

:: Field input data ::						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.08	-8888.00	-8888.00	-8888.00	N/A	120.90
2	0.16	-8888.00	-8888.00	-8888.00	N/A	120.90
3	0.25	-8888.00	-8888.00	-8888.00	N/A	120.90
4	0.33	-8888.00	-8888.00	-8888.00	N/A	120.90
5	0.41	-8888.00	-8888.00	-8888.00	N/A	120.90
6	0.49	-8888.00	-8888.00	-8888.00	N/A	120.90
7	0.57	-8888.00	-8888.00	-8888.00	N/A	120.90
8	0.66	-8888.00	-8888.00	-8888.00	N/A	120.90
9	0.74	-8888.00	-8888.00	-8888.00	N/A	120.90
10	0.82	-8888.00	-8888.00	-8888.00	N/A	120.90
11	0.90	-8888.00	-8888.00	-8888.00	N/A	120.90
12	0.98	-8888.00	-8888.00	-8888.00	N/A	120.90
13	1.07	-8888.00	-8888.00	-8888.00	N/A	120.90
14	1.15	-8888.00	-8888.00	-8888.00	N/A	120.90
15	1.23	-8888.00	-8888.00	-8888.00	N/A	120.90
16	1.31	-8888.00	-8888.00	-8888.00	N/A	120.90
17	1.39	-8888.00	-8888.00	-8888.00	N/A	120.90
18	1.48	-8888.00	-8888.00	-8888.00	N/A	120.90
19	1.56	-8888.00	-8888.00	-8888.00	N/A	120.90
20	1.64	-8888.00	-8888.00	-8888.00	N/A	120.90
21	1.72	-8888.00	-8888.00	-8888.00	N/A	120.90
22	1.80	-8888.00	-8888.00	-8888.00	N/A	120.90
23	1.89	-8888.00	-8888.00	-8888.00	N/A	120.90
24	1.97	-8888.00	-8888.00	-8888.00	N/A	120.90
25	2.05	-8888.00	-8888.00	-8888.00	N/A	120.90
26	2.13	-8888.00	-8888.00	-8888.00	N/A	120.90
27	2.21	-8888.00	-8888.00	-8888.00	N/A	120.90
28	2.30	-8888.00	-8888.00	-8888.00	N/A	120.90
29	2.38	-8888.00	-8888.00	-8888.00	N/A	120.90
30	2.46	-8888.00	-8888.00	-8888.00	N/A	120.90
31	2.54	-8888.00	-8888.00	-8888.00	N/A	120.90
32	2.62	-8888.00	-8888.00	-8888.00	N/A	120.90
33	2.71	45.01	1.09	6.67	26.82	115.86
34	2.79	36.22	1.05	2.76	23.65	119.21
35	2.87	28.77	0.92	14.31	27.45	117.87
36	2.95	23.74	0.77	29.26	30.47	116.23
37	3.03	19.17	0.64	102.47	32.15	114.62
38	3.12	17.53	0.55	115.86	32.67	113.23
39	3.20	17.44	0.48	74.65	32.86	112.33
40	3.28	17.13	0.48	28.53	34.00	112.05
41	3.36	16.16	0.52	28.19	35.55	112.18
42	3.44	16.17	0.53	27.36	36.49	112.30
43	3.53	16.20	0.51	24.49	36.84	112.21
44	3.61	15.68	0.50	11.87	37.45	112.01
45	3.69	15.13	0.50	5.19	38.61	111.81
46	3.77	14.58	0.49	0.26	39.93	111.71
47	3.85	14.07	0.50	-0.93	41.73	111.64
48	3.94	13.04	0.51	1.02	43.11	111.52

:: Field input data :: (continued)						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	4.02	12.83	0.49	4.57	44.21	111.34
50	4.10	12.57	0.48	2.27	44.90	111.24
51	4.18	12.22	0.50	-0.99	46.52	111.19
52	4.27	11.36	0.50	0.54	48.27	110.89
53	4.35	10.60	0.45	-0.04	49.94	110.37
54	4.43	10.00	0.43	1.31	51.21	109.54
55	4.51	9.11	0.38	2.01	51.99	108.53
56	4.59	8.52	0.32	4.41	50.39	107.47
57	4.68	9.36	0.28	10.38	48.34	106.35
58	4.76	8.68	0.25	13.91	46.84	105.69
59	4.84	8.26	0.24	28.15	46.55	105.32
60	4.92	8.58	0.25	43.27	45.15	105.49
61	5.00	9.33	0.25	50.74	43.49	106.20
62	5.09	10.33	0.30	40.17	43.09	107.24
63	5.17	10.74	0.35	28.55	44.09	108.26
64	5.25	10.73	0.38	15.19	46.06	108.91
65	5.33	10.39	0.40	4.02	48.26	109.16
66	5.41	9.93	0.40	-0.83	50.27	109.28
67	5.50	9.67	0.41	5.45	51.14	109.16
68	5.58	9.57	0.39	8.08	52.02	108.79
69	5.66	8.74	0.36	4.90	53.06	108.13
70	5.74	8.09	0.33	6.88	54.65	107.62
71	5.82	8.01	0.34	8.04	54.79	107.39
72	5.91	8.26	0.33	13.17	53.64	107.26
73	5.99	8.47	0.31	12.90	51.86	107.04
74	6.07	8.68	0.30	12.31	50.91	106.76
75	6.15	8.43	0.29	14.72	50.91	106.63
76	6.23	8.24	0.30	17.80	51.96	106.55
77	6.32	7.81	0.30	24.56	52.76	106.46
78	6.40	7.70	0.29	28.20	53.56	106.39
79	6.48	7.60	0.29	26.43	54.28	106.34
80	6.56	7.38	0.30	25.50	55.37	106.32
81	6.64	7.17	0.29	26.46	56.11	106.15
82	6.73	7.03	0.28	28.16	56.27	105.84
83	6.81	6.95	0.27	27.51	55.66	105.39
84	6.89	6.94	0.25	28.21	55.22	104.85
85	6.97	6.63	0.23	30.20	55.07	104.14
86	7.05	6.25	0.20	29.62	55.44	103.29
87	7.14	5.95	0.18	28.94	55.90	102.40
88	7.22	5.64	0.17	28.80	55.70	101.48
89	7.30	5.51	0.14	31.74	54.67	100.59
90	7.38	5.48	0.13	38.38	52.88	99.66
91	7.46	5.46	0.11	38.55	51.30	98.77
92	7.55	5.33	0.10	39.09	51.25	98.23
93	7.63	5.03	0.11	43.03	51.74	98.12
94	7.71	5.10	0.11	45.59	53.55	99.37
95	7.79	5.50	0.16	46.39	53.53	100.79
96	7.87	6.11	0.18	49.53	48.91	102.12

:: Field input data :: (continued)						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	7.96	8.66	0.17	30.34	44.13	102.50
98	8.04	9.08	0.16	14.85	39.98	102.43
99	8.12	9.48	0.15	7.55	38.29	101.89
100	8.20	9.59	0.13	8.14	37.11	101.78
101	8.28	9.96	0.15	9.65	37.48	102.45
102	8.37	10.11	0.19	6.00	38.10	103.00
103	8.45	9.90	0.17	4.76	39.17	103.34
104	8.53	9.66	0.18	4.12	40.30	102.87
105	8.61	8.65	0.17	2.38	43.81	102.67
106	8.69	7.28	0.17	1.40	48.38	102.44
107	8.78	6.69	0.18	8.72	52.52	102.34
108	8.86	6.36	0.18	15.61	54.15	102.34
109	8.94	6.24	0.18	24.87	52.74	102.01
110	9.02	6.71	0.16	29.65	49.66	101.78
111	9.10	7.29	0.15	35.05	46.64	101.64
112	9.19	7.63	0.16	28.05	45.80	101.71
113	9.27	7.30	0.16	26.61	38.36	102.31
114	9.35	12.76	0.16	52.03	28.20	103.39
115	9.43	20.05	0.17	35.31	22.56	105.14
116	9.51	21.36	0.23	1.91	20.56	105.65
117	9.60	19.65	0.18	-5.48	21.35	105.45
118	9.68	18.13	0.17	-3.48	20.53	104.28
119	9.76	20.22	0.15	0.51	17.34	104.11
120	9.84	27.74	0.14	0.92	14.92	104.39
121	9.92	27.24	0.16	-1.73	13.91	104.73
122	10.01	25.64	0.16	-0.94	14.83	105.22
123	10.09	25.46	0.18	1.78	14.80	105.17
124	10.17	27.13	0.16	2.79	13.71	104.61
125	10.25	29.02	0.12	-5.14	5.00	103.40
126	10.33	30.24	0.10	-11.58	5.00	102.15
127	10.42	31.53	0.10	-13.90	5.00	101.63
128	10.50	32.86	0.09	-14.88	5.00	102.56
129	10.58	29.20	0.15	-15.13	13.02	104.33
130	10.66	23.46	0.20	-14.61	17.64	105.64
131	10.74	17.84	0.21	-12.68	23.02	106.05
132	10.83	16.24	0.22	-10.39	27.55	105.69
133	10.91	14.03	0.21	-6.54	31.67	105.06
134	10.99	10.56	0.19	-2.52	36.89	103.96
135	11.07	8.50	0.17	9.40	42.68	102.25
136	11.15	6.68	0.12	30.08	45.05	101.06
137	11.24	6.93	0.14	58.76	44.17	100.13
138	11.32	7.17	0.12	70.64	31.73	100.80
139	11.40	16.40	0.11	76.54	22.36	101.69
140	11.48	22.02	0.14	39.15	18.50	102.63
141	11.56	19.11	0.14	-7.84	20.18	103.28
142	11.65	15.07	0.15	-10.85	25.64	103.11
143	11.73	11.63	0.16	-9.14	33.35	103.82
144	11.81	10.05	0.23	1.56	40.66	105.14

:: Field input data :: (continued)						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	11.89	9.46	0.29	49.08	42.09	106.53
146	11.98	11.29	0.29	83.23	32.27	107.96
147	12.06	22.97	0.30	21.72	19.35	109.56
148	12.14	43.05	0.33	1.34	13.01	111.56
149	12.22	55.43	0.42	-6.98	8.96	113.33
150	12.30	75.15	0.44	-6.10	6.02	114.61
151	12.39	103.25	0.42	-7.86	3.34	115.19
152	12.47	134.98	0.39	-9.82	1.69	115.95
153	12.55	159.18	0.47	-8.61	0.72	116.75
154	12.63	180.58	0.48	-7.58	0.29	117.57
155	12.71	189.23	0.50	-7.37	0.05	118.28
156	12.80	199.64	0.57	-7.72	0.21	119.86
157	12.88	209.49	0.83	-8.41	0.46	121.38
158	12.96	211.97	0.91	-9.35	0.41	121.61
159	13.04	212.03	0.63	-10.91	0.00	120.32
160	13.12	211.80	0.45	-12.35	0.00	117.95
161	13.21	214.85	0.36	-12.65	0.00	116.72
162	13.29	225.70	0.40	-13.63	0.00	116.44
163	13.37	239.41	0.38	-17.43	0.00	116.79
164	13.45	243.29	0.40	-16.08	0.00	116.74
165	13.53	248.45	0.38	-15.26	0.00	117.65
166	13.62	253.94	0.53	-14.88	0.00	119.87
167	13.70	256.50	0.85	-15.48	0.06	123.82
168	13.78	249.59	1.64	-16.21	1.31	126.55
169	13.86	236.33	1.93	-16.96	3.04	128.74
170	13.94	209.93	2.52	-17.77	4.66	129.41
171	14.03	175.83	2.48	-18.87	7.29	129.56
172	14.11	123.19	2.56	-15.08	9.79	128.47
173	14.19	101.46	2.02	-16.13	11.88	127.10
174	14.27	99.21	1.70	-8.99	9.67	125.67
175	14.35	138.77	1.37	-1.59	5.98	124.15
176	14.44	166.90	0.83	-7.78	3.18	121.73
177	14.52	151.64	0.49	2.92	1.66	118.46
178	14.60	143.51	0.39	2.66	1.51	116.73
179	14.68	139.85	0.50	2.55	2.04	117.21
180	14.76	131.82	0.61	0.16	2.78	118.70
181	14.85	137.52	0.74	2.83	3.16	119.87
182	14.93	147.85	0.81	1.73	3.18	120.87
183	15.01	153.54	0.88	-8.85	3.22	121.57
184	15.09	153.40	0.95	-10.98	3.28	122.08
185	15.17	158.22	0.98	-11.94	3.26	122.48
186	15.26	165.59	1.01	-12.28	3.01	122.73
187	15.34	173.55	1.02	-13.04	2.80	123.01
188	15.42	177.89	1.05	-13.53	2.70	123.26
189	15.50	178.79	1.09	-14.07	2.73	123.46
190	15.58	178.78	1.09	-14.48	2.72	123.49
191	15.67	179.86	1.06	-14.62	2.63	123.42
192	15.75	182.45	1.05	-14.73	2.51	123.35

:: Field input data :: (continued)						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	15.83	183.92	1.05	-14.82	2.52	123.35
194	15.91	179.92	1.06	-15.22	2.78	123.49
195	15.99	171.90	1.13	-15.55	3.40	123.63
196	16.08	154.94	1.17	-16.04	4.24	123.71
197	16.16	142.65	1.19	-16.29	5.50	123.60
198	16.24	120.12	1.22	-16.49	7.52	123.48
199	16.32	92.04	1.31	-16.63	10.68	123.19
200	16.40	71.20	1.32	-16.46	15.02	122.65
201	16.49	52.89	1.28	-16.25	20.43	121.60
202	16.57	34.61	1.16	-15.99	27.51	119.92
203	16.65	22.54	0.94	-15.76	36.70	117.65
204	16.73	15.27	0.75	-14.97	45.44	114.79
205	16.81	11.30	0.50	-14.27	51.60	111.86
206	16.90	9.94	0.37	-13.12	51.43	108.80
207	16.98	10.17	0.25	-4.05	40.54	106.66
208	17.06	15.48	0.17	97.28	29.60	105.90
209	17.14	21.38	0.23	97.23	27.01	106.78
210	17.22	17.09	0.30	13.59	30.35	107.67
211	17.31	12.53	0.28	14.84	37.41	107.70
212	17.39	11.98	0.29	30.95	37.66	108.33
213	17.47	17.66	0.37	46.09	31.57	110.24
214	17.55	26.28	0.45	45.71	28.59	112.13
215	17.63	24.78	0.53	11.25	29.17	112.78
216	17.72	19.28	0.49	5.68	31.19	112.77
217	17.80	22.23	0.48	8.71	23.94	112.98
218	17.88	45.53	0.44	8.43	15.69	113.38
219	17.96	60.62	0.39	3.74	12.38	112.84
220	18.04	44.21	0.33	-9.50	13.24	112.56
221	18.13	36.80	0.42	-10.61	18.09	112.22
222	18.21	28.10	0.44	-16.17	24.37	112.15
223	18.29	18.73	0.43	-16.02	32.83	111.30
224	18.37	13.20	0.41	-15.82	42.43	109.99
225	18.45	10.99	0.36	-14.68	49.87	108.55
226	18.54	9.28	0.30	-13.89	50.02	106.77
227	18.62	10.42	0.21	-10.18	35.90	105.64
228	18.70	22.24	0.16	-7.04	24.16	105.86
229	18.78	30.51	0.23	-7.57	20.61	107.18
230	18.86	25.02	0.28	-14.98	22.61	108.65
231	18.95	21.04	0.31	-16.09	29.56	109.49
232	19.03	15.73	0.40	-16.08	37.36	109.64
233	19.11	12.24	0.38	-15.87	46.62	109.29
234	19.19	9.97	0.35	-15.54	52.74	107.80
235	19.27	8.61	0.26	-14.81	57.31	105.73
236	19.36	7.05	0.18	-13.62	59.67	102.94
237	19.44	6.10	0.13	-11.34	60.30	100.09
238	19.52	6.00	0.09	-9.54	57.58	97.37
239	19.60	5.96	0.06	-6.10	53.61	95.17
240	19.69	5.98	0.06	-4.07	50.52	93.72

:: Field input data :: (continued)						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	19.77	6.18	0.05	1.20	48.84	93.20
242	19.85	6.17	0.05	8.62	46.99	93.17
243	19.93	6.44	0.05	22.90	45.30	93.49
244	20.01	6.80	0.06	32.17	42.75	93.72
245	20.10	7.12	0.05	52.21	40.89	93.50
246	20.18	6.87	0.05	61.81	40.33	93.90
247	20.26	6.82	0.06	79.81	39.90	94.83
248	20.34	7.62	0.07	93.25	39.57	96.13
249	20.42	7.83	0.08	95.42	39.79	97.89
250	20.51	8.41	0.12	81.80	40.59	100.05
251	20.59	9.43	0.15	93.16	40.37	101.79
252	20.67	10.50	0.16	77.12	41.06	102.47
253	20.75	9.16	0.15	54.09	41.18	102.29
254	20.83	9.53	0.14	65.44	42.25	103.34
255	20.92	11.01	0.23	80.57	36.52	106.22
256	21.00	19.69	0.34	74.40	33.41	108.49
257	21.08	19.78	0.34	18.79	33.07	109.33
258	21.16	14.85	0.32	8.73	38.22	108.77
259	21.24	11.21	0.32	34.38	47.10	108.12
260	21.33	8.72	0.34	47.58	54.82	107.65
261	21.41	7.40	0.32	84.59	57.72	107.08
262	21.49	7.70	0.27	118.17	50.30	107.40
263	21.57	12.62	0.32	131.38	25.33	110.36
264	21.65	50.95	0.43	140.67	12.45	113.12
265	21.74	90.96	0.42	9.89	5.00	114.12
266	21.82	98.84	0.32	-10.51	4.95	114.21
267	21.90	96.77	0.39	-13.31	6.56	115.54
268	21.98	70.28	0.68	-15.40	11.10	117.45
269	22.06	47.14	0.86	-16.67	18.74	118.02
270	22.15	32.37	0.81	-17.88	27.17	117.11
271	22.23	23.54	0.69	-18.39	35.71	115.16
272	22.31	15.29	0.55	-18.76	44.41	113.07
273	22.39	12.03	0.48	-15.95	52.10	110.56
274	22.47	10.35	0.32	-11.72	52.71	107.57
275	22.56	9.77	0.15	-0.62	47.34	102.92
276	22.64	8.91	0.05	29.07	39.66	96.84
277	22.72	8.35	0.03	49.29	34.29	91.22
278	22.80	8.28	0.03	61.94	30.90	89.51
279	22.88	10.33	0.03	68.87	27.67	89.93
280	22.97	12.40	0.03	61.35	25.85	90.67
281	23.05	11.72	0.03	54.19	25.60	90.87
282	23.13	11.28	0.03	46.28	26.88	90.39
283	23.21	10.22	0.03	50.31	27.55	90.58
284	23.29	10.80	0.03	68.33	27.08	93.40
285	23.38	14.35	0.07	79.04	27.46	98.05
286	23.46	15.58	0.13	67.70	29.91	102.32
287	23.54	14.38	0.21	54.97	37.21	106.83
288	23.62	13.43	0.42	36.48	41.45	109.55

:: Field input data :: (continued)						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	23.70	16.21	0.47	62.94	30.69	112.84
290	23.79	41.66	0.58	100.79	13.43	116.09
291	23.87	115.78	0.66	109.83	6.27	121.03
292	23.95	203.14	1.40	-6.20	3.22	124.53
293	24.03	255.72	1.59	-8.85	2.08	127.16
294	24.11	296.41	1.79	-9.59	1.34	127.89
295	24.20	307.86	1.67	-10.40	1.34	128.86
296	24.28	307.43	2.20	-9.89	1.83	130.22
297	24.36	320.33	2.89	24.02	2.35	131.55
298	24.44	333.24	2.95	18.51	2.55	132.33
299	24.52	335.22	3.01	18.12	2.25	132.13
300	24.61	340.21	2.60	21.77	1.55	131.15
301	24.69	350.85	1.83	15.19	0.72	130.07
302	24.77	374.64	1.91	20.02	0.09	128.14
303	24.85	312.96	1.17	25.49	0.31	128.33
304	24.93	328.55	1.99	24.04	0.57	128.09
305	25.02	324.81	1.84	18.61	0.44	127.99
306	25.10	325.74	1.08	31.33	0.00	126.16
307	25.18	322.38	0.91	20.98	0.00	124.40
308	25.26	317.29	1.03	18.82	0.00	122.81
309	25.34	317.29	0.50	21.25	0.00	122.95
310	25.43	332.04	0.95	13.99	0.00	123.24
311	25.51	334.73	1.11	17.38	0.00	123.57
312	25.59	333.56	0.60	21.08	0.00	123.47
313	25.67	333.83	0.91	30.00	0.00	122.19
314	25.75	341.03	0.69	19.70	0.00	123.04
315	25.84	340.73	0.87	15.87	0.00	123.48
316	25.92	321.40	1.07	24.48	0.00	124.63
317	26.00	344.73	1.13	17.53	0.00	125.86
318	26.08	346.89	1.42	36.53	0.00	126.45
319	26.16	331.46	1.37	31.84	0.00	125.90
320	26.25	341.99	0.84	26.94	0.00	125.06
321	26.33	336.99	1.04	16.82	0.00	124.31
322	26.41	342.19	1.04	19.59	0.00	126.50
323	26.49	354.40	1.85	6.24	0.00	126.08
324	26.57	361.86	0.79	16.31	0.00	125.82
325	26.66	383.94	0.87	-2.35	0.00	124.30
326	26.74	372.56	1.18	17.83	0.00	124.55
327	26.82	357.96	0.89	3.74	0.00	123.97
328	26.90	357.58	0.66	11.45	0.00	123.78
329	26.98	355.36	1.12	17.07	0.00	126.18
330	27.07	350.74	1.94	19.44	0.53	129.13
331	27.15	343.08	2.54	19.53	1.09	130.00
332	27.23	333.47	1.87	25.21	1.06	129.75
333	27.31	339.12	1.75	30.06	0.59	128.53
334	27.40	332.27	1.62	14.31	0.35	128.15
335	27.48	345.23	1.58	21.62	0.33	127.66
336	27.56	314.40	1.47	-2.56	0.88	128.58

:: Field input data :: (continued)						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	27.64	312.03	2.28	18.98	1.51	129.20
338	27.72	307.33	2.13	20.49	1.93	129.86
339	27.81	307.25	2.04	27.97	2.33	130.94
340	27.89	333.86	3.25	33.31	2.33	131.60
341	27.97	348.39	2.72	20.57	2.33	132.57
342	28.05	371.88	2.99	13.62	1.56	132.34
343	28.13	410.65	2.77	10.65	0.90	132.65
344	28.22	467.26	2.79	31.58	0.47	133.55
345	28.30	525.30	3.74	27.94	1.08	135.47
346	28.38	481.06	5.36	32.63	1.79	136.72
347	28.46	471.14	5.00	33.44	1.93	136.29
348	28.54	460.64	3.14	22.40	1.32	135.13
349	28.63	469.10	3.41	31.94	0.71	133.52
350	28.71	430.02	2.81	35.28	1.20	134.00
351	28.79	420.48	3.87	24.83	1.55	133.88
352	28.87	405.78	3.41	27.33	1.17	132.81
353	28.95	400.46	1.51	24.80	0.41	131.23
354	29.04	419.58	2.17	14.58	0.00	128.48
355	29.12	380.63	1.22	5.86	0.00	128.39
356	29.20	419.71	1.43	34.13	0.00	128.55
357	29.28	364.01	2.36	25.24	0.66	129.94
358	29.36	313.71	2.39	6.03	3.01	131.82
359	29.45	268.94	3.64	21.83	3.45	131.36
360	29.53	300.26	2.03	26.23	4.04	131.33
361	29.61	265.73	2.51	33.93	2.56	130.01
362	29.69	320.34	2.15	16.31	3.51	131.77
363	29.77	315.40	3.80	42.81	4.37	133.39
364	29.86	291.62	4.51	31.17	6.12	134.87
365	29.94	282.25	4.66	28.51	7.89	134.79
366	30.02	208.49	4.22	-4.46	10.05	134.03
367	30.10	159.77	3.96	38.38	12.59	132.85
368	30.18	155.33	3.56	29.33	15.88	131.80
369	30.27	101.95	3.46	-13.90	17.58	130.28
370	30.35	94.96	2.42	-11.11	17.98	129.58
371	30.43	135.60	2.87	-11.43	12.07	128.99
372	30.51	194.78	2.15	-13.05	6.91	128.62
373	30.59	240.09	1.39	-3.62	4.01	126.74
374	30.68	207.32	1.22	5.37	2.90	125.74
375	30.76	226.57	1.47	21.73	3.40	126.32
376	30.84	229.22	1.75	13.69	3.39	126.99
377	30.92	233.79	1.59	34.48	2.57	125.85
378	31.00	238.36	0.75	34.79	1.20	123.14
379	31.09	238.12	0.48	3.51	1.34	123.45
380	31.17	232.79	1.71	29.52	1.68	124.28
381	31.25	240.92	1.10	30.23	2.26	125.72
382	31.33	247.56	1.17	2.72	1.64	125.03
383	31.41	256.56	1.31	23.72	2.01	124.91
384	31.50	206.08	1.10	34.31	2.57	125.17

<b>:: Field input data :: (continued)</b>						
Point ID	Depth (ft)	q <sub>c</sub> (tsf)	f <sub>s</sub> (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
385	31.58	216.08	1.36	39.07	3.11	125.24
386	31.66	222.89	1.41	36.83	2.91	125.36
387	31.74	223.36	1.13	42.55	3.20	126.06
388	31.82	223.66	1.73	32.00	3.60	127.41
389	31.91	249.97	2.21	30.31	3.76	128.39
390	31.99	254.17	1.77	33.36	3.29	127.16
391	32.07	204.93	0.89	7.13	5.26	128.64
392	32.15	193.61	3.48	2.40	5.18	127.61
393	32.23	219.76	1.06	38.29	5.00	127.62
394	32.32	214.85	0.88	30.27	1.13	122.84
395	32.40	277.15	0.77	40.20	2.45	127.25
396	32.48	283.88	3.15	36.64	4.06	131.50
397	32.56	298.17	4.37	49.49	6.31	134.31
398	32.64	278.81	4.63	27.67	6.68	134.18
399	32.73	255.32	3.08	12.14	7.00	133.86
400	32.81	262.88	4.01	31.67	6.90	133.24
401	32.89	253.42	3.79	43.59	7.79	133.82
402	32.97	237.93	4.07	43.17	7.62	134.10
403	33.05	285.82	4.35	21.82	6.26	134.91
404	33.14	378.41	4.57	47.09	4.38	135.92
405	33.22	454.56	4.96	35.48	2.32	136.63
406	33.30	590.72	4.59	12.69	1.11	136.38
407	33.38	557.88	3.56	11.97	0.26	135.62
408	33.46	552.73	3.44	2.57	0.00	134.76
409	33.55	580.60	3.33	-3.90	0.00	134.62
410	33.63	631.41	3.21	-8.81	0.00	134.35
411	33.71	540.88	3.10	15.54	0.23	135.22
412	33.79	494.08	4.73	13.90	1.15	135.68
413	33.87	491.44	4.27	-14.62	1.57	136.04
414	33.96	503.67	3.82	-0.54	0.97	135.74
415	34.04	572.12	4.01	4.79	0.62	135.68
416	34.12	556.86	4.01	-3.27	0.51	135.98
417	34.20	560.37	4.17	37.60	0.00	133.05
418	34.28	563.88	0.00	34.30	0.00	128.02
419	34.37	491.01	0.00	35.85	N/A	87.36
420	34.45	491.01	0.00	35.85	N/A	87.36
421	34.53	607.27	0.00	38.32	N/A	87.36

**Abbreviations**

Depth:	Depth from free surface, at which CPT was performed (ft)
q <sub>c</sub> :	Measured cone resistance (tsf)
f <sub>s</sub> :	Sleeve friction resistance (tsf)
u:	Pore pressure (tsf)
Fines content:	Percentage of fines in soil (%)
Unit weight:	Bulk soil unit weight (pcf)

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data ::												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	CSR <sub>eq</sub>	$K_\sigma$	User FS	CSR*	Belongs to transition
1	0.08	0.00	0.00	0.00	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
2	0.16	0.01	0.00	0.01	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
3	0.25	0.01	0.00	0.01	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
4	0.33	0.02	0.00	0.02	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
5	0.41	0.02	0.00	0.02	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
6	0.49	0.03	0.00	0.03	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
7	0.57	0.03	0.00	0.03	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
8	0.66	0.04	0.00	0.04	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
9	0.74	0.04	0.00	0.04	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
10	0.82	0.05	0.00	0.05	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
11	0.90	0.05	0.00	0.05	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
12	0.98	0.06	0.00	0.06	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
13	1.07	0.06	0.00	0.06	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
14	1.15	0.07	0.00	0.07	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
15	1.23	0.07	0.00	0.07	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
16	1.31	0.08	0.00	0.08	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
17	1.39	0.08	0.00	0.08	1.00	0.351	1.15	0.305	1.00	1.00	2.000	No
18	1.48	0.09	0.00	0.09	1.00	0.350	1.15	0.305	1.00	1.00	2.000	No
19	1.56	0.09	0.00	0.09	1.00	0.350	1.15	0.305	1.00	1.00	2.000	No
20	1.64	0.10	0.00	0.10	1.00	0.350	1.15	0.305	1.00	1.00	2.000	No
21	1.72	0.10	0.00	0.10	1.00	0.350	1.15	0.305	1.00	1.00	2.000	No
22	1.80	0.11	0.00	0.11	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
23	1.89	0.11	0.00	0.11	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
24	1.97	0.12	0.00	0.12	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
25	2.05	0.12	0.00	0.12	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
26	2.13	0.13	0.00	0.13	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
27	2.21	0.13	0.00	0.13	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
28	2.30	0.14	0.00	0.14	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
29	2.38	0.14	0.00	0.14	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
30	2.46	0.15	0.00	0.15	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
31	2.54	0.15	0.00	0.15	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
32	2.62	0.16	0.00	0.16	1.00	0.350	1.15	0.304	1.00	1.00	2.000	No
33	2.71	0.16	0.00	0.16	1.00	0.349	1.15	0.304	1.00	1.00	2.000	No
34	2.79	0.17	0.00	0.17	1.00	0.349	1.15	0.304	1.00	1.00	2.000	No
35	2.87	0.17	0.00	0.17	1.00	0.349	1.15	0.304	1.00	1.00	2.000	No
36	2.95	0.18	0.00	0.18	1.00	0.349	1.15	0.304	1.00	1.00	2.000	No
37	3.03	0.18	0.00	0.18	0.99	0.349	1.15	0.304	1.00	1.00	2.000	No
38	3.12	0.19	0.00	0.19	0.99	0.349	1.15	0.304	1.00	1.00	2.000	No
39	3.20	0.19	0.00	0.19	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
40	3.28	0.20	0.00	0.20	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
41	3.36	0.20	0.00	0.20	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
42	3.44	0.21	0.00	0.21	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
43	3.53	0.21	0.00	0.21	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
44	3.61	0.21	0.00	0.21	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
45	3.69	0.22	0.00	0.22	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
46	3.77	0.22	0.00	0.22	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
47	3.85	0.23	0.00	0.23	0.99	0.349	1.15	0.303	1.00	1.00	2.000	No
48	3.94	0.23	0.00	0.23	0.99	0.348	1.15	0.303	1.00	1.00	2.000	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	CSR <sub>eq</sub>	$K_\sigma$	User FS	CSR*	Belongs to transition
49	4.02	0.24	0.00	0.24	0.99	0.349	1.15	0.304	1.00	1.00	0.304	No
50	4.10	0.24	0.00	0.24	0.99	0.353	1.15	0.307	1.00	1.00	0.307	No
51	4.18	0.25	0.01	0.24	0.99	0.356	1.15	0.310	1.00	1.00	0.310	No
52	4.27	0.25	0.01	0.24	0.99	0.360	1.15	0.313	1.00	1.00	0.313	No
53	4.35	0.26	0.01	0.25	0.99	0.363	1.15	0.316	1.00	1.00	0.316	No
54	4.43	0.26	0.01	0.25	0.99	0.367	1.15	0.319	1.00	1.00	0.319	No
55	4.51	0.26	0.02	0.25	0.99	0.370	1.15	0.322	1.00	1.00	0.322	No
56	4.59	0.27	0.02	0.25	0.99	0.374	1.15	0.325	1.00	1.00	0.325	No
57	4.68	0.27	0.02	0.25	0.99	0.377	1.15	0.328	1.00	1.00	0.328	No
58	4.76	0.28	0.02	0.25	0.99	0.380	1.15	0.330	1.00	1.00	0.330	No
59	4.84	0.28	0.03	0.26	0.99	0.383	1.15	0.333	1.00	1.00	0.333	No
60	4.92	0.29	0.03	0.26	0.99	0.386	1.15	0.336	1.00	1.00	0.336	No
61	5.00	0.29	0.03	0.26	0.99	0.389	1.15	0.339	1.00	1.00	0.339	No
62	5.09	0.30	0.03	0.26	0.99	0.392	1.15	0.341	1.00	1.00	0.341	No
63	5.17	0.30	0.04	0.26	0.99	0.395	1.15	0.344	1.00	1.00	0.344	No
64	5.25	0.30	0.04	0.27	0.99	0.398	1.15	0.346	1.00	1.00	0.346	No
65	5.33	0.31	0.04	0.27	0.99	0.401	1.15	0.349	1.00	1.00	0.349	No
66	5.41	0.31	0.04	0.27	0.99	0.404	1.15	0.351	1.00	1.00	0.351	No
67	5.50	0.32	0.05	0.27	0.99	0.407	1.15	0.354	1.00	1.00	0.354	No
68	5.58	0.32	0.05	0.27	0.99	0.410	1.15	0.356	1.00	1.00	0.356	No
69	5.66	0.33	0.05	0.27	0.99	0.412	1.15	0.359	1.00	1.00	0.359	No
70	5.74	0.33	0.05	0.28	0.99	0.415	1.15	0.361	1.00	1.00	0.361	No
71	5.82	0.34	0.06	0.28	0.99	0.418	1.15	0.363	1.00	1.00	0.363	No
72	5.91	0.34	0.06	0.28	0.99	0.420	1.15	0.365	1.00	1.00	0.365	No
73	5.99	0.34	0.06	0.28	0.99	0.423	1.15	0.368	1.00	1.00	0.368	No
74	6.07	0.35	0.06	0.28	0.99	0.426	1.15	0.370	1.00	1.00	0.370	No
75	6.15	0.35	0.07	0.29	0.99	0.428	1.15	0.372	1.00	1.00	0.372	No
76	6.23	0.36	0.07	0.29	0.99	0.431	1.15	0.374	1.00	1.00	0.374	No
77	6.32	0.36	0.07	0.29	0.99	0.433	1.15	0.376	1.00	1.00	0.376	No
78	6.40	0.37	0.07	0.29	0.99	0.435	1.15	0.379	1.00	1.00	0.379	No
79	6.48	0.37	0.08	0.29	0.99	0.438	1.15	0.381	1.00	1.00	0.381	No
80	6.56	0.37	0.08	0.29	0.99	0.440	1.15	0.383	1.00	1.00	0.383	No
81	6.64	0.38	0.08	0.30	0.99	0.443	1.15	0.385	1.00	1.00	0.385	No
82	6.73	0.38	0.09	0.30	0.99	0.445	1.15	0.387	1.00	1.00	0.387	No
83	6.81	0.39	0.09	0.30	0.99	0.447	1.15	0.389	1.00	1.00	0.389	No
84	6.89	0.39	0.09	0.30	0.99	0.449	1.15	0.391	1.00	1.00	0.391	No
85	6.97	0.40	0.09	0.30	0.99	0.452	1.15	0.393	1.00	1.00	0.393	No
86	7.05	0.40	0.10	0.31	0.99	0.454	1.15	0.395	1.00	1.00	0.395	No
87	7.14	0.40	0.10	0.31	0.99	0.456	1.15	0.397	1.00	1.00	0.397	No
88	7.22	0.41	0.10	0.31	0.99	0.458	1.15	0.398	1.00	1.00	0.398	No
89	7.30	0.41	0.10	0.31	0.99	0.461	1.15	0.400	1.00	1.00	0.400	No
90	7.38	0.42	0.11	0.31	0.98	0.463	1.15	0.402	1.00	1.00	0.402	No
91	7.46	0.42	0.11	0.31	0.98	0.465	1.15	0.404	1.00	1.00	0.404	No
92	7.55	0.43	0.11	0.31	0.98	0.467	1.15	0.406	1.00	1.00	0.406	No
93	7.63	0.43	0.11	0.32	0.98	0.469	1.15	0.408	1.00	1.00	0.408	No
94	7.71	0.43	0.12	0.32	0.98	0.471	1.15	0.410	1.00	1.00	0.410	No
95	7.79	0.44	0.12	0.32	0.98	0.473	1.15	0.412	1.00	1.00	0.412	No
96	7.87	0.44	0.12	0.32	0.98	0.475	1.15	0.413	1.00	1.00	0.413	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	CSR <sub>eq</sub>	$K_\sigma$	User FS	CSR*	Belongs to transition
97	7.96	0.45	0.12	0.32	0.98	0.477	1.15	0.415	1.00	1.00	0.415	No
98	8.04	0.45	0.13	0.32	0.98	0.479	1.15	0.417	1.00	1.00	0.417	No
99	8.12	0.45	0.13	0.33	0.98	0.481	1.15	0.418	1.00	1.00	0.418	No
100	8.20	0.46	0.13	0.33	0.98	0.483	1.15	0.420	1.00	1.00	0.420	No
101	8.28	0.46	0.13	0.33	0.98	0.485	1.15	0.422	1.00	1.00	0.422	No
102	8.37	0.47	0.14	0.33	0.98	0.487	1.15	0.423	1.00	1.00	0.423	No
103	8.45	0.47	0.14	0.33	0.98	0.489	1.15	0.425	1.00	1.00	0.425	No
104	8.53	0.48	0.14	0.33	0.98	0.491	1.15	0.427	1.00	1.00	0.427	No
105	8.61	0.48	0.14	0.34	0.98	0.493	1.15	0.428	1.00	1.00	0.428	No
106	8.69	0.48	0.15	0.34	0.98	0.494	1.15	0.430	1.00	1.00	0.430	No
107	8.78	0.49	0.15	0.34	0.98	0.496	1.15	0.431	1.00	1.00	0.431	No
108	8.86	0.49	0.15	0.34	0.98	0.498	1.15	0.433	1.00	1.00	0.433	No
109	8.94	0.50	0.15	0.34	0.98	0.500	1.15	0.434	1.00	1.00	0.434	No
110	9.02	0.50	0.16	0.34	0.98	0.501	1.15	0.436	1.00	1.00	0.436	No
111	9.10	0.50	0.16	0.35	0.98	0.503	1.15	0.437	1.00	1.00	0.437	No
112	9.19	0.51	0.16	0.35	0.98	0.505	1.15	0.439	1.00	1.00	0.439	No
113	9.27	0.51	0.16	0.35	0.98	0.507	1.15	0.440	1.00	1.00	0.440	No
114	9.35	0.52	0.17	0.35	0.98	0.508	1.15	0.442	1.00	1.00	0.442	No
115	9.43	0.52	0.17	0.35	0.98	0.510	1.15	0.443	1.00	1.00	0.443	No
116	9.51	0.53	0.17	0.35	0.98	0.511	1.15	0.445	1.00	1.00	0.445	No
117	9.60	0.53	0.17	0.36	0.98	0.513	1.15	0.446	1.00	1.00	0.446	No
118	9.68	0.53	0.18	0.36	0.98	0.514	1.15	0.447	1.00	1.00	0.447	No
119	9.76	0.54	0.18	0.36	0.98	0.516	1.15	0.449	1.00	1.00	0.449	No
120	9.84	0.54	0.18	0.36	0.98	0.518	1.15	0.450	1.00	1.00	0.450	No
121	9.92	0.55	0.18	0.36	0.98	0.519	1.15	0.451	1.00	1.00	0.451	No
122	10.01	0.55	0.19	0.36	0.98	0.520	1.15	0.453	1.00	1.00	0.453	No
123	10.09	0.56	0.19	0.37	0.98	0.522	1.15	0.454	1.00	1.00	0.454	No
124	10.17	0.56	0.19	0.37	0.98	0.523	1.15	0.455	1.00	1.00	0.455	No
125	10.25	0.56	0.20	0.37	0.98	0.525	1.15	0.456	1.00	1.00	0.456	No
126	10.33	0.57	0.20	0.37	0.98	0.526	1.15	0.458	1.00	1.00	0.458	No
127	10.42	0.57	0.20	0.37	0.98	0.528	1.15	0.459	1.00	1.00	0.459	No
128	10.50	0.58	0.20	0.37	0.98	0.529	1.15	0.460	1.00	1.00	0.460	No
129	10.58	0.58	0.21	0.38	0.98	0.531	1.15	0.461	1.00	1.00	0.461	No
130	10.66	0.59	0.21	0.38	0.98	0.532	1.15	0.463	1.00	1.00	0.463	No
131	10.74	0.59	0.21	0.38	0.98	0.533	1.15	0.464	1.00	1.00	0.464	No
132	10.83	0.59	0.21	0.38	0.98	0.535	1.15	0.465	1.00	1.00	0.465	No
133	10.91	0.60	0.22	0.38	0.98	0.536	1.15	0.466	1.00	1.00	0.466	No
134	10.99	0.60	0.22	0.38	0.98	0.537	1.15	0.467	1.00	1.00	0.467	No
135	11.07	0.61	0.22	0.39	0.98	0.539	1.15	0.468	1.00	1.00	0.468	No
136	11.15	0.61	0.22	0.39	0.98	0.540	1.15	0.470	1.00	1.00	0.470	No
137	11.24	0.62	0.23	0.39	0.98	0.541	1.15	0.471	1.00	1.00	0.471	No
138	11.32	0.62	0.23	0.39	0.98	0.543	1.15	0.472	1.00	1.00	0.472	No
139	11.40	0.62	0.23	0.39	0.98	0.544	1.15	0.473	1.00	1.00	0.473	No
140	11.48	0.63	0.23	0.39	0.98	0.545	1.15	0.474	1.00	1.00	0.474	No
141	11.56	0.63	0.24	0.40	0.98	0.547	1.15	0.475	1.00	1.00	0.475	No
142	11.65	0.64	0.24	0.40	0.98	0.548	1.15	0.476	1.00	1.00	0.476	No
143	11.73	0.64	0.24	0.40	0.98	0.549	1.15	0.477	1.00	1.00	0.477	No
144	11.81	0.64	0.24	0.40	0.98	0.550	1.15	0.478	1.00	1.00	0.478	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	CSR <sub>eq</sub>	$K_\sigma$	User FS	CSR*	Belongs to transition
145	11.89	0.65	0.25	0.40	0.98	0.551	1.15	0.479	1.00	1.00	0.479	No
146	11.98	0.65	0.25	0.40	0.97	0.553	1.15	0.480	1.00	1.00	0.480	No
147	12.06	0.66	0.25	0.41	0.97	0.554	1.15	0.481	1.00	1.00	0.481	No
148	12.14	0.66	0.25	0.41	0.97	0.555	1.15	0.482	1.00	1.00	0.482	No
149	12.22	0.67	0.26	0.41	0.97	0.556	1.15	0.483	1.00	1.00	0.483	No
150	12.30	0.67	0.26	0.41	0.97	0.556	1.15	0.484	1.00	1.00	0.484	No
151	12.39	0.68	0.26	0.42	0.97	0.557	1.15	0.485	1.00	1.00	0.485	No
152	12.47	0.68	0.26	0.42	0.97	0.558	1.15	0.485	1.00	1.00	0.485	No
153	12.55	0.69	0.27	0.42	0.97	0.559	1.15	0.486	1.00	1.00	0.486	No
154	12.63	0.69	0.27	0.42	0.97	0.560	1.15	0.487	1.00	1.00	0.487	No
155	12.71	0.70	0.27	0.42	0.97	0.561	1.15	0.487	1.00	1.00	0.487	No
156	12.80	0.70	0.27	0.43	0.97	0.561	1.15	0.488	1.00	1.00	0.488	No
157	12.88	0.71	0.28	0.43	0.97	0.562	1.15	0.489	1.00	1.00	0.489	No
158	12.96	0.71	0.28	0.43	0.97	0.563	1.15	0.489	1.00	1.00	0.489	No
159	13.04	0.72	0.28	0.43	0.97	0.563	1.15	0.490	1.00	1.00	0.490	No
160	13.12	0.72	0.28	0.44	0.97	0.564	1.15	0.491	1.00	1.00	0.491	No
161	13.21	0.73	0.29	0.44	0.97	0.565	1.15	0.491	1.00	1.00	0.491	No
162	13.29	0.73	0.29	0.44	0.97	0.566	1.15	0.492	1.00	1.00	0.492	No
163	13.37	0.74	0.29	0.44	0.97	0.566	1.15	0.492	1.00	1.00	0.492	No
164	13.45	0.74	0.29	0.44	0.97	0.567	1.15	0.493	1.00	1.00	0.493	No
165	13.53	0.74	0.30	0.45	0.97	0.568	1.15	0.494	1.00	1.00	0.494	No
166	13.62	0.75	0.30	0.45	0.97	0.569	1.15	0.494	1.00	1.00	0.494	No
167	13.70	0.75	0.30	0.45	0.97	0.569	1.15	0.495	1.00	1.00	0.495	No
168	13.78	0.76	0.31	0.45	0.97	0.570	1.15	0.495	1.00	1.00	0.495	No
169	13.86	0.77	0.31	0.46	0.97	0.570	1.15	0.496	1.00	1.00	0.496	No
170	13.94	0.77	0.31	0.46	0.97	0.570	1.15	0.496	1.00	1.00	0.496	No
171	14.03	0.78	0.31	0.46	0.97	0.571	1.15	0.496	1.00	1.00	0.496	No
172	14.11	0.78	0.32	0.47	0.97	0.571	1.15	0.497	1.00	1.00	0.497	No
173	14.19	0.79	0.32	0.47	0.97	0.572	1.15	0.497	1.00	1.00	0.497	No
174	14.27	0.79	0.32	0.47	0.97	0.572	1.15	0.497	1.00	1.00	0.497	No
175	14.35	0.80	0.32	0.47	0.97	0.573	1.15	0.498	1.00	1.00	0.498	No
176	14.44	0.80	0.33	0.48	0.97	0.573	1.15	0.498	1.00	1.00	0.498	No
177	14.52	0.81	0.33	0.48	0.97	0.574	1.15	0.499	1.00	1.00	0.499	No
178	14.60	0.81	0.33	0.48	0.97	0.574	1.15	0.499	1.00	1.00	0.499	No
179	14.68	0.82	0.33	0.48	0.97	0.575	1.15	0.500	1.00	1.00	0.500	No
180	14.76	0.82	0.34	0.48	0.97	0.576	1.15	0.500	1.00	1.00	0.500	No
181	14.85	0.83	0.34	0.49	0.97	0.576	1.15	0.501	1.00	1.00	0.501	No
182	14.93	0.83	0.34	0.49	0.97	0.577	1.15	0.501	1.00	1.00	0.501	No
183	15.01	0.84	0.34	0.49	0.97	0.577	1.15	0.502	1.00	1.00	0.502	No
184	15.09	0.84	0.35	0.49	0.97	0.578	1.15	0.502	1.00	1.00	0.502	No
185	15.17	0.85	0.35	0.50	0.97	0.578	1.15	0.503	1.00	1.00	0.503	No
186	15.26	0.85	0.35	0.50	0.97	0.579	1.15	0.503	1.00	1.00	0.503	No
187	15.34	0.86	0.35	0.50	0.97	0.579	1.15	0.503	1.00	1.00	0.503	No
188	15.42	0.86	0.36	0.50	0.97	0.579	1.15	0.504	1.00	1.00	0.504	No
189	15.50	0.87	0.36	0.51	0.97	0.580	1.15	0.504	1.00	1.00	0.504	No
190	15.58	0.87	0.36	0.51	0.97	0.580	1.15	0.505	1.00	1.00	0.505	No
191	15.67	0.88	0.36	0.51	0.97	0.581	1.15	0.505	1.00	1.00	0.505	No
192	15.75	0.88	0.37	0.51	0.97	0.581	1.15	0.505	1.00	1.00	0.505	No

