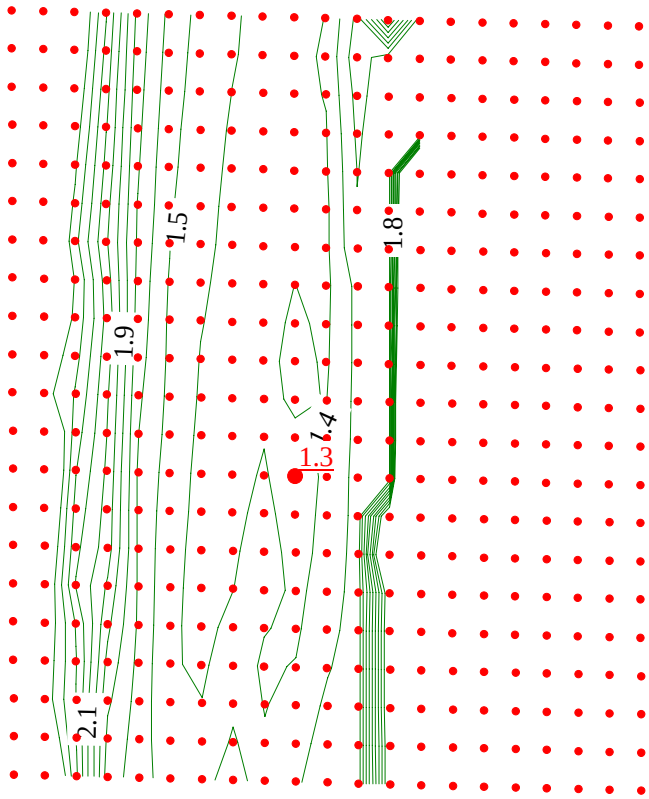
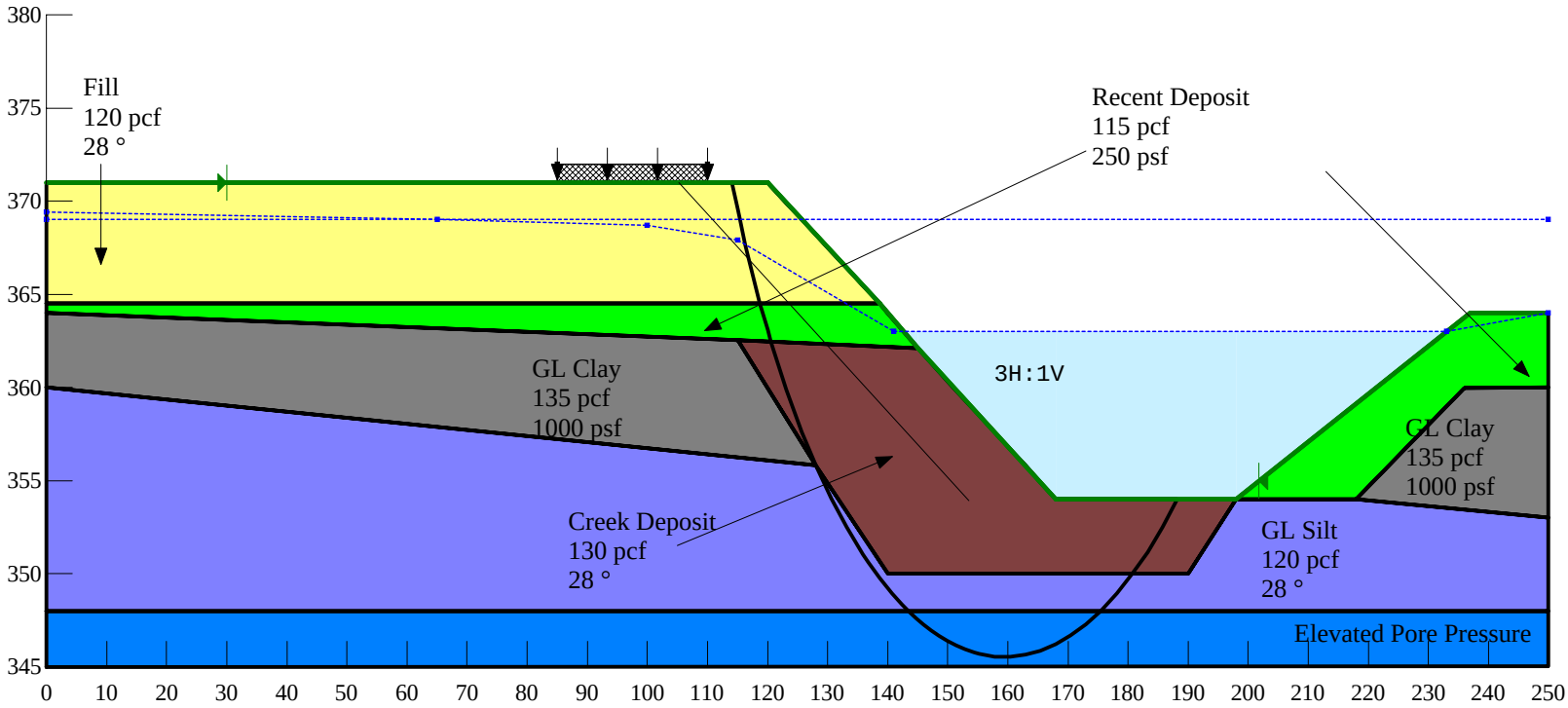
Figure 3.2

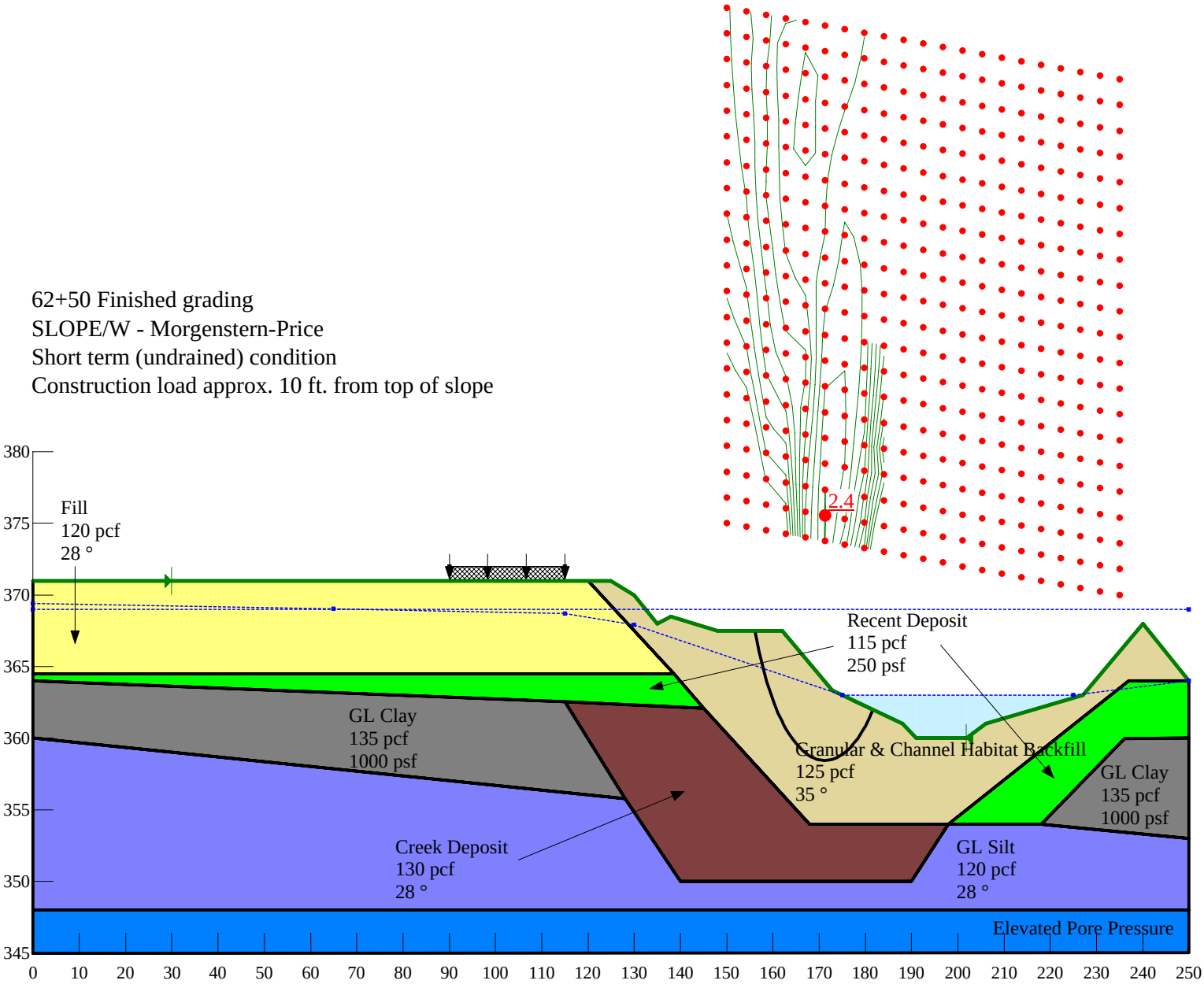


62+50 Excavation
SLOPE/W - Morgenstern-Price
Short term (undrained) condition
Construction load approx. 10 ft. from top of slope



C:\Documents and Settings\P0005619\My Documents\Ninemile Creek\Stability\95%\
62+50_channel excavation 95%.gsz

Figure 3.3



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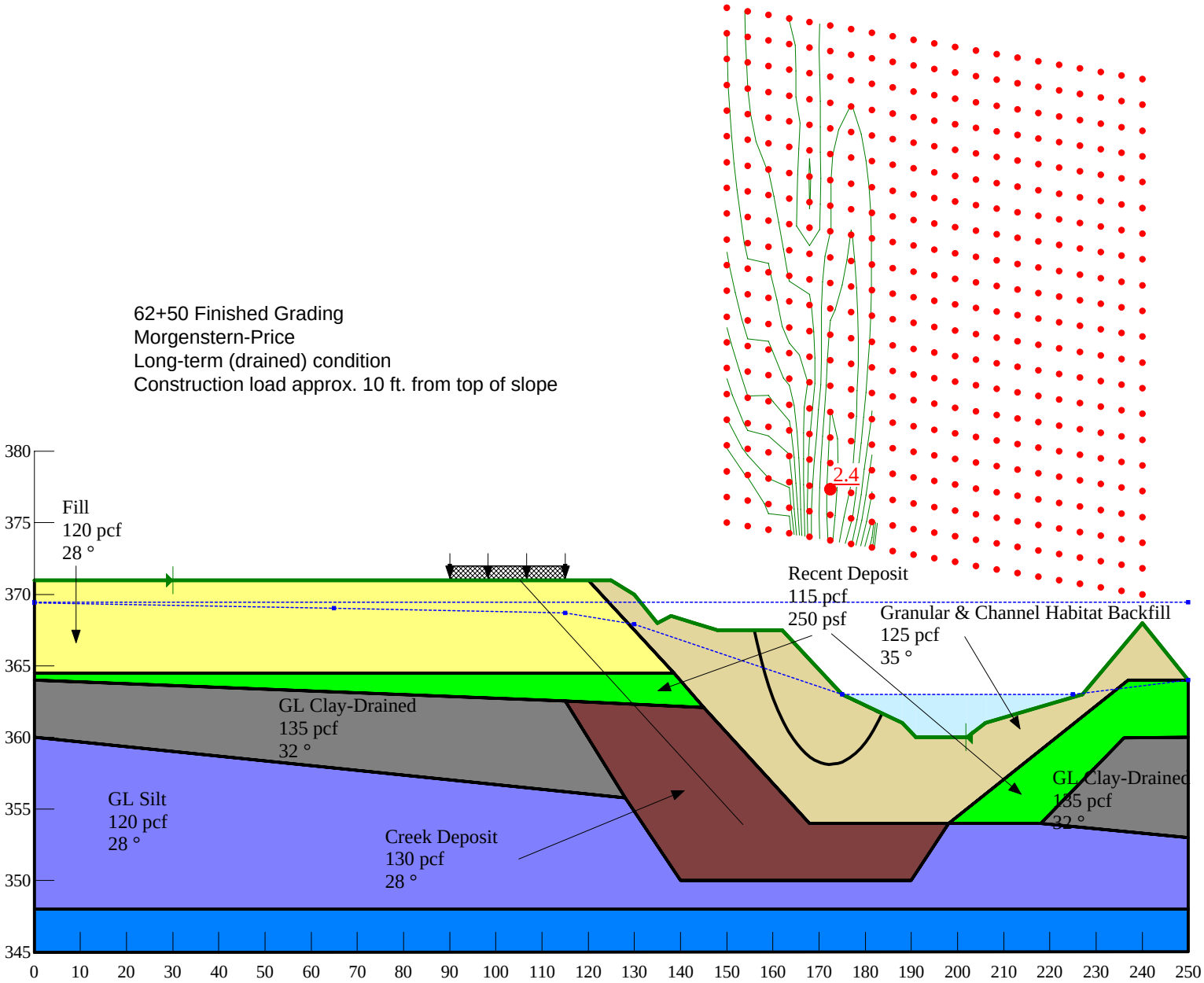
62+50_finished grading - Undr 95%.gsz

Figure 3.4



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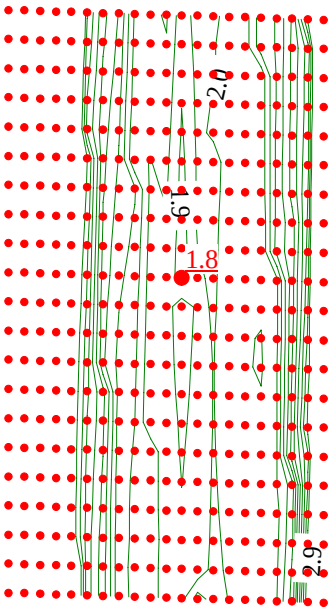
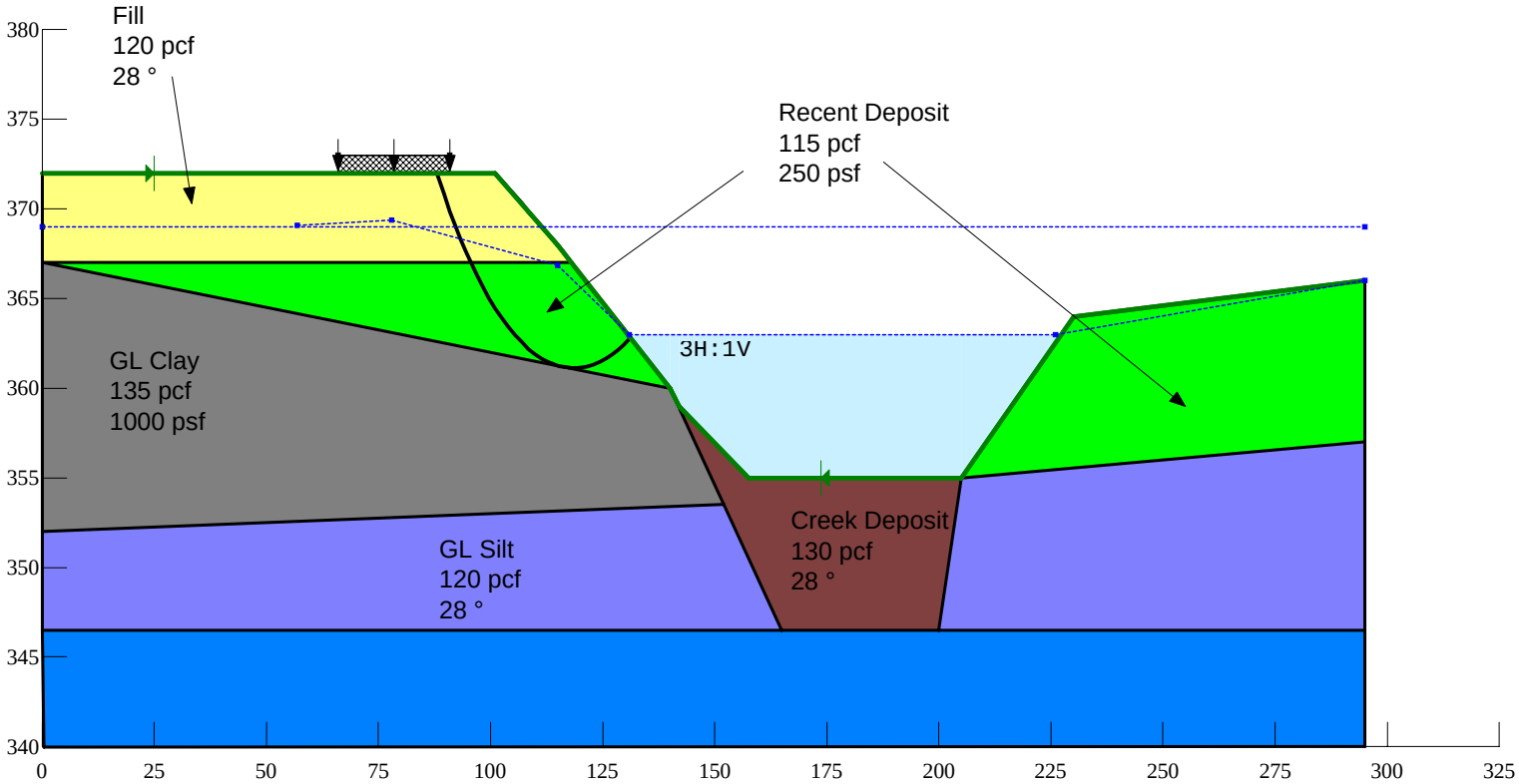
62+50_finished grading - Drained Clay 95%.gsz

