APPENDIX B TO §302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Iridium-195	77	1000 (3.7E 13)
Iron-52	26	100 (3.7E 12)
Iron-55	26	100 (3.7E 12)
Iron-59	26	10 (3.7E 11)
Iron-60	26	0.1 (3.7E 9)
Krypton-74	36	10 (3.7E 11)
Krypton-76	36	10 (3.7E 11)
Krypton-77	36	10 (3.7E 11)
Krypton-79	36	100 (3.7E 12)
Krypton-81	36	1000 (3.7E 13)
Krypton-83m	36	1000 (3.7E 13)
Krypton-85m	36	100 (3.7E 12)
Krypton-85	36	1000 (3.7E 13)
Krypton-87	36	10 (3.7E 11)
Krypton-88	36	10 (3.7E 11)
Lanthanum-131	57	1000 (3.7E 13)
Lanthanum-132	57	100 (3.7E 12)
Lanthanum-135	57	1000 (3.7E 13)
Lanthanum-137	57	10 (3.7E 11)
Lanthanum-138	57	1 (3.7E 10)
Lanthanum-140	57	10 (3.7E 11)
Lanthanum-141	57	1000 (3.7E 13)
Lanthanum-142	57	100 (3.7E 12)
Lanthanum-143	57	1000 (3.7E 13)
Lead-195m	82	1000 (3.7E 13)
Lead-198	82	100 (3.7E 12)
Lead-199	82	100 (3.7E 12)
Lead-200	82	100 (3.7E 12)
Lead-201	82	100 (3.7E 12)
Lead-202m	82	10 (3.7E 11)
Lead-202	82	1 (3.7E 10)
Lead-203	82	100 (3.7E 12)
Lead-205	82	100 (3.7E 12)
Lead-209	82	1000 (3.7E 13)
Lead-210	82	0.01 (3.7E 8)
Lead-211	82	100 (3.7E 12)
Lead-212	82	10 (3.7E 11)
Lead-214	82	100 (3.7E 12)
Lutetium-169	71	10 (3.7E 11)
Lutetium-170	71	10 (3.7E 11)
Lutetium-171	71	10 (3.7E 11)
Lutetium-172	71	10 (3.7E 11)
Lutetium-173	71	100 (3.7E 12)
Lutetium-174m	71	10 (3.7E 11)
Lutetium-174	71	10 (3.7E 11)
Lutetium-176m	71	1000 (3.7E 13)
Lutetium-176	71	1 (3.7E 10)
Lutetium-177m	71	10 (3.7E 11)
Lutetium-177	71	100 (3.7E 12)
Lutetium-178m	71	1000 (3.7E 13)
Lutetium-178	71	1000 (3.7E 13)
Lutetium-179	71	1000 (3.7E 13)
Magnesium-28	12	10 (3.7E 11)
Manganese-51	25	1000 (3.7E 13)
Manganese-52m	25	1000 (3.7E 13)
Manganese-52	25	10 (3.7E 11)
Manganese-53	25	1000 (3.7E 13)
Manganese-54	25	10 (3.7E 11)
Manganese-56	25	100 (3.7E 12)
Mendelevium-257	101	100 (3.7E 12)
Mendelevium-258	101	1 (3.7E 10)
Mercury-193m	80	10 (3.7E 11)
Mercury-193	80	100 (3.7E 12)
Mercury-194	80	0.1 (3.7E 9)
Mercury-195m	80	100 (3.7E 12)
Mercury-195	80	100 (3.7E 12)
Mercury-197m	80	1000 (3.7E 13)
Mercury-197	80	1000 (3.7E 13)
Mercury-199m	80	1000 (3.7E 13)
Mercury-203	80	10 (3.7E 11)
Molybdenum-90	42	100 (3.7E 12)
Molybdenum-93m	42	10 (3.7E 11)
Molybdenum-93	42	100 (3.7E 12)
Molybdenum-99	42	100 (3.7E 12)
Molybdenum-101	42	1000 (3.7E 13)
Neodymium-136	60	1000 (3.7E 13)
Neodymium-138	60	1000 (3.7E 13)
Neodymium-139m	60	100 (3.7E 12)
Neodymium-139	60	1000 (3.7E 13)
Neodymium-141	60	1000 (3.7E 13)
Neodymium-147	60	10 (3.7E 11)
Neodymium-149	60	100 (3.7E 12)
Neodymium-151	60	1000 (3.7E 13)
Neptunium-232	93	1000 (3.7E 13)
Neptunium-233	93	1000 (3.7E 13)
Neptunium-234	93	10 (3.7E 11)
Neptunium-235	93	1000 (3.7E 13)
Neptunium-236 (1.2 E 5 yr)	93	0.1 (3.7E 9)
Neptunium-236 (22.5 hr)	93	100 (3.7E 12)
Neptunium-237	93	0.01 (3.7E 8)
Neptunium-238	93	10 (3.7E 11)
Neptunium-239	93	100 (3.7E 12)
Neptunium-240	93	100 (3.7E 12)
Nickel-56	28	10 (3.7E 11)
Nickel-57	28	10 (3.7E 11)
Nickel-59	28	100 (3.7E 12)
Nickel-63	28	100 (3.7E 12)
Nickel-65	28	100 (3.7E 12)
Nickel-66	28	10 (3.7E 11)
Niobium-88	41	100 (3.7E 12)
Niobium-89 (66 min)	41	100 (3.7E 12)
Niobium-89 (122 min)	41	100 (3.7E 12)
Niobium-90	41	10 (3.7E 11)
Niobium-93m	41	100 (3.7E 12)
Niobium-94	41	10 (3.7E 11)
Niobium-95m	41	100 (3.7E 12)
Niobium-95	41	10 (3.7E 11)
Niobium-96	41	10 (3.7E 11)
Niobium-97	41	100 (3.7E 12)
Niobium-98	41	1000 (3.7E 13)
Osmium-180	76	1000 (3.7E 13)
Osmium-181	76	100 (3.7E 12)
Osmium-182	76	100 (3.7E 12)
Osmium-185	76	10 (3.7E 11)
Osmium-189m	76	1000 (3.7E 13)
Osmium-191m	76	1000 (3.7E 13)
Osmium-191	76	100 (3.7E 12)
Osmium-193	76	100 (3.7E 12)
Osmium-194	76	1 (3.7E 10)
Palladium-100	46	100 (3.7E 12)
Palladium-101	46	100 (3.7E 12)
Palladium-103	46	100 (3.7E 12)
Palladium-107	46	100 (3.7E 12)
Palladium-109	46	1000 (3.7E 13)
Phosphorus-32	15	0.1 (3.7E 9)
Phosphorus-33	15	1 (3.7E 10)
Platinum-186	78	100 (3.7E 12)
Platinum-188	78	100 (3.7E 12)
Platinum-189	78	100 (3.7E 12)
Platinum-191	78	100 (3.7E 12)
Platinum-193m	78	100 (3.7E 12)
Platinum-193	78	1000 (3.7E 13)
Platinum-195m	78	100 (3.7E 12)
Platinum-197m	78	1000 (3.7E 13)
Platinum-197	78	1000 (3.7E 13)
Platinum-199	78	1000 (3.7E 13)
Platinum-200	78	100 (3.7E 12)
Plutonium-234	94	1000 (3.7E 13)
Plutonium-235	94	1000 (3.7E 13)
Plutonium-236	94	0.1 (3.7E 9)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Plutonium-237	94	1000 (3.7E 13)
Plutonium-238	94	0.01 (3.7E 8)
Plutonium-239	94	0.01 (3.7E 8)
Plutonium-240	94	0.01 (3.7E 8)
Plutonium-241	94	1 (3.7E 10)
Plutonium-242	94	0.01 (3.7E 8)
Plutonium-243	94	1000 (3.7E 13)
Plutonium-244	94	0.01 (3.7E 8)
Plutonium-245	94	100 (3.7E 12)
Polonium-203	84	100 (3.7E 12)
Polonium-205	84	100 (3.7E 12)
Polonium-207	84	10 (3.7E 11)
Polonium-210	84	0.01 (3.7E 8)
Potassium-40	19	1 (3.7E 10)
Potassium-42	19	100 (3.7E 12)
Potassium-43	19	10 (3.7E 11)
Potassium-44	19	100 (3.7E 12)
Potassium-45	19	1000 (3.7E 13)
Praseodymium-136	59	1000 (3.7E 13)
Praseodymium-137	59	1000 (3.7E 13)
Praseodymium-138m	59	100 (3.7E 12)
Praseodymium-139	59	1000 (3.7E 13)
Praseodymium-142m	59	1000 (3.7E 13)
Praseodymium-142	59	100 (3.7E 12)
Praseodymium-143	59	10 (3.7E 11)
Praseodymium-144	59	1000 (3.7E 13)
Praseodymium-145	59	1000 (3.7E 13)
Praseodymium-147	59	1000 (3.7E 13)
Promethium-141	61	1000 (3.7E 13)
Promethium-143	61	100 (3.7E 12)
Promethium-144	61	10 (3.7E 11)
Promethium-145	61	100 (3.7E 12)
Promethium-146	61	10 (3.7E 11)
Promethium-147	61	10 (3.7E 11)
Promethium-148m	61	10 (3.7E 11)
Promethium-148	61	10 (3.7E 11)
Promethium-149	61	100 (3.7E 12)
Promethium-150	61	100 (3.7E 12)
Promethium-151	61	100 (3.7E 12)
Protactinium-227	91	100 (3.7E 12)
Protactinium-228	91	10 (3.7E 11)
Protactinium-230	91	10 (3.7E 11)
Protactinium-231	91	0.01 (3.7E 8)
Protactinium-232	91	10 (3.7E 11)
Protactinium-233	91	100 (3.7E 12)
Protactinium-234	91	10 (3.7E 11)
Radium-223	88	1 (3.7E 10)
Radium-224	88	10 (3.7E 11)
Radium-225	88	1 (3.7E 10)
Radium-226Φ	88	0.1 (3.7E 9)
Radium-227	88	1000 (3.7E 13)
Radium-228	88	0.1 (3.7E 9)
Radon-220	86	0.1 (3.7E 9)
Radon-222	86	0.1 (3.7E 9)
Rhenium-177	75	1000 (3.7E 13)
Rhenium-178	75	1000 (3.7E 13)
Rhenium-181	75	100 (3.7E 12)
Rhenium-182 (12.7 hr)	75	10 (3.7E 11)
Rhenium-182 (64.0 hr)	75	10 (3.7E 11)
Rhenium-184m	75	10 (3.7E 11)
Rhenium-184	75	10 (3.7E 11)
Rhenium-186m	75	10 (3.7E 11)
Rhenium-186	75	100 (3.7E 12)
Rhenium-187	75	1000 (3.7E 13)
Rhenium-188m	75	1000 (3.7E 13)
Rhenium-188	75	1000 (3.7E 13)
Rhenium-189	75	1000 (3.7E 13)
Rhodium-99m	45	100 (3.7E 12)
Rhodium-99	45	10 (3.7E 11)
Rhodium-100	45	10 (3.7E 11)
Rhodium-101m	45	100 (3.7E 12)
Rhodium-101	45	10 (3.7E 11)
Rhodium-102m	45	10 (3.7E 11)
Rhodium-102	45	10 (3.7E 11)
Rhodium-103m	45	1000 (3.7E 13)
Rhodium-105	45	100 (3.7E 12)
Rhodium-106m	45	10 (3.7E 11)
Rhodium-107	45	1000 (3.7E 13)
Rubidium-79	37	1000 (3.7E 13)
Rubidium-81m	37	1000 (3.7E 13)
Rubidium-81	37	100 (3.7E 12)
Rubidium-82m	37	10 (3.7E 11)
Rubidium-83	37	10 (3.7E 11)
Rubidium-84	37	10 (3.7E 11)
Rubidium-86	37	10 (3.7E 11)
Rubidium-88	37	1000 (3.7E 13)
Rubidium-89	37	1000 (3.7E 13)
Rubidium-87	37	10 (3.7E 11)
Ruthenium-94	44	1000 (3.7E 13)
Ruthenium-97	44	100 (3.7E 12)
Ruthenium-103	44	10 (3.7E 11)
Ruthenium-105	44	100 (3.7E 12)
Ruthenium-106	44	1 (3.7E 10)
Samarium-141m	62	1000 (3.7E 13)
Samarium-141	62	1000 (3.7E 13)
Samarium-142	62	1000 (3.7E 13)
Samarium-145	62	100 (3.7E 12)
Samarium-146	62	0.01 (3.7E 8)
Samarium-147	62	0.01 (3.7E 8)
Samarium-151	62	10 (3.7E 11)
Samarium-153	62	100 (3.7E 12)
Samarium-155	62	1000 (3.7E 13)
Samarium-156	62	100 (3.7E 12)
Scandium-43	21	1000 (3.7E 13)
Scandium-44m	21	10 (3.7E 11)
Scandium-44	21	100 (3.7E 12)
Scandium-46	21	10 (3.7E 11)
Scandium-47	21	100 (3.7E 12)
Scandium-48	21	10 (3.7E 11)
Scandium-49	21	1000 (3.7E 13)
Selenium-70	34	1000 (3.7E 13)
Selenium-73m	34	100 (3.7E 12)
Selenium-73	34	10 (3.7E 11)
Selenium-75	34	10 (3.7E 11)
Selenium-79	34	10 (3.7E 11)
Selenium-81m	34	1000 (3.7E 13)
Selenium-81	34	1000 (3.7E 13)
Selenium-83	34	1000 (3.7E 13)
Silicon-31	14	1000 (3.7E 13)
Silicon-32	14	1 (3.7E 10)
Silver-102	47	100 (3.7E 12)
Silver-103	47	1000 (3.7E 13)
Silver-104m	47	1000 (3.7E 13)
Silver-104	47	1000 (3.7E 13)
Silver-105	47	10 (3.7E 11)
Silver-106m	47	10 (3.7E 11)
Silver-106	47	1000 (3.7E 13)
Silver-108m	47	10 (3.7E 11)
Silver-110m	47	10 (3.7E 11)
Silver-111	47	10 (3.7E 11)
Silver-112	47	100 (3.7E 12)
Silver-115	47	1000 (3.7E 13)
Sodium-22	11	10 (3.7E 11)
Sodium-24	11	10 (3.7E 11)
Strontium-80	38	100 (3.7E 12)
Strontium-81	38	1000 (3.7E 13)
Strontium-83	38	100 (3.7E 12)
Strontium-85m	38	1000 (3.7E 13)
Strontium-85	38	10 (3.7E 11)
Strontium-87m	38	100 (3.7E 12)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Strontium-89	38	10 (3.7E 11)
Strontium-90	38	0.1 (3.7E 9)
Strontium-91	38	10 (3.7E 11)
Strontium-92	38	100 (3.7E 12)
Sulfur-35	16	1 (3.7E 10)
Tantalum-172	73	100 (3.7E 12)
Tantalum-173	73	100 (3.7E 12)
Tantalum-174	73	100 (3.7E 12)
Tantalum-175	73	100 (3.7E 12)
Tantalum-176	73	10 (3.7E 11)
Tantalum-177	73	1000 (3.7E 13)
Tantalum-178	73	1000 (3.7E 13)
Tantalum-179	73	1000 (3.7E 13)
Tantalum-180m	73	1000 (3.7E 13)
Tantalum-180	73	100 (3.7E 12)
Tantalum-182m	73	1000 (3.7E 13)
Tantalum-182	73	10 (3.7E 11)
Tantalum-183	73	100 (3.7E 12)
Tantalum-184	73	10 (3.7E 11)
Tantalum-185	73	1000 (3.7E 13)
Tantalum-186	73	1000 (3.7E 13)
Technetium-93m	43	1000 (3.7E 13)
Technetium-93	43	100 (3.7E 12)
Technetium-94m	43	100 (3.7E 12)
Technetium-94	43	10 (3.7E 11)
Technetium-96m	43	1000 (3.7E 13)
Technetium-96	43	10 (3.7E 11)
Technetium-97m	43	100 (3.7E 12)
Technetium-97	43	100 (3.7E 12)
Technetium-98	43	10 (3.7E 11)
Technetium-99m	43	100 (3.7E 12)
Technetium-99	43	10 (3.7E 11)
Technetium-101	43	1000 (3.7E 13)
Technetium-104	43	1000 (3.7E 13)
Tellurium-116	52	1000 (3.7E 13)
Tellurium-121m	52	10 (3.7E 11)
Tellurium-121	52	10 (3.7E 11)
Tellurium-123m	52	10 (3.7E 11)
Tellurium-123	52	10 (3.7E 11)
Tellurium-125m	52	10 (3.7E 11)
Tellurium-127m	52	10 (3.7E 11)
Tellurium-127	52	1000 (3.7E 13)
Tellurium-129m	52	10 (3.7E 11)
Tellurium-129	52	1000 (3.7E 13)
Tellurium-131m	52	10 (3.7E 11)
Tellurium-131	52	1000 (3.7E 13)
Tellurium-132	52	10 (3.7E 11)
Tellurium-133m	52	1000 (3.7E 13)
Tellurium-133	52	1000 (3.7E 13)
Tellurium-134	52	1000 (3.7E 13)
Terbium-147	65	100 (3.7E 12)
Terbium-149	65	100 (3.7E 12)
Terbium-150	65	100 (3.7E 12)
Terbium-151	65	10 (3.7E 11)
Terbium-153	65	100 (3.7E 12)
Terbium-154	65	10 (3.7E 11)
Terbium-155	65	100 (3.7E 12)
Terbium-156m (5.0 hr)	65	1000 (3.7E 13)
Terbium-156m (24.4 hr)	65	1000 (3.7E 13)
Terbium-156	65	10 (3.7E 11)
Terbium-157	65	100 (3.7E 12)
Terbium-158	65	10 (3.7E 11)
Terbium-160	65	10 (3.7E 11)
Terbium-161	65	100 (3.7E 12)
Thallium-194m	81	100 (3.7E 12)
Thallium-194	81	1000 (3.7E 13)
Thallium-195	81	100 (3.7E 12)
Thallium-197	81	100 (3.7E 12)
Thallium-198m	81	100 (3.7E 12)
Thallium-198	81	10 (3.7E 11)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Thallium-199	81	100 (3.7E 12)
Thallium-200	81	10 (3.7E 11)
Thallium-201	81	1000 (3.7E 13)
Thallium-202	81	10 (3.7E 11)
Thallium-204	81	10 (3.7E 11)
Thorium-226	90	100 (3.7E 12)
Thorium-227	90	1 (3.7E 10)
Thorium-228	90	0.01 (3.7E 8)
Thorium-229	90	0.001 (3.7E 7)
Thorium-230	90	0.01 (3.7E 8)
Thorium-231	90	100 (3.7E 12)
Thorium-232Φ	90	0.001 (3.7E 7)
Thorium-234	90	100 (3.7E 12)
Thulium-162	69	1000 (3.7E 13)
Thulium-166	69	10 (3.7E 11)
Thulium-167	69	100 (3.7E 12)
Thulium-170	69	10 (3.7E 11)
Thulium-171	69	100 (3.7E 12)
Thulium-172	69	100 (3.7E 12)
Thulium-173	69	100 (3.7E 12)
Thulium-175	69	1000 (3.7E 13)
Tin-110	50	100 (3.7E 12)
Tin-111	50	1000 (3.7E 13)
Tin-113	50	10 (3.7E 11)
Tin-117m	50	100 (3.7E 12)
Tin-119m	50	10 (3.7E 11)
Tin-121m	50	10 (3.7E 11)
Tin-121	50	1000 (3.7E 13)
Tin-123m	50	1000 (3.7E 13)
Tin-123	50	10 (3.7E 11)
Tin-125	50	10 (3.7E 11)
Tin-126	50	1 (3.7E 10)
Tin-127	50	100 (3.7E 12)
Tin-128	50	1000 (3.7E 13)
Titanium-44	22	1 (3.7E 10)
Titanium-45	22	1000 (3.7E 13)
Tungsten-176	74	1000 (3.7E 13)
Tungsten-177	74	100 (3.7E 12)
Tungsten-178	74	100 (3.7E 12)
Tungsten-179	74	1000 (3.7E 13)
Tungsten-181	74	100 (3.7E 12)
Tungsten-185	74	10 (3.7E 11)
Tungsten-187	74	100 (3.7E 12)
Tungsten-188	74	10 (3.7E 11)
Uranium-230	92	1 (3.7E 10)
Uranium-231	92	1000 (3.7E 13)
Uranium-232	92	0.01 (3.7E 8)
Uranium-233	92	0.1 (3.7E 9)
Uranium-234φ	92	0.1 (3.7E 9)
Uranium-235φ	92	0.1 (3.7E 9)
Uranium-236	92	0.1 (3.7E 9)
Uranium-237	92	100 (3.7E 12)
Uranium-238φ	92	0.1& (3.7E 9)
Uranium-239	92	1000 (3.7E 13)
Uranium-240	92	1000 (3.7E 13)
Vanadium-47	23	1000 (3.7E 13)
Vanadium-48	23	10 (3.7E 11)
Vanadium-49	23	1000 (3.7E 13)
Xenon-120	54	100 (3.7E 12)
Xenon-121	54	10 (3.7E 11)
Xenon-122	54	100 (3.7E 12)
Xenon-123	54	10 (3.7E 11)
Xenon-125	54	100 (3.7E 12)
Xenon-127	54	100 (3.7E 12)
Xenon-129m	54	1000 (3.7E 13)
Xenon-131m	54	1000 (3.7E 13)
Xenon-133m	54	1000 (3.7E 13)
Xenon-133	54	1000 (3.7E 13)
Xenon-135m	54	10 (3.7E 11)
Xenon-135	54	100 (3.7E 12)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Xenon-138	54	10 (3.7E 11)
Ytterbium-162	70	1000 (3.7E 13)
Ytterbium-166	70	10 (3.7E 11)
Ytterbium-167	70	1000 (3.7E 13)
Ytterbium-169	70	10 (3.7E 11)
Ytterbium-175	70	100 (3.7E 12)
Ytterbium-177	70	1000 (3.7E 13)
Ytterbium-178	70	1000 (3.7E 13)
Yttrium-86m	39	1000 (3.7E 13)
Yttrium-86	39	10 (3.7E 11)
Yttrium-87	39	10 (3.7E 11)
Yttrium-88	39	10 (3.7E 11)
Yttrium-90m	39	100 (3.7E 12)
Yttrium-90	39	10 (3.7E 11)
Yttrium-91m	39	1000 (3.7E 13)
Yttrium-91	39	10 (3.7E 11)
Yttrium-92	39	100 (3.7E 12)
Yttrium-93	39	100 (3.7E 12)
Yttrium-94	39	1000 (3.7E 13)
Yttrium-95	39	1000 (3.7E 13)
Zinc-62	30	100 (3.7E 12)
Zinc-63	30	1000 (3.7E 13)
Zinc-65	30	10 (3.7E 11)
Zinc-69m	30	100 (3.7E 12)
Zinc-69	30	1000 (3.7E 13)
Zinc-71m	30	100 (3.7E 12)
Zinc-72	30	100 (3.7E 12)
Zirconium-86	40	100 (3.7E 12)
Zirconium-88	40	10 (3.7E 11)
Zirconium-89	40	100 (3.7E 12)
Zirconium-93	40	1 (3.7E 10)
Zirconium-95	40	10 (3.7E 11)
Zirconium-97	40	10 (3.7E 11)

Ci—Curie. The curie represents a rate of radioactive decay. One curie is the quantity of any radioactive nuclide which undergoes 3.7E 10 disintegrations per second.

Bq—Becquerel. The becquerel represents a rate of radioactive decay. One becquerel is the quantity of any radioactive nuclide which undergoes one disintegration per second. One curie is equal to 3.7E 10 becquerel.

@—Final RQs for all radionuclides apply to chemical compounds containing the radionuclides and elemental forms regardless of the diameter of pieces of solid material.

&—The adjusted RQ of one curie applies to all radionuclides not otherwise listed. Whenever the RQs in table 302.4 and this appendix to the table are in conflict, the lowest RQ shall apply. For example, uranyl acetate and uranyl nitrate have adjusted RQs shown in table 302.4 of 100 pounds, equivalent to about one-tenth the RQ level for uranium-238 listed in this appendix.

E—Exponent to the base 10. For example, 1.3E 2 is equal to 130 while 1.3E 3 is equal to 1300.

m—Signifies a nuclear isomer which is a radionuclide in a higher energy metastable state relative to the parent isotope.

φ—Notification requirements for releases of mixtures or solutions of radionuclides can be found in § 302.6(b) of this rule. Final RQs for the following four common radionuclide mixtures are provided: radium-226 in secular equilibrium with its daughters (0.053 curie); natural uranium (0.1 curie); natural uranium in secular equilibrium with its daughters (0.052 curie); and natural thorium in secular equilibrium with its daughters (0.011 curie).

[54 FR 33449, Aug. 14, 1989]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 302.4, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at www.fdsys.gov.

§ 302.5 Determination of reportable quantities.

(a) *Listed hazardous substances.* The quantity listed in the column "Final RQ" for each substance in table 302.4, or in appendix B to table 302.4, is the reportable quantity (RQ) for that substance. The RQs in table 302.4 are in units of pounds based on chemical toxicity, while the RQs in appendix B to table 302.4 are in units of curies based on radiation hazard. Whenever the RQs in table 302.4 and appendix B to the table are in conflict, the lowest RQ shall apply.

(b) *Unlisted hazardous substances.* Unlisted hazardous substances designated by 40 CFR 302.4(b) have the reportable quantity of 100 pounds, except for those unlisted hazardous wastes which exhibit toxicity identified in 40 CFR 261.24. Unlisted hazardous wastes which exhibit toxicity have the reportable quantities listed in Table 302.4 for the contaminant on which the characteristic of toxicity is based. The reportable quantity applies to the waste itself, not merely to the toxic contaminant. If an unlisted hazardous waste exhibits toxicity on the basis of more than one contaminant, the reportable quantity for that waste shall be the lowest of the reportable quantities listed in Table 302.4 for those contaminants. If an unlisted hazardous waste exhibits the characteristic of toxicity and one or more of the other characteristics referenced in 40 CFR 302.4(b), the reportable quantity for that waste shall be the lowest of the applicable reportable quantities.

[51 FR 34547, Sept. 29, 1986, as amended at 54 FR 22538, May 24, 1989; 67 FR 45356, July 9, 2002]

§ 302.6 Notification requirements.

(a) Any person in charge of a vessel or an offshore or an onshore facility shall, as soon as he or she has knowledge of any release (other than a federally permitted release or application of a pesticide) of a hazardous substance from such vessel or facility in a quantity equal to or exceeding the reportable quantity determined by this part in any 24-hour period, immediately notify the National Response Center (1–800–424–8802; in Washington, DC 202–267–

agreement between a State and a Tribe, the SERC shall be the entity identified in the agreement.

State means any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, any other territory or possession over which the United States has jurisdiction and Indian Country.

Threshold planning quantity means, for a substance listed in Appendices A and B of this part, the quantity listed in the column "threshold planning quantity" for that substance.

[73 FR 65462, Nov. 3, 2008, as amended at 73 FR 76960, Dec. 18, 2008]

APPENDIX A TO PART 355—THE LIST OF EXTREMELY HAZARDOUS SUBSTANCES AND THEIR THRESHOLD PLANNING QUANTITIES

[Alphabetical Order]

CAS No.	Chemical name	Notes	Reportable quantity* (pounds)	Threshold planning quantity (pounds)
75–86–5	Acetone Cyanohydrin		10	1,000
1752–30–3	Acetone Thiosemicarbazide		1,000	1,000/10,000
107–02–8	Acrolein		1	500
79–06–1	Acrylamide	f	5,000	1,000/10,000
107–13–1	Acrylonitrile	f	100	10,000
814–68–6	Acrylyl Chloride	d	100	100
111–69–3	Adiponitrile	f	1,000	1,000
116–06–3	Aldicarb	b	1	100/10,000
309–00–2	Aldrin		1	500/10,000
107–18–6	Allyl Alcohol		100	1,000
107–11–9	Allylamine		500	500
20859–73–8	Aluminum Phosphide	a	100	500
54–62–6	Aminopterin		500	500/10,000
78–53–5	Amiton		500	500
3734–97–2	Amiton Oxalate		100	100/10,000
7664–41–7	Ammonia	f	100	500
300–62–9	Amphetamine		1,000	1,000
62–53–3	Aniline	f	5,000	1,000
88–05–1	Aniline, 2,4,6-Trimethyl-		500	500
7783–70–2	Antimony Pentafluoride		500	500
1397–94–0	Antimycin A	b	1,000	1,000/10,000
86–88–4	ANTU		100	500/10,000
1303–28–2	Arsenic Pentoxide		1	100/10,000
1327–53–3	Arsenous Oxide	d	1	100/10,000
7784–34–1	Arsenous Trichloride		1	500
7784–42–1	Arsine		100	100
2642–71–9	Azinphos-Ethyl		100	100/10,000
86–50–0	Azinphos-Methyl		1	10/10,000
98–87–3	Benzal Chloride		5,000	500
98–16–8	Benzenamine, 3-(Trifluoromethyl)-		500	500
100–14–1	Benzene, 1-(Chloromethyl)-4-Nitro-		500	500/10,000
98–05–5	Benzenearsonic Acid		10	10/10,000
3615–21–2	Benzimidazole, 4,5-Dichloro-2-(Trifluoromethyl)-	c	500	500/10,000
98–07–7	Benzotrichloride		10	100
100–44–7	Benzyl Chloride		100	500
140–29–4	Benzyl Cyanide	d	500	500
15271–41–7	Bicyclo[2.2.1]Heptane-2-Carbonitrile, 5-Chloro-6-((((Methylamino)Carbonyl)Oxy)Imino)-, (1s-(1-alpha,2-beta,4-alpha,5-alpha,6E))-.		500	500/10,000
534–07–6	Bis(Chloromethyl) Ketone		10	10/10,000
4044–65–9	Bitoscanate		500	500/10,000
10294–34–5	Boron Trichloride		500	500
7637–07–2	Boron Trifluoride		500	500
353–42–4	Boron Trifluoride Compound With Methyl Ether (1:1)		1,000	1,000
28772–56–7	Bromadiolone		100	100/10,000
7726–95–6	Bromine	f	500	500
1306–19–0	Cadmium Oxide		100	100/10,000
2223–93–0	Cadmium Stearate	b	1,000	1,000/10,000
7778–44–1	Calcium Arsenate		1	500/10,000
8001–35–2	Camphechlor		1	500/10,000
56–25–7	Cantharidin		100	100/10,000
51–83–2	Carbachol Chloride		500	500/10,000
26419–73–8	Carbamic Acid, Methyl-, O-(((2,4-Dimethyl-1, 3-Dithiolan-2-yl)Methylene)Amino)-.		100	100/10,000

[Alphabetical Order]

CAS No.	Chemical name	Notes	Reportable quantity* (pounds)	Threshold planning quantity (pounds)
1563–66–2	Carbofuran		10	10/10,000
75–15–0	Carbon Disulfide	f	100	10,000
786–19–6	Carbophenothion		500	500
57–74–9	Chlordane		1	1,000
470–90–6	Chlorfenvinfos		500	500
7782–50–5	Chlorine		10	100
24934–91–6	Chlormephos		500	500
999–81–5	Chlormequat Chloride	d	100	100/10,000
79–11–8	Chloroacetic Acid		100	100/10,000
107–07–3	Chloroethanol		500	500
627–11–2	Chloroethyl Chloroformate		1,000	1,000
67–66–3	Chloroform	f	10	10,000
542–88–1	Chloromethyl Ether	d	10	100
107–30–2	Chloromethyl Methyl Ether	b	10	100
3691–35–8	Chlorophacinone		100	100/10,000
1982–47–4	Chloroxuron		500	500/10,000
21923–23–9	Chlorthiophos	d	500	500
10025–73–7	Chromic Chloride		1	1/10,000
62207–76–5	Cobalt, ((2,2′-(1,2-Ethanediylbis (Nitrilomethylidyne)) Bis(6-Fluorophenolato))(2-)-N,N′,O,O′)-.		100	100/10,000
10210–68–1	Cobalt Carbonyl	d	10	10/10,000
64–86–8	Colchicine	d	10	10/10,000
56–72–4	Coumaphos		10	100/10,000
5836–29–3	Coumatetralyl		500	500/10,000
95–48–7	Cresol, o-		100	1,000/10,000
535–89–7	Crimidine		100	100/10,000
4170–30–3	Crotonaldehyde		100	1,000
123–73–9	Crotonaldehyde, (E)-		100	1,000
506–68–3	Cyanogen Bromide		1,000	500/10,000
506–78–5	Cyanogen Iodide		1,000	1,000/10,000
2636–26–2	Cyanophos		1,000	1,000
675–14–9	Cyanuric Fluoride		100	100
66–81–9	Cycloheximide		100	100/10,000
108–91–8	Cyclohexylamine	f	10,000	10,000
17702–41–9	Decaborane(14)		500	500/10,000
8065–48–3	Demeton		500	500
919–86–8	Demeton-S-Methyl		500	500
10311–84–9	Dialifor		100	100/10,000
19287–45–7	Diborane		100	100
111–44–4	Dichloroethyl ether		10	10,000
149–74–6	Dichloromethylphenylsilane		1,000	1,000
62–73–7	Dichlorvos		10	1,000
141–66–2	Dicrotophos		100	100
1464–53–5	Diepoxybutane		10	500
814–49–3	Diethyl Chlorophosphate	d	500	500
71–63–6	Digitoxin	b	100	100/10,000
2238–07–5	Diglycidyl Ether		1,000	1,000
20830–75–5	Digoxin	d	10	10/10,000
115–26–4	Dimefox		500	500
60–51–5	Dimethoate		10	500/10,000
2524–03–0	Dimethyl Phosphorochloridothioate		500	500
77–78–1	Dimethyl sulfate		100	500
75–78–5	Dimethyldichlorosilane	d	500	500
57–14–7	Dimethylhydrazine		10	1,000
99–98–9	Dimethyl-p-Phenylenediamine		10	10/10,000
644–64–4	Dimetilan		1	500/10,000
534–52–1	Dinitrocresol		10	10/10,000
88–85–7	Dinoseb		1,000	100/10,000
1420–07–1	Dinoterb		500	500/10,000
78–34–2	Dioxathion		500	500
82–66–6	Diphacinone		10	10/10,000
152–16–9	Diphosphoramide, Octamethyl-		100	100
298–04–4	Disulfoton		1	500
514–73–8	Dithiazanine Iodide		500	500/10,000
541–53–7	Dithiobiuret		100	100/10,000
316–42–7	Emetine, Dihydrochloride	d	1	1/10,000
115–29–7	Endosulfan		1	10/10,000
2778–04–3	Endothion		500	500/10,000
72–20–8	Endrin		1	500/10,000
106–89–8	Epichlorohydrin	f	100	1,000
2104–64–5	EPN		100	100/10,000

[Alphabetical Order]

CAS No.	Chemical name	Notes	Reportable quantity* (pounds)	Threshold planning quantity (pounds)
50–14–6	Ergocalciferol	b	1,000	1,000/10,000
379–79–3	Ergotamine Tartrate		500	500/10,000
1622–32–8	Ethanesulfonyl Chloride, 2-Chloro-		500	500
10140–87–1	Ethanol, 1,2-Dichloro-, Acetate		1,000	1,000
563–12–2	Ethion		10	1,000
13194–48–4	Ethoprophos		1,000	1,000
538–07–8	Ethylbis(2-Chloroethyl)Amine	d	500	500
371–62–0	Ethylene Fluorohydrin	b, d	10	10
75–21–8	Ethylene Oxide	f	10	1,000
107–15–3	Ethylenediamine		5,000	10,000
151–56–4	Ethyleneimine		1	500
542–90–5	Ethylthiocyanate		10,000	10,000
22224–92–6	Fenamiphos		10	10/10,000
115–90–2	Fensulfothion	d	500	500
4301–50–2	Fluenetil		100	100/10,000
7782–41–4	Fluorine	e	10	500
640–19–7	Fluoroacetamide		100	100/10,000
144–49–0	Fluoroacetic Acid		10	10/10,000
359–06–8	Fluoroacetyl Chloride	b	10	10
51–21–8	Fluorouracil		500	500/10,000
944–22–9	Fonofos		500	500
50–00–0	Formaldehyde	f	100	500
107–16–4	Formaldehyde Cyanohydrin	d	1,000	1,000
23422–53–9	Formetanate Hydrochloride	d	100	500/10,000
2540–82–1	Formothion		100	100
17702–57–7	Formparanate		100	100/10,000
21548–32–3	Fosthietan		500	500
3878–19–1	Fuberidazole		100	100/10,000
110–00–9	Furan		100	500
13450–90–3	Gallium Trichloride		500	500/10,000
77–47–4	Hexachlorocyclopentadiene	d	10	100
4835–11–4	Hexamethylenediamine, N,N′-Dibutyl-		500	500
302–01–2	Hydrazine		1	1,000
74–90–8	Hydrocyanic Acid		10	100
7647–01–0	Hydrogen Chloride (gas only)	f	5,000	500
7664–39–3	Hydrogen Fluoride		100	100
7722–84–1	Hydrogen Peroxide (Conc > 52%)	f	1,000	1,000
7783–07–5	Hydrogen Selenide		10	10
7783–06–4	Hydrogen Sulfide	f	100	500
123–31–9	Hydroquinone	f	100	500/10,000
13463–40–6	Iron, Pentacarbonyl-		100	100
297–78–9	Isobenzan		100	100/10,000
78–82–0	Isobutyronitrile	d	1,000	1,000
102–36–3	Isocyanic Acid, 3,4-Dichlorophenyl Ester		500	500/10,000
465–73–6	Isodrin		1	100/10,000
55–91–4	Isofluorphate	b	100	100
4098–71–9	Isophorone Diisocyanate	g	500	500
108–23–6	Isopropyl Chloroformate		1,000	1,000
119–38–0	Isopropylmethyl-pyrazolyl Dimethylcarbamate		100	500
78–97–7	Lactonitrile		1,000	1,000
21609–90–5	Leptophos		500	500/10,000
541–25–3	Lewisite	b, d	10	10
58–89–9	Lindane		1	1,000/10,000
7580–67–8	Lithium Hydride	a	100	100
109–77–3	Malononitrile		1,000	500/10,000
12108–13–3	Manganese, Tricarbonyl Methylcyclopentadienyl	d	100	100
51–75–2	Mechlorethamine	b	10	10
950–10–7	Mephosfolan		500	500
1600–27–7	Mercuric Acetate		500	500/10,000
7487–94–7	Mercuric Chloride		500	500/10,000
21908–53–2	Mercuric Oxide		500	500/10,000
10476–95–6	Methacrolein Diacetate		1,000	1,000
760–93–0	Methacrylic Anhydride		500	500
126–98–7	Methacrylonitrile	d	1,000	500
920–46–7	Methacryloyl Chloride		100	100
30674–80–7	Methacryloyloxyethyl Isocyanate	d	100	100
10265–92–6	Methamidophos		100	100/10,000
558–25–8	Methanesulfonyl Fluoride		1,000	1,000
950–37–8	Methidathion		500	500/10,000
2032–65–7	Methiocarb		10	500/10,000
16752–77–5	Methomyl	d	100	500/10,000

[Alphabetical Order]

CAS No.	Chemical name	Notes	Reportable quantity* (pounds)	Threshold planning quantity (pounds)
151–38–2	Methoxyethylmercuric Acetate		500	500/10,000
80–63–7	Methyl 2-Chloroacrylate		500	500
74–83–9	Methyl Bromide	f	1,000	1,000
79–22–1	Methyl Chloroformate	d	1,000	500
60–34–4	Methyl Hydrazine		10	500
624–83–9	Methyl Isocyanate		10	500
556–61–6	Methyl Isothiocyanate	a	500	500
74–93–1	Methyl Mercaptan	f	100	500
3735–23–7	Methyl Phenkapton		500	500
676–97–1	Methyl Phosphonic Dichloride	a	100	100
556–64–9	Methyl Thiocyanate		10,000	10,000
78–94–4	Methyl Vinyl Ketone		10	10
502–39–6	Methylmercuric Dicyanamide		500	500/10,000
75–79–6	Methyltrichlorosilane	d	500	500
1129–41–5	Metolcarb		1,000	100/10,000
7786–34–7	Mevinphos		10	500
315–18–4	Mexacarbate	d	1,000	500/10,000
50–07–7	Mitomycin C		10	500/10,000
6923–22–4	Monocrotophos		10	10/10,000
2763–96–4	Muscimol		1,000	500/10,000
505–60–2	Mustard Gas	d	500	500
13463–39–3	Nickel Carbonyl		10	1
54–11–5	Nicotine	b	100	100
65–30–5	Nicotine Sulfate		100	100/10,000
7697–37–2	Nitric Acid		1,000	1,000
10102–43–9	Nitric Oxide	b	10	100
98–95–3	Nitrobenzene	f	1,000	10,000
1122–60–7	Nitrocyclohexane		500	500
10102–44–0	Nitrogen Dioxide		10	100
62–75–9	Nitrosodimethylamine	d	10	1,000
991–42–4	Norbormide		100	100/10,000
	Organorhodium Complex (PMN–82–147)		10	10/10,000
630–60–4	Ouabain	b	100	100/10,000
23135–22–0	Oxamyl		100	100/10,000
78–71–7	Oxetane, 3,3-Bis(Chloromethyl)-		500	500
2497–07–6	Oxydisulfoton	d	500	500
10028–15–6	Ozone		100	100
1910–42–5	Paraquat Dichloride		10	10/10,000
2074–50–2	Paraquat Methosulfate		10	10/10,000
56–38–2	Parathion	b	10	100
298–00–0	Parathion-Methyl	b	100	100/10,000
12002–03–8	Paris Green		1	500/10,000
19624–22–7	Pentaborane		500	500
2570–26–5	Pentadecylamine		100	100/10,000
79–21–0	Peracetic Acid		500	500
594–42–3	Perchloromethylmercaptan		100	500
108–95–2	Phenol		1,000	500/10,000
4418–66–0	Phenol, 2,2′-Thiobis(4-Chloro-6-Methyl)-		100	100/10,000
64–00–6	Phenol, 3-(1-Methylethyl)-, Methylcarbamate		10	500/10,000
58–36–6	Phenoxarsine, 10,10′-Oxydi-		500	500/10,000
696–28–6	Phenyl Dichloroarsine	d	1	500
59–88–1	Phenylhydrazine Hydrochloride		1,000	1,000/10,000
62–38–4	Phenylmercury Acetate		100	500/10,000
2097–19–0	Phenylsilatrane	d	100	100/10,000
103–85–5	Phenylthiourea		100	100/10,000
298–02–2	Phorate		10	10
4104–14–7	Phosacetim		100	100/10,000
947–02–4	Phosfolan		100	100/10,000
75–44–5	Phosgene	f	10	10
13171–21–6	Phosphamidon		100	100
7803–51–2	Phosphine		100	500
2703–13–1	Phosphonothioic Acid, Methyl-, O-Ethyl O-(4-(Methylthio) Phenyl) Ester.		500	500
50782–69–9	Phosphonothioic Acid, Methyl-, S-(2-(Bis(1Methylethyl)Amino)Ethyl) O-Ethyl Ester.		100	100
2665–30–7	Phosphonothioic Acid, Methyl-, O-(4-Nitrophenyl) O-Phenyl Ester.		500	500
3254–63–5	Phosphoric Acid, Dimethyl 4-(Methylthio)Phenyl Ester.		500	500
2587–90–8	Phosphorothioic Acid, O,O-Dimethyl-S-(2-Methylthio) Ethyl Ester.	b, c	500	500

[Alphabetical Order]

CAS No.	Chemical name	Notes	Reportable quantity* (pounds)	Threshold planning quantity (pounds)
7723–14–0	Phosphorus	a, d	1	100
10025–87–3	Phosphorus Oxychloride		1,000	500
10026–13–8	Phosphorus Pentachloride	a	500	500
7719–12–2	Phosphorus Trichloride		1,000	1,000
57–47–6	Physostigmine		100	100/10,000
57–64–7	Physostigmine, Salicylate (1:1)		100	100/10,000
124–87–8	Picrotoxin		500	500/10,000
110–89–4	Piperidine		1,000	1,000
23505–41–1	Pirimifos-Ethyl		1,000	1,000
10124–50–2	Potassium Arsenite		1	500/10,000
151–50–8	Potassium Cyanide	a	10	100
506–61–6	Potassium Silver Cyanide	a	1	500
2631–37–0	Promecarb	d	1,000	500/10,000
106–96–7	Propargyl Bromide		10	10
57–57–8	Propiolactone, Beta-		10	500
107–12–0	Propionitrile		10	500
542–76–7	Propionitrile, 3-Chloro-		1,000	1,000
70–69–9	Propiophenone, 4-Amino-	c	100	100/10,000
109–61–5	Propyl Chloroformate		500	500
75–56–9	Propylene Oxide	f	100	10,000
75–55–8	Propyleneimine		1	10,000
2275–18–5	Prothoate		100	100/10,000
129–00–0	Pyrene	b	5,000	1,000/10,000
140–76–1	Pyridine, 2-Methyl-5-Vinyl-		500	500
504–24–5	Pyridine, 4-Amino-	d	1,000	500/10,000
1124–33–0	Pyridine, 4-Nitro-,l-Oxide		500	500/10,000
53558–25–1	Pyriminil	d	100	100/10,000
14167–18–1	Salcomine		500	500/10,000
107–44–8	Sarin	d	10	10
7783–00–8	Selenious Acid		10	1,000/10,000
7791–23–3	Selenium Oxychloride		500	500
563–41–7	Semicarbazide Hydrochloride		1,000	1,000/10,000
3037–72–7	Silane, (4-Aminobutyl)Diethoxymethyl-		1,000	1,000
7631–89–2	Sodium Arsenate		1	1,000/10,000
7784–46–5	Sodium Arsenite		1	500/10,000
26628–22–8	Sodium Azide ($Na(N_3)$)	a	1,000	500
124–65–2	Sodium Cacodylate		100	100/10,000
143–33–9	Sodium Cyanide (Na(CN))	a	10	100
62–74–8	Sodium Fluoroacetate		10	10/10,000
13410–01–0	Sodium Selenate		100	100/10,000
10102–18–8	Sodium Selenite	d	100	100/10,000
10102–20–2	Sodium Tellurite		500	500/10,000
900–95–8	Stannane, Acetoxytriphenyl-	c	500	500/10,000
57–24–9	Strychnine	b	10	100/10,000
60–41–3	Strychnine Sulfate		10	100/10,000
3689–24–5	Sulfotep		100	500
3569–57–1	Sulfoxide, 3-Chloropropyl Octyl		500	500
7446–09–5	Sulfur Dioxide	f	500	500
7783–60–0	Sulfur Tetrafluoride		100	100
7446–11–9	Sulfur Trioxide	a	100	100
7664–93–9	Sulfuric Acid		1,000	1,000
77–81–6	Tabun	b, d	10	10
7783–80–4	Tellurium Hexafluoride	e	100	100
107–49–3	TEPP		10	100
13071–79–9	Terbufos	d	100	100
78–00–2	Tetraethyllead	b	10	100
597–64–8	Tetraethyltin	b	100	100
75–74–1	Tetramethyllead	b, f	100	100
509–14–8	Tetranitromethane		10	500
10031–59–1	Thallium Sulfate	d	100	100/10,000
6533–73–9	Thallous Carbonate	b, d	100	100/10,000
7791–12–0	Thallous Chloride	b, d	100	100/10,000
2757–18–8	Thallous Malonate	b, d	100	100/10,000
7446–18–6	Thallous Sulfate		100	100/10,000
2231–57–4	Thiocarbazide		1,000	1,000/10,000
39196–18–4	Thiofanox		100	100/10,000
297–97–2	Thionazin		100	500
108–98–5	Thiophenol		100	500
79–19–6	Thiosemicarbazide		100	100/10,000
5344–82–1	Thiourea, (2-Chlorophenyl)-		100	100/10,000
614–78–8	Thiourea, (2-Methylphenyl)-		500	500/10,000

[Alphabetical Order]

CAS No.	Chemical name	Notes	Reportable quantity* (pounds)	Threshold planning quantity (pounds)
7550–45–0	Titanium Tetrachloride		1,000	100
584–84–9	Toluene 2,4-Diisocyanate		100	500
91–08–7	Toluene 2,6-Diisocyanate		100	100
110–57–6	Trans-1,4-Dichlorobutene		500	500
1031–47–6	Triamiphos		500	500/10,000
24017–47–8	Triazofos		500	500
76–02–8	Trichloroacetyl Chloride		500	500
115–21–9	Trichloroethylsilane	d	500	500
327–98–0	Trichloronate	e	500	500
98–13–5	Trichlorophenylsilane	d	500	500
1558–25–4	Trichloro(Chloromethyl)Silane		100	100
27137–85–5	Trichloro(Dichlorophenyl) Silane		500	500
998–30–1	Triethoxysilane		500	500
75–77–4	Trimethylchlorosilane		1,000	1,000
824–11–3	Trimethylolpropane Phosphite	d	100	100/10,000
1066–45–1	Trimethyltin Chloride		500	500/10,000
639–58–7	Triphenyltin Chloride		500	500/10,000
555–77–1	Tris(2-Chloroethyl)Amine	d	100	100
2001–95–8	Valinomycin	b	1,000	1,000/10,000
1314–62–1	Vanadium Pentoxide		1,000	100/10,000
108–05–4	Vinyl Acetate Monomer	f	5,000	1,000
81–81–2	Warfarin		100	500/10,000
129–06–6	Warfarin Sodium	d	100	100/10,000
28347–13–9	Xylylene Dichloride		100	100/10,000
58270–08–9	Zinc, Dichloro(4,4-Dimethyl-5((((Methylamino)Carbonyl) Oxy)Imino)Pentanenitrile)-, (T-4)-.		100	100/10,000
1314–84–7	Zinc Phosphide	a	100	500

*Only the statutory or final RQ is shown. For more information, see 40 CFR 355.61.

Notes:

a. This material is a reactive solid. The TPQ does not default to 10,000 pounds for non-powder, non-molten, non-solution form.

b. The calculated TPQ changed after technical review as described in a technical support document for the final rule, April 22, 1987.

c. Chemicals added by final rule, April 22, 1987.

d. Revised TPQ based on new or re-evaluated toxicity data, April 22, 1987.

e. The TPQ was revised due to calculation error, April 22, 1987.

f. Chemicals on the original list that do not meet toxicity criteria but because of their acute lethality, high production volume and known risk are considered chemicals of concern (“Other chemicals”), November 17, 1986 and February 15, 1990.

g. The TPQ was recalculated (September 8, 2003) since it was mistakenly calculated in the April 22, 1987 final rule under the wrong assumption that this chemical is a reactive solid, when in fact it is a liquid. RQ for this chemical was adjusted on September 11, 2006.

Appendix B to Part 355—The List of Extremely Hazardous Substances and Their Threshold Planning Quantities

[CAS Number Order]

CAS No.	Chemical name	Notes	Reportable quantity* (pounds)	Threshold planning quantity (pounds)
0	Organorhodium Complex (PMN–82–147)		10	10/10,000
50–00–0	Formaldehyde	f	100	500
50–07–7	Mitomycin C		10	500/10,000
50–14–6	Ergocalciferol	b	1,000	1,000/10,000
51–21–8	Fluorouracil		500	500/10,000
51–75–2	Mechlorethamine	b	10	10
51–83–2	Carbachol Chloride		500	500/10,000
54–11–5	Nicotine	b	100	100
54–62–6	Aminopterin		500	500/10,000
55–91–4	Isofluorphate	b	100	100
56–25–7	Cantharidin		100	100/10,000
56–38–2	Parathion	b	10	100
56–72–4	Coumaphos		10	100/10,000
57–14–7	Dimethylhydrazine		10	1,000
57–24–9	Strychnine	b	10	100/10,000
57–47–6	Physostigmine		100	100/10,000
57–57–8	Propiolactone, Beta-		10	500
57–64–7	Physostigmine, Salicylate (1:1)		100	100/10,000
57–74–9	Chlordane		1	1,000
58–36–6	Phenoxarsine, 10,10′-Oxydi-		500	500/10,000
58–89–9	Lindane		1	1,000/10,000

HARRISON POWER STATION ICP

Section III – Annexes

Annex 14 – Determination of EPA Worst Case Discharge Volume

Part A: Worst Case Discharge Planning Volume Calculation for On-Shore Storage Facilities[1]

Part A of this worksheet is to be completed by the owner or operator of an SPCC-regulated facility (excluding oil production facilities) if the facility meets the criteria as presented in Appendix C to this part, or if it is determined by the RA that the facility could cause substantial harm to the environment. If you are the owner or operator of a production facility, please proceed to Part B of this worksheet.

A.1 *Single-Tank Facilities*

For facilities containing only one aboveground oil storage tank, the worst-case discharge planning volume equals the capacity of the oil storage tank. If adequate secondary containment (sufficiently large to contain the capacity of the aboveground oil storage tank plus sufficient freeboard to allow for precipitation) exists for the oil storage tank, multiply the capacity of the tank by 0.8.

(1) FINAL WORST CASE VOLUME: __N/A__ GAL

(2) Do not proceed further.

A.2 *Secondary Containment - Multiple Tank Facilities*

Are all aboveground oil storage tanks or groups of aboveground oil storage tanks at the facility without adequate secondary containment?[2]

_N_ (Y/N)

A.2.1 If the answer is yes, the final worst case discharge planning volume equals the total aboveground oil storage capacity at the facility.

(1) FINAL WORST CASE VOLUME: __N/A__ GAL
(2) Do not proceed further.

A.2.2 If the answer is no, calculate the total aboveground oil storage capacity of tanks without adequate secondary containment. If all aboveground oil storage tanks or groups of aboveground oil storage tanks at the facility have adequate secondary containment, ENTER "0" (zero).

[1]Storage facilities" represent all facilities subject to this part, excluding oil production facilities.

[2]Secondary containment is defined in 40 CFR□112.7 subparts A through C. Acceptable methods and structures for containment are also given in 40 CFR 112.7(c)(1).

Section III – Annexes

Annex 14 – Determination of EPA Worst Case Discharge Volume

__0__ GAL

A.2.3 Calculate the capacity of the largest single aboveground oil storage tank within an adequate secondary containment area or the combined capacity of a group of aboveground oil storage tanks permanently manifolded together, whichever is greater, PLUS THE VOLUME FROM QUESTION A.2.2

- FINAL WORST CASE VOLUME:[3] __12,000__ Gal.

Part B: Worst Case Discharge Planning Volume Calculation for On-Shore Production Facilities

Part B of this worksheet is to be completed by the owner or operator of an SPCC-regulated oil production facility if the facility meets the criteria presented in Appendix C to this part, or if it is determined by the RA that the facility could cause substantial harm. A production facility consists of all wells (producing and exploratory) and related equipment in a single geographical oil or gas field operated by a single operator.

__N/A__

[3] All "complexes" that are jointly regulated by EPA and the USCG must also calculate the worst case discharge planning volume for the transportation-related portions of the facility and plan for whichever volume is greater.

Section III – Annexes

Annex 15 – List of Common Environmental Acronyms

ACBAPC	- Allegheny County Bureau of Air Pollution Control
ACP	- Area Contingency Plan
AE	- Allegheny Energy, Inc
AESC	- Allegheny Energy Supply Company, LLC
AP	- Allegheny Power
ANPR	- Advanced Notice of Proposed Rulemaking
APS	- Allegheny Power System, Inc.
AST	- Aboveground Storage Tank
BACT	- Best Available Control Technology
BART	- Best Available Retrofit Technology
BAT	- Best Available Treatment Technology
BBLS	- Barrels
BCT	- Best Conventional Pollutant Control Technology
BOD	- Biochemical Oxygen Demand
BPJ	- Best Professional Judgment
CAA	- Clean Air Act
CASAC	- Clean Air Scientific Advisory Committee
CAWG	- Clean Air Working Group
CEM	- Continuous Emission Monitor
CEQ	- Council of Environmental Quality
CERCLA	- Comprehensive Environmental Response, Compensation & Liability Act
CHRIS	- Chemical Hazards Response Information System
COTP	- Captain of the Port
CWA	- Clean Water Act
DOT	- Department of Transportation
EHS	- Extremely Hazardous Substance
EPA	- Environmental Protection Agency
EPCRA	- Emergency Planning & Community Right-to-Know Act
EPR	- Environmental Permitting and Reporting department of Allegheny Energy
EQB	- Environmental Quality Board
FE	- First Energy
FEMA	- Federal Emergency Management Agency
FIFRA	- Federal Insecticide, Fungicide, and Rodenticide Act
FWPCA	- Federal Water Pollution Control Act
GAL	- Gallons
GEP	- Good Engineering Practice
GBU	- Generation Business Unit (of Allegheny Power)
GFECT	- Generation Facility Engineering & Construction Teams
HAZMAT	- Hazardous Materials
HCS	- Hazard Communication Standard
HMR	- Hazardous Materials Regulations
HMTA	- Hazardous Materials Transportation Act
LAER	- Lowest Achievable Emission Rate

Section III – Annexes

Annex 15 – List of Common Environmental Acronyms

LEPC	- Local Emergency Planning Committee
MDAMA	- Maryland Air Management Administration
MDE	- Maryland Department of the Environment
MDHMH	- Maryland Department of Health and Mental Hygiene
MDLI	- Maryland Division of Labor and Industry
MP	- Monongahela Power Company
MSDA	- Material Safety Data Sheet
MTR	- Marine Transportation-Related
NAAQS	- National Ambient Air Quality Standards
NAS	- National Academy of Science
NCP	- National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP	- National Emission Standards for Hazardous Air Pollutants
NPDES	- National Pollutant Discharge Elimination System
NPDWR	- National Primary Drinking Water Regulations
NPS	- National Park Service
NRC	- National Response Center
NRDC	- National Resource Defense Council
NRT	- National Response Team
NSF	- National Science Foundation
NSPS	- New Source Performance Standards
NSR	- New Source Review
NVIC	- Navigation and Vessel Inspection Circular
NWF	- National Wildlife Federation
O&G	- Oil and Grease
OPA	- Oil Pollution Act of 1990
OPP	- Office of Pesticide Programs
OSC	- On-Scene Coordinator
OSHA	- Occupational Safety and Health Administration
OSW	- Office of Solid Waste (EPA)
PADEP	- Pennsylvania Department of Environmental Protection
PCB	- Polychlorinated Biphenyl
PCDD	- Polychlorinated Dibenzo Dioxin
PCDF	- Polychlorinated Dibenzo Furan
PE	- The Potomac Edison Company
PEC	- Pennsylvania Environmental Council
PEERC	- Pennsylvania Electric Energy Research Council
PEMA	- Pennsylvania Emergency Management Association
PM	- Particulate Matter
PPC	- Preparedness, Prevention, and Contingency Plan
PSD	- Prevention of Significant Deterioration
QNCR	- Quarterly Noncompliance Reporting Requirements
RA	- Regional Administrator
RACT	- Reasonably Available Control Technology

Section III – Annexes

Annex 15 – List of Common Environmental Acronyms

RCRA	- Resource Conservation and Recovery Act
RRT	- Regional Response Team
RSPA	- Research & Special Programs Administration
SARA	- Superfund Amendments and Reauthorization Act
SCOTE	- Special Committee on the Environment (PEA)
SDWA	- Safe Drinking Water Act of 1986
SERC	- State Emergency Response Commission
SI	- Surface Impoundment
SIC	- Standard Industry Codes
SIP	- State Implementation Plan
SPCC	- Spill Prevention, Control and Countermeasures
SQG	- Small Quantity Generator
TCLP	- Toxic Characteristic Leaching Procedure
TRE	- Toxic Reduction Evaluation
TSCA	- Toxic Substance Control Act
TSP	- Total Suspended Particulate
TSS	- Total Suspended Solids
UAPSP	- Utility Acid Precipitation Study Program
UARG	- Utility Air Regulatory Group
USCG	- United States Coast Guard
UST	- Underground Storage Tanks
USWAG	- Utility Solid Waste Activities Group
UWAG	- Utility Water Act Group
VASAPCB	- Virginia State Air Pollution Control Board
WPP	- West Penn Power
WVDEP	- West Virginia Department of Environmental Protection

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Section III – Annexes

Annex 16 – Definitions

Adverse Weather	Weather conditions that make it difficult for response equipment and personnel to clean up or remove spilled oil. These conditions include significant wave height, ice, extreme temperatures, weather-related reduced visibility, and fast currents.
Alteration	Any work on a tank or related equipment involving cutting, burning, welding, or heating operations that change the physical dimensions or configuration of a tank.
Bulk Storage Container	Any container used to store oil for the purposes including, but not limited to, the storage of oil prior to use, while being used or prior to further distribution in commerce. Oil-filled electrical, operating or manufacturing equipment is not a bulk storage container.
Discharge	Includes, but not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping of oil (or any other material).
Navigable Waters	All waters that are currently used, were used in the past or may be susceptible to use in interstate or foreign commerce including all intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes or natural ponds.
NPDES Permit Non-compliance	NPDES Permit limit exceedance or bypass of wastewater from any portion of the treatment facility to waters of the US (Form 34-001)
Oil	Oil of any kind or in any form including, but not limited to: fats, oils, or greases of animal, fish or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and other oils and greases including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse or oil mixed with wastes other than dredged spoil.
Oil-filled Operational Equipment	Equipment that includes an oil storage container (or multiple containers) in which the oil is present solely to support the function of the apparatus or the device. Oil-filled operational equipment is not considered to be a bulk storage container.
Oil Handling Personnel	Includes all employees engaged in the operation and maintenance of oil storage containers or the operation of equipment related to storage containers and emergency response personnel.
Permanently Closed	Any container for which: All liquid and sludge has been removed from the container and connecting line; and All connecting lines and piping have been disconnected from the container and blanked off, all valves (except for ventilation valves) have been closed and locked, and conspicuous signs have been posted on each container stating that it is a permanently closed container and noting the date of closure.
Petroleum Oil	Petroleum in any form including but not limited to crude oil, fuel oil, mineral oil, sludge, oil refuse and refined products.
Repair	Any work necessary to maintain or restore a container to a condition suitable for safe operation other than that necessary for ordinary day-to-day maintenance to maintain the functional integrity of the container and that does not weaken the container

Section III – Annexes

Annex 16 – Definitions

Spill	The unintentional release of a material from the container or device storing, using or transporting the material. This includes: 1. Regulatory and non-regulatorily reportable releases; 2. An NPDES permit noncompliance if the noncompliance is due to an unintentional release of a material. 3. Material still contained within a secondary containment structure if it has been unintentionally released from the tank within the containment; 4. Events inside or outside of a building even if the area drains to wastewater treatment. Exceptions: 1. Uncontrollable, negligible releases (ie: drips) from mechanical equipment contained within a building 2. Negligible releases from filling and dispensing of material from containers or devices storing or using the material that require none or minimal efforts to clean up 3. Releases of CCB's within the designed loading area(s) that are directed to wastewater treatment References: 1. Material: Including but not limited to oil, diesel fuel, gasoline, turbine oil, hydraulic oil, mineral oil, hazardous substances, fly ash, bottom ash, FGD/Gypsum, paint, solvents, treatment chemicals, etc. 2. NPDES Permit Noncompliance – NPDES Permit limit exceedance or bypass of wastewater from any portion of the treatment facility to waters of the US (Form 34-001)
Storage Capacity	The shell capacity of the container
Wetlands	Those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include playa lakes, swamps, marshes, bogs and similar areas such as sloughs, prairie potholes, wet meadows, prairie river overflows, mudflats and natural ponds.

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Annex 17 – Guideline for Managing Spills Involving Polychlorinated Biphenyls (PCB's) and Handling and Disposal of Fluids, Devices and Materials Containing PCB's

Please refer to the FirstEnergy Portal (internal website) under "COMMUNITIES – ENVIORNMENTAL – ENVIRONMETAL PRACTICES"

Environmental Practice 5.2.22 – Polychlorinated Biphenyls (PCB) Management

Section III – Annexes

Annex 18 – Containment Calculations for Diked Storage Areas

1. All of the storage tanks and ancillary equipment located inside the station building have adequate secondary containment, even if direct secondary containment dikes are present, since all floor drains are routed to a wastewater treatment unit.

2. The following is a summary of all outdoor diked storage areas.

Tank Number(s)	Substance Contained	Volume (gallons)	Containment Volume[1] (gallons)
A4HR	Sulfuric Acid	10,000	15,400
A20HR	Kerosene	4,000	4,600
A298HR	Transformer Oil	27,600	84,700[2]
A41HR	Transformer Oil	29,900	89,200[2]
A42HR	Transformer Oil	24,600	89,200[2]
A43HR	Transformer Oil	2,800	84,700[2]
A44HR	Transformer Oil	2,800	89,200[2]
A45HR	Transformer Oil	2,800	89,200[2]
A46HR	Transformer Oil	2,800	84,700[2]
A47HR	Transformer Oil	2,800	89,200[2]
A48HR	Transformer Oil	2,800	89,100[2]
A49HR	Transformer Oil	4,750	10,800
A50HR	Transformer Oil	4,750	9,200
A53HR	No. 2 Fuel Oil	12,000	13,600
A54HR	Transformer Oil	3,660	19,700
A55HR	Transformer Oil	3,660	19,500
A56HR	Transformer Oil	3,660	18,400
A57HR	Transformer Oil	4,185	19,300
A58HR	Transformer Oil	4,185	19,300
A128HR	Transformer Oil	333	1,100
A146HR	Transformer Oil	393	440
A147HR	Transformer Oil	75	210
A148HR	Transformer Oil	286	510
A40HR	Transformer Oil	27,600	33,000
A312HR and A313HR	Transformer Oil	29,542 and 4,410	57,000

1 The containment volume shown is the volume available for oil storage after consideration for sufficient freeboard (ie, precipitation from the 25-year 24-hour rainfall event, 4.65 inches).

2 Each unit has a main transformer (A298HR, A41HR and A42HR), an “A” auxiliary transformer (A43HR, A44HR and A45HR) and a “B” auxiliary transformer (A46HR, A47HR and A48HR). There is valved piping that connects the containment of each “B” to the corresponding “A”, and the “A” containment to the main transformer containment. These valves are typically left open and any accumulated stormwater is pumped from the main transformer containment areas.

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Annex 18 – Containment Calculations for Diked Storage Areas

Attached are drawing excepts and calculation sheets for these containment volumes.

1

Harrison - Containment Calculations for Diked Storage Areas

25-year 24-hr rainfall = 4.65 inches
(0.39 ft)

A4HR - 10,000 gal sulfuric acid

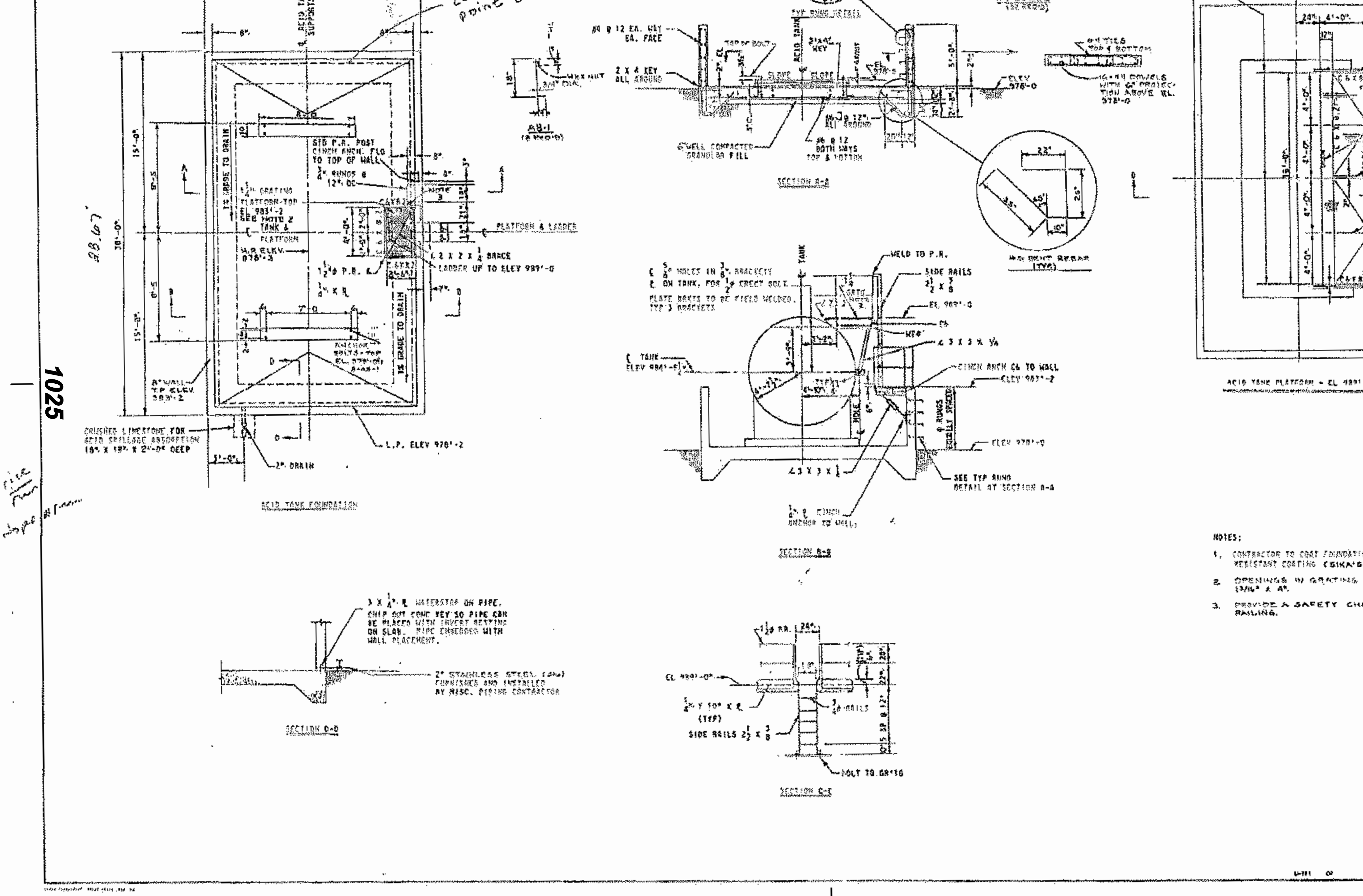
from Dwg 402-911 (note: neglect floor slope)

28.67' * 16.67' * (983.17 - 978.46) * 7.48 = 16,838 gal

rainfall volume: 28.67' * 16.67' * 0.39' * 7.48 = 1,394 gal

15,444 gal

OK



Title: Drawing 402-911

Tank A19HR (125,000 gal Diesel)

(dwg: 1968 - DF - 779)

x-sect area of foundation: $\pi \left(\frac{29}{2}\right)^2 = 660.5$ sf

area @ El. 976.75': (66.67' * 66.67') - 660.5 = 3784.4 sf

area @ El. 977.42': (66.67' * 66.67') = 4444.9 sf

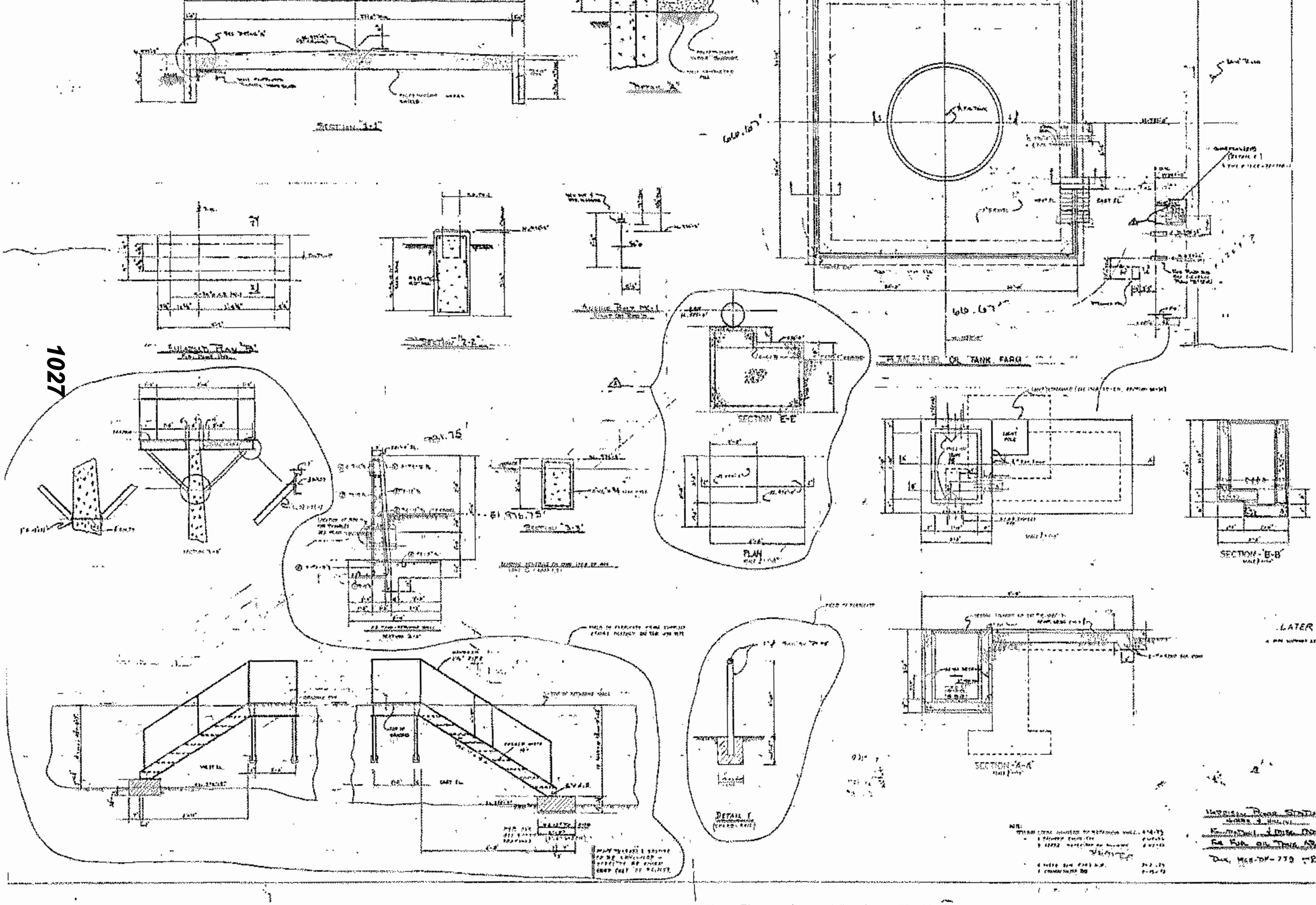
El.	area	avg area	Δh	vol	cuml vol	cuml vol (gal)
976.75'	3784.4				0	0
		4114.7	0.67	2756.8		
977.42'	4444.9				2756.8	20,621
		4444.9	4.33	19246.4		
981.75'	4444.9				22003.2	164,584
						OK

125,000 * 1.1 = 137,500 gal

rainfall volume: 66.67' * 66.67' * 0.39 * 7.48 = 12,967 gal

164,584
-12,967
151,617 gal OK

1027



Title: Drawing 1968-DF-779

A20HR - 4,000 gal Kerosene

- based on field measurements

21' * 9' * 3.67' * 7.48 = 5,188 gal

-

rainfall vol: 21' * 9' * 0.39' * 7.48 = 551 gal

4,637 gal

OK

Notes on Main + Auxillary Transformers:

- In 2006 No. 1 Main Transformer (A40HR) failed + was replaced with the Spare Main Transformer (A298HR)
- A29HR has a COPS tank which overhangs the main containment
- There are valved drain lines near the bottom of the containments not shown on the reference drawings that connect the A + B Aux. transformers to each corresponding main transformer containment area as follows:

Unit #1 main: A298HR (was A40HR)
Aux A: A43HR
Aux B: A46HR

Unit #2 Main: A41HR
Aux A: A44HR
Aux B: A47HR

Unit #3 Main: A42HR
Aux A: A45HR
Aux B: A48HR

- bottom elevation of all transformer containments the same (ie: can consider each main, aux A + B to be one containment)

Main Transformer Containments:

- from Dwgs 502-070 shts 1 & 2, 502-092
- neglect 15" Ø CMP overflow pipe connecting aux. to main transformer

area of foundation: 25.17' × 29.58' = 744.5 sf

area of containment: 49.83' × 29.75' = 1482.4 sf

volume = (1482.4 − 744.5') × 10' × 7.48 = 55,195 gal

− rainfall vol: 49.83' × 29.75' × 0.39' × 7.48 = 4,325 gal

50,870 gal

Unit #1 Transformer:

A29SHR: 27,600 gal

A45HR: 2,850 gal

A46HR: 2,880 gal

Σ = 33,360 gal

Unit #2 & Unit #3 Transformers:

A41HR / A42HR: 24,600 gal

A44HR / A45HR: 2,850 gal

A47HR / A48HR: 2,900 gal

30,360 gal

Unit #1 Transformers:

- COPS Tank Containment (dwgs. 308-554 & 309-791)

pier volume: 2 [2' x 5'6" x (977'11" - 977'5")] = 11 cf => 82 ga

vol @ El. 976'10" = 0 sf

vol @ El. 977'5" + 977'11" = 17' x 43'6" = 739.5 sf

storage volume:

El.	area	avg area	Δh	vol	cumul vol (cf)	cumul vol (gal)
976'10"	0				0	0
		369.8	0.58	214.5		
977'5'	739.5				214.5	1,604 ga
		739.5	0.5	369.8		
977'11"	739.5				584.3	4,370 ga

vol available: 4,370 - 82 = 4,288

note: there is a pipe that will be kept open allowing this containment to drain into the containment of the main transformer.

rainfall vol: 739.5 sf x 0.39' x 7.48 = 2,157 gal

Unit #1 Transformers cont'd:

- A43HR (neglect 12" Ø + 15" Ø CMP Overflow Pipes)
  - area of foundation: 6.69' * 21.25' = 142.16 sf
  - area of containment: 18.75' * 21.25' = 398.44 sf
  - volume: (398.44 - 142.16) * 10' * 7.48 = 19,170 gal
  - rainfall vol: 398.44 * 0.39 * 7.48 = 1,162 gal

- A46HR (neglect 12" Ø CMP overflow pipes)
  - area of foundation (approx): 21.25 * 6.69 = 142 sf
  - area of containment: 18.75 * 21.25 = 398 sf
  - volume: (398 - 142) * 10' * 7.48 = 19,150 gal
  - rainfall vol: 398 * 0.39 * 7.48 = 1162 gal

volume available: 55,195 + 19,170 + 19150 = [illegible] gal

\- rainfall volume: 4,325 + 1162 + 1162 + 2157 = 8,806 gal

vol avail after spill = 84,709 gal

OK

(since > 33,360 gal)

Unit #2 Transformers

- A44HR (neglect connecting overflow pipes)
  - area of foundation: 6.71 * 18.98 = 127 sf
  - area of containment: 18.75 * 21.25 = 398 sf
  - volume: (398 - 127) * 10' * 7.48 = 20,271 gal
  - rainfall volume: 18.75 * 21.25 * 0.39 * 7.48 = 1162 gal

- A47HR (neglect connecting overflow pipes)
  - area of foundation: 6.63 * 19.03 = 126 sf
  - area of containment: 18.76 * 21.25 = 399 sf
  - volume: (399 - 126) * 10 * 7.48 = 20,420 gal
  - rainfall volume: 18.76 * 21.25 * 0.39 * 7.48 = 1162 gal

volume available: 55,195 + 20,271 + 20,420 = 95,886 gal
- rainfall volume: 4325 + 1162 + 1162 = 6,649 gal

89,237 gal

OK

(since > 30,360 gal)

Unit #3 Transformers

· A45HR (neglect connecting overflow pipes)

area of foundation: 6.67 * 18.96 = 126 sf

area of containment: 21.25 * 18.76 = 399 sf

volume (399 - 126) * 10 * 7.48 = 20,420 sf

rainfall volume = 1,162 gal

· A48HR (neglect connecting overflow pipes)

area of foundation (aprx): 6.67 * 18.98 = 127 sf

area of containment: 18.75 * 21.25 = 398 sf

volume: (398 - 127) * 10 * 7.48 = 20,270 gal

rainfall volume = 1162 gal

volume available: 55,195 + 20,420 + 20,270 = 95,885 gal

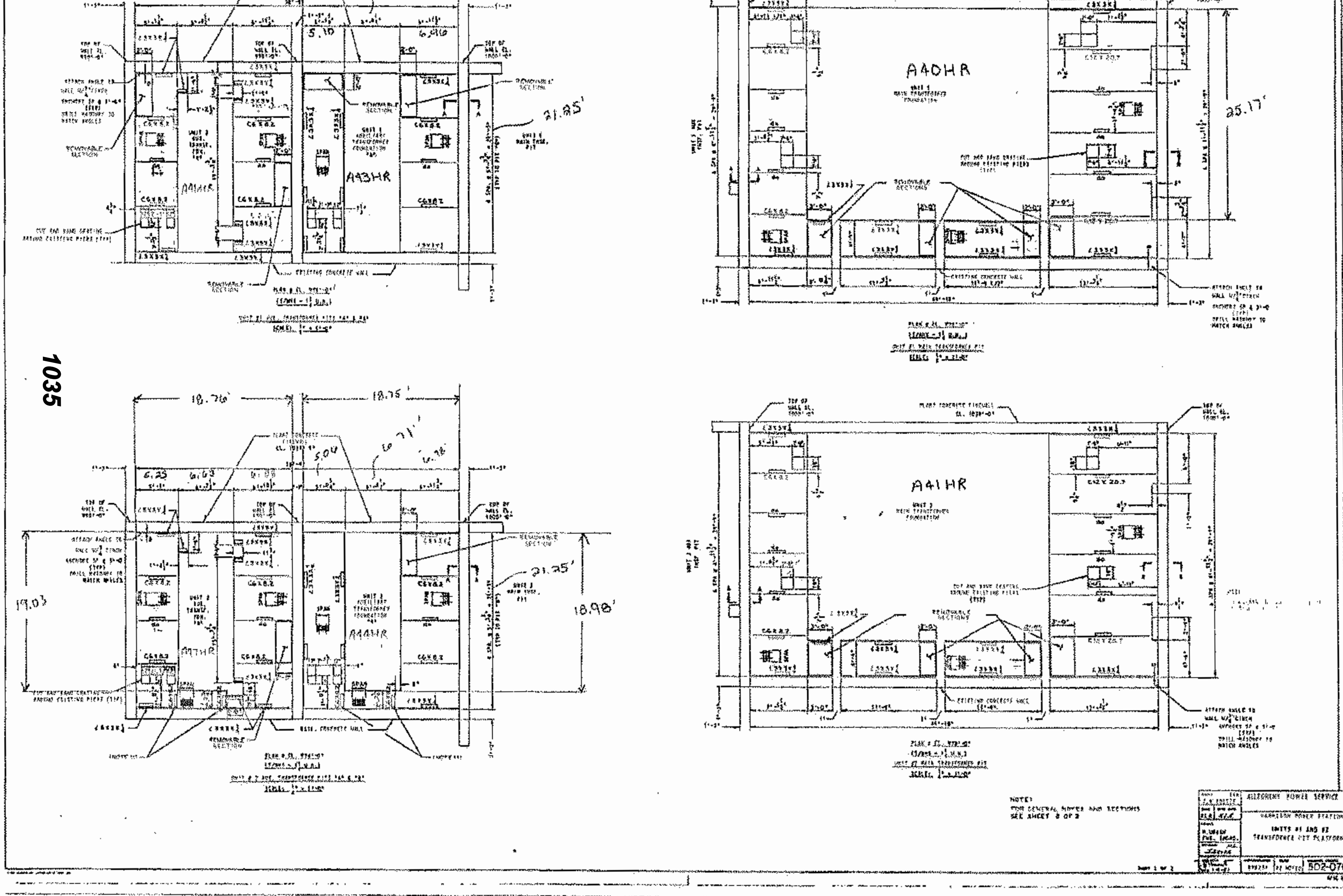
- rainfall volume: 4325 + 1162 + 1162 = 6,649 gal

89,236 gal

<u>OK</u>

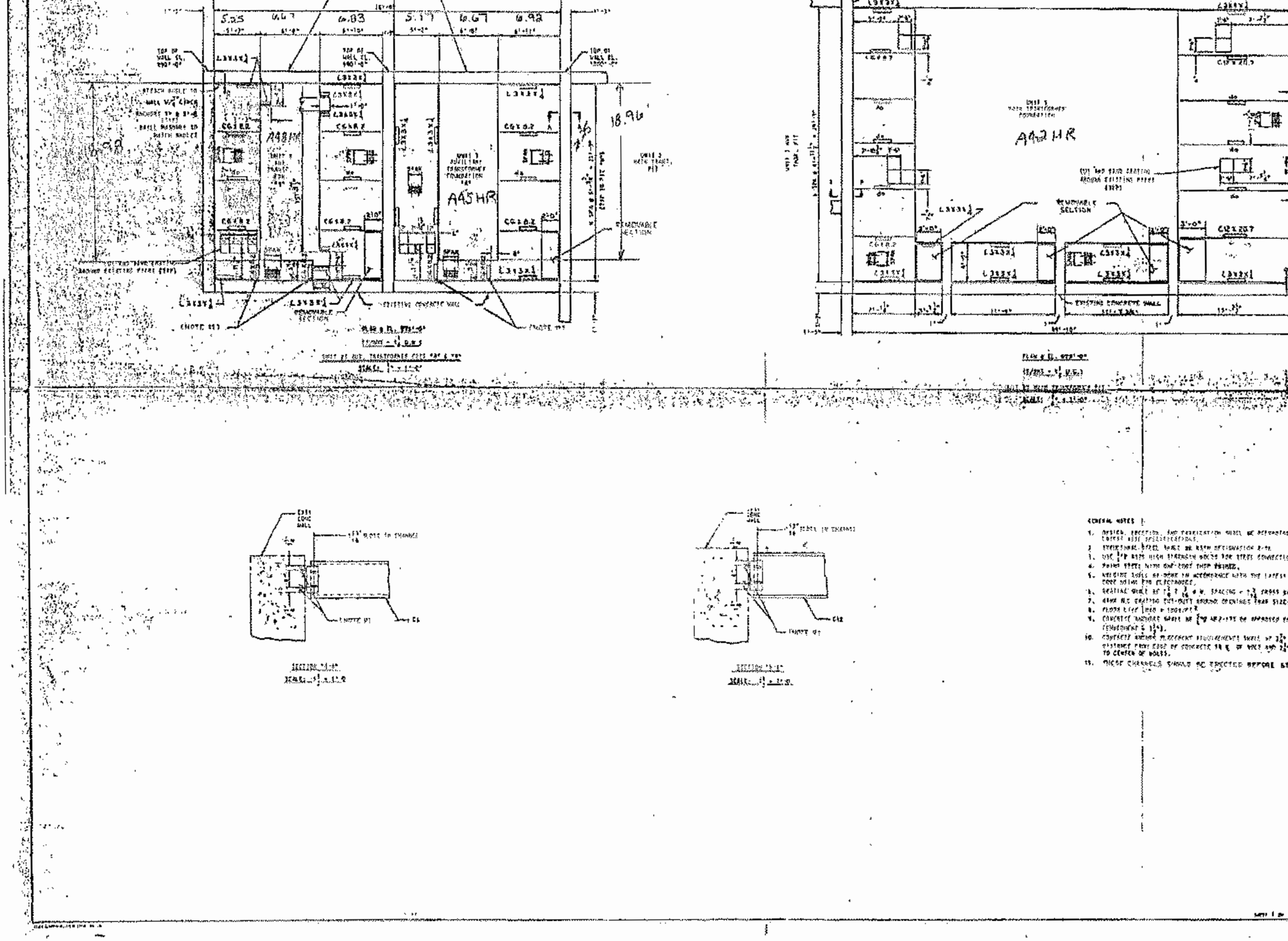
(since > 30,360 gal)

1035



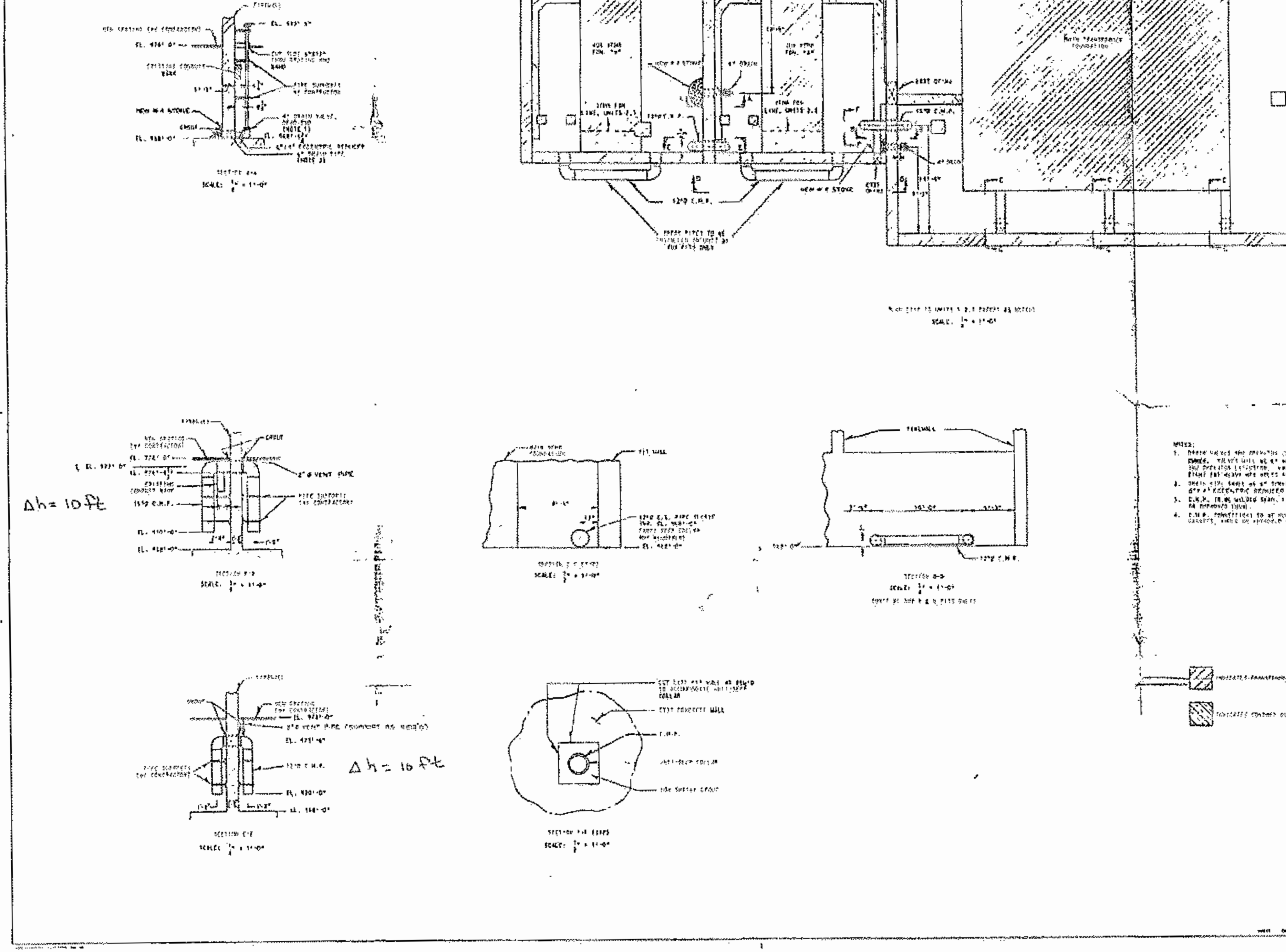
Title: Drawing 502-070

1036

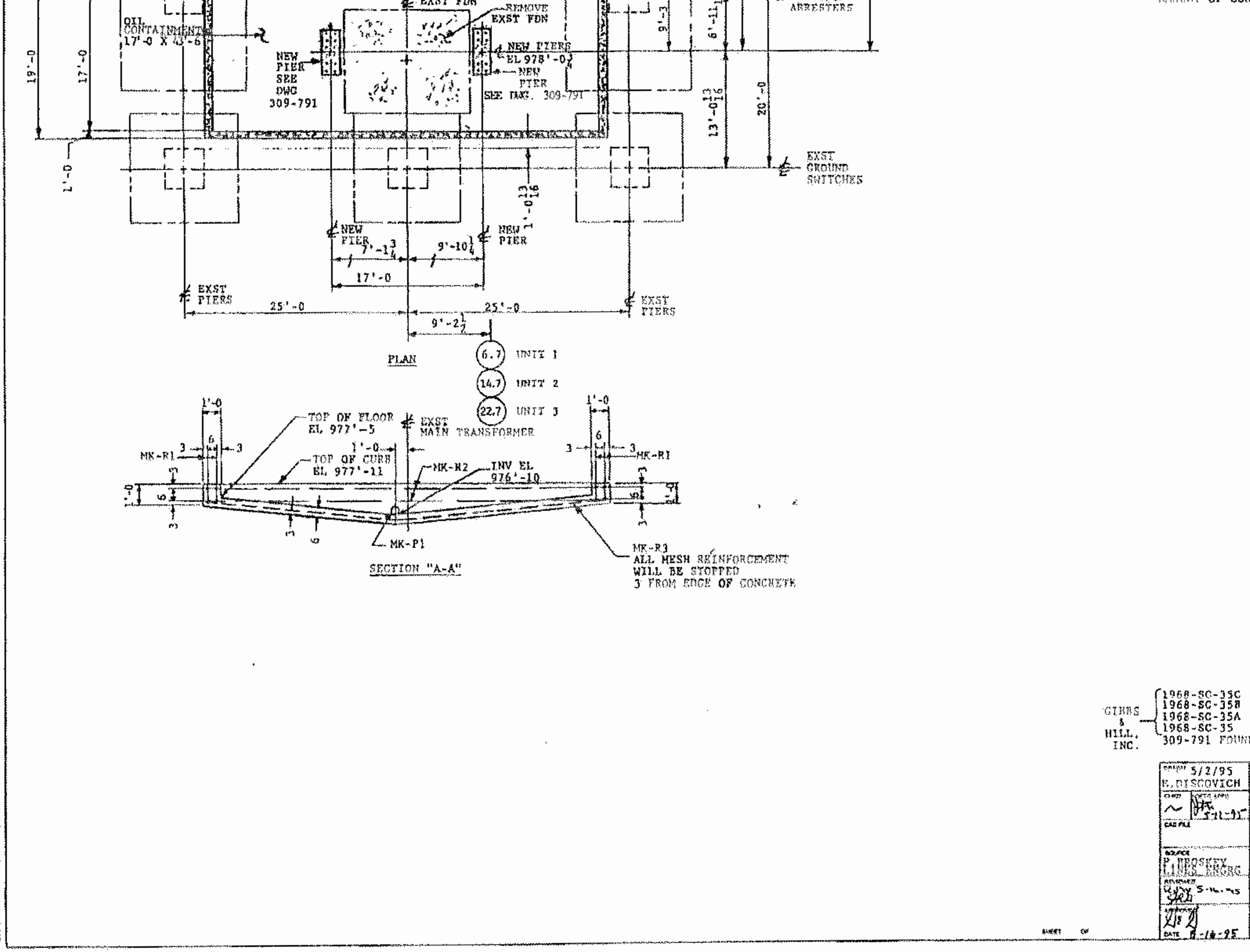


Title: Drawing 502-070

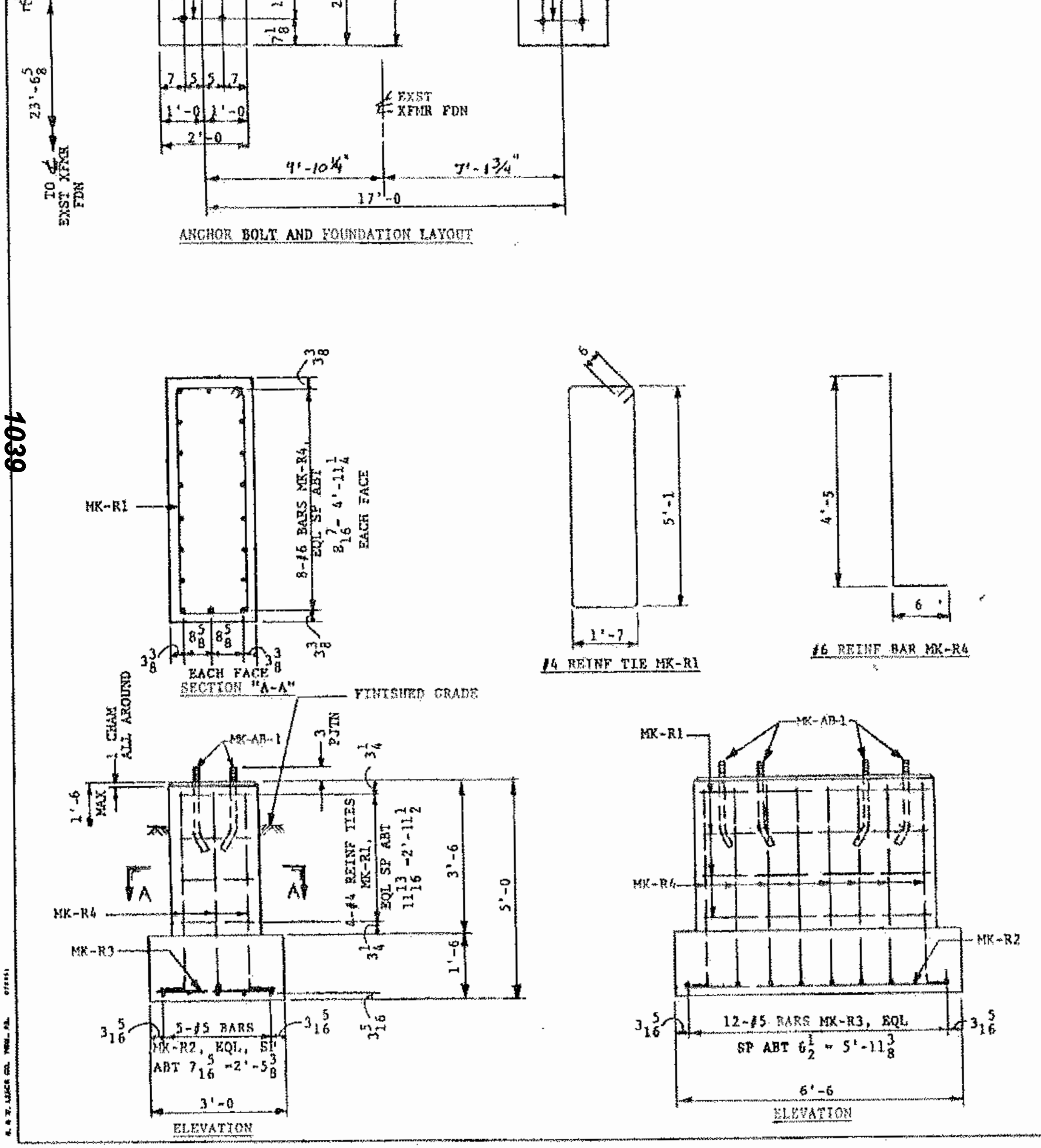
1037



Title: Drawing 502-092



OIL CONTAINMENT 17'-0 X 43'-6
REMOVE EXST FDN
NEW PIER SEE DWG 309-791
NEW PIERS EL 978'-0
NEW PIER SEE DWG. 309-791
ARRESTERS
EXST GROUND SWITCHES
NEW PIER
NEW PIER
7'-1 3/4
9'-10 1/4
17'-0
EXST PIERS
25'-0
25'-0
9'-2 1/2
EXST PIERS
PLAN
6.7 UNIT 1
14.7 UNIT 2
22.7 UNIT 3
TOP OF FLOOR EL 977'-5
EXST MAIN TRANSFORMER
TOP OF CURB EL 977'-11
MK-R1
MK-R2
INV EL 976'-10
MK-P1
MK-R3
ALL MESH REINFORCEMENT WILL BE STOPPED 3 FROM EDGE OF CONCRETE
SECTION "A-A"
GIBBS & HILL, INC.
1968-SC-35C
1968-SC-35B
1968-SC-35A
1968-SC-35
309-791 FOUN
5/2/95
E.DISCOVICH
CAD FILE
SOURCE
REVIEWED
5-16-95
DATE
SHEET OF



1039

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MS 2600
MS 2600

ABB POWER
T & D CO.
INC.

GBM 226
DRAWN 3/2
R.DISCO
CHKD R.L.G.
SOURCE J.GLOV
LINES
4/11/
DATE 4-11-

SHEET OF

Tank A49HR (4,750 gal reserve transformer)
(Dwg. 407 - 411)

area of tank foundation: 12' * 6.67' = 80 sf
area @ El. 0.67': [(17.16 * 25.33) + (4.75 * 25.33)] - 80 = 475 sf
area @ El. 1.08 & above: (25.33 * 24.83) - 80 = 549 sf

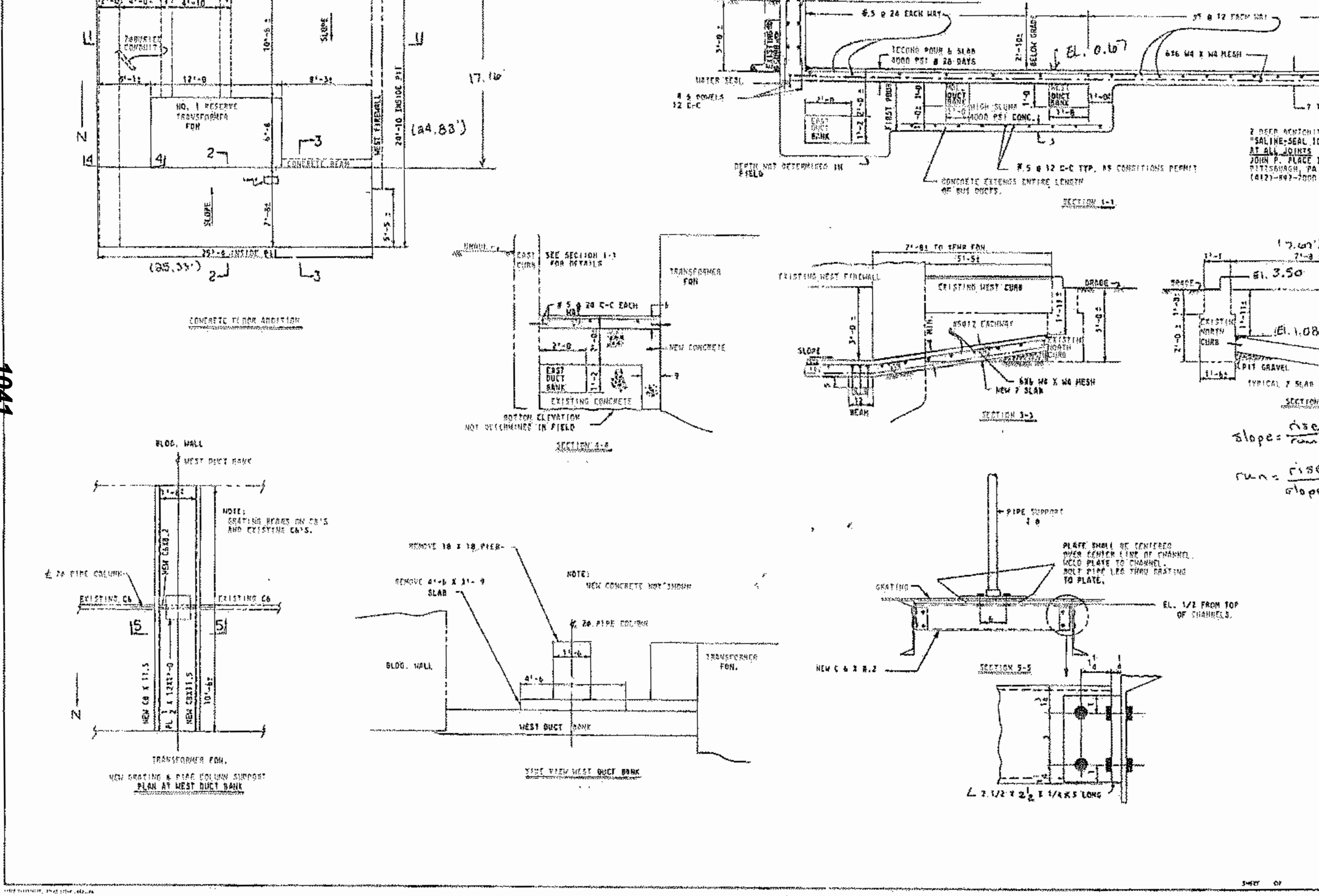
El.	area	avg area	Δh	vol	cum'l vol (cf)	cum'l vol (gal)
0.00	0				0	0
		237.5	0.67	159		
0.67	475				159	1189
		512	0.41	210		
1.08	549				369	2760
		549	2.42	1329		
3.50	549				1698	12,701

− rainfall volume = 25.33' * 24.83' * 0.39 * 7.48 = 1,835

10,866 gal

OK

1041



Title: Drawing 407-411

Tank A5DHR (4,750 gal transformer)
field measurements 8/2002
12'1" * 23'3" * 80" deep
vol = 12.08 * 23.25 * 6.67 * 7.48 = 14,012 gal
rainfal vol: 12.08 * 23.25 * 0.39 * 7.48 = 819 gal
aprx. vol of foundation. 12 * 6.67 * 6.67 * 7.48 = 3993 gal
9,200 gal
OK

Tank 53MR (12,000 gal gasoline) (dwg. 412-884)

area of tank foundation = 4.8284 $(4.67)^2$ = 105.3 sf

area @ EL 970'0" = (20.5' * 20.5') - 105.3 sf = 315 sf

area @ EL 970.5' = (20.5' * 0.5') + 315 sf = 325.25 sf

area @ EL. 972.33' = (20.5' * 2.33') * 20.5' = 468. sf

El.	area	avg. area	Δh	vol	cum'l vol (cf.)	cum'l vol (gal)
970.0'	315				0	0
		320.1	0.5	160.05		
970.5'	325.25				160.05	1,197
		396.6	1.83	725.78		
972.33'	468.				885.83	6626
		484	1.5	726		
973.83'	499				1611	12,050
		749	0.17	127		
974.0'	999				1738	13,000
		1091	0.5	546		
974.5'	1183				2284	17,084

area @ EL. 973.83: (20.5' + 3.83') * 20.5' = 499

area @ EL. 974.0: (10' * 50') + [(20.5' + 3.83') * 20.5'] = 999

area @ EL 974.5: (12.92' * 52.92) + [(20.5 + 3.83') * 20.5'] = 1183

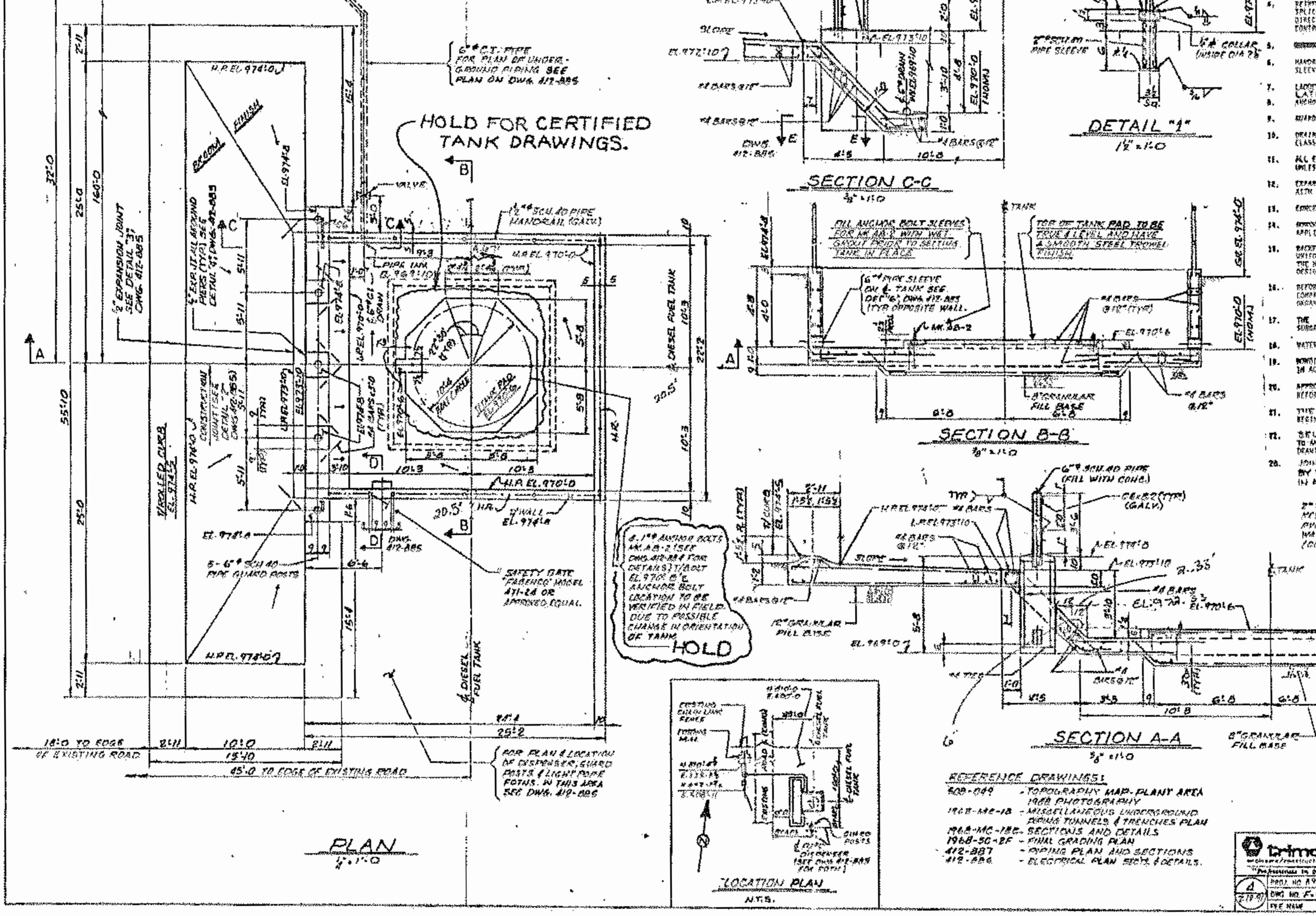
- rainfall volume (at area @ El 974.5) = 1183 sf * 0.39 * 7.48 = 3451 gal

17,084

− 3,451

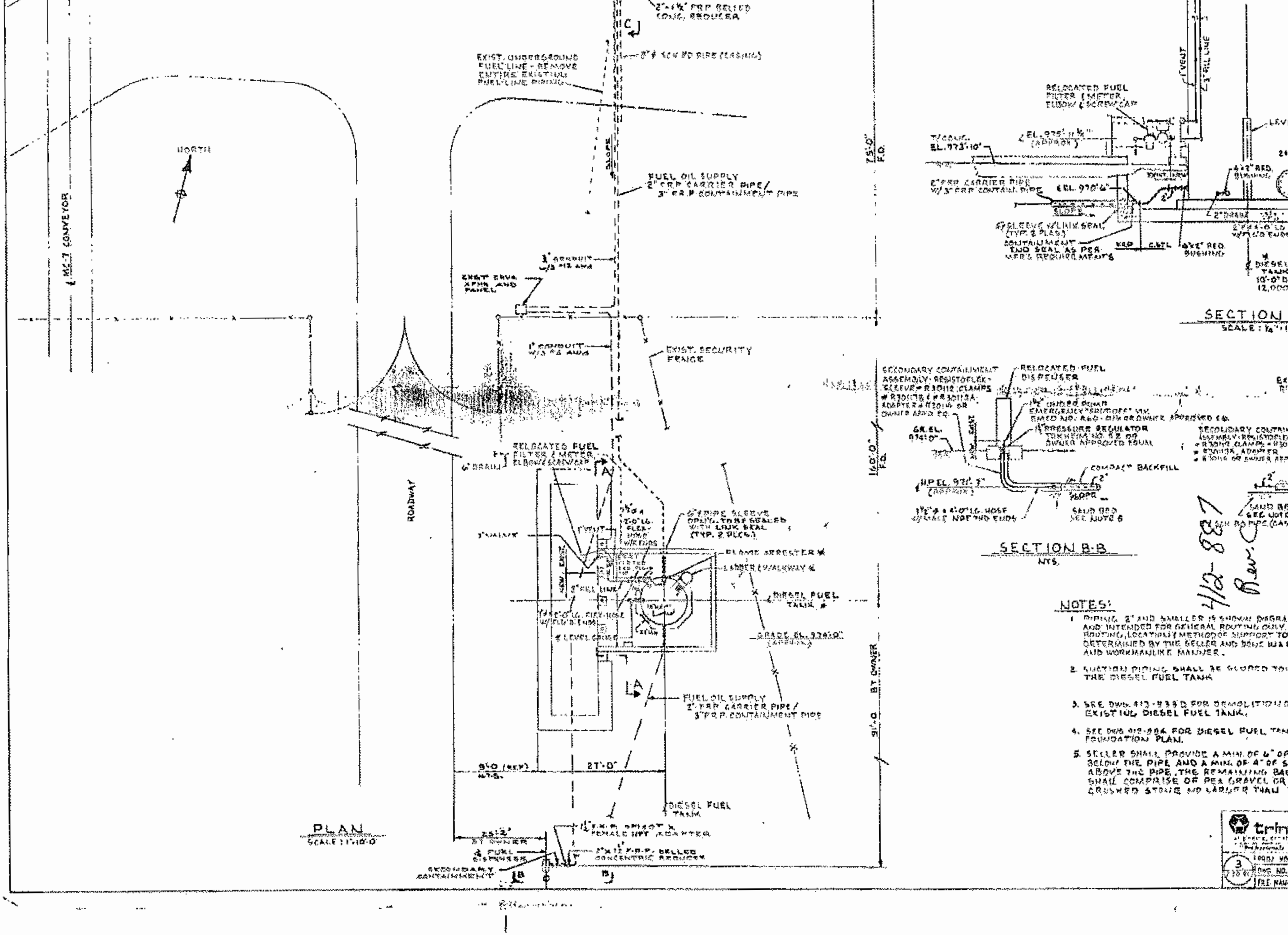
13,633 ok

1044



Title: Drawing 412-884

1045



Title: Drawing 412-887

A54HR - 3,660 gal transformer

- see dwg. 58950219

- area of foundation: 12' * 7' = 84 sf

area of containment: 23.29' * 21' = 489 sf

volume: (489 - 84) * 7' * 7.48 = 21,206 gal

- rainfall vol: 23.29 * 21 * 0.39 * 7.48 = 1,427 gal

19,779 gal

OK

ASSHP - 3,660 gal transformer

· see dwg. 58950219

· area of foundation: 12' * 7' = 84 sf

· area of containment: 23.29' * 20.80' = 484 sf

volume: (484-84) * 7 * 7.48 = 20,944 gal

- rainfall vol: 23.29 * 20.80 * 0.39 * 7.48 = 1,413 gal

19,531 gal

OK

A56HR - 3,660 gal transformer

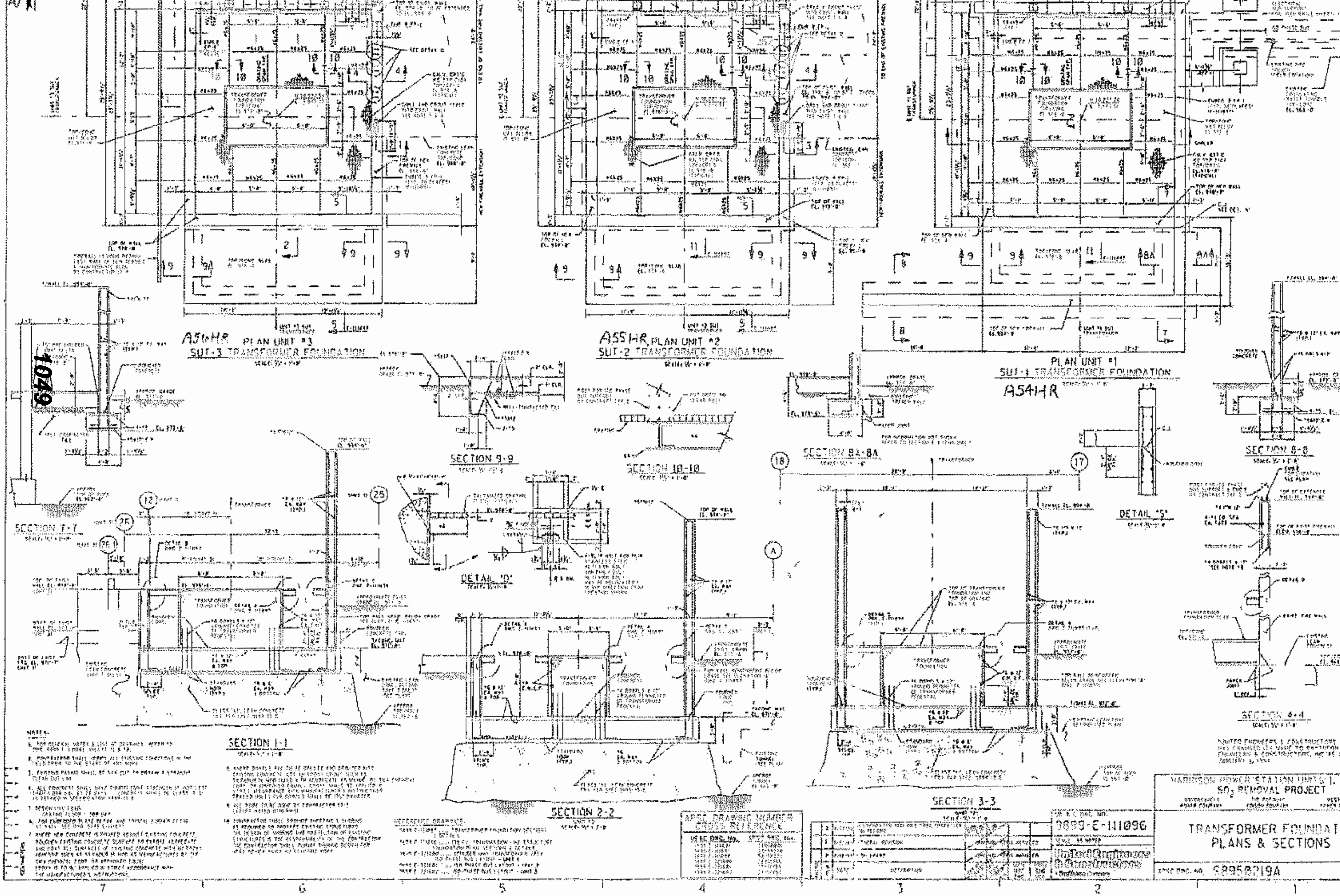
- see dwg 58950219
- area of foundation: 12' * 7' = 84 sf
- area of containment: 23.29 * 19.84 = 462 sf

volume: (462 - 84) * 7 * 7.48 = 19,792 gal

- rainfall vol: 23.29 * 19.84 * 0.39 * 7.48 = 1,348 gal

18,444 gal

OK



Drawing S8950219

A57HR + A58HR - each are 4,185 gal transformers

see dwg 58950046

area of foundation: 13' * 7.28' = 95 sf

area of containment: 23.36 * 21.12 = 493 sf

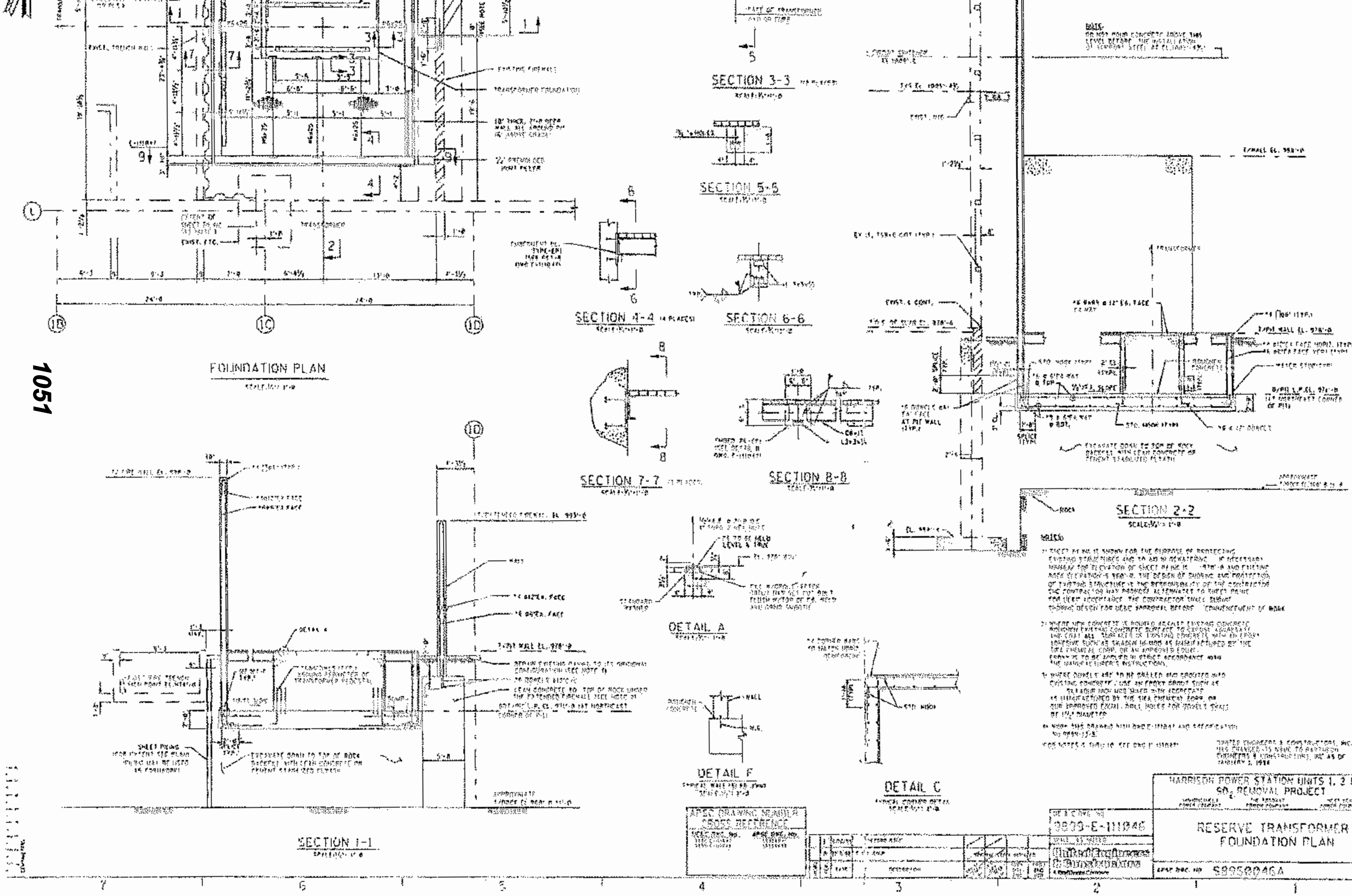
volume: (493 - 95) * 7 * 7.48 = 20,839 sf

- rainfall vol: 23.36 * 21.13 * 0.39 * 7.48 = 1,440 gal

19,399 gal

OK

1051



Drawing S8950046

A123HR - 333 gal transformer

field measurements on 7/18/02 + 8/29/07

14.17' * 21.33' * (11/12') * 7.48 = 2,072 gal

-rainfall vol: 14.17 * 21.33 * 0.39 * 7.48 = 882 gal

1,190 gal

OK

A146HR - 393 gal transformer

see dwg. C8950 3367 (neglect slope of containments area)

- area of containment: (9 * 8) + (12 * 3.5) = 114 sf
- apr. area of foundation: 4 * 4 = 16 sf
- ∴ volume: (114 - 16) * (1"/12) * 7.48 = 782 gal
- rainfall volume: 114 * 0.39 * 7.48 = 333 gal

449 gal

OK

A147HR - 75 gal transformer

see dwg C89503367

(neglect slope of containment)

· area of containment: (9 * 7.5) + (12 * 3) = 103.5 sf

9''

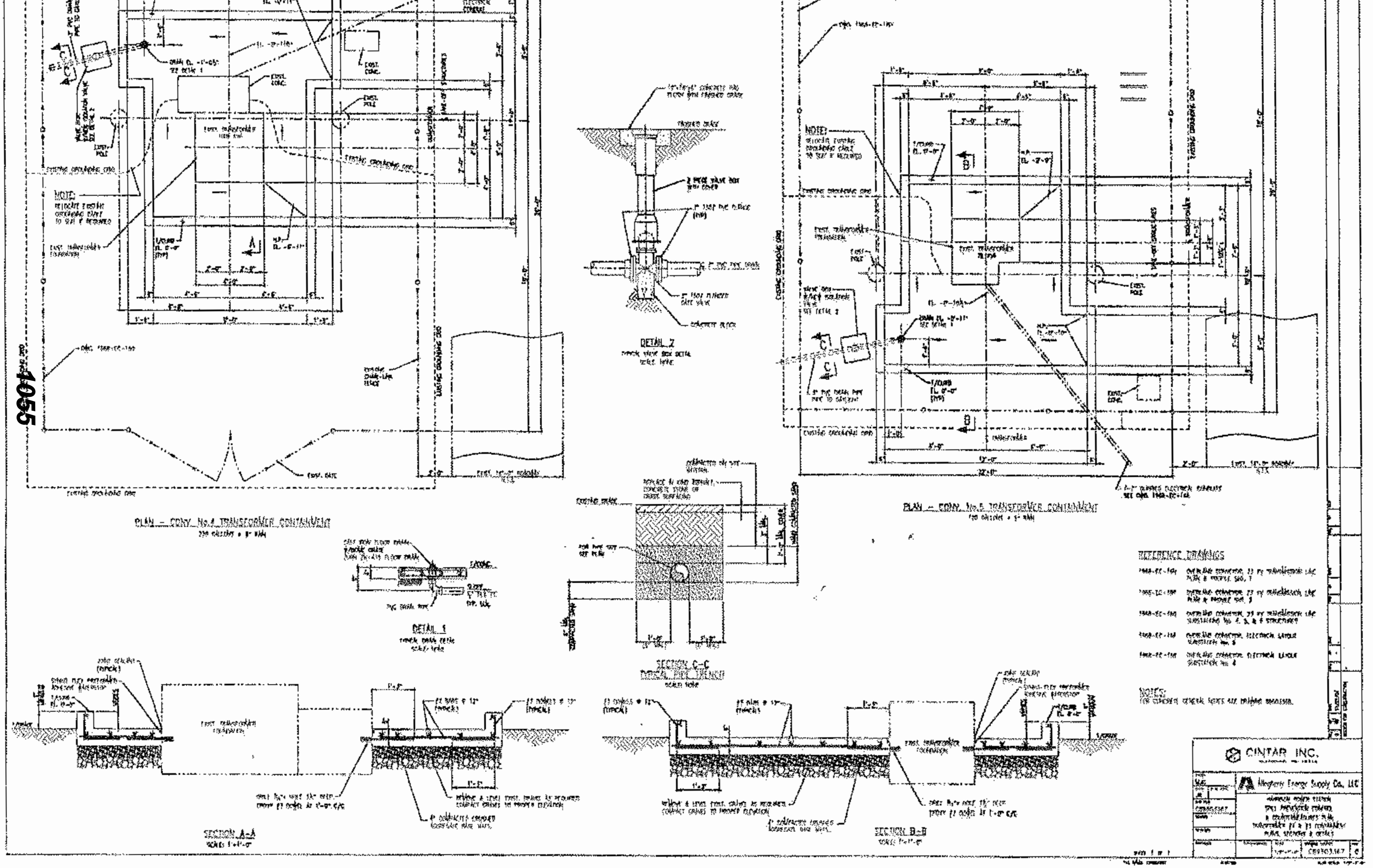
· area of foundation: 4 * 3 = 12 sf

· volume: (103.5 - 12) * (9/12) * 7.48 = 513 gal

· rainfall volume: 103.5 * 0.39 * 7.48 = 302 gal

211 gal

OK



1055
NOTE:
PLAN – CONV. No.4 TRANSFORMER CONTAINMENT
DETAIL 2
DETAIL 1
SECTION C–C
TYPICAL PIPE TRENCH
PLAN – CONV. No.5 TRANSFORMER CONTAINMENT
REFERENCE DRAWINGS
NOTES:
SECTION A–A
SECTION B–B
CINTAR INC.
Allegheny Energy Supply Co. LLC

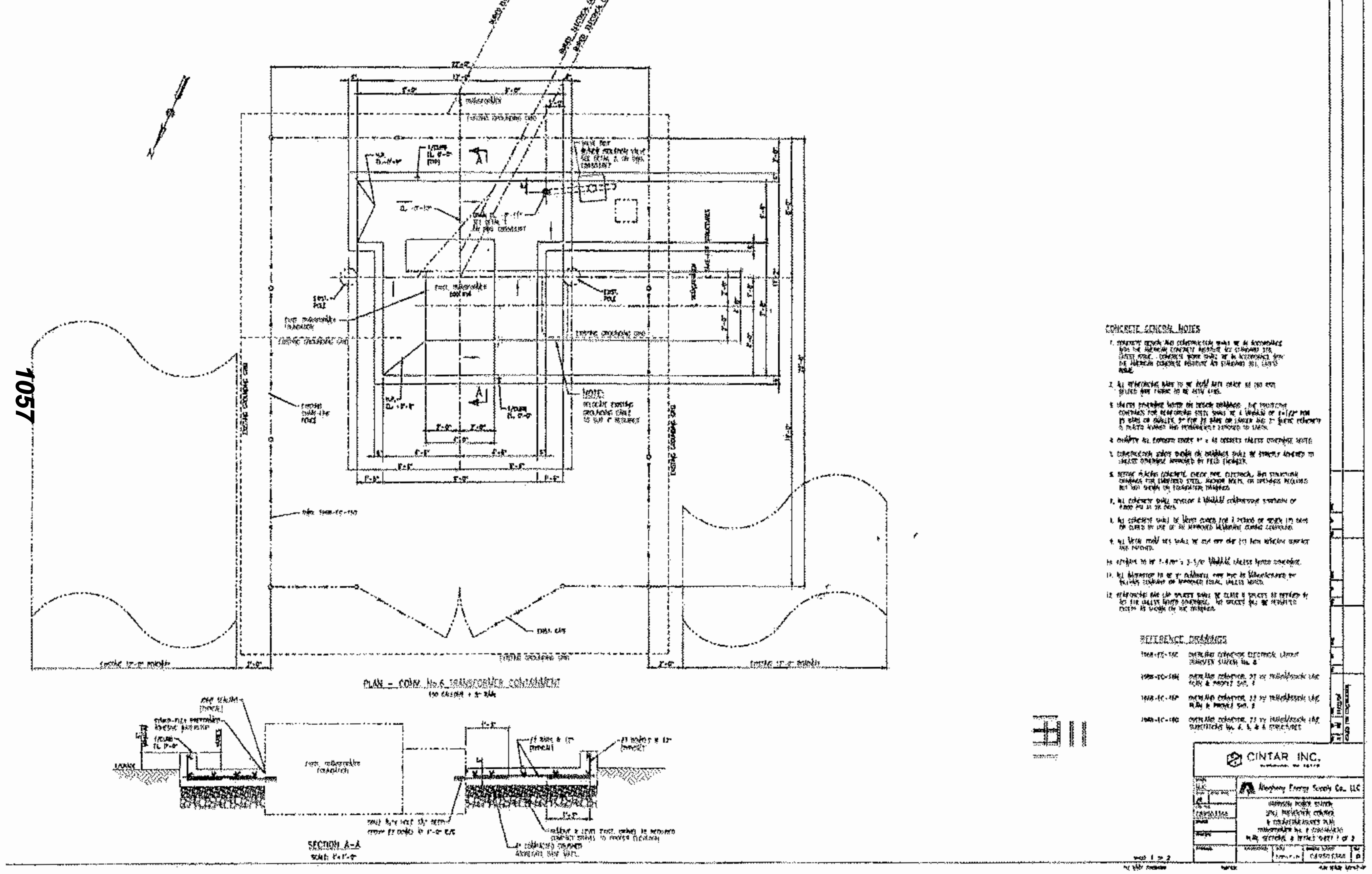
A148HR (286 gal transformer)

see dwg [illegible] [illegible] [illegible]

[illegible] from what is shown on the drawing.

