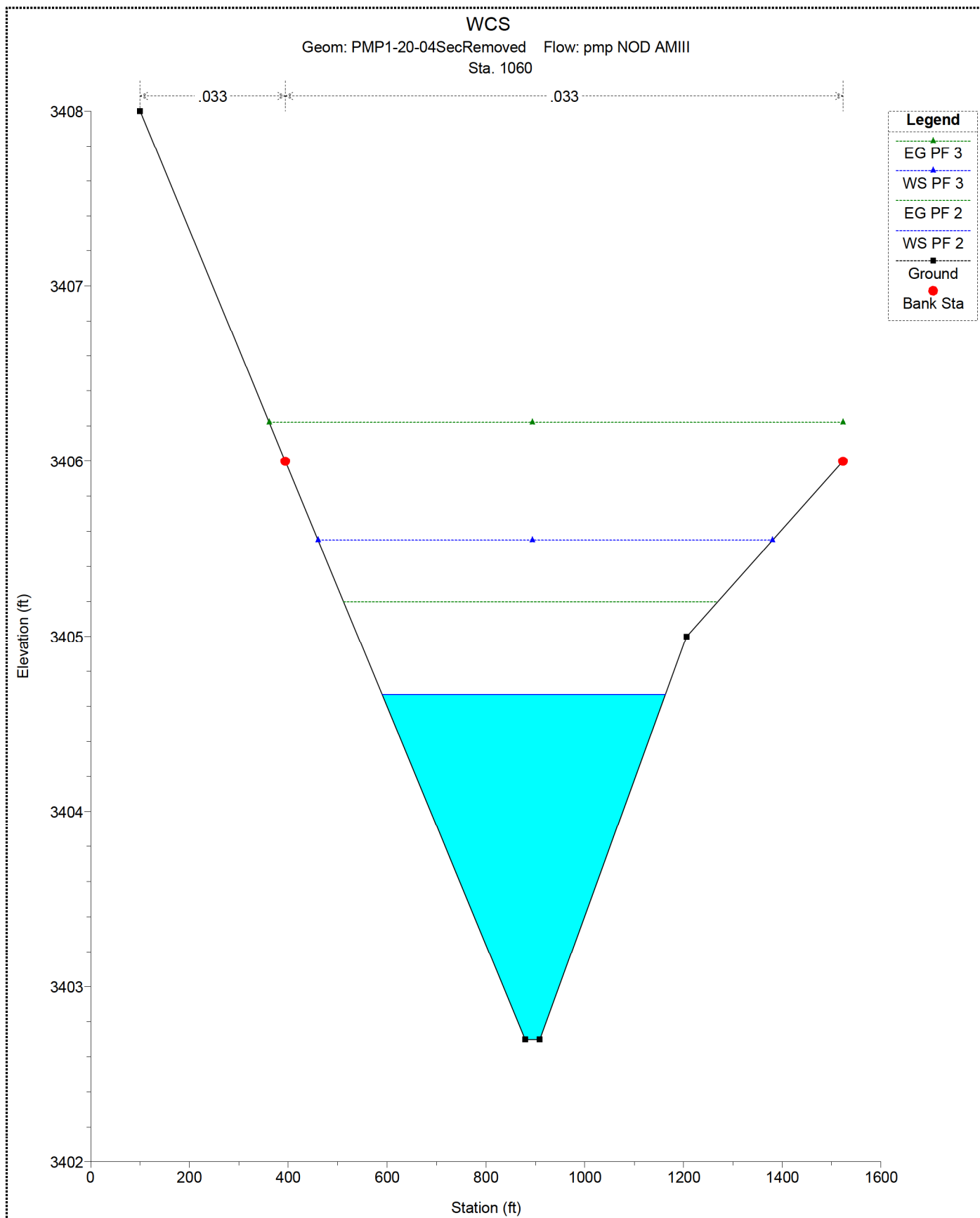














APPENDIX B SOIL STUDY



United States
Department of
Agriculture

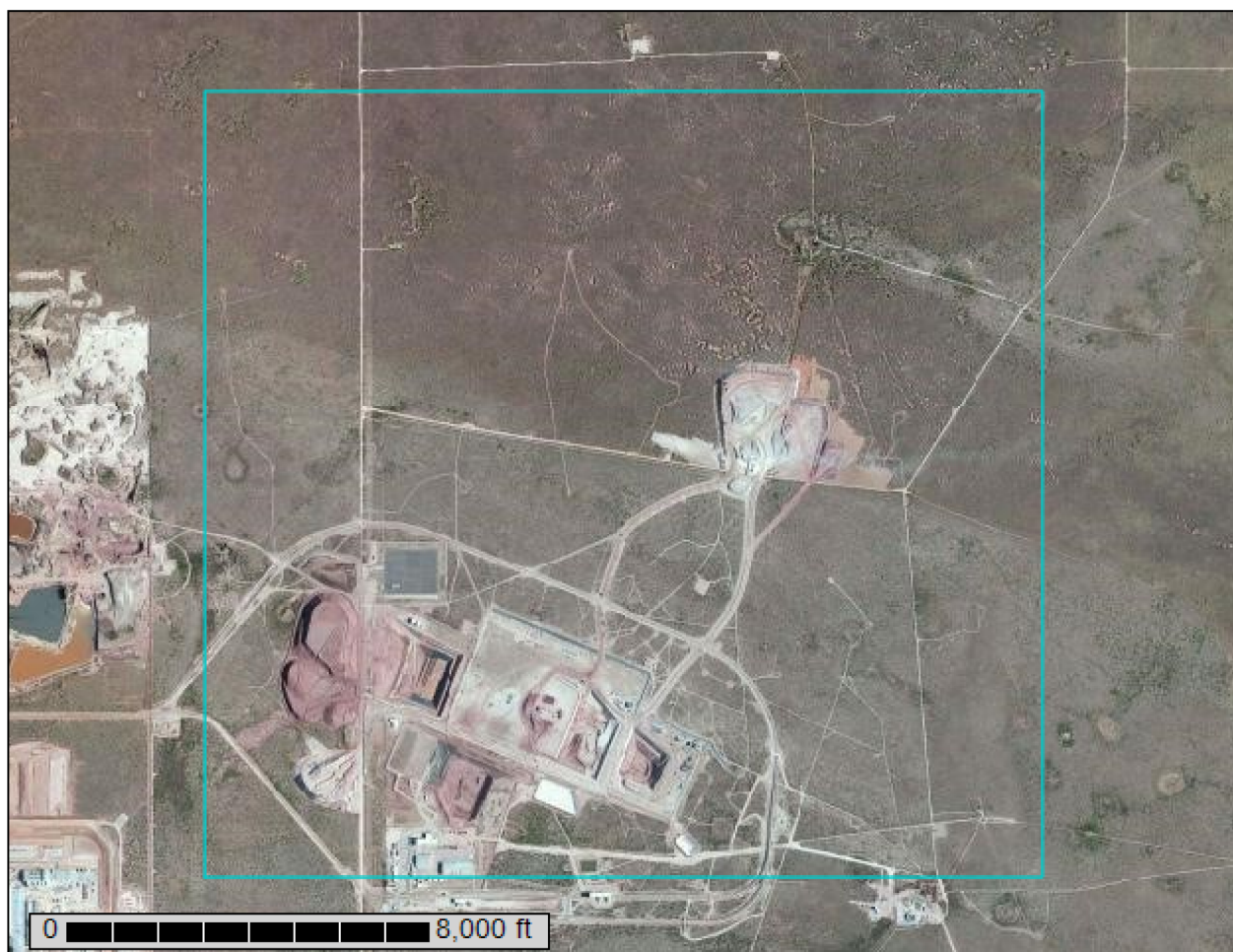
NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Andrews County, Texas, and Lea County, New Mexico**

WCS



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

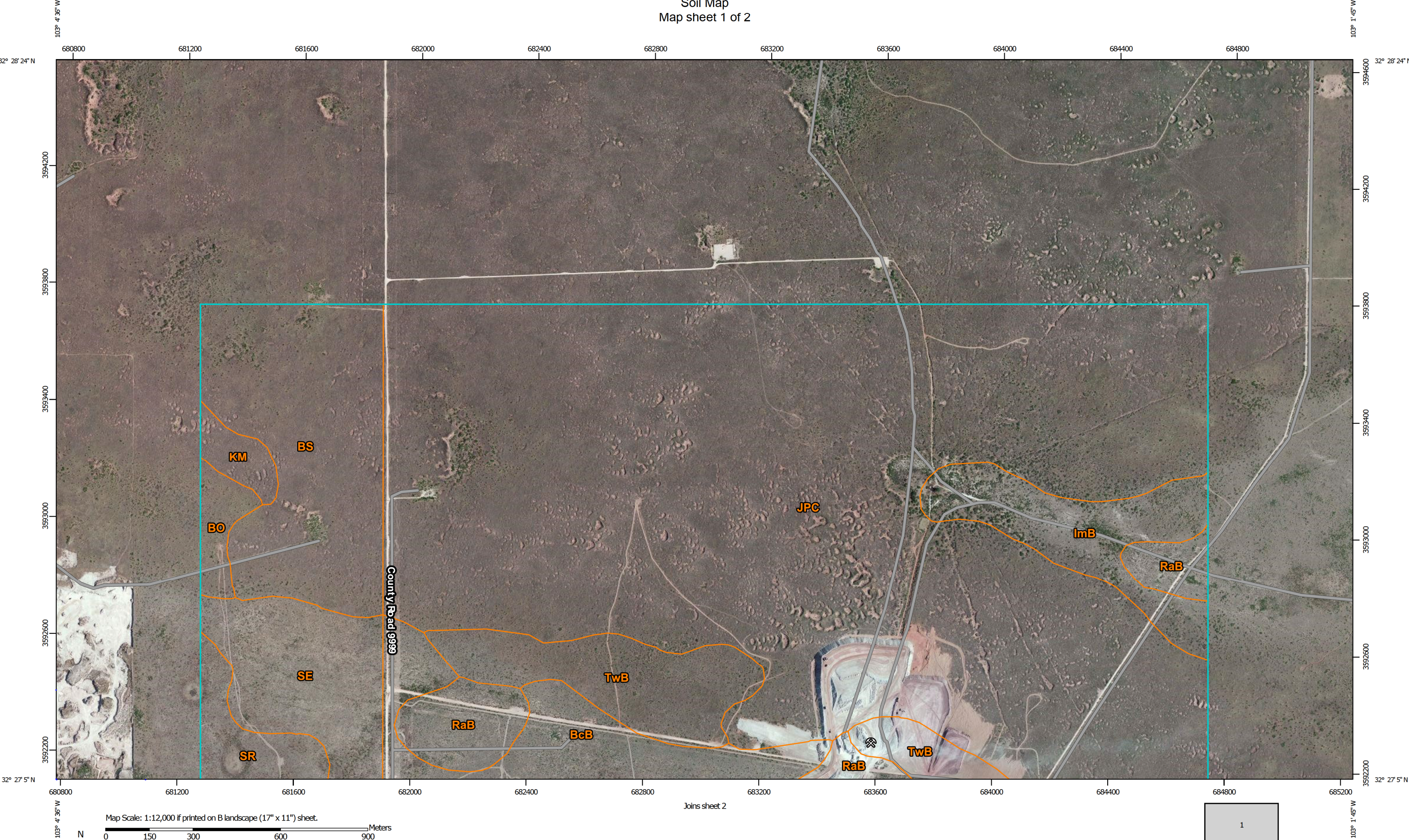
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map
Index Sheet



Custom Soil Resource Report
Soil Map
Map sheet 1 of 2

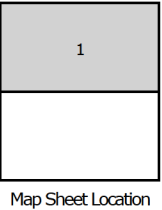


Map Scale: 1:12,000 if printed on B landscape (17" x 11") sheet.