**:: Cyclic Stress Ratio fully adjusted (CSR\*) calculation data :: (continued)**

Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	CSR <sub>eq</sub>	$K_\sigma$	User FS	CSR*	Belongs to transition
193	15.83	0.89	0.37	0.52	0.97	0.582	1.15	0.506	1.00	1.00	0.506	No
194	15.91	0.89	0.37	0.52	0.97	0.582	1.15	0.506	1.00	1.00	0.506	No
195	15.99	0.90	0.37	0.52	0.97	0.582	1.15	0.506	1.00	1.00	0.506	No
196	16.08	0.90	0.38	0.52	0.97	0.583	1.15	0.507	1.00	1.00	0.507	No
197	16.16	0.91	0.38	0.53	0.97	0.583	1.15	0.507	1.00	1.00	0.507	No
198	16.24	0.91	0.38	0.53	0.97	0.583	1.15	0.507	1.00	1.00	0.507	No
199	16.32	0.92	0.38	0.53	0.97	0.584	1.15	0.508	1.00	1.00	0.508	No
200	16.40	0.92	0.39	0.53	0.97	0.584	1.15	0.508	1.00	1.00	0.508	No
201	16.49	0.93	0.39	0.54	0.97	0.585	1.15	0.508	1.00	1.00	0.508	No
202	16.57	0.93	0.39	0.54	0.97	0.585	1.15	0.509	1.00	1.00	0.509	No
203	16.65	0.94	0.39	0.54	0.96	0.585	1.15	0.509	1.00	1.00	0.509	No
204	16.73	0.94	0.40	0.54	0.96	0.586	1.15	0.509	1.00	1.00	0.509	No
205	16.81	0.95	0.40	0.55	0.96	0.587	1.15	0.510	1.00	1.00	0.510	No
206	16.90	0.95	0.40	0.55	0.96	0.587	1.15	0.510	1.00	1.00	0.510	No
207	16.98	0.95	0.40	0.55	0.96	0.588	1.15	0.511	1.00	1.00	0.511	No
208	17.06	0.96	0.41	0.55	0.96	0.588	1.15	0.512	1.00	1.00	0.512	No
209	17.14	0.96	0.41	0.55	0.96	0.589	1.15	0.512	1.00	1.00	0.512	No
210	17.22	0.97	0.41	0.55	0.96	0.590	1.15	0.513	1.00	1.00	0.513	No
211	17.31	0.97	0.42	0.56	0.96	0.590	1.15	0.513	1.00	1.00	0.513	No
212	17.39	0.98	0.42	0.56	0.96	0.591	1.15	0.514	1.00	1.00	0.514	No
213	17.47	0.98	0.42	0.56	0.96	0.591	1.15	0.514	1.00	1.00	0.514	No
214	17.55	0.99	0.42	0.56	0.96	0.592	1.15	0.515	1.00	1.00	0.515	No
215	17.63	0.99	0.43	0.56	0.96	0.592	1.15	0.515	1.00	1.00	0.515	No
216	17.72	0.99	0.43	0.57	0.96	0.593	1.15	0.515	1.00	1.00	0.515	No
217	17.80	1.00	0.43	0.57	0.96	0.593	1.15	0.516	1.00	1.00	0.516	No
218	17.88	1.00	0.43	0.57	0.96	0.594	1.15	0.516	1.00	1.00	0.516	No
219	17.96	1.01	0.44	0.57	0.96	0.594	1.15	0.517	1.00	1.00	0.517	No
220	18.04	1.01	0.44	0.58	0.96	0.595	1.15	0.517	1.00	1.00	0.517	No
221	18.13	1.02	0.44	0.58	0.96	0.595	1.15	0.517	1.00	1.00	0.517	No
222	18.21	1.02	0.44	0.58	0.96	0.596	1.15	0.518	1.00	1.00	0.518	No
223	18.29	1.03	0.45	0.58	0.96	0.596	1.15	0.518	1.00	1.00	0.518	No
224	18.37	1.03	0.45	0.58	0.96	0.597	1.15	0.519	1.00	1.00	0.519	No
225	18.45	1.04	0.45	0.59	0.96	0.597	1.15	0.519	1.00	1.00	0.519	No
226	18.54	1.04	0.45	0.59	0.96	0.598	1.15	0.520	1.00	1.00	0.520	No
227	18.62	1.04	0.46	0.59	0.96	0.598	1.15	0.520	1.00	1.00	0.520	No
228	18.70	1.05	0.46	0.59	0.96	0.599	1.15	0.521	1.00	1.00	0.521	No
229	18.78	1.05	0.46	0.59	0.96	0.599	1.15	0.521	1.00	1.00	0.521	No
230	18.86	1.06	0.46	0.59	0.96	0.600	1.15	0.521	1.00	1.00	0.521	No
231	18.95	1.06	0.47	0.60	0.96	0.600	1.15	0.522	1.00	1.00	0.522	No
232	19.03	1.07	0.47	0.60	0.96	0.601	1.15	0.522	1.00	1.00	0.522	No
233	19.11	1.07	0.47	0.60	0.96	0.601	1.15	0.523	1.00	1.00	0.523	No
234	19.19	1.08	0.47	0.60	0.96	0.602	1.15	0.523	1.00	1.00	0.523	No
235	19.27	1.08	0.48	0.60	0.96	0.602	1.15	0.524	1.00	1.00	0.524	No
236	19.36	1.08	0.48	0.61	0.96	0.603	1.15	0.524	1.00	1.00	0.524	No
237	19.44	1.09	0.48	0.61	0.96	0.603	1.15	0.525	1.00	1.00	0.525	No
238	19.52	1.09	0.48	0.61	0.96	0.604	1.15	0.525	1.00	1.00	0.525	No
239	19.60	1.10	0.49	0.61	0.96	0.605	1.15	0.526	1.00	1.00	0.526	No
240	19.69	1.10	0.49	0.61	0.96	0.605	1.15	0.526	1.00	1.00	0.526	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	CSR <sub>eq</sub>	$K_\sigma$	User FS	CSR*	Belongs to transition
241	19.77	1.10	0.49	0.61	0.96	0.606	1.15	0.527	1.00	1.00	0.527	No
242	19.85	1.11	0.49	0.61	0.96	0.607	1.15	0.528	1.00	1.00	0.528	No
243	19.93	1.11	0.50	0.61	0.96	0.608	1.15	0.528	1.00	1.00	0.528	No
244	20.01	1.12	0.50	0.62	0.96	0.608	1.15	0.529	1.00	1.00	0.529	No
245	20.10	1.12	0.50	0.62	0.96	0.609	1.15	0.529	1.00	1.00	0.529	No
246	20.18	1.12	0.50	0.62	0.96	0.610	1.15	0.530	1.00	1.00	0.530	No
247	20.26	1.13	0.51	0.62	0.96	0.610	1.15	0.531	1.00	1.00	0.531	No
248	20.34	1.13	0.51	0.62	0.96	0.611	1.15	0.531	1.00	1.00	0.531	No
249	20.42	1.14	0.51	0.62	0.96	0.612	1.15	0.532	1.00	1.00	0.532	No
250	20.51	1.14	0.51	0.62	0.96	0.612	1.15	0.532	1.00	1.00	0.532	No
251	20.59	1.14	0.52	0.63	0.96	0.613	1.15	0.533	1.00	1.00	0.533	No
252	20.67	1.15	0.52	0.63	0.96	0.613	1.15	0.533	1.00	1.00	0.533	No
253	20.75	1.15	0.52	0.63	0.95	0.614	1.15	0.533	1.00	1.00	0.533	No
254	20.83	1.16	0.53	0.63	0.95	0.614	1.15	0.534	1.00	1.00	0.534	No
255	20.92	1.16	0.53	0.63	0.95	0.615	1.15	0.534	1.00	1.00	0.534	No
256	21.00	1.16	0.53	0.63	0.95	0.615	1.15	0.535	1.00	1.00	0.535	No
257	21.08	1.17	0.53	0.64	0.95	0.615	1.15	0.535	1.00	1.00	0.535	No
258	21.16	1.17	0.54	0.64	0.95	0.616	1.15	0.535	1.00	1.00	0.535	No
259	21.24	1.18	0.54	0.64	0.95	0.616	1.15	0.536	1.00	1.00	0.536	No
260	21.33	1.18	0.54	0.64	0.95	0.616	1.15	0.536	1.00	1.00	0.536	No
261	21.41	1.19	0.54	0.64	0.95	0.617	1.15	0.536	1.00	1.00	0.536	No
262	21.49	1.19	0.55	0.65	0.95	0.617	1.15	0.537	1.00	1.00	0.537	No
263	21.57	1.20	0.55	0.65	0.95	0.617	1.15	0.537	1.00	1.00	0.537	No
264	21.65	1.20	0.55	0.65	0.95	0.618	1.15	0.537	1.00	1.00	0.537	No
265	21.74	1.21	0.55	0.65	0.95	0.618	1.15	0.537	1.00	1.00	0.537	No
266	21.82	1.21	0.56	0.65	0.95	0.618	1.15	0.537	1.00	1.00	0.537	No
267	21.90	1.21	0.56	0.66	0.95	0.618	1.15	0.538	1.00	1.00	0.538	No
268	21.98	1.22	0.56	0.66	0.95	0.619	1.15	0.538	1.00	1.00	0.538	No
269	22.06	1.22	0.56	0.66	0.95	0.619	1.15	0.538	1.00	1.00	0.538	No
270	22.15	1.23	0.57	0.66	0.95	0.619	1.15	0.538	1.00	1.00	0.538	No
271	22.23	1.23	0.57	0.67	0.95	0.619	1.15	0.538	1.00	1.00	0.538	No
272	22.31	1.24	0.57	0.67	0.95	0.619	1.15	0.538	1.00	1.00	0.538	No
273	22.39	1.24	0.57	0.67	0.95	0.620	1.15	0.539	1.00	1.00	0.539	No
274	22.47	1.25	0.58	0.67	0.95	0.620	1.15	0.539	1.00	1.00	0.539	No
275	22.56	1.25	0.58	0.67	0.95	0.620	1.15	0.539	1.00	1.00	0.539	No
276	22.64	1.26	0.58	0.67	0.95	0.621	1.15	0.540	1.00	1.00	0.540	No
277	22.72	1.26	0.58	0.68	0.95	0.621	1.15	0.540	1.00	1.00	0.540	No
278	22.80	1.26	0.59	0.68	0.95	0.622	1.15	0.541	1.00	1.00	0.541	No
279	22.88	1.27	0.59	0.68	0.95	0.623	1.15	0.541	1.00	1.00	0.541	No
280	22.97	1.27	0.59	0.68	0.95	0.623	1.15	0.542	1.00	1.00	0.542	No
281	23.05	1.27	0.59	0.68	0.95	0.624	1.15	0.542	1.00	1.00	0.542	No
282	23.13	1.28	0.60	0.68	0.95	0.624	1.15	0.543	1.00	1.00	0.543	No
283	23.21	1.28	0.60	0.68	0.95	0.625	1.15	0.543	1.00	1.00	0.543	No
284	23.29	1.29	0.60	0.68	0.95	0.626	1.15	0.544	1.00	1.00	0.544	No
285	23.38	1.29	0.60	0.68	0.95	0.626	1.15	0.544	1.00	1.00	0.544	No
286	23.46	1.29	0.61	0.69	0.95	0.626	1.15	0.545	1.00	1.00	0.545	No
287	23.54	1.30	0.61	0.69	0.95	0.627	1.15	0.545	1.00	1.00	0.545	No
288	23.62	1.30	0.61	0.69	0.95	0.627	1.15	0.545	1.00	1.00	0.545	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	$CSR_{eq}$	$K_\sigma$	User FS	CSR*	Belongs to transition
289	23.70	1.31	0.61	0.69	0.95	0.627	1.15	0.545	1.00	1.00	0.545	No
290	23.79	1.31	0.62	0.69	0.95	0.627	1.15	0.545	1.00	1.00	0.545	No
291	23.87	1.32	0.62	0.70	0.95	0.627	1.15	0.545	1.00	1.00	0.545	No
292	23.95	1.32	0.62	0.70	0.95	0.627	1.15	0.545	1.00	1.00	0.545	No
293	24.03	1.33	0.63	0.70	0.95	0.627	1.15	0.545	1.00	1.00	0.545	No
294	24.11	1.33	0.63	0.70	0.94	0.627	1.15	0.545	1.00	1.00	0.545	No
295	24.20	1.34	0.63	0.71	0.94	0.627	1.15	0.545	1.00	1.00	0.545	No
296	24.28	1.34	0.63	0.71	0.94	0.627	1.15	0.545	1.00	1.00	0.545	No
297	24.36	1.35	0.64	0.71	0.94	0.626	1.15	0.545	1.00	1.00	0.545	No
298	24.44	1.35	0.64	0.72	0.94	0.626	1.15	0.545	1.00	1.00	0.545	No
299	24.52	1.36	0.64	0.72	0.94	0.626	1.15	0.544	1.00	1.00	0.544	No
300	24.61	1.36	0.64	0.72	0.94	0.626	1.15	0.544	1.00	1.00	0.544	No
301	24.69	1.37	0.65	0.72	0.94	0.626	1.15	0.544	1.00	1.00	0.544	No
302	24.77	1.38	0.65	0.73	0.94	0.626	1.15	0.544	1.00	1.00	0.544	No
303	24.85	1.38	0.65	0.73	0.94	0.626	1.15	0.544	1.00	1.00	0.544	No
304	24.93	1.39	0.65	0.73	0.94	0.625	1.15	0.544	1.00	1.00	0.544	No
305	25.02	1.39	0.66	0.74	0.94	0.625	1.15	0.544	1.00	1.00	0.544	No
306	25.10	1.40	0.66	0.74	0.94	0.625	1.15	0.544	1.00	1.00	0.544	No
307	25.18	1.40	0.66	0.74	0.94	0.625	1.15	0.544	1.00	1.00	0.544	No
308	25.26	1.41	0.66	0.74	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
309	25.34	1.41	0.67	0.75	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
310	25.43	1.42	0.67	0.75	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
311	25.51	1.42	0.67	0.75	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
312	25.59	1.43	0.67	0.75	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
313	25.67	1.43	0.68	0.76	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
314	25.75	1.44	0.68	0.76	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
315	25.84	1.44	0.68	0.76	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
316	25.92	1.45	0.68	0.76	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
317	26.00	1.45	0.69	0.77	0.94	0.625	1.15	0.543	1.00	1.00	0.543	No
318	26.08	1.46	0.69	0.77	0.94	0.624	1.15	0.543	1.00	1.00	0.543	No
319	26.16	1.46	0.69	0.77	0.94	0.624	1.15	0.543	1.00	1.00	0.543	No
320	26.25	1.47	0.69	0.77	0.94	0.624	1.15	0.543	1.00	1.00	0.543	No
321	26.33	1.47	0.70	0.78	0.94	0.624	1.15	0.543	1.00	1.00	0.543	No
322	26.41	1.48	0.70	0.78	0.94	0.624	1.15	0.543	1.00	1.00	0.543	No
323	26.49	1.48	0.70	0.78	0.94	0.624	1.15	0.542	1.00	1.00	0.542	No
324	26.57	1.49	0.70	0.78	0.94	0.624	1.15	0.542	1.00	1.00	0.542	No
325	26.66	1.49	0.71	0.79	0.94	0.624	1.15	0.542	1.00	1.00	0.542	No
326	26.74	1.50	0.71	0.79	0.94	0.624	1.15	0.542	1.00	1.00	0.542	No
327	26.82	1.50	0.71	0.79	0.93	0.623	1.15	0.542	1.00	1.00	0.542	No
328	26.90	1.51	0.71	0.79	0.93	0.623	1.15	0.542	1.00	1.00	0.542	No
329	26.98	1.51	0.72	0.80	0.93	0.623	1.15	0.542	1.00	1.00	0.542	No
330	27.07	1.52	0.72	0.80	0.93	0.623	1.15	0.542	1.00	1.00	0.542	No
331	27.15	1.52	0.72	0.80	0.93	0.623	1.15	0.541	1.00	1.00	0.541	No
332	27.23	1.53	0.72	0.80	0.93	0.623	1.15	0.541	1.00	1.00	0.541	No
333	27.31	1.53	0.73	0.81	0.93	0.622	1.15	0.541	1.00	1.00	0.541	No
334	27.40	1.54	0.73	0.81	0.93	0.622	1.15	0.541	1.00	1.00	0.541	No
335	27.48	1.55	0.73	0.81	0.93	0.622	1.15	0.541	1.00	1.00	0.541	No
336	27.56	1.55	0.74	0.82	0.93	0.622	1.15	0.541	1.00	1.00	0.541	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	$CSR_{eq}$	$K_\sigma$	User FS	CSR*	Belongs to transition
337	27.64	1.56	0.74	0.82	0.93	0.622	1.15	0.541	1.00	1.00	0.541	No
338	27.72	1.56	0.74	0.82	0.93	0.622	1.15	0.540	1.00	1.00	0.540	No
339	27.81	1.57	0.74	0.82	0.93	0.621	1.15	0.540	1.00	1.00	0.540	No
340	27.89	1.57	0.75	0.83	0.93	0.621	1.15	0.540	1.00	1.00	0.540	No
341	27.97	1.58	0.75	0.83	0.93	0.621	1.15	0.540	1.00	1.00	0.540	No
342	28.05	1.58	0.75	0.83	0.93	0.621	1.15	0.539	1.00	1.00	0.539	No
343	28.13	1.59	0.75	0.84	0.93	0.620	1.15	0.539	1.00	1.00	0.539	No
344	28.22	1.59	0.76	0.84	0.93	0.620	1.15	0.539	1.00	1.00	0.539	No
345	28.30	1.60	0.76	0.84	0.93	0.620	1.15	0.539	1.00	1.00	0.539	No
346	28.38	1.60	0.76	0.84	0.93	0.619	1.15	0.539	1.00	1.00	0.539	No
347	28.46	1.61	0.76	0.85	0.93	0.619	1.15	0.538	1.00	1.00	0.538	No
348	28.54	1.62	0.77	0.85	0.93	0.619	1.15	0.538	1.00	1.00	0.538	No
349	28.63	1.62	0.77	0.85	0.93	0.619	1.15	0.538	1.00	1.00	0.538	No
350	28.71	1.63	0.77	0.86	0.93	0.618	1.15	0.537	1.00	1.00	0.537	No
351	28.79	1.63	0.77	0.86	0.93	0.618	1.15	0.537	1.00	1.00	0.537	No
352	28.87	1.64	0.78	0.86	0.93	0.618	1.15	0.537	1.00	1.00	0.537	No
353	28.95	1.64	0.78	0.86	0.93	0.617	1.15	0.537	1.00	1.00	0.537	No
354	29.04	1.65	0.78	0.87	0.93	0.617	1.15	0.537	1.00	1.00	0.537	No
355	29.12	1.65	0.78	0.87	0.92	0.617	1.15	0.536	1.00	1.00	0.536	No
356	29.20	1.66	0.79	0.87	0.92	0.617	1.15	0.536	1.00	1.00	0.536	No
357	29.28	1.66	0.79	0.88	0.92	0.617	1.15	0.536	1.00	1.00	0.536	No
358	29.36	1.67	0.79	0.88	0.92	0.616	1.15	0.536	1.00	1.00	0.536	No
359	29.45	1.68	0.79	0.88	0.92	0.616	1.15	0.536	1.00	1.00	0.536	No
360	29.53	1.68	0.80	0.88	0.92	0.616	1.15	0.535	1.00	1.00	0.535	No
361	29.61	1.69	0.80	0.89	0.92	0.616	1.15	0.535	1.00	1.00	0.535	No
362	29.69	1.69	0.80	0.89	0.92	0.615	1.15	0.535	1.00	1.00	0.535	No
363	29.77	1.70	0.80	0.89	0.92	0.615	1.15	0.535	1.00	1.00	0.535	No
364	29.86	1.70	0.81	0.90	0.92	0.615	1.15	0.534	1.00	1.00	0.534	No
365	29.94	1.71	0.81	0.90	0.92	0.614	1.15	0.534	1.00	1.00	0.534	No
366	30.02	1.71	0.81	0.90	0.92	0.614	1.15	0.534	1.00	1.00	0.534	No
367	30.10	1.72	0.81	0.90	0.92	0.614	1.15	0.534	1.00	1.00	0.534	No
368	30.18	1.72	0.82	0.91	0.92	0.613	1.15	0.533	1.00	1.00	0.533	No
369	30.27	1.73	0.82	0.91	0.92	0.613	1.15	0.533	1.00	1.00	0.533	No
370	30.35	1.73	0.82	0.91	0.92	0.613	1.15	0.533	1.00	1.00	0.533	No
371	30.43	1.74	0.82	0.92	0.92	0.613	1.15	0.533	1.00	1.00	0.533	No
372	30.51	1.75	0.83	0.92	0.92	0.612	1.15	0.532	1.00	1.00	0.532	No
373	30.59	1.75	0.83	0.92	0.92	0.612	1.15	0.532	1.00	1.00	0.532	No
374	30.68	1.76	0.83	0.92	0.92	0.612	1.15	0.532	1.00	1.00	0.532	No
375	30.76	1.76	0.83	0.93	0.92	0.612	1.15	0.532	1.00	1.00	0.532	No
376	30.84	1.77	0.84	0.93	0.92	0.612	1.15	0.532	1.00	1.00	0.532	No
377	30.92	1.77	0.84	0.93	0.92	0.611	1.15	0.531	1.00	1.00	0.531	No
378	31.00	1.78	0.84	0.93	0.92	0.611	1.15	0.531	1.00	1.00	0.531	No
379	31.09	1.78	0.85	0.94	0.91	0.611	1.15	0.531	1.00	1.00	0.531	No
380	31.17	1.79	0.85	0.94	0.91	0.611	1.15	0.531	1.00	1.00	0.531	No
381	31.25	1.79	0.85	0.94	0.91	0.610	1.15	0.531	1.00	1.00	0.531	No
382	31.33	1.80	0.85	0.94	0.91	0.610	1.15	0.531	1.00	1.00	0.531	No
383	31.41	1.80	0.86	0.95	0.91	0.610	1.15	0.530	1.00	1.00	0.530	No
384	31.50	1.81	0.86	0.95	0.91	0.610	1.15	0.530	1.00	1.00	0.530	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)												
Point ID	Depth (ft)	$\sigma_v$ (tsf)	$u_0$ (tsf)	$\sigma_v'$ (tsf)	$r_d$	CSR	MSF	CSR <sub>eq</sub>	$K_\sigma$	User FS	CSR*	Belongs to transition
385	31.58	1.81	0.86	0.95	0.91	0.610	1.15	0.530	1.00	1.00	0.530	No
386	31.66	1.82	0.86	0.95	0.91	0.609	1.15	0.530	1.00	1.00	0.530	No
387	31.74	1.82	0.87	0.96	0.91	0.609	1.15	0.530	1.00	1.00	0.530	No
388	31.82	1.83	0.87	0.96	0.91	0.609	1.15	0.529	1.00	1.00	0.529	No
389	31.91	1.83	0.87	0.96	0.91	0.609	1.15	0.529	1.00	1.00	0.529	No
390	31.99	1.84	0.87	0.97	0.91	0.608	1.15	0.529	1.00	1.00	0.529	No
391	32.07	1.84	0.88	0.97	0.91	0.608	1.15	0.529	1.00	1.00	0.529	No
392	32.15	1.85	0.88	0.97	0.91	0.608	1.15	0.528	1.00	1.00	0.528	No
393	32.23	1.85	0.88	0.97	0.91	0.607	1.15	0.528	1.00	1.00	0.528	No
394	32.32	1.86	0.88	0.98	0.91	0.607	1.15	0.528	1.00	1.00	0.528	No
395	32.40	1.86	0.89	0.98	0.91	0.607	1.15	0.528	1.00	1.00	0.528	No
396	32.48	1.87	0.89	0.98	0.91	0.607	1.15	0.527	1.00	1.00	0.527	No
397	32.56	1.88	0.89	0.98	0.91	0.606	1.15	0.527	1.00	1.00	0.527	No
398	32.64	1.88	0.89	0.99	0.91	0.606	1.15	0.527	1.00	1.00	0.527	No
399	32.73	1.89	0.90	0.99	0.91	0.606	1.15	0.526	1.00	1.00	0.526	No
400	32.81	1.89	0.90	0.99	0.90	0.605	1.15	0.526	1.00	1.00	0.526	No
401	32.89	1.90	0.90	1.00	0.90	0.605	1.15	0.526	1.00	1.00	0.526	No
402	32.97	1.90	0.90	1.00	0.90	0.604	1.15	0.526	1.00	1.00	0.526	No
403	33.05	1.91	0.91	1.00	0.90	0.604	1.15	0.525	1.00	1.00	0.525	No
404	33.14	1.91	0.91	1.00	0.90	0.604	1.15	0.525	1.00	1.00	0.525	No
405	33.22	1.92	0.91	1.01	0.90	0.603	1.15	0.524	1.00	1.00	0.524	No
406	33.30	1.92	0.91	1.01	0.90	0.603	1.15	0.524	1.00	1.00	0.524	No
407	33.38	1.93	0.92	1.01	0.90	0.602	1.15	0.524	1.00	1.00	0.524	No
408	33.46	1.94	0.92	1.02	0.90	0.602	1.15	0.523	1.00	1.00	0.523	No
409	33.55	1.94	0.92	1.02	0.90	0.602	1.15	0.523	1.00	1.00	0.523	No
410	33.63	1.95	0.92	1.02	0.90	0.601	1.15	0.523	1.00	1.00	0.523	No
411	33.71	1.95	0.93	1.03	0.90	0.601	1.15	0.522	1.00	1.00	0.522	No
412	33.79	1.96	0.93	1.03	0.90	0.601	1.15	0.522	1.00	1.00	0.522	No
413	33.87	1.96	0.93	1.03	0.90	0.600	1.15	0.522	1.00	1.00	0.522	No
414	33.96	1.97	0.93	1.03	0.90	0.600	1.15	0.521	1.00	1.00	0.521	No
415	34.04	1.97	0.94	1.04	0.90	0.599	1.15	0.521	1.00	1.00	0.521	No
416	34.12	1.98	0.94	1.04	0.90	0.599	1.15	0.521	1.00	1.00	0.521	No
417	34.20	1.99	0.94	1.04	0.90	0.599	1.15	0.520	1.00	1.00	0.520	No
418	34.28	1.99	0.94	1.05	0.90	0.598	1.15	0.520	1.00	1.00	0.520	No
419	34.37	1.99	0.95	1.05	0.89	0.598	1.15	0.520	1.00	1.00	2.000	No
420	34.45	2.00	0.95	1.05	0.89	0.598	1.15	0.520	1.00	1.00	2.000	No
421	34.53	2.00	0.95	1.05	0.89	0.599	1.15	0.520	1.00	1.00	2.000	No

### Abbreviations

Depth:	Depth from free surface, at which CPT was performed (ft)
$\sigma_v$ :	Total overburden pressure at test point (tsf)
$u_0$ :	Water pressure at test point (tsf)
$\sigma_v'$ :	Effective overburden pressure based on GWT during earthquake (tsf)
$r_d$ :	Nonlinear shear mass factor
CSR:	Cyclic Stress Ratio
MSF:	Magnitude Scaling Factor
CSR <sub>eq</sub> :	CSR adjusted for M=7.5
$K_\sigma$ :	Effective overburden stress factor
CSR*:	CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) calculation data ::												
Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	Fr (%)	n	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	CRR <sub>7.5</sub>	Belongs to trans. layer	Clay-like behaviour	FS
1	0.08	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
2	0.16	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
3	0.25	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
4	0.33	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
5	0.41	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
6	0.49	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
7	0.57	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
8	0.66	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
9	0.74	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
10	0.82	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
11	0.90	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
12	0.98	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
13	1.07	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
14	1.15	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
15	1.23	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
16	1.31	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
17	1.39	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
18	1.48	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
19	1.56	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
20	1.64	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
21	1.72	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
22	1.80	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
23	1.89	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
24	1.97	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
25	2.05	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
26	2.13	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
27	2.21	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
28	2.30	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
29	2.38	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
30	2.46	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
31	2.54	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
32	2.62	0.00	N/A	0.00	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
33	2.71	27.12	2.41	2.65	0.78	50.96	2.43	123.67	4.000	No	No	2.00
34	2.79	36.78	2.33	2.79	0.75	69.21	2.04	141.42	4.000	No	No	2.00
35	2.87	29.80	2.43	3.08	0.78	56.00	2.51	140.63	4.000	No	No	2.00
36	2.95	24.60	2.50	3.18	0.81	46.16	2.95	136.00	4.000	No	No	2.00
37	3.03	21.34	2.53	3.09	0.82	39.99	3.48	139.06	4.000	No	No	2.00
38	3.12	19.45	2.54	2.89	0.83	36.42	3.74	136.38	4.000	No	No	2.00
39	3.20	18.42	2.55	2.75	0.83	34.45	3.85	132.63	4.000	No	No	2.00
40	3.28	17.54	2.57	2.83	0.84	32.79	4.51	147.76	4.000	No	No	2.00
41	3.36	16.89	2.60	3.03	0.85	31.55	5.55	175.07	4.000	No	No	2.00
42	3.44	16.56	2.62	3.17	0.86	30.92	6.27	193.86	4.000	No	No	2.00
43	3.53	16.32	2.63	3.19	0.86	30.46	6.56	199.66	4.000	No	No	2.00
44	3.61	15.87	2.64	3.22	0.87	29.60	7.08	209.62	4.000	No	No	2.00
45	3.69	15.22	2.66	3.32	0.88	28.35	8.17	231.61	4.000	No	No	2.00
46	3.77	14.62	2.69	3.46	0.89	27.21	9.57	260.47	4.000	No	No	2.00
47	3.85	13.90	2.72	3.67	0.90	25.84	4.96	128.20	4.000	No	Yes	2.00
48	3.94	13.34	2.75	3.82	0.91	24.77	5.24	129.87	4.000	No	Yes	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)												
Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	Fr (%)	n	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	CRR <sub>7.5</sub>	Belongs to trans. layer	Clay-like behaviour	FS
49	4.02	12.85	2.77	3.92	0.92	23.84	5.47	130.48	1.137	No	Yes	2.00
50	4.10	12.57	2.78	3.98	0.92	23.30	5.62	130.90	1.111	No	Yes	2.00
51	4.18	12.06	2.81	4.18	0.93	22.33	5.97	133.23	1.065	No	Yes	2.00
52	4.27	11.39	2.84	4.34	0.94	21.05	6.35	133.76	1.004	No	Yes	2.00
53	4.35	10.66	2.87	4.42	0.95	19.67	6.73	132.35	0.938	No	Yes	2.00
54	4.43	9.92	2.89	4.36	0.96	18.26	7.02	128.18	0.871	No	Yes	2.00
55	4.51	9.25	2.90	4.18	0.97	16.98	7.20	122.29	0.810	No	Yes	2.00
56	4.59	9.08	2.87	3.71	0.96	16.65	6.83	113.73	0.794	No	Yes	2.00
57	4.68	8.99	2.84	3.23	0.94	16.48	6.37	104.92	0.786	No	Yes	2.00
58	4.76	9.02	2.81	2.94	0.93	16.52	6.04	99.74	0.788	No	Yes	2.00
59	4.84	8.92	2.81	2.84	0.93	16.32	5.97	97.49	0.779	No	Yes	2.00
60	4.92	9.31	2.79	2.74	0.92	17.06	5.67	96.73	0.814	No	Yes	2.00
61	5.00	10.06	2.76	2.72	0.91	18.46	5.32	98.23	0.881	No	Yes	2.00
62	5.09	10.71	2.75	2.88	0.91	19.68	5.24	103.08	0.939	No	Yes	2.00
63	5.17	11.00	2.77	3.19	0.92	20.23	5.45	110.20	0.965	No	Yes	2.00
64	5.25	10.85	2.80	3.56	0.93	19.94	5.87	116.97	0.951	No	Yes	2.00
65	5.33	10.44	2.84	3.88	0.94	19.15	6.35	121.61	0.913	No	Yes	2.00
66	5.41	10.04	2.87	4.16	0.96	18.38	6.81	125.10	0.877	No	Yes	2.00
67	5.50	9.78	2.89	4.24	0.96	17.89	7.01	125.37	0.854	No	Yes	2.00
68	5.58	9.42	2.90	4.25	0.97	17.19	7.21	123.97	0.820	No	Yes	2.00
69	5.66	8.90	2.92	4.20	0.97	16.20	7.46	120.81	0.773	No	Yes	2.00
70	5.74	8.38	2.94	4.26	0.98	15.21	7.84	119.18	0.726	No	Yes	2.00
71	5.82	8.26	2.94	4.21	0.98	14.98	7.87	117.87	0.714	No	Yes	1.97
72	5.91	8.41	2.93	4.03	0.98	15.26	7.59	115.86	0.728	No	Yes	1.99
73	5.99	8.65	2.90	3.77	0.97	15.71	7.17	112.69	0.749	No	Yes	2.00
74	6.07	8.72	2.88	3.59	0.96	15.82	6.95	109.99	0.755	No	Yes	2.00
75	6.15	8.66	2.88	3.56	0.96	15.71	6.95	109.24	0.749	No	Yes	2.00
76	6.23	8.43	2.90	3.66	0.97	15.27	7.20	109.86	0.728	No	Yes	1.95
77	6.32	8.26	2.91	3.72	0.97	14.92	7.38	110.18	0.712	No	Yes	1.89
78	6.40	8.09	2.92	3.80	0.98	14.59	7.58	110.53	0.696	No	Yes	1.84
79	6.48	7.95	2.94	3.86	0.98	14.32	7.75	110.92	0.683	No	Yes	1.79
80	6.56	7.76	2.95	3.98	0.99	13.96	8.01	111.85	0.666	No	Yes	1.74
81	6.64	7.58	2.96	4.02	0.99	13.61	8.19	111.49	0.649	No	Yes	1.69
82	6.73	7.45	2.97	3.96	0.99	13.35	8.23	109.87	0.637	No	Yes	1.65
83	6.81	7.38	2.96	3.77	0.99	13.21	8.08	106.77	0.630	No	Yes	1.62
84	6.89	7.25	2.95	3.59	0.99	12.97	7.98	103.45	0.619	No	Yes	1.58
85	6.97	7.03	2.95	3.40	0.99	12.54	7.94	99.57	0.598	No	Yes	1.52
86	7.05	6.70	2.95	3.24	0.99	11.92	8.03	95.66	0.568	No	Yes	1.44
87	7.14	6.37	2.96	3.09	0.99	11.27	8.14	91.78	0.538	No	Yes	1.36
88	7.22	6.13	2.96	2.87	0.99	10.82	8.09	87.53	0.516	No	Yes	1.29
89	7.30	6.02	2.94	2.61	0.99	10.60	7.84	83.09	0.505	No	Yes	1.26
90	7.38	6.00	2.91	2.31	0.97	10.56	7.41	78.28	0.504	No	Yes	1.25
91	7.46	5.98	2.89	2.06	0.97	10.51	7.04	74.02	0.501	No	Yes	1.24
92	7.55	5.85	2.89	1.97	0.97	10.26	7.03	72.14	0.489	No	Yes	1.21
93	7.63	5.77	2.90	1.99	0.97	10.09	7.15	72.09	0.481	No	Yes	1.18
94	7.71	5.86	2.92	2.31	0.98	10.25	7.57	77.60	0.489	No	Yes	1.19
95	7.79	6.25	2.92	2.56	0.98	10.98	7.57	83.12	0.524	No	Yes	1.27
96	7.87	7.36	2.85	2.44	0.95	13.08	6.50	84.99	0.624	No	Yes	1.51