- apix. area of foundation: [illegible] + (1×5) = 21 sf
- area of pad [illegible]: (3.5×10) + (9×[illegible]) = 111 sf
- volume: (111−21) × (15/12) × [illegible] = 842 gal
- [illegible]: [illegible] 529 [illegible] 3[illegible]

[illegible]



1057
PLAN - CONV. No.6 TRANSFORMER CONTAINMENT
SECTION A-A
CONCRETE GENERAL NOTES
REFERENCE DRAWINGS
CINTAR INC.
Allegheny Energy Supply Co. LLC

A164HR & A165HR - 13,450 gal urea dissolver tanks

A166HR - 40,000 urea reactor feed tank

These [illegible] along w/ 4 granular urea silos & numerous pumps, etc. are situated in a concrete containments area. This area is sloped towards the NE corner to a sump pit. The sump pit gravity drains (although is typically kept shut) to a wastewater collection trench which flows to the wastewater lagoons.

=> the containment is OK

10/2010

A40HR (24,600 gal transformer, formerly #1 main transformer now as spare GSU in switchyard)

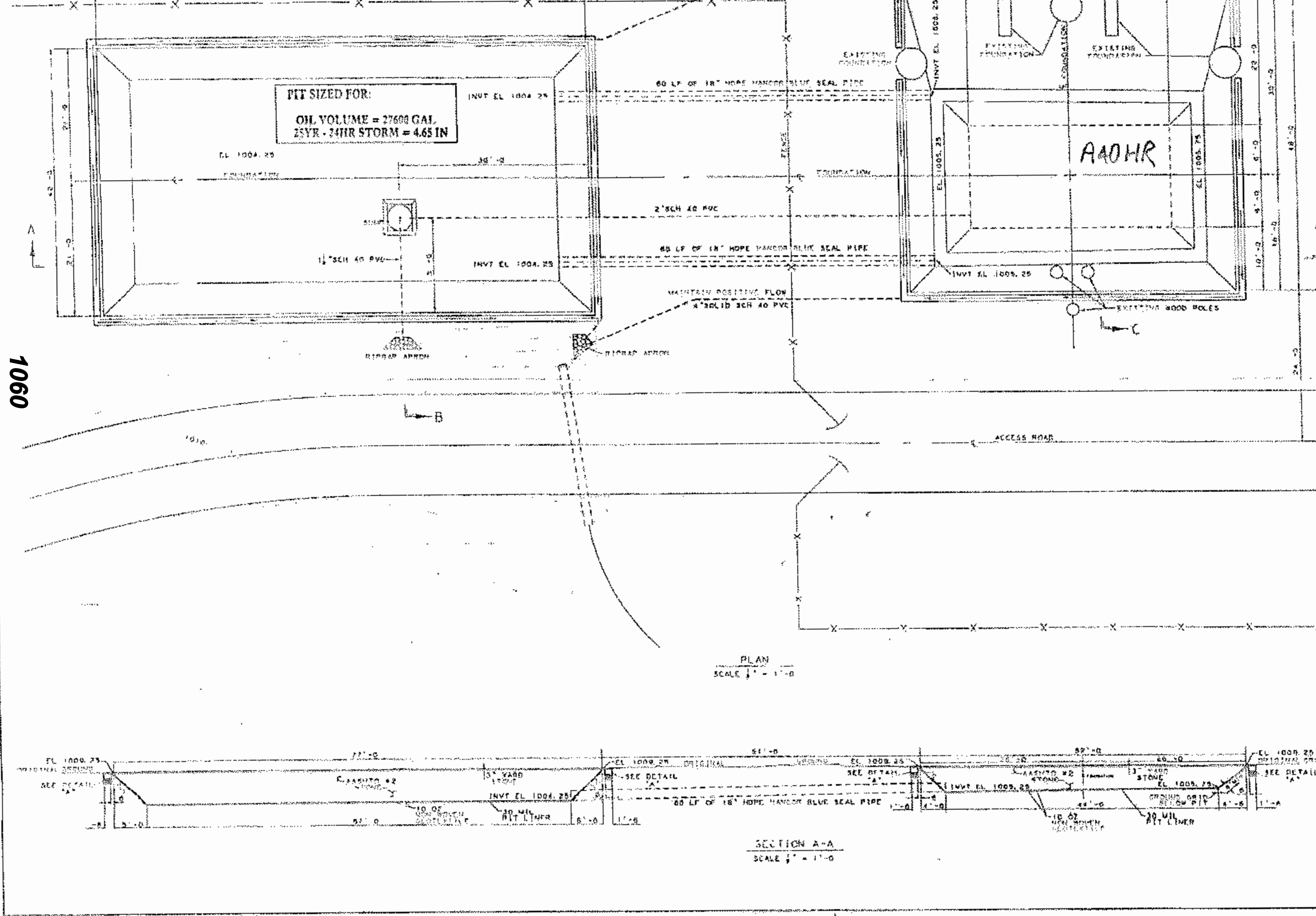
Ref'n dwgs 418-228 Sheets 1 + 2

overview: 2 below grade HDPE lined pits filled w/ stone + equipped w/ oil detecting sump pump

vol of large pit:

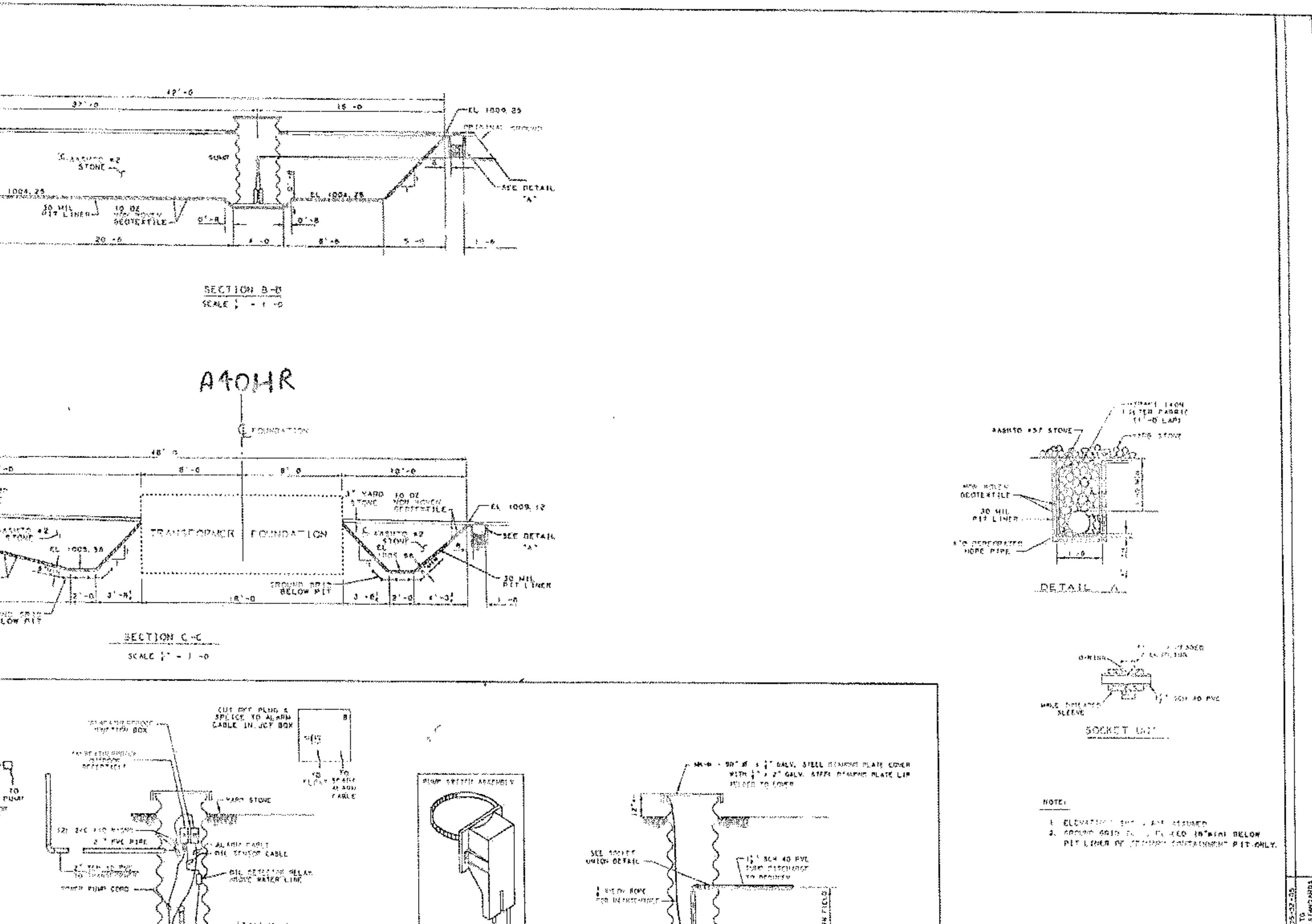
vol Cont = (72 * 37) * 5 * 7.48 = 99,634 gal
- rainfall vol: [(77 * 42) + (52 * 48)] * 0.39 * 7.48 = 16,716 gal
+ assume 40% void space of AASHTO #2 stone
=> 33,167 gal
≃ 33,000 gal
OK

1060



PLAN

SECTION A-A



SECTION B-B
SCALE 1/4" = 1'-0"
A40HR
SECTION C-C
SCALE 1/4" = 1'-0"
TRANSFORMER FOUNDATION
EL 1009.25
SEE DETAIL "A"
30 MIL PIT LINER
10 OZ NON WOVEN GEOTEXTILE
AASHTO #2 STONE
SUMP
GROUND GRID BELOW PIT
DETAIL "A"
AASHTO #57 STONE
30 MIL PIT LINER
SOCKET UNIT
PUMP SWITCH ASSEMBLY
CUT OFF PLUG & SPLICE TO ALARM CABLE IN JCT BOX
YARD STONE
ALARM CABLE
OIL SENSOR CABLE
OIL DETECTION RELAY ABOVE WATER LINE
SEE SOCKET UNION DETAIL
NOTE:
1. ELEVATIONS ARE ASSUMED
2. GROUND GRID TO BE PLACED 18" MIN. BELOW PIT LINER OF CONTAINMENT PIT ONLY.

10/2010

Evaluation of proposed containment system for new spare GSU (former #3 Main) + new spare scrubber reserve transformers

Ref'n Dwgs: 9475-E009, 9475-F005, 9475-F006

Volume for oil storage:

rentention pit: $\left(\frac{(64*44)+(30*50)}{2}\right)*7*7.48 = 112,993$ gal

GSU area: $\left[\left(\frac{(68*53)+(60*45)}{2}\right)*4\right]$
$-\left[(32*19)+(8*21)\right]*4$
$*\ 7.48 = 71,089$ gal

scrubber transf. area: $\left[\left[\left(\frac{(30*28)+(24*22)}{2}\right)*3\right]-\left[(14*6.5)*3\right]\right]*7.48 = 13,307$

(assume 40% pore volume)

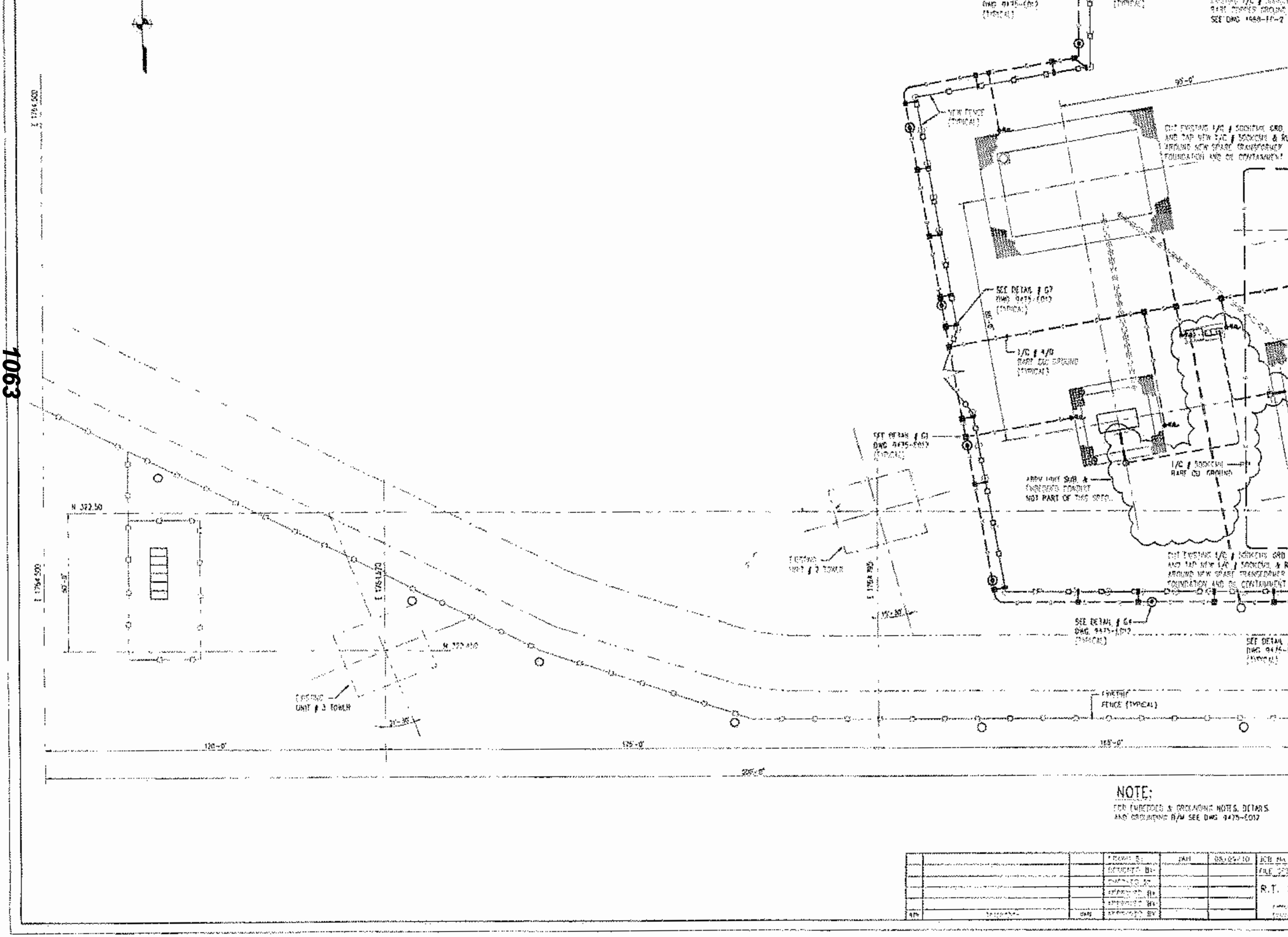
$\Sigma = (112,993 + 71,089 + 13,307) * 0.4 = 78,956$ gal

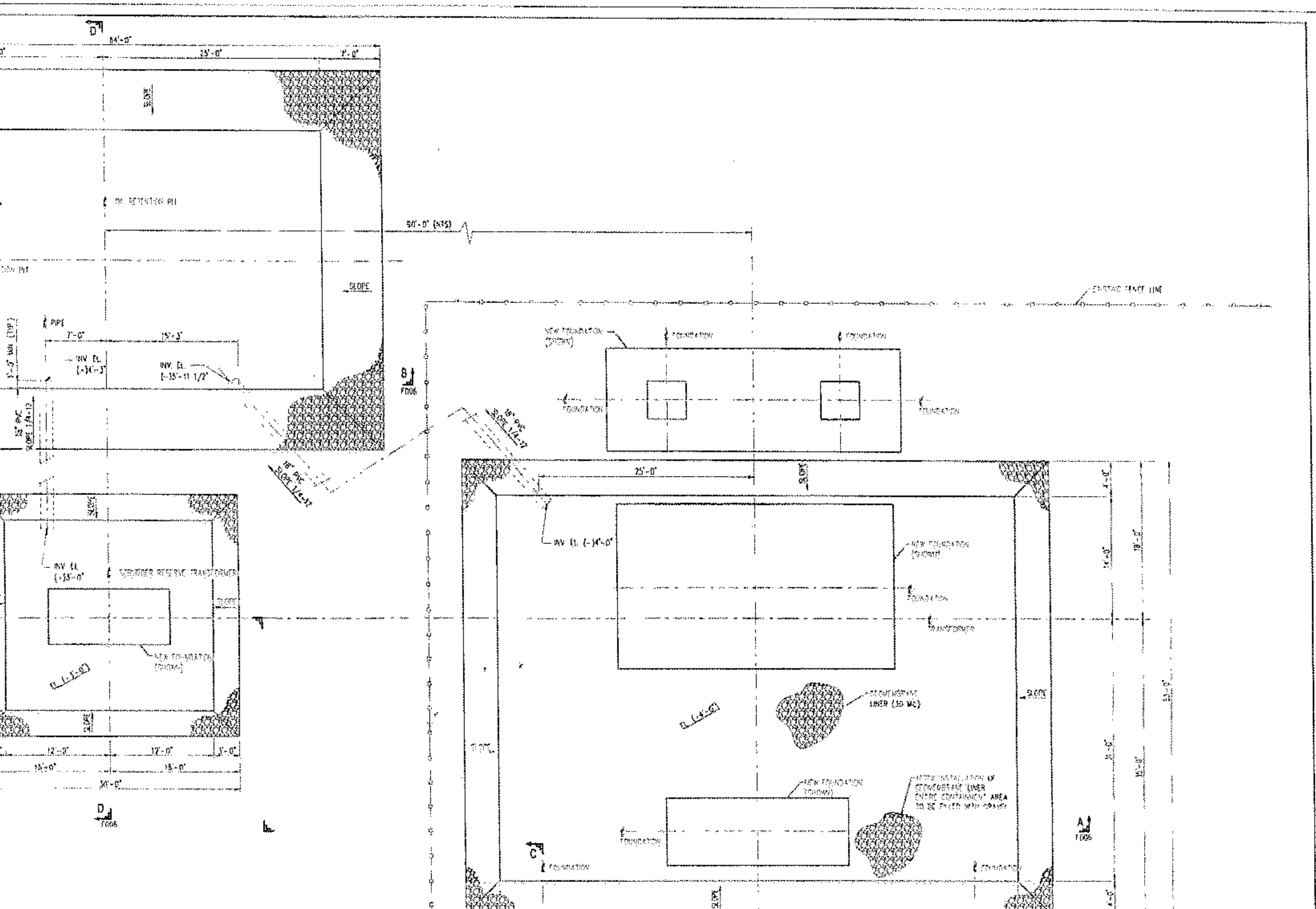
$-$ rainfall vol: $[(68*53)+(64*44)+(30*28)]*0.39*7.48 = 21,179$ gal

$\therefore$ vol available $\cong$ 57,000 gal

OK for either
existing #3 main (A42HR)
or new GSU (A312HR)
+ spare reserve scrubber
transformer (A313HR)

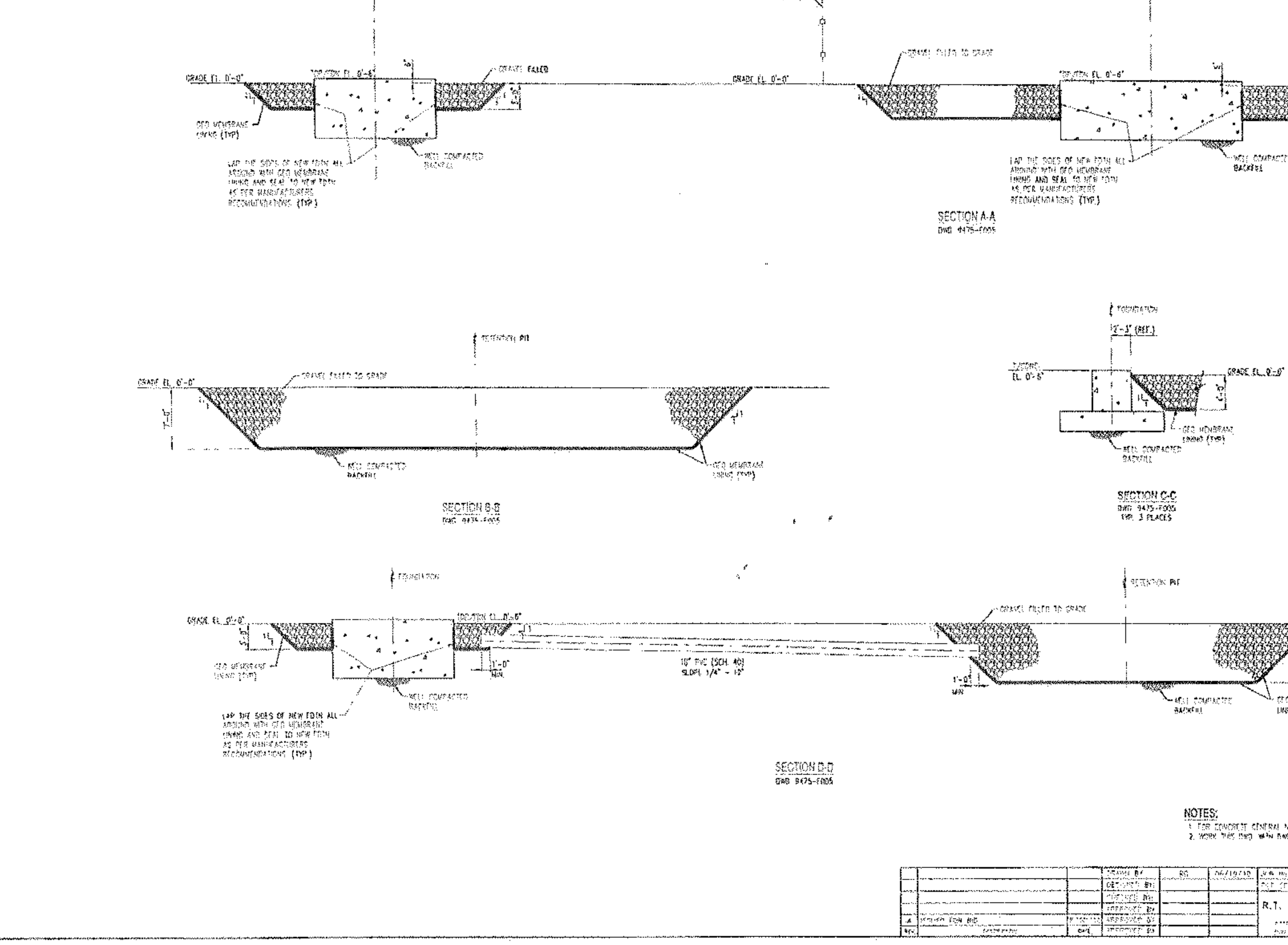
1063


NEW FENCE (TYPICAL)
SEE DETAIL # G7 DWG 9475-E012 (TYPICAL)
SEE DETAIL # G1 DWG 9475-E012 (TYPICAL)
SEE DETAIL # G4 DWG 9475-E012 (TYPICAL)
1/C # 4/0 BARE CU GROUND (TYPICAL)
1/C # 500KCMIL BARE CU GROUND
EXISTING UNIT # 2 TOWER
EXISTING UNIT # 3 TOWER
EXISTING FENCE (TYPICAL)
N 372.50
90'-0"
120'-0"
175'-0"
155'-0"
NOTE:
FOR EMBEDDED & GROUNDING NOTES, DETAILS AND GROUNDING B/M SEE DWG 9475-E012
DRAWN BY
DESIGNED BY
CHECKED BY
APPROVED BY

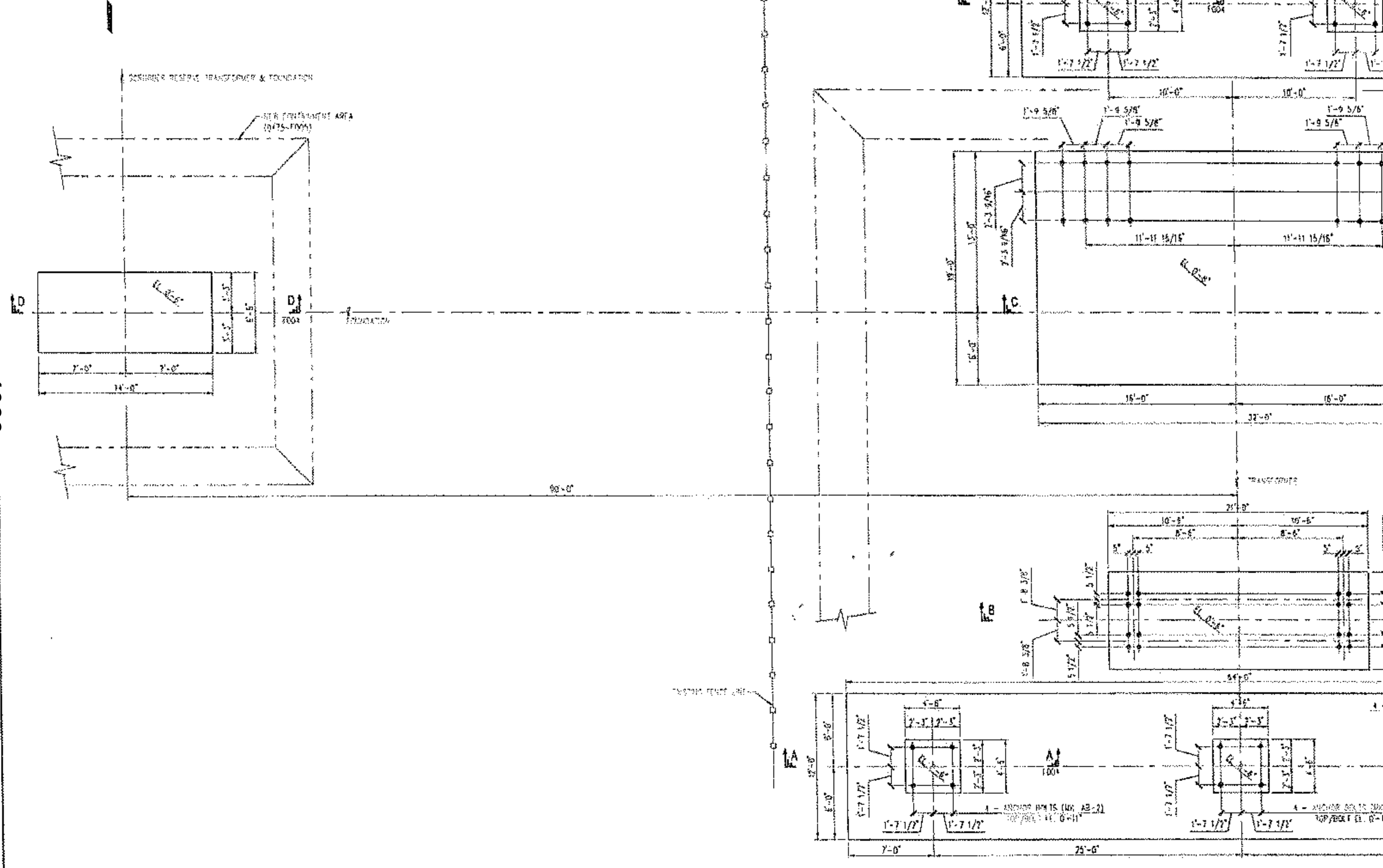


EXISTING FENCE LINE
NEW FOUNDATION (TYPICAL)
FOUNDATION
TRANSFORMER
GEOMEMBRANE LINER (30 MIL)
AFTER INSTALLATION OF GEOMEMBRANE LINER ENTIRE CONTAINMENT AREA TO BE FILLED WITH GRAVEL
EL (-4'-0")
INV. EL. (-)4'-0"
SLOPE
25'-0"
50'-0" (NTS)
18" PVC SLOPE 1/4-12
OW RETENTION PIT
PIPE
INV. EL. (-)4'-3"
INV. EL. (-)5'-11 1/2"
INV. EL. (-)5'-0"
SPARE RESERVE TRANSFORMER
EL (-5'-0")
7'-0"
15'-3"
64'-0"
30'-0"
15'-0"
12'-0"
3'-0"

1065



GRADE EL. 0'-0"
GRAVEL FILLED TO GRADE
GEO MEMBRANE LINING (TYP)
WELL COMPACTED BACKFILL
LAP THE SIDES OF NEW FDTN ALL AROUND WITH GEO MEMBRANE LINING AND SEAL TO NEW FDTN AS PER MANUFACTURERS RECOMMENDATIONS (TYP.)
SECTION A-A
DWG 9475-F005
SECTION B-B
DWG 9475-F005
SECTION C-C
DWG 9475-F005
TYP. 3 PLACES
10" PVC (SCH. 40)
SLOPE 1/4" = 12"
SECTION D-D
DWG 9475-F005
NOTES:
R.T.

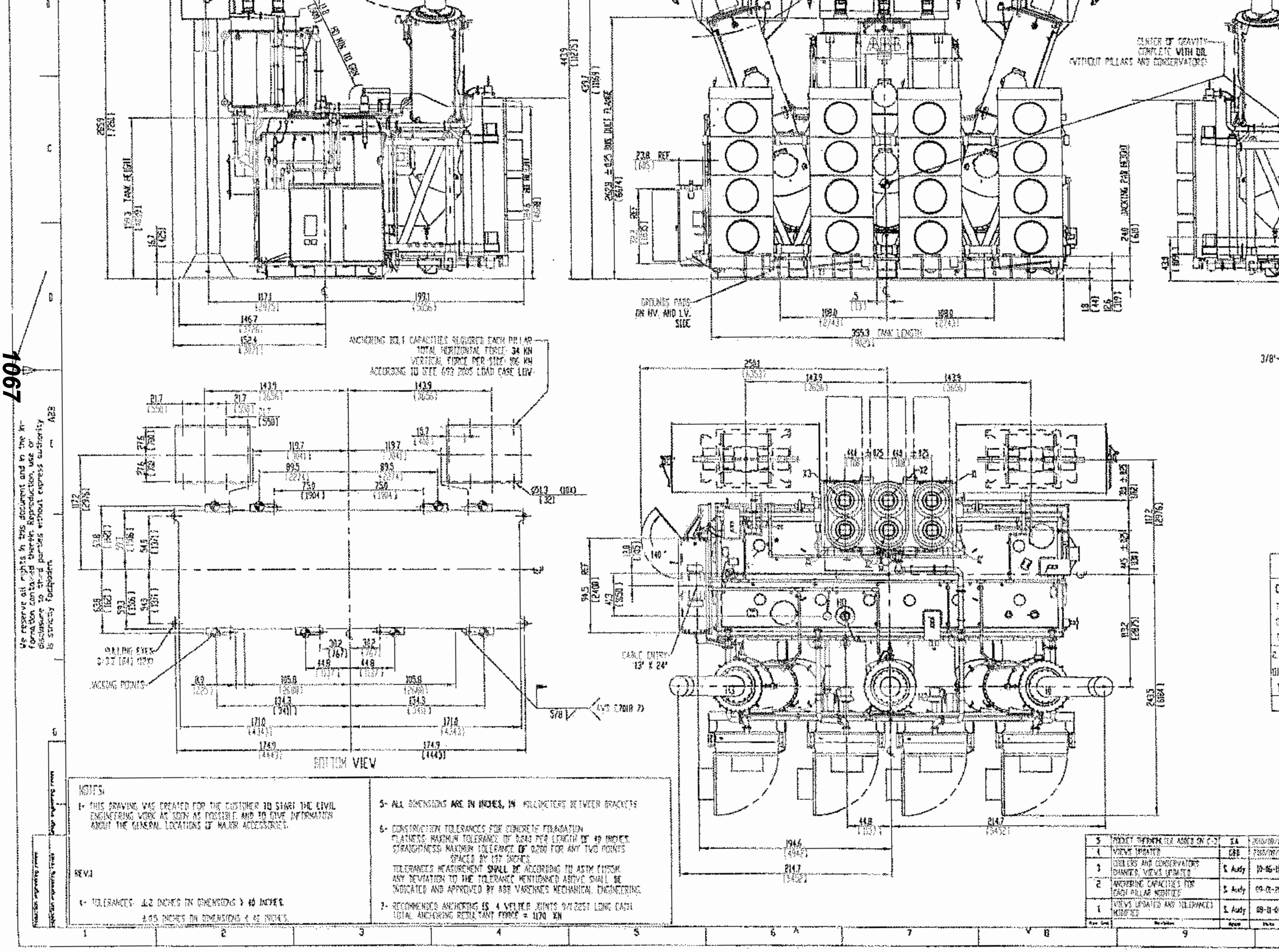


1066

NOTES:
1. FOR CONCRETE GENERAL NOTES SEE DWG. 0475-F001
2. VERIFY THIS DWG WITH DWGS. 0475-F002 AND F004 THRU F006

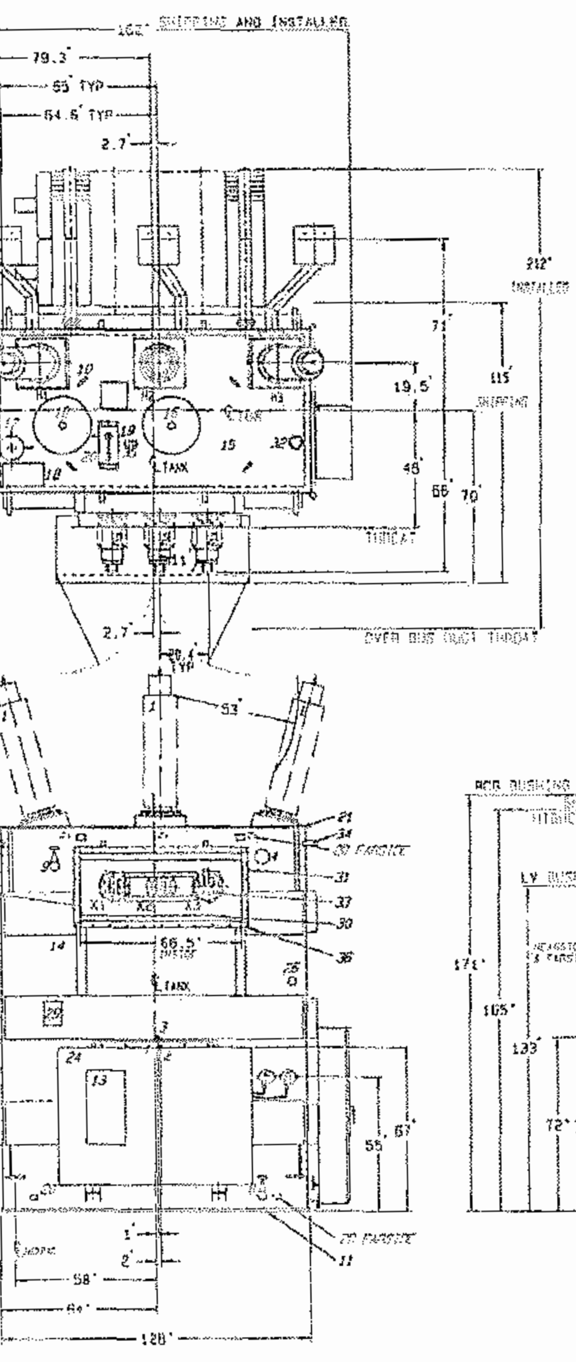
FOUNDATION PLAN

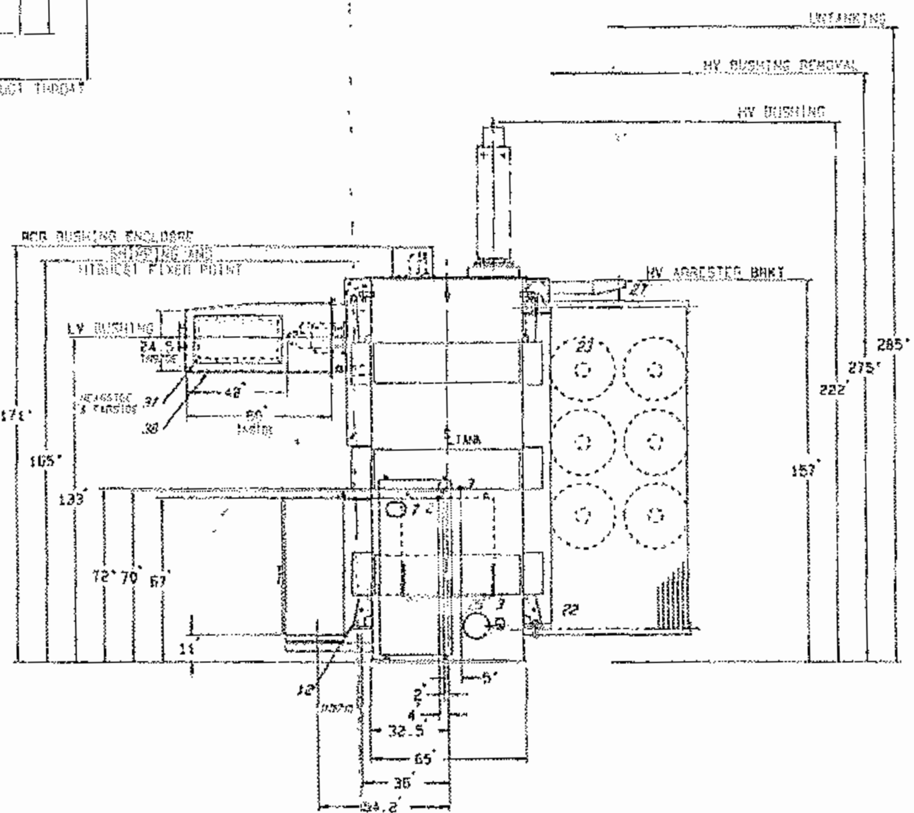
			DRAWN BY	RG	
			DESIGNED BY		
			CHECKED BY		
			APPROVED BY		
A	ISSUED FOR BID		APPROVED BY		
REV	DESCRIPTION	DATE	APPROVED BY		



BOTTOM VIEW
NOTES:
1- THIS DRAWING WAS CREATED FOR THE CUSTOMER TO START THE CIVIL ENGINEERING WORK AS SOON AS POSSIBLE AND TO GIVE INFORMATION ABOUT THE GENERAL LOCATIONS OF MAJOR ACCESSORIES.
4- TOLERANCES: ±1.2 INCHES ON DIMENSIONS > 40 INCHES. ±0.5 INCHES ON DIMENSIONS < 40 INCHES.
5- ALL DIMENSIONS ARE IN INCHES, IN MILLIMETERS BETWEEN BRACKETS
6- CONSTRUCTION TOLERANCES FOR CONCRETE FOUNDATION
FLATNESS: MAXIMUM TOLERANCE OF 0.040 PER LENGTH OF 40 INCHES.
STRAIGHTNESS: MAXIMUM TOLERANCE OF 0.200 FOR ANY TWO POINTS SPACED BY 197 INCHES.
TOLERANCES MEASUREMENT SHALL BE ACCORDING TO ASTM E1155M.
ANY DEVIATION TO THE TOLERANCE MENTIONNED ABOVE SHALL BE INDICATED AND APPROVED BY ABB VARENNES MECHANICAL ENGINEERING.
7- RECOMMENDED ANCHORING IS 4 WELDED JOINTS 9" LONG EACH. TOTAL ANCHORING RESULTANT FORCE = 1170 KN
ANCHORING BOLT CAPACITIES REQUIRED EACH PILLAR
TOTAL HORIZONTAL FORCE: 34 KN
VERTICAL FORCE PER SIDE: 106 KN
ACCORDING TO IEEE 693 2005 LOAD CASE LOW
TANK HEIGHT
TANK LENGTH
GROUNDING PADS ON HV. AND LV. SIDE
CENTER OF GRAVITY COMPLETE WITH OIL (WITHOUT PILLARS AND CONSERVATOR)
JACKING PAD
JACKING POINTS
PULLING EYES
CABLE ENTRY 13" X 24"
REF.
REV.1
3 COOLERS AND CONSERVATORS CHANGED, VIEWS UPDATED
2 ANCHORING CAPACITIES FOR EACH PILLAR MODIFIED
1 VIEWS UPDATED AND TOLERANCES MODIFIED
4 VIEWS UPDATED
S. Audy
Revision

A313HR





NOTES:
1) ALL ITEMS MARKED '*' ARE TO BE REMOVED FOR SHIPMENT.
2) UNIT IS DESIGNED TO SHIP BY TRUCK OR RAIL.
3) CENTERLINE OF TANK = ℄ TANK.
5) INERT GAS EQUIPMENT, ITEM 7, IS EQUIPPED WITH NITROGEN BOTTLE, REGULATORS, PRESSURE, VACUUM AND GAS SUPPLY PRESSURE GAGES WITH CONTACTS.
6) UNIT IS TO BE SHIPPED
- ☐ IN OIL WITH NITROGEN BLANKET.
- ☐ IN OIL WITH DRY AIR BLANKET.
- ☐ WITHOUT OIL FILLED WITH NITROGEN.
- ☒ WITHOUT OIL FILLED WITH DRY AIR.

7) APPROXIMATELY 1400 GALS OF OIL MUST BE REMOVED TO REPLACE LV BUSHINGS IN COMPLETELY ASSEMBLED TRANSFORMER. (RADIATOR VALVES CLOSED IF RADIATORS ARE BOLT-ON)
8) CENTER OF GRAVITY SHIPPING W/OIL = ⊕1. W/O OIL = ⊕2. INSTALLED = ⊕3.
9) H.F.P. = HIGHEST FIXED POINT.
10) OIL TEMPERATURE GAGE SETTINGS:
- 70 DEG. C - 1ST STAGE COOLING
- 80 DEG. C - 2ND STAGE COOLING
- 85 DEG. C - ALARM
- 110 DEG. C - TRIP

WINDING TEMPERATUREGAGE SETTINGS:
- 80 DEG. C - 1ST STAGE COOLING
- 90 DEG. C - 2ND STAGE COOLING
- 105 DEG. C - ALARM
- 130 DEG. C - TRIP

11) TOTAL KVA REQUIREMENTS FOR FANS - 3.54 KVA
12) CANTILEVER WORKING LOAD TO TOP TERMINAL
- HV BUSHING - 350 LBS.
- LV BUSHING - 250 LBS.

	ITEM	QTY	DESCRIPTION	
*	1	3	HIGH VOLTAGE BUSHING ABB 138W0800AA	THREAD 1.5-12
	2	3	LOW VOLTAGE BUSHING ABB 025T0450HX	SPADE
	3	1	TAP CHANGER FOR DE-ENERGIZED OPERATION, W/PADLOCKING PROVISIONS	
	4	1	LIQUID LEVEL GAGE, W/CONTACTS	
	5	1	LIQUID TEMPERATURE GAGE, EYE LEVEL, W/CONTACTS	
	6	1	WINDING TEMPERATURE GAGE, EYE LEVEL, W/CONTACTS	
	7	1	INERT GAS SYSTEM, SEE NOTE 5	
	8	1	DRAIN AND SAMPLING VALVE, 2.0", GATE VALVE W/SIDE SAMPLER	
	9	1	UPPER FILTER PRESS VALVE, 2.0", GATE VALVE W/SIDE SAMPLER	
	10	4	EYES FOR LIFTING COVER	
	11	1	BASE FOR SKIDDING IN ANY DIRECTION	
	12	4	JACK PAD, W/PULLING EYES	
	13	1	NAMEPLATE	
	14	1	TANK (PAINT ANSI 70, SKY GRAY, 5MILS)	
	15	1	COVER (WELD-ON)	
	16	2	MANHOLE, 20 IN. DIA W/BOLT ON COVER	
	17	1	PRESSURE RELIEF DEVICE, W/CONTACTS & SEMAPHORE	
	18	1	JUNCTION BOX FOR CURRENT TRANSFORMER LEADS	
*	19	1	REMOVEABLE CORE GROUND BUSHING WITH ENCLOSURE	
	20	7	GROUND PAD, W/2 1/2-13 UNC TAPS ON 1.75 IN. CENTERS	
	21	4	HOOKS FOR LIFTING TRANSFORMER	
*	22	5	RADIATOR (BOLT-ON W/VALVES WELDED TO TANK)	
*	23	6	FAN 1/6 HP, 1140 RPM, 460 VOLTS, THREE PHASE	
	24	1	CONTROL EQUIPMENT CABINET W/40" DOOR SWING	
	25	1	HANDHOLE, 7.0" DIA W/WELD ON COVER	
*	26	1	QUALITROL RAPID PRESSURE RISE RELAY	
*	27	3	HIGH VOLTAGE SURGE ARRESTOR BRACKET	
	28	1	TRANSFER SWITCH CABINET W/39" DOOR SWING	
	29	1	AUXILIARY TRANSFORMER	
	30	1	1/4" X 2" BUS BAR FOR GROUNDING CABLE SHIELDS	
	31	1	LV BUSHING THROAT	
	32	1	4" VACUUM CONNECTION	
*	33	12	TERMINALS FOR CUSTOMER'S CABLE CONNECTION	
	34	10	RAIL MOUNTING BRACKETS	
	35	1	CORE GROUND BUSHING NAMEPLATE	
*	36	1	LOW VOLTAGE BUSHING ENCLOSURE	
*	37	2	SIDE REMOVABLE PLATE W/GASKET	
*	38	1	BOTTOM REMOVABLE PLATE W/GASKET	

APPROXIMATE WEIGHTS		LBS
CORE & COIL (UNTANKING WEIGHT)		48600
TANK, FITTINGS & RADIATOR		31400
RADS. (BOLT ON)	9300 LBS.	
OIL-MAIN TANK	3800 GALS	
OIL-RADIATORS	385 GALS	
OIL-TOTAL	4185 GALS	31400
TOTAL WEIGHT		111400
SHIPPING WEIGHTS	WITHOUT OIL	WITH OIL
SHIPPING UNIT	68100	97800
SHIPPING PARTS	11900	13600
SHIPPING TOTAL	80000	111400

CUSTOMER. ALLEGHENY POWER SERVICE CORPORATION
"ALLEGHENY POWER SYSTEM"
APS OPERATING CO. - MONONGAHELA POWER COMPANY -
HARRISON POWER STATION
SCRUBBER RESERVE TRANSFORMER

SERIAL NO. A1540
CUSTOMER ORDER NO. 1M-0040
MAGNETEK ELECTRIC ORDER NO., 11181-02
MAGNETEK WORK ORDER NO.: W02-1540

POWER TRANSFORMER

CLASS OA/FA/FA	3 PHASE 60 HZ
MVA 21/28/35	CONT. TEMP RISE 55°C
MVA 23 5/31.4/39.2	CONT. TEMP RISE 65°C
HV 135300	VOLTS
LV 6900	VOLTS

HARRISON POWER STATION ICP

Section III – Annexes

Annex 19 – BLANK

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Section III – Annexes

Annex 20 – Harmful Substance/Oil Spill Report

This form provides a list of the information required when notifying the National Response Center (NRC) or other governmental agencies of a release. Complete all available information prior to contacting the NRC or other agencies. (Note: Do not delay notification to collect all information on the form.) Forward a copy of the completed form to:

Environmental Department
Greensburg Corporate Center
Room C109

This form is also available electronically on the First Energy internal networking system.

FirstEnergy

SPILL REPORT

FORM NO. X-3082 (REV. 11-15) Page 1 of 2

ENVIRONMENTAL HOTLINE: 800-634-6094

Location or Address of Spill			**Date/Time of Spill**
City		**State**	**Service Center**
Town/Township	**County**	**Enter FE Incident No. OR Order/WBS**	

Substance Spilled/Discharged & Amount	**Source of Spill/Discharge**	**If Source was Electrical Equip. Complete the Following**	**PCB Concentration** (Complete ONLY if Dielectric Oil was Spilled)
☐ Dielectric Mineral Oil ☐ Hydraulic Oil ☐ Diesel Fuel ☐ Other Estimate Volume Spilled (Gal.) __________	☐ Poletop Transformer ☐ Padmount Transformer ☐ Underground Transformer ☐ Other ________	Manufacturer: Serial No: Pole/Pad No: kVA Rating:	☐ Non-PCB (<50ppm) ☐ PCB (>=500ppm) ☐ PCB Contaminated (50-499ppm) ☐ Unknown (Sample Required) Field Sample Number: ______ Concentration : _____ ppm PCB's Fire Involved? _____

Cause of Spill/ Discharge	**Area Affected by Spill/Discharge** (Check all that apply)	**Agency/Organization Present** (If Any)
☐ Car-Pole Accident ☐ Storm Damage ☐ Equipment Failure ☐ Animal Contact ☐ Human Error ☐ Other ________	☐ Limited to FirstEnergy Property ☐ Affected Adjacent Property ☐ Onto Concrete/Macadam/Asphalt ☐ Into Surface Water or Storm Drain (or Ditch – Ohio) ☐ Into Vegetable Garden/Grazing Land ☐ Into Containment ☐ Onto Soil/Gravel ☐ Vegetation ☐ Other ________ Name of Water Body: ________ Volume Reaching Water: _____ gallons	Representative's Name: Agency: Representative's Name: Agency:

Containment Activities	**Clean-up Activities**	**Cleaned Up By**
☐ Placed Absorbent Pads ☐ Placed Absorbent Booms ☐ Placed Oil Dri; Sorbent C; etc. ☐ Constructed Intercept Trench ☐ Other: ________	☐ Removed Soil/Gravel ☐ Pumped/Removed Water ☐ Removed Vegetation ☐ Washed Solid Surfaces ☐ Other: ________	☐ Clean-Up Contractor Name ______ ☐ FirstEnergy Crew ☐ Other: ________ Clean-Up Start Date/Time: Clean-Up End Date/Time:
No. Drums Used:	No. Roll-offs Used:	Estimate amount cleaned-up (in pounds):

Employees Reporting Spill/Discharge Information
Date/Time Information Reported
Employee Reporting Information Name/SAP No.
Employee Receiving Information Name/SAP No.

FirstEnergy

SPILL REPORT
FORM NO. X-3082 (REV. 11-15) Page 2 of 2

Agency Notification

Notify agencies even if they are at the spill site.

Agency	Operator	Case Number	Date Called	Time Called
National Response Center (800-424-8802)				

Additional Information

HARRISON POWER STATION ICP

Section III – Annexes

Annex 21 – Training Logs

The following forms are utilized and are also available in an interactive electronic format on the First Energy intranet.

Course Completion Record (Form X-2314)

FirstEnergy

COURSE COMPLETION RECORD

FORM X-2314 (REV.04-18)

(Please Print Clearly With Blue or Black Ink)

COURSE NO.	PAGE OF

COURSE NAME			TRAINING LOCATION/ROOM NO.
START DATE/TIME	END DATE/TIME	TOTAL COURSE HOURS	INSTRUCTOR(S) NAME/SAP NO.

Company or Plant (Initials)	Department	SAP No.	Full Name (First, M.I., Last) (Print Clearly)	Employee Signature	CLASS DATES (Mark Initials On Days Attended)					COMPLETION Code: S=Successful I=Incomplete NS=No Show	
										CODE	SCORE

NOTES:	RECORDED BY:
	SCHEDULED OFFERING ID:

DO NOT USE BACK OF FORM FOR ATTENDANCE

HARRISON POWER STATION ICP

Section III – Annexes

Annex 22 – Inspections

1.0 The station Operators perform a daily walk-around inspection of the station facilities and external equipment that have potential to cause release to the environment. A log indicating what shift the daily inspection was conducted is maintained in the Control Room.

2.0 Station operating personnel perform informal inspections of station facilities and equipment while conducting daily routines during normal work hours. This includes work areas, curbs, dikes, sumps, pipe lines, basins, aboveground storage tanks, etc. Any abnormalities or problems are reported to either: a regional engineer, manager or combination thereof for appropriate action.

3.0 A self-monitoring program is in place for National Pollutant Discharge Elimination System (NPDES), solid wastes, and air requirements. Samples of process waters (NPDES) and groundwater (solid waste landfill) are taken and analyzed pursuant to permit requirements. Process waters are sampled by the plant environmentalist or designated chemical technician and groundwater samples are obtained by the plant environmentalist or chemical technician and contracted groundwater sampling team. Refer to Section III Annex 11 of this ICP for a summary of both NDPES Discharge Monitoring Requirements and Groundwater Requirements.

4.0 Inspection of storage tanks, operation equipment, and chemical storage occurs pursuant to regulations set forth in RCRA (Subtitle I and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (SARA Title III/OSHA)). All aboveground tanks and their containment are inspected for leakage, defects, and any other abnormal situations. Maintenance on bulk storage tanks, containment structures, and equipment is recorded.

5.0 Weekly inspections of all Level 1 AST containments and monthly inspections of all Level 1 ASTs are conducted and logged by technical services personnel in addition to the operator's logs.

6.0 All aboveground valves and pipelines are inspected on a scheduled periodic basis in accordance with procedures contained in the "Operating, Maintenance, Inspection, and Testing Procedures," of the Station Procedures Manual.

7.0 Attached are some of the inspection forms used at the station.

WV REGULATED AST INSPECTION

FACILITY	TANK ID/NAME/LOCATION: HA0-WACIRC-INJACID-10	DATE
Harrison Power Station	PRODUCT: Tank #4/Cooling Tower Treatment-Sulfuric Acid	

STATUS CODES: S = SATISFACTORY U = UNSATISFACTORY NA = NOT APPLICABLE

ITEM	S	U	NA	COMMENTS/WORK ORDER # IF APPLICABLE
Complete weekly for Level 1 ASTs				
Containment Areas				
*Water in containment <10%. (If >10%, drain water & document below)				
Any evidence of an obvious release, spill, overflow or leakage from the regulated AST system, including any ancillary regulated equipment.				
Drain valves secured in a closed position				
Containment area free of damage or deterioration.				
Containment area is free of debris or fire hazards.				
Interstitial monitor in working order (if used)				
Complete monthly for Level 1 ASTs				
AST and Ancillary Equipment				
Any evidence of cracks, distortion or areas of wear				
Corrosion - Condition of external coatings, paints and insulation, if present				
Condition of support structure and foundation				
Any evidence of pipes or valves leaking				
Leak Detection System - (Includes both tank and regulated piping up to the first point of isolation)				
If installed is the leak detection system in working order (alarm test button functional if present)				
Any evidence of release from ancillary equipment and appurtenances up to the first point of isolation				
Ancillary Equipment				
Overfill prevention device functioning properly (Veeder-Root, clock gauge, sight glass)				
Relief vents are in place and clear of restrictions.				
Safety Precautions				
Spill containment/Fire extinguishers present (if required)				
Tank is labeled properly along with WVDEP signage in place and legible				
Safety precautions posted (e.g. NO SMOKING/FLAMMABLE)				
Tank is appropriately grounded.				
Lighting adequate, tank system secured to prevent vandalism and unauthorized use				
General area housekeeping is satisfactory.				

CONTAINMENT RELEASE NOTE/ADDITIONAL COMMENTS/ACTIONS

* If Containment was drained indicate time Valve Opened: ____________________ Valve Closed: ________________

All records are to be kept for a minimum of 12 months

INSPECTED BY	SIGNATURE

WV REGULATED AST INSPECTION

FACILITY	TANK ID/NAME/LOCATION: HA0-WACIRCW-INFCHLO-10	DATE
Harrison Power Station	PRODUCT: Tank #314 - Sodium Hypochlorite	

STATUS CODES: S = SATISFACTORY U = UNSATISFACTORY NA = NOT APPLICABLE

ITEM	S	U	NA	COMMENTS/WORK ORDER # IF APPLICABLE
Complete weekly for Level 1 ASTs				
Containment Areas				
*Water in containment <10%. (If >10%, drain water & document below)				
Any evidence of an obvious release, spill, overflow or leakage from the regulated AST system, including any ancillary regulated equipment.				
Drain valves secured in a closed position				
Containment area free of damage or deterioration.				
Containment area is free of debris or fire hazards.				
Interstitial monitor in working order (if used)				
Complete monthly for Level 1 ASTs				
AST and Ancillary Equipment				
Any evidence of cracks, distortion or areas of wear				
Corrosion - Condition of external coatings, paints and insulation, if present				
Condition of support structure and foundation				
Any evidence of pipes or valves leaking				
Leak Detection System - (Includes both tank and regulated piping up to the first point of isolation)				
If installed is the leak detection system in working order (alarm test button functional if present)				
Any evidence of release from ancillary equipment and appurtenances up to the first point of isolation				
Ancillary Equipment				
Overfill prevention device functioning properly (Veeder-Root, clock gauge, sight glass)				
Relief vents are in place and clear of restrictions.				
Safety Precautions				
Spill containment/Fire extinguishers present (if required)				
Tank is labeled properly along with WVDEP signage in place and legible				
Safety precautions posted (e.g. NO SMOKING/FLAMMABLE)				
Tank is appropriately grounded.				
Lighting adequate, tank system secured to prevent vandalism and unauthorized use				
General area housekeeping is satisfactory.				

CONTAINMENT RELEASE NOTE/ADDITIONAL COMMENTS/ACTIONS

* If Containment was drained indicate time Valve Opened: ____________________ Valve Closed: ________________

All records are to be kept for a minimum of 12 months

INSPECTED BY	SIGNATURE

WV REGULATED AST INSPECTION

FACILITY Harrison Power Station	TANK ID/NAME/LOCATION: HA0-WDLEACH-TANK2 PRODUCT: Tank #354/Hydrogen Peroxide	DATE

STATUS CODES: S = SATISFACTORY U = UNSATISFACTORY NA = NOT APPLICABLE

ITEM	S	U	NA	COMMENTS/WORK ORDER # IF APPLICABLE
Complete weekly for Level 1 ASTs				
Containment Areas				
*Water in containment <10%. (If >10%, drain water & document below)				
Any evidence of an obvious release, spill, overflow or leakage from the regulated AST system, including any ancillary regulated equipment.				
Drain valves secured in a closed position				
Containment area free of damage or deterioration.				
Containment area is free of debris or fire hazards.				
Interstitial monitor in working order (if used)				
Complete monthly for Level 1 ASTs				
AST and Ancillary Equipment				
Any evidence of cracks, distortion or areas of wear				
Corrosion - Condition of external coatings, paints and insulation, if present				
Condition of support structure and foundation				
Any evidence of pipes or valves leaking				
Leak Detection System - (Includes both tank and regulated piping up to the first point of isolation)				
If installed is the leak detection system in working order (alarm test button functional if present)				
Any evidence of release from ancillary equipment and appurtenances up to the first point of isolation				
Ancillary Equipment				
Overfill prevention device functioning properly (Veeder-Root, clock gauge, sight glass)				
Relief vents are in place and clear of restrictions.				
Safety Precautions				
Spill containment/Fire extinguishers present (if required)				
Tank is labeled properly along with WVDEP signage in place and legible				
Safety precautions posted (e.g. NO SMOKING/FLAMMABLE)				
Tank is appropriately grounded.				
Lighting adequate, tank system secured to prevent vandalism and unauthorized use				
General area housekeeping is satisfactory.				

CONTAINMENT RELEASE NOTE/ADDITIONAL COMMENTS/ACTIONS

* If Containment was drained indicate time draining started: ____________________ Draining Completed: N/A

All records are to be kept for a minimum of 12 months

INSPECTED BY	SIGNATURE

WV REGULATED AST INSPECTION

FACILITY	TANK ID/NAME/LOCATION: HA0-WDLEACH-TANK4	DATE
Harrison Power Station	PRODUCT: Tank #355/Sodium Hydroxide	

STATUS CODES: S = SATISFACTORY U = UNSATISFACTORY NA = NOT APPLICABLE

ITEM	S	U	NA	COMMENTS/WORK ORDER # IF APPLICABLE
Complete weekly for Level 1 ASTs				
Containment Areas				
*Water in containment <10%. (If >10%, drain water & document below)				
Any evidence of an obvious release, spill, overflow or leakage from the regulated AST system, including any ancillary regulated equipment.				
Drain valves secured in a closed position				
Containment area free of damage or deterioration.				
Containment area is free of debris or fire hazards.				
Interstitial monitor in working order (if used)				

ITEM	S	U	NA	COMMENTS/WORK ORDER # IF APPLICABLE
Complete monthly for Level 1 ASTs				
AST and Ancillary Equipment				
Any evidence of cracks, distortion or areas of wear				
Corrosion - Condition of external coatings, paints and insulation, if present				
Condition of support structure and foundation				
Any evidence of pipes or valves leaking				
Leak Detection System - (Includes both tank and regulated piping up to the first point of isolation)				
If installed is the leak detection system in working order (alarm test button functional if present)				
Any evidence of release from ancillary equipment and appurtenances up to the first point of isolation				
Ancillary Equipment				
Overfill prevention device functioning properly (Veeder-Root, clock gauge, sight glass)				
Relief vents are in place and clear of restrictions.				
Safety Precautions				
Spill containment/Fire extinguishers present (if required)				
Tank is labeled properly along with WVDEP signage in place and legible				
Safety precautions posted (e.g. NO SMOKING/FLAMMABLE)				
Tank is appropriately grounded.				
Lighting adequate, tank system secured to prevent vandalism and unauthorized use				
General area housekeeping is satisfactory.				

CONTAINMENT RELEASE NOTE/ADDITIONAL COMMENTS/ACTIONS

* If Containment was drained indicate time draining started: ____________________ Draining Completed: ________________

All records are to be kept for a minimum of 12 months

INSPECTED BY	SIGNATURE

WV REGULATED AST INSPECTION

FACILITY	TANK ID/NAME/LOCATION: HA0-WDLEACH-TANK3	DATE
Harrison Power Station	PRODUCT: Tank #356/Nalmet 1689	

STATUS CODES: S = SATISFACTORY U = UNSATISFACTORY NA = NOT APPLICABLE

ITEM	S	U	NA	COMMENTS/WORK ORDER # IF APPLICABLE
Complete weekly for Level 1 ASTs				
Containment Areas				
*Water in containment <10%. (If >10%, drain water & document below)				
Any evidence of an obvious release, spill, overflow or leakage from the regulated AST system, including any ancillary regulated equipment.				
Drain valves secured in a closed position				
Containment area free of damage or deterioration.				
Containment area is free of debris or fire hazards.				
Interstitial monitor in working order (if used)				
Complete monthly for Level 1 ASTs				
AST and Ancillary Equipment				
Any evidence of cracks, distortion or areas of wear				
Corrosion - Condition of external coatings, paints and insulation, if present				
Condition of support structure and foundation				
Any evidence of pipes or valves leaking				
Leak Detection System - (Includes both tank and regulated piping up to the first point of isolation)				
If installed is the leak detection system in working order (alarm test button functional if present)				
Any evidence of release from ancillary equipment and appurtenances up to the first point of isolation				
Ancillary Equipment				
Overfill prevention device functioning properly (Veeder-Root, clock gauge, sight glass)				
Relief vents are in place and clear of restrictions.				
Safety Precautions				
Spill containment/Fire extinguishers present (if required)				
Tank is labeled properly along with WVDEP signage in place and legible				
Safety precautions posted (e.g. NO SMOKING/FLAMMABLE)				
Tank is appropriately grounded.				
Lighting adequate, tank system secured to prevent vandalism and unauthorized use				
General area housekeeping is satisfactory.				

CONTAINMENT RELEASE NOTE/ADDITIONAL COMMENTS/ACTIONS

* If Containment was drained indicate time draining started: ____________________ Draining Completed: ________________

All records are to be kept for a minimum of 12 months

INSPECTED BY	SIGNATURE

WV REGULATED AST INSPECTION

FACILITY	TANK ID/NAME/LOCATION: HA0-WDLEACH-TANK1	DATE
Harrison Power Station	PRODUCT: Tank #357/Nalco 71264 Ferric Chloride	

STATUS CODES: S = SATISFACTORY U = UNSATISFACTORY NA = NOT APPLICABLE

ITEM	S	U	NA	COMMENTS/WORK ORDER # IF APPLICABLE
Complete weekly for Level 1 ASTs				
Containment Areas				
*Water in containment <10%. (If >10%, drain water & document below)				
Any evidence of an obvious release, spill, overflow or leakage from the regulated AST system, including any ancillary regulated equipment.				
Drain valves secured in a closed position				
Containment area free of damage or deterioration.				
Containment area is free of debris or fire hazards.				
Interstitial monitor in working order (if used)				
Complete monthly for Level 1 ASTs				
AST and Ancillary Equipment				
Any evidence of cracks, distortion or areas of wear				
Corrosion - Condition of external coatings, paints and insulation, if present				
Condition of support structure and foundation				
Any evidence of pipes or valves leaking				
Leak Detection System - (Includes both tank and regulated piping up to the first point of isolation)				
If installed is the leak detection system in working order (alarm test button functional if present)				
Any evidence of release from ancillary equipment and appurtenances up to the first point of isolation				
Ancillary Equipment				
Overfill prevention device functioning properly (Veeder-Root, clock gauge, sight glass)				
Relief vents are in place and clear of restrictions.				
Safety Precautions				
Spill containment/Fire extinguishers present (if required)				
Tank is labeled properly along with WVDEP signage in place and legible				
Safety precautions posted (e.g. NO SMOKING/FLAMMABLE)				
Tank is appropriately grounded.				
Lighting adequate, tank system secured to prevent vandalism and unauthorized use				
General area housekeeping is satisfactory.				

CONTAINMENT RELEASE NOTE/ADDITIONAL COMMENTS/ACTIONS

* If Containment was drained indicate time draining started: ____________________ Draining Completed: ________________

All records are to be kept for a minimum of 12 months

INSPECTED BY	SIGNATURE

HR 1M SPCC - ABOVE GROUND STORAGE TANKS (1 Month Check)

Date of Observation (month-day-year): ____________________

Work Order Number: ______________

Time of Observation (Time AM/PM): ____________________

Form Completed by (All participants): ____________________

Check all Tanks/Pipes for:

** Condition of tank/piping exterior*
** Condition of tank foundation and supports*
** Condition of overfill Protection*
** Vents clear of restrictions*
** Leakage indication by looking for:*
Drip marks or puddles
Tank/piping discoloration
Locally dead vegetation
Monitor leak detection systems (if equipped)

Check all Containment Areas for:

**Overall integrity*
** Standing water*
** Oil film on surface*
** Debris or fire hazards*
** Drain Valve Operational Tag*

Ensure Safety by:

** Check posted signs for visibility:*
** Contents label*
** "Disconnect Transfer Line" sign (fuels)*
** Safety precaution sign*
** Observe that all safety equipment is in place and operative*
** Ensure fire extinguishers are in place (if applicable)*
** Observe function of gages (if equipped)*
** Observe sight piece (if equipped)*

Note: The "X" box indicates that the inspector has observed the site. If there are any problems please comment on them in the Notes section.
The Valve Open/Closed columns are for time recording.

AST #	SAP FUNCTIONAL LOCATION	Description	Volume	Substance	"X" BOX AFTER CHECKED	Valve Open or Pumped	Valve Closed	NOTES
315	HA0-ANGASOL	Gasoline Stor Tank	1,500	Gasoline				
51	HA0-ANWSTOL-STORGTK	Waste Oil Brnr Tank 1,200 Gal	1,200	Waste Oil				
53	HA0-FLCHDSL-TANK001	Diesel Mob Equip Tank 2 Fuel Oil-12K Gal	12,000	Fuel Oil				
300	HA0-TGTURBN-LUBEOIL-10	Turb LO Used Oil Tank	16,570	Lube oil				
299	HA0-TGTURBN-LUBEOIL-11	Turb LO New Oil Tank	16,570	Lube oil				
	HA0-SOLUNLD-RACAPOS-1012	Railcar Posner Hydrlc Reservoir	250	Hydrualic oil				
16	HA0-ELEMGEN-DIESGN1-1012	Diesel Gen 1 Fuel Tank	300	#2 Fuel Oil				
17	HA0-ELEMGEN-DIESGN2-1012	Diesel Gen 2 Fuel Tank	300	#2 Fuel Oil				
	HA0-WAFPWTR-PUMPFI2-1012	Diesel Peerless Fire Pmp Fuel Tank	200	#2 Fuel Oil				
20	HA0-FAMPBLD-TANK001	Kerosene Tank	4,000	Kerosene				
95	HA0-ELEMGEN-DIESGN3-1012	Diesel Gen SO2 Fuel Oil Sys Fuel Tank	275	#2 Fuel Oil				
	HA0-FLCHDSL-TANK002	On road diesel tank	1,000	Diesel				

HR 1M SPCC - ABOVE GROUND STORAGE TANKS (1 Month Check)

Date of Observation (month-day-year): ____________________

Work Order Number: ______________

Time of Observation (Time AM/PM): ____________________

Form Completed by (All participants): ____________________

Check all Tanks/Pipes for:

** Condition of tank/piping exterior*
** Condition of tank foundation and supports*
** Condition of overfill Protection*
** Vents clear of restrictions*
** Leakage indication by looking for:*
Drip marks or puddles
Tank/piping discoloration
Locally dead vegetation
Monitor leak detection systems (if equipped)

Check all Containment Areas for:

**Overall integrity*
** Standing water*
** Oil film on surface*
** Debris or fire hazards*
** Drain Valve Operational Tag*

Ensure Safety by:

** Check posted signs for visibility:*
** Contents label*
** "Disconnect Transfer Line" sign (fuels)*
** Safety precaution sign*
** Observe that all safety equipment is in place and operative*
** Ensure fire extinguishers are in place (if applicable)*
** Observe function of gages (if equipped)*
** Observe sight piece (if equipped)*

Note: The "X" box indicates that the inspector has observed the site. If there are any problems please comment on them in the Notes section.
The Valve Open/Closed columns are for time recording.

AST #	SAP FUNCTIONAL LOCATION	Description	Volume	Substance	AFTER CHECKED	Open or Pumped	Valve Closed	NOTES
315	HA0-ANGASOL	Gasoline Stor Tank	1,500	Gasoline				
95	HA0-ELEMGEN-DIESGN3-1012	Diesel Gen SO2 Fuel Oil Sys Fuel Tank	275	#2 Fuel Oil				
	HA0-FLCHDSL-TANK002	On road diesel tank	1,000	Diesel				

HR 1M SPCC - ABOVE GROUND STORAGE TANKS (1 Month Check)

Date of Observation (month-day-year): ____________

Work Order Number: ____________

Time of Observation (Time AM/PM): ____________

Form Completed by (All participants): ____________

Check all Tanks/Pipes for:
** Condition of tank/piping exterior*
** Condition of tank foundation and supports*
** Condition of overfill Protection*
** Vents clear of restrictions*
** Leakage indication by looking for:*
Drip marks or puddles
Tank/piping discoloration
Locally dead vegetation
Monitor leak detection systems (if equipped)

Check all Containment Areas for:
**Overall integrity*
** Standing water*
** Oil film on surface*
** Debris or fire hazards*
** Drain Valve Operational Tag*

Ensure Safety by:
** Check posted signs for visibility:*
** Contents label*
** "Disconnect Transfer Line" sign (fuels)*
** Safety precaution sign*
** Observe that all safety equipment is in place and operative*
** Ensure fire extinguishers are in place (if applicable)*
** Observe function of gages (if equipped)*
** Observe sight piece (if equipped)*

Note: The "X" box indicates that the inspector has observed the site. If there are any problems please comment on them in the Notes section.
The Valve Open/Closed columns are for time recording.

AST #	SAP FUNCTIONAL LOCATION	Description	Volume	Substance	AFTER CHECKED	Open or Pumped	Valve Closed	NOTES
53	HA0-FLCHDSL-TANK001	Diesel Mob Equip Tank 2 Fuel	12,000	Fuel Oil				
	HA0-SOLUNLD-RACAPOS-1012	Railcar Posner Hydrlc Reservoir	250	Hydrualic oil				
20	HA0-FAMPBLD-TANK001	Kerosene Tank	4,000	Kerosene				

HARRISON POWER STATION QUARTERLY TANK INSPECTION

AREA: A Operator Equipment

Rev. Date: 01/26/2021

DATE ___________________________

CHECKED BY: ___________________________

SUPERVISOR: ___________________________

Check all Tanks/Pipes for:
Condition of tank/piping exterior
Condition of tank foundation and supports
Condition of overfill Protection: button test
Vents clear of restrictions
Leakage indication by looking for:
- Drip marks or puddles
- Tank/piping discoloration
- Locally dead vegetation

Check all Containment Areas for:
Overall integrity
Drain excessive standing water
Oil film on surface
Debris or fire hazards
Lockable drain valve
Drain valve locked

USE "O/S" FOR TANKS OUT OF SERVICE

EnsureSafety by:
Inspect posted signs for visibility:
Contents label
"Disconnect Transfer Line" sign
Safety precaution sign
Observe that all safety equipment is in place and operative
Ensure fire extinguishers are in place and operative
Check condition of facility fence and gates

		MARK WITH AN X TO SHOW INSPECTED			
DESCRIPTION	**AST ID #**	**TANK**	**PIPES**	**CONTAINMENT**	**REMARKS**
UNIT 1 MAIN TRANSFORMER	298				
UNIT 2 MAIN TRANSFORMER	41				
UNIT 3 MAIN TRANSFORMER	42				
UNIT 1 AUX. TRANSFORMER A	43				
UNIT 1 AUX. TRANSFORMER B	46				
UNIT 2 AUX. TRANSFORMER A	44				
UNIT 2 AUX. TRANSFORMER B	47				
UNIT 3 AUX. TRANSFORMER A	45				
UNIT 3 AUX. TRANSFORMER B	48				
RESERVE TRANSFORMER A	49				
RESERVE TRANSFORMER B	50				
SCRUBBER UNIT TRANSFORMER 1	54				
SCRUBBER UNIT TRANSFORMER 2	55				
SCRUBBER UNIT TRANSFORMER 3	56				
SCRUBBER RESV TRANSFORMER A	57				
SCRUBBER RESV TRANSFORMER B	58				
#1 EMER. GEN DAY TANK - 300 Gal	16				
#2 EMER. GEN DAY TANK - 300 Gal	17				
BFP 1A TURB OIL RES - LUBE OIL	21				
BFP 1B TURB OIL RES - LUBE OIL	22				
BFP 2A TURB OIL RES - LUBE OIL	23				
BFP 2B TURB OIL RES - LUBE OIL	24				
BFP 3A TURB OIL RES - LUBE OIL	25				
BFP 3B TURB OIL RES - LUBE OIL	26				
SOOT BLOWER COMP 1 - LUBE OIL	27				
SOOT BLOWER COMP 2 - LUBE OIL	28				
SOOT BLOWER COMP 3 - LUBE OIL	29				
TURBINE RESERVE 1 - LUBE OIL	30				
TURBINE RESERVE 2 - LUBE OIL	31				
TURBINE RESERVE 3 - LUBE OIL	32				
TURB. 1 OIL PURIFIER - LUBE OIL	33				
TURB. 2 OIL PURIFIER - LUBE OIL	34				
TURB. 3 OIL PURIFIER - LUBE OIL	35				
E.H. SYSTEM 1	307				

HARRISON POWER STATION QUARTERLY TANK INSPECTION

AREA: A Operator Equipment

Rev. Date: 01/26/2021

DATE ___________________________

CHECKED BY: ___________________________

SUPERVISOR: ___________________________

Check all Tanks/Pipes for:
Condition of tank/piping exterior
Condition of tank foundation and supports
Condition of overfill Protection: button test
Vents clear of restrictions
Leakage indication by looking for:
- Drip marks or puddles
- Tank/piping discoloration
- Locally dead vegetation

Check all Containment Areas for:
Overall integrity
Drain excessive standing water
Oil film on surface
Debris or fire hazards
Lockable drain valve
Drain valve locked

USE "O/S" FOR TANKS OUT OF SERVICE

EnsureSafety by:
Inspect posted signs for visibility:
Contents label
"Disconnect Transfer Line" sign
Safety precaution sign
Observe that all safety equipment is in place and operative
Ensure fire extinguishers are in place and operative
Check condition of facility fence and gates

		MARK WITH AN X TO SHOW INSPECTED			
DESCRIPTION	**AST ID #**	**TANK**	**PIPES**	**CONTAINMENT**	**REMARKS**
E.H. SYSTEM 2	308				
E.H. SYSTEM 3	309				
UNIT #1 SEAL OIL TANK	301				
UNIT #2 SEAL OIL TANK	302				
UNIT #3 SEAL OIL TANK	303				
LUBE OIL VAULT 1 (New Oil)	299				
LUBE OIL VAULT 2 (Clean Oil)	300				
#3 DIESEL GENERATOR DAY TANK	95				
SULFURIC ACID (OUTSIDE)	4				
BIOCIDE BLDG ACTI-BROM #1338	97				
BIOCIDE BLDG CORESHELL 71301	98				
SCALE INHIBITOR FEED TRAC 109	104				
UNIT #1 AMMONIUM HYDROXIDE	116				
UNIT #2 AMMONIUM HYDROXIDE	117				
UNIT #3 AMMONIUM HYDROXIDE	118				
AMMONIUM HYDROXIDE SPARE TANK	119				
TRISODIUM PHOSPHATE	120				
AMMONIUM HYDROXIDE AT AUX BOILER	121				
U2 CIRC H20 DIESEL TANK	358				
AT BIOCIDE BLDG SURECOOL #1393	167				
N. OF BIOCIDE BLDG SODIUM HYPOCHLORITI	314				
NALCO CORE SHELL 71301 - WASTE BLDG	352				
SPARE GSU TRANSFORMER IN SWITCHYARD	40				
SPARE GSU NOTE: Inspect the discharge pipe from the automated sump pump to verity no oil is being discharged to the adjacent ditch.					

HARRISON POWER STATION QUARTERLY TANK INSPECTION

AREA: B Operator Equipment

Rev. Date: 01/26/2021

DATE ___________________________

CHECKED BY: ___________________________

SUPERVISOR: ___________________________

Check all Tanks/Pipes for:
Condition of tank/piping exterior
Condition of tank foundation and supports
Condition of overfill Protection: button test
Vents clear of restrictions
Leakage indication by looking for:
- Drip marks or puddles
- Tank/piping discoloration
- Locally dead vegetation

Check all Containment Areas for:
Overall integrity
Drain excessive standing water
Oil film on surface
Debris or fire hazards
Lockable drain valve
Drain valve locked

USE "O/S" FOR TANKS OUT OF SERVICE

EnsureSafety by:
Inspect posted signs for visibility:
Contents label
"Disconnect Transfer Line" sign
Safety precaution sign
Observe that all safety equipment is in place and operative
Ensure fire extinguishers are in place and operative
Check condition of facility fence and gates

		MARK WITH AN X TO SHOW INSPECTED			
DESCRIPTION	**AST ID #**	**TANK**	**PIPES**	**CONTAINMENT**	**REMARKS**
GLYCOL 1	9				
GLYCOL 2	10				
GLYCOL 3	11				
USED OIL (B1)	51				
LIME SLURRY STORAGE TANK 1	88				
LIME SLURRY STORAGE TANK 2	89				
LIME SLURRY STORAGE TANK 3	90				
ORGANO SULFIDE SKID - CLARIFIER	320				
NALCO 1689 SKID - CLARIFIER	321				
METAL WASH CLEAN EFFLUENT TANK	15				
PROPYLENE GLYCOL - NO. 2 CON. PIT	125				
PROPYLENE GLYCOL - NO. 2 CON. PIT	353				
UREA DISSOLVER TANK 501-1	164				
UREA DISSOLVER TANK 501-2	165				
UREA REACTOR FEED TANK	166				
UNIT 1 SCR DAMPER RESERVIOR	175				
UNIT 2 SCR DAMPER RESERVIOR	176				
UNIT 3 SCR DAMPER RESERVIOR	177				
UNIT 1 DUCT A PRECIPITATOR TR'S	185-200				
UNIT 1 DUCT B PRECIPITATOR TR'S	201-216				
UNIT 2 DUCT A PRECIPITATOR TR'S	217-232				
UNIT 2 DUCT B PRECIPITATOR TR'S	233-248				
UNIT 3 DUCT A PRECIPITATOR TR'S	249-264				
UNIT 3 DUCT B PRECIPITATOR TR'S	265-280				
UNIT 1A ID FAN OIL RESERVOIR	281				
UNIT 1B ID FAN OIL RESERVOIR	282				
UNIT 2A ID FAN OIL RESERVOIR	283				
UNIT 2B ID FAN OIL RESERVOIR	284				
UNIT 3A ID FAN OIL RESERVOIR	285				
UNIT 3B ID FAN OIL RESERVOIR	286				
UNIT 1A BOOSTER FAN OIL RES.	287				
UNIT 1B BOOSTER FAN OIL RES.	288				
UNIT 2A BOOSTER FAN OIL RES.	289				
UNIT 2B BOOSTER FAN OIL RES.	290				

HARRISON POWER STATION QUARTERLY TANK INSPECTION

AREA: B Operator Equipment

Rev. Date: 01/26/2021

DATE ___________________________

CHECKED BY: ____

SUPERVISOR: ____

Check all Tanks/Pipes for:

Condition of tank/piping exterior
Condition of tank foundation and supports
Condition of overfill Protection: button test
Vents clear of restrictions
Leakage indication by looking for:
- Drip marks or puddles
- Tank/piping discoloration
- Locally dead vegetation

Check all Containment Areas for:

Overall integrity
Drain excessive standing water
Oil film on surface
Debris or fire hazards
Lockable drain valve
Drain valve locked

USE "O/S" FOR TANKS OUT OF SERVICE

EnsureSafety by:

Inspect posted signs for visibility:
Contents label
"Disconnect Transfer Line" sign
Safety precaution sign
Observe that all safety equipment is in place and operative
Ensure fire extinguishers are in place and operative
Check condition of facility fence and gates

		MARK WITH AN X TO SHOW INSPECTED			
DESCRIPTION	**AST ID #**	**TANK**	**PIPES**	**CONTAINMENT**	**REMARKS**
UNIT 3A BOOSTER FAN OIL RES.	291				
UNIT 3B BOOSTER FAN OIL RES.	292				
UNIT 1 SCRUBBER KNIFE GATE OIL RES.	182				
UNIT 2 SCRUBBER KNIFE GATE OIL RES.	183				
UNIT 3 SCRUBBER KNIFE GATE OIL RES.	184				

HARRISON POWER STATION QUARTERLY TANK INSPECTION

AREA: C Operator Equipment | **Rev. Date: 01/26/2021**

DATE ________________________

CHECKED BY: ________________________

SUPERVISOR: ________________________

Check all Tanks/Pipes for:

Condition of tank/piping exterior
Condition of tank foundation and supports
Condition of overfill Protection: button test
Vents clear of restrictions
Leakage indication by looking for:
- Drip marks or puddles
- Tank/piping discoloration
- Locally dead vegetation

Check all Containment Areas for:

Overall integrity
Drain excessive standing water
Oil film on surface
Debris or fire hazards
Lockable drain valve
Drain valve locked

USE "O/S" FOR TANKS OUT OF SERVICE

EnsureSafety by:

Inspect posted signs for visibility:
Contents label
"Disconnect Transfer Line" sign
Safety precaution sign
Observe that all safety equipment is in place and operative
Ensure fire extinguishers are in place and operative
Check condition of facility fence and gates

		MARK WITH AN X TO SHOW INSPECTED			
DESCRIPTION	**AST ID #**	**TANK**	**PIPES**	**CONTAINMENT**	**REMARKS**
SODIUM SULFITE (BLUE)	103				
OILY WASTE SKIMMER OIL COLLECTION TANK	39				
COOLING TOWER NALCO 3DT121	14				
SCREEN HOUSE FIRE PUMP DIESEL TANK	18				
DEMINERALIZER SULFURIC ACID DAY TANK	105				
DEMINERALIZER CAUSTIC DAY TANK	106				
AQUA AMMONIA 35% (TOTE-WEST OF U2 ELEVATOR)	96				
NALCO 7396 - POTABLE WATER PRE-TREATMENT	122				
PARTS WASHER - UNIT 1 AREA	168				
PARTS WASHER - UNIT #2 AREA H15	171				
SEWAGE PLANT - SODIUM HYPOCHLORITE	110				

HARRISON POWER STATION ICP

Section III – Annexes

Annex 23 – Evacuation Procedure

(Excerpted from Harrison Power Station Emergency Plan and Prevention, 02/2019)

A. Evacuation Plan – Area/Partial/Complete Evacuations general information

Certain conditions, for example, aerial lift, major fires, explosions, bomb threats, chemical release, severe boiler leak etc. may occur that necessitate **AREA, PARTIAL or COMPLETE** evacuation of the facility. All possible circumstances cannot be anticipated. However, this procedure will serve as guidance for the Process Supervisor (Incident Commander) to determine the appropriate evacuation level.

The Incident Commander determines the level of evacuations that is required for the situation. If an event occurs that requires evacuation, the Process Supervisor is the INCIDENT COMMANDER and shall initiate the appropriate evacuation.

NOTE: All announcements will be made over the Plant PA system and the Plant radios.

B. Area/Partial/Complete Evacuations Definitions, Announcements, and Initial Evacuation Action.

1. Area Evacuation

An area evacuation is an evacuation of a certain area in a facility (ex. Area within the Main Plant, Scrubber Building or other auxiliary area) that may contain a hazardous situation in that part of the station (examples: boiler X-Rays, overhead lifts, localized spills etc.). No accountability is taken. The emergency shall be announced over the P.A. system and radio by the Control Room Operator.

NOTE: Area evacuation for x-ray and blasting may be made by lead man or supervisor in charge

Example
Step 1 – Announce Attention! Attention! Attention! - This is an <u>area</u> evacuation. We have X-Rays taking place on unit 1, 4th floor.
Step 2 – Announce Attention! Attention! Attention! - This is an <u>area</u> evacuation. We have X-Rays taking place on unit 1, 4th floor.
Step 3 – Announce Attention! Attention! Attention! - This is an <u>area</u> evacuation. We have X-Rays taking place on unit 1, 4th floor.

All personnel except those designated to have access are to stay clear of the area until the Control Room Operator announces an all clear on the Area Evacuation

2. Partial Evacuation

Section III – Annexes

Annex 23 – Evacuation Procedure

A partial evacuation is an evacuation of the entire station except for Essential Personnel. Example: Fire, bomb threat or any other situation that requires the evacuation of all employees from the station with the exception of Essential Personnel, as defined in section C, 1. a. The emergency shall be announced utilizing the audible alarm and the P.A. system and radio by the Control Room Operator.

Example –
Step 1 - Sound the audible evacuation alarm for 10 seconds, then announce "this is a <u>partial</u> evacuation. We have an emergency at 1A mill. All non-essential personnel need to evacuate immediately and report to designated accountability area".
Step 2 - Announce "this is a <u>partial</u> evacuation. We have an emergency at 1A mill.

Step 3 - Announce "this is a <u>partial</u> evacuation. We have an emergency at 1A mill.

All non-essential employees are to exit the building via the nearest exit unless the nearest exit would put them in harm's way and assemble at their designated reporting area (Section C, 1. b) for accountability.
Note: Never use the elevators when evacuating for any emergency.

3. <u>Complete Evacuation</u>

A complete evacuation is an evacuation of **all** station personnel. This is done strictly as a last resort when it is unsafe for any personnel to remain in the facility. The emergency shall be announced over the P.A. system and radio by the Control Room Operator.

Example—Attention! Attention! Attention! This is a <u>complete</u> evacuation. All employees are to evacuate at once and report to designated reporting areas. The complete evacuation announcement shall be repeated a minimum of three (3) times followed by the audible evacuation whistle.

Example –
Step 1 - Sound the audible evacuation alarm for 10 seconds, then announce "this is a <u>complete</u> evacuation. All employees are to evacuate at once and report to their designated reporting areas.
Step 2 - Sound the audible evacuation alarm for 10 seconds, then announce "this is a complete evacuation. All employees are to evacuate at once.
Step 3 - Sound the audible evacuation alarm for 10 seconds, then announce "this is a <u>complete</u> evacuation. All employees are to evacuate at once.
Step 4 – Sound Evacuation alarm for 10 seconds (minimum)

Control Room Operators shall remove units from service as directed by the Incident Commander.

Section III – Annexes

Annex 23 – Evacuation Procedure

All personnel are to exit the building via the nearest exit unless the nearest exit would put them in harm's way and assemble at their accountability areas for accountability. In the event that the accountability areas are not safe, all personnel shall report to the Flagpole.
Note: Never use the elevators when evacuating for any emergency.

C. <u>Evacuation Plan - Partial Evacuation Accountability and Roles and Responsibilities</u>

Note: The Central Accountability Officer shall report to the Maintenance Shop. The Accountability Officers are listed in Section E

1. <u>Accountability- Partial Evacuation</u>

a) Essential Personnel: Station Director, Operations Manager, Operations Superintendent (If on site) and all Operations personnel report to the Control Room. Control Room Operator shall account for persons reporting to the Control Room. The Control Room Operator will report accountability to the Central Accountability Officer.

Note: In the event of a fire the essential personnel also includes the Rescue Team

b) Non-essential Personnel

i. Coal Handling personnel shall report to the Coal Handling Office. Coal Handling Supervisor on shift shall be responsible to take accountability and report status to the Central Accountability Officer as quickly as possible.

ii. Contractors shall proceed to the Quonset Hut in event of evacuation. The contractor superintendent or designee is responsible to account for their personnel and reporting to the FE Contractor Representative. The Contractor Superintendent shall report the status to the Central Accountability Officer as quickly as possible.

iii. Visitors and all other station personnel with the exception of security shall report to their accountability areas, assemble in teams and the supervisor or designated accountability officer for each team will report accountability for their team to the Central Accountability Officer. **<u>If the accountability area is not a safe evacuation area, you are to assemble at the flagpole.</u>**

Note: Persons not accounted for shall be submitted to Central Accountability Officer indicating name and work location.

The Incident Commander will direct the Rescue Team to search for missing employees.

Note: Weekends, Holidays, and Monday-Friday 2:30 P.M. – 7:00 A.M.:
-Accountability will be reported to the Control Room Operator who will report overall accountability to the Incident Commander. The Incident Commander will assume the Role of Central Accountability Officer.
-The Incident Commander will assign an operator to account for Visitors and all other personnel.

2. **Roles and Responsibilities – Partial Evacuation**

a) Process Supervisor (Incident Commander):

i. Serves as Incident Commander overall responsibility for the evacuation and all supporting activities.
ii. Assesses need for evacuation and orders appropriate level of evacuation if required.
iii. Overall responsibility for accountability.
iv. Directs emergency response including:
   a. Directs the Rescue teams if needed.
   b. Determines if outside help is needed, if so, he will direct Control Room Operator to call for outside help.
   c. Orders Equipment in and out of service.
   d. Directs Security
v. Verifies outside agencies are notified as required
vi. Contacts and reports damage to Director and/or Operations Manager as soon as practical during off shift.
vii. Directs the Control Room Operator to announce, “All Clear” when Emergency is over and Accountability is cleared.

b) Control Room Operator

i. Announces Emergency and activates Evacuation Alarm.
ii. Accounts for Essential Personnel reporting to the Control Room.
iii. Calls for outside help when directed.
iv. De-energizes and takes equipment out of service when directed.
v. Directs Security to open all motorized gates.
vi. When directed, announces the “All Clear”.

c) Operations Personnel

i. Report to Control Room for non-fire emergency
ii. Reports to scene of fire. See Fire and Accountability procedure

d) Rescue Team

i. Shall evacuate with normal crew (if no fire).
ii. Await direction of Incident Commander
iii. At direction of Incident Commander report to incident site.

Note: In the case of a fire all Rescue team members immediately report to the fire

e) Security

i. Opens all motorized gates and remains at Main guard house.
ii. Notifies the Incident Commander when Emergency Response services arrive and directs them to the required reporting location.
iii. Restricts entrance to anyone except Station employees or emergency personnel and/or emergency vehicles.
iv. Informs Control Room of the presence of media and news agencies but does not permit them to enter the site.
v. Delivers visitor log to Central Accountability Officer.
vi. Keeps a record of anyone leaving the property and the reason for leaving.

vii. Keeps Log of all Emergency vehicles coming on site.

f) Station Director, Operations Manager and Operations Superintendent
- Reports to control room to support Process Supervisor/Incident Commander.

g) Central Accountability Officer
-Gathers accountability data from FE Supervision, FE Contractor Reps, and Accountability Officers

D. Evacuation Plan - Complete Evacuation Accountability and Roles and Responsibilities

1. **Accountability-Complete Evacuation** (the Accountability Officers are listed in Section E)
   a) Contractors shall proceed to the Quonset Hut. The contractor superintendent or designee is responsible to account for their personnel. The status shall be reported to the FE Contractor Representative. The FE Contractor Representative shall report the accountability to the Central Accountability Officer as quickly as possible.

   b) All other personnel on site with the exception of security and contractors shall report to the Flagpole, assemble in teams and the supervisor or designated accountability officer for each team will report accountability for their team to the Central Accountability Officer.

   Note: Persons not accounted for shall be submitted to Central Accountability Officer indicating name and work location.
   The Incident Commander will direct the Rescue Team to search for missing employees.

   Note: Weekends, Holidays, and Monday-Friday 2:30 P.M. – 7:00 A.M., accountability will be reported to the Incident Commander. The Incident Commander will assume the Role of Central Accountability Officer.

2. **Roles and Responsibilities – Complete Evacuation**
   a) Process Supervisor (Incident Commander):
      i. Serves as Incident Commander overall responsibility for the evacuation and all supporting activities.
      ii. Assesses need for evacuation and orders appropriate level of evacuation if required.
      iii. Overall responsibility for accountability.
      iv. Directs emergency response including:
         a. Directs Rescue teams if needed.
         b. Determines if outside help is needed, if so, he will direct Control Room Operator to call for outside help.
         c. Directs Control Room Operators to remove units from service. Specifies whether to trip the units or remove in a controlled manner.
         d. Orders Equipment in and out of service, based on the emergency (example for flooding, all electrical systems may be de energized.
         e. Directs the Control Room Operators to evacuate. Evacuates with the Control Room Operators.

f. Directs Security

v. Verifies outside agencies are notified as required

vi. Contacts and reports damage to Director and/or Operations Manager as soon as practical during off shift.

vii. Directs the Control Room Operator to announce, "All Clear" when Emergency is over and Accountability is cleared.

b) Control Room Operator

i. Announces Emergency and activates Evacuation Alarm.

ii. Calls for outside help when directed.

iii. Removes Units from service as directed by the Incident Commander

iv. Removes additional equipment and systems from service as directed by the Incident Commander.

v. Directs Security to open all motorized gates.

vi. Evacuates after confirming with the Incident Commander that all directives are complete.

vii. At the Direction of the Incident Commanders verbally announces the "All Clear" at the accountability areas.

c) Rescue Team

i. Shall evacuate with normal crew, if no fire.

ii. Will support the complete evacuation at direction of the Incident Commander.

d) Security

i. Opens all motorized gates and remains at Main guard house.

ii. Notifies the Incident Commander when Emergency Response services arrive and directs them to the required reporting location.

iii. Restricts entrance to anyone except Station employees or emergency personnel and/or emergency vehicles.

iv. Informs Control Room of the presence of media and news agencies but does not permit them to enter the site.

v. Delivers visitor log to Central Accountability Officer.

vi. Keeps a record of anyone leaving the property and the reason for leaving.

vii. Keeps Log of all Emergency vehicles coming on site.

e) Station Director, Operations Manager and Operations Superintendent.

i. Reports to the Control Room to support the Incident Commander/Incident Commander.

E. Emergency Procedures-Accountability Officers

1. **Weekends, Holidays, and Monday-Friday 2:30 P.M. – 7:00 A.M.** the Incident Commander will serve as the Central Accountability Officer, and assign an operator to account for Visitors and all other personnel.
2. **Daylight Shift-(7:00 A.M. – 2:30 P.M.)**

a) **Central Accountability Officer**: Maintenance Superintendent (Primary)

Maintenance Supervisor (Secondary)
Meeting Area: **Partial Evacuation** (Maintenance Shop)
Complete Evacuation (Flag Pole)

b) **Visitors and Front Office Accountability**: Front Desk AA
Meeting Area: **Partial Evacuation** (Front Lobby)
Complete Evacuation (flagpole)

c) **Solid Waste Processing Accountability Officers**: Department Supervisor or Fill in Supervisor.
Meeting Area: Partial Evacuation Solid Waste control room.
Complete Evacuation (flagpole)

d) **West End Accountability Officers**: Construction Superintendent
Meeting Area: West end 1st floor Lobby
Complete Evacuation (flagpole)

e) **Coal Handling Accountability Officers**: Department Supervisor or Fill in Supervisor.
Meeting Area: **Partial Evacuation** Coal Handling Office.
Complete Evacuation (flagpole)

f) **Maintenance, Storeroom, Work Management, and Tech Services Accountability Officer**: Department Supervisor
Meeting Area: **Partial Evacuation** (Maintenance Shop)
Complete Evacuation (Flag Pole)

g) **Spare Operating crew, Director, and Tech Service Manager Accountability Officer:** Production Supervisor
Meeting Area: **Partial Evacuation** Control room
Complete Evacuation (flagpole)

h) **Contractors Accountability Officer**: Contractor Superintendent
Meeting Area: Partial Evacuation Quonset Hut
Complete I Evacuation Quonset Hut

i) **Operating crew, Ops Manager, Maint Manager, Safety Rep, Ops Superintendent and Emergency Response Liasons Accountability Officer**: Dayshift Operations Superintendent and Process Supervisor on off shifts and weekends
Meeting Area: Partial Evacuation Emergency scene
Complete Evacuation (flagpole)

j) **Mobile Maintenance Crew:** Mobile Maintenance Lead man
Meeting Area: **Partial Evacuation**: Maintenance Shop
Complete Evacuation (flagpole)

Section III – Annexes

Annex 23 – Evacuation Procedure

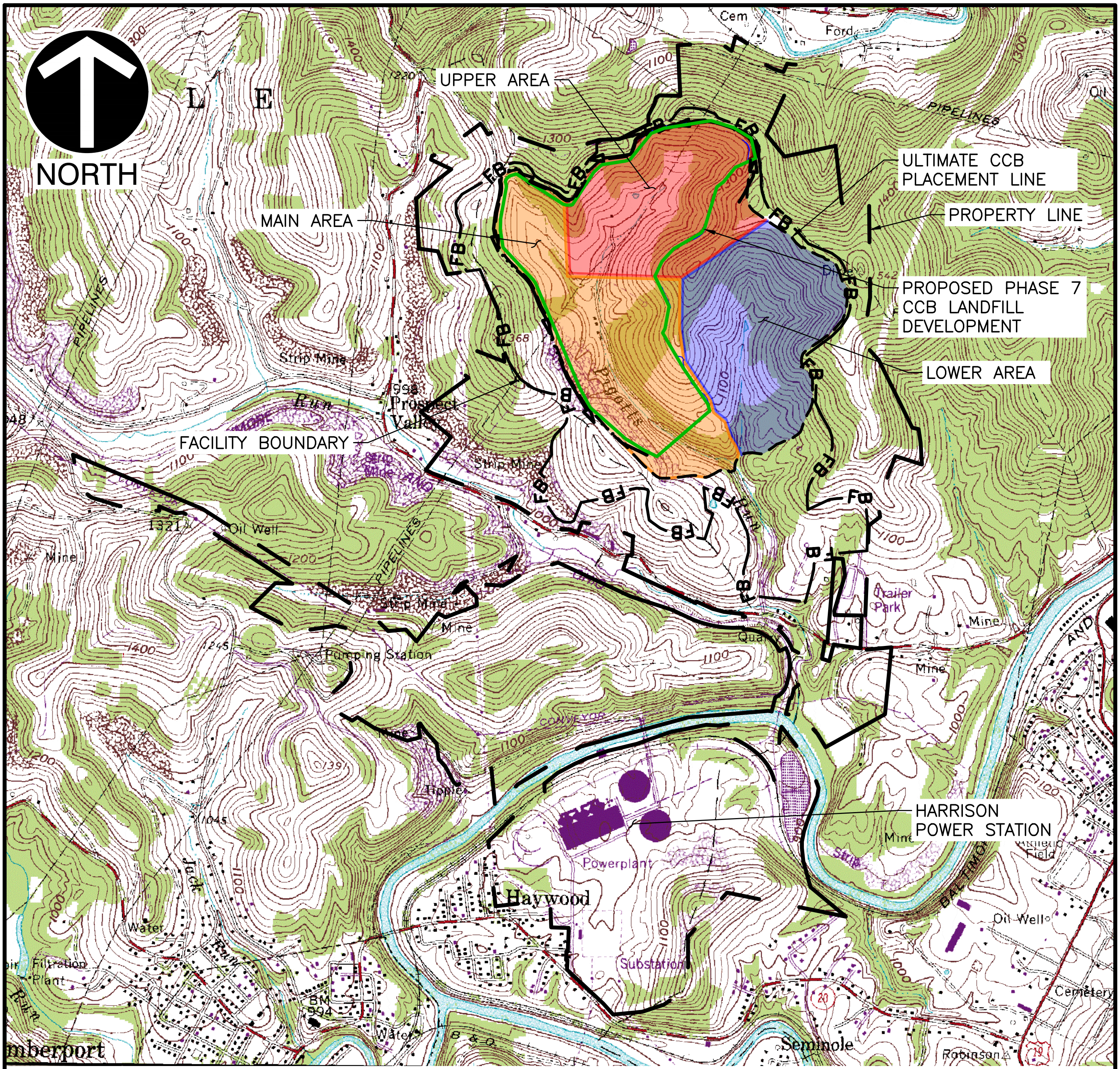
Accountability List

	FIRE	Partial Evacuation	Complete Evacuation
Front Office Business Services Visitors	Front Office	Front Office	Flagpole
Accountability taken by:	Front Desk AA		
Maintenance Storeroom Work management Tech Services	Maintenance Shop	Maintenance Shop	Flagpole
Accountability taken by:	Department Supervisor		
Solid Waste Processing Randy Davis	SWP Control Room	SWP Control Room	Flagpole
Accountability taken by:	SWP Supervisor		
Coal Handling	Coal Handling Office	Coal Handling Office	Flagpole
Accountability taken by:	Coal Handling Supervisor		
Electricians Construction West end Personnel	West End 1st floor Lobby	West End 1st floor Lobby	Flagpole
Accountability taken by:	Construction Superintendent		
Operations Crew on Shift Operations Manager Maintenance Manager Safety Representative	Fire Scene	Emergency Scene	Flagpole
Accountability taken by:	Operations Superintendent Dayshift / Process Supervisor off-shifts		
Mobile Maintenance	Maintenance Shop	Maintenance Shop	Flag pole
Accountability taken by:	Mobile Maintenance Lead man		
Contractors	Work Area	Quonset Hut	Quonset Hut
Accountability taken by:	Contractor Supts (reports to Outage Supt.)		
Spare Crew Operations Overtime Crew Tech Services Manager Director	Control Room	Control Room	Flagpole
Accountability taken by:	Control Room Foreman		
Rescue Team	Supervisor first	Evacuate with crew and await instructions	Flagpole
Accountability taken by:	Supervisor	Department Supervisor	Department Supervisor

In all situations: Accountability is reported to the Central Accountability officer (Maintenance Superintendent)

Section III – Annexes

Annex 23 – Evacuation Procedure



LEGEND

PROPOSED PHASE 7 EXPANSION

UPPER AREA

LOWER AREA

MAIN AREA

SCALE IN FEET

0 2000 4000

CEC

Civil & Environmental Consultants, Inc.

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412-429-2324 · 800-365-2324

www.cecinc.com

MONONGAHELA POWER, A FIRSTENERGY COMPANY
PHASE 7 CCB LANDFILL EXPANSION
HARRISON POWER STATION
HARRISON COUNTY, WEST VIRGINIA

SITE LOCATION MAP

DRAWN BY: TAF	CHECKED BY: MRF	APPROVED BY: DMT*	FIGURE NO.:
DATE: MARCH 2021	DWG SCALE: 1"=2000'	PROJECT NO: 302-918	1

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PERMIT MODIFICATION APPLICATION FOR PHASE 7 EXPANSION

Solid Waste Permit No WV 0075795 and Phase 7 Expansion

PREPARED FOR:

MONONGAHELA POWER, A FIRST ENERGY COMPANY
Harrison Power Station
CCB Landfill
Haywood, Harrison County West Virginia 26366

PREPARED BY:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

March 2021

VOLUME I of I

APPLICATION FOR RENEWAL
SOLID WASTE PERMIT NO. WV 0075795 AND PROPOSED PHASE 7 EXPANSION AREAS

Prepared For:

MonPower®
A FirstEnergy Company

MONONGAHELA POWER COMPANY
A FIRSTENERGY COMPANY
HARRISON COUNTY POWER STATION
HARRISON COUNTY, WEST VIRGINIA

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
PITTSBURGH, PENNSYLVANIA

CEC Project 302-918

March 2021

CEC
Civil & Environmental Consultants, Inc.

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PROFESSIONAL ENGINEER'S CERTIFICATION

I, Daniel M. Tolmer, being a Registered Professional Engineer in the State of West Virginia do hereby certify that to the best of my knowledge, information, and belief that the information contained in the accompanying modification application for Solid Waste Permit No. WV 0075795 and Phase 7 Expansion has been prepared in accordance with accepted engineering practice, is true and correct, and is in conformance with Title 33: Legislative Rule, West Virginia Department of Environmental Protection, Office of Waste Management, Series 1: Solid Waste Management Rule, Effective Date June 30, 2014.

Facility Name: Harrison Power Station CCB Landfill
Facility Location: Harrison County

Engineer's Signature: [signature] WV License No. 23162

DANIEL M. TOLMER
REGISTERED
23162
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER

3/12/2021

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Pittsburgh, PA, 15205

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1.0 PROJECT OVERVIEW

1.1 Permit Status

Pursuant to West Virginia Department of Environmental Protection (WVDEP) Legislative Rule, Title 33, Series 1 ("Solid Waste Management Rule," June 2014), Monongahela Power Company (MonPower) a direct subsidiary of FirstEnergy Corp. hereby submits the Solid Waste Application for Renewal of Permit No. WV 0075795 (Permit No. WV0075795), for the operation of a Class F Coal Combustion By-product (CCB) Solid Waste Disposal Facility. This application contains information related to the Phase 7 Expansion of this Facility. This Facility, referred to hereafter as the CCB Landfill, is a captive site used for the placement of solid wastes generated from operation and maintenance of the Harrison Power Station. Approximately 92 percent of the waste placed in the CCB Landfill will consist of fixated flue gas desulfurization (FGD) material produced at the station. Fly ash, bottom ash, and other wastes related to the generation of electricity compose the remaining eight percent. Refer to Table 1, Summary of Solid Waste Materials and Tonnages, Harrison Power Station – CCB Landfill for the approximate composition of waste disposed in the CCB landfill.

The Harrison Power Station is a coal-fired electric generating Facility located near the community of Shinnston in Harrison County, West Virginia (WV) as shown on Figure 1, Site Location Map. The station consists of three generating units which are capable of producing 1,920 megawatts of electricity. CCBs generated at this Facility are placed in the CCB Landfill, which is located approximately one mile north northeast of the station (refer to Figure 1). The approximate center of the CCB Landfill is located at 39˚ 24' 16" north latitude and 80˚ 19' 56" west longitude. The community of Shinnston, WV is located approximately one mile southeast of the site. Approximately 250 acres are currently permitted for landfill operations under Permit No. WV0075795.

1.2 Application Format

The application consists of two parts: the Solid Waste Permit renewal and expansion documents; and the National Pollutant Discharge Elimination Permit System (NPDES) information, which is entered via the WV Electronic Submission System (ESS.) This application is for the renewal and expansion of Permit No. WV 0075795 and has been prepared in accordance with 33CSR1, the "Solid Waste Management Rule", Section 3.7. Permit Application Requirements. The application, supplemented by previously-submitted documentation for the CCB landfill referenced herein, provides the applicable administrative and technical information required for final approval of the Permit renewal. The application format generally follows 33CSR1.3.7.

The application presents the following information:

- Update of information on site conditions and wastes;
- Descriptions of the current permitted area and proposed expansion activities anticipated to occur during the five-year Permit period;
- Summaries of information presented in submitted Permit documents; and
- Summaries of approved Permit waivers and approved Permit modifications obtained.

Detailed information and design calculations provided in submitted documents, approved by WVDEP, and referenced herein, have been summarized to the extent practicable, to reduce the duplication of information. Tables are used to simplify the presentation of this information.

1.3 Application Preparation

This application is for renewal and expansion of the Solid Waste/National Pollutant Discharge Elimination System (NPDES) Water Pollution Control Permit No. WV 0075795 for the CCB Landfill at the Harrison Power Station which expires on September 18, 2021.

Applicant: Monongahela Power Company
800 Cabin Hill Drive
Greensburg, Pennsylvania 15601
Telephone: 724-838-6101

This application was prepared under the supervision of Mr. Daniel Tolmer, a licensed Professional Engineer in the State of West Virginia, registration number 23162. Mr. Tolmer is employed by:

Civil & Environmental Consultants, Inc.
Pittsburgh Office
333 Baldwin Road
Pittsburgh, Pennsylvania 15205

2.0 SITE INFORMATION

2.1 Site Description and Development History

The Harrison Power Station CCB Landfill is located in Harrison County, WV. As shown on Figure 1, the CCB Landfill site is located approximately 1.25 miles northeast of Haywood, WV.

2.1.1 Site Description

The active site consists of the three areas, referred to as the Upper Area, the Main Area, and the Lower Area. The approximate footprint of each of these areas are depicted on Figure 1. Portions of the Lower Area, Main Area, and Upper Area are currently included in the permitted solid waste area. A portion of the Main Area previously used for landfilling fly ash was closed in 1979, when landfill operations shifted to the Lower Area. The site development approved in 1992 through 2017 include the following: The Phase 3 expansion on the eastern side of the landfill, was approved in 1993 and modified through 1997, the Phase 4 expansion situated in the Main and Upper Areas, was initially approved in 2003, and further developed in 2006 and 2010, the Phase 5 expansion on the northern and northwestern side of the landfill, was approved in August 2011, the Phase 6 expansion area above the Phase 5 expansion area on the northern side of the landfill was approved in September 2016, and the Phase 6A Expansion Area on the western side and central portion of the landfill was approved in December 2017. The proposed Phase 7 Expansion will include the Eastern and Saddle Expansion areas comprising approximately 12.6 acres of liner installation that will be adjacent to or overlay portions of the previously permitted liner areas.

The permitted areas of the CCB Landfill not presently affected by landfill operations are primarily wooded, with moderately steep slopes. Electric transmission lines, gas transmission lines, and active and abandoned gas wells are present on or near the site. The land around the site is rural, composed of forests, open fields, pastures, and areas of past surface mining, reclaimed to varying degrees.

The site is underlain by the Pittsburgh coal seam. The Pittsburgh coal seam has been deep mined by room and pillar and retreat mining methods. The Pittsburgh coal seam is typically seven to nine feet thick. There is no active mining beneath the site. The extent of the mining is shown on Drawing No. C89506723 previously provided in the Phase 5 Permit Application. Portions of existing mining that could affect the landfill stability have been previously stabilized (Reference 14 and 15). These areas were addressed in permitting for Phases 3 and 4.

2.1.2 Site Development History

The historical development of the landfill site is shown on Drawing No. C89503057 (Reference 18).

Disposal activities began after the plant was constructed in 1972. Coal ash was initially placed on the west side of the Main Area, ("Pre-1980 Ash" on Drawing No. C89503057 Reference 18). The ash was placed in this area as a side hill fill, and continued in this area until 1979.

In 1979, two ash fill slides occurred which required reconfiguring of the ash disposal area to be more stable. A piping system was installed from the upper section of the Main Area to convey stormwater beneath the regraded ash fill. The abandoned Pittsburgh coal seam mine workings were grouted for a 24-foot to 44-foot width along the alignment of the pipes to prevent subsidence under the piping system. No additional ash was placed in the Main Area following completion of these remedial measures. Ash placement was then initiated in the Lower Area. The Lower Area was not lined prior to initial disposal, (Drawing No. C89503057, Reference 18). However, a prepared subgrade, with a central underdrain and blanket drain to pick up seeps and springs, was installed. The 1987 Permit application included a design for expansion of the Lower Area (Reference 2).

Revised facility design and solid waste permit application for the Lower Area was submitted in 1991/1992 (References 3 and 4). This included a liner system for additional portions of the Lower Area comprised of the following components, from bottom to top:

- a six-inch thick subbase, maximum permeability of 1 x 10^{-5} centimeters per second (cm/sec);
- a 12-inch thick leachate detection zone, minimum permeability of 1 x 10^{-3} cm/sec;
- a 24-inch thick compacted clay liner (CCL), maximum permeability of 1 x 10^{-7} cm/sec; and
- an 18-inch thick leachate collection zone, minimum permeability of 1 x 10^{-3} cm/sec.

Subsequent hydrologic and hydraulic conductivity analyses were performed and demonstrated that reducing the leachate collection zone to a 12-inch thick layer and reducing the leachate detection zone to a six-inch thick layer and leachate detection zone would perform adequately.

These Permit modifications were approved by the WVDEP, (Reference 5 and 6, respectively),

In 1994, sulfur dioxide (SO2) scrubbers were installed at the station to satisfy requirements of the Clean Air Act Amendments, this and a change in the station's coal supply led to an overall increase in the amount of solid waste generated by the Station by approximately five-fold. A permit modification for expansion of the Lower Area requested to increase the disposal area footprint to a total of 126 acres to provide additional airspace volume to accommodate disposal for the increased waste generation (Drawing No. C89503057 Reference 18 and Reference 7).

During the investigation for the landfill expansion in 1999, 1.54 acres of wetlands were identified within the proposed landfill expansion area, and 0.23-acre of wetlands were identified within the proposed Sedimentation Pond No. 1 expansion area (Reference 9). A donation was made to the WVDEP with the understanding that these funds would be used to construct wetlands in a nearby wildlife management area.

November 2001 applications were submitted to the WVDEP to approve expansion of Sedimentation Pond No. 1, and construction of a passive treatment wetland system (Drawing No. C89503057 Reference 18 and Reference 8). The original pond, constructed in 1995, needed to be enlarged to accommodate future landfill expansion into the Upper Area and Main Area. Enlarged Sedimentation Pond No. 1 was designed to receive surface water runoff and leachate flows from all areas associated with the development and operation of the CCB Landfill.

An application for a lateral expansion of operations into the Main and Upper Areas of the site, referred to hereafter as the Phase 4 Area (see Drawing No. C89503057) (Reference 18), was made in January 2003 (Reference 1) and approved in April 2003. The expansion resulted in an additional 95 acres of landfill footprint.

Another lateral expansion, Phase 4C, was permitted in April 2010 and constructed during the summer and fall of 2010. This expansion added 26 acres of landfill footprint and was the first utilization of the alternate liner system.

The Phase 5 expansion was permitted in August 2011 and constructed in sections during 2012 to 2015. The Phase 5 expansion added 35.17 acres of landfill footprint using the alternative liner system. The Phase 6 expansion was permitted in September 2016, and included the overlaid lined area of approximately 7.1 acres. The Phase 6 expansion area has not been constructed. The Phase 6A expansion was permitted in December 2017 and was constructed during the summer of 2018. The Phase 6A expansion added two lined areas, approximately 3.4 and 2.0 acres, at the southeast and southwest limits of the existing permitted landfill disposal area footprint.

2.2 Property Rights

The CCB Landfill property is solely owned by MonPower. Deeds for the property are recorded in the Office of the Clerk of the County Commission of Harrison County, WV.

2.3 Location Standards

The site has been reviewed with respect to the location standards in Section 3.2 of the WV Solid Waste Management Rule (WVSWMR).

The Facility meets or has a Permit waiver for each location standard in Section 3.2 of the WVSWMR. Greater detail is provided in Section 6.(References 1, 3, and 12).

WVSWMR Subsection	Location Standard	Compliance
3.2.a	Surface Water	Permit Waiver
3.2.b	Natural Wetlands	Permit Waiver
3.2.c	Perennial Streams	Permit Waiver
3.2.d	Floodplains	Yes
3.2.e	Highways and Public Parks	Yes
3.2.f	Fault Areas	Yes
3.2.g	Airport Safety	Yes
3.2.h	Dwellings	Yes
3.2.i	Water Supply Wells	Yes
3.2.j	Unstable Areas	Permit Waiver
3.2.k	Underground Mines	Permit Waiver

WVSWMR Subsection	Location Standard	Compliance
3.2.l	Surface Mines	Permit Waiver
3.2.m	Seismic Impact Zones	Yes
3.2.n	Air Criteria	Yes
3.2.o	Property Line Distance	Yes

MonPower purchased an additional piece of property along the northern edge of the property as shown on Drawing No. C89509685 the 2021 Subgrade Construction Grading Plan. This property was purchased to accommodate the Saddle Area expansion for construction of additional lined area for CCB placement adjacent to existing permitted lined disposal areas along the northern edge of the property. The purchase of the property will allow MonPower to construct additional lined areas and place CCB in accordance with location restrictions for liner construction and waste placement in this area

This application is not requesting expansion of areas beyond the ultimate disposal limit that was approved in previous permits and submittals.

2.4 Endangered Species and Historic Sites

On June 28, 1990, the State of WV, Department of Commerce, Labor and Environmental Resources, Division of Natural Resources, responded to an inquiry from Allegheny Power Systems (now MonPower) concerning rare/threatened/ endangered (RTE) species for the CCB Landfill site. The letter indicated that no RTE species were within or adjacent to the project site. A March 7, 2002 letter from the Division of Natural Resources to AE Supply reaffirmed this conclusion (see Reference 1, Appendix H).

A study of the site for historical sites was performed for previous Permit applications. The study identified that no historical sites were known to exist; however, the WV State Historic Preservation Office (SHPO) does require that a 100 foot buffer area be maintained surrounding the Duncan Cemetery. The study and its findings were described in the previous Phase 5 Permit Application, Section 2.4.