0 150 300 600 900 Meters

0 500 1000 2000 3000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



Custom Soil Resource Report
Soil Map
Map sheet 2 of 2

Joins sheet 1



Map Scale: 1:12,000 if printed on B landscape (17" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



Map Sheet Location

Custom Soil Resource Report

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 scales ranging from 1:20,000 to 1:31,700.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
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: Andrews County, Texas
Survey Area Data: Version 13, Sep 18, 2015

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 12, Sep 29, 2015

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Data not available.

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

Andrews County, Texas (TX003)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BcB	Blakeney and Conger soils, gently undulating	795.1	28.6%
FdB	Faskin and Douro soils, gently undulating	40.8	1.5%
ImB	Ima loamy fine sand, 0 to 3 percent slopes	61.8	2.2%
JPC	Jalmar-Penwell association, undulating	907.7	32.6%
KmB	Kimbrough soils, gently undulating	21.2	0.8%
RaB	Ratliff soils, gently undulating	342.7	12.3%
TwB	Triomas and Wickett soils, gently undulating	109.6	3.9%
Subtotals for Soil Survey Area		2,278.8	82.0%
Totals for Area of Interest		2,780.3	100.0%

Lea County, New Mexico (NM025)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AB	Amarillo-Arvana loamy fine sands association	12.5	0.5%
BO	Brownfield-Springer association	47.5	1.7%
BS	Brownfield-Springer association, hummocky	134.3	4.8%
KM	Kermit soils and dune land, 0 to 12 percent slopes	11.5	0.4%
MU	Mixed alluvial land	19.4	0.7%
PG	Portales and gomez fine sandy loams	17.9	0.6%
SE	Simona fine sandy loam, 0 to 3 percent slopes	117.0	4.2%
SR	Simona-Upton association	141.3	5.1%
Subtotals for Soil Survey Area		501.5	18.0%
Totals for Area of Interest		2,780.3	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

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An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Andrews County, Texas

BcB—Blakeney and Conger soils, gently undulating

Map Unit Setting

National map unit symbol: d53f
Elevation: 1,500 to 3,600 feet
Mean annual precipitation: 10 to 17 inches
Mean annual air temperature: 63 to 68 degrees F
Frost-free period: 210 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeney and similar soils: 49 percent
Conger and similar soils: 47 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeney

Setting

Landform: Ridges, divides
Landform position (two-dimensional): Summit
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Loamy eolian deposits in the blackwater draw formation of pleistocene age overlying calcareous loamy alluvium in the ogallala formation of miocene-pliocene age

Typical profile

H1 - 0 to 18 inches: fine sandy loam
H2 - 18 to 32 inches: cemented material
H3 - 32 to 68 inches: gravelly loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Natural drainage class: Well drained
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 in profile: 70 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Shallow 12-17" PZ (R077DY048TX)

Description of Conger

Setting

Landform: Ridges, divides

Landform position (two-dimensional): Summit

Down-slope shape: Convex

Across-slope shape: Convex, linear

Parent material: Loamy eolian deposits in the blackwater draw formation of pleistocene age overlying calcareous loamy alluvium in the ogallala formation of miocene-pliocene age

Typical profile

H1 - 0 to 17 inches: loam

H2 - 17 to 39 inches: cemented material

H3 - 39 to 75 inches: gravelly loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: 8 to 20 inches to petrocalcic

Natural drainage class: Well drained

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 in profile: 70 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: D

Ecological site: Shallow 12-17" PZ (R077DY048TX)

Minor Components

Unnamed

Percent of map unit: 4 percent

FdB—Faskin and Douro soils, gently undulating

Map Unit Setting

National map unit symbol: d53h

Elevation: 2,750 to 3,400 feet

Mean annual precipitation: 13 to 17 inches

Mean annual air temperature: 57 to 70 degrees F

Frost-free period: 210 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Faskin and similar soils: 63 percent

Douro and similar soils: 21 percent

Minor components: 16 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Faskin

Setting

Landform: Plains

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Loamy eolian deposits from the blackwater draw formation of pleistocene age

Typical profile

H1 - 0 to 8 inches: fine sandy loam

H2 - 8 to 42 inches: sandy clay loam

H3 - 42 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

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 in profile: 50 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: Sandy Loam 12-17" PZ (R077DY047TX)

Description of Douro

Setting

Landform: Plains

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Loamy eolian deposits in the blackwater draw formation of pleistocene age overlying calcareous loamy alluvium in the ogallala formation of miocene-pliocene age

Typical profile

H1 - 0 to 9 inches: fine sandy loam

H2 - 9 to 30 inches: sandy clay loam

H3 - 30 to 51 inches: cemented material

H4 - 51 to 75 inches: gravelly loam

Properties and qualities

Slope: 0 to 3 percent

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Depth to restrictive feature: 20 to 40 inches to petrocalcic
Natural drainage class: Well drained
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 in profile: 80 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Sandy Loam 12-17" PZ (R077DY047TX)

Minor Components

Unnamed

Percent of map unit: 16 percent

ImB—Ima loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: d53j
Elevation: 4,000 to 4,600 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 57 to 63 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Ima and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ima

Setting

Landform: Plains
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy alluvium and eolian deposits derived from calcareous sandstone of triassic and/or permian age

Typical profile

H1 - 0 to 14 inches: loamy fine sand
H2 - 14 to 55 inches: fine sandy loam
H3 - 55 to 80 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
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 in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: A
Ecological site: Sandy 12-17" PZ (R077DY046TX)

JPC—Jalmar-Penwell association, undulating

Map Unit Setting

National map unit symbol: d53k
Elevation: 2,400 to 3,500 feet
Mean annual precipitation: 10 to 17 inches
Mean annual air temperature: 61 to 70 degrees F
Frost-free period: 210 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Jalmar and similar soils: 56 percent
Penwell and similar soils: 40 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jalmar

Setting

Landform: Sand sheets
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy eolian deposits of holocene age over loamy eolian deposits from the blackwater draw formation of pleistocene age

Typical profile

H1 - 0 to 14 inches: fine sand
H2 - 14 to 26 inches: fine sand
H3 - 26 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 8 percent

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Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
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 in profile: 25 percent
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy 12-17" PZ (R077DY046TX)

Description of Penwell

Setting

Landform: Sand sheets
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy eolian deposits of holocene age

Typical profile

H1 - 0 to 13 inches: fine sand
H2 - 13 to 80 inches: fine sand

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Sand Hills 12-17" PZ (R077DY045TX)

Minor Components

Unnamed

Percent of map unit: 4 percent

KmB—Kimbrough soils, gently undulating

Map Unit Setting

National map unit symbol: d53l
Elevation: 2,000 to 5,000 feet
Mean annual precipitation: 10 to 17 inches
Mean annual air temperature: 57 to 75 degrees F
Frost-free period: 175 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Kimbrough and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kimbrough

Setting

Landform: Plains
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous, loamy alluvium in the ogallala formation of miocene-pliocene age

Typical profile

H1 - 0 to 8 inches: loam
H2 - 8 to 31 inches: cemented material

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 4 to 20 inches to petrocalcic
Natural drainage class: Well drained
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 in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Shallow 12-17" PZ (R077DY048TX)

RaB—Ratliff soils, gently undulating

Map Unit Setting

National map unit symbol: d53s

Elevation: 2,500 to 3,400 feet

Mean annual precipitation: 13 to 17 inches

Mean annual air temperature: 63 to 70 degrees F

Frost-free period: 210 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Ratliff and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ratliff

Setting

Landform: Plains

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Calcareous, loamy eolian deposits from the blackwater draw formation of pleistocene age

Typical profile

H1 - 0 to 10 inches: loam

H2 - 10 to 25 inches: clay loam

H3 - 25 to 80 inches: clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

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 in profile: 50 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: Limy Upland 12-17" PZ (R077DY042TX)

TwB—Triomas and Wickett soils, gently undulating

Map Unit Setting

National map unit symbol: d53w

Elevation: 2,300 to 3,500 feet

Mean annual precipitation: 10 to 17 inches

Mean annual air temperature: 63 to 68 degrees F

Frost-free period: 210 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Triomas and similar soils: 78 percent

Wickett and similar soils: 16 percent

Minor components: 6 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Triomas

Setting

Landform: Plains

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Sandy eolian deposits from the blackwater draw formation of pleistocene age

Typical profile

H1 - 0 to 16 inches: fine sand

H2 - 16 to 68 inches: sandy clay loam

H3 - 68 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 5 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

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 in profile: 30 percent

Available water storage in profile: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

Ecological site: Sandy 12-17" PZ (R077DY046TX)

Description of Wickett

Setting

Landform: Plains

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Landform position (three-dimensional): Talf

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Sandy eolian deposits overlying calcareous, loamy alluvium in the Ogallala formation of Miocene-Pliocene age

Typical profile

H1 - 0 to 16 inches: loamy fine sand

H2 - 16 to 33 inches: fine sandy loam

H3 - 33 to 53 inches: cemented material

H4 - 53 to 67 inches: gravelly loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: 20 to 40 inches to petrocalcic

Natural drainage class: Well drained

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 in profile: 85 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

Ecological site: Sandy 12-17" PZ (R077DY046TX)

Minor Components

Unnamed

Percent of map unit: 6 percent

Lea County, New Mexico

AB—Amarillo-Arvana loamy fine sands association

Map Unit Setting

National map unit symbol: dmnr

Elevation: 3,500 to 4,400 feet

Mean annual precipitation: 12 to 16 inches

Mean annual air temperature: 58 to 60 degrees F

Frost-free period: 190 to 205 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Amarillo and similar soils: 50 percent

Arvana and similar soils: 40 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Amarillo

Setting

Landform: Plains

Landform position (three-dimensional): Rise

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 8 inches: loamy fine sand

Bt - 8 to 36 inches: sandy clay loam

Bk - 36 to 60 inches: marly loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 50 percent

Gypsum, maximum in profile: 1 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: Sandy Plains (R077CY056NM)

Description of Arvana

Setting

Landform: Plains

Landform position (three-dimensional): Rise

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 6 inches: loamy fine sand

Bt - 6 to 28 inches: sandy clay loam

Bkm - 28 to 38 inches: cemented material

BCK - 38 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: 20 to 40 inches to petrocalcic

Natural drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.60 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 50 percent

Gypsum, maximum in profile: 1 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 6e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: C

Ecological site: Sandy Plains (R077CY056NM)

Minor Components

Portales

Percent of map unit: 2 percent

Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Brownfield

Percent of map unit: 2 percent

Ecological site: Sandy 12-17" PZ (R077DY046TX)