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)												
Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	Fr (%)	n	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	CRR <sub>7.5</sub>	Belongs to trans. layer	Clay-like behaviour	FS
97	7.96	8.40	2.77	2.14	0.92	15.04	5.46	82.07	0.717	No	Yes	1.73
98	8.04	9.32	2.69	1.83	0.89	16.77	9.63	161.54	0.425	No	No	1.02
99	8.12	9.53	2.66	1.65	0.88	17.15	7.86	134.70	0.277	No	No	0.66
100	8.20	9.80	2.64	1.57	0.87	17.65	6.78	119.72	0.216	No	No	0.51
101	8.28	10.00	2.64	1.67	0.87	18.03	7.11	128.13	0.248	No	No	0.59
102	8.37	10.09	2.65	1.78	0.88	18.19	7.67	139.52	0.299	No	No	0.71
103	8.45	9.96	2.68	1.90	0.89	17.94	8.74	156.79	0.395	No	No	0.93
104	8.53	9.46	2.70	1.91	0.89	16.98	10.00	169.79	0.482	No	No	1.13
105	8.61	8.57	2.76	2.14	0.92	15.29	5.39	82.41	0.729	No	Yes	1.70
106	8.69	7.60	2.84	2.45	0.95	13.46	6.38	85.81	0.642	No	Yes	1.49
107	8.78	6.90	2.91	2.77	0.97	12.12	7.33	88.85	0.578	No	Yes	1.34
108	8.86	6.67	2.93	2.91	0.98	11.67	7.72	90.07	0.557	No	Yes	1.29
109	8.94	6.77	2.91	2.72	0.98	11.87	7.38	87.58	0.566	No	Yes	1.30
110	9.02	7.18	2.86	2.43	0.96	12.62	6.67	84.11	0.602	No	Yes	1.38
111	9.10	7.65	2.81	2.18	0.94	13.51	5.99	80.97	0.645	No	Yes	1.47
112	9.19	7.84	2.80	2.13	0.93	13.85	5.81	80.50	0.661	No	Yes	1.51
113	9.27	9.74	2.66	1.71	0.88	17.45	7.92	138.24	0.293	No	No	0.67
114	9.35	13.92	2.44	1.21	0.80	25.33	2.61	66.21	0.107	No	No	0.24
115	9.43	18.48	2.30	1.04	0.74	33.95	1.93	65.49	0.106	No	No	0.24
116	9.51	20.50	2.25	0.97	0.72	37.76	1.74	65.69	0.106	No	No	0.24
117	9.60	19.68	2.27	1.00	0.73	36.19	1.81	65.52	0.106	No	No	0.24
118	9.68	19.29	2.24	0.88	0.72	35.45	1.74	61.60	0.102	No	No	0.23
119	9.76	22.02	2.15	0.72	0.69	40.60	1.50	61.00	0.101	No	No	0.23
120	9.84	25.07	2.07	0.62	0.66	46.35	1.38	63.88	0.104	No	No	0.23
121	9.92	26.87	2.03	0.60	0.64	49.51	1.34	66.30	0.107	No	No	0.24
122	10.01	26.11	2.07	0.66	0.65	48.31	1.37	66.40	0.107	No	No	0.24
123	10.09	26.10	2.07	0.66	0.65	48.28	1.37	66.30	0.107	No	No	0.24
124	10.17	27.20	2.03	0.58	0.64	49.54	1.33	65.98	0.107	No	No	0.23
125	10.25	28.73	1.97	0.45	0.62	51.03	1.00	51.03	0.092	No	No	0.20
126	10.33	30.12	1.92	0.36	0.60	52.21	1.00	52.21	0.093	No	No	0.20
127	10.42	31.35	1.88	0.32	0.59	53.56	1.00	53.56	0.094	No	No	0.21
128	10.50	30.99	1.91	0.37	0.60	53.35	1.00	53.35	0.094	No	No	0.20
129	10.58	28.29	2.00	0.53	0.63	50.35	1.31	65.93	0.107	No	No	0.23
130	10.66	23.30	2.16	0.82	0.69	42.93	1.52	65.29	0.106	No	No	0.23
131	10.74	19.00	2.31	1.14	0.75	34.80	1.98	68.77	0.110	No	No	0.24
132	10.83	15.89	2.43	1.39	0.79	28.92	2.52	73.00	0.116	No	No	0.25
133	10.91	13.52	2.52	1.59	0.83	24.42	3.24	79.21	0.126	No	No	0.27
134	10.99	11.03	2.63	1.82	0.87	19.71	6.60	129.99	0.256	No	No	0.55
135	11.07	8.76	2.74	1.99	0.91	15.40	5.16	79.42	0.735	No	Yes	1.57
136	11.15	7.84	2.78	1.98	0.93	13.67	5.65	77.22	0.652	No	Yes	1.39
137	11.24	7.69	2.77	1.79	0.92	13.38	5.46	73.09	0.638	No	Yes	1.36
138	11.32	11.15	2.52	1.16	0.83	19.91	3.27	65.19	0.106	No	No	0.22
139	11.40	16.09	2.30	0.79	0.74	29.23	1.91	55.77	0.096	No	No	0.20
140	11.48	19.69	2.19	0.68	0.70	35.99	1.58	56.82	0.097	No	No	0.20
141	11.56	18.83	2.23	0.79	0.72	34.40	1.71	58.72	0.099	No	No	0.21
142	11.65	15.13	2.38	1.05	0.78	27.40	2.28	62.38	0.103	No	No	0.22
143	11.73	12.16	2.56	1.56	0.84	21.78	4.12	89.75	0.147	No	No	0.31
144	11.81	10.58	2.70	2.28	0.90	18.78	4.75	89.14	0.896	No	Yes	1.87

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)												
Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	$F_r$ (%)	$n$	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
145	11.89	10.91	2.73	2.63	0.91	19.39	5.03	97.61	0.925	No	Yes	1.93
146	11.98	15.31	2.54	2.00	0.83	27.71	3.54	98.05	0.168	No	No	0.35
147	12.06	26.28	2.21	1.19	0.71	47.81	1.64	78.43	0.125	No	No	0.26
148	12.14	40.56	2.00	0.87	0.63	68.77	1.31	90.03	0.148	No	No	0.31
149	12.22	57.82	1.84	0.69	0.57	92.55	1.19	110.20	0.204	No	No	0.42
150	12.30	77.84	1.69	0.55	0.51	118.35	1.00	118.35	0.234	No	No	0.48
151	12.39	104.35	1.53	0.40	0.45	149.74	1.00	149.74	0.392	No	No	0.81
152	12.47	132.35	1.41	0.32	0.41	181.77	1.00	181.77	0.639	No	No	1.32
153	12.55	158.12	1.33	0.28	0.38	210.60	1.00	210.60	4.000	No	No	2.00
154	12.63	176.22	1.29	0.28	0.36	230.94	1.00	230.94	4.000	No	No	2.00
155	12.71	189.71	1.26	0.27	0.35	246.14	1.00	246.14	4.000	No	No	2.00
156	12.80	199.34	1.28	0.32	0.36	259.68	1.00	259.68	4.000	No	No	2.00
157	12.88	206.91	1.31	0.37	0.37	271.38	1.00	271.38	4.000	No	No	2.00
158	12.96	211.03	1.30	0.38	0.37	275.83	1.00	275.83	4.000	No	No	2.00
159	13.04	211.78	1.26	0.31	0.35	272.35	1.00	272.35	4.000	No	No	2.00
160	13.12	212.72	1.19	0.23	0.32	266.85	1.00	266.85	4.000	No	No	2.00
161	13.21	217.26	1.15	0.19	0.31	268.39	1.00	268.39	4.000	No	No	2.00
162	13.29	226.44	1.12	0.17	0.30	276.65	1.00	276.65	4.000	No	No	2.00
163	13.37	235.91	1.11	0.17	0.29	286.43	1.00	286.43	4.000	No	No	2.00
164	13.45	243.48	1.09	0.16	0.28	293.47	1.00	293.47	4.000	No	No	2.00
165	13.53	248.34	1.10	0.18	0.29	299.81	1.00	299.81	4.000	No	No	2.00
166	13.62	252.74	1.14	0.23	0.31	309.31	1.00	309.31	4.000	No	No	2.00
167	13.70	253.12	1.26	0.40	0.35	321.90	1.00	321.90	4.000	No	No	2.00
168	13.78	247.24	1.38	0.60	0.40	325.87	1.00	325.87	4.000	No	No	2.00
169	13.86	231.70	1.51	0.88	0.45	317.82	1.00	317.82	4.000	No	No	2.00
170	13.94	207.10	1.62	1.12	0.49	292.75	1.00	292.75	4.000	No	No	2.00
171	14.03	169.40	1.76	1.50	0.54	249.47	1.10	274.44	4.000	No	No	2.00
172	14.11	133.25	1.87	1.78	0.59	202.53	1.22	246.97	4.000	No	No	2.00
173	14.19	107.76	1.96	1.96	0.62	167.37	1.28	213.65	4.000	No	No	2.00
174	14.27	113.02	1.87	1.51	0.58	170.20	1.22	206.89	4.000	No	No	2.00
175	14.35	134.87	1.69	0.97	0.52	192.01	1.00	192.01	0.738	No	No	1.48
176	14.44	152.40	1.52	0.59	0.45	205.70	1.00	205.70	4.000	No	No	2.00
177	14.52	154.01	1.41	0.37	0.41	200.43	1.00	200.43	4.000	No	No	2.00
178	14.60	145.04	1.40	0.32	0.40	187.64	1.00	187.64	0.694	No	No	1.39
179	14.68	138.42	1.44	0.36	0.42	181.01	1.00	181.01	0.632	No	No	1.26
180	14.76	136.42	1.50	0.45	0.44	180.97	1.00	180.97	0.631	No	No	1.26
181	14.85	139.09	1.52	0.52	0.45	185.57	1.00	185.57	0.674	No	No	1.35
182	14.93	146.28	1.52	0.56	0.45	194.92	1.00	194.92	0.769	No	No	1.53
183	15.01	151.51	1.53	0.58	0.45	201.63	1.00	201.63	4.000	No	No	2.00
184	15.09	154.90	1.53	0.61	0.46	205.98	1.00	205.98	4.000	No	No	2.00
185	15.17	158.90	1.53	0.62	0.46	210.75	1.00	210.75	4.000	No	No	2.00
186	15.26	165.61	1.51	0.61	0.45	218.14	1.00	218.14	4.000	No	No	2.00
187	15.34	172.15	1.50	0.60	0.44	225.38	1.00	225.38	4.000	No	No	2.00
188	15.42	176.55	1.49	0.60	0.44	230.23	1.00	230.23	4.000	No	No	2.00
189	15.50	178.28	1.49	0.61	0.44	232.11	1.00	232.11	4.000	No	No	2.00
190	15.58	178.94	1.49	0.61	0.44	232.44	1.00	232.44	4.000	No	No	2.00
191	15.67	180.15	1.49	0.60	0.44	233.13	1.00	233.13	4.000	No	No	2.00
192	15.75	181.86	1.48	0.58	0.44	234.32	1.00	234.32	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)												
Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	Fr (%)	n	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	CRR <sub>7.5</sub>	Belongs to trans. layer	Clay-like behaviour	FS
193	15.83	181.88	1.48	0.58	0.44	233.90	1.00	233.90	4.000	No	No	2.00
194	15.91	178.36	1.50	0.61	0.44	230.04	1.00	230.04	4.000	No	No	2.00
195	15.99	168.69	1.54	0.67	0.46	219.56	1.00	219.56	4.000	No	No	2.00
196	16.08	156.27	1.59	0.75	0.48	205.80	1.00	205.80	4.000	No	No	2.00
197	16.16	139.00	1.67	0.86	0.51	186.15	1.00	186.15	0.680	No	No	1.34
198	16.24	118.03	1.77	1.06	0.55	161.93	1.12	180.90	0.631	No	No	1.24
199	16.32	94.22	1.91	1.38	0.60	133.49	1.24	166.16	0.507	No	No	1.00
200	16.40	71.81	2.07	1.84	0.67	105.50	1.38	145.88	0.369	No	No	0.73
201	16.49	52.67	2.24	2.42	0.73	80.20	1.73	138.63	0.328	No	No	0.64
202	16.57	36.45	2.43	3.17	0.80	57.55	2.52	144.95	0.363	No	No	0.71
203	16.65	23.92	2.63	4.14	0.88	39.06	6.44	251.60	3.600	No	No	2.00
204	16.73	16.15	2.79	4.82	0.94	26.87	5.73	154.07	1.282	No	Yes	2.00
205	16.81	11.96	2.89	4.93	0.98	19.90	7.11	141.55	0.949	No	Yes	1.86
206	16.90	10.32	2.89	4.01	0.98	16.85	7.07	119.17	0.804	No	Yes	1.57
207	16.98	12.25	2.70	2.35	0.91	19.32	4.72	91.29	0.922	No	Yes	1.80
208	17.06	16.59	2.48	1.38	0.82	25.20	2.82	70.95	0.113	No	No	0.22
209	17.14	18.98	2.41	1.29	0.80	28.54	2.45	69.97	0.112	No	No	0.22
210	17.22	17.60	2.49	1.62	0.83	26.79	2.93	78.43	0.125	No	No	0.24
211	17.31	14.15	2.64	2.21	0.88	21.95	7.04	154.64	0.382	No	No	0.74
212	17.39	14.50	2.65	2.32	0.88	22.48	7.27	163.49	0.438	No	No	0.85
213	17.47	19.23	2.52	2.04	0.84	29.33	3.19	93.70	0.157	No	No	0.30
214	17.55	23.40	2.45	2.01	0.81	35.35	2.67	94.34	0.158	No	No	0.31
215	17.63	23.75	2.47	2.15	0.82	35.89	2.75	98.79	0.170	No	No	0.33
216	17.72	22.22	2.51	2.36	0.83	33.75	3.02	101.96	0.179	No	No	0.35
217	17.80	29.12	2.34	1.67	0.77	42.79	2.08	88.85	0.145	No	No	0.28
218	17.88	42.89	2.10	1.04	0.68	60.05	1.41	84.86	0.137	No	No	0.27
219	17.96	50.13	1.98	0.78	0.63	68.35	1.29	88.20	0.144	No	No	0.28
220	18.04	47.13	2.01	0.82	0.64	64.50	1.32	84.91	0.137	No	No	0.26
221	18.13	36.19	2.17	1.12	0.70	50.96	1.55	79.00	0.126	No	No	0.24
222	18.21	27.67	2.35	1.60	0.77	40.10	2.12	85.19	0.138	No	No	0.27
223	18.29	19.78	2.55	2.27	0.85	29.45	3.83	112.80	0.213	No	No	0.41
224	18.37	14.08	2.74	3.05	0.92	21.35	5.10	108.95	1.018	No	Yes	1.96
225	18.45	10.94	2.87	3.59	0.97	16.63	6.71	111.66	0.793	No	Yes	1.53
226	18.54	10.04	2.87	3.19	0.97	15.07	6.75	101.71	0.719	No	Yes	1.38
227	18.62	13.83	2.61	1.73	0.87	20.15	5.81	116.99	0.206	No	No	0.40
228	18.70	20.93	2.34	1.00	0.77	29.46	2.10	61.88	0.102	No	No	0.20
229	18.78	25.78	2.25	0.90	0.73	35.77	1.74	62.39	0.103	No	No	0.20
230	18.86	25.34	2.30	1.12	0.76	35.48	1.93	68.58	0.110	No	No	0.21
231	18.95	20.37	2.47	1.70	0.82	29.23	2.81	82.11	0.131	No	No	0.25
232	19.03	16.11	2.64	2.42	0.88	23.55	7.00	164.88	0.447	No	No	0.86
233	19.11	12.42	2.81	3.33	0.95	18.38	5.99	110.05	0.877	No	Yes	1.68
234	19.19	10.05	2.91	3.68	0.99	14.81	7.38	109.29	0.706	No	Yes	1.35
235	19.27	8.33	2.98	3.66	1.00	12.01	8.49	101.96	0.573	No	Yes	1.09
236	19.36	7.06	3.02	3.20	1.00	9.87	9.09	89.70	0.471	No	Yes	0.90
237	19.44	6.22	3.03	2.64	1.00	8.45	9.25	78.16	0.403	No	Yes	0.77
238	19.52	5.89	2.99	1.98	1.00	7.89	8.56	67.52	0.376	No	Yes	0.72
239	19.60	5.89	2.93	1.47	0.99	7.83	7.59	59.42	0.374	No	Yes	0.71
240	19.69	6.00	2.88	1.17	0.97	7.91	6.86	54.32	0.377	No	Yes	0.72

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)												
Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	Fr (%)	n	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	CRR <sub>7.5</sub>	Belongs to trans. layer	Clay-like behaviour	FS
241	19.77	6.14	2.85	1.05	0.96	8.07	6.48	52.28	0.385	No	Yes	0.73
242	19.85	6.42	2.82	0.98	0.95	8.44	6.07	51.22	0.403	No	Yes	0.76
243	19.93	6.77	2.79	0.94	0.94	8.93	5.70	50.91	0.426	No	Yes	0.81
244	20.01	7.30	2.74	0.87	0.92	9.64	5.17	49.84	0.460	No	Yes	0.87
245	20.10	7.63	2.71	0.79	0.91	10.06	4.79	48.23	0.480	No	Yes	0.91
246	20.18	7.87	2.70	0.80	0.91	10.38	10.04	104.16	0.167	No	No	0.31
247	20.26	8.23	2.69	0.84	0.90	10.89	9.54	103.91	0.166	No	No	0.31
248	20.34	8.71	2.68	0.93	0.90	11.58	9.17	106.25	0.172	No	No	0.32
249	20.42	9.25	2.69	1.08	0.90	12.38	9.41	116.58	0.205	No	No	0.38
250	20.51	9.85	2.70	1.32	0.91	13.31	4.73	62.99	0.635	No	Yes	1.19
251	20.59	10.66	2.70	1.50	0.91	14.48	10.08	145.96	0.332	No	No	0.62
252	20.67	10.77	2.71	1.62	0.91	14.66	4.83	70.77	0.699	No	Yes	1.31
253	20.75	10.68	2.71	1.60	0.91	14.48	4.85	70.21	0.691	No	Yes	1.29
254	20.83	10.86	2.73	1.80	0.92	14.78	5.07	74.85	0.705	No	Yes	1.32
255	20.92	14.47	2.62	1.77	0.88	19.78	6.29	124.40	0.233	No	No	0.44
256	21.00	17.66	2.56	1.82	0.86	24.14	4.15	100.30	0.174	No	No	0.33
257	21.08	18.59	2.55	1.90	0.85	25.40	3.96	100.63	0.175	No	No	0.33
258	21.16	15.57	2.66	2.26	0.89	21.37	7.79	166.40	0.458	No	No	0.86
259	21.24	12.02	2.82	3.00	0.95	16.56	6.09	100.90	0.790	No	Yes	1.47
260	21.33	9.91	2.94	3.73	1.00	13.59	7.88	107.07	0.648	No	Yes	1.21
261	21.41	9.14	2.99	3.89	1.00	12.35	8.59	106.13	0.589	No	Yes	1.10
262	21.49	10.84	2.87	3.16	0.98	14.76	6.81	100.56	0.704	No	Yes	1.31
263	21.57	25.63	2.37	1.41	0.78	33.94	2.24	75.96	0.121	No	No	0.22
264	21.65	52.86	1.98	0.76	0.64	66.56	1.29	86.02	0.139	No	No	0.26
265	21.74	80.92	1.74	0.49	0.54	97.97	1.00	97.97	0.167	No	No	0.31
266	21.82	95.46	1.64	0.40	0.50	113.49	1.00	113.49	0.216	No	No	0.40
267	21.90	88.44	1.72	0.53	0.54	106.57	1.04	110.41	0.205	No	No	0.38
268	21.98	71.18	1.93	0.92	0.62	88.55	1.26	111.22	0.208	No	No	0.39
269	22.06	49.69	2.19	1.62	0.72	64.18	1.60	102.39	0.180	No	No	0.33
270	22.15	34.10	2.42	2.39	0.80	45.20	2.47	111.79	0.210	No	No	0.39
271	22.23	23.47	2.61	3.07	0.88	31.54	5.67	178.73	0.550	No	No	1.02
272	22.31	16.70	2.77	3.71	0.94	22.51	5.51	124.16	1.074	No	Yes	1.99
273	22.39	12.34	2.90	4.06	0.99	16.48	7.23	119.14	0.786	No	Yes	1.46
274	22.47	10.58	2.91	3.37	0.99	13.85	7.37	102.13	0.661	No	Yes	1.23
275	22.56	9.76	2.82	2.01	0.96	12.41	6.15	76.25	0.592	No	Yes	1.10
276	22.64	9.38	2.68	0.93	0.91	11.55	9.27	107.08	0.175	No	No	0.32
277	22.72	9.18	2.58	0.45	0.86	11.04	4.69	51.78	0.093	No	No	0.17
278	22.80	9.85	2.50	0.32	0.84	11.80	2.90	34.16	0.078	No	No	0.15
279	22.88	11.26	2.43	0.28	0.81	13.54	2.54	34.40	0.079	No	No	0.15
280	22.97	12.37	2.39	0.27	0.79	14.90	2.30	34.31	0.079	No	No	0.15
281	23.05	12.58	2.38	0.27	0.79	15.14	2.27	34.40	0.079	No	No	0.15
282	23.13	11.80	2.41	0.28	0.80	14.15	2.43	34.45	0.079	No	No	0.14
283	23.21	11.56	2.43	0.29	0.81	13.84	2.52	34.94	0.079	No	No	0.15
284	23.29	12.74	2.42	0.37	0.80	15.38	2.46	37.85	0.082	No	No	0.15
285	23.38	14.61	2.43	0.58	0.81	17.88	2.51	44.90	0.087	No	No	0.16
286	23.46	15.74	2.48	0.93	0.83	19.54	2.86	55.91	0.096	No	No	0.18
287	23.54	15.23	2.64	1.81	0.89	19.28	6.87	132.54	0.267	No	No	0.49
288	23.62	15.41	2.72	2.58	0.92	19.75	4.90	96.83	0.942	No	Yes	1.73

**:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)**

Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	$F_r$ (%)	$n$	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
289	23.70	24.73	2.50	2.08	0.84	31.55	2.81	88.55	0.145	No	No	0.27
290	23.79	59.20	2.02	0.98	0.65	71.97	1.32	95.18	0.160	No	No	0.29
291	23.87	121.18	1.71	0.73	0.53	141.55	1.00	142.08	0.347	No	No	0.64
292	23.95	192.00	1.53	0.64	0.46	218.40	1.00	218.40	4.000	No	No	2.00
293	24.03	251.64	1.44	0.64	0.43	282.57	1.00	282.57	4.000	No	No	2.00
294	24.11	286.52	1.38	0.59	0.41	318.49	1.00	318.49	4.000	No	No	2.00
295	24.20	303.76	1.38	0.62	0.41	337.21	1.00	337.21	4.000	No	No	2.00
296	24.28	311.89	1.42	0.73	0.43	347.84	1.00	347.84	4.000	No	No	2.00
297	24.36	320.49	1.46	0.84	0.44	359.02	1.00	359.02	4.000	No	No	2.00
298	24.44	329.89	1.48	0.90	0.45	369.78	1.00	369.78	4.000	No	No	2.00
299	24.52	336.50	1.46	0.85	0.44	375.34	1.00	375.34	4.000	No	No	2.00
300	24.61	342.35	1.40	0.73	0.42	378.18	1.00	378.18	4.000	No	No	2.00
301	24.69	355.51	1.33	0.60	0.39	388.07	1.00	388.07	4.000	No	No	2.00
302	24.77	346.44	1.27	0.47	0.37	374.29	1.00	374.29	4.000	No	No	2.00
303	24.85	339.05	1.29	0.50	0.38	366.95	1.00	366.95	4.000	No	No	2.00
304	24.93	322.43	1.32	0.52	0.39	349.67	1.00	349.67	4.000	No	No	2.00
305	25.02	326.72	1.30	0.50	0.38	353.24	1.00	353.24	4.000	No	No	2.00
306	25.10	324.65	1.24	0.39	0.36	347.34	1.00	347.34	4.000	No	No	2.00
307	25.18	322.15	1.18	0.31	0.33	341.54	1.00	341.54	4.000	No	No	2.00
308	25.26	319.28	1.13	0.26	0.32	336.01	1.00	336.01	4.000	No	No	2.00
309	25.34	322.46	1.13	0.26	0.32	338.95	1.00	338.95	4.000	No	No	2.00
310	25.43	328.27	1.13	0.26	0.32	344.64	1.00	344.64	4.000	No	No	2.00
311	25.51	333.69	1.13	0.27	0.32	350.00	1.00	350.00	4.000	No	No	2.00
312	25.59	334.37	1.13	0.26	0.31	350.16	1.00	350.16	4.000	No	No	2.00
313	25.67	336.48	1.08	0.22	0.30	350.08	1.00	350.08	4.000	No	No	2.00
314	25.75	338.84	1.10	0.24	0.31	353.18	1.00	353.18	4.000	No	No	2.00
315	25.84	334.67	1.13	0.26	0.31	349.46	1.00	349.46	4.000	No	No	2.00
316	25.92	335.89	1.16	0.31	0.33	351.97	1.00	351.97	4.000	No	No	2.00
317	26.00	338.05	1.20	0.36	0.34	355.59	1.00	355.59	4.000	No	No	2.00
318	26.08	341.44	1.22	0.38	0.35	359.45	1.00	359.45	4.000	No	No	2.00
319	26.16	340.57	1.20	0.36	0.34	357.32	1.00	357.32	4.000	No	No	2.00
320	26.25	337.18	1.18	0.32	0.33	352.37	1.00	352.37	4.000	No	No	2.00
321	26.33	340.69	1.14	0.29	0.32	354.31	1.00	354.31	4.000	No	No	2.00
322	26.41	344.74	1.21	0.38	0.35	361.13	1.00	361.13	4.000	No	No	2.00
323	26.49	353.02	1.18	0.35	0.34	368.08	1.00	368.08	4.000	No	No	2.00
324	26.57	366.83	1.15	0.32	0.32	380.58	1.00	380.58	4.000	No	No	2.00
325	26.66	372.94	1.08	0.25	0.30	383.78	1.00	383.78	4.000	No	No	2.00
326	26.74	371.58	1.10	0.26	0.30	382.50	1.00	382.50	4.000	No	No	2.00
327	26.82	362.86	1.09	0.25	0.30	373.00	1.00	373.00	4.000	No	No	2.00
328	26.90	357.12	1.10	0.25	0.31	366.92	1.00	366.92	4.000	No	No	2.00
329	26.98	354.79	1.19	0.35	0.34	367.64	1.00	367.64	4.000	No	No	2.00
330	27.07	349.99	1.31	0.54	0.39	367.17	1.00	367.17	4.000	No	No	2.00
331	27.15	342.74	1.36	0.62	0.41	361.02	1.00	361.02	4.000	No	No	2.00
332	27.23	338.92	1.36	0.61	0.41	356.39	1.00	356.39	4.000	No	No	2.00
333	27.31	335.29	1.32	0.52	0.39	350.52	1.00	350.52	4.000	No	No	2.00
334	27.40	339.19	1.29	0.49	0.38	353.33	1.00	353.33	4.000	No	No	2.00
335	27.48	330.79	1.29	0.47	0.38	344.05	1.00	344.05	4.000	No	No	2.00
336	27.56	324.07	1.34	0.55	0.40	338.34	1.00	338.34	4.000	No	No	2.00

<b>:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)</b>												
Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	Fr (%)	n	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	CRR <sub>7.5</sub>	Belongs to trans. layer	Clay-like behaviour	FS
337	27.64	311.43	1.40	0.63	0.42	326.38	1.00	326.38	4.000	No	No	2.00
338	27.72	309.19	1.43	0.70	0.43	324.61	1.00	324.61	4.000	No	No	2.00
339	27.81	316.54	1.46	0.79	0.45	332.86	1.00	332.86	4.000	No	No	2.00
340	27.89	330.23	1.46	0.81	0.45	346.79	1.00	346.79	4.000	No	No	2.00
341	27.97	351.70	1.46	0.85	0.45	368.87	1.00	368.87	4.000	No	No	2.00
342	28.05	377.19	1.40	0.75	0.42	392.97	1.00	392.97	4.000	No	No	2.00
343	28.13	416.87	1.35	0.69	0.40	431.65	1.00	431.65	4.000	No	No	2.00
344	28.22	468.07	1.31	0.66	0.39	482.47	1.00	482.47	4.000	No	No	2.00
345	28.30	491.65	1.36	0.81	0.41	508.66	1.00	508.66	4.000	No	No	2.00
346	28.38	492.95	1.42	0.96	0.43	511.87	1.00	511.87	4.000	No	No	2.00
347	28.46	471.37	1.43	0.96	0.44	489.11	1.00	489.11	4.000	No	No	2.00
348	28.54	467.38	1.38	0.83	0.42	482.21	1.00	482.21	4.000	No	No	2.00
349	28.63	453.68	1.33	0.69	0.40	465.30	1.00	465.30	4.000	No	No	2.00
350	28.71	440.31	1.37	0.77	0.41	452.52	1.00	452.52	4.000	No	No	2.00
351	28.79	419.18	1.40	0.81	0.42	431.15	1.00	431.15	4.000	No	No	2.00
352	28.87	409.28	1.37	0.72	0.41	419.28	1.00	419.28	4.000	No	No	2.00
353	28.95	408.93	1.30	0.58	0.39	416.12	1.00	416.12	4.000	No	No	2.00
354	29.04	400.44	1.20	0.41	0.35	403.87	1.00	403.87	4.000	No	No	2.00
355	29.12	406.90	1.19	0.40	0.34	409.53	1.00	409.53	4.000	No	No	2.00
356	29.20	388.43	1.22	0.43	0.36	391.58	1.00	391.58	4.000	No	No	2.00
357	29.28	366.12	1.32	0.56	0.40	371.25	1.00	371.25	4.000	No	No	2.00
358	29.36	315.81	1.51	0.89	0.47	323.87	1.00	323.87	4.000	No	No	2.00
359	29.45	294.56	1.54	0.92	0.48	302.13	1.00	302.13	4.000	No	No	2.00
360	29.53	278.70	1.58	0.98	0.49	286.09	1.00	286.09	4.000	No	No	2.00
361	29.61	295.81	1.48	0.76	0.46	301.25	1.00	301.25	4.000	No	No	2.00
362	29.69	300.94	1.55	0.94	0.48	307.40	1.00	307.40	4.000	No	No	2.00
363	29.77	309.55	1.60	1.13	0.50	316.87	1.00	316.87	4.000	No	No	2.00
364	29.86	296.92	1.70	1.46	0.54	305.28	1.00	305.28	4.000	No	No	2.00
365	29.94	261.05	1.79	1.72	0.57	269.20	1.14	306.85	4.000	No	No	2.00
366	30.02	217.14	1.89	1.99	0.61	224.52	1.23	275.52	4.000	No	No	2.00
367	30.10	174.84	1.99	2.26	0.65	181.16	1.30	234.85	4.000	No	No	2.00
368	30.18	139.27	2.10	2.66	0.69	144.63	1.42	205.72	4.000	No	No	2.00
369	30.27	117.43	2.16	2.72	0.71	121.78	1.52	184.82	0.667	No	No	1.25
370	30.35	110.66	2.17	2.67	0.72	114.48	1.54	176.63	0.592	No	No	1.11
371	30.43	141.61	1.97	1.77	0.64	145.07	1.28	185.93	0.678	No	No	1.27
372	30.51	190.02	1.74	1.13	0.56	192.54	1.07	205.83	4.000	No	No	2.00
373	30.59	214.01	1.58	0.75	0.50	214.87	1.00	214.87	4.000	No	No	2.00
374	30.68	224.77	1.50	0.61	0.47	224.59	1.00	224.59	4.000	No	No	2.00
375	30.76	221.23	1.54	0.68	0.48	221.12	1.00	221.12	4.000	No	No	2.00
376	30.84	230.20	1.54	0.70	0.48	229.82	1.00	229.82	4.000	No	No	2.00
377	30.92	234.19	1.48	0.59	0.46	232.87	1.00	232.87	4.000	No	No	2.00
378	31.00	237.11	1.37	0.40	0.42	234.30	1.00	234.30	4.000	No	No	2.00
379	31.09	236.75	1.38	0.42	0.42	233.82	1.00	233.82	4.000	No	No	2.00
380	31.17	237.58	1.41	0.46	0.43	234.67	1.00	234.67	4.000	No	No	2.00
381	31.25	240.72	1.46	0.56	0.45	237.99	1.00	237.99	4.000	No	No	2.00
382	31.33	248.62	1.41	0.48	0.43	245.03	1.00	245.03	4.000	No	No	2.00
383	31.41	237.02	1.44	0.51	0.44	233.53	1.00	233.53	4.000	No	No	2.00
384	31.50	226.70	1.48	0.56	0.46	223.40	1.00	223.40	4.000	No	No	2.00

**:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)**

Point ID	Depth (ft)	$q_t$ (tsf)	$I_c$	Fr (%)	n	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	CRR <sub>7.5</sub>	Belongs to trans. layer	Clay-like behaviour	FS
385	31.58	215.54	1.52	0.60	0.47	212.38	1.00	212.38	4.000	No	No	2.00
386	31.66	221.35	1.51	0.59	0.47	217.75	1.00	217.75	4.000	No	No	2.00
387	31.74	223.84	1.53	0.64	0.48	220.10	1.00	220.10	4.000	No	No	2.00
388	31.82	232.84	1.55	0.73	0.49	228.94	1.00	228.94	4.000	No	No	2.00
389	31.91	243.06	1.56	0.79	0.49	238.84	1.00	238.84	4.000	No	No	2.00
390	31.99	236.70	1.53	0.69	0.48	231.97	1.00	231.97	4.000	No	No	2.00
391	32.07	217.78	1.65	0.95	0.53	213.87	1.00	213.87	4.000	No	No	2.00
392	32.15	206.33	1.65	0.89	0.52	202.21	1.00	202.21	4.000	No	No	2.00
393	32.23	209.75	1.64	0.87	0.52	205.22	1.00	205.22	4.000	No	No	2.00
394	32.32	237.77	1.37	0.38	0.42	230.63	1.00	230.63	4.000	No	No	2.00
395	32.40	259.14	1.47	0.62	0.46	252.02	1.00	252.02	4.000	No	No	2.00
396	32.48	287.00	1.58	0.97	0.50	279.83	1.00	279.83	4.000	No	No	2.00
397	32.56	287.50	1.71	1.42	0.55	280.89	1.01	283.16	4.000	No	No	2.00
398	32.64	277.86	1.73	1.46	0.56	271.10	1.05	283.97	4.000	No	No	2.00
399	32.73	266.02	1.75	1.48	0.56	259.14	1.08	279.25	4.000	No	No	2.00
400	32.81	257.63	1.74	1.42	0.56	250.47	1.07	267.54	4.000	No	No	2.00
401	32.89	251.98	1.78	1.58	0.58	244.78	1.13	277.58	4.000	No	No	2.00
402	32.97	259.58	1.78	1.58	0.57	251.74	1.12	282.85	4.000	No	No	2.00
403	33.05	301.26	1.71	1.45	0.55	291.53	1.00	292.27	4.000	No	No	2.00
404	33.14	373.43	1.60	1.25	0.51	360.47	1.00	360.47	4.000	No	No	2.00
405	33.22	475.02	1.46	0.99	0.45	457.15	1.00	457.15	4.000	No	No	2.00
406	33.30	534.68	1.36	0.82	0.42	513.21	1.00	513.21	4.000	No	No	2.00
407	33.38	567.24	1.29	0.68	0.39	543.20	1.00	543.20	4.000	No	No	2.00
408	33.46	563.79	1.25	0.61	0.37	538.97	1.00	538.97	4.000	No	No	2.00
409	33.55	588.20	1.21	0.57	0.36	561.48	1.00	561.48	4.000	No	No	2.00
410	33.63	584.31	1.20	0.55	0.36	557.12	1.00	557.12	4.000	No	No	2.00
411	33.71	555.56	1.28	0.67	0.39	529.55	1.00	529.55	4.000	No	No	2.00
412	33.79	508.87	1.37	0.80	0.42	484.79	1.00	484.79	4.000	No	No	2.00
413	33.87	496.39	1.40	0.86	0.43	472.43	1.00	472.43	4.000	No	No	2.00
414	33.96	522.36	1.35	0.78	0.41	496.39	1.00	496.39	4.000	No	No	2.00
415	34.04	544.22	1.32	0.73	0.40	516.50	1.00	516.50	4.000	No	No	2.00
416	34.12	563.30	1.31	0.72	0.40	534.01	1.00	534.01	4.000	No	No	2.00
417	34.20	560.70	1.17	0.49	0.35	530.56	1.00	530.56	4.000	No	No	2.00
418	34.28	538.94	0.99	0.26	0.28	509.04	1.00	509.04	4.000	No	No	2.00
419	34.37	515.81	N/A	0.00	1.00	490.60	1.00	490.60	4.000	No	No	2.00
420	34.45	530.29	N/A	0.00	1.00	503.93	1.00	503.93	4.000	No	No	2.00
421	34.53	569.06	N/A	0.00	1.00	540.38	1.00	540.38	4.000	No	No	2.00

**Abbreviations**

Depth:	Depth from free surface, at which CPT was performed (ft)
$q_t$ :	Total cone resistance
$I_c$ :	Soil behavior type index
Fr:	Normalized friction ratio (%)
n:	Stress exponent
$Q_{tn}$ :	Normalized cone resistance
$K_c$ :	Cone resistance correction factor due to fines
$Q_{tn,cs}$ :	Normalized and adjusted cone resistance
CRR <sub>7.5</sub> :	Cyclic resistance ratio for $M_w=7.5$
FS:	Factor of safety against soil liquefaction