2.5 Geologic and Hydrogeologic Information

2.5.1 Geology

2.5.1.1 Bedrock

Published reports and previous investigations indicate that strata of the Pennsylvanian age Conemaugh Group, Monongahela Group, and the Lower Permian/Pennsylvanian age Dunkard Group comprise the near surface bedrock at the site. The lowermost member of the Monongahela Group, the Pittsburgh coal, crops out in limited areas of the Main Area and Lower Area at approximate elevation 950 feet. Figure 2 is a typical cross-section of the geology described above. Boring logs from subsurface investigation are provided in Appendix A of the Phase 5 Permit Application

The Monongahela Group averages approximately 410 feet in thickness on-site. The lowermost member, the Pittsburgh coal, is typically eight feet thick and, based on available mine mapping, has been extensively deep mined under the site (Drawing No. C8950198 in Reference 1). In areas where the Pittsburgh coal cropped out it was surface mined as well. A detailed description of the geology of the site is contained in Reference 1.

2.5.1.2 Decomposed Rock

There is a zone of decomposed rock above competent rock throughout the site. The thickness and degree of decomposition varies based on rock type, amount of soil cover and topography. Decomposed rock thicknesses of one foot to over 25 feet have been observed, and decomposition has ranged from slight weathering to near soil conditions.

2.5.1.3 Soils

Published information indicates that the soils on-site consist of silty clays. Section 2.6 of this permit application addresses the soil resources in much greater detail. Generally, soil thicknesses encountered during the various site investigations ranged from zero to 33 feet, and were predominantly silty clays. The typical soil thickness is 10 feet. Area soils include colluvial and residual soils. Surface mine backfill and fly ash are also located near the surface.

2.5.2 Structural Geology

The site is positioned on the east flank of the Wolf summit Anticline, where the dip is 100 feet per mile or one degree to the northeast. The contours of the base of the Pittsburgh coal at the site and surrounding area, obtained from published information and/or subsurface investigations, are shown on the regional structure contour map, Figure 3. A set of contours representing the base of the Pittsburgh coal is shown on Drawing No. C8950198 in Reference 1.

2.5.3 Hydrogeology

This section provides an overview of hydrogeologic characteristics at the site based on previous studies as well as more recent work completed under the CCR Rule monitoring program.

Groundwater in the CCB Landfill area occurs primarily within the fractured bedrock of the Monongahela Group, with flow patterns at the site being primarily controlled by structure (i.e. migration down-dip within a groundwater flow unit). Three principal water-bearing units have been identified at the site, including in descending stratigraphic order the Lower Uniontown Coal horizon, the Lower Sewickley Sandstone, and the Pittsburgh Coal. The Lower Uniontown Coal is a perched aquifer restricted to ridge areas. The Lower Sewickley Sandstone is continuous under most of the area (except a portion of lower Pigott's Run where it has been eroded away), and the Pittsburgh Coal is also present under most of the area except where eroded away or strip-mined in the lower reaches of Pigott's Run. The Lower Sewickley Sandstone, which underlies most of the disposal area, is considered the appropriate groundwater monitoring zone (i.e., uppermost aquifer) for the CCB Landfill.

Based on boring logs, cross sections, and structure contour mapping, the Lower Sewickley Sandstone is continuous beneath the UA and LA disposal areas. It is also present throughout the upper reaches of the MA disposal area but is eroded away along a narrow band on either side of Pigott's Run within the downstream reaches of the disposal area (the outcrop area is now covered by landfilled CCR material).

A total of 19 monitoring well borings have been advanced into the Lower Sewickley Sandstone at the CCB Landfill over the last 25 years (MW-1 through MW-20; MW-14 was never drilled). Of those well borings, 14 have been abandoned due to a combination of site operations or, in some cases, little or no groundwater encountered during drilling.

The active groundwater monitoring network at the site for both the WVDEP and CCR programs consists of the same wells: MW-5, MW-17, MW-18, MW-19, and MW-20. Based on both water level and bedrock structure data, well MW-5 is positioned as the site's upgradient well and the remaining wells are positioned both downgradient and down dip of the CCB Landfill. Depending on their topographic positioning, most of these wells range between 208 feet (MW-5) and 514 feet (MW-19) in total depth, with the exception being MW-17, which has a total depth of 63 feet.

Hydrogeologic properties for the CCB Landfill area have been estimated as part of previous studies. Estimates of hydraulic conductivity (K) are available for the landfill waste materials, natural soils, and bedrock. The estimates are based on limited testing data and should be considered generalized estimates only, particularly for the bedrock, as individual fractures in fractured rock groundwater flow systems typically vary widely in water-yielding capabilities. Estimated K values for landfill waste are in the range of 10^{-5} to 10^{-6} centimeters (cm)/second (sec), while remolded K values for the natural soils present across the site (mostly silt/clay) range from 10^{-7} to 10^{-9} cm/sec. Based on slug tests in well borings, bulk hydraulic conductivities of bedrock range from 10^{-4} to 10^{-7} cm/sec, with an overall geometric mean value of approximately 2.4×10^{-5} cm/sec (0.07 foot/day). Slug tests measure the overall K of the tested portion of a boring, so it is likely that discrete fracture K values are much higher than the overall average.

Historic and recent groundwater level data indicate the overall groundwater flow direction within the Lower Sewickley Sandstone is from west to east, which also approximates the dip of the bedrock. Groundwater elevations in upgradient well MW-5 typically fluctuate around elevation 1095 feet, with downgradient elevations averaging approximately the following: 1050 feet between MW-17 and MW-20; 1000 feet at MW-18; and 970 feet at MW-19. The lower groundwater elevations measured in MW-18 and MW-19 versus MW-17 and MW-20 may be due to some localized mine subsidence-related fracturing and associated vertical drainage of groundwater into the underlying abandoned Pittsburgh Coal mine workings, by the continuing development of the upgradient UA disposal area which reduces rainfall infiltration recharge to the monitored aquifer, or by a combination of both occurrences. As noted in Section 1.3 of the Federal CCR Rule Assessment of Corrective Measures Report, leachate and groundwater from lined portions of the Main Area and Lower Area disposal areas and from all of the Upper Area disposal area are captured by both a leachate collection system and a combined leachate detection/ groundwater underdrain system. These flows are then routed through and discharged off-site via Sedimentation Pond No. 1. It is believed that the leachate collection and leachate detection/groundwater underdrain systems have a significant impact in reducing groundwater flow and hydraulic heads across the site as they capture and reroute surface infiltration which would otherwise provide recharge to the monitored aquifer and continue to flow downgradient of the landfill.

Figures 3-6, 3-8, and 3-11 provide geologic cross-sections completed as part of the solid waste permit application for the site. Figure 3-8 shows cross-section B-B' is a generally west-east section extending from the upgradient portion of the landfill area to the facility boundary (near the location of active well MW-18). The section cuts through the upper portion of the Main Area and the lower portions of the Upper Area and Lower Area and depicts the location and dip of the Lower Sewickley Sandstone below the CCB Landfill. As shown, groundwater occurs under unconfined and semi-confined conditions in the line of section area, with unconfined conditions occurring at upgradient well MW-5. Figure 3-11 shows cross-section E-E' is generally a north-south section beginning at the upgradient end of the Lower Area (near active well MW-20) and then extending through the center of the Lower Area, across the lower Main Area (formerly the Piggott's Run valley), and then ending near the current facility boundary. As indicated, groundwater in the line of section area occurs under unconfined conditions in the Lower Sewickley Sandstone and the layer exhibits little to no dip in this direction.

Section 5 describes the monitoring network that has been utilized over the past years, and the monitoring program for this permit application.

2.6 Soil Resources

A comprehensive soil resource inventory that identified and delineated soil resources on the CCB Landfill property, and specified potential borrow areas for subbase, clay liner, and general fill materials to be used for future landfill expansion, was performed in 1994 (References 11 and 12).

Natural soils mapped in the project area, and shown on the 1980 United States Department of Agriculture (USDA) Web Soil Survey (Figure 4), include the Clarksburg soil, formed in colluvium, and the Gilpin and Westmoreland soils, both formed in residuum. A detailed discussion of the soil types and their usage is provided in Reference 1.

Since the completion of the 1994 inventory, expansion phases have been constructed, and some of the soil resources delineated in the 1994 inventory have been used. Various field investigations and laboratory testing programs were conducted to update the soil resource inventory since that time. The most recent field investigation was conducted in August 2020.

2.6.1 August 2020 Site Soils Investigation and Results

With the proposed expansion of the Phase 7 Development, the August 2020 field investigation consisted of a confirmatory test pit sample collection program focused on the soils within the proposed Phase 7 area, and the western, southwestern and southern borrow areas shown on Drawing No. C89509683. The test pit program was performed to update soil borrow resource information, and to collect samples for geotechnical laboratory testing and analysis. Test pit excavations were completed to varying depths using an excavator manned by an operator. Based on visual observations, test pit depth, soil color, soil texture, and apparent moisture conditions were documented. Soil samples of the materials were obtained at varying depth intervals and transported to the laboratory for geotechnical testing.

A summary of the soil investigation observations from the August 2020 Site Soils Investigation is provided in Appendix B.

Laboratory testing has been performed to determine the geotechnical properties of selected samples to evaluate their use as potential liner material. Consistent with the results of previous investigations (see Appendix C in Reference 1), most of the samples were classified in accordance with the Unified Soil Classification System as a CH (fat clay) or CL (lean clay) material. Materials with a CH or CL classification generally are acceptable as liner material.

The soils were classified in accordance with USCS and UDSA as provided in Appendix B. The sieve analysis showed 100% particle sizes less than 6-inch diameter, 87% particle sizes less than 1-inch diameter on average, and 69% passing the No. 10 sieve on average. Hydrometer results for the samples indicated silt contents ranging from 16% to 51% with an average silt content of 31%, and clay contents ranging from 4% to 56% with an average clay content of 18%. Standard Proctor density testing indicated maximum dry densities of 109.5 pcf on average with optimum moisture contents of 15.9% on average.

2.6.2 Soil Resource Update

It was determined from the August 2020 site soils investigation that approximately 156,000 cubic yards of soil is available from excavation that will be perfomed to achieve proposed liner grades within the Phase 7 Expansion Area. Additionally, there is approximately 606,800 cubic yards of soil available that was identified in the western, southwestern, and southern borrow areas. Based the soil laboratory results and comparing them to a recent construction events, the soils share similar characteristics and would be suitable as subbase, general fill, or final cover soil material. As construction of the CCB Landfill progresses, additional testing will be performed on the soil specific to the intended use of the soil. Laboratory test results for samples tested as part of this investigation are summarized and presented in Appendix C.

2.6.2.1 Soils for Liner Systems

Approximately 10,000 cubic yards of soil with a permeability of less than $1x10^{-6}$ cm/sec is required for the subbase of the Phase 7 Expansion Area. Approximately 31,000 cubic yards of earthen material is required to create the fills necessary for the Phase 7 Expansion Area. Approximately 187,000 cubic yards of earthen material will be cut to achieve the design of the Phase 7 Expansion Area. The soil and earthen material required is available from borrow areas identified on Drawing No. C89509683 - Existing Conditions/Site Overall Plan.

2.6.2.2 Soils for Cover

It is estimated that the Phase 7 Expansion Area will require approximately 353,100 cubic yards of cover soil. With the currently identified excess soil from the Phase 7 Expansion Area grading and the western, southwestern, and southern borrow areas that were investigated in August of 2020, there is adequate soil available to cover the Phase 7 Expansion Area. Additional information on the site soil balance is summarized in Attachment D – Site Soil Balance, included in Appendix B – August 2020 Site Soils Investigation.

2.6.3 Bottom Ash

The leachate detection and leachate collection systems for Proposed Phase 7 Expansion Area will require approximately 29,300 cubic yards of bottom ash. The required volumes of bottom ash will be produced and stockpiled from the station, and if necessary, obtained from the Fort Martin Plant.

2.7 Mining

The CCB Landfill is underlain by abandoned mine workings in the deep-mined Pittsburgh coal seam. The coal was extracted by room and pillar and retreat mining methods, with remnant coal pillars being left at mine level. Coal was surface mined where outcrops occur.

2.7.1 Mine Stabilization and Subsidence Prevention

Investigations have determined that subsidence impacts have not occurred in the landfill area. Mine stabilization and other preventative measures have been implemented to prevent subsidence impacts (see Reference 1).To prevent mine subsidence from impacting the landfill, the portions of the mine where the overburden was less than 100 feet were grouted, and a geosynthetic reinforcement liner support system is installed where the overburden is between 100 and 150 feet. Areas where the overburden above the mine workings is greater than 150 feet will not be impacted by mine subsidence (see References 12, 14, and 15. All mine stabilization that was required to be performed to construct the site to its ultimate development has been performed.

3.0 SITE PLANS, DETAILS, AND DESIGN CONSIDERATIONS

3.1 Current and Proposed Areas

3.1.1 Current Operation Areas

Current placement operations are predominantly in the previously permitted Phase 4, 5, 6, and 6A areas, within potions of the main and Upper Areas. A portion of the Phase 3 (Lower Area) area is still actively receiving waste on a limited basis.

3.1.2 Phase 7 Expansion Areas

The Phase 7 landfill expansion is broken into two areas, referred to as the Saddle Area Expansion and the Eastern Area Expansion. The Saddle Area Expansion includes approximately 1.1 acre of liner area which is scheduled to be constructed in 2021. The Eastern Area Expansion includes approximately 6.4 acres of liner area which is currently planned to be constructed and developed in 2022 through 2025. The sequence of construction of the Eastern area will be dependent on site operations and CCB placement rates during this time. The development of the Eastern Area Expansion will be phased in smaller portions as is needed to facilitate site disposal needs and the site contractor's plans for CCB placement.

The landfill area provided by the Phase 7 Expansion in conjunction with the remaining active portion of Phase 3, will provide sufficient waste disposal volume beyond 2026 at current disposal rates which are summarized in Table 1.

3.2 Underdrain

An underdrain was constructed below the Phase 4 and Phase 5 areas to collect water from springs and seeps within the pre-1980 unlined ash disposal area (Drawing No. C89503057) (Reference 18). This underdrain is effectively a French drain consisting of perforated pipes in gravel trenches to collect springs and seeps. As the site has been developed, the underdrain system has been expanded to collect springs and seeps from newly developed areas. The underdrain system conveys water separately from the leachate collection/detection piping. The underdrain system will expanded into the Phase 7 Expansion area as shown on Drawing C89509687– Liner and Leachate Collection Piping Plan.

3.3 Liner System

Information regarding the previous liner systems used for previous phases of the landfill can be found in the previous permit applications documents. The Phase 7 Expansion Area liner system is described in detail in Section 4.5.3 of this application narrative.

3.4 Leachate Management

Water from the underdrain system installed in the Phase 1, 2 and 3 area is collected and carried by gravity and then pumped to the previously permitted treatment wetlands. Water from Sedimentation Pond No. 1 underdrain system is also pumped to the treatment wetlands. A schematic of the wetland passive treatment system is shown on previously submitted Figure 6 (Reference 18).

In 2019, MonPower installed a Leachate Compliance System. The system includes a two-chamber leachate collection sump and associated piping to collect leachate for recycling or treatment. Leachate that is not collected by the sump and water that is collected in the landfill's leachate detection/groundwater underdrain systems flows by gravity to Sedimentation Pond No. 1 for treatment.

The Leachate Collection Sump receives flow by gravity from various leachate collection piping systems from the landfill. The collected leachate flow can be split between the two chambers: the Recycle Chamber, which includes pumps installed to recycle leachate via conveyance to the Harrison Power Station FGD System thickener distribution boxes; and the Treatment Chamber, which aerates and chemically treats the leachate prior to discharging into Sedimentation Pond No. 1.

The landfill's underdrain, leachate detection, and leachate collection piping systems are shown on Drawing C89509687 – Liner and Leachate Collection Piping Plan.

3.5 Surface Water

The CCB landfill areas (Main Area, Upper Area, and Lower Area) are contained entirely within the same watershed. Surface runoff generally flows south/southeast through the Main Area.

The lower portion of the CCB site is occupied by Sedimentation Pond No. 1, which is used as a settling pond for runoff from active landfill areas and from other areas where earth disturbances occur. An 84-inch RCP is used to convey runoff around the pond from undisturbed areas. This pipe (Outfall 018) discharges to Robinson Run via a grouted riprap channel.

The emergency spillway from Sedimentation Pond No. 1 discharges to Robinson Run just to the south of the site. Robinson Run has its confluence with the West Fork River approximately 1,000 feet south of this point. The West Fork River flows northwest and eventually joins the Tygart Valley River to form the Monongahela River about 10.6 miles from the site.

The property boundary for the site extends beyond the watershed divide on the north, south, and west sides. On the northern side, where the property is beyond the drainage divide, surface flow is within the Bingamon Creek watershed. The property beyond the divide to the west and south drains to the Robinson Run watershed.

3.6 Stormwater Runoff and Run-on Control

Stormwater runoff and run on controls are a series of collection and diversion channels located around the perimeter of the landfill. These channels are shown on C89509688 – Drainage Areas. With the Phase 7 Expansion and Development Area, the North edges will reach the proposed ultimate final development of the landfill. Existing and future temporary channels will be replaced with permanent diversion and collection channels that will be constructed as landfill development proceeds toward the proposed ultimate final landfill configuration.

3.6.1 Diversion Drainage

Non-impacted (clean) stormwater above the active landfill are currently diverted by the existing Eastern and Western Diversion System and will continue to be diverted as much as possible during the Phase 7 Expansion. During construction of the Phase 7 Expansion, portions of the Eastern Diversion System and existing channels will be removed and reconstructed in areas adjacent to the Phase 7 Expansion as shown on Drawing No. C89509688 – Drainage Areas.

The Western Diversion System carries non-impacted stormwater from the western side of the landfill area to discharge into Robinson Run through Monitoring Point 018.

The Eastern Diversion System drains to existing twin 72-inch pipes at the Phase 4 landfill toe. Depending on site operations one of the two 72-inch pipes can be blocked to direct flow to discharge to Robinson Run through monitoring point 018 or to direct flow to Sedimentation Pond No. 1. The existing and proposed diversion channels shown on the west side of the landfill on Drawing C89509688 are part of the Western Diversion System and discharge to either Sedimentation Pond No. 1 or discharge to Robinson Run through Monitoring Point 018, based on landfill operations.

3.6.2 Active Area Runoff Control

Impacted stormwater within the active working area flows through constructed collection channels along the west side of the permitted area and drains to Sedimentation Pond 1. The site disposal contractor has also installed a piping system of contact stormwater drain risers attached to a set of drainage pipes buried in the FGD material above the liner which carries stormwater from the active disposal areas to Sedimentation Pond No. 1.This piping system reduces stormwater flow to the collection channels. This main discharge pipe is directed to the east diversion channel that currently drains to Sedimentation Pond No. 1 as shown on Drawing C89509686. Channels used as stormwater controls in service for more than 6 months are designed to pass the peak flow from the 25-year, 24-hour storm. Sedimentation Pond No. 1 is the final significant structure used for run-off and run-on control. The pond design is described in Reference 8. The piping system will be extended vertically through the Phase 7 Expansion Area.

3.6.3 Erosion and Sedimentation Control Measures

Sedimentation Pond No. 1 and the interceptor channels are the principal erosion and sedimentation (E&S) control measures for the landfill used throughout the landfill construction and development. Additional localized erosion and sedimentation controls such as rock check damn, silt fencing, grading operations, and other temporary measures are incorporated as appropriate to reduce the sediment load being conveyed to the sedimentation pond. All E&S control measures used during landfill operations and the Phase 7 Expansion will be in accordance with the WV E&S BMP Manual and the WV Solid Waste Management Rule.

3.7 Stability Analysis

Approximately 86 percent of the CCBs to be placed in the landfill is stabilized FGD material. As such, the engineering properties of this material govern the slope stability of the landfill. A detailed characterization of the Harrison Power Station's stabilized FGD material is presented in the previous Phase 5 Permit Application, Section 4.1 and Appendix F. The stability analysis in the Phase 5 Permit Application indicated a minimum factor of safety for static conditions was found to be 1.5 for the circular failure analyses. The minimum factor of safety for seismic conditions was found to be 1.2, also for the circular failure analyses. A summary of the engineering characteristics and the stability analysis is provided in Reference 1.

This Phase 7 Expansion Area application includes a stability analysis which verifies an acceptable slope stability analysis for the Phase 7 Expansion area liner system to be constructed at a proposed slope of 3H:1V or flatter. The minimum factor of safety for static conditions was also found to be 1.50 static for the rotational failure analyses, and the minimum factor of safety for seismic conditions was also found to be 1.20 static for the rotational failure analyses. With respect to current state of practice, these factors of safety are adequate for long term stability of the landfill. The Phase 7 Expansion Area stability analysis is provided in Appendix C.

4.0 OPERATIONS PLAN

This Operations Plan focuses on the systems, tasks, monitoring, and reporting required for daily landfill operations. These operations are performed by a contractor retained and monitored by MonPower. Operation of Sedimentation Pond No. 1 (dam and appurtenances) is performed by MonPower and is addressed in this section. The contractor's maintenance building is privately owned and operated and, as such, their operating procedures are not addressed in this Plan. The bottom ash processing facility on the west side of the landfill is currently not in operation.

4.1 Waste Sources, Properties, and Quantities

The waste sources and approximate quantities are summarized in Table 1. As stabilized FGD material comprises approximately 86 percent of the waste stream placed at the landfill, its physical and chemical characteristics govern the design operation, and monitoring of the landfill.

The CCB Landfill is designed to provide for the placement of stabilized FGD material and other miscellaneous wastes generated at the Harrison Power Station. The station currently produces approximately two million tons of stabilized FGD material per year. The station also produces approximately 300,000 tons of miscellaneous wastes generated from operation and maintenance of the facilities. These miscellaneous wastes include construction/demolition debris, various wastewater treatment and settling basin sludges, and other solid wastes. A summary of the materials and tonnages placed at the CCB Landfill is provided as Table 1. As stabilized FGD material comprises approximately 86 percent of the waste stream placed at the CCB Landfill, its physical and chemical characteristics govern the design, operation, and monitoring of the landfill.

Results from a 1996 characterization study of the FGD (Reference 17) indicate that the physical properties of the FGD material can be variable, depending on many factors. However, in general, properly stabilized, placed, and compacted FGD material at the CCB Landfill has a typical bulk density of 95 pounds per cubic foot (lb/ft3), a compressive strength greater than 100 pounds per square inch (psi), and a permeability on the order of 5.0 x 10-6 cm/sec. A summary of geotechnical testing results from the 1996 study is provided in Table 4. After in-situ solidification is complete, the stabilized FGD material tends to be brittle, but generally solid without a preponderance of interconnected fractures. Material strength increases with increased compactive effort and decreases with increased moisture content. However, permeability does not appear to be significantly impacted by compactive effort nor does it appear to change significantly as the stabilized FGD material ages.

The CCB Landfill permit also grants the disposal of fly ash and bottom ash from MonPower's Fort Martin Power Station

4.2 General Facility Operations

Operations at the CCB Landfill are performed 24 hours per day, seven days per week. Material is generally taken to the landfill by, VAC Trucks, tri-axle trucks, off road trucks, or 100 ton DART trucks. Depending on the material being disposed, records are kept of the amount of material being taken to the landfill either by load count or by tonnage, using station scales. The annual landfill volume placed is calculated by comparing the current site contours with the previous year's contours to determine the volume of waste placed during that time period.

4.2.1 Access Control

Access to the CCB Landfill is controlled by a combination of fences, manned and unmanned gates, and natural barriers such as creeks and topography. Direct access between the power station and the CCB Landfill site is provided by a privately owned paved road which crosses over both the West Fork River and WV County Road 3. The haul road enters the site from the south and currently proceeds along the eastern edge of Lower Area before turning into the active landfill area. Access to the haul roads is controlled by gates located at the main entrance to the power station and along VW County Road 3. A maintenance building and truck wash facility are located along the haul road, just past the Cunningham Bridge, which crosses WV County Road 3.

4.2.2 Communications

The landfill operations contractor maintains two-way radio communication between the landfill and the station. The maintenance building located along the existing haul road has telephones in case of emergencies and for the conduct of day-to-day business for the landfill operations contractor. Cellphones also have service and are used for day-to-day business for the power station and the landfill operations contractor.

4.2.3 Fire Control

Due to the composition of materials placed in the CCB Landfill, there is a negligible risk of fire with the landfilled material. However, the possibility exists of a fire on a piece of equipment operating at the landfill during the facility's daily operations. A combination of factory-installed fire suppression systems and/or portable fire extinguishers are operational on all pieces of heavy equipment at all times. For larger equipment fires or other serious fire outbreaks, the Shinnston Fire Department will respond.

4.2.4 Safety

Access to the CCB Landfill is controlled by manned and/or locked gates. No unauthorized access to the site is permitted. All primary operating equipment at the site is provided with rollover protection cabs, audible reverse warning devices, fire extinguishers, and first aid kits. Personnel working at the landfill are encouraged to complete a Basic First Aid Course. In addition, all persons on-site are required to comply with MonPower's worker safety program.

4.2.5 Equipment and Personnel Requirements

The landfill operations contractor maintains on-site equipment and provides the personnel required to perform all necessary landfill activities. Routine maintenance and minor and major repair work on the equipment is performed at the contractor's maintenance facility located just north of the haul road crossing WV County Road 3. The equipment that is expected to be used for the various operations at the landfill is listed in Table 5.

4.2.6 Utilities

Electrical power, water, telephone and restrooms are provided at the maintenance building located near the Lower Area. Portable restroom facilities are provided at the landfill working area. No other utilities area available at the working area.

4.3 CCB Handling and Landfill Operations

CCB handling and landfill operations at the CCB landfill are performed in general accordance with the operational criteria outlined in Section 4.6 of the WVSWMR.

4.3.1 Phasing and Filling Sequence

Most disposal activities will occur in the Phase 7 Development Area which encompasses portions of the previously permitted liner areas of Phase 4, 5, 6 and 6A areas, with occasional use of the existing permitted Lower Area. The filling will generally occur from the north to the south in the active placement area. Limited use and disposal activities will occur in the existing permitted Phase 3 Area (Lower Area). The Phase 3 area has intermediate soil cover placed over a majority of the area; a portion of the area will be kept active.

4.3.2 Material Testing

Testing of CCB materials placed in the CCB Landfill occurs at least once a year. For information regarding other Permitted wastes, refer to Section 4.3.5 of this Plan.

4.3.3 CCB Placement

4.3.3.1 Haul Roads

Fixated FGD material, fly ash, and bottom ash are hauled to the landfill in trucks. These trucks currently travel from the station to the landfill on a dedicated paved haul road that runs along the western limit of the Phase 3 area. For development of Phase 7, the existing haul roads leading to the landfill will continue to be utilized. Once the trucks reach the active working areas, the temporary roads that are placed and maintained by the on-site contractor will be used. As placement of material progresses from the north to the south, the haul roads will be realigned as needed by the hauling contractor.

4.3.3.2 Placement Limits and Compaction

<u>FGD</u>

The size of the active working face for each day's operations is kept as small as practical. During warm (greater than 40˚F) and dry weather, the stabilized FGD material is dumped near the active working face and spread in approximately five-foot thick lifts using a low ground pressure (LGP) dozer. The placed stabilized waste slowly solidifies and develops compressive strength over time. Due to the characteristics of the waste, a permit waiver has been previously approved by the WVDEP to allow this lift thicknesses (see Section 6.1). The final graded waste lifts are gently sloped to allow for positive drainage away from the work area and completed slopes. Once the work area has received a full lift layer, subsequent lift layers are placed atop the previous lift. Total daily work area heights are kept to a maximum of eight feet and the maximum final waste slope of the working face is kept at 2.5 horizontal to 1 vertical (2.5H:1V). Waste is placed and compacted for adequate stability of the waste. Tracking by dozers provides a roughened surface for subsequent lift placement. To aid in the placement of the CCB wastes, temporary roads are periodically built across the active landfill. These roads generally built of fly ash, bottom ash, or imported crushed stone.

<u>Fly Ash and Bottom Ash</u>

Bottom ash is mostly used/placed in the landfill for temporary roads. During expansion construction, bottom ash will be used as the leachate collection layer. Bottom ash is also used as anti-skid material on the site. Fly ash is mostly used for road construction. Occasionally, fly ash is separated and temporarily placed on-site for upcoming beneficial use projects. If fly ash is disposed in the landfill, it is encapsulated within stabilized FGD material as soon as practicable.

4.3.3.3 Placement Limits and Compaction Height Monitoring

The landfill is developed using a series of benches, as shown on Drawing C89509685 – Phase 7 Pile Development and Drawing C89509695 – Ultimate Development Plan. The landfill operations contractor monitors the landfill top and side slope elevations during filling operations. When such elevations approach the proposed final grading, as shown on the drawings, the area is surveyed and staked to prevent over-placement of CCBs. In addition to daily placement monitoring, aerial topographic mapping of the landfill is performed annually to monitor CCB placement lines and grades and to evaluate remaining permitted airspace at the site.

4.3.4 Inclement Weather Conditions

Additional precautions are taken for placement of stabilized FGD material during precipitation events or when the ambient temperature is below 40˚F, as strength development in the material is inhibited by excess water and cold temperatures. These events generally do not stop the solidification of the stabilized waste but rather slow down the process. During such events, the placement and incorporation of the material into the landfill is modified. This may include limiting traffic in the working area, or suspending placement operations during heavy rainfall events, or placing the material in a temporary stockpile at the landfill or at the station.

If existing waste becomes frozen, it is scraped off prior to placement of the next lift and incorporated into the fresh FGD material. If it exists, snow is also removed from the placement area prior to placement of the material.

4.3.5 Low-Volume Wastes

4.3.5.1 Handling

Other low-volume wastes that may be placed in the CCB Landfill are those materials generated from operation and maintenance of the Harrison Power Station. These low volume wastes include construction/demolition debris, various wastewater treatment and settling basin sludges, sand blasting grit, spent resin, and other solid wastes are listed is Table 1. These materials are currently permitted to be placed in the CCB Landfill. The special wastes are transported to the landfill by truck.

Permitted dry wastes are dumped, spread, and tracked into the active working area using LGP dozers. They are then covered with additional FGD material so that no waste is left exposed for an extended period of time. Treatment and settling sludges are stabilized with ash and/or FGD material and also incorporated into the stabilized FGD material in a similar fashion as the dry waste.

4.3.5.2 Testing

Special wastes, except for sand blasting grit, are typically tested once per year. Sand blasting grit is tested for each source after it is generated. Testing requirements are in accordance with Code of Federal Regulations (CFR) 40CFR261.

4.3.6 Daily and Intermediate Cover

Since the materials to be placed in the CCB Landfill are non-putrescible, odorless, and resistant to erosion, there is little need to provide daily or intermediate cover. Permit waivers for both the daily and intermediate covers have been previously approved by the WVDEP (see Section 6.1).

4.3.7 Cover and Revegetation

As the placed waste material reaches the designed final grades, a 12-inch thick layer of soil is proposed to be placed on the finished slopes and benches. The soil cover will be fertilized, seeded, and mulched in accordance with Section 10 – Soil Revegetation of the CQA/QC Plan.

4.4 Environmental Management

This section reviews the overall environmental management tasks required for the successful operation of the CCB Landfill. Emphasis is given to surface water control measures required for the Facility.

4.4.1 Surface Water Control

Proper control of surface water at the CCB landfill will accomplish the following:

- Minimize the run-on of surface water into the active working area
- Collect the run-off of surface water that has come into contact with waste
- Maximize the separation of surface water from leachate
- Limit the erosion caused by surface water
- Limit the sediments carried off-site by surface water

4.4.2 Run-On Control

Temporary and permanent diversion channels are used to effectively manage surface drainage at the site. Temporary and Permanent diversion channels are extended as required for the development of the landfill.

4.4.3 Erosion and Sedimentation Control

Erosion and sedimentation control measures are described in Section 3.6.3. Erosion and sedimentation control provisions and measures are adequately maintained in order to perform as designed. The control measures and operations techniques to be used are:

- Keeping the active working slope at a maximum of a 2.5 horizontal to 1 vertical (2.5H:1V), with a maximum daily height of eight feet.
- Drainage benches installed over the finished slopes every 25 vertical feet to limit the run- off flow length down the slope.
- Drainage benches are sloped towards collection channels at a maximum slope of 1.5 percent to minimize flow velocity.
- Collection channels are appropriately lined to prevent scouring.
- Waste impacted run-off is routed into Sedimentation Pond No. 1.
- The soil cover layer is seeded as soon as practical after placement to promote stabilization.

4.4.4 Dust Control

Dust generation is not a significant problem at the CCB landfill due to the moisture content of newly placed material and the physical characteristics of the stabilized FGD material. Once the material has been spread and compacted the material is smooth drum rolled and begins to harden. During hot, dry weather, the potential for dusting can occur. In these instances, dusting is minimized by applying water from a water truck. Dust related to waste hauling on the haul road is minimized as the majority of the road is paved. A water truck and/or sweeper truck are used at times to minimize the haul road dusting.

4.4.4.1 General Maintenance

Weekly inspections are performed on the haul road, slopes, vegetation, diversion and collection channels, culverts, and sedimentation pond. Repairs to and maintenance of the CCB landfill are performed based on the findings of these weekly inspections.

The haul road and its drainage are inspected quarterly and after major storms. The required roadway cross-slope is maintained, ruts and potholes are kept to a minimum, and the haul road is kept in usable condition and treated for dust, mud, and snow as necessary. Culverts and culvert outlets are kept clean of sediment and debris from erosion events and repaired if necessary.

Landfill vegetated areas are inspected quarterly for proper vegetation. No more than 2 benches are unseeded at any time. Benches are inspected for proper grade, cross-slope, and that no water is ponding.

Diversion and collection channels are inspected quarterly and after major storms. Eroded areas are repaired and sediment build-ups are removed. Channel linings are repaired as necessary, and diversion structures are maintaining in proper working order.

Sedimentation Pond 1 is inspected quarterly and after major storms so that it can be maintained to function as designed. The pond structures are thoroughly inspected in accordance with the dam permit, and any corrective actions are performed in as soon as conditions allow. Sediment is removed as it reaches the clean-out elevations. The sediment removed from the pond is transported to the active portion of the landfill.

4.5 Design of Phase 7 Expansion Area

4.5.1 Phasing

The Phase 7 Expansion will result in an additional 7.5 acres of landfill footprint and will expand the overall disposal footprint of the CCB landfill to approximately 190.0 acres of permitted lined area. Drawing Number C89509689 –Phase 7 Pile Development – Max Top of Waste 1280 show the approximate development plan for the Phase 7 Expansion Area. The volume of storage provided by this development will provide approximately 16.6 million cubic yards which is sufficient disposal volume for disposal operations through 2025 The proposed development of the landfill will be annual construction events including construction of lined areas, perimeter roads, and channels based on planned development and operations for the following year. Design features are shown in the permit drawings of this application. The development of the landfill will be reviewed annually and adjusted for site needs as the Proposed Phase 7 Area is developed.

4.5.2 Liner System

The Phase 7 Expansion Area liner system is shown on Drawing C89509691 –Subgrade and Liner Details (Sheet 1). The liner system is the same configuration as the previously approved liner system and consists of (from bottom to top):

- Subgrade or Subbase – six inches (minimum of compacted soil having a maximum permeability of 1 x 10^{-6} cm/sec);
- A Geocomposite Drainage Net (GDN)/Leachate Detection Layer;
- A Geosynthetic Clay Liner (GCL);
- A 60-mil Textured HDPE Geomembrane;
- Leachate Collection Layer – a 16 oz/sy Cushion Geotextile and 12 inches of bottom ash (or sand) having a minimum permeability of 1 x 10^{-3} cm/sec; and
- Protective cover layer – 12 inches of CCB material.

4.5.2.1 Subgrade or Subbase

The subgrade or subbase layer will provide the foundation for the geosynthetics layers and leachate collection layer. A description of each of these layers is as follows.

4.5.2.1.1 Subgrade

The subgrade contours are indicated on Drawing Nos. C89509685 and C89509686. In liner areas requiring excavation, the excavation will extend to the top of the subgrade contours. If testing indicates that the subgrade soil meets the permeability, atterberg limits, and gradation requirements for subbase soil, then the subgrade will be the foundation for the geosynthetic layers to be constructed on.

4.5.2.1.2 Subbase

For subgrade soils that do not meet the permeability, atterberg limits, and gradation requirements of subbase soil or if the area being lined requires fill, then subbase placement is required.

For areas requiring fill, general fill would be placed to within six inches below the subgrade grades shown on Drawing Nos. C89509685 and C89509686. The bottom of subbase grading would then be surveyed for verification purposes. A minimum six-inch layer of subbase material would then be placed which would have to meet the requirements listed for subbase soil in Table 2-2 of the approved CQA/QC Plan. An additional survey would then be performed to verify the subbase thickness is a minimum of six-inches thick.

For areas where the subgrade was excavated and didn't meet the subbase requirements listed in the CQA/QC Plan, the in-situ soils would need to be over-excavated a minimum of six inches below the subgrade grades shown on Drawing Nos. C89509685 and C89509686. Following excavation, the grades would then need to be surveyed for verification purposes. A minimum six-inch layer of subbase material would then be placed which would have to meet the requirements listed for subbase in Table 2-2 of the approved CQA/QC Plan. An additional survey would then be performed to verify the subbase thickness is a minimum of six-inches thick.

For the purposes of construction clarity, the top of subbase is also considered to be the top of subgrade layer meaning that all subbase constructed would need to match the grades shown on Drawing No. C89509685 – Proposed 2021 Subgrade Construction Grading Plan and Drawing No. C89509686– Proposed 2022-2025 Subgrade Construction Grading Plan.

4.5.2.2 Leachate Detection Layer

The Leachate Detection Layer serves to collect and convey potential liner system leakage to leachate detection monitoring points, while providing for the collection and conveyance of groundwater (seeps and springs) that may be encountered beneath the installed liner system. This zone includes a double-sided geocomposite drainage net below the geomembrane layer.

4.5.2.3 Geosynthetic Clay Liner

The Geosynthetic Clay Liner (GCLs) is manufactured geosynthetic low permeability alternative to a compacted clay layer. GCL is comprised of a sodium bentonite core sandwiched between two layers of geotextile providing a hydraulic barrier with hydraulic conductivities less than compacted clay soil exhibiting typical hydraulic conductivities of $1\text{x}10^{-7}$ cm/sec or less. GCL is an engineered product exhibiting benefits over compacted clay including ease of installation, better hydraulic performance, resistance to varying weather conditions, and reduction of the risk of failure due to adverse field and operating conditions.

4.5.2.4 Geomembrane

The geomembrane layer consists of a textured 60-mil HDPE Geomembrane placed on top of the double-sided geocomposite drainage net leachate detection layer. This layer serves to create a near impermeable layer between the waste and the leachate detection zone to minimize the flow of leachate into the detection zone.

4.5.2.5 Leachate Collection Layer

The Leachate Collection Layer serves to collect leachate and convey it to the leachate collection system. This layer consists of a 16 oz/sy cushion geotextile and a 12 inch thick bottom ash or sand layer over the geomembrane layer. The leachate collection layer is drained using a series of perforated high density polyethylene (HDPE) pipes encapsulated in AASHTO 57 aggregate and geotextile for leachate collection. The drainage material is placed at a relative density between 70 and 90 percent and has a minimum permeability of $1x10^{-3}$ cm/sec.

The leachate collection pipes in the Phase 7 leachate collection layer will be tied into the existing leachate collection/leachate detection pipes.

4.5.2.6 Protective Cover Layer

The protective cover layer consists of 12 inches of CCB material placed on top of the leachate collection zone to protect the underlying composite liner system.

4.5.3 Underdrain

The underdrain which currently extends to the constructed portions of the landfill will be extended through the Phase 7 Expansion Area. The underdrain is described in Section 3.2 of this application.

4.5.4 Alternative Enhanced FGD Material Liner System

The Alternative Enhanced FGD Material Liner System consists of 48 inches of Enhanced FGD material (FGD material with lime added to obtain permeability requirement) placed in compacted lifts. The Enhanced FGD material is placed and compacted in two 24-inch lifts to 95 percent maximum density and has a maximum permeability of 9.0×10^{-7} cm/sec at 90 days.

The Alternative Enhanced FGD Material Liner System was previously permitted and installed. However, for the purposes of this permit renewal, there is no intent to use the Alternative Enhance FGD Material Liner System as part of the Phase 7 Expansion or future expansions. This section is being included for informational purposes because the Alternative Enhanced FGD Material Liner System is part of the approved permit and parts of the Phase 7 liner expansion tie into it.

4.5.5 Utility Abandonment and Relocation

The Phase 7 Area does not have any known gas wells or other utilities within the expansion area limits; however, there is an existing gas line to the east of the Phase 7 Eastern Expansion Area that may need relocated based on final grading that could extend beyond the extents of the proposed liner area. The timeframe of the relocation of the gas line will be dependent on site operations and development.

4.5.6 Leachate Management System

Management of leachate which is collected in the leachate detection/ground water underdrain and leachate collection systems is described in Section 3.4. The leachate collection piping system will be extended from existing as-built locations to the Phase 7 waste limits shown on Drawing No. C89509686 – Liner and Leachate Collection Piping Plan.

4.5.7 Stormwater Run-On/ Run-Off Controls

Diversion channels are established along the perimeter of the landfill to minimize the amount of non-contact water entering the active site area. Diversion Channels will be established above the Phase 7 Expansion Area footprint. Proposed stormwater controls to be installed for the Phase 7 expansion are shown on Drawing Number C89509688 – Drainage Area Plan, and drainage details are provided on Drawing Number C89509693 – Piping and Channel Details.

The active area runoff/runon controls and Sedimentation Pond 1 used for runoff/runon control will operate as described in Section 3.5.

4.5.8 Access Control and Haul Roads

Access to the Phase 7 Expansion Area for construction, hauling, and equipment will be provided via an existing haul road which ties into the southern portion of the Phase 7 Expansion, as shown on Drawing C89509683 – Existing Conditions/Site Overall Plan.

The haul roads are privately owned and maintained by the power station with controlled access through site security and gates.

5.0 ENVIRONMENTAL MONITORING PLAN

5.1 Ground Water Monitoring

The ground water monitoring system consists of five monitoring wells, one upgradient and four downgradient. The ground water monitoring wells are listed in Table 2. The wells monitor ground water in the Lower Sewickley sandstone, which is continuous under much of the site. The groundwater monitoring system will function as described in the previous Permit Applications

5.2 Surface Water Monitoring

5.2.1 Surface Water Monitoring Network

The surface water monitoring consists of ten outfalls. The locations of the surface water monitoring outfalls are listed in Table 3. The monitoring locations of these outfalls may change during the life of the landfill because of on-going and future construction activities. Approval will be requested from the WVDEP prior to any changes. A description of each outfall location and the sampling frequency is included in the NPDES Permit.

5.2.2 Sample Collection

The surface water quality monitoring is conducted in accordance with the requirements of the NPDES permit.

5.2.3 Data Interpretation

The water quality results are compared to the discharge limits identified in the NPDES permit. If sampling and analysis indicate that there are parameters that are not within these limits, the procedures outlines by the permit are followed.

5.3 Stormwater Pollution Prevention Plan and Ground Water Protection Plan

A Stormwater Pollution Prevention Plan (SWPPP)/Ground-Water Protection Plan (GPP) were prepared for the CCB Landfill in 1999 (Reference #17). The plan identifies potential contaminant sources and areas, the pollution prevention measures in use, and the responsibilities associated for implementing the plan. The SWPPP/GPP should be referenced for specific information.

6.0 WAIVERS AND PERMIT MODIFICATIONS

6.1 Waivers

The following full or partial waivers of regulatory requirements under Title 33, Solid Waste Management Rule, have been specifically requested and approved for operation of the CCB Landfill. MonPower requests that the waivers be continued for the Permit renewal period. The dates for the Waiver Request and its Approval are provided for each waiver, along with the section of the regulations under Title 33, and a brief description.

Section 3.2.k	"Location Standard for Underground Mines" Mine stabilization plans have been developed and implemented to mitigate potential damage to the landfill liner system. Waiver Request: June 9, 1992 and November 20, 1992 Waiver Approval: March 25, 1993
Section 4.4	"Operating Record" The Facility is a captive site used exclusively for the placement of solid wastes generated from normal operation and maintenance of the Harrison Power Station. Waiver Request: June 15, 192 Waiver Approval: March 25, 1993
Section 4.6.b.2.A	"Solid Waste Placement, Daily Cover" Relief from the daily cover requirement, due to type of waste. Waiver Request: June 15, 1992 Waiver Approval: March 25, 1993
Section 4.6.b.2.B	"Solid Waste Placement, Intermediate Cover" Relief from the intermediate cover requirement, due to type of waste. Waiver Request: June 15, 1992 and November 10, 1992 Waiver Approval: March 25, 1993
Section 4.12	"Reporting" Waiver Request: June 15, 1992; November 10, 1992, and November 20, 1992 Waiver Approval: March 25, 1993
Section 6.1.e.1.A.4	"Closure and Post-Closure Care, Vegetative Cover Layer" Waiver Request: November 10, 1992 Waiver Approval: March 25, 1993
Section 3.2.c	"Perennial Stream Location Standards" Waiver Request: January 6, 1995 Waiver Approval: October 23, 1995

Section 3.2.k	"Location Standards for Underground Mines" As pertains to Sedimentation Pond No. 1 construction. Waiver Request: January 6, 1995 Waiver Approval: October 23, 1995
Section 3.2.b	"Location Standards for Natural Wetlands" A wetland mitigation plan has been developed and implemented for impacted wetlands. Waiver Request: March 3, 1995 Waiver Approval: Determined Exempt March 3, 1995
Section 4.6.b.1.C	"Solid Waste Placement, Layering and Compaction Relief from layering and compaction requirements, due to type of waste. Waiver Request: March 3, 1995 Waiver Approval: October 23, 1995

6.2 Permit Modifications

The following modifications to the Solid Waste Permit have been issued since the last permit cycle:

- Modification No. 1 WVDEP letter dated September 9, 2016, Phase 6 Permit Renewal Application
- Modification No. 1. WVDEP letter dated December 11, 2017 Modification for Phase 6A Expansion

7.0 REFERENCES

1. GAI Consultants, Inc. 2003. Permit Application for Lateral Expansion, CCB Landfill, Harrison Power Station, Harrison County, West Virginia. January 2003.
2. L. Robert Kimball and Associates. 1987. NPDES Discharge Permit Application Supplement for a Solid Waste Disposal Site for Allegheny Power Systems, Harrison Power Station, Harrison County, West Virginia. December 1987.
3. GAI Consultants, Inc. 1991. Solid Waste/NPDES Permit Application No. WV0075795, Solid Waste Portion, Lower Tributary Valley, Harrison Power Station, Solid Waste Disposal Site, Harrison County, West Virginia. February 1991.
4. GAI Consultants, Inc. 1992. Supplement - Permit Application No. WV0075795, Solid Waste Portion, Main Valley and Lower Tributary Valley Ash Disposal Sites. May 1992.
5. Permit Modification No. 2, West Virginia Department of Environmental Protection letter dated June 21, 1994, for request made November 22, 1993.
6. Permit Modification No. 4, West Virginia Department of Environmental Protection letter dated June 26, 1997, for request made June 26, 1997.
7. GAI Consultants, Inc. 1994. Modification - Solid Waste/NPDES Permit No. WV0075795 - Solid Waste Portion, Lower Tributary Expansion, Pigotts Run Disposal Site, Harrison Power Station. October 1994.
8. GAI Consultants, Inc. 2001. Design Report, Sedimentation Pond No. 1 Expansion, Phase IV CCB Landfill, Harrison Power Station. November 2001.
9. Gannett Fleming, Inc. 2000. Wetland Delineation Report, Revised November 23, 2000.
10. Ferguson, H. F. 1967. Valley Stress Release in the Allegheny Plateau. Engineering Geology, Volume 4, No. 1, pp. 63 71.
11. GAI Consultants, Inc. 1994. Final Report, Comprehensive Soil Resource Inventory, Pigott's Run Disposal Site, Harrison County, West Virginia. June 1994.
12. Earth Science Consultants, Inc. 1999. Permit Renewal Application, Solid Waste Portion, Permit No. WV0075795, Pigotts Run Coal Combustion By Product Facility, Harrison Power Station. 1999 (Revision).
13. United States Department of Agriculture, Soil Conservation Service. 1980. Soil Survey of Harrison and Taylor Counties, West Virginia. April 1980.
14. GAI Consultants, Inc. 1995. Summary of Mine Stabilization Program to Mitigate Impact of Sinkhole Type Mine Subsidence on Proposed Liner System, Lower Tributary Valley Downstream Expansion, Pigott's Run Disposal Site, Harrison Power Station. May 1995.
15. GAI Consultants, Inc. 2002. Summary of Mine Stabilization Program, Phase IV CCB Landfill and Sedimentation Pond No. 1 Expansion, Harrison Power Station. December 2002.
16. GAI Consultants, Inc. 1999. Groundwater Monitoring Program Data Evaluation and Reporting, CCB Landfill, Harrison Power Station. Narch 1999.
17. HMI. 1999. Stormwater Pollution Prevention Plan and Ground-Water Protection Plan.
18. GAI Consultants, Inc. May 2004. Permit Renewal Application, Harrison Power Station.
19. GAI Consultants, Inc. January 2011. Phase 5 Permit Renewal Application, Harrison Power Station.
20. GAI Consultants, Inc. February 2016. Phase 6 Permit Renewal Application, Harrison Power Station.
21. GAI Consultants, Inc. December 2017. Phase 6A Permit Renewal Application, Harrison Power Station.

TABLES

TABLE 1

SUMMARY OF SOLID WASTE MATERIALS AND TONNAGES

HARRISON POWER STATION - CCB LANDFILL

Table 1
Summary of Solid Waste Materials and Tonnages
Harrison Power Station – CCB Landfill

Type of Material	Estimated Quantity (tons per year)
Fly Ash	100,000
Bottom Ash	130,000
FGD Scrubber Material	2,000,000
Construction/Demolition Waste[(1)]	150
Excavated Soils (not contaminated with oil)	500
Boiler Refractory (ceramic base)	75
Wastewater Lagoon Sludge[(2)]	65,000
Cooling Tower Basin Sludge	6,000
Settling Basin Sludge (river silt)	2
Coal Pile Sludge	50
Solids from Sedimentation Pond Cleanouts	15,000
Grit Chamber Sludge	450
Filter Materials (spent): Sand, Silica Gel, Anthracite Coal, Activated Carbon, and Activated Aluminas	8
Spent Ion Exchange Resins	5
Abrasive Blasting Material	55
Screenhouse Debris (leaves, branches, silt etc.)	375
Lime from Plant Housekeeping	550
Lime Grits and slurry (>20% solids)	450
Pumphouse (collection vault) sludge cleanout	5
Treatment Wetlands Cleanout Materials	50
Acid Mine drainage sludge	5
Total	**2,318,730**

Notes:

1) As defined by Item 2.38 of Title 33, Series 1, of the West Virginia Solid Waste Management Rule.

2) CCB Lagoon Cleaning-Alternates between North and South (once per year).

TABLE 2

GROUNDWATER MONITORING PROGRAM

HARRISON POWER STATION - CCB LANDFILL

Table 2
Groundwater Monitoring Program
Harrison Power Station – CCB Landfill

Monitoring Well	Year Installed	Formation Monitored	Ground Surface Elevation (ft MSL)	Total Well Depth (ft bgs)	Monitored Interval (ft bgs)	Monitored Interval (ft MSL)	Casing ID and Material
Upgradient (Background)							
MW-5	1993	Lower Sewickley SS	1283.98	208.5	148.5 – 208.5	1075.52 – 1135.52	4" - Sch. 40 PVC
Downgradient							
MW-17	1997	Lower Sewickley SS	1070.64	60.6	20.6 – 60.6	1010.04 – 1050.04	2" - Sch. 40 PVC
MW-18	1997	Lower Sewickley SS	1265.91	264.8	224.8 – 264.8	1001.11 – 1041.11	4" - Sch. 40 PVC
MW-19	2016	Lower Sewickley SS	1462.87	513.9	503.9 – 513.9	948.99 – 958.99	2.5" - Sch. 80 PVC
MW-20	2016	Lower Sewickley SS	1414.28	364.0	349.0 – 364.0	1050.30 – 1065.30	2.5" - Sch. 80 PVC

Notes: SS = sandstone MSL = mean sea level bgs = below ground surface ID = inside diameter PVC = polyvinyl chloride

TABLE 3

SURFACE WATER MONITORING NETWORK

HARRISON POWER STATION - CCB LANDFILL

Table 3
Surface Water Monitoring Network
Harrison Power Station – CCB Landfill

Sampling Point Designation	Description	Sampling Frequency	Monitor Only/ Discharge Limits
008	Surface Impoundment No. 1, Constructed Wetlands Treatment System, and the sediment basin located at the southeast side of the haul road bridge.	Monthly	Discharge Limits
012	Storm Water Runoff & Mine Drainage	Monthly	Monitor Only
013	Storm Water Runoff & Mine Drainage	Monthly	Monitor Only
014	Storm Water Runoff & Mine Drainage	Monthly	Monitor Only
015	Storm Water Runoff & Mine Drainage	Monthly	Monitor Only
018	Storm Water Runoff	Monthly	Monitor Only
020	Storm Water Runoff. Emergency overflow of Surface Impoundment No. 1	Monthly	Discharge Limits
022	Storm Water Runoff. Emergency Overflow from constructed treatment wetlands	Monthly	Discharge Limits
023	Storm Water Runoff	Monthly	Discharge Limits

TABLE 4

STABILIZED FGD GEOTECHNICAL PROPERTIES

HARRISON POWER STATION - CCB LANDFILL

Table 4
Stabilized FGD Geotechnical Properties
Summary of Geotechnical Laboratory Testing - 1996
Harrison Power Station – CCB Landfill

Index Properties										
Source[1]	**Specific Gravity**	**Atterberg Limits**			**Grain Size Percent Passing**			**Soil Size Classification (Percent)**		
		LL	PL	Pl	#10	#40	#200	Sand	Silt	Clay
Field	2.48	NT[2]	46.2	NP[3]	100	93	85	15	73	12

Engineering Properties								
Source[1]	**Bulk Density (pcf)**	**Natural Water Content**	**Modified Proctor**		**Unconfined Compressive Strength (psi)**	**Permeability (cm/sec)**	**Tri-axial Shear**	
			Maximum Dry Density (pcf)	**Optimum Water Content (%)**			**c' (psi)**	**M' (degrees)**
Plant	99.2				59	3.2×10^{-6}	-	-
Field	94.5	55.9	79.6	24.5	236[4]	2.9×10^{-6}	5.2	51.2
In-situ	99.6	51.6			237	8.8×10^{-5}	11.3	42.2

Notes:
1. Plant samples obtained at the station, field samples obtained at the landfill working area prior to compaction, and in-situ samples obtained from coring at the landfill.
2. NT - Not tested - the FGD material could not be tested for the Liquid Limit.
3. NP - Non-plastic.
4. Samples aged several weeks due to initial geotechnical testing prior to sample preparation.

TABLE 5

EQUIPMENT LIST

HARRISON POWER STATION - CCB LANDFILL

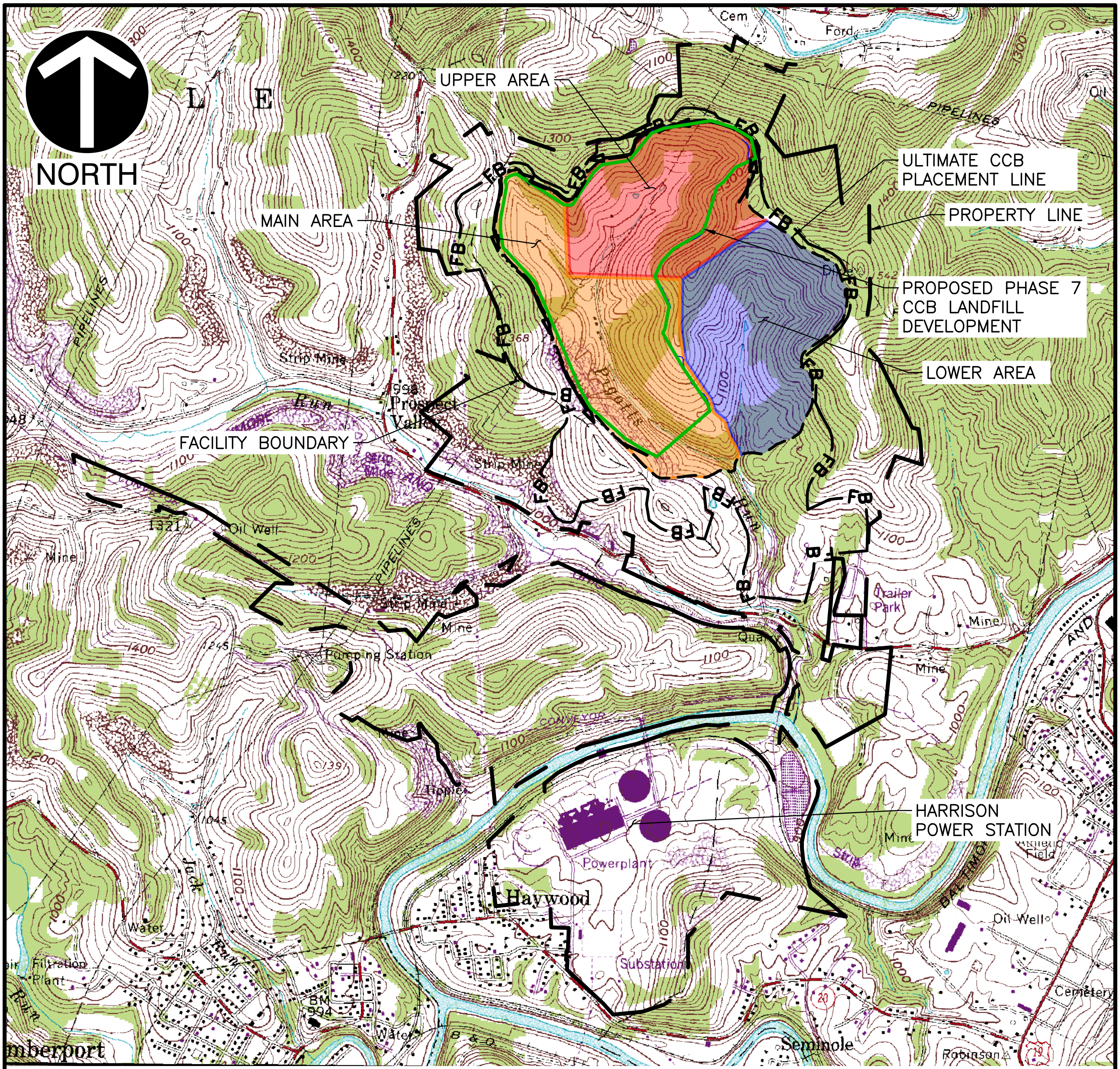
Table 5
Equipment List
Harrison Power Station – CCB Landfill

Operation	Equipment Required
Primary	
Hauling (Station to Landfill)	Four Off-Highway Dump Trucks
Spreading and Compacting CCB	Two Dozers One Smooth Drum Vibratory Roller
Secondary	
Clearing and Grubbing	One Dozer One Front-End Loader Two Dump Trucks
Topsoil Stripping/Stockpiling	One Dozer One Front-End Loader Two Dump Trucks
Soil Compaction	One Dozer One Towed Sheepsfoot Roller
Channel Excavation/Pond Cleaning	One Backhoe or Front-End Loader Two Dump Trucks
Haul Road Construction	One Dozer One Grader One Spreader One Tandem Roller Two Dump Trucks

FIGURES

FIGURE 1

SITE LOCATION MAP



LEGEND

- PROPOSED PHASE 7 EXPANSION
- UPPER AREA
- LOWER AREA
- MAIN AREA

SCALE IN FEET

0 2000 4000

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MONONGAHELA POWER, A FIRSTENERGY COMPANY
PHASE 7 CCB LANDFILL EXPANSION
HARRISON POWER STATION
HARRISON COUNTY, WEST VIRGINIA

SITE LOCATION MAP

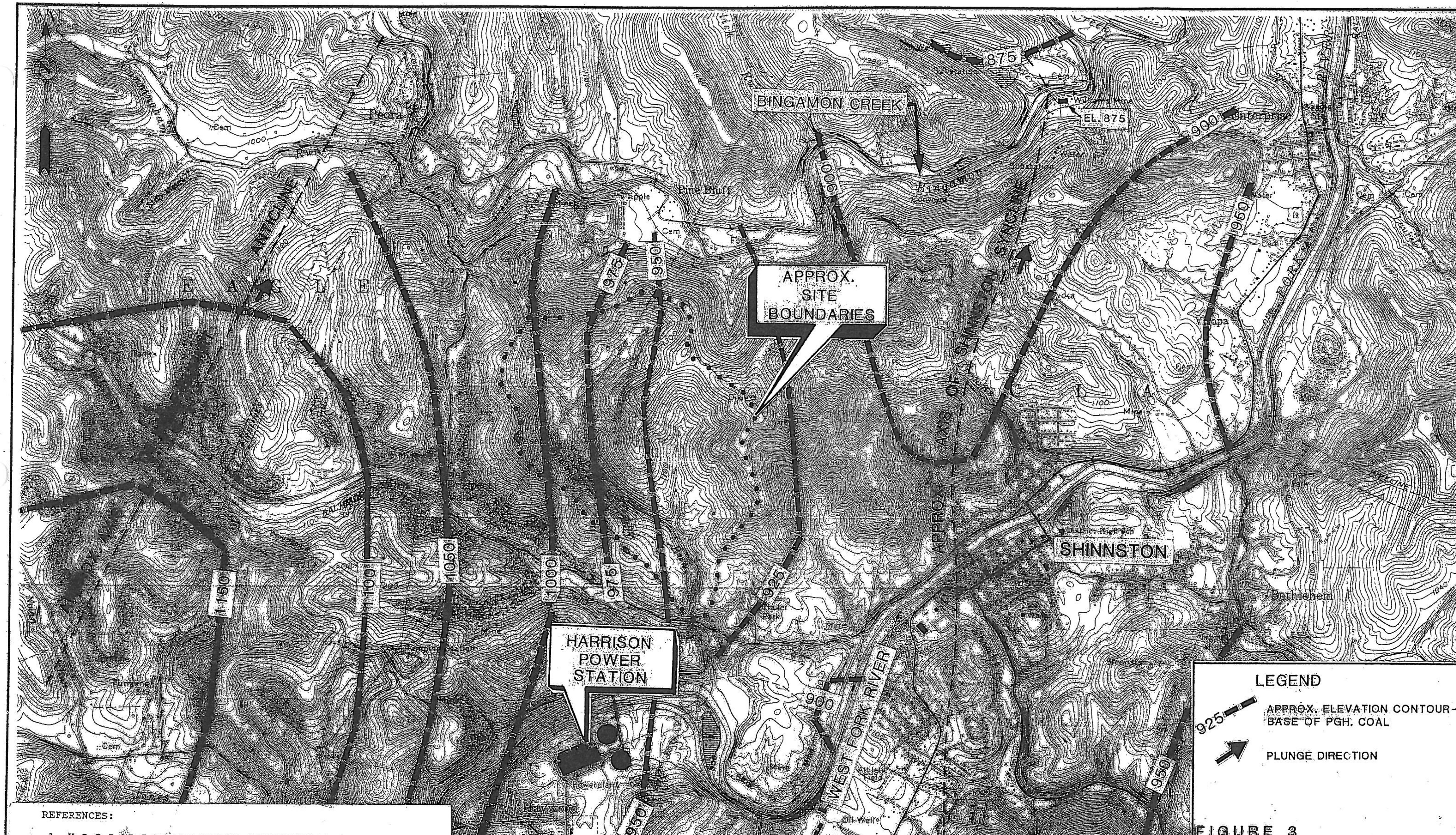
DRAWN BY:	TAF	CHECKED BY:	MRF	APPROVED BY:	DMT*	FIGURE NO.:
DATE:	MARCH 2021	DWG SCALE:	1"=2000'	PROJECT NO:	302-918	1

1153

S:\302-918\-CADD\Dwg\SW03-PH 7 CCB Expansion\302918-SW03-FIG-1_FIG-4.dwg{FIG 1} LS:(2/26/2021 - jleidy) - LP: 3/12/2021 12:59 PM

FIGURE 2

TYPICAL STRATIGRAPHIC SECTION (UNCHANGED)



REFERENCES:

1. U.S.G.S. 7.5 MINUTE SERIES (TOPOGRAPHIC) SHINNSTON, WEST VIRGINIA QUADRANGLE, PHOTOREVISED 1977.
2. "GEOLOGY OF THE SHINNSTON, WEST VIRGINIA 7.5 MINUTE QUADRANGLE", NORMAN L. WILLIAMSON, MS THESIS, WEST VIRGINIA UNIVERSITY, MORGANTOWN, WV., 1967.
3. VARIOUS MINE MAPS FOR KATHERINE MINE, WILLIAMS MINE, BINGAMON MINE, CLEARWATER MINE, WYATT MINE, PINE BLUFF MINE, ROBERT MINE, AND CONSOLIDATION COAL CO. NO. 42 MINE.

FIGURE 3

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists
570 Beatty Rd. • Pittsburgh, Monroeville, Pa. 15146
412-856-6400

HARRISON POWER STATION
CCB LANDFILL SITE
GENERALIZED STRUCTURE CONTOUR MAP OF PITTSBURGH COAL

ALLEGHENY ENERGY SUPPLY
MONROEVILLE, PENNSYLVANIA

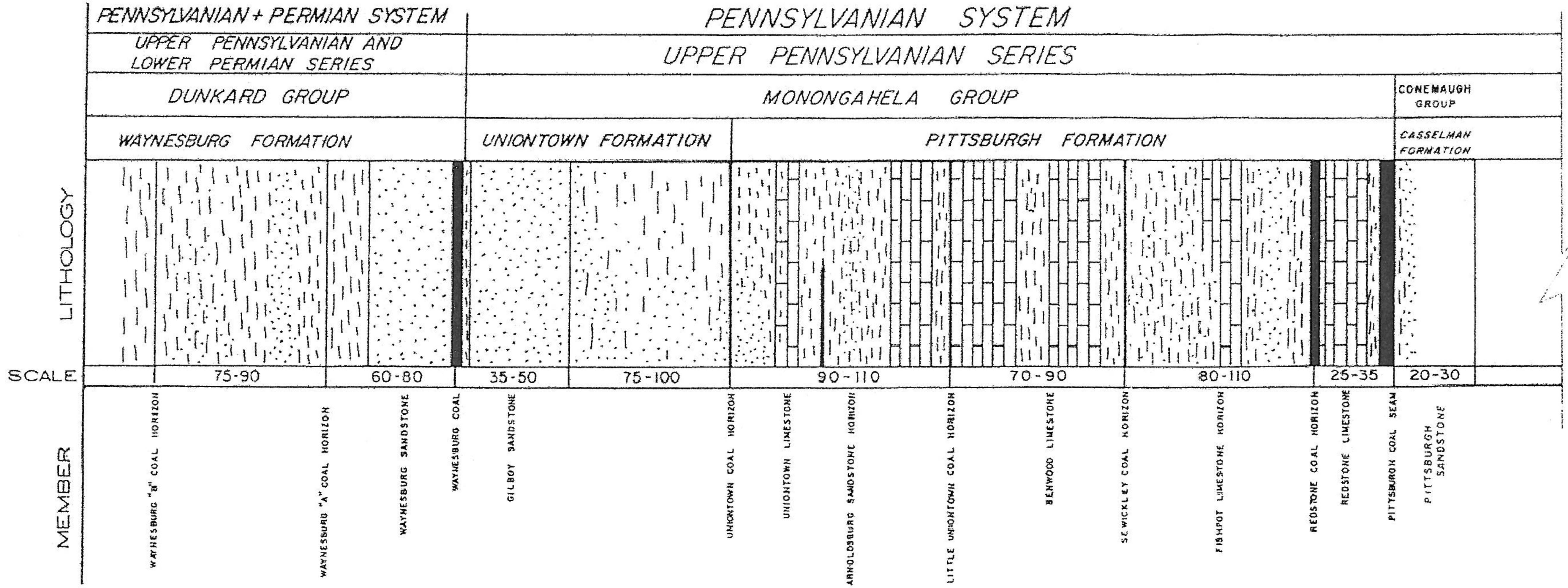
DWN. RSE	CHKD. SCW
APPD. TNK	DATE 10-18-01
SCALE: 1" = 2000'	
DRAWING NUMBER 00-276-B001	REV 1

FIGURE 3

GENERALIZED STRUCTURE CONTOUR MAP OF PITTSBURGH COAL

(UNCHANGED)

TYPICAL STRATIGRAPHIC SECTION



NOTE: BED THICKNESS IS VARIABLE

FIGURE 2

REFERENCE:
GAI CONSULTANTS, INC. (GAI) DRAWING 90-292-B21
TYPICAL STRATIGRAPHIC SECTION
PIGGOT'S RUN DISPOSAL SITE
HARRISON POWER STATION
HARRISON COUNTY, WEST VIRGINIA 1994

gai CONSULTANTS, INC. Engineers • Geologists • Planners Environmental Specialists 570 Beatty Rd • Pittsburgh, Monroeville Pa 15146 412-856-6400	TYPICAL STRATIGRAPHIC SECTION HARRISON POWER STATION PHASE IV CCB LANDFILL	DWN. ____ CHKD. ____ APPD. JDP DATE 1/16/03
	ALLEGHENY ENERGY SUPPLY MONROEVILLE, PENNSYLVANIA	SCALE: NOT TO SCALE DRAWING NUMBER 00-276-B15 REV

FIGURE 3-6

LOCATIONS OF GEOLOGIC CROSS-SECTIONS AT THE PRDF SITE

K001405A.DWG

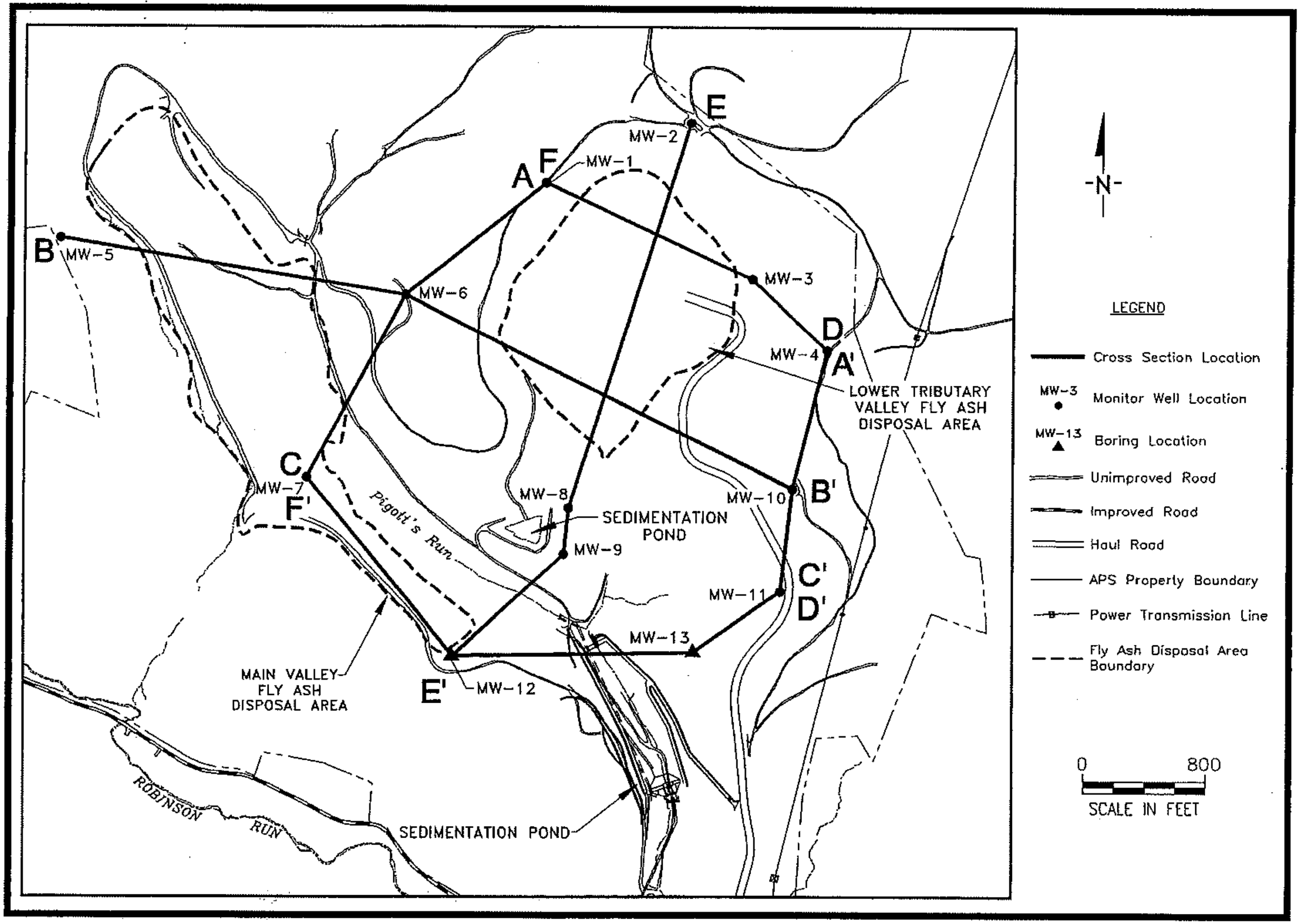


Figure 3-6 Locations of geologic cross-sections at the PRDF site.

FIGURE 3-8

GEOLOGIC CROSS-SECTION B-B’ AT THE PRDF SITE

K001407A.DWG

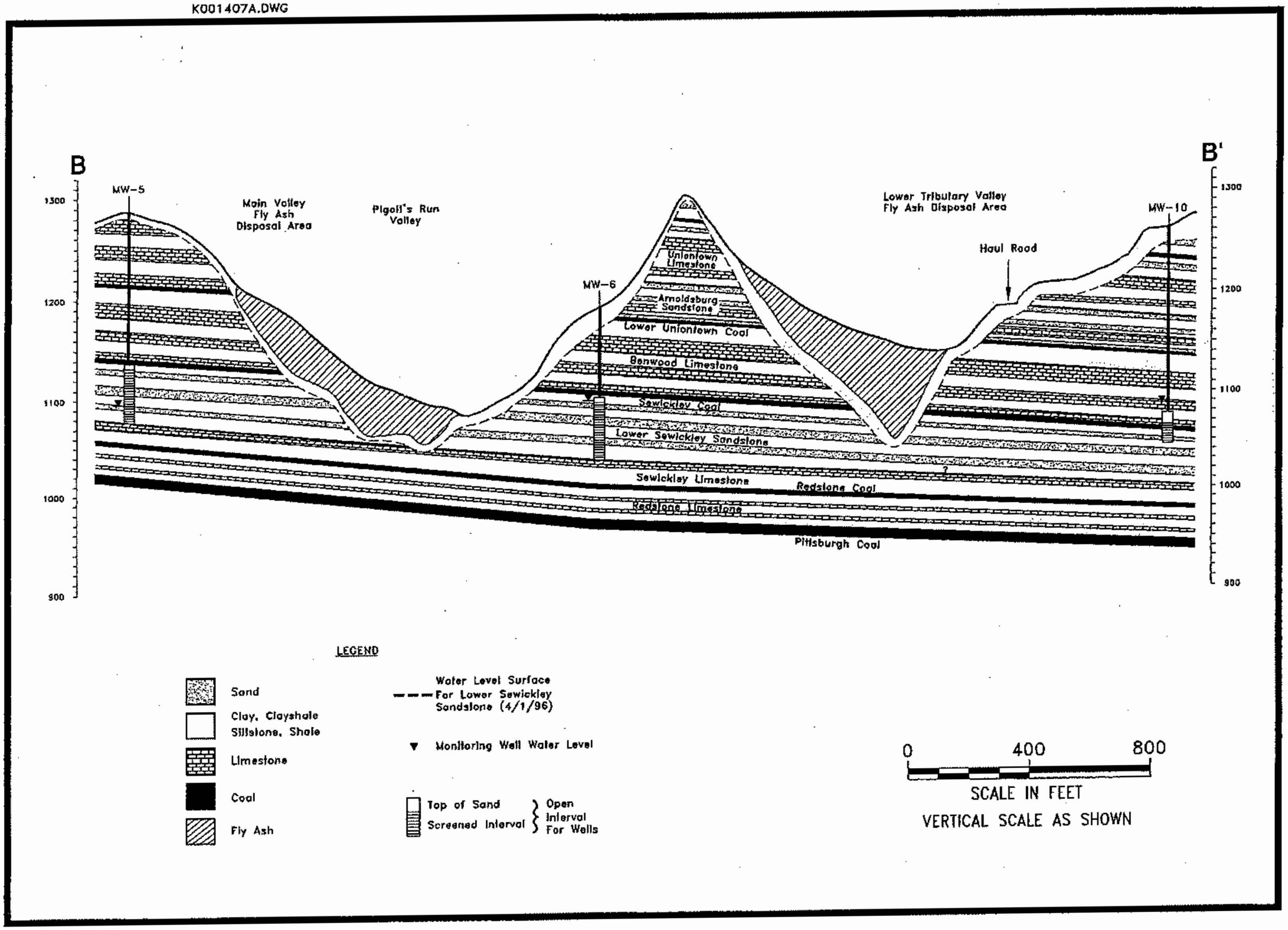


Figure 3-8 Geologic cross-section B-B' at the PRDF site.

FIGURE 3-11

GEOLOGIC CROSS-SECTION E-E' AT THE PRDF SITE

K001410A.dwg

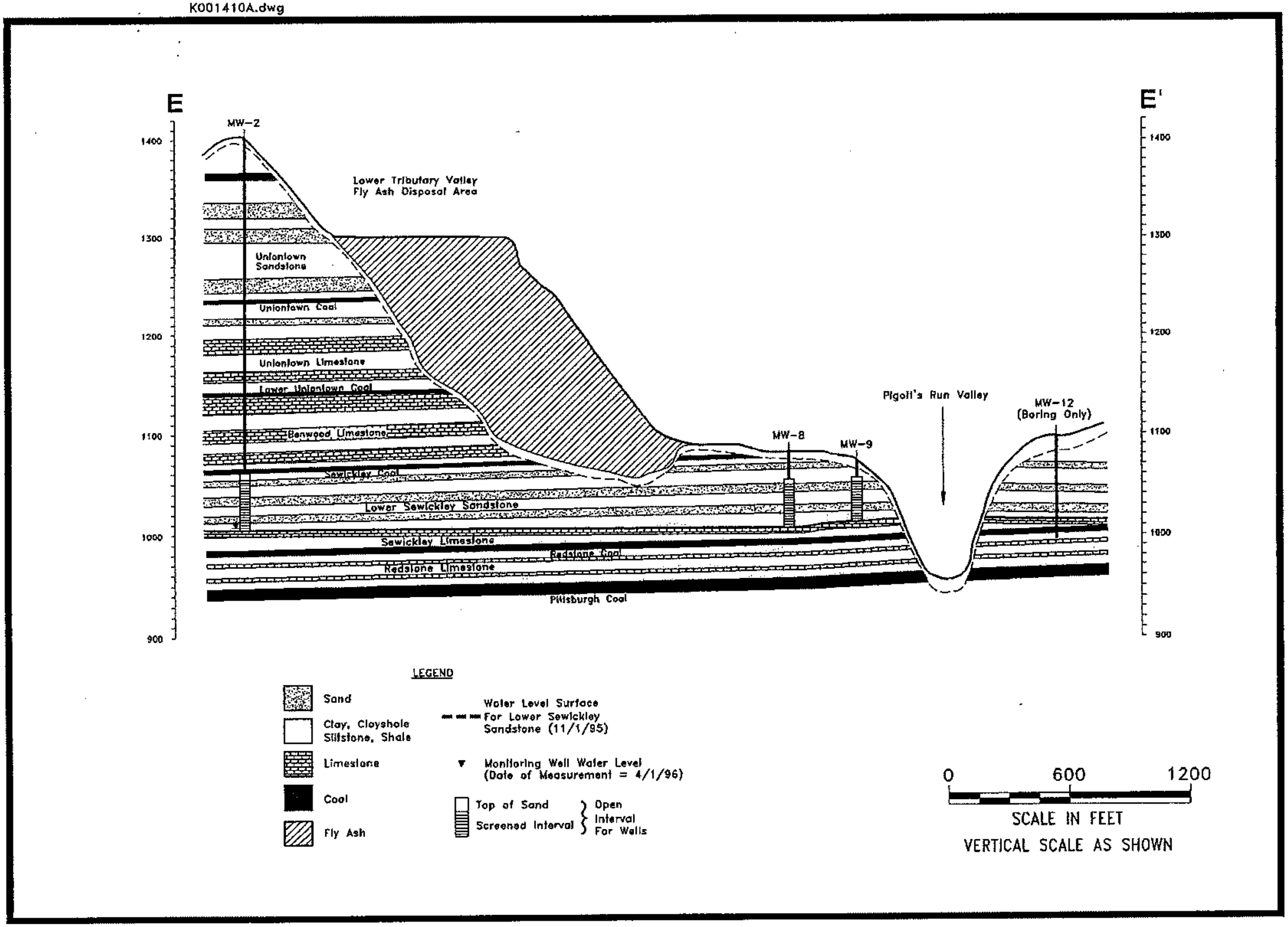
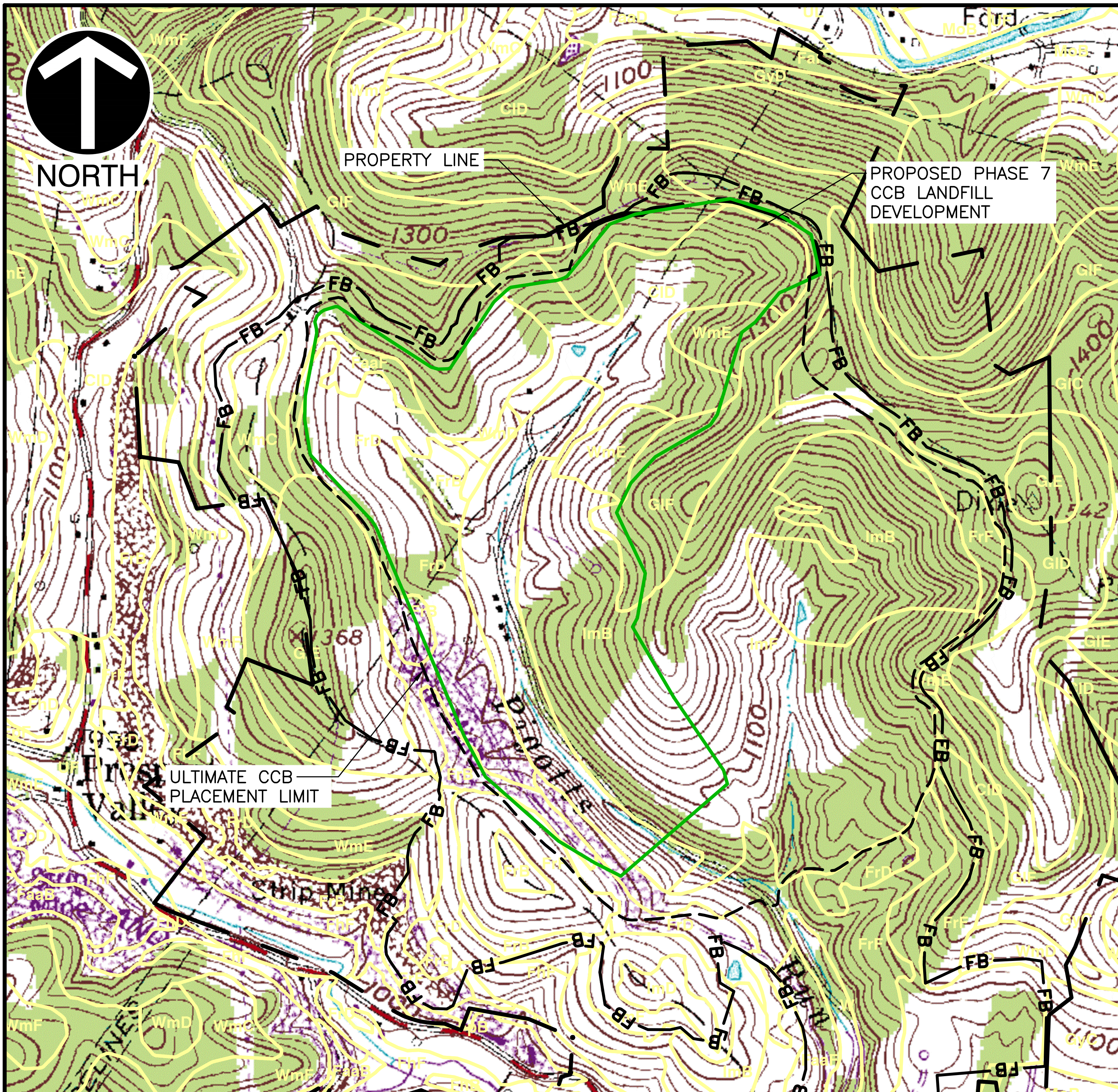


Figure 3-11 Geologic cross-section E-E' at the PRDF site.

FIGURE 4

SOILS MAP



REFERENCE

1. USDA WEB SOIL SURVEY – HARRISON AND TAYLOR COUNTIES, WEST VIRGINIA
2. WEST VIRGINIA STATEWIDE ONE-FOOT RESOLUTION SHERIFFS ASSOCIATION AERIAL IMAGERY. IMAGERY DATE: 2020.

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0 1000 2000

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PHASE 7 CCB LANDFILL EXPANSION
HARRISON POWER STATION
HARRISON COUNTY, WEST VIRGINIA

SOILS MAP

DRAWN BY: TAF	CHECKED BY: MRF	APPROVED BY: DMT*	FIGURE NO.:
DATE: MARCH 2021	DWG SCALE: 1"=2000'	PROJECT NO: 302-918	4

1165

S:\302-918\-CADD\Dwg\SW03-PH 7 CCB Expansion\302918-SW03-FIG-1_FIG-4.dwg{FIG 4} LS:(2/26/2021 - jleidy) - LP: 3/12/2021 12:59 PM

APPENDICES

APPENDIX A

CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL (CQA/QC) PLAN

TABLE OF CONTENTS

LIST OF QA/QC FORMS

Number	Title
QAQC.1	Daily Field Report
QAQC.2	Nuclear Compaction Test Data
QAQC. 3	Drainage Composite Deployment Log
QAQC.4	GCL Deployment Log
QAQC. 5	Trial Seam Report
QAQC. 6	Geomembrane Deployment Log
QAQC.7	Geomembrane Panel Field Seaming Log
QAQC.8	Geomembrane Repair Log
QAQC.9	Geotextile Deployment Log
QAQC.10	Interim Certification of Facility Construction Activity

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

SECTION 1 - GENERAL

1.0 Introduction

Construction Quality Assurance/Quality Control (CQA/QC) is a planned system of activities that provides assurance that the project is constructed as specified in the design. Thus, CQA/QC refers to those activities initiated by the Owner of the facility so that the construction of the entire facility, including manufacture, fabrication, and installation of the various components of the lining and final cover systems, meets design and performance requirements.

This CQA Plan addresses the components of the liner system and the soil cover system, and is divided into the following sections:

Section 1	General;
Section 2	Soils Construction Quality Assurance;
Section 3	Surveying Construction Quality Assurance;
Section 4	Geotextile Construction Quality Assurance;
Section 5	Protective Cover/Leachate Collection and Groundwater Underdrains Quality Assurance;
Section 6	GDN Construction Quality Assurance;
Section 7	Geomembrane Construction Quality Assurance;
Section 8	Geosynthetic Clay Liner Construction Quality Assurance;
Section 9	Concrete Construction Quality Assurance;
Section 10	Soil Revegetation Quality Assurance; and
Section 11	QA/QC Forms.

1.1 Definitions Relating to Construction Quality Assurance

1.1.1 Construction Quality Assurance/Quality Control

This CQA/QC Plan is devoted to Construction Quality Assurance and, regarding the soils components only, to Construction Quality Control. In the context of this plan, Construction Quality Assurance and Quality Control are defined as follows:

a. Construction Quality Assurance (CQA): A planned and systematic pattern of means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

b. Quality Control (QC): Those actions which provide a means to measure and regulate the characteristics of an item or service to contractual and regulatory requirements.

c. Construction Certification: Certification of final liner construction will be submitted to the West Virginia Department of Environmental Protection (WVDEP) following completion. WVDEP will be notified upon completion of liner construction. Following inspection of the completed liner area, written approval by the CQA Consultant will be transmitted to WVDEP prior to waste placement.

1.1.2 Use of the Terms in this Plan in the Context of This Document:

a. Construction Quality Assurance (CQA) refers to means and actions employed by the CQA Consultant to assess conformity of the liner and soil cover systems preparation, production and installation with this Plan and Contract Drawings. CQA is provided by a party independent from production and installation.

b. Quality Control (QC) refers to those actions taken by Manufacturers, Fabricators, Installers, Contractors, or Owners to ensure that the materials and the workmanship meet the requirements of this Plan and the Contract Drawings. In the case of soils, QC is provided by the Owner. In the case of geotextiles, QC is provided by the Manufacturer of the geotextiles.

1.2 Parties to Construction Quality Assurance

1.2.1 Description of the Parties

The parties to Construction Quality Assurance include the Owner or Buyer, Buyer's Representative, Engineer, General Contractor or Seller, Geotextiles Manufacturer, Geotextiles Transporter, CQA Consultant, and CQA Laboratory. The lines of authority and communications between each of the parties involved in the CQA are illustrated on Figure 1-1.

a. <u>Buyer or Buyer's Representative</u>: FirstEnergy or it's designated representative, the Engineer and/or CQA Consultant, to which quality assurance responsibilities have been assigned.

b. <u>Engineer</u>: The Engineer is responsible for the designs, drawings, and plans for the liner and cover systems.

c. <u>General Contractor (Seller)</u>: The General Contractor is responsible for the preparation of the subgrade, and construction of the subgrade drains, leak detection zone, liner system, leachate collection system, and protective cover for the liner system and construction of the landfill soil cover.

d. <u>Geotextiles Manufacturer</u>: The Geotextile Manufacturer is responsible for the production of geotextiles.

e. <u>Geotextile Installer</u>: The Geotextile Installer(s) is responsible for field handling, storing, placing, loading (against wind), and other aspects of the geotextile installation.

f. <u>Transporter</u>: The Transporter conveys the geotextile between the manufacturing plant and the site.

g. <u>Construction Quality Assurance Consultant</u>: The CQA Consultant is a party, independent from the General Contractor, Geotextile Manufacturer, and Geotextile Installer, who is responsible for observing and documenting activities related to the CQA of the earthwork at the site for the soil cover and liner systems and the production and installation of the geotextile component of the liner system. He/she is also responsible for issuing a liner certification report, sealed by a Professional Engineer registered in the State of West Virginia, and filing installation forms required and supplied by the WVDEP.

h. Soils Construction Quality Assurance Laboratory: The Soils CQA Laboratory is independent from the Soils Supplier, and General Contractor and is responsible for conducting tests in the laboratory on samples of soil taken from the borrow source, stockpile, or site.

i. Owner (Buyer): The Owner is Monongahela Power Company, a direct subsidiary of FirstEnergy Corp. who owns, and/or is responsible for the construction and operation of the facility.

1.2.2 Qualifications of the Parties

The following qualifications will be required of parties involved with the design, manufacture, fabrication, installation, transportation, and CQA of materials for the liner systems.

a. Engineer: The Engineer will be a qualified and registered Professional Engineer in WV or State recognized by WV. The Engineer will have a history which demonstrates familiarity with soils.

b. Geosynthetics Manufacturers: The Geosynthetics Manufacturers shall be able to provide sufficient production capacity and qualified personnel to meet the demands of the project.

The Geosynthetics Manufacturer shall be pre-qualified and approved by the Engineer and the Owner.

c. Transporter: personnel responsible for the loading, transport, and unloading of the geotextile must be fully aware of the consequences of damage to the geotextile, and familiar with handling and transport constraints required by the Manufacturer.

d. CQA Consultant: The independent CQA Consultant shall be an engineer registered in West Virginia with experience in the design, installation, and monitoring, of liner systems, geotextiles, and earthwork.

e. Qualifications of Independent Quality Assurance (QA) field personnel: QA field personnel will report directly to the designated CQA Consultant. The QA field Personnel will provide the documentation for the Construction Certification Report. The minimum qualifications of the QA field personnel to implement the CQA Plan for construction of the lined landfill facility is as follows:

Supervisory Personnel shall:

- Be a licensed nuclear density gauge operator;
- Have a minimum of 1 year experience in monitoring the placement and compaction of soils and aggregates;
- Have a minimum of 1 year experience in monitoring and installation of geotextiles; and
- Have good oral and writing skills to clarify the intent of and to provide clear documentation of various construction activities.

Assisting Personnel shall:

- Have a minimum of 4 hours of classroom training on materials placement and testing; and
- Have a minimum of 16 hours field experience training under direct supervision of qualified supervisory personnel.

f. Qualifications of the Certification Engineer: The Certification Engineer will be a Professional Engineer registered in the State of West Virginia. The Certification Engineer shall have the same qualifications as the QA Consultant.

1.3 Scope of Construction Quality Assurance

The scope of this CQA Plan includes the CQA of the soils and geosynthetics components of the liner systems, which includes manufacturing, fabricating, shipping, handling and installation of geosynthetics.

1.4 Units

In this CQA Plan, properties and dimensions are expressed in U.S. units.

1.5 References

The CQA Plan includes references to test procedures of the American Society for Testing and Materials (ASTM), the Federal Test Method Standards (FTMS), and the "Standards for Flexible Membrane Liners" of the National Sanitation Foundation (NSF).

1.6 Site and Project Control

To guarantee a high degree of quality during installation, clear, open channels of communication are essential and meetings are critical. A copy of the field notes and completed forms shall be given to the Buyer's Representative at the end of the day's work or end of a work unit, whichever is shorter. These notes will be retained by the Buyer's Representative on-site.

1.6.1 Resolution Meeting

Following the completion of the design and plans, a Resolution Meeting will be held. This meeting will include the CQA Consultant, the Engineer, and the Buyer's Representative.

The resolution meeting is for beginning planning for coordination of tasks, anticipating problems which might cause difficulties and delays in construction, and presenting the CQA/QC Plan to the parties involved. It is very important that the construction requirements regarding testing, repair, and controls, be known and accepted.

This meeting includes:

a. Communicating the relevant documents;

b. Reviewing critical design details of the project;

c. Reviewing the seam layout drawing provided by the Installer or the Fabricator;

d. Reviewing the CQA/QC Plan;

e. Making modifications to the CQA/QC Plan to ensure it specifies the necessary CQA activities;

f. Reaching a consensus on the CQA Plan and quality control procedures, especially on methods for determining acceptability of the soils and geosynthetics comprising the liner system and soil cover cap;

g. Selecting and reviewing testing equipment and protocols for testing and placement of soil materials;

h. Confirming the methods for documenting and reporting, and for distributing documents and reports; and

i. Confirming the lines of authority and communication.

The meeting will be documented by a person designated at the beginning of the meeting, and minutes will be transmitted to attendees.

1.6.2 Pre-Construction Meeting

A Pre-Construction Meeting will be held at the site. The meeting will be attended by the CQA Consultant, the General Contractor, and the Buyer's Representative. The WV Department of Environmental Protection will be invited.

This meeting includes:

a. Making modifications to the CQA Plan/QC;

b. Reviewing the responsibilities of each party;

c. Reviewing lines of authority and communication;

d. Reviewing methods for documenting and reporting, and for distributing documents and report forms as outlined in Section 1.6.5 of this CQA/QC Plan;

e. Establishing protocols for testing;

f. Establishing protocols for handling deficiencies, repairs, and retesting;

g. Reviewing the time schedule for operations;

h. Outlining procedures for packaging and storing archive samples;

i. Reviewing repair procedures;

j. Conducting a site walk-around and review material storage locations;

k. Establishing soil stockpiling locations, if applicable; and

l. Establishing soil borrow locations;

The meeting will be documented by a person designated at the beginning of the meeting, and minutes will be transmitted to attendees.

1.6.3 Progress Meetings

A weekly progress meeting will be held between the CQA Consultant, the General Contractor, the Buyer's Representative, and other concerned parties. This meeting will discuss current progress, planned activities for the next week, and new business or revisions to the work. The CQA Consultant will log problems, decisions, or questions arising at this meeting in their daily reports. Matters requiring action which are raised in this meeting will be reported to the appropriate parties.

1.6.4 Problem or Work Deficiency Meeting

A special meeting will be held if and when a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by the affected contractors, the Buyer's Representative, and the CQA Consultant. If the problem requires a design modification, the Engineer should also be present. The purpose of the meeting is to define and resolve the problem or work deficiency:

a. Defining and discussing the problem or deficiency;

b. Reviewing alternative solutions; and

c. Implementing an action plan to resolve the problem or deficiency;

The meeting will be documented by a person designated at the meeting and minutes will be transmitted to affected parties. The Engineer or the Buyer's Representative will be responsible to inform the WVDEP of proposed design modifications. Design modifications will not be made without prior WVDEP approval.

1.6.5 Recording and Reporting Construction Quality Control Inspection

Recording and reporting the Construction Quality Control inspection of a geomembrane installation is essential. The following forms will be used. Copies are provided in Section 9.

a. Form QAQC.1 – Daily Field Report

b. Form QAQC.2 – Nuclear Compaction Test Data

c. Form QAQC.3 – Drainage Geocomposite Deployment Log

d. Form QAQC.4 – GCL Deployment Log

e. Form QAQC.5 – Trial Seam Report

f. Form QAQC.6 – Geomembrane Deployment Log

g. Form QAQC.7 – Geomembrane Panel Field Seaming Log

h. Form QAQC.8 – Geomembrane Repair Log

i. Form QAQC.9 – Geotextile Deployment Log

j. Form QAQC.10 – Interim Certification of Facility Construction Activity

1.7 Additional Installation Requirements for Geosynthetics

a. It is the Contractor's responsibility to verify to the satisfaction of the CQA Consultant that whatever equipment or means used to deploy geosynthetics does not damage the geosynthetic being deployed nor any of the underlying geosynthetics. **Prior consultation with the CQA Consultant regarding operation of equipment or liner geosynthetics is required.**

b. Heavy vehicular traffic on the geosynthetics shall not be allowed. Rubber-tired ATVs and trucks are acceptable, if wheel contact is less than 5 psi, for deployment of geosynthetics over the top of other geosynthetics. With the exception that no vehicular traffic will be allowed directly over the geomembrane layers.

c. Skid steer-type vehicles are not allowed directly on top of any geosynthetics.

d. The tires of ATVs or other suitable vehicles shall not be allowed to spin on top of the geosynthetics. In addition, no sharp turns shall be performed on top of geosynthetics.

e. For placement of aggregate within the leachate collection zone, it is possible to use a small loader/utility vehicle (such as a John Deere Gator), with a maximum capacity of 1/2 cubic yard, with low pressure tires or treads (less than 10 psi ground pressure), to place the aggregate. To protect the underlying GDN and 60 mil textured HDPE geomembrane, the Contractor will be responsible for placement of a sacrificial layer of 60 mil HDPE liner beneath the path where the vehicle will be transporting the stone. The bottom of the liner will be smooth and the top will be textured. The liner will be removed after the stone is placed in the leachate collection zone. There are other suitable methods for placement of the leachate collection aggregate which do not involve running on the underlying GDN and 60 mil HDPE liner with equipment such as crabs with concrete buckets, conveyors, staged construction of the synthetic liner system, etc.

f. Any aggregate spilled on the geosynthetics, outside of the leachate collection zone shall immediately be swept off and removed from the site area. No aggregate shall be placed in the liner system, except where specifically called for on the drawings.

g. It is the Contractor’s responsibility to repair any damage caused to any geosynthetics.

SECTION 2 - SOILS CONSTRUCTION QUALITY ASSURANCE

2.0 Introduction

This section addresses the soils components of the liner system and soil cover cap and outlines the soils CQA program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and treatment of problems.

2.1 Soils Components of the Liner and Cover Systems

2.1.1 Subgrade/ General Fill

Subgrade soil placement shall be compacted fill (of soil types general fill and/or cover soil).

Unsuitable, soft, or organic materials detected during subgrade preparation shall be over excavated until material acceptable to the Owner is encountered and backfilled with compacted subbgrade fill.

Subgrade which does not meet the requirements for moisture content at the time of compaction shall be dried or wetted to meet the specified requirements. If the subgrade requires drying, this may be accomplished by reworking it under warm and dry atmospheric conditions. Water, for wetting, shall be added carefully by sprinkling and care shall be taken that no more than the amount needed is applied.

Subgrade shall not be placed on frozen ground, and frozen material shall not be used for subgrade. Frozen materials shall be removed to expose unfrozen materials. These materials shall be reconditioned or stockpiled for future placement.

2.1.2 Subbase

A minimum 6-inch thick layer of subbase shall be placed on prepared subgrade. For in place soils, the top 6 inches of soil shall meet the requirements of the subbase. Subbase shall comply with requirements of the test standards and frequencies listed on Table 2-1 and Table 2-2.

Sampling and performance of laboratory compaction tests should be performed in accordance with ASTM D 698 for each soil type used in the subbase.

In-place density tests by nuclear (ASTM D 2922) or sand cone (ASTM D 1556) methods, and a moisture test (ASTM D 3017 or ASTM D 2216) shall be performed to ensure moisture and compaction are attained as presented in Table 2-2.

One-point Proctor tests or 3-point compaction tests (ASTM D 5080) shall be performed to verify field density testing results and to confirm that the appropriate laboratory density-moisture curve is being used. The CQA Consultant shall be equipped to perform this test in the field.

Subbase material shall be in place soils or soils supplied from approved excavation and borrow sources and comply with the specified requirements listed in Table 2-2.

The approved sources will be pre-qualified by laboratory testing for the required properties and for the typical index properties of grain size and Atterberg Limits in order to establish a range of acceptable index property values. During subbase placement, the installed subbase will undergo verification testing for the index and required properties according to the Table 2-2. If in-place material is encountered during verification testing that does not meet the established range for the typical index properties for plasticity index, grain size and Atterberg Limits, the General Contractor or CQA Consultant may test the permeability of the subbase soil by laboratory testing of compacted in-place soil (sampled by pushing a Shelby tube) to verify that the material is acceptable for use.

At the completion of each test or within 24 hours, test results shall be recorded on Form QAQC.2 to present to the CQA Consultant for review of test results versus the requirements. If a deficiency is discovered, the nature and extent will be determined and the Owner and General Contractor will be notified immediately.

The subbase soil shall be sprayed with water as needed to maintain the required moisture content. Subbase shall be smooth-rolled as a surface-seal for overnight, the working area will be restricted to limit surface exposure, and the compacted subbase soil shall be covered with geotextile as soon as practical.

The final subbase surface shall be smoothed with a smooth-drum roller, and free of voids and cracks, prior to geotextile placement.

2.1.3 Cover Soil

Cover soil shall comply with the General Notes of the Contract Drawings. Cover soil shall comply with general fill requirements.

The cover soil shall be placed on the outer face of the landfill in 1 lift.

Cover soil may be used as general fill as long as the material meets acceptance criteria in Table 2-2 for general fill/subgrade.

The cover soil shall not be placed during or directly after a rain event.

Cover soil shall not be placed on frozen ground, and frozen material shall not be used for the soil cover.

At the end of the day's operation, the cover soil shall be sloped to provide drainage over the cross-section and length to reduce the entry of excess moisture.

In steep slope areas, cover soil shall be placed from the bottom of the slope upward. The dozer shall avoid trafficking on the CCB material to prevent commingling of the CCB material and cover soil.

2.1.4 Material Requirements

Material requirements shall be in accordance with the drawings.

2.2 Soils Testing

2.2.1 Test Methods

Testing used to evaluate the suitability or conformance of soils materials shall be carried out in accordance with the current versions of the corresponding ASTM, American Association State Highway & Transportation Officials (AASHTO), West Virginia Department of Transportation, Division of Highways (WVDOT), United States Department of Agriculture (USDA) and United States Army Corps of Engineers (USACE) test procedures as referenced. The test methods indicated in Table 2-1 are those which will be used for this soils CQA program.

When nuclear densometers are used, each apparatus shall be calibrated to the soil being monitored prior to use.

2.2.2 Testing Requirements

The frequency of soils testing for materials evaluation shall conform to the minimum frequencies presented in Table 2-2. Additional testing may be required as determined by the CQA Consultant or Owner.

2.3 Soils Construction Quality Assurance

Soils CQA shall be performed on soil and aggregate components of the liner system and soil cover construction prior to and during construction. To determine that the soil or aggregate sources meet the design requirements, laboratory tests shall be conducted on samples taken at the borrow source and/or stockpile. Construction evaluation testing consists of: (1) monitoring the work; and (2) laboratory and field tests. Field tests will be conducted during the course of the work.

2.3.1 Monitoring

The CQA Consultant will monitor and document the construction of components. Monitoring the construction work for the subgrade, subbase, enhanced FGD material, coarse aggregate, protective cover/leachate collection layer of the liner system, and the soil cover cap will be as listed on Table 2-2.

CQA Consultants shall be responsible for performing and documenting observations, inspections, and tests in accordance with the Contract Drawings, and this CQA Plan. The CQA Consultant is responsible for completing forms QAQC.1, QAQC.2, QAQC.10.

Soil and aggregate monitoring shall be performed such that underlying geosynthetics are not punctured or otherwise damaged.

2.3.2 Laboratory and Field Tests

The laboratory and field test methods and testing frequencies presented in the Tables 2-1 and 2-2 will apply.

At locations where the testing of the subgrade and subbase indicates that the material does not meet the requirements of this CQA Plan, the failing area may be reworked. Reworking can include compacting, or removal and replacement.

At locations where the laboratory testing of the soil cover cap indicates that the soil is not of the specified USDA textural classification, particle size or has a combustible or coal content higher than allowed, the material shall be removed and replaced.

2.3.3 Construction Quality Control Testing Frequency

Soils CQC testing will be conducted by the CQA Consultant in accordance with the CQA Plan or more frequently as directed by the Owner. Documentation and reporting of test results will be in accordance with the requirements identified in appropriate sections of this CQA Plan.

Pre-construction testing shall be conducted on material samples obtained from the borrow source and/or stockpile(s) to pre-qualify the source. Construction Quality Control testing shall be conducted on samples taken from the as-received material during the course of the work.

Routine testing frequencies for material evaluation and construction quality evaluation are presented in Table 2-2. Sampling locations will be selected by the CQA Consultant.

During construction, the frequency of testing may be increased at the discretion of the Owner when visual observations of construction performance indicate a potential problem.

2.3.4 Deficiencies

If a defect is discovered in the subbase or subgrade, the CQA Consultant shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the deficient area and direct the work be redone until acceptance criteria is achieved and documented by additional tests, observations, review of records, or other means that the CQA Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant shall stop work until conditions are improved and the work area is corrected so that the work can be completed in a satisfactory manner.

2.3.5 Notification

After determining the extent and nature of a defect, the CQA Consultant shall notify the Owner and General Contractor and schedule appropriate retests when the work deficiency is corrected.

2.3.6 Repairs and Retesting

The General Contractor shall correct the deficiency to the satisfaction of the CQA Consultant and Owner. If a project criterion cannot be met, or unusual weather conditions hinder work, then the CQA Consultant shall develop and present to the Owner and the Engineer suggested solutions for approval.

Holes resulting from testing procedures for soil material after placement by test instruments, equipment or probes will be packed with the proper soil material or bentonite clay. The material shall be tamped into the disturbed area in layers with a metal tamping rod.

Retests recommended by the CQA Consultant must verify that the defect has been corrected before additional work is performed by the Contractor in the area of the deficiency. The CQA Consultant shall also verify that installation requirements are met and submittals are provided.

SECTION 3 - SURVEYING CONSTRUCTION QUALITY ASSURANCE

3.0 Introduction

Surveying of lines and grades shall be conducted on an ongoing basis during construction of the soil layers, pipe, and geosynthetics placement. Surveying is to provide documentation for record drawings and verify construction. The Construction Contractor is responsible for layouts and as-built conditions. The CQA Consultant shall spot check the work as deemed necessary. The surveying conducted at the site shall be part of the construction quality assurance program. The surveyor and contractor shall remove stakes from the liner area immediately after they are broken or no longer required for grade control. No stakes shall be left in fill below or above the liner.

3.1 Survey Control

A permanent benchmark shall be established for the site at a location convenient for daily tie-in. The vertical and horizontal controls for this benchmark shall be established within normal land surveying standards.

3.2 Surveying Personnel

The survey crew shall consist of a Senior Surveyor, and as many Surveying CQA personnel as are required to satisfactorily undertake the requirements of the work. Surveying CQA personnel shall be experienced in the provision of these services, including detailed, accurate documentation.

Surveying Construction Quality Assurance shall be performed under the direct supervision of a qualified Land Surveyor. Survey results shall be certified by a registered professional land surveyor.

3.3 Precision and Accuracy

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work shall be sufficiently precise and accurate to attain third order survey for traverse and leveling surveys. Survey instruments should be capable of distance measurements to a precision of 0.01-foot and with angle readings of 20 sec.

3.4 Lines and Grades

The following surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include:

a. Surface of the subgrade, subbase, leachate detection zone, Composite Liner, Leachate collection layer and Top of Protective Cover. A separate survey of each layer does not need to be created if the required thickness of each liner system layer is verified by the CQA Consultant using field measurements and observations, if approved by the Owner and CQA Consultant.

b. Temporary and permanent edge of liner (outside edge of perimeter liner termination area).

c. Alignment and inverts of piping and fittings (both “as found” and “as left).

d. Locations and inverts of encountered underground utilities.

e. Locations of cleanouts.

f. Any other additional information required to complete as-built drawings for the site.

In addition, the locations of geomembrane panels, repairs, patches, destructs, etc. shall be located by field survey or by appropriate field measuring methods (i.e., measuring wheel, tape measure, etc.) by the CQA Consultant or QA field personnel as part of their documentation for the Construction Certification Report.

3.5 Frequency and Spacing

Surveying shall be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks during construction are necessary to assist the Contractor in complying with the required grades.

The following spacing and locations shall be provided, as a minimum, for survey points.

a. Surfaces with slopes less than 10 percent shall be surveyed on a square grid not wider than 100 linear foot.

b. On slopes greater than 10 percent, as a minimum, a line at the crest, midpoint, and toe of the slope will be taken (including tops and bottoms of pipe trenches in liner areas).

c. A line of survey points no farther than 100 feet apart shall be taken along slope break (this includes the inside edge and outside edge of benches on a slope).

d. Edges of liner material placement shall be verified at a minimum of every 100 feet along the perimeter and at sudden changes in bearing and grade.

e. Pipe alignment shall be verified at fittings, terminations, connections, and approximately every 100 feet on straight runs of pipe.

3.6 Tolerances

Acceptable position tolerances on survey coordinates shall be plus or minus 0.2-foot in elevation and plus or minus 1-foot horizontally.

3.7 Documentation

Field survey notes shall be retained by the CQA Consultant. A copy of these notes shall be given to the Owner at the end of each day or surveying task, whichever is shorter. The results from the field surveys shall be documented on a set of Survey Record Drawings in AutoCad, Version 2020 format, including point blocks and contours, where applicable. These drawings should at least include the information required in this document. The drawings shall be updated by the Engineer. In addition to the record drawings, an ASCII file shall be provided for the surveys. This file shall be in the following format: point number, north coordinate, east coordinate, elevation, and description.

SECTION 4 - GEOTEXTILE CONSTRUCTION QUALITY ASSURANCE

4.0 Geotextile

4.1 General

The geotextiles used in the liner system are described as filter and separation geotextiles.

The CQA consultant is responsible for completing forms QAQC.9.

4.2 Manufacturing

The Geotextile Manufacturer shall provide the Buyer's Representative with a list of certified "minimum average roll value" properties (as defined by the Federal Highway Administration), for the type of geotextile to be delivered. The Geotextile Manufacturer shall also provide the Buyer's Representative with a written certification signed by a responsible party that the materials delivered have "minimum average roll values" properties which meet or exceed values certified for that type of geomembrane. In addition, a MQA/MQC plan for the geotextile shall be submitted for review and approval.

The CQA Consultant shall examine manufacturer certifications to check that the property values listed on the certifications meet or exceed those specified for the particular type of geotextile. Deviations shall be reported to the Buyer's Representative.

4.3 Labeling

The Geotextile Manufacturer shall identify rolls of geotextile with at least the following information:

a. Manufacturer's name.

b. Product identification.

c. Lot Number.

d. Roll Number.

e. Roll Weight.

f. Roll dimensions.

If special handling of the geotextile is required, it shall be marked on the top surface of the geotextile.

The CQA Consultant shall examine rolls upon delivery and deviation from the above requirements shall be reported to the Buyer's Representative.

4.4 Shipment and Storage

During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or other damaging or deleterious conditions.

Geotextile shall not be exposed to precipitation prior to being installed. Wrappings protecting geotextile rolls shall be removed less than 1-hour prior to unrolling the geotextile. After the wrapping has been removed, a geotextile shall not be exposed to sunlight for more than 30 days, unless otherwise specified and guaranteed by the Geotextile Manufacturer.

The CQA Consultant shall observe rolls upon delivery at the site and deviation from the above requirements shall be reported to the Buyer's Representative. Damaged rolls shall be rejected and replaced at no cost to the Owner.

4.5 Conformance Sampling and Testing

4.5.1 Sampling Frequency and Test Methods

Conformance sampling and testing of the cushion geotextile shall be performed by CQA Consultant in accordance with the minimum sampling frequencies and test methods outlined in Table 4-1 of this Plan.

Conformance sampling and testing of the filter geotextile shall be performed by CQA Consultant in accordance with the minimum sampling frequencies and test methods outlined in Table 4-2 of this Plan.

4.5.2 Sampling Procedures

a. Cut a sample from the geotextile that is 3 feet long by the full roll width wide. Mark the sample with arrows indicating the machine direction of the geotextile roll.

b. Affix an adhesive label that lists pertinent project and geotextile product information to the geomembrane sample.

c. Complete chain-of custody and testing request forms and furnish conformance samples to the Geosynthetics CQA Laboratory for analysis.

d. Geotextile may be shipped directly from the Manufacturer to an independent testing lab for conformance testing at the option of the CQA Consultant.

4.5.3 Acceptance and Failure Procedures

a. The CQA Consultant shall review results from conformance testing to verify compliance with the requirements of Tables 4-1, 4-2, 4-3a, 4-3b and 9-1 of this Plan. If requirements are met, the CQA Consultant shall issue written acceptance of the geotextile for deployment. If the requirements are not met, CQA Consultant shall provide the Owner, Engineer, Contractor, and Geotextile Installer with written notice of non-conformance, including copies of test results.

b. Geotextile that is rejected shall be removed from the project site and replaced at Contractor's cost. Sampling and conformance testing of geotextile supplied as replacement for rejected material shall be performed by the CQA Consultant at Contractor's cost.

4.6 Handling and Placement

The Installer shall handle geotextile in such a manner so that they are not damaged. The following shall be complied with:

a. The use of woven slit film geotextiles (i.e., geotextiles made from yarns of flat, tape-like character) and heat calendared nonwoven geotextiles will not be allowed.

b. On slopes, the geotextiles shall be securely anchored and then rolled down the slope in such a manner as to continually keep the geomembrane in tension.

c. In the presence of wind, geotextiles shall be ballasted with sandbags or the equivalent. Sandbags shall be installed during placement and shall remain until replaced with protective cover soils.

d. Geotextiles shall be kept continually under slight tension to minimize the presence of wrinkles in the geotextiles

e. If white colored geotextile is used, precautions shall be taken against "snow blindness" of personnel.

The CQA Consultant shall note non-compliances and report it to the Buyer's Representative.

4.7 Seams and Overlaps

Geotextiles shall be overlapped 18 inches or continuously sewn together with a single lock-type stich seam (factory stich) or 2 rows of Type 401 stitching (field-stich). Geotextiles shall be overlapped at a minimum of 6 inches prior to seaming. Horizontal seams on side slopes shall be as per the manufacturer's recommendations. Horizontal seams shall be minimized at best as practical, except as part of a patch. Heat seaming using a wedge welder or other method may be used if the method used is approved by the CQA Consultant and Engineer.

4.8 Repair

Holes or tears in the geotextile shall be repaired as follows:

a. A patch made from the same geotextile shall be spot-seamed in place with a minimum of 24-inch overlap in all directions.

b. Care shall be taken to remove soil or other material which may have penetrated the torn geotextile.

c. The CQA Consultant shall observe the repair, note non-compliance with the requirements, and report them to the Buyer's Representative.

4.9 Placement and Materials

The Installer shall place materials located on top of a geotextile in such a manner to ensure:

a. No damage to the geotextile.

b. Minimal slippage of the geotextile on underlying layers.

c. No excess tensile stresses in the geotextile.

d. In no instance shall equipment travel directly on geotextile. Only track equipment with ground pressures not to exceed 6 psi shall be allowed to routinely cross geotextile areas provided a minimum of 12 inches of cover is maintained. Rubber tired vehicles can occasionally cross the area provided a minimum of 18 inches of cover is maintained and the vehicle wheels do not slip.

Non-compliance shall be noted by the CQA Consultant and reported to the Buyer's Representative.

SECTION 5 - PROTECTIVE COVER/LEACHATE COLLECTION AND GROUNDWATER UNDERDRAINS QUALITY ASSURANCE

5.0 PIPE AND FITTINGS, AGGREGATE, AND PROTECTIVE COVER

5.1 Material Requirements

5.1.1 Pipe

Pipe shall comply with the Construction Drawings.

5.1.2 Fittings

Pipe fittings shall be furnished by the manufacturer of the pipe with which they are used or field fabricated and conform to the requirements for standard fittings.

5.1.3 Joints

HDPE drain pipe joints shall be joined using butt fusion or a collar fusion device. Joints shall be inspected prior to and after construction. Culvert pipes may use gasketed, push-on bell and spigot joints if approved by the Buyer's Representative.

5.1.4 Aggregate, Bottom Ash, and Sand

Aggregate, bottom ash, and sand shall comply with the Construction Drawings. Testing shall be performed as shown in Table 2-2.

5.1.5 Stabilized FGD Material

Stabilized FGD material will be supplied by the Buyer and shall comply with the Construction Drawings. Observation shall be performed as shown in Table 2-2.

5.2 Pipe Manufacturer

5.2.1 Manufacturer Submittals

Prior to the installation of pipe, the Pipe Manufacturer shall provide to the Engineer:

a. A properties sheet including specified properties, measured using test methods indicated, or equivalent.

b. A list of quantities and descriptions of other materials which comprise the pipe.

c. A certification that property values given in the properties sheet are minimum values and are guaranteed by the Pipe Manufacturer.

5.2.2 Engineer Verification

The Engineer shall verify that:

a. The property values certified by the Pipe Manufacturer.

b. The measurements of properties by the Pipe Manufacturer are properly documented and that the test methods used are acceptable.

5.2.3 Shipping Verification and Identification

Prior to shipment, the Pipe Manufacturer shall provide the Buyer's Representative, Engineer and the Geosynthetic CQA Consultant with a quality control certificate for each lot/batch of pipe provided. The quality control certificate shall be signed by a responsible party employed by the Pipe Manufacturer, such as the Production Manager. The quality control certificate shall include:

a. Lot/batch numbers and identification.

b. Sampling procedures and results of quality control tests.

The Engineer and the Geosynthetic CQA Consultant shall review the quality control certificates and verify the certified properties.

5.3 Non-Destructive Testing of Pipe

Joints on non-perforated pipe outside the liner area shall be non-destructively tested using a hydrostatic pressure test. Sufficient time shall be allowed for the HDPE pipes expansion to stabilize prior to pressure drop measurements. The Installer shall be responsible for performing the test to be witnessed by the CQA Consultant. Other non-destructive test methods may be used only when:

a. The Installer can prove its effectiveness.

b. The method is approved by the Pipe Manufacturer.

c. The method is approved by the Buyer's Representative.

5.4 Installation of Pipe

Bedding is to be placed at the locations and thicknesses indicated on the Drawings. Care shall be taken to avoid damage to pipes, the liner, or geotextiles. Bedding placement and condition of the liner system components will be verified by visual inspection.

Perforated pipes shall be laid with the holes facing downward unless indicated otherwise on Contract Drawings. The Engineer shall verify that the holes are of the proper size and spacing.

The pipe will be in continuous and uniform contact with the stone bedding. In no case shall equipment travel directly across a pipe.

Verification of lines and grades shall be checked visually, with surveyed spot checks of plan location and elevation as indicated in Section 3.

Trenching into the bottom ash leachate collection layer or existing protective cover material must be performed with EXTREME CARE to protect the geotextile, and the bottom of the trench shall be a minimum of 3 inches above the geotextile. The use of equipment with teeth on the bucket is prohibited for this operation. In this case pipe bedding in the pipe envelope is not required.

Trenches shall not be backfilled until pipe joints are made, required tests performed, pipe is encased as necessary, as-built survey information is obtained, and Owner approval is granted to proceed.

Care shall be taken so as not to cause vertical or lateral displacement of pipe during backfilling. Maintenance of existing grades and locations shall be verified by visual observation. The Owner shall be notified if difficulties are encountered.

Backfill around pipes shall be placed so that the elevation of the fill is the same on both sides. If the pipe trench is within the liner system the surrounding geotextile should then be sewn with stitching of similar polymers or heat bonded (leistered) to the additional geotextile. After backfilling, the disturbed areas shall be fine graded to blend in with existing contours and left with puddle-free drainage when outside the limits of the liner system. Verification of pipe location shall be made by survey.

5.5 Liner System Protection

5.5.1 Equipment

Light ground pressure equipment (less than 6 psi contact pressure) shall be operated on a minimum of 12 inches of cover and must not be driven on the geosynthetics. Heavy equipment and trucks *over leachate collection pipes or on repeated crossing areas* shall operate on a minimum of 5 feet of cover. In no instance shall equipment with teeth on the bucket or blade be allowed to operate within 2 feet vertically above the liner or geotextile.

5.5.2 Leachate Collection System and Leachate Detection Zone Piping

Piping shall be placed so that the pipe shall be in uniform contact with the bedding (cover) material under the pipe.

5.5.3 Sand

Sand shall be carefully placed in the liner system. The sand shall be placed as part of the leachate detection zone and can be used as part of the leachate collection zone. The sand shall be placed in 1 lift to the dimensions shown on the drawings. Sand spillage beyond the dimensions shown on the drawings shall be removed prior to resuming liner construction.

5.5.4 Coarse Aggregate

Coarse aggregate shall be carefully placed in the liner system. The aggregate backfill shall be placed as part of the leachate collection leachate detection and underdrain groundwater interceptor zone. The remaining coarse aggregate shall be placed in 1 lift to the dimensions shown on the Drawings. No vehicular traffic shall be allowed on the liner system to place aggregate without a minimum of 12 inches of fine-grained material being placed above the geosynthetics. Aggregate spillage beyond the dimensions shown on the Drawings shall be removed prior to resuming liner construction.

5.5.5 FGD Protective Cover

The FGD shall be placed as protective cover as part of the liner system. The FGD shall be placed in 1 lift a minimum of 12 inches thick. Typically, the material will be placed in 24-inch thick lifts.

5.5.6 Bottom Ash

The bottom ash shall be placed as part of the leachate collection system and protective cover for the liner system. The bottom ash shall be placed in 1 lift to the dimensions shown on the drawings.

5.5.7 Placement of Lifts

Placement of the lifts shall proceed from the closest point of access for the furthest point(s) on the liner system to avoid damage to the liner system components. Lift thickness shall be controlled by survey or depth checks

5.5.8 Cover Procedure

Leachate collection zone bottom ash and other leachate collection aggregates shall not be dropped onto the geomembrane or overlying geosynthetics, such as cushion geotextile, from a height greater than 3 feet. The leachate collection zone bottom ash shall be pushed out over the geomembrane or overlying geosynthetics in an upward tumbling motion. The leachate collection zone bottom ash shall be placed from the bottom of the slope upward.

SECTION 6 - GDN CONSTRUCTION QUALITY ASSURANCE

6.0 Geocomposite Drainage Net

6.1 General

Geocomposite used in the liner system is identified as Geocomposite Drainage Net (GDN) on the Drawings. The leachate collection GDN consists of a 250-mil HDPE geonet with 8-ounce per square yard geotextile heat-bonded to its upper and lower surfaces, respectively.

The CQA Consultant is responsible for completing Forms QAQC.3.

6.2 Manufacturing

The GDN Manufacturer shall provide the Buyer's Representative with a list of certified properties for the type of GDN to be supplied. The GDN Manufacturer shall provide the Buyer's Representative with a written certification signed by a responsible party that the GDN delivered has properties which meet or exceed the certified properties. In addition, at least 2 transmissivity tests shall be performed by the CQA Consultant using the actual site materials and loading conditions. The transmissivity tests shall be performed in accordance with the procedures outlined in Section 6.5.1, below.

The CQA Consultant shall examine manufacturers' certifications and test results to ensure that the property values listed on the certifications meet or exceed those specified. Deviations shall be reported to the Buyer's Representative.