Figure 3.5



64 + 50 Excavation
Morgenstern-Price
Short term (undrained) conditions
Construction load approx. 10 ft from top of slope



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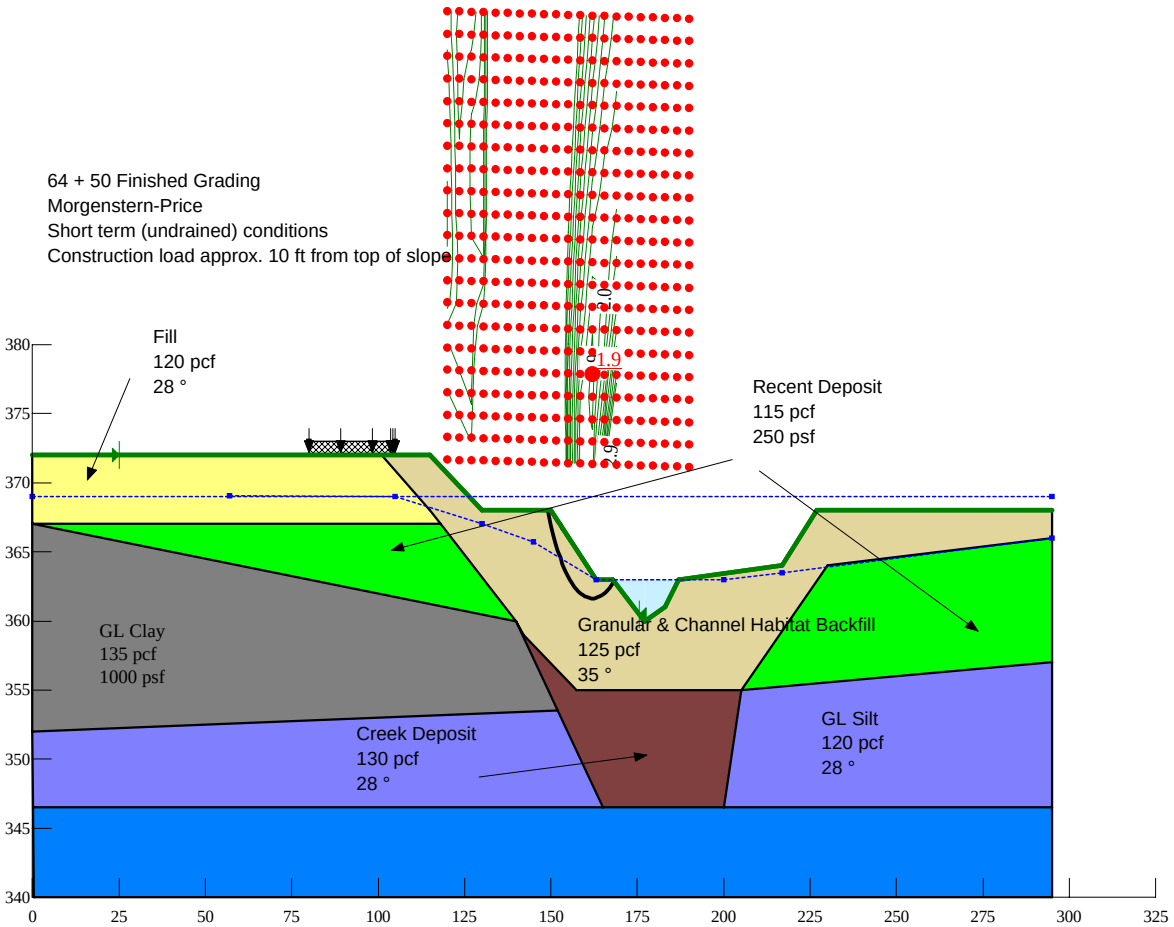
64+50_channel excavation 95%.gsz

Figure 3.6



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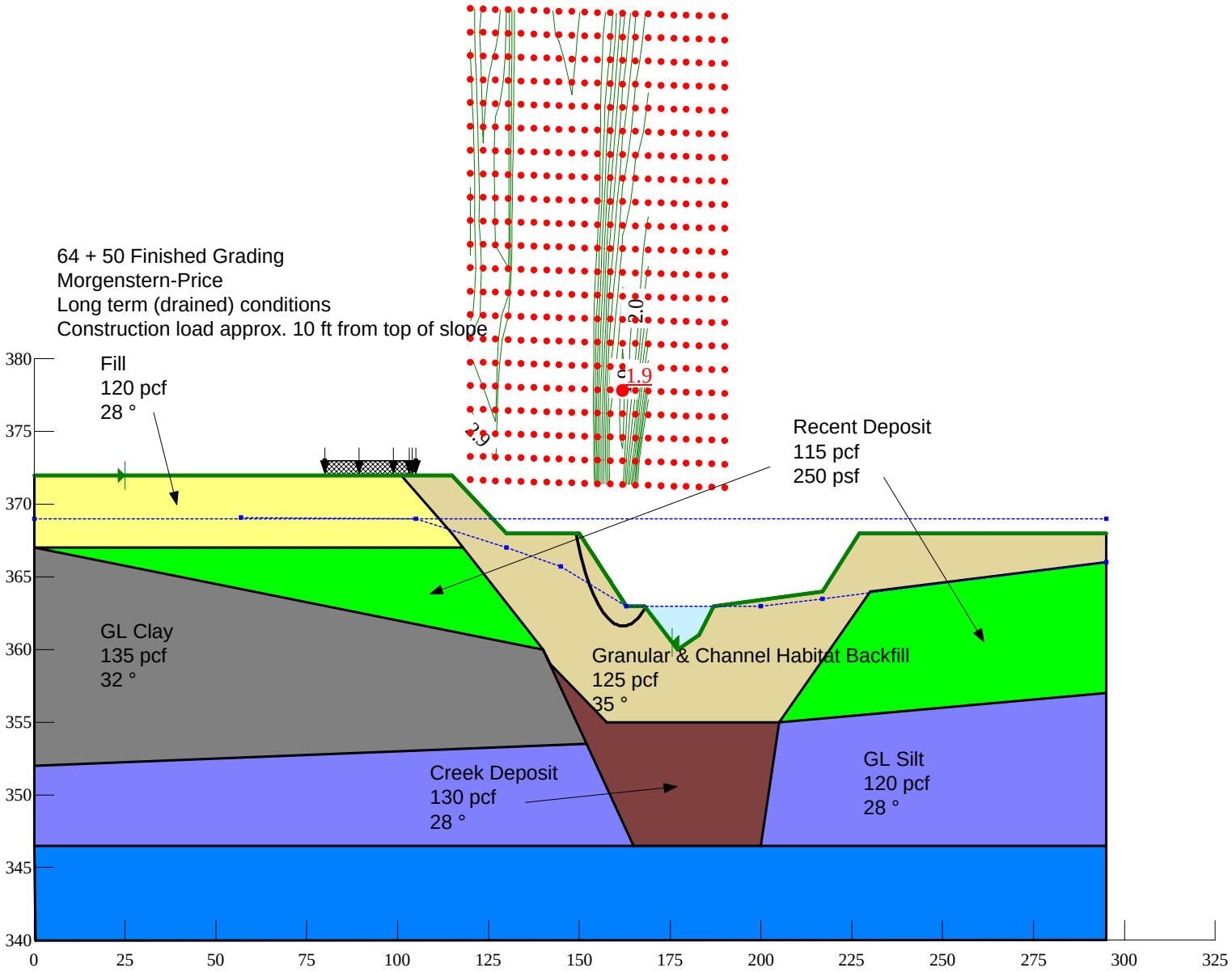
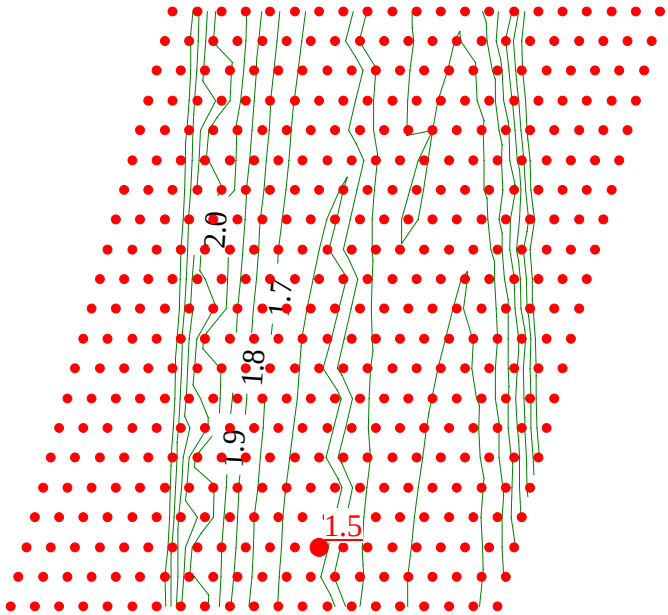
64+50_FINISHED GRADING Undr 95%.gsz

Figure 3.7

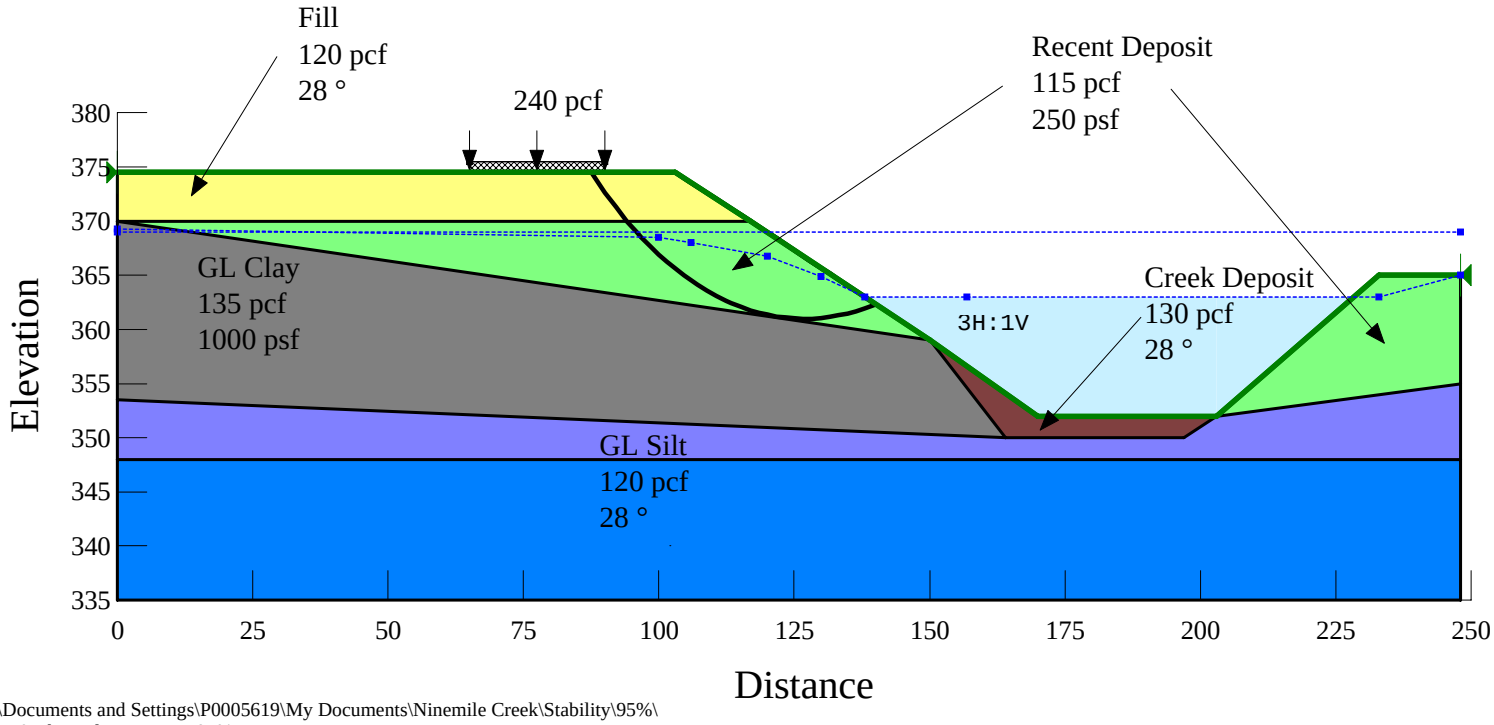


C:\Documents and Settings\P0005619\My Documents\Ninemile Creek\Stability\95%\
64+50_FINISHED GRADING Drained 95%.gsz

Figure 3.8

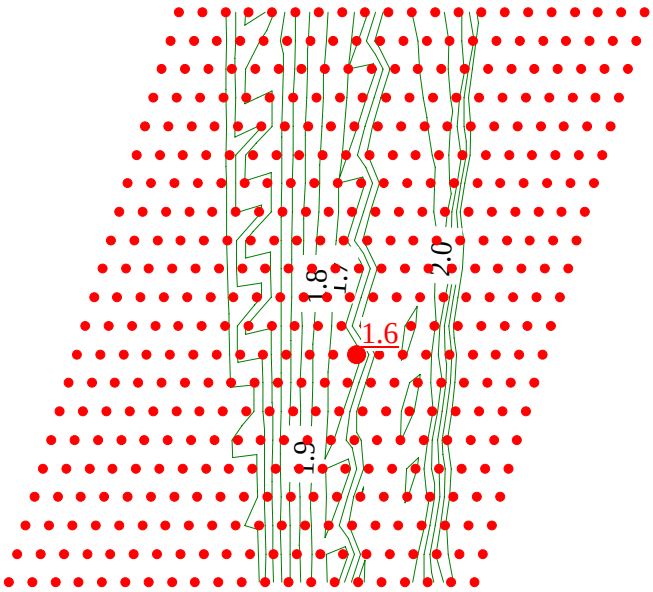


65+50 Excavation
Morgenstern-Price
Short term (undrained) condition
Construction load approximately 10 ft. from top of slope