:: Liquefaction Potential Index calculation data ::											
Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI	Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI
0.08	2.00	0.00	0.00	0.00	0.00	0.16	2.00	0.00	0.00	0.00	0.00
0.25	2.00	0.00	0.00	0.00	0.00	0.33	2.00	0.00	0.00	0.00	0.00
0.41	2.00	0.00	0.00	0.00	0.00	0.49	2.00	0.00	0.00	0.00	0.00
0.57	2.00	0.00	0.00	0.00	0.00	0.66	2.00	0.00	0.00	0.00	0.00
0.74	2.00	0.00	0.00	0.00	0.00	0.82	2.00	0.00	0.00	0.00	0.00
0.90	2.00	0.00	0.00	0.00	0.00	0.98	2.00	0.00	0.00	0.00	0.00
1.07	2.00	0.00	0.00	0.00	0.00	1.15	2.00	0.00	0.00	0.00	0.00
1.23	2.00	0.00	0.00	0.00	0.00	1.31	2.00	0.00	0.00	0.00	0.00
1.39	2.00	0.00	0.00	0.00	0.00	1.48	2.00	0.00	0.00	0.00	0.00
1.56	2.00	0.00	0.00	0.00	0.00	1.64	2.00	0.00	0.00	0.00	0.00
1.72	2.00	0.00	0.00	0.00	0.00	1.80	2.00	0.00	0.00	0.00	0.00
1.89	2.00	0.00	0.00	0.00	0.00	1.97	2.00	0.00	0.00	0.00	0.00
2.05	2.00	0.00	0.00	0.00	0.00	2.13	2.00	0.00	0.00	0.00	0.00
2.21	2.00	0.00	0.00	0.00	0.00	2.30	2.00	0.00	0.00	0.00	0.00
2.38	2.00	0.00	0.00	0.00	0.00	2.46	2.00	0.00	0.00	0.00	0.00
2.54	2.00	0.00	0.00	0.00	0.00	2.62	2.00	0.00	0.00	0.00	0.00
2.71	2.00	0.00	0.00	0.08	0.00	2.79	2.00	0.00	0.00	0.08	0.00
2.87	2.00	0.00	0.00	0.08	0.00	2.95	2.00	0.00	0.00	0.08	0.00
3.03	2.00	0.00	0.00	0.08	0.00	3.12	2.00	0.00	0.00	0.08	0.00
3.20	2.00	0.00	0.00	0.08	0.00	3.28	2.00	0.00	0.00	0.08	0.00
3.36	2.00	0.00	0.00	0.08	0.00	3.44	2.00	0.00	0.00	0.08	0.00
3.53	2.00	0.00	0.00	0.08	0.00	3.61	2.00	0.00	0.00	0.08	0.00
3.69	2.00	0.00	0.00	0.08	0.00	3.77	2.00	0.00	0.00	0.08	0.00
3.85	2.00	0.00	0.00	0.08	0.00	3.94	2.00	0.00	0.00	0.08	0.00
4.02	2.00	0.00	0.00	0.08	0.00	4.10	2.00	0.00	0.00	0.08	0.00
4.18	2.00	0.00	0.00	0.08	0.00	4.27	2.00	0.00	0.00	0.08	0.00
4.35	2.00	0.00	0.00	0.08	0.00	4.43	2.00	0.00	0.00	0.08	0.00
4.51	2.00	0.00	0.00	0.08	0.00	4.59	2.00	0.00	0.00	0.08	0.00
4.68	2.00	0.00	0.00	0.08	0.00	4.76	2.00	0.00	0.00	0.08	0.00
4.84	2.00	0.00	0.00	0.08	0.00	4.92	2.00	0.00	0.00	0.08	0.00
5.00	2.00	0.00	0.00	0.08	0.00	5.09	2.00	0.00	0.00	0.08	0.00
5.17	2.00	0.00	0.00	0.08	0.00	5.25	2.00	0.00	0.00	0.08	0.00
5.33	2.00	0.00	0.00	0.08	0.00	5.41	2.00	0.00	0.00	0.08	0.00
5.50	2.00	0.00	0.00	0.08	0.00	5.58	2.00	0.00	0.00	0.08	0.00
5.66	2.00	0.00	0.00	0.08	0.00	5.74	2.00	0.00	0.00	0.08	0.00
5.82	1.97	0.00	0.00	0.08	0.00	5.91	1.99	0.00	0.00	0.08	0.00
5.99	2.00	0.00	0.00	0.08	0.00	6.07	2.00	0.00	0.00	0.08	0.00
6.15	2.00	0.00	0.00	0.08	0.00	6.23	1.95	0.00	0.00	0.08	0.00
6.32	1.89	0.00	0.00	0.08	0.00	6.40	1.84	0.00	0.00	0.08	0.00
6.48	1.79	0.00	0.00	0.08	0.00	6.56	1.74	0.00	0.00	0.08	0.00
6.64	1.69	0.00	0.00	0.08	0.00	6.73	1.65	0.00	0.00	0.08	0.00
6.81	1.62	0.00	0.00	0.08	0.00	6.89	1.58	0.00	0.00	0.08	0.00
6.97	1.52	0.00	0.00	0.08	0.00	7.05	1.44	0.00	0.00	0.08	0.00
7.14	1.36	0.00	0.00	0.08	0.00	7.22	1.29	0.00	0.00	0.08	0.00
7.30	1.26	0.00	0.00	0.08	0.00	7.38	1.25	0.00	0.00	0.08	0.00
7.46	1.24	0.00	0.00	0.08	0.00	7.55	1.21	0.00	0.00	0.08	0.00
7.63	1.18	0.00	0.00	0.08	0.00	7.71	1.19	0.00	0.00	0.08	0.00
7.79	1.27	0.00	0.00	0.08	0.00	7.87	1.51	0.00	0.00	0.08	0.00

:: Liquefaction Potential Index calculation data :: (continued)											
Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI	Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI
7.96	1.73	0.00	0.00	0.08	0.00	8.04	1.02	0.00	0.00	0.08	0.00
8.12	0.66	0.00	0.00	0.08	0.07	8.20	0.51	0.00	0.00	0.08	0.11
8.28	0.59	0.00	0.00	0.08	0.09	8.37	0.71	0.00	0.00	0.08	0.06
8.45	0.93	0.00	0.00	0.08	0.02	8.53	1.13	0.00	0.00	0.08	0.00
8.61	1.70	0.00	0.00	0.08	0.00	8.69	1.49	0.00	0.00	0.08	0.00
8.78	1.34	0.00	0.00	0.08	0.00	8.86	1.29	0.00	0.00	0.08	0.00
8.94	1.30	0.00	0.00	0.08	0.00	9.02	1.38	0.00	0.00	0.08	0.00
9.10	1.47	0.00	0.00	0.08	0.00	9.19	1.51	0.00	0.00	0.08	0.00
9.27	0.67	0.33	0.80	0.08	0.07	9.35	0.24	0.76	0.29	0.08	0.16
9.43	0.24	0.76	0.29	0.08	0.16	9.51	0.24	0.76	0.29	0.08	0.16
9.60	0.24	0.76	0.29	0.08	0.16	9.68	0.23	0.77	0.29	0.08	0.16
9.76	0.23	0.77	0.29	0.08	0.16	9.84	0.23	0.77	0.29	0.08	0.16
9.92	0.24	0.76	0.29	0.08	0.16	10.01	0.24	0.76	0.29	0.08	0.16
10.09	0.24	0.76	0.29	0.08	0.16	10.17	0.23	0.77	0.29	0.08	0.16
10.25	0.20	0.80	0.28	0.08	0.17	10.33	0.20	0.80	0.28	0.08	0.17
10.42	0.21	0.79	0.28	0.08	0.17	10.50	0.20	0.80	0.28	0.08	0.17
10.58	0.23	0.77	0.29	0.08	0.16	10.66	0.23	0.77	0.29	0.08	0.16
10.74	0.24	0.76	0.29	0.08	0.16	10.83	0.25	0.75	0.30	0.08	0.16
10.91	0.27	0.73	0.31	0.08	0.15	10.99	0.55	0.45	0.54	0.08	0.09
11.07	1.57	0.00	0.00	0.08	0.00	11.15	1.39	0.00	0.00	0.08	0.00
11.24	1.36	0.00	0.00	0.08	0.00	11.32	0.22	0.78	0.29	0.08	0.16
11.40	0.20	0.80	0.28	0.08	0.16	11.48	0.20	0.80	0.28	0.08	0.16
11.56	0.21	0.79	0.28	0.08	0.16	11.65	0.22	0.78	0.28	0.08	0.16
11.73	0.31	0.69	0.33	0.08	0.14	11.81	1.87	0.00	0.00	0.08	0.00
11.89	1.93	0.00	0.00	0.08	0.00	11.98	0.35	0.65	0.35	0.08	0.13
12.06	0.26	0.74	0.30	0.08	0.15	12.14	0.31	0.69	0.33	0.08	0.14
12.22	0.42	0.58	0.40	0.08	0.12	12.30	0.48	0.52	0.46	0.08	0.10
12.39	0.81	0.00	0.00	0.08	0.04	12.47	1.32	0.00	0.00	0.08	0.00
12.55	2.00	0.00	0.00	0.08	0.00	12.63	2.00	0.00	0.00	0.08	0.00
12.71	2.00	0.00	0.00	0.08	0.00	12.80	2.00	0.00	0.00	0.08	0.00
12.88	2.00	0.00	0.00	0.08	0.00	12.96	2.00	0.00	0.00	0.08	0.00
13.04	2.00	0.00	0.00	0.08	0.00	13.12	2.00	0.00	0.00	0.08	0.00
13.21	2.00	0.00	0.00	0.08	0.00	13.29	2.00	0.00	0.00	0.08	0.00
13.37	2.00	0.00	0.00	0.08	0.00	13.45	2.00	0.00	0.00	0.08	0.00
13.53	2.00	0.00	0.00	0.08	0.00	13.62	2.00	0.00	0.00	0.08	0.00
13.70	2.00	0.00	0.00	0.08	0.00	13.78	2.00	0.00	0.00	0.08	0.00
13.86	2.00	0.00	0.00	0.08	0.00	13.94	2.00	0.00	0.00	0.08	0.00
14.03	2.00	0.00	0.00	0.08	0.00	14.11	2.00	0.00	0.00	0.08	0.00
14.19	2.00	0.00	0.00	0.08	0.00	14.27	2.00	0.00	0.00	0.08	0.00
14.35	1.48	0.00	0.00	0.08	0.00	14.44	2.00	0.00	0.00	0.08	0.00
14.52	2.00	0.00	0.00	0.08	0.00	14.60	1.39	0.00	0.00	0.08	0.00
14.68	1.26	0.00	0.00	0.08	0.00	14.76	1.26	0.00	0.00	0.08	0.00
14.85	1.35	0.00	0.00	0.08	0.00	14.93	1.53	0.00	0.00	0.08	0.00
15.01	2.00	0.00	0.00	0.08	0.00	15.09	2.00	0.00	0.00	0.08	0.00
15.17	2.00	0.00	0.00	0.08	0.00	15.26	2.00	0.00	0.00	0.08	0.00
15.34	2.00	0.00	0.00	0.08	0.00	15.42	2.00	0.00	0.00	0.08	0.00
15.50	2.00	0.00	0.00	0.08	0.00	15.58	2.00	0.00	0.00	0.08	0.00
15.67	2.00	0.00	0.00	0.08	0.00	15.75	2.00	0.00	0.00	0.08	0.00

:: Liquefaction Potential Index calculation data :: (continued)											
Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI	Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI
15.83	2.00	0.00	0.00	0.08	0.00	15.91	2.00	0.00	0.00	0.08	0.00
15.99	2.00	0.00	0.00	0.08	0.00	16.08	2.00	0.00	0.00	0.08	0.00
16.16	1.34	0.00	0.00	0.08	0.00	16.24	1.24	0.00	0.00	0.08	0.00
16.32	1.00	0.00	0.00	0.08	0.00	16.40	0.73	0.27	1.04	0.08	0.05
16.49	0.64	0.36	0.73	0.08	0.07	16.57	0.71	0.29	0.98	0.08	0.05
16.65	2.00	0.00	0.00	0.08	0.00	16.73	2.00	0.00	0.00	0.08	0.00
16.81	1.86	0.00	0.00	0.08	0.00	16.90	1.57	0.00	0.00	0.08	0.00
16.98	1.80	0.00	0.00	0.08	0.00	17.06	0.22	0.78	0.29	0.08	0.14
17.14	0.22	0.78	0.28	0.08	0.14	17.22	0.24	0.76	0.30	0.08	0.14
17.31	0.74	0.00	0.00	0.08	0.05	17.39	0.85	0.00	0.00	0.08	0.03
17.47	0.30	0.70	0.32	0.08	0.13	17.55	0.31	0.69	0.33	0.08	0.13
17.63	0.33	0.67	0.34	0.08	0.12	17.72	0.35	0.65	0.35	0.08	0.12
17.80	0.28	0.72	0.31	0.08	0.13	17.88	0.27	0.73	0.30	0.08	0.13
17.96	0.28	0.72	0.31	0.08	0.13	18.04	0.26	0.74	0.30	0.08	0.13
18.13	0.24	0.76	0.29	0.08	0.14	18.21	0.27	0.73	0.31	0.08	0.13
18.29	0.41	0.59	0.39	0.08	0.11	18.37	1.96	0.00	0.00	0.08	0.00
18.45	1.53	0.00	0.00	0.08	0.00	18.54	1.38	0.00	0.00	0.08	0.00
18.62	0.40	0.60	0.38	0.08	0.11	18.70	0.20	0.80	0.28	0.08	0.14
18.78	0.20	0.80	0.28	0.08	0.14	18.86	0.21	0.79	0.28	0.08	0.14
18.95	0.25	0.75	0.30	0.08	0.13	19.03	0.86	0.00	0.00	0.08	0.03
19.11	1.68	0.00	0.00	0.08	0.00	19.19	1.35	0.00	0.00	0.08	0.00
19.27	1.09	0.00	0.00	0.08	0.00	19.36	0.90	0.00	0.00	0.08	0.02
19.44	0.77	0.00	0.00	0.08	0.04	19.52	0.72	0.28	1.00	0.08	0.05
19.60	0.71	0.29	0.97	0.08	0.05	19.69	0.72	0.28	1.00	0.08	0.05
19.77	0.73	0.00	0.00	0.08	0.05	19.85	0.76	0.00	0.00	0.08	0.04
19.93	0.81	0.00	0.00	0.08	0.03	20.01	0.87	0.00	0.00	0.08	0.02
20.10	0.91	0.00	0.00	0.08	0.02	20.18	0.31	0.69	0.33	0.08	0.12
20.26	0.31	0.69	0.33	0.08	0.12	20.34	0.32	0.68	0.34	0.08	0.12
20.42	0.38	0.62	0.37	0.08	0.11	20.51	1.19	0.00	0.00	0.08	0.00
20.59	0.62	0.38	0.68	0.08	0.06	20.67	1.31	0.00	0.00	0.08	0.00
20.75	1.29	0.00	0.00	0.08	0.00	20.83	1.32	0.00	0.00	0.08	0.00
20.92	0.44	0.56	0.41	0.08	0.10	21.00	0.33	0.67	0.34	0.08	0.11
21.08	0.33	0.67	0.34	0.08	0.11	21.16	0.86	0.00	0.00	0.08	0.02
21.24	1.47	0.00	0.00	0.08	0.00	21.33	1.21	0.00	0.00	0.08	0.00
21.41	1.10	0.00	0.00	0.08	0.00	21.49	1.31	0.00	0.00	0.08	0.00
21.57	0.22	0.78	0.29	0.08	0.13	21.65	0.26	0.74	0.30	0.08	0.12
21.74	0.31	0.69	0.33	0.08	0.12	21.82	0.40	0.60	0.39	0.08	0.10
21.90	0.38	0.62	0.37	0.08	0.10	21.98	0.39	0.61	0.38	0.08	0.10
22.06	0.33	0.67	0.34	0.08	0.11	22.15	0.39	0.61	0.38	0.08	0.10
22.23	1.02	0.00	0.00	0.08	0.00	22.31	1.99	0.00	0.00	0.08	0.00
22.39	1.46	0.00	0.00	0.08	0.00	22.47	1.23	0.00	0.00	0.08	0.00
22.56	1.10	0.00	0.00	0.08	0.00	22.64	0.32	0.68	0.34	0.08	0.11
22.72	0.17	0.83	0.27	0.08	0.14	22.80	0.15	0.85	0.26	0.08	0.14
22.88	0.15	0.85	0.26	0.08	0.14	22.97	0.15	0.85	0.26	0.08	0.14
23.05	0.15	0.85	0.26	0.08	0.14	23.13	0.14	0.86	0.26	0.08	0.14
23.21	0.15	0.85	0.26	0.08	0.14	23.29	0.15	0.85	0.26	0.08	0.14
23.38	0.16	0.84	0.26	0.08	0.14	23.46	0.18	0.82	0.27	0.08	0.13
23.54	0.49	0.51	0.47	0.08	0.08	23.62	1.73	0.00	0.00	0.08	0.00

:: Liquefaction Potential Index calculation data :: (continued)											
Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI	Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI
23.70	0.27	0.73	0.31	0.08	0.12	23.79	0.29	0.71	0.32	0.08	0.11
23.87	0.64	0.36	0.71	0.08	0.06	23.95	2.00	0.00	0.00	0.08	0.00
24.03	2.00	0.00	0.00	0.08	0.00	24.11	2.00	0.00	0.00	0.08	0.00
24.20	2.00	0.00	0.00	0.08	0.00	24.28	2.00	0.00	0.00	0.08	0.00
24.36	2.00	0.00	0.00	0.08	0.00	24.44	2.00	0.00	0.00	0.08	0.00
24.52	2.00	0.00	0.00	0.08	0.00	24.61	2.00	0.00	0.00	0.08	0.00
24.69	2.00	0.00	0.00	0.08	0.00	24.77	2.00	0.00	0.00	0.08	0.00
24.85	2.00	0.00	0.00	0.08	0.00	24.93	2.00	0.00	0.00	0.08	0.00
25.02	2.00	0.00	0.00	0.08	0.00	25.10	2.00	0.00	0.00	0.08	0.00
25.18	2.00	0.00	0.00	0.08	0.00	25.26	2.00	0.00	0.00	0.08	0.00
25.34	2.00	0.00	0.00	0.08	0.00	25.43	2.00	0.00	0.00	0.08	0.00
25.51	2.00	0.00	0.00	0.08	0.00	25.59	2.00	0.00	0.00	0.08	0.00
25.67	2.00	0.00	0.00	0.08	0.00	25.75	2.00	0.00	0.00	0.08	0.00
25.84	2.00	0.00	0.00	0.08	0.00	25.92	2.00	0.00	0.00	0.08	0.00
26.00	2.00	0.00	0.00	0.08	0.00	26.08	2.00	0.00	0.00	0.08	0.00
26.16	2.00	0.00	0.00	0.08	0.00	26.25	2.00	0.00	0.00	0.08	0.00
26.33	2.00	0.00	0.00	0.08	0.00	26.41	2.00	0.00	0.00	0.08	0.00
26.49	2.00	0.00	0.00	0.08	0.00	26.57	2.00	0.00	0.00	0.08	0.00
26.66	2.00	0.00	0.00	0.08	0.00	26.74	2.00	0.00	0.00	0.08	0.00
26.82	2.00	0.00	0.00	0.08	0.00	26.90	2.00	0.00	0.00	0.08	0.00
26.98	2.00	0.00	0.00	0.08	0.00	27.07	2.00	0.00	0.00	0.08	0.00
27.15	2.00	0.00	0.00	0.08	0.00	27.23	2.00	0.00	0.00	0.08	0.00
27.31	2.00	0.00	0.00	0.08	0.00	27.40	2.00	0.00	0.00	0.08	0.00
27.48	2.00	0.00	0.00	0.08	0.00	27.56	2.00	0.00	0.00	0.08	0.00
27.64	2.00	0.00	0.00	0.08	0.00	27.72	2.00	0.00	0.00	0.08	0.00
27.81	2.00	0.00	0.00	0.08	0.00	27.89	2.00	0.00	0.00	0.08	0.00
27.97	2.00	0.00	0.00	0.08	0.00	28.05	2.00	0.00	0.00	0.08	0.00
28.13	2.00	0.00	0.00	0.08	0.00	28.22	2.00	0.00	0.00	0.08	0.00
28.30	2.00	0.00	0.00	0.08	0.00	28.38	2.00	0.00	0.00	0.08	0.00
28.46	2.00	0.00	0.00	0.08	0.00	28.54	2.00	0.00	0.00	0.08	0.00
28.63	2.00	0.00	0.00	0.08	0.00	28.71	2.00	0.00	0.00	0.08	0.00
28.79	2.00	0.00	0.00	0.08	0.00	28.87	2.00	0.00	0.00	0.08	0.00
28.95	2.00	0.00	0.00	0.08	0.00	29.04	2.00	0.00	0.00	0.08	0.00
29.12	2.00	0.00	0.00	0.08	0.00	29.20	2.00	0.00	0.00	0.08	0.00
29.28	2.00	0.00	0.00	0.08	0.00	29.36	2.00	0.00	0.00	0.08	0.00
29.45	2.00	0.00	0.00	0.08	0.00	29.53	2.00	0.00	0.00	0.08	0.00
29.61	2.00	0.00	0.00	0.08	0.00	29.69	2.00	0.00	0.00	0.08	0.00
29.77	2.00	0.00	0.00	0.08	0.00	29.86	2.00	0.00	0.00	0.08	0.00
29.94	2.00	0.00	0.00	0.08	0.00	30.02	2.00	0.00	0.00	0.08	0.00
30.10	2.00	0.00	0.00	0.08	0.00	30.18	2.00	0.00	0.00	0.08	0.00
30.27	1.25	0.00	0.00	0.08	0.00	30.35	1.11	0.00	0.00	0.08	0.00
30.43	1.27	0.00	0.00	0.08	0.00	30.51	2.00	0.00	0.00	0.08	0.00
30.59	2.00	0.00	0.00	0.08	0.00	30.68	2.00	0.00	0.00	0.08	0.00
30.76	2.00	0.00	0.00	0.08	0.00	30.84	2.00	0.00	0.00	0.08	0.00
30.92	2.00	0.00	0.00	0.08	0.00	31.00	2.00	0.00	0.00	0.08	0.00
31.09	2.00	0.00	0.00	0.08	0.00	31.17	2.00	0.00	0.00	0.08	0.00
31.25	2.00	0.00	0.00	0.08	0.00	31.33	2.00	0.00	0.00	0.08	0.00
31.41	2.00	0.00	0.00	0.08	0.00	31.50	2.00	0.00	0.00	0.08	0.00

:: Liquefaction Potential Index calculation data :: (continued)											
Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI	Depth (ft)	FS	F <sub>L</sub>	w <sub>z</sub>	d <sub>z</sub>	LPI
31.58	2.00	0.00	0.00	0.08	0.00	31.66	2.00	0.00	0.00	0.08	0.00
31.74	2.00	0.00	0.00	0.08	0.00	31.82	2.00	0.00	0.00	0.08	0.00
31.91	2.00	0.00	0.00	0.08	0.00	31.99	2.00	0.00	0.00	0.08	0.00
32.07	2.00	0.00	0.00	0.08	0.00	32.15	2.00	0.00	0.00	0.08	0.00
32.23	2.00	0.00	0.00	0.08	0.00	32.32	2.00	0.00	0.00	0.08	0.00
32.40	2.00	0.00	0.00	0.08	0.00	32.48	2.00	0.00	0.00	0.08	0.00
32.56	2.00	0.00	0.00	0.08	0.00	32.64	2.00	0.00	0.00	0.08	0.00
32.73	2.00	0.00	0.00	0.08	0.00	32.81	2.00	0.00	0.00	0.08	0.00
32.89	2.00	0.00	0.00	0.08	0.00	32.97	2.00	0.00	0.00	0.08	0.00
33.05	2.00	0.00	0.00	0.08	0.00	33.14	2.00	0.00	0.00	0.08	0.00
33.22	2.00	0.00	0.00	0.08	0.00	33.30	2.00	0.00	0.00	0.08	0.00
33.38	2.00	0.00	0.00	0.08	0.00	33.46	2.00	0.00	0.00	0.08	0.00
33.55	2.00	0.00	0.00	0.08	0.00	33.63	2.00	0.00	0.00	0.08	0.00
33.71	2.00	0.00	0.00	0.08	0.00	33.79	2.00	0.00	0.00	0.08	0.00
33.87	2.00	0.00	0.00	0.08	0.00	33.96	2.00	0.00	0.00	0.08	0.00
34.04	2.00	0.00	0.00	0.08	0.00	34.12	2.00	0.00	0.00	0.08	0.00
34.20	2.00	0.00	0.00	0.08	0.00	34.28	2.00	0.00	0.00	0.08	0.00
34.37	2.00	0.00	0.00	0.08	0.00	34.45	2.00	0.00	0.00	0.08	0.00
34.53	2.00	0.00	0.00	0.08	0.00						

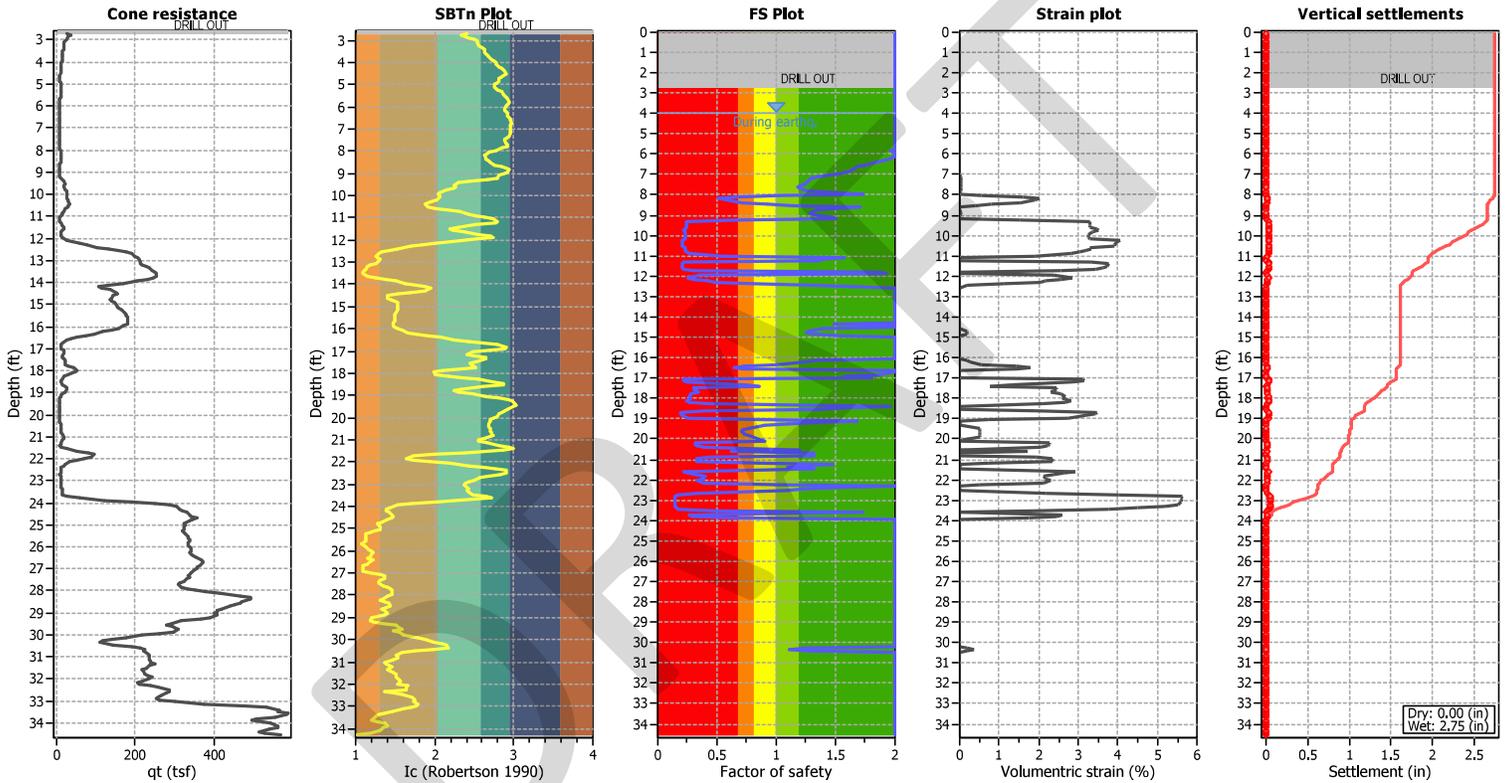
**Overall liquefaction potential: 12.16**

LPI = 0.00 - Liquefaction risk very low  
 LPI between 0.00 and 5.00 - Liquefaction risk low  
 LPI between 5.00 and 15.00 - Liquefaction risk high  
 LPI > 15.00 - Liquefaction risk very high

**Abbreviations**

FS: Calculated factor of safety for test point  
 F<sub>L</sub>: 1 - FS  
 w<sub>z</sub>: Function value of the extend of soil liquefaction according to depth  
 d<sub>z</sub>: Layer thickness (ft)  
 LPI: Liquefaction potential index value for test point

### Estimation of post-earthquake settlements



**Abbreviations**

- q<sub>t</sub>: Total cone resistance (cone resistance q<sub>c</sub> corrected for pore water effects)
- I<sub>c</sub>: Soil Behaviour Type Index
- FS: Calculated Factor of Safety against liquefaction
- Volumetric strain: Post-liquefaction volumetric strain

:: Post-earthquake settlement due to soil liquefaction ::											
Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)	Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)
4.02	130.48	2.00	0.00	1.00	0.00	4.10	130.90	2.00	0.00	1.00	0.00
4.18	133.23	2.00	0.00	1.00	0.00	4.27	133.76	2.00	0.00	1.00	0.00
4.35	132.35	2.00	0.00	1.00	0.00	4.43	128.18	2.00	0.00	1.00	0.00
4.51	122.29	2.00	0.00	1.00	0.00	4.59	113.73	2.00	0.00	1.00	0.00
4.68	104.92	2.00	0.00	1.00	0.00	4.76	99.74	2.00	0.00	1.00	0.00
4.84	97.49	2.00	0.00	1.00	0.00	4.92	96.73	2.00	0.00	1.00	0.00
5.00	98.23	2.00	0.00	1.00	0.00	5.09	103.08	2.00	0.00	1.00	0.00
5.17	110.20	2.00	0.00	1.00	0.00	5.25	116.97	2.00	0.00	1.00	0.00
5.33	121.61	2.00	0.00	1.00	0.00	5.41	125.10	2.00	0.00	1.00	0.00
5.50	125.37	2.00	0.00	1.00	0.00	5.58	123.97	2.00	0.00	1.00	0.00
5.66	120.81	2.00	0.00	1.00	0.00	5.74	119.18	2.00	0.00	1.00	0.00
5.82	117.87	1.97	0.00	1.00	0.00	5.91	115.86	1.99	0.00	1.00	0.00
5.99	112.69	2.00	0.00	1.00	0.00	6.07	109.99	2.00	0.00	1.00	0.00
6.15	109.24	2.00	0.00	1.00	0.00	6.23	109.86	1.95	0.00	1.00	0.00
6.32	110.18	1.89	0.00	1.00	0.00	6.40	110.53	1.84	0.00	1.00	0.00
6.48	110.92	1.79	0.00	1.00	0.00	6.56	111.85	1.74	0.00	1.00	0.00
6.64	111.49	1.69	0.01	1.00	0.00	6.73	109.87	1.65	0.01	1.00	0.00
6.81	106.77	1.62	0.01	1.00	0.00	6.89	103.45	1.58	0.01	1.00	0.00
6.97	99.57	1.52	0.01	1.00	0.00	7.05	95.66	1.44	0.01	1.00	0.00
7.14	91.78	1.36	0.02	1.00	0.00	7.22	87.53	1.29	0.02	1.00	0.00
7.30	83.09	1.26	0.03	1.00	0.00	7.38	78.28	1.25	0.03	1.00	0.00
7.46	74.02	1.24	0.03	1.00	0.00	7.55	72.14	1.21	0.03	1.00	0.00
7.63	72.09	1.18	0.03	1.00	0.00	7.71	77.60	1.19	0.03	1.00	0.00
7.79	83.12	1.27	0.02	1.00	0.00	7.87	84.99	1.51	0.01	1.00	0.00
7.96	82.07	1.73	0.00	1.00	0.00	8.04	161.54	1.02	0.57	1.00	0.01
8.12	134.70	0.66	1.61	1.00	0.02	8.20	119.72	0.51	2.02	1.00	0.02
8.28	128.13	0.59	1.91	1.00	0.02	8.37	139.52	0.71	1.53	1.00	0.02
8.45	156.79	0.93	0.81	1.00	0.01	8.53	169.79	1.13	0.39	1.00	0.00
8.61	82.41	1.70	0.00	1.00	0.00	8.69	85.81	1.49	0.01	1.00	0.00
8.78	88.85	1.34	0.02	1.00	0.00	8.86	90.07	1.29	0.02	1.00	0.00
8.94	87.58	1.30	0.02	1.00	0.00	9.02	84.11	1.38	0.01	1.00	0.00
9.10	80.97	1.47	0.01	1.00	0.00	9.19	80.50	1.51	0.01	1.00	0.00
9.27	138.24	0.67	1.55	1.00	0.02	9.35	66.21	0.24	3.28	1.00	0.03
9.43	65.49	0.24	3.31	1.00	0.03	9.51	65.69	0.24	3.30	1.00	0.03
9.60	65.52	0.24	3.30	1.00	0.03	9.68	61.60	0.23	3.48	1.00	0.03
9.76	61.00	0.23	3.50	1.00	0.03	9.84	63.88	0.23	3.37	1.00	0.03
9.92	66.30	0.24	3.27	1.00	0.03	10.01	66.40	0.24	3.27	1.00	0.03
10.09	66.30	0.24	3.27	1.00	0.03	10.17	65.98	0.23	3.29	1.00	0.03
10.25	51.03	0.20	4.06	1.00	0.04	10.33	52.21	0.20	3.98	1.00	0.04
10.42	53.56	0.21	3.90	1.00	0.04	10.50	53.35	0.20	3.91	1.00	0.04
10.58	65.93	0.23	3.29	1.00	0.03	10.66	65.29	0.23	3.31	1.00	0.03
10.74	68.77	0.24	3.18	1.00	0.03	10.83	73.00	0.25	3.02	1.00	0.03
10.91	79.21	0.27	2.83	1.00	0.03	10.99	129.99	0.55	1.88	1.00	0.02
11.07	79.42	1.57	0.01	1.00	0.00	11.15	77.22	1.39	0.01	1.00	0.00
11.24	73.09	1.36	0.01	1.00	0.00	11.32	65.19	0.22	3.32	1.00	0.03
11.40	55.77	0.20	3.77	1.00	0.04	11.48	56.82	0.20	3.71	1.00	0.04
11.56	58.72	0.21	3.62	1.00	0.04	11.65	62.38	0.22	3.44	1.00	0.03
11.73	89.75	0.31	2.55	1.00	0.03	11.81	89.14	1.87	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)											
Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)	Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)
11.89	97.61	1.93	0.00	1.00	0.00	11.98	98.05	0.35	2.37	1.00	0.02
12.06	78.43	0.26	2.85	1.00	0.03	12.14	90.03	0.31	2.55	1.00	0.03
12.22	110.20	0.42	2.16	1.00	0.02	12.30	118.35	0.48	2.04	1.00	0.02
12.39	149.74	0.81	1.13	1.00	0.01	12.47	181.77	1.32	0.19	1.00	0.00
12.55	210.60	2.00	0.00	1.00	0.00	12.63	230.94	2.00	0.00	1.00	0.00
12.71	246.14	2.00	0.00	1.00	0.00	12.80	259.68	2.00	0.00	1.00	0.00
12.88	271.38	2.00	0.00	1.00	0.00	12.96	275.83	2.00	0.00	1.00	0.00
13.04	272.35	2.00	0.00	1.00	0.00	13.12	266.85	2.00	0.00	1.00	0.00
13.21	268.39	2.00	0.00	1.00	0.00	13.29	276.65	2.00	0.00	1.00	0.00
13.37	286.43	2.00	0.00	1.00	0.00	13.45	293.47	2.00	0.00	1.00	0.00
13.53	299.81	2.00	0.00	1.00	0.00	13.62	309.31	2.00	0.00	1.00	0.00
13.70	321.90	2.00	0.00	1.00	0.00	13.78	325.87	2.00	0.00	1.00	0.00
13.86	317.82	2.00	0.00	1.00	0.00	13.94	292.75	2.00	0.00	1.00	0.00
14.03	274.44	2.00	0.00	1.00	0.00	14.11	246.97	2.00	0.00	1.00	0.00
14.19	213.65	2.00	0.00	1.00	0.00	14.27	206.89	2.00	0.00	1.00	0.00
14.35	192.01	1.48	0.00	1.00	0.00	14.44	205.70	2.00	0.00	1.00	0.00
14.52	200.43	2.00	0.00	1.00	0.00	14.60	187.64	1.39	0.00	1.00	0.00
14.68	181.01	1.26	0.19	1.00	0.00	14.76	180.97	1.26	0.19	1.00	0.00
14.85	185.57	1.35	0.19	1.00	0.00	14.93	194.92	1.53	0.00	1.00	0.00
15.01	201.63	2.00	0.00	1.00	0.00	15.09	205.98	2.00	0.00	1.00	0.00
15.17	210.75	2.00	0.00	1.00	0.00	15.26	218.14	2.00	0.00	1.00	0.00
15.34	225.38	2.00	0.00	1.00	0.00	15.42	230.23	2.00	0.00	1.00	0.00
15.50	232.11	2.00	0.00	1.00	0.00	15.58	232.44	2.00	0.00	1.00	0.00
15.67	233.13	2.00	0.00	1.00	0.00	15.75	234.32	2.00	0.00	1.00	0.00
15.83	233.90	2.00	0.00	1.00	0.00	15.91	230.04	2.00	0.00	1.00	0.00
15.99	219.56	2.00	0.00	1.00	0.00	16.08	205.80	2.00	0.00	1.00	0.00
16.16	186.15	1.34	0.19	1.00	0.00	16.24	180.90	1.24	0.27	1.00	0.00
16.32	166.16	1.00	0.55	1.00	0.01	16.40	145.88	0.73	1.44	1.00	0.01
16.49	138.63	0.64	1.79	1.00	0.02	16.57	144.95	0.71	1.45	1.00	0.01
16.65	251.60	2.00	0.00	1.00	0.00	16.73	154.07	2.00	0.00	1.00	0.00
16.81	141.55	1.86	0.00	1.00	0.00	16.90	119.17	1.57	0.01	1.00	0.00
16.98	91.29	1.80	0.00	1.00	0.00	17.06	70.95	0.22	3.10	1.00	0.03
17.14	69.97	0.22	3.13	1.00	0.03	17.22	78.43	0.24	2.85	1.00	0.03
17.31	154.64	0.74	1.32	1.00	0.01	17.39	163.49	0.85	0.76	1.00	0.01
17.47	93.70	0.30	2.46	1.00	0.02	17.55	94.34	0.31	2.45	1.00	0.02
17.63	98.79	0.33	2.36	1.00	0.02	17.72	101.96	0.35	2.30	1.00	0.02
17.80	88.85	0.28	2.57	1.00	0.03	17.88	84.86	0.27	2.67	1.00	0.03
17.96	88.20	0.28	2.59	1.00	0.03	18.04	84.91	0.26	2.67	1.00	0.03
18.13	79.00	0.24	2.83	1.00	0.03	18.21	85.19	0.27	2.66	1.00	0.03
18.29	112.80	0.41	2.12	1.00	0.02	18.37	108.95	1.96	0.00	1.00	0.00
18.45	111.66	1.53	0.01	1.00	0.00	18.54	101.71	1.38	0.01	1.00	0.00
18.62	116.99	0.40	2.05	1.00	0.02	18.70	61.88	0.20	3.46	1.00	0.03
18.78	62.39	0.20	3.44	1.00	0.03	18.86	68.58	0.21	3.18	1.00	0.03
18.95	82.11	0.25	2.75	1.00	0.03	19.03	164.88	0.86	0.75	1.00	0.01
19.11	110.05	1.68	0.00	1.00	0.00	19.19	109.29	1.35	0.01	1.00	0.00
19.27	101.96	1.09	0.03	1.00	0.00	19.36	89.70	0.90	0.05	1.00	0.00
19.44	78.16	0.77	0.50	1.00	0.00	19.52	67.52	0.72	0.50	1.00	0.00
19.60	59.42	0.71	0.50	1.00	0.00	19.69	54.32	0.72	0.50	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)											
Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)	Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)
19.77	52.28	0.73	0.50	1.00	0.00	19.85	51.22	0.76	0.50	1.00	0.00
19.93	50.91	0.81	0.50	1.00	0.00	20.01	49.84	0.87	0.06	1.00	0.00
20.10	48.23	0.91	0.05	1.00	0.00	20.18	104.16	0.31	2.26	1.00	0.02
20.26	103.91	0.31	2.26	1.00	0.02	20.34	106.25	0.32	2.22	1.00	0.02
20.42	116.58	0.38	2.06	1.00	0.02	20.51	62.99	1.19	0.02	1.00	0.00
20.59	145.96	0.62	1.71	1.00	0.02	20.67	70.77	1.31	0.01	1.00	0.00
20.75	70.21	1.29	0.01	1.00	0.00	20.83	74.85	1.32	0.01	1.00	0.00
20.92	124.40	0.44	1.95	1.00	0.02	21.00	100.30	0.33	2.33	1.00	0.02
21.08	100.63	0.33	2.32	1.00	0.02	21.16	166.40	0.86	0.74	1.00	0.01
21.24	100.90	1.47	0.01	1.00	0.00	21.33	107.07	1.21	0.02	1.00	0.00
21.41	106.13	1.10	0.02	1.00	0.00	21.49	100.56	1.31	0.01	1.00	0.00
21.57	75.96	0.22	2.93	1.00	0.03	21.65	86.02	0.26	2.64	1.00	0.03
21.74	97.97	0.31	2.38	1.00	0.02	21.82	113.49	0.40	2.11	1.00	0.02
21.90	110.41	0.38	2.15	1.00	0.02	21.98	111.22	0.39	2.14	1.00	0.02
22.06	102.39	0.33	2.29	1.00	0.02	22.15	111.79	0.39	2.13	1.00	0.02
22.23	178.73	1.02	0.51	1.00	0.01	22.31	124.16	1.99	0.00	1.00	0.00
22.39	119.14	1.46	0.01	1.00	0.00	22.47	102.13	1.23	0.02	1.00	0.00
22.56	76.25	1.10	0.02	1.00	0.00	22.64	107.08	0.32	2.21	1.00	0.02
22.72	51.78	0.17	4.01	1.00	0.04	22.80	34.16	0.15	5.64	1.00	0.06
22.88	34.40	0.15	5.61	1.00	0.06	22.97	34.31	0.15	5.62	1.00	0.06
23.05	34.40	0.15	5.61	1.00	0.06	23.13	34.45	0.14	5.60	1.00	0.06
23.21	34.94	0.15	5.53	1.00	0.05	23.29	37.85	0.15	5.18	1.00	0.05
23.38	44.90	0.16	4.51	1.00	0.04	23.46	55.91	0.18	3.76	1.00	0.04
23.54	132.54	0.49	1.85	1.00	0.02	23.62	96.83	1.73	0.00	1.00	0.00
23.70	88.55	0.27	2.58	1.00	0.03	23.79	95.18	0.29	2.43	1.00	0.02
23.87	142.08	0.64	1.75	1.00	0.02	23.95	218.40	2.00	0.00	1.00	0.00
24.03	282.57	2.00	0.00	1.00	0.00	24.11	318.49	2.00	0.00	1.00	0.00
24.20	337.21	2.00	0.00	1.00	0.00	24.28	347.84	2.00	0.00	1.00	0.00
24.36	359.02	2.00	0.00	1.00	0.00	24.44	369.78	2.00	0.00	1.00	0.00
24.52	375.34	2.00	0.00	1.00	0.00	24.61	378.18	2.00	0.00	1.00	0.00
24.69	388.07	2.00	0.00	1.00	0.00	24.77	374.29	2.00	0.00	1.00	0.00
24.85	366.95	2.00	0.00	1.00	0.00	24.93	349.67	2.00	0.00	1.00	0.00
25.02	353.24	2.00	0.00	1.00	0.00	25.10	347.34	2.00	0.00	1.00	0.00
25.18	341.54	2.00	0.00	1.00	0.00	25.26	336.01	2.00	0.00	1.00	0.00
25.34	338.95	2.00	0.00	1.00	0.00	25.43	344.64	2.00	0.00	1.00	0.00
25.51	350.00	2.00	0.00	1.00	0.00	25.59	350.16	2.00	0.00	1.00	0.00
25.67	350.08	2.00	0.00	1.00	0.00	25.75	353.18	2.00	0.00	1.00	0.00
25.84	349.46	2.00	0.00	1.00	0.00	25.92	351.97	2.00	0.00	1.00	0.00
26.00	355.59	2.00	0.00	1.00	0.00	26.08	359.45	2.00	0.00	1.00	0.00
26.16	357.32	2.00	0.00	1.00	0.00	26.25	352.37	2.00	0.00	1.00	0.00
26.33	354.31	2.00	0.00	1.00	0.00	26.41	361.13	2.00	0.00	1.00	0.00
26.49	368.08	2.00	0.00	1.00	0.00	26.57	380.58	2.00	0.00	1.00	0.00
26.66	383.78	2.00	0.00	1.00	0.00	26.74	382.50	2.00	0.00	1.00	0.00
26.82	373.00	2.00	0.00	1.00	0.00	26.90	366.92	2.00	0.00	1.00	0.00
26.98	367.64	2.00	0.00	1.00	0.00	27.07	367.17	2.00	0.00	1.00	0.00
27.15	361.02	2.00	0.00	1.00	0.00	27.23	356.39	2.00	0.00	1.00	0.00
27.31	350.52	2.00	0.00	1.00	0.00	27.40	353.33	2.00	0.00	1.00	0.00
27.48	344.05	2.00	0.00	1.00	0.00	27.56	338.34	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)											
Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)	Depth (ft)	Q <sub>tn,cs</sub>	FS	e <sub>v</sub> (%)	DF	Settlement (in)
27.64	326.38	2.00	0.00	1.00	0.00	27.72	324.61	2.00	0.00	1.00	0.00
27.81	332.86	2.00	0.00	1.00	0.00	27.89	346.79	2.00	0.00	1.00	0.00
27.97	368.87	2.00	0.00	1.00	0.00	28.05	392.97	2.00	0.00	1.00	0.00
28.13	431.65	2.00	0.00	1.00	0.00	28.22	482.47	2.00	0.00	1.00	0.00
28.30	508.66	2.00	0.00	1.00	0.00	28.38	511.87	2.00	0.00	1.00	0.00
28.46	489.11	2.00	0.00	1.00	0.00	28.54	482.21	2.00	0.00	1.00	0.00
28.63	465.30	2.00	0.00	1.00	0.00	28.71	452.52	2.00	0.00	1.00	0.00
28.79	431.15	2.00	0.00	1.00	0.00	28.87	419.28	2.00	0.00	1.00	0.00
28.95	416.12	2.00	0.00	1.00	0.00	29.04	403.87	2.00	0.00	1.00	0.00
29.12	409.53	2.00	0.00	1.00	0.00	29.20	391.58	2.00	0.00	1.00	0.00
29.28	371.25	2.00	0.00	1.00	0.00	29.36	323.87	2.00	0.00	1.00	0.00
29.45	302.13	2.00	0.00	1.00	0.00	29.53	286.09	2.00	0.00	1.00	0.00
29.61	301.25	2.00	0.00	1.00	0.00	29.69	307.40	2.00	0.00	1.00	0.00
29.77	316.87	2.00	0.00	1.00	0.00	29.86	305.28	2.00	0.00	1.00	0.00
29.94	306.85	2.00	0.00	1.00	0.00	30.02	275.52	2.00	0.00	1.00	0.00
30.10	234.85	2.00	0.00	1.00	0.00	30.18	205.72	2.00	0.00	1.00	0.00
30.27	184.82	1.25	0.19	1.00	0.00	30.35	176.63	1.11	0.38	1.00	0.00
30.43	185.93	1.27	0.19	1.00	0.00	30.51	205.83	2.00	0.00	1.00	0.00
30.59	214.87	2.00	0.00	1.00	0.00	30.68	224.59	2.00	0.00	1.00	0.00
30.76	221.12	2.00	0.00	1.00	0.00	30.84	229.82	2.00	0.00	1.00	0.00
30.92	232.87	2.00	0.00	1.00	0.00	31.00	234.30	2.00	0.00	1.00	0.00
31.09	233.82	2.00	0.00	1.00	0.00	31.17	234.67	2.00	0.00	1.00	0.00
31.25	237.99	2.00	0.00	1.00	0.00	31.33	245.03	2.00	0.00	1.00	0.00
31.41	233.53	2.00	0.00	1.00	0.00	31.50	223.40	2.00	0.00	1.00	0.00
31.58	212.38	2.00	0.00	1.00	0.00	31.66	217.75	2.00	0.00	1.00	0.00
31.74	220.10	2.00	0.00	1.00	0.00	31.82	228.94	2.00	0.00	1.00	0.00
31.91	238.84	2.00	0.00	1.00	0.00	31.99	231.97	2.00	0.00	1.00	0.00
32.07	213.87	2.00	0.00	1.00	0.00	32.15	202.21	2.00	0.00	1.00	0.00
32.23	205.22	2.00	0.00	1.00	0.00	32.32	230.63	2.00	0.00	1.00	0.00
32.40	252.02	2.00	0.00	1.00	0.00	32.48	279.83	2.00	0.00	1.00	0.00
32.56	283.16	2.00	0.00	1.00	0.00	32.64	283.97	2.00	0.00	1.00	0.00
32.73	279.25	2.00	0.00	1.00	0.00	32.81	267.54	2.00	0.00	1.00	0.00
32.89	277.58	2.00	0.00	1.00	0.00	32.97	282.85	2.00	0.00	1.00	0.00
33.05	292.27	2.00	0.00	1.00	0.00	33.14	360.47	2.00	0.00	1.00	0.00
33.22	457.15	2.00	0.00	1.00	0.00	33.30	513.21	2.00	0.00	1.00	0.00
33.38	543.20	2.00	0.00	1.00	0.00	33.46	538.97	2.00	0.00	1.00	0.00
33.55	561.48	2.00	0.00	1.00	0.00	33.63	557.12	2.00	0.00	1.00	0.00
33.71	529.55	2.00	0.00	1.00	0.00	33.79	484.79	2.00	0.00	1.00	0.00
33.87	472.43	2.00	0.00	1.00	0.00	33.96	496.39	2.00	0.00	1.00	0.00
34.04	516.50	2.00	0.00	1.00	0.00	34.12	534.01	2.00	0.00	1.00	0.00
34.20	530.56	2.00	0.00	1.00	0.00	34.28	509.04	2.00	0.00	1.00	0.00
34.37	490.60	2.00	0.00	1.00	0.00	34.45	503.93	2.00	0.00	1.00	0.00
34.53	540.38	2.00	0.00	1.00	0.00						