6.3 Labeling

The GDN Manufacturer shall identify rolls of GDN with the following:

a. Manufacturer's name.

b. Product designation.

c. Lot number.

d. Roll number.

e. Roll dimensions and weight.

f. Geotextile orientation.

The CQA Consultant shall examine rolls upon delivery and deviations from the above requirements shall be reported to the Buyer's Representative.

6.4 Shipment and Storage

GDN cleanliness is essential to its performance and GDN rolls shall be wrapped in polyethylene sheets or otherwise protected against dust and dirt during shipping and storage.

The wrapping shall be removed less than 1-hour before placement. The CQA Consultant shall verify that the GDN is free of dirt and dust just before installation. The CQA Consultant shall report the outcome of this verification to the Buyer's Representative, and if the GDN is judged dirty or dusty, it shall be washed by the Installer prior to installation.

Washing operations shall be observed by the CQA Consultant and improper washing operations shall be reported to the Buyer's Representative.

6.5 Conformance Testing

6.5.1 Tests

Upon delivery of the rolls of GDN, the CQA Consultant shall ensure that samples are removed and forwarded to the Geosynthetic CQA Laboratory for testing to ensure conformance to both the Conformance sampling and testing shall be performed in accordance with Table 6-1, 6-1a, 6-2, 6-2b, 6-3a, 6-3b, and 9-1 of this Plan.

6.5.2 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall be 3 feet long by the roll width. The CQA Consultant shall mark the machine direction on the samples with an arrow. GDN may be shipped directly from the Manufacturer to an independent testing lab for conformance testing at the option of the CQA Consultant.

6.5.3 Test Results

The CQA Consultant will examine results from laboratory conformance testing and shall report non-conformances to the Buyer's Representative. The minimum standards for GDN are provided in Table 6-1 and 6-2.

6.6 Conformance Test Failure

The following procedure shall apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

a. The Installer shall replace the roll of GDN that is in non-conformance with a roll that meets the requirements.

b. The Installer shall remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These 2 samples must conform to the material requirements. If either of these samples fail, the 5 numerically closest untested rolls on both sides of the failed sample shall be tested by the Geosynthetics CQA

Laboratory. These 10 samples must conform to the material requirements. If any of these samples fail, every roll of GDN on-site and every subsequently delivered roll that is from the same supplier must be tested by the Geosynthetics CQA Laboratory. This additional conformance testing will be at the expense of the Installer.

The CQA Consultant shall document actions taken in conjunction with conformance test failures.

6.7 Intentionally Not Used

6.8 Handling and Placement

6.8.1 Location

The CQA Consultant shall verify that field panels are installed at the location indicated on the Installer's field installation drawings, as approved or modified.

6.8.2 Placement

The Installer shall handle GDN in such a manner as to ensure that it is not damaged. The following shall be complied with:

a. On slopes, the GDN shall be secured in the perimeter liner termination area and then rolled down the slope in such a manner as to continually keep the GDN in continuous contact with the geomembrane surface. If necessary, GDN shall be positioned by hand after being unrolled to minimize wrinkles.

b. In the presence of wind, GDN shall be ballasted with sandbags or equivalent. Such sandbags shall be installed during placement and shall remain until replaced with overlying material.

c. Unless otherwise specified, GDN shall not be welded to geomembranes. No burn through geotextiles shall be permitted. No glue or adhesive shall be permitted.

d. The Installer shall take necessary precautions to prevent damage to the underlying layers during placement of the GDN.

e. During placement of GDN, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the GDN, it shall be hosed clean prior to placement of the next material on top of it. In this regard, care shall be taken with the handling of sandbags to prevent rupture or damage of the sandbag.

f. In no instance shall equipment travel directly on liner, geotextile, or other geosynthetic material. Only track equipment with ground pressures not to exceed 6 psi shall be allowed to routinely cross liner or geotextile areas provided a minimum of 12 inches of cover is maintained. Rubber tired vehicles can occasionally cross the area a minimum of 18 inches of cover

is maintained and the vehicle wheels do not slip. For temporary access roads crossing a liner edge, or for access roads over the liner in order to end dump protective cover or waste, the contractor shall maintain a 5-foot (minimum) layer of cover over the liner. Refer to Section 1.7 of this plan for additional information on vehicular traffic on the GDN.

The CQA Consultant shall note non-compliances and report it to the Buyer's Representative.

6.9 Joining

Adjacent GDN panels shall be joined according to the requirements. As a minimum, the following requirements shall be met:

a. Adjacent panels shall be overlapped by at least 3 inches and end of panel or horizontal seam connections shall be overlapped by 24 inches, and the covering geotextile for adjacent panels mechanically seamed, or an 18-inch minimum width geotextile leistered over the end seam.

b. Overlaps shall be secured by tying.

c. Tying shall be achieved by nylon cable or HDPE fasteners. Tying devices shall be white or yellow for easy observation. Metallic devices shall not be used.

d. Tying fasteners shall be spaced every 5 feet along panel edges, every 6 inches across panel ends and in corners, and every 6 inches in the perimeter liner termination area.

The CQA Consultant shall note non-compliances and report it to the Buyer's Representative.

6.10 Repair

Holes or tears in the GDN shall be repaired by placing a patch extending 12 inches beyond edges of the hole or tear. The patch shall be secured to the original GDN by tying fasteners every 6 inches. If the hole or tear width across the roll is more than 50 percent the width of the roll, the damaged area shall be cut out and the 2 portions of the GDN shall be joined.

The CQA Consultant shall observe repairs, note non-compliances with the above requirements and report them to the Buyer's Representative.

SECTION 7 - GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

7.0 Geomembrane

7.1 General

The geomembrane used in the diversion and collection channel leak barrier shall be 60-mil HDPE having textured upper and lower sheet surfaces. The CQA consultant shall be responsible for completing forms QAQC.5, QAQC.6, QAQC.7, and QAQC.8.

7.2 Manufacturing

The Geomembrane Manufacturer shall provide the Buyer's Representative with a list of certified "material" properties for the type of geomembrane to be delivered. The Geomembrane Manufacturer shall also provide the Buyer's Representative with a written certification signed by a responsible party that the materials delivered have properties which meet or exceed values certified for that type of geomembrane. In addition, a MQA/MQC plan for the geomembrane shall be submitted for review and approval.

The CQA Consultant shall examine manufacturer certifications to check that the property values listed on the certifications meet or exceed those specified for the particular type of geomembrane and as required by the construction documents. Deviations shall be reported to the Buyer's Representative.

7.3 Labeling

The Geomembrane Manufacturer shall identify rolls of geomembrane with at least the following information:

a. Manufacturer's name.

b. Product identification.

c. Lot Number.

d. Roll Number.

e. Roll Weight.

f. Roll dimensions.

If special handling of the geomembrane is required, it shall be marked on the top surface of the geomembrane.

The CQA Consultant shall examine rolls upon delivery and deviations from the above requirements will be reported to the Buyer's Representative.

7.4 Shipment and Storage

During shipment and storage, the geomembrane shall be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or other damaging or deleterious conditions.

The CQA Consultant shall observe rolls upon delivery at the site and deviations from the above requirements shall be reported to the Buyer's Representative. Damaged rolls shall be rejected and replaced at no cost to the Owner.

7.5 Conformance Sampling and Testing

7.5.1 Sampling Frequency and Test Methods

Conformance sampling and testing of the geomembrane shall be performed by CQA Consultant in accordance with the minimum sampling frequencies and test methods outlined in Table 7-1 and 7-1a of this Plan. Conformance sampling and testing shall be completed at a minimum frequency of 1-sample per geomembrane production lot.

7.5.2 Sampling Procedures

a. Cut a sample from the geomembrane that is 3 feet long by the full roll width wide. Mark the sample with arrows indicating the machine direction of the geomembrane roll.

b. Affix an adhesive label that lists pertinent project and geomembrane product information to the geomembrane sample.

c. Complete chain-of custody and testing request forms and furnish conformance samples to the Geosynthetics CQA Laboratory for analysis.

d. Geomembrane may be shipped directly from the Manufacturer to an independent testing lab for conformance testing at the option of the CQA Consultant.

7.5.3 Acceptance and Failure Procedures

a. The CQA Consultant shall review results from conformance testing to verify compliance with the requirements of Tables 7-1, 7-1a, 7-2, 7-2a, 7-2b, 7-3a, 7-3b, and 9-1 of this Plan. If requirements are met, the CQA Consultant shall issue written acceptance of the geomembrane for deployment. If the requirements are not met, CQA Consultant shall provide the Owner, Engineer, Contractor, and Geomembrane Installer with written notice of non-conformance, including copies of test results.

b. The following procedure shall apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

    (i) Geomembrane that is rejected shall be removed from the project site and replaced at Contractor's cost. Sampling and conformance testing of geomembrane supplied as replacement for rejected material shall be performed by the CQA Consultant at Contractor's cost.

(ii) The Installer shall remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These 2 samples must conform to the material requirements. If either of these samples fail, the 5 numerically closest untested rolls on both sides of the failed sample shall be tested by the Geosynthetics CQA Laboratory. These 10 samples must conform to the material requirements. If any of these samples fail, every roll of geomembrane on-site and every subsequently delivered roll that is from the same supplier must be tested by the Geosynthetics CQA Laboratory. This additional conformance testing will be at the expense of the Installer.

7.6 Deployment and Placement

7.6.1 General

The Installer shall handle geomembrane in such a manner so that they are not damaged. The following shall be complied with:

a. On slopes, the geomembrane shall be securely anchored and then rolled down the slope in such a manner as to continually keep the geomembrane in tension.

b. In the presence of wind, geomembrane shall be ballasted with sandbags or the equivalent. Sandbags shall be installed during placement and shall remain until replaced with protective cover soils.

c. Geomembranes shall be kept continually under slight tension to minimize the presence of wrinkles in the geomembrane.

The CQA Consultant shall note non-compliances and report it to the Buyer's Representative.

7.6.2 Weather Conditions

Geomembrane shall only be deployed and placed when weather conditions, (temperature, humidity, precipitation, wind speed and direction, etc.) are within the limits established. In general the CQA Consultant shall not allow deployment and placement of geomembrane under the following conditions:

a. In the presence of precipitation, such as rain, snow, sleet, dew or fog.

b. When wind speeds exceed the allowable limit established for the project or when dirt or debris is blown into seaming areas.

c. When seaming temperatures cannot be adequately monitored and controlled. Seaming shall not be conducted when geomembrane sheet temperatures are above or below the allowable limits established for the project.

7.6.3 Damage and Repairs

a. The CQA Consultant shall visibly inspect each geomembrane panel for damage after placement and prior to seaming. If defects are found, CQA Consultant shall clearly mark the defect, assign it a repair identification code, and identify the precise location of the defect.

b. If significant damage has occurred, the CQA Consultant may mark portions or, if necessary, an entire geomembrane panel for rejection. In these instances, the CQA Consultant shall verify and record that panels or panel portions marked as "rejected" have been removed for the work area.

c. Panel repairs are to be made in accordance with the requirements.

7.7 Seaming

7.7.1 Seaming Methods

Lap joints and thermo-fusion seaming methods shall be used to join geomembrane panels in the field. Seams shall be hot wedge or extrusion welded as prescribed by the Geomembrane Manufacturer and approved by the Engineer. For joining geomembrane panels dual hot wedge is the preferred seaming method. Extrusion seaming shall be used primarily for repairs and detailing.

7.7.2 Production Seaming

a. Geomembrane panels shall be permanently seamed on the same day they are placed except where explicitly approved by the CQA Consultant.

b. For geomembrane that is to be hot wedge seamed, the CQA Consultant shall:

1. Verify that geomembrane sheets are positioned to create the minimum overlap as required.

2. Verify that geomembrane sheets are temporarily anchored in a manner that prevents movement during seaming, maintains a "flat" lap of sheets, and does not damage the geomembrane. No glue or tape shall be used to temporarily hold sheets together before seaming.

3. Verify that the Geomembrane Installer has prepared the seam overlap area to provide a suitable welding surface. The overlap area shall be free of dirt, dust, moisture, or other foreign material. No solvents shall be used to clean geomembrane sheets prior to seaming.

4. Verify that seaming is completed as soon as is practical after preparation and cleaning is completed. If more than 30 minutes has elapsed since a seaming area was prepared, the CQA Consultant shall re-evaluate the overlap area prior to allowing production seaming to commence.

c. For geomembrane that is to be extrusion seamed, the CQA Consultant shall:

1. Verify that geomembrane sheets are positioned to create the minimum overlap as required.

2. Verify that the Geomembrane Installer grinds the edge of the upper geomembrane sheet to a 45 degree bevel using a disc grinder or equivalent tool. The Geomembrane Installer should lift the upper geomembrane sheet away from the lower sheet beveling to prevent gouging of the lower sheet.

3. Verify the Geomembrane Installer temporarily bonds geomembrane sheets using hot air ("leister") equipment, to prevent movement during seaming and to maintain a "flat" lap of sheets. No glue or tape shall be used to temporarily hold sheets together before seaming.

4. Verify that Geomembrane surfaces that are to receive the extrusion weld bead are ground using a disc grinder or equivalent to no more than 15 minutes prior to seaming. The CQA Consultant shall verify that the grinding area extends no more than 1/4-inch beyond the weld bead area and the grinding depth does not exceed 10 percent of the geomembrane sheet thickness. Extrusion seam ends that are more than 5 minutes old shall also be ground prior to joining or extending the seam.

5. Verify that geomembrane residue generated during grinding is cleared from the seaming area.

6. The CQA Consultant may require repair of areas exhibiting excessive grinding or improper beveling, which may include removal and replacement of affected geomembrane.

d. Labeling (identification) of geomembrane production seams is the responsibility of the Geomembrane Installer. The CQA Consultant shall verify that the following information is marked on each of the field seams at the location(s) selected by the CQA Consultant:

1. A seam "identification code" (number or letter-number combination) will be used for CQA records.

2. The date and time welding of the seam was started and completed.

3. The seaming technician initials and seaming machine identification number.

4. Seaming parameters (set temperature, rate of travel, etc.) used to prepare the seam.

7.7.3 Damage and Repair

a. The CQA Consultant shall visually inspect each geomembrane seam during and after seaming operations. If defects are found, the CQA Consultant shall:

1. Clearly mark the defect and assign it a repair identification code that is referenced to the seam identification code.

2. Identify the precise location of the damage.

b. Seam repairs are to be made in accordance with the requirements. If a significant defect is found, the CQA Consultant may mark portions or, if necessary, an entire geomembrane seam for rejection and reconstruction.

7.8 Non-Destructive Testing

7.8.1 General

The Geomembrane Installer shall be responsible for non-destructive testing of the entire length (100 percent) of production seams and repair to verify their continuity. Non-destructive testing shall be conducted as geomembrane seaming and repair work progresses and shall be performed in the presence of the CQA Consultant.

7.8.2 Test Methods

Non-destructive test methods shall include the vacuum test, air-pressure test, spark test, or other methods as required. Non-destructive testing procedures shall be described in the Geomembrane Installer's approved CQC Manual and shall comply with requirements of this Plan.

7.8.3 Testing Standards

ASTM Standards D 5641 (Standards Practice for Geomembrane Seam Evaluation by Vacuum Chamber) and D 5820 (Standards Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes) are summarized in Attachments A and B of this Plan, respectively. Vacuum and Air Pressure testing performed for this project shall be in accordance with these test methods with the following exceptions/additions:

a. Vacuum Chamber: Minimum Pressure = 5 psi
Test Duration (at each location) = 15 seconds

b. Pressurized Air: Maximum Pressure = 30 to 35 psi
Test Duration = 5 minutes
Maximum Pressure Loss = 3 psi

7.8.4 CQA Consultant Requirements

The CQA Consultant shall observe non-destructive testing and record testing information and results on QAQC.7.

7.9 Destructive Testing

7.9.1 General

a. Laboratory destructive testing of production seams is the responsibility of the CQA Consultant. Field destructive testing of production seams is the responsibility of the Geomembrane Installer. The Geomembrane Installer is also responsible for obtaining samples and repairing sampling locations for laboratory and field destructive testing.

b. Destructive testing sample locations shall be repaired in accordance with the requirements.

7.9.2 Sampling

Production seam samples suitable for laboratory destructive testing shall be obtained by the Geomembrane Installer at locations established by the CQA Consultant as production seaming progresses. The CQA Consultant shall verify that seaming equipment and welding technicians are representatively sampled at the rate established. Additional samples shall be obtained by the Geomembrane Installer from areas of questionable integrity, as directed by the CQA Consultant.

7.9.3 Sampling CQA

During destructive seam sampling, the CQA Consultant shall:

a. Verify that destructive samples are cut to length and width required.

b. Verify that the Geomembrane Installer divides the destructive sample into the number of individual samples required. Samples are to be furnished to the CQA Consultant who will forward 1 sample to the Geosynthetic CQA Laboratory where it shall be destructively tested in peel and shear in accordance with ASTM D 6392. Duplicate samples shall be disturbed by the CQA Consultant as required.

c. Verify that the Geomembrane Installer marks the samples with the sample identification number, date of seaming, seaming machine identification, seaming technician initials, and seaming parameters (set temperature, rate of travel, etc.) used to prepare the seam.

d. An additional duplicate destructive sample may be obtained and retained for testing by the Geomembrane Installer at the Installer's discretion.

7.9.4 Acceptance Criteria

The CQA Consultant shall review laboratory testing data to verify that production seam destructive testing meets the requirements of Table 7-1 of this Plan. Acceptable failure of seam specimens shall be in the geomembrane sheet, not within the seam itself. A partial seam separation "peel incursion" during testing will be accepted as indicated in Table 7-1. Excessive peel incursion within the seam area shall constitute disqualification even if strength criteria are met.

7.9.5 Failure Resolution

a. If any specimens fail to meet qualification criteria, the CQA Consultant may elect to have additional specimens from the sample tested in order to determine production seam acceptance. Failures attributed to excessive grinding beyond weld bead areas for extrusion seams may require resampling and retesting, as directed by the CQA Consultant. CQA Consultant shall determine acceptance of destructive testing in cases of dispute.

b. If a destructive test sample fails to meet qualification criteria, the Geomembrane Installer shall obtain 2 additional production seam samples, each a distance of approximately 10 feet in opposite directions for the original sample, for laboratory destructive testing. In order for the production seam to be accepted, the failed destructive test sample shall be bounded by 2 passing destructive test samples, and the seam between the 2 passing test locations shall be reconstructed. Alternatively, the entire length of the seam in question may be repaired by placement of a cap strip, or by another repair procedure, as directed by the CQA Consultant.

c. The CQA Consultant, Engineer, or Owner may require that additional destructive test samples be taken at random locations from production seams completed during the same work shift as a failing destructive test sample or in areas that visibly appear defective or not in accordance with the requirements. Testing of these samples shall be performed by the CQA Consultant, but obtaining the samples and repairing the sampling locations shall be the responsibility of the Geomembrane Installer and shall be performed at no cost to the Owner.

7.10 Repairs

7.10.1 Identification

During installation, the Geomembrane Installer and CQA Consultant shall visually inspect geomembrane panels and seams for damage, defects, or non-compliance with the Contract Drawings, and shall mark such areas for repair. The CQA Consultants shall:

a. Verify that the Geomembrane Installer repairs marked areas as soon as possible. Defects that could allow surface water runoff beneath the geomembrane shall be repaired on the same day theyare marked.

b. Verify that repairs are made in accordance with the acceptable geomembrane repair methods listed.

c. Verify that no seams have been repaired by placing extrusion seams directly atop previously seamed areas (“piggybacking”).

7.10.2 Replacement

The CQA Consultant may require repair or replacement of areas where excessive grinding, overheating, or unacceptable preparation, seaming or testing techniques are observed. Such repair or replacement may be required even if samples removed from affected areas pass destructive testing.

7.10.3 Non-Destructive Testing

The CQA Consultant shall verify that repairs are non-destructively tested by the Geomembrane Installer in accordance with Section 7.10.1 of this Plan.

7.11 Final Inspection and Covering

7.11.1 Procedure

a. Final visual examination of geomembrane panels, seams, and repairs shall be completed by the CQA Consultant prior to accepting geomembrane. The CQA Consultant’s inspection shall only be performed following a complete inspection and approval by the Geomembrane Installer’s field superintendent or designated quality control technician. Geomembrane Installer shall be responsible for cleaning, sweeping, or other measures necessary to provide a thoroughly visible geomembrane surface for the CQA Consultant’s Inspection.

b. The Geomembrane Installer shall repair and test areas identified during the CQA Consultant’s final inspection as not being in accordance with the Contract Drawings.

c. No geomembrane shall be covered until it has been accepted by the CQA Consultant in writing. Once accepted, geomembrane shall be covered as soon as possible in accordance with the Contract Drawings.

SECTION 8 - GEOSYNTHETIC CLAY LINER CONSTRUCTION QUALITY ASSURANCE

8.0 Geosynthetic Clay Layer

8.1 General

The CQA Consultant is responsible for completing Forms QAQC.1 and QAQC.4.

8.2 Quality Control

Bentonite and geotextiles shall be certified by the manufacturer.

8.3 Labeling

The GCL manufacturer shall identify rolls with the following:

a. Manufacturer's name;

b. Product designation;

c. Lot number;

d. Roll number;

e. Roll weight; and

f. Roll dimensions.

The CQA Consultant and Contractor shall examine rolls upon delivery and deviations from the above requirements will be reported to the Buyer’s Representative.

8.4 Handling and Storage

The rolls of the GCL shall be carefully unloaded by the Contractor upon arrival at the site. GCL shall only be unloaded and handled using a stinger or spreader bar assembly meeting the requirements of ASTM D 5888. If other methods of handling are to be used, consult the Manufacturer for recommendations.

Rolls of GCL shall be stored in their original, unopened, protective cover in a clean, dry area. The material shall be stored off the ground, be continuously supported along its length, and shall be covered with a heavy, protective tarpaulin or enclosed within a storage facility. Care shall be used to keep accessory bentonite clean and free from debris prior to installation.

8.5 Conformance Testing

8.5.1 Tests

Upon delivery of the rolls, the CQA Consultant shall verify that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to ensure conformance to this CQA Plan and the Manufacturer's certified properties.

Conformance sampling and testing shall be performed in accordance with Tables 8-1 of this plan.

8.5.2 Sampling Procedure

Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. The CQA Consultant shall mark the machine direction on the samples with an arrow.

GCL may be shipped directly from the Manufacturer to an independent testing lab for conformance testing at the option of the CQA Consultant.

8.5.3 Test Results

The CQA Consultant shall examine results from the laboratory conformance testing and shall report non-conformances to the Owner. The minimum standards for materials are given in Tables 8-1, 8-2a, 8-2b and 9-1 of this plan.

8.5.4 Conformance Test Failure

The following procedure shall apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

a. GCL that is rejected shall be removed from the project site and replaced at Contractor's cost. Sampling and conformance testing of GCL supplied as replacement for rejected material shall be performed by the CQA Consultant at Contractor's cost.

b. The Installer shall remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These 2 samples must conform to the material requirements. If either of these samples fail, the 5 numerically closest untested rolls on both sides of the failed sample shall be tested by the Geosynthetics CQA Laboratory. These 10 samples must conform to the material requirements. If any of these samples fail, every roll of GCL on-site and every subsequently delivered roll that is from the same supplier must be tested by the Geosynthetics CQA Laboratory. This additional conformance testing will be at the expense of the Installer.

8.6 Protection from Moisture

The GCL shall be stored in a dry environment on firm, level ground. The rolls should be protected by an additional waterproof cover; i.e., canvas tarp, plastic sheet, etc. The GCL rolls shall not be stacked more than 3 rolls high. Care shall be taken to keep vehicles from making direct contact with the enhanced bentonite portion of the GCL. The GCL is shipped in plastic wrapping which needs to remain on the GCL until it is ready to be installed. It is best to install the GCL so that it is covered directly after being laid down. A sudden rain may cause rework. The Buyer's Representative will determine when GCL that has become wet will be removed and replaced.

GCL placement should not take place during precipitation, in the presence of excessive moisture, or in the presence of excessive wind.

8.7 Underlying Surface Construction

8.7.1 Surface Preparation

The General Contractor shall be responsible for preparing the underlying surface. The CQA

Consultant shall document that:

a. A qualified Land Surveyor has verified pipe locations and grades.

b. The requirements of Leachate Detection Layer, Subbase and other underlying layers are satisfied.

The CQA Consultant, Contractor, and Installer shall certify in writing that the surface on which the GCL is to be installed is acceptable. After the supporting subbase or aggregate and geotextile have has been accepted, it shall be the Installer's responsibility to indicate to the Buyer's Representative changes in the supporting condition that may require repair work. If The CQA Consultant concurs with the Installer, then the Buyer's Representative will ensure that the supporting surface is repaired.

8.8 GCL Installation

8.8.1 Field Panel Placement

The CQA Consultant shall complete Form QAQC.4.

8.8.2 Location

The CQA Consultant shall verify that field panels are installed at the location indicated in the Installer's field installation drawings, as approved or modified.

8.8.3 Anchorage System

The perimeter liner termination areas shall be excavated by the Contractor to the lines and widths shown on the Drawings, prior to GCL placement. The CQA Consultant will verify that perimeter liner termination areas have been constructed according to the Drawings.

Slightly rounded corners shall be provided in termination areas and aggregate envelopes where the GCL adjoins the areas so as to avoid sharp bends in the GCL. No loose rocks shall underlie the GCL in the perimeter liner termination areas.

8.8.4 Anchoring and Placement

Anchoring shall be done in accordance with this CQA Plan. The GCL panel shall extend to the back side of the perimeter liner termination area. The perimeter liner termination area shall be secured at with sandbags or other means until the overlying geomembrane is placed.

GCL shall be deployed consistent with the orientation of testing as shown on Table 8.2b (same side of GCL against geomembrane in field as intest).

As each roll is moved for placement from the storage area, the labels shall be removed by the Installer and submitted to the CQA Consultant. Dragging of the GCL panels over the subbase or aggregate shall not be allowed. The GCL shall be placed over the subbase in such a manner as to assure minimum handling. The perimeter liner termination area for the area to be lined shall be excavated before installation of the GCL begins. The geomembrane shall be placed over the GCL during the same day as the placement of the GCL. Only those GCL panels which can be anchored and covered that same day shall be unpackaged and placed in position. The GCL shall not be installed in standing water or during rain. The GCL must be dry when installed and must be dry when covered. In areas where wind is prevalent, GCL installation should be started at the upwind side of the project and proceed downwind. The leading edge of the GCL shall be secured with sandbags or other means sufficient to hold it down. The GCL shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation. Stretching of the GCL is not permitted. The GCL shall be straightened to smooth out creases or irregularities in the runs.

8.8.5 Seams and Overlaps

Overlapping is to be a 6-inch minimum, for panel edges, and 24-inch minimum for panel ends.

Soil, gravel, or other debris shall be removed from the overlap area. The overlap area shall have a bead of accessory bentonite applied at a minimum application rate of 1/4 pound per lineal foot of seam. Installer must be present during this operation.

Seams shall overlap such that the direction of flow is from the top sheet to the bottom sheet to form a shingle effect.

On slopes, runs shall be from crest to toe with the GCL machine direction running perpendicular to the base. The free end at the crest shall be locked or ballasted into the perimeter liner termination area on the back side.

8.8.6 Patching and Repairs

Repair patches in installed GCL extend a minimum of 12 inches beyond the edge(s) of a defect. Horizontal patch seams shall be secured with accessory bentonite or bentonite mastic as approved by both the Manufacturer and the Engineer. Alternatively, the patches can be placed under the defective liner in order to prevent slippage of the patch, but must be approved by the Engineer.

8.8.7 Cover Placement

The GCL must be covered the same day with geomembrane. To prevent premature hydration or contraction in hot, arid conditions, only the amount of GCL that can be anchored, inspected, repaired and covered in the same day shall be installed.

Geomembrane cover material placement equipment shall push the geomembrane material in front of it, travelling only on the previously placed cover material, never directly on the GCL. No sudden turns or accelerations which may abrade the covered GCL shall occur while equipment is directly above the GCL.

In no instance shall equipment travel directly on liner, geotextile, or other geosynthetic material. Only track equipment with ground pressures not to exceed 6 psi shall be allowed to routinely cross liner or geotextile areas provided a minimum of 12 inches of cover is maintained. Rubber tired vehicles can occasionally cross the area as long as 18 inches of cover are maintained and the vehicle wheels do not slip. For temporary access roads crossing a liner edge, or for access roads over the liner in order to end dump protective cover or waste, the contractor shall maintain a 5-foot (minimum) layer of cover over the liner.

8.8.8 Sealing around Penetrations

The GCL shall be sealed around penetrations, pipes and structures, in accordance with the recommendations of the Manufacturers.

Pipe penetrations shall incorporate a collar of GCL wrapped around the pipe and securely fastened. Bentonite sealing compound shall be placed around the corners for additional protection.

An additional GCL skirt placed over the bentonite sealing compound shall be used to provide a third level of protection and prevent the bentonite sealing compound from being displaced.

SECTION 9 - CONCRETE CONSTRUCTION QUALITY ASSURANCE

9.0 Concrete

Concrete component materials, mix design, and placement shall be in accordance with technical specifications and monitored at the frequencies defined in this section.

9.1 General

The Construction Quality Assurance (CQA) Consultant is responsible for monitoring concrete placement, performing tests on placed concrete, and verifying the seller is following the required concrete procedures per the technical specifications and drawings. The CQA Consultant performing conformance testing shall be certified as an American Concrete Institute (ACI) Field Testing Technician Grade I.

9.2 Quality Control

Prior to concrete delivery to site, the submittals listed in the construction package, with the exception of concrete batch tickets, shall be reviewed and approved.

The concrete mix design submittal shall define the requirements for slump, air entrainment, and compressive strength testing of the concrete mix being used. The concrete mix design submittal shall be accompanied by testing data demonstrating that the concrete mix design meets the parameters defined in the technical specifications and this CQA/QC Plan.

Concrete material components shall be tested per the qualification tests in the construction package at a minimum of one time per source of materials.

Concrete conformance testing shall occur at the frequencies defined in later sections.

9.3 Conformance Testing

During concrete placement, the CQA Consultants shall visually observe the concrete placement methods used, and prepare compressive strength cylinder samples per West Virginia Department of Highways Specification, Section 601.

9.4 Visual Observation

The CQA Consultant shall continuously observe concrete placement requirements, concrete finishes, curing and protection methods, and concrete protective coatings used during the placement of concrete.

9.5 Qualification Testing

The CQA Consultant shall verify that qualification tests have been performed and concrete material is approved prior to concrete delivery.

9.6 Slump

Concrete slump shall be established with the concrete mix design submitted for approval. The slump shall be measured at a minimum frequency of 1 test per 50 cubic yards of concrete with a minimum of 1 test per day of concrete placement and shall be maintained within one inch of the established slump requirement.

9.7 Air Entrainment Testing

Concrete air entrainment shall be 7% plus or minus 2.5%. The CQA Consultant is responsible for testing air entrainment at a minimum frequency of 1 test per 50 cubic yards of concrete with a minimum of 1 test per day of concrete placement.

9.8 Compressive Strength Testing

Concrete used for structural concrete shall have a 28-day unconfined compressive strength of 3,000 psi. Compressive strength testing shall be performed at a minimum frequency of 1 test per 50 cubic yards of concrete with a minimum of 1 test per day of concrete placement.

Compressive Strength testing shall be performed in accordance with ASTM C39. For testing purposed each compressive strength sample set shall have 4 cylinders prepared following ASTM C31. Cylinder sample size shall be 6-inch diameter and height of 12 inches. Laboratory test one cylinder at 7 days, two cylinders at 28 days, and hold one cylinder as a spare.

The CQA Consultant is responsible for maintaining records of placement location representing each compressive strength sample set and results of compressive strength testing.

9.9 Testing Results

The CQA Consultant shall examine results from conformance testing and shall report non-conformances to the Owner.

9.10 Conformance Test Failure

If concrete arrives to the site and does not meet the required specifications, the CQA Consultant, at their discretion, may reject the non-conforming concrete or allow a field adjustments to the concrete and retest concrete for conformance.

In the event that 28-day compressive strength testing results in a non-conformance, the CQA Consultant and buyer's representative will evaluate the failure and make a determination of effected concrete placement. The spare compressive strength sample may be tested at 56-days for acceptance or the non-conforming concrete may be removed and replaced

SECTION 10 – SOIL REVEGETATION

10.0 Soil Revegetation

Soil revegetation materials, seed mixes, sample analysis, and application shall be in accordance with the technical specifications defined in this section.

10.1 Introduction

The proposed final cover system for the closure of the Harrison Disposal Area includes a geomembrane, double-sided geocomposite, and at least 1 foot of cover soil placed directly over in-situ Coal Combustion By-Products (CCB).

Disturbed soil areas and final cover soil sources will be evaluated using conventional soil testing methods and will be tested, amended, seeded, and mulched as described below. Because experience may show that seed mixtures, amendments, and/or procedures can be improved, materials and procedures will be re-evaluated as necessary, and significant changes to revegetation materials and procedures will be reviewed with WVDEP and other stakeholders as needed.

10.2 Sample Collection

Soil samples from final cover soil sources or disturbed soil areas will be collected and analyzed before the soils are revegetated. Analyses will be done to determine fertilizer and lime requirements. Representative composite samples of soil will be tested at a frequency of at least one sample per ten acres. The proposed sampling approach is summarized below.

Composite Sample Source	Minimum Number of Subsamples in Composite Sample	Depth of Subsample Collection	Maximum Area Represented by Sample
Final Cover Soil Sources	14	4 inches	20,000 Cubic Yards
Disturbed Soil Areas	14	4 inches	4 Acres

Composite soil sample remaining after shipping a smaller portion to the laboratory should be air-dried and retained until soil sample test results have been reviewed.

10.3 Sample Analysis

Soil samples will be analyzed revegetated using methods consistent with the WVU Soil Testing Laboratory, with recommendations requested for or made consistent with the ”C07 Grass-Legume Seeding” crop code. Soil fertility testing will include pH, lime requirement (Mehlich buffer), and Mehlich-3 fertility levels, with recommendations made for lime requirement and nitrogen (N), phosphorus (or phosphate, P_2O_5), potassium (or potash, K_2O), and magnesium (Mg) amendment. Lime requirements for areas that can be tilled (5:1 H:V or flatter slopes) will be set assuming a 6-inch plow depth, and lime requirements for areas that are too steep for tillage will be set assuming no-till and a lime rate set to half the 6-inch plow depth liming rate

10.4 Seeding Options

10.4.1 Cover Crop

Cereal grain cover crops (oats or grain rye) can be used to temporarily stabilize soils for approximately one year, or longer if site inspection and conditions permit. On areas that are at their final grade and ready for perennial seeding, existing cereal grain cover crops can be mowed to a 6- to 12-inch height after seed heads have begun to form and before grain has ripened, then drill-seeded with perennial species. Frost-seeding, broadcast seeding done in winter or early spring when the soil surface is frozen, can be a viable alternative to drill seeding into cereal grain cover crops.

10.4.2 Nurse Crop

Cereal grains can be used in combination with perennial seed as a “nurse crop” to provide quick cover while slower-to-establish perennial species take hold. Nurse crop seeding rates are generally a fraction of the rate used in establishing a cover crop or as outlined in the seed mixtures below.

NURSE CROP					
Seed Mixture			Seed Quality		Seeding Dates
Common Name	Species	Lbs./acre	Min. % Germ.	Min. % Purity	
Depending on the season, either of *the following temporary small grains:*					
Spring Oats	*Avena sativa*	64	85	98	4/15 to 8/15
or Winter Rye	*Secale cereal*	112	85	98	4/15 to 9/15
or "Aroostook" variety Winter Rye	*Secale cereal*	168	85	98	9/15 to 4/15

10.4.3 Permanent Seed Mixtures

Use when and where directed on drawing and details

PERMANENT SEED MIXTURE-B(1)[a]					
Seed Mixture			Seed Quality		Seeding Dates
Common Name	Species	Lbs./acre	Min. % Germ.	Min. % Purity	
Red Fescue	*Festuca rubra*	50	80	95	4/15 to 8/15
Redtop	*Agrostis stolonifera, var. Major*	2	80	92	4/15 to 9/15
"Potomac" Orchardgrass	*Dactylis glomerata*	20	85	95	4/15 to 9/15
"Tioga" Deertongue Grass	*Panicum clandestinum*	6	80	95	4/15 to 9/15
Birdsfoot Trefoil with legume inoculant[b]	*Lotus corniculatus*	20	75	95	4/15 to 9/15
If drill seeding or frost seeding into small grain stubble, the crops below are not needed. Otherwise, *and depending on the season, add* ***either of*** *the following small grains:*					
Spring Oats[c]	*Avena sativa*	30	85	98	4/15 to 8/15
or Winter Rye[d]	*Secale cereal*	30	85	98	4/15 to 9/15
or "Aroostook" variety Winter Rye[b][c]	Secale cereal	112	85	98	9/15 to 4/15

a. *General Use Seed Mixture for Permanent Seeding of Soil Covered Areas and Disturbed Soils*
b. *Legume inoculant should be specific to the species being sown, and, unless seed is pre-inoculated, should be applied at five (5) times the manufacturer's recommended rate.*
c. *If drill seeding or frost seeding into small grain stubble, no nurse crop is needed. Otherwise, and depending on the season, add either of these small grains*
d. *High application rates of winter rye can compete with perennial species. If necessary to reduce competition, winter rye should be mowed to a 12 inch height in late May after seed heads have begun to form and before grain has ripened.*

10.4.4 Native Seed Mixture 1 - (Pollinator Mix)

"Ernst Native Habitat for Strip Mines Mix" (ERNMX-111) for Permanent Seeding of Soil Covered Areas and Disturbed Soils
Details:https://www.ernstseed.com/product/ernst-native-habitat-for-strip-mines-mix/?anchor=10 *also see supplemental sheet at the end of Section 10*

PERMANENT SEED MIXTURE-B(2)[a] (POLLINATOR MIX)					
Seed Mixture			Seed Quality		Seeding Dates
Common Name	Species	Lbs./acre	Min. % Germ.	Min. % Purity	
ERNMX-111	*various*	20-40			4/15 to 6/1 or after 11/15 (dormant seeding into small grain stubble at 2x rate)
If drill seeding or frost seeding into small grain stubble, the crops below are not needed. Otherwise, *and depending on the season, add* ***either of*** *the following small grains:*					
Spring Oats[(c)]	*Avena sativa*	30	85	98	4/15 to 8/15
or Winter Rye[(c) (d)]	*Secale cereal*	30	85	98	4/15 to 9/15
or "Aroostook" variety Winter Rye[(b)(c)]	*Secale cereal*	112	85	98	9/15 to 4/15

a. *Native Seed Mixture 1 "Ernst Native Habitat for Strip Mines Mix" (ERNMX-111) for Permanent Seeding of Soil Covered Areas and Disturbed Soils*
b. *Legume inoculant should be specific to the species being sown, and, unless seed is pre-inoculated, should be applied at five (5) times the manufacturer's recommended rate.*
c. *If drill seeding or frost seeding into small grain stubble, no nurse crop is needed. Otherwise, and depending on the season, add either of these small grains*
d. *High application rates of winter rye can compete with perennial species. If necessary to reduce competition, winter rye should be mowed to a 12 inch height in late May after seed heads have begun to form and before grain has ripened.*

10.4.5 Native Seed Mixture 2 - (Pollinator Mix)

"Mesic to Dry Native Pollinator Mix" (ERNMX-105) for Permanent Seeding of Soil Covered Areas and Disturbed Soils
Details:https://www.ernstseed.com/product/mesic-to-dry-native-pollinator-mix/?anchor=3
also see supplemental sheet at the end of Section 10

PERMANENT SEED MIXTURE-B(3)[a] (POLLINATOR MIX)					
Seed Mixture			Seed Quality		Seeding Dates
Common Name	Species	Lbs./acre	Min. % Germ.	Min. % Purity	
ERNMX-105	*various*	20			4/15 to 6/1 or after 11/15 (dormant seeding into small grain stubble at 2x rate)
If drill seeding or frost seeding into small grain stubble, the crops below are not needed. Otherwise, *and depending on the season, add* ***either of*** *the following small grains:*					
Spring Oats[(c)]	*Avena sativa*	30	85	98	4/15 to 8/15
or Winter Rye[(c) (d)]	*Secale cereal*	30	85	98	4/15 to 9/15
or "Aroostook" variety Winter Rye[(b)(c)]	*Secale cereal*	112	85	98	9/15 to 4/15

a. *Native Seed Mixture 2 "Mesic to Dry Native Pollinator Mix" (ERNMX-105) for Permanent Seeding of Soil Covered Areas and Disturbed Soils*
b. *Legume inoculant should be specific to the species being sown, and, unless seed is pre-inoculated, should be applied at five (5) times the manufacturer's recommended rate.*
c. *If drill seeding or frost seeding into small grain stubble, no nurse crop is needed. Otherwise, and depending on the season, add either of these small grains*
d. *High application rates of winter rye can compete with perennial species. If necessary to reduce competition, winter rye should be mowed to a 12 inch height in late May after seed heads have begun to form and before grain has ripened.*

10.5 Soil Amendments

The Fertilizers and, if needed, limestone (to raise pH) will be applied to disturbed areas. Soil amendments will be evenly applied using drop-, cyclone-, or blower-type spreaders or may be applied in slurry form using a hydroseeder. Limestone may be applied and mixed into borrow soils before or during stockpiling to avoid the need to apply and incorporate limestone into soils placed over geomembranes or other areas where tillage operations may be difficult.

Soil amendments for seeding disturbed soil areas will be applied to soils at rates based upon soil test results. Slow-release nitrogen fertilizers, manure, or compost will be used to supply at least 80 of the 120 pounds per acre of nitrogen in a slow-release form. If soil test results are not available, evenly apply each of the fertilizers listed below (in combination fertilizers supply at least 120-150-150 pounds per acre N-P_2O_5-K_2O):

- 210 pounds per acre 38-0-0 <u>methylene urea</u> slow-release nitrogen fertilizer (the 30-0-0 application rate can be reduced to 105 pounds per acre in areas seeded with the native seed mixtures)
- 365 pounds per acre 11-46-0 monoammonium phosphate
- 150 pounds per acre 0-0-50 sulfate of potash
- 125 pounds per acre 0-0-60 muriate of potash

The choice of application and incorporation equipment will depend on site conditions and the efficiency and availability of the equipment. <u>In areas underlain with a geomembrane, no tillage will be done within 6 inches of the geomembrane.</u> Where no geomembrane is present and slopes permit safe tillage, fertilizer and limestone soil amendments applied to disturbed soil areas will be incorporated (tilled under the surface) to a depth of 6 inches using a disk, chisel plow, or rotary tillage equipment. The tillage steps and seedbed preparation will be done when soils are sufficiently dry to prevent excessive compaction. Where possible, the final pass of tillage equipment will be made in a manner which will create furrows that are parallel to site contours.

Where steep slopes or the presence of a geomembrane prohibits tillage, the seedbed in disturbed soil areas will be prepared by tracking the surface with a dozer, or using other methods to scarify the surface to a depth of 0.5 to 4-inches and create grooves or furrows approximately parallel to the site contours. On soil-covered areas where limestone requirements are 2.0 tons per acre or less, and soil pH is above 5.5, limestone and fertilizers may be applied without incorporation, provided that the seedbed is prepared by tracking and soil is promptly seeded and mulched.

10.6 Seeding

Seeding is expected to be done using hydroseeding, broadcast, and/or drill methods that will place seed no deeper than 3/8-inches below the ground surface. In some instances application of soil amendments, seeding, and mulching may be done during the dormant winter season, when the soil surface is frozen. In such cases subsequent freeze/thaw action would incorporate seed and fertilizers into the upper surface.

10.7 Mulching

Straw, wood cellulose fiber hydromulch, or "Flexterra FGM" (applied with a hydroseeder) will be used for mulching. Where added erosion protection is required, as in ditches, Flexterra FGM may be used where indicated on drawings instead of straw or conventional wood cellulose fiber hydromulch. Straw mulch will be applied at a rate of 2 to 3 tons per acre and shall be clean (reasonably weed and seed free) cereal straw from production of wheat, oats, barley, or rye. Straw or hay of switchgrass grown for seed production (very clean of all but switchgrass seed) from approved sources may also be used. If hydromulching is done, wood fiber hydromulch will be applied at a rate of at least 3,000 pounds per acre. If Flexterra FGM is used, it will be applied at a rate of 3,000 pounds per acre or per the construction drawings. If erosion control blankets are used, they will be applied where indicated on the drawings and anchored according to manufacturer's instructions.

Straw mulch material shall be reasonably dry and shall be reasonably free of mold or other evidence of decomposition and weed seed. Mulch materials shall also be free from foreign material, coarse stems, substances toxic to plant growth, and mature seed-bearing stalks or roots of prohibited and noxious weeds as defined by state and federal seed laws. Compliance with all state and federal domestic plant quarantine regulations is required.

Straw mulch will be tacked into place by either 1) "crimping" with crimper disks set to run with no offset to the direction of travel, 2) by applying wood fiber hydromulch over the straw at a rate of 1,000 pounds per acre, or, 3) by tracking with cleats of tracked equipment.

10.8 Performance Measurement and Correction

10.8.1 Performance Evaluation

Visual checks on the success of vegetation will be made four to six weeks after seeding and germination, after significant storm events (more than __ inches over __ hours), and after establishment on at least an annual basis.

Regular visual checks of vegetative cover are no longer required when successful vegetation has been established. Repairs to the vegetative cover will be made as required. Criteria for successful revegetation will be:

- A minimum of 75% perennial vegetative cover,
- No contiguous areas larger than 3,000 square feet with less than 30% perennial cover,
- No erosion rills or other visible erosion.

10.8.2 Correction of Deficiencies

Areas with inadequate vegetative cover will be corrected as soon as practicable. If necessary, surfaces will be regraded, and soil amendments, seed, and/or mulch will be applied. Remedial revegetation work will be done in a manner which minimizes the disturbance of existing vegetation or stubble. If inclement weather prevents the establishment of an appropriate vegetate cover, exposed surfaces will be mulched to reduce erosion until successful seeding can be done, or soil amendments, seed, and mulch will be applied dormantly.

SUPPLEMENT SHEET FOR SEED MIX COMPOSITION

Ernst Native Habitat for Strip Mines Mix (ERNMX-111)

Mix Composition
29.6% *Andropogon gerardii, 'Niagara'* (Big Bluestem, 'Niagara')
25.0% *Panicum virgatum, 'Shelter'* (Switchgrass, 'Shelter')
18.9% *Sorghastrum nutans, 'Scout'* (Indiangrass, 'Scout')
17.0% *Elymus virginicus, 'Madison'* (Virginia Wildrye, 'Madison')
3.0% *Rudbeckia hirta* (Blackeyed Susan)
2.0% *Chamaecrista fasciculata, PA Ecotype* (Partridge Pea, PA Ecotype)
2.0% *Heliopsis helianthoides, PA Ecotype* (Oxeye Sunflower, PA Ecotype)
1.8% *Desmodium canadense, PA Ecotype* (Showy Ticktrefoil, PA Ecotype)
0.3% *Monarda fistulosa, Fort Indiantown Gap-PA Ecotype* (Wild Bergamot, Fort Indiantown Gap-PA Ecotype)
0.2% *Asclepias syriaca* (Common Milkweed)
0.1% *Pycnanthemum tenuifolium* (Narrowleaf Mountainmint)
0.1% *Solidago canadensis, PA Ecotype* (Canada Goldenrod, PA Ecotype)

General Product Information:
A permanent meadow mix for wildlife cover and pollinator habitat on disturbed sites. Mix formulations are subject to change without notice depending on the availability of existing and new products. While the formula may change, the guiding philosophy and function of the mix will not.

Product Categories: Erosion Control & Revegetation

Height: 1.0 – 6.3 Ft

Seeding Rate: 20 lbs/acre with 30 lbs/acre of a cover crop. For a cover crop use either grain oats (1 Jan to 31 Jul) or grain rye (1 Aug to 31 Dec).

SUPPLEMENT SHEET FOR SEED MIX COMPOSITION

Mesic to Dry Native Pollinator Mix (ERNMX-105)

Mix Composition
29.1% *Schizachyrium scoparium, 'Prairie View'-IN Ecotype* (Little Bluestem ‘Prairie View’-IN Ecotype)
20.0% *Sorghastrum nutans, WI Ecotype* (Indiangrass, WI Ecotype)
15.0% *Elymus virginicus, 'Madison'* (Virginia Wildrye, ‘Madison’)
8.0% *Echinacea purpurea* (Purple Coneflower)
5.0% *Panicum clandestinum, Tioga* (Deertongue, Tioga)
3.0% *Chamaecrista fasciculata, PA Ecotype* (Partridge Pea, PA Ecotype)
3.0% *Coreopsis lanceolata* (Lanceleaf Coreopsis)
3.0% *Rudbeckia hirta* (Blackeyed Susan)
3.0% *Verbena hastata, PA Ecotype* (Blue Vervain, PA Ecotype)
2.0% *Heliopsis helianthoides, PA Ecotype* (Oxeye Sunflower, PA Ecotype)
1.5% *Asclepias incarnata, PA Ecotype* (Swamp Milkweed, PA Ecotype)
1.0% *Aster novae-angliae, PA Ecotype* (New England Aster, PA Ecotype)
1.0% *Pycnanthemum tenuifolium* (Narrowleaf Mountainmint)
1.0% *Senna hebecarpa, VA & WV Ecotype* (Wild Senna, VA & WV Ecotype)
0.8% *Tradescantia ohiensis, PA Ecotype* (Ohio Spiderwort, PA Ecotype)
0.6% *Eupatorium perfoliatum, PA Ecotype* (Boneset, PA Ecotype)
0.6% *Zizia aurea* (Golden Alexanders)
0.5% *Baptisia australis, Southern WV Ecotype* (Blue False Indigo, Southern WV Ecotype)
0.5% *Monarda fistulosa, Fort Indiantown Gap-PA Ecotype* (Wild Bergamot, Fort Indiantown Gap-PA Ecotype)
0.5% *Solidago nemoralis, PA Ecotype* (Gray Goldenrod, PA Ecotype)
0.3% *Asclepias syriaca* (Common Milkweed)
0.3% *Penstemon digitalis* (Tall White Beardtongue)
0.2% *Solidago rugosa, PA Ecotype* (Wrinkleleaf Goldenrod, PA Ecotype)
0.1% *Aster umbellatus, PA Ecotype* (Flat Topped White Aster, PA Ecotype)

General Product Information:
The native wildflowers and grasses in this mix provide an attractive display of color from spring to fall. Designed for mesic to upland sites and full sun to lightly shaded areas. This mix will attract a variety of pollinators and songbirds. Mix formulations are subject to change without notice depending on the availability of existing and new products. While the formula may change, the guiding philosophy and function of the mix will not.

Product Categories: Pollinator Favorites, Uplands & Meadows

Height: 1.0 – 6.0 Ft

Seeding Rate: 20 lbs/acre with 30 lbs/acre of a cover crop. For a cover crop use either grain oats (1 Jan to 31 Jul) or grain rye (1 Aug to 31 Dec).

SECTION 11 - QA/QC FORMS

Form QAQC.1	Daily Field Report.
Form QAQC.2	Nuclear Compaction Test Data
Form QAQC.3	Drainage Composite Deployment Log
Form QAQC.4	GCL Deployment Log.
Form QAQC.5	Trial Seam Report
Form QAQC.6	Geomembrane Deployment Log
Form QAQC.7	Geomembrane Panel Field Seaming Log
Form QAQC.8	Geomembrane Repair Log
Form QAQC.9	Geotextile Deployment Log
Form QAQC.10	Interim Certification of Facility Construction Activity

(All forms are provided for example only: Alternate forms or data tracking methods may be used if approved by the Buyer's Representative)

Civil & Environmental Consultants, Inc.

DAILY FIELD REPORT

DATE ______________

PROJECT INFORMATION

PROJECT NAME: ______________

LOCATION: ______________ PROJECT NO.: ______________

PLANS AND SPECS BY: ______________ WEATHER: ______________

ISSUED DATE: ______________ TEMP. RANGE (°F) ______________ TO ______________

PERSONNEL

CEC FIELD REP: ______________ CEC PROJ MANAGER: ______________

CLIENT: ______________ CLIENT CONTACT: ______________

CONSTRUCTION MANAGER: ______________ SUPERVISOR: ______________

CONTRACTORS: ______________ SUPERVISOR: ______________

SAFETY MEETING PARTICIPATION

Participation in Contractor's Tailgate Safety Meeting? ☐ **Yes or** ☐ **No**
(If you Participated, Summarize the Primary Topics discussed. If No, Identify Safety Concerns Relevant to the Work Being Performed Today and Identify Steps to Reduce Any Risks):

HAS WORK BEEN PERFORMED SINCE CEC'S LAST SITE VISIT? ☐ **YES (DESCRIBE)** ☐ **NO**

SUMMARY OF WORK OBSERVED, LOCATION, AND CONTRACTOR PERFORMING WORK

UNEXPECTED, UNUSUAL, OR NONCONFORMING OBSERVATIONS (NEW / RESOLVED)

SUMMARY OF MEETINGS / DISCUSSIONS / TELEPHONE CONVERSATIONS / VISITORS ON-SITE

ATTACHMENTS

DESCRIPTION OF SAMPLES TAKEN OR MATERIALS DELIVERED TO LAB

APPROVED BY

FIELD REP: ______________ DATE: ______________ CEC MANAGER: ______________ DATE: ______________

THIS DOCUMENT IS DRAFT UNTIL REVIEWED AND APPROVED BY CEC MANAGER

DAILY FIELD REPORT

DATE

FIELD SKETCH

Civil & Environmental Consultants, Inc.

PAGE ________ of ________

DATE ____________________

NUCLEAR COMPACTION TEST DATA (ASTM D6938)

PROJECT NAME: ______________________ **PROJECT NO.:** ______________________

CEC TECHNICIAN: ______________________ **GAUGE NO.:** ______________________

CONTRACTOR: ______________________ **EQUIPMENT:** ______________________

STANDARD COUNTS:

DENSITY __________ **% DEVIATION** __________ **±1% PASSING**

MOISTURE __________ **% DEVIATION** __________ **±2% PASSING**

TEST NUMBER (MM-DD-##)								
LAYER DESCRIPTION								
LOCATION								
ELEVATION OR LIFT NO.								
LIFT THICKNESS (in)								
NUMBER OF PASSES								
PROBE DEPTH (in)								
FIELD WET DENSITY (pcf)								
FIELD DRY DENSITY (pcf)								
COMPACTION (%)								
COMPACTION PASS/FAIL								
FIELD MOISTURE (%)								
MOISTURE PASS/FAIL								

PROCTOR CURVE NO.								
MODIFIED OR STANDARD PROCTOR?	☐ MOD. ☐ STD.	☐ MOD. ☐ STD.	☐ MOD. ☐ STD.	☐ MOD. ☐ STD.	☐ MOD. ☐ STD.	☐ MOD. ☐ STD.	☐ MOD. ☐ STD.	☐ MOD. ☐ STD.
LABORATORY MDD (pcf)								
SPECIFIED MIN. COMPACTION								
LABORATORY OMC (%)								
SPECIFIED MOISTURE RANGE								

RETEST NO.								
REMARKS								

NOTES:
1. **MDD denotes Maximum Dry Density**
2. **OMC denotes Optimum Moisture Content**
3. **Elevations and lift thicknesses are approximate.**
4. **Refer to the Field Sketch associated with the Daily Field Report for specific test locations.**

APPROVED BY
CEC REVIEW: ____________________ DATE: ____________

Civil & Environmental Consultants, Inc.

PAGE ______ of ______

DATE ______________

DRAINAGE COMPOSITE DEPLOYMENT LOG

PROJECT NAME: ______________________ PROJECT NO.: ______________________

CEC TECHNICIAN: ______________________ CONTRACTOR: ______________________

MATERIAL DESCRIPTION: ______________________

	MFG. ROLL NO.	LENGTH (ft)	WIDTH (ft)	AREA (sf)	SEAM DESCRIPTION	COMMENTS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
TOTAL SQUARE FOOTAGE THIS PAGE						

SEAM DESCRIPTIONS:

For geonet, describe spacing of ties.

Describe geotextile seam type:

SRP – Single Row Stitch, Prayer Seam

DRP – Double Row Stitch, Prayer Seam

SRJ – Single Row Stitch, J-Seam

DRJ – Double Row Stitch, J-Seam

Civil & Environmental Consultants, Inc.

PAGE ________ of ________

DATE ______________

GCL DEPLOYMENT LOG

PROJECT NAME: ______________________ PROJECT NO.: ______________________

CEC TECHNICIAN: ______________________ CONTRACTOR: ______________________

MATERIAL DESCRIPTION: ______________________

	MFG. ROLL NO.	LENGTH (ft)	WIDTH (ft)	AREA (sf)	SEAM DESCRIPTION	COMMENTS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
TOTAL SQUARE FOOTAGE THIS PAGE						

SEAM DESCRIPTIONS:

GJ: Glued Joint   LONB: Loose Overlap, No Bentonite   LOWB: Loose Overlap With Bentonite

APPROVED BY
CEC REVIEW: ______________ DATE: __________

Civil & Environmental Consultants, Inc.

TRIAL SEAM REPORT

PROJECT NAME: ______________________ PROJECT NO.: ______________________

CEC TECHNICIAN: ______________________ CONTRACTOR: ______________________

MATERIAL DESCRIPTION: ______________________ TENSIOMETER NO. ______________________

TEST REQUIREMENTS

	FUSION (ppi)	EXTRUSION (ppi)
PEEL		
SHEAR		

DATE/ TIME	AMBIENT TEMP (°F)	SEAMER INITIALS	MACHINE NUMBER	EXTRUSION WELDS		FUSION WELDS		PEEL VALUES lbs/inch	SHEAR VALUES lbs/inch	PASS/ FAIL	COMMENTS
				BARREL TEMP (°F)	PREHEAT TEMP (°F)	WEDGE TEMP (°F)	SPEED SETTING (ft/min)				

All trial welds shall demonstrate Film Tear Bond (FTB) failure.

APPROVED BY
CEC REVIEW: ______________ DATE: ______________

Civil & Environmental
Consultants, Inc.

GEOMEMBRANE DEPLOYMENT LOG

PROJECT NAME: ______________________ **PROJECT NO.:** ______________________

CEC TECHNICIAN: ______________________ **CONTRACTOR:** ______________________

MATERIAL DESCRIPTION: ______________________

	DATE/ TIME	PANEL NUMBER	MFG. ROLL NUMBER	PANEL DIMENSIONS			SUBBASE CONDITION	COMMENTS
				WIDTH (ft)	LENGTH (ft)	AREA (sf)		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
TOTAL SQUARE FOOTAGE THIS PAGE								

APPROVED BY
CEC REVIEW: ______________ DATE: ______________

Civil & Environmental Consultants, Inc.

GEOMEMBRANE PANEL FIELD SEAMING LOG

PROJECT NAME: ____________________ **PROJECT NO.:** ____________________

CEC TECHNICIAN: ____________________ **CONTRACTOR:** ____________________

MATERIAL DESCRIPTION: ____________________

SEAM ID & ZONE	DATE SEAMED	TIME SEAMED START/ STOP	SEAM LENGTH (ft)	SEAMER ID	DEVICE NO.	SHEET TEMP. (°F) / AMBIENT TEMP (°F)	TEMP. SET. (°F) / SPEED SET. (ft/min)	DS ID & LOCATION	TYPE OF SEAM	SEAM DESCRIPTION

GEOMEMBRANE FIELD SEAM TESTING LOG

SEAM ID & ZONE	DATE TESTED	START TIME	END TIME	START PRESSURE (psi)	END PRESSURE (psi)	PRESSURE LOSS (psi)	VACUUM TEST	INSTALLER ID	CQA ID	RESULTS P/F	COMMENTS

DESCRIPTIONS:

DS ID – Destructive Sample Identification FUS – Fusion EXT – Extrusion

APPROVED BY

CEC REVIEW: ____________________ DATE: ____________

Civil & Environmental Consultants, Inc.

PAGE ______ of ______

GEOMEMBRANE REPAIR LOG

PROJECT NAME: ____________________ **PROJECT NO.:** ____________________

CEC TECHNICIAN: ____________________ **CONTRACTOR:** ____________________

MATERIAL DESCRIPTION: ____________________

REPAIR ID	SEAM OR PANEL DESCRIPTION	LOCATION	REPAIR TYPE	SIZE	DATE REPAIRED	DATE TESTED	P/F

REPAIR TYPE DESCRIPTIONS:
P – Patch **B – Bead**

APPROVED BY
CEC REVIEW: ____________________ DATE: __________

Civil & Environmental Consultants, Inc.

PAGE ________ of ________

DATE ______________

GEOTEXTILE DEPLOYMENT LOG

PROJECT NAME: ______________________ **PROJECT NO.:** ______________________

CEC TECHNICIAN: ______________________ **CONTRACTOR:** ______________________

MATERIAL DESCRIPTION: ____

	MFG. ROLL NO.	LENGTH (ft)	WIDTH (ft)	AREA (sf)	SEAM DESCRIPTION	COMMENTS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
TOTAL SQUARE FOOTAGE THIS PAGE						

SEAM DESCRIPTIONS:

Describe Seam Type:

SRP – Single Row Stitch, Prayer Seam
DRP – Double Row Stitch, Prayer Seam
SRJ – Single Row Stitch, J-Seam
DRJ – Double Row Stitch, J-Seam

APPROVED BY
CEC REVIEW: ______________ DATE: __________

INTERIM CERTIFICATION OF FACILITY CONSTRUCTION ACTIVITY

Site Identification

Applicant/Permittee: Monongahela Power Company
Site Name: Harrison CCB Landfill Facility

P.E. Certification

I, ___________________, being a Registered Professional Engineer in the State of West Virginia do hereby certify that to the best of my knowledge, information, and belief that the following construction activity for:

Facility Name: Harrison CCB Landfill Facility, Phase ____________
Facility Location: Harrison County

is constructed, and prepared in accordance with the documents, statements, designs, and plans submitted by the Permittee for this site and approved by the West Virginia Department of Environmental Protection (see attached sketch for specific location or area being certified).

Construction Activity ☒ **Landfill** ☐ **Sediment Pond**
(Per WV Title 33 Series 1 Section 4.5.d.7.b for reference)

☐ Subbase ☐ Protective Cover
☐ Leachate Detection Zone
☐ Primary Liner
☐ Secondary Liner ☐ Other
☐ Leachate Collection System
☐ Leachate Conveyance (pipelines, ditches)

Comments:

This construction activity was observed by myself or a person under my direct supervision in a manner consistent with the approved permit.

Engineer's Signature: ________________________ WV License No. ____________

Name of Firm: ________________________ Date: ____________________
Address: ____
Telephone No.: ________________________
Seal:

LIST OF TABLES

TABLES

Table 2-1
TEST PROCEDURES FOR THE EVALUATION OF SOILS AND AGGREGATES

Test Method	To Determine	Test Method
Moisture Content	Moisture Content	ASTM D 2216
Standard Proctor	Moisture/Density Relationship of Soil	ASTM D 698
Hydrometer Analysis	Particle Size Distribution of Fine-Grained Soils	ASTM D 422
Sieve Analysis (Gradation)	Particle Size Distribution of Coarse-Grained Soils	ASTM D 422 (Wet) or ASTM C 136
Sieve and Hydrometer Analysis	USDA Textural Classification	ASTM D 422
Atterberg Limits	Plasticity Index	ASTM D 4318
Calcium Carbonate	To Determine Calcium Carbonate Content of Aggregate	ASTM D 3042
Angularity	To Determine Shape of Aggregate	ASTM D 2488
Permeability	To Determine Permeability of Screened Bottom Ash	ASTM D 2434
Permeability	To Determine Permeability of Subbase	ASTM D 5084
Direct Shear	Soil Shear Strength	ASTM D 3080
Direct Shear	Interface Shear Strength	ASTM D 5321
Fineness Modulus	Fineness Modulus	PTM No. 501
Loss by Washing	Loss by Washing	ASTM C 117
Minimum Strength Ratio	Minimum Strength Ratio	AASHTO T21
Soundness Test	Soundness	PTM No. 510
Relative Density	Relative Density	ASTM D 4253
Field Test Procedures		
Nuclear Densometer	Soil Density Moisture Content	ASTM D 2922
Sand Cone (For Checking/Calibration only)	Soil Density Moisture Content	ASTM D 1556
Three-Point Compaction	Compaction	ASTM D 5080
Shelby Tube	Field Permeability (As Needed for Verification Only)	ASTM D 1587
Soil Description	Identification of Soils and Aggregate	ASTM D 2488
Ruler, Scale or Elevation Reading	Lift Depths	
Microwave Oven	Moisture Content	ASTM D 4643
Penn State University Mehlich 3 Test	Soil Fertility Testing	-

Table 2-2
MONITORING OF SOILS AND AGGREGATES

Item	Requirement	Minimum Test Frequency/Observation	Acceptance Criteria
1. General Fill/Subgrade	Verification that undesirable materials are not in fill	Continuous observation.	-
	Gradation	One test for each 20,000 cubic yards of material placed and whenever it appears that a problem exists in the gradation of the material.	Six-inch maximum particle size and 3-inch maximum particle size where compaction is performed with hand-directed equipment; less than 50 percent (by weight) greater than 1-inch.
	Standard Proctor Test	Pre-construction - 1 test for each 10,000 cubic yards of material placed and each time the type or source of material is changed.	-
	Field Density and Moisture Content Tests	One test per lift/acre of general fill/subgrade (maximum); and whenever it appears that a problem exists in the moisture content or density of the material.	95 percent of maximum dry density and water content of minus 4 percent to plus 4 percent of optimum moisture content (Standard Proctor).
	Soil Description	Every time a test or inspection is performed on the subgrade.	-
	Proof-rolling	Visual observation of the action of the compaction equipment (i.e., penetration, pumping, and cracking). Visual observation of surface condition of subgrade of both cut and fill.	-
	Verification that the final surface is smooth and uniform	Visual observation.	-
	Verify Lines and Grades	Survey - spot check as necessary.	-
	Lift Thickness	One test per lift.	Nine-inch (loose) maximum.
2. Subbase	Verification of subbase preparation, including compaction equipment utilized	Continuous observation.	-
	Verification that undesirable materials are not in fill	Continuous observation.	-
	Standard Proctor Test	Pre-construction - 1 test for each 10,000 cubic yards of subbase material placed.	-
	Field Density and Moisture Content Tests	One test per lift/acre of subbase (minimum); and whenever it appears that a problem exists in the moisture content or density of the material.	95 percent of maximum dry density and water content of 3% to 5% wet of optimum (Standard Proctor - ASTM D698).
	Soil Description	Every time a test or inspection is performed on the subbase.	-
	Proof-rolling	Visual observation of the action of the compaction equipment (i.e., penetration, pumping, and cracking). Visual observation of surface condition of subbase.	-
	Verification that the final surface is smooth and uniform	Visual observation.	-
	Verify Lines and Grades	Survey - spot check as necessary.	-

Table 2-2
MONITORING OF SOILS AND AGGREGATES

Item	Requirement	Minimum Test Frequency/Observation	Acceptance Criteria
2. Subbase (continued)	Permeability	One laboratory test per 2 acres of material placed (minimum).	1 x 10^{-6} cm/sec maximum.
	Gradation	One laboratory test per acre.	2-inch maximum particle size; 50 percent minimum passing No. 200 sieve.
	Atterberg Limits	One laboratory test per acre.	Minimum Liquid Limit of 35 and Minimum Plasticity Index of 11.
	Lift Thickness	One test per lift.	9-inch (loose) maximum or 6-inch (compacted) minimum.
3. Sand	Gradation	One test for each ***5***,000 cubic yards of sand material placed and whenever it appears that a problem exists in the gradation of the material.	Conform to applicable WVDOH Section 702.5 Alt Gradation with modified such that only up to 73 percent may pass the No. 16 sieve instead of up to 80 percent passing the No. 16 and not more than 5% passing the No. 200 sieve.
	Verify Lines and Grades	Visual observation – spot check depth	6-inch minimum
	Permeability	One laboratory test per 2 acres of material placed (minimum).	1 x 10^{-3} cm/sec minimum.
4. AASHTO No. 57 Aggregates for Leachate Collection, Leachate Detection/Underdrain and Groundwater Interceptor Zone Systems	Gradation	One test for each 5,000 tons of material placed and whenever it appears that a problem exists in the gradation of the material.	Conform to applicable WVDOH Section 703.1 tolerances.
	Calcium Carbonate	One test for each 5,000 tons of material placed and whenever it appears that a problem exists in the calcium carbonate content of the material.	Equal to or less than 10 percent.
	Angularity/Roundness	Continuous observation	Rounded for Leachate Collection Stone against Liner System.
	Cross-Section Dimensions	Visual observation.	-
5. Bottom Ash	Verification that undesirable materials are not in fill	Continuous observation.	-
	Placement Shall Not Damage Geosynthetics	Visual observation.	-
	Placement Shall Not Cause Wrinkles, Folds or Bends in Geosynthetics	Visual observation.	-
	Gradation	One test for each 5,000 cubic yards of material placed and whenever it appears that a problem exists in the gradation of the material.	3/4-inch maximum particle size.
	Permeability	One laboratory test per 2 acres of material placed (minimum).	1 x 10^{-3} cm/sec minimum.
	Lift Thickness	One test per acre.	12-inch minimum.
	Type of Compaction Equipment and Number of Passes	Visual observation.	-
	Shall be Placed After Backfilling the Anchor Trench/ Perimeter Liner Termination Area	Visual observation.	-

Table 2-2
MONITORING OF SOILS AND AGGREGATES

Item	Requirement	Minimum Test Frequency/Observation	Acceptance Criteria
5. Bottom Ash (continued)	Shall be Placed from the Bottom by Pushing the Cover Material Upward	Visual observation.	-
	Verify Lines and Grades	Survey - spot check as necessary.	-
6. Protective Cover Stabilized FGD	Lift Thickness	One test per acre.	12-inch minimum.
	Shall be Placed from the Bottom by Pushing the Cover Material Upward	Visual observation.	-
	Standard Proctor Test	Pre-construction - 1 test for each 10,000 cubic yards of Protective Cover FGD material placed.	-
	Field Density and Moisture Content Tests	One test per lift/acre; and whenever it appears that a problem exists in the moisture content or density of the material.	Minimum 90% D698 (Standard Proctor) Maximum Dry Density at -4% to +2% Optimum moisture content
7. Cover Soil	Gradation	One test per 5,000 cubic yards of material placed.	40 percent minimum finer than #10 sieve.
	Maximum Particle Size	Visual observation.	6-inch.
	Lift Thickness	One test per acre.	12-inch minimum.
	Verify Lines and Grades Prior to Placement of Soil Cover Cap	Survey - spot check as necessary.	-
	Combustible Content	One test per 10,000 cubic yards of material placed.	12 percent maximum.
	Soil Fertility Testing	One test per 10,000 cubic yards of material placed.	-

Note:
(1) Test Methods and Standards are listed in Table 2-1. Sample size and location are given in the Test Standards. Acceptance Criteria are listed in the General Notes of the Contract Drawings. Corrective action if test fails is specifically listed under sections entitled "Conformance Test Failure" or generally to remove, replace or recompact until acceptance.

Table 4-1
CQA CONFORMANCE SAMPLING AND TESTING REQUIREMENTS FOR CUSHION GEOTEXTILES

PROPERTY	TEST METHOD(1)(2)	16 OZ/SY CUSHION GEOTEXTILE REQUIRED VALUES	8 OZ/SY CUSHION GEOTEXTILE REQUIRED VALUES(3)	MANUFACTURER QC TEST FREQUENCY	QUALITY ASSURANCE TEST FREQUENCY(4)
Weight	ASTM D5261	16 oz/sy (min.)	8 oz/sy (min.)	90,000 sf	1 per 250,000 sf
Grab Tensile Strength	ASTM D4632	370 lbs MARV	203 lbs MARV	90,000 sf	1 per 250,000 sf
Grab Elongation	ASTM D4632	50 percent (min.)	50 percent (min.)	90,000 sf	1 per 250,000 sf
Trapezoidal Tear Strength	ASTM D4533 in machine and cross-machine directions	145 lbs MARV	90 lbs MARV	90,000 sf	1 per 250,000 sf
Puncture Strength	ASTM D6241	900 lbs MARV	600 lbs MARV	90,000 sf	1 per 250,000 sf
Minimum Interface Shear Strength	ASTM D5321	See Tables 4-3a and 4-3b of this CQA Plan			

Notes:
(1) The required properties specified herein may be revised by the Engineer to reflect new or revised test methods or to conform with improvements to the state-of-the practice.
(2) Number of specimens per test established in applicable test method unless otherwise noted.
(3) If approved by the Engineer, an 8 oz/sy cushion geotextile may be used if the bottom ash leachate collection layer is material with maximum particle size of 1/2-inch.
(4) The CQA Team may elect to have the Project material sampled at the manufacturer's factory and shipped to an independent testing laboratory for conformance testing.

Table 4-2
CQA CONFORMANCE SAMPLING AND TESTING REQUIREMENTS FOR NONWOVEN FILTER GEOTEXTILE

PROPERTY	TEST METHOD(1)(2)	REQUIRED VALUES	MANUFACTURER QC TEST FREQUENCY	QUALITY ASSURANCE TEST FREQUENCY(3)
Weight	ASTM D5261	8 oz/sy (min.)	90,000 sf	1 per 200,000 sf
Grab Tensile Strength	ASTM D4632	203 lbs MARV	90,000 sf	1 per 200,000 sf
Trapezoidal Tear Strength	ASTM D4533 in machine and cross-machine directions	90 lbs MARV	90,000 sf	1 per 200,000 sf
Puncture Strength	ASTM D6241	600 lbs MARV	90,000 sf	1 per 200,000 sf
Apparent Opening Size	ASTM D4751	0.18 mm (max.)	540,000 sf	1 per 200,000 sf
Permittivity	ASTM D4491	1.26 sec^{-1} MARV	540,000 sf	1 per 200,000 sf

Notes:
(1) The required properties specified herein may be revised by the Engineer to reflect new or revised test methods or to conform with improvements to the state-of-the practice.
(2) Number of specimens per test established in applicable test method unless otherwise noted.
(3) The CQA Team may elect to have the Project material sampled at the manufacturer's factory and shipped to an independent testing laboratory for conformance testing.

Table 4-3a

INTERFACE SHEAR STRENGTH REQUIREMENTS FOR CUSHION GEOTEXTILE[1]

Strength Requirements	
Normal Stress [Pounds per Square Foot (psf)]	**Peak Shear Strength (psf)[2]**
144	70
360	175
1,000	484

Notes:

(1) Testing to be performed in accordance with ASTM D5321 or ASTM D6243 utilizing the test conditions and procedures outlined in Table 4-3b.

(2) Required peak shear strengths listed are minimum values.

Table 4-3b
INTERFACE SHEAR STRENGTH TESTING REQUIREMENTS FOR CUSHION GEOTEXTILE

Testing Set-Up		
ASTM D5321	Conditioning:	Set up each test to match field placement orientation. Run all tests under wet conditions.
	Procedure A:	Cushion Geotextile against Textured Geomembrane Substrate: Project Geomembrane Superstratum: Project Cushion Geotextile Displacement Rate: 0.04 ipm (maximum) Total Displacement: 2.50 inches (minimum)
	Procedure B:	Cushion Geotextile against Bottom Ash Substrate: Project Cushion Geotextile Superstratum: Bottom ash, moderately tamped at as-received moisture content Displacement Rate: 0.04 ipm (maximum) Total Displacement: 2.50 inches (minimum)
	Special Instructions:	None.

Notes:

(1) Test individual interfaces between Steel rasp platens. In lieu of testing individual interfaces, a system test may be performed using a configuration that allows failure to occur through the weakest shearing plane. System test configuration, conditions, and procedures must be accepted by the Engineer prior to submitting test results for review and approval.

(2) Geosynthetics shall be oriented such that the shear force is parallel to the down slope orientation of these components in the field.

Table 6-1

CQA CONFORMANCE SAMPLING AND TESTING REQUIREMENTS FOR GEOCOMPOSITE DRAINAGE NET(1)

Property (Units)	CQA Testing Frequency (Minimum)	Test Method(2)	Required Value
Finished HDPE Geonet(3)			
Density, (g/cc)	Every 200,000 s.f.	ASTM D 1505 or D 792	0.940 (min ave)
Thickness (mil)	Every 200,000 s.f.	ASTM D 5199	250 (min ave)(3)
Finished GDN(4)			
Transmissivity (m^2/sec)	Every 200,000 s.f.	ASTM D 4716	6.1×10^{-5} (MARV)(5)(6)
Ply Adhesion (lb/in)	Every 200,000 s.f.	ASTM D7005	1.0 (MARV)(6)(7)
Interface Shear Strength	Every 200,000 s.f.	ASTM D 5321	See Tables 6-2a and 6-2b

Notes:

(1) The required properties specified herein may be revised by the Buyer's Agent to reflect new or revised test methods or to conform with improvements to the state-of-the practice.

(2) Number of specimens per test established in applicable test method unless otherwise noted.

(3) Nominal values.

(4) Nonwoven geotextile heat-bonded to both sides.

(5) Perform test using deaired water, project geosynthetic clay liner for substrate, and project subbase soil compacted to 95% D698 maximum dry density at 3% to 5% wet of optimum moisture content for superstratum. Test conditions for the West Liner area normal stress = 8,500 lb/ft², Hydraulic Gradient = 0.33, seating period 100 hrs. If GDN is proposed in the East Liner area, normal stress = 32,000 lb/ft²; Hydraulic gradient = 0.33; Seating period = 100 hours.

(6) MARV is statistically defined as mean minus 2 standard deviations and it is the value, which is exceeded by 97.5 percent of all the test data.

(7) Average of 5 equally spaced tests across the roll width. Lowest individual value = 0.5 lb/in.

Table 6-1a

CQA CONFORMANCE SAMPLING AND TESTING REQUIREMENTS FOR FINAL COVER GEOCOMPOSITE (1)

Property (Units)	CQA Testing Frequency (Minimum)	Test Method(2)	Required Value
Finished HDPE Geonet(3)			
Density, (g/cc)	Every 200,000 s.f.	ASTM D 1505 or D 792	0.940 (min ave)
Thickness (mil)	Every 200,000 s.f.	ASTM D 5199	250 (min ave)(3)
Finished GDN(4)			
Transmissivity (m^2/sec)	Every 200,000 s.f.	ASTM D 4716	8.3×10^{-4} (MARV)(5)(6)
Ply Adhesion (lb/in)	Every 200,000 s.f.	ASTM D7005	1.0 (MARV)(6)(7)
Interface Shear Strength	Every 200,000 s.f.	ASTM D 5321	See Tables 6-3a and 6-3b

Notes:

(1) The required properties specified herein may be revised by the Buyer's Agent to reflect new or revised test methods or to conform with improvements to the state-of-the practice.

(2) Number of specimens per test established in applicable test method unless otherwise noted.

(3) Nominal values.

(4) Nonwoven geotextile heat-bonded to both sides.

(5) Perform test using deaired water, 40-mil textured geomembrane for substrate, and project final cover soil minimally compacted to model dozer tracking at as-recieved moisture content for superstratum. Test conditions for the final cover normal stress = 900 lb/ft^2, Hydraulic Gradient = 0.33, seating period 100 hrs. Hydraulic gradient = 0.33; Seating period = 24 hours.

(6) MARV is statistically defined as mean minus 2 standard deviations and it is the value, which is exceeded by 97.5 percent of all the test data.

(7) Average of 5 equally spaced tests across the roll width. Lowest individual value = 0.5 lb/in.

Table 6-2a

INTERFACE SHEAR STRENGTH REQUIREMENTS FOR GEOCOMPOSITE DRAINAGE NET[1]

Strength Requirements	
Normal Stress [Pounds per Square Foot (psf)]	Minimum Peak Shear Strength (psf)[2]
144	70
360	175
1,000	484

Notes:

(1) Testing to be performed in accordance with ASTM D5321 or ASTM D6243 utilizing the test conditions and procedures outlined in Table 6-2b.

(2) Required peak shear strengths listed are minimum values.

Table 6-2b

INTERFACE SHEAR STRENGTH TESTING REQUIREMENTS FOR GEOCOMPOSITE DRAINAGE NET[(1)(2)(3)(4)]

Testing Set-Up		
ASTM D5321	Conditioning:	Set up each test to match field placement orientation. Run all tests under wet conditions.
	Procedure A:	Geocomposite Drainage Net against Geosynthetic Clay Liner Refer to Tables 8-2a and 8-2b
	Procedure B:	Geocomposite Drainage Net against West Side Subbase Soil Substrate: Prepared West Side Subbase Soil Compacted to 95% D698 Maximum Dry Density at Optimum Moisture Content Superstratum: Project Geocomposite Drainage Net Displacement Rate: 0.04 ipm (maximum) Total Displacement: 2.50 inches (minimum)
	Procedure C (if GDN used on East Side):	Geocomposite Drainage Net against East Side Subbase Soil Substrate: Prepared East Side Subbase Soil Compacted to 95% D698 Maximum Dry Density at Optimum Moisture Content Superstratum: Project Geocomposite Drainage Net Displacement Rate: 0.04 ipm (maximum) Total Displacement: 2.50 inches (minimum)
	Special Instructions:	None.

Notes:

(1) Test individual interfaces between Steel rasp platens

(2) Geosynthetics shall be oriented such that the shear force is parallel to the down slope orientation of these components in the field.

(3) Interfaces shall be saturated for a minimum of 24 hours prior to testing.

(4) Testing to be performed in accordance with ASTM 5321 utilizing the test conditions and procedures outlined. GDN is not acceptable if geotextile delaminates from the geonet, even if required strengths are attained.

Table 6-3a

INTERFACE SHEAR STRENGTH REQUIREMENTS FOR FINAL COVER GEOCOMPOSITE[1]

Strength Requirements	
Normal Stress [Pounds per Square Foot (psf)]	**Minimum Peak Shear Strength (psf)[2]**
900	460

Notes:

(1) Testing to be performed in accordance with ASTM D5321 or ASTM D6243 utilizing the test conditions and procedures outlined in Table 6-3b.

(2) Required peak shear strengths listed are minimum values.

Table 6-3b

INTERFACE SHEAR STRENGTH TESTING REQUIREMENTS FOR FINAL COVER GEOCOMPOSITE (1)(2)(3)(4)

Testing Set-Up		
ASTM D5321	Conditioning:	Set up each test to match field placement orientation. Run all tests under wet conditions.
	Procedure A:	Geocomposite Drainage Net against 40-mil textured geomembrane
	Procedure B:	Geocomposite Drainage Net against final cover soil Substrate: 40-mil textured geomembrane Superstratum: Prepared final cover soil, lighly comapacted to model dozer tracking, at as-received moisture content. Net Displacement Rate: 0.04 ipm (maximum) Total Displacement: 2.50 inches (minimum)
	Special Instructions:	None.

Notes:

(1) Test individual interfaces between Steel rasp platens

(2) Geosynthetics shall be oriented such that the shear force is parallel to the down slope orientation of these components in the field.

(3) Interfaces shall be saturated for a minimum of 24 hours prior to testing.

(4) Testing to be performed in accordance with ASTM 5321 utilizing the test conditions and procedures outlined. GDN is not acceptable if geotextile delaminates from the geonet, even if required strengths are attained.

Table 7-1

CQA CONFORMANCE SAMPLING AND TESTING REQUIREMENTS FOR TEXTURED 60 MIL HDPE GEOMEMBRANE[1]

PROPERTY	TEST METHOD[2]	REQUIRED VALUES	MANUFACTURER QC TEST FREQUENCY	QUALITY ASSURANCE TEST FREQUENCY
REQUIRED PHYSICAL PROPERTIES				
Core Thickness (mil)	ASTM D5994	57 (min. avg.)[3]	Each Roll	Every 100,000 sf
Asperity Height (mil)	ASTM D7466	16 (min. avg.)[4]	Every 2nd Roll	Every 100,000 sf
Sheet Density (g/cc)	ASTM D1505 or ASTM D792	0.940 (min. avg.)	200,000 lbs	Every 100,000 sf
Tensile Properties (each direction)				
1. Yield Strength (lb/in)	ASTM D6693 Test in machine direction and cross-machine direction.	126 (min. avg.)	20,000 lbs	Every 100,000 sf
2. Break Strength (lb/in)		90 (min. avg.)		
3. Yield Elongation (%)		12 (min. avg.)		
4. Break Elongation (%)		100 (min. avg.)		
Carbon Black Content (%)	ASTM D4218	2.0 - 3.0 (allowable range)	20,000 lbs	Every 100,000 sf
Carbon Black Dispersion (views)	ASTM D5596	9 in Categories 1 or 2, and 1 in Category 3 (acceptable levels)	45,000 lbs	Every 100,000 sf
Puncture Resistance (lb)	ASTM D4833	90 (min. avg.)	45,000 lbs	Every 100,000 sf
Tear Resistance (lb)	ASTM D1004, Die C	42 (min. avg.)	45,000 lbs	Every 100,000 sf
Oxidative Induction Time				
1. Standard (min) or	ASTM D3895	100 (min. avg.)	200,000 lbs	Not Required
2. High Pressure (min)	ASTM D5885	400 (min. avg.)		
Oven Aging at 85°C	ASTM D5721			
1. Standard OIT (% retained after 90 days)	ASTM D3895	55% (min. avg.)	Certify Each Formulation	Not Required
2. High Pressure OIT (% retained after 90 days)	ASTM D5885	80% (min. avg.)		
UV Resistance, High Pressure OIT (% retained after 1,600 hours)	ASTM D5885	50% (min. avg.)	Certify Each Formulation	Not Required
Stress Crack Resistance (hours)	ASTM D5397	500 (min.)	Per GRI GM 10	Not Required
Interface Shear Strength	ASTM D5321 and ASTM D6243	See Table 7-2a[5]		
GEOMEMBRANE RESIN				
Density (g/ml)	ASTM D1505/D792	0.932 (min.)	Each Resin Batch	Not Required
Melt Flow Index (g/10 min)	ASTM D1238	1.0 (max.)	Each Resin Batch	Not Required

Notes:

(1) The required properties specified herein may be revised by the Engineer to reflect new or revised test methods or to conform with improvements to the state-of-the practice.

(2) Number of specimens per test established in applicable test method unless otherwise noted.

(3) Lowest individual value for 8 out of 10 readings = 54 mil; lowest individual value for all readings = 51 mil.

(4) Test both sides of sheet.

(5) Perform tests incorporating the test conditions and procedures outlined in Tables 7-2b.

Table 7-1 (CONT.)

INSTALLATION TESTING SUMMARY				
PROPERTY	**TEST METHOD(1)**	**SAMPLE SIZE**	**FIELD TEST FREQUENCY(2)**	**ACCEPTANCE CRITERIA(3)**
TRIAL SEAM TESTING(4):				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	48 inches along seam 12 inches wide	Minimum 1 test per welder/machine combination; and prior to each seaming period	The average of the 5 tests shall be greater than 91 lb/in. Five (5) out of five (5) tests shall not fail in adhesion unless seam incursion is less than 25% (AD or AD-BRK) or in separation of plane (SIP).
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 test per welder/machine combination; and prior to each seaming period	The average of the 5 tests shall be greater than 78 lb/in. Five (5) out of five (5) tests shall not fail in adhesion unless seam incursion is less than 25% (AD or AD-BRK) or in separation of plane (SIP).
DESTRUCTIVE SEAM TESTING(4):				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	48 inches along seam 12 inches wide	Minimum 1 per 500 lf of seaming per device	The average of the 5 tests shall be greater than 91 lb/in. Five (5) out of five (5) tests shall not fail in adhesion unless seam incursion is less than 10% (AD or AD-BRK) or in separation of plane (SIP).
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 per 500 lf of seaming per device	The average of the 5 tests shall be greater than 78 lb/in. Five (5) out of five (5) tests shall not fail in adhesion unless seam incursion is less than 10% (AD or AD-BRK) or in separation of plane (SIP).
SHEAR TEST (lb/in) Fusion Welds	ASTM D6392	1 inch wide	Minimum 1 per 500 lf of seaming per device	The average of the 5 tests shall be greater than 120 lb/in. Five (5) out of five (5) tests shall meet minimum shear elongation at break values of 50% and shall not fail in adhesion (AD1 and AD2). AD-WLD is acceptable if strength, shear elongation, and peel separation are achieved.
SHEAR TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 per 500 lf of seaming per device	The average of the 5 tests shall be greater than 120 lb/in. Five (5) out of five (5) tests shall meet minimum shear elongation at break values of 50% and shall not fail in adhesion (AD1 and AD2). AD-WLD is acceptable if strength, shear elongation, and peel separation are achieved.
NON-DESTRUCTIVE SEAM TESTING:				
AIR PRESSURE	GRI GM6		Every Fusion-Welded Seam	No more than 3 psi drop with initial pressure of 30 to 35 psi for 5 minutes.
VACUUM	ASTM D5641		Every Extrusion Weld	Examine weld for 15 seconds with minimum vacuum of 5 psi.

Notes:

(1) The required properties specified herein may be revised by the Engineer to reflect new or revised test methods or to conform with improvements to the state-of-the practice.

(2) Field test in accordance with project CQA Plan. Trial seams shall be prepared for each piece of seaming equipment whenever any of the following conditions occur:

- shift start-up;
- every 4 to 6 hours of continuous seaming within a shift;
- “cold" restart of seaming equipment;
- change in welding technician;
- significant change in geomembrane sheet temperatures; and
- as required by the Owner’s Representative.

(3) Accepted specifications for breaks and unacceptable break codes obtained from the standard specifications in GRI-GM19.

(4) For double fusion welded seams, both tracks shall be tested for compliance with the minimum property values listed.

Table 7-1a

CQA CONFORMANCE SAMPLING AND TESTING REQUIREMENTS FOR TEXTURED 40 MIL HDPE GEOMEMBRANE[1]

PROPERTY	TEST METHOD[2]	REQUIRED VALUES	MANUFACTURER QC TEST FREQUENCY	QUALITY ASSURANCE TEST FREQUENCY
REQUIRED PHYSICAL PROPERTIES				
Core Thickness (mil)	ASTM D5994	38 (min. avg.)[3]	Each Roll	Every 100,000 sf
Asperity Height (mil)	ASTM D7466	16 (min. avg.)[4]	Every 2nd Roll	Every 100,000 sf
Sheet Density (g/cc)	ASTM D1505 or ASTM D792	0.940 (min. avg.)	200,000 lbs	Every 100,000 sf
Tensile Properties (each direction)				
1. Yield Strength (lb/in)	ASTM D6693 Test in machine direction and cross-machine direction.	84 (min. avg.)	20,000 lbs	Every 100,000 sf
2. Break Strength (lb/in)		60 (min. avg.)		
3. Yield Elongation (%)		12 (min. avg.)		
4. Break Elongation (%)		100 (min. avg.)		
Carbon Black Content (%)	ASTM D4218	2.0 - 3.0 (allowable range)	20,000 lbs	Every 100,000 sf
Carbon Black Dispersion (views)	ASTM D5596	9 in Categories 1 or 2, and 1 in Category 3 (acceptable levels)	45,000 lbs	Every 100,000 sf
Puncture Resistance (lb)	ASTM D4833	60 (min. avg.)	45,000 lbs	Every 100,000 sf
Tear Resistance (lb)	ASTM D1004, Die C	28 (min. avg.)	45,000 lbs	Every 100,000 sf
Oxidative Induction Time				
1. Standard (min) or	ASTM D3895	100 (min. avg.)	200,000 lbs	Not Required
2. High Pressure (min)	ASTM D5885	400 (min. avg.)		
Oven Aging at 85°C	ASTM D5721			
1. Standard OIT (% retained after 90 days)	ASTM D3895	55% (min. avg.)	Certify Each Formulation	Not Required
2. High Pressure OIT (% retained after 90 days)	ASTM D5885	80% (min. avg.)		
UV Resistance, High Pressure OIT (% retained after 1,600 hours)	ASTM D5885	50% (min. avg.)	Certify Each Formulation	Not Required
Stress Crack Resistance (hours)	ASTM D5397	500 (min.)	Per GRI GM 10	Not Required
Interface Shear Strength	ASTM D5321 and ASTM D6243	See Table 7-3a[5]		
GEOMEMBRANE RESIN				
Density (g/ml)	ASTM D1505/D792	0.932 (min.)	Each Resin Batch	Not Required
Melt Flow Index (g/10 min)	ASTM D1238	1.0 (max.)	Each Resin Batch	Not Required

Notes:

(1) The required properties specified herein may be revised by the Engineer to reflect new or revised test methods or to conform with improvements to the state-of-the practice.

(2) Number of specimens per test established in applicable test method unless otherwise noted.

(3) Lowest individual value for 8 out of 10 readings = 36 mil; lowest individual value for all readings = 34 mil.

(4) Test both sides of sheet.

(5) Perform tests incorporating the test conditions and procedures outlined in Tables 7-3b.

Table 7-1a (CONT.)

INSTALLATION TESTING SUMMARY				
PROPERTY	**TEST METHOD(1)**	**SAMPLE SIZE**	**FIELD TEST FREQUENCY(2)**	**ACCEPTANCE CRITERIA(3)**
TRIAL SEAM TESTING(4):				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	48 inches along seam 12 inches wide	Minimum 1 test per welder/machine combination; and prior to each seaming period	The average of the 3 tests shall be greater than 60 lb/in with one result being less than 60 lb/in but greater than 48 lb/in. Three (3) out of three (3) tests shall not fail in adhesion unless seam incursion is less than 25% (AD or AD-BRK) or in separation of plane (SIP).
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 test per welder/machine combination; and prior to each seaming period	The average of the 3 tests shall be greater than 52 lb/in with one result being less than 52 lb/in but greater than 42 lb/in. Three (3) out of three (3) tests shall not fail in adhesion (AD1, AD2, AD-BRK or AD-WLD) or separation of plane failure (SIP).
DESTRUCTIVE SEAM TESTING(4):				
PEEL TEST (lb/in) Fusion Welds	ASTM D6392	48 inches along seam 12 inches wide	Minimum 1 per 500 lf of seaming per device	The average of the 5 tests shall be greater than 60 lb/in with one result being less than 60 lb/in but greater than 48 lb/in. Five (5) out of five (5) tests shall not fail in adhesion unless seam incursion is less than 25% (AD or AD-BRK) or in separation of plane (SIP).
PEEL TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 per 500 lf of seaming per device	The average of the 5 tests shall be greater than 52 lb/in with one result being less than 52 lb/in but greater than 42 lb/in. Five (5) out of five (5) tests shall not fail in adhesion (AD1, AD2, AD-BRK or AD-WLD) or separation of plane failure (SIP).
SHEAR TEST (lb/in) Fusion Welds	ASTM D6392	1 inch wide	Minimum 1 per 500 lf of seaming per device	The average of the 5 tests shall be greater than 80 lb/in with one result being as low as 64 lb/in. Five (5) out of five (5) tests shall not fail in adhesion (AD and AD-Brk > 25%). AD-WLD is acceptable if strength, shear elongation and peel separation are achieved.
SHEAR TEST (lb/in) Extrusion Welds	ASTM D6392		Minimum 1 per 500 lf of seaming per device	The average of 5 tests shall be greater than 80 lb/in with one result being as low as 64 lb/in. Five (5) out of five (5) tests shall not fail in adhesion (AD1 and AD2). AD-WLD is acceptable if strength, shear elongation and peel separation are achieved.
NON-DESTRUCTIVE SEAM TESTING:				
AIR PRESSURE	GRI GM6		Every Fusion-Welded Seam	No more than 3 psi drop with initial pressure of 30 to 35 psi for 5 minutes.
VACUUM	ASTM D5641		Every Extrusion Weld	Examine weld for 15 seconds with minimum vacuum of 5 psi.

Notes:

(1) The required properties specified herein may be revised by the Engineer to reflect new or revised test methods or to conform with improvements to the state-of-the practice.

(2) Field test in accordance with project CQA Plan. Trial seams shall be prepared for each piece of seaming equipment whenever any of the following conditions occur:

- shift start-up;
- every 4 to 6 hours of continuous seaming within a shift;
- “cold" restart of seaming equipment;
- change in welding technician;
- significant change in geomembrane sheet temperatures; and
- as required by the Owner’s Representative.

(3) Accepted specifications for breaks and unacceptable break codes obtained from the standard specifications in GRI-GM19.

(4) For double fusion welded seams, both tracks shall be tested for compliance with the minimum property values listed.

Table 7-2a

INTERFACE SHEAR STRENGTH REQUIREMENTS FOR TEXTURED 60 MIL HDPE GEOMEMBRANE[(1)]

Strength Requirements	
Normal Stress [Pounds per Square Foot (psf)]	**Peak Shear Strength (psf)[(2)]**
144	70
360	175
1,000	484

Notes:

(1) Testing to be performed in accordance with ASTM D5321 or ASTM D6243 utilizing the test conditions and procedures outlined in Table 7-2b.

(2) Required peak shear strengths listed are minimum values.

Table 7-2b

INTERFACE SHEAR STRENGTH TESTING REQUIREMENTS FOR TEXTURED 60 MIL HDPE GEOMEMBRANE[(1)(2)(3)]

Testing Set-Up		
ASTM D5321	Conditioning:	Set up each test to match field placement orientation. Run all tests under wet conditions.
	Procedure A:	Textured Geomembrane against GCL Refer to Table 8-2b.
	Procedure B:	Textured Geomembrane against Cushion Geotextile Substrate: Project Geomembrane Superstratum: Cushion Geotextile Displacement Rate: 0.04 ipm (maximum) Total Displacement: 2.50 inches (minimum)
	Special Instructions:	None.

Notes:

(1) Test individual interfaces between Steel rasp platens.

(2) Interfaces shall be saturated for a minimum of 24 hours prior to testing.

(3) Geosynthetics shall be oriented such that the shear force is parallel to the down slope orientation of these components in the field.

Table 7-3a

INTERFACE SHEAR STRENGTH REQUIREMENTS FOR TEXTURED 40 MIL HDPE GEOMEMBRANE(1)

Strength Requirements	
Normal Stress [Pounds per Square Foot (psf)]	Peak Shear Strength (psf)(2)
900	460

Notes:

(1) Testing to be performed in accordance with ASTM D5321 or ASTM D6243 utilizing the test conditions and procedures outlined in Table 7-3b.

(2) Required peak shear strengths listed are minimum values.

Table 7-3b
INTERFACE SHEAR STRENGTH TESTING REQUIREMENTS FOR TEXTURED 40 MIL HDPE GEOMEMBRANE(1)(2)(3)

Testing Set-Up		
ASTM D5321	Conditioning:	Set up each test to match field placement orientation. Run all tests under wet conditions.
	Procedure A:	Textured Geomembrane against CCB
	Procedure B:	Textured Geomembrane against Double Sided Drainage Geocomposite Superstratum: Double Sided Drainage Geocomposite Displacement Rate: 0.04 ipm (maximum) Total Displacement: 2.50 inches (minimum)
	Special Instructions:	None.

Notes:

(1) Test individual interfaces between Steel rasp platens.

(2) Interfaces shall be saturated for a minimum of 24 hours prior to testing.

(3) Geosynthetics shall be oriented such that the shear force is parallel to the down slope orientation of these components in the field.

Table 8-1
CQA CONFORMANCE SAMPLING AND TESTING REQUIREMENTS FOR REINFORCED GEOSYNTHETIC CLAY LINER(1)

Material Property	Test Method	Test Frequency(2)	Required Values
Bentonite Swell Index(3)	ASTM D 5890	At least 1 per 200,000 s.f. prior to installation	24 ml/2g minimum
Bentonite Fluid Loss(3)	ASTM D 5891	At least 1 per 200,000 s.f. prior to installation	18 ml maximum
Bentonite Mass/Area(3)	ASTM D 5993	At least 1 per 200,000 s.f. prior to installation	0.75 lb./s.f. minimum
GCL Tensile Strength(4)	ASTM D 6768	At least 1 per 200,000 s.f. prior to installation	50 lbs/in minimum
GCL Peel Strength(4)	ASTM D 6496	At least 1 per 200,000 s.f. prior to installation	3.5 lbs/in minimum

Notes:

(1) The required properties specified herein are satisfied by the RESISTEX® 200 FLW9 as manufactured by CETCO Lining Technologies but may be revised by the Engineer to reflect new or revised test methods or to conform with improvements in state-of-the practice.

(2) Number of specimens per test established in applicable test method unless otherwise noted.

(3) Perform tests on as-received material before incorporation into finished GCL.

(4) All tensile strength testing is performed in the machine direction using ASTM D6768. All peel strength testing is performed using ASTM D6496.

Table 8-2a
INTERFACE SHEAR STRENGTH
REQUIREMENTS FOR REINFORCED GEOSYNTHETIC CLAY LINER(1)

Normal Load (psf)	Standard Test Peak Shear Strength (psf)(2)
144	70
360	175
1,000	484

Notes:

(1) Testing to be performed in accordance with ASTM D6243 utilizing the test conditions and procedures outlined in Table 8-2b.

(2) Required peak shear strengths listed are minimum values.

Table 8-2b

INTERFACE SHEAR STRENGTH TESING REQUIREMENTS FOR REINFORCED GEOSYNTHETIC CLAY LINER(1)(2)(3)

Testing Set-Up	
ASTM D6243	• Conditioning and Set-Up: 1. Configure specimens to match the field placements listed below. All geosynthetics are to be oriented for shearing in the machine direction of the samples. 2. Hydrate specimens with tap water for 24 hours at 0 psf normal stress. 3. Consolidate specimens using the following laoding sequence until the required shear test normal stress is reached. Maintain each consolidation load increment as shown: 144 psf for 24 hours, 360 psf for 24 hours, 576 psf for 24 hours, 1000 psf for 24 hours. 4. Run all tests under wet conditions at the displacement rates listed below to a minimum total of displacement of 2.5 inches. See Table 8-2a for normal loads to shear. • Procedure: 1. Top of GCL against Bottom of Geomembrane (Agru textured 60 mil HDPE) Substratum and Superstratum: Rigid Plate Field Placement: top side of GCL against textured geomembrane Discplacement Rate: 0.04 ipm (max) 2. Bottom of GCL against Sand (to be provided) Substratum and Superstratum: Rigid Plate Field Displacement: bottom side of GCL against sand Displacement Rate: 0.04 ipm (max) 3. Bottom of GCL against Top of GDN (Agru 250 mil with 8 oz/sy both sides) Substratum and Superstratum: Rigid Plate Field Placement bottom side of GCL against GDN Displacement Rate: 0.04 ipm (max)

Notes:

(1) Test individual interfaces between Steel rasp platens. In lieu of testing individual interfaces, a system test may be performed using a configuration that allows failure to occur through the weakest shearing plane. System test configuration, conditions, and procedures must be accepted by the Engineer prior to submitting test results for review and approval.

(2) Interfaces shall be saturated for a minimum of 24 hours prior to testing.

(3) Geosynthetics shall be oriented such that the shear force is parallel to the down slope orientation of these components in the field.

Table 9-1
MINIMUM INTERNAL/INTERFACE SHEAR STRENGTHS

		Interface or Material which Internal Shear Strength is to be Measured (2)	Normal Stress σ (psf)	Shear Stress(1) τ (psf)
Baseliner System	Peak Strengths	Subbase Soil (internal)	Drained: Internal Friction Angle = 27 degrees Cohesion = 0 psf	
		Structural Fill/In-situ subgrade (internal)	Drained: Internal Friction Angle = 27 degrees Cohesion = 0 psf	
		Bottom Ash Leachate Collection (internal)	Drained: Internal Friction Angle = 30 degrees Cohesion = 0 psf	
		CCB Protective Cover Layer (internal)	Drained: Internal Friction Angle = 42 degrees Cohesion = 0 psf	
		Subbase Soil to Double Sided Geocomposite Double Sided Geocomposite to GCL GCL to Geomembrane Geomembrane to Cushion Geotextile Cushion Geotextile to Bottom Ash Leachate Collection Layer	0 144 360 1000	0 70 175 484
Final Cover	Peak Strengths	Subbase Soil to Double Sided Geocomposite CCB to Geomembrane Geomembrane to Double Sided Geocomposite Double Sided Geocomposite to Final Cover Soil	900	460

Notes:

(1) Minimum shear strengths are provided at specified normal loads. Shear stress is calculated using the equation: $\tau = c + [\sigma * \mathrm{Tan}(\phi)]$ where c equals cohesion or adhesion, and ϕ is the friction angle. Any combination of c and ϕ that results in a shear strength $\geq$ the required shear strength is acceptable.

(2) Each interface and internal shear strength will be tested twice prior to using a new material at the facility, and once per construction event thereafter for the interface with the highest risk of slope failure.

LIST OF FIGURES

LIST OF ATTACHMENTS

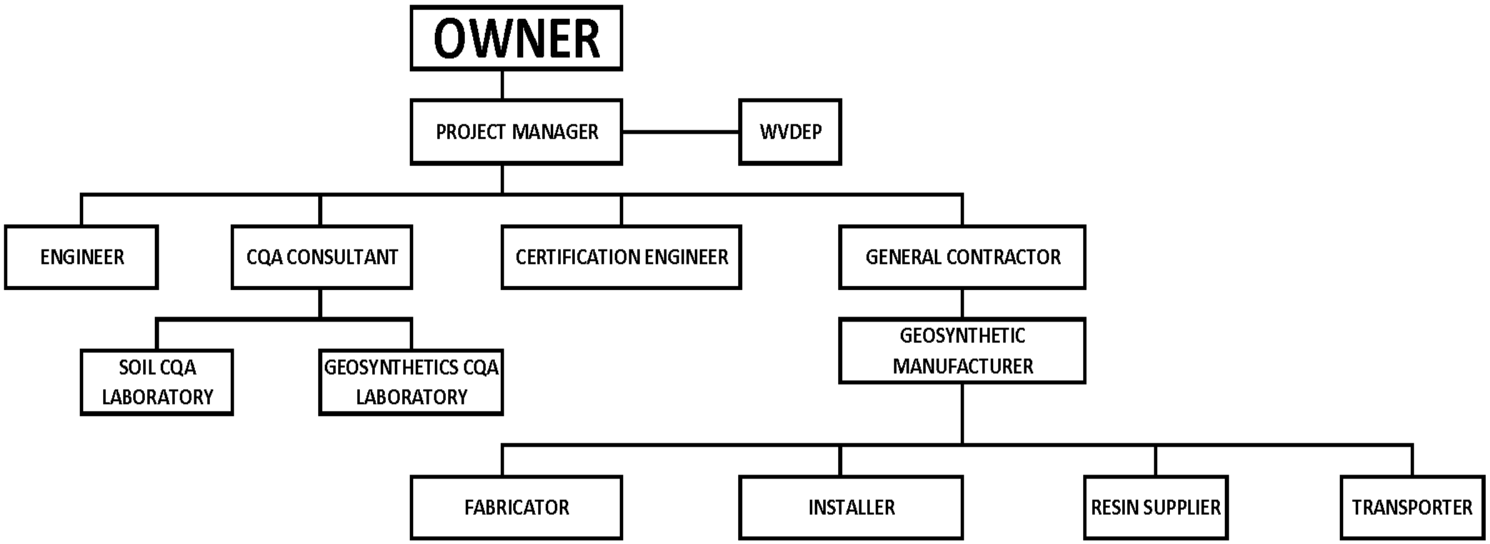

FIGURE 1-1. CHART OF LINES OF AUTHORITY AND COMMUNICATIONS

ATTACHMENT A

PRESSURIZED CHANNEL TEST FOR DUAL SEAMED HDPE GEOMEMBRANE

Equipment for pressure testing double fusion seams shall be comprised of the following:

1. An air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 30 psi and mounted on a cushion to protect the geomembrane.

2. A manometer equipped with a sharp hollow needle, or other approved pressure feed device.

The following procedures shall be followed by the Geomembrane Installer:

1. Seal both ends of the seam to be tested.

2. Insert needle or other approved pressure feed device into the tunnel created by the double wedge fusion weld.

3. Energize the air pump to a pressure of 30 to 35 psi, close valve, and sustain pressure for approximately five minutes.

4. If loss of pressure exceeds 3 psi, or pressure does not stabilize, locate faulty area, repair and retest.

5. Remove needle or other approved pressure feed device and seal.

6. Record test results adjacent to test seam.

ATTACHMENT B

VACUUM BOX TESTING (HDPE LINER)

Vacuum box testing equipment for testing HDPE extrusion seams shall be comprised of the following:

1. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the bottom, valve assembly, and a vacuum gauge.

2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A plastic bucket and wide paint brush.

5. A soapy solution.

The following procedures shall be followed by the Geomembrane Installer:

1. Excess sheet overlap shall be trimmed away.

2. Clean the window, gasket surfaces, and check for leaks in the vacuum box assembly.

3. Energize the vacuum pump and reduce the tank pressure to approximately 5 psi.

4. Wet a strip of geomembrane approximately 12 inches by 48 inches (length of box) with the soapy solution.

5. Place the box over the wetted area and compress.

6. Close the bleed valve and open the vacuum valve.

7. Check that a leak tight seal is created.

8. For a period of approximately 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

9. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum three inches overlap and repeat the process.

10. All areas where soap bubbles appear shall be marked and repaired and then retested.

11. All tested seams and/or patches shall be marked with the liner installer technician's initials and date is test is accepted.

APPENDIX B

AUGUST 2020 – SITE SOILS INVESTIGATION

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APPENDICES

1.0 INTRODUCTION

1.1 PURPOSE

Civil & Environmental Consultants, Inc. (CEC) performed an investigation of the Soil Borrow Areas around the Harrison Power Station CCB Landfill (Landfill) located in Shinnston, West Virginia.

The purpose of our engineering services was to perform a borrow area investigation and evaluation of potential borrow soils areas on MonPower property to supplement existing geotechnical information, evaluate the stability of the subgrade soils, and gather information to aid in the design of proposed landfill expansion areas, and assess the availability and suitability of on-site soils. This investigation was performed to determine the approximate quantity of available soil material on-site in areas adjacent to the existing previously permitted lined disposal areas, the proposed Phase 7 Expansion area, and within the proposed Phase 7 Expansion area to determine material acceptability for use for liner system construction and cover soils. This work consisted of excavating test pits at various locations within potential borrow areas and within the proposed Phase 7 Expansion area, observing and documenting soils conditions within the excavated test pits, collecting soil samples, performing laboratory analysis to classify the soils and determining the soil balance for the future use at the CCB Landfill.

This investigation consisted of excavation of 14 test pits at locations within the Phase 7 expansion area and proposed borrow areas, as shown on the Soil Test Pit Locations Figure provided in Attachment A. Soil conditions that were observed by CEC personnel within the excavated test pits were documented on test pit logs which are provided in Attachment B. Laboratory test results are provided in Attachment C.

1.2 INVESTIGATION PROCEDURE DESCRIPTION

CEC developed a Work Plan to safety conduct the investigation of the borrow areas including test pit locations, equipment to be utilized, samples to be collected, and laboratory testing to be performed. The Work Plan was submitted to MonPower discussed prior to the commencement of on-site activities. The following describes the procedures used to accomplish the borrow area investigation and evaluation.

CEC coordinated with MonPower and their onsite operator to perform the test pit excavations at the locations shown on the Soil Test Pit Locations Figure. The operator excavated the test pits and CEC personnel documented observations and collected soil samples for laboratory testing as noted on the test pit logs. All test pits were backfilled prior to relocating to the next location.

Soil samples collected were transported to Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania for laboratory analysis. CEC reviewed and tabulated the laboratory soils analysis results. A summary of laboratory test results are provided in Appendix C.

CEC evaluated the soil characteristics and depths of usable soil and performed a soil balance calculation to quantify the soils available within the proposed liner construction areas which are identified as the expansion area subgrade grading volumes in the calculation and within potential on-site borrow areas for use in development and construction of future lined areas and final cover soil material, and compared the available soil to the required soil in accordance with regulatory requirements. The borrow area soil balance calculation is provided in Attachment D.

The following sections of this report summarize the field investigation and laboratory analyses obtained from the investigation and the soil balance evaluation and present conclusions and recommendations in accordance with our findings.

2.0 FIELD INVESTIGATION

2.1 EXCAVATION AND FIELD DOCUMENTATION

The field borrow area investigation was performed from August 18 and 19, 2020 by a CEC representative accompanied by a MonPower on-site operator. The test pits were excavated to varying depths based on encountering a rock layer or maximum reach of the excavator.

A summary of the test pit depths are provided below.

Test Pit Depth Summary

TEST PIT NUMBER	DEPTH OF EXCAVATION (FT.)	DEPTH OF USABLE SOIL (FT.)
TP-1	14’ +	12’
TP-2	15’	12’
TP-3	7’	3.5’
TP-4	16’ +	15’
TP-5	4’	1.5’
TP-6	11’	9’
TP-7	12’	0
TP-8	3’	0
TP-9	3’	4’
TP-10	5’	5’
TP-11	4’	4’
TP-12	10’	10’
TP-14	12’	10’
TP-15	17’	10’
Note: * The depth of useable soil for test pits is based off of visual documentation and removing potentially undesirable soil layers.		

A CEC field representative was present during each test pit excavation to observe and document soil color, depth, visual composition, consistency, and moisture. At test pits T-1 through T-15, CEC collected composite samples as outlined in Attachment B which provides detailed descriptions of the soil conditions encountered in the test pits and also document the approximate depths of sample collection.

2.2 SUBSURFACE CONDITIONS

A layer of topsoil was present to an approximate 1-foot depth at the top of each test pit. Varying gradations of clay, silt, sand, and rock fragments were encountered from below the topsoil layer to the bottom of most of the test pit excavations. The depth of soil and soil-like materials varied from east test pit.

3.0 LABORATORY TESTING

Laboratory testing was performed by Geotechnics on selected representative soil samples obtained during the subsurface exploration. The samples were tested for the following parameters:

- Natural Water Content
- Visual Description
- Atterberg Limits
- Sieve Analysis
- Hydrometer
- Unified Soil Classification System Category
- Standard Proctor

The soils were classified in accordance with USCS and UDSA as shown in the summary table. The sieve analysis showed 100% particle sizes less than 6-inch diameter, 87% particle sizes less than 1-inch diameter on average, and 69% passing the No. 10 sieve on average. Hydrometer results for the samples indicated silt contents ranging from 16% to 51% with an average silt content of 31%, and clay contents ranging from 4% to 56% with an average clay content of 18%. Standard Proctor density testing indicated maximum dry densities of 109.5 pcf on average with optimum moisture contents of 15.9% on average.

Based the soil laboratory results and comparing them to a recent construction event, the soils share similar characteristics and would be suitable as subbase, general fill, or final cover soil material. As expansion of the CCB Landfill progresses, additional testing will be performed on the soil specific to the intended use of the soil. Laboratory test results for samples tested as part of this investigation are summarized and presented in Appendix C.

4.0 BORROW SOIL SUITABILITY

For the purposes of this investigation, CEC is presenting the following information regarding the suitability of the borrow area soils as final cover soil. MonPower will perform additional borrow area investigations, as future development and construction of the CCB Landfill progresses. Additional testing will be performed on the soil specific to the intended use of the soil prior to designating specific borrow areas for specific uses.

4.1 REGULATORY REQUIREMENTS

USEPA CCR Rule 257.102(d)(3)(i)(A), (B), and (C) requires a final cover system comprised of a minimum 18-inch thickness of earthen material as an infiltration layer and a minimum of 6-inch thickness of earthen material as an erosion layer. This is also consistent with the West Virginia Department of Environmental Protection (WVDEP) Waste Management Rule 6.1.e.1.A.2 and 6.1.e.1.A.2.1 which also requires a minimum 18-inch thickness of earthen material as an infiltration layer and a minimum of 6-inch thickness of earthen material as an erosion layer. Both the USEPA CCR and WVDEP regulations require the infiltration layer to have a maximum permeability of 1×10^{-5} cm/sec.

Both the USEPA CCR Rule and WVDEP regulations allow for an alternative final cover system.

The currently permitted final cover system design for the Harrison CCB landfill includes from bottom to top, a 40-mil textured geomembrane, a double-sided geocomposite drainage layer, and a 1-foot thick vegetative cover layer.

This borrow soil investigation indicates that the on-site soils possess typical characteristics and classifications that would be suitable for final cover soil

4.2 SOIL PROCESSING OBSERVATIONS

The soils tested have on average 87% less than 1-inch in size and typically require minimal processing (crushing and/or screening) to meet the gradation for final cover soil.

4.3 DETERMINATION OF AVAILABLE FINAL COVER SOIL VOLUME

Information gathered during the borrow area investigation was used to determine an approximate useable soil depth and useable soil volume within potential borrow areas. As presented in the soil balance calculation provided in Attachment D, the depth of available soil from the test pits varies from approximately 4 feet to 10 feet. Based on the information from the soil borrow area investigation, CEC calculated the useable soil volume as approximately 752,000 cubic yards.

Depending on which option is being looked at, the estimated area of the CCB Landfill requiring capping varies. The multiple areas that would require capping are presented in Attachment D.

The soil balance calculation in Appendix D provides an estimate of volume of usable soil in on-site borrow areas that have currently been investigated compares this to the required volume of soil needed for closure of the landfill. This calculation indicates that the potential on-site borrow shown are inadequate volumes of soil. However, MonPower still owns additional property and plans to investigate other potential borrow areas prior to the CCB Landfill reaching Closure.

5.0 RECOMMENDATIONS AND CONCLUSIONS

5.1 RECOMMENDATIONS

As part of future closure permitting and design, CEC recommends that the borrow areas be assessed for wetlands to determine if there are jurisdictional wetlands/streams that will require permitting or avoided. In addition, some borrow areas are heavily wooded and may require federal and state approval to clear such large areas of trees due to potential habitat of endangered bat species. Regulatory requirements typically dictate the time of year that tree clearing can be performed, generally between November 1st and March 31st depending on the location. Also, work within borrow areas may require site stormwater management and erosion and sedimentation plans associated with proposed site earth disturbances. Because the current borrow areas that were identified are inadequate to cover the 2 of the 6 closure options presented in the soil balance calculation in Attachment D, CEC recommends identifying and investigation potential borrow areas prior to Closure.

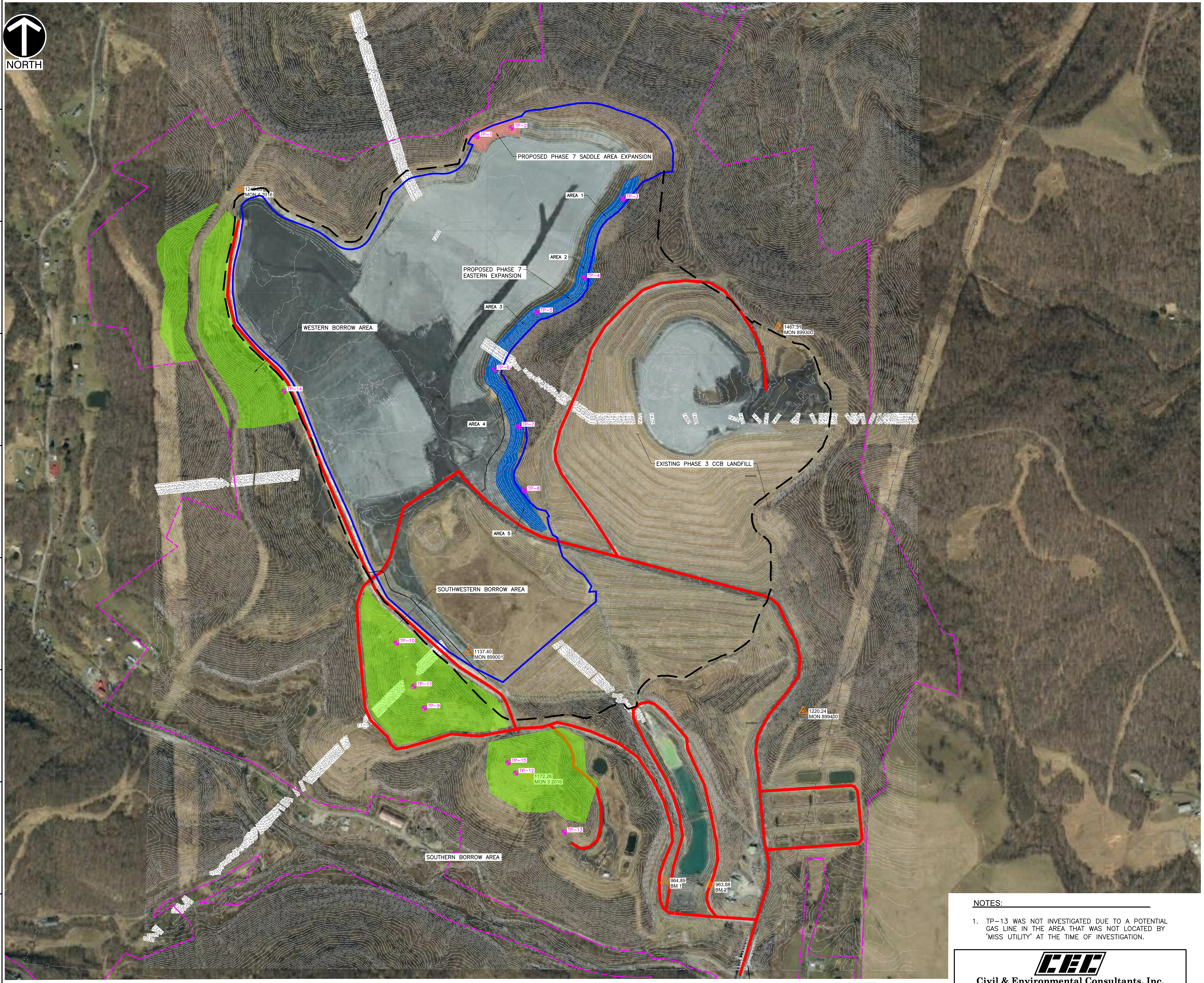
As shown on the Soil Test Pit Location figure, gas lines do exist adjacent to and in potential future borrow areas and within future grading areas for the proposed expansion around the site. Prior to future investigations or excavations in identified borrow areas, WV Miss Utility should be contacted to locate the gas lines so that they can be protected.

5.2 CONCLUSIONS

This borrow soil investigation was a preliminary investigation to identify potential borrow areas that exist on the site. As discussed with MonPower, these identified borrow areas were only investigated due to the proximity of the Phase 7 Expansion. As future expansions are proposed and the site is further developed, additional borrow areas should be investigated to determine soil that would be suitable for liner construction and final cover soil as required by both USEPA CCR and WVDEP regulations.

ATTACHMENT A

SOIL TEST PIT LOCATION FIGURE



REVISION RECORD

NO	DATE	DESCRIPTION

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

LEGEND:

- PROPERTY BOUNDARY
- EXISTING CONTOURS
- EXISTING FE SURVEY CONTROL MONUMENT
- PROPOSED TEST PIT LOCATION
- ACCESS ROAD
- EASTERN EXPANSION AREA INVESTIGATION
- SADDLE INVESTIGATION AREA
- BORROW AREA INVESTIGATION
- EXISTING STREAM OR WATERBODY
- ST — EXISTING STORM PIPE
- W — EXISTING WATER LINE
- G — EXISTING GAS LINE
- GAS — EXISTING GAS LINE
- E — EXISTING ELECTRIC LINE
- T — EXISTING TELEPHONE LINE
- EXISTING DRAINAGE DITCH
- EXISTING STRUCTURE
- SAN — EXISTING SANITARY SEWER LINE
- OH-E — EXISTING OVERHEAD WIRE
- E — EXISTING ELECTRIC LINE
- UG-E — EXISTING UNDERGROUND ELECTRIC LINE
- FO — EXISTING FIBER OPTIC LINE
- EXISTING WETLAND
- AUT — UNDERGROUND TELEPHONE LINE (BY OTHERS)
- PHASE 7 EXPANSION PROPOSED LIMITS
- ULTIMATE DEVELOPMENT LIMITS

TEST PIT SCHEDULE

DESCRIPTION	NORTHING	EASTING	ELEVATION	TEST PIT DEPTH
TP-1	332762.5247	1733917.9465	1259.090	14'+
TP-2	332832.8091	1734197.3892	1240.071	15'
TP-3	332260.3373	1735100.0079	1255.112	7'
TP-4	331618.5541	1734787.2616	1257.093	16'+
TP-5	331339.0883	1734404.8756	1248.284	4'
TP-6	330875.7297	1734057.1044	1245.376	11'
TP-7	330414.4071	1734257.2253	1238.910	12'
TP-8	329895.6967	1734302.3491	1249.704	3'
TP-9	328136.0117	1733493.6466	1191.543	3'
TP-10	328663.2541	1733267.4582	1220.039	5'
TP-11	328312.6767	1733408.6152	1230.000	4'
TP-12	327610.5117	1734233.5108	1178.285	10'
TP-13	327130.87	1734625.0000	1101.95	N/A (SEE NOTE 1)
TP-14	330700.6482	1732355.9128	1204.964	12'
TP-15	327693.8901	1734171.2737	1185.457	17'

SURVEY CONTROL MONUMENT POINTS

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION	DETAIL
1	326740.19	1735438.40	964.89	BM 1	METAL SURVEY MARKER
2	326708.00	1735801.80	963.95	BM 2	METAL SURVEY MARKER
3	327583.72	1734338.23	1172.26	MON 3 2016	ALUMINUM MONUMENT
4	332336.97	1731996.05	1246.89	MON 4 2016	ALUMINUM MONUMENT
899300	331221.80	1736358.36	1467.31	MON 899300	ALUMINUM MONUMENT
899400	328111.23	1736559.63	1220.24	MON 899400	ALUMINUM MONUMENT

NOTES:

1. TP-13 WAS NOT INVESTIGATED DUE TO A POTENTIAL GAS LINE IN THE AREA THAT WAS NOT LOCATED BY 'MISS UTILITY' AT THE TIME OF INVESTIGATION.