Patricia

Percent of map unit: 2 percent

Ecological site: Sandy Plains (R077CY056NM)

Gomez

Percent of map unit: 2 percent

Ecological site: Sandy Plains (R077CY056NM)

Mansker

Percent of map unit: 1 percent

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Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Tivoli

Percent of map unit: 1 percent

Ecological site: Sandy 12-17" PZ (R077DY046TX)

BO—Brownfield-Springer association

Map Unit Setting

National map unit symbol: dmpj

Elevation: 3,500 to 4,400 feet

Mean annual precipitation: 12 to 16 inches

Mean annual air temperature: 58 to 60 degrees F

Frost-free period: 190 to 205 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Brownfield and similar soils: 60 percent

Springer and similar soils: 30 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brownfield

Setting

Landform: Plains

Landform position (three-dimensional): Rise

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 22 inches: fine sand

Bt - 22 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: Moderate (about 7.0 inches)

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Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy 12-17" PZ (R077DY046TX)

Description of Springer

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 14 inches: loamy fine sand
Bt - 14 to 60 inches: fine sandy loam
Bk - 60 to 79 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: Sandy 12-17" PZ (R077DY046TX)

Minor Components

Patricia

Percent of map unit: 4 percent
Ecological site: Sandy Plains (R077CY056NM)

Amarillo

Percent of map unit: 4 percent
Ecological site: Sandy 16-21" PZ (R077CY035TX)

Tivoli

Percent of map unit: 1 percent
Ecological site: Sandy 12-17" PZ (R077DY046TX)

Gomez

Percent of map unit: 1 percent
Ecological site: Sandy Plains (R077CY056NM)

BS—Brownfield-Springer association, hummocky

Map Unit Setting

National map unit symbol: dmpk

Elevation: 3,500 to 4,400 feet

Mean annual precipitation: 12 to 16 inches

Mean annual air temperature: 58 to 60 degrees F

Frost-free period: 190 to 205 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Brownfield and similar soils: 65 percent

Springer and similar soils: 25 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brownfield

Setting

Landform: Plains

Landform position (three-dimensional): Rise

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 22 inches: fine sand

Bt - 22 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

Ecological site: Sandy 12-17" PZ (R077DY046TX)

Description of Springer

Setting

Landform: Plains

Landform position (three-dimensional): Rise

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 7 inches: loamy fine sand

Bt - 7 to 60 inches: fine sandy loam

Bk - 60 to 79 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 20 percent

Gypsum, maximum in profile: 1 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: A

Ecological site: Sandy 12-17" PZ (R077DY046TX)

Minor Components

Amarillo

Percent of map unit: 4 percent

Ecological site: Sandy 16-21" PZ (R077CY035TX)

Arvana

Percent of map unit: 3 percent

Ecological site: Sandy 16-21" PZ (R077CY035TX)

Tivoli

Percent of map unit: 2 percent

Ecological site: Sandy 12-17" PZ (R077DY046TX)

Dune land

Percent of map unit: 1 percent

KM—Kermit soils and dune land, 0 to 12 percent slopes

Map Unit Setting

National map unit symbol: dmpx
Elevation: 3,000 to 4,400 feet
Mean annual precipitation: 10 to 15 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 205 days
Farmland classification: Not prime farmland

Map Unit Composition

Dune land: 45 percent
Kermit and similar soils: 45 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kermit

Setting

Landform: Dunes
Landform position (two-dimensional): Shoulder, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear, concave
Across-slope shape: Convex
Parent material: Calcareous sandy eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 8 inches: fine sand
C - 8 to 60 inches: fine sand

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Very high (20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Gypsum, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A

Custom Soil Resource Report

Ecological site: Sandhills (R042XC022NM)

Description of Dune Land

Setting

Landform: Dunes

Landform position (two-dimensional): Shoulder, backslope, footslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex, linear, concave

Across-slope shape: Convex

Typical profile

A - 0 to 6 inches: fine sand

C - 6 to 60 inches: fine sand

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8e

Hydrologic Soil Group: A

Minor Components

Palomas

Percent of map unit: 3 percent

Ecological site: Loamy Sand (R042XC003NM)

Pyote

Percent of map unit: 3 percent

Ecological site: Loamy Sand (R042XC003NM)

Maljamar

Percent of map unit: 2 percent

Ecological site: Loamy Sand (R042XC003NM)

Wink

Percent of map unit: 2 percent

Ecological site: Loamy Sand (R042XC003NM)

MU—Mixed alluvial land

Map Unit Setting

National map unit symbol: dmqq

Elevation: 3,600 to 4,400 feet

Mean annual precipitation: 12 to 16 inches

Mean annual air temperature: 58 to 62 degrees F

Frost-free period: 190 to 205 days

Farmland classification: Not prime farmland

Map Unit Composition

Ustifluvents and similar soils: 85 percent

Minor components: 15 percent

Custom Soil Resource Report

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ustifluvents

Setting

Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Mixed alluvium derived from sedimentary rock

Typical profile

C - 0 to 60 inches: stratified sand to loamy fine sand to loam to sandy clay loam to clay loam to clay

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Bottomland (R042XC017NM)

Minor Components

Amarillo

Percent of map unit: 7 percent
Ecological site: Sandy Plains (R077CY056NM)

Portales

Percent of map unit: 7 percent
Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Playas

Percent of map unit: 1 percent
Landform: Flood-plain playas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave

PG—Portales and gomez fine sandy loams

Map Unit Setting

National map unit symbol: dmqm

Elevation: 3,600 to 4,400 feet

Mean annual precipitation: 12 to 16 inches

Mean annual air temperature: 58 to 60 degrees F

Frost-free period: 190 to 205 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Portales and similar soils: 45 percent

Gomez and similar soils: 45 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gomez

Setting

Landform: Plains

Landform position (three-dimensional): Dip

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Calcareous alluvium and/or calcareous lacustrine deposits derived from sedimentary rock

Typical profile

A - 0 to 6 inches: fine sandy loam

Bk1 - 6 to 22 inches: fine sandy loam

Bk2 - 22 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 50 percent

Gypsum, maximum in profile: 1 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4c

Hydrologic Soil Group: A

Custom Soil Resource Report

Ecological site: Sandy 16-21" PZ (R077CY035TX)

Description of Portales

Setting

Landform: Plains

Landform position (three-dimensional): Dip

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 8 inches: fine sandy loam

Bk - 8 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 50 percent

Gypsum, maximum in profile: 1 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: Sandy 16-21" PZ (R077CY035TX)

Minor Components

Lea

Percent of map unit: 4 percent

Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Arvana

Percent of map unit: 3 percent

Ecological site: Sandy 16-21" PZ (R077CY035TX)

Amarillo

Percent of map unit: 2 percent

Ecological site: Sandy Plains (R077CY056NM)

Playas

Percent of map unit: 1 percent

Landform: Playa floors

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

SE—Simona fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: dmr2

Elevation: 3,000 to 4,400 feet

Mean annual precipitation: 10 to 16 inches

Mean annual air temperature: 58 to 62 degrees F

Frost-free period: 190 to 205 days

Farmland classification: Not prime farmland

Map Unit Composition

Simona and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Simona

Setting

Landform: Plains

Landform position (three-dimensional): Rise

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Calcareous eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 8 inches: fine sandy loam

Bk - 8 to 16 inches: gravelly fine sandy loam

Bkm - 16 to 26 inches: cemented material

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: 7 to 20 inches to petrocalcic

Natural 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 in profile: 35 percent

Gypsum, maximum in profile: 1 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 2.0

Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): 6s

Land capability classification (nonirrigated): 7s

Custom Soil Resource Report

Hydrologic Soil Group: D

Ecological site: Shallow Sandy (R042XC002NM)

Minor Components

Kimbrough

Percent of map unit: 7 percent

Ecological site: Very Shallow 16-21" PZ (R077CY037TX)

Lea

Percent of map unit: 7 percent

Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Playas

Percent of map unit: 1 percent

Landform: Playa floors

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

SR—Simona-Upton association

Map Unit Setting

National map unit symbol: dmr3

Elevation: 3,000 to 4,400 feet

Mean annual precipitation: 10 to 16 inches

Mean annual air temperature: 58 to 62 degrees F

Frost-free period: 190 to 205 days

Farmland classification: Not prime farmland

Map Unit Composition

Simona and similar soils: 50 percent

Upton and similar soils: 35 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Simona

Setting

Landform: Ridges

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Rise

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Calcareous eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 8 inches: gravelly fine sandy loam

Bk - 8 to 16 inches: fine sandy loam

Bkm - 16 to 26 inches: cemented material

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Natural drainage class: Well drained
Runoff class: Very low
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 in profile: 50 percent
Gypsum, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Very low (about 1.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Shallow Sandy (R042XC002NM)

Description of Upton

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 8 inches: gravelly loam
Bkm - 8 to 18 inches: cemented material
BCK - 18 to 60 inches: very gravelly loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 75 percent
Gypsum, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Very low (about 0.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 7s

Custom Soil Resource Report

Hydrologic Soil Group: D

Ecological site: Shallow (R042XC025NM)

Minor Components

Stegall

Percent of map unit: 5 percent

Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Kimbrough

Percent of map unit: 5 percent

Ecological site: Very Shallow 16-21" PZ (R077CY037TX)

Slaughter

Percent of map unit: 4 percent

Ecological site: Limy Upland 16-21" PZ (R077CY028TX)

Playas

Percent of map unit: 1 percent

Landform: Playa floors

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

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APPENDIX C CALCULATIONS



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT CURVE NUMBER CALCULATIONS



10/10/19
 Calculations
 16 Pages

Diana G. Dworaczky

WCS
 File: 15052 - CN
 Revised 12/08/2016
 Revised 09/13/19
CURVE NUMBER

DES DD 9/6/2016 CHK DD 3/8/2016
 DD DD

- Reference: 1. drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P CN.dwg
 2. Soil information taken from US Department Of Agriculture, Natural Resources Conservation Service Custom Soil Resource Report For Andrews County, Texas, And Lea County, New Mexico, dated December 22, 2015
 3. Texas Engineering Technical Note, No. 210-18-TX5, *Estimating Runoff for Conservation Practices*, 1990

Drainage Area - P DA 1		A= 101.5 Acres		0.159 sq mi	
Cover Type & Hydrologic Condition	Soil Type	Hyd. Soil Group	Area	CN*	Area x CN
Desert Shrub Poor	JPC	B/A***	55.08	77	4241.2
		Imp. Cover	0.00	98	0.0
Desert Shrub Poor	TwB	B	12.79	77	984.8
		Imp. Cover	0.00	98	0.0
Desert Shrub Poor	BCB	D	13.19	88	1160.7
		Imp. Cover	0.00	98	0.0
Desert Shrub Poor	RaB	B	18.43	77	1419.1
		Imp. Cover	2.00	98	196.0
Total			101.5		8001.8

COMPOSITE CN

79

62

91

Drainage Area - P DA 2A		A= 25.8 Acres		0.040 sq mi	
Cover Type & Hydrologic Condition	Soil Type	Hyd. Soil Group	Area	CN*	Area x CN
Desert Shrub Poor	BcB	D	25.75	88	2266.0
		Imp. Cover	0.00	98	0.0
Desert Shrub Poor	RaB	B	0.05	77	3.6
		Imp. Cover	0.00	98	0.0
Total			25.8		2269.6