**:: Post-earthquake settlement due to soil liquefaction :: (continued)**

Depth (ft)	$Q_{tn,cs}$	FS	$e_v$ (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	$e_v$ (%)	DF	Settlement (in)
------------	-------------	----	-----------	----	-----------------	------------	-------------	----	-----------	----	-----------------

**Total estimated settlement: 2.75**

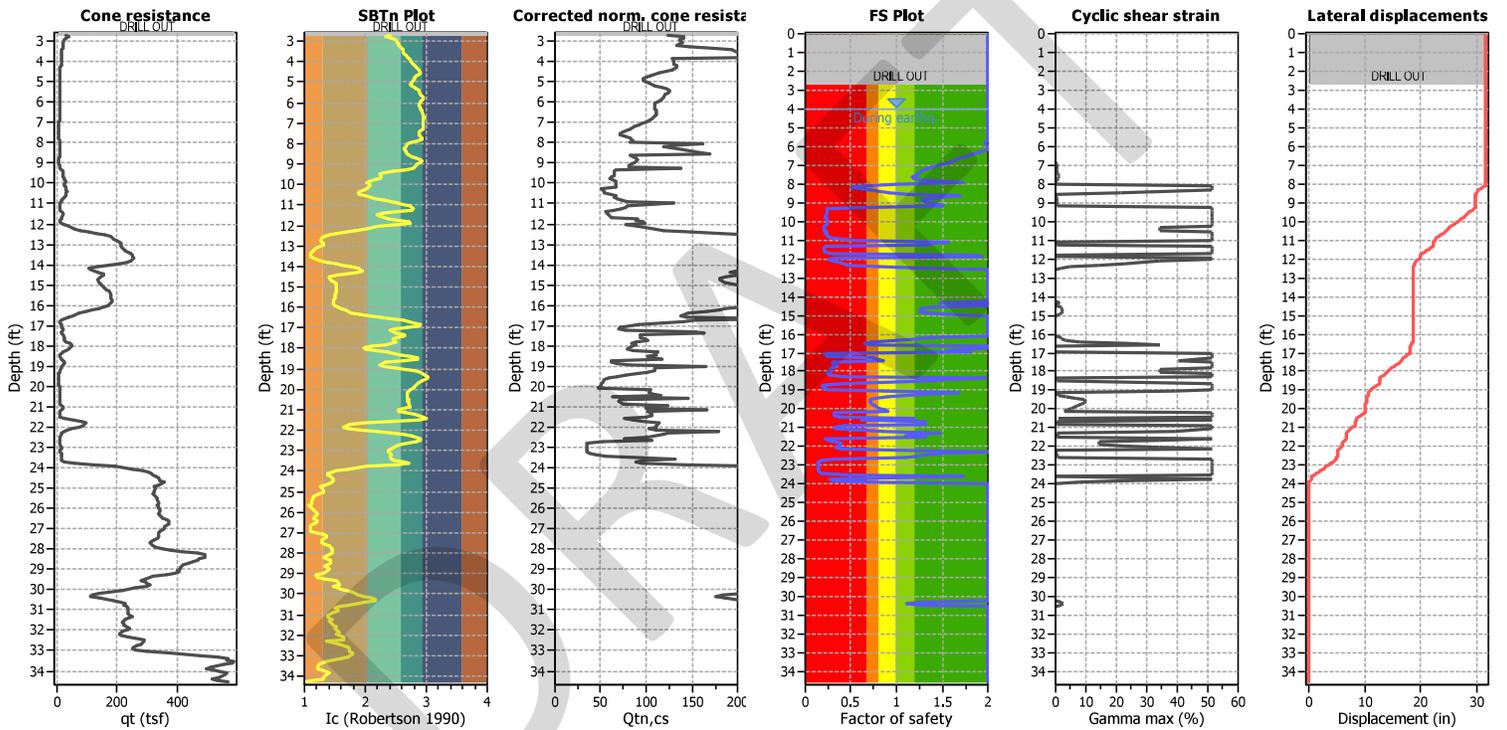
**Abbreviations**

- $Q_{tn,cs}$ : Equivalent clean sand normalized cone resistance
- FS: Factor of safety against liquefaction
- $e_v$  (%): Post-liquefaction volumetric strain
- DF:  $e_v$  depth weighting factor
- Settlement: Calculated settlement

DRAFT

### Estimation of post-earthquake lateral Displacements

Geometric parameters: Level ground (or gently sloping) with free face (L: 70.00 ft - H: 5.00 ft)



**Abbreviations**

$q_t$ : Total cone resistance (cone resistance  $q_c$  corrected for pore water effects)  
 $I_c$ : Soil Behaviour Type Index  
 $Q_{tn,cs}$ : Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety  
 $\gamma_{max}$ : Maximum cyclic shear strain  
 LDI: Lateral displacement index

**Surface condition**



:: Lateral displacement index calculation ::								
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$R_f$ (%)	$Q_{tn,cs}$	FS	$D_r$	$\text{Gamma}_{max}$ (%)	Lat. disp. (in)
4.02	12.85	23.84	3.84	130.48	2.00	19.68	0.05	0.00
4.10	12.57	23.30	3.90	130.90	2.00	18.92	0.05	0.00
4.18	12.06	22.33	4.10	133.23	2.00	17.51	0.05	0.00
4.27	11.39	21.05	4.25	133.76	2.00	15.57	0.06	0.00
4.35	10.66	19.67	4.32	132.35	2.00	13.33	0.06	0.00
4.43	9.92	18.26	4.25	128.18	2.00	10.87	0.06	0.00
4.51	9.25	16.98	4.06	122.29	2.00	8.47	0.07	0.00
4.59	9.08	16.65	3.60	113.73	2.00	7.82	0.07	0.00
4.68	8.99	16.48	3.13	104.92	2.00	7.48	0.07	0.00
4.76	9.02	16.52	2.85	99.74	2.00	7.57	0.07	0.00
4.84	8.92	16.32	2.75	97.49	2.00	7.17	0.07	0.00
4.92	9.31	17.06	2.66	96.73	2.00	8.63	0.07	0.00
5.00	10.06	18.46	2.64	98.23	2.00	11.23	0.06	0.00
5.09	10.71	19.68	2.80	103.08	2.00	13.34	0.06	0.00
5.17	11.00	20.23	3.10	110.20	2.00	14.26	0.06	0.00
5.25	10.85	19.94	3.46	116.97	2.00	13.77	0.06	0.00
5.33	10.44	19.15	3.76	121.61	2.00	12.44	0.06	0.00
5.41	10.04	18.38	4.03	125.10	2.00	11.09	0.06	0.00
5.50	9.78	17.89	4.11	125.37	2.00	10.20	0.06	0.00
5.58	9.42	17.19	4.11	123.97	2.00	8.88	0.07	0.00
5.66	8.90	16.20	4.05	120.81	2.00	6.92	0.07	0.00
5.74	8.38	15.21	4.09	119.18	2.00	4.84	0.07	0.00
5.82	8.26	14.98	4.04	117.87	1.97	4.33	0.08	0.00
5.91	8.41	15.26	3.87	115.86	1.99	4.95	0.07	0.00
5.99	8.65	15.71	3.62	112.69	2.00	5.91	0.07	0.00
6.07	8.72	15.82	3.45	109.99	2.00	6.13	0.07	0.00
6.15	8.66	15.71	3.42	109.24	2.00	5.91	0.07	0.00
6.23	8.43	15.27	3.50	109.86	1.95	4.96	0.08	0.00
6.32	8.26	14.92	3.56	110.18	1.89	4.21	0.09	0.00
6.40	8.09	14.59	3.62	110.53	1.84	3.47	0.11	0.00
6.48	7.95	14.32	3.68	110.92	1.79	2.85	0.12	0.00
6.56	7.76	13.96	3.79	111.85	1.74	2.02	0.14	0.00
6.64	7.58	13.61	3.82	111.49	1.69	1.17	0.16	0.00
6.73	7.45	13.35	3.76	109.87	1.65	0.53	0.18	0.00
6.81	7.38	13.21	3.57	106.77	1.62	0.19	0.20	0.00
6.89	7.25	12.97	3.40	103.45	1.58	0.00	0.22	0.00
6.97	7.03	12.54	3.21	99.57	1.52	0.00	0.27	0.00
7.05	6.70	11.92	3.05	95.66	1.44	0.00	0.35	0.00
7.14	6.37	11.27	2.89	91.78	1.36	0.00	0.48	0.00
7.22	6.13	10.82	2.68	87.53	1.29	0.00	0.60	0.00
7.30	6.02	10.60	2.43	83.09	1.26	0.00	0.68	0.00
7.38	6.00	10.56	2.15	78.28	1.25	0.00	0.70	0.01
7.46	5.98	10.51	1.91	74.02	1.24	0.00	0.73	0.01
7.55	5.85	10.26	1.83	72.14	1.21	0.00	0.84	0.01
7.63	5.77	10.09	1.84	72.09	1.18	0.00	0.94	0.01
7.71	5.86	10.25	2.13	77.60	1.19	0.00	0.88	0.01
7.79	6.25	10.98	2.38	83.12	1.27	0.00	0.64	0.00
7.87	7.36	13.08	2.29	84.99	1.51	0.00	0.27	0.00

:: Estimation of post-earthquake lateral Displacements :: (continued)								
Depth (ft)	q <sub>e</sub> (tsf)	Q <sub>tn</sub>	R <sub>f</sub> (%)	Q <sub>tn,cs</sub>	FS	D <sub>r</sub>	Gamma <sub>max</sub> (%)	Lat. disp. (in)
7.96	8.40	15.04	2.02	82.07	1.73	4.47	0.14	0.00
8.04	9.32	16.77	1.74	161.54	1.02	8.07	0.00	0.00
8.12	9.53	17.15	1.57	134.70	0.66	8.80	51.20	0.37
8.20	9.80	17.65	1.49	119.72	0.51	9.76	51.20	0.37
8.28	10.00	18.03	1.59	128.13	0.59	10.45	51.20	0.37
8.37	10.09	18.19	1.70	139.52	0.71	10.74	51.20	0.37
8.45	9.96	17.94	1.81	156.79	0.93	10.28	21.40	0.15
8.53	9.46	16.98	1.82	169.79	1.13	8.47	0.00	0.00
8.61	8.57	15.29	2.02	82.41	1.70	5.02	0.15	0.00
8.69	7.60	13.46	2.29	85.81	1.49	0.80	0.28	0.00
8.78	6.90	12.12	2.57	88.85	1.34	0.00	0.48	0.00
8.86	6.67	11.67	2.69	90.07	1.29	0.00	0.59	0.00
8.94	6.77	11.87	2.52	87.58	1.30	0.00	0.55	0.00
9.02	7.18	12.62	2.26	84.11	1.38	0.00	0.41	0.00
9.10	7.65	13.51	2.04	80.97	1.47	0.94	0.30	0.00
9.19	7.84	13.85	1.99	80.50	1.51	1.76	0.27	0.00
9.27	9.74	17.45	1.62	138.24	0.67	9.37	51.20	0.37
9.35	13.92	25.33	1.17	66.21	0.24	21.68	51.20	0.37
9.43	18.48	33.95	1.02	65.49	0.24	31.35	51.20	0.37
9.51	20.50	37.76	0.95	65.69	0.24	34.85	51.20	0.37
9.60	19.68	36.19	0.97	65.52	0.24	33.45	51.20	0.37
9.68	19.29	35.45	0.85	61.60	0.23	32.77	51.20	0.37
9.76	22.02	40.60	0.70	61.00	0.23	37.25	51.20	0.37
9.84	25.07	46.35	0.61	63.88	0.23	41.62	51.20	0.37
9.92	26.87	49.51	0.58	66.30	0.24	43.80	51.20	0.37
10.01	26.11	48.31	0.65	66.40	0.24	42.99	51.20	0.37
10.09	26.10	48.28	0.64	66.30	0.24	42.96	51.20	0.37
10.17	27.20	49.54	0.56	65.98	0.23	43.81	51.20	0.37
10.25	28.73	51.03	0.44	51.03	0.20	44.79	51.20	0.37
10.33	30.12	52.21	0.35	52.21	0.20	45.55	34.10	0.24
10.42	31.35	53.56	0.31	53.56	0.21	46.39	34.10	0.24
10.50	30.99	53.35	0.36	53.35	0.20	46.26	34.10	0.24
10.58	28.29	50.35	0.51	65.93	0.23	44.35	51.20	0.37
10.66	23.30	42.93	0.80	65.29	0.23	39.09	51.20	0.37
10.74	19.00	34.80	1.11	68.77	0.24	32.16	51.20	0.37
10.83	15.89	28.92	1.34	73.00	0.25	26.05	51.20	0.37
10.91	13.52	24.42	1.52	79.21	0.27	20.47	51.20	0.37
10.99	11.03	19.71	1.72	129.99	0.55	13.40	51.20	0.37
11.07	8.76	15.40	1.85	79.42	1.57	5.26	0.21	0.00
11.15	7.84	13.67	1.82	77.22	1.39	1.31	0.39	0.00
11.24	7.69	13.38	1.65	73.09	1.36	0.61	0.43	0.00
11.32	11.15	19.91	1.10	65.19	0.22	13.73	51.20	0.37
11.40	16.09	29.23	0.76	55.77	0.20	26.41	51.20	0.37
11.48	19.69	35.99	0.66	56.82	0.20	33.27	51.20	0.37
11.56	18.83	34.40	0.77	58.72	0.21	31.78	51.20	0.37
11.65	15.13	27.40	1.00	62.38	0.22	24.27	51.20	0.37
11.73	12.16	21.78	1.48	89.75	0.31	16.69	51.20	0.37
11.81	10.58	18.78	2.14	89.14	1.87	11.79	0.08	0.00

:: Estimation of post-earthquake lateral Displacements :: (continued)								
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$R_f$ (%)	$Q_{tn,cs}$	FS	$D_r$	$\text{Gamma}_{max}$ (%)	Lat. disp. (in)
11.89	10.91	19.39	2.48	97.61	1.93	12.86	0.07	0.00
11.98	15.31	27.71	1.92	98.05	0.35	24.64	51.20	0.37
12.06	26.28	47.81	1.16	78.43	0.26	42.64	51.20	0.37
12.14	40.56	68.77	0.86	90.03	0.31	54.64	34.10	0.24
12.22	57.82	92.55	0.68	110.20	0.42	64.44	22.70	0.16
12.30	77.84	118.35	0.54	118.35	0.48	72.56	14.50	0.10
12.39	104.35	149.74	0.40	149.74	0.81	80.33	5.00	0.04
12.47	132.35	181.77	0.32	181.77	1.32	86.72	1.99	0.01
12.55	158.12	210.60	0.28	210.60	2.00	91.58	0.00	0.00
12.63	176.22	230.94	0.27	230.94	2.00	94.63	0.00	0.00
12.71	189.71	246.14	0.27	246.14	2.00	96.73	0.00	0.00
12.80	199.34	259.68	0.32	259.68	2.00	98.50	0.00	0.00
12.88	206.91	271.38	0.37	271.38	2.00	99.95	0.00	0.00
12.96	211.03	275.83	0.37	275.83	2.00	100.00	0.00	0.00
13.04	211.78	272.35	0.31	272.35	2.00	100.00	0.00	0.00
13.12	212.72	266.85	0.23	266.85	2.00	99.40	0.00	0.00
13.21	217.26	268.39	0.18	268.39	2.00	99.59	0.00	0.00
13.29	226.44	276.65	0.17	276.65	2.00	100.00	0.00	0.00
13.37	235.91	286.43	0.17	286.43	2.00	100.00	0.00	0.00
13.45	243.48	293.47	0.16	293.47	2.00	100.00	0.00	0.00
13.53	248.34	299.81	0.18	299.81	2.00	100.00	0.00	0.00
13.62	252.74	309.31	0.23	309.31	2.00	100.00	0.00	0.00
13.70	253.12	321.90	0.40	321.90	2.00	100.00	0.00	0.00
13.78	247.24	325.87	0.60	325.87	2.00	100.00	0.00	0.00
13.86	231.70	317.82	0.88	317.82	2.00	100.00	0.00	0.00
13.94	207.10	292.75	1.12	292.75	2.00	100.00	0.00	0.00
14.03	169.40	249.47	1.49	274.44	2.00	97.17	0.00	0.00
14.11	133.25	202.53	1.77	246.97	2.00	90.29	0.00	0.00
14.19	107.76	167.37	1.94	213.65	2.00	84.00	0.00	0.00
14.27	113.02	170.20	1.50	206.89	2.00	84.55	0.00	0.00
14.35	134.87	192.01	0.96	192.01	1.48	88.53	1.60	0.01
14.44	152.40	205.70	0.59	205.70	2.00	90.81	0.00	0.00
14.52	154.01	200.43	0.37	200.43	2.00	89.95	0.00	0.00
14.60	145.04	187.64	0.32	187.64	1.39	87.77	1.80	0.01
14.68	138.42	181.01	0.36	181.01	1.26	86.59	2.14	0.02
14.76	136.42	180.97	0.45	180.97	1.26	86.58	2.15	0.02
14.85	139.09	185.57	0.52	185.57	1.35	87.41	1.91	0.01
14.93	146.28	194.92	0.55	194.92	1.53	89.03	1.51	0.01
15.01	151.51	201.63	0.58	201.63	2.00	90.15	0.00	0.00
15.09	154.90	205.98	0.60	205.98	2.00	90.85	0.00	0.00
15.17	158.90	210.75	0.62	210.75	2.00	91.61	0.00	0.00
15.26	165.61	218.14	0.60	218.14	2.00	92.74	0.00	0.00
15.34	172.15	225.38	0.60	225.38	2.00	93.82	0.00	0.00
15.42	176.55	230.23	0.60	230.23	2.00	94.52	0.00	0.00
15.50	178.28	232.11	0.60	232.11	2.00	94.79	0.00	0.00
15.58	178.94	232.44	0.60	232.44	2.00	94.84	0.00	0.00
15.67	180.15	233.13	0.59	233.13	2.00	94.94	0.00	0.00
15.75	181.86	234.32	0.58	234.32	2.00	95.11	0.00	0.00

:: Estimation of post-earthquake lateral Displacements :: (continued)								
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$R_f$ (%)	$Q_{tn,cs}$	FS	$D_r$	$\text{Gamma}_{max}$ (%)	Lat. disp. (in)
15.83	181.88	233.90	0.58	233.90	2.00	95.05	0.00	0.00
15.91	178.36	230.04	0.61	230.04	2.00	94.50	0.00	0.00
15.99	168.69	219.56	0.67	219.56	2.00	92.96	0.00	0.00
16.08	156.27	205.80	0.75	205.80	2.00	90.82	0.00	0.00
16.16	139.00	186.15	0.86	186.15	1.34	87.51	1.92	0.01
16.24	118.03	161.93	1.05	180.90	1.24	82.91	2.05	0.01
16.32	94.22	133.49	1.36	166.16	1.00	76.53	3.23	0.02
16.40	71.81	105.50	1.82	145.88	0.73	68.77	8.08	0.06
16.49	52.67	80.20	2.38	138.63	0.64	59.72	22.70	0.16
16.57	36.45	57.55	3.09	144.95	0.71	48.76	34.10	0.24
16.65	23.92	39.06	3.98	251.60	2.00	35.97	0.00	0.00
16.73	16.15	26.87	4.54	154.07	2.00	23.62	0.05	0.00
16.81	11.96	19.90	4.54	141.55	1.86	13.72	0.08	0.00
16.90	10.32	16.85	3.64	119.17	1.57	8.22	0.19	0.00
16.98	12.25	19.32	2.16	91.29	1.80	12.74	0.10	0.00
17.06	16.59	25.20	1.30	70.95	0.22	21.50	51.20	0.37
17.14	18.98	28.54	1.23	69.97	0.22	25.61	51.20	0.37
17.22	17.60	26.79	1.53	78.43	0.24	23.52	51.20	0.37
17.31	14.15	21.95	2.06	154.64	0.74	16.95	51.20	0.37
17.39	14.50	22.48	2.17	163.49	0.85	17.74	40.47	0.29
17.47	19.23	29.33	1.93	93.70	0.30	26.52	51.20	0.37
17.55	23.40	35.35	1.93	94.34	0.31	32.67	51.20	0.37
17.63	23.75	35.89	2.06	98.79	0.33	33.18	51.20	0.37
17.72	22.22	33.75	2.25	101.96	0.35	31.15	51.20	0.37
17.80	29.12	42.79	1.62	88.85	0.28	38.98	51.20	0.37
17.88	42.89	60.05	1.02	84.86	0.27	50.17	34.10	0.24
17.96	50.13	68.35	0.77	88.20	0.28	54.44	34.10	0.24
18.04	47.13	64.50	0.80	84.91	0.26	52.53	34.10	0.24
18.13	36.19	50.96	1.09	79.00	0.24	44.75	51.20	0.37
18.21	27.67	40.10	1.54	85.19	0.27	36.84	51.20	0.37
18.29	19.78	29.45	2.15	112.80	0.41	26.65	51.20	0.37
18.37	14.08	21.35	2.83	108.95	1.96	16.03	0.06	0.00
18.45	10.94	16.63	3.25	111.66	1.53	7.79	0.22	0.00
18.54	10.04	15.07	2.86	101.71	1.38	4.54	0.37	0.00
18.62	13.83	20.15	1.60	116.99	0.40	14.13	51.20	0.37
18.70	20.93	29.46	0.95	61.88	0.20	26.66	51.20	0.37
18.78	25.78	35.77	0.86	62.39	0.20	33.07	51.20	0.37
18.86	25.34	35.48	1.08	68.58	0.21	32.80	51.20	0.37
18.95	20.37	29.23	1.62	82.11	0.25	26.40	51.20	0.37
19.03	16.11	23.55	2.26	164.88	0.86	19.27	39.46	0.28
19.11	12.42	18.38	3.04	110.05	1.68	11.09	0.14	0.00
19.19	10.05	14.81	3.29	109.29	1.35	3.96	0.42	0.00
19.27	8.33	12.01	3.19	101.96	1.09	0.00	1.19	0.01
19.36	7.06	9.87	2.71	89.70	0.90	0.00	3.15	0.02
19.44	6.22	8.45	2.18	78.16	0.77	0.00	6.76	0.05
19.52	5.89	7.89	1.61	67.52	0.72	0.00	9.50	0.07
19.60	5.89	7.83	1.19	59.42	0.71	0.00	9.91	0.07
19.69	6.00	7.91	0.96	54.32	0.72	0.00	9.47	0.07

:: Estimation of post-earthquake lateral Displacements :: (continued)								
Depth (ft)	q <sub>e</sub> (tsf)	Q <sub>tn</sub>	R <sub>f</sub> (%)	Q <sub>tn,cs</sub>	FS	D <sub>r</sub>	Gamma <sub>max</sub> (%)	Lat. disp. (in)
19.77	6.14	8.07	0.86	52.28	0.73	0.00	8.67	0.06
19.85	6.42	8.44	0.81	51.22	0.76	0.00	7.00	0.05
19.93	6.77	8.93	0.79	50.91	0.81	0.00	5.35	0.04
20.01	7.30	9.64	0.73	49.84	0.87	0.00	3.68	0.03
20.10	7.63	10.06	0.67	48.23	0.91	0.00	3.00	0.02
20.18	7.87	10.38	0.68	104.16	0.31	0.00	51.20	0.37
20.26	8.23	10.89	0.73	103.91	0.31	0.00	51.20	0.37
20.34	8.71	11.58	0.81	106.25	0.32	0.00	51.20	0.37
20.42	9.25	12.38	0.95	116.58	0.38	0.00	51.20	0.37
20.51	9.85	13.31	1.17	62.99	1.19	0.43	0.77	0.01
20.59	10.66	14.48	1.34	145.96	0.62	3.22	51.20	0.37
20.67	10.77	14.66	1.45	70.77	1.31	3.63	0.47	0.00
20.75	10.68	14.48	1.43	70.21	1.29	3.21	0.51	0.00
20.83	10.86	14.78	1.61	74.85	1.32	3.88	0.46	0.00
20.92	14.47	19.78	1.63	124.40	0.44	13.51	51.20	0.37
21.00	17.66	24.14	1.70	100.30	0.33	20.09	51.20	0.37
21.08	18.59	25.40	1.78	100.63	0.33	21.77	51.20	0.37
21.16	15.57	21.37	2.09	166.40	0.86	16.07	39.73	0.28
21.24	12.02	16.56	2.71	100.90	1.47	7.65	0.26	0.00
21.33	9.91	13.59	3.28	107.07	1.21	1.12	0.71	0.01
21.41	9.14	12.35	3.38	106.13	1.10	0.00	1.15	0.01
21.49	10.84	14.76	2.81	100.56	1.31	3.86	0.47	0.00
21.57	25.63	33.94	1.34	75.96	0.22	31.33	51.20	0.37
21.65	52.86	66.56	0.74	86.02	0.26	53.56	34.10	0.24
21.74	80.92	97.97	0.48	97.97	0.31	66.32	14.50	0.10
21.82	95.46	113.49	0.39	113.49	0.40	71.18	14.50	0.10
21.90	88.44	106.57	0.52	110.41	0.38	69.10	14.50	0.10
21.98	71.18	88.55	0.90	111.22	0.39	62.99	22.70	0.16
22.06	49.69	64.18	1.58	102.39	0.33	52.36	34.10	0.24
22.15	34.10	45.20	2.30	111.79	0.39	40.79	51.20	0.37
22.23	23.47	31.54	2.90	178.73	1.02	28.92	0.00	0.00
22.31	16.70	22.51	3.43	124.16	1.99	17.79	0.05	0.00
22.39	12.34	16.48	3.65	119.14	1.46	7.48	0.28	0.00
22.47	10.58	13.85	2.97	102.13	1.23	1.76	0.66	0.00
22.56	9.76	12.41	1.76	76.25	1.10	0.00	1.15	0.01
22.64	9.38	11.55	0.81	107.08	0.32	0.00	51.20	0.37
22.72	9.18	11.04	0.38	51.78	0.17	0.00	51.20	0.37
22.80	9.85	11.80	0.28	34.16	0.15	0.00	51.20	0.37
22.88	11.26	13.54	0.25	34.40	0.15	0.99	51.20	0.37
22.97	12.37	14.90	0.24	34.31	0.15	4.17	51.20	0.37
23.05	12.58	15.14	0.24	34.40	0.15	4.70	51.20	0.37
23.13	11.80	14.15	0.25	34.45	0.14	2.46	51.20	0.37
23.21	11.56	13.84	0.26	34.94	0.15	1.73	51.20	0.37
23.29	12.74	15.38	0.33	37.85	0.15	5.20	51.20	0.37
23.38	14.61	17.88	0.53	44.90	0.16	10.18	51.20	0.37
23.46	15.74	19.54	0.86	55.91	0.18	13.10	51.20	0.37
23.54	15.23	19.28	1.65	132.54	0.49	12.68	51.20	0.37
23.62	15.41	19.75	2.36	96.83	1.73	13.45	0.11	0.00

:: Estimation of post-earthquake lateral Displacements :: (continued)								
Depth (ft)	q <sub>e</sub> (tsf)	Q <sub>tn</sub>	R <sub>f</sub> (%)	Q <sub>tn,cs</sub>	FS	D <sub>r</sub>	Gamma <sub>max</sub> (%)	Lat. disp. (in)
23.70	24.73	31.55	1.97	88.55	0.27	28.92	51.20	0.37
23.79	59.20	71.97	0.96	95.18	0.29	56.14	22.70	0.16
23.87	121.18	141.55	0.73	142.08	0.64	78.47	8.25	0.06
23.95	192.00	218.40	0.63	218.40	2.00	92.78	0.00	0.00
24.03	251.64	282.57	0.63	282.57	2.00	100.00	0.00	0.00
24.11	286.52	318.49	0.59	318.49	2.00	100.00	0.00	0.00
24.20	303.76	337.21	0.62	337.21	2.00	100.00	0.00	0.00
24.28	311.89	347.84	0.72	347.84	2.00	100.00	0.00	0.00
24.36	320.49	359.02	0.84	359.02	2.00	100.00	0.00	0.00
24.44	329.89	369.78	0.89	369.78	2.00	100.00	0.00	0.00
24.52	336.50	375.34	0.85	375.34	2.00	100.00	0.00	0.00
24.61	342.35	378.18	0.72	378.18	2.00	100.00	0.00	0.00
24.69	355.51	388.07	0.59	388.07	2.00	100.00	0.00	0.00
24.77	346.44	374.29	0.47	374.29	2.00	100.00	0.00	0.00
24.85	339.05	366.95	0.50	366.95	2.00	100.00	0.00	0.00
24.93	322.43	349.67	0.52	349.67	2.00	100.00	0.00	0.00
25.02	326.72	353.24	0.50	353.24	2.00	100.00	0.00	0.00
25.10	324.65	347.34	0.39	347.34	2.00	100.00	0.00	0.00
25.18	322.15	341.54	0.31	341.54	2.00	100.00	0.00	0.00
25.26	319.28	336.01	0.25	336.01	2.00	100.00	0.00	0.00
25.34	322.46	338.95	0.26	338.95	2.00	100.00	0.00	0.00
25.43	328.27	344.64	0.26	344.64	2.00	100.00	0.00	0.00
25.51	333.69	350.00	0.27	350.00	2.00	100.00	0.00	0.00
25.59	334.37	350.16	0.26	350.16	2.00	100.00	0.00	0.00
25.67	336.48	350.08	0.22	350.08	2.00	100.00	0.00	0.00
25.75	338.84	353.18	0.24	353.18	2.00	100.00	0.00	0.00
25.84	334.67	349.46	0.26	349.46	2.00	100.00	0.00	0.00
25.92	335.89	351.97	0.30	351.97	2.00	100.00	0.00	0.00
26.00	338.05	355.59	0.36	355.59	2.00	100.00	0.00	0.00
26.08	341.44	359.45	0.38	359.45	2.00	100.00	0.00	0.00
26.16	340.57	357.32	0.36	357.32	2.00	100.00	0.00	0.00
26.25	337.18	352.37	0.32	352.37	2.00	100.00	0.00	0.00
26.33	340.69	354.31	0.29	354.31	2.00	100.00	0.00	0.00
26.41	344.74	361.13	0.38	361.13	2.00	100.00	0.00	0.00
26.49	353.02	368.08	0.35	368.08	2.00	100.00	0.00	0.00
26.57	366.83	380.58	0.32	380.58	2.00	100.00	0.00	0.00
26.66	372.94	383.78	0.25	383.78	2.00	100.00	0.00	0.00
26.74	371.58	382.50	0.26	382.50	2.00	100.00	0.00	0.00
26.82	362.86	373.00	0.25	373.00	2.00	100.00	0.00	0.00
26.90	357.12	366.92	0.25	366.92	2.00	100.00	0.00	0.00
26.98	354.79	367.64	0.35	367.64	2.00	100.00	0.00	0.00
27.07	349.99	367.17	0.53	367.17	2.00	100.00	0.00	0.00
27.15	342.74	361.02	0.62	361.02	2.00	100.00	0.00	0.00
27.23	338.92	356.39	0.61	356.39	2.00	100.00	0.00	0.00
27.31	335.29	350.52	0.52	350.52	2.00	100.00	0.00	0.00
27.40	339.19	353.33	0.49	353.33	2.00	100.00	0.00	0.00
27.48	330.79	344.05	0.47	344.05	2.00	100.00	0.00	0.00
27.56	324.07	338.34	0.55	338.34	2.00	100.00	0.00	0.00

:: Estimation of post-earthquake lateral Displacements :: (continued)								
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$R_f$ (%)	$Q_{tn,cs}$	FS	$D_r$	$\text{Gamma}_{max}$ (%)	Lat. disp. (in)
27.64	311.43	326.38	0.63	326.38	2.00	100.00	0.00	0.00
27.72	309.19	324.61	0.70	324.61	2.00	100.00	0.00	0.00
27.81	316.54	332.86	0.78	332.86	2.00	100.00	0.00	0.00
27.89	330.23	346.79	0.81	346.79	2.00	100.00	0.00	0.00
27.97	351.70	368.87	0.85	368.87	2.00	100.00	0.00	0.00
28.05	377.19	392.97	0.75	392.97	2.00	100.00	0.00	0.00
28.13	416.87	431.65	0.68	431.65	2.00	100.00	0.00	0.00
28.22	468.07	482.47	0.66	482.47	2.00	100.00	0.00	0.00
28.30	491.65	508.66	0.81	508.66	2.00	100.00	0.00	0.00
28.38	492.95	511.87	0.95	511.87	2.00	100.00	0.00	0.00
28.46	471.37	489.11	0.95	489.11	2.00	100.00	0.00	0.00
28.54	467.38	482.21	0.82	482.21	2.00	100.00	0.00	0.00
28.63	453.68	465.30	0.69	465.30	2.00	100.00	0.00	0.00
28.71	440.31	452.52	0.76	452.52	2.00	100.00	0.00	0.00
28.79	419.18	431.15	0.80	431.15	2.00	100.00	0.00	0.00
28.87	409.28	419.28	0.72	419.28	2.00	100.00	0.00	0.00
28.95	408.93	416.12	0.58	416.12	2.00	100.00	0.00	0.00
29.04	400.44	403.87	0.41	403.87	2.00	100.00	0.00	0.00
29.12	406.90	409.53	0.39	409.53	2.00	100.00	0.00	0.00
29.20	388.43	391.58	0.43	391.58	2.00	100.00	0.00	0.00
29.28	366.12	371.25	0.56	371.25	2.00	100.00	0.00	0.00
29.36	315.81	323.87	0.88	323.87	2.00	100.00	0.00	0.00
29.45	294.56	302.13	0.91	302.13	2.00	100.00	0.00	0.00
29.53	278.70	286.09	0.98	286.09	2.00	100.00	0.00	0.00
29.61	295.81	301.25	0.75	301.25	2.00	100.00	0.00	0.00
29.69	300.94	307.40	0.94	307.40	2.00	100.00	0.00	0.00
29.77	309.55	316.87	1.13	316.87	2.00	100.00	0.00	0.00
29.86	296.92	305.28	1.46	305.28	2.00	100.00	0.00	0.00
29.94	261.05	269.20	1.71	306.85	2.00	99.69	0.00	0.00
30.02	217.14	224.52	1.97	275.52	2.00	93.69	0.00	0.00
30.10	174.84	181.16	2.24	234.85	2.00	86.61	0.00	0.00
30.18	139.27	144.63	2.63	205.72	2.00	79.18	0.00	0.00
30.27	117.43	121.78	2.68	184.82	1.25	73.50	1.67	0.01
30.35	110.66	114.48	2.63	176.63	1.11	71.46	2.36	0.02
30.43	141.61	145.07	1.75	185.93	1.27	79.28	1.95	0.01
30.51	190.02	192.54	1.12	205.83	2.00	88.62	0.00	0.00
30.59	214.01	214.87	0.74	214.87	2.00	92.25	0.00	0.00
30.68	224.77	224.59	0.61	224.59	2.00	93.71	0.00	0.00
30.76	221.23	221.12	0.67	221.12	2.00	93.19	0.00	0.00
30.84	230.20	229.82	0.70	229.82	2.00	94.47	0.00	0.00
30.92	234.19	232.87	0.58	232.87	2.00	94.90	0.00	0.00
31.00	237.11	234.30	0.40	234.30	2.00	95.10	0.00	0.00
31.09	236.75	233.82	0.41	233.82	2.00	95.03	0.00	0.00
31.17	237.58	234.67	0.46	234.67	2.00	95.16	0.00	0.00
31.25	240.72	237.99	0.55	237.99	2.00	95.62	0.00	0.00
31.33	248.62	245.03	0.48	245.03	2.00	96.58	0.00	0.00
31.41	237.02	233.53	0.50	233.53	2.00	94.99	0.00	0.00
31.50	226.70	223.40	0.55	223.40	2.00	93.53	0.00	0.00