CONTROL MONUMENTS:

1. COORDINATES SHOWN ARE BASED ON THE WEST VIRGINIA STATE PLANE COORDINATE SYSTEM, NORTH ZONE NAD 83.

* HELD FOR SURVEY CONTROL

SCALE IN FEET
0 300 600

CEC
Civil & Environmental Consultants, Inc.
333 Baldwin Road · Pittsburgh, PA 15205
Ph: 412.429.2324 · 800.365.2324 · Fax: 412.429.2114
www.cecinc.com

FUNCTIONAL LOCATION NO. ____________

*HAND SIGNATURE ON FILE

Last .Net editor version: 1.1.2.0

INITIAL PROJECT #

THIS IS AN AutoCAD DRAWING - DO NOT MANUALLY REVISE

REFERENCE DRAWINGS

DWG. NO.	TITLE

ENGINEERING	DATE
DR JML	03/12/2021
CHKD MRF	03/12/2021
APPD DMT*	03/12/2021
SCALE	

MONONGAHELA POWER COMPANY
PERMIT RENEWAL AND LINER EXPANSION TEST PIT INVESTIGATION
HARRISON POWER STATION
HARRISON COUNTY, WEST VIRGINIA
FACILITY HARRISON UNIT COMMON

MonPower
A FirstEnergy Company

DWG. NO. ATTACHMENT A
SITE SOILS INVESTIGATION

REV. 0

REVISION	DR	CHKD	APPD	DATE
PROJECT NUMBER				

ATTACHMENT B

2020 TEST PIT LOGS

ATTACHMENT B
HARRISON PERMIT RENEWAL
SOIL BORROW AREA INVESTIGATION
TEST PIT LOGS

Test Pit ID	Date	Total Depth (ft)	Sample Interval (ft)	Layer Depth (ft)	Soil Description
T-1	8/18/2020	14 +	0 - 4 and 5 - 14	0 - 1	Debris, Topsoil
				2 - 3	Brown, sandy loam soil, dry, sandstone fragments
			Sample TP-1A @ 4' Sample TP-1B @ 14’	4 - 14	Brown, sandy loam soil, moist, sandstone fragments
					*Depth of excavator reached, no rock visible
T-2	8/18/2020	15	0 - 4 and 5 - 15	0 - 1	Debris, Topsoil
				2 - 3	Brown, sandy clay soil, dry, sandstone fragments
			Sample TP-2A @ 4'	4 - 14	Brown/Gray, sandy clay soil, dry, sandstone fragments
			Sample TP-2B @ 15’	15	Brown/Gray, sandy clay soil, dry, sandstone layer
T-3	8/18/2020	7	0 – 3 and 4 - 7	0 - 1	Debris, Topsoil
			Sample TP-3A @ 3’	2 - 5	Brown, dry, sandy clay soil, sandstone fragments
				6	Coal layer, mixed brown, dry sandy clay soil
			Sample TP-3B @ 7'	7	Coal/sandstone layer, mixed brown, dry sandy clay soil
T-4	8/18/2020	16 +	0 - 3 and 4 - 16	0 - 1	Debris, Topsoil
			Sample TP-4A @ 3'	2 - 15	Brown, sandy loam soil, sandstone fragments
			Sample TP-4B	16	Brown, sandy loam soil, sandstone layer
					*Depth of excavator reached, no rock visible
T-5	8/18/2020	4	0 - 3 and 4	0 - 1	Debris, Topsoil
			Sample TP-5A @ 3'	2 - 3	Brown, dry, sandy loam soil, sandstone fragments
			Sample TP-5B @ 4'	4	Brown, dry, sandy-loam soil, sandstone layer
T-6	8/18/2020	11	0 - 4 and 5 - 11	0 - 1	Debris, Topsoil
				2 - 3	Brown/orange, dry, sandy clay soil, sandstone fragments
			Sample TP-6A @ 4’	4 - 10	Brown, dry, sandy clay soil, sandstone fragments
			Sample TP-6B @ 11'	11	Brown, dry, sandy clay soil, sandstone layer
T-7	8/18/2020	12	0 - 3 and 4 - 12	0 - 1	Debris, Topsoil
			Sample TP-7A @ 3’	2 - 9	Brown, dry, sandy clay soil, sandstone fragments
			Sample TP-7B @ 10’	10 - 11	Brown/gray, moist, clay soil, shale fragments
				12	Brown/gray, moist, clay soil, shale layer
T-8	8/18/2020	3	0 - 2 and 3	0 - 1	Debris, Topsoil
			Sample TP-8A @ 2'	2	Brown, sandy clay soil, dry, sandstone fragments
			Sample TP-8B @ 3’	3	Brown, dry, sandy clay soil, sandstone layer

ATTACHMENT B HARRISON PERMIT RENEWAL SOIL BORROW AREA INVESTIGATION TEST PIT LOGS					
Test Pit ID	**Date**	**Total Depth (ft)**	**Sample Interval (ft)**	**Layer Depth (ft)**	**Soil Description**
T-9	8/19/2020	3	0 - 2 and 3	0 - 1	Debris, Topsoil
			Sample TP-9A @ 2’	2	Brown, sandy loam soil, dry, sandstone fragments
			Sample TP-9B @ 3’	3	Brown, sandy loam soil, moist, sandstone layer
T-10	8/19/2020	5	0 - 2 and 3 - 5	0 - 1	Debris, Topsoil
			Sample TP-10A @ 2'	2 -4	Brown/tan, dry, sandy loam soil, sandstone fragments
			Sample TP-10B @ 5'	5	Brown/tan, dry, sandy loam soil, sandstone layer
T-11	8/19/2020	4	0 – 2 and 3 - 4	0 - 1	Debris, Topsoil
			Sample TP-11A @ 2’	2 - 3	Brown, shale fragments, minimal soil
			Sample TP-11B @ 4’	4	Brown, shale layer, minimal soil
T-12	8/19/2020	10	0 - 3 and 4 - 10	0 - 1	Debris, Topsoil
			Sample TP-12A @ 3'	2 - 4	Brown/tan, dry, sandy loam soil, sandstone fragments
				5 - 6	Gray, fine shale
				7 - 8	Coal layer
				9	Coal layer, Gray/Brown shale fragments
			Sample TP-12B @ 10’	10	Coal layer, Gray/Brown shale layer
T-14	8/19/2020	13	0 - 3 and 4 - 13	0 - 1	Debris, Topsoil
			Sample TP-14A @ 3' Sample TP-14B @ 12'	2 - 12	Brown, dry, sandy clay soil, small shale fragments
				13	Limestone/shale layer
T-15	8/19/2020	17	0 - 4 and 5 - 11	0 - 1	Debris, Topsoil
			Sample TP-15A @ 3’ Sample TP-15C Sample TP-15D Sample TP-15E Sample TP-15F	2 - 14	Brown, dry, sandy clay soil, fine
			Sample TP-15B @ 15’	15 -16	Brown/gray, shale fragments
				17	Brown/gray, shale layer

ATTACHMENT C
2020 LABORATORY TEST RESULTS

ATTACHMENT C
HARRISON PERMIT RENEWAL
2020 LABORATORY TEST RESULTS SUMMARY

TEST PIT NUMBER	SAMPLE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAIN SIZE DISTRIBUTION — WASH SIEVE ANALYSIS % PASSING 6" SIEVE	% PASSING 1" SIEVE	% PASSING 3/4" SIEVE	% PASSING No. 10 SIEVE	USDA CLASSIFICATION SYSTEM GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	USCS SYMBOL	USCS CLASSIFICATION	USDA CLASSIFICATION	OPTIMUM MOISTURE CONTENT (%)	MAXIMUM DRY DENSITY (pcf)
		ASTM D2216	ASTM D4318		ASTM D6913 / D7928											ASTM D698	
TP-1	TP-1A	14.7	34	18	100	89	87	67	33.46	23.47	28.97	14.10	SC	Clayey Sand with Gravel	Loam	-	-
TP-1	TP-1B	14.5	31	11	100	80	76	47	53.32	18.84	19.15	8.69	GC	Clayey Gravel with Sand	Loam	-	-
TP-2	TP-2A	14.8	37	18	100	89	87	69	30.94	19.19	30.59	19.28	CL	Gravelly Lean Clay with Sand	Clay Loam	14.5	111.1
TP-3	TP-3A	13.5	34	16	100	90	88	70	29.80	23.59	28.86	17.76	SC	Clayey Sand with Gravel	Loam	-	-
TP-4	TP-4A	13.7	28	9	100	79	76	64	36.30	22.08	28.41	13.20	GC	Clayey Gravel with Sand	Loam	-	-
TP-4	TP-4B	17.2	28	10	100	94	93	78	22.20	32.17	31.28	14.35	CL	Sandy Lean Clay with Gravel	Loam	13.2	112.4
TP-5	TP-5A	12.8	31	15	100	83	80	52	47.63	19.26	24.89	8.22	GC	Clayey Gravel with Sand	Loam	-	-
TP-6	TP-6A	31.5	50	26	100	74	72	56	43.60	8.60	26.05	21.76	CH	Gravelly Fat Clay	Silty Clay Loam	22.5	98.0
TP-7	TP-7A	21.0	41	19	100	100	100	77	22.64	13.44	41.11	22.81	CL	Gravelly Lean Clay	Silty Clay Loam	-	-
TP-7	TP-7B	13.2	37	17	100	100	100	93	6.84	25.45	51.19	16.52	CL	Lean Clay with Sand	Silt Loam	13.5	116.5
TP-8	TP-8A	17.2	48	21	100	87	85	65	34.79	19.36	29.75	16.11	GC	Clayey Gravel with Sand	Loam	-	-
TP-9	TP-9A	14.8	39	20	100	88	84	64	35.63	16.06	30.65	17.66	CL	Gravelly Lean Clay with Sand	Clay Loam	-	-
TP-10	TP-10A	11.4	37	19	100	77	73	61	39.26	16.99	27.51	16.23	GC	Clayey Gravel with Sand	Loam	-	-
TP-11	TP-11A	9.5	33	12	100	67	58	38	61.82	17.70	16.02	4.46	GC	Clayey Gravel with Sand	Loam	-	-
TP-12	TP-12A	12.3	40	17	100	100	100	89	11.14	27.58	42.05	19.23	CL	Sandy Lean Clay	Loam	-	-
TP-14	TP-14A	13.2	46	23	100	94	91	81	18.99	23.06	33.14	24.82	CL	Sandy Lean Clay	Clay Loam	-	-
TP-15	TP-15A	27.2	64	33	100	100	100	99.8	0.20	5.37	38.79	55.63	CH	Fat Clay	Clay	-	-
TP-15	TP-15B	12.7	39	17	100	73	70	62	38.17	20.64	26.19	15.00	GC	Clayey Gravel with Sand	Loam	-	-
HIGHEST VALUE		31.5	64	33	100	100	100	99.8	61.82	32.17	51.19	55.63	--	--	--	22.5	116.5
LOWEST VALUE		9.5	28	9	100	67	58	38	0.20	5.37	16.02	4.46	--	--	--	13.2	98.0
AVERAGE		15.8	39	18	100	87	84	68	31.49	19.60	30.81	18.10	--	--	--	15.9	109.5

MOISTURE CONTENT

ASTM D 2216-10

Client: Civil & Environmental Consultants
Client Reference: Harrison Site 302-918.0030
Project No.: 2020-444-001

Lab ID:	001	002	003	004	005
Boring No.:	8/18/20	8/18/20	8/18/20	8/18/20	8/18/20
Depth (ft):	NA	NA	NA	NA	NA
Sample No.:	TP-1A	TP-1B	TP-2A	TP-3A	TP-4A
Tare Number	3319	3055	3515	3529	3222
Wt. of Tare & Wet Sample (g)	356.64	361.57	349.93	359.44	368.53
Wt. of Tare & Dry Sample (g)	312.04	316.93	305.85	317.61	324.99
Weight of Tare (g)	8.20	8.10	8.12	8.07	8.13
Weight of Water (g)	44.60	44.64	44.08	41.83	43.54
Weight of Dry Sample (g)	303.84	308.83	297.73	309.54	316.86
Water Content (%)	**14.7**	**14.5**	**14.8**	**13.5**	**13.7**

Lab ID	006	007	008	009	010
Boring No.	8/18/20	8/18/20	8/18/20	8/18/20	8/18/20
Depth (ft)	NA	NA	NA	NA	NA
Sample No.	TP-4B	TP-5A	TP-6A	TP-7A	TP-7B
Tare Number	3023	3375	3274	3400	3103
Wt. of Tare & Wet Sample (g)	376.45	397.04	310.79	368.31	458.55
Wt. of Tare & Dry Sample (g)	322.51	352.84	238.33	305.93	406.11
Weight of Tare (g)	8.26	8.38	8.29	8.18	8.06
Weight of Water (g)	53.94	44.20	72.46	62.38	52.44
Weight of Dry Sample (g)	314.25	344.46	230.04	297.75	398.05
Water Content (%)	**17.2**	**12.8**	**31.5**	**21.0**	**13.2**

Notes :

Tested By *SG* *Date* *9/3/20* *Checked By* *BRB* *Date* *9/7/20*

DCN: CT-S1 DATE: 3/18/13 REVISION: 4

S:\Excel\Excel Qa\Spreadsheets\Water Content.xls

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MOISTURE CONTENT

ASTM D 2216-10

Client:	Civil & Environmental Consultants
Client Reference:	Harrison Site 302-918.0030
Project No.:	2020-444-001

Lab ID:	011	012	013	014	015
Boring No.:	8/18/20	8/19/20	8/19/20	8/19/20	8/19/20
Depth (ft):	NA	NA	NA	NA	NA
Sample No.:	TP-8A	TP-9A	TP-10A	TP-11A	TP-12A
Tare Number	3520	3038	3523	3516	3295
Wt. of Tare & Wet Sample (g)	378.15	328.43	316.70	408.27	321.50
Wt. of Tare & Dry Sample (g)	323.79	287.12	285.06	373.60	287.09
Weight of Tare (g)	8.05	8.52	8.11	8.26	8.36
Weight of Water (g)	54.36	41.31	31.64	34.67	34.41
Weight of Dry Sample (g)	315.74	278.60	276.95	365.34	278.73
Water Content (%)	**17.2**	**14.8**	**11.4**	**9.5**	**12.3**

Lab ID	016	017	018
Boring No.	8/19/20	8/19/20	8/19/20
Depth (ft)	NA	NA	NA
Sample No.	TP-14A	TP-15A	TP-15B
Tare Number	3236	3203	2982
Wt. of Tare & Wet Sample (g)	389.12	273.30	379.72
Wt. of Tare & Dry Sample (g)	344.73	216.54	337.79
Weight of Tare (g)	8.12	8.12	8.40
Weight of Water (g)	44.39	56.76	41.93
Weight of Dry Sample (g)	336.61	208.42	329.39
Water Content (%)	**13.2**	**27.2**	**12.7**

Notes :

Tested By	*SG*	*Date*	*9/3/20*	*Checked By*	*BRB*	*Date*	*9/7/20*

DCN: CT-S1 DATE: 3/18/13 REVISION: 4

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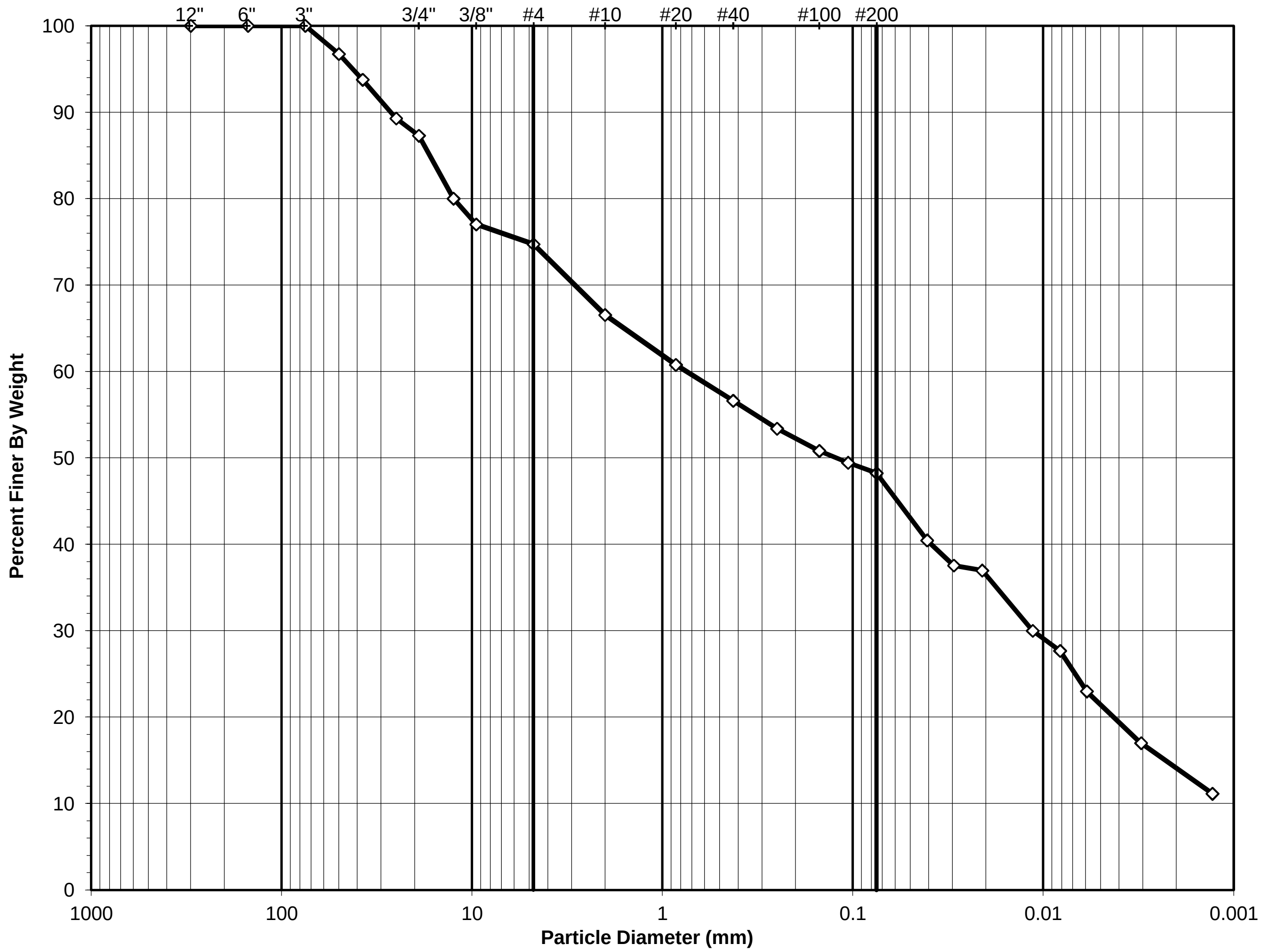
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1A
Lab ID:	2020-444-001-001	Soil Color:	Brown

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol:

SC, TESTED

D50 = 0.12

USCS Classification:

CLAYEY SAND WITH GRAVEL

Tested By NR Date 9/4/20 Checked By BRB Date 9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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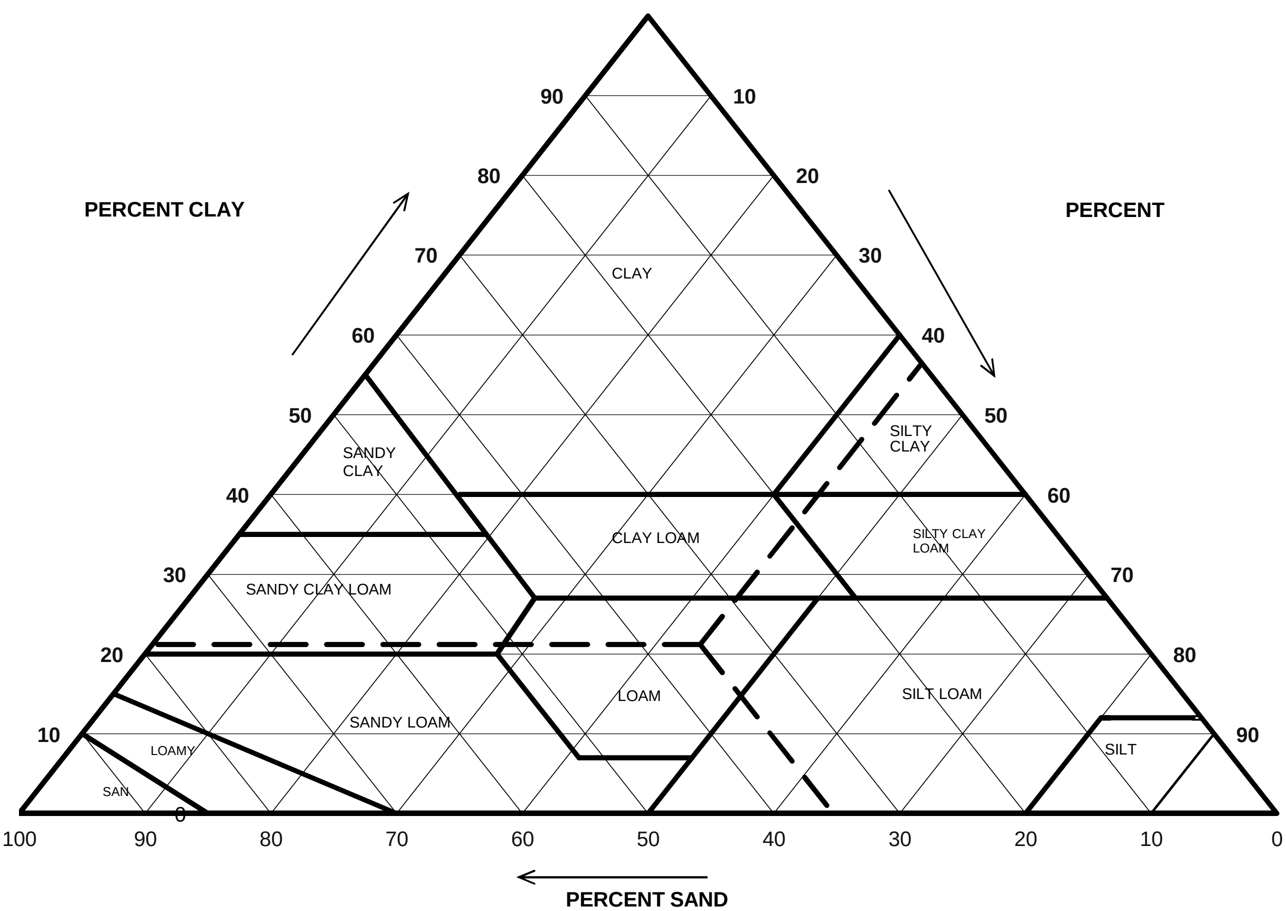
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1A
Lab ID:	2020-444-001-001	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	33.46	
2	66.54	Sand	23.47	35.27
0.05	43.07	Silt	28.97	43.54
0.002	14.10	Clay	14.10	21.19

USDA Classification: LOAM

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WASH SIEVE ANALYSIS

ASTM D6913-17

geotechnics
geotechnical & geosynthetic testing

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1A
Lab ID:	2020-444-001-001	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	2901	Tare No.:	3270
Wt. of Tare & Wet Sample (g):	293.31	Weight of Tare & Wet Sample (g):	337.12
Wt. of Tare & Dry Sample (g):	264.09	Weight of Tare & Dry Sample (g):	326.77
Weight of Tare (g):	8.36	Weight of Tare (g):	8.80
Weight of Water (g):	29.22	Weight of Water (g):	10.35
Weight of Dry Soil (g):	255.73	Weight of Dry Soil (g):	317.97
Moisture Content (%):	**11.4**	**Moisture Content (%):**	**3.3**

Wet Weight of -3/4" Sample (g):	19879.00	Total Dry Weight of Sample (g):	20439.91
Tare No. (-3/4" Sub-Specimen):	1499	Wet Weight of +3/4" Sample (g):	2684.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1263.13	Dry Weight of + 3/4" Sample (g):	2599.39
Weight of Tare (g):	148.18	Dry Weight of - 3/4" Sample (g):	17840.52
Sub-Specimen -3/4" Wet Weight (g):	1114.95	Dry Weight -3/4" +3/8" Sample (g):	2097.28
Tare No. (-3/8" Sub-Specimen):	569	Dry Weight of -3/8" Sample (g):	15743.24
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	270.50	J - Factor (% Finer than 3/4"):	87.3%
Weight of Tare (g):	82.92	J - Factor (% Finer than 3/8"):	77.0%
Sub-Specimen -3/8" Wet Weight (g):	187.58		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	689.00	(*)	3.26	3.26	96.74	**97**
1 1/2"	37.5	628.00		2.98	6.24	93.76	**94**
1"	25	945.00		4.48	10.72	89.28	**89**
3/4"	19	422.00		2.00	12.72	87.28	**87**
1/2"	12.5	83.50	(**)	8.34	8.34	91.66	**80**
3/8"	9.5	34.13		3.41	11.76	88.24	**77**
#4	4.75	5.03		2.99	2.99	97.01	**75**
#10	2	17.88		10.62	13.61	86.39	**67**
#20	0.85	12.62	(**)	7.50	21.11	78.89	**61**
#40	0.425	9.08		5.39	26.50	73.50	**57**
#60	0.25	7.06		4.19	30.69	69.31	**53**
#100	0.15	5.62		3.34	34.03	65.97	**51**
#140	0.106	2.99		1.78	35.81	64.19	**49**
#200	0.075	2.65		1.57	37.38	62.62	**48**
Pan	-	105.41		62.62	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1A
Lab ID:	2020-444-001-001	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	40.5	22.9	5.68	9.6	0.0407	83.9	40.5
2	38.0	22.9	5.68	10.1	0.0295	77.9	37.5
4	37.5	22.9	5.68	10.2	0.0209	76.7	37.0
15	31.5	22.9	5.68	11.2	0.0114	62.2	30.0
30	29.5	22.9	5.68	11.6	0.0082	57.4	27.7
61	25.5	22.8	5.72	12.3	0.0059	47.7	23.0
240	20.0	23.7	5.37	13.3	0.0031	35.2	17.0
1440	15.0	23.6	5.41	14.2	0.0013	23.1	11.1

Soil Specimen Data

Tare No.:	679	Percent Finer than # 200:	48.23
Wt. of Tare & Dry Material (g):	138.10		
Weight of Tare (g):	92.05	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	41.05		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/8/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1A
Lab ID:	2020-444-001-001	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

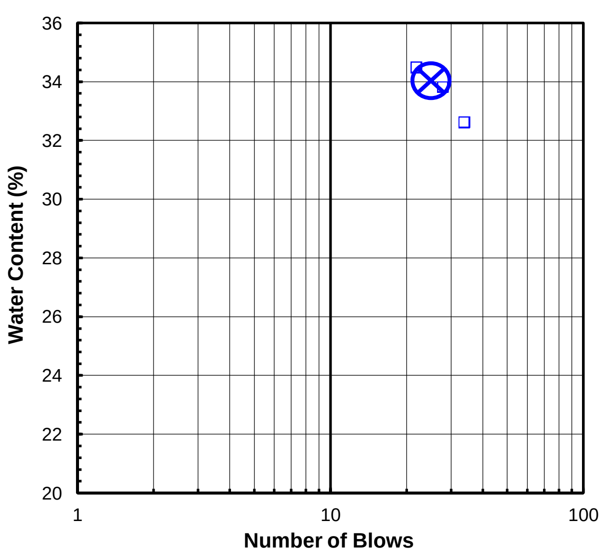
As Received Moisture Content ASTM D2216-19		**Liquid Limit Test** 1	2	3	M U L T I P O I N T
Tare Number:	3319	346	9	114	
Wt. of Tare & Wet Sample (g):	356.64	40.83	39.67	38.59	
Wt. of Tare & Dry Sample (g):	312.04	35.84	34.53	33.42	
Weight of Tare (g):	8.20	20.53	19.32	18.42	
Weight of Water (g):	44.6	5.0	5.1	5.2	
Weight of Dry Sample (g):	303.8	15.3	15.2	15.0	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**14.7**	**32.6**	**33.8**	**34.5**	
Number of Blows:		**34**	**28**	**22**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	193	609	
Wt. of Tare & Wet Sample (g):	23.02	24.95	
Wt. of Tare & Dry Sample (g):	22.18	24.12	
Weight of Tare (g):	16.95	18.80	
Weight of Water (g):	0.8	0.8	
Weight of Dry Sample (g):	5.2	5.3	
Moisture Content (%):	**16.1**	**15.6**	**0.5**

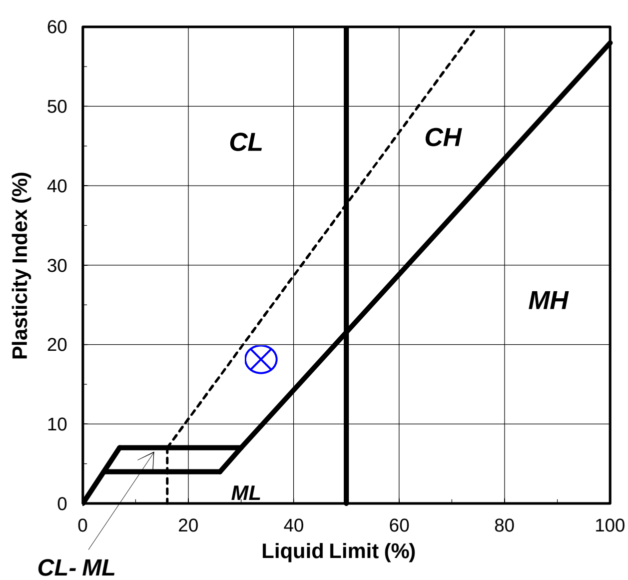
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**34**
Plastic Limit (%):	**16**
Plasticity Index (%):	**18**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By FS *Date* 9/15/20 *Checked By* BRB *Date* 9/16/20

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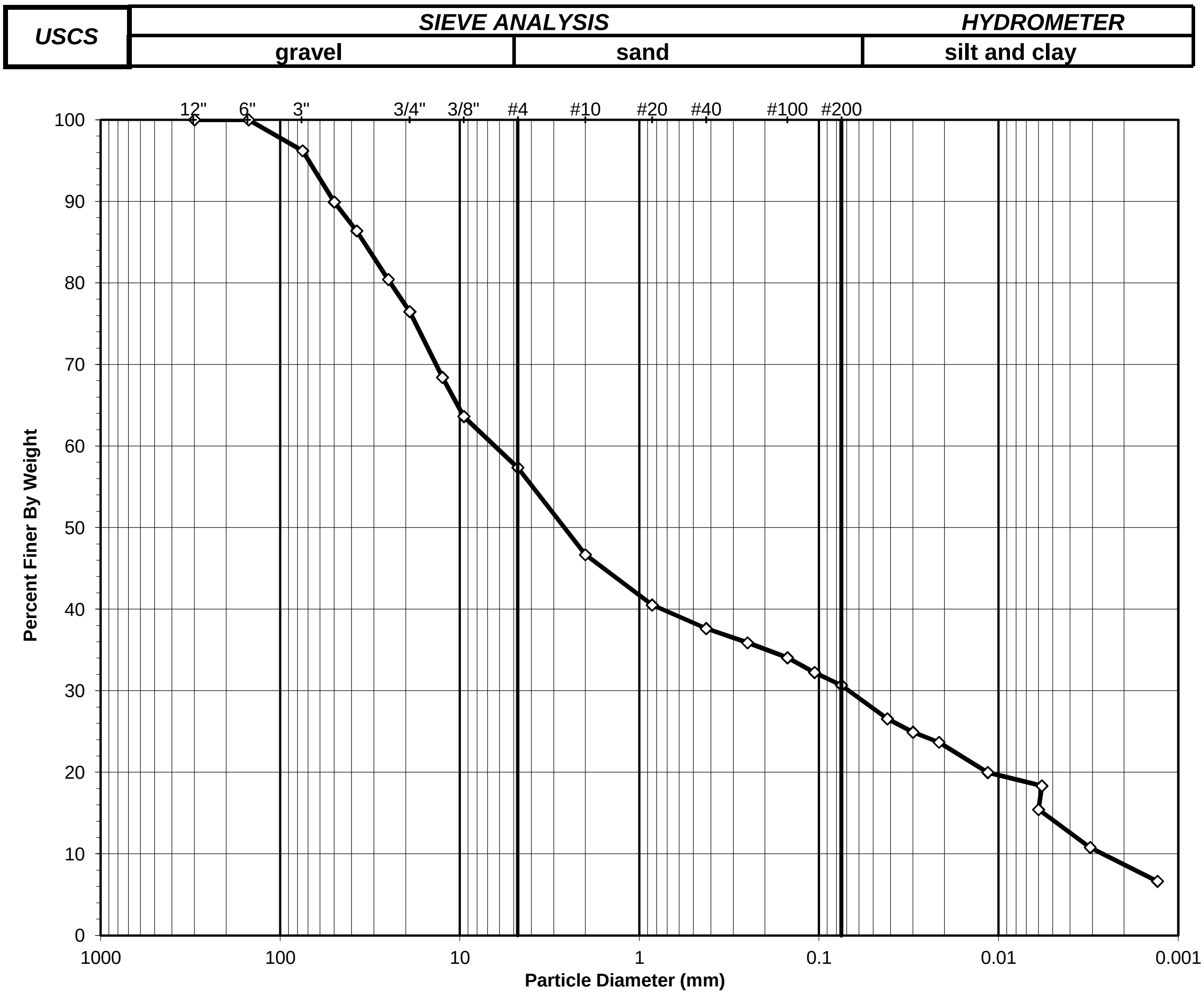
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1B
Lab ID:	2020-444-001-002	Soil Color:	Brown



USCS Symbol:

GC, TESTED

D50 = 2.62

USCS Classification:

CLAYEY GRAVEL WITH SAND

Tested By NR Date 9/4/20 Checked By BRB Date 9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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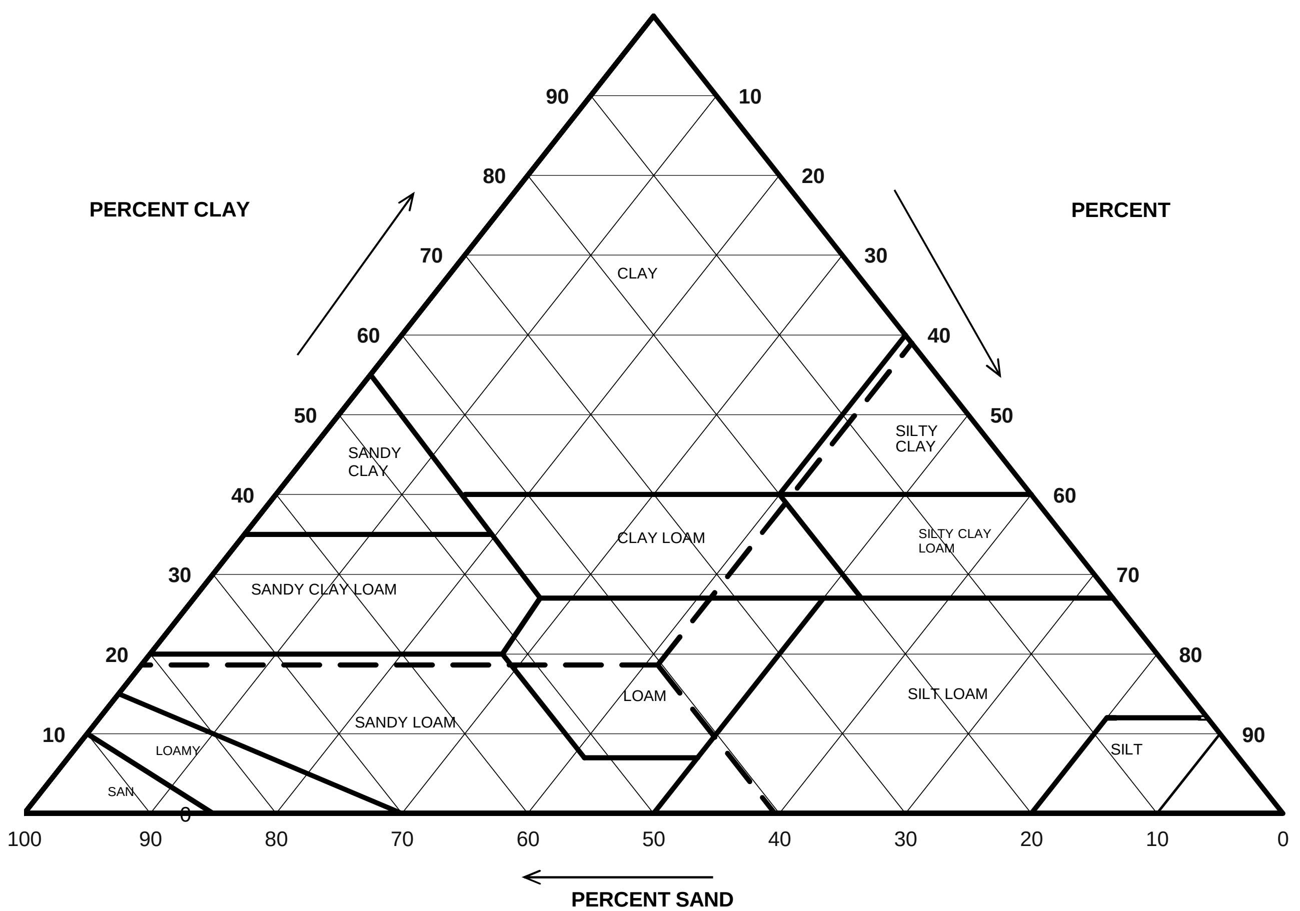
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1B
Lab ID:	2020-444-001-002	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	53.32	
2	46.68	Sand	18.84	40.36
0.05	27.84	Silt	19.15	41.02
0.002	8.69	Clay	8.69	18.62

USDA Classification: **LOAM**

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1B
Lab ID:	2020-444-001-002	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3225	Tare No.:	3329
Wt. of Tare & Wet Sample (g):	439.52	Weight of Tare & Wet Sample (g):	313.74
Wt. of Tare & Dry Sample (g):	401.20	Weight of Tare & Dry Sample (g):	299.44
Weight of Tare (g):	8.07	Weight of Tare (g):	8.12
Weight of Water (g):	38.32	Weight of Water (g):	14.30
Weight of Dry Soil (g):	393.13	Weight of Dry Soil (g):	291.32
Moisture Content (%):	**9.7**	**Moisture Content (%):**	**4.9**

Wet Weight of -3/4" Sample (g):	17747.00	Total Dry Weight of Sample (g):	21143.66
Tare No. (-3/4" Sub-Specimen):	1530	Wet Weight of +3/4" Sample (g):	5217.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1260.12	Dry Weight of + 3/4" Sample (g):	4972.90
Weight of Tare (g):	147.96	Dry Weight of - 3/4" Sample (g):	16170.77
Sub-Specimen -3/4" Wet Weight (g):	1112.16	Dry Weight -3/4" +3/8" Sample (g):	2717.20
Tare No. (-3/8" Sub-Specimen):	566	Dry Weight of -3/8" Sample (g):	13453.57
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	278.78	J - Factor (% Finer than 3/4"):	76.5%
Weight of Tare (g):	84.62	J - Factor (% Finer than 3/8"):	63.6%
Sub-Specimen -3/8" Wet Weight (g):	194.16		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	841.00		3.79	3.79	96.21	**96**
2"	50	1394.00	(*)	6.28	10.08	89.92	**90**
1 1/2"	37.5	785.00		3.54	13.61	86.39	**86**
1"	25	1322.00		5.96	19.57	80.43	**80**
3/4"	19	875.00		3.94	23.52	76.48	**76**
1/2"	12.5	106.78	(**)	10.54	10.54	89.46	**68**
3/8"	9.5	63.50		6.27	16.80	83.20	**64**
#4	4.75	17.42		9.85	9.85	90.15	**57**
#10	2	29.70		16.79	26.63	73.37	**47**
#20	0.85	17.13	(**)	9.68	36.32	63.68	**41**
#40	0.425	8.04		4.54	40.86	59.14	**38**
#60	0.25	4.85		2.74	43.60	56.40	**36**
#100	0.15	5.10		2.88	46.49	53.51	**34**
#140	0.106	5.02		2.84	49.32	50.68	**32**
#200	0.075	4.34		2.45	51.78	48.22	**31**
Pan	-	85.32		48.22	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1B
Lab ID:	2020-444-001-002	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	38.0	22.9	5.68	10.1	0.0417	86.6	26.6
2	36.0	22.9	5.68	10.4	0.0300	81.2	24.9
4	34.5	22.9	5.68	10.7	0.0215	77.2	23.7
15	30.0	22.9	5.68	11.5	0.0115	65.1	20.0
62	28.0	22.9	5.68	11.9	0.0057	59.8	18.3
60	24.5	22.8	5.72	12.5	0.0060	50.3	15.4
240	18.5	23.7	5.37	13.6	0.0031	35.2	10.8
1440	13.5	23.6	5.41	14.5	0.0013	21.7	6.6

Soil Specimen Data

Tare No.:	637	Percent Finer than # 200:	30.68
Wt. of Tare & Dry Material (g):	136.89		
Weight of Tare (g):	94.97	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	36.92		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/8/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-1B
Lab ID:	2020-444-001-002	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

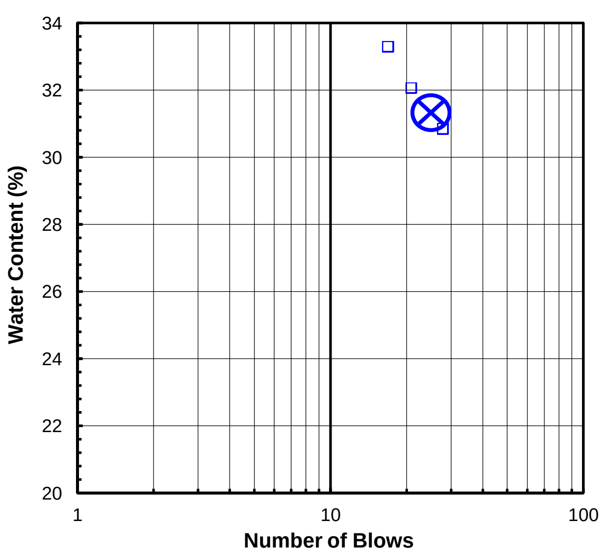
As Received Moisture Content ASTM D2216-19		Liquid Limit Test 1	2	3	M U L T I P O I N T
Tare Number:	3055	222	224	529	
Wt. of Tare & Wet Sample (g):	361.57	41.77	41.23	41.20	
Wt. of Tare & Dry Sample (g):	316.93	36.85	36.02	36.02	
Weight of Tare (g):	8.10	20.89	19.76	20.45	
Weight of Water (g):	44.6	4.9	5.2	5.2	
Weight of Dry Sample (g):	308.8	16.0	16.3	15.6	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**14.5**	**30.8**	**32.0**	**33.3**	
Number of Blows:		**28**	**21**	**17**	

Plastic Limit Test	1	2	Range
Tare Number:	335	1350	
Wt. of Tare & Wet Sample (g):	25.30	25.75	
Wt. of Tare & Dry Sample (g):	24.24	24.70	
Weight of Tare (g):	18.82	19.39	
Weight of Water (g):	1.1	1.1	
Weight of Dry Sample (g):	5.4	5.3	
Moisture Content (%):	**19.6**	**19.8**	**-0.2**

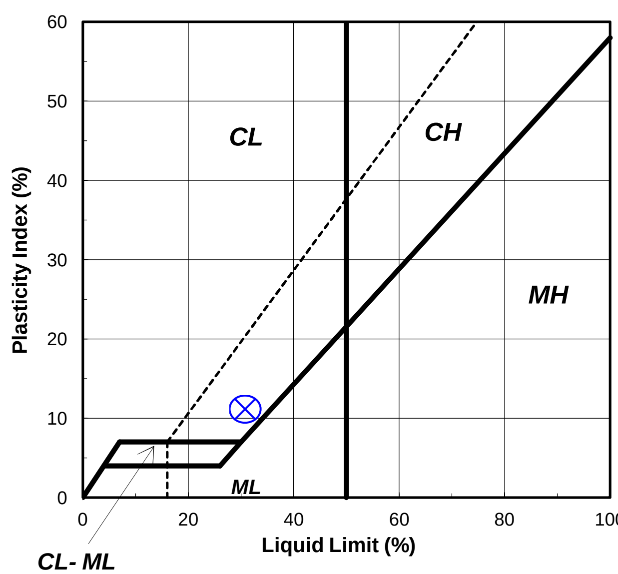
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**31**
Plastic Limit (%):	**20**
Plasticity Index (%):	**11**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By	*TO*	*Date*	*9/14/20*	*Checked By*	*BRB*	*Date*	*9/16/20*

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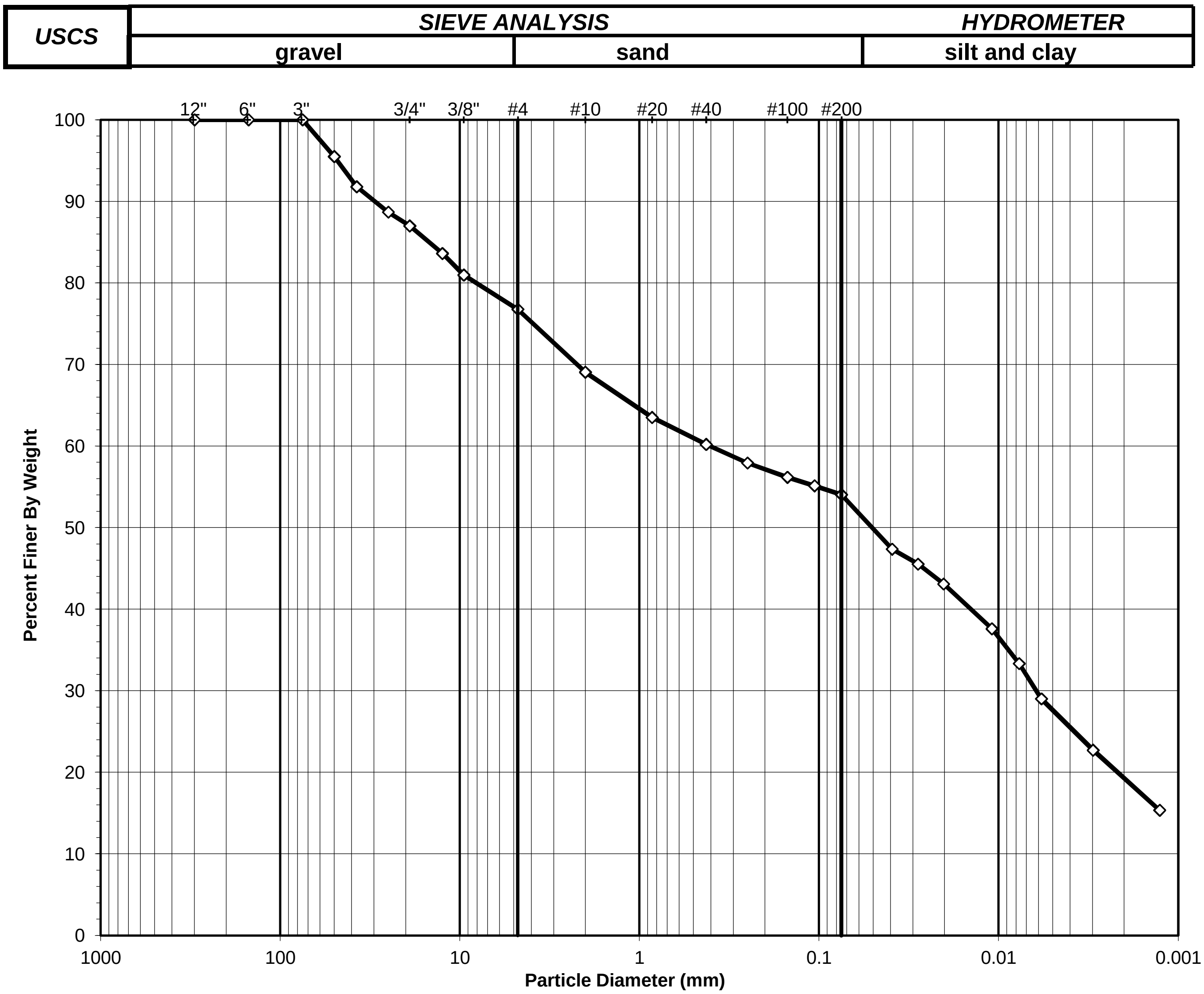
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003	Soil Color:	Brown



USCS Symbol:

CL, TESTED

D50 = 0.05

USCS Classification:

GRAVELLY LEAN CLAY WITH SAND

Tested By NR Date 9/4/20 Checked By BRB Date 9/16/20

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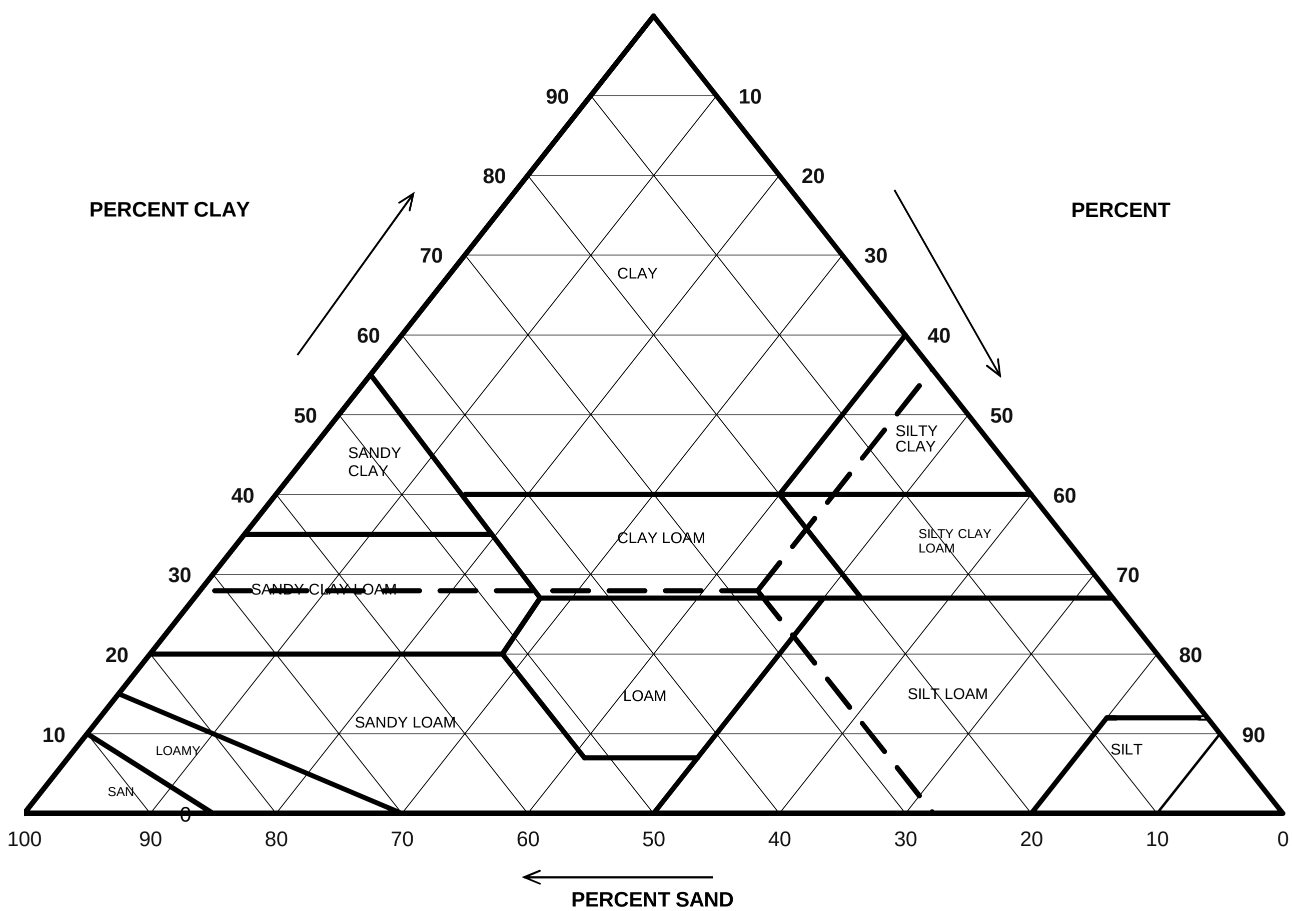
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	30.94	
2	69.06	Sand	19.19	27.78
0.05	49.87	Silt	30.59	44.29
0.002	19.28	Clay	19.28	27.92

USDA Classification: CLAY LOAM

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WASH SIEVE ANALYSIS

ASTM D6913-17

geotechnics
geotechnical & geosynthetic testing

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3133	Tare No.:	3502
Wt. of Tare & Wet Sample (g):	347.56	Weight of Tare & Wet Sample (g):	359.12
Wt. of Tare & Dry Sample (g):	312.73	Weight of Tare & Dry Sample (g):	344.24
Weight of Tare (g):	8.42	Weight of Tare (g):	8.08
Weight of Water (g):	34.83	Weight of Water (g):	14.88
Weight of Dry Soil (g):	304.31	Weight of Dry Soil (g):	336.16
Moisture Content (%):	**11.4**	**Moisture Content (%):**	**4.4**

Wet Weight of -3/4" Sample (g):	20291.00	Total Dry Weight of Sample (g):	20929.59
Tare No. (-3/4" Sub-Specimen):	1495	Wet Weight of +3/4" Sample (g):	2843.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1335.05	Dry Weight of + 3/4" Sample (g):	2722.49
Weight of Tare (g):	146.74	Dry Weight of - 3/4" Sample (g):	18207.10
Sub-Specimen -3/4" Wet Weight (g):	1188.31	Dry Weight -3/4" +3/8" Sample (g):	1259.83
Tare No. (-3/8" Sub-Specimen):	555	Dry Weight of -3/8" Sample (g):	16947.26
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	261.65	J - Factor (% Finer than 3/4"):	87.0%
Weight of Tare (g):	81.55	J - Factor (% Finer than 3/8"):	81.0%
Sub-Specimen -3/8" Wet Weight (g):	180.10		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	984.00	(*)	4.50	4.50	95.50	**95**
1 1/2"	37.5	810.00		3.71	8.21	91.79	**92**
1"	25	679.00		3.11	11.31	88.69	**89**
3/4"	19	370.00		1.69	13.01	86.99	**87**
1/2"	12.5	41.39	(**)	3.88	3.88	96.12	**84**
3/8"	9.5	32.39		3.04	6.92	93.08	**81**
#4	4.75	8.40		5.20	5.20	94.80	**77**
#10	2	15.37		9.51	14.71	85.29	**69**
#20	0.85	11.08	(**)	6.86	21.57	78.43	**64**
#40	0.425	6.60		4.08	25.65	74.35	**60**
#60	0.25	4.54		2.81	28.46	71.54	**58**
#100	0.15	3.50		2.17	30.62	69.38	**56**
#140	0.106	2.08		1.29	31.91	68.09	**55**
#200	0.075	2.18		1.35	33.26	66.74	**54**
Pan	-	107.85		66.74	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	44.5	22.9	5.68	8.9	0.0392	87.6	47.4
2	43.0	22.9	5.68	9.2	0.0281	84.3	45.5
4	41.0	22.9	5.68	9.5	0.0203	79.7	43.1
15	36.5	22.9	5.68	10.3	0.0109	69.6	37.6
32	33.0	22.9	5.68	11.0	0.0077	61.7	33.3
60	29.5	22.8	5.72	11.6	0.0058	53.7	29.0
240	24.0	23.7	5.37	12.6	0.0030	42.1	22.7
1440	18.0	23.6	5.41	13.7	0.0013	28.4	15.4

Soil Specimen Data

Tare No.:	949	Percent Finer than # 200:	54.04
Wt. of Tare & Dry Material (g):	144.40		
Weight of Tare (g):	95.60	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	43.80		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/8/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

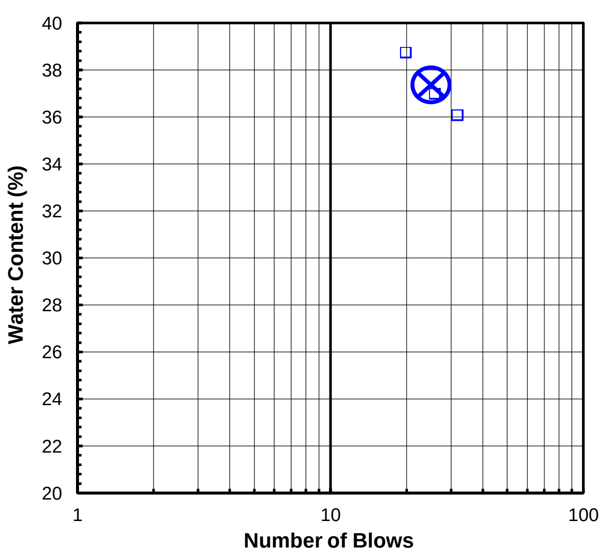
Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

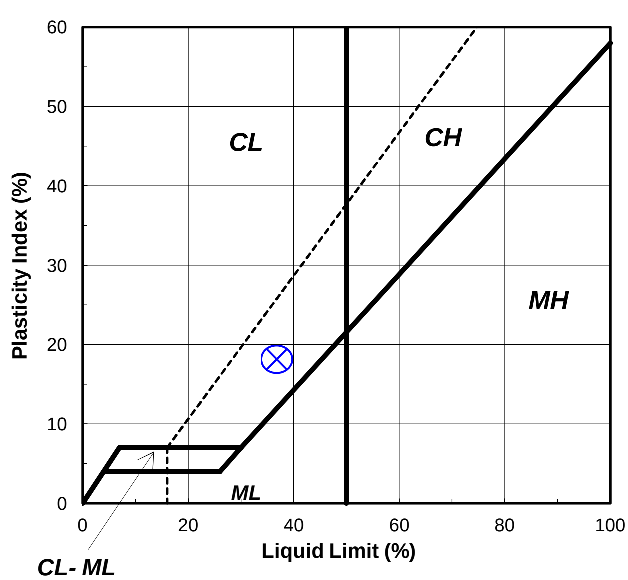
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-19		**1**	**2**	**3**	**M**
Tare Number:	3515	647	621	235	**U**
Wt. of Tare & Wet Sample (g):	349.93	39.95	39.66	38.78	**L**
Wt. of Tare & Dry Sample (g):	305.85	34.64	34.22	33.19	**T**
Weight of Tare (g):	8.12	19.91	19.50	18.75	**I**
Weight of Water (g):	44.1	5.3	5.4	5.6	**P**
Weight of Dry Sample (g):	297.7	14.7	14.7	14.4	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**14.8**	**36.0**	**37.0**	**38.7**	**N**
Number of Blows:		**32**	**26**	**20**	**T**

Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	514	508		**Liquid Limit (%):**	**37**
Wt. of Tare & Wet Sample (g):	25.44	25.46			
Wt. of Tare & Dry Sample (g):	24.49	24.48		**Plastic Limit (%):**	**19**
Weight of Tare (g):	19.37	19.31			
Weight of Water (g):	1.0	1.0		**Plasticity Index (%):**	**18**
Weight of Dry Sample (g):	5.1	5.2			
				USCS Symbol:	**CL**
Moisture Content (%):	**18.6**	**19.0**	**-0.4**		
Note: The acceptable range of the two Moisture Contents is ±			1.12		

Flow Curve



Plasticity Chart



Tested By *FS* *Date* *9/15/20* *Checked By* *BRB* *Date* 9/16/20

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MOISTURE - DENSITY RELATIONSHIP

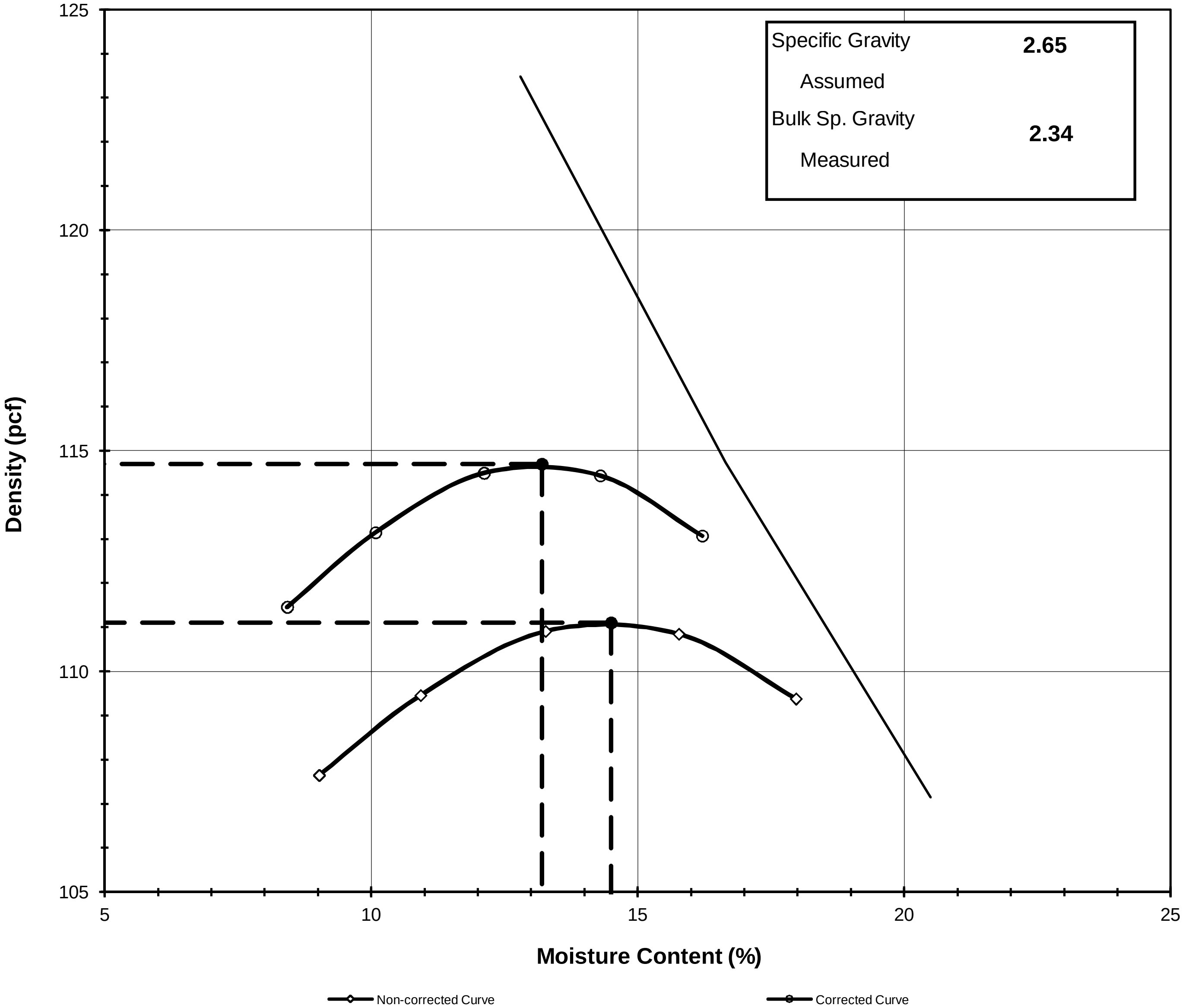
(Corrected for Oversize Particles)

ASTM D 4718-15, D 698-12e2 (SOP-S12,S39)

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003	Test Method	STANDARD

Visual Description: Brown Clay with Rocks

Optimum Moisture Content (%):	**14.5**	**Corrected Moisture Content (%):**	**13.2**
Maximum Dry Density (pcf):	**111.1**	**Corrected Dry Density (pcf):**	**114.7**



Tested By	*PC*	*Date*	*9/9/20*	*Checked By*	*JLK*	*Date*	9/11/20

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MOISTURE - DENSITY RELATIONSHIP

(Corrected for Oversize Particles) *ASTM D 4718-15, D698-12e2 (SOP-S12,S39)*

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003		

Visual Description: Brown Clay with Rocks

Total Weight of the Sample (g):	NA
As Received Water Content (%):	NA
Assumed Specific Gravity	2.65

Percent Retained on 3/4" (Dry):	13.01
Percent Retained on 3/8" (Dry):	NA
Percent Retained on #4 (Dry):	NA
Oversize Material:	Not included
Procedure Used:	C

TestType:	**STANDARD**
Rammer Weight (lb):	5.5
Rammer Drop (in):	12
Rammer Type:	MECHANICAL
Machine ID:	G774
Mold ID:	G1679
Mold diameter (in):	6"
Weight of the Mold (g):	5649
Volume Of the Mold (cm^3):	2122

Mold/Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Weight of Mold & Wet Sample (g):	9640	9778	9921	10013	10037
Weight of Mold (g):	5649	5649	5649	5649	5649
Weight of Wet Sample (g):	3991	4129	4272	4364	4388
Mold Volume (cm^3):	2122	2122	2122	2122	2122

Moisture Content/Density

Tare Number:	1598	1596	605	575	913
Weight of Tare & Wet Sample (g):	451.71	462.04	459.01	444.64	450.70
Weight of Tare & Dry Sample (g):	422.34	426.02	415.30	395.24	398.83
Weight of Tare (g):	96.88	96.37	85.84	82.05	110.21
Weight of Water (g):	29.37	36.02	43.71	49.40	51.87
Weight of Dry Sample (g):	325.46	329.65	329.46	313.19	288.62

Wet Density (g/cm^3):	1.88	1.95	2.01	2.06	2.07
Wet Density (pcf):	117.4	121.4	125.6	128.3	129.0
Moisture Content (%):	**9.0**	**10.9**	**13.3**	**15.8**	**18.0**
Dry Density (pcf):	**107.6**	**109.5**	**110.9**	**110.8**	**109.4**

Zero Air Voids

Moisture Content (%):		12.8	16.7	20.5	
Dry Unit Weight (pcf):		123.5	114.7	107.2	

Calculated Oversize Corrected Moisture & Density

Moisture Content (%):	**8.4**	**10.1**	**12.1**	**14.3**	**16.2**
Dry Density (pcf):	**111.5**	**113.1**	**114.5**	**114.4**	**113.1**

Tested By PC *Date* 9/9/20 *Checked By* JLK *Date* 9/11/20

 DCN:CT-S 39 DATE: 10/17/17, Revision 15 *S:Excel\Excel QA\Spreadsheets\Proctor wRock Correction.xls*

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Correction of Unit Weight and Water Content for Soils Containing Oversize Particles by Specific Gravity

ASTM D4718/D4718M-15

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-2A
Lab ID:	2020-444-001-003		

Visual Description: Brown Clay with Rocks

Total Dry Weight of Sample (g): **20929.6**

COARSE PORTION

Total Wet Weight of + 3/4" Portion (g):	2843.0
Total Dry Weight of + 3/4" Portion (g):	2722.5
Percent + 3/4" By Dry Weight (%):	13.01

FINE PORTION

Total Wet Weight of - 3/4" Portion (g):	20291.0
Total Dry Weight of - 3/4" Portion (g):	18207.1
Percent - 3/4" By Dry Weight (%):	86.99

MOISTURE CONTENT OF +3/4" PORTION

Tare Number:	3502
Weight of Tare & Wet Sample (g):	359.12
Weight of Tare & Dry Sample (g):	344.24
Weight of Tare (g):	8.08
Weight of Water (g):	14.88
Weight of Dry Sample (g):	336.16
Moisture Content (%):	4.43

MOISTURE CONTENT OF -3/4" PORTION

Tare Number:	3133
Weight of Tare & Wet Sample (g):	347.56
Weight of Tare & Dry Sample (g):	312.73
Weight of Tare (g):	8.42
Weight of Water (g):	34.83
Weight of Dry Sample (g):	304.31
Moisture Content (%):	11.45

SPECIFIC GRAVITY DETERMINATION

Weight of Basket in Air (g):	1033.9
Weight of Saturated Surface Dry Sample & Basket in Air (g):	2089.5
Weight of Saturated Surface Dry Sample in Air (g):	1055.6
Weight of Basket in Water (g):	901.3
Weight of Saturated Sample & Basket in Water (g):	1530.1
Weight of Saturated Sample in Water (g):	628.8
Tare No.:	1444
Weight of Tare and Dried Sample (g):	1145.0
Weight of Tare (g):	145.6
Weight of Dried Soil (g):	999.4
Bulk Specific Gravity (+3/4"):	**2.34**

Tested By FS *Date* 9/2/20 *Checked By* JLK *Date* 9/8/20

DCN: CT-S39 DATE: 10/17/17 REVISION: 2e

S:\Excel\Excel QA\Spreadsheets\Oversize Correction.xls

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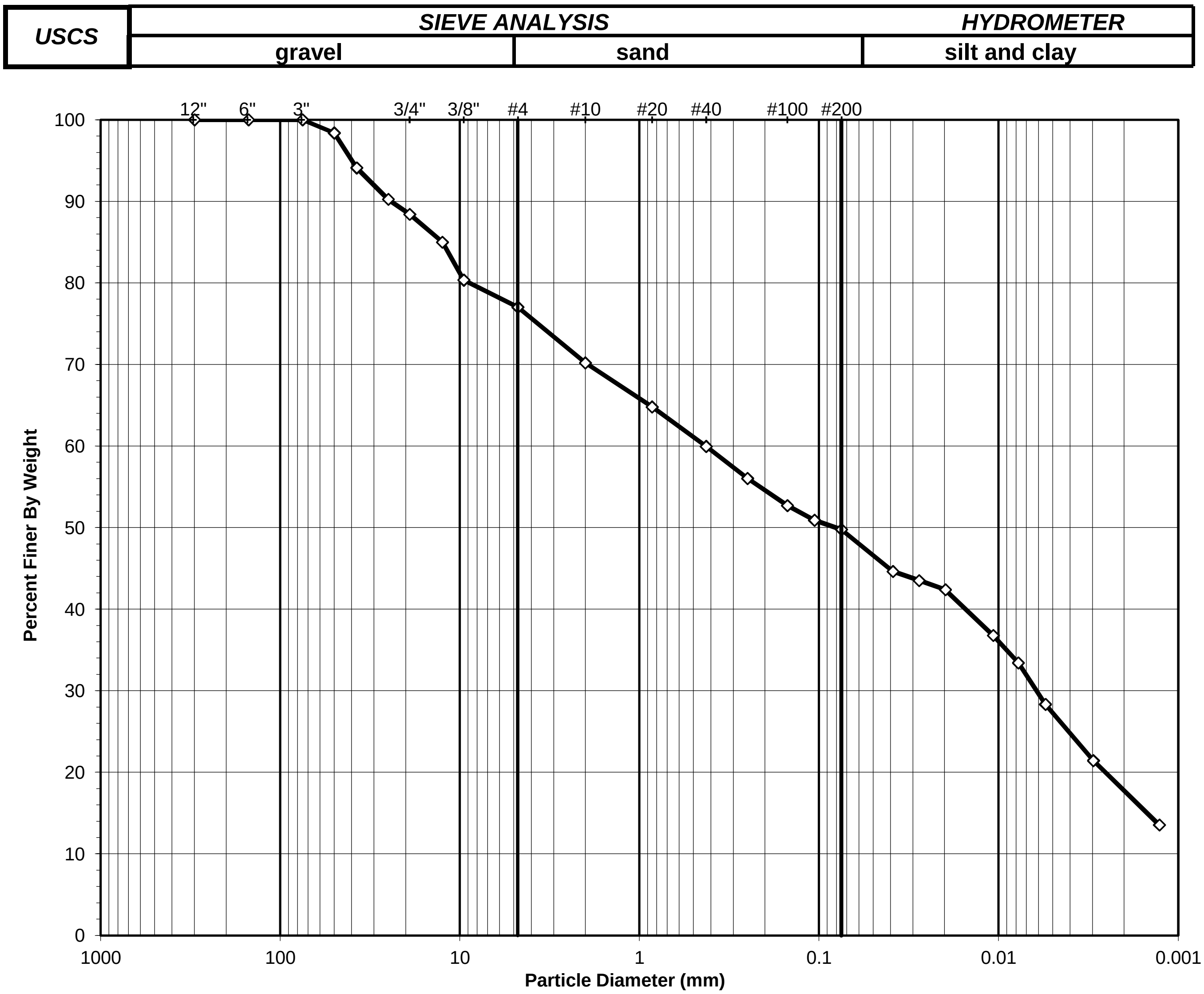
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-3A
Lab ID:	2020-444-001-004	Soil Color:	Brown



USCS Symbol:

SC, TESTED

D50 = 0.08

USCS Classification:

CLAYEY SAND WITH GRAVEL

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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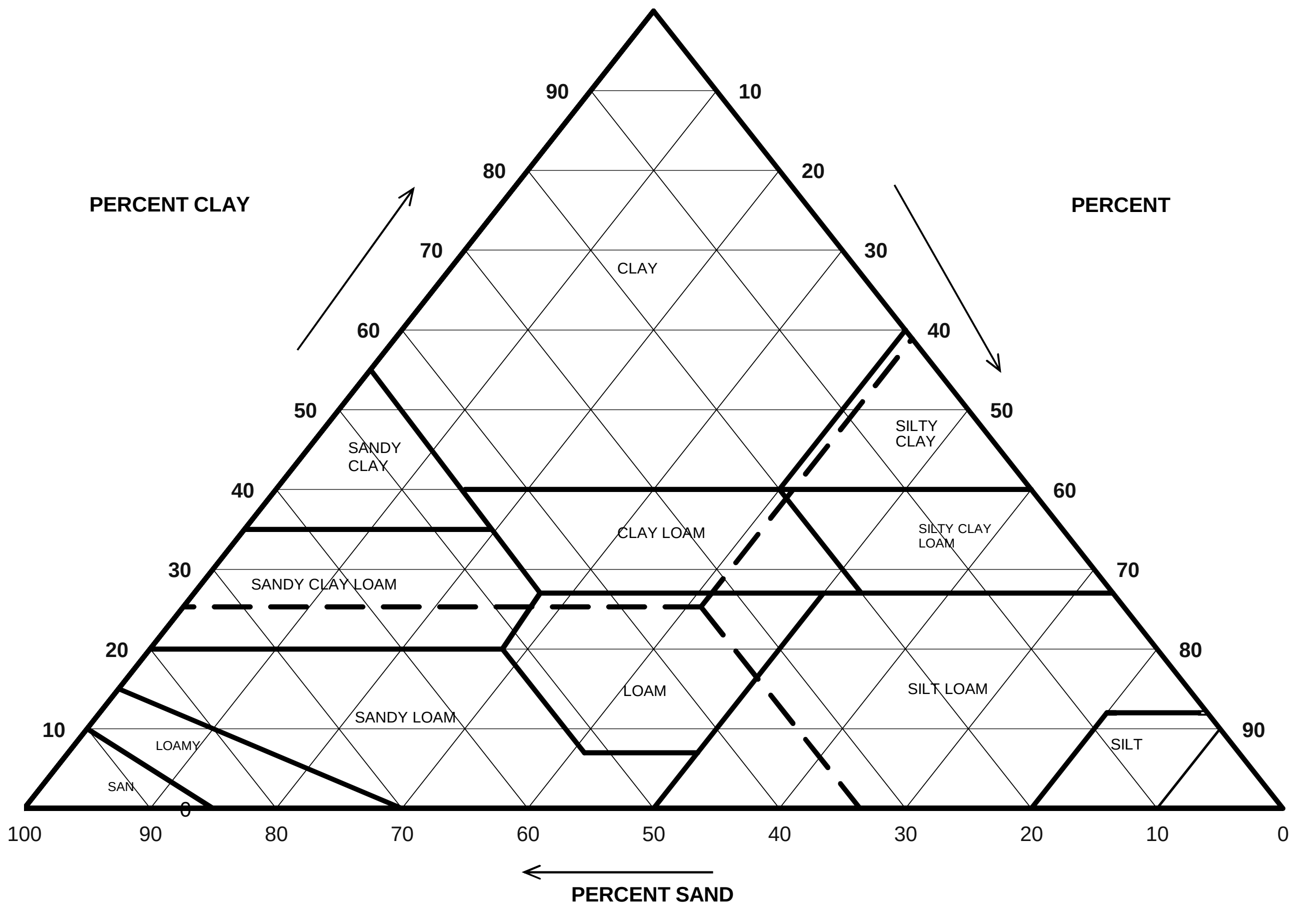
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-3A
Lab ID:	2020-444-001-004	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	29.80	
2	70.20	Sand	23.59	33.60
0.05	46.61	Silt	28.86	41.11
0.002	17.76	Clay	17.76	25.29

USDA Classification: LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-3A
Lab ID:	2020-444-001-004	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3391	Tare No.:	3292
Wt. of Tare & Wet Sample (g):	342.60	Weight of Tare & Wet Sample (g):	264.72
Wt. of Tare & Dry Sample (g):	306.30	Weight of Tare & Dry Sample (g):	256.43
Weight of Tare (g):	8.06	Weight of Tare (g):	8.06
Weight of Water (g):	36.30	Weight of Water (g):	8.29
Weight of Dry Soil (g):	298.24	Weight of Dry Soil (g):	248.37
Moisture Content (%):	**12.2**	**Moisture Content (%):**	**3.3**
Wet Weight of -3/4" Sample (g):	21130.00	Total Dry Weight of Sample (g):	21306.81
Tare No. (-3/4" Sub-Specimen):	1503	Wet Weight of +3/4" Sample (g):	2552.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1382.04	Dry Weight of + 3/4" Sample (g):	2469.57
Weight of Tare (g):	147.16	Dry Weight of - 3/4" Sample (g):	18837.24
Sub-Specimen -3/4" Wet Weight (g):	1234.88	Dry Weight -3/4" +3/8" Sample (g):	1717.43
Tare No. (-3/8" Sub-Specimen):	11314	Dry Weight of -3/8" Sample (g):	17119.81
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	251.34	J - Factor (% Finer than 3/4"):	88.4%
Weight of Tare (g):	84.05	J - Factor (% Finer than 3/8"):	80.3%
Sub-Specimen -3/8" Wet Weight (g):	167.29		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	356.00	(*)	1.62	1.62	98.38	**98**
1 1/2"	37.5	941.00		4.27	5.89	94.11	**94**
1"	25	849.00		3.86	9.75	90.25	**90**
3/4"	19	406.00		1.84	11.59	88.41	**88**
1/2"	12.5	42.47	(**)	3.86	3.86	96.14	**85**
3/8"	9.5	57.90		5.26	9.12	90.88	**80**
#4	4.75	6.16		4.13	4.13	95.87	**77**
#10	2	12.68		8.50	12.63	87.37	**70**
#20	0.85	10.02	(**)	6.72	19.35	80.65	**65**
#40	0.425	8.99		6.03	25.38	74.62	**60**
#60	0.25	7.29		4.89	30.27	69.73	**56**
#100	0.15	6.17		4.14	34.40	65.60	**53**
#140	0.106	3.33		2.23	36.64	63.36	**51**
#200	0.075	2.12		1.42	38.06	61.94	**50**
Pan	-	92.38		61.94	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-3A
Lab ID:	2020-444-001-004	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	45.5	22.9	5.68	8.7	0.0388	89.7	44.6
2	44.5	22.9	5.68	8.9	0.0277	87.4	43.5
4	43.5	22.9	5.68	9.1	0.0198	85.2	42.4
15	38.5	22.9	5.68	10.0	0.0107	73.9	36.8
30	35.5	22.9	5.68	10.5	0.0078	67.2	33.4
65	31.0	22.8	5.72	11.3	0.0055	56.9	28.3
240	24.5	23.7	5.37	12.5	0.0030	43.1	21.4
1440	17.5	23.6	5.41	13.8	0.0013	27.2	13.5

Soil Specimen Data

Tare No.:	692	Percent Finer than # 200:	49.77
Wt. of Tare & Dry Material (g):	140.82		
Weight of Tare (g):	91.91	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	43.91		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/8/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-3A
Lab ID:	2020-444-001-004	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

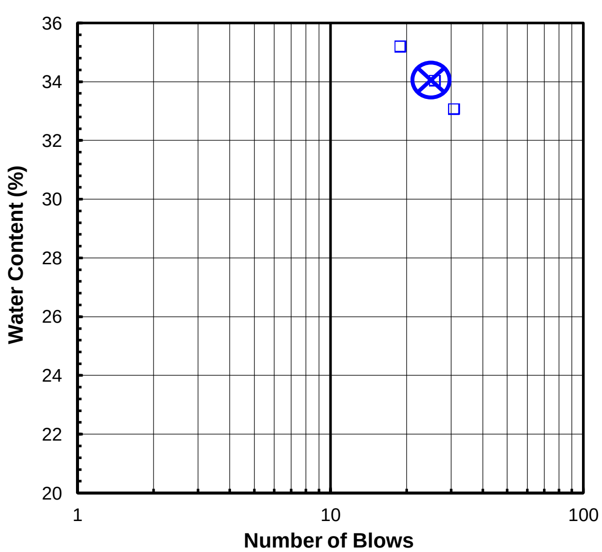
As Received Moisture Content ASTM D2216-19		Liquid Limit Test 1	2	3	MULTIPOINT
Tare Number:	3529	328	606	629	
Wt. of Tare & Wet Sample (g):	359.44	41.00	38.19	39.29	
Wt. of Tare & Dry Sample (g):	317.61	35.63	33.19	33.93	
Weight of Tare (g):	8.07	19.38	18.49	18.69	
Weight of Water (g):	41.8	5.4	5.0	5.4	
Weight of Dry Sample (g):	309.5	16.3	14.7	15.2	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**13.5**	**33.0**	**34.0**	**35.2**	
Number of Blows:		**31**	**26**	**19**	

Plastic Limit Test	1	2	Range
Tare Number:	217	342	
Wt. of Tare & Wet Sample (g):	25.37	27.03	
Wt. of Tare & Dry Sample (g):	24.38	25.99	
Weight of Tare (g):	18.66	20.21	
Weight of Water (g):	1.0	1.0	
Weight of Dry Sample (g):	5.7	5.8	
Moisture Content (%):	**17.3**	**18.0**	**-0.7**

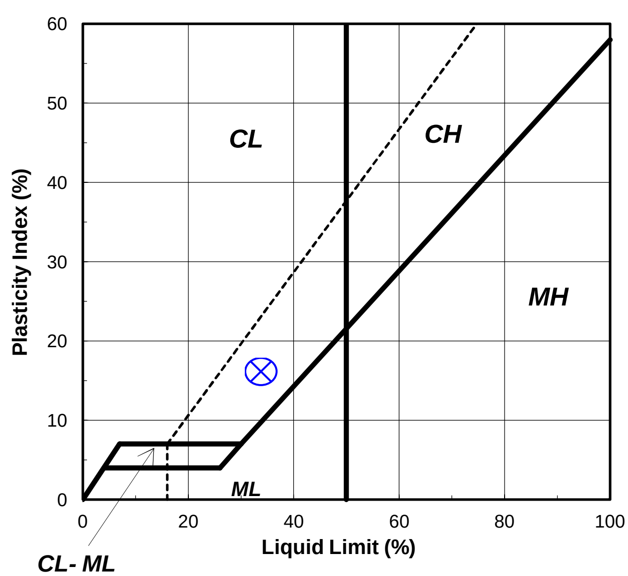
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**34**
Plastic Limit (%):	**18**
Plasticity Index (%):	**16**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By	*JP*	*Date*	*9/14/20*	*Checked By*	*BRB*	*Date*	*9/16/20*

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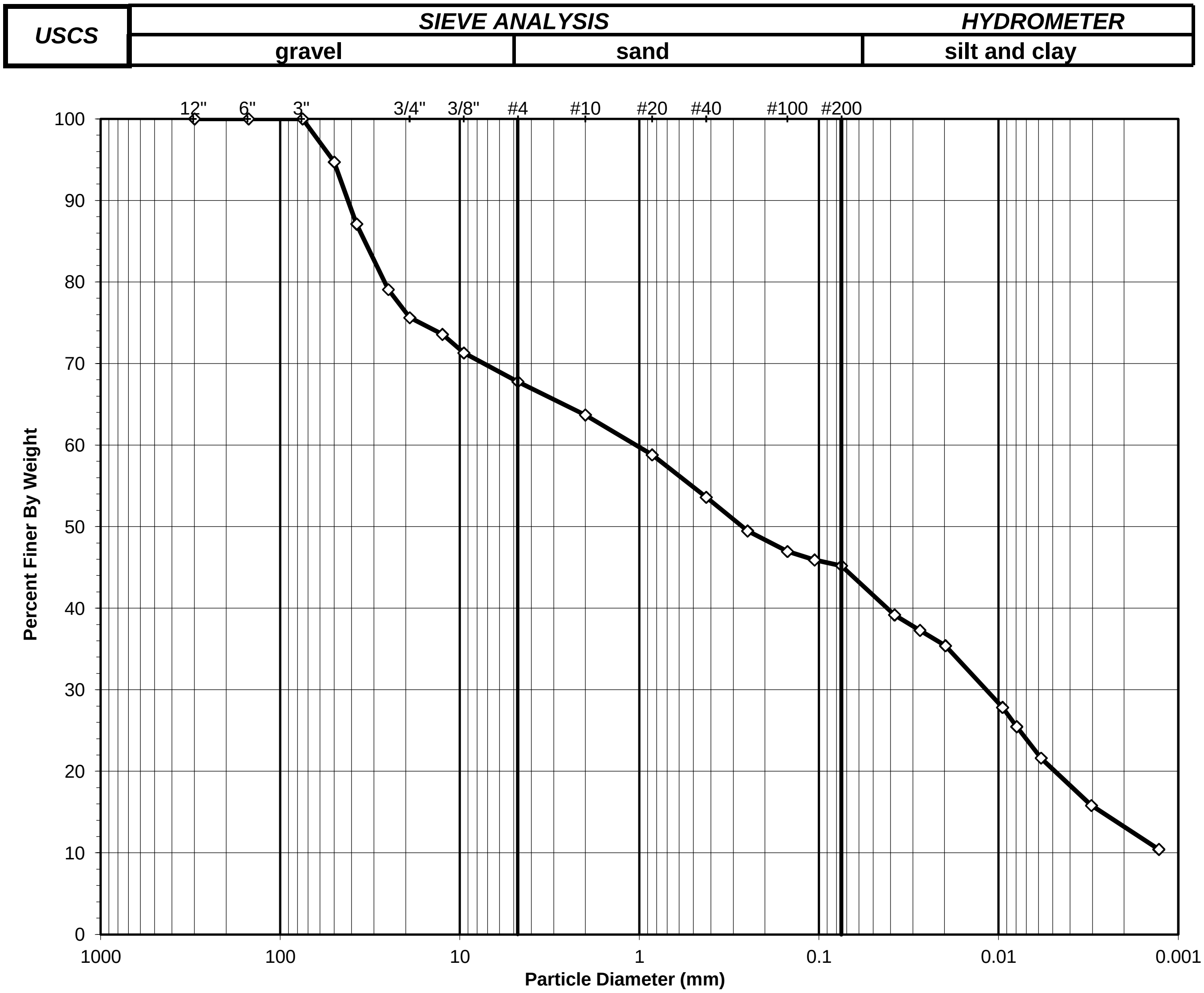
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4A
Lab ID:	2020-444-001-005	Soil Color:	Brown



USCS Symbol:

GC, TESTED

D50 = 0.27

USCS Classification:

CLAYEY GRAVEL WITH SAND

Tested By	NR	Date	9/4/20	Checked By	JLK	Date	9/21/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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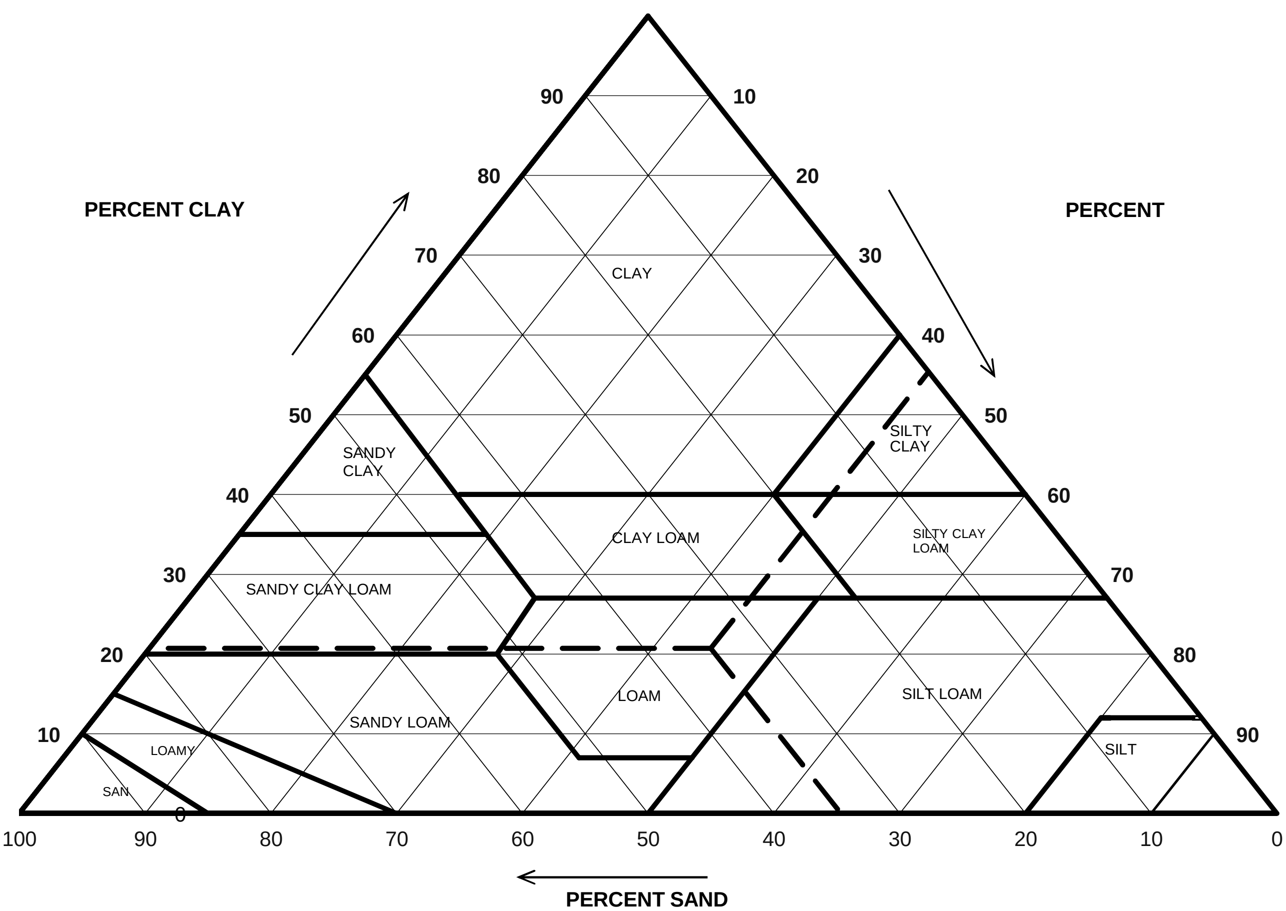
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4A
Lab ID:	2020-444-001-005	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	36.30	
2	63.70	Sand	22.08	34.67
0.05	41.62	Silt	28.41	44.61
0.002	13.20	Clay	13.20	20.73

USDA Classification: **LOAM**

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4A
Lab ID:	2020-444-001-005	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3023	Tare No.:	3529
Wt. of Tare & Wet Sample (g):	277.74	Weight of Tare & Wet Sample (g):	297.11
Wt. of Tare & Dry Sample (g):	248.48	Weight of Tare & Dry Sample (g):	284.64
Weight of Tare (g):	8.28	Weight of Tare (g):	8.07
Weight of Water (g):	29.26	Weight of Water (g):	12.47
Weight of Dry Soil (g):	240.20	Weight of Dry Soil (g):	276.57
Moisture Content (%):	**12.2**	**Moisture Content (%):**	**4.5**

Wet Weight of -3/4" Sample (g):	19253.00	Total Dry Weight of Sample (g):	22693.96
Tare No. (-3/4" Sub-Specimen):	2025	Wet Weight of +3/4" Sample (g):	5781.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1229.42	Dry Weight of + 3/4" Sample (g):	5531.59
Weight of Tare (g):	146.77	Dry Weight of - 3/4" Sample (g):	17162.36
Sub-Specimen -3/4" Wet Weight (g):	1082.65	Dry Weight -3/4" +3/8" Sample (g):	980.39
Tare No. (-3/8" Sub-Specimen):	560	Dry Weight of -3/8" Sample (g):	16181.98
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	266.98	J - Factor (% Finer than 3/4"):	75.6%
Weight of Tare (g):	82.13	J - Factor (% Finer than 3/8"):	71.3%
Sub-Specimen -3/8" Wet Weight (g):	184.85		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	1253.00	(*)	5.28	5.28	94.72	**95**
1 1/2"	37.5	1804.00		7.61	12.89	87.11	**87**
1"	25	1906.00		8.04	20.93	79.07	**79**
3/4"	19	818.00		3.45	24.37	75.63	**76**
1/2"	12.5	26.12	(**)	2.71	2.71	97.29	**74**
3/8"	9.5	29.01		3.01	5.71	94.29	**71**
#4	4.75	8.14		4.94	4.94	95.06	**68**
#10	2	9.43		5.72	10.66	89.34	**64**
#20	0.85	11.30	(**)	6.86	17.52	82.48	**59**
#40	0.425	12.02		7.29	24.82	75.18	**54**
#60	0.25	9.55		5.80	30.61	69.39	**49**
#100	0.15	5.82		3.53	34.14	65.86	**47**
#140	0.106	2.40		1.46	35.60	64.40	**46**
#200	0.075	1.64		1.00	36.59	63.41	**45**
Pan	-	104.48		63.41	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	JLK	Date	9/21/20

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4A
Lab ID:	2020-444-001-005	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	47.0	23.3	5.53	8.4	0.0380	86.7	39.2
2	45.0	23.3	5.53	8.8	0.0274	82.5	37.3
4	43.0	23.3	5.53	9.2	0.0198	78.3	35.4
20	35.0	23.3	5.53	10.6	0.0095	61.6	27.8
30	32.5	23.3	5.53	11.1	0.0079	56.4	25.5
60	28.5	23.1	5.60	11.8	0.0058	47.8	21.6
240	22.5	22.7	5.75	12.9	0.0030	35.0	15.8
1440	16.5	23.5	5.45	13.9	0.0013	23.1	10.4

Soil Specimen Data

Tare No.:	979	Percent Finer than # 200:	45.21
Wt. of Tare & Dry Material (g):	147.02		
Weight of Tare (g):	94.70	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	47.32		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/17/20 Checked By JLK Date 9/21/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4A
Lab ID:	2020-444-001-005	Soil Description:	BROWN LEAN CLAY

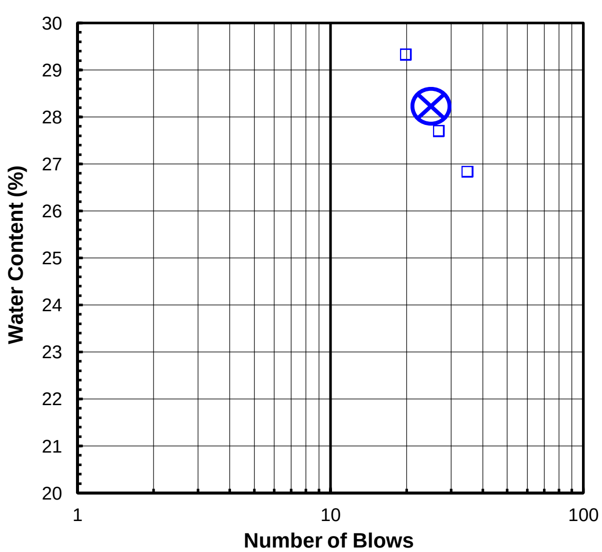
***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

As Received Moisture Content ASTM D2216-19		**Liquid Limit Test** 1	2	3	**M**
Tare Number:	3222	101	304	305	**U**
Wt. of Tare & Wet Sample (g):	368.53	41.53	39.44	40.49	**L**
Wt. of Tare & Dry Sample (g):	324.99	36.33	35.06	35.63	**T**
Weight of Tare (g):	8.13	16.94	19.24	19.05	**I**
Weight of Water (g):	43.5	5.2	4.4	4.9	**P**
Weight of Dry Sample (g):	316.9	19.4	15.8	16.6	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**13.7**	**26.8**	**27.7**	**29.3**	**N**
Number of Blows:		**35**	**27**	**20**	**T**

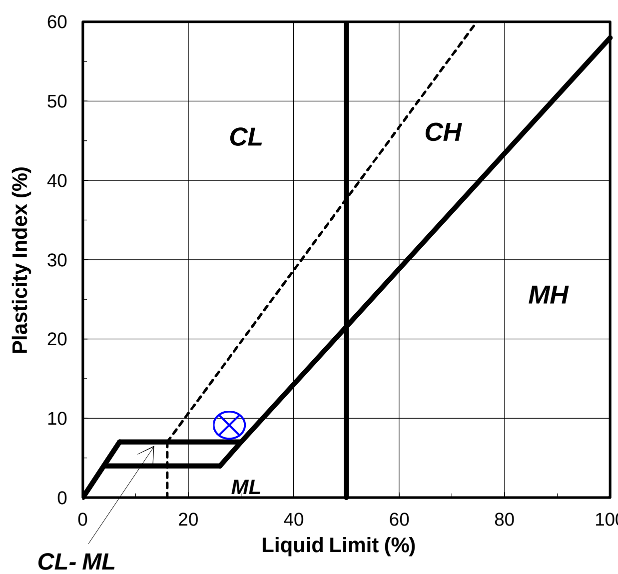
Plastic Limit Test	**1**	**2**	**Range**	
Tare Number:	431	509		
Wt. of Tare & Wet Sample (g):	20.91	25.65		
Wt. of Tare & Dry Sample (g):	19.92	24.66		
Weight of Tare (g):	14.85	19.41		
Weight of Water (g):	1.0	1.0		
Weight of Dry Sample (g):	5.1	5.3		
Moisture Content (%):	**19.5**	**18.9**	**0.7**	
Note: The acceptable range of the two Moisture Contents is ±				1.12

Test Results	
Liquid Limit (%):	**28**
Plastic Limit (%):	**19**
Plasticity Index (%):	**9**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By	*BS*	*Date*	*9/14/20*	*Checked By*	*BRB*	*Date*	*9/16/20*

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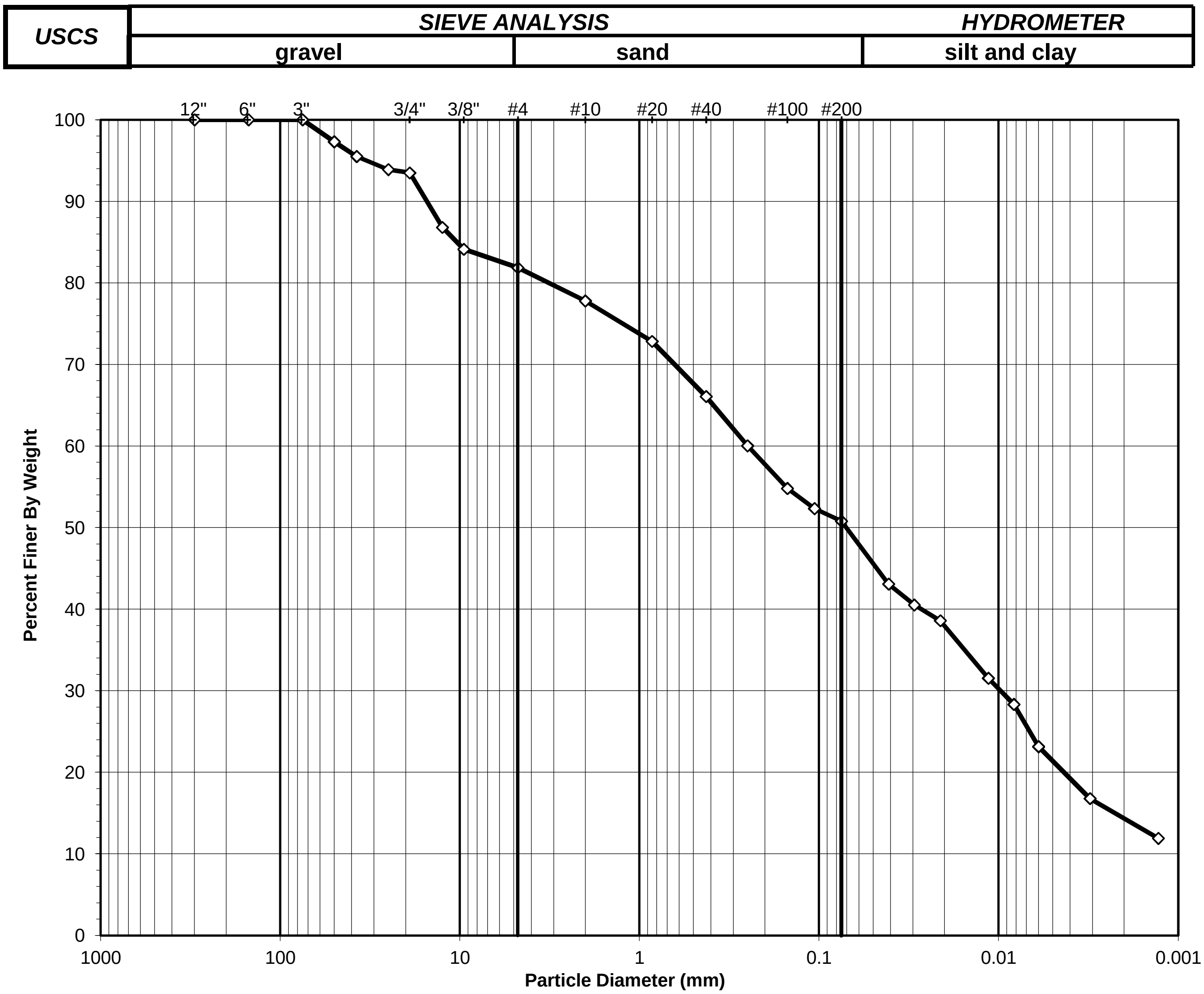
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006	Soil Color:	Brown



USCS Symbol:
CL, TESTED

D50 = 0.07

USCS Classification:
SANDY LEAN CLAY WITH GRAVEL

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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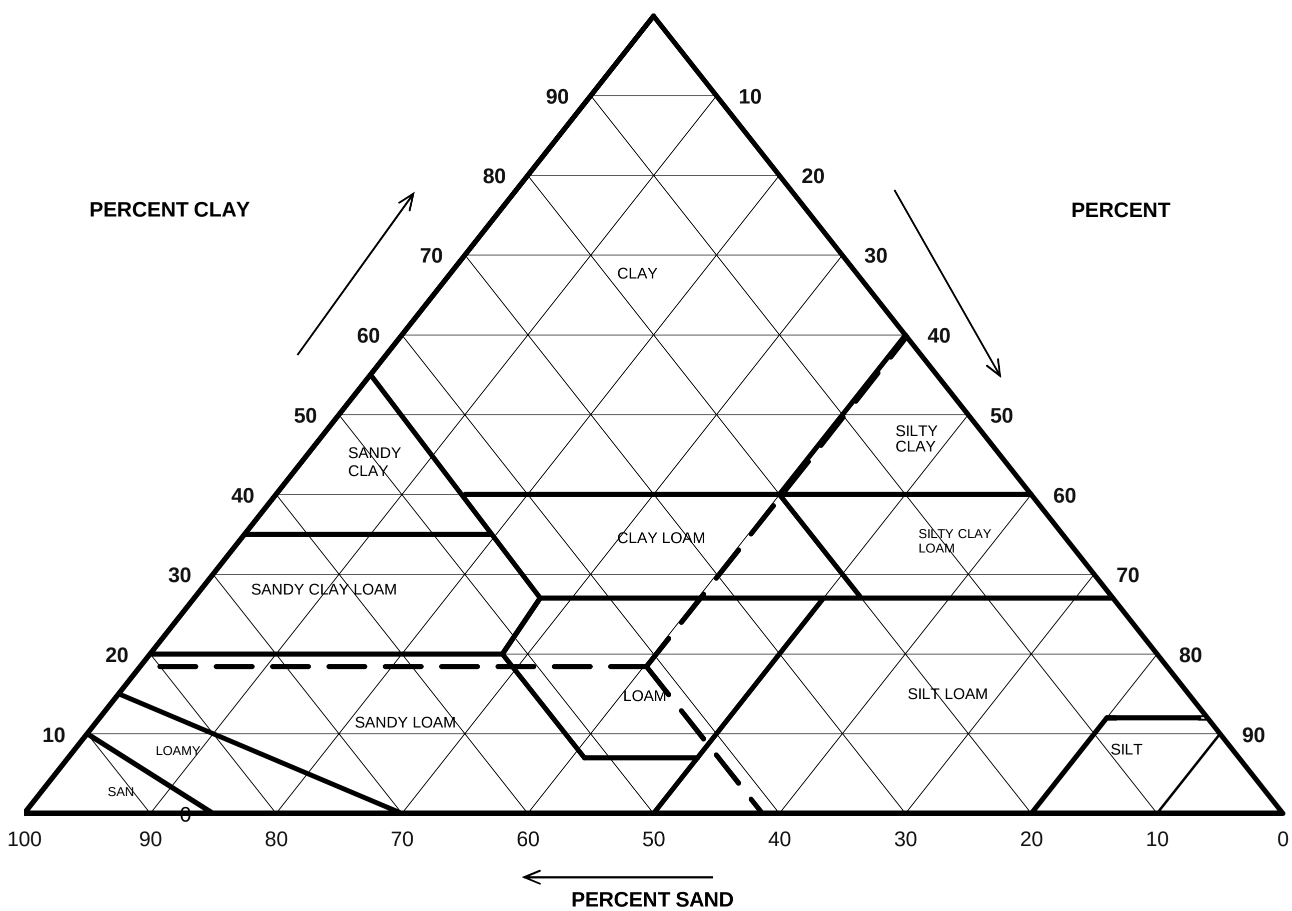
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	22.20	
2	77.80	Sand	32.17	41.35
0.05	45.63	Silt	31.28	40.21
0.002	14.35	Clay	14.35	18.45

USDA Classification: LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3225	Tare No.:	3353
Wt. of Tare & Wet Sample (g):	302.08	Weight of Tare & Wet Sample (g):	194.96
Wt. of Tare & Dry Sample (g):	273.66	Weight of Tare & Dry Sample (g):	188.53
Weight of Tare (g):	8.10	Weight of Tare (g):	8.05
Weight of Water (g):	28.42	Weight of Water (g):	6.43
Weight of Dry Soil (g):	265.56	Weight of Dry Soil (g):	180.48
Moisture Content (%):	**10.7**	**Moisture Content (%):**	**3.6**
Wet Weight of -3/4" Sample (g):	22069.00	Total Dry Weight of Sample (g):	21322.12
Tare No. (-3/4" Sub-Specimen):	2015	Wet Weight of +3/4" Sample (g):	1436.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1299.84	Dry Weight of + 3/4" Sample (g):	1386.60
Weight of Tare (g):	145.47	Dry Weight of - 3/4" Sample (g):	19935.52
Sub-Specimen -3/4" Wet Weight (g):	1154.37	Dry Weight -3/4" +3/8" Sample (g):	1998.19
Tare No. (-3/8" Sub-Specimen):	615	Dry Weight of -3/8" Sample (g):	17937.33
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	264.98	J - Factor (% Finer than 3/4"):	93.5%
Weight of Tare (g):	83.68	J - Factor (% Finer than 3/8"):	84.1%
Sub-Specimen -3/8" Wet Weight (g):	181.30		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	595.00	(*)	2.69	2.69	97.31	**97**
1 1/2"	37.5	397.00		1.80	4.49	95.51	**96**
1"	25	355.00		1.61	6.10	93.90	**94**
3/4"	19	89.00		0.40	6.50	93.50	**93**
1/2"	12.5	74.60	(**)	7.15	7.15	92.85	**87**
3/8"	9.5	29.92		2.87	10.02	89.98	**84**
#4	4.75	4.41		2.69	2.69	97.31	**82**
#10	2	7.91		4.83	7.52	92.48	**78**
#20	0.85	9.66	(**)	5.90	13.42	86.58	**73**
#40	0.425	13.16		8.04	21.46	78.54	**66**
#60	0.25	11.76		7.18	28.64	71.36	**60**
#100	0.15	10.18		6.22	34.85	65.15	**55**
#140	0.106	4.80		2.93	37.78	62.22	**52**
#200	0.075	3.00		1.83	39.62	60.38	**51**
Pan	-	98.89		60.38	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	39.0	23.6	5.41	9.9	0.0410	84.8	43.1
2	37.0	23.6	5.41	10.2	0.0295	79.8	40.5
4	35.5	23.6	5.41	10.5	0.0211	76.0	38.6
15	30.0	23.6	5.41	11.5	0.0114	62.1	31.5
30	27.5	23.6	5.41	12.0	0.0082	55.8	28.3
60	23.5	23.5	5.45	12.7	0.0060	45.6	23.2
240	18.5	23.6	5.41	13.6	0.0031	33.0	16.8
1440	14.5	24.1	5.22	14.3	0.0013	23.4	11.9

Soil Specimen Data

Tare No.:	923	Percent Finer than # 200:	50.80
Wt. of Tare & Dry Material (g):	141.71		
Weight of Tare (g):	97.55	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	39.16		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/8/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

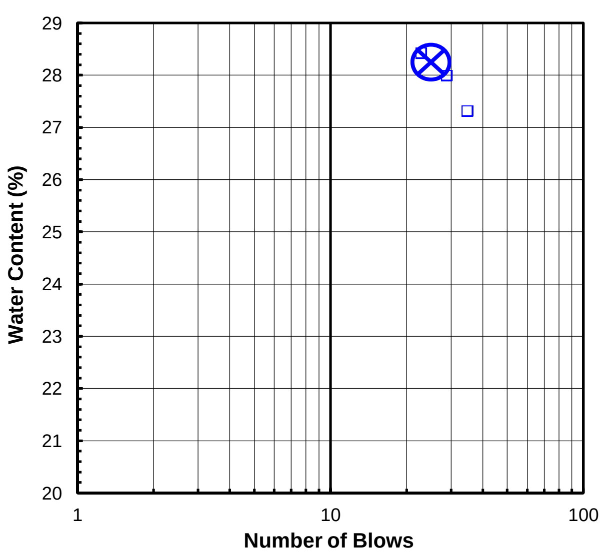
Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

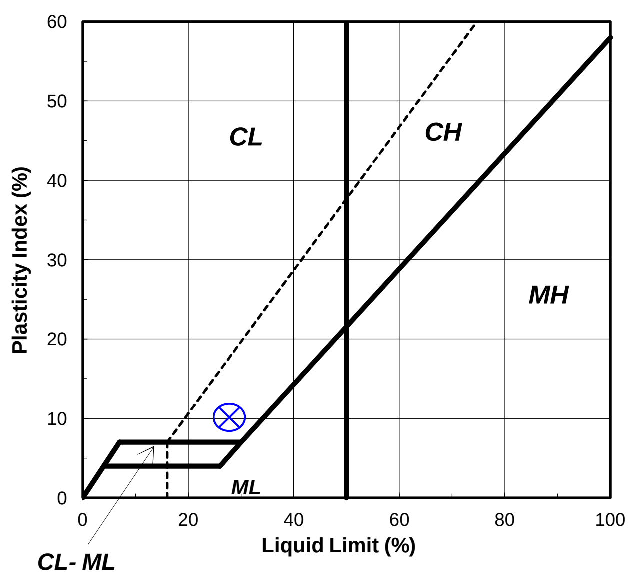
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-19		1	2	3	M
Tare Number:	3023	237	646	323	U
Wt. of Tare & Wet Sample (g):	376.45	38.83	39.73	40.86	L
Wt. of Tare & Dry Sample (g):	322.51	34.53	35.32	36.34	T
Weight of Tare (g):	8.26	18.78	19.56	20.43	I
Weight of Water (g):	53.9	4.3	4.4	4.5	P
Weight of Dry Sample (g):	314.3	15.8	15.8	15.9	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**17.2**	**27.3**	**28.0**	**28.4**	N
Number of Blows:		**35**	**29**	**23**	T

Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	604	502		**Liquid Limit (%):**	**28**
Wt. of Tare & Wet Sample (g):	24.75	25.41			
Wt. of Tare & Dry Sample (g):	23.79	24.52		**Plastic Limit (%):**	**18**
Weight of Tare (g):	18.49	19.37			
Weight of Water (g):	1.0	0.9		**Plasticity Index (%):**	**10**
Weight of Dry Sample (g):	5.3	5.2			
				USCS Symbol:	**CL**
Moisture Content (%):	**18.1**	**17.3**	**0.8**		
Note: The acceptable range of the two Moisture Contents is ±			1.12		

Flow Curve



Plasticity Chart



Tested By	*FS*	*Date*	*9/15/20*	*Checked By*	*BRB*	*Date*	9/16/20

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MOISTURE - DENSITY RELATIONSHIP

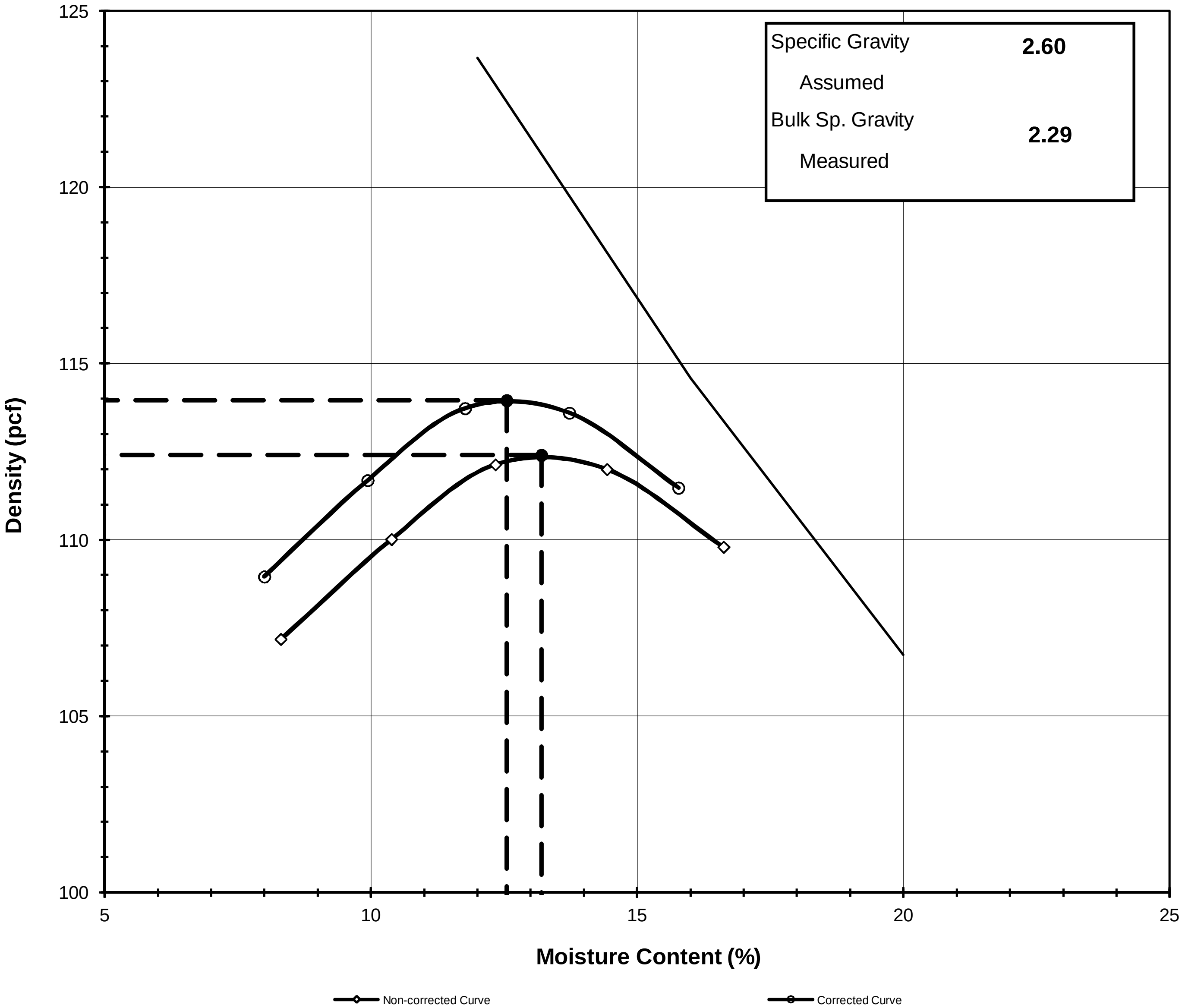
(Corrected for Oversize Particles)

ASTM D 4718, D 698-91 (SOP-S12,S39)

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006	Test Method	STANDARD

Visual Description: Brown Clay with Rocks

Optimum Moisture Content (%):	**13.2**	**Corrected Moisture Content (%):**	**12.6**
Maximum Dry Density (pcf):	**112.4**	**Corrected Dry Density (pcf):**	**114.0**



Tested By	*AMC*	*Date*	*9/13/20*	*Checked By*	*JLK*	*Date*	9/15/20

 DCN:CT-S 39 DATE: 10/17/17, Revision 15 *S:Excel\Excel QA\Spreadsheets\Proctor wRock Correction.xls*

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MOISTURE - DENSITY RELATIONSHIP

(Corrected for Oversize Particles) *ASTM D 4718-15, D698-12e2 (SOP-S12,S39)*

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006		

Visual Description: Brown Clay with Rocks

Total Weight of the Sample (g):	NA
As Received Water Content (%):	NA
Assumed Specific Gravity	2.60

Percent Retained on 3/4" (Dry):	6.50
Percent Retained on 3/8" (Dry):	NA
Percent Retained on #4 (Dry):	NA
Oversize Material:	Not included
Procedure Used:	C

TestType:	**STANDARD**
Rammer Weight (lb):	5.5
Rammer Drop (in):	12
Rammer Type:	MECHANICAL
Machine ID:	G1916
Mold ID:	G1923
Mold diameter (in):	6"
Weight of the Mold (g):	5727
Volume Of the Mold (cm^3):	2134

Mold/Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Weight of Mold & Wet Sample (g):	9697	9880	10035	10110	10106
Weight of Mold (g):	5727	5727	5727	5727	5727
Weight of Wet Sample (g):	3970	4153	4308	4383	4379
Mold Volume (cm^3):	2134	2134	2134	2134	2134

Moisture Content/Density

Tare Number:	1458	1126	1744	897	785
Weight of Tare & Wet Sample (g):	681.61	684.30	603.30	730.32	587.99
Weight of Tare & Dry Sample (g):	635.66	627.87	546.16	652.00	516.29
Weight of Tare (g):	82.59	84.43	83.04	109.34	85.01
Weight of Water (g):	45.95	56.43	57.14	78.32	71.70
Weight of Dry Sample (g):	553.07	543.44	463.12	542.66	431.28

Wet Density (g/cm^3):	1.86	1.95	2.02	2.05	2.05
Wet Density (pcf):	116.1	121.4	126.0	128.2	128.0
Moisture Content (%):	**8.3**	**10.4**	**12.3**	**14.4**	**16.6**
Dry Density (pcf):	**107.2**	**110.0**	**112.1**	**112.0**	**109.8**

Zero Air Voids

Moisture Content (%):		12.0	16.0	20.0	
Dry Unit Weight (pcf):		123.7	114.6	106.7	

Calculated Oversize Corrected Moisture & Density

Moisture Content (%):	**8.0**	**9.9**	**11.8**	**13.7**	**15.8**
Dry Density (pcf):	**109.0**	**111.7**	**113.7**	**113.6**	**111.5**

Tested By *AMC* *Date* *9/13/20* *Checked By* *JLK* *Date* 9/15/20

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Correction of Unit Weight and Water Content for Soils Containing Oversize Particles by Specific Gravity

ASTM D4718/D4718M-15

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-4B
Lab ID:	2020-444-001-006		

Visual Description: Brown Clay & Rock

Total Dry Weight of Sample (g): 21322.1

COARSE PORTION		***FINE PORTION***	
Total Wet Weight of + 3/4" Portion (g):	1436.0	Total Wet Weight of - 3/4" Portion (g):	22069.0
Total Dry Weight of + 3/4" Portion (g):	1386.6	Total Dry Weight of - 3/4" Portion (g):	19935.5
Percent + 3/4" By Dry Weight (%):	6.50	Percent - 3/4" By Dry Weight (%):	93.50

MOISTURE CONTENT OF +3/4" PORTION		***MOISTURE CONTENT OF -3/4" PORTION***	
Tare Number:	3353	Tare Number:	3225
Weight of Tare & Wet Sample (g):	194.96	Weight of Tare & Wet Sample (g):	302.08
Weight of Tare & Dry Sample (g):	188.53	Weight of Tare & Dry Sample (g):	273.66
Weight of Tare (g):	8.05	Weight of Tare (g):	8.10
Weight of Water (g):	6.43	Weight of Water (g):	28.42
Weight of Dry Sample (g):	180.48	Weight of Dry Sample (g):	265.56
Moisture Content (%):	3.56	**Moisture Content (%):**	10.70

SPECIFIC GRAVITY DETERMINATION

Weight of Basket in Air (g):	1033.8
Weight of Saturated Surface Dry Sample & Basket in Air (g):	2214.2
Weight of Saturated Surface Dry Sample in Air (g):	1180.4
Weight of Basket in Water (g):	901.5
Weight of Saturated Sample & Basket in Water (g):	1592.5
Weight of Saturated Sample in Water (g):	691.0
Tare No.:	67
Weight of Tare and Dried Sample (g):	1320.2
Weight of Tare (g):	197.6
Weight of Dried Soil (g):	1122.6
Bulk Specific Gravity (+3/4"):	**2.29**

Tested By FS *Date* 9/3/20 *Checked By* BRB *Date* 9/7/20

DCN: CT-S39 DATE: 10/17/17 REVISION: 2e

S:\Excel\Excel QA\Spreadsheets\Oversize Correction.xls

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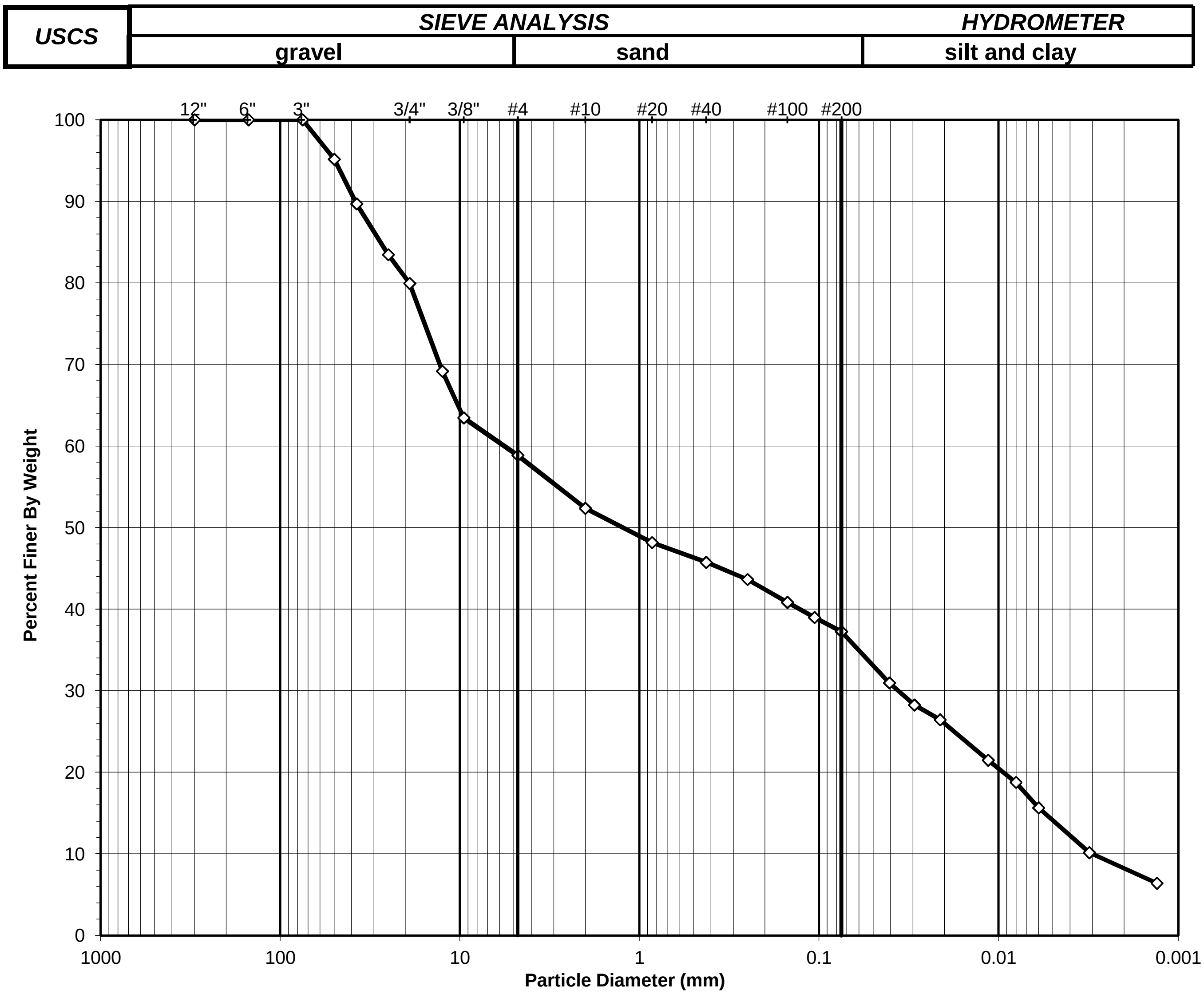
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-5A
Lab ID:	2020-444-001-007	Soil Color:	Brown