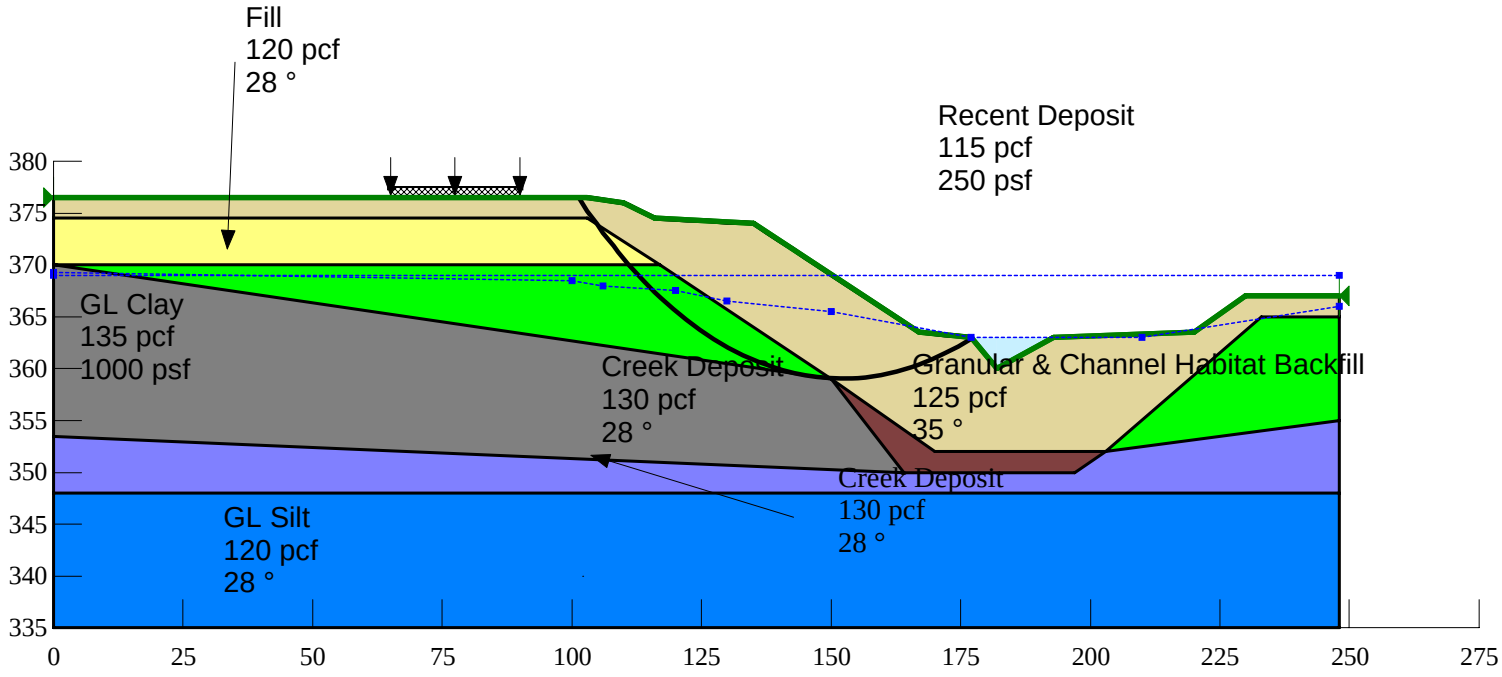


C:\Documents and Settings\P0005619\My Documents\Ninemile Creek\Stability\95%\
65+50_channel excavation 95%.gsz

Figure 3.9

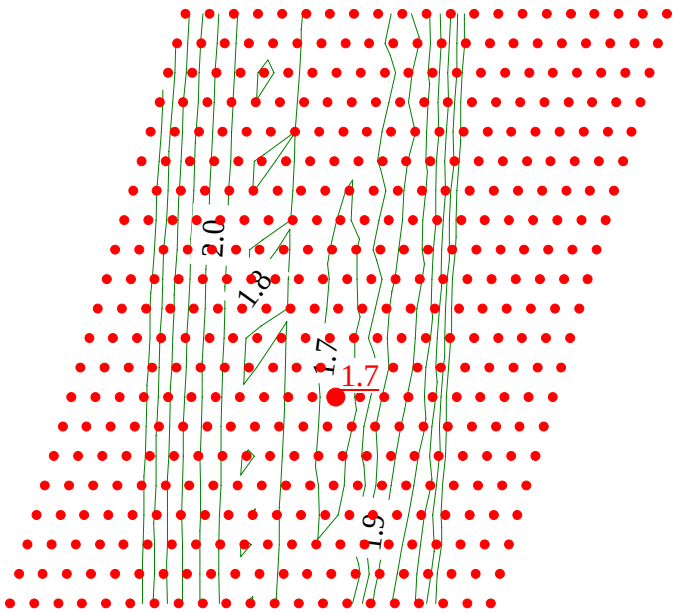


65+50 Finished Grading
Morgenstern-Price
Short term (undrained) condition
Construction load approximately 10 ft. from top of slope

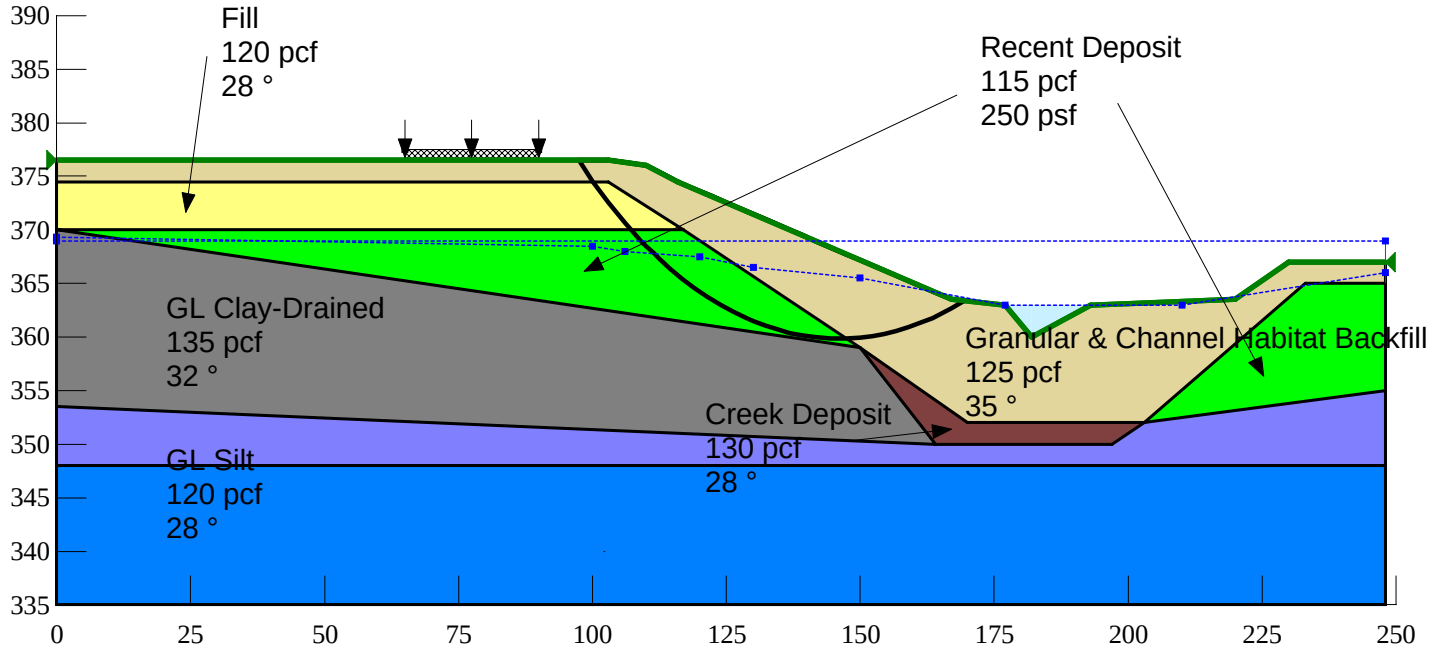


C:\Documents and Settings\P0005619\My Documents\Ninemile Creek\Stability\95%\
65+50_FINISHED GRADING 95%.gsz

Figure 3.10



65+50 Finished Grading
Morgenstern-Price
Long-term (drained) condition
Construction load approximately 10 ft. from top of slope



C:\Documents and Settings\P0005619\My Documents\Ninemile Creek\Stability\95%\
65+50_FINISHED GRADING-drained clay 95%.gsz

ATTACHMENT B-5

RESIDUAL ANALYSIS

ATTACHMENT B-5

RESIDUALS ANALYSIS

1.0 INTRODUCTION

Residual concentrations and concentrations that may be present following installation of the base layer within Reach CD and AB are estimated using the process described in USACE 2008 and are shown in Tables B-5-1 and B-5-2, respectively. Table B-5-1 has been updated to reflect removal depths as presented in the 95% design. Table B-5-2 is provided for context and represents removal depths as presented in the Ninemile Creek 50% Design Report; this table will be updated with submittal of supplemental design. The method and assumptions used are discussed below.

As described in NRC 2007 and USACE 2008, dredge residuals are sediments that are dislodged or re-suspended by dredge operations and subsequently re-deposited on the bottom. As described in USACE 2008, although there is currently no standardized method to accurately predict the mass or chemical concentrations in residuals, a generally accepted method to estimate the mass and chemical concentrations in residuals is to assume that the residual concentration would be equal to the depth-weighted average concentration of the sediment removed, and that the dry weight of the residual layer would be a percentage of the dry weight of the sediment removed. The sand base layer to be installed as part of the project, which would be placed immediately above the excavation surface to support the material above, would also attenuate residual concentrations. The presence of the sand base layer has been incorporated into the estimates.

2.0 CALCULATION METHOD

Residual concentrations were estimated using the process described in USACE 2008 and are shown in Tables B-5-1 and B-5-2. As illustrated in the right hand column of the tables, estimated concentrations in the base layer following installation are estimated on a point by point basis, and as a transect average. Residual concentrations and concentrations in the base layer are estimated using two estimates of percent loss of sediment disturbed by the dredging (i.e., 5% and 9%); actual percent loss will depend on properties of the removed material and the removal method.

3.0 ASSUMPTIONS

The following assumptions regarding removal approaches have been made to estimate the residual concentrations and concentrations in the base layer. The estimates may require revision if alternative approaches are implemented.

- Reach CD – Upstream of the Large Island: The estimates are based on the assumption that a single pass dredge cut could range up to approximately 5 ft depth. In this area, it

is not anticipated that significant removals will be conducted greater than 5 ft, therefore estimates are based on total removal in one pass. Base layer concentrations in this area are based on a 1.0 ft thick layer.

- Reach CD – Large Island: The estimates are based on the assumption that a single pass dredge cut could range up to approximately 5 ft depth. Removals in this area are expected to be generally less than 10 ft, but may be as great as approximately 11 ft. To simplify the analysis, estimates have been developed assuming a first pass dredge of 0-5 ft, followed by a second pass dredge from 5 ft to the bottom of excavation. Base layer concentrations in this area are based on a 1.0 ft thick layer.
- Reach AB – Removals in this reach are to an approximate average depth below existing grade of 2.5 ft within the channel. It is not anticipated that significant removals will be conducted greater than 5 ft, therefore estimates are based on total removal in one pass. Base layer concentrations in this area are based on a 0.5 ft thick layer.

Additionally, specific assumptions used in estimating concentrations are described below:

- Some of the more recent sample locations in the Reach CD channel did not include analysis of the top 3 ft for chemical parameters because at the time of sampling it had been determined this material would be removed. For the purposes of estimating residuals, a concentration for mercury has been assumed for the 0-3 ft intervals based on the historic sampling, by averaging the collected 0-3 ft data in adjacent areas.
- At some sample locations, the anticipated depth of removal is below the depth of the bottom sample interval. When this occurred, samples in the transect that have data to the design depths were averaged to estimate the concentrations to the full depth of removal.
- If a non-detect result was encountered within the depth of removal, an estimated concentration of 0.01 mg/kg was assumed based on approximately half of the detection limit.
- For sample locations where sampled intervals spilt intervals presented in the table, the average of the sampled intervals with respect to the table intervals has been applied.

4.0 SUMMARY

Estimated concentrations in the base layer are presented in Tables B-5-1 and Table B-5-2 and summarized by area below:

- Reach CD – Upstream the Large island: Estimated concentrations in the base layer following installation, on a point by point basis, average 0.25 mg/kg and range from less than 0.01 mg/kg to 1.39 mg/kg (or range from 0.02 mg/kg to 0.58 mg/kg on a transect by transect basis), depending on the assumptions used in the calculations (e.g. 5% vs. 9% loss of sediment disturbed by the dredging process).
- Reach CD – Large Island: Estimated concentrations in the base layer following installation, on a point by point basis, average 1.22 mg/kg and range from 0.11 mg/kg

to 5.64 mg/kg (or range from 0.66 mg/kg to 2.39 mg/kg on a transect by transect basis), depending on the assumptions used in the calculations (e.g. 5% vs. 9% loss of sediment disturbed by the dredging process).

- Reach AB - Estimated concentrations in the base layer following installation, on a point by point basis, average 0.07 mg/kg and range from less than 0.01 mg/kg to 0.81 mg/kg (or range from less than 0.01 mg/kg to 0.30 mg/kg on a transect by transect basis), depending on the assumptions used in the calculations (e.g. 5% vs. 9% loss of sediment disturbed by the dredging process).

Attached:

- Table B-5-1 - Estimated Reach CD Residual and Base Layer Mercury Concentrations
- Table B-5-2 - Estimated Reach AB Residual and Base Layer Mercury Concentrations

References

NRC 2007. Sediment Dredging at Superfund Megasites: Assessing the Effectiveness. Prepublication Copy, National Academics Press, Washington, D.C.

USACE 2008. Technical Guidelines for Environmental Dredging on Contaminated Sediments. Technical Report ERDC/EL TR-08-29. United States Army Corps of Engineers (USACE), Environmental Laboratory, Vicksburg, MS. September 2008.