**:: Estimation of post-earthquake lateral Displacements :: (continued)**

Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$R_f$ (%)	$Q_{tn,cs}$	FS	$D_r$	$\text{Gamma}_{max}$ (%)	Lat. disp. (in)
31.58	215.54	212.38	0.60	212.38	2.00	91.86	0.00	0.00
31.66	221.35	217.75	0.59	217.75	2.00	92.68	0.00	0.00
31.74	223.84	220.10	0.64	220.10	2.00	93.04	0.00	0.00
31.82	232.84	228.94	0.73	228.94	2.00	94.34	0.00	0.00
31.91	243.06	238.84	0.78	238.84	2.00	95.74	0.00	0.00
31.99	236.70	231.97	0.69	231.97	2.00	94.77	0.00	0.00
32.07	217.78	213.87	0.94	213.87	2.00	92.09	0.00	0.00
32.15	206.33	202.21	0.88	202.21	2.00	90.24	0.00	0.00
32.23	209.75	205.22	0.86	205.22	2.00	90.73	0.00	0.00
32.32	237.77	230.63	0.38	230.63	2.00	94.58	0.00	0.00
32.40	259.14	252.02	0.62	252.02	2.00	97.51	0.00	0.00
32.48	287.00	279.83	0.96	279.83	2.00	100.00	0.00	0.00
32.56	287.50	280.89	1.41	283.16	2.00	100.00	0.00	0.00
32.64	277.86	271.10	1.45	283.97	2.00	99.92	0.00	0.00
32.73	266.02	259.14	1.47	279.25	2.00	98.43	0.00	0.00
32.81	257.63	250.47	1.41	267.54	2.00	97.30	0.00	0.00
32.89	251.98	244.78	1.57	277.58	2.00	96.55	0.00	0.00
32.97	259.58	251.74	1.57	282.85	2.00	97.47	0.00	0.00
33.05	301.26	291.53	1.44	292.27	2.00	100.00	0.00	0.00
33.14	373.43	360.47	1.24	360.47	2.00	100.00	0.00	0.00
33.22	475.02	457.15	0.99	457.15	2.00	100.00	0.00	0.00
33.30	534.68	513.21	0.82	513.21	2.00	100.00	0.00	0.00
33.38	567.24	543.20	0.68	543.20	2.00	100.00	0.00	0.00
33.46	563.79	538.97	0.61	538.97	2.00	100.00	0.00	0.00
33.55	588.20	561.48	0.57	561.48	2.00	100.00	0.00	0.00
33.63	584.31	557.12	0.55	557.12	2.00	100.00	0.00	0.00
33.71	555.56	529.55	0.66	529.55	2.00	100.00	0.00	0.00
33.79	508.87	484.79	0.79	484.79	2.00	100.00	0.00	0.00
33.87	496.39	472.43	0.86	472.43	2.00	100.00	0.00	0.00
33.96	522.36	496.39	0.77	496.39	2.00	100.00	0.00	0.00
34.04	544.22	516.50	0.73	516.50	2.00	100.00	0.00	0.00
34.12	563.30	534.01	0.72	534.01	2.00	100.00	0.00	0.00
34.20	560.70	530.56	0.49	530.56	2.00	100.00	0.00	0.00
34.28	538.94	509.04	0.26	509.04	2.00	100.00	0.00	0.00
34.37	515.81	490.60	0.00	490.60	2.00	100.00	0.00	0.00
34.45	530.29	503.93	0.00	503.93	2.00	100.00	0.00	0.00
34.53	569.06	540.38	0.00	540.38	2.00	100.00	0.00	0.00

**Total estimated displacement: 31.50****Abbreviations**

$q_t$ :	Total cone resistance
$Q_{tn}$ :	Adjusted cone resistance to an effective overburden stress of 1 atm
$R_f$ :	Friction ration
$Q_{tn,cs}$ :	Adjusted and corrected cone resistance due to fines
FS:	Calculated factor of safety against liquefaction
$D_r$ :	Calculated relative density
$\text{Gamma}_{max}$ :	Calculated maximum cyclic shear strain
Lat. disp.:	Lateral displacement

:: Strength loss calculation (Robertson (2009)) ::							
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(tiq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.08	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.16	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.25	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.33	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.41	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.49	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.57	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.66	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.74	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.82	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.90	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
0.98	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.07	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.15	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.23	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.31	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.39	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.48	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.56	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.64	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.72	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.80	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.89	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
1.97	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.05	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.13	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.21	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.30	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.38	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.46	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.54	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.62	0.00	-1.00	1.00	-1.00	-1.00	0.00	0.00
2.71	27.12	50.96	2.43	123.67	2.41	0.79	0.79
2.79	36.78	69.21	2.04	141.42	2.33	0.82	0.82
2.87	29.80	56.00	2.51	140.63	2.43	0.81	0.81
2.95	24.60	46.16	2.95	136.00	2.50	0.81	0.81
3.03	21.34	39.99	3.21	128.36	2.53	0.81	0.81
3.12	19.45	36.42	3.29	119.98	2.54	0.81	0.81
3.20	18.42	34.45	3.33	114.61	2.55	0.80	0.80
3.28	17.54	32.79	3.52	115.31	2.57	0.82	0.82
3.36	16.89	31.55	3.79	119.47	2.60	2.56	5.93
3.44	16.56	30.92	3.96	122.30	2.62	2.56	5.68
3.53	16.32	30.46	4.02	122.41	2.63	2.44	5.47
3.61	15.87	29.60	4.13	122.29	2.64	2.34	5.21
3.69	15.22	28.35	4.35	123.29	2.66	2.26	4.88
3.77	14.62	27.21	4.60	125.26	2.69	2.20	4.59
3.85	13.90	25.84	4.96	128.20	2.72	2.20	4.27
3.94	13.34	24.77	5.24	129.87	2.75	2.18	4.01

**:: Strength loss calculation (Robertson (2009)) :: (continued)**

Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(tiq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
4.02	12.85	23.84	5.47	130.48	2.77	2.06	3.80
4.10	12.57	23.30	5.62	130.90	2.78	2.03	3.68
4.18	12.06	22.33	5.97	133.23	2.81	2.07	3.50
4.27	11.39	21.05	6.35	133.76	2.84	2.06	3.27
4.35	10.66	19.67	6.73	132.35	2.87	1.85	3.03
4.43	9.92	18.26	7.02	128.18	2.89	1.73	2.79
4.51	9.25	16.98	7.20	122.29	2.90	1.54	2.58
4.59	9.08	16.65	6.83	113.73	2.87	1.26	2.51
4.68	8.99	16.48	6.37	104.92	2.84	1.12	2.47
4.76	9.02	16.52	6.04	99.74	2.81	0.97	2.45
4.84	8.92	16.32	5.97	97.49	2.81	0.95	2.41
4.92	9.31	17.06	5.67	96.73	2.79	0.95	2.50
5.00	10.06	18.46	5.32	98.23	2.76	0.97	2.69
5.09	10.71	19.68	5.24	103.08	2.75	1.14	2.84
5.17	11.00	20.23	5.45	110.20	2.77	1.32	2.90
5.25	10.85	19.94	5.87	116.97	2.80	1.42	2.84
5.33	10.44	19.15	6.35	121.61	2.84	1.49	2.71
5.41	10.04	18.38	6.81	125.10	2.87	1.49	2.58
5.50	9.78	17.89	7.01	125.37	2.89	1.53	2.49
5.58	9.42	17.19	7.21	123.97	2.90	1.43	2.38
5.66	8.90	16.20	7.46	120.81	2.92	1.30	2.23
5.74	8.38	15.21	7.84	119.18	2.94	1.21	2.08
5.82	8.26	14.98	7.87	117.87	2.94	1.21	2.03
5.91	8.41	15.26	7.59	115.86	2.93	1.18	2.06
5.99	8.65	15.71	7.17	112.69	2.90	1.10	2.10
6.07	8.72	15.82	6.95	109.99	2.88	1.05	2.10
6.15	8.66	15.71	6.95	109.24	2.88	1.03	2.08
6.23	8.43	15.27	7.20	109.86	2.90	1.03	2.01
6.32	8.26	14.92	7.38	110.18	2.91	1.03	1.95
6.40	8.09	14.59	7.58	110.53	2.92	0.99	1.89
6.48	7.95	14.32	7.75	110.92	2.94	1.00	1.85
6.56	7.76	13.96	8.01	111.85	2.95	1.00	1.79
6.64	7.58	13.61	8.19	111.49	2.96	0.99	1.73
6.73	7.45	13.35	8.23	109.87	2.97	0.93	1.69
6.81	7.38	13.21	8.08	106.77	2.96	0.89	1.66
6.89	7.25	12.97	7.98	103.45	2.95	0.81	1.62
6.97	7.03	12.54	7.94	99.57	2.95	0.75	1.56
7.05	6.70	11.92	8.03	95.66	2.95	0.67	1.47
7.14	6.37	11.27	8.14	91.78	2.96	0.59	1.39
7.22	6.13	10.82	8.09	87.53	2.96	0.54	1.32
7.30	6.02	10.60	7.84	83.09	2.94	0.47	1.29
7.38	6.00	10.56	7.41	78.28	2.91	0.41	1.28
7.46	5.98	10.51	7.04	74.02	2.89	0.36	1.27
7.55	5.85	10.26	7.03	72.14	2.89	0.32	1.23
7.63	5.77	10.09	7.15	72.09	2.90	0.34	1.21
7.71	5.86	10.25	7.57	77.60	2.92	0.35	1.22
7.79	6.25	10.98	7.57	83.12	2.92	0.50	1.30
7.87	7.36	13.08	6.50	84.99	2.85	0.55	1.54

**:: Strength loss calculation (Robertson (2009)) :: (continued)**

Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(tiq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
7.96	8.40	15.04	5.46	82.07	2.77	0.53	1.76
8.04	9.32	16.77	4.61	77.38	2.69	0.50	1.96
8.12	9.53	17.15	4.29	73.53	2.66	0.48	1.99
8.20	9.80	17.65	4.07	71.82	2.64	0.41	2.04
8.28	10.00	18.03	4.14	74.58	2.64	0.46	2.07
8.37	10.09	18.19	4.25	77.33	2.65	0.59	2.08
8.45	9.96	17.94	4.46	79.92	2.68	0.51	2.04
8.53	9.46	16.98	4.68	79.40	2.70	0.53	1.92
8.61	8.57	15.29	5.39	82.41	2.76	0.50	1.72
8.69	7.60	13.46	6.38	85.81	2.84	0.51	1.51
8.78	6.90	12.12	7.33	88.85	2.91	0.54	1.35
8.86	6.67	11.67	7.72	90.07	2.93	0.53	1.30
8.94	6.77	11.87	7.38	87.58	2.91	0.52	1.31
9.02	7.18	12.62	6.67	84.11	2.86	0.45	1.39
9.10	7.65	13.51	5.99	80.97	2.81	0.44	1.48
9.19	7.84	13.85	5.81	80.50	2.80	0.46	1.51
9.27	9.74	17.45	4.30	75.05	2.66	0.45	1.89
9.35	13.92	25.33	2.61	66.21	2.44	0.19	0.67
9.43	18.48	33.95	1.93	65.49	2.30	0.18	0.67
9.51	20.50	37.76	1.74	65.69	2.25	0.18	0.67
9.60	19.68	36.19	1.81	65.52	2.27	0.18	0.67
9.68	19.29	35.45	1.74	61.60	2.24	0.13	0.66
9.76	22.02	40.60	1.50	61.00	2.15	0.12	0.66
9.84	25.07	46.35	1.38	63.88	2.07	0.15	0.67
9.92	26.87	49.51	1.34	66.30	2.03	0.19	0.67
10.01	26.11	48.31	1.37	66.40	2.07	0.19	0.67
10.09	26.10	48.28	1.37	66.30	2.07	0.19	0.67
10.17	27.20	49.54	1.33	65.98	2.03	0.18	0.67
10.25	28.73	51.03	1.00	51.03	1.97	0.06	0.63
10.33	30.12	52.21	1.00	52.21	1.92	0.06	0.63
10.42	31.35	53.56	1.00	53.56	1.88	0.07	0.64
10.50	30.99	53.35	1.00	53.35	1.91	0.07	0.64
10.58	28.29	50.35	1.31	65.93	2.00	0.18	0.67
10.66	23.30	42.93	1.52	65.29	2.16	0.17	0.67
10.74	19.00	34.80	1.98	68.77	2.31	0.23	0.68
10.83	15.89	28.92	2.52	73.00	2.43	0.33	0.69
10.91	13.52	24.42	3.13	76.50	2.52	0.55	0.71
10.99	11.03	19.71	4.03	79.39	2.63	0.50	1.94
11.07	8.76	15.40	5.16	79.42	2.74	0.44	1.51
11.15	7.84	13.67	5.65	77.22	2.78	0.32	1.33
11.24	7.69	13.38	5.46	73.09	2.77	0.35	1.30
11.32	11.15	19.91	3.14	62.58	2.52	0.17	0.67
11.40	16.09	29.23	1.91	55.77	2.30	0.08	0.64
11.48	19.69	35.99	1.58	56.82	2.19	0.09	0.65
11.56	18.83	34.40	1.71	58.72	2.23	0.10	0.65
11.65	15.13	27.40	2.28	62.38	2.38	0.14	0.66
11.73	12.16	21.78	3.41	74.20	2.56	0.73	0.73
11.81	10.58	18.78	4.75	89.14	2.70	0.57	1.77

:: Strength loss calculation (Robertson (2009)) :: (continued)							
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
11.89	10.91	19.39	5.03	97.61	2.73	0.72	1.82
11.98	15.31	27.71	3.23	89.48	2.54	0.74	0.74
12.06	26.28	47.81	1.64	78.43	2.21	0.51	0.70
12.14	40.56	68.77	1.31	90.03	2.00	0.73	0.73
12.22	57.82	92.55	1.19	110.20	1.84	0.77	0.77
12.30	77.84	118.35	1.00	118.35	1.69	0.78	0.78
12.39	104.35	149.74	1.00	149.74	1.53	0.83	0.83
12.47	132.35	181.77	1.00	181.77	1.41	0.87	0.87
12.55	158.12	210.60	1.00	210.60	1.33	0.90	0.90
12.63	176.22	230.94	1.00	230.94	1.29	0.92	0.92
12.71	189.71	246.14	1.00	246.14	1.26	0.93	0.93
12.80	199.34	259.68	1.00	259.68	1.28	0.94	0.94
12.88	206.91	271.38	1.00	271.38	1.31	0.95	0.95
12.96	211.03	275.83	1.00	275.83	1.30	0.96	0.96
13.04	211.78	272.35	1.00	272.35	1.26	0.96	0.96
13.12	212.72	266.85	1.00	266.85	1.19	0.95	0.95
13.21	217.26	268.39	1.00	268.39	1.15	0.95	0.95
13.29	226.44	276.65	1.00	276.65	1.12	0.96	0.96
13.37	235.91	286.43	1.00	286.43	1.11	0.97	0.97
13.45	243.48	293.47	1.00	293.47	1.09	0.97	0.97
13.53	248.34	299.81	1.00	299.81	1.10	0.98	0.98
13.62	252.74	309.31	1.00	309.31	1.14	0.99	0.99
13.70	253.12	321.90	1.00	321.90	1.26	0.99	0.99
13.78	247.24	325.87	1.00	325.87	1.38	1.00	1.00
13.86	231.70	317.82	1.00	317.82	1.51	0.99	0.99
13.94	207.10	292.75	1.00	292.75	1.62	0.97	0.97
14.03	169.40	249.47	1.10	274.44	1.76	0.96	0.96
14.11	133.25	202.53	1.22	246.97	1.87	0.93	0.93
14.19	107.76	167.37	1.28	213.65	1.96	0.90	0.90
14.27	113.02	170.20	1.22	206.89	1.87	0.89	0.89
14.35	134.87	192.01	1.00	192.01	1.69	0.88	0.88
14.44	152.40	205.70	1.00	205.70	1.52	0.89	0.89
14.52	154.01	200.43	1.00	200.43	1.41	0.89	0.89
14.60	145.04	187.64	1.00	187.64	1.40	0.87	0.87
14.68	138.42	181.01	1.00	181.01	1.44	0.87	0.87
14.76	136.42	180.97	1.00	180.97	1.50	0.87	0.87
14.85	139.09	185.57	1.00	185.57	1.52	0.87	0.87
14.93	146.28	194.92	1.00	194.92	1.52	0.88	0.88
15.01	151.51	201.63	1.00	201.63	1.53	0.89	0.89
15.09	154.90	205.98	1.00	205.98	1.53	0.89	0.89
15.17	158.90	210.75	1.00	210.75	1.53	0.90	0.90
15.26	165.61	218.14	1.00	218.14	1.51	0.91	0.91
15.34	172.15	225.38	1.00	225.38	1.50	0.91	0.91
15.42	176.55	230.23	1.00	230.23	1.49	0.92	0.92
15.50	178.28	232.11	1.00	232.11	1.49	0.92	0.92
15.58	178.94	232.44	1.00	232.44	1.49	0.92	0.92
15.67	180.15	233.13	1.00	233.13	1.49	0.92	0.92
15.75	181.86	234.32	1.00	234.32	1.48	0.92	0.92

:: Strength loss calculation (Robertson (2009)) :: (continued)							
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.83	181.88	233.90	1.00	233.90	1.48	0.92	0.92
15.91	178.36	230.04	1.00	230.04	1.50	0.92	0.92
15.99	168.69	219.56	1.00	219.56	1.54	0.91	0.91
16.08	156.27	205.80	1.00	205.80	1.59	0.89	0.89
16.16	139.00	186.15	1.00	186.15	1.67	0.87	0.87
16.24	118.03	161.93	1.12	180.90	1.77	0.87	0.87
16.32	94.22	133.49	1.24	166.16	1.91	0.85	0.85
16.40	71.81	105.50	1.38	145.88	2.07	0.82	0.82
16.49	52.67	80.20	1.73	138.63	2.24	0.81	0.81
16.57	36.45	57.55	2.52	144.95	2.43	0.82	0.82
16.65	23.92	39.06	3.99	156.01	2.63	1.74	3.03
16.73	16.15	26.87	5.73	154.07	2.79	1.39	2.00
16.81	11.96	19.90	7.11	141.55	2.89	0.92	1.44
16.90	10.32	16.85	7.07	119.17	2.89	0.68	1.22
16.98	12.25	19.32	4.72	91.29	2.70	0.46	1.47
17.06	16.59	25.20	2.82	70.95	2.48	0.28	0.69
17.14	18.98	28.54	2.45	69.97	2.41	0.25	0.68
17.22	17.60	26.79	2.93	78.43	2.49	0.51	0.70
17.31	14.15	21.95	4.12	90.53	2.64	0.50	1.69
17.39	14.50	22.48	4.17	93.78	2.65	0.52	1.73
17.47	19.23	29.33	3.12	91.41	2.52	0.74	0.74
17.55	23.40	35.35	2.67	94.34	2.45	0.74	0.74
17.63	23.75	35.89	2.75	98.79	2.47	0.75	0.75
17.72	22.22	33.75	3.06	103.16	2.51	0.75	0.75
17.80	29.12	42.79	2.08	88.85	2.34	0.73	0.73
17.88	42.89	60.05	1.41	84.86	2.10	0.72	0.72
17.96	50.13	68.35	1.29	88.20	1.98	0.72	0.72
18.04	47.13	64.50	1.32	84.91	2.01	0.72	0.72
18.13	36.19	50.96	1.55	79.00	2.17	0.54	0.70
18.21	27.67	40.10	2.12	85.19	2.35	0.72	0.72
18.29	19.78	29.45	3.32	97.80	2.55	0.77	0.77
18.37	14.08	21.35	5.10	108.95	2.74	0.71	1.60
18.45	10.94	16.63	6.71	111.66	2.87	0.61	1.21
18.54	10.04	15.07	6.75	101.71	2.87	0.51	1.10
18.62	13.83	20.15	3.85	77.55	2.61	0.35	1.55
18.70	20.93	29.46	2.10	61.88	2.34	0.13	0.66
18.78	25.78	35.77	1.74	62.39	2.25	0.14	0.66
18.86	25.34	35.48	1.93	68.58	2.30	0.23	0.68
18.95	20.37	29.23	2.81	82.11	2.47	0.70	0.71
19.03	16.11	23.55	4.11	96.91	2.64	0.67	1.80
19.11	12.42	18.38	5.99	110.05	2.81	0.63	1.35
19.19	10.05	14.81	7.38	109.29	2.91	0.59	1.07
19.27	8.33	12.01	8.49	101.96	2.98	0.43	0.86
19.36	7.06	9.87	9.09	89.70	3.02	0.30	0.71
19.44	6.22	8.45	9.25	78.16	3.03	0.22	0.60
19.52	5.89	7.89	8.56	67.52	2.99	0.15	0.56
19.60	5.89	7.83	7.59	59.42	2.93	0.10	0.56
19.69	6.00	7.91	6.86	54.32	2.88	0.09	0.57

:: Strength loss calculation (Robertson (2009)) :: (continued)							
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(tiq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
19.77	6.14	8.07	6.48	52.28	2.85	0.08	0.59
19.85	6.42	8.44	6.07	51.22	2.82	0.08	0.62
19.93	6.77	8.93	5.70	50.91	2.79	0.09	0.66
20.01	7.30	9.64	5.17	49.84	2.74	0.09	0.72
20.10	7.63	10.06	4.79	48.23	2.71	0.08	0.75
20.18	7.87	10.38	4.68	48.59	2.70	0.08	0.78
20.26	8.23	10.89	4.60	50.08	2.69	0.10	0.82
20.34	8.71	11.58	4.53	52.51	2.68	0.11	0.87
20.42	9.25	12.38	4.58	56.67	2.69	0.13	0.93
20.51	9.85	13.31	4.73	62.99	2.70	0.18	1.00
20.59	10.66	14.48	4.69	67.91	2.70	0.24	1.09
20.67	10.77	14.66	4.83	70.77	2.71	0.25	1.10
20.75	10.68	14.48	4.85	70.21	2.71	0.25	1.08
20.83	10.86	14.78	5.07	74.85	2.73	0.23	1.10
20.92	14.47	19.78	3.96	78.32	2.62	0.36	1.50
21.00	17.66	24.14	3.42	82.49	2.56	0.75	0.75
21.08	18.59	25.40	3.36	85.35	2.55	0.75	0.75
21.16	15.57	21.37	4.27	91.36	2.66	0.50	1.61
21.24	12.02	16.56	6.09	100.90	2.82	0.50	1.21
21.33	9.91	13.59	7.88	107.07	2.94	0.52	0.97
21.41	9.14	12.35	8.59	106.13	2.99	0.50	0.88
21.49	10.84	14.76	6.81	100.56	2.87	0.42	1.07
21.57	25.63	33.94	2.24	75.96	2.37	0.42	0.70
21.65	52.86	66.56	1.29	86.02	1.98	0.72	0.72
21.74	80.92	97.97	1.00	97.97	1.74	0.74	0.74
21.82	95.46	113.49	1.00	113.49	1.64	0.77	0.77
21.90	88.44	106.57	1.04	110.41	1.72	0.77	0.77
21.98	71.18	88.55	1.26	111.22	1.93	0.77	0.77
22.06	49.69	64.18	1.60	102.39	2.19	0.75	0.75
22.15	34.10	45.20	2.47	111.79	2.42	0.77	0.77
22.23	23.47	31.54	3.82	120.34	2.61	1.03	2.39
22.31	16.70	22.51	5.51	124.16	2.77	0.83	1.65
22.39	12.34	16.48	7.23	119.14	2.90	0.72	1.18
22.47	10.58	13.85	7.37	102.13	2.91	0.47	0.99
22.56	9.76	12.41	6.15	76.25	2.82	0.22	0.90
22.64	9.38	11.55	4.55	52.57	2.68	0.08	0.86
22.72	9.18	11.04	3.57	39.38	2.58	0.06	0.63
22.80	9.85	11.80	3.01	35.53	2.50	0.02	0.62
22.88	11.26	13.54	2.54	34.40	2.43	0.02	0.62
22.97	12.37	14.90	2.30	34.31	2.39	0.02	0.62
23.05	12.58	15.14	2.27	34.40	2.38	0.02	0.62
23.13	11.80	14.15	2.43	34.45	2.41	0.02	0.62
23.21	11.56	13.84	2.52	34.94	2.43	0.02	0.62
23.29	12.74	15.38	2.46	37.85	2.42	0.02	0.62
23.38	14.61	17.88	2.51	44.90	2.43	0.04	0.62
23.46	15.74	19.54	2.86	55.91	2.48	0.08	0.64
23.54	15.23	19.28	4.09	78.83	2.64	0.30	1.45
23.62	15.41	19.75	4.90	96.83	2.72	0.61	1.46

:: Strength loss calculation (Robertson (2009)) :: (continued)							
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(tiq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
23.70	24.73	31.55	2.98	94.02	2.50	0.73	0.73
23.79	59.20	71.97	1.32	95.18	2.02	0.74	0.74
23.87	121.18	141.55	1.00	142.08	1.71	0.82	0.82
23.95	192.00	218.40	1.00	218.40	1.53	0.91	0.91
24.03	251.64	282.57	1.00	282.57	1.44	0.96	0.96
24.11	286.52	318.49	1.00	318.49	1.38	0.99	0.99
24.20	303.76	337.21	1.00	337.21	1.38	1.01	1.01
24.28	311.89	347.84	1.00	347.84	1.42	1.01	1.01
24.36	320.49	359.02	1.00	359.02	1.46	1.02	1.02
24.44	329.89	369.78	1.00	369.78	1.48	1.03	1.03
24.52	336.50	375.34	1.00	375.34	1.46	1.03	1.03
24.61	342.35	378.18	1.00	378.18	1.40	1.03	1.03
24.69	355.51	388.07	1.00	388.07	1.33	1.04	1.04
24.77	346.44	374.29	1.00	374.29	1.27	1.03	1.03
24.85	339.05	366.95	1.00	366.95	1.29	1.03	1.03
24.93	322.43	349.67	1.00	349.67	1.32	1.01	1.01
25.02	326.72	353.24	1.00	353.24	1.30	1.02	1.02
25.10	324.65	347.34	1.00	347.34	1.24	1.01	1.01
25.18	322.15	341.54	1.00	341.54	1.18	1.01	1.01
25.26	319.28	336.01	1.00	336.01	1.13	1.00	1.00
25.34	322.46	338.95	1.00	338.95	1.13	1.01	1.01
25.43	328.27	344.64	1.00	344.64	1.13	1.01	1.01
25.51	333.69	350.00	1.00	350.00	1.13	1.01	1.01
25.59	334.37	350.16	1.00	350.16	1.13	1.01	1.01
25.67	336.48	350.08	1.00	350.08	1.08	1.01	1.01
25.75	338.84	353.18	1.00	353.18	1.10	1.02	1.02
25.84	334.67	349.46	1.00	349.46	1.13	1.01	1.01
25.92	335.89	351.97	1.00	351.97	1.16	1.02	1.02
26.00	338.05	355.59	1.00	355.59	1.20	1.02	1.02
26.08	341.44	359.45	1.00	359.45	1.22	1.02	1.02
26.16	340.57	357.32	1.00	357.32	1.20	1.02	1.02
26.25	337.18	352.37	1.00	352.37	1.18	1.02	1.02
26.33	340.69	354.31	1.00	354.31	1.14	1.02	1.02
26.41	344.74	361.13	1.00	361.13	1.21	1.02	1.02
26.49	353.02	368.08	1.00	368.08	1.18	1.03	1.03
26.57	366.83	380.58	1.00	380.58	1.15	1.04	1.04
26.66	372.94	383.78	1.00	383.78	1.08	1.04	1.04
26.74	371.58	382.50	1.00	382.50	1.10	1.04	1.04
26.82	362.86	373.00	1.00	373.00	1.09	1.03	1.03
26.90	357.12	366.92	1.00	366.92	1.10	1.03	1.03
26.98	354.79	367.64	1.00	367.64	1.19	1.03	1.03
27.07	349.99	367.17	1.00	367.17	1.31	1.03	1.03
27.15	342.74	361.02	1.00	361.02	1.36	1.02	1.02
27.23	338.92	356.39	1.00	356.39	1.36	1.02	1.02
27.31	335.29	350.52	1.00	350.52	1.32	1.02	1.02
27.40	339.19	353.33	1.00	353.33	1.29	1.02	1.02
27.48	330.79	344.05	1.00	344.05	1.29	1.01	1.01
27.56	324.07	338.34	1.00	338.34	1.34	1.01	1.01

:: Strength loss calculation (Robertson (2009)) :: (continued)							
Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(tiq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
27.64	311.43	326.38	1.00	326.38	1.40	1.00	1.00
27.72	309.19	324.61	1.00	324.61	1.43	1.00	1.00
27.81	316.54	332.86	1.00	332.86	1.46	1.00	1.00
27.89	330.23	346.79	1.00	346.79	1.46	1.01	1.01
27.97	351.70	368.87	1.00	368.87	1.46	1.03	1.03
28.05	377.19	392.97	1.00	392.97	1.40	1.04	1.04
28.13	416.87	431.65	1.00	431.65	1.35	1.07	1.07
28.22	468.07	482.47	1.00	482.47	1.31	1.10	1.10
28.30	491.65	508.66	1.00	508.66	1.36	1.11	1.11
28.38	492.95	511.87	1.00	511.87	1.42	1.11	1.11
28.46	471.37	489.11	1.00	489.11	1.43	1.10	1.10
28.54	467.38	482.21	1.00	482.21	1.38	1.10	1.10
28.63	453.68	465.30	1.00	465.30	1.33	1.09	1.09
28.71	440.31	452.52	1.00	452.52	1.37	1.08	1.08
28.79	419.18	431.15	1.00	431.15	1.40	1.07	1.07
28.87	409.28	419.28	1.00	419.28	1.37	1.06	1.06
28.95	408.93	416.12	1.00	416.12	1.30	1.06	1.06
29.04	400.44	403.87	1.00	403.87	1.20	1.05	1.05
29.12	406.90	409.53	1.00	409.53	1.19	1.05	1.05
29.20	388.43	391.58	1.00	391.58	1.22	1.04	1.04
29.28	366.12	371.25	1.00	371.25	1.32	1.03	1.03
29.36	315.81	323.87	1.00	323.87	1.51	1.00	1.00
29.45	294.56	302.13	1.00	302.13	1.54	0.98	0.98
29.53	278.70	286.09	1.00	286.09	1.58	0.97	0.97
29.61	295.81	301.25	1.00	301.25	1.48	0.98	0.98
29.69	300.94	307.40	1.00	307.40	1.55	0.98	0.98
29.77	309.55	316.87	1.00	316.87	1.60	0.99	0.99
29.86	296.92	305.28	1.00	305.28	1.70	0.98	0.98
29.94	261.05	269.20	1.14	306.85	1.79	0.98	0.98
30.02	217.14	224.52	1.23	275.52	1.89	0.96	0.96
30.10	174.84	181.16	1.30	234.85	1.99	0.92	0.92
30.18	139.27	144.63	1.42	205.72	2.10	0.89	0.89
30.27	117.43	121.78	1.52	184.82	2.16	0.87	0.87
30.35	110.66	114.48	1.54	176.63	2.17	0.86	0.86
30.43	141.61	145.07	1.28	185.93	1.97	0.87	0.87
30.51	190.02	192.54	1.07	205.83	1.74	0.89	0.89
30.59	214.01	214.87	1.00	214.87	1.58	0.90	0.90
30.68	224.77	224.59	1.00	224.59	1.50	0.91	0.91
30.76	221.23	221.12	1.00	221.12	1.54	0.91	0.91
30.84	230.20	229.82	1.00	229.82	1.54	0.92	0.92
30.92	234.19	232.87	1.00	232.87	1.48	0.92	0.92
31.00	237.11	234.30	1.00	234.30	1.37	0.92	0.92
31.09	236.75	233.82	1.00	233.82	1.38	0.92	0.92
31.17	237.58	234.67	1.00	234.67	1.41	0.92	0.92
31.25	240.72	237.99	1.00	237.99	1.46	0.92	0.92
31.33	248.62	245.03	1.00	245.03	1.41	0.93	0.93
31.41	237.02	233.53	1.00	233.53	1.44	0.92	0.92
31.50	226.70	223.40	1.00	223.40	1.48	0.91	0.91

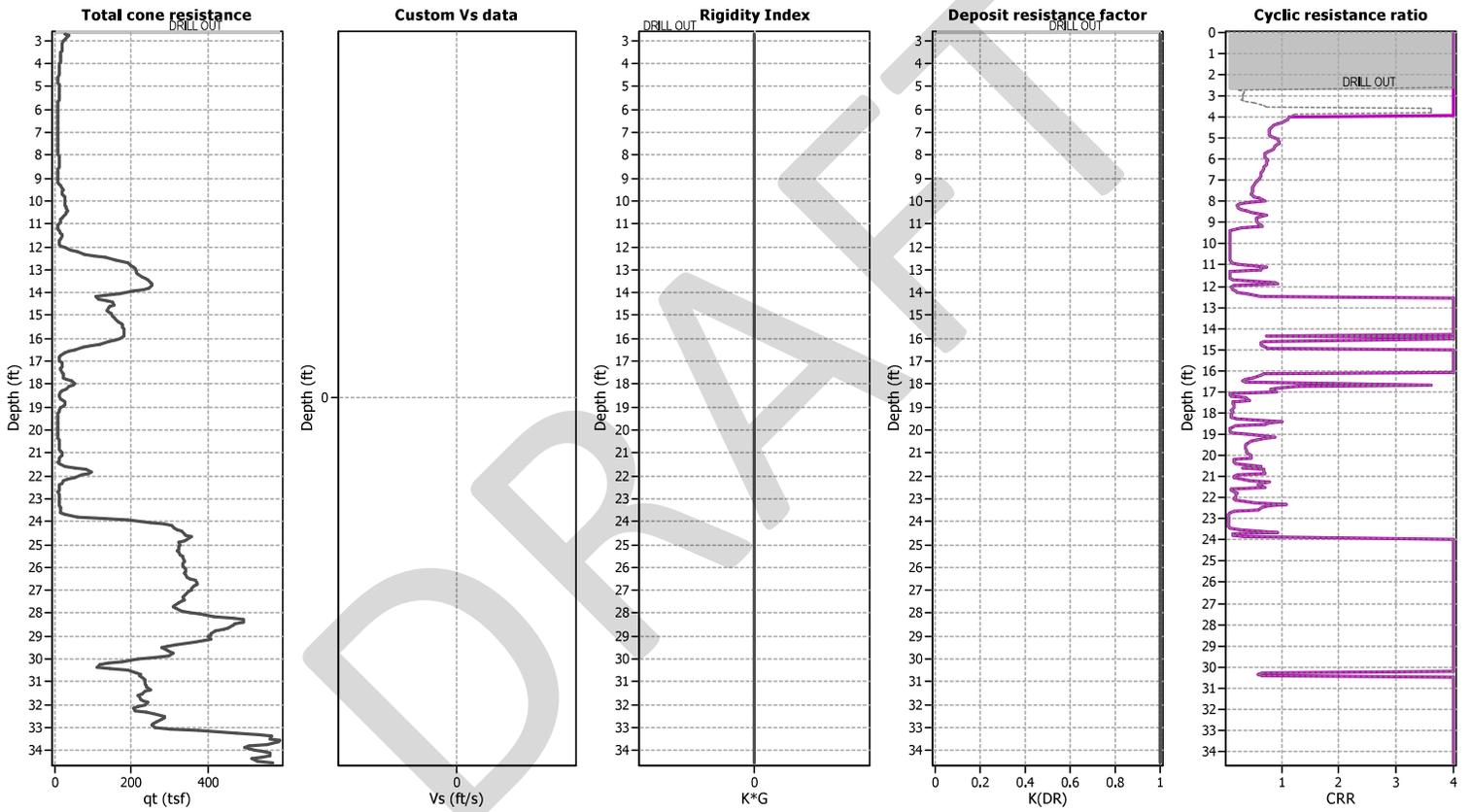
**:: Strength loss calculation (Robertson (2009)) :: (continued)**

Depth (ft)	$q_t$ (tsf)	$Q_{tn}$	$K_c$	$Q_{tn,cs}$	$I_c$	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
31.58	215.54	212.38	1.00	212.38	1.52	0.90	0.90
31.66	221.35	217.75	1.00	217.75	1.51	0.91	0.91
31.74	223.84	220.10	1.00	220.10	1.53	0.91	0.91
31.82	232.84	228.94	1.00	228.94	1.55	0.92	0.92
31.91	243.06	238.84	1.00	238.84	1.56	0.93	0.93
31.99	236.70	231.97	1.00	231.97	1.53	0.92	0.92
32.07	217.78	213.87	1.00	213.87	1.65	0.90	0.90
32.15	206.33	202.21	1.00	202.21	1.65	0.89	0.89
32.23	209.75	205.22	1.00	205.22	1.64	0.89	0.89
32.32	237.77	230.63	1.00	230.63	1.37	0.92	0.92
32.40	259.14	252.02	1.00	252.02	1.47	0.94	0.94
32.48	287.00	279.83	1.00	279.83	1.58	0.96	0.96
32.56	287.50	280.89	1.01	283.16	1.71	0.96	0.96
32.64	277.86	271.10	1.05	283.97	1.73	0.97	0.97
32.73	266.02	259.14	1.08	279.25	1.75	0.96	0.96
32.81	257.63	250.47	1.07	267.54	1.74	0.95	0.95
32.89	251.98	244.78	1.13	277.58	1.78	0.96	0.96
32.97	259.58	251.74	1.12	282.85	1.78	0.96	0.96
33.05	301.26	291.53	1.00	292.27	1.71	0.97	0.97
33.14	373.43	360.47	1.00	360.47	1.60	1.02	1.02
33.22	475.02	457.15	1.00	457.15	1.46	1.08	1.08
33.30	534.68	513.21	1.00	513.21	1.36	1.11	1.11
33.38	567.24	543.20	1.00	543.20	1.29	1.13	1.13
33.46	563.79	538.97	1.00	538.97	1.25	1.13	1.13
33.55	588.20	561.48	1.00	561.48	1.21	1.14	1.14
33.63	584.31	557.12	1.00	557.12	1.20	1.13	1.13
33.71	555.56	529.55	1.00	529.55	1.28	1.12	1.12
33.79	508.87	484.79	1.00	484.79	1.37	1.10	1.10
33.87	496.39	472.43	1.00	472.43	1.40	1.09	1.09
33.96	522.36	496.39	1.00	496.39	1.35	1.10	1.10
34.04	544.22	516.50	1.00	516.50	1.32	1.11	1.11
34.12	563.30	534.01	1.00	534.01	1.31	1.12	1.12
34.20	560.70	530.56	1.00	530.56	1.17	1.12	1.12
34.28	538.94	509.04	1.00	509.04	0.99	1.11	1.11
34.37	515.81	490.60	1.00	490.60	-1.00	1.10	1.10
34.45	530.29	503.93	1.00	503.93	-1.00	1.11	1.11
34.53	569.06	540.38	1.00	540.38	-1.00	1.13	1.13