USCS Symbol:
GC, TESTED

D50 = 1.23

USCS Classification:
CLAYEY GRAVEL WITH SAND

Tested By NR Date 9/4/20 Checked By BRB Date 9/16/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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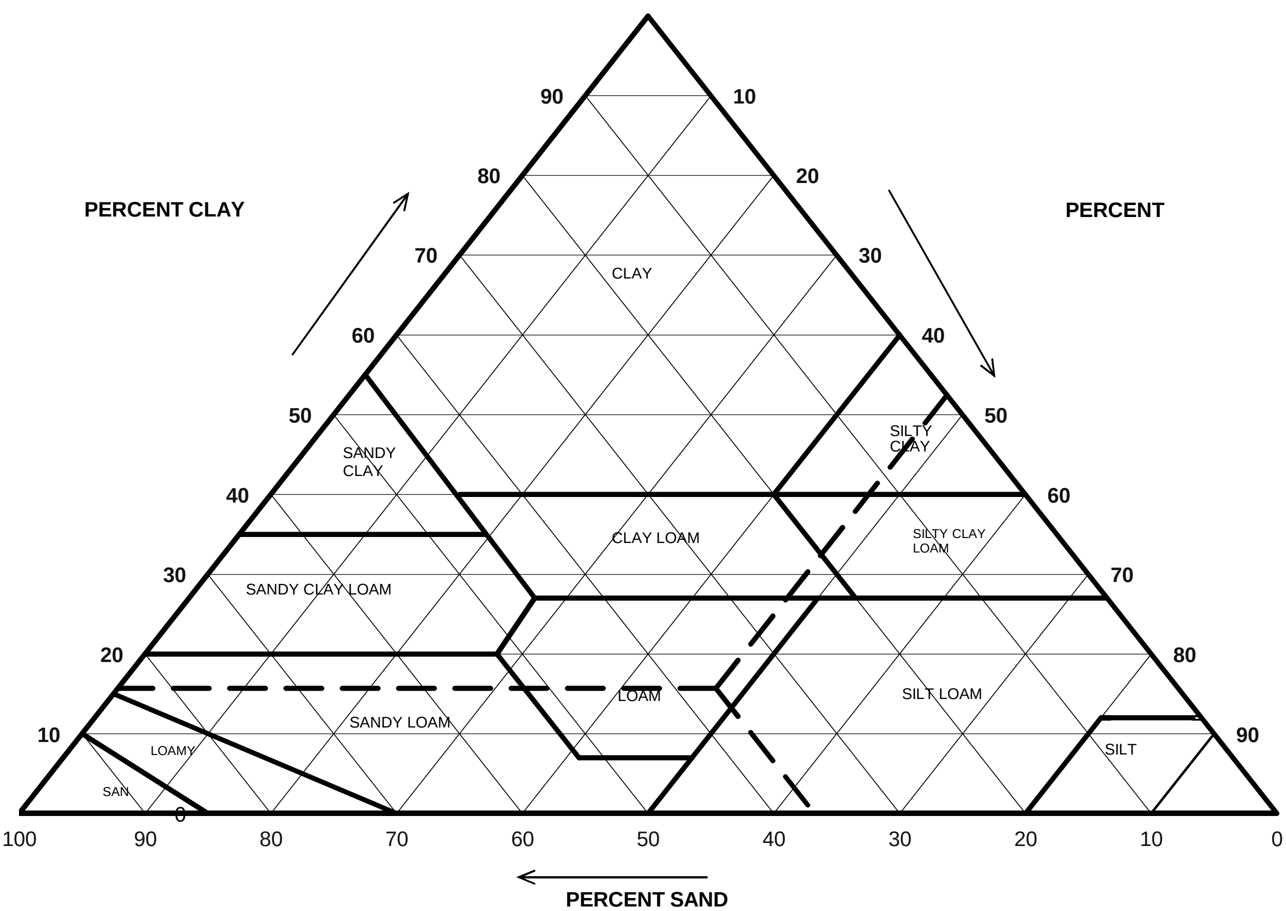
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-5A
Lab ID:	2020-444-001-007	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	47.63	
2	52.37	Sand	19.26	36.77
0.05	33.11	Silt	24.89	47.53
0.002	8.22	Clay	8.22	15.70

USDA Classification: **LOAM**

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-5A
Lab ID:	2020-444-001-007	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3223	Tare No.:	3351
Wt. of Tare & Wet Sample (g):	313.13	Weight of Tare & Wet Sample (g):	253.54
Wt. of Tare & Dry Sample (g):	281.06	Weight of Tare & Dry Sample (g):	244.44
Weight of Tare (g):	8.08	Weight of Tare (g):	8.00
Weight of Water (g):	32.07	Weight of Water (g):	9.10
Weight of Dry Soil (g):	272.98	Weight of Dry Soil (g):	236.44
Moisture Content (%):	**11.7**	**Moisture Content (%):**	**3.8**

Wet Weight of -3/4" Sample (g):	20979.00	Total Dry Weight of Sample (g):	23486.09
Tare No. (-3/4" Sub-Specimen):	2028	Wet Weight of +3/4" Sample (g):	4894.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1321.39	Dry Weight of + 3/4" Sample (g):	4712.62
Weight of Tare (g):	148.38	Dry Weight of - 3/4" Sample (g):	18773.47
Sub-Specimen -3/4" Wet Weight (g):	1173.01	Dry Weight -3/4" +3/8" Sample (g):	3868.65
Tare No. (-3/8" Sub-Specimen):	914	Dry Weight of -3/8" Sample (g):	14904.82
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	328.05	J - Factor (% Finer than 3/4"):	79.9%
Weight of Tare (g):	110.03	J - Factor (% Finer than 3/8"):	63.5%
Sub-Specimen -3/8" Wet Weight (g):	218.02		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	1178.00	(*)	4.83	4.83	95.17	**95**
1 1/2"	37.5	1336.00		5.48	10.31	89.69	**90**
1"	25	1519.00		6.23	16.54	83.46	**83**
3/4"	19	861.00		3.53	20.07	79.93	**80**
1/2"	12.5	141.16	(**)	13.45	13.45	86.55	**69**
3/8"	9.5	75.15		7.16	20.61	79.39	**63**
#4	4.75	14.13		7.24	7.24	92.76	**59**
#10	2	19.97		10.24	17.48	82.52	**52**
#20	0.85	12.90	(**)	6.61	24.09	75.91	**48**
#40	0.425	7.47		3.83	27.92	72.08	**46**
#60	0.25	6.45		3.31	31.23	68.77	**44**
#100	0.15	8.60		4.41	35.63	64.37	**41**
#140	0.106	5.71		2.93	38.56	61.44	**39**
#200	0.075	5.32		2.73	41.29	58.71	**37**
Pan	-	114.55		58.71	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-5A
Lab ID:	2020-444-001-007	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	39.5	24.1	5.22	9.8	0.0405	83.1	31.0
2	36.5	24.1	5.22	10.3	0.0294	75.8	28.3
4	34.5	24.1	5.22	10.7	0.0212	71.0	26.5
15	29.0	24.1	5.22	11.7	0.0114	57.7	21.5
32	26.0	24.1	5.22	12.2	0.0080	50.4	18.8
60	22.5	24.2	5.18	12.9	0.0060	42.0	15.6
240	16.5	24.0	5.26	13.9	0.0031	27.3	10.2
1440	12.5	23.6	5.41	14.7	0.0013	17.2	6.4

Soil Specimen Data

Tare No.:	704	Percent Finer than # 200:	37.26
Wt. of Tare & Dry Material (g):	136.29		
Weight of Tare (g):	90.50	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	40.79		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/10/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

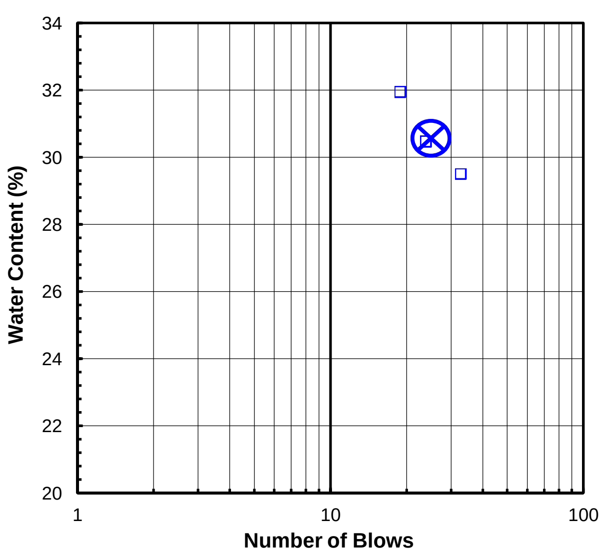
Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-5A
Lab ID:	2020-444-001-007	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

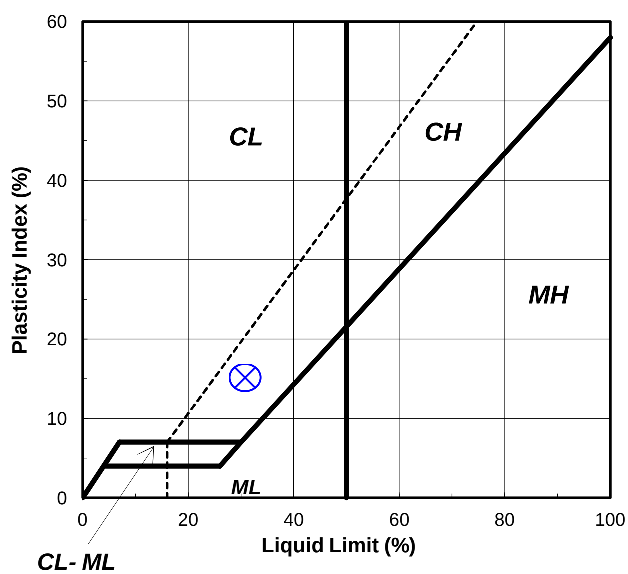
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-19		1	2	3	M
Tare Number:	3375	307	333	438	U
Wt. of Tare & Wet Sample (g):	397.04	40.15	39.96	38.09	L
Wt. of Tare & Dry Sample (g):	352.84	35.43	35.18	33.03	T
Weight of Tare (g):	8.38	19.42	19.48	17.18	I
Weight of Water (g):	44.2	4.7	4.8	5.1	P
Weight of Dry Sample (g):	344.5	16.0	15.7	15.9	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**12.8**	**29.5**	**30.4**	**31.9**	**N**
Number of Blows:		**33**	**24**	**19**	**T**

Plastic Limit Test	1	2	Range		Test Results	
Tare Number:	229	342			**Liquid Limit (%):**	**31**
Wt. of Tare & Wet Sample (g):	24.39	26.77				
Wt. of Tare & Dry Sample (g):	23.50	25.88			**Plastic Limit (%):**	**16**
Weight of Tare (g):	18.19	20.21				
Weight of Water (g):	0.9	0.9			**Plasticity Index (%):**	**15**
Weight of Dry Sample (g):	5.3	5.7				
					USCS Symbol:	**CL**
Moisture Content (%):	**16.8**	**15.7**	**1.1**			
Note: The acceptable range of the two Moisture Contents is ±				1.12		

Flow Curve



Plasticity Chart



Tested By	*JP*	*Date*	*9/15/20*	*Checked By*	*BRB*	*Date*	*9/16/20*

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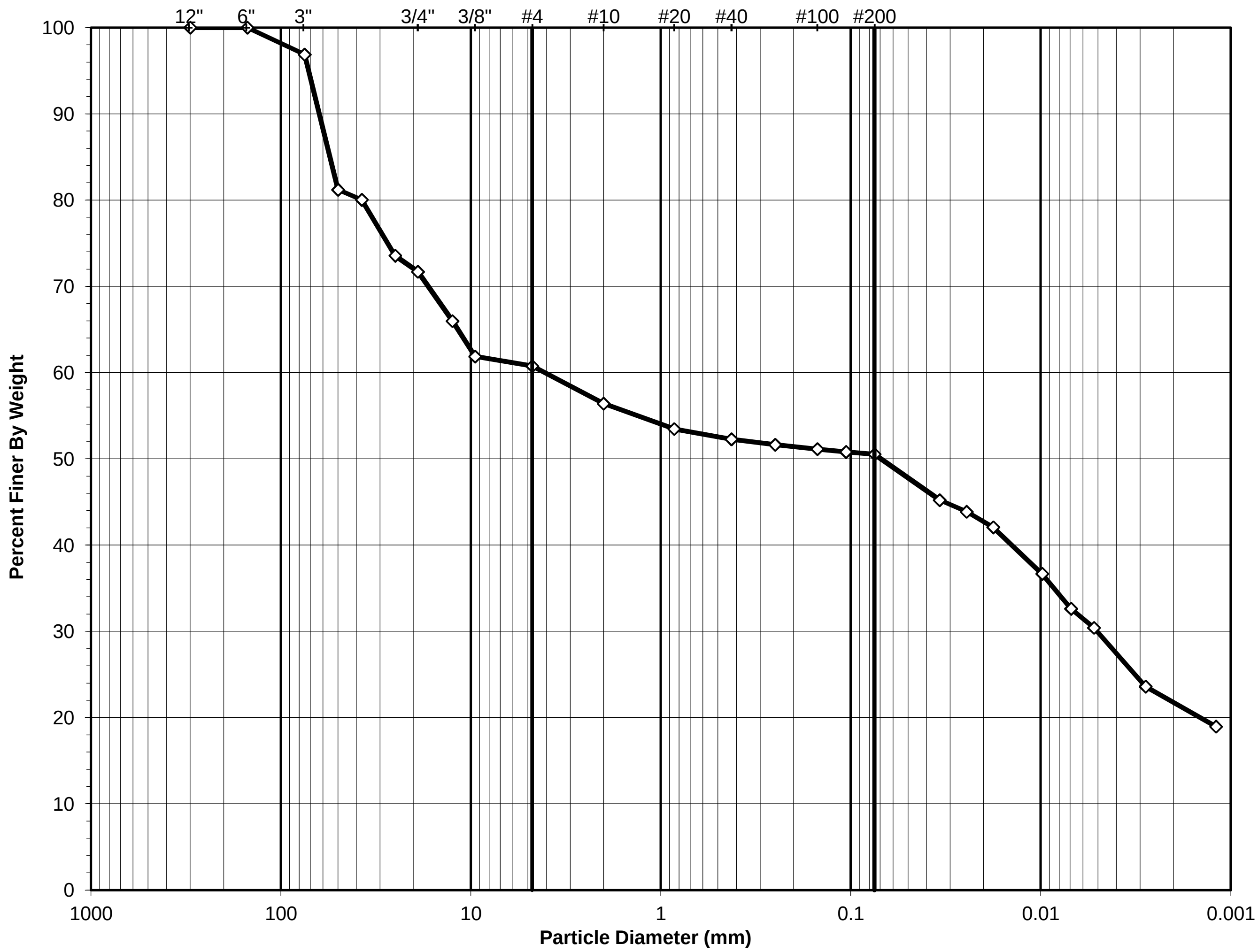
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008	Soil Color:	Brown

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol:
CH, TESTED

D50 = 0.07

USCS Classification:
GRAVELLY FAT CLAY

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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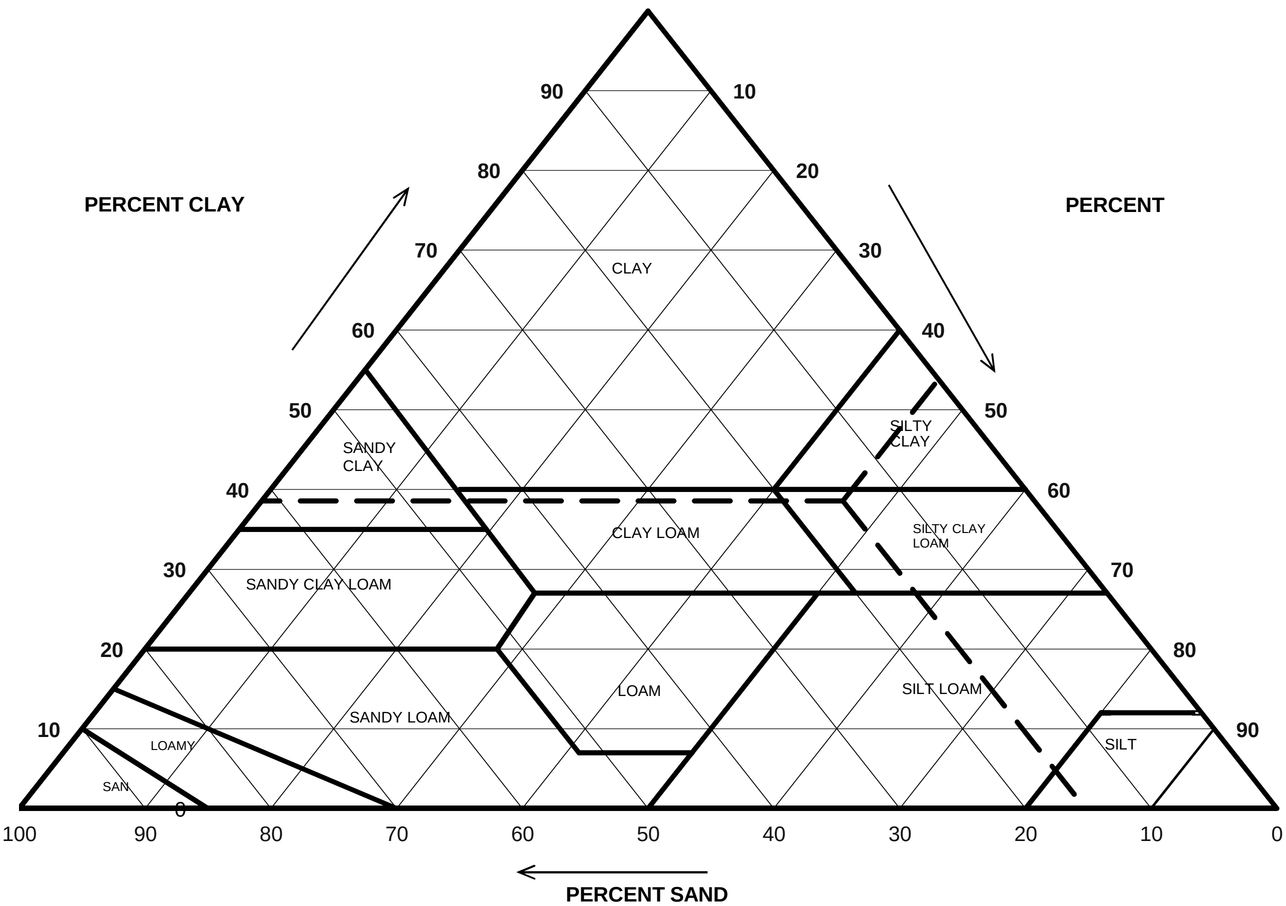
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	43.60	
2	56.40	Sand	8.60	15.24
0.05	47.81	Silt	26.05	46.18
0.002	21.76	Clay	21.76	38.58

USDA Classification: SILTY CLAY LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3316	Tare No.:	3512
Wt. of Tare & Wet Sample (g):	253.65	Weight of Tare & Wet Sample (g):	437.87
Wt. of Tare & Dry Sample (g):	207.50	Weight of Tare & Dry Sample (g):	409.04
Weight of Tare (g):	8.04	Weight of Tare (g):	8.05
Weight of Water (g):	46.15	Weight of Water (g):	28.83
Weight of Dry Soil (g):	199.46	Weight of Dry Soil (g):	400.99
Moisture Content (%):	**23.1**	**Moisture Content (%):**	**7.2**
Wet Weight of -3/4" Sample (g):	15940.00	Total Dry Weight of Sample (g):	18054.51
Tare No. (-3/4" Sub-Specimen):	1542	Wet Weight of +3/4" Sample (g):	5477.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1178.05	Dry Weight of + 3/4" Sample (g):	5109.63
Weight of Tare (g):	143.94	Dry Weight of - 3/4" Sample (g):	12944.88
Sub-Specimen -3/4" Wet Weight (g):	1034.11	Dry Weight -3/4" +3/8" Sample (g):	1774.64
Tare No. (-3/8" Sub-Specimen):	589	Dry Weight of -3/8" Sample (g):	11170.24
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	247.97	J - Factor (% Finer than 3/4"):	71.7%
Weight of Tare (g):	82.58	J - Factor (% Finer than 3/8"):	61.9%
Sub-Specimen -3/8" Wet Weight (g):	165.39		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	604.00		3.12	3.12	96.88	**97**
2"	50	3033.00	(*)	15.67	18.79	81.21	**81**
1 1/2"	37.5	226.00		1.17	19.96	80.04	**80**
1"	25	1254.00		6.48	26.44	73.56	**74**
3/4"	19	360.00		1.86	28.30	71.70	**72**
1/2"	12.5	67.02	(**)	7.98	7.98	92.02	**66**
3/8"	9.5	48.11		5.73	13.71	86.29	**62**
#4	4.75	2.42		1.80	1.80	98.20	**61**
#10	2	9.45		7.04	8.84	91.16	**56**
#20	0.85	6.37	(**)	4.74	13.58	86.42	**53**
#40	0.425	2.58		1.92	15.50	84.50	**52**
#60	0.25	1.39		1.03	16.54	83.46	**52**
#100	0.15	1.10		0.82	17.35	82.65	**51**
#140	0.106	0.70		0.52	17.88	82.12	**51**
#200	0.075	0.58		0.43	18.31	81.69	**51**
Pan	-	109.72		81.69	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	55.5	24.1	5.22	6.9	0.0341	89.5	45.2
2	54.0	24.1	5.22	7.2	0.0246	86.8	43.9
4	52.0	24.1	5.22	7.5	0.0178	83.2	42.1
15	46.0	24.1	5.22	8.6	0.0098	72.6	36.7
33	41.5	24.1	5.22	9.4	0.0069	64.6	32.6
60	39.0	24.2	5.18	9.9	0.0053	60.2	30.4
240	31.5	24.0	5.26	11.2	0.0028	46.7	23.6
1440	26.5	23.6	5.41	12.1	0.0012	37.5	19.0

Soil Specimen Data

Tare No.:	1463	Percent Finer than # 200:	50.54
Wt. of Tare & Dry Material (g):	159.35		
Weight of Tare (g):	98.77	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	55.58		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/10/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008	Soil Description:	BROWN FAT CLAY

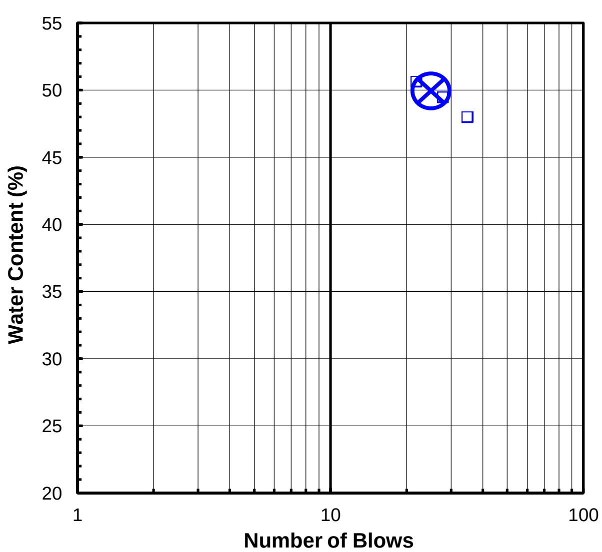
Note: The **USCS** ***symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*** . (Minus No. 40 sieve material, Air dried)

As Received Moisture Content ASTM D2216-19		Liquid Limit Test 1	2	3	
Tare Number:	3274	211	281	431	**M**
Wt. of Tare & Wet Sample (g):	310.79	38.56	45.75	35.66	**U**
Wt. of Tare & Dry Sample (g):	238.33	31.95	38.91	28.67	**L**
Weight of Tare (g):	8.29	18.16	25.07	14.85	**T**
Weight of Water (g):	72.5	6.6	6.8	7.0	**I**
Weight of Dry Sample (g):	230.0	13.8	13.8	13.8	**P**
Was As Received MC Preserved:	**Yes**				**O**
					I
Moisture Content (%):	**31.5**	**47.9**	**49.4**	**50.6**	**N**
Number of Blows:		**35**	**28**	**22**	**T**

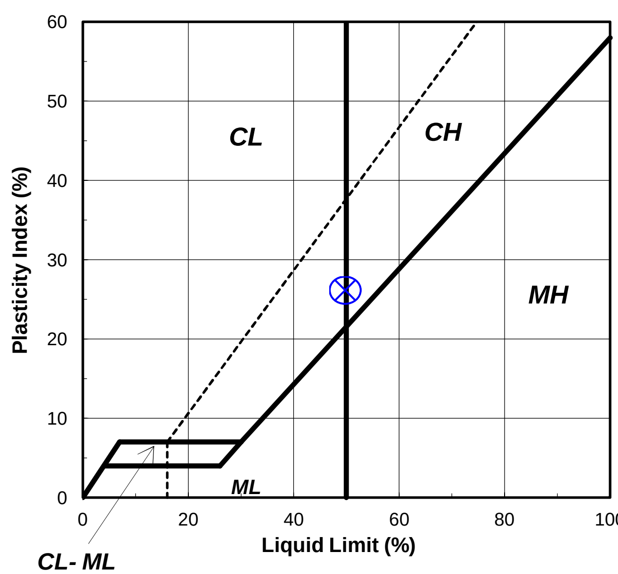
Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	231	294		**Liquid Limit (%):**	**50**
Wt. of Tare & Wet Sample (g):	25.88	29.17			
Wt. of Tare & Dry Sample (g):	24.67	27.95		**Plastic Limit (%):**	**24**
Weight of Tare (g):	19.67	22.99			
Weight of Water (g):	1.2	1.2		**Plasticity Index (%):**	**26**
Weight of Dry Sample (g):	5.0	5.0			
				USCS Symbol:	**CH**
Moisture Content (%):	**24.2**	**24.6**	**-0.4**		

Note: The acceptable range of the two Moisture Contents is ± 1.4

Flow Curve



Plasticity Chart



Tested By	*JP*	*Date*	*9/15/20*	*Checked By*	*BRB*	*Date*	*9/16/20*

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MOISTURE - DENSITY RELATIONSHIP

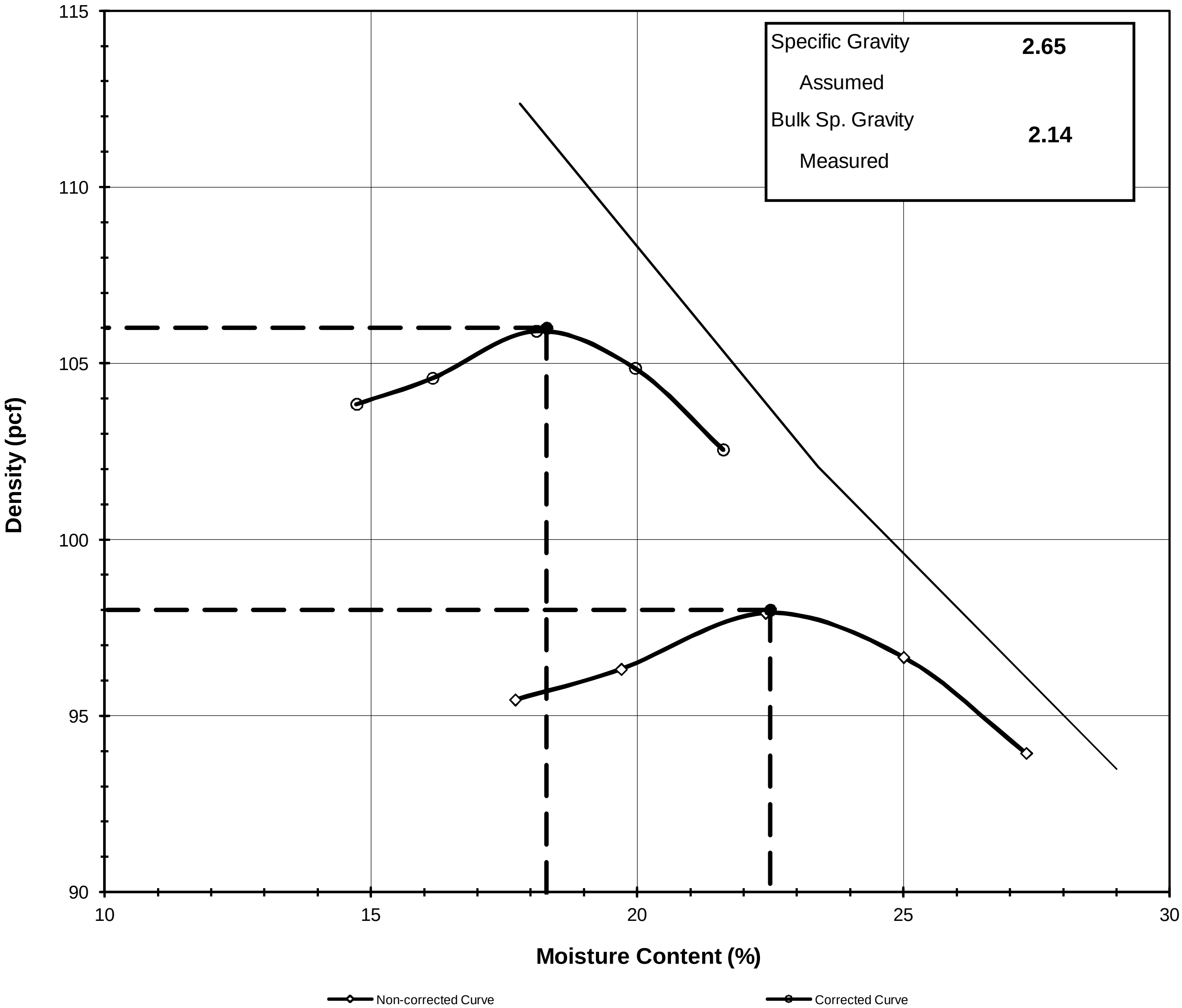
(Corrected for Oversize Particles)

ASTM D 4718-15, D 698-12e2 (SOP-S12,S39)

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008	Test Method	STANDARD

Visual Description: Brown Clay with Rocks

Optimum Moisture Content (%):	**22.5**	**Corrected Moisture Content (%):**	**18.3**
Maximum Dry Density (pcf):	**98.0**	**Corrected Dry Density (pcf):**	**106.0**



Tested By	*PC*	*Date*	*9/10/20*	*Checked By*	*JLK*	*Date*	*9/11/20*

 DCN:CT-S 39 DATE: 10/17/17, Revision 15 *S:Excel\Excel QA\Spreadsheets\Proctor wRock Correction.xls*

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MOISTURE - DENSITY RELATIONSHIP

(Corrected for Oversize Particles) *ASTM D 4718-15, D698-12e2 (SOP-S12,S39)*

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008		

Visual Description: Brown Clay with Rocks

Total Weight of the Sample (g):	NA
As Received Water Content (%):	NA
Assumed Specific Gravity	2.65

Percent Retained on 3/4" (Dry):	28.30
Percent Retained on 3/8" (Dry):	NA
Percent Retained on #4 (Dry):	NA
Oversize Material:	Not included
Procedure Used:	C

TestType:	**STANDARD**
Rammer Weight (lb):	5.5
Rammer Drop (in):	12
Rammer Type:	MECHANICAL
Machine ID:	G774
Mold ID:	G1679
Mold diameter (in):	6"
Weight of the Mold (g):	5649
Volume Of the Mold (cm^3):	2122

Mold/Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Weight of Mold & Wet Sample (g):	9470	9570	9725	9758	9716
Weight of Mold (g):	5649	5649	5649	5649	5649
Weight of Wet Sample (g):	3821	3921	4076	4109	4067
Mold Volume (cm^3):	2122	2122	2122	2122	2122

Moisture Content/Density

Tare Number:	785	203	591	880	1125
Weight of Tare & Wet Sample (g):	451.26	444.37	438.61	470.77	455.16
Weight of Tare & Dry Sample (g):	396.15	387.46	374.26	398.31	375.43
Weight of Tare (g):	84.98	98.55	87.16	108.51	83.47
Weight of Water (g):	55.11	56.91	64.35	72.46	79.73
Weight of Dry Sample (g):	311.17	288.91	287.10	289.80	291.96

Wet Density (g/cm^3):	1.80	1.85	1.92	1.94	1.92
Wet Density (pcf):	112.4	115.3	119.9	120.8	119.6
Moisture Content (%):	**17.7**	**19.7**	**22.4**	**25.0**	**27.3**
Dry Density (pcf):	**95.5**	**96.3**	**97.9**	**96.7**	**93.9**

Zero Air Voids

Moisture Content (%):		17.8	23.4	29.0	
Dry Unit Weight (pcf):		112.4	102.1	93.5	

Calculated Oversize Corrected Moisture & Density

Moisture Content (%):	**14.7**	**16.2**	**18.1**	**20.0**	**21.6**
Dry Density (pcf):	**103.8**	**104.6**	**105.9**	**104.9**	**102.6**

Tested By PC *Date* 9/10/20 *Checked By* JLK *Date* 9/11/20

DCN:CT-S 39 DATE: 10/17/17, Revision 15
S:Excel\Excel QA\Spreadsheets\Proctor wRock Correction.xls

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Correction of Unit Weight and Water Content for Soils Containing Oversize Particles by Specific Gravity

ASTM D4718/D4718M-15

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-6A
Lab ID:	2020-444-001-008		

Visual Description: Brown Clay & Rock

Total Dry Weight of Sample (g): 18054.5

COARSE PORTION		***FINE PORTION***	
Total Wet Weight of + 3/4" Portion (g):	5477.0	Total Wet Weight of - 3/4" Portion (g):	15940.0
Total Dry Weight of + 3/4" Portion (g):	5109.6	Total Dry Weight of - 3/4" Portion (g):	12944.9
Percent + 3/4" By Dry Weight (%):	28.30	Percent - 3/4" By Dry Weight (%):	71.70

MOISTURE CONTENT OF +3/4" PORTION		***MOISTURE CONTENT OF -3/4" PORTION***	
Tare Number:	3512	Tare Number:	3316
Weight of Tare & Wet Sample (g):	437.87	Weight of Tare & Wet Sample (g):	253.65
Weight of Tare & Dry Sample (g):	409.04	Weight of Tare & Dry Sample (g):	207.50
Weight of Tare (g):	8.05	Weight of Tare (g):	8.04
Weight of Water (g):	28.83	Weight of Water (g):	46.15
Weight of Dry Sample (g):	400.99	Weight of Dry Sample (g):	199.46
Moisture Content (%):	7.19	**Moisture Content (%):**	23.14

SPECIFIC GRAVITY DETERMINATION

Weight of Basket in Air (g):	1033.8
Weight of Saturated Surface Dry Sample & Basket in Air (g):	2487.9
Weight of Saturated Surface Dry Sample in Air (g):	1454.1
Weight of Basket in Water (g):	901.5
Weight of Saturated Sample & Basket in Water (g):	1738.4
Weight of Saturated Sample in Water (g):	836.9
Tare No.:	56
Weight of Tare and Dried Sample (g):	1524.2
Weight of Tare (g):	201.1
Weight of Dried Soil (g):	1323.1
Bulk Specific Gravity (+3/4"):	**2.14**

Tested By FS *Date* 9/3/20 *Checked By* BRB *Date* 9/7/20

DCN: CT-S39 DATE: 10/17/17 REVISION: 2e

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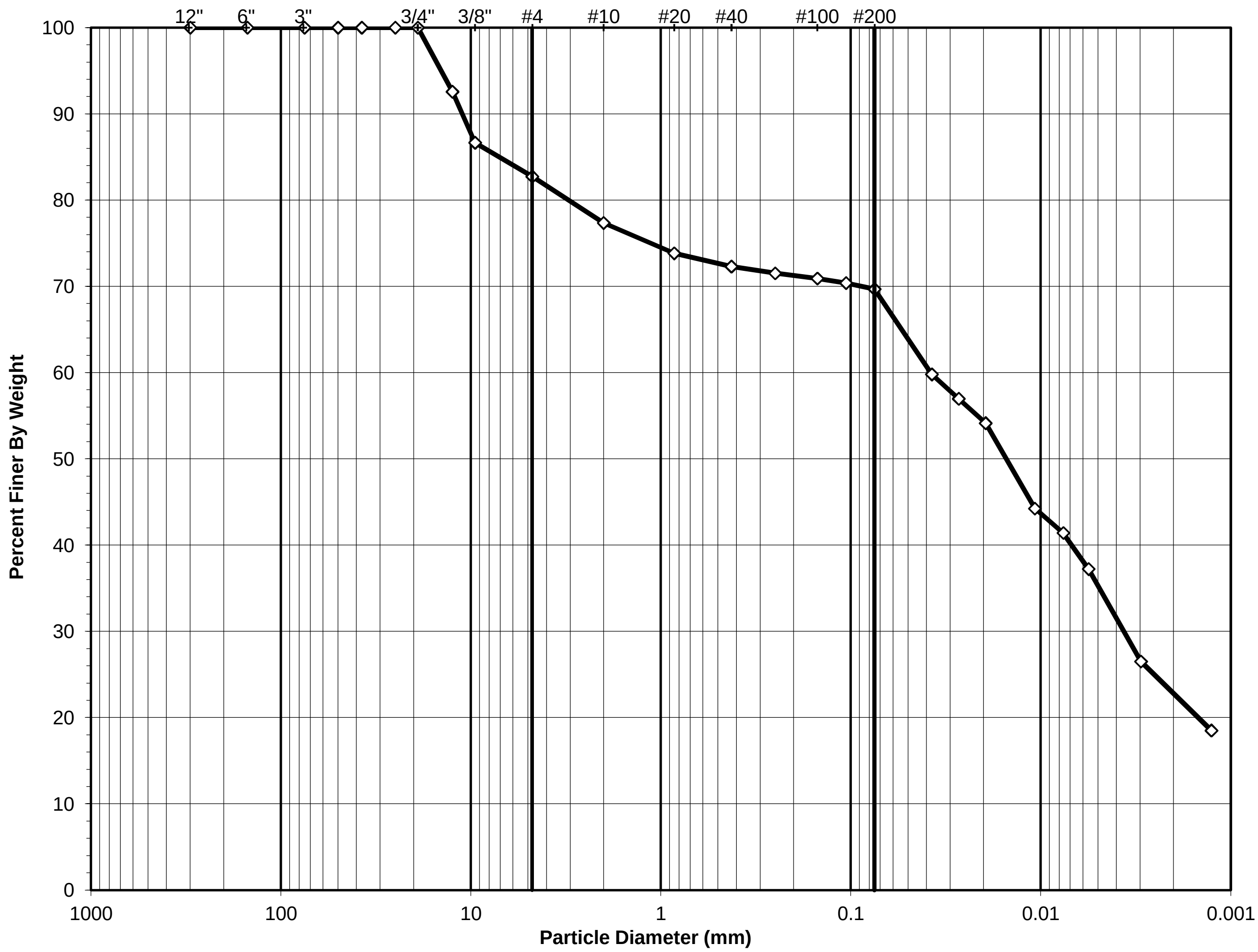
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7A
Lab ID:	2020-444-001-009	Soil Color:	Brown

USCS	***SIEVE ANALYSIS***		***HYDROMETER***
	gravel	**sand**	**silt and clay**



USCS Symbol:
CL, TESTED

D50 = 0.02

USCS Classification:
GRAVELLY LEAN CLAY

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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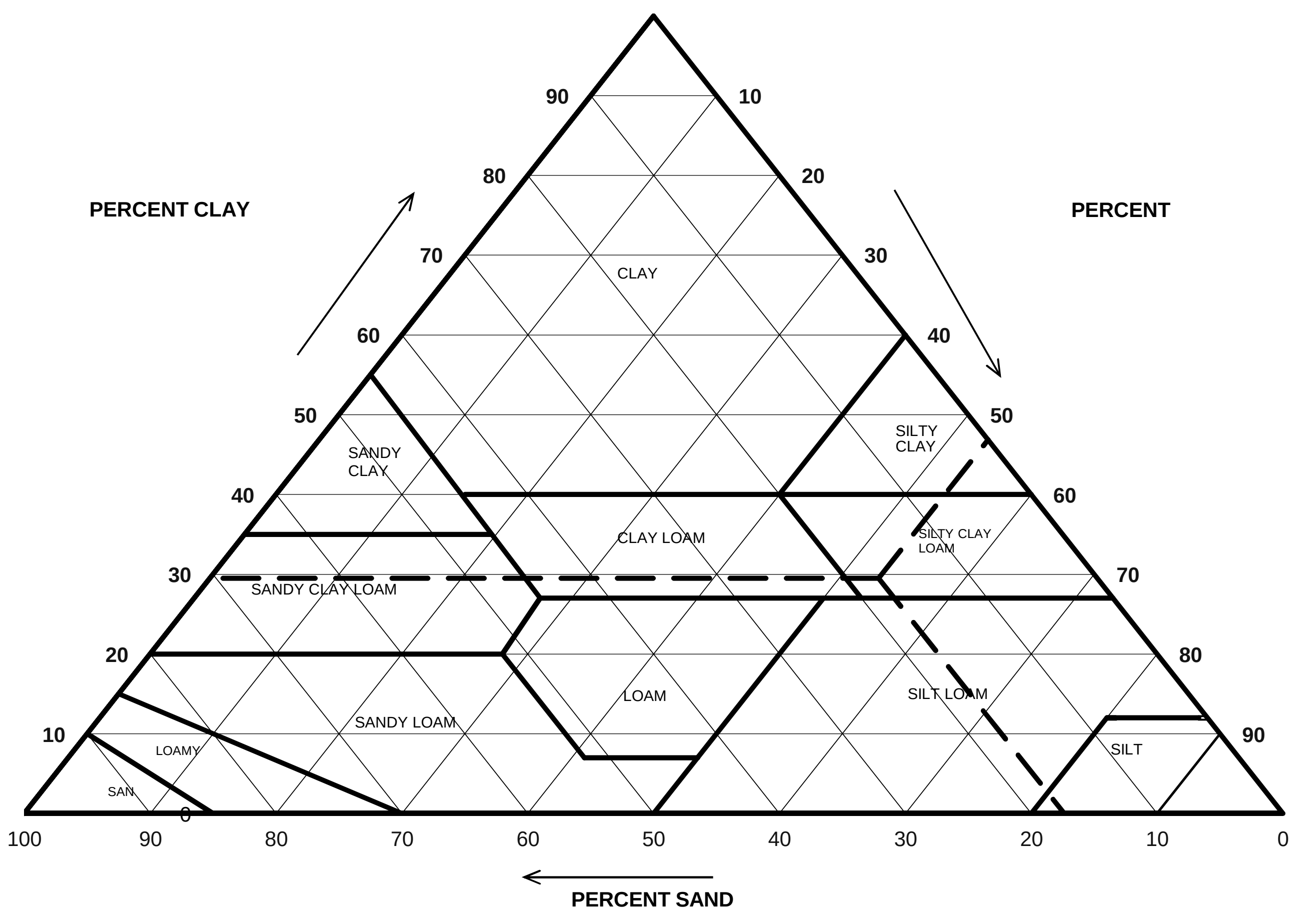
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7A
Lab ID:	2020-444-001-009	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	22.64	
2	77.36	Sand	13.44	17.38
0.05	63.91	Silt	41.11	53.14
0.002	22.81	Clay	22.81	29.48

USDA Classification: SILTY CLAY LOAM

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7A
Lab ID:	2020-444-001-009	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3509	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	308.61	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	270.88	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	8.14	Weight of Tare (g):	NA
Weight of Water (g):	37.73	Weight of Water (g):	NA
Weight of Dry Soil (g):	262.74	Weight of Dry Soil (g):	NA
Moisture Content (%):	**14.4**	**Moisture Content (%):**	**0.0**
Wet Weight of -3/4" Sample (g):	NA	Total Dry Weight of Sample (g):	932.67
Tare No. (-3/4" Sub-Specimen):	1456	Wet Weight of +3/4" Sample (g):	0.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1197.70	Dry Weight of + 3/4" Sample (g):	0.00
Weight of Tare (g):	131.10	Dry Weight of - 3/4" Sample (g):	932.67
Sub-Specimen -3/4" Wet Weight (g):	1066.60	Dry Weight -3/4" +3/8" Sample (g):	124.43
Tare No. (-3/8" Sub-Specimen):	893	Dry Weight of -3/8" Sample (g):	808.24
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	302.64	J - Factor (% Finer than 3/4"):	NA
Weight of Tare (g):	110.35	J - Factor (% Finer than 3/8"):	86.7%
Sub-Specimen -3/8" Wet Weight (g):	192.29		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	0.00	(*)	0.00	0.00	100.00	**100**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100**
1"	25	0.00		0.00	0.00	100.00	**100**
3/4"	19	0.00		0.00	0.00	100.00	**100**
1/2"	12.5	69.30	(**)	7.43	7.43	92.57	**93**
3/8"	9.5	55.13		5.91	13.34	86.66	**87**
#4	4.75	7.60		4.52	4.52	95.48	**83**
#10	2	10.45		6.21	10.73	89.27	**77**
#20	0.85	6.83	(**)	4.06	14.80	85.20	**74**
#40	0.425	2.98		1.77	16.57	83.43	**72**
#60	0.25	1.52		0.90	17.47	82.53	**72**
#100	0.15	1.16		0.69	18.16	81.84	**71**
#140	0.106	1.02		0.61	18.77	81.23	**70**
#200	0.075	1.38		0.82	19.59	80.41	**70**
Pan	-	135.20		80.41	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	BRB	Date	9/16/20

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7A
Lab ID:	2020-444-001-009	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	47.5	24.1	5.22	8.4	0.0374	85.8	59.8
2	45.5	24.1	5.22	8.7	0.0270	81.8	57.0
4	43.5	24.1	5.22	9.1	0.0195	77.7	54.1
15	36.5	24.1	5.22	10.3	0.0108	63.5	44.2
31	34.5	24.1	5.22	10.7	0.0076	59.4	41.4
60	31.5	24.2	5.18	11.2	0.0056	53.4	37.2
240	24.0	24.0	5.26	12.6	0.0030	38.0	26.5
1440	18.5	23.6	5.41	13.6	0.0013	26.6	18.5

Soil Specimen Data

Tare No.:	952	Percent Finer than # 200:	69.68
Wt. of Tare & Dry Material (g):	154.37		
Weight of Tare (g):	100.65	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	48.72		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/10/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

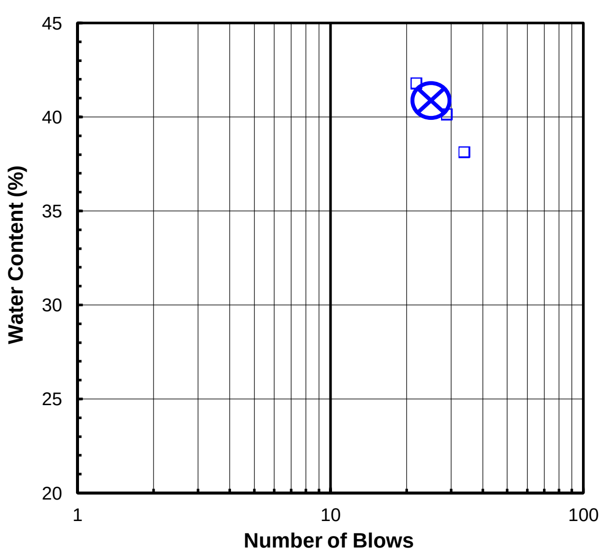
Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7A
Lab ID:	2020-444-001-009	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

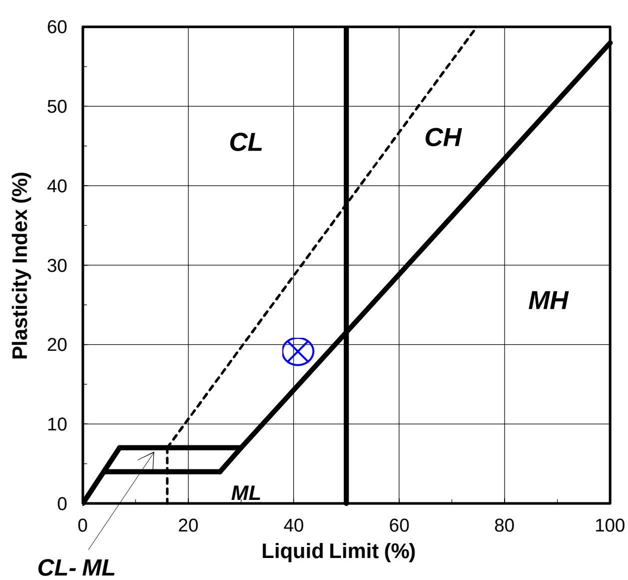
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-19		**1**	**2**	**3**	**M**
Tare Number:	3400	247	328	635	**U**
Wt. of Tare & Wet Sample (g):	368.31	36.07	36.08	39.32	**L**
Wt. of Tare & Dry Sample (g):	305.93	31.40	31.30	33.27	**T**
Weight of Tare (g):	8.18	19.14	19.38	18.78	**I**
Weight of Water (g):	62.4	4.7	4.8	6.1	**P**
Weight of Dry Sample (g):	297.8	12.3	11.9	14.5	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**21.0**	**38.1**	**40.1**	**41.8**	**N**
Number of Blows:		**34**	**29**	**22**	**T**

Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	167	319		**Liquid Limit (%):**	**41**
Wt. of Tare & Wet Sample (g):	24.57	26.92			
Wt. of Tare & Dry Sample (g):	23.48	25.78		**Plastic Limit (%):**	**22**
Weight of Tare (g):	18.43	20.66			
Weight of Water (g):	1.1	1.1		**Plasticity Index (%):**	**19**
Weight of Dry Sample (g):	5.1	5.1			
				USCS Symbol:	**CL**
Moisture Content (%):	**21.6**	**22.3**	**-0.7**		
Note: The acceptable range of the two Moisture Contents is ±			1.12		

Flow Curve



Plasticity Chart



Tested By	*JP*	*Date*	*9/15/20*	*Checked By*	*BRB*	*Date*	9/16/20

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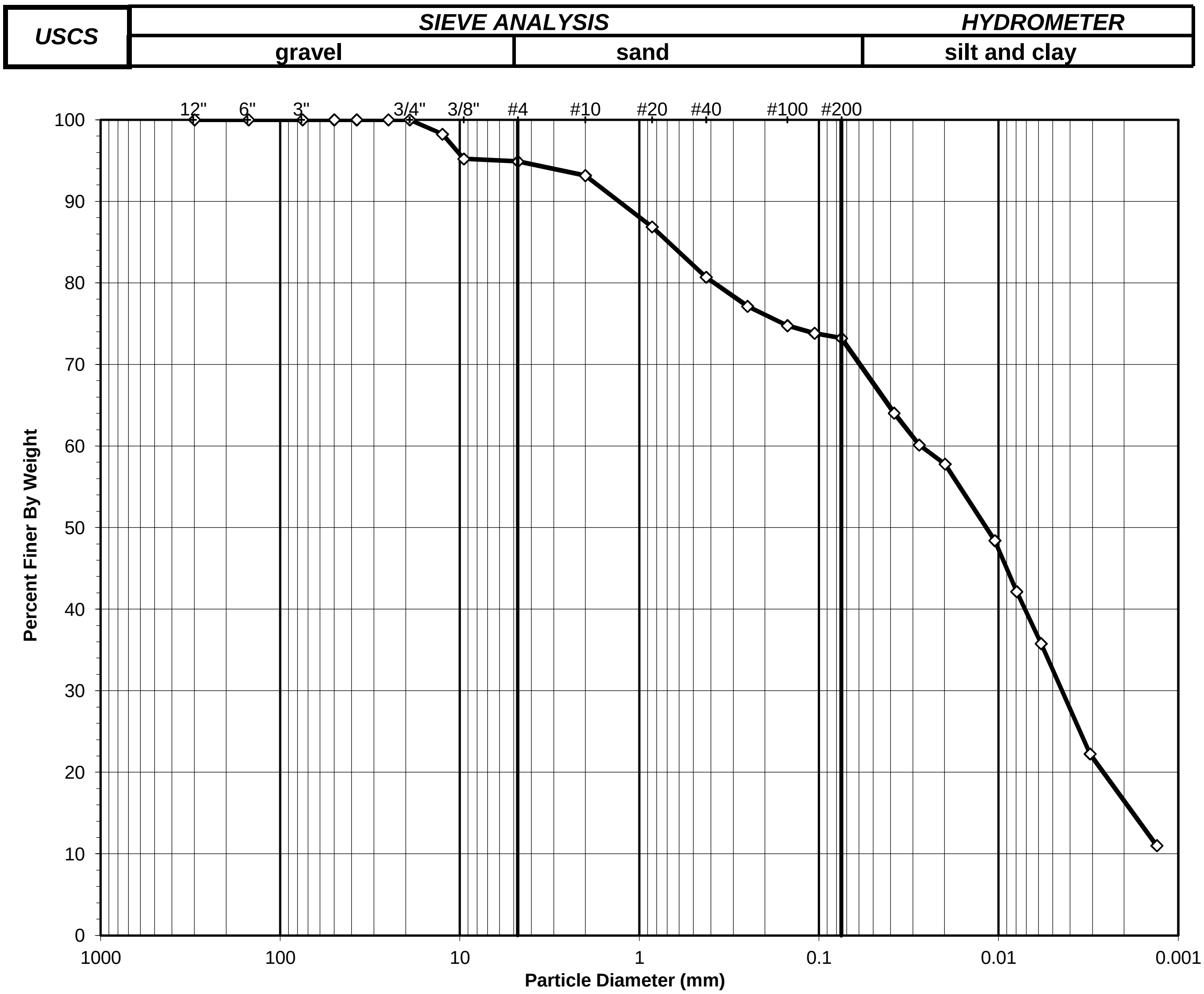
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7B
Lab ID:	2020-444-001-010	Soil Color:	Brown



USCS Symbol:
CL, TESTED

D50 = 0.01

USCS Classification:
LEAN CLAY WITH SAND

Tested By	NR	Date	9/4/20	Checked By	JLK	Date	9/21/20

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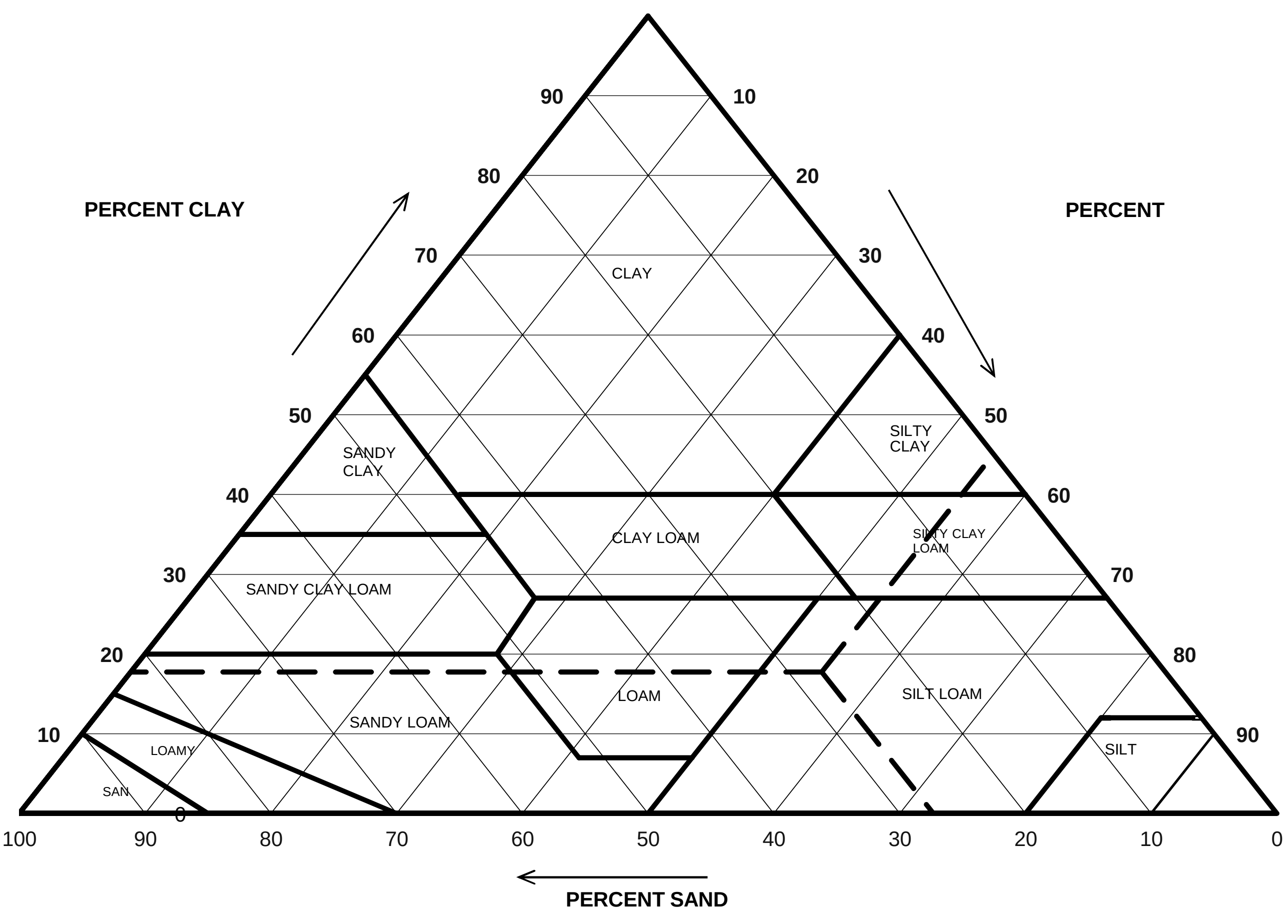
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7B
Lab ID:	2020-444-001-010	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	6.84	
2	93.16	Sand	25.45	27.32
0.05	67.71	Silt	51.19	54.95
0.002	16.52	Clay	16.52	17.73

USDA Classification: SILT LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7B
Lab ID:	2020-444-001-010	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3102	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	387.79	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	353.77	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	8.22	Weight of Tare (g):	NA
Weight of Water (g):	34.02	Weight of Water (g):	NA
Weight of Dry Soil (g):	345.55	Weight of Dry Soil (g):	NA
Moisture Content (%):	**9.8**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Total Dry Weight of Sample (g):	1138.31
Tare No. (-3/4" Sub-Specimen):	1498	Wet Weight of +3/4" Sample (g):	0.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1399.34	Dry Weight of + 3/4" Sample (g):	0.00
Weight of Tare (g):	148.96	Dry Weight of - 3/4" Sample (g):	1138.31
Sub-Specimen -3/4" Wet Weight (g):	1250.38	Dry Weight -3/4" +3/8" Sample (g):	54.60
Tare No. (-3/8" Sub-Specimen):	577	Dry Weight of -3/8" Sample (g):	1083.71
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	300.49	J - Factor (% Finer than 3/4"):	NA
Weight of Tare (g):	84.35	J - Factor (% Finer than 3/8"):	95.2%
Sub-Specimen -3/8" Wet Weight (g):	216.14		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	0.00	(*)	0.00	0.00	100.00	**100**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100**
1"	25	0.00		0.00	0.00	100.00	**100**
3/4"	19	0.00		0.00	0.00	100.00	**100**
1/2"	12.5	20.14	(**)	1.77	1.77	98.23	**98**
3/8"	9.5	34.46		3.03	4.80	95.20	**95**
#4	4.75	0.63		0.32	0.32	99.68	**95**
#10	2	3.59		1.82	2.14	97.86	**93**
#20	0.85	13.00	(**)	6.61	8.75	91.25	**87**
#40	0.425	12.74		6.47	15.23	84.77	**81**
#60	0.25	7.39		3.76	18.98	81.02	**77**
#100	0.15	4.90		2.49	21.47	78.53	**75**
#140	0.106	1.92		0.98	22.45	77.55	**74**
#200	0.075	1.25		0.64	23.08	76.92	**73**
Pan	-	151.35		76.92	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	JLK	Date	9/21/20

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7B
Lab ID:	2020-444-001-010	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	46.5	23.3	5.53	8.5	0.0382	87.4	64.0
2	44.0	23.3	5.53	9.0	0.0277	82.1	60.1
4	42.5	23.3	5.53	9.3	0.0199	78.9	57.8
16	36.5	23.3	5.53	10.3	0.0105	66.1	48.4
30	32.5	23.3	5.53	11.1	0.0079	57.6	42.2
60	28.5	23.1	5.60	11.8	0.0058	48.9	35.8
240	20.0	22.7	5.75	13.3	0.0031	30.4	22.3
1440	12.5	23.5	5.45	14.7	0.0013	15.0	11.0

Soil Specimen Data

Tare No.:	967	Percent Finer than # 200:	73.23
Wt. of Tare & Dry Material (g):	149.74		
Weight of Tare (g):	98.41	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	46.33		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/17/20 Checked By JLK Date 9/21/20

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ATTERBERG LIMITS

ASTM D 4318-17

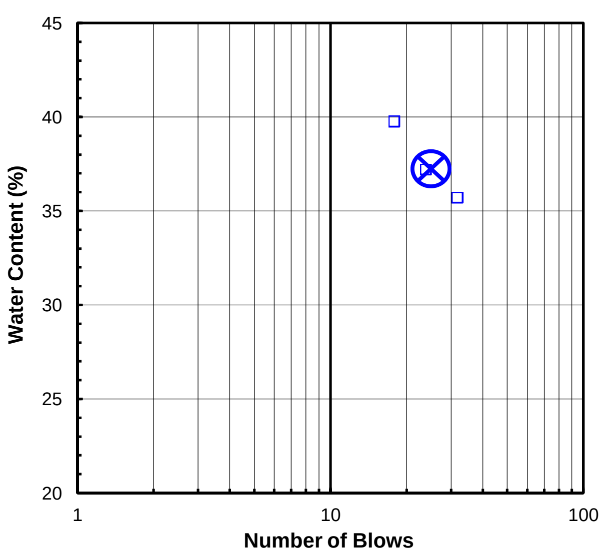
Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7B
Lab ID:	2020-444-001-010	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

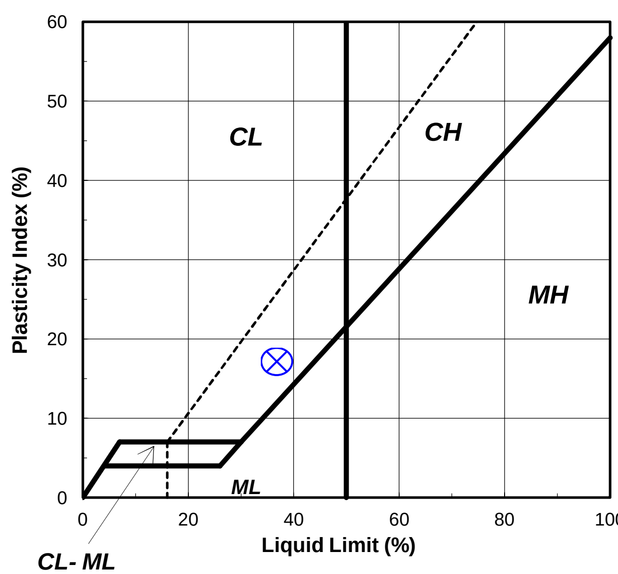
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-19		**1**	**2**	**3**	**M**
Tare Number:	3103	3	175	180	**U**
Wt. of Tare & Wet Sample (g):	458.55	40.72	41.86	41.00	**L**
Wt. of Tare & Dry Sample (g):	406.11	34.98	35.85	34.93	**T**
Weight of Tare (g):	8.06	18.89	19.68	19.65	**I**
Weight of Water (g):	52.4	5.7	6.0	6.1	**P**
Weight of Dry Sample (g):	398.1	16.1	16.2	15.3	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**13.2**	**35.7**	**37.2**	**39.7**	**N**
Number of Blows:		**32**	**24**	**18**	**T**

Plastic Limit Test	1	2	Range		Test Results	
Tare Number:	612	638			**Liquid Limit (%):**	**37**
Wt. of Tare & Wet Sample (g):	25.84	25.61				
Wt. of Tare & Dry Sample (g):	24.83	24.61			**Plastic Limit (%):**	**20**
Weight of Tare (g):	19.79	19.54				
Weight of Water (g):	1.0	1.0			**Plasticity Index (%):**	**17**
Weight of Dry Sample (g):	5.0	5.1				
					USCS Symbol:	**CL**
Moisture Content (%):	**20.0**	**19.7**	**0.3**			
Note: The acceptable range of the two Moisture Contents is ±				1.12		

Flow Curve



Plasticity Chart



Tested By	*BS*	*Date*	*9/14/20*	*Checked By*	*BRB*	*Date*	9/16/20

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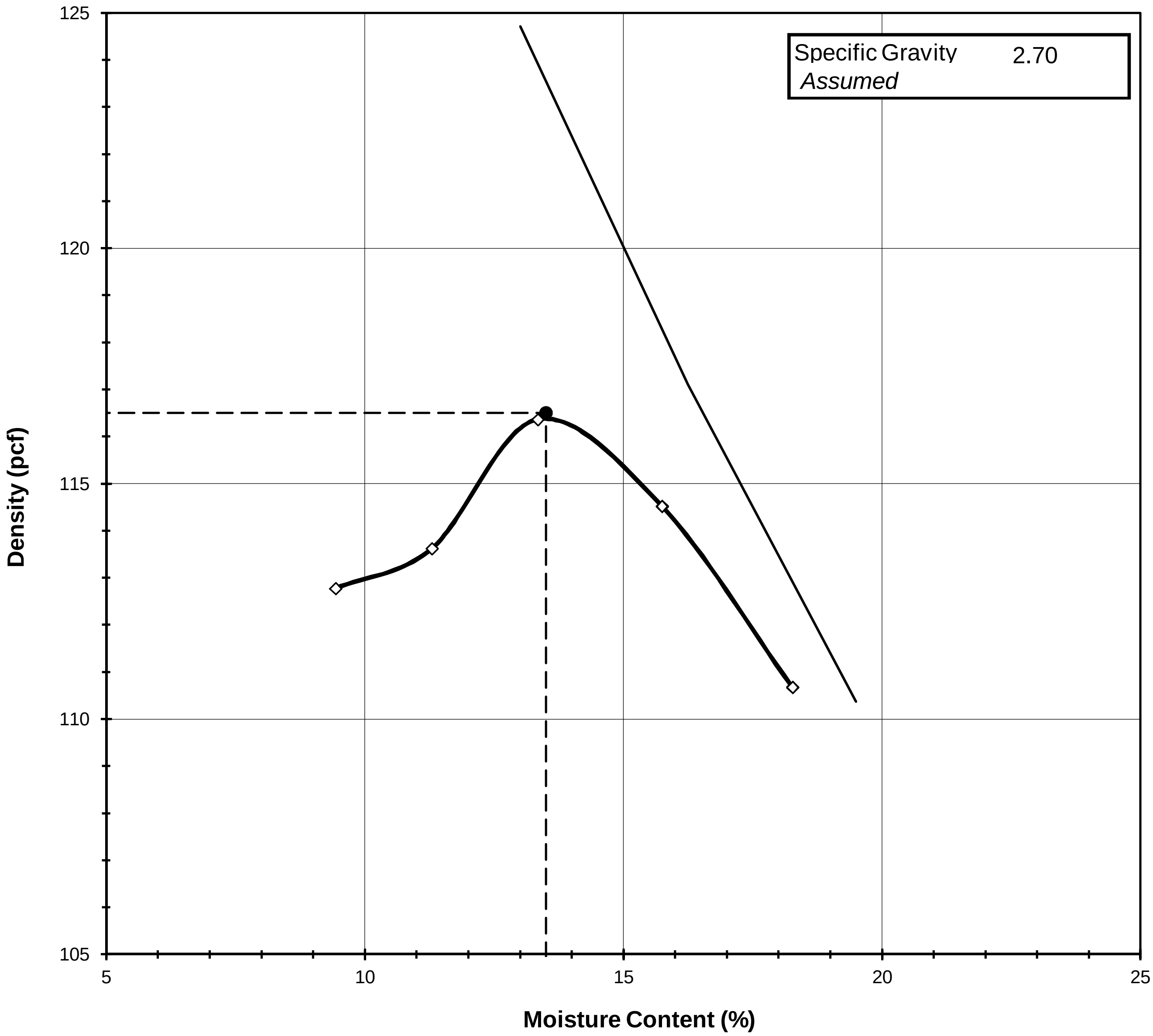
MOISTURE - DENSITY RELATIONSHIP

ASTM D698-12

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7B
Lab ID:	2020-444-001-010	Test Method	**STANDARD**

Visual Description: Brown Clay with Clay Stone

Optimum Moisture Content (%): **13.5**
Maximum Dry Density (pcf): **116.5**



Tested By	*AMC*	*Date*	*9/13/20*	*Checked By*	*JLK*	*Date*	9/15/20

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MOISTURE - DENSITY RELATIONSHIP

ASTM D698-12

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-7B
Lab ID:	2020-444-001-010		

Visual Description: Brown Clay with Clay Stone

Total Weight of the Sample (g):	NA
As Received Water Content (%):	NA
Assumed Specific Gravity:	2.70
Percent Retained on 3/4":	NA
Percent Retained on 3/8":	NA
Percent Retained on #4:	NA
Oversize Material:	Not included
Procedure Used:	B

Test Type:	**STANDARD**
Rammer Weight (lb):	5.5
Rammer Drop (in):	12
Rammer Type:	MECHANICAL
Machine ID:	G1916
Mold ID:	G1924
Mold diameter:	4"
Weight of the Mold (g):	4264
Volume of the Mold (cm^3):	942

Mold / Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Weight of Mold & Wet Sample (g):	6127	6173	6255	6265	6240
Weight of Mold (g):	4264	4264	4264	4264	4264
Weight of Wet Sample (g):	1863	1909	1991	2001	1976
Mold Volume (cm^3):	942	942	942	942	942

Moisture Content / Density

Tare Number:	552	1724	1596	1598	1741
Weight of Tare & Wet Sample (g):	593.17	635.60	609.33	620.99	567.68
Weight of Tare & Dry Sample (g):	549.02	579.45	548.94	549.70	492.76
Weight of Tare (g):	80.90	82.40	96.35	96.93	82.67
Weight of Water (g):	44.15	56.15	60.39	71.29	74.92
Weight of Dry Sample (g):	468.12	497.05	452.59	452.77	410.09

Wet Density (g/cm^3):	1.98	2.03	2.11	2.12	2.10
Wet Density (pcf):	123.4	126.5	131.9	132.6	130.9
Moisture Content (%):	**9.4**	**11.3**	**13.3**	**15.7**	**18.3**
Dry Density (pcf):	**112.8**	**113.6**	**116.4**	**114.5**	**110.7**

Zero Air Voids

Moisture Content (%):		13.0	16.3	19.5	
Dry Unit Weight (pcf):		124.7	117.1	110.4	

Tested By AMC *Date* 9/13/20 *Checked By* JLK *Date* 9/15/20

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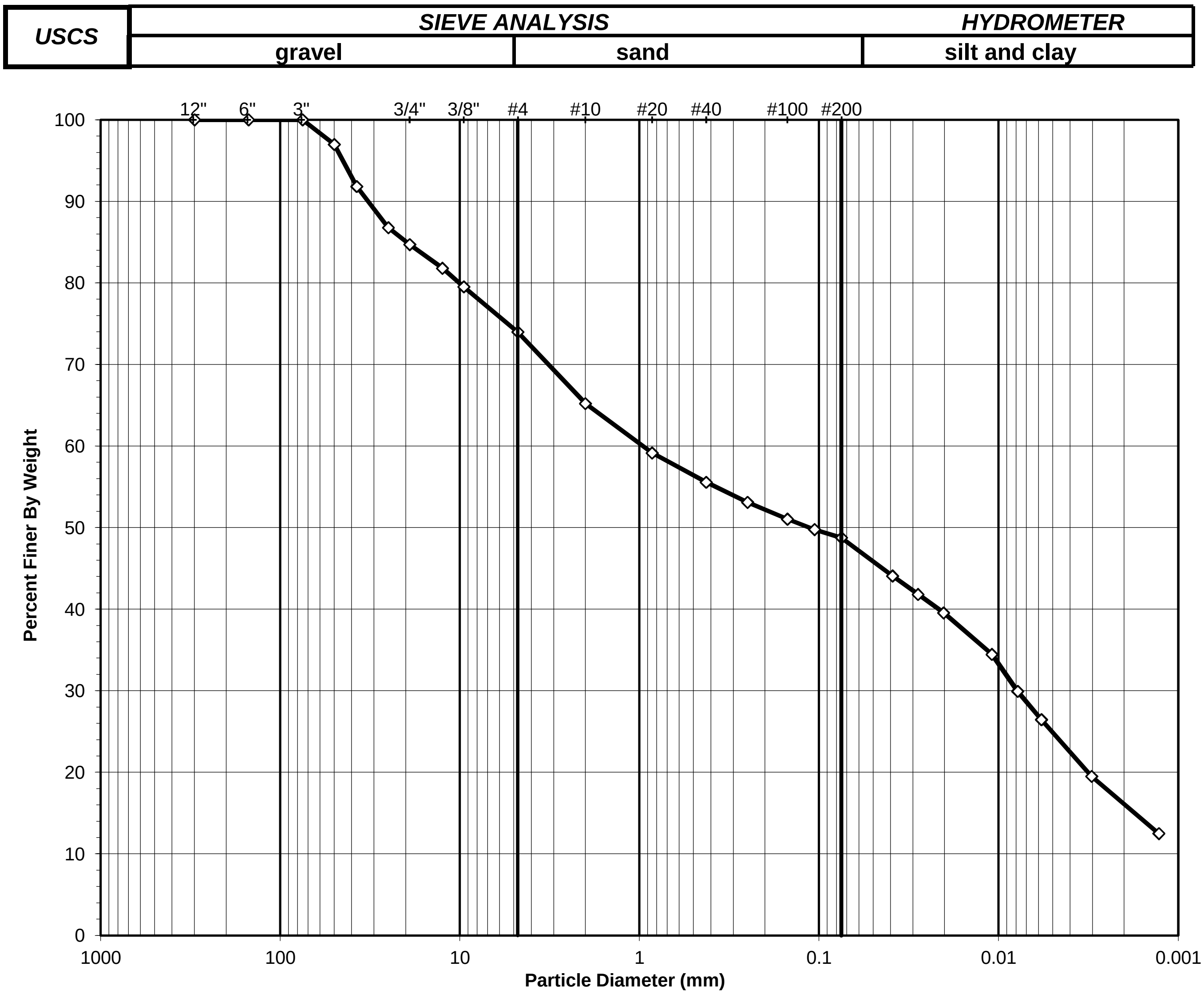
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-8A
Lab ID:	2020-444-001-011	Soil Color:	Brown



USCS Symbol:

GC, TESTED

D50 = 0.11

USCS Classification:

CLAYEY GRAVEL WITH SAND

Tested By NR Date 9/4/20 Checked By JLK Date 9/21/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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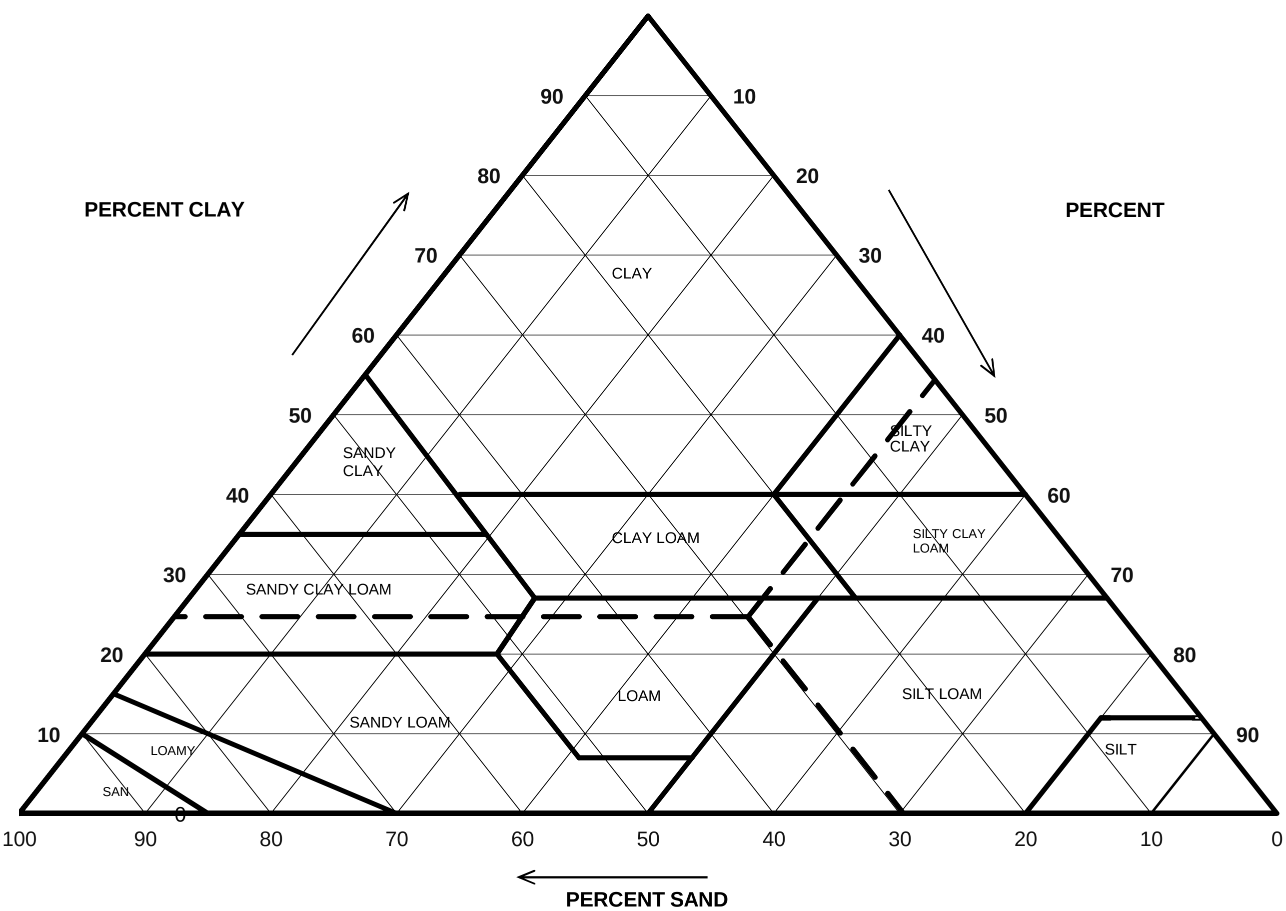
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-8A
Lab ID:	2020-444-001-011	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	34.79	
2	65.21	Sand	19.36	29.68
0.05	45.86	Silt	29.75	45.61
0.002	16.11	Clay	16.11	24.70

USDA Classification: LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-8A
Lab ID:	2020-444-001-011	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3222	Tare No.:	2972
Wt. of Tare & Wet Sample (g):	283.35	Weight of Tare & Wet Sample (g):	323.55
Wt. of Tare & Dry Sample (g):	247.32	Weight of Tare & Dry Sample (g):	301.62
Weight of Tare (g):	8.14	Weight of Tare (g):	8.28
Weight of Water (g):	36.03	Weight of Water (g):	21.93
Weight of Dry Soil (g):	239.18	Weight of Dry Soil (g):	293.34
Moisture Content (%):	**15.1**	**Moisture Content (%):**	**7.5**

Wet Weight of -3/4" Sample (g):	19688.00	Total Dry Weight of Sample (g):	20200.48
Tare No. (-3/4" Sub-Specimen):	2018	Wet Weight of +3/4" Sample (g):	3321.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1272.71	Dry Weight of + 3/4" Sample (g):	3089.99
Weight of Tare (g):	146.74	Dry Weight of - 3/4" Sample (g):	17110.48
Sub-Specimen -3/4" Wet Weight (g):	1125.97	Dry Weight -3/4" +3/8" Sample (g):	1046.15
Tare No. (-3/8" Sub-Specimen):	542	Dry Weight of -3/8" Sample (g):	16064.33
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	272.41	J - Factor (% Finer than 3/4"):	84.7%
Weight of Tare (g):	81.90	J - Factor (% Finer than 3/8"):	79.5%
Sub-Specimen -3/8" Wet Weight (g):	190.51		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	656.00	(*)	3.02	3.02	96.98	**97**
1 1/2"	37.5	1119.00		5.15	8.18	91.82	**92**
1"	25	1096.00		5.05	13.22	86.78	**87**
3/4"	19	450.00		2.07	15.30	84.70	**85**
1/2"	12.5	33.55	(**)	3.43	3.43	96.57	**82**
3/8"	9.5	26.28		2.69	6.11	93.89	**80**
#4	4.75	11.53		6.96	6.96	93.04	**74**
#10	2	18.27		11.03	18.00	82.00	**65**
#20	0.85	12.61	(**)	7.62	25.61	74.39	**59**
#40	0.425	7.48		4.52	30.13	69.87	**56**
#60	0.25	5.12		3.09	33.22	66.78	**53**
#100	0.15	4.29		2.59	35.82	64.18	**51**
#140	0.106	2.65		1.60	37.42	62.58	**50**
#200	0.075	2.11		1.27	38.69	61.31	**49**
Pan	-	101.51		61.31	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	JLK	Date	9/21/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-8A
Lab ID:	2020-444-001-011	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	44.5	23.3	5.53	8.9	0.0390	90.4	44.1
2	42.5	23.3	5.53	9.3	0.0281	85.8	41.8
4	40.5	23.3	5.53	9.6	0.0203	81.1	39.6
15	36.0	23.3	5.53	10.4	0.0109	70.7	34.5
31	32.0	23.3	5.53	11.1	0.0078	61.4	29.9
60	29.0	23.1	5.60	11.7	0.0058	54.3	26.5
240	23.0	22.7	5.75	12.8	0.0030	40.0	19.5
1440	16.5	23.5	5.45	13.9	0.0013	25.6	12.5

Soil Specimen Data

Tare No.:	976	Percent Finer than # 200:	48.76
Wt. of Tare & Dry Material (g):	146.37		
Weight of Tare (g):	98.74	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	42.63		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/17/20 Checked By JLK Date 9/21/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/18/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-8A
Lab ID:	2020-444-001-011	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

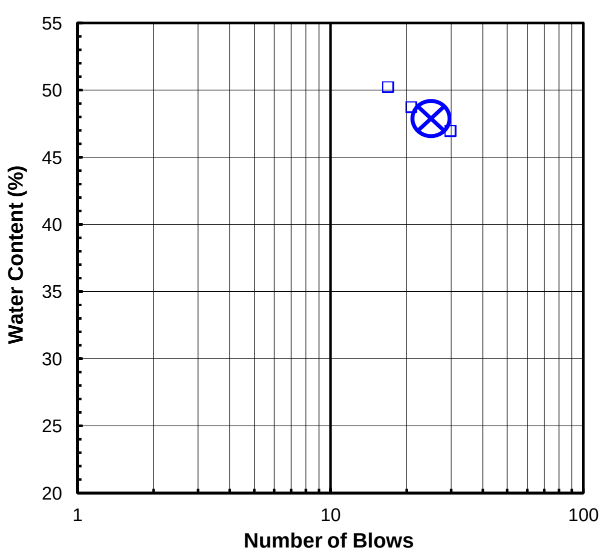
As Received Moisture Content ASTM D2216-19		Liquid Limit Test 1	2	3	
Tare Number:	3520	162	1289	506	M U L T I P O I N T
Wt. of Tare & Wet Sample (g):	378.15	28.19	37.36	36.27	
Wt. of Tare & Dry Sample (g):	323.79	24.78	32.04	30.61	
Weight of Tare (g):	8.05	17.51	21.11	19.33	
Weight of Water (g):	54.4	3.4	5.3	5.7	
Weight of Dry Sample (g):	315.7	7.3	10.9	11.3	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**17.2**	**46.9**	**48.7**	**50.2**	
Number of Blows:		**30**	**21**	**17**	

Plastic Limit Test	1	2	Range
Tare Number:	626	1271	
Wt. of Tare & Wet Sample (g):	25.01	27.80	
Wt. of Tare & Dry Sample (g):	23.69	26.52	
Weight of Tare (g):	18.74	21.80	
Weight of Water (g):	1.3	1.3	
Weight of Dry Sample (g):	5.0	4.7	
Moisture Content (%):	**26.7**	**27.1**	**-0.5**

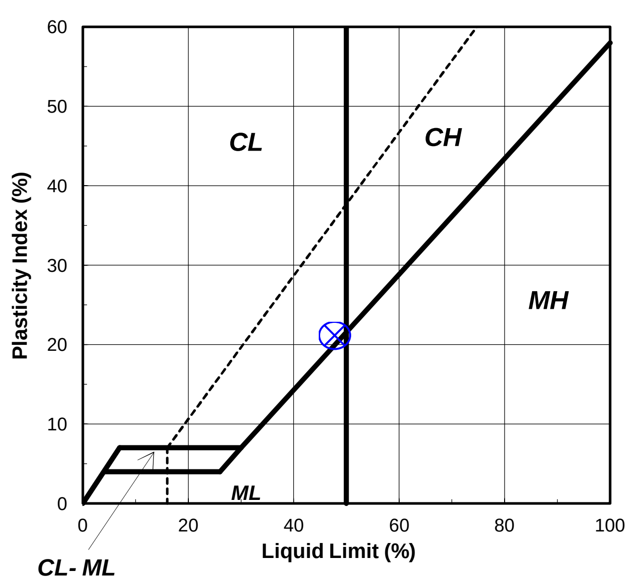
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**48**
Plastic Limit (%):	**27**
Plasticity Index (%):	**21**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By	*TO*	*Date*	*9/14/20*	*Checked By*	*BRB*	*Date*	9/16/20

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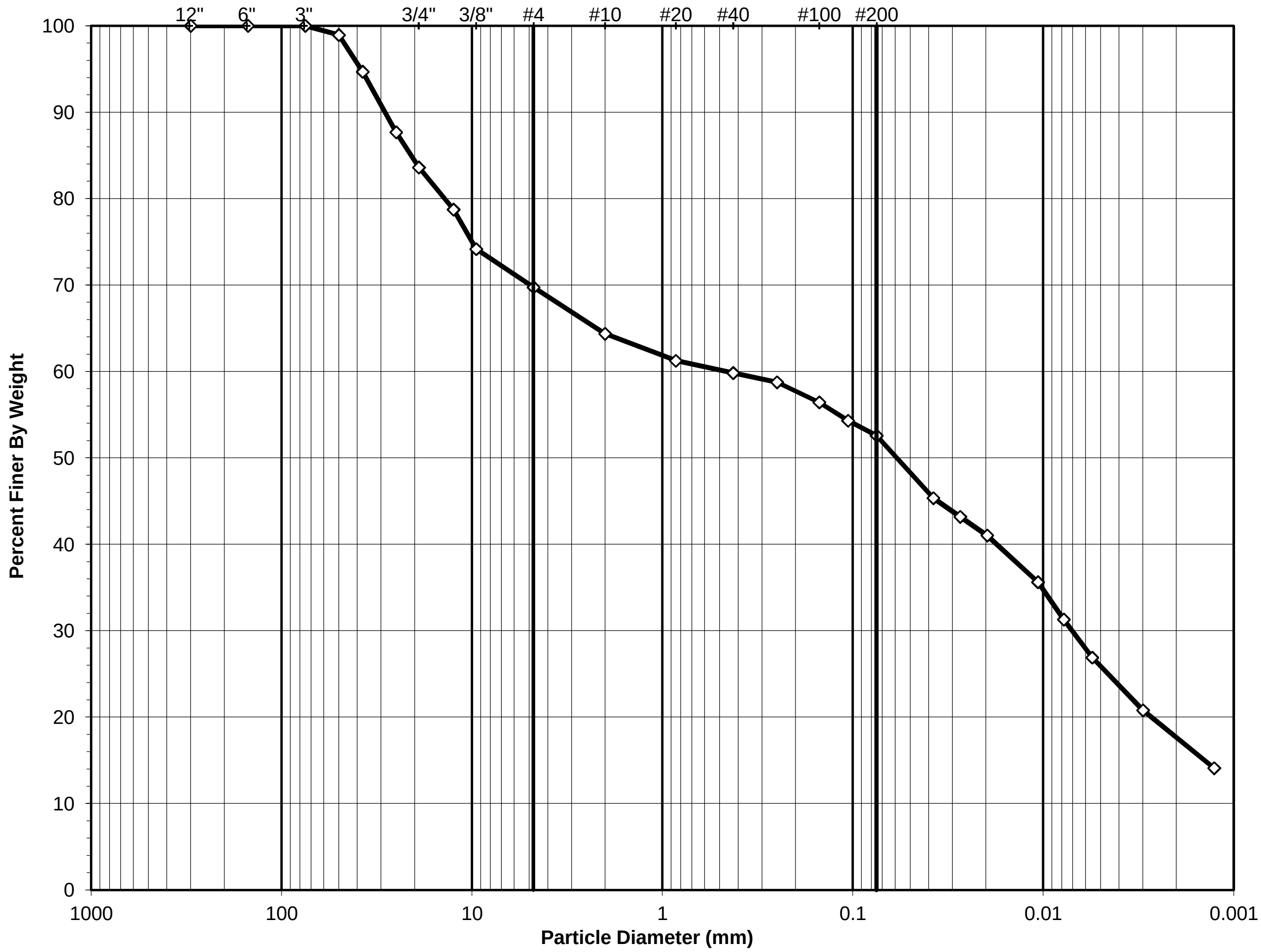
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-9A
Lab ID:	2020-444-001-012	Soil Color:	Brown

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol:
CL, TESTED

D50 = 0.06

USCS Classification:
GRAVELLY LEAN CLAY WITH SAND

Tested By	NR	Date	9/4/20	Checked By	JLK	Date	9/21/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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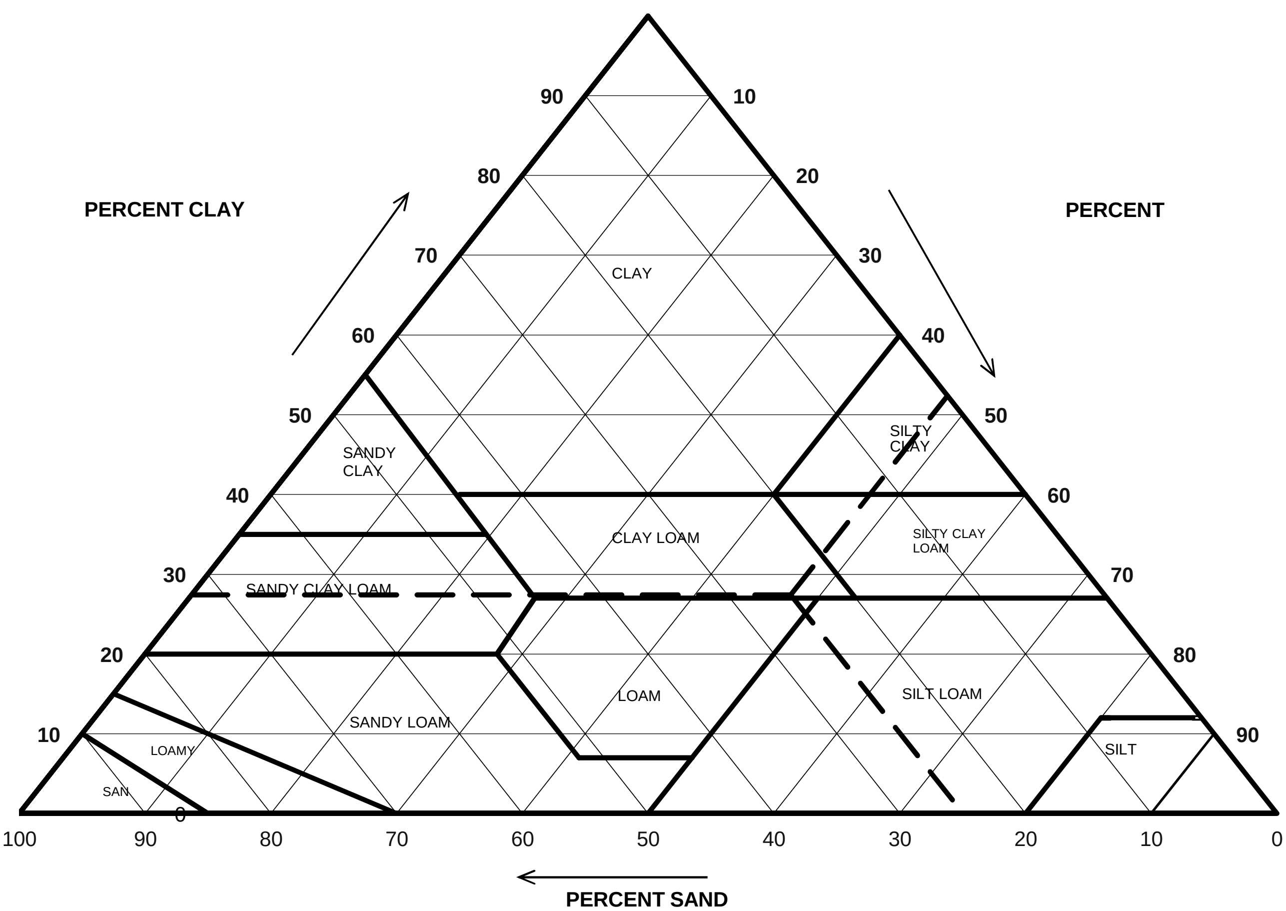
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-9A
Lab ID:	2020-444-001-012	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	35.63	
2	64.37	Sand	16.06	24.96
0.05	48.30	Silt	30.65	47.61
0.002	17.66	Clay	17.66	27.43

USDA Classification: CLAY LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-9A
Lab ID:	2020-444-001-012	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3094	Tare No.:	3299
Wt. of Tare & Wet Sample (g):	243.26	Weight of Tare & Wet Sample (g):	234.60
Wt. of Tare & Dry Sample (g):	217.65	Weight of Tare & Dry Sample (g):	227.74
Weight of Tare (g):	8.10	Weight of Tare (g):	8.21
Weight of Water (g):	25.61	Weight of Water (g):	6.86
Weight of Dry Soil (g):	209.55	Weight of Dry Soil (g):	219.53
Moisture Content (%):	**12.2**	**Moisture Content (%):**	**3.1**

Wet Weight of -3/4" Sample (g):	20550.00	Total Dry Weight of Sample (g):	21901.83
Tare No. (-3/4" Sub-Specimen):	2022	Wet Weight of +3/4" Sample (g):	3702.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1346.52	Dry Weight of + 3/4" Sample (g):	3589.82
Weight of Tare (g):	145.70	Dry Weight of - 3/4" Sample (g):	18312.01
Sub-Specimen -3/4" Wet Weight (g):	1200.82	Dry Weight -3/4" +3/8" Sample (g):	2068.66
Tare No. (-3/8" Sub-Specimen):	898	Dry Weight of -3/8" Sample (g):	16243.35
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	285.77	J - Factor (% Finer than 3/4"):	83.6%
Weight of Tare (g):	109.87	J - Factor (% Finer than 3/8"):	74.2%
Sub-Specimen -3/8" Wet Weight (g):	175.90		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	240.00	(*)	1.06	1.06	98.94	**99**
1 1/2"	37.5	960.00		4.25	5.31	94.69	**95**
1"	25	1582.00		7.00	12.32	87.68	**88**
3/4"	19	920.00		4.07	16.39	83.61	**84**
1/2"	12.5	62.36	(**)	5.83	5.83	94.17	**79**
3/8"	9.5	58.52		5.47	11.30	88.70	**74**
#4	4.75	9.34		5.96	5.96	94.04	**70**
#10	2	11.37		7.25	13.21	86.79	**64**
#20	0.85	6.60	(**)	4.21	17.42	82.58	**61**
#40	0.425	3.00		1.91	19.34	80.66	**60**
#60	0.25	2.26		1.44	20.78	79.22	**59**
#100	0.15	4.91		3.13	23.91	76.09	**56**
#140	0.106	4.48		2.86	26.77	73.23	**54**
#200	0.075	3.65		2.33	29.10	70.90	**53**
Pan	-	111.13		70.90	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/4/20	Checked By	JLK	Date	9/21/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-9A
Lab ID:	2020-444-001-012	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^{o})	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	47.5	23.3	5.53	8.4	0.0378	86.2	45.3
2	45.5	23.3	5.53	8.7	0.0273	82.1	43.2
4	43.5	23.3	5.53	9.1	0.0197	78.0	41.0
15	38.5	23.3	5.53	10.0	0.0107	67.7	35.6
30	34.5	23.3	5.53	10.7	0.0078	59.5	31.3
64	30.5	23.1	5.60	11.4	0.0055	51.1	26.9
240	25.0	22.7	5.75	12.4	0.0030	39.5	20.8
1440	18.5	23.5	5.45	13.6	0.0013	26.8	14.1

Soil Specimen Data

Tare No.:	704	Percent Finer than # 200:	52.58
Wt. of Tare & Dry Material (g):	143.59		
Weight of Tare (g):	90.46	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	48.13		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/17/20 Checked By JLK Date 9/21/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-9A
Lab ID:	2020-444-001-012	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

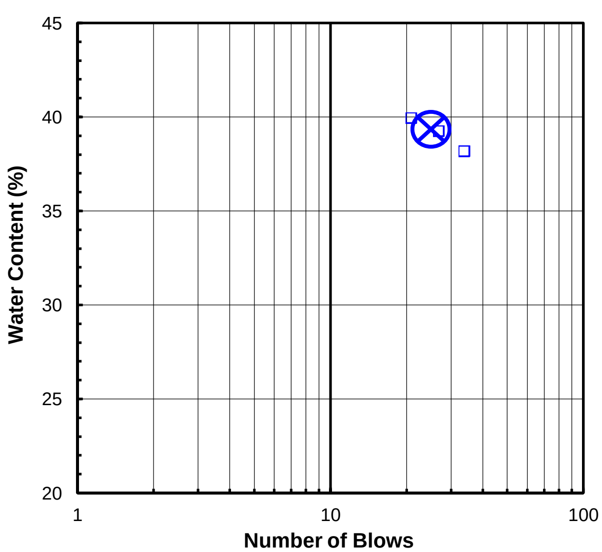
As Received Moisture Content ASTM D2216-19		**Liquid Limit Test** 1	2	3	**M U L T I P O I N T**
Tare Number:	3038	307	309	438	
Wt. of Tare & Wet Sample (g):	328.43	40.13	39.43	37.33	
Wt. of Tare & Dry Sample (g):	287.12	34.41	33.76	31.58	
Weight of Tare (g):	8.52	19.41	19.30	17.17	
Weight of Water (g):	41.3	5.7	5.7	5.8	
Weight of Dry Sample (g):	278.6	15.0	14.5	14.4	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**14.8**	**38.1**	**39.2**	**39.9**	
Number of Blows:		**34**	**27**	**21**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	177	189	
Wt. of Tare & Wet Sample (g):	26.74	25.67	
Wt. of Tare & Dry Sample (g):	25.68	24.73	
Weight of Tare (g):	20.22	19.65	
Weight of Water (g):	1.1	0.9	
Weight of Dry Sample (g):	5.5	5.1	
Moisture Content (%):	**19.4**	**18.5**	**0.9**

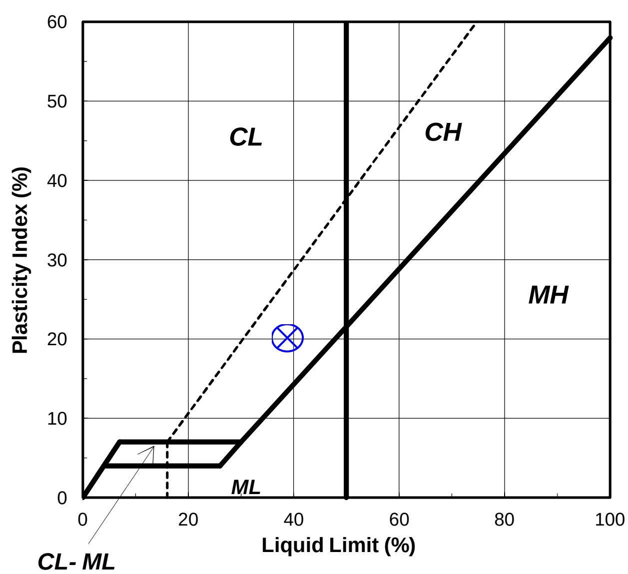
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**39**
Plastic Limit (%):	**19**
Plasticity Index (%):	**20**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By *TO* *Date* *9/14/20* *Checked By* BRB *Date* 9/16/20

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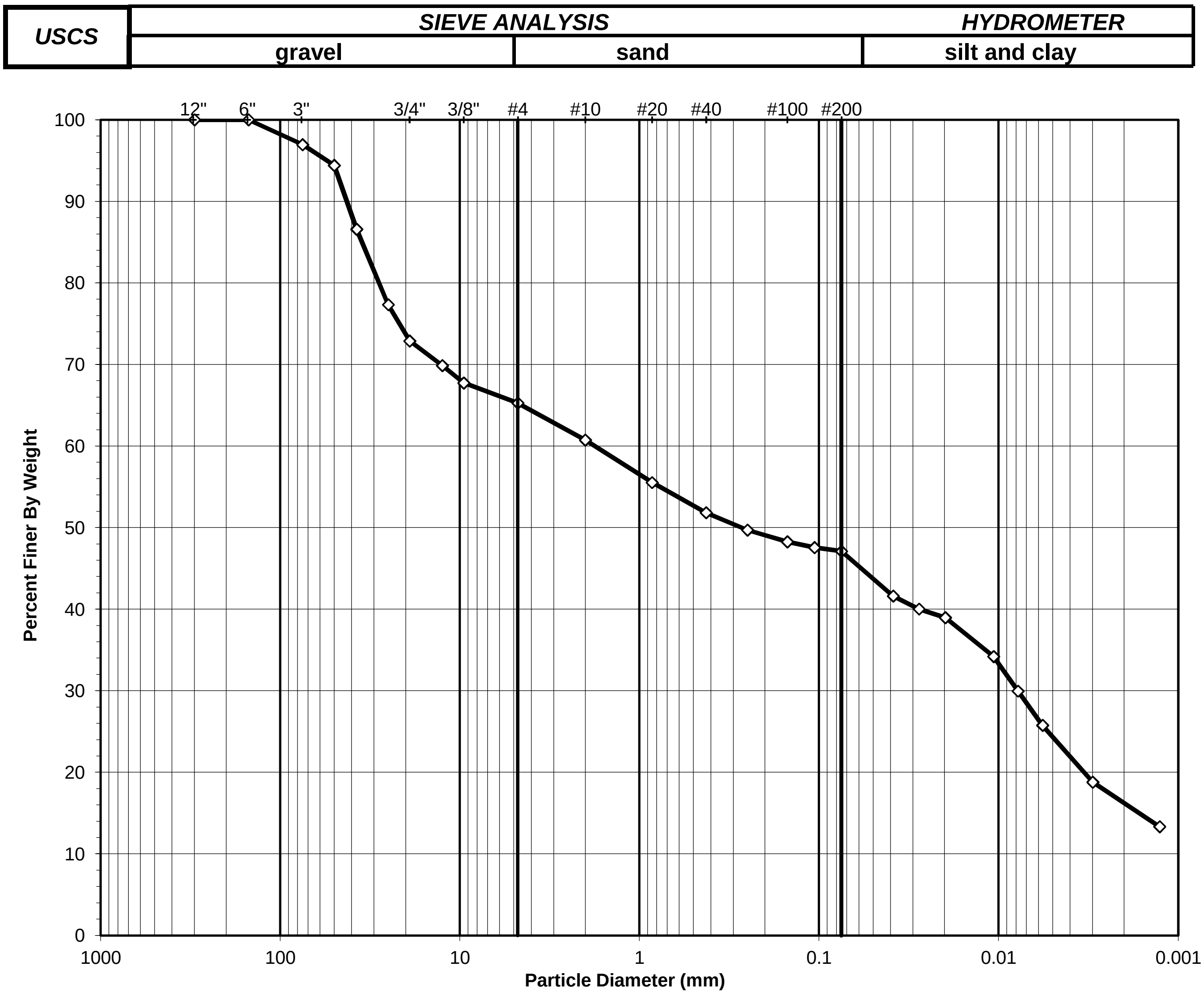
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-10A
Lab ID:	2020-444-001-013	Soil Color:	Brown



USCS Symbol:

GC, TESTED

D50 = 0.27

USCS Classification:

CLAYEY GRAVEL WITH SAND

Tested By NR Date 9/9/20 Checked By BRB Date 9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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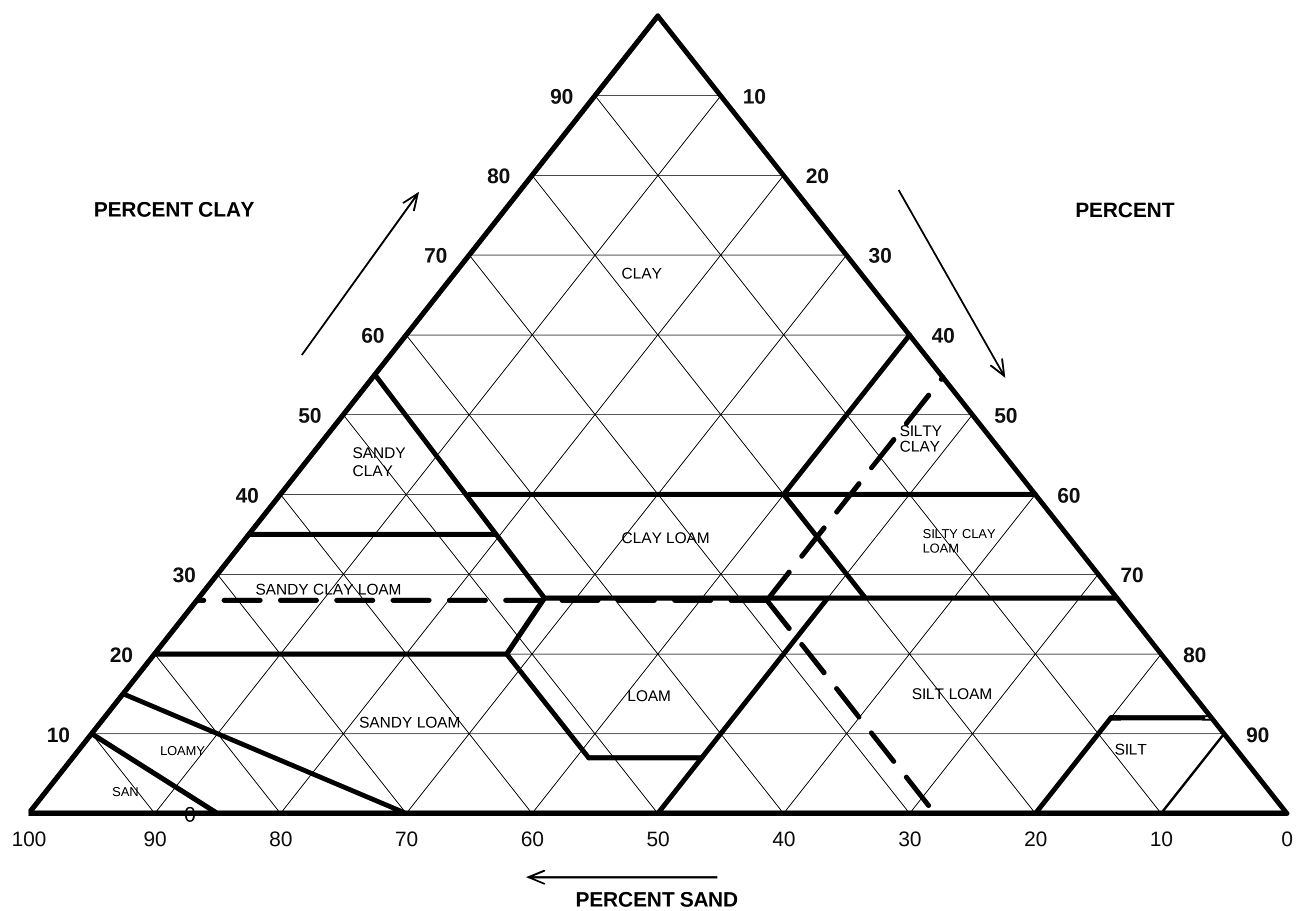
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-10A
Lab ID:	2020-444-001-013	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	39.26	
2	60.74	Sand	16.99	27.97
0.05	43.75	Silt	27.51	45.30
0.002	16.23	Clay	16.23	26.73

USDA Classification: **LOAM**

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-10A
Lab ID:	2020-444-001-013	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3509	Tare No.:	3102
Wt. of Tare & Wet Sample (g):	308.16	Weight of Tare & Wet Sample (g):	372.31
Wt. of Tare & Dry Sample (g):	280.24	Weight of Tare & Dry Sample (g):	352.82
Weight of Tare (g):	8.16	Weight of Tare (g):	8.22
Weight of Water (g):	27.92	Weight of Water (g):	19.49
Weight of Dry Soil (g):	272.08	Weight of Dry Soil (g):	344.60
Moisture Content (%):	**10.3**	**Moisture Content (%):**	**5.7**

Wet Weight of -3/4" Sample (g):	20201.00	Total Dry Weight of Sample (g):	25138.38
Tare No. (-3/4" Sub-Specimen):	1485	Wet Weight of +3/4" Sample (g):	7203.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1341.77	Dry Weight of + 3/4" Sample (g):	6817.42
Weight of Tare (g):	147.63	Dry Weight of - 3/4" Sample (g):	18320.96
Sub-Specimen -3/4" Wet Weight (g):	1194.14	Dry Weight -3/4" +3/8" Sample (g):	1293.96
Tare No. (-3/8" Sub-Specimen):	614	Dry Weight of -3/8" Sample (g):	17027.00
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	293.66	J - Factor (% Finer than 3/4"):	72.9%
Weight of Tare (g):	84.03	J - Factor (% Finer than 3/8"):	67.7%
Sub-Specimen -3/8" Wet Weight (g):	209.63		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	810.00		3.05	3.05	96.95	**97**
2"	50	675.00	(*)	2.54	5.59	94.41	**94**
1 1/2"	37.5	2080.00		7.83	13.42	86.58	**87**
1"	25	2456.00		9.25	22.67	77.33	**77**
3/4"	19	1182.00		4.45	27.12	72.88	**73**
1/2"	12.5	44.85	(**)	4.14	4.14	95.86	**70**
3/8"	9.5	31.64		2.92	7.06	92.94	**68**
#4	4.75	6.92		3.64	3.64	96.36	**65**
#10	2	12.72		6.69	10.33	89.67	**61**
#20	0.85	14.62	(**)	7.69	18.02	81.98	**56**
#40	0.425	10.37		5.45	23.47	76.53	**52**
#60	0.25	5.98		3.15	26.62	73.38	**50**
#100	0.15	4.04		2.12	28.74	71.26	**48**
#140	0.106	1.98		1.04	29.79	70.21	**48**
#200	0.075	1.28		0.67	30.46	69.54	**47**
Pan	-	132.21		69.54	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/9/20	Checked By	BRB	Date	9/16/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-10A
Lab ID:	2020-444-001-013	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	44.5	24.1	5.22	8.9	0.0386	88.3	41.6
2	43.0	24.1	5.22	9.2	0.0277	85.0	40.0
4	42.0	24.1	5.22	9.3	0.0198	82.7	39.0
15	37.5	24.1	5.22	10.2	0.0107	72.6	34.2
30	33.5	24.1	5.22	10.9	0.0078	63.6	30.0
60	29.5	24.2	5.18	11.6	0.0057	54.7	25.8
240	23.0	24.0	5.26	12.8	0.0030	39.9	18.8
1440	18.0	23.6	5.41	13.7	0.0013	28.3	13.3

Soil Specimen Data

Tare No.:	697	Percent Finer than # 200:	47.10
Wt. of Tare & Dry Material (g):	144.61		
Weight of Tare (g):	95.64	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	43.97		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/10/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-10A
Lab ID:	2020-444-001-013	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

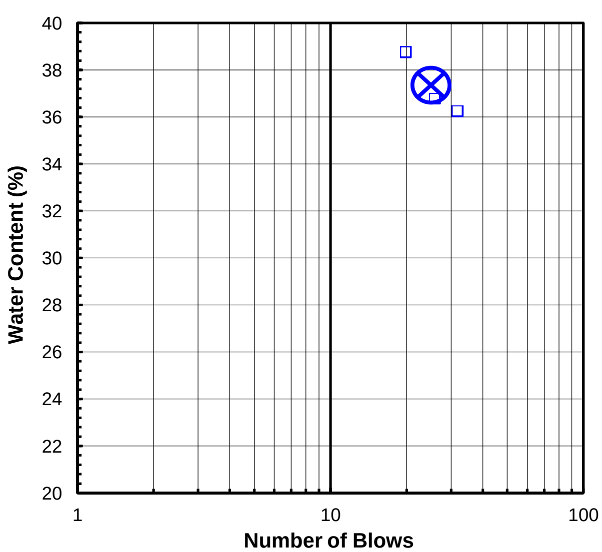
As Received Moisture Content ASTM D2216-19		Liquid Limit Test 1	2	3	
Tare Number:	3523	327	367	613	**M**
Wt. of Tare & Wet Sample (g):	316.70	40.49	40.89	39.81	**U**
Wt. of Tare & Dry Sample (g):	285.06	35.05	35.37	34.19	**L**
Weight of Tare (g):	8.11	20.03	20.35	19.68	**T**
Weight of Water (g):	31.6	5.4	5.5	5.6	**I**
Weight of Dry Sample (g):	277.0	15.0	15.0	14.5	**P**
Was As Received MC Preserved:	**Yes**				**O**
Moisture Content (%):	**11.4**	**36.2**	**36.8**	**38.7**	**I** **N**
Number of Blows:		**32**	**26**	**20**	**T**

Plastic Limit Test	1	2	Range
Tare Number:	628	209	
Wt. of Tare & Wet Sample (g):	25.12	25.69	
Wt. of Tare & Dry Sample (g):	24.15	24.71	
Weight of Tare (g):	18.79	19.30	
Weight of Water (g):	1.0	1.0	
Weight of Dry Sample (g):	5.4	5.4	
Moisture Content (%):	**18.1**	**18.1**	**0.0**

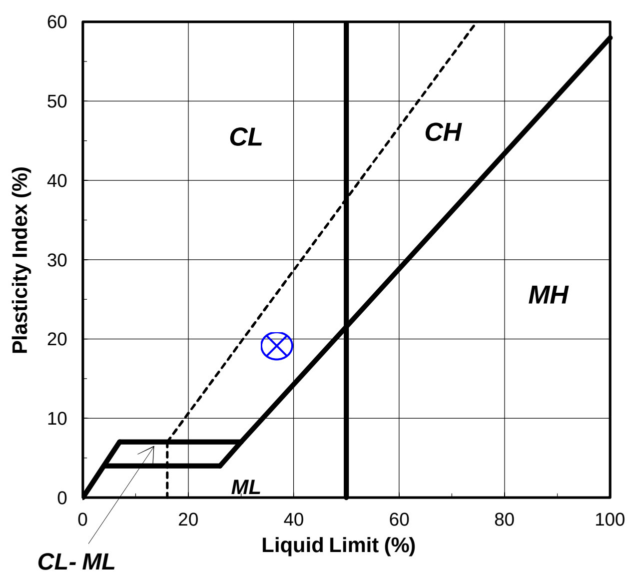
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**37**
Plastic Limit (%):	**18**
Plasticity Index (%):	**19**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By	*FS*	*Date*	*9/15/20*	*Checked By*	*BRB*	*Date*	9/16/20

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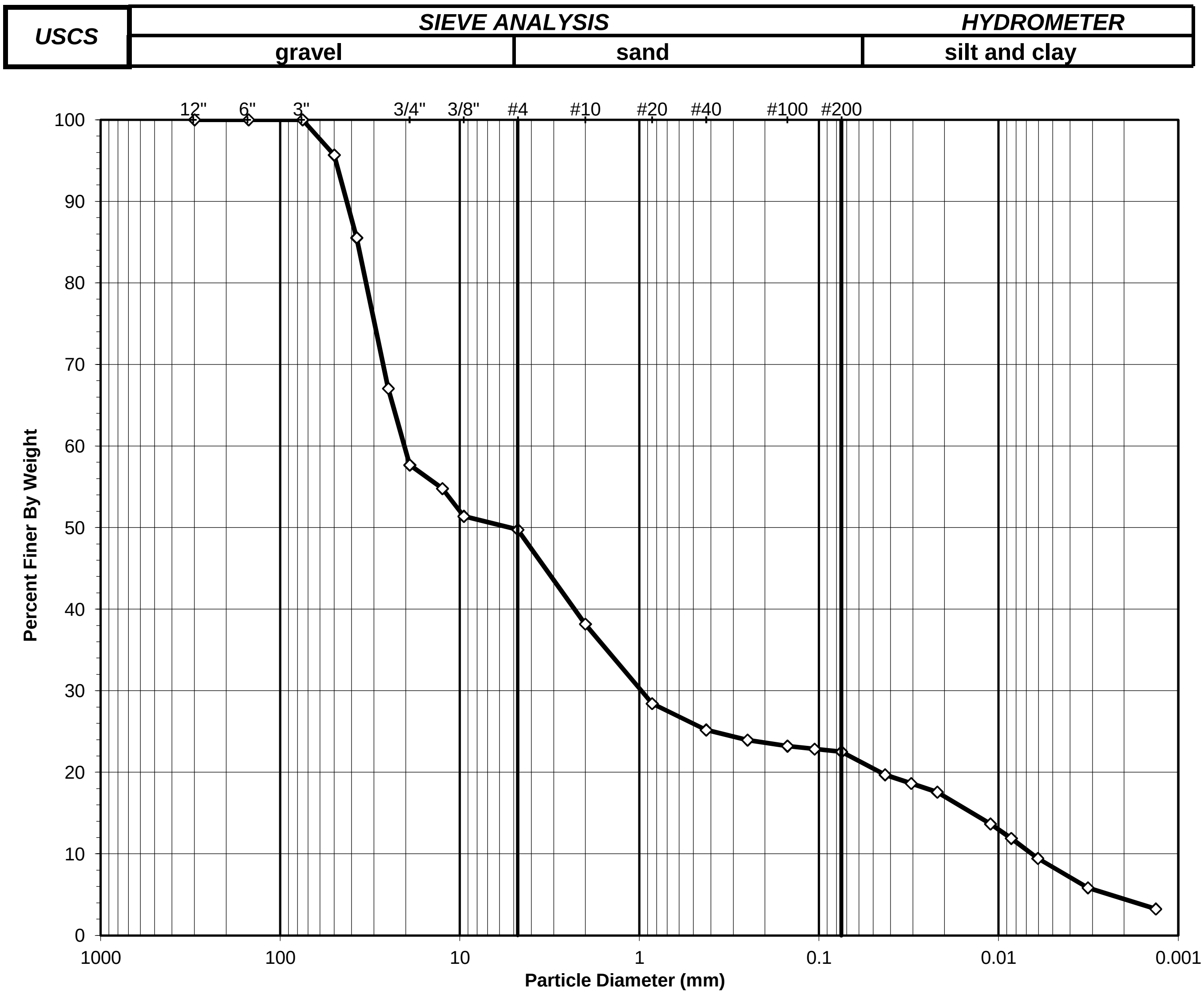
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-11a
Lab ID:	2020-444-001-014	Soil Color:	Brown



USCS Symbol:
GC, TESTED

D50 = 5.27

USCS Classification:
CLAYEY GRAVEL WITH SAND

Tested By NR Date 9/9/20 Checked By BRB Date 9/16/20

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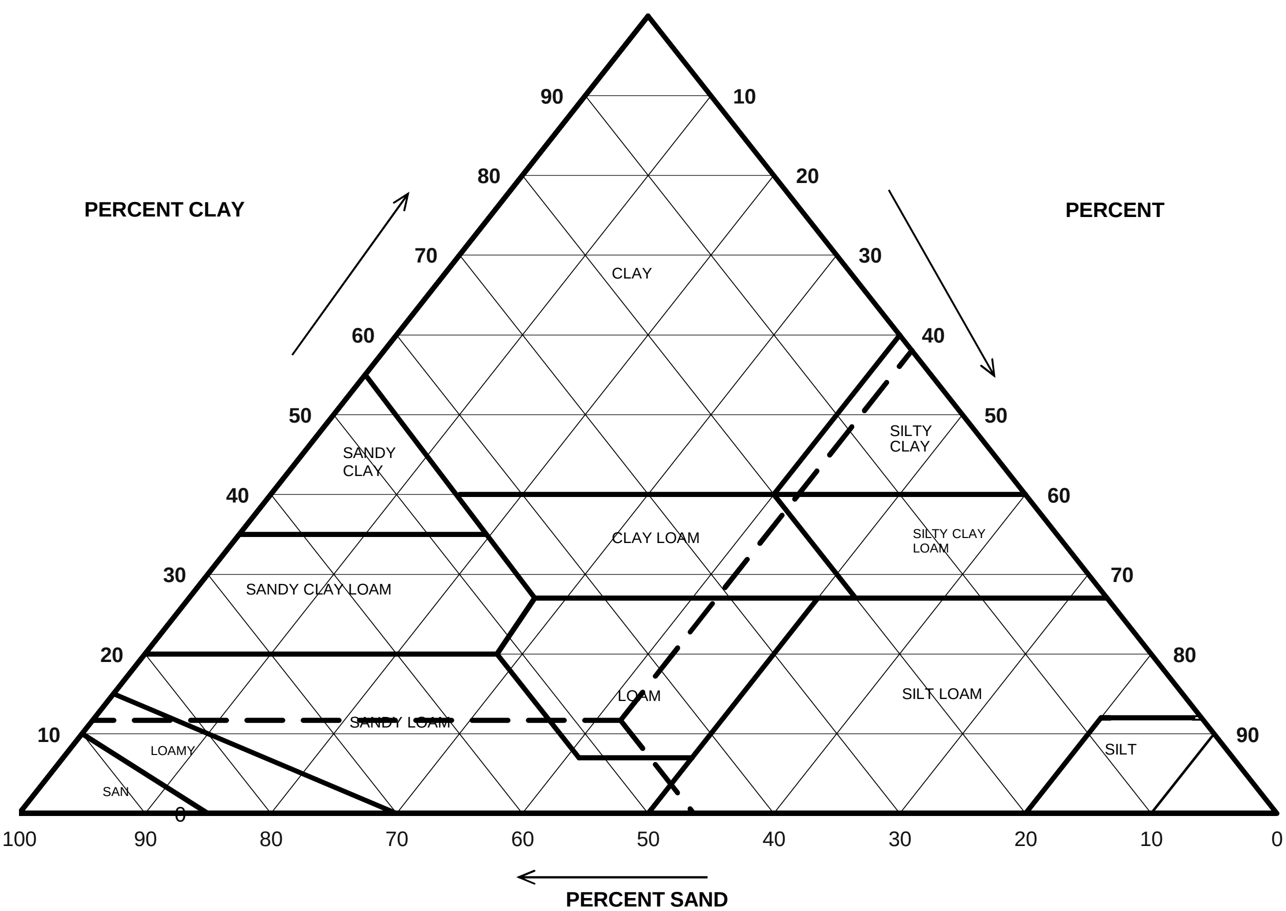
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-11a
Lab ID:	2020-444-001-014	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	61.82	
2	38.18	Sand	17.70	46.36
0.05	20.48	Silt	16.02	41.95
0.002	4.46	Clay	4.46	11.68