TABLE B-5-1
ESTIMATED REACH CD RESIDUAL AND BASE LAYER MERCURY CONCENTRATIONS
NINEMILE CREEK 100% DESIGN

Sample Location ID	Thickness of Dredged Sediment (ft)	Conc. (mg/kg) at Depth (ft)												0-5 foot, Production Pass						5 foot-excavation depth, Production Pass						Base Layer [1]			
		(0-0.5)	(0.5-1.0)	(1.0-2.0)	(2.0-3.0)	(3.0-4.0)	(4.0-5.0)	(5.0-6.0)	(6.0-7.0)	(7.0-8.0)	(8.0-9.0)	(9.0-10.0)	(10.0-20.0)	First Pass Depth of Removal (ft)	Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Second Pass Depth of Removal (ft)	Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer						
																	Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)				Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)	Thickness (ft)	Dry Density (Kg/m3)	Mass (kg-ft/m3)	**Base Layer Conc. (mg/Kg)**
Upstream Large Island Transects																													
TN-16-1	4	0.04	1.67	0.08	0.08	0.08								4	0.27	9%	190.8	52.23	6.19	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**0.03**
TN-16-1	4	0.04	1.67	0.08	0.08	0.08								4	0.27	5%	106	29.02	3.44	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**0.02**
TN-16-2	4.5	0.08	0.05	0.08	0.08	0.08	0.08							4.5	0.07	9%	214.65	14.74	6.96	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**0.01**
TN-16-2	4.5	0.08	0.05	0.08	0.08	0.08	0.08							4.5	0.07	5%	119.25	8.19	3.87	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**0.00**
TN-16-3	2	2	3.276	0.08										2	1.36	9%	95.4	129.65	3.09	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**0.08**
TN-16-3	2	2	3.276	0.08										2	1.36	5%	53	72.03	1.72	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**0.04**
TRANSECT AVERAGE AT APPROXIMATE STATION 70+50																													**0.04**
TRANSECT AVERAGE AT APPROXIMATE STATION 70+50																													**0.02**
NMC-SED-042	3.2					2	0.024	0.019	0.046	15.3	0.1	0.026		3.2	N/A	9%	N/A	N/A	N/A	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**N/A**
NMC-SED-042	3.2					2	0.024	0.019	0.046	15.3	0.1	0.026		3.2	N/A	5%	N/A	N/A	N/A	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**N/A**
NMC-SED-041	4					0.12	0.29	0.098	0.038	0.032	0.033	0.026		4	N/A	9%	N/A	N/A	N/A	0	N/A	9%	N/A	N/A	N/A	1	1600	800	**N/A**
NMC-SED-041	4					0.12	0.29	0.098	0.038	0.032	0.033	0.026		4	N/A	5%	N/A	N/A	N/A	0	N/A	5%	N/A	N/A	N/A	1	1600	800	**N/A**
TRANSECT AVERAGE AT APPROXIMATE STATION 69+00[2]																													**N/A**
TRANSECT AVERAGE AT APPROXIMATE STATION 69+00[2]																													**N/A**
NMC-VC-002	5.5	5.101	17.3	1.62	0.24	0.15	0.15	0.0345	0.035	0.021	0.021	0.028		5.5	2.43	9%	262.35	638.12	8.51	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**0.34**
NMC-VC-002	5.5	5.101	17.3	1.62	0.24	0.15	0.15	0.035	0.035	0.021	0.021	0.028		5.5	2.43	5%	145.75	354.52	4.73	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**0.20**
TN-15-2	3	0.17	0.0505	0.04	0.034									3	0.06	9%	143.1	8.91	4.64	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**0.01**
TN-15-2	3	0.17	0.0505	0.04	0.034									3	0.06	5%	79.5	4.95	2.58	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**0.00**
TN-15-1	0	0.083	0.032	0.032										0	N/A	9%	0	N/A	0.00	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**N/A**
TN-15-1	0	0.083	0.032	0.032										0	N/A	5%	0	N/A	0.00	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**N/A**
NMC-VC-001[3]	2.3					ND	ND	ND	ND	0.022	ND			2.3	N/A	9%	N/A	N/A	N/A	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**N/A**
NMC-VC-001[3]	2.3					ND	ND	ND	ND	1.022	ND			2.3	N/A	5%	N/A	N/A	N/A	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**N/A**
TN-15-3	5.8	15.05	34.55	18.88	1.72	2.52	4.81	2.41	0.02					5.8	9.42	9%	276.66	2606.87	8.97	0	N/A	9%	N/A	N/A	N/A	1	1600	1600	**1.39**
TN-15-3	5.8	15.05	34.55	18.88	1.72	2.52	4.81	2.41	0.02					5.8	9.42	5%	153.7	1448.26	4.98	0	N/A	5%	N/A	N/A	N/A	1	1600	1600	**0.83**
TRANSECT AVERAGE AT APPROXIMATE STATION 67+50																													**0.58**
TRANSECT AVERAGE AT APPROXIMATE STATION 67+50																													**0.34**

TABLE B-5-1
ESTIMATED REACH CD RESIDUAL AND BASE LAYER MERCURY CONCENTRATIONS
NINEMILE CREEK 100% DESIGN

Sample Location ID	Thickness of Dredged Sediment (ft)	Conc. (mg/kg) at Depth (ft)												First Pass Depth of Removal (ft)	Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Second Pass Depth of Removal (ft)	Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Base Layer [1]			
		(0-0.5)	(0.5-1.0)	(1.0-2.0)	(2.0-3.0)	(3.0-4.0)	(4.0-5.0)	(5.0-6.0)	(6.0-7.0)	(7.0-8.0)	(8.0-9.0)	(9.0-10.0)	(10.0-20.0)				Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)				Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)	Thickness (ft)	Dry Density (Kg/m3)	Mass (kg-ft/m3)	**Base Layer Conc. (mg/Kg)**
Large Island Area Transects																													
NMC-SED-44	9.7	31.39	31.39	31.39	31.39	59.2	114	26.2	30.1	0.78	0.09	0.044		5	53.47	9%	238.5	12753.55	7.74	4.7	19.50	9%	245.655	4791.31	7.97	1	1600	1600	**2.60**
NMC-SED-44	9.7	31.39	31.39	31.39	31.39	59.2	114	26.2	30.1	0.78	0.09	0.044		5	53.47	5%	132.5	7085.31	4.30	4.7	16.24	5%	131.175	2130.90	4.25	1	1600	1600	**1.23**
NMC-SED-45	10.7	31.39	31.39	31.39	31.39	59.2	26.9	0.029	1.3	0.12	0.09	0.044	0.044	5	36.05	9%	238.5	8598.88	7.74	5.7	4.36	9%	293.355	1279.13	9.51	1	1600	1600	**0.68**
NMC-SED-45	10.7	31.39	31.39	31.39	31.39	59.2	26.9	0.029	1.3	0.12	0.09	0.044	0.044	5	36.05	5%	132.5	4777.16	4.30	5.7	2.55	5%	157.675	401.80	5.11	1	1600	1600	**0.23**
TRANSECT AVERAGE AT APPROXIMATE STATION 66+50																													**1.64**
TRANSECT AVERAGE AT APPROXIMATE STATION 66+50																													**0.73**
NMC-SED-46	10.5	31.39	31.39	31.39	31.39	0.15	0.15	73.3	2.3	3.4	20.1	3.8	0.01	5	18.89	9%	238.5	4506.22	7.74	5.5	20.92	9%	283.815	5938.41	9.20	1	1600	1600	**3.15**
NMC-SED-46	10.5	31.39	31.39	31.39	31.39	0.15	0.15	73.3	2.3	3.4	20.1	3.8	0.01	5	18.89	5%	132.5	2503.46	4.30	5.5	19.94	5%	152.375	3038.26	4.94	1	1600	1600	**1.73**
NMC-SED-47	10.9	31.39	31.39	31.39	31.39	55.1	99.4	86.5	6.5	10.1	62.5	11.4	0.01	5	49.73	9%	238.5	11861.56	7.74	5.9	35.44	9%	302.895	10733.12	9.82	1	1600	1600	**5.64**
NMC-SED-47	10.9	31.39	31.39	31.39	31.39	55.1	99.4	86.5	6.5	10.1	62.5	11.4	0.01	5	49.73	5%	132.5	6589.76	4.30	5.9	33.02	5%	162.975	5381.47	5.29	1	1600	1600	**3.05**
NMC-VC-003	11.2	31.39	31.39	31.39	31.39	1.5	1.5	0.018	0.018	0.01	0.01	0.01	0.01	5	19.43	9%	238.5	4635.01	7.74	6.2	2.03	9%	317.205	644.90	10.29	1	1600	1600	**0.34**
NMC-VC-003	11.2	31.39	31.39	31.39	31.39	1.5	1.5	0.018	0.018	0.01	0.01	0.01	0.01	5	19.43	5%	132.5	2575.01	4.30	6.2	1.14	5%	164.3	186.49	5.33	1	1600	1600	**0.11**
NMC-SED-078	9.4	31.39	31.39	31.39	31.39	8.4	8.1	0.21	0.4	0.01	0.01	0.01	ND	5	22.13	9%	238.5	5278.96	7.74	4.4	3.39	9%	231.345	783.49	7.50	1	1600	1600	**0.43**
NMC-SED-078	9.4	31.39	31.39	31.39	31.39	8.4	8.1	0.21	0.4	0.01	0.01	0.01	ND	5	22.13	5%	132.5	2932.76	4.30	4.4	1.95	5%	123.225	239.74	4.00	1	1600	1600	**0.14**
TRANSECT AVERAGE AT APPROXIMATE STATION 65+00																													**2.39**
TRANSECT AVERAGE AT APPROXIMATE STATION 65+00																													**1.26**
TN-14-3	9.4	21.1	68.55	93.53	73.38	14.55	0.84	0.47	0.09	0.78	0.046	0.046	0.03	5	45.42	9%	238.5	10833.62	7.74	4.4	6.97	9%	231.345	1612.47	7.50	1	1600	1600	**0.88**
TN-14-3	9.4	21.1	68.55	93.53	73.38	14.55	0.84	0.47	0.09	0.78	0.046	0.046	0.03	5	45.42	5%	132.5	6018.68	4.30	4.4	4.01	5%	123.225	494.43	4.00	1	1600	1600	**0.29**
NMC-SED-48	9.3	31.39	31.39	31.39	31.39	60.6	74.2	48.4	39.3	0.19	3.2	0.028		5	45.79	9%	238.5	10921.87	7.74	4.3	28.05	9%	226.575	6355.53	7.35	1	1600	1600	**3.48**
NMC-SED-48	9.3	31.39	31.39	31.39	31.39	60.6	74.2	48.4	39.3	0.19	3.2	0.028		5	45.79	5%	132.5	6067.71	4.30	4.3	25.00	5%	120.575	3014.31	3.91	1	1600	1600	**1.75**
NMC-SED-079	10	31.39	31.39	31.39	31.39	0.06	0.01	0.01	0.01	0.01	0.01	0.01	ND	5	18.85	9%	238.5	4495.25	7.74	5.0	2.44	9%	259.965	634.28	8.43	1	1600	1600	**0.34**
NMC-SED-079	10	31.39	31.39	31.39	31.39	0.06	0.01	0.01	0.01	0.01	0.01	0.01	ND	5	18.85	5%	132.5	2497.36	4.30	5.0	1.36	5%	139.125	189.20	4.51	1	1600	1600	**0.11**
MN-2	9.6	18.1	54.9	28.3	0.9	0.09	25.03	16.18	13.14	0.101	1.104	0.028		5	18.16	9%	238.5	4332.11	7.74	4.6	9.18	9%	240.885	2212.49	7.81	1	1600	1600	**1.20**
MN-2	9.6	18.1	54.9	28.3	0.9	0.09	25.03	16.18	13.14	0.101	1.104	0.028		5	18.16	5%	132.5	2406.73	4.30	4.6	8.05	5%	128.525	1035.09	4.17	1	1600	1600	**0.60**
TRANSECT AVERAGE AT APPROXIMATE STATION 64+50																													**1.48**
TRANSECT AVERAGE AT APPROXIMATE STATION 64+50																													**0.69**
NMC-SED-49	9.8	31.39	31.39	31.39	31.39	43.5	20.6	21.8	0.11	0.034	0.028	0.024		5	31.65	9%	238.5	7549.48	7.74	4.8	8.83	9%	250.425	2211.84	8.12	1	1600	1600	**1.20**
NMC-SED-49	9.8	31.39	31.39	31.39	31.39	43.5	20.6	21.8	0.11	0.034	0.028	0.024		5	31.65	5%	132.5	4194.16	4.30	4.8	6.94	5%	133.825	929.16	4.34	1	1600	1600	**0.54**
NMC-SED-080	7	31.39	31.39	31.39	31.39	0.43	0.43	0.23	0.071	0.035	0.023	0.022	0.023	5	19.01	9%	238.5	4532.93	7.74	2.0	6.46	9%	116.865	754.43	3.79	1	1600	1600	**0.44**
NMC-SED-080	7	31.39	31.39	31.39	31.39	0.43	0.43	0.23	0.071	0.035	0.023	0.022	0.023	5	19.01	5%	132.5	2518.30	4.30	2.0	3.73	5%	59.625	222.59	1.93	1	1600	1600	**0.13**
NMC-VC-004	5.2	31.39	31.390	31.39	31.39	0.086	0.086	0.04	0.04	0.033	0.033	0.026	0.025	5.2	18.14	9%	248.04	4500.50	8.04	0.0	0.00	9%	22.3236	0.00	0.72	1	1600	1600	**2.44**
NMC-VC-004	5.2	31.39	31.390	31.39	31.39	0.086	0.086	0.04	0.04	0.033	0.033	0.026	0.025	5.2	18.14	5%	137.8	2500.28	4.47	0.0	0.00	5%	6.89	0.00	0.22	1	1600	1600	**1.44**
TRANSECT AVERAGE AT APPROXIMATE STATION 63+50																													**1.36**
TRANSECT AVERAGE AT APPROXIMATE STATION 63+50																													**0.70**

TABLE B-5-1
ESTIMATED REACH CD RESIDUAL AND BASE LAYER MERCURY CONCENTRATIONS
NINEMILE CREEK 100% DESIGN

Sample Location ID	Thickness of Dredged Sediment (ft)	Conc. (mg/kg) at Depth (ft)												First Pass Depth of Removal (ft)	Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Second Pass Depth of Removal (ft)	Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Base Layer (1)			
		(0-0.5)	(0.5-1.0)	(1.0-2.0)	(2.0-3.0)	(3.0-4.0)	(4.0-5.0)	(5.0-6.0)	(6.0-7.0)	(7.0-8.0)	(8.0-9.0)	(9.0-10.0)	(10.0-20.0)				Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)				Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)	Thickness (ft)	Dry Density (Kg/m3)	Mass (kg-ft/m3)	**Base Layer Conc. (mg/Kg)**
NMC-SED-51	11.4	31.39	31.39	31.39	31.39	0.83	1.1	1.5	1.9	13.8	39.1	25.5	0.06	5	19.22	9%	238.5	4583.97	7.74	6.4	14.73	9%	326.745	4813.01	10.60	1	1600	1600	**2.50**
NMC-SED-51	11.4	31.39	31.39	31.39	31.39	0.83	1.1	1.5	1.9	13.8	39.1	25.5	0.06	5	19.22	5%	132.5	2546.65	4.30	6.4	13.87	5%	176.225	2444.21	5.72	1	1600	1600	**1.38**
NMC-VC-005	8.4	31.39	31.39	31.39	31.39	7.7	7.7	1.2	1.2	0.091	0.091	0.024	0.025	5	21.91	9%	238.5	5226.49	7.74	3.4	4.90	9%	183.645	899.48	5.96	1	1600	1600	**0.50**
NMC-VC-005	8.4	31.39	31.39	31.39	31.39	7.7	7.7	1.2	1.2	0.091	0.091	0.024	0.025	5	21.91	5%	132.5	2903.61	4.30	3.4	3.05	5%	96.725	295.15	3.14	1	1600	1600	**0.17**
TN-13-3	8.7	1.7	16.1	23.1	21.75	21.8	30.2	16.4	2.6	1.32	0.03	0.06	0.09	5	21.15	9%	238.5	5044.28	7.74	3.7	9.18	9%	197.955	1817.66	6.42	1	1600	1600	**1.01**
TN-13-3	8.7	1.7	16.1	23.1	21.75	21.8	30.2	16.4	2.6	1.32	0.03	0.06	0.09	5	21.15	5%	132.5	2802.38	4.30	3.7	7.54	5%	104.675	789.73	3.39	1	1600	1600	**0.46**
TRANSECT AVERAGE AT APPROXIMATE STATION 62+50																													**1.34**
TRANSECT AVERAGE AT APPROXIMATE STATION 62+50																													**0.67**
CN-1	4.8	0.05	0.03	0.025	0.02	58.6	17.2							4.8	15.09	9%	228.96	3455.63	7.43	0.0	0.00	9%	20.6064	0.00	0.67	1	1600	1600	**1.89**
CN-1	4.8	0.05	0.03	0.025	0.02	58.6	17.2							4.8	15.09	5%	127.2	1919.79	4.13	0.0	0.00	5%	6.36	0.00	0.21	1	1600	1600	**1.11**
NMC-SED-53	8.1	31.39	31.39	31.39	31.39	58.6	17.2	0.064	0.016	0.016				5	33.99	9%	238.5	8107.57	7.74	3.1	7.10	9%	169.335	1202.19	5.49	1	1600	1600	**0.68**
NMC-SED-53	8.1	31.39	31.39	31.39	31.39	58.6	17.2	0.064	0.016	0.016				5	33.99	5%	132.5	4504.21	4.30	3.1	3.96	5%	88.775	351.36	2.88	1	1600	1600	**0.21**
TRANSECT AVERAGE AT APPROXIMATE STATION 61+50																													**1.28**
TRANSECT AVERAGE AT APPROXIMATE STATION 61+50																													**0.66**

(1) Does not account for background concentrations present in imported material.