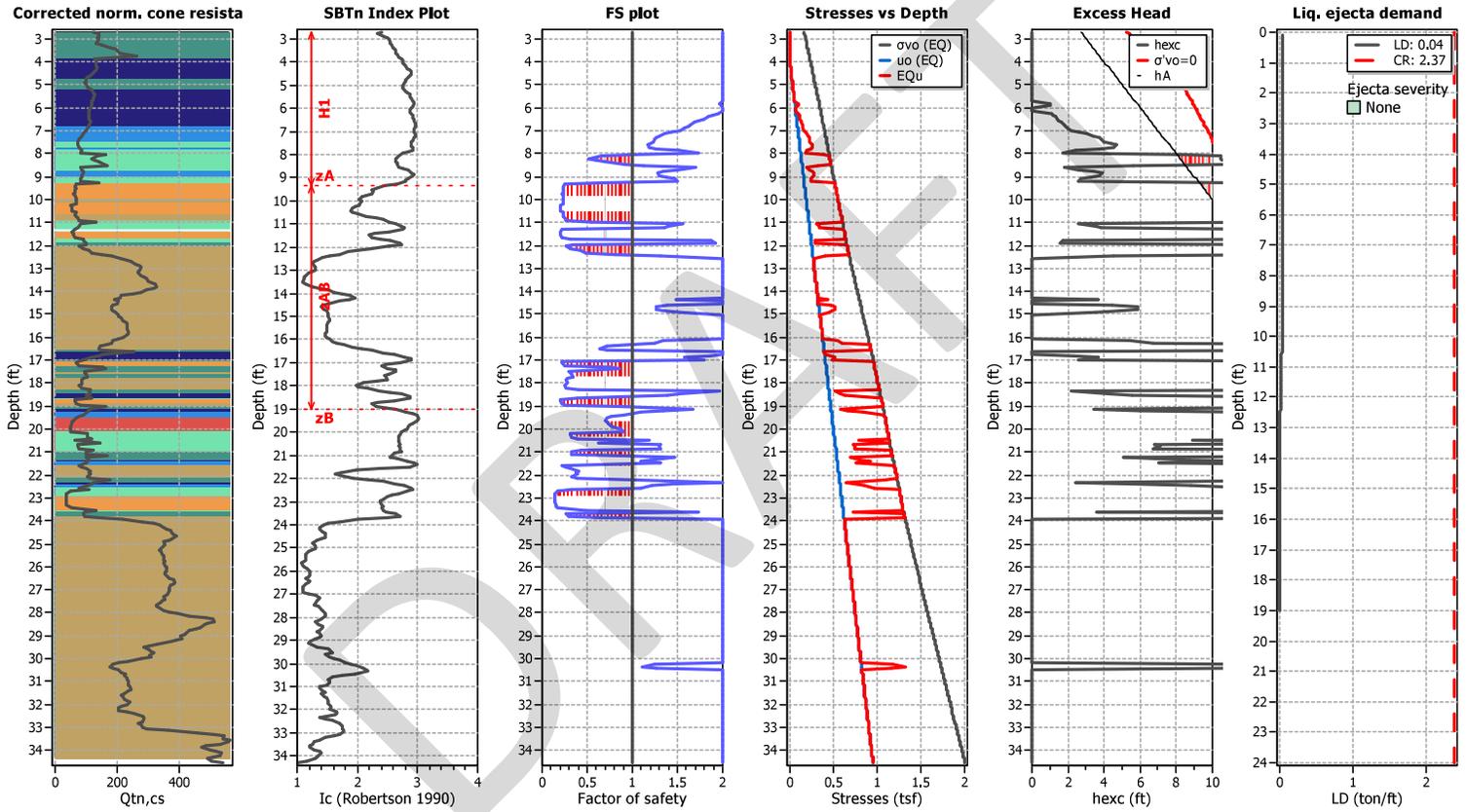
**Abbreviations**

$q_t$ :	Total cone resistance
$K_c$ :	Cone resistance correction factor due to fines
$Q_{tn,cs}$ :	Adjusted and corrected cone resistance due to fines
$I_c$ :	Soil behavior type index
$S_{u(liq)}/\sigma'_v$ :	Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$ :	Calculated peak undrained strength ratio

### Aging Calculation Estimation

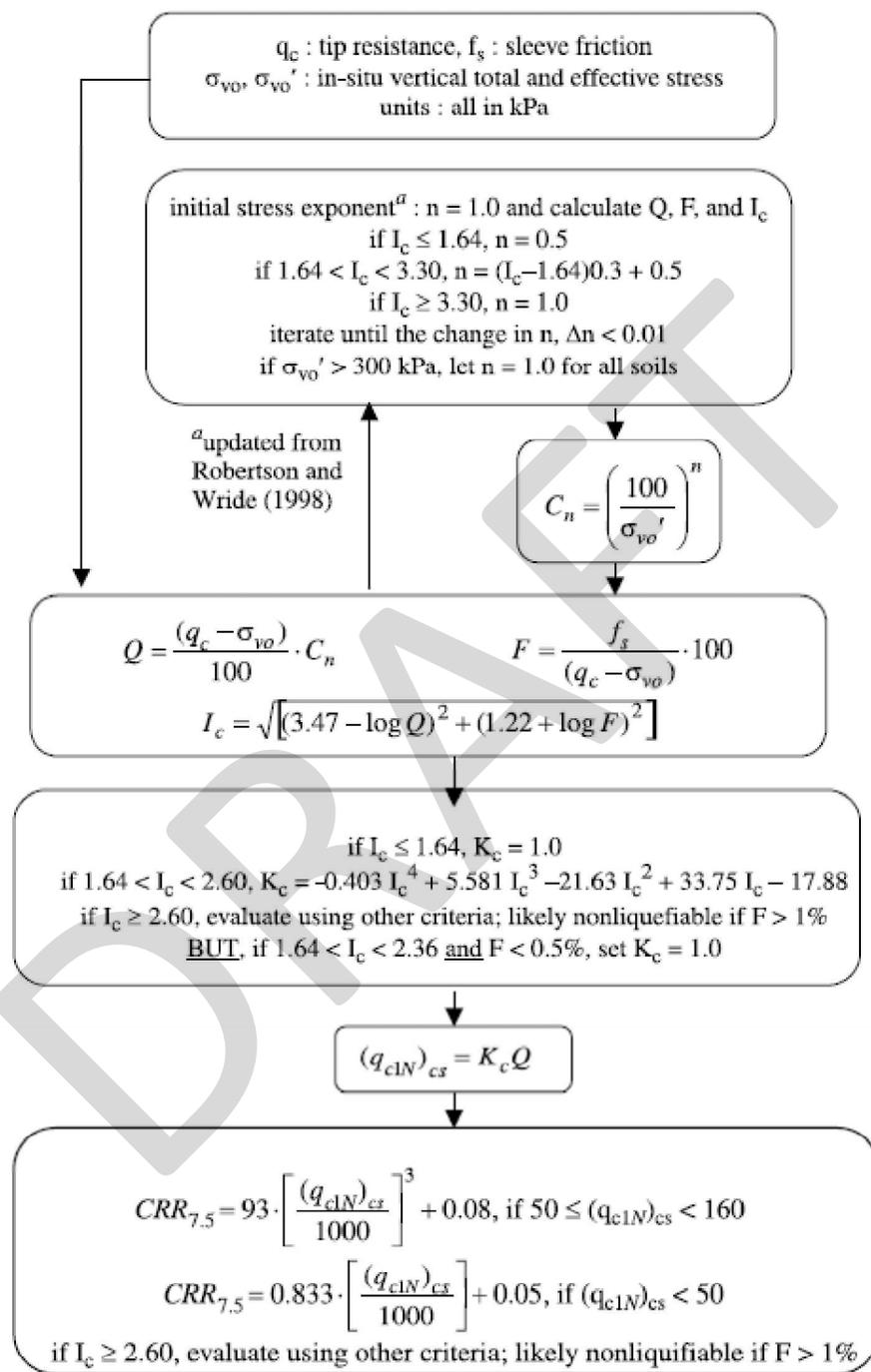


### Ejecta Severity Estimation



## Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

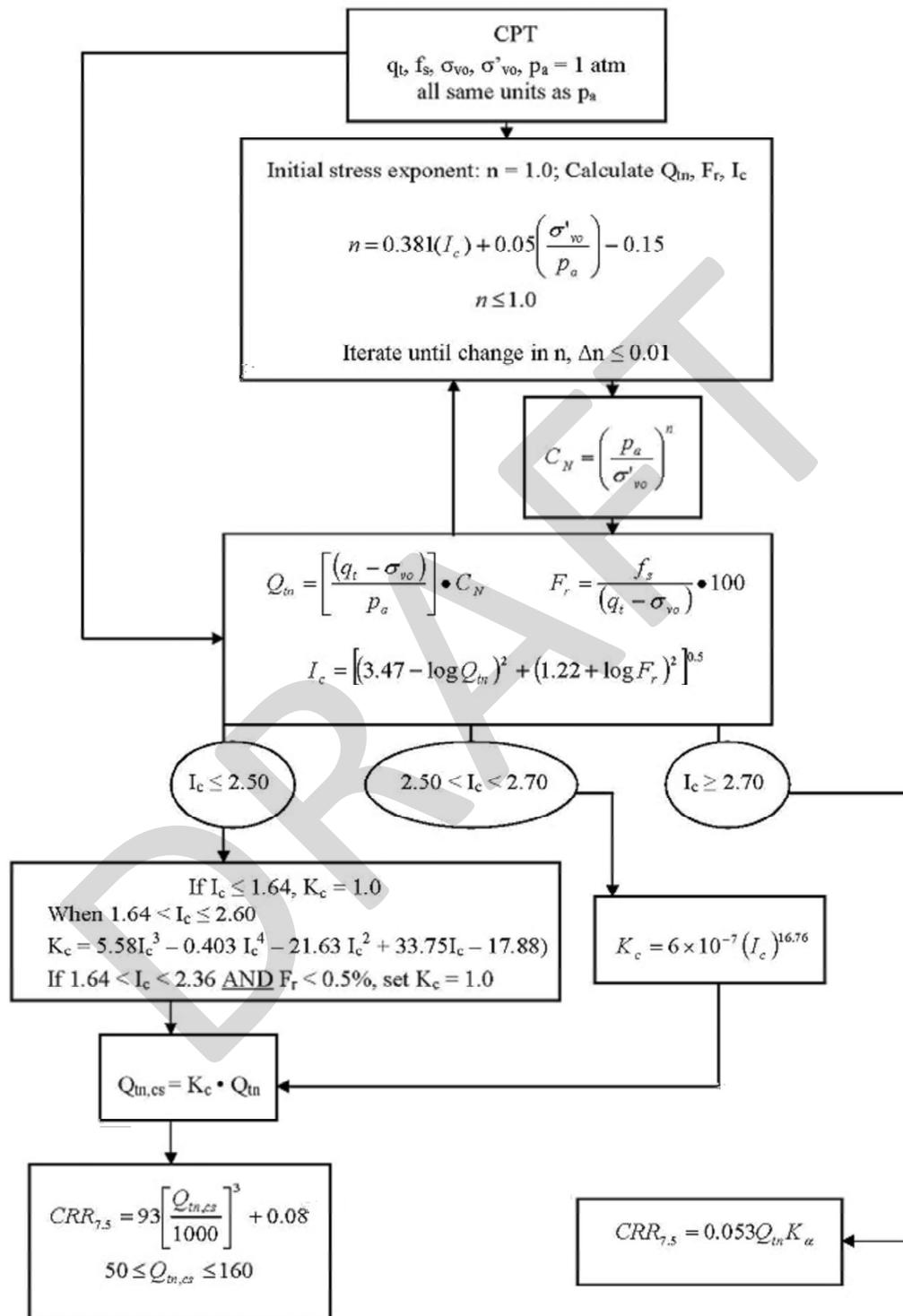
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart<sup>1</sup>:



<sup>1</sup> "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

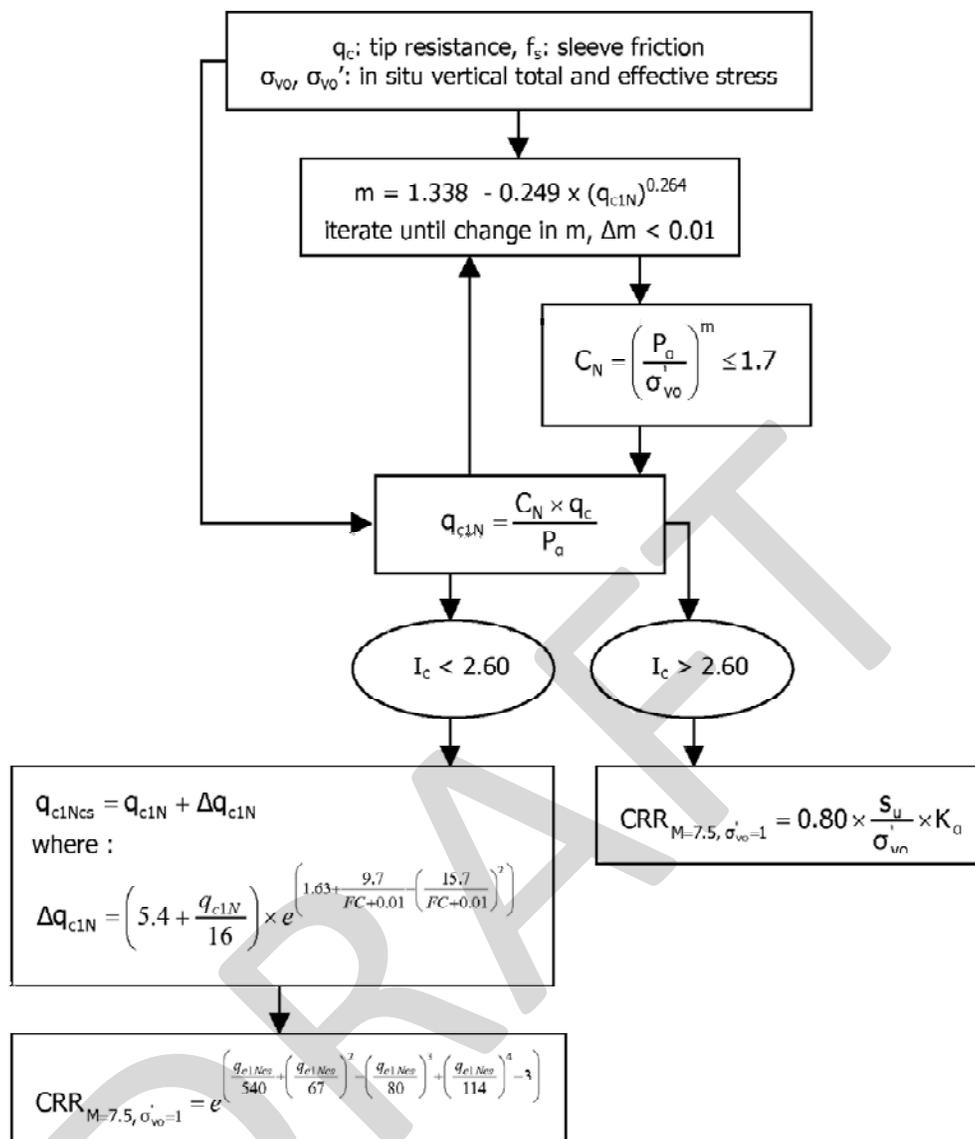
## Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart<sup>1</sup>:

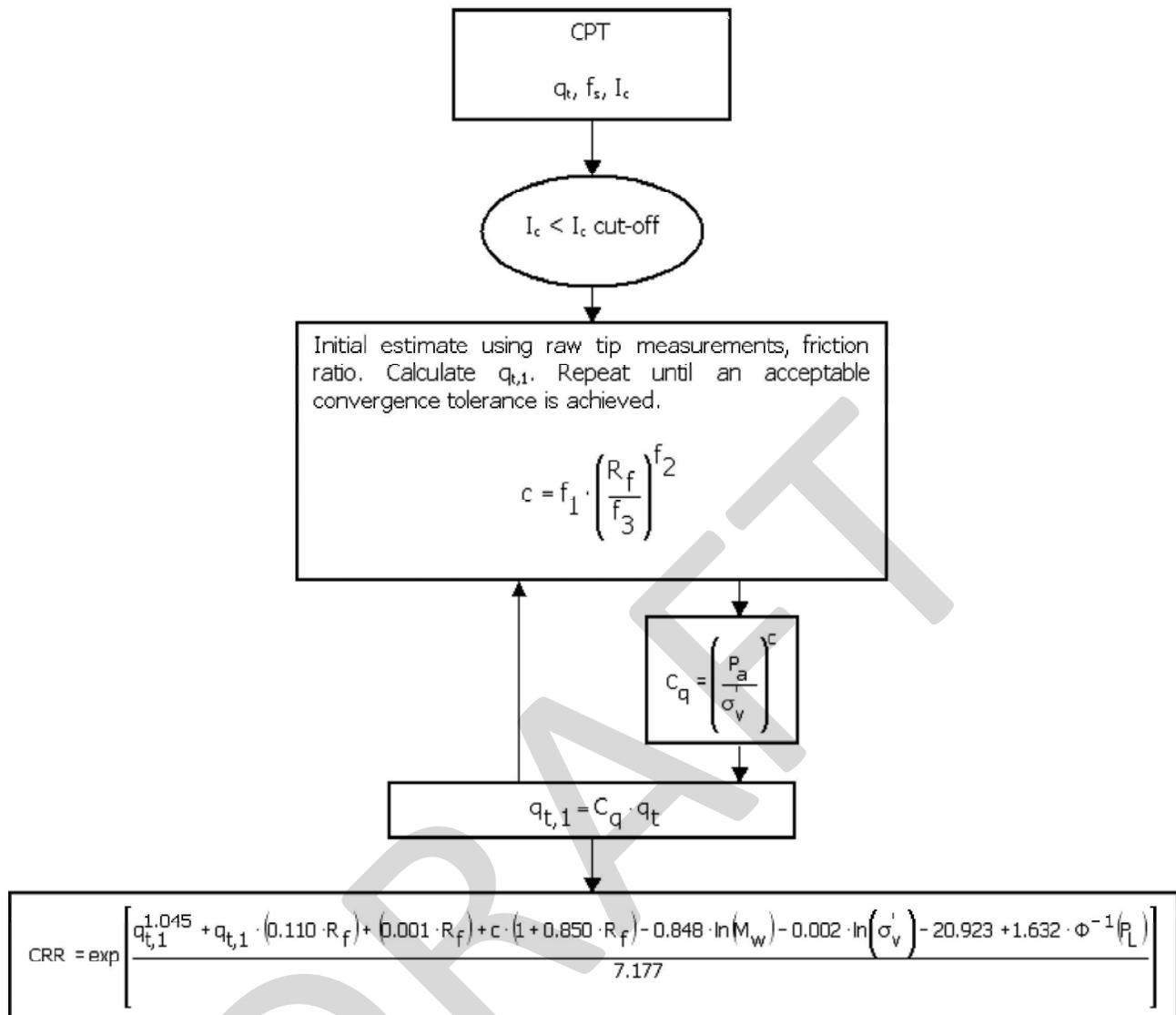


<sup>1</sup> P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

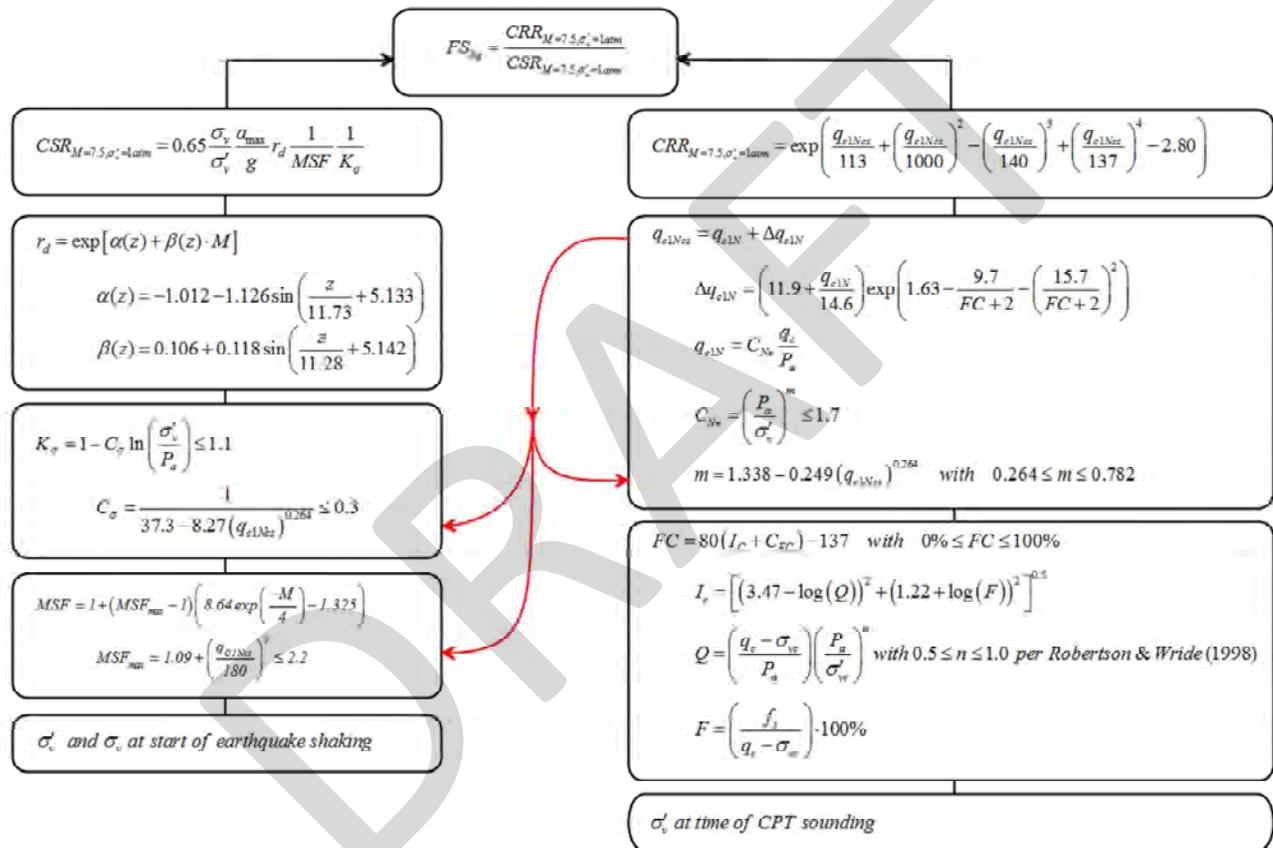
Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



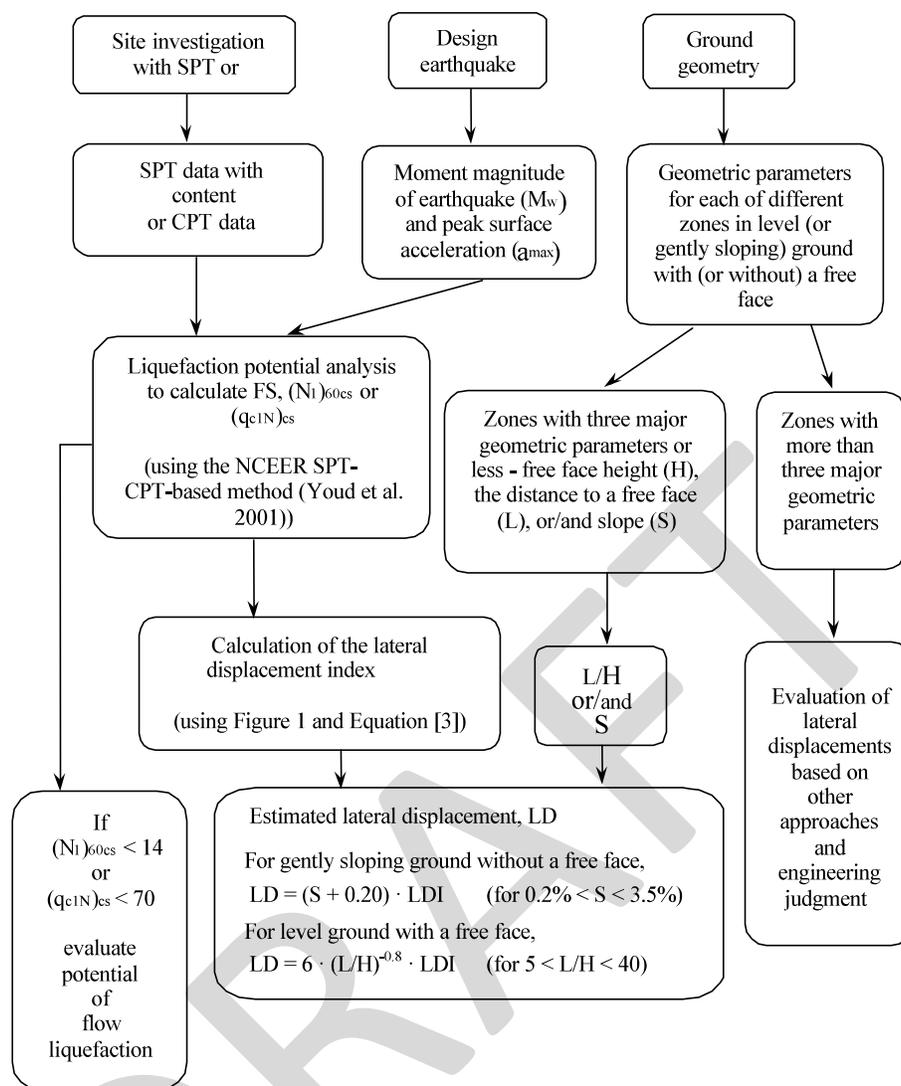
Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



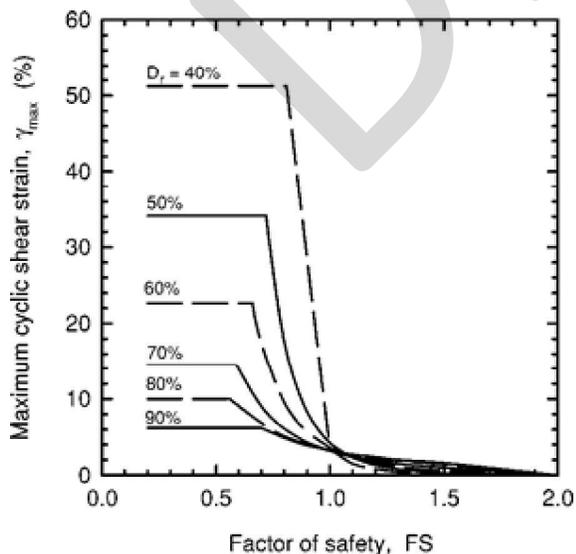
Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)



## Procedure for the evaluation of liquefaction-induced lateral spreading displacements



<sup>1</sup> Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



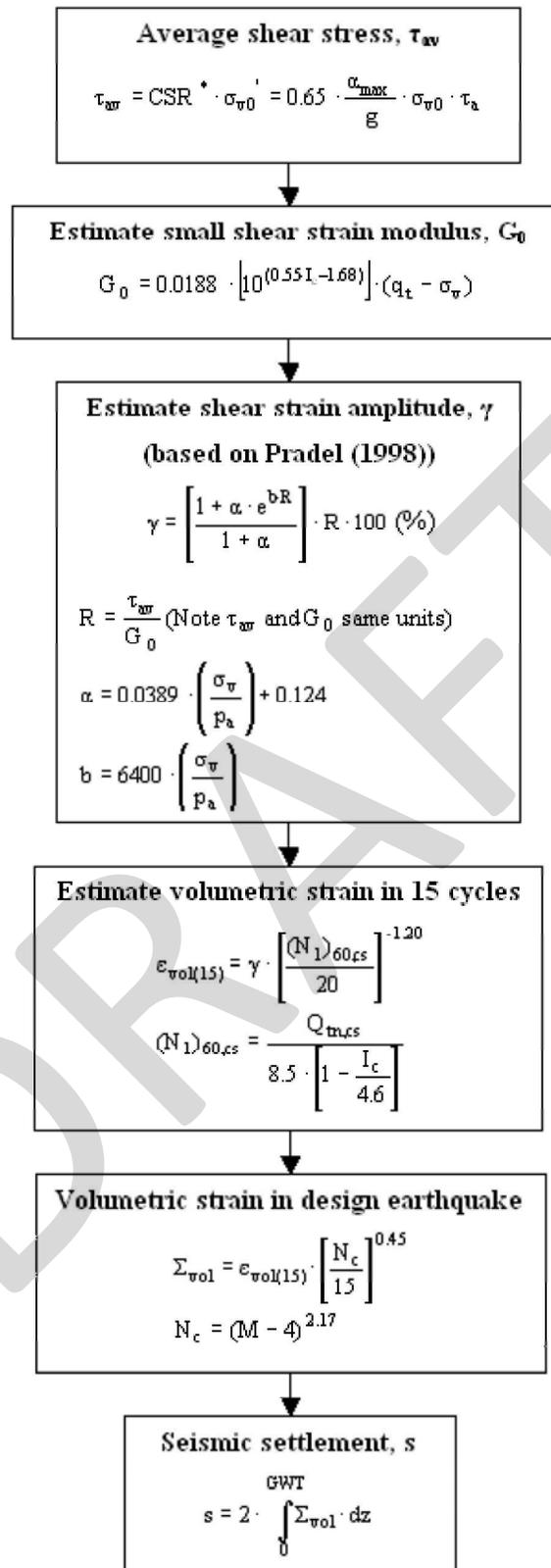
<sup>1</sup> Figure 1

$$LDI = \int_0^{Z_{max}} \gamma_{max} dz$$

<sup>1</sup> Equation [3]

<sup>1</sup> "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

**Procedure for the estimation of seismic induced settlements in dry sands**



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

## Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methodology developed by Iwasaki (1982) and is adopted by AFPS.

To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$LPI = \int_0^{20} (10 - 0,5z) \times F_L \times dz$$

where:

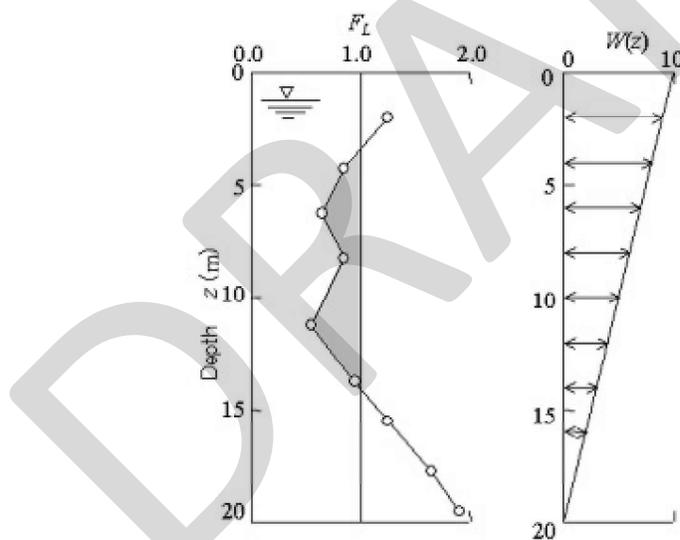
$F_L = 1 - F.S.$  when F.S. less than 1

$F_L = 0$  when F.S. greater than 1

$z$  depth of measurement in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- $0 < LPI \leq 5$  : Liquefaction risk is low
- $5 < LPI \leq 15$  : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

## Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$\begin{aligned} \ln(Ds) = & c1 + c2 * LBS + 0.58 * \ln\left(\tanh\left(\frac{HL}{6}\right)\right) + \\ & 4.59 * \ln(Q) - 0.42 * \ln(Q)^2 - 0.02 * B + \\ & 0.84 * \ln(CAVdp) + 0.41 * \ln(Sa1) + \varepsilon \end{aligned}$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, w is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε<sub>shear</sub>) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

## References

- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.
- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641-652
- Boulanger, R.W. and Idriss, I. M., 2014. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS
- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at <http://www.geologismiki.gr/>
- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151-8.
- Robertson, P.K. and Wride, C.E., 1998. Cyclic Liquefaction and its Evaluation based on the CPT Canadian Geotechnical Journal, 1998, Vol. 35, August.
- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833
- Zhang, G., Robertson, P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180
- Zhang, G., Robertson, P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871
- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368
- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state-of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70
- Papathanassiou G., 2008, LPI-based approach for calibrating the severity of liquefaction-induced failures and for assessing the probability of liquefaction surface evidence, Eng. Geol. 96:94-104
- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355
- P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009
- Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, *Symposium in honor of professor I. M. Idriss*, SAN diego, CA
- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT-Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 8, August 1, 2006
- I. M. Idriss and R. W. Boulanger, 2008. Soil liquefaction during earthquakes, Earthquake Engineering Research Institute MNO-12
- Jonathan D. Bray & Jorge Macedo, Department of Civil & Environmental Engineering, Univ. of California, Berkeley, CA, USA, Simplified procedure for estimating liquefaction-induced building settlement, *Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 201*

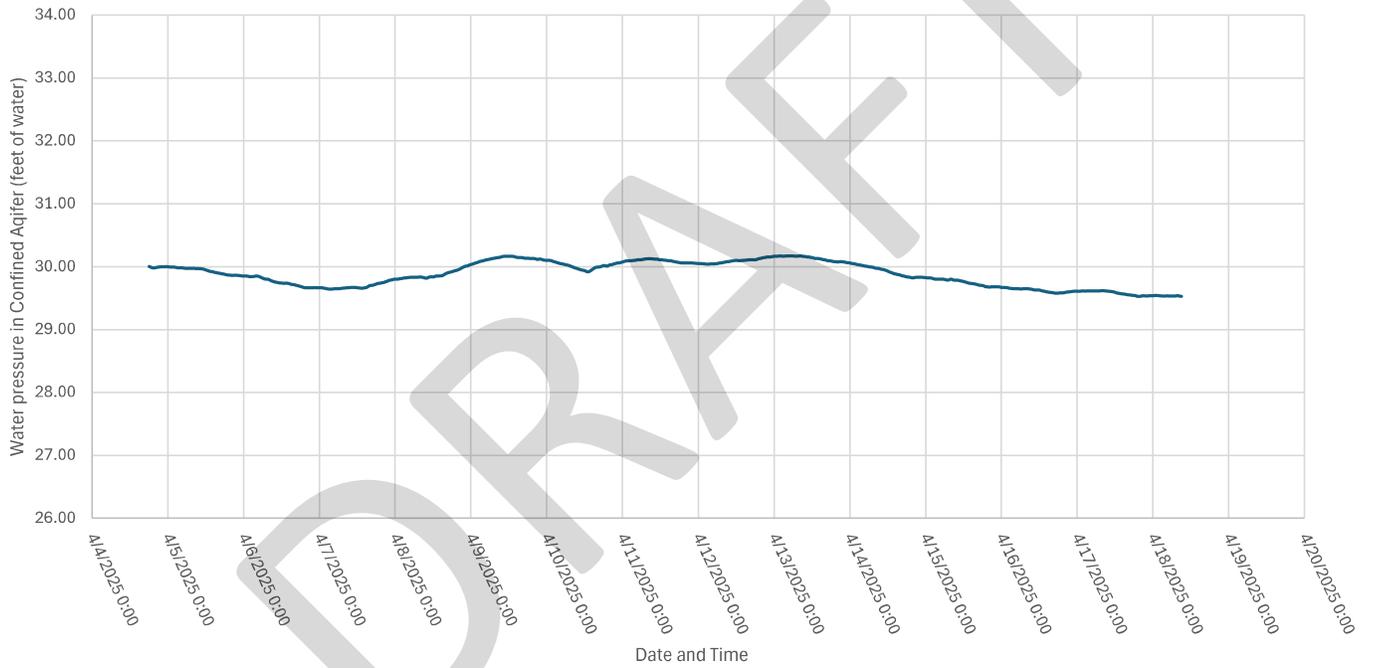
# APPENDIX F

## GROUNDWATER MONITORING DATA

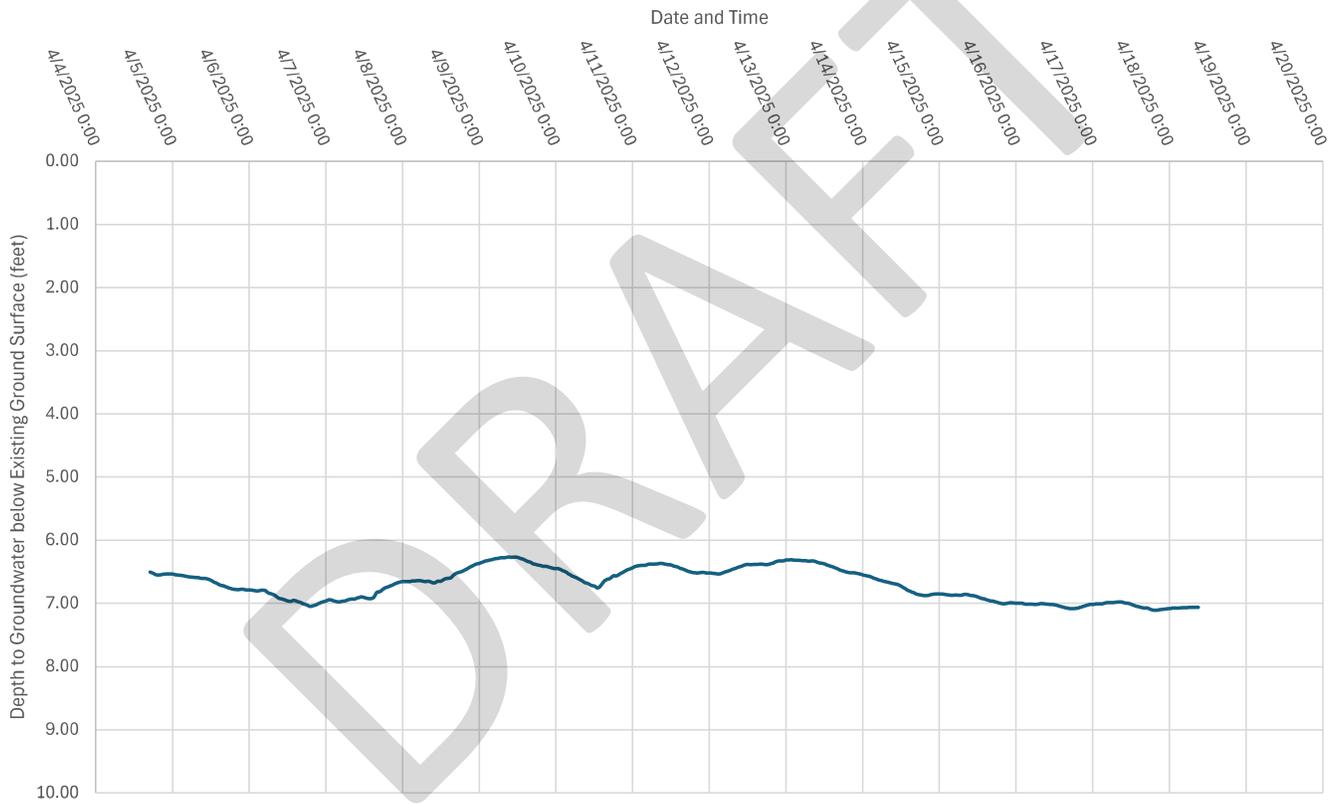
Groundwater Monitoring Data for B-4 .....	F-1
Groundwater Monitoring Data for B-5 .....	F-2
Groundwater Monitoring Data for B-6 .....	F-3
Groundwater Monitoring Data for B-7 .....	F-4

DRAFT

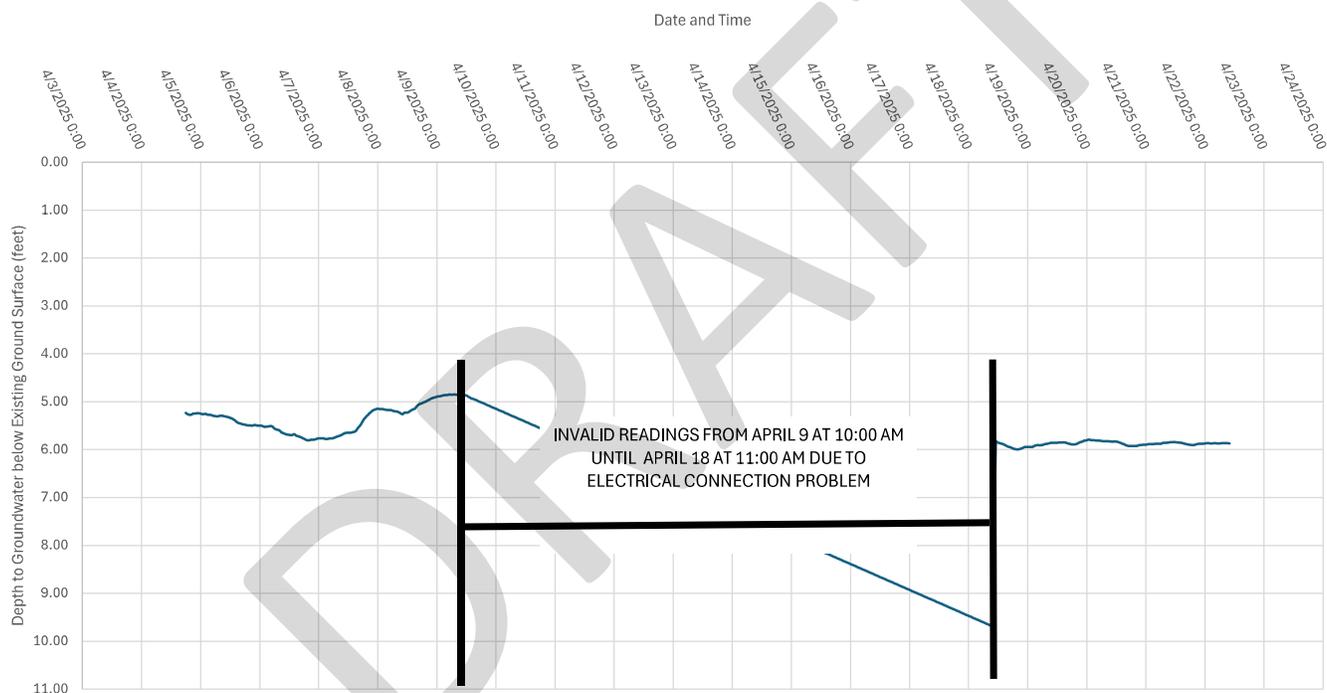
FS 32 - Groundwater Pressure in Confined (Artesian) Aquifer, VWP tip at D = 30 ft, Boring B-4, (Surface Elevation = 76 ft NAVD88)