COMPOSITE CN

88

75

95

Drainage Area - P DA 2B		A= 9.6 Acres		0.015 sq mi	
Cover Type & Hydrologic Condition	Soil Type	Hyd. Soil Group	Area	CN*	Area x CN
Desert Shrub Poor	BcB	D	7.88	88	693.2
		Imp. Cover	0.00	98	0.0
Desert Shrub Poor	RaB	B	1.71	77	131.3
		Imp. Cover	0.00	98	0.0
Total			9.6		824.5

COMPOSITE CN

86

72

94



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT CURVE NUMBER CALCULATIONS

Drainage Area - P DA 3						ARC I Adjustment** (60 Min.)	ARC III Adjustment** (60 Min.)
Cover Type & Hydrologic Condition	Soil Type	Hyd. Soil Group	A= 42.8 Acres Area	0.067 sq mi CN*	Area x CN		
Desert Shrub Poor	RaB	B	2.95	77	227.1		
		Imp. Cover	0.00	0	0.0		
Desert Shrub Poor	BcB	D	34.20	88	3009.6		
		Imp. Cover	5.65	98	553.8		
Total			42.8		3790.5		
COMPOSITE CN			89			76	96

Drainage Area - P DA 4						ARC I Adjustment** (60 Min.)	ARC III Adjustment** (60 Min.)
Cover Type & Hydrologic Condition	Soil Type	Hyd. Soil Group	A= 679.34 Acres Area	1.061 sq mi CN*	Area x CN		
Stockpile (Bare soil)		D	60.67	94	5703.3		
Desert Shrub Poor	JPC	B/A***	150.67	77	11601.5		
		Imp. Cover	21.88	98	2143.9		
Desert Shrub Poor	RaB	B	215.19	77	16569.4		
		Imp. Cover	4.48	98	439.3		
Desert Shrub Poor	BcB	D	98.43	88	8662.1		
		Imp. Cover	54.29	98	5320.2		
Desert Shrub Poor	TwB	B	25.88	77	1992.8		
		Imp. Cover	47.81	98	4685.8		
Total			679.3		57118.4		
COMPOSITE CN			84			68	93

*Taken from Table 2c of Texas Engineering Technical Note, Hydrology, No. 210-18-TX5,
 Estimating Runoff for Conservation Practices

**Taken from Table 3 of Texas Engineering Technical Note, Hydrology, No. 210-18-TX5,
 Estimating Runoff for Conservation Practices

***USDA Soil Survey indicates 46% A and 50% B. CN is conservatively calculated to be 100% B



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT DRAINAGE AREA TIME OF CONCENTRATION

DES CHK
WCS DD 9/6/2016 DD 3/8/2016
Revised 12/08/16 DD
Revised 09/23/19 DD

Reference: 1. United States Department of Agriculture, Urban Hydrology for Small Watersheds TR-55, 1986
2. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P Hydraulic Calcs DD.dwg

Drainage Area	P DA 1			P DA 2A			P DA 2B			P DA 3			P DA 4		
	A	101.5 (acres) 0.159 (sqmi)		A	25.8 (acres) 0.040 (sqmi)		A	9.6 (acres) 0.015 (sqmi)		A	42.8 (acres) 0.067 (sqmi)		A	679.3 (acres) 1.061 (sqmi)	
Sheet Flow															
Manning's roughness coef. ¹	n	0.15	n/a	n	0.011	n/a	n	0.011	n/a	n	0.011	n/a	n	0.15	n/a
Flow Length	L	300	feet	L	300	feet	L	300	feet	L	300	feet	L	300	feet
2-year, 24-hour rainfall	P2	2.5	inches	P2	2.5	inches	P2	2.5	inches	P2	2.5	inches	P2	2.5	inches
Slope	s	0.015	ft/ft	s	0.003	ft/ft	s	0.005	ft/ft	s	0.003	ft/ft	s	0.01400	ft/ft
Travel time ²	Tt	0.50	hours	Tt	0.11	hours	Tt	0.10	hours	Tt	0.11	hours	Tt	0.51	hours
		30.0	min.		6.8	min.		5.7	min.		6.8	min.		30.8	min.
Shallow Concentrated Flow															
Flow Length	L	1540	feet	L	1589	feet	L	784	feet	L	1681	feet	L	3545	feet
Slope	s	0.01650	ft/ft	s	0.00736	ft/ft	s	0.00714	ft/ft	s	0.00476	ft/ft	s	0.00555	ft/ft
Surface (1=paved or 2=unpaved)		2	n/a		2	n/a		2	n/a		2	n/a		2	n/a
Velocity ³	V	2.07	ft/sec	V	1.38	ft/sec	V	1.36	ft/sec	V	1.11	ft/sec	V	1.20	ft/sec
Travel time	Tt	0.21	hours	Tt	0.32	hours	Tt	0.16	hours	Tt	0.42	hours	Tt	0.82	hours
		12.38	min.		19.13	min.		9.58	min.		25.17	min.		49.15	min.
Manning's Equation															
Flow Length	L	1605	feet	L	0	feet	L	0	feet	L	0	feet	L	0	feet
Slope	S	0.00460	ft/ft	S	0.00000	ft/ft	S	0.00000	ft/ft	S	0.00000	ft/ft	S	0.00000	ft/ft
roughness ⁴	n	0.028	n/a	n	0.028	n/a	n	0.028	n/a	n	0.028	n/a	n	0.028	n/a
Open Channel															
Bottom Width	BW	150	feet	BW	0	feet	BW	0	feet	BW	0	feet	BW	0	feet
Side Slopes (ft/ft, H:V) Rt.	H:V	125	feet	H:V	0	feet	H:V	0	feet	H:V	0	feet	H:V	0	feet
Side Slopes (ft/ft, H:V) Lt.	H:V	125	feet	H:V	0	feet	H:V	0	feet	H:V	0	feet	H:V	0	feet
Depth	d	0.5	feet	d	0	feet	d	0	feet	d	0	feet	d	0	feet
Flow Rate	Q	203	cfs	Q	0	cfs	Q	0	cfs	Q	0	cfs	Q	0	cfs
Velocity	V	1.91	ft/sec	V	0	ft/sec	V	0	ft/sec	V	1	ft/sec	V	1	ft/sec
Travel time	Tt	0.23	hours	Tt	0.00	hours	Tt	0.00	hours	Tt	0.00	hours	Tt	0.00	hours
		14.01	min.		0.00	min.		0.00	min.		0.00	min.		0.00	min.
Total Travel Time	T	0.94	hours	T	0.43	hours	T	0.26	hours	T	0.53	hours	T	1.33	hours
	T	56.34	min.	T	25.89	min.	T	15.33	min.	T	31.93	min.	T	79.94	min.
Lag Time (Tc*0.6)	Tlag	0.56	hours	Tlag	0.26	hours	Tlag	0.15	hours	Tlag	0.32	hours	Tlag	0.80	hours
	Tlag	33.80	min.	Tlag	15.53	min.	Tlag	9.20	min.	Tlag	19.16	min.	Tlag	47.97	min.

Notes:

- Manning's roughness coefficient taken from 'Table 3-1 Roughness coefficients (Manning's n) for sheet flow' - United States Department of Agriculture, *Urban Hydrology for Small Watersheds TR-55*, 1986
 - Equation 3-3, United States Department of Agriculture, *Urban Hydrology for Small Watersheds TR-55*, 1986
 - Figure 3-1, United States Department of Agriculture, *Urban Hydrology for Small Watersheds TR-55*, 1986
 - Reference Manning's 'n' calculations in APPDX C: POST-DEVELOPMENT HYDRAULIC CALCULATIONS
- S:\Projects\W - Z\WCS (Waste Control Specialists)\draft\15052 Floodplain Analysis CISF\Engineering\15052 - Tc.xls



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT HYDRAULIC CALCULATIONS

	DES		CHK	
WCS	AVV	3/8/2016	DD	3/8/2016

Reference: 1. Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains, The U.S. Department of Transportation, 1984

Manning's Roughness Coefficient

Eq. 3
$$n = (n_0 + n_1 + n_2 + n_3 + n_4)m$$

Where:

- n_0 = a base value of n for straight, uniform, smooth channel in natural materials
- n_1 = a value added to correct for the effect of surface irregularities
- n_2 = a value for variations in shape and size of the channel cross section
- n_3 = a value for obstructions
- n_4 = a value for vegetation and flow conditions
- m= a correction factor for meandering of the channel

Channel Roughness

n_0 =	0.020 earth	Table1
n_1 =	0.000 smooth	Table 2
n_2 =	0.000 gradual	Table 2
n_3 =	0.000 neglibl	Table 2
n_4 =	0.008 low	Table 2
m=	1.0 minor	Table 2

$$n = (0.02 + 0.000 + 0.000 + 0.000 + 0.008)1.0$$
$$= 0.028$$



APPENDIX C **WCS - CISF FLOOD ANALYSIS** **POST-DEVELOPMENT HYDRAULIC CALCULATIONS**

WCS DES
 AVV 3/8/2016 CHK
 DD 3/8/2016
 Revised 12/09/2016 DD
 Revised 10/01/2019 DD

Reference: 1. Topographic aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014. 10220 Forest Lane, Dallas, Texas 214-349-2190, 800-862-2190, Fax 214-349-2193.
 2. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P Hydraulic Calcs DD.dwg

Manning's Formula

$$Q = vA = (1.49/n)AR^{2/3}s^{1/2}$$

Where:

Q= Flow Rate (cfs)
 v= velocity, (ft/s)
 A= Flow Area, (ft²)
 n= Manning's Roughness Coefficient
 R= Hydraulic Radius, (ft)
 s= Channel Slope, (ft/ft)

AP-1 Stateline Road

Road Elevation at P AP 1: 3486.5 ft

AMC I

100 YR

Roughness Coef n ²	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	119.4	1.59	0.38

500 YR

Roughness Coef n ²	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	247.7	2.01	0.56

PMP

Roughness Coef n ²	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	413.3	2.35	0.73

AMC II

100 YR

Roughness Coef n ²	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	225.5	1.97	0.53



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT HYDRAULIC CALCULATIONS

500 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	376.6	2.27	0.7

PMP

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	424.2	2.36	0.74

AMC III

100 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	294.7	2.09	0.62

500 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	444.8	2.39	0.76

PMP

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.0046	125	125	150	426.9	2.34	0.75



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT HYDRAULIC CALCULATIONS

AP-2B Stateline Road

Road Elevation at P AP 2B: 3486.4 ft

Assumptions: Road is basically flat at this location, therefore use a large bottom width and relatively flat side slopes.