(2) Residual concentration not estimated for given transect because no direct analytical data is available within the dredge prism of that transect.

(3) Sample not used in residual estimate because given sample provided no additional direct analytical data of removed concentrations within the dredge prism.

(4) The concentration present in the residuals prior to placement of the sand layer is presented in the column titled 'Depth Weighted Hg Conc. of Sediment'; where two dredge passes have been included, the Depth Weighted Hg Conc. of Sediment for the second pass dredge represents the concentration present in the residuals prior to placement of the sand base layer.

(5) Table B-5-1 has been updated to reflect removal depths as presented in the 100% design.

General Notes:

- The dry densities (or solids concentrations) were calculated based on a solids content of 30% by weight for residuals, 40% for soft sediment in the creek channel and 70% for sand cover material and assuming that the specific gravity of the sediment particles was 2.6. The corresponding dry densities are 370 Kg/m3 for residuals, 530 Kg/m3 for soft sediments and 1,600 Kg/m3 for sand cover.

- Samples shaded in blue are estimated because no analytical data is available at that interval. The estimate is based on an average of all available channel sample intervals adjacent to the southern side of the large island in the 0-3 foot interval below existing ground surface. Specific sample locations used in the average are; TN-15-3, TN-14-3, MN-2, and TN-13-3.

- Samples shaded in light purple are non-detects, for the purposes of this analysis not-detects are assumed to have a mercury concentrations of 0.01 mg/kg, based on approximately half the detection limit.

- Samples shaded in gray are estimated because no analytical results are available at that interval. The estimate is based on an average of the other identical sample intervals with analytical data within that transect. If no other analytical data is available in a given transect at a specific sample interval the sample interval above in elevation is applied down.

Reference : Palermo, M.R., Schroeder, P.R., Estes, T.J. and Francingues, N.R. (2008). Technical Guidelines for Environmental Dredging of Contaminated Sediments.
Technical Report ERDC/EL TR-08-29. United States Army Corps of Engineers (USACE), Environmental Laboratory, Vicksburg, MS. September 2008.

TABLE B-5-2
ESTIMATED REACH AB RESIDUAL AND BASE LAYER MERCURY CONCENTRATIONS
NINEMILE CREEK 100% DESIGN

Sample Location ID	Thickness of Dredged Sediment (ft)	Conc. (mg/kg) at Depth (ft)												Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Base Layer [1]			
		(0-0.5)	(0.5-1.0)	(1.0-2.0)	(2.0-3.0)	(3.0-4.0)	(4.0-5.0)	(5.0-6.0)	(6.0-7.0)	(7.0-8.0)	(8.0-9.0)	(9.0-10.0)	(10.0-20.0)			Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)	Thickness (ft)	Dry Density (Kg/m3)	Mass (kg-ft/m3)	**Base Layer Conc. (mg/Kg)**
NM9	1.9	0.285	0.33	0.33										0.32	9%	90.63	28.83	2.94	0.5	1600	800	**0.03**
NM9	1.9	0.285	0.33	0.33										0.32	5%	50.35	16.02	1.63	0.5	1600	800	**0.02**
TN-5-1	2.5	1.65	4.7	2.495	0.29	0.29								2.33	9%	119.25	277.38	3.87	0.5	1600	800	**0.30**
TN-5-1	2.5	1.65	4.7	2.495	0.29	0.29								2.33	5%	66.25	154.10	2.15	0.5	1600	800	**0.18**
TN-5-2	0.4	0.58	0.51	0.425	0.345	0.33	0.31	0.28	0.28	0.07	0.07	0.03		0.58	9%	19.08	11.07	0.62	0.5	1600	800	**0.01**
TN-5-2	0.4	0.58	0.51	0.425	0.345	0.33	0.31	0.28	0.28	0.07	0.07	0.03		0.58	5%	10.6	6.15	0.34	0.5	1600	800	**0.01**
TN-5-3[2]	-1	0.23	0.31	0.36	0.265									N/A	9%	N/A	N/A	N/A	0.5	1600	800	**N/A**
TN-5-3[2]	-1	0.23	0.31	0.36	0.265									N/A	5%	N/A	N/A	N/A	0.5	1600	800	**N/A**
TRANSECT AVERAGE AT APPROXIMATE STATION 29+00																						**0.12**
TRANSECT AVERAGE AT APPROXIMATE STATION 29+00																						**0.07**
CDR-P	3.4	2.9	0.85	0.89	0.018	0.038								0.82	9%	162.18	133.47	5.26	0.5	1600	800	**0.14**
CDR-P	3.4	2.9	0.85	0.89	0.038	0.038								0.83	5%	90.1	74.68	2.92	0.5	1600	800	**0.08**
NMC-SED-081	3.3	0.1	0.1	0.18	0.01	ND	ND	ND	0.039	ND	ND	ND		0.09	9%	157.41	13.83	5.11	0.5	1600	800	**0.01**
NMC-SED-081	3.3	0.1	0.1	0.18	0.01	ND	ND	ND	0.039	ND	ND	ND		0.09	5%	87.45	7.69	2.84	0.5	1600	800	**0.01**
NMC-VC-020	2.5	1.6	1.6	1.6	0.026	0.026	0.023	0.023	0.021	0.021	0.022	ND		1.29	9%	119.25	153.26	3.87	0.5	1600	800	**0.17**
NMC-VC-020	2.5	1.6	1.6	1.6	0.026	0.026	0.023	0.023	0.021	0.021	0.022	ND		1.29	5%	66.25	85.14	2.15	0.5	1600	800	**0.10**
TRANSECT AVERAGE AT APPROXIMATE STATION 26+50																						**0.11**
TRANSECT AVERAGE AT APPROXIMATE STATION 26+50																						**0.06**
TN-4-1	3.9	0.82	0.39	0.23	0.08	0.08								0.25	9%	186.03	47.08	6.03	0.5	1600	800	**0.05**
TN-4-1	3.9	0.82	0.39	0.23	0.08	0.08								0.25	5%	103.35	26.16	3.35	0.5	1600	800	**0.03**
TN-4-2	3.6	0.77	0.54	0.295	0.04	0.025								0.28	9%	171.72	47.94	5.57	0.5	1600	800	**0.05**
TN-4-2	3.6	0.77	0.54	0.295	0.04	0.025								0.28	5%	95.4	26.63	3.09	0.5	1600	800	**0.03**
TN-4-3	2.5	0.08	0.04	0.04	0.045									0.05	9%	119.25	5.84	3.87	0.5	1600	800	**0.01**
TN-4-3	2.5	0.08	0.04	0.04	0.045									0.05	5%	66.25	3.25	2.15	0.5	1600	800	**0.00**
TRANSECT AVERAGE AT APPROXIMATE STATION 24+00																						**0.03**
TRANSECT AVERAGE AT APPROXIMATE STATION 24+00																						**0.02**
NMC-SED-083	3.3	0.43	0.43	0.01	0.081	0.051	ND	0.013	0.013	ND	ND	ND		0.16	9%	157.41	24.85	5.11	0.5	1600	800	**0.03**
NMC-SED-083	3.3	0.43	0.43	0.01	0.081	0.051	ND	0.013	0.013	ND	ND	ND		0.16	5%	87.45	13.81	2.84	0.5	1600	800	**0.02**
NMC-SED-082	2.3	0.19	0.19	0.25	0.22	0.78	0.2	0.086						0.19	9%	109.71	20.99	3.56	0.5	1600	800	**0.02**
NMC-SED-082	2.3	0.19	0.19	0.25	0.22	0.78	0.2	0.086						0.19	5%	60.95	11.66	1.98	0.5	1600	800	**0.01**
TRANSECT AVERAGE AT APPROXIMATE STATION 21+50																						**0.02**
TRANSECT AVERAGE AT APPROXIMATE STATION 21+50																						**0.01**

TABLE B-5-2
ESTIMATED REACH AB RESIDUAL AND BASE LAYER MERCURY CONCENTRATIONS
NINEMILE CREEK 100% DESIGN

Sample Location ID	Thickness of Dredged Sediment (ft)	Conc. (mg/kg) at Depth (ft)												Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Base Layer [1]			
		(0-0.5)	(0.5-1.0)	(1.0-2.0)	(2.0-3.0)	(3.0-4.0)	(4.0-5.0)	(5.0-6.0)	(6.0-7.0)	(7.0-8.0)	(8.0-9.0)	(9.0-10.0)	(10.0-20.0)			Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)	Thickness (ft)	Dry Density (Kg/m3)	Mass (kg-ft/m3)	**Base Layer Conc. (mg/Kg)**
TN-3-1	2.5	0.21	0.31	0.595	0.72	0.56								0.49	9%	119.25	57.96	3.87	0.5	1600	800	**0.06**
TN-3-1	2.5	0.21	0.31	0.595	0.72	0.56								0.49	5%	66.25	32.20	2.15	0.5	1600	800	**0.04**
TN-3-2	2.4	4.4	13.2	6.715	0.13	0.03								6.49	9%	114.48	742.55	3.71	0.5	1600	800	**0.81**
TN-3-2	2.4	4.4	13.2	6.715	0.13	0.03								6.49	5%	63.6	412.53	2.06	0.5	1600	800	**0.48**
TN-3-3	2.5	0.14	0.084	0.047	0.01	0.01	0.01	0.01	ND	ND	0.01	0.01		0.07	9%	119.25	7.82	3.87	0.5	1600	800	**0.01**
TN-3-3	2.5	0.14	0.084	0.047	0.01	0.01	0.01	0.01	ND	ND	0.01	0.01		0.07	5%	66.25	4.35	2.15	0.5	1600	800	**0.01**
TRANSECT AVERAGE AT APPROXIMATE STATION 19+00																						**0.29**
TRANSECT AVERAGE AT APPROXIMATE STATION 19+00																						**0.17**
NMC-SED-085	2.5	0.05	0.05	0.01	0.021	ND	ND	0.015	ND	ND	ND	ND		0.03	9%	119.25	3.36	3.87	0.5	1600	800	**0.00**
NMC-SED-085	2.5	0.05	0.05	0.01	0.021	ND	ND	0.015	ND	ND	ND	ND		0.03	5%	66.25	1.87	2.15	0.5	1600	800	**0.00**
NMC-SED-084	2.5	0.85	0.85	0.04	0.01	ND	0.025	0.031	0.02	ND	ND	0.018		0.36	9%	119.25	42.69	3.87	0.5	1600	800	**0.05**
NMC-SED-084	2.5	0.85	0.85	0.04	0.01	ND	0.025	0.031	0.02	ND	ND	0.018		0.36	5%	66.25	23.85	2.15	0.5	1600	800	**0.03**
TRANSECT AVERAGE AT APPROXIMATE STATION 15+00																						**0.03**
TRANSECT AVERAGE AT APPROXIMATE STATION 15+00																						**0.01**
TN-2-1	2.5	0.755	0.037	0.044	0.043									0.18	9%	119.25	22.01	3.87	0.5	1600	800	**0.02**
TN-2-1	2.5	0.755	0.037	0.044	0.043									0.18	5%	66.25	12.23	2.15	0.5	1600	800	**0.01**
TN-2-2[2]	0	0.925	ND	ND	0.021	0.0325	0.0219	0.0219	0.0219		0.03		0.032	N/A	9%	N/A	N/A	N/A	0.5	1600	800	**N/A**
TN-2-2[2]	0	0.925	ND	ND	0.021	0.0325	0.0219	0.0219	0.0219		0.03		0.032	N/A	5%	N/A	N/A	N/A	0.5	1600	800	**N/A**
TN-2-3	2.5	0.575	0.053	0.0315	0.01	ND								0.14	9%	119.25	16.72	3.87	0.5	1600	800	**0.02**
TN-2-3	2.5	0.575	0.053	0.0315	0.01	ND								0.14	5%	66.25	9.29	2.15	0.5	1600	800	**0.01**
TRANSECT AVERAGE AT APPROXIMATE STATION 11+00																						**0.02**
TRANSECT AVERAGE AT APPROXIMATE STATION 11+00																						**0.01**
NM10	2.5	0.012	0.0101	0.012	0.123									0.03	9%	119.25	4.03	3.87	0.5	1600	800	**0.00**
NM10	2.5	0.012	0.0101	0.012	0.123									0.03	5%	66.25	2.24	2.15	0.5	1600	800	**0.00**
NMC-SED-086	0.7	0.01	0.01	ND	ND									0.01	9%	119.25	1.71	3.87	0.5	1600	800	**0.00**
NMC-SED-086	0.7	0.01	0.01	ND	ND									0.01	9%	119.25	1.71	3.87	0.5	1600	800	**0.00**
TRANSECT AVERAGE AT APPROXIMATE STATION 8+50																						**0.00**
TRANSECT AVERAGE AT APPROXIMATE STATION 8+50																						**0.00**
TN-1-1	2.5	0.615	1.9	0.989	0.042									0.91	9%	119.25	108.16	3.87	0.5	1600	800	**0.12**
TN-1-1	2.5	0.615	1.9	0.989	0.042									0.91	5%	66.25	60.09	2.15	0.5	1600	800	**0.07**
TN-1-2	1	0.84	0.335	0.19	0.041	0.035	0.035	0.035		0.03	0.03	0.03	0.03	0.59	9%	47.7	28.02	1.55	0.5	1600	800	**0.03**
TN-1-2	1	0.84	0.335	0.19	0.041	0.035	0.035	0.035		0.03	0.03	0.03	0.03	0.59	5%	26.5	15.57	0.86	0.5	1600	800	**0.02**
TN-1-3	2.5	12.35	0.855	0.461	0.057	0.047								2.84	9%	119.25	338.29	3.87	0.5	1600	800	**0.37**
TN-1-3	2.5	12.35	0.855	0.461	0.057	0.047								2.84	5%	66.25	187.94	2.15	0.5	1600	800	**0.22**
TRANSECT AVERAGE AT APPROXIMATE STATION 8+00																						**0.17**
TRANSECT AVERAGE AT APPROXIMATE STATION 8+00																						**0.10**

TABLE B-5-2
ESTIMATED REACH AB RESIDUAL AND BASE LAYER MERCURY CONCENTRATIONS
NINEMILE CREEK 100% DESIGN

Sample Location ID	Thickness of Dredged Sediment (ft)	Conc. (mg/kg) at Depth (ft)												Depth-Weighted Hg Conc. of Sediment (mg/kg)	% Dry Mass of Sediment Left After Dredging	Residuals Layer			Base Layer (1)			
		(0-0.5)	(0.5-1.0)	(1.0-2.0)	(2.0-3.0)	(3.0-4.0)	(4.0-5.0)	(5.0-6.0)	(6.0-7.0)	(7.0-8.0)	(8.0-9.0)	(9.0-10.0)	(10.0-20.0)			Mass (kg-ft/m3)	Contaminant Mass (mg-ft/m3)	Thickness (in)	Thickness (ft)	Dry Density (Kg/m3)	Mass (kg-ft/m3)	**Base Layer Conc. (mg/Kg)**
NMC-SED-065	2.5	0.0064	0.0064	0.019	0.019	0.021	0.02	0.016	0.015	0.017	0.016	0.013		0.01	9%	119.25	1.66	3.87	0.5	1600	800	**0.00**
NMC-SED-065	2.5	0.0064	0.0064	0.019	0.019	0.021	0.02	0.016	0.015	0.017	0.016	0.013		0.01	5%	66.25	0.92	2.15	0.5	1600	800	**0.00**
NMC-SED-066	5.2	1.1	1.1	0.045	0.024	0.013	0.0072	0.0072	0.0058	0.01	0.026	0.022		0.23	9%	248.04	56.79	8.04	0.5	1600	800	**0.05**
NMC-SED-066	5.2	1.1	1.1	0.045	0.024	0.013	0.0072	0.0072	0.0058	0.01	0.026	0.022		0.23	5%	137.8	31.55	4.47	0.5	1600	800	**0.03**
NMC-SED-067	4.9	0.26	0.26	0.05	0.01	0.012	0.0052	0.005	0.0067	0.012	0.011			0.07	9%	233.73	16.08	7.58	0.5	1600	800	**0.02**
NMC-SED-067	4.9	0.26	0.26	0.05	0.01	0.012	0.0052	0.005	0.0067	0.012	0.011			0.07	5%	129.85	8.94	4.21	0.5	1600	800	**0.01**
TRANSECT AVERAGE AT APPROXIMATE STATION 6+00																						**0.02**
TRANSECT AVERAGE AT APPROXIMATE STATION 6+00																						**0.01**
NMC-SED-068	2.4	0.011	0.011	0.0054	0.004	0.004	0.018	0.022	0.021	0.019	0.021	0.016		0.01	9%	114.48	0.97	3.71	0.5	1600	800	**0.00**
NMC-SED-068	2.4	0.011	0.011	0.0054	0.004	0.004	0.018	0.022	0.021	0.019	0.021	0.016		0.01	5%	63.6	0.54	2.06	0.5	1600	800	**0.00**
NMC-SED-075	2.4	3.9	3.9	0.0052	0.12	0.022	0.019	0.026	0.017	0.027	0.015	0.013		1.68	9%	114.48	192.00	3.71	0.5	1600	800	**0.21**
NMC-SED-075	2.4	3.9	3.9	0.0052	0.12	0.022	0.019	0.026	0.017	0.027	0.015	0.013		1.68	5%	63.6	106.67	2.06	0.5	1600	800	**0.12**
NMC-SED-069	1.7	0.01	0.01	0.01	ND	0.0048	0.017	0.021	0.022	0.018	0.02	0.011		0.01	9%	81.09	0.95	2.63	0.5	1600	800	**0.00**
NMC-SED-069	1.7	0.01	0.01	0.01	ND	0.0048	0.017	0.021	0.022	0.018	0.02	0.011		0.01	5%	45.05	0.53	1.46	0.5	1600	800	**0.00**
TRANSECT AVERAGE AT APPROXIMATE STATION 4+00																						**0.07**
TRANSECT AVERAGE AT APPROXIMATE STATION 4+00																						**0.04**

(1) Does not account for background concentrations present in imported material.