USDA Classification: LOAM

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-11a
Lab ID:	2020-444-001-014	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3081	Tare No.:	3353
Wt. of Tare & Wet Sample (g):	303.15	Weight of Tare & Wet Sample (g):	290.10
Wt. of Tare & Dry Sample (g):	281.68	Weight of Tare & Dry Sample (g):	274.77
Weight of Tare (g):	8.40	Weight of Tare (g):	8.08
Weight of Water (g):	21.47	Weight of Water (g):	15.33
Weight of Dry Soil (g):	273.28	Weight of Dry Soil (g):	266.69
Moisture Content (%):	**7.9**	**Moisture Content (%):**	**5.7**
Wet Weight of -3/4" Sample (g):	14295.00	Total Dry Weight of Sample (g):	22981.55
Tare No. (-3/4" Sub-Specimen):	1616	Wet Weight of +3/4" Sample (g):	10287.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1463.98	Dry Weight of + 3/4" Sample (g):	9727.82
Weight of Tare (g):	142.26	Dry Weight of - 3/4" Sample (g):	13253.73
Sub-Specimen -3/4" Wet Weight (g):	1321.72	Dry Weight -3/4" +3/8" Sample (g):	1443.43
Tare No. (-3/8" Sub-Specimen):	586	Dry Weight of -3/8" Sample (g):	11810.30
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	307.14	J - Factor (% Finer than 3/4"):	57.7%
Weight of Tare (g):	81.78	J - Factor (% Finer than 3/8"):	51.4%
Sub-Specimen -3/8" Wet Weight (g):	225.36		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	1050.00	(*)	4.32	4.32	95.68	**96**
1 1/2"	37.5	2465.00		10.14	14.46	85.54	**86**
1"	25	4489.00		18.47	32.93	67.07	**67**
3/4"	19	2283.00		9.39	42.33	57.67	**58**
1/2"	12.5	61.25	(**)	5.00	5.00	95.00	**55**
3/8"	9.5	72.21		5.89	10.89	89.11	**51**
#4	4.75	6.65		3.18	3.18	96.82	**50**
#10	2	47.07		22.53	25.71	74.29	**38**
#20	0.85	39.64	(**)	18.97	44.68	55.32	**28**
#40	0.425	13.13		6.28	50.97	49.03	**25**
#60	0.25	5.03		2.41	53.37	46.63	**24**
#100	0.15	2.99		1.43	54.80	45.20	**23**
#140	0.106	1.50		0.72	55.52	44.48	**23**
#200	0.075	1.37		0.66	56.18	43.82	**23**
Pan	-	91.56		43.82	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/9/20	Checked By	BRB	Date	9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-11a
Lab ID:	2020-444-001-014	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^{o})	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	33.0	24.1	5.22	11.0	0.0429	87.5	19.7
2	31.5	24.1	5.22	11.2	0.0307	82.8	18.6
4	30.0	24.1	5.22	11.5	0.0220	78.0	17.6
17	24.5	24.1	5.22	12.5	0.0111	60.7	13.7
30	22.0	24.1	5.22	12.9	0.0085	52.9	11.9
62	18.5	24.2	5.18	13.6	0.0061	42.0	9.4
240	13.5	24.0	5.26	14.5	0.0032	26.0	5.8
1440	10.0	23.6	5.41	15.1	0.0013	14.4	3.3

Soil Specimen Data

Tare No.:	2333	Percent Finer than # 200:	22.52
Wt. of Tare & Dry Material (g):	131.06		
Weight of Tare (g):	94.66	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	31.40		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/10/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-11A
Lab ID:	2020-444-001-014	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

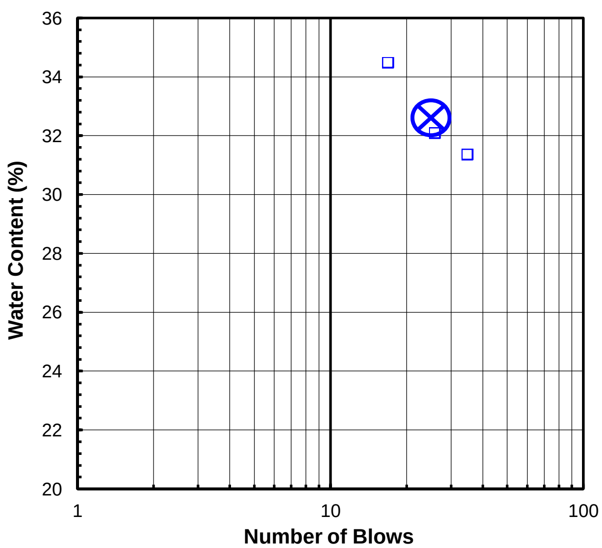
As Received Moisture Content ASTM D2216-19		Liquid Limit Test 1	2	3	M U L T I P O I N T
Tare Number:	3516	331	523	1275	
Wt. of Tare & Wet Sample (g):	408.27	28.83	27.71	30.54	
Wt. of Tare & Dry Sample (g):	373.60	26.58	25.69	27.79	
Weight of Tare (g):	8.26	19.40	19.39	19.81	
Weight of Water (g):	34.7	2.3	2.0	2.8	
Weight of Dry Sample (g):	365.3	7.2	6.3	8.0	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**9.5**	**31.3**	**32.1**	**34.5**	
Number of Blows:		**35**	**26**	**17**	

Plastic Limit Test	1	2	Range
Tare Number:	115	1113	
Wt. of Tare & Wet Sample (g):	25.07	25.12	
Wt. of Tare & Dry Sample (g):	23.96	24.09	
Weight of Tare (g):	18.65	18.98	
Weight of Water (g):	1.1	1.0	
Weight of Dry Sample (g):	5.3	5.1	
Moisture Content (%):	**20.9**	**20.2**	**0.7**

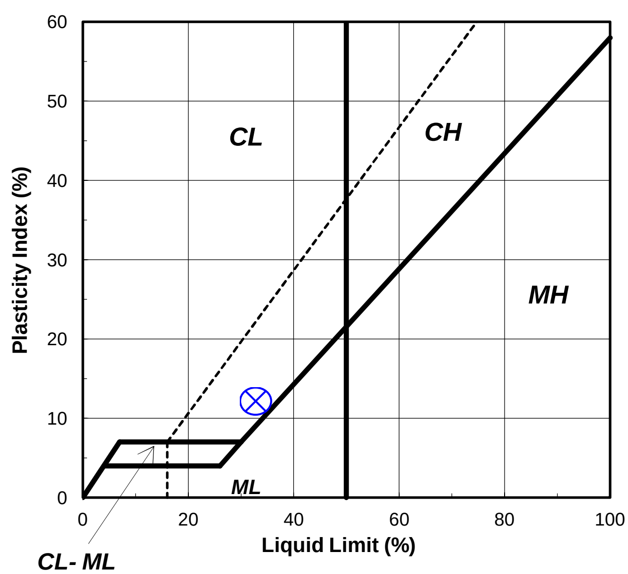
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**33**
Plastic Limit (%):	**21**
Plasticity Index (%):	**12**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By	*TO*	*Date*	*9/14/20*	*Checked By*	*BRB*	*Date*	*9/16/20*

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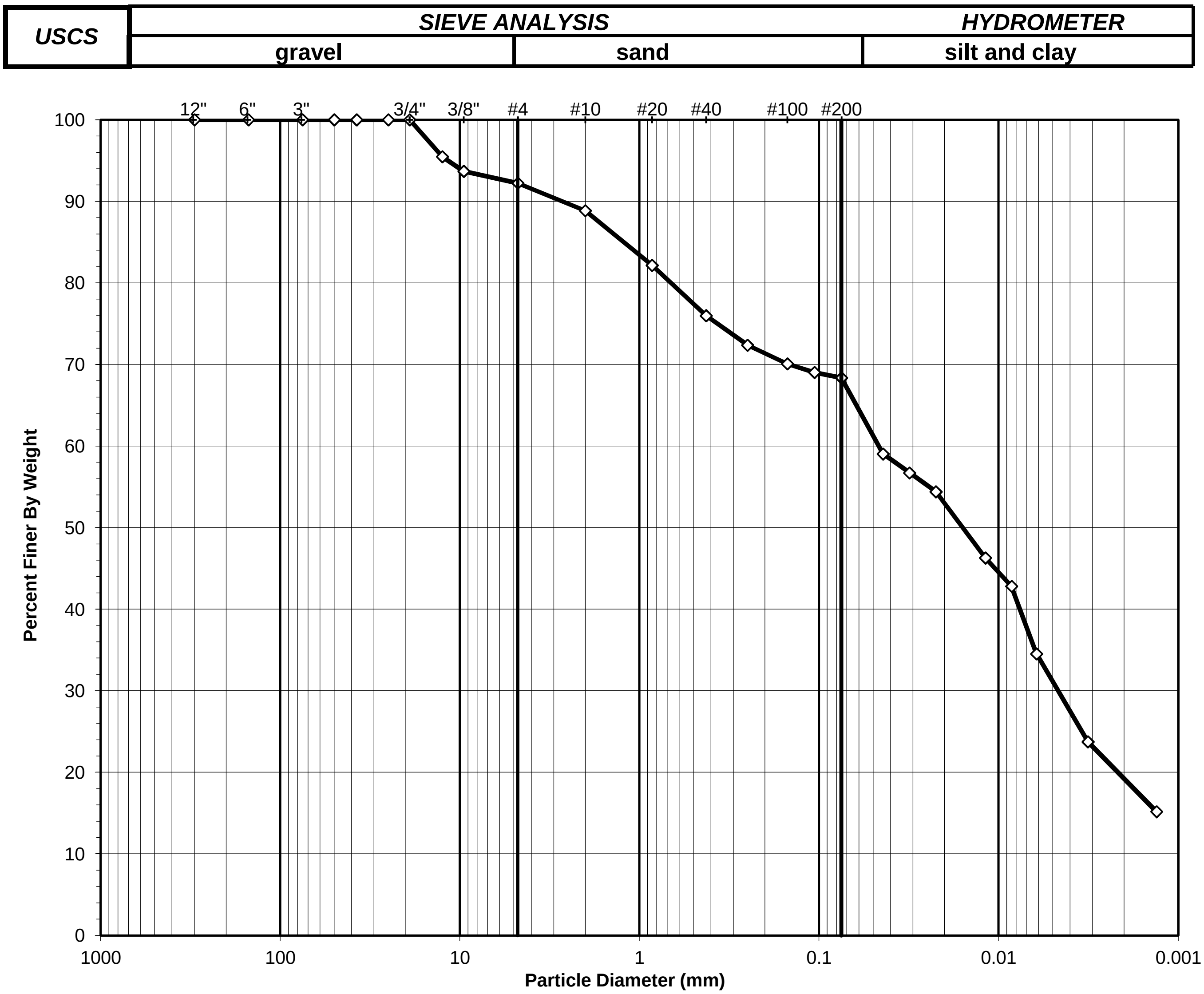
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-12A
Lab ID:	2020-444-001-015	Soil Color:	Brown



USCS Symbol:
CL, TESTED

D50 = 0.02

USCS Classification:
SANDY LEAN CLAY

Tested By	NR	Date	9/8/20	Checked By	JLK	Date	9/21/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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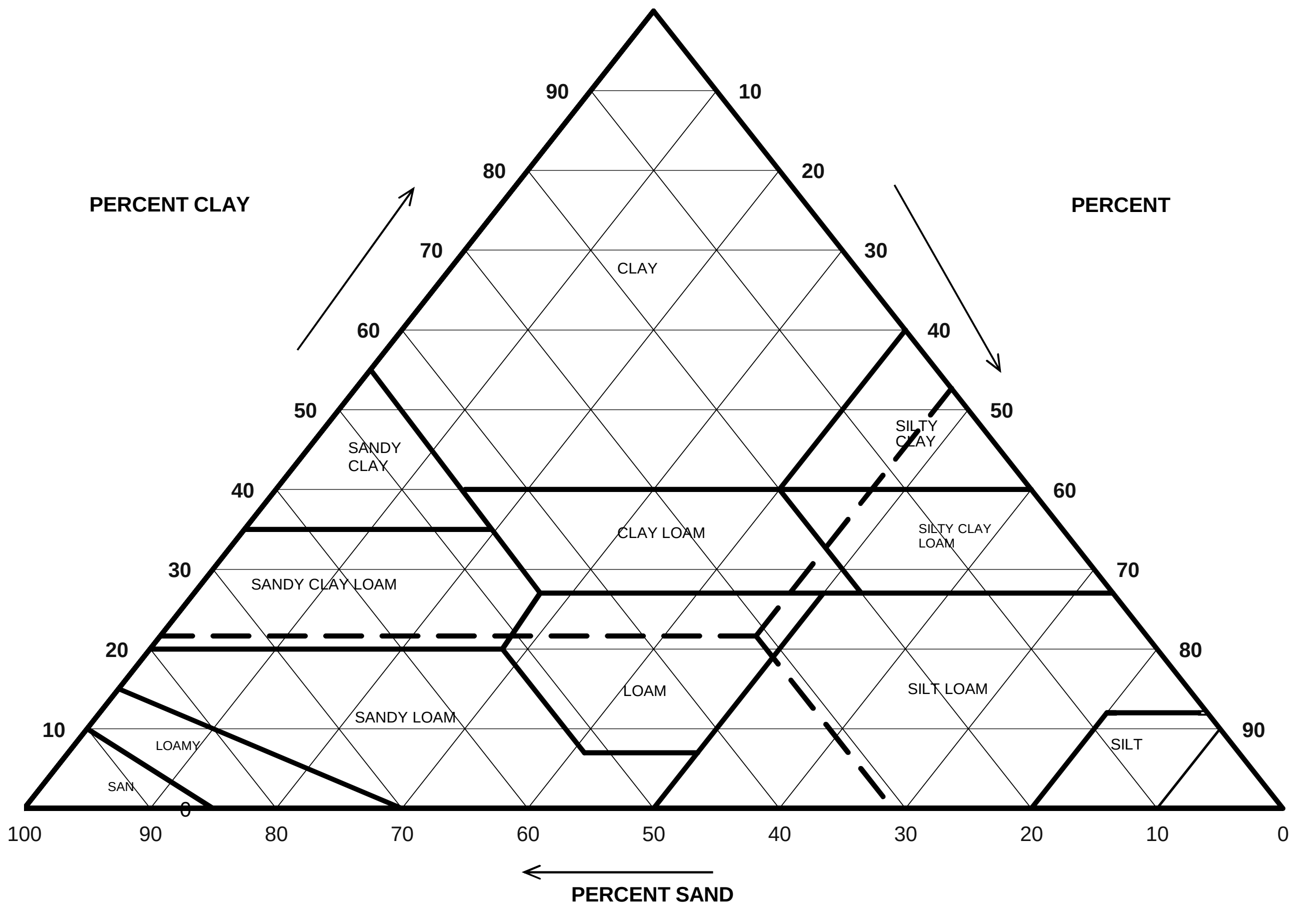
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-12A
Lab ID:	2020-444-001-015	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	11.14	
2	88.86	Sand	27.58	31.04
0.05	61.27	Silt	42.05	47.32
0.002	19.23	Clay	19.23	21.64

USDA Classification: **LOAM**

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-12A
Lab ID:	2020-444-001-015	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3351	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	374.78	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	338.25	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	8.01	Weight of Tare (g):	NA
Weight of Water (g):	36.53	Weight of Water (g):	NA
Weight of Dry Soil (g):	330.24	Weight of Dry Soil (g):	NA
Moisture Content (%):	**11.1**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Total Dry Weight of Sample (g):	1154.58
Tare No. (-3/4" Sub-Specimen):	1612	Wet Weight of +3/4" Sample (g):	0.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1430.42	Dry Weight of + 3/4" Sample (g):	0.00
Weight of Tare (g):	148.12	Dry Weight of - 3/4" Sample (g):	1154.58
Sub-Specimen -3/4" Wet Weight (g):	1282.30	Dry Weight -3/4" +3/8" Sample (g):	72.87
Tare No. (-3/8" Sub-Specimen):	1128	Dry Weight of -3/8" Sample (g):	1081.71
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	272.51	J - Factor (% Finer than 3/4"):	NA
Weight of Tare (g):	84.74	J - Factor (% Finer than 3/8"):	93.7%
Sub-Specimen -3/8" Wet Weight (g):	187.77		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	0.00	(*)	0.00	0.00	100.00	**100**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100**
1"	25	0.00		0.00	0.00	100.00	**100**
3/4"	19	0.00		0.00	0.00	100.00	**100**
1/2"	12.5	52.28	(**)	4.53	4.53	95.47	**95**
3/8"	9.5	20.59		1.78	6.31	93.69	**94**
#4	4.75	2.62		1.55	1.55	98.45	**92**
#10	2	6.10		3.61	5.16	94.84	**89**
#20	0.85	12.09	(**)	7.15	12.31	87.69	**82**
#40	0.425	11.14		6.59	18.90	81.10	**76**
#60	0.25	6.53		3.86	22.76	77.24	**72**
#100	0.15	4.12		2.44	25.20	74.80	**70**
#140	0.106	1.90		1.12	26.32	73.68	**69**
#200	0.075	1.20		0.71	27.03	72.97	**68**
Pan	-	123.37		72.97	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/8/20	Checked By	JLK	Date	9/21/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-12A
Lab ID:	2020-444-001-015	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	31.0	23.3	5.53	11.3	0.0440	86.3	59.0
2	30.0	23.3	5.53	11.5	0.0313	83.0	56.7
4	29.0	23.3	5.53	11.7	0.0223	79.6	54.4
15	25.5	23.3	5.53	12.3	0.0118	67.7	46.3
30	24.0	23.3	5.53	12.6	0.0085	62.6	42.8
60	20.5	23.1	5.60	13.2	0.0061	50.5	34.5
240	16.0	22.7	5.75	14.0	0.0032	34.7	23.7
1440	12.0	23.5	5.45	14.7	0.0013	22.2	15.2

Soil Specimen Data

Tare No.:	700	Percent Finer than # 200:	68.36
Wt. of Tare & Dry Material (g):	121.06		
Weight of Tare (g):	86.89	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	29.17		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/17/20 Checked By JLK Date 9/21/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-12A
Lab ID:	2020-444-001-015	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

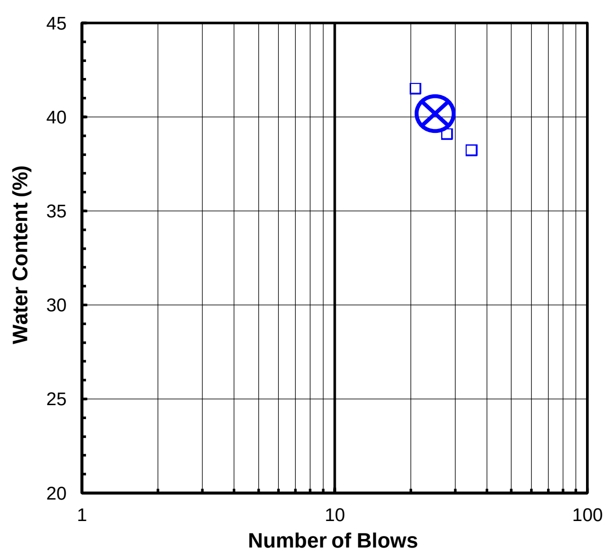
As Received Moisture Content ASTM D2216-19		**Liquid Limit Test 1**	**2**	**3**	**M**
Tare Number:	3295	169	366	470	**U**
Wt. of Tare & Wet Sample (g):	321.50	39.99	40.64	39.36	**L**
Wt. of Tare & Dry Sample (g):	287.09	34.27	34.02	33.45	**T**
Weight of Tare (g):	8.36	19.29	17.07	19.20	**I**
Weight of Water (g):	34.4	5.7	6.6	5.9	**P**
Weight of Dry Sample (g):	278.7	15.0	17.0	14.3	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**12.3**	**38.2**	**39.1**	**41.5**	**N**
Number of Blows:		**35**	**28**	**21**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	505	532	
Wt. of Tare & Wet Sample (g):	26.56	26.81	
Wt. of Tare & Dry Sample (g):	25.40	25.64	
Weight of Tare (g):	20.34	20.45	
Weight of Water (g):	1.2	1.2	
Weight of Dry Sample (g):	5.1	5.2	
Moisture Content (%):	**22.9**	**22.5**	**0.4**

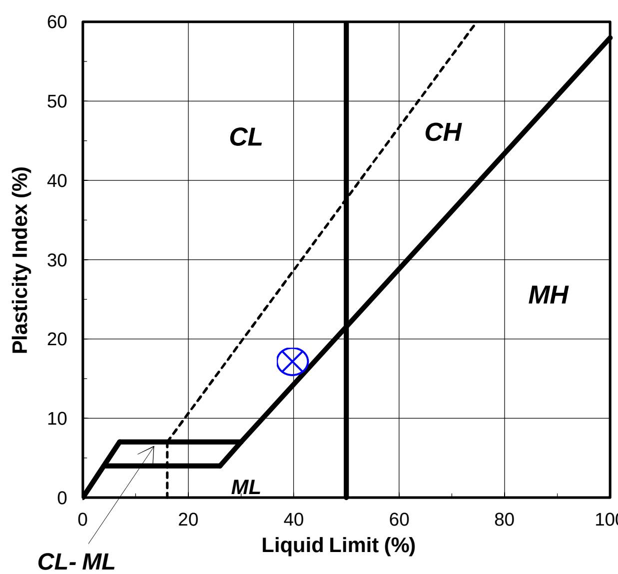
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**40**
Plastic Limit (%):	**23**
Plasticity Index (%):	**17**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By *TO* *Date* *9/14/20* *Checked By* *BRB* *Date* 9/16/20

page 1 of 1 DCN: CTS4B, REV. 8, 5/22/18 *S:\Excel\Excel QA\Spreadsheets\Limit 3Pt.xls*

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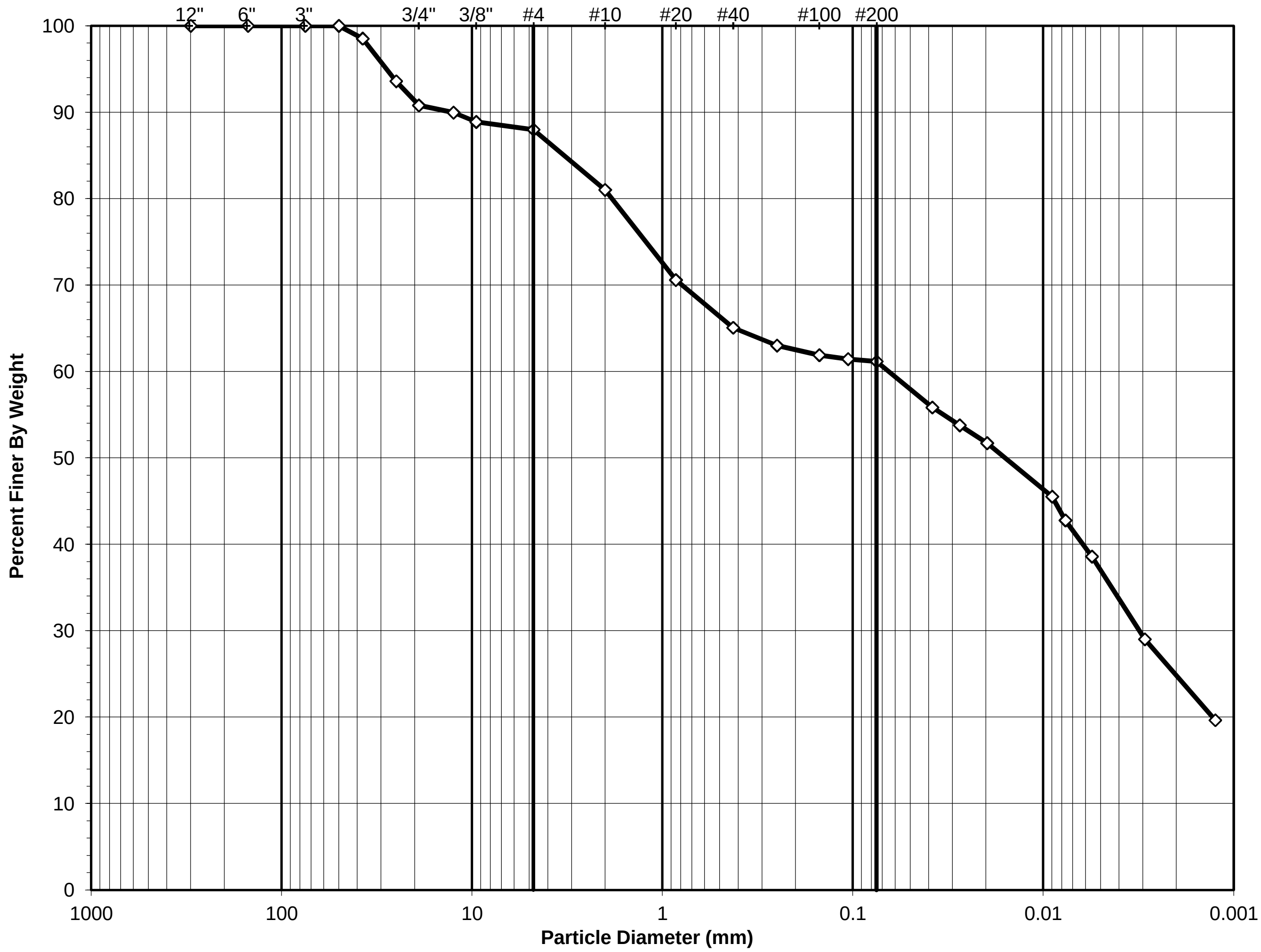
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-14A
Lab ID:	2020-444-001-016	Soil Color:	Brown

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol:
CL, TESTED

D50 = 0.02

USCS Classification:
SANDY LEAN CLAY

Tested By NR Date 9/9/20 Checked By BRB Date 9/16/20

page 1 of 4 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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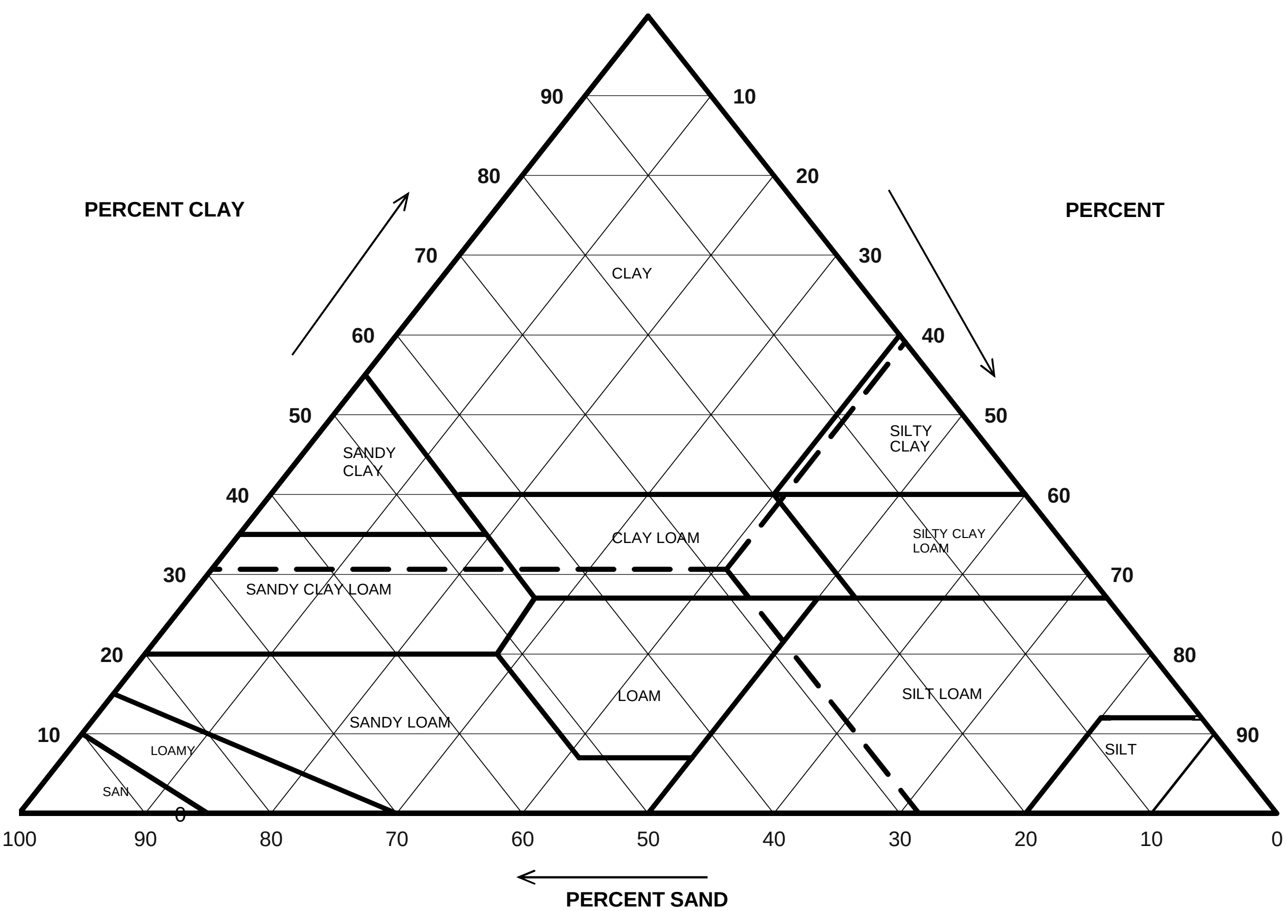
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-14A
Lab ID:	2020-444-001-016	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	18.99	
2	81.01	Sand	23.06	28.46
0.05	57.96	Silt	33.14	40.90
0.002	24.82	Clay	24.82	30.64

USDA Classification: CLAY LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-14A
Lab ID:	2020-444-001-016	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3512	Tare No.:	3299
Wt. of Tare & Wet Sample (g):	318.75	Weight of Tare & Wet Sample (g):	329.13
Wt. of Tare & Dry Sample (g):	283.12	Weight of Tare & Dry Sample (g):	306.49
Weight of Tare (g):	8.06	Weight of Tare (g):	8.22
Weight of Water (g):	35.63	Weight of Water (g):	22.64
Weight of Dry Soil (g):	275.06	Weight of Dry Soil (g):	298.27
Moisture Content (%):	**13.0**	**Moisture Content (%):**	**7.6**

Wet Weight of -3/4" Sample (g):	20595.00	Total Dry Weight of Sample (g):	20082.77
Tare No. (-3/4" Sub-Specimen):	2044	Wet Weight of +3/4" Sample (g):	1990.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1431.12	Dry Weight of + 3/4" Sample (g):	1849.61
Weight of Tare (g):	146.44	Dry Weight of - 3/4" Sample (g):	18233.16
Sub-Specimen -3/4" Wet Weight (g):	1284.68	Dry Weight -3/4" +3/8" Sample (g):	383.15
Tare No. (-3/8" Sub-Specimen):	579	Dry Weight of -3/8" Sample (g):	17850.01
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	317.43	J - Factor (% Finer than 3/4"):	90.8%
Weight of Tare (g):	82.82	J - Factor (% Finer than 3/8"):	88.9%
Sub-Specimen -3/8" Wet Weight (g):	234.61		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	0.00	(*)	0.00	0.00	100.00	**100**
1 1/2"	37.5	320.00		1.48	1.48	98.52	**99**
1"	25	1066.00		4.93	6.41	93.59	**94**
3/4"	19	604.00		2.80	9.21	90.79	**91**
1/2"	12.5	10.42	(**)	0.92	0.92	99.08	**90**
3/8"	9.5	13.48		1.19	2.10	97.90	**89**
#4	4.75	2.11		1.02	1.02	98.98	**88**
#10	2	16.28		7.84	8.85	91.15	**81**
#20	0.85	24.36	(**)	11.73	20.58	79.42	**71**
#40	0.425	12.90		6.21	26.79	73.21	**65**
#60	0.25	4.83		2.33	29.12	70.88	**63**
#100	0.15	2.59		1.25	30.37	69.63	**62**
#140	0.106	1.06		0.51	30.88	69.12	**61**
#200	0.075	0.65		0.31	31.19	68.81	**61**
Pan	-	142.92		68.81	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/9/20	Checked By	BRB	Date	9/16/20

 DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-14A
Lab ID:	2020-444-001-016	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^o)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	46.0	23.6	5.41	8.6	0.0383	91.3	55.8
2	44.5	23.6	5.41	8.9	0.0275	87.9	53.8
4	43.0	23.6	5.41	9.2	0.0197	84.6	51.7
21	38.5	23.6	5.41	10.0	0.0090	74.4	45.5
30	36.5	23.6	5.41	10.3	0.0076	69.9	42.8
60	33.5	23.5	5.45	10.9	0.0056	63.1	38.6
240	26.5	23.6	5.41	12.1	0.0029	47.4	29.0
1440	19.5	24.1	5.22	13.4	0.0012	32.1	19.7

Soil Specimen Data

Tare No.:	975	Percent Finer than # 200:	61.16
Wt. of Tare & Dry Material (g):	142.93		
Weight of Tare (g):	93.97	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	43.96		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/10/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

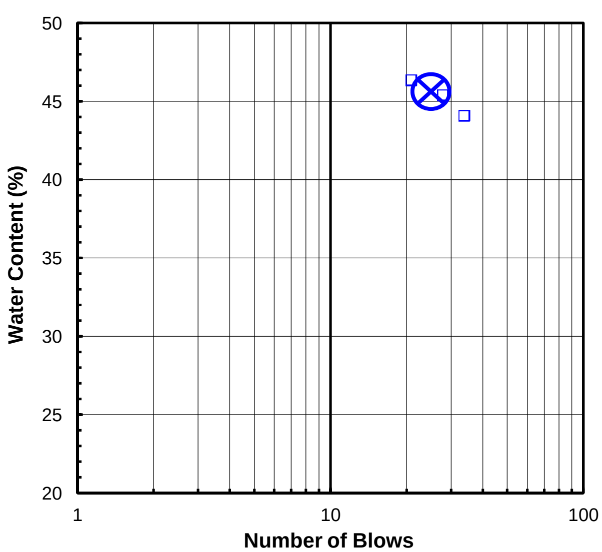
Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-14A
Lab ID:	2020-444-001-016	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

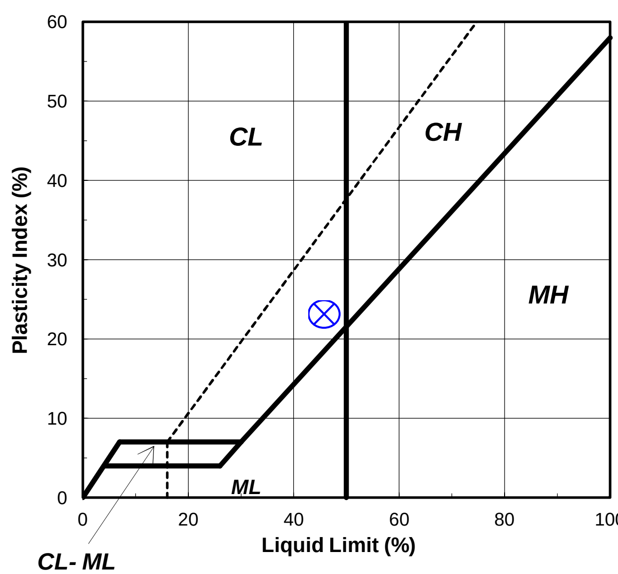
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-19		1	2	3	M
Tare Number:	3236	117	144	606	U
Wt. of Tare & Wet Sample (g):	389.12	41.55	38.43	39.88	L
Wt. of Tare & Dry Sample (g):	344.73	35.02	32.05	33.11	T
Weight of Tare (g):	8.12	20.19	17.98	18.49	I
Weight of Water (g):	44.4	6.5	6.4	6.8	P
Weight of Dry Sample (g):	336.6	14.8	14.1	14.6	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**13.2**	**44.0**	**45.3**	**46.3**	N
Number of Blows:		**34**	**28**	**21**	T

Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	169	175		**Liquid Limit (%):**	**46**
Wt. of Tare & Wet Sample (g):	25.63	26.30			
Wt. of Tare & Dry Sample (g):	24.45	25.01		**Plastic Limit (%):**	**23**
Weight of Tare (g):	19.28	19.67			
Weight of Water (g):	1.2	1.3		**Plasticity Index (%):**	**23**
Weight of Dry Sample (g):	5.2	5.3			
				USCS Symbol:	**CL**
Moisture Content (%):	**22.8**	**24.2**	**-1.3**		
Note: The acceptable range of the two Moisture Contents is ±			1.12		

Flow Curve



Plasticity Chart



Tested By	*JP*	*Date*	*9/15/20*	*Checked By*	*BRB*	*Date*	*9/16/20*

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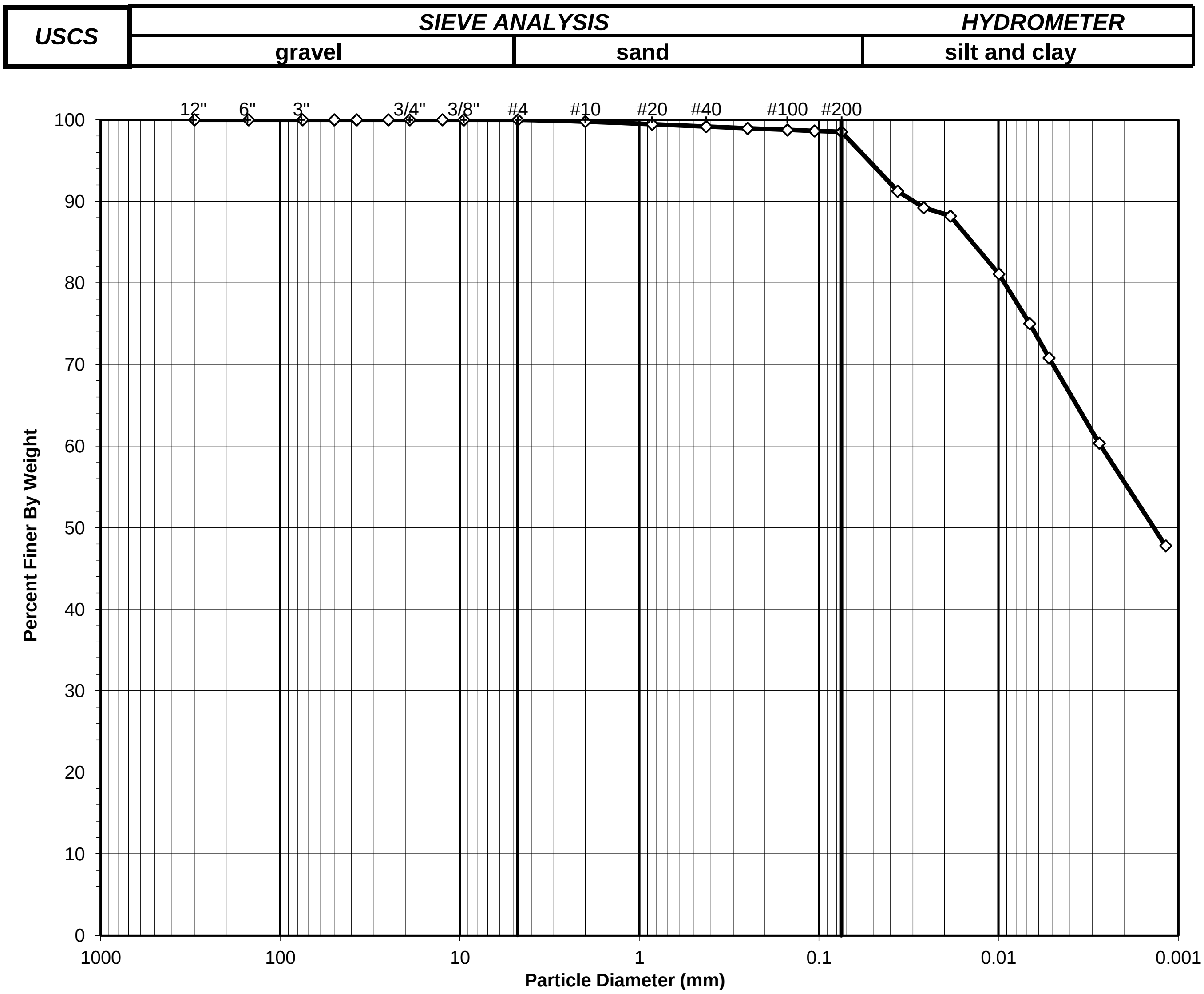
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15A
Lab ID:	2020-444-001-017	Soil Color:	Brown



USCS Symbol:

CH, TESTED

D50 = 0.00

USCS Classification:

FAT CLAY

Tested By	NR	Date	9/9/20	Checked By	JLK	Date	9/21/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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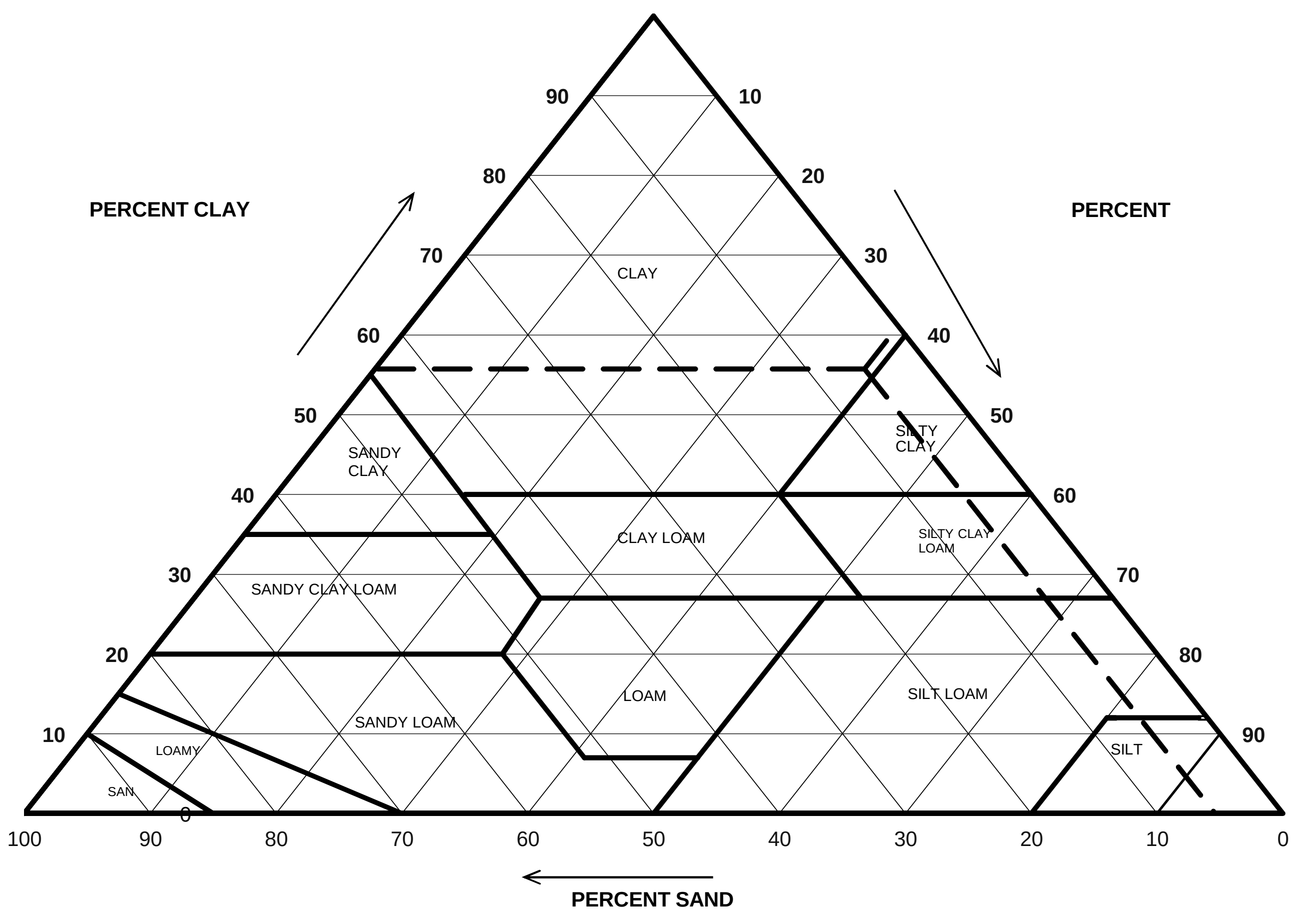
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15A
Lab ID:	2020-444-001-017	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	0.20	
2	99.80	Sand	5.37	5.38
0.05	94.42	Silt	38.79	38.87
0.002	55.63	Clay	55.63	55.74

USDA Classification: **CLAY**

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

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Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15A
Lab ID:	2020-444-001-017	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	3221	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	334.01	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	281.86	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	8.11	Weight of Tare (g):	NA
Weight of Water (g):	52.15	Weight of Water (g):	NA
Weight of Dry Soil (g):	273.75	Weight of Dry Soil (g):	NA
Moisture Content (%):	**19.1**	**Moisture Content (%):**	**0.0**

Wet Weight of -3/4" Sample (g):	NA	Total Dry Weight of Sample (g):	942.64
Tare No. (-3/4" Sub-Specimen):	1487	Wet Weight of +3/4" Sample (g):	0.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1268.94	Dry Weight of + 3/4" Sample (g):	0.00
Weight of Tare (g):	146.73	Dry Weight of - 3/4" Sample (g):	942.64
Sub-Specimen -3/4" Wet Weight (g):	1122.21	Dry Weight -3/4" +3/8" Sample (g):	0.00
Tare No. (-3/8" Sub-Specimen):	870	Dry Weight of -3/8" Sample (g):	942.64
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	286.05	J - Factor (% Finer than 3/4"):	NA
Weight of Tare (g):	109.35	J - Factor (% Finer than 3/8"):	100.0%
Sub-Specimen -3/8" Wet Weight (g):	176.70		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.0**
6"	150	0.00		0.00	0.00	100.00	**100.0**
3"	75	0.00		0.00	0.00	100.00	**100.0**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.0**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.0**
1"	25	0.00		0.00	0.00	100.00	**100.0**
3/4"	19	0.00		0.00	0.00	100.00	**100.0**
1/2"	12.5	0.00	(**)	0.00	0.00	100.00	**100.0**
3/8"	9.5	0.00		0.00	0.00	100.00	**100.0**
#4	4.75	0.00		0.00	0.00	100.00	**100.0**
#10	2	0.30		0.20	0.20	99.80	**99.8**
#20	0.85	0.53	(**)	0.36	0.56	99.44	**99.4**
#40	0.425	0.39		0.26	0.82	99.18	**99.2**
#60	0.25	0.34		0.23	1.05	98.95	**98.9**
#100	0.15	0.27		0.18	1.23	98.77	**98.8**
#140	0.106	0.20		0.13	1.37	98.63	**98.6**
#200	0.075	0.15		0.10	1.47	98.53	**98.5**
Pan	-	146.24		98.53	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By	NR	Date	9/9/20	Checked By	JLK	Date	9/21/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15A
Lab ID:	2020-444-001-017	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C°)	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	50.5	23.3	5.53	7.8	0.0365	92.6	91.2
2	49.5	23.3	5.53	8.0	0.0261	90.5	89.2
4	49.0	23.3	5.53	8.1	0.0186	89.5	88.2
15	45.5	23.3	5.53	8.7	0.0100	82.3	81.1
35	42.5	23.3	5.53	9.3	0.0067	76.1	75.0
60	40.5	23.1	5.60	9.6	0.0052	71.9	70.8
240	35.5	22.7	5.75	10.5	0.0028	61.3	60.4
1440	29.0	23.5	5.45	11.7	0.0012	48.5	47.8

Soil Specimen Data

Tare No.:	2333	Percent Finer than # 200:	98.53
Wt. of Tare & Dry Material (g):	147.87		
Weight of Tare (g):	94.85	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	48.02		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/17/20 Checked By JLK Date 9/21/20

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15A
Lab ID:	2020-444-001-017	Soil Description:	BROWN FAT CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

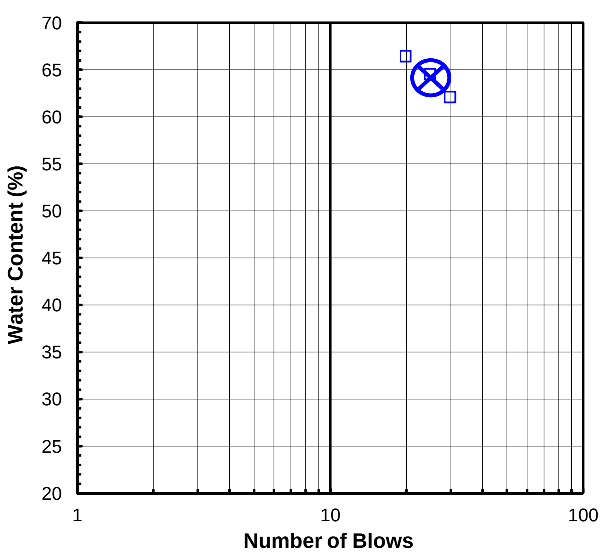
As Received Moisture Content ASTM D2216-19		Liquid Limit Test 1	2	3	MULTIPOINT
Tare Number:	3203	640	531	619	
Wt. of Tare & Wet Sample (g):	273.00	39.60	40.93	39.80	
Wt. of Tare & Dry Sample (g):	216.54	31.93	32.97	31.77	
Weight of Tare (g):	8.12	19.56	20.62	19.67	
Weight of Water (g):	56.5	7.7	8.0	8.0	
Weight of Dry Sample (g):	208.4	12.4	12.4	12.1	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**27.1**	**62.0**	**64.5**	**66.4**	
Number of Blows:		**30**	**25**	**20**	

Plastic Limit Test	1	2	Range
Tare Number:	44	603	
Wt. of Tare & Wet Sample (g):	23.62	24.91	
Wt. of Tare & Dry Sample (g):	22.17	23.45	
Weight of Tare (g):	17.44	18.82	
Weight of Water (g):	1.5	1.5	
Weight of Dry Sample (g):	4.7	4.6	
Moisture Content (%):	**30.7**	**31.5**	**-0.9**

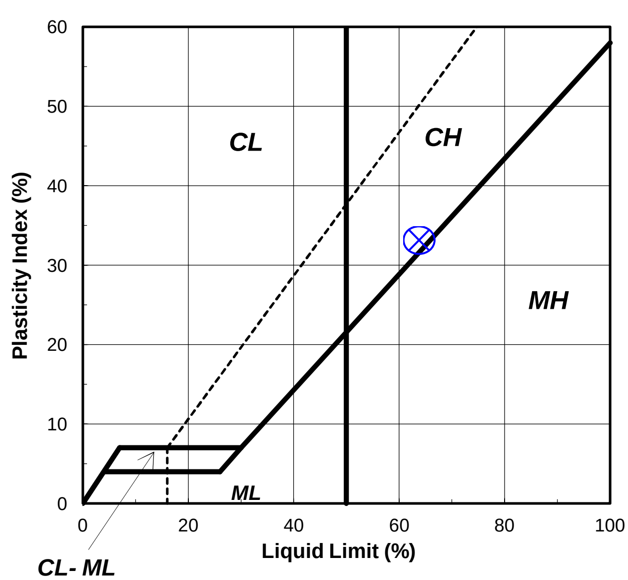
Note: The acceptable range of the two Moisture Contents is ± 1.4

Test Results	
Liquid Limit (%):	**64**
Plastic Limit (%):	**31**
Plasticity Index (%):	**33**
USCS Symbol:	**CH**

Flow Curve



Plasticity Chart



Tested By	*FS*	*Date*	*9/15/20*	*Checked By*	*BRB*	*Date*	9/16/20

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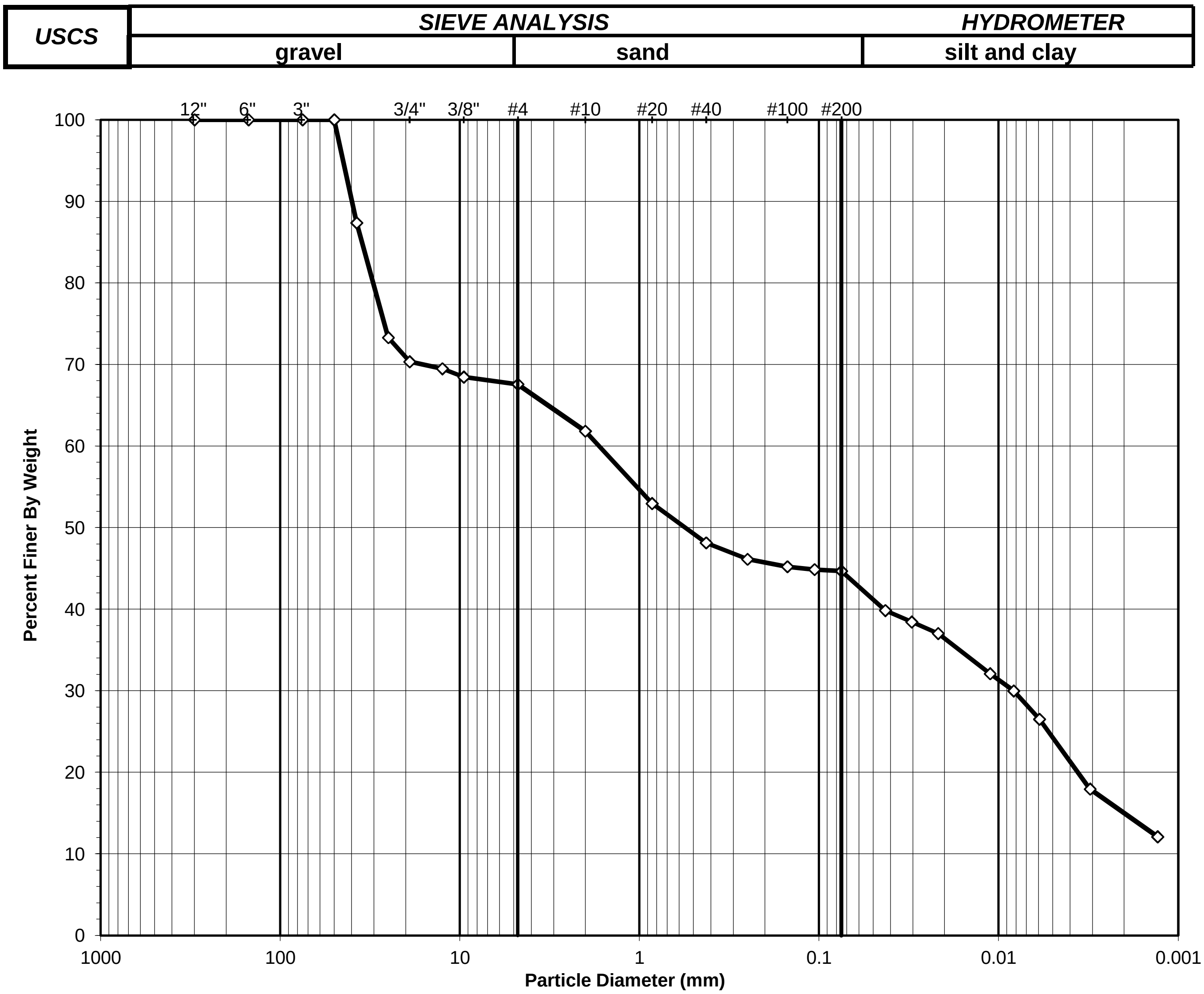
SIEVE AND HYDROMETER ANALYSIS

ASTM D6913 / D7928

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15B
Lab ID:	2020-444-001-018	Soil Color:	Brown



USCS Symbol:

GC, TESTED

D50 = 0.56

USCS Classification:

CLAYEY GRAVEL WITH SAND

Tested By	NR	Date	9/9/20	Checked By	BRB	Date	9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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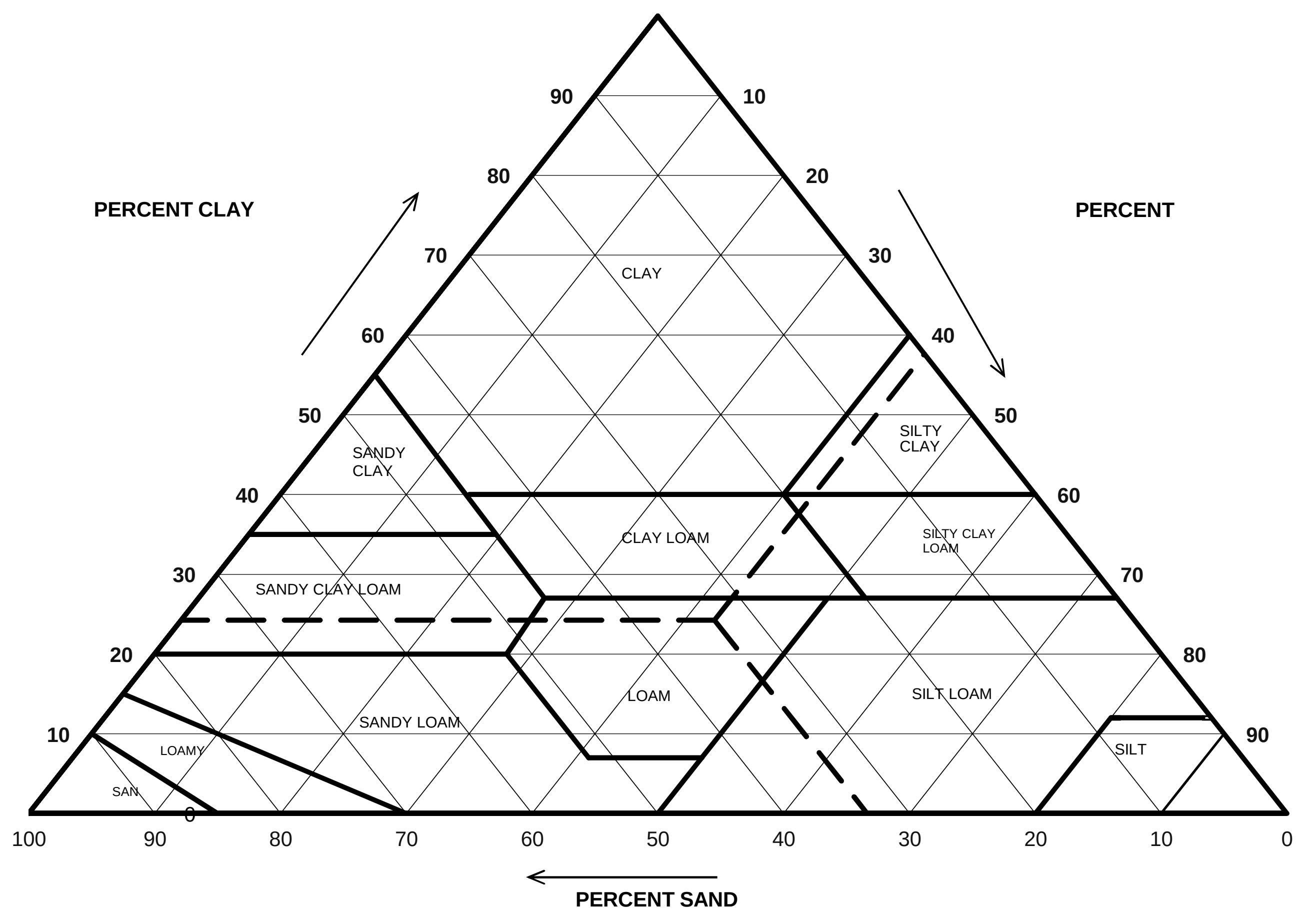
USDA CLASSIFICATION CHART

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15B
Lab ID:	2020-444-001-018	Soil Color:	Brown



USDA SUMMARY				
Particle Size (mm)	Percent Finer		Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classification
		Gravel	38.17	
2	61.83	Sand	20.64	33.38
0.05	41.19	Silt	26.19	42.36
0.002	15.00	Clay	15.00	24.26

USDA Classification: LOAM

page 2 of 4

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WASH SIEVE ANALYSIS

ASTM D6913-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15B
Lab ID:	2020-444-001-018	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	2972	Tare No.:	3094
Wt. of Tare & Wet Sample (g):	376.82	Weight of Tare & Wet Sample (g):	377.22
Wt. of Tare & Dry Sample (g):	342.69	Weight of Tare & Dry Sample (g):	349.83
Weight of Tare (g):	8.27	Weight of Tare (g):	8.08
Weight of Water (g):	34.13	Weight of Water (g):	27.39
Weight of Dry Soil (g):	334.42	Weight of Dry Soil (g):	341.75
Moisture Content (%):	**10.2**	**Moisture Content (%):**	**8.0**

Wet Weight of -3/4" Sample (g):	16853.00	Total Dry Weight of Sample (g):	21741.43
Tare No. (-3/4" Sub-Specimen):	1448	Wet Weight of +3/4" Sample (g):	6966.00
Wt. of Tare & Wet -3/4" Sub-Specimen (g):	1251.94	Dry Weight of + 3/4" Sample (g):	6449.13
Weight of Tare (g):	137.89	Dry Weight of - 3/4" Sample (g):	15292.31
Sub-Specimen -3/4" Wet Weight (g):	1114.05	Dry Weight -3/4" +3/8" Sample (g):	408.45
Tare No. (-3/8" Sub-Specimen):	1723	Dry Weight of -3/8" Sample (g):	14883.86
Wt. of Tare & Wet -3/8" Sub-Specimen (g):	275.62	J - Factor (% Finer than 3/4"):	70.3%
Weight of Tare (g):	82.84	J - Factor (% Finer than 3/8"):	68.5%
Sub-Specimen -3/8" Wet Weight (g):	192.78		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100**
6"	150	0.00		0.00	0.00	100.00	**100**
3"	75	0.00		0.00	0.00	100.00	**100**
2"	50	0.00	(*)	0.00	0.00	100.00	**100**
1 1/2"	37.5	2967.00		12.63	12.63	87.37	**87**
1"	25	3303.00		14.06	26.70	73.30	**73**
3/4"	19	696.00		2.96	29.66	70.34	**70**
1/2"	12.5	12.30	(**)	1.22	1.22	98.78	**69**
3/8"	9.5	14.70		1.45	2.67	97.33	**68**
#4	4.75	2.27		1.30	1.30	98.70	**68**
#10	2	14.67		8.39	9.68	90.32	**62**
#20	0.85	22.67	(**)	12.96	22.64	77.36	**53**
#40	0.425	12.31		7.04	29.68	70.32	**48**
#60	0.25	5.15		2.94	32.62	67.38	**46**
#100	0.15	2.33		1.33	33.96	66.04	**45**
#140	0.106	0.89		0.51	34.47	65.53	**45**
#200	0.075	0.49		0.28	34.75	65.25	**45**
Pan	-	114.15		65.25	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" and - 3/8" sieve analysis is based on the Weight of the Dry Specimen*

Tested By NR Date 9/9/20 Checked By BRB Date 9/16/20

DCN: CT-S73J, DATE 5/22/17, REV. 1e

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HYDROMETER ANALYSIS

ASTM D7928-17

Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15B
Lab ID:	2020-444-001-018	Soil Color:	Brown

Elapsed Time (min)	Reading rm	Temp. (C^{o})	Offset rd,m	Effective Depth, Hm (cm)	D (mm)	Mass Percent (%) Finer, Nm	Mass Percent (%) Finer, Nm'
0	NA	NA	NA	NA	NA	NA	NA
1	33.5	24.1	5.22	10.9	0.0427	89.2	39.8
2	32.5	24.1	5.22	11.1	0.0305	86.0	38.4
4	31.5	24.1	5.22	11.2	0.0217	82.9	37.0
16	28.0	24.1	5.22	11.9	0.0112	71.8	32.1
30	26.5	24.1	5.22	12.1	0.0082	67.1	30.0
60	24.0	24.2	5.18	12.6	0.0059	59.4	26.5
240	18.0	24.0	5.26	13.7	0.0031	40.2	18.0
1440	14.0	23.6	5.41	14.4	0.0013	27.1	12.1

Soil Specimen Data

Tare No.:	694	Percent Finer than # 200:	44.67
Wt. of Tare & Dry Material (g):	134.50		
Weight of Tare (g):	98.14	Specific Gravity:	2.70 Assumed
Weight of Deflocculant (g):	5.0		
Weight of Dry Material (g):	31.36		

Notes: Hydrometer test is performed on - # 200 sieve material.

Hydrometer - 152H	G- 1819
Cylinder	G- 356
Thermometer	G- 1505
Balance	G- 657
#200 Sieve	G- 1944
Foam Inhibitor Used	No

Tested By TO Date 9/10/20 Checked By BRB Date 9/16/20

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ATTERBERG LIMITS

ASTM D 4318-17

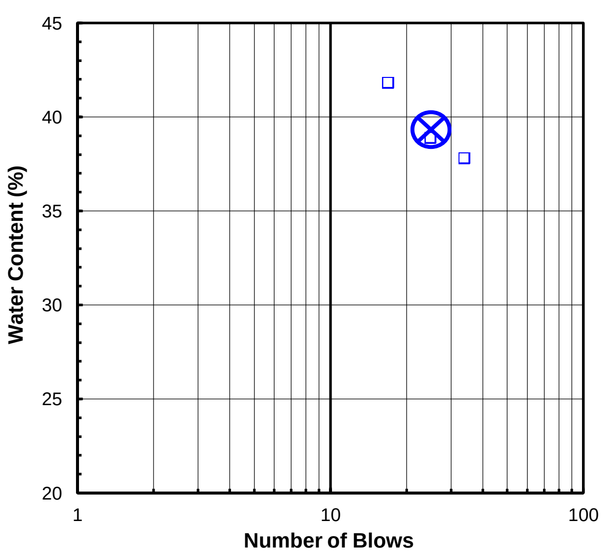
Client:	Civil & Environmental Consultants	Boring No.:	8/19/20
Client Reference:	Harrison Site 302-918.0030	Depth (ft):	NA
Project No.:	2020-444-001	Sample No.:	TP-15B
Lab ID:	2020-444-001-018	Soil Description:	BROWN LEAN CLAY

***Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.** (Minus No. 40 sieve material, Air dried)

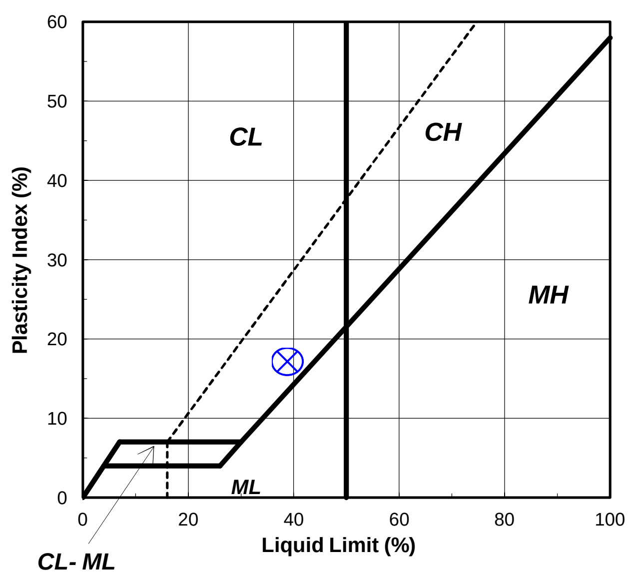
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-19		1	2	3	M
Tare Number:	2982	1277	332	310	U
Wt. of Tare & Wet Sample (g):	379.72	39.17	39.90	40.24	L
Wt. of Tare & Dry Sample (g):	337.79	33.10	34.18	33.91	T
Weight of Tare (g):	8.40	17.03	19.46	18.76	I
Weight of Water (g):	41.9	6.1	5.7	6.3	P
Weight of Dry Sample (g):	329.4	16.1	14.7	15.2	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**12.7**	**37.8**	**38.9**	**41.8**	N
Number of Blows:		**34**	**25**	**17**	T

Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	240	632		**Liquid Limit (%):**	**39**
Wt. of Tare & Wet Sample (g):	23.99	24.92			
Wt. of Tare & Dry Sample (g):	22.90	23.83		**Plastic Limit (%):**	**22**
Weight of Tare (g):	17.94	18.83			
Weight of Water (g):	1.1	1.1		**Plasticity Index (%):**	**17**
Weight of Dry Sample (g):	5.0	5.0			
				USCS Symbol:	**CL**
Moisture Content (%):	**22.0**	**21.8**	**0.2**		
Note: The acceptable range of the two Moisture Contents is ±			1.12		

Flow Curve



Plasticity Chart



Tested By TO *Date* 9/14/20 *Checked By* BRB *Date* 9/16/20

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ATTACHMENT D

SOIL BALANCE CALCULATION

ULTIMATE OBJECTIVE

This calculation estimates the volume of available useable soil on-site and compares this volume to the soil required for the proposed expansion and closure of the landfill. The volume of available usable soil was determined based on calculations of soil excavation and fill volumes for the proposed subgrade grading plans for development of the Phase 7 Expansion area grading as shown on Drawings C89509685 and C89509686, and from the borrow area test pit investigation that was performed in August 2020. The volume of soil required for the proposed expansion and closure of the landfill was determined for the proposed expansion area, and for various cover soil placement areas and thickness scenarios as described below.

CALCULATIONS

Soil Available

Phase 7 Expansion Areas

The proposed liner construction area subgrade grading for the Phase 7 expansion, including the areas identified as the Saddle Area, the Eastern Expansion Area, and portions of the previously permitted Phase 6 Area that was not constructed, will require the earthwork volumes shown in the table below.

Expansion Area Subgrade Grading Volumes	
Description	**Volume (CY)**
Excavation (cut)	187,000
Soil Placement (fill)	31,000
NET SOIL AVAILABLE	**156,000**

Western Borrow Area

The Western Borrow Area is located on the western edge of the landfill and was determined to have a 10-foot depth of usable soil. The Western Borrow Area is shown on Attachment A. The Western Borrow Area is estimated to have an 835,300 square foot surface area and is estimated to contain approximately 309,400 CY of available soil.

Southwestern Borrow Area

The Southwestern Borrow Area is located in the southwestern corner of the landfill and was determined to have a 4-foot depth of usable soil. The Southwestern Borrow Area is shown on Attachment A. The Southwestern Borrow Area is estimated to have a 748,000 square foot surface area and is estimated to contain approximately 110,900 CY of available soil.

Southern Borrow Area

The Southern Borrow Area is located in the southern end of the landfill and was determined to have a 10-foot depth of usable soil. The Southern Borrow Area is shown on Attachment A. The Southern Borrow Area is estimated to have a 503,300 square foot surface area and is estimated to contain approximately 186,500 CY of available soil.

Borrow Area Volumes			
Borrow Area	**Area (AC)**	**Est. Thickness of Useable Borrow (FT)**	**Net Soil Available (CY)**
Western	19.2	10	309,400
Southwestern	17.2	4	110,900
Southern	11.6	10	186,500
TOTAL	**48.0**	--	**606,800**

The total amount of soil available from combining the Western, Southwestern, and Southern Borrow Area is 606,800 CY.

Soil Needed

Subbase Soil

The liner system subbase consists of a six-inch thick soil layer for development of design grades for the proposed liner system as shown on shown on Drawings C89509685 and C89509686. This layer will provide the foundation for the overlying leachate detection/ground water underdrain layer. If testing indicates that the existing in-place soils meet the requirements of subbase soil, these soils will be left in-place for the subbase layer of the liner system. If testing indicates that the existing in-place soils do not meet the subbase requirements, the subgrade will be over excavated to a minimum of six inches below the grades shown on Drawings C89509685 and C89509686. The subbase will be constructed of on-site on-site clayey soils and will be placed at a minimum density of 95 percent of the

Standard Proctor maximum dry density and at moisture contents required to achieve a maximum permeability of 1 x 10^{-6} cm/sec as required for the subbase as presented in the facility's Construction Quality Assurance/Quality Control (QA/QC Plan). For the purposes of this soil balance calculation, the following table presents the subbase soil quantities needed for the proposed Phase 7 Area liner if all areas were to require six inches of subbase soil.

Required Subbase Soil Volume		
Expansion Area	**Area (AC)**	**Subbase Volume (CY)**
Saddle	1.1	1,000
Eastern	6.4	5,200
Previously Permitted Phase 6	4.6	3,800
TOTAL	**12.1**	**10,000**

Final Cover Soil

The volume of cover soil required for the landfill cap without geosynthetics is specified in USEPA CCR Rule 257.102 (d)(3)(i)(A), (B), and (C) which requires a minimum 18 inches of earthen material as an infiltration layer and a minimum of 6 inches of earthen material as an erosion layer. This is also consistent with the West Virginia Department of Environmental Protection (WVDEP) Waste Management Rule 6.1.e.1.A.2 and 6.1.e.1.A.2.1 which requires a minimum 18 inches of earthen material as an infiltration layer and a minimum of 6 inches of earthen material as an erosion layer.

Both the USEPA CCR rule and WVDEP rule require the infiltration layer be less permeable or equal the permeability of any bottom liner system or natural subsoils present, or have a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less. This is consistent with the alternative cap layer requirement in the WVDEP Rule 6.1.e.1.A.2.1 and the USEPA CCR Rule 257 requirements.

The current approved WVDEP permitted cap design specifies a 1-foot thick final cover soil layer placed over a geosynthetic cap. With the use of a geombrane layer in the cap system, there would not be a permeability requirement for the soil component of the cap. Therefore soil permeability testing for the cover soil would not be required for this option. However, the soil would be required to support sustained vegetation growth.

The required final cover soil was calculated based on the following proposed cap installation scenarios:

- The required final cover soil was estimated based WVDEP permitted closure soil cover depth requirements of 1-ft thick final cover soil for:
  - o The proposed expansion closure area
  - o The proposed expansion closure area and Phase 3 limit area
  - o The ultimate landfill projected closure area

Proposed Phase 7 Expansion Area

The Proposed Expansion Area was calculated to be approximately 190 acres.

Proposed Expansion Area and Phase 3 Area

The Proposed Expansion Area and Phase 3 Area was calculated to be 319 acres.

Ultimate Disposal Area

The Ultimate CCR Area was calculated to be 345 acres.

Required Cover Soil Volume(1)	
Area	**Soil Needed (CY)**
Proposed Phase 7 Expansion Area	353,100
Proposed Phase 7 Expansion Area and Phase 3 Area	591,600
Ultimate Disposal Area	642,700

Note: 1. The soil thicknesses were increased by 10% to account for soil fluff and waste.

CONCLUSIONS

The soil volumes shown in the following table calculate the soil remaining after using the available soil from proposed Phase 7 Expansion Area cut and the soil available in the borrow areas:

Areas	Soil Volume Required (CY)	Excess Soil (CY)
Proposed Phase 7 Expansion Area	353,100	399,700

Proposed Phase 7 Expansion Area and Phase 3 Area	591,600	161,200
Ultimate Disposal Area	642,700	110,100

Based on the net soil balance calculations performed above, there is adequate on-site soil available for all closure areas described above and for use in future landfill expansion and construction.

REFERENCES

1. 40 CCR Parts 257 and 261. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. Volume 80, Number 74. April 17, 2015.
2. West Virginia Department of Environmental Protection. Waste Management, Solid Waste Management Rule, Series 1. Title 33 Legislative Rule. June 1, 2006.

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3/12/2021

APPENDIX C

SLOPE STABILITY ANALYSIS

OBJECTIVE

The objective of this analysis is to determine the shear strengths that will provide an acceptable unsaturated veneer slope stability factor of safety (FS) with respect to the drainage layer, subbase soil, or baseliner geosynthetics along the baseliner 3:1 (H:V) side slopes. The calculation will also consider the presence of equipment placing and spreading the drainage layer and protective cover material across the side slope.

The transmissivity of the geocomposite for the landfill baseliner system was determined in a separate calculation titled "Leachate Detection Zone Geocomposite Transmissivity" (provided in Appendix C) by determining a transmissivity that should prevent the leachate head build up on the landfill baseliner from exceeding 12 inches. The West Virginia Title 33 Legislative Rule Series 1 (§33-1) requires in Rule 5.4.b.4.C that the leachate collection and protective cover zone must be designed to ensure that the hydraulic leachate head does not exceed one (1) foot at the expected flow capacity from the drainage area except during storm event.

Spreadsheet methods were utilized to complete the analyses. The spreadsheet uses methodology presented in GRI Report #18 and #19.

FACTORY OF SAFETY SELECTION

West Virginia Solid Waste Management Rule does not specify a minimum factor of safety for the liner system. The rule states that liner must "be designed to withstand the calculated tensile forces acting upon the synthetic materials…" The CCR rule states that the composite liner must be "constructed of materials that provide appropriate shear resistance of the upper and lower component interface to prevent sliding of the upper component including on slopes". The CCR rule does not specify a minimum factor of safety for the liner system for landfills but does require a factor of safety of 1.4 and 1.5 for different static conditions involving impoundments.

Consistent with previous analysis performed for the facility, CEC has selected a minimum factor of safety of 1.5 for static conditions, and 1.2 for pseudo-static conditions for the long-term condition analysis.

For short-term conditions during construction, CEC has selected a factor of safety of 1.25 for static conditions based on the following guidance: For landfill liner systems, section 4.2.3.2 of the EPA Guide to Technical Resources for the Design of Land Disposal Facilities (EPA/625/6-88/018) states that for liner slopes the static minimum factor of safety can be as low as 1.1 to 1.2 because the slope will be unsupported for a short time. Exhibit 3.3 of this guidance also references using a 1.25 static factor of safety for slopes where uncertainty of strength parameters is low and there is no imminent danger to life or the environment.

The table below presents the scenarios evaluated and the target FS:

Table 1: Target FS

Saturated or Unsaturated	Short-Term or Long-Term	Static or Seismic	Translational or Rotational	Method of Calculation	Target FS
Unsaturated	Short-term	Static	Translational	Spreadsheet	1.25
		Seismic	Translational	Spreadsheet	1.20
	Long-term	Static	Translational	Spreadsheet	1.50
		Seismic	Translational	Spreadsheet	1.20

REFERENCES

1. Harrison Power Station, Phase 6A Expansion Area, Slope Stability Analysis, GAI Consultants, 2017
2. Harrison Power Station, Phase 6 Expansion Area, Slope Stability Analysis, GAI Consultants, 2015
3. Harrison Power Station, Phase 5 Expansion Area, Slope Stability Analysis, GAI Consultants, 2011
4. Harrison 2002 Phase 4 Landfill Lateral Expansion Permit.
5. United States Environmental Protection Agency (USEPA), 2015. 40 CFR Parts 257 and 261 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. April 17, 2015.
6. USEPA, 1988. Guide to Technical Resources for the Design of Land Disposal Facilities. Document No. EPA/625/6-88-018. December 1988.
7. USEPA, 1995. RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities. Document No. EPA/600/R-95-051. April 1995
8. United States Geological Survey (USGS), Earthquake Hazard Program, Unified Hazard Tool, 2014 data, https://earthquake.usgs.gov/hazards/interactive/, accessed November 23, 2020.
9. "Cover Soil Slope Stability Involving Geosynthetic Interfaces", (GRI REPORT #18), by Te-Yang Soong and Robert M. Koerner, December 9, 1996, Geosynthetic Research Institute (GRI), Drexel University
10. "Design of Drainage Systems Over Geosynthetically Lined Slopes" (GRI REPORT # 19) by Te-Yang Soong and Robert M. Koerner, June 17, 1997, Geosynthetic Research Institute (GRI), Drexel University.
11. GRI Standard – GC8, Determination of the Allowable Flow Rate of a Drainage Geocomposite, January 9, 2013, Geosynthetic Research Institute (GRI).
12. NAVAC Design Manual 7.2, 1986

METHODOLOGY

Multiple reference methods were utilized within this analysis and are described below.

<u>"Cover Soil Slope Stability Involving Geosynthetic Interfaces", (GRI REPORT #18), by Te-Yang Soong and Robert M. Koerner, December 9, 1996, Geosynthetic Research Institute (GRI), Drexel University.</u>

The analytical method presented in this reference was utilized to compute the FS for the static translational (veneer) analyses. It considers the weight of equipment on top of the cover layer and provides a FS based on the most critical interface shear strength of baseliner components. The spreadsheet calculates a FS by dividing the cover material along the side slope into active and passive blocks. Then inter-wedge force equations are set equal to each other and are arranged in the form of a quadratic equation that can be solved to calculate a FS.

<u>"Design of Drainage Systems Over Geosynthetically Lined Slopes" (GRI REPORT # 19) by Te-Yang Soong and Robert M. Koerner, June 17, 1997, Geosynthetic Research Institute (GRI), Drexel University.</u>

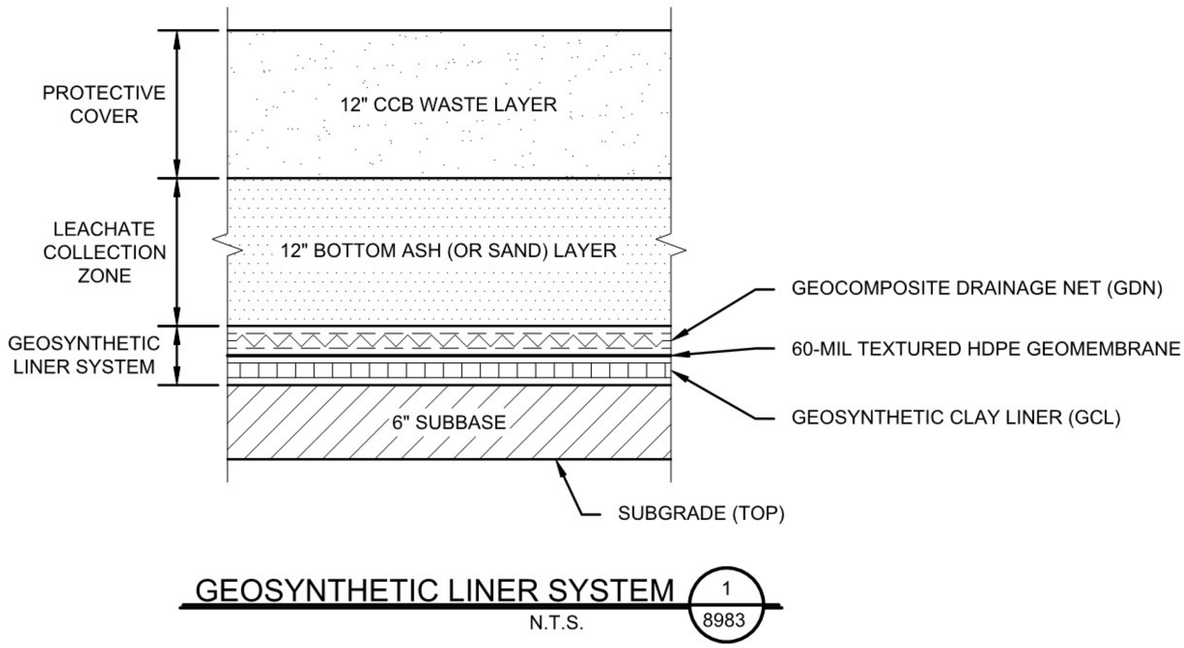
The analytical method presented in this reference was utilized to determine the required transmissivity of the final cover geocomposite. This method analyzes the ability of the drainage geocomposite in the final cover system to adequately transmit leachate infiltrating through the protective cover and leachate collection layers. GRI Report #19 discusses in detail the design of drainage systems.

PROPOSED BASELINER

The proposed liner and leachate collection system consists of the following components (from bottom to top):

- 6-inch thick Subbase Layer;
- Double Sided Geocomposite Drainage Net (GDN) Leachate Detection Zone;
- Geosynthetic Clay Liner (GCL);
- 60-mil HDPE Textured Geomembrane Liner;
- 16 oz/sy Cushion Geotextile;
- 12-inch thick Leachate Collection Layer consisting of Granular Bottom Ash material (or sand); and
- 12-inch thick Protective Cover Layer consisting CCB material.

The proposed liner system detail is shown below



CRITICAL CROSS SECTION

The critical cross section was modeled as the 3H:1V baseliner slope in the Phase 7 Saddle Area Expansion, which is located on the northern edge of the facility. The longest slope was measured to be approximately 107 feet long and 40 feet high.

Short-term conditions were modeled with a 12-inch thick Bottom Ash leachate collection layer (LCL). Long-term conditions were modeled with a 12-inch thick Bottom Ash LCL and the overlying 12-inch thick CCB (PC).

MATERIAL PARAMETERS

The following materials and material parameters were utilized in this analysis.

Bottom Ash /CCB Leachate Collection

Effective Stress (drained)
Unit weight: γ = 75 pcf;
Cohesion: c = 0 psf;
Internal Friction Angle: ϕ = 30 degrees: and
Thickness = 12-inches.

CCB Protective Cover

Effective Stress (drained)
Unit weight: γ = 80 pcf;
Cohesion: c = 0 psf;
Internal Friction Angle: ϕ = 42 degrees: and
Thickness = 12-inches.

Subbase Soil Layer

Effective Stress (drained)
Unit weight: γ' = 120 pcf
Cohesion: c' = 0 psf;
Internal Friction Angle: ϕ' = 27 degrees: and
Thickness = 6-inches.

Liner System Interface Shear Strength

The calculations were used to determine the shear strength parameters (contact interface friction angle for the liner system) that results in acceptable factors of safety. The input variables of baseliner slope length, cover material, and LGP equipment will be held constant within the spreadsheet while the contact interface friction angle is varied until an acceptable FS is achieved considering translational failure.

All proposed interfaces are required to meet the minimum calculated contact interface shear strength which is included with other minimum shear strength parameters specified for the Phase 7 Area Expansion.

SEISMIC COEFFICIENT

A shear wave accelerating through the landfill will produce horizontal and vertical accelerations and stresses within the MSW, baseliner system, in-situ soils and bedrock producing a slope stability FS that is less than a corresponding slope stability FS governed by static conditions. The shear wave acceleration is modeled within the stability analysis by inputting a coefficient, k_y, which is some fraction of gravity. The peak acceleration for the site is estimated to be 0.0476 g which is taken from the "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years (site: NEHRP B-C boundary)" published by the U.S.G.S in 2014.

CALCULATIONS

Required Transmissivity

The West Virginia Title 33 Legislative Rule Series 1 (§33-1) requires in Rule 4.5.d.6.A that the leachate collection and protective cover zone have a minimum permeability of $1x10^{-3}$ cm/sec and have a minimum thickness of 18 inches. A previous permit modification was approved by the West Virginia Department of Environmental Protection (WVDEP) reducing the thickness of the leachate collection zone from 18 inches to 12 inches. The required transmissivity of the leachate drainage layer was calculated using the regulatory minimum permeability of $1x10^{-3}$ cm/sec and the approved minimum thickness of 12 inches. The equivalent long term transmissivity was found to be 3.048×10^{-6} m^2/sec in a separate calculation titled "Leachate Detection Zone Geocomposite Transmissivity", which is included in Appendix C.

Specified Transmissivity

To meet this required long-term transmissivity, the specified value of transmissivity for the geocomposite at the time of testing must be higher than the long-term transmissivity to account for clogging and creep that will occur during long-term conditions.

The ultimate transmissivity was found to be 6.1×10^{-5} m^2/sec in a separate calculation titled "Leachate Detection Zone Geocomposite Transmissivity", which is included in Appendix C.

Spreadsheet Calculation – Static & Seismic Unsaturated Translational Analysis

An analysis was completed using a spreadsheet (Excel) recommended by GRI to evaluate the stability of the baseliner considering veneer failures. The spreadsheet calculation was used to analyze the 3H:1V baseliner side slopes at the landfill. Figure 1 illustrates the proposed geometry of the baseliner side slope and the free body diagram of the forces acting along the side slope.

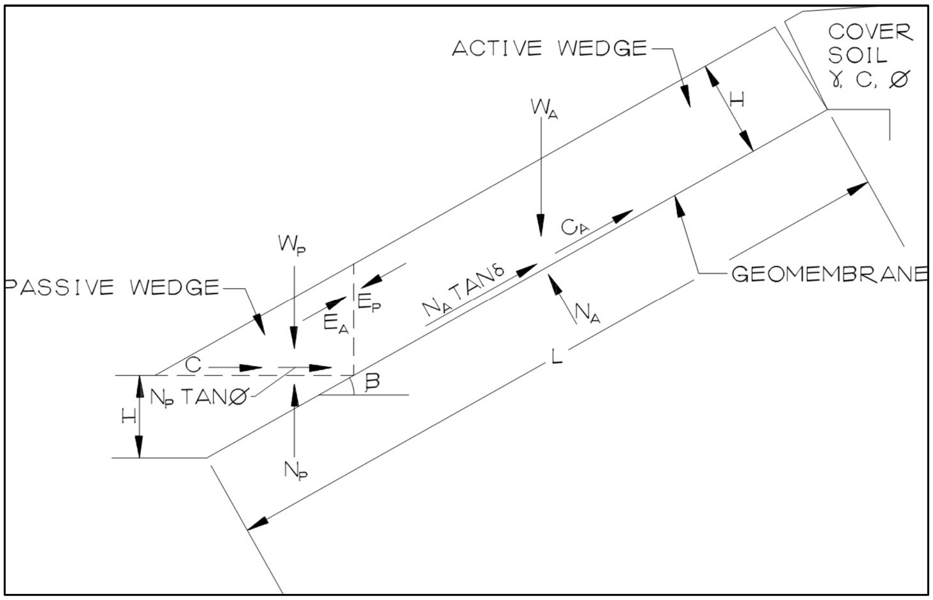


Figure 1: Side Slope Geometry & Free Body Diagram

Table 2: Side Slope Geometry & Free Body Diagram

Slope Dimensions	
Maximum Length of Baseliner Side slope (along the length of the geomembrane)	107 feet
Baseliner Side Slope Orientation	3H:1V or 18.43 degrees

Spreadsheet Variables Defined:

W_A = Total weight of the active wedge;
W_P = Total weight of the passive wedge;
N_A = Effective force normal to the failure plane of the active wedge;
N_P = Effective force normal to the failure plane of the passive wedge;
γ = Unit weight of the drainage layer/protective cover soil;
h = Thickness of the drainage layer/protective cover soil;
L = Length of slope measured along the geomembrane;
β = Soil slope angle beneath the geomembrane;
ϕ = Internal angle of friction within the protective cover soil;
δ = Interface friction angle between the most critical geosynthetic interface;
C_a = Adhesive force between the components lying along the most critical geosynthetic interface of the active wedge;

c_a = The adhesion developed between the components lying along the most critical geosynthetic interface of the active wedge;
C = Cohesive force along the failure plane of the passive wedge;
c = cohesion of the drainage layer/protective cover soil;
E_A = Inter-wedge force acting on the active wedge from the passive wedge;
E_P = Inter-wedge force acting on the passive wedge from the active wedge and
FS = Factor of safety against drainage layer/protective cover soil sliding down the slope.

The veneer slope stability analysis was performed using the following assumptions:

- The shear strength component of adhesion developed between geosynthetic material layers is ignored.
- Tensile strength of the geosynthetic materials contributing to the veneer slope stability FS is ignored.
- The drainage layer/protective cover material provides a buttress at the toe of the slope, i.e. the passive soil wedge.
- The anticipated granular nature of the proposed drainage layer/protective cover material suggests that cohesive strength does not exist, therefore only the internal angle of friction will be utilized.
- Short-term stability is evaluated with a 12-inch thick layer of bottom ash leachate collection layer.
- Long-term stability is conservatively evaluated with a 24-inch thick layer of bottom ash representing both the leachate collection layer and the protective cover layer, since the bottom ash material has a lower friction angle than the FGD material.
- Weights of the geosynthetic components are negligible compared to the weight of drainage layer/protective cover material and therefore are not considered in the calculations.
- All calculations will utilize a 1-foot unit width of side slope.
- The presence of equipment along the 3:1 (H:V) protective cover side slope is analyzed within GRI Report #18.

A Low Ground Pressure (LGP) bulldozer will be used to place protective cover material across the side slope. The pressure exerted upon the top of the geosynthetic layers by a bulldozer is modeled as illustrated in Figure 2, assuming that the bulldozer will not operate over the geosynthetic layers until the leachate collection layer or both the leachate collection layer and protective cover layers are placed.

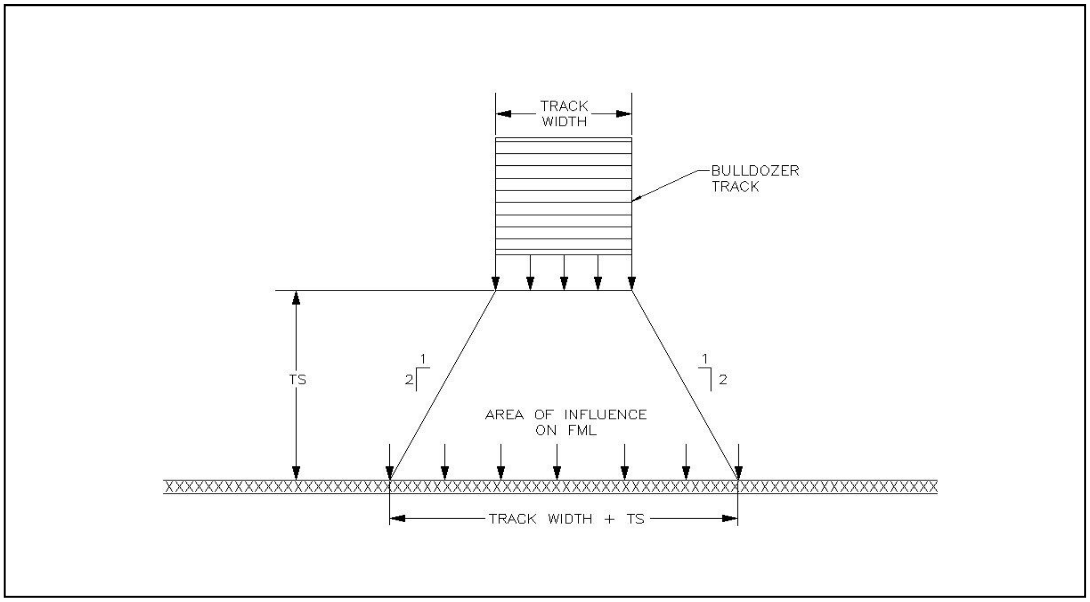


Figure 2: Stress Distribution of the LGP Bull Dozer upon the Geosynthetic Layers

A Caterpillar D6M low ground pressure (LGP) dozer specifications are used within the GRI Report #18.

- 2 tracks
- Track length = 10.2 feet
- Track width = 2.33 feet
- Operating weight = 36,400 lbs
- One Track Contact area = 28.2 ft^2
- One Track Contact pressure = 18,200 / 23.8 ft^2 = 764.7 psf

Subsequently, the forces are resolved below to produce a veneer slope stability FS. The equations are shown on pages 13 and 14 of GRI Report #18 and for ease of calculations are incorporated into a spreadsheet to produce a FS corresponding to a given set of input parameters. GRI Report #18 utilizes an influence factor which is a function of the ratio of the bulldozer track width to the thickness of the drainage layer/protective cover soil to account for the dissipation of surface forces through the cover soil to the geosynthetic interface. As shown on the GRI Report #18 calculation provided in Attachment A, a bulldozer track width of 2.33-feet and a drainage layer/protective cover soil thickness of 1-foot or 2-feet correspond to an influence factor of 0.92. Since the GRI Report #18 calculation applies pressures over a smaller area of influence to the underlying geosynthetics than would be applied by using the typical stress distribution as shown in Figure 2 above, the GRI Report #18 calculation represents a conservative approach for dissipation of forces through the drainage layer/protective cover soil to the underlying geomembrane.

Using the spreadsheet, the input variables of drainage layer/protective cover thickness, side slope orientation, unit weight, and friction angle were held constant. The minimum interface friction angle between the most critical interfaces in the geosynthetics was calculated to be **25.8 degrees** to achieve acceptable factors of safety. A copy of the spreadsheet calculations displaying the results is included in Attachment A.

CONCLUSIONS

The following table presents a summary of the calculated FS for the analyses performed.

Table 3: Proposed Baseliner Analyses Results

Saturated or Unsaturated	Short-Term or Long-Term	Static or Seismic	Translational or Rotational	Method of Calculation	Target FS	Calculated FS
Unsaturated	Short-term	Static	Translational	Spreadsheet	1.25	1.47
		Seismic	Translational	Spreadsheet	1.20	1.28
	Long-term	Static	Translational	Spreadsheet	1.50	1.50
		Seismic	Translational	Spreadsheet	1.20	1.31

Interface Shear Strength Requirements

The analyses indicate that a contact interface shear strength friction angle of 25.8 will result in acceptable slope stability factors of safety for the long and short term scenarios model. This value is specified as a shear stress of **70 psf at normal load of 144 psf, 175 psf at normal load of 360 psf** and **484 psf at normal load of 1,000 psf** as the requirement for baseliner interface shear strength under low normal loads for the Phase 7 Expansion.

This peak shear strength value was determined as follows:

$$\tau = C_a + \sigma_n \tan \phi$$

Where: $C_a =$ 0 psf

$\sigma_n =$ 144 psf , 360 psf, and 1000 psf

ϕ = 25.8

Therefore:

All proposed interfaces are required to meet the minimum calculated contact interface shear strength as specified in the CQA/QC Plan.

Soil Shear Strength Requirements

The following parameters will be specified for the 6-inch thick subbase soil:

Effective Stress - Drained
c': Cohesion = 0 psf
φ': Friction angle = 27 degrees

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ATTACHMENT A

SPREADSHEET BASED STABILITY ANALYSIS

HARRISON POWER STATION
SADDLE AREA LINER EXPANSION
BASELINER SYSTEM
SHALLOW SLOPE STABILITY ANALYSIS
INPUT TABLE

Denotes an input value
Denotes an automatically calculated cell

INPUT VALUES

thickness of cover soil at the top of the slope = hc =	2.00	ft	=	0.6096	meters =	609.6	mm
thickness of cover soil at the bottom of the slope = D =	2.00	ft					
slope beneath the geomembrane (xH:1V) =	3.00	H:1V					
slope angle beneath the geomembrane = b =	18.43	degrees					
finished slope angle = w =	18.43	degrees		(for uniform cover soil thickness w = b)			
length of slope measured along the geomembrane = L =	107.0	ft	=	32.6136	meters		
length of slope between drainage outlets = L =	107.0	ft	=	32.6136	meters		
moist unit weight of cover soil = γ_t =	75.00	pcf	=	11.78	kN/m^3		
friction angle of the cover soil = f =	30.0	degrees					
cohesion of the cover soil = c =	0.0	lb/ft^2					
minimum interface friction angle = d =	25.8	degrees					
minimum interface adhesion = ca =	0.0	lb/ft^2					
Long Term Design Transmissivity = q =	3.048E-06	m^2/sec					
Overall FS for drainage = FS_D =	2						
Reduction Factor for geotextile intrusion = RF_{IN} =	1						
Reduction Factor for creep deformation = RF_{CR} =	5.13						
Reduction Factor for chemical clogging = RF_{CC} =	1.5						
Reduction Factor for biological clogging = RF_{BC} =	1.3						
equipment ground pressure (= wt. of equipment/(2wb)) = q =	764.7	lb/ft^2					
length of each equipment track = w =	10.20	ft					
width of each equipment track = b =	2.33	ft					
influence factor* at geomembrane interface = I =	0.92	See Table -->					
acceleration/deceleration of the bulldozer = a =	0.00	g					
seismic coefficient = Cs =	0.0476	g					

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
≤ 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
≥ 1000 mm	0.95	0.75	0.30

OUTPUT SUMMARY

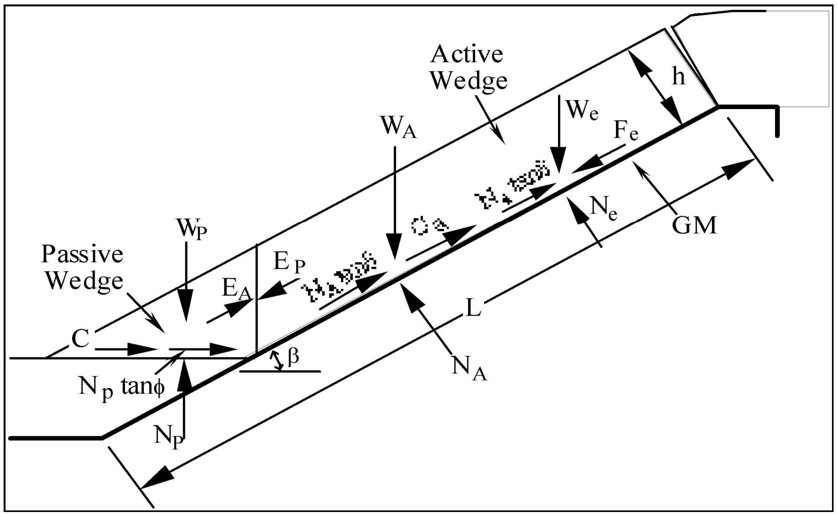
Ultimate Geocomposite Transmissivity Specification = **6.10E-05** **m^2/sec**

Slope Stability Factor of Safety Summary

Method	FS	Required FS
Static - Translational - Unsaturated	1.50	1.50
Seismic - Translational - Unsaturated	1.31	1.20

HARRISON POWER STATION
SADDLE AREA LINER EXPANSION
BASELINER SYSTEM
SHALLOW SLOPE STABILITY ANALYSIS

Placement of the Cover Material Layer across the sideslopes with the incorporation of Equipment Loads



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Calculation of FS

Active Wedge:

Wa= 15051.3 lb

Na= 14278.9 lb

Passive Wedge:

Wp= 500.0 lb

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= 6668.2

b= -11243

c= 1861.1

FS= 1.500

thickness of cover soil = h =	2.00	ft				
cov. mat. slope angle beneath the geomembrane = b =	18.43	0.001	*= 0.32*	*(rad.)*		
finished cover material slope angle = w =	18.43	7.87	*= 0.32*	*(rad.)*		
length of slope measured along the geomembrane = L =	107.0	0				
unit weight of the cover soil = g =	75.0	lb/ft^3				
friction angle of the cover soil = f =	30.0	°	*= 0.52*	*(rad.)*		
cohesion of thecover soil = c =	0.0	lb/ft^2			*C= 0*	*lb*
critical interface friction angle = d =	25.80	°	*= 0.45*	*(rad.)*		
adhesion = ca =	0.0	lb/ft^2			*Ca= 0*	*lb*

thickness of the cover soil = h =	2.00	ft	*b/h=*	*1.2*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	764.7	lb/ft^2	*We=qwI=*	*7175.9*
length of each equipment track = w =	10.2	ft	*Ne=Wecosb=*	*6807.7*
width of each equipment track = b =	2.3	ft	*Fe=We(a/g)=*	*0.0*
influence factor* at geomembrane interface = I =	0.92			
acceleration/deceleration of the bulldozer = a =	0.00	g		

*Influence Factor Default Values

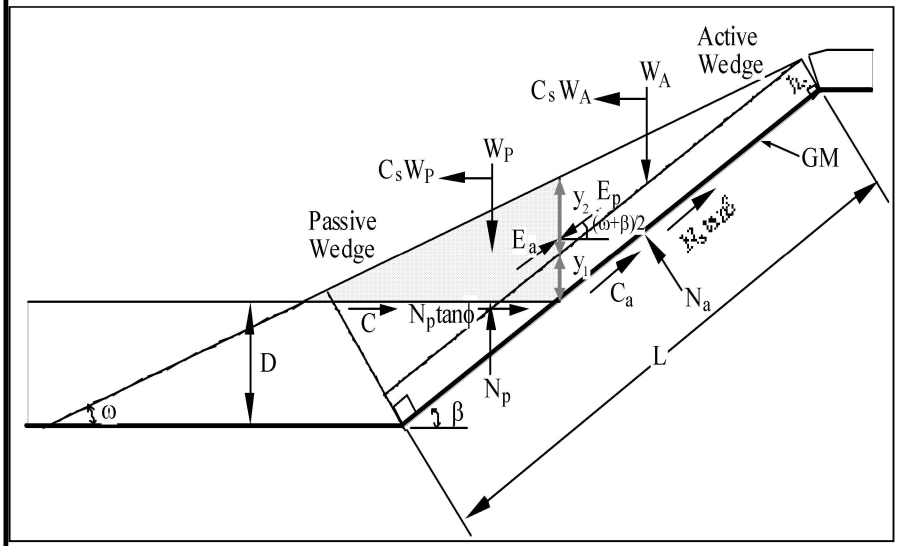
Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
²300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
³ 1000 mm	0.95	0.75	0.30

Note: Denotes an automatically calculated cell

Denotes input values

HARRISON POWER STATION
SADDLE AREA LINER EXPANSION
BASELINER SYSTEM
SHALLOW SLOPE STABILITY ANALYSIS

Uniformed and/or Tapered Cover Soil with Consideration of Seismic Forces



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Calculation of FS

Active Wedge:

Wa=	*15051.3*	*lb*
Na=	*14278.9*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*500.0*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*4985.9*
b=	*-7441*
c=	*1195.6*

FS= 1.309

(Note: for uniform cover soil thickness the input value of w = b)

thickness of cover soil at top (crest) of the slope = hc =	2.00	ft		
thickness of cover soil along the bottom of the site = D =	2.00	ft		
soil slope angle beneath the geomembrane = b =	18.43	0.001	*= 0.32*	*(rad.)*
finished cover soil slope angle = w =	18.43	7.87	*= 0.32*	*(rad.)*
length of slope measured along the geomembrane = L =	107.0	0		

y2=	*0.00*	*(ft)*
y1=	*2.11*	*(ft)*
(w+b)/2=	*0.322*	*(rad.)*
(=	*18.4*	*°)*

unit weight of the cover soil = g =	75.0	lb/ft^3		
friction angle of the cover soil = f =	30.0	°	*= 0.52*	*(rad.)*
cohesion of the cover soil = c =	0.0	lb/ft^2		
critical interface friction angle = d =	25.8	°	*= 0.45*	*(rad.)*
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2		

seismic coefficient = Cs = 0.04760 g

Note: Denotes an automatically calculated cell

Denotes input values

numbers in Italics are calculated values

HARRISON POWER STATION
SADDLE AREA LINER EXPANSION
BASELINER SYSTEM
SHALLOW SLOPE STABILITY ANALYSIS
INPUT TABLE

Denotes an input value

Denotes an automatically calculated cell

INPUT VALUES

thickness of cover soil at the top of the slope = hc =	1.00	ft	=	0.3048	meters =	304.8	mm
thickness of cover soil at the bottom of the slope = D =	1.00	ft					
slope beneath the geomembrane (xH:1V) =	3.00	H:1V					
slope angle beneath the geomembrane = b =	18.43	degrees					
finished slope angle = w =	18.43	degrees		(for uniform cover soil thickness w = b)			
length of slope measured along the geomembrane = L =	107.0	ft	=	32.6136	meters		
length of slope between drainage outlets = L =	107.0	ft	=	32.6136	meters		
moist unit weight of cover soil = γ_t =	75.00	pcf	=	11.78	kN/m^3		
friction angle of the cover soil = f =	30.0	degrees					
cohesion of the cover soil = c =	0.0	lb/ft^2					
minimum interface friction angle = d =	25.8	degrees					
minimum interface adhesion = ca =	0.0	lb/ft^2					

equipment ground pressure (= wt. of equipment/(2wb)) = q =	764.7	lb/ft^2
length of each equipment track = w =	10.20	ft
width of each equipment track = b =	2.33	ft
influence factor* at geomembrane interface = I =	0.92	See Table -->
acceleration/deceleration of the bulldozer = a =	0.00	g
seismic coefficient = Cs =	0.0476	g

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
² 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
³ 1000 mm	0.95	0.75	0.30

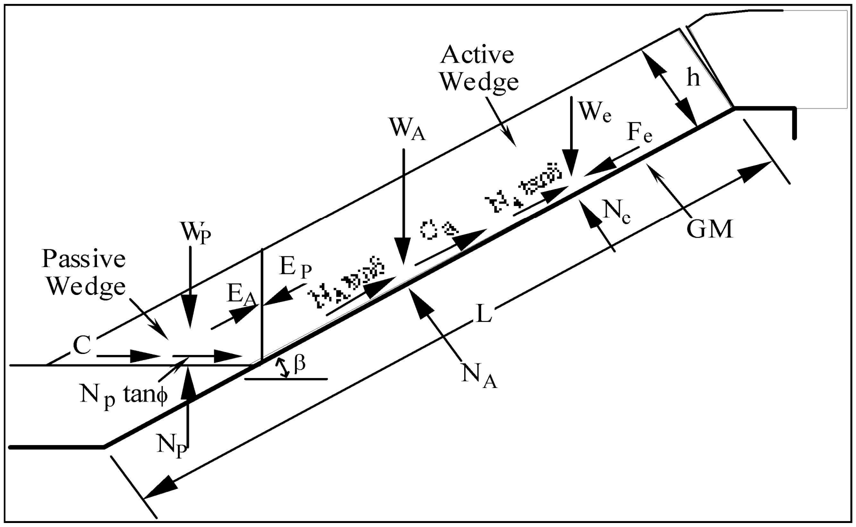
OUTPUT SUMMARY

Slope Stability Factor of Safety Summary

Method	FS	Required FS
Static - Translational - Unsaturated	1.47	1.25
Seismic - Translational - Unsaturated	1.28	1.20

HARRISON POWER STATION
SADDLE AREA LINER EXPANSION
BASELINER SYSTEM
SHALLOW SLOPE STABILITY ANALYSIS

Placement of the Cover Material Layer across the sideslopes with the incorporation of Equipment Loads



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Calculation of FS

Active Wedge:

Wa= *7775.3 lb*

Na= *7376.3 lb*

Passive Wedge:

Wp= *125.0 lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= *4485.4*

b= *-7440*

c= *1251.9*

FS= 1.469

thickness of cover soil = h =	1.00	ft					
cov. mat. slope angle beneath the geomembrane = b =	18.43	0.001	*= 0.32*	*(rad.)*			
finished cover material slope angle = w =	18.43	7.87	*= 0.32*	*(rad.)*			
length of slope measured along the geomembrane = L =	107.0	0					
unit weight of the cover soil = g =	75.0	lb/ft^3					
friction angle of the cover soil = f =	30.0	°	*= 0.52*	*(rad.)*			
cohesion of thecover soil = c =	0.0	lb/ft^2			*C=*	*0*	*lb*
critical interface friction angle = d =	25.80	°	*= 0.45*	*(rad.)*			
adhesion = ca =	0.0	lb/ft^2			*Ca=*	*0*	*lb*

thickness of the cover soil = h =	1.00	ft	*b/h=*	*2.3*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	764.7	lb/ft^2	*We=qwI=*	*7175.9*
length of each equipment track = w =	10.2	ft	*Ne=Wecosb=*	*6807.7*
width of each equipment track = b =	2.3	ft	*Fe=We(a/g)=*	*0.0*
influence factor* at geomembrane interface = I =	0.92			
acceleration/deceleration of the bulldozer = a =	0.00	g		

*Influence Factor Default Values

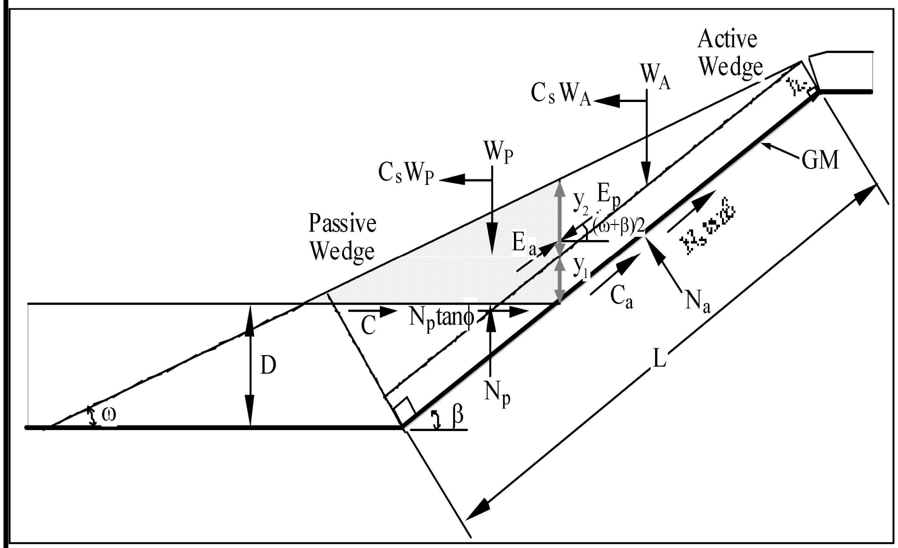
Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
^{2}300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
^{3} 1000 mm	0.95	0.75	0.30

Note: Denotes an automatically calculated cell

Denotes input values

HARRISON POWER STATION
SADDLE AREA LINER EXPANSION
BASELINER SYSTEM
SHALLOW SLOPE STABILITY ANALYSIS

Uniformed and/or Tapered Cover Soil with Consideration of Seismic Forces



65

Calculation of FS

Active Wedge:

Wa=	*7775.3*	*lb*
Na=	*7376.3*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*125.0*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*2569.7*
b=	*-3771*
c=	*617.6*

FS= 1.280

(Note: for uniform cover soil thickness the input value of w = b)

thickness of cover soil at top (crest) of the slope = hc =	1.00	ft			
thickness of cover soil along the bottom of the site = D =	1.00	ft			
soil slope angle beneath the geomembrane = b =	18.43	0.001	*= 0.32*	*(rad.)*	
finished cover soil slope angle = w =	18.43	7.87	*= 0.32*	*(rad.)*	
length of slope measured along the geomembrane = L =	107.0	0			

y2=	*0.00*	*(ft)*
y1=	*1.05*	*(ft)*
(w+b)/2=	*0.322*	*(rad.)*
(=	*18.4*	*°)*

unit weight of the cover soil = g =	75.0	lb/ft^3		
friction angle of the cover soil = f =	30.0	°	*= 0.52*	*(rad.)*
cohesion of the cover soil = c =	0.0	lb/ft^2		
critical interface friction angle = d =	25.8	°	*= 0.45*	*(rad.)*
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2		

seismic coefficient = Cs = 0.04760 g

Note: Denotes an automatically calculated cell

Denotes input values

numbers in Italics are calculated values

OBJECTIVE

The objective of this analysis is to determine (1) the shear strengths of the final cover system components and (2) the required geocomposite drainage layer transmissivity. These calculations consider the proposed 3H:1V outer landfill final cover slopes with 20 foot wide final cover benches spaced at approximately 25 foot vertical intervals, which equates to a 3H:1V slope length of approximately 79 feet between the surface water control benches.

FACTOR OF SAFETY SELECTION

West Virginia Solid Waste Management Rule (Reference 1) does not specify a minimum factor of safety for the liner system. The rule states that liner must "be designed to withstand the calculated tensile forces acting upon the synthetic materials…" The CCR rule (Reference 2) states that the composite liner must be "constructed of materials that provide appropriate shear resistance of the upper and lower component interface to prevent sliding of the upper component including on slopes". The CCR rule does not specify a minimum factor of safety for the liner system for landfills but does require a factor of safety of 1.4 and 1.5 for different static conditions involving impoundments.

Consistent with previous analysis (References 3 through 6) performed for the facility, CEC has selected a minimum factor of safety of 1.50 for static conditions, 1.20 for pseudo-static conditions for the long-term condition analysis, and 1.30 for static saturated conditions.

The table below presents the scenarios evaluated and the target FS:

Table 1: Target FS

Translational or Rotational	Static or Seismic	Saturated or Unsaturated	Required FS	Method of Calculation
Translational	Static	Unsaturated	1.50	Software & Spreadsheet*
Translational	Seismic	Unsaturated	1.20	Software & Spreadsheet*
Translational	Static	Saturated	1.30	Software & Spreadsheet*
Rotational	Static	Unsaturated	1.50	Software
Rotational	Seismic	Unsaturated	1.20	Software
Rotational	Static	Saturated	1.30	Software

*Software calculations were performed to analyze the 3H:1V slopes including the final cover benches; spreadsheet calculations were performed to analyze the geosynthetic interfaces at 3H:1V slope.

REFERENCES

1. West Virginia Code 33-1 Solid Waste Management Rule, West Virginia Department of Environmental Protection, May 1, 2015.
2. United States Environmental Protection Agency (USEPA), 2015. 40 CFR Parts 257 and 261 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. April 17, 2015.
3. Harrison Power Station, Phase 4 Landfill Lateral Expansion Permit Application, 2002
4. Harrison Power Station, Phase 5 Expansion Area, Slope Stability Analysis, GAI Consultants, 2011
5. Harrison Power Station, Phase 6 Expansion Area, Slope Stability Analysis, GAI Consultants, 2015
6. Harrison Power Station, Phase 6A Expansion Area, Slope Stability Analysis, GAI Consultants, 2017
7. "Cover Soil Slope Stability Involving Geosynthetic Interfaces", (GRI REPORT #18), by Te-Yang Soong and Robert M. Koerner, December 9, 1996, Geosynthetic Research Institute (GRI), Drexel University
8. "Design of Drainage Systems Over Geosynthetically Lined Slopes" (GRI REPORT # 19) by Te-Yang Soong and Robert M. Koerner, June 17, 1997, Geosynthetic Research Institute (GRI), Drexel University.
9. GRI Standard – GC8, Determination of the Allowable Flow Rate of a Drainage Geocomposite, January 9, 2013, Geosynthetic Research Institute (GRI).
10. Slide2, Version 9.0, by Interactive Roc Science (2020).
11. NOAA's National Weather Service, Hydrometeorological Design Studies Center, *Precipitation Frequency Data Server (PFDS)*, accessed December 11, 2020 from https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html
12. United States Geological Survey (USGS), Earthquake Hazard Program, Unified Hazard Tool, 2014 data, https://earthquake.usgs.gov/hazards/interactive/, accessed November 23, 2020
13. NAVAC Design Manual 7.2, 1986
14. USEPA, 1995. RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities. Document No. EPA/600/R-95-051. April 1995
15. USEPA, 1988. Guide to Technical Resources for the Design of Land Disposal Facilities. Document No. EPA/625/6-88-018. December 1988.

METHODOLOGY

Multiple reference methods were utilized within this analysis and are described below.

"Cover Soil Slope Stability Involving Geosynthetic Interfaces", (GRI REPORT #18), by Te-Yang Soong and Robert M. Koerner, December 9, 1996, Geosynthetic Research Institute (GRI), Drexel University. (Reference 7).

The analytical method presented in this reference was utilized to compute the FS for the static and seismic translational (veneer) analyses for the slopes between the final cover benches. It considers the presence of equipment on top of the cover layer and provides a FS based on the most critical interface shear strength of final cover system components. The spreadsheet calculates a FS by dividing the cover material along the 3H:1V landfill final cover slope into active and passive blocks. Then interwedge force equations are set equal to each other and are arranged in the form of a quadratic equation that can be solved to calculate a FS.

"Design of Drainage Systems Over Geosynthetically Lined Slopes" (GRI Report # 19) by Te-Yang Soong and Robert M. Koerner, June 17, 1997, Geosynthetic Research Institute (GRI), Drexel University. (Reference 8).

The analytical method presented in this reference was utilized to determine the head within the final cover system as well as determine the required transmissivity of the final cover geocomposite. This method analyzes the ability of the drainage geocomposite in the final cover system to adequately transmit the rain flow from a specified storm event infiltrating through the cover soil and evaluates the impact on the final cover slope stability FS. GRI Report #19 discusses in detail the design of drainage systems incorporating the effects of seepage forces upon slope stability.

GRI Standard – GC8, Determination of the Allowable Flow Rate of a Drainage Geocomposite (Reference 9)

This paper presents the methodology for application of reduction factors in the specification of required transmissivity of a geocomposite.

Slide2, by RocScience (Reference 10)

Slide is a computer software program that uses 2D limit equilibrium techniques to determine the minimum FS. Slide will calculate FS for both rotational and translational failure surfaces within a cross-section in terms of both static and seismic conditions based upon slope geometry, water surfaces, shear strength parameters of materials, and the most critical contact interface within the proposed liner system. The software utilizes a CAD based graphical interface. This program was used to analyze translational and rotational failures through the final cover system. Spencer's Method was used to calculate all FS.

The following Attachments are included with this analysis:

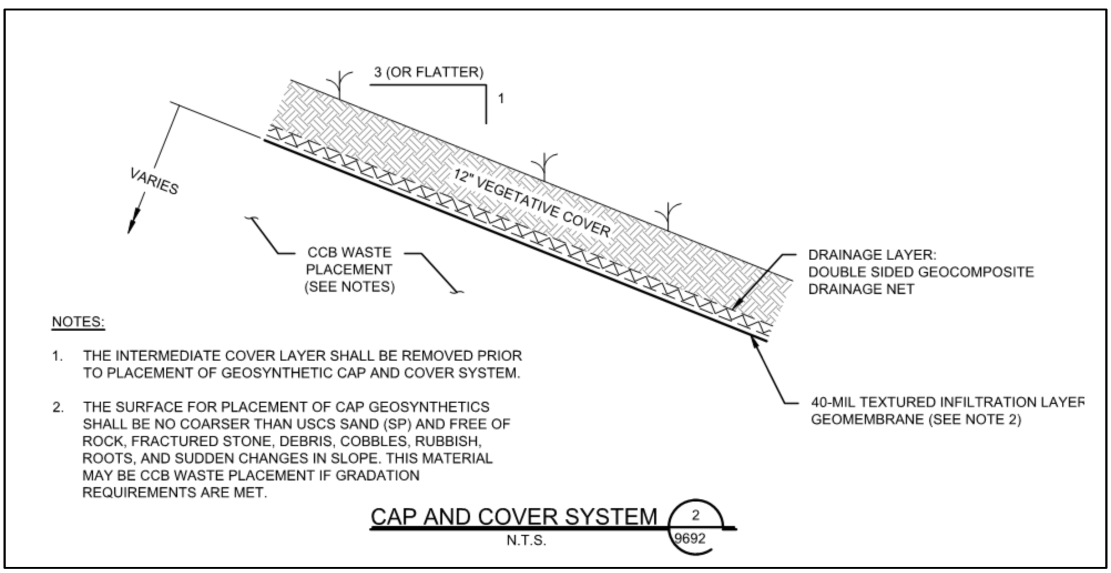
- Attachment A – Spreadsheet Based Translational Slope Stability Analysis
- Attachment B – Software Based Slope Stability Analysis

PROPOSED CAP AND COVER SYSTEM

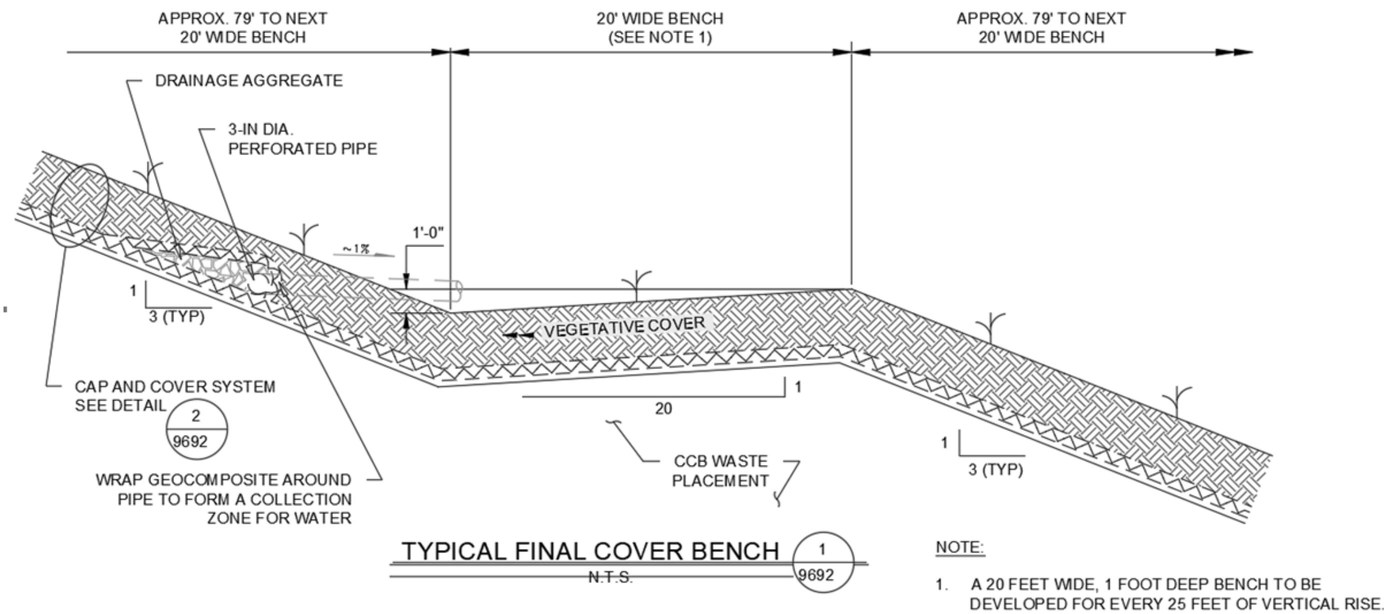
The proposed Phase 7 cap and cover system consists of the following components (from top to bottom):

- 12-inches of Vegetative Cover
- Double Sided Geocomposite Drainage Net (GDN);
- 40-mil HDPE Textured Geomembrane Liner;

The proposed cap and cover system detail is included on Drawing C89509692.