AMC I

100 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	37.1	0.76	0.09

500 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	65.5	0.97	0.12

PMP

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	39.8	0.81	0.09

AMC II

100 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	53	0.87	0.11

500 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	82.5	1.03	0.14

PMP

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	40.2	0.82	0.09



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT HYDRAULIC CALCULATIONS

AMC III

100 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	59.9	0.89	0.12

500 YR

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	88.5	1.03	0.15

PMP

Roughness Coef n^2	Channel Slope (ft/ft)	Left Side Slope (ft/ft) (H:V)	Right Side Slope (ft/ft) (H:V)	Bottom Width (ft)	Peak Discharge (CFS)	Peak Velocity (ft/s)	Peak Depth (ft)
0.028	0.007	500	500	500	40.3	0.82	0.09

Notes:

1. Channel geometry sources from aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014.
2. See Manning's Roughness Coefficient calculation. Manning's n from Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains, The U.S. Department of Transportation, 1984
3. Peak velocity and depth calculated using AutoCAD Civil 3D Hydraflow Express 2019.

APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT ELEVATION-STORAGE TABLES

	DES		CHK	
WCS	AVV	2/1/2016	DD	2/4/2016
Revised 09/23/19	DD			

Elevation-Storage-Discharge

Reference: 1. 2008 URS As-built Rail Drawings - R/T Infrastructure Improvements Facilities G.E. Hudson River Project Andrews County, Texas Project No. 29600

2. Topographic aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014. 10220 Forest Lane, Dallas, Texas 214-349-2190, 800-862-2190, Fax 214-349-2193.

3. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P GRND 9-23-19.dwg

P DA 2A

Elevation ¹ ft	Storage cu yd	Storage ac-ft
3480	0	0.0000
3481	0.24	0.0001
3482	4	0.0024
3483	23	0.0142
3484	61	0.0379
3485	201	0.1244
3486	436	0.2699
3486.4	476	0.2947

Notes:

1. Topographic elevations reference aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014.



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT ELEVATION-STORAGE TABLES

	DES		CHK	
WCS	AVV	2/1/2016	DD	2/4/2016

Elevation-Storage-Discharge

Reference:

1. 2008 URS As-Built Rail Drawings - R/T Infrastructure Improvements Facilities G.E. Hudson River Project Andrews County, Texas Project No. 29600
2. Topographic aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014. 10220 Forest Lane, Dallas,
3. WCS CISF Rail Plans, 1/22/16
4. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - Elevation-Storage Calcs.dwg.dwg

P DA 3

Elevation ¹	Storage	Storage
ft	cu yd	ac-ft
3484	0	0.0000
3486	12111	7.5068
3488	43926	27.2267
3490	103970	64.4437

Notes:

1. Topographic elevations reference aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014.



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT ELEVATION-STORAGE TABLES

WCS DES CHK
 AVV DD DD
Revised 12/08/16 2/1/2016 2/4/2016

Elevation-Storage-Discharge

Reference: 1. 2008 URS As-Built Rail Drawings - R/T Infrastructure Improvements Facilities G.E. Hudson River Project Andrews County, Texas Project No. 29600
2. Topographic aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014. 10220 Forest Lane, Dallas,
3. WCS CISF Rail Plans, 1/22/16
4. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Design\Surfaces\15052 - EX TOPO & PROP.dwg

Playa

Elevation ¹ ft	Storage cu yd	Storage ac-ft
3476.65	0	0
3478	3559	2.2060
3480	34133	21.1567
3482	84014	52.0744
3484	172618	106.9938
3486	476370	295.2684
3487	762062	472.3489
3488	1104022	684.3060
3489	1514069	938.4654
3490	1963987	1217.3381

Notes:

1. Topographic elevations reference aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014.



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT NON-LEVEL DAM TOP CROSS SECTIONS

	DES		CHK	
WCS	AVV	3/8/2016	DD	3/8/2016

Revised: 09/27/2019 DD

Cross Sections

Reference:

1. Topographic aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014. 10220 Forest Lane, Dallas, Texas 214-349-2190, 800-862-2190, Fax 214-349-2193.
2. 2008 URS As-Built Rail Drawings - R/T Infrastructure Improvements Facilities G.E. Hudson River Project Andrews County, Texas Project No. 29600
3. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P GRND 9-23-19.dwg (Alignment - Stateline RD Profile).

Non-Level Dam - P DA 2A

Profile Station	Station Elevation
100.00	3486.40
193.95	3486.22
346.64	3485.70
354.52	3485.41
382.77	3484.02
385.72	3484.02
402.37	3486.00
408.34	3486.40



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT NON-LEVEL DAM TOP CROSS SECTIONS

	DES		CHK	
WCS	AVV	3/8/2016	DD	3/8/2016

Cross Sections

Reference: 1. WCS CISF Rail Plans, 1/22/16

Non-Level Dam - P DA 3

	Rail XS Station ¹	Station Elevation	Slope Ahead
p-rail	5477.49	3489.00	-0.16%
p-rail	5489.81	3488.98	-0.13%
p-rail	5689.81	3488.72	-0.13%
p-rail	5889.81	3488.46	-0.13%
p-rail	6089.81	3488.20	-0.12%
p-rail	6262.89	3488.00	0.22%
p-rail	6632.18	3488.80	0.06%
p-rail	7407.91	3489.23	-

NOTES:

1. Proposed rail stations reference the proposed WCS CISF Rail Plans, 1/22/16



APPENDIX C
WCS - CISF FLOOD ANALYSIS
POST-DEVELOPMENT NON-LEVEL DAM TOP CROSS SECTIONS

	DES		CHK	
WCS	AVV	3/8/2016	DD	3/8/2016

Cross Sections

Reference: 1. 2008 URS As-Built Rail Drawings - R/T Infrastructure Improvements Facilities G.E. Hudson River Project Andrews County, Texas Project No. 29600
2. Topographic aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014. 10220 Forest Lane, Dallas, Texas 214-349-2190, 800-862-2190, Fax 214-349-2193.
3. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P Hydraulic Calcs PMP.dwg

Non-Level Dam - P DA 4

	Rail Station	XS Station	Station Elevation	Slope Ahead
ex-rail ¹	8500.00	8500.00	3489.96	-0.12%
ex-rail ¹	9900.00	9900.00	3488.28	-0.15%
ex-rail ¹	10017.67	10017.67	3488.10	-0.20%
ex-rail ¹	10387.00	10387.00	3487.36	-8.00%
topo ²	-	10404.00	3486.00	5.58%
topo ²	-	10439.87	3488.00	0.00%
topo ²	-	10742.10	3488.00	0.65%
topo ²	-	11051.85	3490.00	-

NOTES:

- Existing rail stations reference 2008 URS rail as-built drawings - R/T Infrastructure Improvements Facilities G.E. Hudson River Project Andrews County, Texas Project No. 29600 and are approximate
- Topographic elevations come from the topographic aerial survey provided by Dallas Aerial Surveys, Inc., flown 5-29-2014.



APPENDIX C

WCS - CISF FLOOD ANALYSIS

POST-DEVELOPMENT PAD OVERLAND DEPTH OF FLOW

	DES	CHK
WCS	AVV 3/8/2016	DD 3/8/2016
Revised 11/11/16	Clarifications	DD

Reference:

1. Reference Drawing: Figure 1.1.2-1
2. Fundamentals of Hydraulic Engineering Systems, Ned H.C. Hwang, 1982

Manning Equation

$$v = 1.49/n * R_h^{2/3} * s^{1/2}$$

Where,

v= velocity (ft/s)

n= Manning's n

R_h = hydraulic radius

s= slope (ft/ft)

And

$$q = v * y$$

Where,

q= unit discharge (ft²/s)

y= depth

For sheet flow and a wide rectangular channel:

$$R_h \cong y \quad \text{Reference 2, page 182}$$

Therefore

$$\begin{aligned} q &= (1.49/n * y^{2/3} * s^{1/2})(y) \\ &= 1.49/n * y^{5/3} * s^{1/2} \end{aligned}$$

And

$$\begin{aligned} y &= (q / (1.49/n * s^{1/2}))^{3/5} \\ v &= q/y \end{aligned}$$

Where,

q= unit discharge (ft²/s)

v= velocity (ft/s)

n= Manning's n

y= depth

s= slope (ft/ft)

Max flow

$$q_{Max} = I * L$$

Where,

q_{Max} = maximum unit discharge (ft²/s)

I= maximum rainfall Intensity

L= Length of Pad



Max depth

$$y_{\max} = (q_{\max} / (1.49 / n * s^{1/2}))^{3/5}$$

Where,

$y_{\max}$ = Maximum depth of flow (ft)

$q_{\max}$ = Maximum unit discharge

n = Manning's n

s = slope (ft/ft)

Max velocity

$$v_{\max} = q_{\max} / y_{\max}$$

Where,

$q_{\max}$ = maximum unit discharge (ft²/s)

$y_{\max}$ = Maximum depth of flow (ft)

Inputs

s =	0.0075 ft/ft	phase slope
L =	515 ft	length of phase
I =	0.210 in/min	Max 500 yr-24hr rainfall intensity (HEC-HMS 500 yr SCS Storm)
	2.92E-04 ft/s	
n =	0.015	manning's n for concrete

Calculation

$$q_{\max} = I * L$$

$$q_{\max} = 1.50E-01 \text{ ft}^2/\text{s}$$

$y_{\max} = 0.088154 \text{ ft}$ $= 1.1 \text{ in}$
--

$v_{\max} = 1.7 \text{ ft/s}$



APPENDIX D HEC-HMS OUTPUT

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 24Sep2019, 16:58:21

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	119.4	01Jan2016, 12:29	2.09

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 24Sep2019, 17:24:35

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	247.7	01Jan2016, 12:27	4.11

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC I

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 25Sep2019, 11:16:23

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	413.3	03Jan2016, 06:01	33.97

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 25Sep2019, 11:32:56

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	225.5	01Jan2016, 12:26	3.68

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 25Sep2019, 11:35:21

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	376.6	01Jan2016, 12:26	6.17

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC II

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 25Sep2019, 11:37:05

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	424.2	03Jan2016, 06:00	37.48

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 25Sep2019, 11:39:00

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	294.7	01Jan2016, 12:25	4.96

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 25Sep2019, 11:40:30

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	444.8	01Jan2016, 12:25	7.63

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 1 AMC III

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 25Sep2019, 11:42:16

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 1	0.159	426.9	03Jan2016, 06:00	39.34

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 26Sep2019, 11:36:24

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.04	84.0	01Jan2016, 12:08	3.28
P DA 2A Storage	0.04	83.9	01Jan2016, 12:09	3.26

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 11:39:06

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.04	145.1	01Jan2016, 12:08	5.69
P DA 2A Storage	0.04	144.9	01Jan2016, 12:09	5.66

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC I

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 26Sep2019, 11:41:22

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.04	106.4	03Jan2016, 06:00	36.76
P DA 2A Storage	0.04	106.4	03Jan2016, 06:00	36.74

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 26Sep2019, 11:30:40

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.04	115.4	01Jan2016, 12:08	4.63
P DA 2 STORAGE	0.04	115.1	01Jan2016, 12:08	4.60

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 11:53:08

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.04	177.1	01Jan2016, 12:08	7.26
P DA 2 STORAGE	0.04	177.1	01Jan2016, 12:08	7.24

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00 Basin Model: P AP 2A AMC II
End of Run: 05Jan2016, 00:00 Meteorologic Model: PMP Distribution A
Compute Time: 26Sep2019, 12:01:54 Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.04	107.3	03Jan2016, 06:00	38.91
P DA 2 STORAGE	0.04	107.3	03Jan2016, 06:00	38.89