(2) No residual concentration estimated at location because no remedial are anticipated at given location.

(3) The concentration present in the residuals prior to placement of the sand layer is presented in the column titled 'Depth Weighted Hg Conc. of Sediment.

(4) This table is provided for context and represents removal depths as presented in the Ninemile Creek 50% Design Report; this table will be updated with submittal of supplemental design.

General Notes:

- The dry densities (or solids concentrations) were calculated based on a solids content of 30% by weight for residuals, 40% for soft sediment in the creek channel and 70% for sand cover material and assuming that the specific gravity of the sediment particles was 2.6. The corresponding dry densities are 370 Kg/m3 for residuals, 530 Kg/m3 for soft sediments and 1,600 Kg/m3 for sand cover.

- Samples shaded in light purple are non-detects, for the purposes of this analysis not-detects are assumed to have a mercury concentrations of 0.01 mg/kg, based on approximately half the detection limit.

- Samples shaded in gray are estimated because no analytical results are available at that interval. The estimate is based on an average of the corresponding sample intervals with analytical data within that transect. If no other analytical data is available in a given transect at a specific sample interval The sample interval above in elevation is applied down.

Reference : Palermo, M.R., Schroeder, P.R., Estes, T.J. and Francingues, N.R. (2008). Technical Guidelines for Environmental Dredging of Contaminated Sediments. Technical Report ERDC/EL TR-08-29. United States Army Corps of Engineers (USACE), Environmental Laboratory, Vicksburg, MS. September 2008.

ATTACHMENT B-6

UTILITIES

(ATTACHED AS PRESENTED IN THE NINEMILE CREEK 95% AND DRAFT 100% DESIGN REPORTS)

From:	Considine, John J
To:	D"Hollander, Ray
Cc:	Smith, Michael
Subject:	RE: Potential Verizon Line along Pumphouse Road Crossing Ninemile Creek in Geddes, NY
Date:	Friday, October 14, 2011 6:04:57 AM

Ray,

I apologize for the delay.

Yes, the corrections made to the original drawing are a more accurate location.

Thank You
Please call me if you have any questions.

John Considine

From: D'Hollander, Ray [mailto:ray.dhollander@parsons.com]
Sent: Tuesday, October 11, 2011 6:56 PM
To: Considine, John J
Cc: Smith, Michael
Subject: Potential Verizon Line along Pumphouse Road Crossing Ninemile Creek in Geddes, NY

I am developing drawings for doing sediment remediation in Ninemile Creek. You have been speaking with Michael Smith of our office regarding this.

In 2008, you provided a drawing to Thew Associates (e-mail message string attached) that shows a Verizon line along Pumphouse Road crossing under Ninemile Creek on Honeywell property and then under the CSX tracks, all west of I-695. This information was then provided to us on their survey for the site.

Based on various UFPO call-ins that we have done for investigations in Ninemile Creek and remediation work in Geddes Brook, I am about to remove this Verizon line from our design drawing set as UFPO does not identify it where it is shown on the drawings provided to us.

I have attached documentation from the UFPO call-ins, including photographs of a “Bell” fiber-optic manhole east of the I-695 south of Geddes Brook.

I have attached a marked-up drawing showing where I believe the line actually goes (titled “Verizon Lines along NMC”). Please confirm that this interpretation is correct and that it does not exist west of I-695 south of the Utility Bridge that crosses Ninemile Creek by State Fair Boulevard.

Raymond D'Hollander, P.E., P.Eng.
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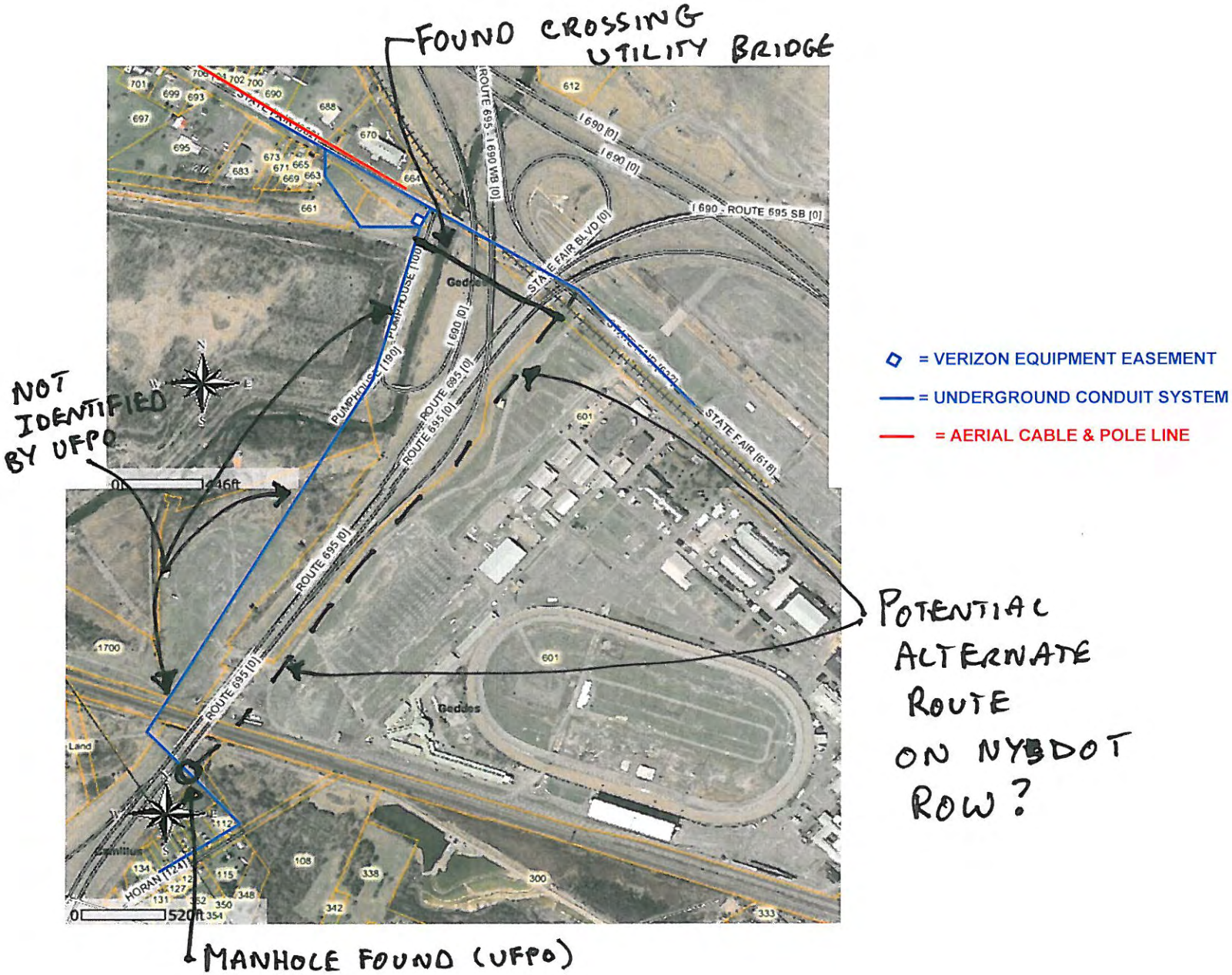

FOUND CROSSING UTILITY BRIDGE
NOT IDENTIFIED BY UFPO
POTENTIAL ALTERNATE ROUTE ON NYSDOT ROW?
MANHOLE FOUND (UFPO)
= VERIZON EQUIPMENT EASEMENT
= UNDERGROUND CONDUIT SYSTEM
= AERIAL CABLE & POLE LINE
ROUTE 695 - I 690 WB [0]
I 690 [0]
I 690 - ROUTE 695 SB [0]
STATE FAIR BLVD [0]
STATE FAIR [618]
PUMPHOUSE [190]
PUMPHOUSE [100]
ROUTE 695 [0]
HORAN [124]
Geddes
0 46ft
0 520ft

ATTACHMENT B-7

STORMWATER MANAGEMENT

(ATTACHED AS PRESENTED IN THE NINEMILE CREEK DRAFT 100% DESIGN REPORT)

1.0 INTRODUCTION

1.1 Objective of Analysis

The objective of this analysis is to calculate design storm flows to proposed swales which will convey overland storm flow from upgradient sources and direct them to controlled discharges. The resulting flows are used for design of an erosion resistant surface (stone lined) for the swale and discharges.

1.2 Assumptions

The following assumptions were made in this calculation:

- Collection swales (approximately parallel to Nine Mile Creek) will be trapezoidal with a 2 foot base, a 2:1 sideslope, and a maximum slope of 0.8%.
- Discharge swales (approximately perpendicular to Nine Mile Creek) will be trapazodial with a 3 foot base, 3:1 sideslope, and a maximum slope of 3H: 1V.
- Time of concentration (Tc) is 15 minutes (see Attachment 1).
- A 100-year, 24 hour design storm was used for the calculations to provide a conservative design for the long-term condition.
- A factor of safety of 50% will be applied to calculated stone diameters where the project intends to use rounded, river stone is swales and discharges.

2.0 Calculations

Calculations were performed in accordance with the following:

- New York State Department of Environmental Conservation "New York State Standards and Specifications for Erosion and Sediment Control" , August 2005;

- U.S. Department of Agriculture "Technical Release 55, Urban Hydrology for Small Watershed" , June 1986; and

- \U.S. Department of Transportation FHWA "Hydraulic Engineering Circular No. 15, Third Edition, Design of Roadside Channels with Flexible Linings", September 2005

Calculations were performed to estimate values for the peak storm flow, the Mannings n-value and the subsequent appropriate rip rap sizing for channel linings, and to size outlet protection for the swales. These calculations are discussed below.

2.1 Peak Storm Flow

To estimate peak storm flow, the areas uphill of the proposed swale alignment were divided into catchment areas based upon the slope of the proposed swale alignment. Seven catchment areas were delineated, ranging in size from 0.68 acres to 2.64 acres for Reach CD (see **Figure 1**).

Peak storm flow for the catchment areas was estimated using the United States Department of Agriculture (USDA) Technical Release 55 (TR-55) method. The curve number of 76 was used for all catchment areas based on the "Brush – Fair Condition" cover description in Table 2-2c of the TR-55 manual. The peak discharge was calculated based on a type II, 100 year, 24 hour storm with a time of concentration of 15 minutes. Peak discharge was calculated using the equation:

Qp = Qu Am Q Fp where,

Qp = peak discharge (cfs)
Qu = unit peak discharge (csm/in) taken from Exhibit 4-II
Am = catchment area (in square miles)
Q = runoff (in) calculated using equations 2-3 and 2-4)

Peak storm flows were found to range from 1.95 cubic feet per second (cfs) to 7.58 cfs. A summary of peak storm flows calculated, and the values used in calculation, is included in **Table 1**.

2.2 Mannings n-Value and Minimum Rip Rap Size

Mannings n-values and minimum rip rap size were calculated for the collection swales (swales running approximately parallel to Nine Mile Creek), as well as the discharge swales (swales running approximately perpendicular to the creek). These were calculated using different methods, discussed below.

Collection Swales

Swales were sized using the maximum peak flow rate calculated above (7.6 cfs). Collection swales were calculated using the U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA) Hydraulic Engineering Circular (HEC) 15 methodology. Mannings n-values were calculated using the Blodgett equation calculated by the trial and error method. First, a value was estimated for the average stone diameter (D_{50}) and depth mid-channel (d). Using this information, basic geometric quantities relating to the channel were calculated including area, hydraulic radius, and average depth (d_a). This information was then used to calculate the Mannings n-value using the Blodgett equation. This equation is included in Section 6.1 of the FHWA Hydraulic Engineering Circular No. 15 (HEC-15) Manual. The equation is:

$$n = \frac{\alpha\, d_a^{1/6}}{2.25 + 5.23 \log\left(\frac{d_a}{D_{50}}\right)}$$

where,

n = Manning's roughness coefficient, dimensionless

d_a = average flow depth in the channel, m (ft)

D_{50} = median riprap/gravel size, m (ft)

α = unit conversion constant, 0.319 (SI) and 0.262 (CU)

Equation taken directly from page 6-1 of the Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition "Design of Roadside Channels with Flexible Linings"

The calculated Mannings n-value, obtained from the equation above, was then used in Mannings equation to obtain a predicted flow for the estimated depth. Using depth as the variable, the flow rate was calculated by trial and error. Values of depth input were adjusted until the calculated flow matched the calculated peak flow obtained from the TR-55.

After the Mannings n-value was calculated, the estimated sizing of rip rap was evaluated based on the permissible shear equation given in FHWA HEC-15 manual for channels with a bed slope less than five percent. This equation is:

$$D_{50} \geq \frac{SF\ d\ S_o}{F_*(SG - 1)}$$

where,

d = maximum channel depth, m (ft)

SG = specific gravity of rock (γ_s/γ), dimensionless

Equation taken directly from page 6-3 of the Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition "Design of Roadside Channels with Flexible Linings"

The safety factor and shields number were obtained from Table 6.1 of the FHWA HEC-15 manual based on the Reynolds number for each swale.

Calculations show that a 1.2 inch average diameter stone (D_{50} = 1.2") would be adequate for collection swales conveying a maximum of 7.6 cfs. Calculations for the collection swale sizing are included in **Attachment 2**.