The top width of the final cover benches is approximately 20 feet to accommodate a 1.0-foot deep channel. The proposed final cover bench is included on Drawing C89509692.



MATERIAL PARAMETERS

The final cover system was analyzed using the following material properties for the slope stability analysis:

Vegetative Cover

The properties for the vegetative cover soil are based on the information from previous permit expansion applications (Reference 3) and the results of this calculation.

Effective Stress (drained)
Unit weight: $\gamma_t = 120$ pcf
Cohesion: c = 0 psf
Internal Friction Angle: $\phi = 27$ degrees
Permeability: $k = 1.0 \times 10^{-5}$ cm/sec
Thickness = 12 inches
Saturated unit weight: $\gamma_t = 130$ pcf (assumed)

Geosynthetics

The geosynthetics layer is modeled as a weak layer in SLIDE.

Unit weight: γ_t = 100 pcf
Cohesion: c' = 0 psf
Internal Friction Angle: ϕ' = 27 degrees
Thickness = negligible

CCB Waste

The properties for the CCB Waste are based on the information in the 2011 Phase 5 Landfill Expansion (Reference 4).

Effective Stress (drained)
Unit weight: γ_t = 80 pcf
Cohesion: c = 400 psf
Internal Friction Angle: ϕ = 42 degrees
Thickness: varies

WATER SURFACE

A water table was input within the stability analyses and assigned to the final cover vegetative/frost protection layer soil in Slide. For the saturated analysis a head of 0.05 meters (0.17 feet) was assumed, which is conservative since the maximum head above the liner from the 100-year, 1-hour storm event is 0.001 meters. The conservative approach is used because storm events greater than the specified design storm may occur during and after the post-closure period. Significant storm events which would exceed the design storm event have been considered due to the potential for slope failure.

The precipitation values for each storm event are referenced from the National Oceanic and Atmosphere Administration (NOAA) online Atlas 14 data for the landfill, which is near Shinnston, West Virginia (Reference 11).

SEISMIC COEFFICIENT

A shear wave accelerating through the facility will produce horizontal and vertical accelerations and stresses within the waste and liner system producing a slope stability FS that is less than a corresponding slope stability FS governed by static conditions. The shear wave acceleration is modeled within the stability analysis by inputting a coefficient, k_y, which is some fraction of gravity. The peak acceleration for the site is estimated to be 0.0476 g which is taken from the "Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years (site: NEHRP B-C boundary)" published by the U.S.G.S in 2014 (Reference 12).

When plotting this value onto Singh and Sun's 1995 figure below for the relationship between maximum horizontal seismic acceleration at the base and crest of 100 feet of refuse, there is an increase from 0.0476 g to approximately 0.072 g. All seismic stability analyses were performed with an average horizontal acceleration of 0.072 g, consistent with previous analyses.

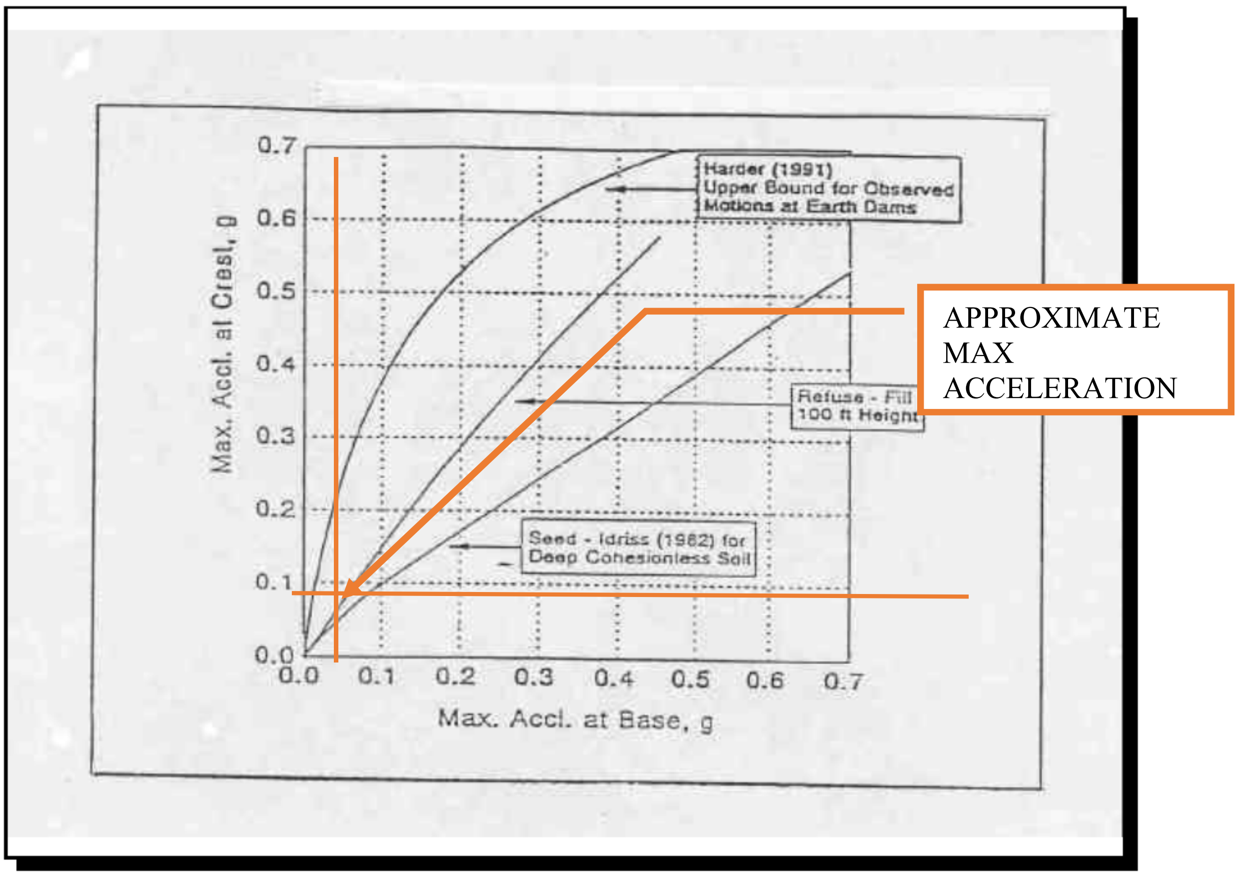


Figure 9-9 The relationship between maximum horizontal seismic acceleration at the base and crest of 100 feet of refuse, on top of deep cohesionless soils, and on top of earth dams. Singh and Sun, 1995, Figure 3.

Figure 9-9: Singh and Sun Figure 3

SPREADSHEET CALCULATION

Static and Seismic Unsaturated Translational Analysis

Stability analyses were completed using spreadsheets (Excel) recommended by GRI to evaluate the stability of the final cover system components considering veneer failures. The spreadsheet calculations were used to analyze the 3H:1V final cover slopes. Figure 1 illustrates the proposed geometry of the final cover slopes and the free body diagram of the forces acting along the slope.

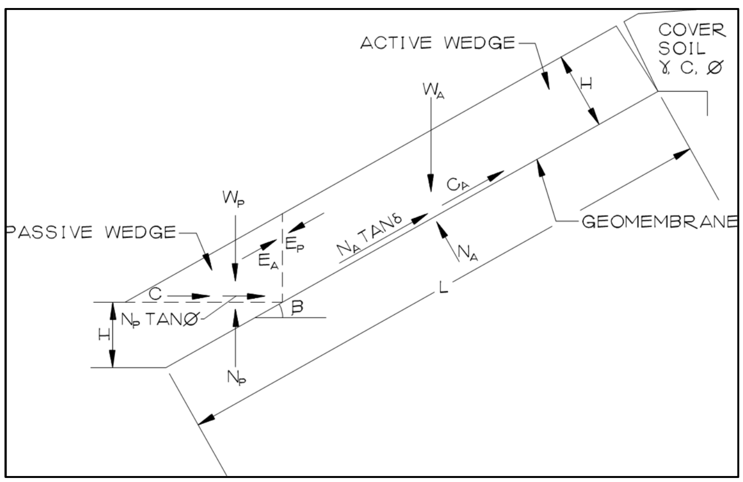


Figure 1: Slope Geometry & Free Body Diagram

Table 2: Slope Geometry & Free Body Diagram

Slope Dimensions	
Length of Slopes: (along the length of the geomembrane between final cover benches	79 feet
Slope Orientation	3H:1V or 18.43 degrees

The GRI Report #18 and #19 veneer slope stability calculations are prepared proposing the following assumptions:

- The shear strength component of adhesion developed between geosynthetic material layers is ignored.

- Tensile strength of the geosynthetic materials contributing to the veneer slope stability FS is ignored.
- The cover material provides a buttress at the toe of the slope, i.e. the passive soil wedge.
- Weights of the geosynthetic components are negligible compared to the weight of cover material and therefore are not considered in the calculations.
- Cohesion within the vegetative cover soil is assumed to be 0 psf
- All calculations will utilize a 1-foot unit width of sideslope.
- The presence of equipment along the 3H:1V slope is analyzed within GRI Report #18.
- The effect of seepage forces upon the veneer stability of the final cover soil layer, generated by a storm event, is evaluated GRI Report #19.

A Low Ground Pressure (LGP) bulldozer will be used to place final cover soil. The presence of equipment was only modeled in the static unsaturated analysis. The pressure exerted upon the top of the geosynthetic layers by a bulldozer is modeled as illustrated in Figure 2.

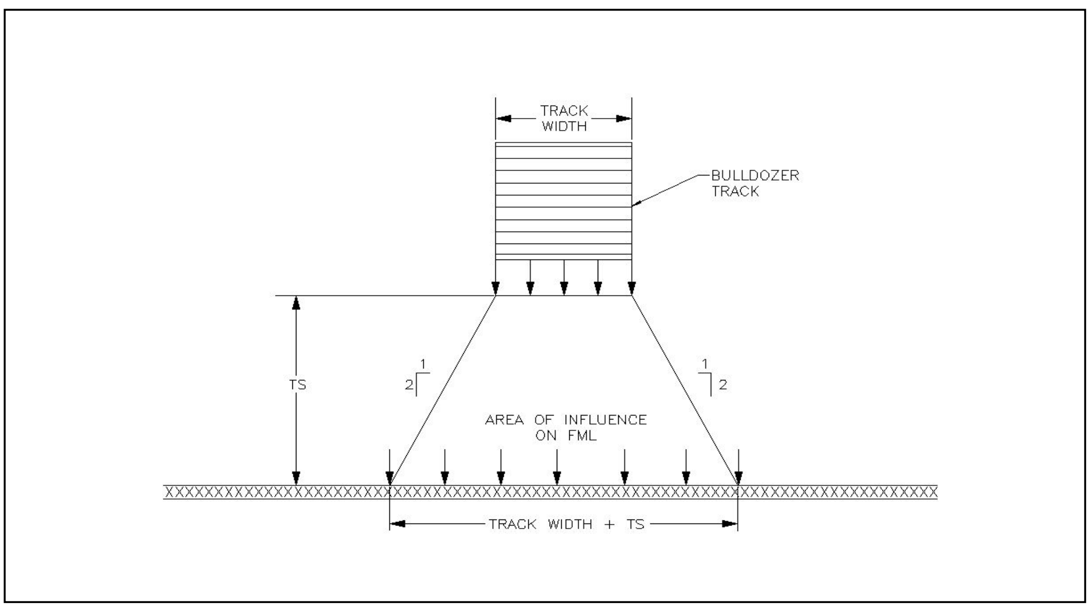


Figure 2: Stress Distribution of the LGP Bull Dozer upon the Geosynthetic Layers

The following typical LGP Bulldozer equipment specifications are used within the GRI Report #18.

- 2 tracks
- Track length = 10.2 feet
- Track width = 28 inches (2.33 feet)

- Operating weight = 36,400 lbs
- Ground Contact area = 6820 in^2
- Contact pressure = 36,400 lbs / 6820 ft^2 = 5.4 psi = 769 psf

Subsequently, the forces are resolved to produce a veneer slope stability FS. The equations are shown on pages 13 and 14 of GRI Report #18 and for ease of calculations are incorporated into a spreadsheet to produce a FS corresponding to a given set of input parameters.

Using the spreadsheet, the input variables of cover thickness, slope orientation, cover unit weight, and friction angle were held constant. The 3H:1V slope length was assumed to be approximately 79-feet. The minimum interface friction angle between the most critical interfaces in the geosynthetics was assumed to be 27 degrees to achieve a FS of greater than 1.50 for static unsaturated conditions and greater than 1.30 for static saturated conditions. Using the same input parameters, the seismic coefficient was also entered into the spreadsheet and the forces were resolved to produce a veneer slope stability FS for seismic conditions. With the assumed input parameters, a FS of greater than 1.20 was achieved for seismic unsaturated conditions.

Static Saturated Translational Analysis

Exceeding the drainage capacity of geocomposite in the final cover geocomposite will cause the final cover material to become saturated and possibly unstable. GRI Report #19 discusses in detail the design of drainage systems incorporating the effects of seepage forces upon slope stability. GRI Report #19 includes a spreadsheet calculation that considers the effects of rainfall and drainage layer capacity parameters upon a given slope stability condition. The GRI Report #19 spreadsheet is a modified version of the slope stability spreadsheet calculation presented within GRI Report #18.

An analysis was completed using the spreadsheet (Excel) recommended by GRI to evaluate the transmissivity of the geocomposite to adequately transmit the rain flow from a storm event infiltrating through the cover soil and evaluate the impact on the final cover slope stability FS. The required transmissivity of the geocomposite will be calculated assuming the 100 year, 1 hour storm event for the site. The precipitation amount for the storm event was obtained from the National Oceanic and Atmosphere Administration (NOAA) online Atlas 14 data for the station located in Shinnston, West Virginia, and is 2.52 inches. A 2.0 factor of safety was applied to this rainfall event, which results in rainfall of 5.04 inches.

An important input parameter within the GRI Report #19 spreadsheet calculation that impacts slope stability is the “runoff coefficient”, RC. The RC estimates the amount of precipitation that drains off the final cover slope as surface water runoff, thereby not infiltrating, saturating and reducing the shear strength of the final cover material. Calculating the RC (as a function of time) consists of determining a Soil

Conservation Service (SCS) curve number (CN) using the proposed length and orientation of the final cover sideslope and the magnitude of a given storm event. Subsequent equations are then used to determine "potential retention" and "accumulated precipitation" values, which are then input into an equation to calculate a RC. Based on Figure 3, a curve number (CN) of 80 was assumed for grass covered areas of the landfill with clay soils.

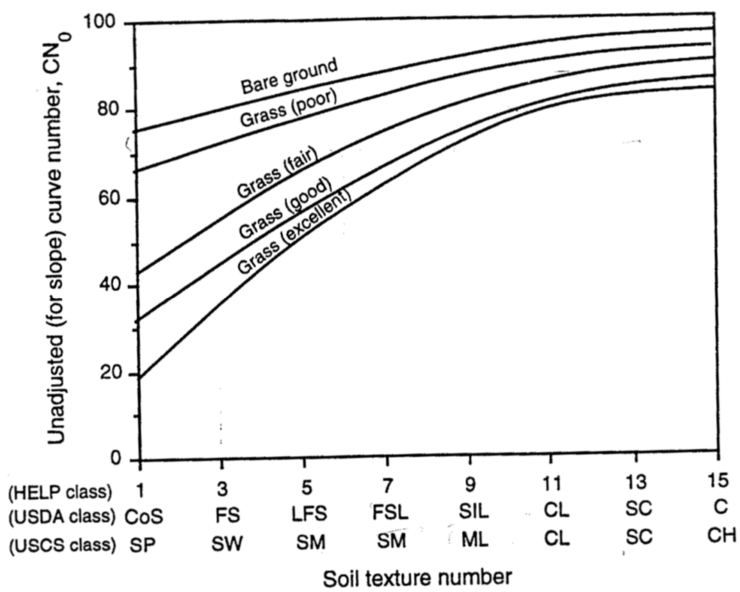


Figure 3: Figure A-3 of GRI Report #19

The following additional parameters were input within the GRI Report #19 spreadsheet calculation:

- A final cover soil permeability of $k = 1.0 \times 10^{-5}$ cm/sec;
- A geocomposite thickness of h_d = 250 mils = 0.635 cm; and
- A long term geocomposite transmissivity of $\theta_{lt} = 1.0 \times 10^{-4}$ m^2/sec.

The geocomposite thickness and transmissivity were varied until an acceptable FS was achieved.

In this analysis, the permeability of the drainage layer (k_d) is a function of the required transmissivity and thickness of the geocomposite and can be calculated using the following equation:

$$K_d = \theta_{lt} / h_d$$

Where h_d equals the thickness of the geocomposite

Therefore the permeability of the geocomposite equals:

$K_d = (1.0 * 10^{-4}\ m^2/sec) * (10{,}000\ cm^2/m^2) / (0.635\ cm) = 1.575\ cm/sec$

Geocomposite Transmissivity Calculation

To account for the reduction in transmissivity over the long term, the geocomposite required transmissivity will be increased using reduction factors based on ***GRI Standard – GC8, "Determination of the Allowable Flow Rate of a Drainage Geocomposite"***, to develop the transmissivity specification at the time of installation. The Reduction factors for the flow capacity of geocomposites having a geonet core used in landfill cover drainage layer applications are listed below.

$\theta_{ult} = \theta_{lt} * (RF_{IN} * RF_{CR} * RF_{CC} * RF_{BC}) * FS$

Where :

RF_{IN} = Reduction Factor for geotextile intrusion (1.0 to 1.2);
RF_{CR} = Reduction Factor for creep deformation (1.2 to 1.4);
RF_{CC} = Reduction Factor for chemical clogging (1.0 to 1.2); and
RF_{BC} = Reduction Factor for biological clogging (1.2 to 3.5).

Since the laboratory testing will be performed using site-specific boundary conditions, the reduction factor for intrusion of the geotextile into the geonet will be ignored (RF_{IN} =1.0). Reduction factors for creep deformation, RF_{CR} = 1.4, chemical clogging, RF_{CC} =1.1, and biological clogging, RF_{BC} = 2.7, and were utilized based on the recommendations specified in GRI Standard – GC8, Determination of the Allowable Flow Rate of Drainage Geocomposite. The following presents the bases for the selection of the reduction factors:

- Creep Deformation: CEC elected to apply the reduction factor as the potential for creep increases with increased overburden stress. CEC recognizes that this reduction factor is conservative in a final cover application.
- Chemical Clogging: CEC conservatively elected to apply an average reduction.
- Biological Clogging: CEC conservatively elected to apply an average reduction factor based on the limited potential for growth of biological organisms such as fungi, algae, or root penetration through the overlying soil.

The resulting ultimate transmissivity (θ_{ult}) is calculated as shown below.

$$\theta_{ult} = 1.0 * 10^{-4}\ m^2/sec * (1.0 * 1.4 * 1.1 * 2.7) * (2.0) = 8.3 * 10^{-4}\ m^2/sec$$

With the assumed input parameters, a FS of greater than 1.30 was achieved for saturated conditions, a FS greater than 1.50 was achieved for unsaturated conditions, and a FS greater than 1.20 was achieved for seismic conditions. The GRI Report # 18 and 19 calculation spreadsheets are provided in Attachment A.

SOFTWARE CALCULATIONS

Static and Seismic Unsaturated Rotational Analyses and Static Saturated Rotational Analysis

Slide2 was used to perform translational and rotational shallow slope stability analyses. The input values utilized in the Slide analyses are the same values as utilized in the spreadsheet calculations. These calculations consider the proposed 3H:1V landfill final cover slopes and the final cover benches. The required FS were achieved for all analyses. A summary of these calculations is provided in the conclusion section of this document. Output files from the software analyses are included in Attachment B.

RESULTS

The following table presents a summary of the calculated factors of safety for the various analyses performed for the final cover system. As shown, all calculated factors of safety meet the requirements of OAC 3745-27-08(C)(8). The spreadsheet outputs for these analyses are provided in Attachment A, and the software outputs for these analyses are provided in Attachment B.

Table 3: Proposed Final Cover Analyses Results

Translational or Rotational	Static or Seismic	Unsaturated or Saturated	Calculated Factor of Safety	Required Factor of Safety	Method of Calculation
Translational	Static	Unsaturated	1.55	1.50	Spreadsheet[1]
Translational	Seismic	Unsaturated	1.26	1.20	Spreadsheet[1]
Translational	Static	Saturated	1.57	1.30	Spreadsheet[1]
Rotational	Seismic	Unsaturated	1.23	1.20	Software
Rotational	Static	Unsaturated	1.53	1.50	Software
Rotational	Static	Saturated	1.47	1.30	Software
Translational	Static	Unsaturated	1.54	1.50	Software
Translational	Seismic	Unsaturated	1.23	1.20	Software

Translational or Rotational	Static or Seismic	Unsaturated or Saturated	Calculated Factor of Safety	Required Factor of Safety	Method of Calculation
Translational	Static	Saturated	1.42	1.30	Software

Note 1: Software calculations were performed to analyze the 3H:1V slopes including the final cover benches; spreadsheet calculations were performed to analyze the 3H:1V slopes.

CONCLUSIONS

Interface Shear Strength Requirements

The analyses indicate that a contact interface shear strength friction angle of 27 degrees results in acceptable factors of safety. This value is specified as a shear stress of **900 psf** as the requirement for interface shear strength under low normal loads.

This peak shear strength value was determined as follows:

$$\tau = c + \sigma_n \tan \phi$$

Where: c = 0 psf

σ_n = 900 psf (conservative for equipment loading and vegetative soil)

ϕ = 27°

τ = 460 psf

Any combination of c and ϕ yielding a $\tau \geq 460$ psf under a normal load of 900 psf will be considered acceptable.

Geocomposite Requirements

The results of the geocomposite transmissivity calculation indicate that a geonet thickness of **250 mil** and a transmissivity of **8.3 x 10^{-4} m^2/sec** are required. These values are specified in the CQA/QC Plan. To accurately model field conditions, the selected geocomposite shall be tested with a normal load of 900 psf. Testing shall be performed at a hydraulic gradient of 0.33 ft/ft (to model the 3H:1V final cover slopes) with the site specific boundary conditions of the final cover system.

Final Cover Soil Shear Strength Requirements

The following parameters will be specified for the final cover soil:

Effective Stress (Drained):
c': Cohesion = 0 psf
φ': Friction angle = 27 degrees
Permeability: k = 1.0 x 10^{-5} cm/sec

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ATTACHMENT A

SPREADSHEET BASED TRANSLATIONAL SLOPE STABILITY ANALYSIS

HARRISON POWER STATION
PHASE 7 EXPANSION
FINAL COVER SYSTEM
SHALLOW SLOPE STABILITY ANALYSIS
INPUT TABLE

Denotes an input value
Denotes an automatically calculated cell

INPUT VALUES

Parameter	Value	Unit		Converted	Unit	Converted	Unit
thickness of cover soil at the top of the slope = hc =	1.00	ft	=	0.3048	meters =	304.8	mm
thickness of cover soil at the bottom of the slope = D =	1.00	ft					
drainage layer thickness = t =	250	mil	=	0.635	cm =	6.35	mm
slope beneath the geomembrane (xH:1V) =	3.00	H:1V					
slope angle beneath the geomembrane = b =	18.43	degrees					
finished slope angle = w =	18.43	degrees		(for uniform cover soil thickness w = b)			
length of slope measured along the geomembrane = L =	79.0	ft	=	24.0792	meters		
length of slope between drainage outlets = L =	79.0	ft	=	24.0792	meters		
moist unit weight of cover soil = γ_t =	120.00	pcf	=	18.85	kN/m^3		
saturated unit weight = γ_{sat} =	130.00	pcf	=	20.42	kN/m^3		
friction angle of the cover soil = f =	27.0	degrees					
cohesion of the cover soil = c =	0.0	lb/ft^2					
minimum interface friction angle = d =	27.0	degrees					
minimum interface adhesion = ca =	0.0	lb/ft^2					
Unadjusted Curve Number	80						
STORM EVENT _____ YEAR	100	Year					
STORM EVENT _____ HOUR	1	Hour					
STORM EVENT RAINFALL	2.5	Inches	=	64.01	mm/hour		
Permeability of cover material = q_h =	1.0.E-05	cm/sec					
Permeability of drainage layer = k_d =	1.575	cm/sec					
Long Term Design Transmissivity = q =	1.0E-04	m^2/sec					
Overall FS for drainage = FS_D =	2						
Reduction Factor for geotextile intrusion = RF_{IN} =	1						
Reduction Factor for creep deformation = RF_{CR} =	1.4						
Reduction Factor for chemical clogging = RF_{CC} =	1.1						
Reduction Factor for biological clogging = RF_{BC} =	2.7						
equipment ground pressure (= wt. of equipment/(2wb)) = q =	764.7	lb/ft^2					
length of each equipment track = w =	10.20	ft					
width of each equipment track = b =	2.33	ft					
influence factor* at geomembrane interface = I =	0.97	See Table -->					
acceleration/deceleration of the bulldozer = a =	0.00	g					
seismic coefficient = Cs =	0.072	g					

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
²300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
³ 1000 mm	0.95	0.75	0.30

OUTPUT SUMMARY

Ultimate Geocomposite Transmissivity Specification = 8.3E-04 m^2/sec

Slope Stability Factor of Safety Summary

Method	FS	Target FS
Static - Translational - Unsaturated	1.55	1.50
Seismic - Translational - Unsaturated	1.26	1.20
Static - Translational - Saturated	1.57	1.30

The adjusted SCS Curve Number is calculated as:

$CN = 100 - (100-CN_0) * (L^2 / S)^{CN_0^{-0.81}}$

Where:

CN_0	SCS curve number (unadjusted for slope), from Figure A-3 of GRI Report #19 Appendix
L	Standardized Dimensionless Length = L divided by 152 meters
S	Standardized Dimensionless Inclination = s / 0.04 (where s is defined as the vertical rise over the horizontal distance expressed as a ratio)

Input Variables

CN_0 =	**80**					
Slope Length =	**79**	feet or	24.07802	meters		
S =	**3.00**	on 1	0.333	percent,	which yields	8.333
Storm Event						
100	year	**1**	hour	storm		
2.520	inches/hour or	64.008	millimeters/hour			

Calculated Variables

$CN_0^{-0.81}$ =	0.02874
L^2 / S =	0.0030
$100 - CN_0$ =	20

The adjusted SCS Curve Number is equal to:

CN = **83.1**

The Potential Retention, (PR) in millimeters is calculated by:

PR = (25400 / CN) - 254

PR = **52** millimeters

The Runoff Coefficient, RC(t), as a function of time is determined by:

$$RC(t) = \frac{[P(t) - 0.2 * PR]^2}{P(t) * [P(t) + 0.8*PR]}$$

Where:
P(t) = Accumulated Precipitation, mm
P(t) = I * t

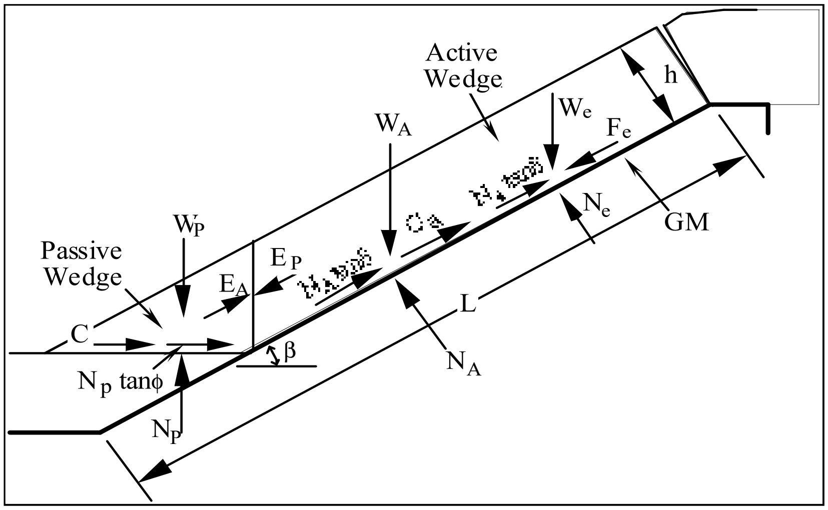
Where: P(t) = I*t
I = Rainfall Intensity, mm per hour
t = time, hours

P(t) = 64.008 millimeters

RC(t) = 0.425

HARRISON POWER STATION
PHASE 7 EXPANSION

Placement of the Cover Material Layer
across the sideslopes with the incorporation of Equipment Loads



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Calculation of FS

Active Wedge:

Wa=	*9080.5*	*lb*
Na=	*8614.5*	*lb*

Passive Wedge:

Wp=	*200.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*4993.9*
b=	*-8584*
c=	*1296.5*

FS= 1.551

thickness of cover soil = h =	1.00	ft					
cov. mat. slope angle beneath the geomembrane = b =	18.43	0.001	= *0.32*	*(rad.)*			
finished cover material slope angle = w =	18.43	7.87	= *0.32*	*(rad.)*			
length of slope measured along the geomembrane = L =	79.0	0					
unit weight of the cover soil = g =	120.0	lb/ft^3					
friction angle of the cover soil = f =	27.0	°	= *0.47*	*(rad.)*			
cohesion of thecover soil = c =	0.0	lb/ft^2			*C=*	*0*	*lb*
critical interface friction angle = d =	27.00	°	= *0.47*	*(rad.)*			
adhesion = ca =	0.0	lb/ft^2			*Ca=*	*0*	*lb*

thickness of the cover soil = h =	1.00	ft	*b/h=*	*2.3*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	764.7	lb/ft^2	*We=qwI=*	*7565.9*
length of each equipment track = w =	10.2	ft	*Ne=Wecosb=*	*7177.7*
width of each equipment track = b =	2.3	ft	*Fe=We(a/g)=*	*0.0*
influence factor* at geomembrane interface = I =	0.97			
acceleration/deceleration of the bulldozer = a =	0.00	g		

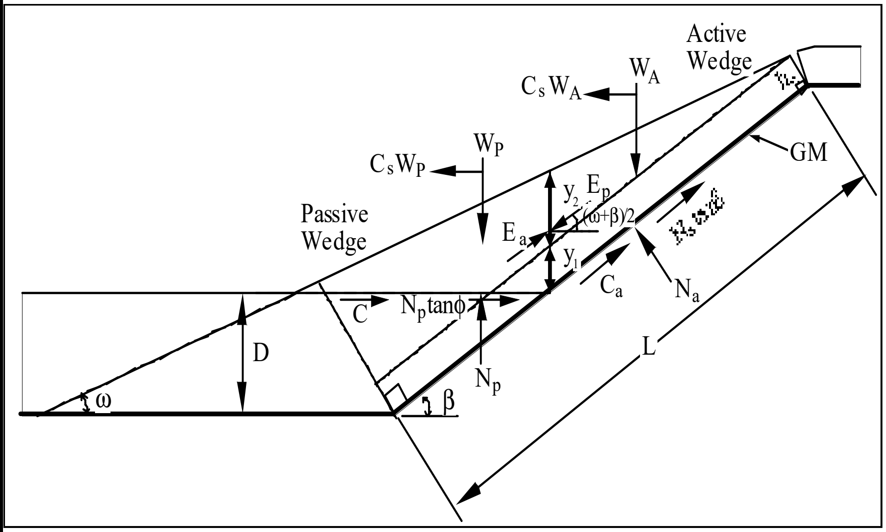
*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
² 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
³ 1000 mm	0.95	0.75	0.30

Note: Denotes an automatically calculated cell
Denotes input values

HARRISON POWER STATION
PHASE 7 EXPANSION

Uniformed and/or Tapered Cover Soil with Consideration of Seismic Forces



65

Calculation of FS

Active Wedge:

Wa=	*9080.5*	*lb*
Na=	*8614.5*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*200.0*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*3218.3*
b=	*-4591*
c=	*670.9*

FS= 1.261

(Note: for uniform cover soil thickness the input value of w = b)

thickness of cover soil at top (crest) of the slope = hc =	1.00	ft			
thickness of cover soil along the bottom of the site = D =	1.00	ft			
soil slope angle beneath the geomembrane = b =	18.43	0.001	*= 0.32*	*(rad.)*	
finished cover soil slope angle = w =	18.43	7.87	*= 0.32*	*(rad.)*	
length of slope measured along the geomembrane = L =	79.0	0			

y2=	*0.00*	*(ft)*
y1=	*1.05*	*(ft)*
(w+b)/2=	*0.322*	*(rad.)*
(=	*18.4*	*°)*

unit weight of the cover soil = g =	120.0	lb/ft^3		
friction angle of the cover soil = f =	27.0	°	*= 0.47*	*(rad.)*
cohesion of the cover soil = c =	0.0	lb/ft^2		
critical interface friction angle = d =	27.0	°	*= 0.47*	*(rad.)*
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2		

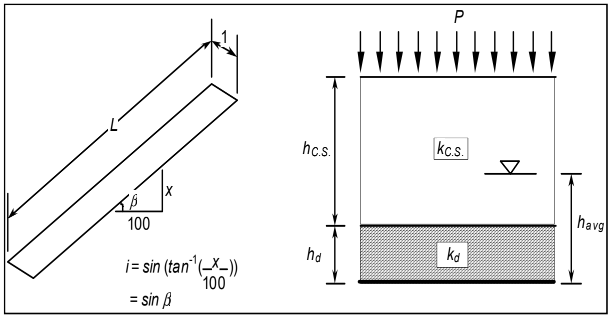
seismic coefficient = Cs = 0.07200 g

Note: Denotes an automatically calculated cell

Denotes input values

numbers in Italics are calculated values

Calculation of DLC and PSR



L = 24.08 m
b = 18.43 °

$h_{C.S.}$ = 304.80 mm
h_d or t_{GS} = 6.35 mm

$k_{C.S.}$ = 1.00E-05 cm/s
k_d or k_{GS} = 1.575 cm/s

P = 64.01 mm/hr
RC = 0.425

* Note: If there is only one soil above the geomembrane treat it as the drainage layer.

i = 0.3162
L (cos*b*) = *22.84* m
x = 7.61 m
$h_{C.S.}$ = *0.3* m
h_d or t_{GS} = *0.00635* m
$h_{C.S.} + h_d$ = *0.31* m

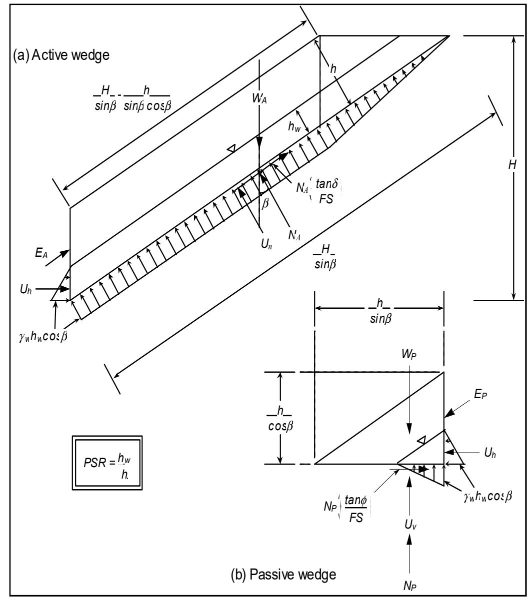
$k_{C.S.}$ = *1.0E-07* m/s
k_d or k_{GS} = *1.6E-02* m/s

P (RC) = 27.2 mm/hr
Actual runoff = 63.65 mm/hr
PERC = 0.36 mm/hr 36.80 0.36
$FLUX_{actual}$ = *0.008* m^3/hr
$FLUX_{allow}$ = *0.114* m^3/hr ***DLC = 13.8432***

q = 2.3E-06 m^3/sec

h_{avg} = *0.000* m -927.8
0.000 ***PSR = 0.001*** 0.000
0.000

DLC	13.843
PSR	0.00147



thickness of cover soil = h = *0.31* m
length of slope measured along the geomembrane = L = *24* m
soil slope angle beneath the geomembrane = *b* = *18.4* ° = *0.32* (rad.)
vertical height of the slope measured from the toe = *H* = *7.6* m
parallel submergence ratio = *PSR* = *0.00*
depth of the water surface measured from the geomembrane = h_w = *0.000* m

dry unit weight of the cover soil = g_{dry} = 18.9 kN/m^3
saturated unit weight of the cover soil = $g_{sat'd}$ = 20.4 kN/m^3
unit weight of water = g_w = 9.81 kN/m^3
friction angle of the cover soil = *f* = 27.0 ° = *0.47* (rad.)
Minimum interface friction angle = *d* = 27.0 ° = *0.47* (rad.)

Calculation of FS

Active Wedge:

W_A = *138.2082* kN
U_n = *0.102791* kN
U_h = *1.03E-06* kN
N_A = *131.013* kN

Passive Wedge:

W_P = *3.041666* kN
U_V = *3.1E-06* kN

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where *a* = *41.5*
b = *-71.9*
c = *10.8*

FS= 1.57

Note: numbers in boxes are input values
numbers in Italics are calculated values

Constructed by Te-Yang Soong

ATTACHMENT B

SOFTWARE BASED SLOPE STABILITY ANALYSIS

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Final Cover		120	Mohr-Coulomb	0	27	None	0
CCB Waste		80	Mohr-Coulomb	400	42	None	0
Geosynthetic Peak Shear Strength		100	Mohr-Coulomb	0	27	None	0

Method Name	Min FS
Spencer	1.23

rocscience

SLIDEINTERPRET 9.009

Project	302-918 Harrison Power Station - Phase 7 Expansion		
Group	final cover-rot-seismic-unsaturated.slim	*Scenario*	final cover-rot-seismic-unsaturated.slim
Drawn By	MAL	*Company*	Civil & Environmental Consultants, Inc.
Date	March 2021	*File Name*	final cover-rot-seismic-unsaturated.slim

Table of Contents

Slide Analysis Information

302-918 Harrison Power Station - Phase 7 Expansion

Project Summary

Slide Modeler Version:	9.009

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	10
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.072

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
CCB Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	80
Cohesion [psf]	400
Friction Angle [deg]	42
Water Surface	None
Ru Value	0
Geosynthetic Peak Shear Strength	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0

Global Minimums

Method: spencer

FS	1.226890
Center:	470.960, 1349.649
Radius:	197.797
Left Slip Surface Endpoint:	532.664, 1161.722
Right Slip Surface Endpoint:	534.353, 1162.285
Resisting Moment:	26.6184 lb-ft
Driving Moment:	21.6959 lb-ft
Resisting Horizontal Force:	0.127669 lb
Driving Horizontal Force:	0.104059 lb
Total Slice Area:	0.00237708 ft2
Surface Horizontal Width:	1.6898 ft
Surface Average Height:	0.00140673 ft

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	3422
Number of Invalid Surfaces:	0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.22689

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.0675918	0.00131472	18.1873	Final Cover	0	27	0.00710809	0.00872085	0.0171156	0	0.0171156	0.0194509	0.0194509
2	0.0675918	0.00383493	18.2079	Final Cover	0	27	0.0207306	0.0254342	0.0499175	0	0.0499175	0.0567365	0.0567365
3	0.0675918	0.00613656	18.2285	Final Cover	0	27	0.0331678	0.0406933	0.0798652	0	0.0798652	0.0907885	0.0907885
4	0.0675918	0.00821955	18.2491	Final Cover	0	27	0.0444199	0.0544983	0.106959	0	0.106959	0.121606	0.121606
5	0.0675918	0.0100838	18.2697	Final Cover	0	27	0.054487	0.0668495	0.131199	0	0.131199	0.149187	0.149187
6	0.0675918	0.0117293	18.2903	Final Cover	0	27	0.0633688	0.0777466	0.152587	0	0.152587	0.173532	0.173532
7	0.0675918	0.0131559	18.311	Final Cover	0	27	0.0710659	0.0871901	0.17112	0	0.17112	0.194638	0.194638
8	0.0675918	0.0143636	18.3316	Final Cover	0	27	0.0775783	0.09518	0.186802	0	0.186802	0.212506	0.212506
9	0.0675918	0.0153522	18.3522	Final Cover	0	27	0.0829056	0.101716	0.19963	0	0.19963	0.227132	0.227132
10	0.0675918	0.0161218	18.3729	Final Cover	0	27	0.0870486	0.106799	0.209605	0	0.209605	0.238517	0.238517
11	0.0675918	0.0166722	18.3935	Final Cover	0	27	0.0900073	0.110429	0.216729	0	0.216729	0.246659	0.246659
12	0.0675918	0.0170032	18.4141	Final Cover	0	27	0.0917817	0.112606	0.221001	0	0.221001	0.251558	0.251558
13	0.0675918	0.017115	18.4348	Final Cover	0	27	0.092371	0.113329	0.22242	0	0.22242	0.25321	0.25321
14	0.0675918	0.0170073	18.4554	Final Cover	0	27	0.0917768	0.1126	0.220989	0	0.220989	0.251617	0.251617
15	0.0675918	0.0166801	18.476	Final Cover	0	27	0.0899975	0.110417	0.216706	0	0.216706	0.246777	0.246777
16	0.0675918	0.0161334	18.4967	Final Cover	0	27	0.0870347	0.106782	0.209572	0	0.209572	0.238688	0.238688
17	0.0675918	0.015367	18.5173	Final Cover	0	27	0.0828884	0.101695	0.199587	0	0.199587	0.227349	0.227349
18	0.0675918	0.0143808	18.538	Final Cover	0	27	0.0775577	0.0951548	0.186752	0	0.186752	0.212759	0.212759
19	0.0675918	0.0131748	18.5586	Final Cover	0	27	0.0710435	0.0871625	0.171066	0	0.171066	0.194917	0.194917
20	0.0675918	0.011749	18.5793	Final Cover	0	27	0.0633454	0.0777178	0.15253	0	0.15253	0.173822	0.173822
21	0.0675918	0.0101031	18.5999	Final Cover	0	27	0.0544637	0.066821	0.131144	0	0.131144	0.149473	0.149473
22	0.0675918	0.00823722	18.6206	Final Cover	0	27	0.0443985	0.0544721	0.106908	0	0.106908	0.121867	0.121867
23	0.0675918	0.00615118	18.6413	Final Cover	0	27	0.0331499	0.0406713	0.0798219	0	0.0798219	0.0910047	0.0910047
24	0.0675918	0.00384493	18.6619	Final Cover	0	27	0.0207181	0.0254188	0.0498871	0	0.0498871	0.0568845	0.0568845
25	0.0675918	0.00131836	18.6826	Final Cover	0	27	0.00710284	0.0087144	0.0171029	0	0.0171029	0.0195047	0.0195047

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.22689

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	532.664	1161.72	0	0	0
2	532.731	1161.74	5.712e-06	0	0
3	532.799	1161.77	2.09859e-05	0	0
4	532.866	1161.79	4.32065e-05	0	0
5	532.934	1161.81	6.99954e-05	0	0
6	533.002	1161.83	9.92113e-05	0	0
7	533.069	1161.86	0.00012895	0	0
8	533.137	1161.88	0.000157544	0	0
9	533.204	1161.9	0.000183565	0	0
10	533.272	1161.92	0.000205819	0	0
11	533.34	1161.95	0.000223353	0	0
12	533.407	1161.97	0.00023545	0	0
13	533.475	1161.99	0.000241632	0	0
14	533.542	1162.01	0.000241657	0	0
15	533.61	1162.04	0.000235524	0	0
16	533.678	1162.06	0.000223469	0	0
17	533.745	1162.08	0.000205967	0	0
18	533.813	1162.1	0.000183731	0	0
19	533.88	1162.13	0.000157713	0	0
20	533.948	1162.15	0.000129105	0	0
21	534.015	1162.17	9.9337e-05	0	0
22	534.083	1162.19	7.00792e-05	0	0
23	534.151	1162.22	4.32406e-05	0	0
24	534.218	1162.24	2.09702e-05	0	0
25	534.286	1162.26	5.65634e-06	0	0
26	534.353	1162.29	0	0	0

Entity Information

External Boundary

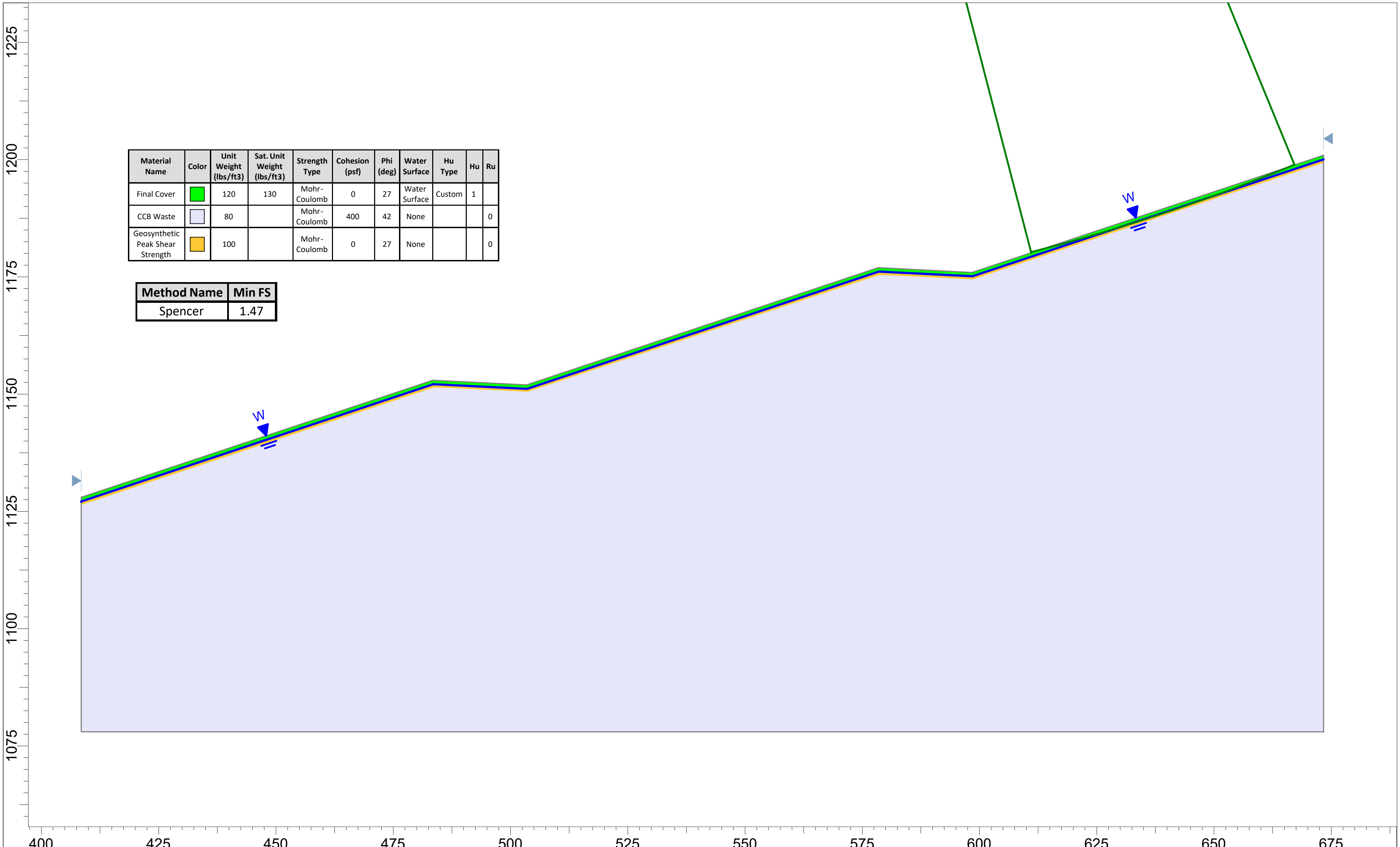
X	Y
673.343	1078
673.343	1199.37
673.343	1199.89
673.343	1200.95
598.397	1175.97
578.397	1176.97
503.451	1151.98
483.451	1152.98
408.505	1128
408.505	1126.95
408.505	1126.42
408.505	1078

Material Boundary

X	Y
408.505	1126.95
483.589	1151.98
503.589	1150.98
578.535	1175.96
598.535	1174.96
673.343	1199.89

Material Boundary

X	Y
408.505	1126.42
483.658	1151.47
503.658	1150.47
578.604	1175.45
598.604	1174.45
673.343	1199.37



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Final Cover		120	130	Mohr-Coulomb	0	27	Water Surface	Custom	1	
CCB Waste		80		Mohr-Coulomb	400	42	None			0
Geosynthetic Peak Shear Strength		100		Mohr-Coulomb	0	27	None			0

Method Name	Min FS
Spencer	1.47

rocscience

SLIDEINTERPRET 9.009

Project	302-918 Harrison Power Station - Phase 7 Expansion		
Group	final cover-rot-static-saturated.slim	*Scenario*	final cover-rot-static-saturated.slim
Drawn By	MAL	*Company*	Civil & Environmental Consultants, Inc.
Date	March 2021	*File Name*	final cover-rot-static-saturated.slim

Table of Contents

Slide Analysis Information

302-918 Harrison Power Station - Phase 7 Expansion

Project Summary

Slide Modeler Version:	9.009

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	10
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	130
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	Water Table
Hu Value	1
CCB Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	80
Cohesion [psf]	400
Friction Angle [deg]	42
Water Surface	None
Ru Value	0
Geosynthetic Peak Shear Strength	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0

Global Minimums

Method: spencer

FS	1.468820
Center:	501.074, 1603.512
Radius:	437.383
Left Slip Surface Endpoint:	611.003, 1180.169
Right Slip Surface Endpoint:	667.137, 1198.880
Resisting Moment:	966342 lb-ft
Driving Moment:	657905 lb-ft
Resisting Horizontal Force:	2097.14 lb
Driving Horizontal Force:	1427.77 lb
Total Slice Area:	39.4617 ft2
Surface Horizontal Width:	56.1342 ft
Surface Average Height:	0.702988 ft

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	3746
Number of Invalid Surfaces:	0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.46882

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.26758	21.8437	14.71	Final Cover	0	27	3.06272	4.49858	8.82894	0	8.82894	9.633	9.633
2	2.26758	63.7596	15.0173	Final Cover	0	27	8.92349	13.107	25.7239	0	25.7239	28.1178	28.1178
3	2.26758	102.125	15.3251	Final Cover	0	27	14.2668	20.9554	41.1272	0	41.1272	45.0369	45.0369
4	2.26758	136.924	15.6333	Final Cover	0	27	19.0932	28.0445	55.0403	0	55.0403	60.3832	60.3832
5	2.26758	168.142	15.942	Final Cover	0	27	23.4032	34.3751	67.4647	0	67.4647	74.1499	74.1499
6	2.26758	195.76	16.2512	Final Cover	0	27	27.1972	39.9478	78.4019	0	78.4019	86.3297	86.3297
7	2.26758	219.764	16.5608	Final Cover	0	27	30.4756	44.7632	87.8527	0	87.8527	96.9152	96.9152
8	2.26758	240.423	16.871	Final Cover	0	27	33.1341	48.6681	95.9774	0.461005	95.5164	106.026	105.565
9	2.26758	258.42	17.1816	Final Cover	0	27	34.3578	50.4654	103.339	4.2952	99.0439	113.963	109.667
10	2.26758	272.559	17.4928	Final Cover	0	27	35.3077	51.8607	109.071	7.2881	101.782	120.198	112.91
11	2.26758	282.704	17.8045	Final Cover	0	27	35.9679	52.8303	113.121	9.43544	103.685	124.672	115.236
12	2.26758	288.834	18.1168	Final Cover	0	27	36.3383	53.3744	115.486	10.7328	104.753	127.375	116.642
13	2.34457	300.768	18.4349	Final Cover	0	27	36.4155	53.4878	116.144	11.1684	104.976	128.282	117.114
14	2.21488	282.179	18.75	Final Cover	0	27	36.2042	53.1774	115.111	10.7452	104.366	127.401	116.656
15	2.21488	276.368	19.0567	Final Cover	0	27	35.7145	52.4582	112.441	9.48581	102.955	124.778	115.292
16	2.21488	266.733	19.364	Final Cover	0	27	34.9487	51.3333	108.145	7.39756	100.747	120.427	113.03
17	2.21488	253.251	19.6718	Final Cover	0	27	33.9067	49.8028	102.219	4.47581	97.7434	114.341	109.865
18	2.21488	235.981	19.9802	Final Cover	0	27	32.5994	47.8826	94.6909	0.715788	93.9752	106.543	105.828
19	2.21488	216.037	20.2892	Final Cover	0	27	29.9897	44.0494	86.4519	0	86.4519	97.539	97.539
20	2.21488	192.818	20.5989	Final Cover	0	27	26.7159	39.2409	77.0147	0	77.0147	87.056	87.056
21	2.21488	165.965	20.9092	Final Cover	0	27	22.9516	33.7118	66.1631	0	66.1631	74.9317	74.9317
22	2.21488	135.454	21.2201	Final Cover	0	27	18.6965	27.4618	53.8969	0	53.8969	61.1564	61.1564
23	2.21488	101.263	21.5317	Final Cover	0	27	13.9505	20.4907	40.2153	0	40.2153	45.7194	45.7194
24	2.21488	63.3686	21.8439	Final Cover	0	27	8.71318	12.7981	25.1176	0	25.1176	28.6104	28.6104
25	2.21488	21.7462	22.1569	Final Cover	0	27	2.98432	4.38343	8.60296	0	8.60296	9.81822	9.81822

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.46882

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	611.003	1180.17	0	0	0
2	613.271	1180.76	1.68904	0	0
3	615.538	1181.37	6.27528	0	0
4	617.806	1181.99	13.0699	0	0
5	620.074	1182.63	21.4403	0	0
6	622.341	1183.28	30.81	0	0
7	624.609	1183.94	40.6595	0	0
8	626.876	1184.61	50.5262	0	0
9	629.144	1185.3	59.6584	0	0
10	631.412	1186	65.1132	0	0
11	633.679	1186.71	67.2294	0	0
12	635.947	1187.44	66.4111	0	0
13	638.214	1188.18	63.1331	0	0
14	640.559	1188.97	57.7431	0	0
15	642.774	1189.72	51.3846	0	0
16	644.989	1190.48	44.4604	0	0
17	647.204	1191.26	37.6864	0	0
18	649.418	1192.05	31.8477	0	0
19	651.633	1192.86	27.7989	0	0
20	653.848	1193.68	23.433	0	0
21	656.063	1194.51	18.4937	0	0
22	658.278	1195.36	13.3428	0	0
23	660.493	1196.22	8.40294	0	0
24	662.708	1197.09	4.15846	0	0
25	664.923	1197.98	1.15632	0	0
26	667.137	1198.88	0	0	0

Entity Information

Water Table

X	Y
408.505	1127.13
483.566	1152.15
503.566	1151.15
578.512	1176.13
598.512	1175.13
673.343	1200.07

External Boundary

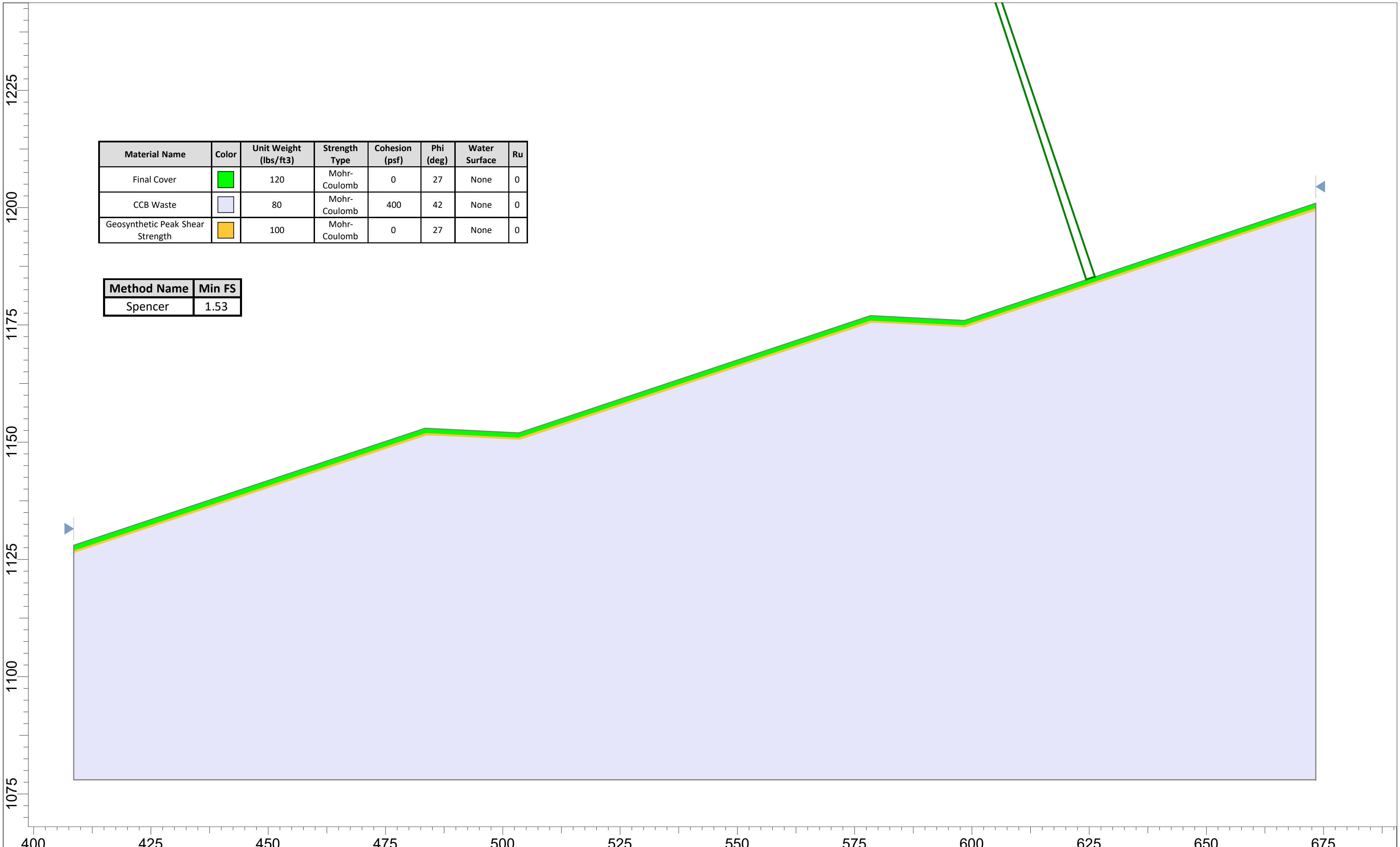
X	Y
673.343	1078
673.343	1199.37
673.343	1199.89
673.343	1200.95
598.397	1175.97
578.397	1176.97
503.451	1151.98
483.451	1152.98
408.505	1128
408.505	1126.95
408.505	1126.42
408.505	1078

Material Boundary

X	Y
408.505	1126.95
483.589	1151.98
503.589	1150.98
578.535	1175.96
598.535	1174.96
673.343	1199.89

Material Boundary

X	Y
408.505	1126.42
483.658	1151.47
503.658	1150.47
578.604	1175.45
598.604	1174.45
673.343	1199.37



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Final Cover		120	Mohr-Coulomb	0	27	None	0
CCB Waste		80	Mohr-Coulomb	400	42	None	0
Geosynthetic Peak Shear Strength		100	Mohr-Coulomb	0	27	None	0

Method Name	Min FS
Spencer	1.53

rocscience

SLIDEINTERPRET 9.009

Project	302-918 Harrison Power Station - Phase 7 Expansion		
Group	final cover-rot-static-unsaturated.slim	*Scenario*	final cover-rot-static-unsaturated.slim
Drawn By	MAL	*Company*	Civil & Environmental Consultants, Inc.
Date	March 2021	*File Name*	final cover-rot-static-unsaturated.slim

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Slide Analysis Information

302-918 Harrison Power Station - Phase 7 Expansion

Project Summary

Slide Modeler Version:	9.009

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	10
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
CCB Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	80
Cohesion [psf]	400
Friction Angle [deg]	42
Water Surface	None
Ru Value	0
Geosynthetic Peak Shear Strength	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0

Global Minimums

Method: spencer

FS	1.528580
Center:	562.537, 1373.307
Radius:	198.556
Left Slip Surface Endpoint:	624.397, 1184.633
Right Slip Surface Endpoint:	626.252, 1185.252
Resisting Moment:	36.0961 lb-ft
Driving Moment:	23.6141 lb-ft
Resisting Horizontal Force:	0.172465 lb
Driving Horizontal Force:	0.112826 lb
Total Slice Area:	0.00313408 ft2
Surface Horizontal Width:	1.85528 ft
Surface Average Height:	0.00168927 ft

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	3657
Number of Invalid Surfaces:	0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.52858

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.0742113	0.00173318	18.1641	Final Cover	0	27	0.00701743	0.0107267	0.0210524	0	0.0210524	0.0233547	0.0233547
2	0.0742113	0.00505557	18.1866	Final Cover	0	27	0.0204667	0.031285	0.0614003	0	0.0614003	0.0681241	0.0681241
3	0.0742113	0.00808989	18.2091	Final Cover	0	27	0.0327464	0.0500555	0.0982394	0	0.0982394	0.109012	0.109012
4	0.0742113	0.010836	18.2317	Final Cover	0	27	0.0438565	0.0670382	0.131569	0	0.131569	0.146016	0.146016
5	0.0742113	0.0132939	18.2542	Final Cover	0	27	0.0537972	0.0822333	0.161392	0	0.161392	0.179136	0.179136
6	0.0742113	0.0154634	18.2768	Final Cover	0	27	0.0625683	0.0956407	0.187705	0	0.187705	0.208369	0.208369
7	0.0742113	0.0173444	18.2993	Final Cover	0	27	0.0701697	0.10726	0.210511	0	0.210511	0.233716	0.233716
8	0.0742113	0.0189367	18.3219	Final Cover	0	27	0.0766018	0.117092	0.229807	0	0.229807	0.255173	0.255173
9	0.0742113	0.0202404	18.3444	Final Cover	0	27	0.0818649	0.125137	0.245595	0	0.245595	0.272739	0.272739
10	0.0742113	0.0212551	18.367	Final Cover	0	27	0.0859582	0.131394	0.257874	0	0.257874	0.286414	0.286414
11	0.0742113	0.021981	18.3896	Final Cover	0	27	0.0888818	0.135863	0.266645	0	0.266645	0.296195	0.296195
12	0.0742113	0.0224177	18.4121	Final Cover	0	27	0.0906358	0.138544	0.271909	0	0.271909	0.302081	0.302081
13	0.0742113	0.0225653	18.4347	Final Cover	0	27	0.0912206	0.139438	0.273663	0	0.273663	0.304069	0.304069
14	0.0742113	0.0224236	18.4573	Final Cover	0	27	0.0906358	0.138544	0.271908	0	0.271908	0.302159	0.302159
15	0.0742113	0.0219925	18.4799	Final Cover	0	27	0.0888812	0.135862	0.266645	0	0.266645	0.296349	0.296349
16	0.0742113	0.0212719	18.5024	Final Cover	0	27	0.0859576	0.131393	0.257874	0	0.257874	0.286639	0.286639
17	0.0742113	0.0202616	18.525	Final Cover	0	27	0.0818642	0.125136	0.245594	0	0.245594	0.273025	0.273025
18	0.0742113	0.0189615	18.5476	Final Cover	0	27	0.0766018	0.117092	0.229806	0	0.229806	0.255507	0.255507
19	0.0742113	0.0173716	18.5702	Final Cover	0	27	0.0701697	0.10726	0.210509	0	0.210509	0.234083	0.234083
20	0.0742113	0.0154917	18.5928	Final Cover	0	27	0.0625678	0.0956399	0.187704	0	0.187704	0.208752	0.208752
21	0.0742113	0.0133217	18.6154	Final Cover	0	27	0.0537965	0.0822323	0.161391	0	0.161391	0.179511	0.179511
22	0.0742113	0.0108615	18.638	Final Cover	0	27	0.0438558	0.0670371	0.131568	0	0.131568	0.146359	0.146359
23	0.0742113	0.00811097	18.6606	Final Cover	0	27	0.0327456	0.0500542	0.0982369	0	0.0982369	0.109296	0.109296
24	0.0742113	0.00506998	18.6832	Final Cover	0	27	0.0204658	0.0312836	0.0613977	0	0.0613977	0.0683183	0.0683183
25	0.0742113	0.00173843	18.7058	Final Cover	0	27	0.00701658	0.0107254	0.0210497	0	0.0210497	0.0234254	0.0234254

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.52858

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	624.397	1184.63	0	0	0
2	624.471	1184.66	8.19173e-06	0	0
3	624.545	1184.68	3.00976e-05	0	0
4	624.62	1184.71	6.19684e-05	0	0
5	624.694	1184.73	0.000100394	0	0
6	624.768	1184.76	0.000142304	0	0
7	624.842	1184.78	0.000184967	0	0
8	624.917	1184.8	0.000225992	0	0
9	624.991	1184.83	0.000263328	0	0
10	625.065	1184.85	0.000295265	0	0
11	625.139	1184.88	0.000320433	0	0
12	625.213	1184.9	0.000337804	0	0
13	625.288	1184.93	0.00034669	0	0
14	625.362	1184.95	0.000346744	0	0
15	625.436	1184.98	0.000337963	0	0
16	625.51	1185	0.000320685	0	0
17	625.584	1185.03	0.00029559	0	0
18	625.659	1185.05	0.000263701	0	0
19	625.733	1185.08	0.000226383	0	0
20	625.807	1185.1	0.000185345	0	0
21	625.881	1185.13	0.000142639	0	0
22	625.956	1185.15	0.000100662	0	0
23	626.03	1185.18	6.21533e-05	0	0
24	626.104	1185.2	3.01967e-05	0	0
25	626.178	1185.23	8.22111e-06	0	0
26	626.252	1185.25	0	0	0

Entity Information

External Boundary

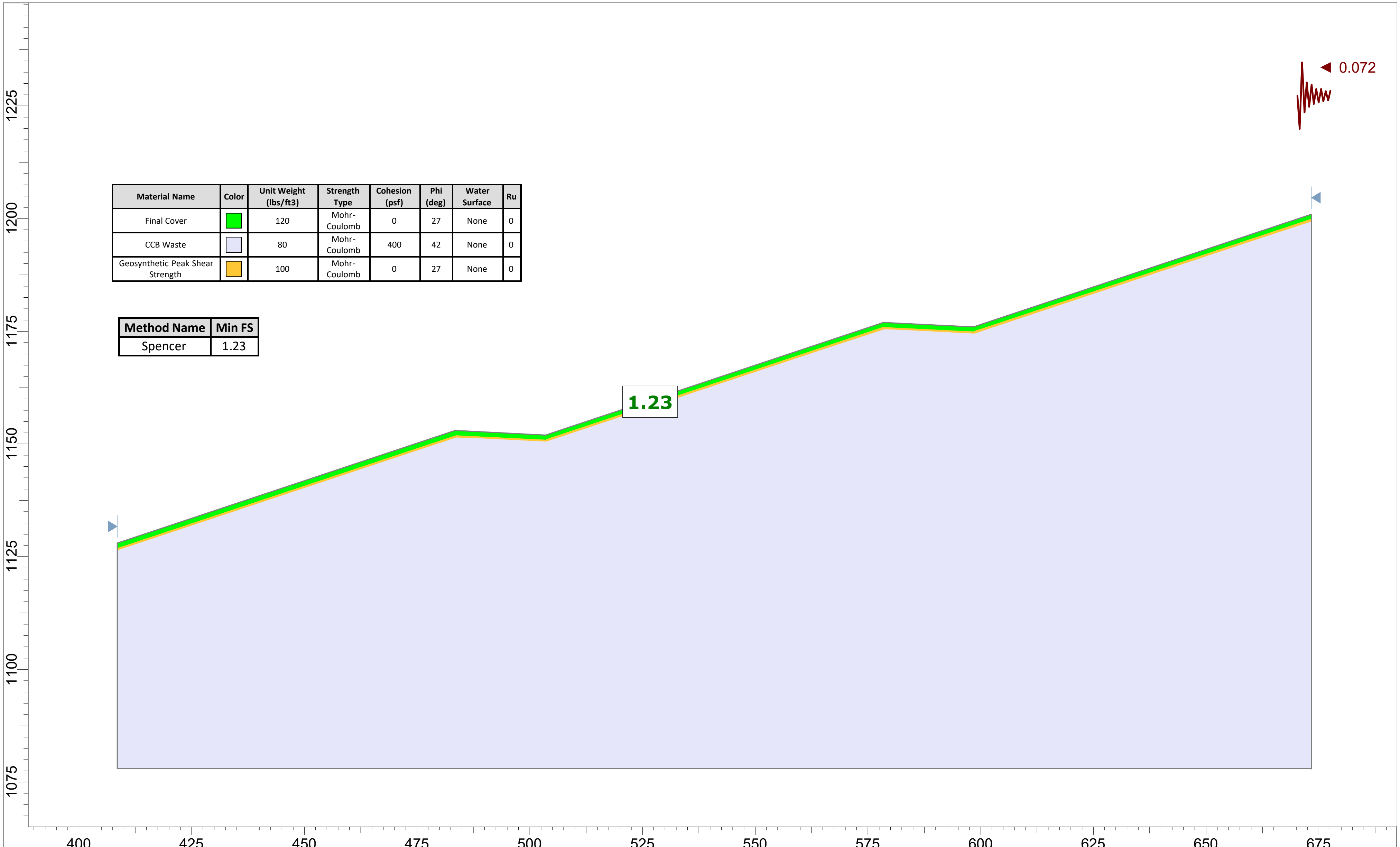
X	Y
673.343	1078
673.343	1199.37
673.343	1199.89
673.343	1200.95
598.397	1175.97
578.397	1176.97
503.451	1151.98
483.451	1152.98
408.505	1128
408.505	1126.95
408.505	1126.42
408.505	1078

Material Boundary

X	Y
408.505	1126.95
483.589	1151.98
503.589	1150.98
578.535	1175.96
598.535	1174.96
673.343	1199.89

Material Boundary

X	Y
408.505	1126.42
483.658	1151.47
503.658	1150.47
578.604	1175.45
598.604	1174.45
673.343	1199.37



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Final Cover		120	Mohr-Coulomb	0	27	None	0
CCB Waste		80	Mohr-Coulomb	400	42	None	0
Geosynthetic Peak Shear Strength		100	Mohr-Coulomb	0	27	None	0

Method Name	Min FS
Spencer	1.23

rocscience

SLIDEINTERPRET 9.009

Project	302-918 Harrison Power Station - Phase 7 Expansion		
Group	final cover-trans-seismic-unsaturated.slim	*Scenario*	final cover-trans-seismic-unsaturated.slim
Drawn By	MAL	*Company*	Civil & Environmental Consultants, Inc.
Date	March 2021	*File Name*	final cover-trans-seismic-unsaturated.slim

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Slide Analysis Information

302-918 Harrison Power Station - Phase 7 Expansion

Project Summary

Slide Modeler Version:	9.009

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Auto Refine Search
Divisions along slope:	10
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Number of vertices per surface:	12
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.072

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
CCB Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	80
Cohesion [psf]	400
Friction Angle [deg]	42
Water Surface	None
Ru Value	0
Geosynthetic Peak Shear Strength	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0

Global Minimums

Method: spencer

FS	1.231310
Axis Location:	521.602, 1161.804
Left Slip Surface Endpoint:	522.307, 1158.270
Right Slip Surface Endpoint:	523.159, 1158.554
Resisting Moment:	3.39814 lb-ft
Driving Moment:	2.75978 lb-ft
Resisting Horizontal Force:	0.896536 lb
Driving Horizontal Force:	0.728115 lb
Total Slice Area:	0.0166769 ft2
Surface Horizontal Width:	0.851773 ft
Surface Average Height:	0.019579 ft

Global Minimum Coordinates

Method: spencer

X	Y
522.307	1158.27
522.384	1158.29
522.462	1158.3
522.539	1158.32
522.617	1158.35
522.694	1158.37
522.772	1158.4
522.849	1158.42
522.926	1158.45
523.004	1158.48
523.081	1158.52
523.159	1158.55

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	4001
Number of Invalid Surfaces:	500
Error Codes	
Error Code -105 reported for 53 surfaces	
Error Code -106 reported for 370 surfaces	
Error Code -111 reported for 77 surfaces	

Error Code Descriptions

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.23131

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.0387169	0.0110142	11.9076	Final Cover	0	27	0.108272	0.133317	0.261648	0	0.261648	0.28448	0.28448
2	0.0387169	0.0330427	11.9076	Final Cover	0	27	0.324817	0.399951	0.784947	0	0.784947	0.853442	0.853442
3	0.0387169	0.052993	13.169	Final Cover	0	27	0.516393	0.63584	1.24791	0	1.24791	1.36873	1.36873
4	0.0387169	0.0708653	13.169	Final Cover	0	27	0.69055	0.850281	1.66877	0	1.66877	1.83034	1.83034
5	0.0387169	0.0866269	14.4369	Final Cover	0	27	0.836735	1.03028	2.02203	0	2.02203	2.23744	2.23744
6	0.0387169	0.100278	14.4369	Final Cover	0	27	0.968586	1.19263	2.34067	0	2.34067	2.59003	2.59003
7	0.0387169	0.111782	15.7121	Final Cover	0	27	1.07015	1.31769	2.58612	0	2.58612	2.88717	2.88717
8	0.0387169	0.121139	15.7121	Final Cover	0	27	1.15973	1.42799	2.80258	0	2.80258	3.12883	3.12883
9	0.0387169	0.128308	16.9954	Final Cover	0	27	1.21739	1.49898	2.94193	0	2.94193	3.31402	3.31402
10	0.0387169	0.133289	16.9954	Final Cover	0	27	1.26465	1.55718	3.05612	0	3.05612	3.44265	3.44265
11	0.0387169	0.136037	18.2874	Final Cover	0	27	1.27905	1.57491	3.09093	0	3.09093	3.51363	3.51363
12	0.0387169	0.136551	18.2874	Final Cover	0	27	1.28388	1.58086	3.10261	0	3.10261	3.5269	3.5269
13	0.0258113	0.0903044	19.5892	Final Cover	0	27	1.26193	1.55383	3.04955	0	3.04955	3.49864	3.49864
14	0.0258113	0.0885025	19.5892	Final Cover	0	27	1.23675	1.52282	2.9887	0	2.9887	3.42883	3.42883
15	0.0258113	0.0867006	19.5892	Final Cover	0	27	1.21157	1.49182	2.92786	0	2.92786	3.35902	3.35902
16	0.0387169	0.124332	20.9017	Final Cover	0	27	1.14752	1.41295	2.77308	0	2.77308	3.21131	3.21131
17	0.0387169	0.115596	20.9017	Final Cover	0	27	1.0669	1.31368	2.57824	0	2.57824	2.98568	2.98568
18	0.0258113	0.0711431	22.2257	Final Cover	0	27	0.975603	1.20127	2.35763	0	2.35763	2.75628	2.75628
19	0.0258113	0.0651246	22.2257	Final Cover	0	27	0.893073	1.09965	2.15818	0	2.15818	2.52311	2.52311
20	0.0258113	0.0591061	22.2257	Final Cover	0	27	0.810539	0.998025	1.95873	0	1.95873	2.28993	2.28993
21	0.0387169	0.0749019	23.5623	Final Cover	0	27	0.678169	0.835036	1.63885	0	1.63885	1.9346	1.9346
22	0.0387169	0.0564152	23.5623	Final Cover	0	27	0.510789	0.628939	1.23436	0	1.23436	1.45712	1.45712
23	0.0258113	0.0262066	24.9127	Final Cover	0	27	0.352413	0.43393	0.851634	0	0.851634	1.01531	1.01531
24	0.0258113	0.0157239	24.9127	Final Cover	0	27	0.211448	0.260358	0.51098	0	0.51098	0.609188	0.609188
25	0.0258113	0.00524132	24.9127	Final Cover	0	27	0.0704827	0.086786	0.170327	0	0.170327	0.203063	0.203063

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.23131

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	522.307	1158.27	0	0	0
2	522.346	1158.28	0.00126276	0	0
3	522.384	1158.29	0.00505106	0	0
4	522.423	1158.3	0.00992406	0	0
5	522.462	1158.3	0.0164405	0	0
6	522.501	1158.31	0.0224446	0	0
7	522.539	1158.32	0.0293949	0	0
8	522.578	1158.34	0.0346124	0	0
9	522.617	1158.35	0.0402668	0	0
10	522.655	1158.36	0.0433488	0	0
11	522.694	1158.37	0.0465505	0	0
12	522.733	1158.38	0.0467283	0	0
13	522.772	1158.4	0.0469067	0	0
14	522.797	1158.4	0.044965	0	0
15	522.823	1158.41	0.0430621	0	0
16	522.849	1158.42	0.0411979	0	0
17	522.888	1158.44	0.0356721	0	0
18	522.926	1158.45	0.0305346	0	0
19	522.952	1158.46	0.0257282	0	0
20	522.978	1158.47	0.0213285	0	0
21	523.004	1158.48	0.0173354	0	0
22	523.043	1158.5	0.0105275	0	0
23	523.081	1158.52	0.00539997	0	0
24	523.107	1158.53	0.00239979	0	0
25	523.133	1158.54	0.000599685	0	0
26	523.159	1158.55	0	0	0

Entity Information

External Boundary

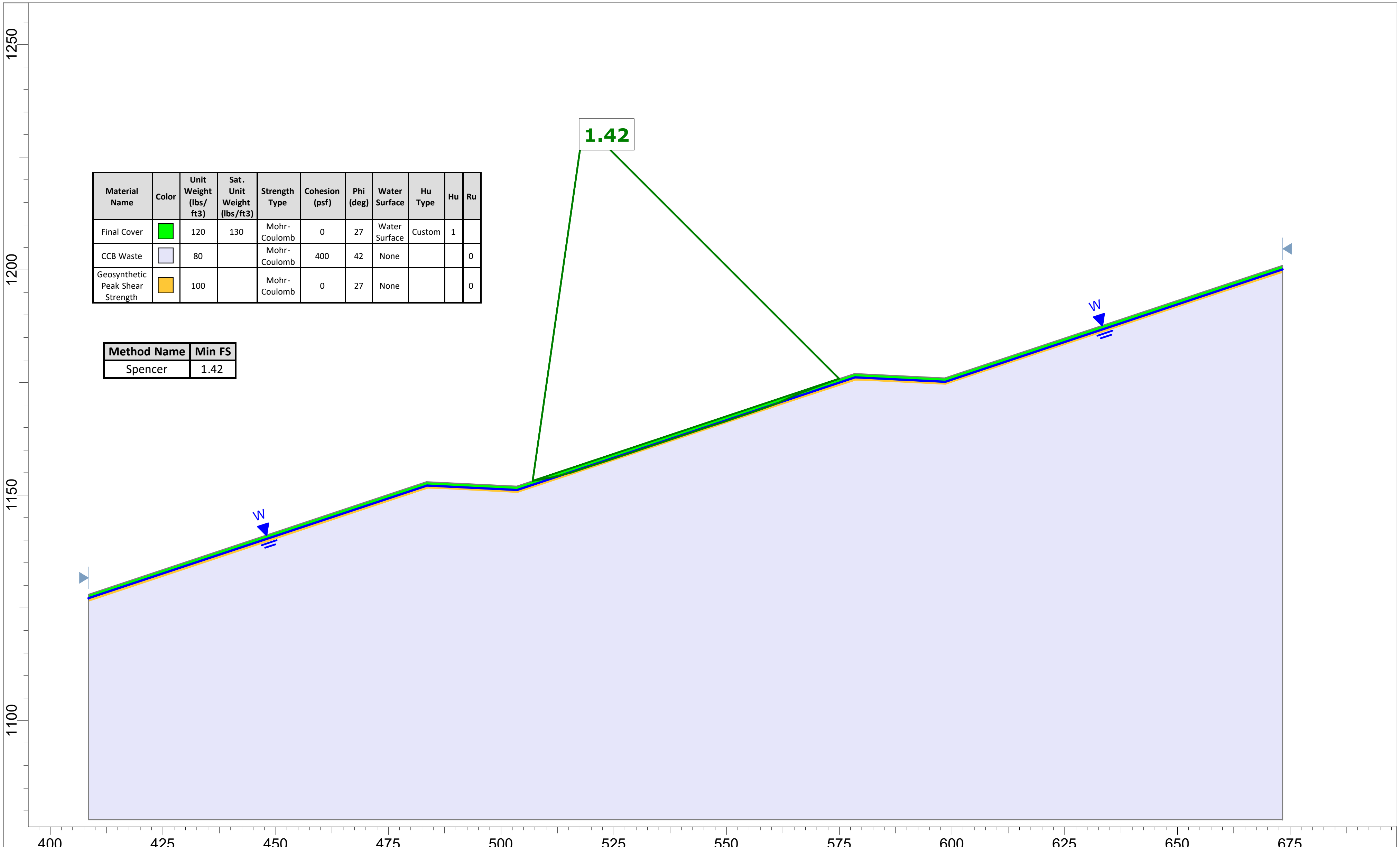
X	Y
673.343	1078
673.343	1199.37
673.343	1199.89
673.343	1200.95
598.397	1175.97
578.397	1176.97
503.451	1151.98
483.451	1152.98
408.505	1128
408.505	1126.95
408.505	1126.42
408.505	1078

Material Boundary

X	Y
408.505	1126.95
483.589	1151.98
503.589	1150.98
578.535	1175.96
598.535	1174.96
673.343	1199.89

Material Boundary

X	Y
408.505	1126.42
483.658	1151.47
503.658	1150.47
578.604	1175.45
598.604	1174.45
673.343	1199.37



Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Final Cover		120	130	Mohr-Coulomb	0	27	Water Surface	Custom	1	
CCB Waste		80		Mohr-Coulomb	400	42	None			0
Geosynthetic Peak Shear Strength		100		Mohr-Coulomb	0	27	None			0

Method Name	Min FS
Spencer	1.42

rocscience

SLIDEINTERPRET 9.009

Project	302-918 Harrison Power Station - Phase 7 Expansion		
Group	final cover-trans-static-saturated.slim	*Scenario*	final cover-trans-static-saturated.slim
Drawn By	MAL	*Company*	Civil & Environmental Consultants, Inc.
Date	March 2021	*File Name*	final cover-trans-static-saturated.slim

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Slide Analysis Information

302-918 Harrison Power Station - Phase 7 Expansion

Project Summary

Slide Modeler Version:	9.009

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Auto Refine Search
Divisions along slope:	10
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Number of vertices per surface:	12
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	130
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	Water Table
Hu Value	1
CCB Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	80
Cohesion [psf]	400
Friction Angle [deg]	42
Water Surface	None
Ru Value	0
Geosynthetic Peak Shear Strength	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0

Global Minimums

Method: spencer

FS	1.416530
Axis Location:	518.314, 1232.495
Left Slip Surface Endpoint:	506.981, 1153.161
Right Slip Surface Endpoint:	574.981, 1175.828
Resisting Moment:	223867 lb-ft
Driving Moment:	158039 lb-ft
Resisting Horizontal Force:	2906.47 lb
Driving Horizontal Force:	2051.82 lb
Total Slice Area:	56.5276 ft2
Surface Horizontal Width:	68.0008 ft
Surface Average Height:	0.831279 ft

Global Minimum Coordinates

Method: spencer

X	Y
506.981	1153.16
511.238	1153.93
515.488	1154.96
519.738	1156.4
523.988	1157.78
528.238	1159.2
532.489	1160.62
536.739	1162.04
540.989	1163.45
545.239	1164.87
549.489	1166.28
552.322	1167.23
555.156	1168.18
557.989	1169.14
560.823	1170.18
563.656	1171.48
566.489	1172.68
570.735	1174.33
574.981	1175.83

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	4162
Number of Invalid Surfaces:	348
Error Codes	
Error Code -105 reported for 180 surfaces	
Error Code -106 reported for 140 surfaces	
Error Code -108 reported for 10 surfaces	
Error Code -111 reported for 15 surfaces	
Error Code -1000 reported for 3 surfaces	

Error Code Descriptions

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-1000 = No valid slip surface is generated

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.41653

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.12863	41.4128	10.2597	Final Cover	0	27	6.95377	9.85022	19.3321	0	19.3321	20.5908	20.5908
2	2.12863	124.238	10.2597	Final Cover	0	27	20.8613	29.5507	57.9964	0	57.9964	61.7724	61.7724
3	2.12506	190.142	13.5996	Final Cover	0	27	30.7019	43.4902	85.3542	0	85.3542	92.7815	92.7815
4	2.12506	241.119	13.5996	Final Cover	0	27	37.4346	53.0273	108.117	4.0449	104.072	117.173	113.128
5	4.25012	530.058	18.6864	Final Cover	0	27	36.8563	52.208	111.922	9.45832	102.464	124.388	114.929
6	4.19511	527.849	17.9688	Final Cover	0	27	37.3588	52.9198	113.852	9.99064	103.861	125.968	115.977
7	0.0550108	7.05832	17.9688	Final Cover	0	27	37.7364	53.4547	116.097	11.186	104.911	128.336	117.15
8	0.775152	99.4581	18.4679	Final Cover	0	27	37.4992	53.1188	115.438	11.186	104.252	127.961	116.775
9	3.47497	445.277	18.4679	Final Cover	0	27	37.475	53.0844	115.285	11.1012	104.184	127.801	116.7
10	2.12506	271.441	18.5323	Final Cover	0	27	37.3833	52.9546	114.836	10.9066	103.929	127.368	116.461
11	2.12506	270.332	18.5323	Final Cover	0	27	37.3045	52.843	114.366	10.6562	103.71	126.871	116.215
12	4.25012	540.009	18.415	Final Cover	0	27	37.3363	52.888	114.381	10.5822	103.799	126.812	116.23
13	2.12506	270.632	18.3644	Final Cover	0	27	37.4049	52.9852	114.713	10.7241	103.989	127.131	116.406
14	2.12506	271.435	18.3644	Final Cover	0	27	37.4622	53.0663	115.054	10.9054	104.148	127.49	116.584
15	4.25012	542.664	18.4793	Final Cover	0	27	37.4006	52.9791	114.859	10.8821	103.977	127.358	116.476
16	4.25012	541.809	18.4282	Final Cover	0	27	37.3943	52.9701	114.745	10.7855	103.96	127.205	116.419
17	2.83341	361.082	18.4573	Final Cover	0	27	37.3739	52.9413	114.668	10.7645	103.903	127.142	116.377
18	2.83341	359.694	18.5497	Final Cover	0	27	37.2564	52.7748	114.106	10.5294	103.576	126.608	116.078
19	2.83341	356.119	18.673	Final Cover	0	27	37.0085	52.4237	112.811	9.92379	102.887	125.318	115.395
20	2.83341	335.39	20.2255	Final Cover	0	27	35.2226	49.8938	104.334	6.41203	97.9221	117.311	110.899
21	2.83341	255.515	24.6188	Final Cover	0	27	27.0939	38.3793	75.3236	0	75.3236	87.7389	87.7389
22	2.83341	151.897	22.9435	Final Cover	0	27	16.4367	23.2831	45.6955	0	45.6955	52.6534	52.6534
23	2.123	66.4487	21.2257	Final Cover	0	27	9.79725	13.8781	27.2373	0	27.2373	31.0425	31.0425
24	2.123	36.6707	21.2257	Final Cover	0	27	5.40676	7.65884	15.0313	0	15.0313	17.1313	17.1313
25	4.246	21.7817	19.467	Final Cover	0	27	1.64006	2.32319	4.55953	0	4.55953	5.13924	5.13924

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.41653

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	506.981	1153.16	0	0	0
2	509.109	1153.55	7.35352	2.41786	18.201
3	511.238	1153.93	29.4141	9.67143	18.201
4	513.363	1154.45	50.7779	16.6959	18.201
5	515.488	1154.96	74.7473	24.5771	18.201
6	519.738	1156.4	70.5071	23.1829	18.201
7	523.933	1157.76	72.3306	23.7825	18.201
8	523.988	1157.78	72.3352	23.784	18.201
9	524.763	1158.03	71.5185	23.5154	18.2009
10	528.238	1159.2	67.9493	22.3419	18.201
11	530.363	1159.91	65.5861	21.5649	18.201
12	532.489	1160.62	63.3898	20.8427	18.201
13	536.739	1162.04	60.2178	19.7998	18.201
14	538.864	1162.74	58.7815	19.3275	18.201
15	540.989	1163.45	57.2266	18.8163	18.201
16	545.239	1164.87	53.0425	17.4405	18.201
17	549.489	1166.28	49.4767	16.2681	18.201
18	552.322	1167.23	46.9314	15.4312	18.201
19	555.156	1168.18	44.0051	14.469	18.201
20	557.989	1169.14	40.8411	13.4287	18.2011
21	560.823	1170.18	31.7242	10.431	18.201
22	563.656	1171.48	10.6954	3.51666	18.2009
23	566.489	1172.68	2.4594	0.808657	18.201
24	568.612	1173.5	0.800418	0.263179	18.201
25	570.735	1174.33	-0.115117	-0.0378507	18.201
26	574.981	1175.83	0	0	0

Entity Information

Water Table

X	Y
408.505	1127.13
483.566	1152.15
503.566	1151.15
578.512	1176.13
598.512	1175.13
673.343	1200.07

External Boundary

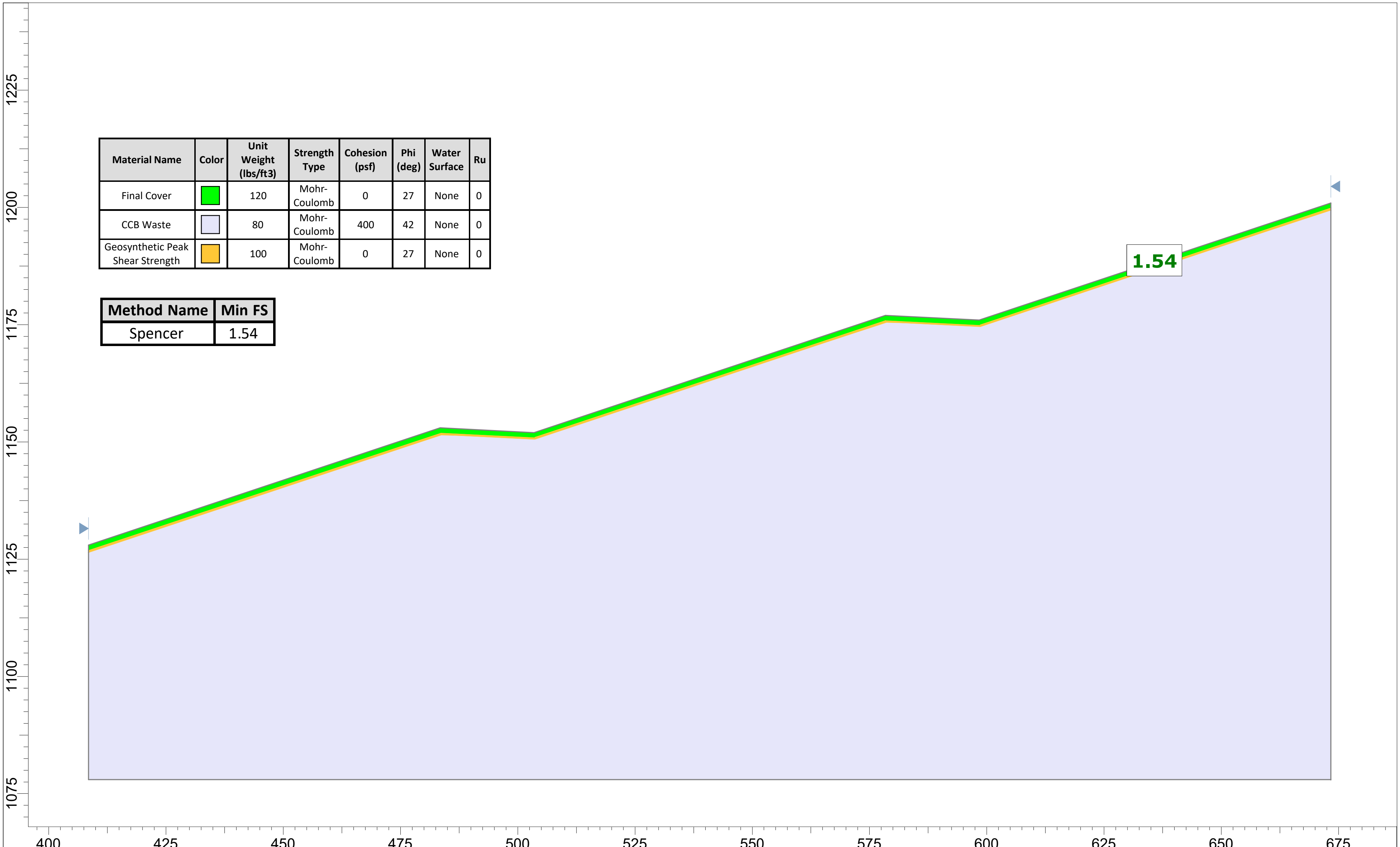
X	Y
673.343	1078
673.343	1199.37
673.343	1199.89
673.343	1200.95
598.397	1175.97
578.397	1176.97
503.451	1151.98
483.451	1152.98
408.505	1128
408.505	1126.95
408.505	1126.42
408.505	1078

Material Boundary

X	Y
408.505	1126.95
483.589	1151.98
503.589	1150.98
578.535	1175.96
598.535	1174.96
673.343	1199.89

Material Boundary

X	Y
408.505	1126.42
483.658	1151.47
503.658	1150.47
578.604	1175.45
598.604	1174.45
673.343	1199.37



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Final Cover		120	Mohr-Coulomb	0	27	None	0
CCB Waste		80	Mohr-Coulomb	400	42	None	0
Geosynthetic Peak Shear Strength		100	Mohr-Coulomb	0	27	None	0

Method Name	Min FS
Spencer	1.54

rocscience

SLIDEINTERPRET 9.009

Project	302-918 Harrison Power Station - Phase 7 Expansion

Group	final cover-trans-static-unsaturated.slim	*Scenario*	final cover-trans-static-unsaturated.slim
Drawn By	MAL	*Company*	Civil & Environmental Consultants, Inc.
Date	March 2021	*File Name*	final cover-trans-static-unsaturated.slim

Table of Contents

Slide Analysis Information

302-918 Harrison Power Station - Phase 7 Expansion

Project Summary

Slide Modeler Version:	9.009

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Auto Refine Search
Divisions along slope:	10
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Number of vertices per surface:	12
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0
CCB Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	80
Cohesion [psf]	400
Friction Angle [deg]	42
Water Surface	None
Ru Value	0
Geosynthetic Peak Shear Strength	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	27
Water Surface	None
Ru Value	0

Global Minimums

Method: spencer

FS	1.537470
Axis Location:	630.841, 1191.089
Left Slip Surface Endpoint:	631.647, 1187.050
Right Slip Surface Endpoint:	632.620, 1187.374
Resisting Moment:	5.20848 lb-ft
Driving Moment:	3.3877 lb-ft
Resisting Horizontal Force:	1.19975 lb
Driving Horizontal Force:	0.780339 lb
Total Slice Area:	0.021782 ft2
Surface Horizontal Width:	0.973454 ft
Surface Average Height:	0.022376 ft

Global Minimum Coordinates

Method: spencer

X	Y
631.647	1187.05
631.735	1187.07
631.824	1187.09
631.912	1187.11
632.001	1187.14
632.089	1187.16
632.178	1187.19
632.266	1187.22
632.355	1187.26
632.443	1187.29
632.532	1187.33
632.62	1187.37

Global Minimum Support Data

No Supports Present

Valid and Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	4147
Number of Invalid Surfaces:	354
Error Codes	
Error Code -105 reported for 53 surfaces	
Error Code -106 reported for 250 surfaces	
Error Code -108 reported for 18 surfaces	
Error Code -111 reported for 33 surfaces	

Error Code Descriptions

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.53747

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.0442479	0.0143859	11.9076	Final Cover	0	27	0.103219	0.158696	0.311459	0	0.311459	0.333225	0.333225
2	0.0442479	0.0431578	11.9076	Final Cover	0	27	0.309658	0.47609	0.934378	0	0.934378	0.999676	0.999676
3	0.0294986	0.0435499	13.169	Final Cover	0	27	0.463125	0.712041	1.39746	0	1.39746	1.50582	1.50582
4	0.0294986	0.0539247	13.169	Final Cover	0	27	0.573454	0.881669	1.73037	0	1.73037	1.86455	1.86455
5	0.0294986	0.0642995	13.169	Final Cover	0	27	0.683786	1.0513	2.06329	0	2.06329	2.22328	2.22328
6	0.0442479	0.113145	14.4369	Final Cover	0	27	0.792529	1.21849	2.39143	0	2.39143	2.59546	2.59546
7	0.0442479	0.130975	14.4369	Final Cover	0	27	0.917416	1.4105	2.76826	0	2.76826	3.00445	3.00445
8	0.0442479	0.146001	15.7121	Final Cover	0	27	1.01029	1.55329	3.04851	0	3.04851	3.33272	3.33272
9	0.0442479	0.158222	15.7121	Final Cover	0	27	1.09486	1.68331	3.30368	0	3.30368	3.61168	3.61168
10	0.0442479	0.167586	16.9954	Final Cover	0	27	1.14547	1.76112	3.45639	0	3.45639	3.80649	3.80649
11	0.0442479	0.174092	16.9954	Final Cover	0	27	1.18994	1.82949	3.59058	0	3.59058	3.95428	3.95428
12	0.0442479	0.177681	18.2874	Final Cover	0	27	1.19943	1.84408	3.61921	0	3.61921	4.01559	4.01559
13	0.0442479	0.178352	18.2874	Final Cover	0	27	1.20396	1.85105	3.63288	0	3.63288	4.03076	4.03076
14	0.0442479	0.17604	19.5892	Final Cover	0	27	1.17343	1.80412	3.54077	0	3.54077	3.95836	3.95836
15	0.0442479	0.170745	19.5892	Final Cover	0	27	1.13814	1.74985	3.43427	0	3.43427	3.8393	3.8393
16	0.0442479	0.162392	20.9017	Final Cover	0	27	1.06866	1.64303	3.22461	0	3.22461	3.63273	3.63273
17	0.0442479	0.150983	20.9017	Final Cover	0	27	0.993574	1.52759	2.99807	0	2.99807	3.37751	3.37751
18	0.0294986	0.0929216	22.2257	Final Cover	0	27	0.905331	1.39192	2.73179	0	2.73179	3.10173	3.10173
19	0.0294986	0.0850607	22.2257	Final Cover	0	27	0.828745	1.27417	2.50069	0	2.50069	2.83933	2.83933
20	0.0294986	0.0771998	22.2257	Final Cover	0	27	0.752151	1.15641	2.26959	0	2.26959	2.57693	2.57693
21	0.0294986	0.0679036	23.5623	Final Cover	0	27	0.652826	1.0037	1.96988	0	1.96988	2.25458	2.25458
22	0.0294986	0.0571721	23.5623	Final Cover	0	27	0.549654	0.845077	1.65856	0	1.65856	1.89827	1.89827
23	0.0294986	0.0464405	23.5623	Final Cover	0	27	0.446481	0.686451	1.34724	0	1.34724	1.54195	1.54195
24	0.0442479	0.0462092	24.9127	Final Cover	0	27	0.292168	0.449199	0.881604	0	0.881604	1.0173	1.0173
25	0.0442479	0.015403	24.9127	Final Cover	0	27	0.0991974	0.152513	0.299324	0	0.299324	0.345397	0.345397

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.53747

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	631.647	1187.05	0	0	0
2	631.691	1187.06	0.00167168	0.000371484	12.5288
3	631.735	1187.07	0.00668672	0.00148594	12.5288
4	631.765	1187.08	0.0107346	0.00238546	12.5288
5	631.794	1187.08	0.0157467	0.00349928	12.5289
6	631.824	1187.09	0.0217232	0.00482739	12.5288
7	631.868	1187.1	0.0296306	0.00658457	12.5288
8	631.912	1187.11	0.038784	0.00861866	12.5288
9	631.957	1187.12	0.0456438	0.0101431	12.5288
10	632.001	1187.14	0.0530779	0.0117951	12.5288
11	632.045	1187.15	0.0571352	0.0126967	12.5288
12	632.089	1187.16	0.06135	0.0136333	12.5288
13	632.134	1187.18	0.0616216	0.0136937	12.5288
14	632.178	1187.19	0.0618942	0.0137543	12.5288
15	632.222	1187.21	0.0581808	0.0129291	12.5288
16	632.266	1187.22	0.0545792	0.0121287	12.5288
17	632.311	1187.24	0.0474843	0.0105521	12.5288
18	632.355	1187.26	0.0408879	0.00908619	12.5288
19	632.384	1187.27	0.0347277	0.00771726	12.5288
20	632.414	1187.28	0.0290886	0.00646414	12.5288
21	632.443	1187.29	0.0239707	0.00532683	12.5288
22	632.473	1187.31	0.0179312	0.00398472	12.5288
23	632.502	1187.32	0.0128462	0.00285471	12.5288
24	632.532	1187.33	0.00871565	0.00193681	12.5288
25	632.576	1187.35	0.00355542	0.000790094	12.5288
26	632.62	1187.37	0	0	0

Entity Information

External Boundary

X	Y
673.343	1078
673.343	1199.37
673.343	1199.89
673.343	1200.95
598.397	1175.97
578.397	1176.97
503.451	1151.98
483.451	1152.98
408.505	1128
408.505	1126.95
408.505	1126.42
408.505	1078

Material Boundary

X	Y
408.505	1126.95
483.589	1151.98
503.589	1150.98
578.535	1175.96
598.535	1174.96
673.343	1199.89

Material Boundary

X	Y
408.505	1126.42
483.658	1151.47
503.658	1150.47
578.604	1175.45
598.604	1174.45
673.343	1199.37

APPENDIX D
DRAINAGE CALCULATIONS

1.0 OBJECTIVE

The objective of these calculations is to evaluate existing surface water control structures and design proposed surface water control structures for the Phase 7 expansion of the Harrison Power Station Landfill. The proposed Phase 7 expansion includes contiguous expansion and liner construction identified as the Saddle Area Expansion, the Eastern Area Expansion and development of a portion of the previously permitted Phase 6 liner area of the existing landfill. This design summary outlines the methods and assumptions used throughout the design of the surface water control structures. All surface water control features will be designed in accordance with West Virginia Rule 4.5.b. *Drainage and Sediment Control Plans.*

2.0 METHODOLOGY

A computer software program called "HydroCAD 10.00" was used to route the design storms through proposed surface water control structures, which include the proposed Phase 7 temporary diversion channels and existing diversion channels based on the proposed site conditions (see Reference 1).

3.0 DESCRIPTION

3.1 DIVERSION SYSTEM

Non-impacted (clean) stormwater above the active landfill is currently diverted by the existing Eastern and Western Diversion System and will continue to be diverted as much as possible during the Phase 7 Expansion. During construction of the Phase 7 Expansion, portions of the Eastern Diversion System and existing channels will be removed and reconstructed in areas adjacent to the Phase 7 Expansion as shown on Drawing No. C89509688 – Drainage Areas.

The Western Diversion System carries non-impacted stormwater from the western side of the landfill area to discharge into Robinson Run through Monitoring Point 018.

The Eastern Diversion System drains to existing twin 72-inch pipes at the Phase 4 landfill toe. Depending on site operations, one of the two 72-inch pipes can be blocked to direct flow to discharge to Robinson Run through monitoring point 018 or the other pipe can be blocked to direct flow to Sedimentation Pond No. 1.

The existing and proposed diversion channels shown on the west side of the landfill on Drawing C89509688 are part of the Western Diversion System and discharge to either Sedimentation Pond No. 1 or discharge to Robinson Run through Monitoring Point 018, based on landfill operations.

The existing western diversion channel system consists of previously permitted Channel UD-2, Channel UD-3, Channel UD-4, Culvert 4D2, Channel 4D1-1, and Channel 4D-2. Portions of permitted Channel UD-2 and permitted Channel UD-1 have not been constructed yet. A portion of the proposed Phase 7 temporary diversion will direct surface water runoff to the constructed section of existing Channel UD-2. The existing eastern diversion channel system consists of previously permitted Channel 5D-3, Channel 6AD-1, Culvert 6AD-1, Channel 6AD-2, Channel East-G, and Channel East-H. As site development continues throughout this permit cycle, an existing Channel 5D-3 and Channel 6AD-1 will be removed and proposed Phase 7 temporary diversion will replace existing Channel 5D-3 and Channel 6AD-1. Surface water runoff will be directed to existing permitted Culvert 6AD-1, which eventually drains to the existing sedimentation pond.

Drawing No. C89509688 – Drainage Area Plan shows the locations of existing and proposed surface water control features. Design HydroCAD output files for existing and proposed surface water control features evaluated are provided in Attachment C.

3.2 COLLECTION SYSTEM

The permitted collection system includes benches, slope drains (downchutes), collection channels, and culverts that will be used to convey surface water runoff from the proposed expansion area inside the limit of waste to existing treatment areas and the existing sedimentation pond. Temporary portions of the existing collection system will be removed as part of the Phase 7 development. Impacted stormwater within the active working area flows through constructed collection channels along the limit of liner area and drains to Sedimentation Pond 1. There is also a series of contact stormwater drain risers attached to a set of drainage pipes embedded in the stabilized scrubber material above the liner which remove stormwater from the active disposal area. This main discharge pipe is directed to the east diversion channel that currently drains to Sedimentation Pond No. 1 as shown on Drawing C89509686. Sedimentation Pond No. 1 is the final significant structure used for run-off and run-on control. The pond design is described in Reference 8. The final collection system will be evaluated in a separate calculation for the proposed ultimate development conditions.

4.0 ANALYSIS

West Virginia Rule 4.5.b. *Drainage and Sediment Control Plans* outlines the requirements for the design of surface water control structures. Rule 4.5.b. requires that the run-on control system (diversion system) and the run-off control system (collection system) be designed to accommodate the peak flow from the 25-year, 24-hour storm event. For this analysis, only the diversion system will be analyzed. The HydroCAD program uses the 2-

year, 24-hour storm event when calculating the time of concentration. The rainfall from the various storm events is presented below in inches:

Table 1 - Design Storms

Storm Frequency	24-Hour Precipitation (Inches)
2-Year	2.52
25-Year	4.10

The precipitation values for each storm event are referenced from the National Oceanic and Atmosphere Administration (NOAA) online Atlas 14 data for the landfill, which is near Shinnston, West Virginia (see Reference 7). The NOAA precipitation data is provided in Attachment A, and is consistent with previous permit application drainage calculations (see References 8 and 9). The Type II storm event was modeled, which is conservative in that it represents the most intense short duration rainfall used to represent most regions of the United States.

4.1 DRAINAGE AREA HYDROLOGY

The drainage areas were delineated using the existing topography and proposed grades for the Phase 7 expansion as shown on Drawing No. C89509688 included in the permit application. The following drainage areas were delineated and used in HydroCAD for proposed diversion controls:

Table 2 - Drainage Areas

Drainage Area ID	Drainage Area (acres)	Composite Curve Number
DA-7D-1	2.5	70
DA-UD1	2.8	70
DA-UD2-A	2.2	70
DA-UD2-B	16.6	70

The HydroCAD program was used to estimate the runoff rates from the design storm events. The Soil Conservation (SCS) Technical Release No. 20 (TR-20) methodology within the HydroCAD program was used to estimate the peak surface water runoff rates from the design storm events. The rate of runoff is based on the relationships between the amount of rainfall, soil type, infiltration, land cover, travel time (time of concentration), and size of the drainage area.

The runoff curve numbers used in this calculation are consistent with previous permit application drainage calculations (see Reference 8). The following table presents the runoff curve numbers (CN) that will be utilized in the HydroCAD program:

Table 3 – CN Data

Description	CN
Disturbed Areas	90
Existing Fields/Undisturbed Woods	70
Ponds	100

The TR-55 methodology within the HydroCAD computer program was used to estimate the times of concentration. The times of concentration are the sum of sheet flow, shallow concentrated flow, and channelized flow. Sheet flow calculations will use an average Manning's Roughness Coefficient from TR-55 Table 3-1, shown below. The maximum sheet flow length will be 100 feet consistent with the previous permit application drainage calculations (Reference 9), disturbed areas will use an average Manning's Roughness Coefficient of 0.011, Existing Fields/Undisturbed Woods will use an average Manning's Roughness Coefficient of 0.40, and Reclaimed Landfill (grassed areas) will use an average Manning's Roughness Coefficient of 0.24.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Shallow flow calculations will be estimated using the velocity factor for unpaved surfaces estimated from TR-55 Figure 3.1, included in Attachment B. This velocity factor is conservatively estimated as 16.1.

The channelized flow calculations will be estimated using the channel design, which takes into account the cross section area, flow depth, channel slope, and channel lining. More information regarding the design of the channel linings is included below.

4.2 CHANNEL ANALYSIS

HydroCAD was utilized to analyze the channels. Drawing No. C89509688 – Drainage Area Plan, shows the location of existing and proposed channels. Each channel segment has been designed to provide a minimum of 0.3 feet of freeboard, consistent with the previous permit application drainage calculations (see Reference 8). The proposed channels are trapezoidal in shape. The summary table below presents the design for each channel segment.

Table 4 – Channel Design

Channel Segment	Invert Elevations		Length (ft)	Slope (ft/ft)	Bottom Width (ft)	Depth (ft)	Side-slopes (ZH:1V)	Lining Type
	Inlet (ft)	Outlet (ft)						
7D-1	1414	1345	680	0.10	0.5	1	2	Earth
UD-1	1345	1330	900	0.02	1	1.5	2	Concrete
UD-2	1330	1270	1200	0.05	1.5	2	2	Concrete

The summary table below presents the total upstream drainage area for each channel segment, and the resulting HydroCad calculated peak flow, maximum velocity, and flow depths for each channel segment.

Table 5 – Channel Results

Channel Segment	Drainage Area (acres)	Peak Flow (cfs)	Average Flow Depth (ft)	Freeboard (ft)	Maximum Velocity (fps)
7D-1	2.5	4.5	0.56	0.44	4.74
UD-1	5.3	8.6	0.59	0.91	6.41
UD-2	24.1	40.8	0.90	1.10	11.86

4.3 CHANNEL LININGS

The velocity in each channel segment was calculated using Manning's equation:

$$V = \frac{Q}{A} = 1.49\frac{R^{2/3}\sqrt{S_f}}{n} = 1.49\frac{\left[\frac{A}{WP}\right]^{2/3}\sqrt{S_f}}{n}$$

Where:

V = Velocity, fps

Q = Flowrate, cfs

A = Cross – Sectional area of flow, sf

R = Hydraulic Radius, ft

WP = Wetted Perimeter, ft

S_f = Slope of channel, ft / ft

n = Manning's roughness coefficient

The channel linings were selected based on the flow depth and the maximum velocity as determined in HydroCAD. Table 4-7 from the West Virginia Department of Highways Drainage Manual presents the Manning's roughness coefficient or 'n-value' for various channel linings (see Reference 3).

Table 4-7

Manning's Roughness Coefficients (n) for Channel Flow

Surface Description	Recommended		Range
Existing Vegetative Lining			
Nearly bare, light grass	0.030		0.030 – 0.035
Grass, weeds, and light brush	0.040		0.030 – 0.050
Thick grass, thick brush, small trees	0.075		0.050 – 0.100
Planned DOH Vegetative Lining			
Type B Seed Mixture (mowed)	0.042		0.036 – 0.050
Type C-1 Seed Mixture (mowed)	0.036		0.030 – 0.040
Type C-2 Seed Mixture (mowed)	0.027		0.022 – 0.033
Type B Seed Mixture (unmowed)	0.090		0.050 – 0.140
Type C-1 Seed Mixture (unmowed)	0.080		0.050 – 0.120
Type C-2 Seed Mixture (unmowed)	0.030		0.025 – 0.040
Non Vegetative Lining	**Based on Depth of Flow**		
	0 - 0.5'	0.5 - 2.0'	> 2.0'
Concrete Lined Ditch or channel	0.015	0.013	0.013
Grouted Rock Lined Ditch or channel	0.040	0.030	0.028
Bare Soil with little or no vegetation	0.023	0.020	0.020
Bare Rock or Rock Cut Ditch	0.045	0.035	0.025
Rock Lined Ditch or channel D_{50} = 4 inches	0.090	0.058	0.035
Rock Lined Ditch or channel D_{50} = 6 inches	0.104	0.069	0.035
Rock Lined Ditch or channel D_{50} = 12 inches	-	0.078	0.040

A manning's n of 0.045 was selected for vegetated channels, consistent with previous permit application drainage calculations. A manning's n of 0.015 was selected for concrete channels, consistent with the 3-inch uniform section mat used previous permit application drainage calculations (see Reference 8 and 9).

5.0 CONCLUSIONS

The HydroCAD program was used to design the surface water control structures for the proposed Phase 7 expansion of the Harrison Power Station Landfill. Drainage area delineation that was developed for the surface water control structures are shown on Drawing No. C89509688 – Drainage Area Plan. The proposed temporary Phase 7 diversion channels are designed for the 25-year, 24-hour storm event. The proposed diversion ditch, channel UD-1, and channel UD-2 meet the design requirements for minimum freeboard. The proposed ditch and channels are sufficient to handle surface water runoff from the areas delineated for drainage. Results of the analysis are provided in Attachment C in the HydroCAD report.

6.0 REFERENCES

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4. "Erosion and Sediment Control Best Management Practice Manual," West Virginia Department of Environmental Protection, Division of Water & Waste Management, 2006, Revised August 29, 2016.

5. "West Virginia Stormwater Management and Design Guidance Manual," West Virginia Department of Environmental Protection, November 2012.

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

7. NOAA's National Weather Service, Hydrometeorological Design Studies Center, *Precipitation Frequency Data Server (PFDS)*, Retrieved December 11, 2020 from https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

8. Harrison Power Station, Phase 6A Expansion Area Permit Application, GAI Consultants, 2017

9. Harrison Power Station, Phase 6 Expansion Area Permit Application, GAI Consultants, 2016

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3/12/2021

ATTACHMENT A

NOAA PRECIPITATION DATA

NOAA Atlas 14, Volume 2, Version 3
Location name: Shinnston, West Virginia, USA*
Latitude: 39.4044°, Longitude: -80.3322°
Elevation: 1080.13 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.319 (0.290-0.352)	0.381 (0.347-0.421)	0.457 (0.416-0.504)	0.516 (0.468-0.567)	0.589 (0.533-0.647)	0.645 (0.581-0.707)	0.698 (0.627-0.764)	0.751 (0.671-0.822)	0.820 (0.729-0.896)	0.870 (0.770-0.950)
10-min	0.495 (0.450-0.547)	0.594 (0.542-0.657)	0.710 (0.646-0.784)	0.796 (0.722-0.876)	0.901 (0.815-0.990)	0.977 (0.881-1.07)	1.05 (0.945-1.15)	1.12 (1.00-1.23)	1.21 (1.07-1.32)	1.27 (1.12-1.38)
15-min	0.607 (0.552-0.671)	0.727 (0.663-0.803)	0.872 (0.793-0.962)	0.979 (0.889-1.08)	1.11 (1.01-1.22)	1.21 (1.09-1.33)	1.31 (1.17-1.43)	1.40 (1.25-1.53)	1.51 (1.34-1.64)	1.58 (1.40-1.73)
30-min	0.803 (0.730-0.888)	0.972 (0.887-1.08)	1.19 (1.09-1.32)	1.36 (1.23-1.50)	1.57 (1.42-1.73)	1.73 (1.56-1.90)	1.89 (1.69-2.06)	2.04 (1.82-2.23)	2.23 (1.98-2.44)	2.37 (2.10-2.59)
60-min	0.981 (0.891-1.08)	1.19 (1.09-1.32)	1.50 (1.36-1.65)	1.73 (1.57-1.90)	2.04 (1.85-2.24)	2.28 (2.05-2.50)	2.52 (2.27-2.76)	2.76 (2.47-3.02)	3.08 (2.74-3.37)	3.33 (2.95-3.64)
2-hr	1.14 (1.03-1.26)	1.38 (1.25-1.53)	1.73 (1.57-1.92)	2.00 (1.81-2.21)	2.37 (2.14-2.61)	2.67 (2.39-2.93)	2.97 (2.65-3.26)	3.27 (2.91-3.59)	3.69 (3.25-4.03)	4.01 (3.51-4.38)
3-hr	1.22 (1.11-1.35)	1.48 (1.34-1.64)	1.85 (1.67-2.04)	2.13 (1.93-2.36)	2.54 (2.28-2.80)	2.86 (2.56-3.14)	3.19 (2.84-3.49)	3.53 (3.13-3.86)	4.00 (3.51-4.35)	4.37 (3.81-4.75)
6-hr	1.47 (1.34-1.62)	1.76 (1.61-1.94)	2.18 (1.99-2.40)	2.52 (2.29-2.78)	3.00 (2.71-3.29)	3.39 (3.05-3.70)	3.79 (3.39-4.13)	4.22 (3.75-4.57)	4.80 (4.23-5.19)	5.27 (4.61-5.69)
12-hr	1.74 (1.60-1.92)	2.08 (1.91-2.29)	2.55 (2.33-2.81)	2.94 (2.68-3.22)	3.49 (3.17-3.82)	3.95 (3.56-4.30)	4.42 (3.97-4.81)	4.93 (4.39-5.34)	5.63 (4.96-6.08)	6.20 (5.42-6.68)
24-hr	2.12 (1.98-2.28)	2.52 (2.35-2.72)	3.06 (2.85-3.29)	3.49 (3.25-3.75)	4.10 (3.80-4.39)	4.59 (4.25-4.91)	5.10 (4.70-5.45)	5.63 (5.17-6.00)	6.36 (5.81-6.77)	6.93 (6.31-7.37)
2-day	2.50 (2.34-2.67)	2.96 (2.77-3.18)	3.55 (3.32-3.81)	4.02 (3.76-4.31)	4.68 (4.36-5.00)	5.20 (4.83-5.55)	5.73 (5.31-6.11)	6.28 (5.80-6.68)	7.02 (6.45-7.47)	7.60 (6.96-8.08)
3-day	2.69 (2.52-2.87)	3.18 (2.98-3.41)	3.80 (3.56-4.06)	4.28 (4.01-4.58)	4.95 (4.62-5.28)	5.47 (5.10-5.83)	6.00 (5.57-6.38)	6.53 (6.05-6.94)	7.25 (6.69-7.70)	7.80 (7.17-8.28)
4-day	2.87 (2.70-3.07)	3.40 (3.20-3.64)	4.04 (3.79-4.32)	4.54 (4.26-4.85)	5.22 (4.88-5.55)	5.74 (5.36-6.10)	6.26 (5.84-6.66)	6.79 (6.31-7.20)	7.48 (6.93-7.93)	8.00 (7.39-8.48)
7-day	3.50 (3.30-3.71)	4.13 (3.89-4.37)	4.83 (4.56-5.12)	5.38 (5.07-5.70)	6.09 (5.74-6.44)	6.63 (6.24-7.01)	7.16 (6.72-7.56)	7.67 (7.19-8.10)	8.33 (7.79-8.79)	8.81 (8.22-9.29)
10-day	4.06 (3.84-4.29)	4.77 (4.51-5.05)	5.54 (5.23-5.86)	6.12 (5.78-6.47)	6.87 (6.48-7.26)	7.43 (7.00-7.85)	7.96 (7.49-8.41)	8.48 (7.97-8.95)	9.12 (8.55-9.63)	9.58 (8.97-10.1)
20-day	5.76 (5.47-6.08)	6.75 (6.42-7.12)	7.72 (7.34-8.14)	8.45 (8.02-8.90)	9.36 (8.87-9.85)	10.0 (9.50-10.6)	10.6 (10.1-11.2)	11.2 (10.6-11.8)	11.9 (11.3-12.6)	12.4 (11.7-13.1)
30-day	7.31 (6.95-7.69)	8.54 (8.13-8.98)	9.65 (9.18-10.1)	10.5 (9.96-11.0)	11.5 (10.9-12.1)	12.2 (11.6-12.9)	12.9 (12.2-13.6)	13.5 (12.8-14.2)	14.3 (13.5-15.0)	14.8 (14.0-15.5)
45-day	9.41 (8.98-9.85)	11.0 (10.4-11.5)	12.2 (11.7-12.8)	13.2 (12.6-13.8)	14.4 (13.7-15.0)	15.2 (14.4-15.9)	15.9 (15.1-16.7)	16.6 (15.8-17.3)	17.4 (16.5-18.2)	17.9 (17.0-18.7)
60-day	11.4 (10.9-11.9)	13.2 (12.6-13.8)	14.6 (14.0-15.3)	15.7 (15.0-16.4)	17.0 (16.2-17.7)	17.9 (17.1-18.6)	18.6 (17.8-19.4)	19.3 (18.5-20.2)	20.1 (19.3-21.0)	20.7 (19.8-21.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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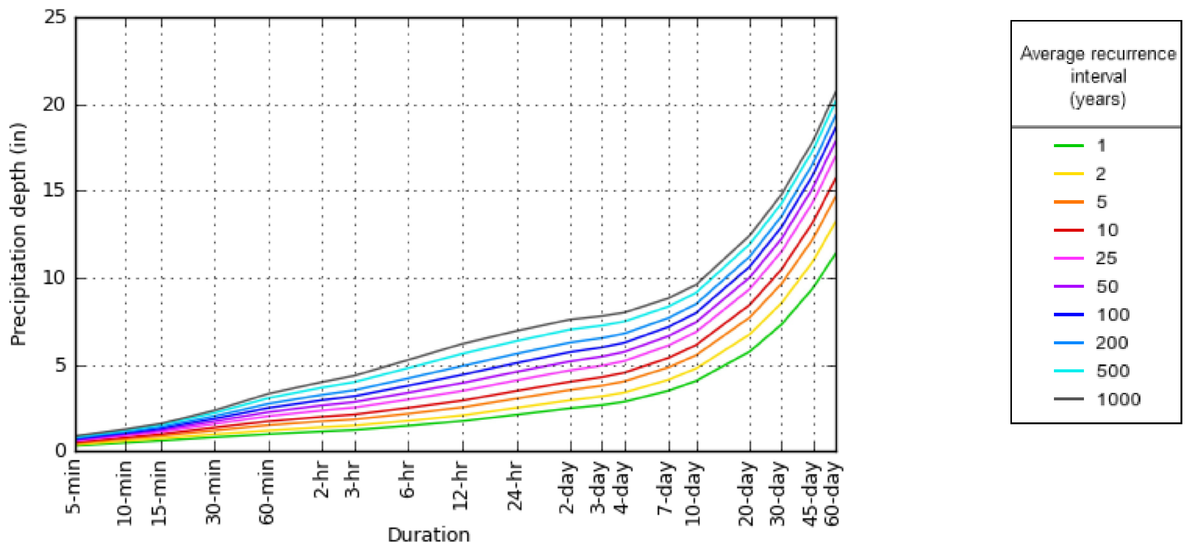
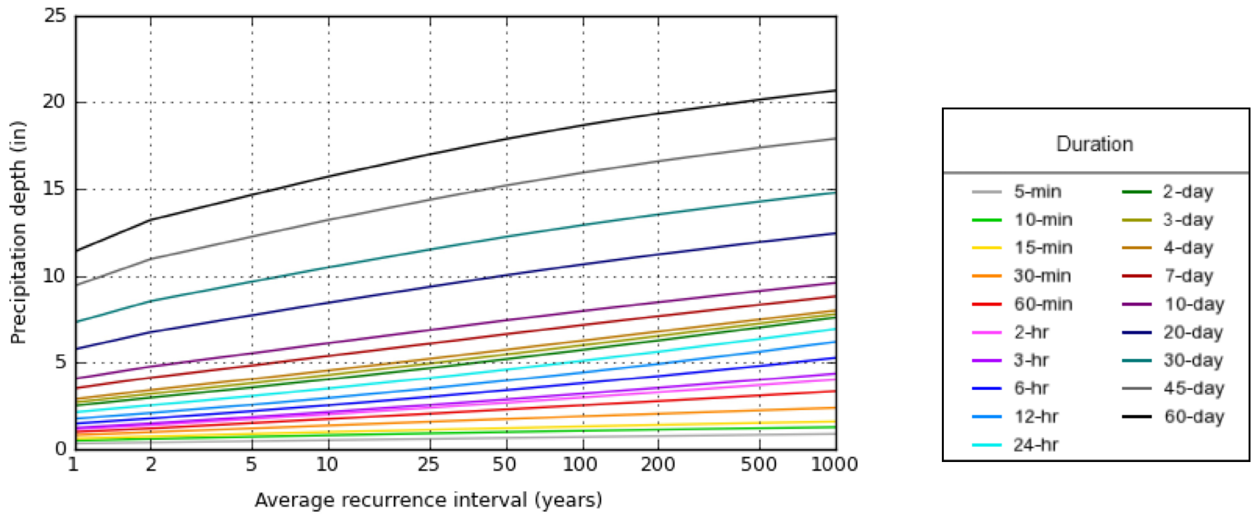
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 39.4044°, Longitude: -80.3322°





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