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 26Sep2019, 12:05:41

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.040	127.5	01Jan2016, 12:08	5.41
P DA 2A STORAGE	0.040	127.4	01Jan2016, 12:08	5.39

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 11:09:09

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.040	187.5	01Jan2016, 12:08	8.11
P DA 2A STORAGE	0.040	187.6	01Jan2016, 12:08	8.08

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00 Basin Model: P AP 2A AMC III
End of Run: 05Jan2016, 00:00 Meteorologic Model: PMP Distribution A
Compute Time: 26Sep2019, 12:09:06 Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2A	0.040	107.5	03Jan2016, 06:00	39.88
P DA 2A STORAGE	0.040	107.5	03Jan2016, 05:59	39.85

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 26Sep2019, 12:25:35

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	37.1	01Jan2016, 12:03	2.99

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 12:28:57

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	65.5	01Jan2016, 12:02	5.32

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC I

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 26Sep2019, 12:30:05

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	39.8	03Jan2016, 06:00	36.18

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 26Sep2019, 12:46:27

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	53.0	01Jan2016, 12:02	4.41

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 12:47:47

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	82.5	01Jan2016, 12:02	7.02

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC II

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 26Sep2019, 12:49:44

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	40.2	03Jan2016, 06:00	38.61

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 26Sep2019, 12:50:48

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	59.9	01Jan2016, 12:02	5.30

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 12:52:12

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	88.5	01Jan2016, 12:02	7.99

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2B AMC III

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 26Sep2019, 12:53:41

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 2B	0.015	40.3	03Jan2016, 06:00	39.74

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 30Sep2019, 15:12:07

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	127.9	01Jan2016, 12:12	3.38
P DA 4	1.061	806.1	01Jan2016, 12:43	2.62
P DA 3 STORAGE	0.067	0.0	01Jan2016, 00:00	0.00
PLAYA	1.128	0.0	01Jan2016, 00:00	0.00

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 30Sep2019, 15:12:14

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	218.8	01Jan2016, 12:11	5.81
P DA 4	1.061	1527.6	01Jan2016, 12:42	4.84
P DA 3 STORAGE	0.067	0.0	01Jan2016, 00:00	0.00
PLAYA	1.128	0.0	01Jan2016, 00:00	0.00

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC I

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 30Sep2019, 15:11:58

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	178.4	03Jan2016, 06:00	36.94
P DA 4	1.061	2787.0	03Jan2016, 06:01	35.35
P DA 3 STORAGE	0.067	178.3	03Jan2016, 06:01	29.18
PLAYA	1.128	2875.1	03Jan2016, 06:19	26.75

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 30Sep2019, 14:59:07

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	174.3	01Jan2016, 12:11	4.74
P DA 4	1.061	1327.9	01Jan2016, 12:41	4.20
P DA 3 STORAGE	0.067	0.0	01Jan2016, 00:00	0.00
PLAYA	1.128	0.0	01Jan2016, 00:00	0.00

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 30Sep2019, 14:59:14

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	266.1	01Jan2016, 12:11	7.38
P DA 4	1.061	2120.0	01Jan2016, 12:40	6.78
P DA 3 STORAGE	0.067	0.0	01Jan2016, 00:00	0.00
PLAYA	1.128	4.6	02Jan2016, 01:53	0.09

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00 Basin Model: P AP3 AMC II
End of Run: 05Jan2016, 00:00 Meteorologic Model: PMP Distribution A
Compute Time: 30Sep2019, 14:58:59 Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	179.8	03Jan2016, 06:00	39.05
P DA 4	1.061	2839.4	03Jan2016, 06:00	38.30
P DA 3 STORAGE	0.067	179.8	03Jan2016, 06:00	31.29
PLAYA	1.128	2980.9	03Jan2016, 06:14	29.65

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 3 AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 30Sep2019, 11:42:47

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	191.6	01Jan2016, 12:11	5.53
P DA 4	1.061	1579.3	01Jan2016, 12:40	5.18
P DA 3 STORAGE	0.067	0.0	01Jan2016, 00:00	0.00
PLAYA	1.128	0.0	01Jan2016, 00:00	0.00

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 3 AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 30Sep2019, 11:23:24

Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	280.7	01Jan2016, 12:11	8.23
P DA 4	1.061	2353.7	01Jan2016, 12:40	7.87
P DA 3 STORAGE	0.067	2.7	02Jan2016, 00:18	0.41
PLAYA	1.128	16.0	02Jan2016, 01:22	0.35

Project: 15052-CISF Simulation Run: PMP Dist A

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 3 AMC III

End of Run: 05Jan2016, 00:00

Meteorologic Model: PMP Distribution A

Compute Time: 30Sep2019, 14:44:32

Control Specifications: Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
P DA 3	0.067	180.1	03Jan2016, 06:00	40.00
P DA 4	1.061	2849.7	03Jan2016, 06:00	39.61
P DA 3 STORAGE	0.067	180.0	03Jan2016, 05:58	32.24
PLAYA	1.128	3005.0	03Jan2016, 06:11	30.94

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Reservoir: P DA 2A Storage

Start of Run: 01Jan2016, 00:00

Basin Model:

P AP 2A AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model:

100 yr

Compute Time: 26Sep2019, 11:36:24

Control Specifications:

Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 84.0 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:07

Peak Discharge: 83.9 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 12:09

Inflow Volume: 3.28 (IN)

Peak Storage:

0.2 (AC-FT)

Discharge Volume: 3.26 (IN)

Peak Elevation:

3485.5 (FT)

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Reservoir: P DA 2A Storage

Start of Run: 01Jan2016, 00:00

Basin Model:

P AP 2A AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model:

500 yr

Compute Time: 26Sep2019, 11:39:06

Control Specifications:

Control 24 HR Storms

Volume Units: N

Computed Results

Peak Inflow: 145.1 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:07

Peak Discharge: 144.9 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 12:09

Inflow Volume: 5.69 (IN)

Peak Storage:

0.2 (AC-FT)

Discharge Volume: 5.66 (IN)

Peak Elevation:

3485.8 (FT)

Project: 15052-CISF Simulation Run: PMP Dist A
Reservoir: P DA 2A Storage

Start of Run:	01Jan2016, 00:00	Basin Model:	P AP 2A AMC I
End of Run:	05Jan2016, 00:00	Meteorologic Model:	PMP Distribution A
Compute Time:	26Sep2019, 11:41:22	Control Specifications:	Control PMP

Volume Units: N

Computed Results

Peak Inflow:	106.4 (CFS)	Date/Time of Peak Inflow:	03Jan2016, 05:59
Peak Discharge:	106.4 (CFS)	Date/Time of Peak Discharge:	03Jan2016, 06:00
Inflow Volume:	36.76 (IN)	Peak Storage:	0.2 (AC-FT)
Discharge Volume:	36.74 (IN)	Peak Elevation:	3485.6 (FT)

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Reservoir: P DA 2 STORAGE

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 26Sep2019, 11:44:45

Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 115.4 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:07

Peak Discharge: 115.1 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 12:08

Inflow Volume: 4.63 (IN)

Peak Storage: 0.2 (AC-FT)

Discharge Volume: 4.60 (IN)

Peak Elevation: 3485.7 (FT)

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Reservoir: P DA 2 STORAGE

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 11:53:08

Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 177.1 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:07

Peak Discharge: 177.1 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 12:08

Inflow Volume: 7.26 (IN)

Peak Storage: 0.3 (AC-FT)

Discharge Volume: 7.24 (IN)

Peak Elevation: 3485.9 (FT)

Project: 15052-CISF Simulation Run: PMP Dist A
Reservoir: P DA 2 STORAGE

Start of Run: 01Jan2016, 00:00 Basin Model: P AP 2A AMC II
End of Run: 05Jan2016, 00:00 Meteorologic Model: PMP Distribution A
Compute Time: 26Sep2019, 12:01:54 Control Specifications: Control PMP

Volume Units: IN

Computed Results

Peak Inflow:	107.3 (CFS)	Date/Time of Peak Inflow:	03Jan2016, 05:59
Peak Discharge:	107.3 (CFS)	Date/Time of Peak Discharge:	03Jan2016, 06:00
Inflow Volume:	38.91 (IN)	Peak Storage:	0.2 (AC-FT)
Discharge Volume:	38.89 (IN)	Peak Elevation:	3485.6 (FT)

Project: 15052-CISF Simulation Run: 100 YR 24 HR
Reservoir: P DA 2A STORAGE

Start of Run: 01Jan2016, 00:00 Basin Model: P AP 2A AMC III
End of Run: 02Jan2016, 12:00 Meteorologic Model: 100 yr
Compute Time: 26Sep2019, 12:05:41 Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow:	127.5 (CFS)	Date/Time of Peak Inflow:	01Jan2016, 12:07
Peak Discharge:	127.4 (CFS)	Date/Time of Peak Discharge:	01Jan2016, 12:08
Inflow Volume:	5.41 (IN)	Peak Storage:	0.2 (AC-FT)
Discharge Volume:	5.39 (IN)	Peak Elevation:	3485.7 (FT)

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Reservoir: P DA 2A STORAGE

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 2A AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 26Sep2019, 11:09:09

Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 187.5 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:07

Peak Discharge: 187.6 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 12:08

Inflow Volume: 8.11 (IN)

Peak Storage: 0.3 (AC-FT)

Discharge Volume: 8.08 (IN)

Peak Elevation: 3486.0 (FT)

Project: 15052-CISF Simulation Run: PMP Dist A
Reservoir: P DA 2A STORAGE

Start of Run:	01Jan2016, 00:00	Basin Model:	P AP 2A AMC III
End of Run:	05Jan2016, 00:00	Meteorologic Model:	PMP Distribution A
Compute Time:	26Sep2019, 12:09:06	Control Specifications:	Control PMP

Volume Units: IN

Computed Results

Peak Inflow:	107.5 (CFS)	Date/Time of Peak Inflow:	03Jan2016, 05:59
Peak Discharge:	107.5 (CFS)	Date/Time of Peak Discharge:	03Jan2016, 05:59
Inflow Volume:	39.88 (IN)	Peak Storage:	0.2 (AC-FT)
Discharge Volume:	39.85 (IN)	Peak Elevation:	3485.6 (FT)

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Reservoir: PLAYA

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 30Sep2019, 15:12:07

Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 806.1 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:42

Peak Discharge: 0.0 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 00:00

Inflow Volume: 2.47 (IN)

Peak Storage: 148.3 (AC-FT)

Discharge Volume: 0.00 (IN)

Peak Elevation: 3484.4 (FT)

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Reservoir: PLAYA

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC I

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 30Sep2019, 15:12:14

Control Specifications: Control 24 HR Storms

Volume Units:IN

Computed Results

Peak Inflow: 1527.6 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:41

Peak Discharge: 0.0 (CFS)

Date/Time of Peak Discharge01Jan2016, 00:00

Inflow Volume: 4.55 (IN)

Peak Storage: 273.8 (AC-FT)

Discharge Volume0.00 (IN)

Peak Elevation: 3485.8 (FT)