Discharge Swales

Discharge swales were also calculated using the HEC-15 methodology. Due to the shallow flow in comparison to the stone size, Mannings n-values were calculated using the Bathurst equation, as required by HEC 15 by the trial and error method. First, a value was estimated for the average stone diameter (D_{50}) and depth mid-channel (d). Using this information, basic geometric quantities relating to the channel were calculated. The Mannings n-value was then calculated using the Bathurst equation. This equation is included in Section 6.1 of the HEC-15) Manual. The equation is:

$$n = \frac{\alpha\, d_a^{1/6}}{\sqrt{g}\, f(Fr)\, f(REG)\, f(CG)}$$

where,

d_a = average flow depth in the channel, m (ft)
g = acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)
Fr = Froude number
REG = roughness element geometry
CG = channel geometry
α = unit conversion constant, 1.0 (SI) and 1.49 (CU)

Equation taken directly from page 6-2 of the Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition "Design of Roadside Channels with Flexible Linings"

Where,

$$f(Fr) = \left(\frac{0.28Fr}{b}\right)^{\log(0.755/b)}$$

$$f(REG) = 13.434\left(\frac{T}{D_{50}}\right)^{0.492} b^{1.025(T/D_{50})^{0.118}}$$

$$f(CG) = \left(\frac{T}{d_a}\right)^{-b}$$

where,

T = channel top width, m (ft)
b = parameter describing the effective roughness concentration.

Equation taken directly from page 6-2 of the Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition "Design of Roadside Channels with Flexible Linings"

And,

$$b = 1.14\left(\frac{D_{50}}{T}\right)^{0.453}\left(\frac{d_a}{D_{50}}\right)^{0.814}$$

Equation taken directly from page 6-2 of the Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition "Design of Roadside Channels with Flexible Linings"

The calculated Mannings n-value, obtained from the equation above, was then used in Mannings equation to obtain a predicted flow for the estimated depth. Using depth as the variable, the flow rate was calculated by trial and error. Values of depth input were adjusted until the calculated flow matched the calculated peak flow obtained from the TR-55. After the Mannings n-value was calculated, the estimated sizing of rip rap was evaluated based on the Simons and Senturk equation given in FHWA HEC-15 manual for channels with a bed slope greater than ten percent. This equation is:

$$D_{50} \geq \frac{SF\, d\, S\, \Delta}{F_s(SG-1)}$$

where,

Δ = function of channel geometry and riprap size

Where,

$$\Delta = \frac{K_1\left(1+\sin(\alpha+\beta)\right)\tan\phi}{2\left(\cos\theta\tan\phi - SF\sin\theta\cos\beta\right)} \qquad (6.12)$$

where,

α = angle of the channel bottom slope

β = angle between the weight vector and the weight/drag resultant vector in the plane of the side slope

θ = angle of the channel side slope

ϕ = angle of repose for the riprap

Finally, β is defined by:

$$\beta = \tan^{-1}\left(\frac{\cos\alpha}{\frac{2\sin\theta}{\eta\tan\phi}+\sin\alpha}\right) \qquad (6.13)$$

where,

η = stability number

The stability number is calculated using:

$$\eta = \frac{\tau_s}{F_s(\gamma_s-\gamma)D_{50}} \qquad (6.14)$$

Equations taken directly from page 6-5 of the Federal Highway Administration Hydraulic Engineering Circular No. 15, Third Edition "Design of Roadside Channels with Flexible Linings"

Calculations show that a 8 inch average diameter stone (D_{50} = 12") would be adequate for discharge swales conveying a maximum of 7.6 cfs. Calculations for the collection swale sizing are included in **Attachment 3**.

2.3 Outlet Protection Sizing

Outlet protection was calculated in accordance with the NYSDEC "New York State Standards and Specifications for Erosion and Sediment Control" manual section of Standard Specifications for Rock Outlet Protection. For the design, a trapezoidal channel 3 feet wide with 2:1 side slopes flowing at 7.6

cfs was used. Calculation of the discharge swales showed that the depth of flow in the channel would be 0.36 feet and the flow velocity would be 5.6 feet per second (fps).

Certain swales will discharge into the floodplain (where no tailwater is expected to occur), while others will discharge into waterways (where the tailwater is anticipated to be greater than one half the depth of flow in the discharge. Therefore outlet protection was sized using Figure 5B.12 for swales discharging to the floodplain, and 5B.13 for swales discharging into waterways. A copy of the figures is included in **Attachment 4**.

For both cases, the outlet protection is sized by first computing the equivalent discharge for a pipe with the diameter equal to the depth of flow in the open channel (d=0.36 feet), and a flow velocity equal to that in the channel (V=5.6 fps).

Therefore:

— where,

Q = volume (cfs)
d= pipe diameter = 0.36 ft
V = velocity = 5.6 fps

With the given input, the calculated volume (*Q*) is 0.57 cfs. This is below the minimum discharge rate shown on both figures 5B.12 and 5B.13. In order to calculate a stone size, a minimum discharge rate of 5 cfs was assumed (approximately 10 times the predicted equivalent discharge rate), with a discharge depth of 12 inches (approximately 4 times the predicted depth, and the minimum diameter included in figures 5B.12 and 5B.13) where the calculated flow rate and depth of flow fell below the charts.

Then, reading figure 5B.12 for the outlets discharging to the floodplain with Q = 5 cfs and d = 12 in, the average rip rap size (D_{50}) is found to be 0.2 feet (~2.5 inches) and minimum apron length is found to be 9 feet. Using the figure shown on Figure 5B.12, the apron width on the upstream side is found to be 9 feet (three times the width of the outlet) and the width downstream is found to be 13 feet (width of the outlet plus the length of the apron).

Reading figure 5B.13 for outlets discharging to waterways with Q = 5 cfs and d = 12 in, the average rip rap size (D_{50}) is found to be 0.2 feet (~2.5 inches) and minimum apron length is found to be 14 feet. Using the figure shown on Figure 5B.13, the apron width on the upstream side is found to be 9 feet (three times the width of the outlet) and the width downstream is found to be 8.6 feet (width of the outlet plus the 0.4 multiplied by the length of the apron).

The proposed dimensions are a length of 14 feet, upstream width of 9 feet, a downstream width of 13 feet, an average stone size (rounded stone) of 8 inches (to coincide with the discharge swale stone size). This shape takes the largest dimensions calculated for each dimension and utilizes a larger stone.

In accordance with the NYDEC guidance, the thickness of the pad must be 1.5 times the maximum stone diameter. For the apron design proposed, the minimum thickness would be 16 inches.

3.0 Conclusions

The project intends to use rounded, river stone in swales and discharges. As a result, calculated stone diameters will be increased by 50% in order to account for the loss in stability. The following conclusions apply to this analysis:

- Analysis of collection swales indicate that an average rip-rap stone sizing (D_{50}) of 1.2 inches will be necessary for angular stone. A 2-inch average, rounded stone will be used to line the collection swales.

- Analysis of the discharge swales indicate that an average rip-rap stone sizing (D_{50}) of 8 inches will be necessary for angular stone. A 12-inch average, rounded stone will be used to line the discharge swales.

- Analysis of the outlet protection determined minimum dimensions for outlet protection aprons. The proposed dimensions are a length of 14 feet, upstream width of 9 feet, a downstream width of 13 feet, an average stone size (rounded stone) of 12 inches, with a minimum thickness of 18 inches.

4.0 References

1. New York State Department of Environmental Conservation, August 2005. *New York State Standards and Specifications for Erosion and Sediment Control*

2. U.S. Department of Agriculture, June 1986. *Technical Release 55, Urban Hydrology for Small Watershed*

3. U.S. Department of Transportation, Federal Highway Administration, September 2005. *Hydraulic Engineering Circular No. 15, Third Edition, Design of Roadside Channels with Flexible Linings*.

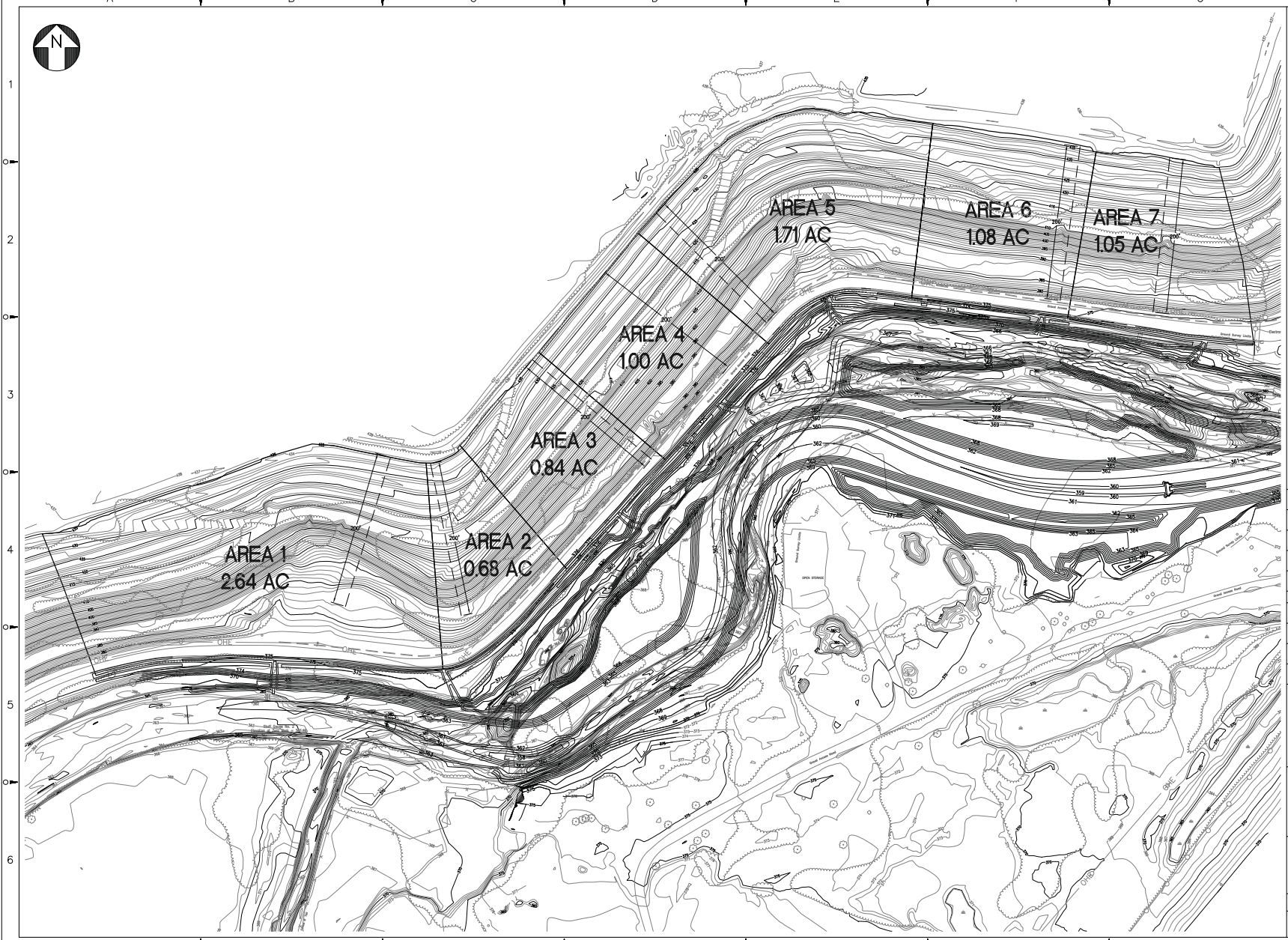
Tables

Table 1 - Peak Storm Flow
Nine Mile Creek
Syracuse, New York

Area (acres)	Curve Number (Table 2-2, Brush-Fair)	Rainfall, P (in)	Potential Max. Retention after Runoff Beings (S) (in) (eq 2-4)	Runoff Q (in) (eq 2-3)	Drainage Area (Am) (sq mi)	Rainfall Distribution	Pond/Swamp Area (percent)	Initial Abstraction (Ia) (table 4-1)	Ia/P	Unit peak discharge (qu) (csm/in) (ex. 4-II)	Pond and Swamp Factor (Fp)	Peak Discharge (Qp) (cfs)
2.64	76	5.0	3.16	2.5	0.004	II	0	0.632	0.1264	725	1.0	7.58
0.68	76	5.0	3.16	2.5	0.001	II	0	0.632	0.1264	725	1.0	1.95
0.84	76	5.0	3.16	2.5	0.001	II	0	0.632	0.1264	725	1.0	2.41
1.00	76	5.0	3.16	2.5	0.002	II	0	0.632	0.1264	725	1.0	2.87
1.71	76	5.0	3.16	2.5	0.003	II	0	0.632	0.1264	725	1.0	4.91
1.08	76	5.0	3.16	2.5	0.002	II	0	0.632	0.1264	725	1.0	3.10
1.05	76	5.0	3.16	2.5	0.002	II	0	0.632	0.1264	725	1.0	3.02

Notes
1) Based on 100 year, 24 hours storm with a Time of Concentration of 15 minutes.
2) Based on TR-55 Methodology. All references to equations, tables, figures reference TR-55 manual, Updated June 1986.

Figures



LEGEND:

— — — — Tc SHEET FLOW PATH

60 30 0 60 120

SCALE: 1"= 60'

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D

DRAWN BY AH	DATE 07/26/11	SEAL
CHECKED BY SA	DATE 07/26/11	
APPROVED BY SB	DATE 07/26/11	
PROJECT MGR. RD	DATE 07/26/11	

PARSONS
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SYRACUSE, NY 13212
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JOB 443575

WBS 04640

PROJECT TITLE

Honeywell
NINEMILE CREEK
95% DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE

DRAINAGE ANALYSIS
REACH CD
SUBCATCHMENT AREAS

SCALE 1"= 60'

DRAWING NO. FIGURE 1

REV. –

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FILE NAME: P:\PIT\PROJECTS\HONEYWELL\NINE MILE CREEK\DESIGN INFORMATION\FIGURES\FIGURE 1 - REACH CD REV 1.DWG
PLOT DATE: 2/1/2012 9:24 AM PLOTTED BY: ANDERSON, SCOTT

Attachment 1

Time of Concentration Calculations

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Honeywell NMC Reach CD - Area 1	SA	2/1/12
Location	**Checked**	**Date**
Syracuse, New York	MBS	2/16/12

Check one: ☐ Present ☑ Developed

Check one: ☑ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Woods, light underbrush	Pervious	
2. Manning's roughness coefficient, n (table 3-1)	0.4		
3. Flow length, L (total L † 300 ft) ..... ft	200		
4. Two-year 24-hour rainfall, P_2 ..... in	2.5		
5. Land slope, s ..... ft/ft	(435-382)/200=0.26		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{\ 0.5}\ s^{0.4}}$ Compute T_t ..... hr	0.25	+	= 0.25

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L .....ft			
9. Watercourse slope, s ..... ft/ft			
10. Average velocity, V (figure 3-1) ..... ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ..... ft^2			
13. Wetted perimeter, p_w ..... ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... ft			
15 Channel slope, s ..... ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V .....ft/s			
18. ~~Flow~~ length, L ..... ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... Hr **0.25 hrs**

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Honeywell NMC Reach CD - Area 2	SA	2/1/12
Location	**Checked**	**Date**
Syracuse, New York	MBS	2/16/12

Check one: ☐ Present ☑ Developed

Check one: ☑ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Woods, light underbrush	Pervious	
2. Manning's roughness coefficient, n (table 3-1)	0.4		
3. Flow length, L (total L † 300 ft) ft	200		
4. Two-year 24-hour rainfall, P_2 in	2.5		
5. Land slope, s ft/ft	(435-388)/200=0.23		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.27	+	= 0.27

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L ft			
9. Watercourse slope, s ft/ft			
10. Average velocity, V (figure 3-1) ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2			
13. Wetted perimeter, p_w ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft			
15 Channel slope, s ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s			
18. Flow length, L ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr 0.27 hrs

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Honeywell NMC Reach CD - Area 3	SA	2/1/12
Location	**Checked**	**Date**
Syracuse, New York	MBS	2/16/12

Check one: ☐ Present ☑ Developed

Check one: ☑ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Woods, light underbrush	Pervious	
2. Manning's roughness coefficient, n (table 3-1)	0.4		
3. Flow length, L (total L † 300 ft) ft	200		
4. Two-year 24-hour rainfall, P_2 in	2.5		
5. Land slope, s ft/ft	(435-377)/200=0.29		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.24	+	= 0.24

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L ft			
9. Watercourse slope, s ft/ft			
10. Average velocity, V (figure 3-1) ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2			
13. Wetted perimeter, p_w ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft			
15 Channel slope, s ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s			
18. Flow length, L ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr **0.24 hrs**

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Honeywell NMC Reach CD - Area 4	SA	2/1/12
Location	**Checked**	**Date**
Syracuse, New York	MBS	2/16/12

Check one: ☐ Present ☑ Developed

Check one: ☑ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Woods, light underbrush	Pervious	
2. Manning's roughness coefficient, n (table 3-1)	0.4		
3. Flow length, L (total L † 300 ft) ft	200		
4. Two-year 24-hour rainfall, P_2 in	2.5		
5. Land slope, s ft/ft	(435-377)/200=0.29		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.24	+	= 0.24

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L ft			
9. Watercourse slope, s ft/ft			
10. Average velocity, V (figure 3-1) ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2			
13. Wetted perimeter, p_w ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft			
15 Channel slope, s ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s			
18. Flow length, L ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr 0.24 hrs

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Honeywell NMC Reach CD - Area 5	SA	2/1/12
Location	**Checked**	**Date**
Syracuse, New York	MBS	2/16/12

Check one: ☐ Present ☑ Developed

Check one: ☑ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Woods, light underbrush	Pervious	
2. Manning's roughness coefficient, n (table 3-1)	0.4		
3. Flow length, L (total L † 300 ft) ft	200		
4. Two-year 24-hour rainfall, P_2 in	2.5		
5. Land slope, s ft/ft	(435-377)/200=0.29		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.24	+	= 0.24

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L ft			
9. Watercourse slope, s ft/ft			
10. Average velocity, V (figure 3-1) ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2			
13. Wetted perimeter, p_w ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft			
15 Channel slope, s ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s			
18. Flow length, L ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr 0.24 hrs

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Honeywell NMC Reach CD - Area 6	SA	2/1/12
Location	**Checked**	**Date**
Syracuse, New York	MBS	2/16/12

Check one: ☐ Present ☑ Developed

Check one: ☑ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Woods, light underbrush	Pervious	
2. Manning's roughness coefficient, n (table 3-1)	0.4		
3. Flow length, L (total L † 300 ft) ft	200		
4. Two-year 24-hour rainfall, P_2 in	2.5		
5. Land slope, s ft/ft	=(435-376)/200=0.29		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.24	+	= 0.24

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L ft			
9. Watercourse slope, s ft/ft			
10. Average velocity, V (figure 3-1) ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2			
13. Wetted perimeter, p_w ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft			
15 Channel slope, s ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s			
18. Flow length, L ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr 0.24 hrs

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Honeywell NMC Reach CD - Area 7	SA	2/1/12
Location	**Checked**	**Date**
Syracuse, New York	MBS	2/16/12

Check one: ☐ Present ☑ Developed

Check one: ☑ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Woods, light underbrush	Pervious	
2. Manning's roughness coefficient, n (table 3-1)	0.4		
3. Flow length, L (total L † 300 ft) ft	200		
4. Two-year 24-hour rainfall, P_2 in	2.5		
5. Land slope, s ft/ft	(435-376)/200=0.29		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.24	+	= 0.24

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L ft			
9. Watercourse slope, s ft/ft			
10. Average velocity, V (figure 3-1) ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2			
13. Wetted perimeter, p_w ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft			
15 Channel slope, s ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s			
18. ~~Flow length~~, L ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr 0.24 hrs

Attachment 2

Collection Swale Calculations

Attachment 2 - Collection Swale Calculations
Nine Mile Creek
Syracuse, New York

Riprap Sizing Calculations

Given:

Q=	7.6	cfs
B=	2	ft
z1=	2	ft
z2=	2	ft
So=	0.008	ft/ft
D50k=	0.166667	ft

Assume:

d (Initial trial depth, midchannel)= 0.95 ft

A (Area of Swale)=	$Bd+z_1d^2/2+z_2d^2/2$	3.70	ft^2
Pw (Wetted Perimeter)=	$B+(dz_1^2+d^2)^{0.5}+(dz_1^2+d^2)^{0.5}$	6.24	ft
R (Hydraulic Radius)=	A/Pw	0.59	ft
T (Top of Swale Width)=	$B+dz_1+dz_2$	5.79	ft
da (Average Depth)=	A/T	0.64	ft
Velocity	Q/A	2.06	ft/sec

Mannings n-value

$d_a/D50$ = 3.8

Blodgett Equation (calculate n)

$n=\alpha d^{1/6}/2.25+4.23 \log(d_a/D_{50})$

Where:

α = 0.262

n = **0.046**
Q = 7.60

Check

Check of D50 based on Shear

Re =	6.8E+03	Reynolds number
F* =	0.047	Shields number
SF =	1.00	Safety Factor
GS =	2.64	Specific Gravity

F and SF Interpolation		
Re	F*	SF
4.0E+04	0.047	1.00
6.8E+03	0.026	0.90
2.0E+05	0.150	1.50

Rip Rap sizing based on permissible Shear
D50 < (SF * d *So) / (F* (SG-1)

D50 > 0.098 Minimum stable riprap size

Attachment 3

Discharge Swale Calculations

Attachment 3 - Discharge Swale Calculations
Nine Mile Creek
Syracuse, New York

Riprap Sizing Calculations

Given:

Q=	7.6	cfs
B=	3	ft
z1=	3	ft
z2=	3	ft
So=	0.33	ft/ft
D50k=	1	ft

Assume:

d (Initial trial depth, midchannel)=	0.20	ft	
A (Area of Swale)=	$Bd+z_1d^2/2+z_2d^2/2$	0.73	ft^2
Pw (Wetted Perimeter)=	$B+(dz_1^2+d^2)^{0.5}+(dz_1^2+d^2)^{0.5}$	4.28	ft
R (Hydraulic Radius)=	A/Pw	0.17	ft
T (Top of Swale Width)=	$B+dz_1+dz_2$	4.22	ft
da (Average Depth)=	A/T	0.17	ft
Velocity	Q/A	10.38	ft/sec

Mannings n-value

$d_a/D50$ = 0.2

Bathurst Equation (calculate n)

$n=\alpha d^{1/6}/((32.2)^{1/2}\ f(Fr)\ f(REG)\ f(CG))$

Where:

α =	1.49	
d_a =	0.17	ft
g=	32.2	ft / sec^2
Fr =	4.39	
b =	0.143	
f(Fr) =	4.7433	
f(REG) =	2.56	
f(CG) =	0.63	
n =	**0.025**	Using Bathurst Equation
Q =	7.60	ft^3/sec

Check of D50 based on Shear

Re =	1.2E+05	Reynolds number
F* =	0.099	Shields number
SF =	1.25	Safety Factor
GS =	2.64	Specific Gravity

F and SF Interpolation

Re	F*	SF
4.0E+04	0.047	1.00
1.2E+05	0.099	1.25
2.0E+05	0.150	1.50

Rip Rap sizing based on Simons and Senturk
D50>/= SF*D*S*△/Fx(SG-1)

Where

$\triangle = K_1(1+\sin(\alpha+\beta)\tan\phi/2(\cos\theta\tan\phi - SF\sin\theta\cos\beta)$

α= 18.26 degrees

ϕ=	39.5	degrees
θ=	18.43	degrees
K1 =	0.802	
τd =	4.2	lb/ft^2
τs =	3.35	lb/ft^2
η =	0.3	
β=	19.8	deg
Δ =	1.30	
D50 >	0.67	ft

Attachment 4

Outlet Protection Design

Figure 5B.12
Outlet Protection Design—Minimum Tailwater Condition
(Design of Outlet Protection from a Round Pipe Flowing Full, Minimum Tailwater Condition: $T_w < 0.5D_o$) (USDA - NRCS)

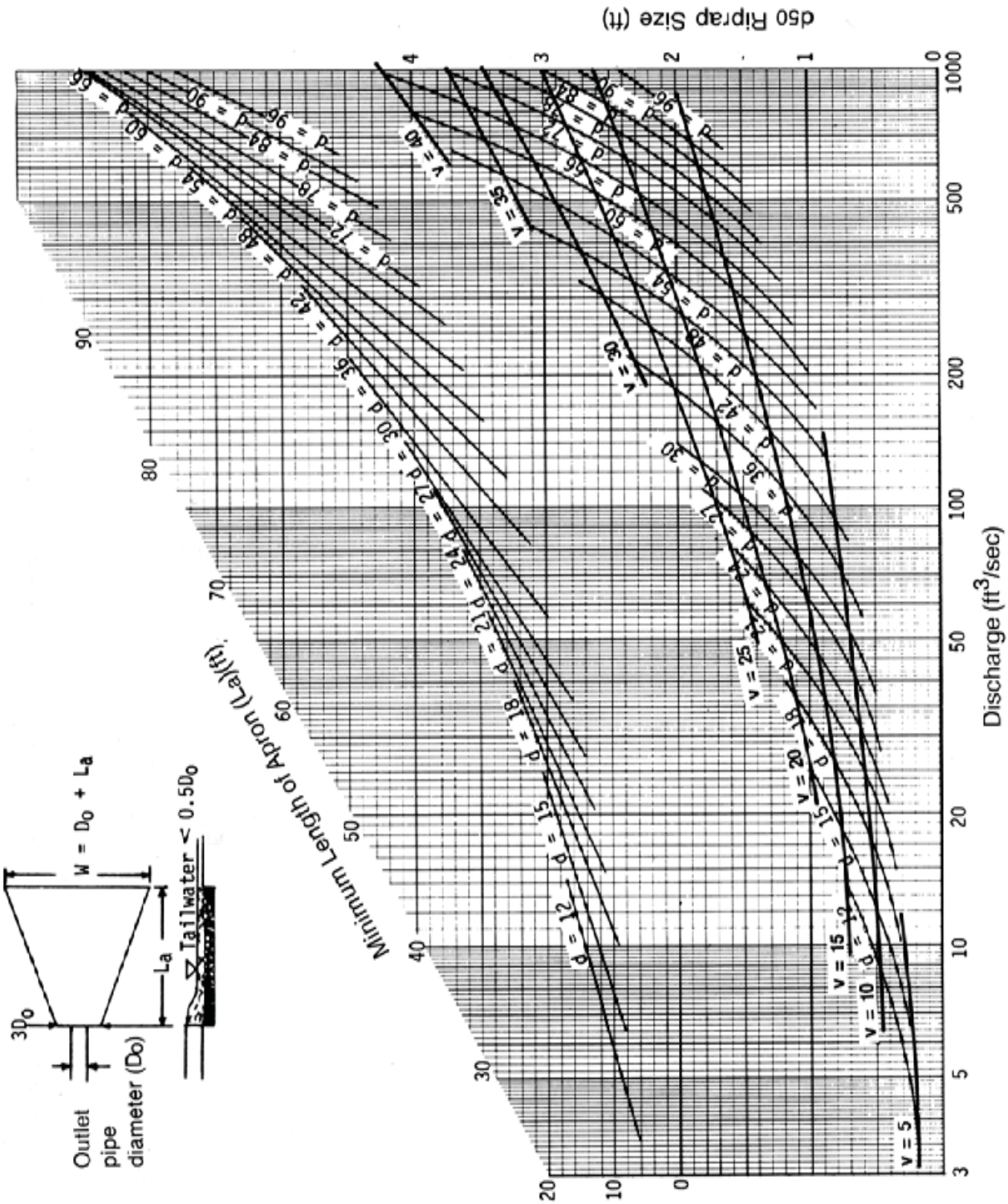
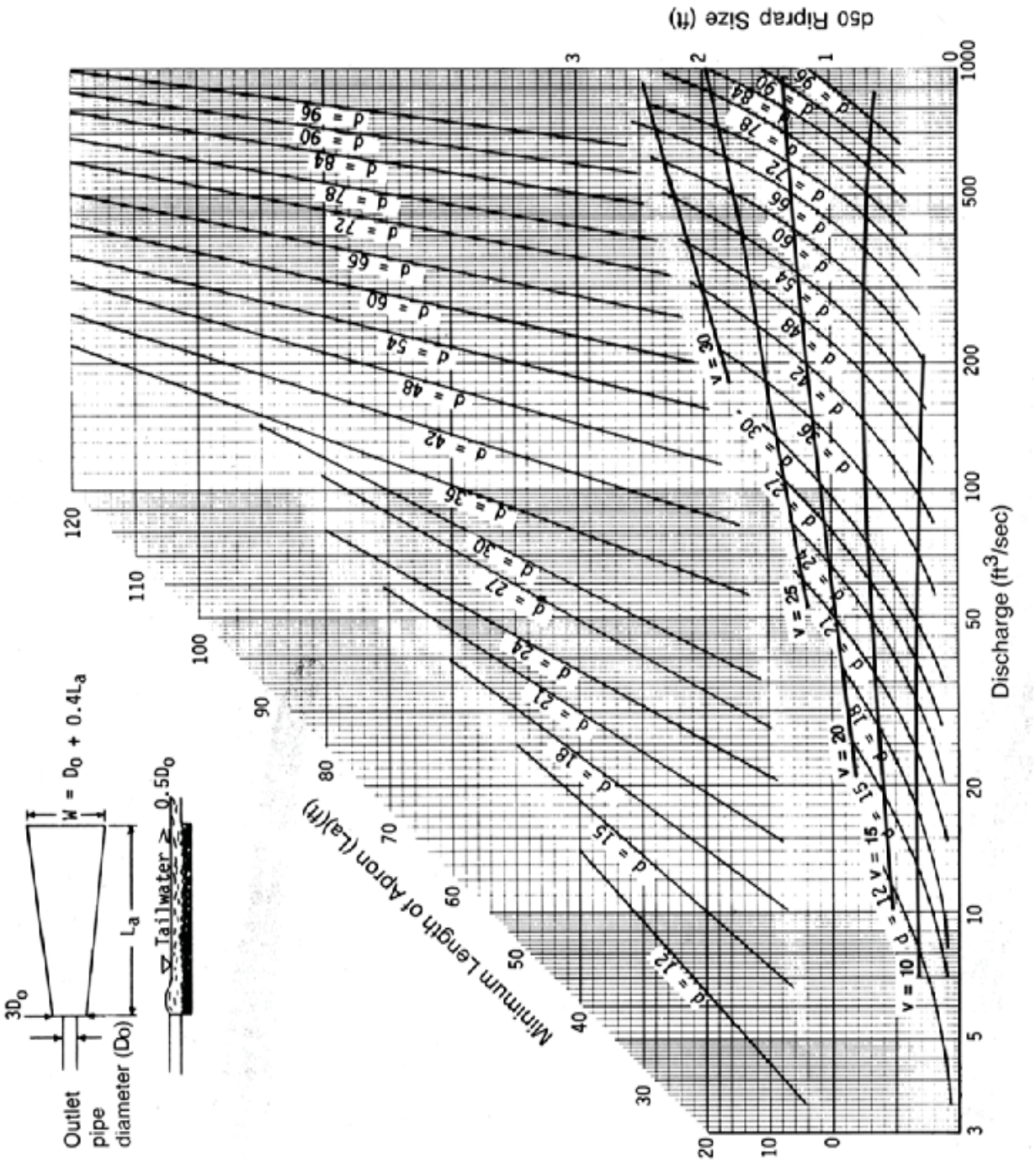
Figure 5B.13
Outlet Protection Design—Maximum Tailwater Condition
(Design of Outlet Protection from a Round Pipe Flowing Full, Maximum Tailwater Condition: $T_w \geq 0.5D_o$) (USDA - NRCS)