Project: 15052-CISF Simulation Run: PMP Dist A
Reservoir: PLAYA

Start of Run:	01Jan2016, 00:00	Basin Model:	P AP3 AMC I
End of Run:	05Jan2016, 00:00	Meteorologic Model:	PMP Distribution A
Compute Time:	30Sep2019, 15:11:58	Control Specifications:	Control PMP

Volume Units:IN

Computed Results

Peak Inflow:	2965.3 (CFS)	Date/Time of Peak Inflow:	03Jan2016, 06:00
Peak Discharge:	2875.1 (CFS)	Date/Time of Peak Discharge	03Jan2016, 06:19
Inflow Volume:	34.99 (IN)	Peak Storage:	894.8 (AC-FT)
Discharge Volume	26.75 (IN)	Peak Elevation:	3488.8 (FT)

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Reservoir: PLAYA

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 30Sep2019, 14:59:07

Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 1327.9 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:40

Peak Discharge: 0.0 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 00:00

Inflow Volume: 3.95 (IN)

Peak Storage: 237.5 (AC-FT)

Discharge Volume: 0.00 (IN)

Peak Elevation: 3485.4 (FT)

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Reservoir: PLAYA

Start of Run: 01Jan2016, 00:00

Basin Model: P AP3 AMC II

End of Run: 02Jan2016, 12:00

Meteorologic Model: 500 yr

Compute Time: 30Sep2019, 14:59:14

Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 2120.0 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:39

Peak Discharge: 4.6 (CFS)

Date/Time of Peak Discharge: 02Jan2016, 01:53

Inflow Volume: 6.38 (IN)

Peak Storage: 381.5 (AC-FT)

Discharge Volume: 0.09 (IN)

Peak Elevation: 3486.5 (FT)

Project: 15052-CISF Simulation Run: PMP Dist A
Reservoir: PLAYA

Start of Run:	01Jan2016, 00:00	Basin Model:	P AP3 AMC II
End of Run:	05Jan2016, 00:00	Meteorologic Model:	PMP Distribution A
Compute Time:	30Sep2019, 14:58:59	Control Specifications:	Control PMP

Volume Units: IN

Computed Results

Peak Inflow:	3019.2 (CFS)	Date/Time of Peak Inflow:	03Jan2016, 05:59
Peak Discharge:	2980.9 (CFS)	Date/Time of Peak Discharge:	03Jan2016, 06:14
Inflow Volume:	37.88 (IN)	Peak Storage:	900.7 (AC-FT)
Discharge Volume:	29.65 (IN)	Peak Elevation:	3488.9 (FT)

Project: 15052-CISF Simulation Run: 100 YR 24 HR

Reservoir: PLAYA

Start of Run: 01Jan2016, 00:00

Basin Model: P AP 3 AMC III

End of Run: 02Jan2016, 12:00

Meteorologic Model: 100 yr

Compute Time: 30Sep2019, 14:44:12

Control Specifications: Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow: 1579.3 (CFS)

Date/Time of Peak Inflow: 01Jan2016, 12:39

Peak Discharge: 0.0 (CFS)

Date/Time of Peak Discharge: 01Jan2016, 00:00

Inflow Volume: 4.87 (IN)

Peak Storage: 293.3 (AC-FT)

Discharge Volume: 0.00 (IN)

Peak Elevation: 3486.0 (FT)

Project: 15052-CISF Simulation Run: 500 YR 24 HR

Reservoir: PLAYA

Start of Run:	01Jan2016, 00:00	Basin Model:	P AP 3 AMC III
End of Run:	02Jan2016, 12:00	Meteorologic Model:	500 yr
Compute Time:	30Sep2019, 11:23:24	Control Specifications:	Control 24 HR Storms

Volume Units: IN

Computed Results

Peak Inflow:	2353.7 (CFS)	Date/Time of Peak Inflow:	01Jan2016, 12:39
Peak Discharge:	16.0 (CFS)	Date/Time of Peak Discharge:	02Jan2016, 01:22
Inflow Volume:	7.42 (IN)	Peak Storage:	437.0 (AC-FT)
Discharge Volume:	0.35 (IN)	Peak Elevation:	3486.8 (FT)

Project: 15052-CISF Simulation Run: PMP Dist A

Reservoir: PLAYA

Start of Run:	01Jan2016, 00:00	Basin Model:	P AP 3 AMC III
End of Run:	05Jan2016, 00:00	Meteorologic Model:	PMP Distribution A
Compute Time:	30Sep2019, 14:44:32	Control Specifications:	Control PMP

Volume Units:IN

Computed Results

Peak Inflow:	3029.7 (CFS)	Date/Time of Peak Inflow:	03Jan2016, 05:59
Peak Discharge:	3005.0 (CFS)	Date/Time of Peak Discharge	03Jan2016, 06:11
Inflow Volume:	39.17 (IN)	Peak Storage:	902.0 (AC-FT)
Discharge Volume	30.94 (IN)	Peak Elevation:	3488.9 (FT)



APPENDIX E HEC-HMS INPUT (CD)



ADDENDUM A BERM BREACH ANALYSIS

ADDENDUM A BERM BREACH ANALYSIS

FEBRUARY 2019
REVISED OCTOBER 2019
(FIGURE A-1 ONLY)

Prepared for:

Waste Control Specialists LLC
P.O. Box 1129
Andrews, Texas 78714

Prepared by:

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Diana Dworaczyk P.E. No. 63724
10 October 2019



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3.0 BERM BREACH	1



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FIGURE

A-1 DEVELOPED DRAINAGE AREA DITCHES

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APPENDIX A CALCULATIONS

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1.0 INTRODUCTION

This addendum presents the results of a hydrologic and hydraulic analysis for an unlikely berm breach of the proposed berm and ditch located just north of the protected area fence for the Centralized Interim Storage Facility (CISF). The same analysis methods, strategies and references that are found in the main part of the flood report are used in this analysis.

The diversion berms and collection ditches, A and B as shown on Figure A-1, will divert surface water runoff from the area north and upgradient of the CISF. Collection ditches A and B drainage areas that will contribute runoff to the ditches and berms are delineated on Figure A-1. Collection Ditch A drainage area is 4.3 acres and Collection Ditch B drainage area is 62.2 acres. Collection Ditch B has the largest drainage area contributing surface water runoff to it by a substantial amount and will carry the largest flow. Therefore, only a berm breach in Collection Ditch B is analyzed since it will yield the greatest potential surface water flow to the storage pads.

2.0 WATERSHED DESCRIPTION AND MODEL

Drainage Area Ditch B DA contains 62.2 acres and drains southeast toward the collection ditch and berm. Collection Ditch B drains to the east and ends several hundred feet past the northeast corner of the protected area fence. The soils in the area draining to Ditch B DA are the Jalmar-Pehnwell series and are classified as hydrologic group A/B as shown on Figure 2.2.1-1, Soils Boundary Map. Curve number (CN) and time of concentration parameters are found in Addendum A, Appendix A, Calculations.

The Ditch B DA parameters are input into the HEC-HMS model to determine peak runoff rates for Collection Ditch B. The 100-year, 500-year and PMP peak discharges for Collection Ditch B are 60 cubic feet per second (CFS), 129 CFS and 251 CFS, respectively. HEC-HMS model setup and inputs are found on the CD in Appendix E of the main part of the report. Results of the HEC-HMS modeling for Collection Ditch B are found in Addendum A, Appendix B, HEC-HMS Output.

3.0 BERM BREACH

Onsite surface water runoff will be mainly sheet flow off the sloped storage pads and the sloped areas in between the pads. The Collection Ditch B berm is 2.6 feet high and approximately 470 feet from the nearest storage pad at the northern side of the CISF as surface water flows, which is the Phase 8 storage pad. The worst-case for a berm breach will be when Collection Ditch B



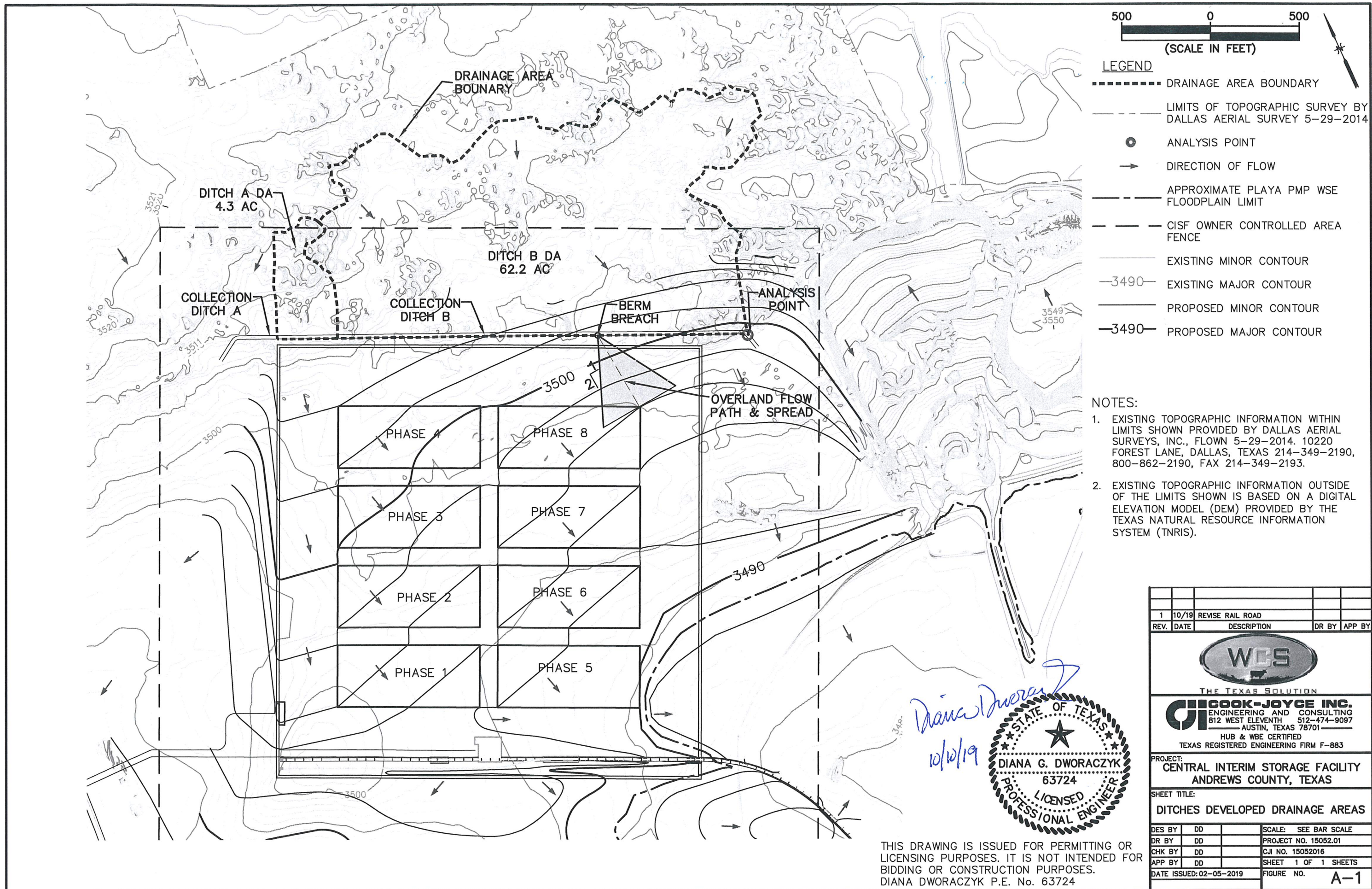
has the greatest amount of surface water flowing in it and will be at the location where breach flow can still reach a storage pad. The peak flow, 251 CFS, in Collection Ditch B is calculated by HEC-HMS at the analysis point depicted on Figure A-1. The analyzed berm breach location is approximately 800 feet upstream from the analysis point, yet the peak flow is conservatively assumed to flow in Collection Ditch B at that location. The berm breach location is depicted on Figure A-1.

Assumptions for the overland depth of flow adjacent to the Phase 8 storage pad from a berm breach include the following: the berm breach is large enough to release the entire PMP flow, even though Ditch B will still be flowing to the southeast; all of the breach flow will reach the storage pad, even though the pads sit above the surrounding area; and the berm breach flow will spread out from the breach at approximately 2:1 angles from the breach area as it returns to overland flow over the approximately 470 feet to the nearest pad.

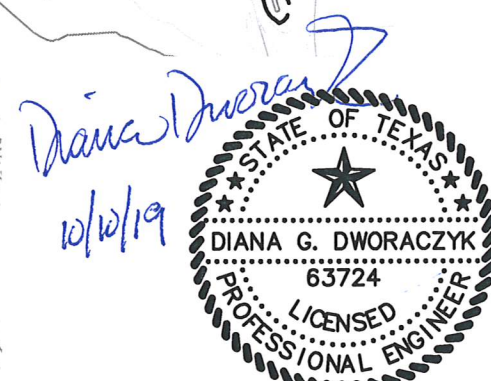
The estimated depth of flow adjacent to the pad is approximately 3 inches. Overland depth of flow calculations are found in Addendum A, Appendix A, Calculations.

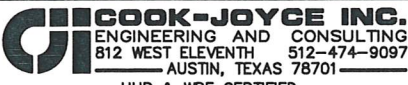


FIGURE



THIS DRAWING IS ISSUED FOR PERMITTING OR LICENSING PURPOSES. IT IS NOT INTENDED FOR BIDDING OR CONSTRUCTION PURPOSES.
DIANA DWORACZYK P.E. No. 63724



1	10/19	REVISE RAIL ROAD		
REV.	DATE	DESCRIPTION	DR BY	APP BY
 THE TEXAS SOLUTION				
 ENGINEERING AND CONSULTING 812 WEST ELEVENTH 512-474-9097 AUSTIN, TEXAS 78701 HUB & WBE CERTIFIED TEXAS REGISTERED ENGINEERING FIRM F-883				
PROJECT: CENTRAL INTERIM STORAGE FACILITY ANDREWS COUNTY, TEXAS				
SHEET TITLE: DITCHES DEVELOPED DRAINAGE AREAS				
DES BY	DD	SCALE:	SEE BAR SCALE	
DR BY	DD	PROJECT NO.	15052.01	
CHK BY	DD	CJI NO.	15052016	
APP BY	DD	SHEET	1 OF 1 SHEETS	
DATE ISSUED: 02-05-2019		FIGURE NO.	A-1	



APPENDICES



APPENDIX A CALCULATIONS



ADDENDUM A
WCS - CISF DITCH B
POST-DEVELOPMENT DRAINAGE AREA TIME OF CONCENTRATION

WCS DES CHK
 DD 1/31/2019 SC 2/5/2019

Reference: 1. United States Department of Agriculture, Urban Hydrology for Small Watersheds TR-55, 1986
 2. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P Hydraulic Calcs DD.dwg



02/06/19
 Calculations
 4 Pages

Drainage Area	DITCH B		
	A	62.2 (acres)	0.097 (sqmi)
Sheet Flow			
Manning's roughness coef. ¹	n	0.15	n/a
Flow Length	L	408	feet
2-year, 24-hour rainfall	P2	2.5	inches
Slope	s	0.0098	ft/ft
Travel time ²	Tt	0.76	hours
		45.4	min.
Shallow Concentrated Flow			
Flow Length	L	1060	feet
Slope	s	0.00710	ft/ft
Surface (1=paved or 2=unpaved)		2	n/a
Velocity ³	V	1.36	ft/sec
Travel time	Tt	0.22	hours
		12.99	min.
Manning's Equation			
Flow Length	L	1383	feet
Slope	S	0.00500	ft/ft
roughness ⁴	n	0.028	n/a
Open Channel			
Bottom Width	BW	4	feet
Side Slopes (ft/ft, H:V) Rt.	H:V	3	feet
Side Slopes (ft/ft, H:V) Lt.	H:V	3	feet
Depth	d	2	feet
Flow Rate	Q	111	cfs
Velocity	V	4.2	ft/sec
Travel time	Tt	0.09	hours
		5.49	min.
Total Travel Time	T	1.06	hours
	T	63.90	min.
Lag Time (Tc*0.6)	Tlag	0.64	hours
	Tlag	38.34	min.

Notes:

1. Manning's roughness coefficient taken from 'Table 3-1 Roughness coefficients (Manning's n) for sheet flow' - United States Department of Agriculture, Urban Hydrology for Small Watersheds TR-55, 1986
 2. Equation 3-3, United States Department of Agriculture, *Urban Hydrology for Small Watersheds TR-55, 1986*
 3. Figure 3-1, United States Department of Agriculture, *Urban Hydrology for Small Watersheds TR-55, 1986*
 4. Reference Manning's 'n' calculations in APPDX C: POST-DEVELOPMENT HYDRAULIC CALCULATIONS
- S:\Projects\W - Z\WCS (Waste Control Specialists)\draft\18059 ISP - NRC Responses\Engineering Checks\Ditch B HEC\190204_TC.xls



ADDENDUM A
WCS - CISF DITCH B
POST-DEVELOPMENT CURVE NUMBER CALCULATIONS

WCS Job No. 18059
File: R190204_CURVE NO

DES		CHK
DD	2/4/2019	SC 2/5/2019

CURVE NUMBER

Reference: 1. CISF Drainage Evaluation and Floodplain Analysis Fig. No. 2.2.1-1, Soils Boundary Map
2. Soil information taken from US Department Of Agriculture, Natural Resources Conservation Service Custom Soil Resource Report For Andrews County, Texas, And Lea County, New Mexico, dated December 22, 2015
3. Texas Engineering Technical Note, No. 210-18-TX5, *Estimating Runoff for Conservation Practices*, 1990

Drainage Area - Ditch B		A=	62.2 Acres	0.097 sq mi	ARC I Adjustment**	ARC III Adjustment**
Cover Type & Hydrologic Condition	Soil Type	Hyd. Soil Group	CN*		(60 Min.)	(60 Min.)
Desert Shrub Poor	JPC	B/A***	77		60	89

*Taken from Table 2c of Texas Engineering Technical Note, Hydrology, No. 210-18-TX5,
Estimating Runoff for Conservation Practices

**Taken from Table 3 of Texas Engineering Technical Note, Hydrology, No. 210-18-TX5,
Estimating Runoff for Conservation Practices

***USDA Soil Survey indicates 46% A and 50% B. CN is conservatively calculated to be 100% B



ADDENDUM A **WCS - CISF BERM BREACH** **POST-DEVELOPMENT BERM BREACH OVERLAND DEPTH OF FLOW**

	DES		CHK
WCS	DD 1/16/2019	SC	2/5/2019

Reference:

1. Reference Drawing: S:\CAD\WCS\15052 CISF Floodplain\Engineering\15052 - P Hydraulic Calcs PMP.dwg

Ditch B carries the largest flow.

Use the PMP peak flow in Ditch B to calculate the pad depth of flow.

Manning Equation

$$v = 1.49/n * R_h^{2/3} * s^{1/2}$$

Where,

v= velocity (ft/s)

n= Manning's n

R_h= hydraulic radius

s= slope (ft/ft)

Manning Equation for Sheet Flow

$$q = v * y = 1.49/n * y^{5/3} * s^{1/2}$$

Therefore

$$y = (q / (1.49/n * s^{1/2}))^{3/5}$$

$$v = q/y$$

Where,

q= unit discharge (ft²/s)

v= velocity (ft/s)

n= Manning's n

y= depth

s= slope (ft/ft)

Max flow

$$q_{Max} = I * L$$

Where,

q_{Max}= maximum unit discharge (ft²/s)

I= Rainfall Intensity

L= Length of flow

Max depth at edge of pad

$$y_{max} = (q_{max} / (1.49/n * s^{1/2}))^{3/5}$$

Where,

y_{max}= Maximum depth of flow (ft)

q_{Max}= Maximum unit discharge

n= Manning's n

s= slope (ft/ft)



Max velocity

$$v_{\max} = q_{\max} / y_{\max}$$

Where,

$q_{\max}$ = maximum unit discharge (ft²/s)

$y_{\max}$ = Maximum depth of flow (ft)

Inputs

$Q_{\max}$ = 251 cfs From HEC-HMS Ditch B

Assumptions: Berm breach is large enough to release Ditch B PMP peak flow

The flow spreads out at approx. 1:2 on each side from center of berm breach,

Length of flow from berm breach to phase 8 pad = 470 ft., See Fig. A-1

Width of flow at phase 8 pad = 470 ft

The peak flow reaches a pad and flows onto a pad.

$$q_{\max} = 0.534043 \text{ ft}^2/\text{s}$$

$$I = q_{\max} / L$$

$s = 0.011 \text{ ft/ft}$ flow slope

$L = 470 \text{ ft}$ length of flow from berm breach to phase 8 pad, see Fig. A-1

$n = 0.025$ Manning's n for gravel

Calculation

$$I = 0.001136 \text{ ft/sec}$$

Max y=	0.228549 ft
	2.7 in
Max v=	2.3 ft/s



APPENDIX B HEC-HMS OUTPUT

Project: 15052 - CISF Design Simulation Run: Collection Ditch B R

Start of Run: 01Jan2016, 00:00 Basin Model: Collection Ditch B revised
End of Run: 02Jan2016, 12:00 Meteorologic Model: 100 yr
Compute Time: 04Feb2019, 16:25:04 Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Collection Ditch B R	0.097	59.7	01Jan2016, 12:34	1.92

Project: 15052 - CISF Design Simulation Run: Collection Ditch B R 500 Yr

Start of Run: 01Jan2016, 00:00 Basin Model: Collection Ditch B revised
End of Run: 02Jan2016, 12:00 Meteorologic Model: 500 yr
Compute Time: 04Feb2019, 16:26:45 Control Specifications: Control 24 HR Storms

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Collection Ditch B R	0.097	128.5	01Jan2016, 12:33	3.87

Project: 15052 - CISF Design Simulation Run: Collection Ditch B R PMP

Start of Run: 01Jan2016, 00:00 Basin Model: Collection Ditch B revised
End of Run: 05Jan2016, 00:00 Meteorologic Model: PMP Distribution A
Compute Time: 04Feb2019, 16:26:51 Control Specifications:Control PMP

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Collection Ditch B R	0.097	250.6	03Jan2016, 06:01	33.47