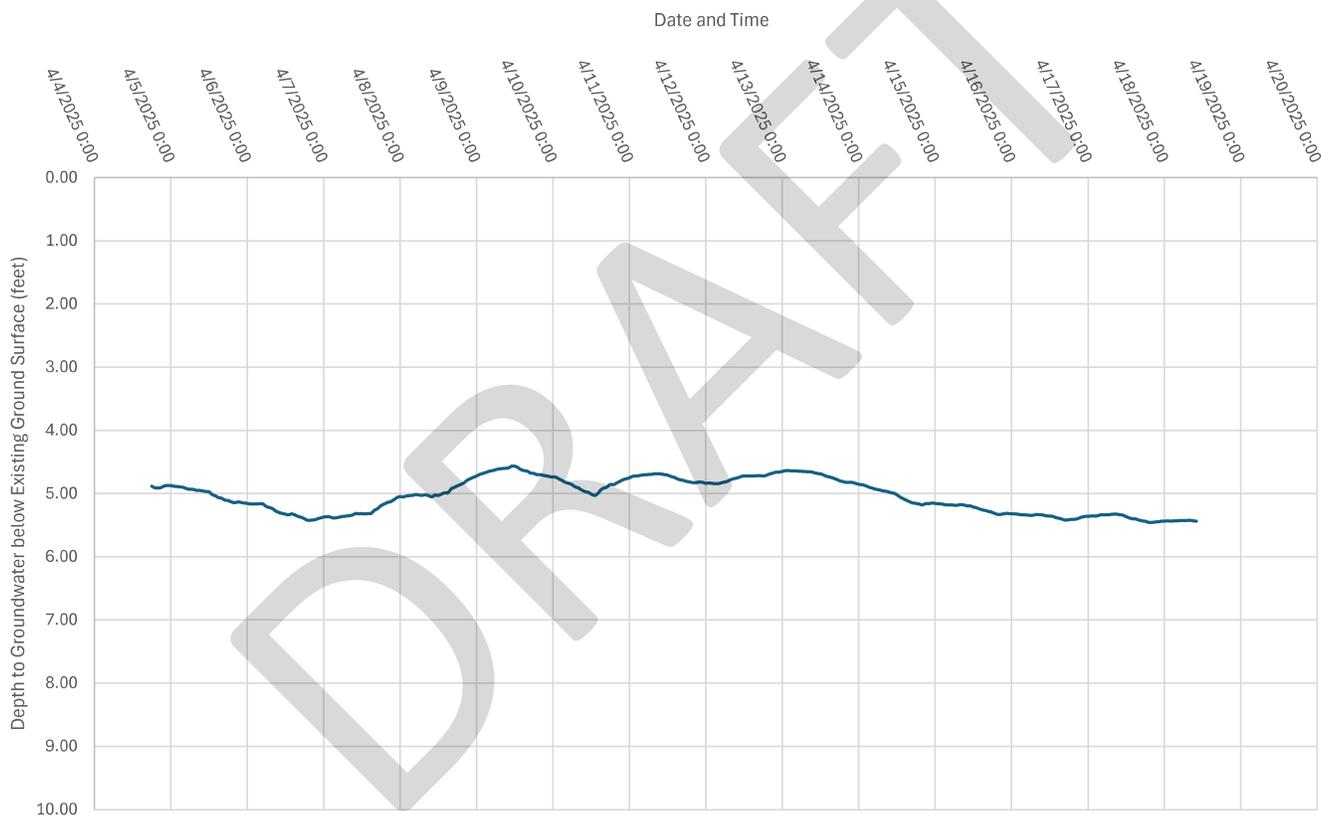
### FS 32 - Depth to Groundwater at Boring B-5 (Surface Elevation = 75 ft NAVD88)



FS 32 - Depth to Groundwater at Boring B-6 (Surface Elevation = 76 ft NAVD88)



### FS 32 - Depth to Groundwater at Boring B-7 (Surface Elevation = 75 ft NAVD88)



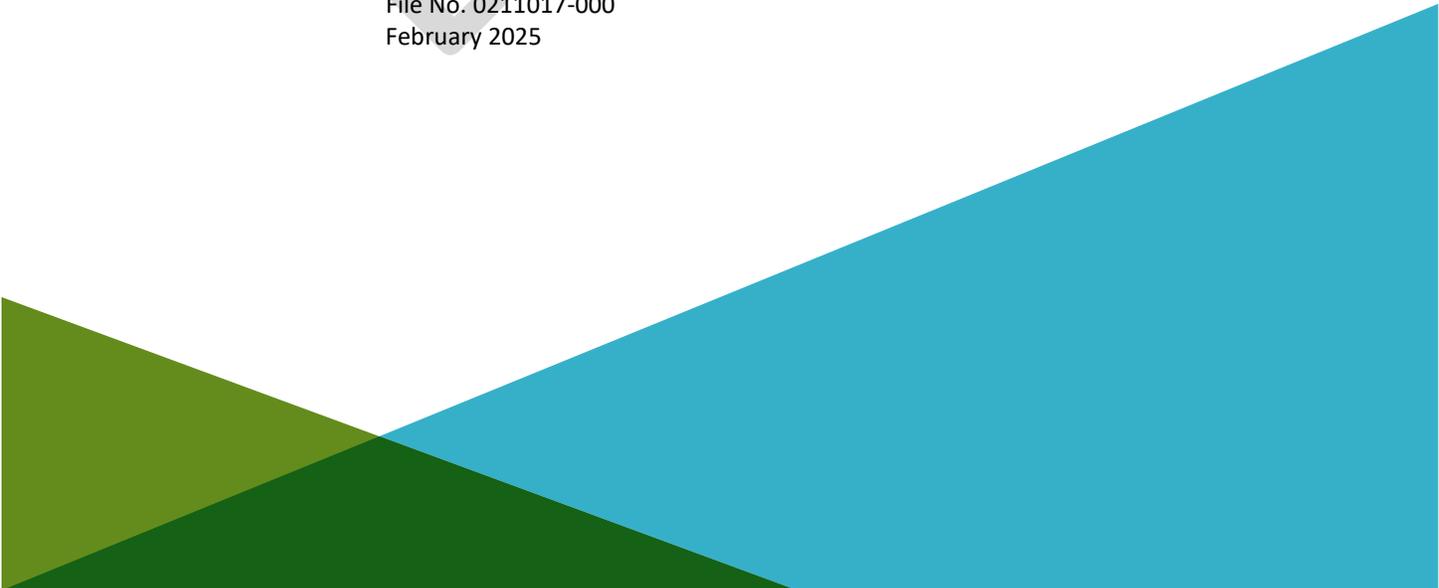
**AQUATIC RESOURCES REPORT  
SNOHOMISH REGIONAL FIRE & RESCUE  
VACANT PARCEL NO. 27070600200300  
MONROE, WASHINGTON**

by  
Haley & Aldrich, Inc.  
Spokane, Washington

for  
OAC Services, Inc.  
Everett, Washington

File No. 0211017-000  
February 2025

DRAFT



**SIGNATURE PAGE FOR**

**REPORT ON  
SNOHOMISH REGIONAL FIRE & RESCUE  
VACANT PARCEL NO. 27070600200300  
MONROE, WASHINGTON**

**PREPARED FOR  
OAC SERVICES, INC.  
EVERETT, WASHINGTON**

PREPARED BY:



---

Lindsay Chutas PWS  
Environmental Scientist  
Haley & Aldrich, Inc.

REVIEWED AND APPROVED BY:



---

Ryan Tobias PWS  
Associate Natural Resource Scientist  
Haley & Aldrich, Inc.

## Executive Summary

The purpose of this Aquatic Resources Report (ARR) is to identify and delineate wetlands occurring within the boundaries of Vacant Parcel No. 27070600200300, located at 19959 Oaks Street in Monroe, Washington (Site). This information may be used for compliance with the City of Monroe's Critical Area Ordinance (CAO; Chapter 22.80 Critical Areas), in conformance with Section 404 of the Clean Water Act, State of Washington Water Pollution Control Act, and Shoreline Management Act.

The subject property was evaluated for its content of potential jurisdictional wetlands and waterbodies, based on criteria set forth in the *2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains Valleys and Coast (Version 2.0)* (Engineer Research and Development Center, 2010) and the City of Monroe CAO Chapter 22.88.070 requirements for Critical Areas Studies. Prior to the Site visit, Haley & Aldrich, Inc. (Haley & Aldrich) reviewed existing project area literature including historical aerial photography, topographic maps, critical areas maps, and hydrology data. A subsequent field evaluation was performed to identify hydric soils, hydrology, and hydrophytic vegetation. Vegetation communities were evaluated and documented to delineate wetland and upland boundaries. The Site visit was performed on 15 May 2024.

Based on the information presented in this ARR and the data collected, Haley & Aldrich concurs that a 0.084-acre wetland (wetland W1) is present within the 2.16-acre study area. In addition, a 402 foot (ft) long stormwater ditch runs along the northeastern edge of the property boundary. The wetland within the investigation area is classified as palustrine emergent (PEM) and is located within the Eastern Puget Riverine Lowlands (2b) level IV ecoregion.

The U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) are the final authority over the jurisdictional status of both wetlands and waters of the U.S., per Section 404 of the Clean Water Act. The State of Washington Department of Ecology (Ecology) has final jurisdiction over wetlands and water of the state. The findings discussed in this report are solely the opinion of Haley & Aldrich and have not been verified by the aforementioned regulatory government agencies.

# Table of Contents

	Page
<b>Executive Summary</b>	<b>i</b>
<b>List of Tables</b>	<b>iii</b>
<b>List of Figures</b>	<b>iii</b>
<b>List of Appendices</b>	<b>iii</b>
<b>1. Introduction</b>	<b>1</b>
<b>2. Project Location/General Setting</b>	<b>2</b>
<b>3. Scope of Services</b>	<b>3</b>
<b>4. Methods</b>	<b>4</b>
4.1 LITERATURE REVIEW	4
4.2 WETLAND DELINEATION	4
4.2.1 Field Methods	4
4.2.2 Vegetation	5
4.2.3 Hydrology	6
4.2.4 Soils	2
4.3 WETLAND CHARACTERISTICS	3
4.4 ORDINARY HIGH-WATER MARK DELINEATION	3
<b>5. Results</b>	<b>2</b>
5.1 LITERATURE REVIEW	2
5.1.1 Soils	2
5.1.2 NWI Map	2
5.1.3 Topographic Maps/Historical Aerial Photographs	2
5.1.4 Critical Areas Maps	2
5.1.5 Climate	2
5.1.6 Flood Plains	3
5.2 FIELD INVESTIGATIONS	3
5.2.1 Wetland Delineation/ Assessment	3
5.2.2 Soils and Hydrology	4
5.2.3 General Vegetation	4
5.3 REGULATORY REVIEW	5
5.3.1 Wetland W1—approximately 3659 square feet (sf) (0.0084 acres) in size	5
5.3.2 Stormwater Ditch S1	6
5.3.3 Regulatory Correspondence	6
<b>6. Conclusions</b>	<b>7</b>
<b>7. Limitations</b>	<b>8</b>
<b>References</b>	<b>9</b>

## List of Tables

<b>Table No.</b>	<b>Title</b>
I	Plant Indicator Status Categories
II	Soil/Hydrology Data Summary
III	Dominant Vegetation
IV	Overview of Aquatic Resources

## List of Figures

<b>Figure No.</b>	<b>Title</b>
1	Vicinity
2	Study Area
3	Desktop Review
4	Delineated Aquatic Resources
5	Delineated Aquatic Resources with Buffers

## List of Appendices

<b>Appendix</b>	<b>Title</b>
A	USACE Wetland Determination Data Sheet
B	Site Photographs
C	NRCS Custom Soil Resource Report
D	Antecedent Precipitation vs. Normal Range
E	National Flood Hazard Layer FIRMette
F	Wetland Rating Summary

## 1. Introduction

Snohomish Regional Fire & Rescue (SRFR) is proposing to build a fire station and parking area on Vacant Parcel No. 27070600200300 located at 19959 Oaks Street in Monroe, Washington (Site). The existing Site is used as a temporary storage site for equipment and trucks. The proposed station will include an approximately 10,000 square foot building with parking in the upland portion of the property. This fire station is intended to improve response times and better serve the greater Monroe community. The purpose of this Aquatic Resources Report (ARR) is to identify and delineate any aquatic resources that are present on the Site.

DRAFT

## 2. Project Location/General Setting

The Site is located within the northwest one-fourth of Section 6, Township 27 north, Range 7, east of the Willamette Meridian, in Monroe, Washington. The Site encompasses 2.16 acres and is located in the valley floor, approximately 0.55 miles northwest of the mainstem of the Skykomish River. The Site is currently undeveloped and overgrown with Himalayan blackberry (*Rubus armeniacus*) and reed canary grass (*Phalaris arundinacea*). It is currently used as a parking area for vehicles and trailers. See Figure 1 for the Vicinity Map and Figure 2 for the Study Area Map.

DRAFT

### 3. Scope of Services

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by OAC Services, Inc. (OAC) to conduct wetland delineation and rating assessment services within the 2.16-acre Site boundary. The scope of services associated with Aquatic Assessment report included:

- **Literature Review/Field Preparation:** Haley & Aldrich reviewed appropriate reference materials pertinent to the Site, including the United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps; United States Geological Survey (USGS) topographic maps; United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Web Soil Survey for Snohomish County, Washington; critical areas maps, recent aerial photographs; and other readily available background information to assist in preparation of the wetland delineation/rating assessment.
- **Field Delineation:** Haley & Aldrich mobilized to the Site to conduct wetland delineation/rating assessment services on 15 May 2024. Wetland boundaries were determined after considering three wetland parameters: (1) vegetation; (2) soils; and (3) hydrology, in accordance with the U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual (1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (WMVC; USACE, 2010). Soil pits were hand excavated throughout the Site, as needed and appropriate, to record soil conditions relative to hydric indicators. Haley & Aldrich assessed the vegetative cover near each soil pit and estimated the relative abundance of hydrophytic species.
- **Wetland Boundaries:** Haley & Aldrich delineated and flagged wetland boundaries in the field for surveying and subsequent mapping by others. Each wetland boundary determination point and data plots were flagged in the field and located by global positioning system (GPS) equipment with sub meter accuracy.
- **Report Preparation:** Haley & Aldrich prepared this ARR to describe the wetland delineation and rating classification results of the wetland identified, in accordance with regulatory requirements and guidance. The report includes documentation of the wetland areas, supporting illustrations, photographs, wetland ratings forms, and reference citations. Map excerpts and appropriate appendices are also presented to support Haley & Aldrich's findings and conclusions.

## 4. Methods

### 4.1 LITERATURE REVIEW

Haley & Aldrich researched existing information on wetlands, streams, ditches, and other man-made aquatic features documented within the project boundary prior to conducting the Site visit. The readily available literature reviewed includes:

- USFWS NWI maps (USFWS, 2023);
- USGS Topographic Map;
- USDA/NRCS Websoil Survey for Snohomish County, WA (USDA NRCS, 2020);
- Critical Areas Maps (City of Monroe, 2024a);
- Readily available online, current, and historical aerial photographs - Aerial Imagery-National Aerial Imagery Program (NAIP; USDA, 2021);
- Washington Department of Natural Resources (WDNR) Hydrography Dataset (DNR, 2023); and
- Precipitation Data, Daily and Monthly and Thirty-Year Averages Precipitation (USDA NRCS, 2023).

### 4.2 WETLAND DELINEATION

The wetland delineation was conducted in accordance with the guidance set forth in the 1987 USACE Wetland Delineation Manual (Environmental Laboratory, 1987) and the 2010 Regional Supplement to the USACE Wetland Delineation Manual: WMVC (USACE, 2010). These manuals follow the three-parameter approach for conducting wetland determinations. This approach documents: (1) the presence of hydrophytic vegetation; (2) hydric soils; and (3) wetland hydrology, all of which are described in further detail below. Except for wetlands with special characteristics, the presence of all three criteria is required for a given area to be classified as a wetland. The USACE and Ecology recognize the use of these methodologies for delineating wetlands in specific vegetation zones.

The Ordinary High-Water Mark (OHWM) of all open-water, non-wetland aquatic resources were also delineated using the appropriate OHWM characteristics, as defined in 33 CFR § 328.3(e) and 33 CFR § 329.11(a)(1) and Ecology guidance (Ecology, 2016). The USACE and Ecology recognize the use of these methodologies for delineating OHWM of open waters such as streams or rivers.

#### 4.2.1 Field Methods

Prior to visiting the Site, a health and safety briefing was completed; field gear and travel plans were prepared; and a communications protocol for the field crew was established. Haley & Aldrich's wetland scientists conducted the field assessment and delineation services on site 15 May 2024.

Based on Site observations, relative to topography, hydrology, and vegetation, wetland boundaries were estimated for subsequent testing to compare upland and wetland characteristics within the depressional and adjacent areas. Soil pits were hand dug to approximately 16 inches below ground surface (bgs) or until refusal or saturation was encountered. Soil pits were advanced within and outside a given wetland boundary to assess soil conditions in wetland and upland areas. Soils in each pit were

evaluated for texture, matrix color, presence, or absence of redoximorphic features or gleying (soil color) and depth of saturation. This information was used to determine the presence/absence of hydric soils and to assist developing wetland boundaries. Details regarding soils evaluation methodology are described in Section 4.2.4.

Wetland hydrology indicators included drainage patterns, presence of surface water and depth of groundwater within soil pits. The vegetation community was assessed within an approximate 30-ft radius of the soil pits. Vegetation, soil, and hydrology information collected during the field study are presented on the standard wetland delineation data forms, which are included in the USACE Wetland Determination Data Sheet, Appendix A.

Wetland boundaries were delineated and flagged in the field for subsequent mapping. A photographic record of Site conditions during our field study is provided in the Site Photographs, Appendix B.

#### 4.2.2 Vegetation

The USACE manual defines hydrophytic vegetation as the community within areas where inundation or soil saturation is either permanent or of sufficient frequency and duration to exert a controlling influence on the plant species present (USACE, 2010). Hydrophytic plant species have the ability to grow, compete, and establish in areas where anaerobic conditions exist due to the presence of surface water and/or groundwater. The USACE and USFWS (Reed, 1988) developed plant indicator categories that describe the probability of vegetation species to occur in wetlands. This list was updated and is now the USACE National Wetlands Plant Inventory (NWPI; USACE, 2020). Each plant species observed, within a given on-Site sample plot, was categorized according to the Arid West indicator status under the NWPI. Table 1 provides summarized definitions of the indicator status categories.

Indicator Status	Indicator Symbol	Description
Obligate Wetland Plants	OBL	Plants that occur in wetlands, under natural conditions, greater than 99 percent of the time
Facultative Wetland Plants	FACW	Plants that occur in wetlands, under natural conditions, between 67 to 99 percent of the time
Facultative Plants	FAC	Plants that occur in wetlands, under natural conditions, between 34 to 66 percent of the time
Facultative Upland Plants	FACU	Plants that occur in wetlands, under natural conditions, between 1 to 33 percent of the time
Obligate Upland Plants	UPL	Plants that occur in wetlands, under natural conditions, less than 1 percent of the time
No Indicator	NI	Indicator status has not been identified for the species
No Occurrence	NO	No known occurrence of the plant in the region

The prevalence of wetland vegetation is characterized by the dominant species comprising the plant community within a wetland. A dominant species is considered any plant species that represents 20 percent or greater total aerial coverage for each vegetative stratum (tree, shrub, herbaceous, or aquatic bed). If more than 50 percent of the dominant plant species in an area were categorized as OBL, FACW

or FAC, the plant community is classified as hydrophytic and, therefore, meets that wetland indicator parameter. Additional observations of hydrophytic plant characteristics include: morphological adaptations (water roots or shallow root systems); physiological adaptations (inflated stems or polymorphic leaves); and reproductive adaptations (delayed flowering or floating seeds).

On-Site wetland vegetation communities, identified by field scientists, were classified according to the Cowardin Classification System (Cowardin, et al., 1979). Vegetation nomenclature described in this report follows the format outlined in the book, *Flora of the Pacific Northwest* (Hitchcock, et al., 1973).

#### 4.2.3 Hydrology

Hydrologic patterns that may create wetlands can be influenced by precipitation, stratigraphy, topography, soil permeability, plant cover, and human disturbance. Wetland hydrology encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season.

Primary and secondary hydrologic indicators used by field biologists to assist in the identification of potential wetlands include the following (USACE, 2008):

- Surface water or inundation
- High water table or saturated soil within 12 inches of the ground surface for 14 or more consecutive days at a minimum frequency of five years out of 10
- Water marks
- Sediment and drift deposits
- Algal mat or crust
- Iron deposits
- Surface soil cracks
- Salt crust
- Inundation visible on aerial photography
- Sparsely vegetated concave surface
- Aquatic invertebrates
- Water-stained leaves
- Hydrogen sulfide odor
- Oxidized rhizospheres along living roots
- Presence of reduced iron
- Stunted or stressed plants

Secondary indicators include (USACE, 2008):

- Drainage patterns
- Dry-season water table
- Saturation visible on aerial photography
- Geomorphic position
- Shallow aquitard
- FAC-neutral test
- Raised ant mounds
- Frost-heave hummocks

The growing season for a region is dependent on climate, precipitation, and topography. Hydrology must be present for at least 14 consecutive days and within 12 inches of the ground surface during the growing season to be considered a wetland. Indicators of the onset of the growing season include: (1) a soil temperature at 41 degrees Fahrenheit (°F) measured at 12 inches bgs; and/or (2) aboveground growth and development of vascular plants (USACE, 2008).

The growing season initiates on a given Site when two or more different non-evergreen vascular plants exhibit one or more of the following indicators of biological activity:

- Emergence of herbaceous plants;
- New growth on vegetative crowns;
- Coleoptiles/cotyledon emergence from seed;
- Bud burst on woody plants;
- Emergence or elongation of woody plant leaves; and
- Emergence or opening of flowers.

The growing season terminates on a given Site when woody deciduous species lose their leaves, and/or the last herbaceous plants cease flowering and their leaves become dry or brown. Additional information may be obtained from the Climate Analysis for Wetlands Tables (WETS) available from the USDA NRCS National Water and Climate Center. The objective of the WETS tables is to define the normal range for monthly precipitation and growing season to assess climatic characteristics for a geographic area over a representative interval. The growing season dates in the WETS tables provide an estimate of air temperature averages above 28°F.

#### 4.2.4 Soils

Hydric soils are formed under conditions of saturation, flooding, or ponding for a period long enough during the growing season that anaerobic conditions develop in the upper soil strata (zero to 20 inches commonly; USACE, 2008). These anaerobic conditions exhibit certain soil characteristics that can be identified in the field to investigate (confirm or deny) the hydric soil wetland parameter. Prolonged anaerobic soil conditions eventually lead to a chemically reduced state, where soil components (iron, manganese, sulfur, and carbon compounds) develop soil colors and other physical characteristics indicative of hydric status. These chemically-reduced soil components persist when the soil is either wet or dry. Specific hydric soil characteristics Haley & Aldrich's wetland scientist used to identify hydric soils include:

- Reduced iron resulting in a soil color that is known as gley (bluish-gray or greenish-gray);
- Loss of iron resulting in a soil color that is known as redox depletion (gray or reddish-gray);
- Loss of iron resulting in concentrated soil patches known as redoximorphic concretions (orange or red);
- Sulfidic odor; and
- High organic matter content (peat or muck) in the upper 32 inches of the soil profile.

Haley & Aldrich's study methods for hydric soil analysis included digging soil pits wherever drainage patterns, ponded areas, or indicators of water presence were observed. Soil pits were hand dug to depths between 10 and 24 inches bgs, as described previously in Section 4.2.1, along a transect perpendicular to the predicted wetland boundary in a gradient from dry to wet. Soils obtained from each soil pit were observed for color profile, odor, and redoximorphic condition. Hydric soil conditions must be met within 12 inches of the ground surface to consider the soil types hydric.

Soil colors were determined using Munsell® Soil Color Charts (Munsell Color, 2009) and their appropriate hue: spectral colors (e.g., 10YR); value: degree of lightness (e.g., 2/); and chroma: strength or purity of the color (e.g., /1). Soil profiles must have a dominant chroma of 2 or less or the layer with dominant chroma of more than 2 must be less than 6 inches thick to meet any hydric soil indicators. Hydric soil indicators commonly found in wetlands are identified in the technical document, *Field Indicators of Hydric Soils in the United States, a Field Guide for Identifying and Delineating Hydric Soils* (USDA NRCS, 2018). These indicators help identify soils formed under saturated, flooded, or ponded conditions long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile.

#### 4.3 WETLAND CHARACTERISTICS

The wetlands delineated in this study were characterized according to the Cowardin classification, which categorizes wetlands and deep-water habitats according to five separate systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (Cowardin, et al., 1979). These systems are then stratified into subsystems based on plant community types and are further stratified into classes and subclasses from substrate material. Each class and subclass are then annotated with specific modifiers for water regimes, water chemistry, soil, and other special modifiers. The USFWS uses this classification system in their NWI maps.

Site wetlands were also identified according to their hydrogeomorphic (HGM) classification to determine their location and function within the watershed. HGM classifications include the following:

- Depressional;
- Riverine;
- Lake-fringe;
- Slope;
- Flats; and
- Freshwater tidal.

#### 4.4 ORDINARY HIGH-WATER MARK DELINEATION

To estimate the presence of stream (lotic) features within the study area, Haley & Aldrich applied the methods utilized by the USACE in their *Regulatory Guidance Letter, Ordinary High Water Mark Identification* (USACE, 2005) and various indicators outlined with the USACE's *A Guide to the Identification of the OHWM in the Arid West Region of the Western United States* documentation (USACE, 2008). Haley & Aldrich's scientists used the Arid West OHWM definition for this study, as described below:

*“The term “OHWM” means that line on the shore established by the fluctuations of weather and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.”*

During the field investigation, we walked the Site to identify physical characteristics present on the shoreline of a given watercourse. Conditions may vary depending on the type of water body and conditions of the area. There are no required physical indicators that must be present to make an OHWM determination. However, the following physical characteristics were considered when making the OHWM determination:

- Natural line impressed on the bank
- Shelving or topographic breaks
- Changes in the character of soil
- Destruction of terrestrial vegetation
- Presence of litter or debris (drift lines)
- Wracking
- Vegetation matted down, bent, or absent
- Sediment sorting
- Leaf litter disturbed or washed away
- Scour
- Deposition
- Multiple observed flow events
- Bed and banks
- Water staining
- Change in plant community

Other methods for determining the OHWM that do not include physical observation:

- Lake and stream gauge data
- Elevation data
- Spillway height
- Flood predictions
- Historic records of water flow
- Statistical evidence

## 5. Results

### 5.1 LITERATURE REVIEW

#### 5.1.1 Soils

The Snohomish County, Washington NRCS Web Soils Soil Survey (USDA NRCS, 2020) identified two soil types within the Site boundary, as shown in the Desktop Review, Figure 3. A general description of the soil types, as defined by the NRCS Web Soil Survey, are provided below. Both soils identified on the property are listed on the National Hydric Soils List as being “hydric” soils.

- **7-Bellingham Silty Clay Loam:** 0 to 3 percent slopes; Landform: Drainageways, depressions; Parent material: Alluvium over lacustrine deposits; Drainage Class: poorly drained; Profile: silty clay loam over silty clay; Hydric.
- **55-Puget Silty Clay Loam:** 0 to 2 percent slopes; Landform: Flood plains; Parent Material: Alluvium; Drainage Class: Poorly drained; Profile: Silty clay loam; Hydric

Haley & Aldrich’s field observations during the Site survey generally confirmed that these soil conditions occurred in the area of the subject Site. See the NRCS Custom Soil Resource Report in Appendix C.

#### 5.1.2 NWI Map

The USFWS NWI online mapping database (USFWS NWI Wetland Mapper) identified a Palustrine Freshwater Emergent (PEM) wetland along the eastern edge of the property boundary, and a Type F (Fish-bearing) stream running north-south through the property, as shown in the Desktop Review, Figure 3.

#### 5.1.3 Topographic Maps/Historical Aerial Photographs

Haley & Aldrich reviewed various Monroe, Washington Quadrangle USGS topographical maps, dating to 1921 and historical aerial photographs, dating to 1985. The scales at which these maps were drawn or photos taken did not provide sufficient quality to determine changes over time. However, from what was observed from both resources, the Site vicinity appears to have remained undeveloped until the mid-1980s when development began on adjacent properties. The Site does not appear to have significantly changed since the mid-1980’s.

#### 5.1.4 Critical Areas Maps

Review of the City of Monroe Streams and Wetlands Maps indicated an unclassified stream (ditch) adjoins the eastern Site boundary. A critical area buffer associated with the unclassified stream is depicted within the project Site. Unclassified wetlands are mapped adjacent to the northeast of the project Site. The Shoreline Environment Designations map did not identify any shoreline designations at the Site (City of Monroe, 2024a).

#### 5.1.5 Climate

The closest weather station that records temperature data to the study area is the Monroe Station, which shows the normal temperature range reaching the low 60s (Fahrenheit) in the summer months

and high 30s in the winter. For the year 2024, January-March has had average temperatures, with a colder-than-average spring from the end of March through early May (USDA NRCS, 2023). See Appendix D for normal and 2024 observed temperatures.

The 30-year normal for precipitation at the Monroe Station is approximately 50 inches annually (USDA NRCS, 2023). The USACE Antecedent Precipitation Tool (APT) provides precipitation information for a specific point using nearby weather station data, weighted depending on horizontal and vertical distance from the specified point. The tool compares recent precipitation conditions to the 30-year normal range (30th-70th percentile) to determine whether field data or observations were made during normal climatic conditions. The tool can assess the presence or absence of drought conditions, or the approximate dates of wet or dry seasons for a given location.

An output from the APT tool was generated for the study area location. In March, April, and May of 2024, the study area was under normal climatic (precipitation) conditions. See Appendix D for precipitation data and deviations from normal.

#### **5.1.6 Flood Plains**

The study area lies within the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 535534. The entire project is within an area of minimal flood hazard and outside of the regulated floodplain. See Appendix E for FEMA FIRM.

### **5.2 FIELD INVESTIGATIONS**

#### **5.2.1 Wetland Delineation/ Assessment**

The study area encompasses approximately 2.16 acres adjacent to the northeast of the intersection of Oaks Street and Woods Creek Road in Monroe, Washington. The study area for the project includes any areas where soil disturbance could occur as a result of this Project. All quantities and areas in this report are referencing the aquatic resources within the study area boundary. See Figure 2 for a map of the Study Area.

The aquatic resources were delineated by Lindsay Chutas and Samantha Fisher from Haley & Aldrich on 15 May 2024. Aside from wetland W1 and the stormwater ditch, no additional aquatic resources were identified during the field investigation. Wetland data points were selected based on topography, hydrophytic vegetation, saturated soils, and drainage patterns. Each data point was assigned a unique number, and a data form from the WMVC Supplement was completed in both upland and wetland representative areas to delineate the wetland boundaries. Additional soil pits were dug periodically around wetland boundaries to confirm that the recorded data points are representative of the soil types and hydrologic conditions of each wetland.

The OHWM was delineated using physical characteristics as described in *A Guide to OHWM Delineation for Non-Perennial Streams in the Western Mountains, Valleys, and Coast Region (WMVC) of the United States* (USACE, 2014) and Ecology (Ecology, 2016) guidance.

Wetland boundaries and data points were mapped in the field and further refined by Haley & Aldrich staff using GIS software, imagery, LiDAR, and field observations. The wetland boundary was flagged with pink pin-flags and labeled with the date of observation.

## 5.2.2 Soils and Hydrology

The Haley & Aldrich scientists established 2 soil pits (WSP-1 and USP-1) within the project Site. Soil pits were located based on site observations such as topography gradient or low points within the terrain, general vegetative cover, or color change. Table II provides a summary of soil and hydrology data conditions encountered during the delineation/assessment.

Soil Pit ID	Approximate Depth (inches bgs)	Hue, Value, Chroma	Redox Features	Soil Description	Sulfide Odor	Depth to Water/Saturation (inches bgs)	Hydric Soils Present? (Yes/No)
WSP-1	0 – 4	10YR 3/3	No	Loamy/Clayey	No	15	Yes
	4 – 7	10YR 4/1	Yes				
	7-16	N4/	No				
USP-1	0 – 7	10YR 3/2	-No	Loamy/Clayey	No	--	No
	7-17	10YR 3/3	Yes				

**Notes:**  
 \* = hydric soil indicators present; however, the soil characteristics did not meet the specific requirements needed to trigger a "hydric soil" condition.  
**Bold** text indicates tests plots that occurred within a wetland.

Soils observed from the sample plot within Wetland W1 (WSP-1) consist of clay ranging from 10YR 3/3 with high organic content in the upper part of the soil, to a gley color in the lower part of the soil profile. Mucky loam was observed from zero to 4 inches depth. 4 to 7 inches depth contained redox concentrations within a 10YR 4/1 matrix, and below 7 inches was 100 percent N4/ gley. Hydric soil indicators observed include Loamy Mucky Mineral (F1), Loamy Gleyed Matrix (F2), Depleted Matrix (F3), and Redox Depressions (F8). USP-1 did not have soil indicative of hydric conditions and, therefore, were not considered wetland/hydric soils.

The wetland determination sample plot data forms are provided in Appendix A, and a photographic record of the soil pit conditions is provided in Appendix B.

## 5.2.3 General Vegetation

The study area consists of upland and riparian corridors and is currently utilized as a parking area for vehicles. The upland areas consist of invasive upland species and grasslands consistent with the eastern Puget Lowlands of Snohomish County, including common tansy (*tanacetum vulgare*), Himalayan blackberry (*Rubus armeniacus*), crabgrass (*poa spp.*), and small flowered cranesbill (*geranium californicum*). The riparian corridor was dominated by reed canary grass, soft rush (*juncus effusus*), western lady fern (*athrium cyclosorum*), and Geyer's willow (*salix geyeriana*).

Hydrophytic vegetation was characterized based on general dominant species observed within the approximately 5 to 30-foot-diameter sample plot surrounding each soil pit. Hydrophytic vegetation was observed across the cultivated areas of the Site, but was prevalent in depressional areas, as described in Table III below.

<b>Wetland</b>	<b>Herbaceous Layer</b> <i>(Common &amp; Scientific Name with Hydric Plant Classification)</i>	<b>Scrub/Shrub Layer</b> <i>(Common &amp; Scientific Name with Hydric Plant Classification)</i>	<b>Forested Layer</b> <i>(Common &amp; Scientific Name with Hydric Plant Classification)</i>
Wetland A	<ul style="list-style-type: none"> <li>• <u>Reed Canarygrass</u> <i>(Phalaris arundinacea)</i> – FACW</li> <li>• <u>Soft Rush</u> <i>(juncus effusus)</i> – FAC</li> <li>• <u>Western Lady Fern</u> <i>(athrium cyclosorum)</i></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Geyer’s Willow</u> <i>(Salix lutea)</i> – FACW</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>

### 5.3 REGULATORY REVIEW

According to the USACE, EPA, and Ecology, a wetland is defined as:

*“Those areas that are inundated or saturated by surface or ground water at a frequency and 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 swamps, marshes, bogs, and similar areas.”*

Based on this regulatory definition, field observations, data collection, historical site data, and previous report documentation, Haley & Aldrich identified one wetland (Wetland 1) that likely meets Ecology and the City of Monroe’s jurisdictional criteria. In addition, a non-wetland water (stormwater ditch) is located along the eastern boundary of the Site. A summary and quantities of aquatic resources delineated within the study area are described in Table IV below.

<b>ID</b>	<b>Type</b>	<b>Cowardin* Classification</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Acres</b>	<b>Linear Feet</b>	<b>Average Width (inches)</b>
W1	Wetland	PEM	47.86114	-121.964324	0.0084	N/A	NA
S1	Stormwater Ditch	Riverine	47.86114	-121.964324	NA	401.61	18-27"
<b>Totals:</b>					<b>0.0084</b>	<b>401.61</b>	
<b>Notes:</b> * = Class as defined in Cowardin, et al., 1979.							

#### 5.3.1 Wetland W1—approximately 3659 square feet (sf) (0.0084 acres) in size

One wetland feature, with a Cowardin classification of PEM and HGM classification of Riverine, was confirmed within the study area. Wetland hydrology comes from surface water runoff from the uplands and overflow of the stormwater ditch into the PEM wetland during wet periods of the year.

The Wetland W1 (0.084 acres) is dominated by reed canary grass and soft rush, with lesser amounts of western lady fern . See Appendix A for wetland determination forms and Figure 4 for a map of delineated aquatic resources. The photographic record of wetland characteristics are provided in Appendix B.

Site observations indicated that the NWI classification/mapping effort incorrectly mapped the Site and/or changes occurred on Site that that may have altered the wetland parameters of hydric soils, hydric vegetation, and hydrology, since the development of the NWI and DNR mapping.

#### **5.3.1.1 Wetland W1 Rating**

Wetland W1 was rated using the Washington State Wetland Rating System for Western Washington (Hruby, et al., 2014). The HGM class used for the rating was Riverine, and found to be an overall Category IV wetland based on functions, with a total score of 14: water quality function rating of 7, hydrologic function rating of 4, and habitat function rating of 3. Buffer widths are recommended as identified in the City of Monroe Development Standards (Table 22.80.090(D)(3)). Utilizing the matrix provided, a 50 ft buffer for the Category IV wetland is recommended. A figure showing the location of buffers relative to the proposed project boundary can be found in Figure 5. Full wetland rating can be found in Appendix F.

#### **5.3.2 Stormwater Ditch S1**

One stormwater ditch (S1) was confirmed on Site. This ditch was identified in the City of Monroe utilities database, but was not depicted as a stream on the NWI database. The DNR Water Courses map indicated a type F (Fish-bearing) stream was located running from the northern most part of the property through the southern boundary of the property. No stream was found in this location. However, the City of Monroe Streams and Wetlands Map identified the stormwater ditch as an unclassified stream with a 50-foot buffer along the eastern boundary of the site (City of Monroe, 2024a), which is consistent with field observations. The confirmed stormwater ditch flows along the northeast property boundary, from northwest to southeast, and exits the property through a stormwater inlet to a 30-inch reinforced concrete pipe. See Appendix B for photographic record of the stormwater ditch.

#### **5.3.3 Regulatory Correspondence**

An agency Site visit to review the findings from the delineation of aquatic resources was conducted on 13 November 2024, with representatives from Ecology and the Washington Department of Fish and Wildlife (WDFW), as well as representatives from the City of Monroe and Haley & Aldrich, in attendance. On 18 November 2024, Ryan Shaw of WDFW communicated via email that WDFW confirmed the stormwater ditch is a non-fish bearing stormwater drainage, with no current or historical connection to a surface water body (R. Shaw personal communication November 18, 2024). An email correspondence dated 12 December 2024 (post-Site visit) from USACE local field representative Ryan Cochoit indicated that the USACE had no concerns about the stormwater ditch as a jurisdictional water body (R. Cochoit personal communication, December 12, 2024).

## 6. Conclusions

Haley & Aldrich conducted a wetland delineation on the 2.16 -acre parcel located at 19959 Oaks Street in Monroe, Washington. The Site is currently used as a parking or storage space for vehicles and trailers, and is largely undeveloped and overgrown with blackberry, reed canary grass, and upland grasses.

Haley & Aldrich identified and delineated one wetland (Wetland 1) within the project Site boundary. This wetland was classified as a PEM wetland, and is approximately 3659 square feet (sf; 0.084 acres) in size.

In addition, one approximately 402-foot-long stormwater ditch (S1) was identified connecting Wetland 1 to a downstream culvert at the site boundary. This stormwater ditch was confirmed as having no surface water connection to any downstream water bodies.

Haley & Aldrich believes Wetland 1 likely meet the requisite criteria to be considered jurisdictional by Ecology under current wetland definitions as defined in the GMA, and Stormwater ditch S1 will not be considered jurisdictional after correspondence with both the USACE, WDFW, and Ecology.

Please note, this report contains opinions from Haley & Aldrich based on specific site data and previous professional experience, however, final determinations will be made by the USACE and Washington Department of Ecology.

## 7. Limitations

The above services consist of professional opinions and conclusions by consulting professional wetland scientists. The only warranty or guarantee made by the consultant, in connection with the services performed for this project, is that such services are performed with the care and skill ordinarily exercised by members of the profession practicing under similar conditions, at the same time, and in the same or a similar locality. No other warranty, expressed or implied, is made or intended by rendering such consulting services, or by furnishing written reports of the findings.

DRAFT

## References

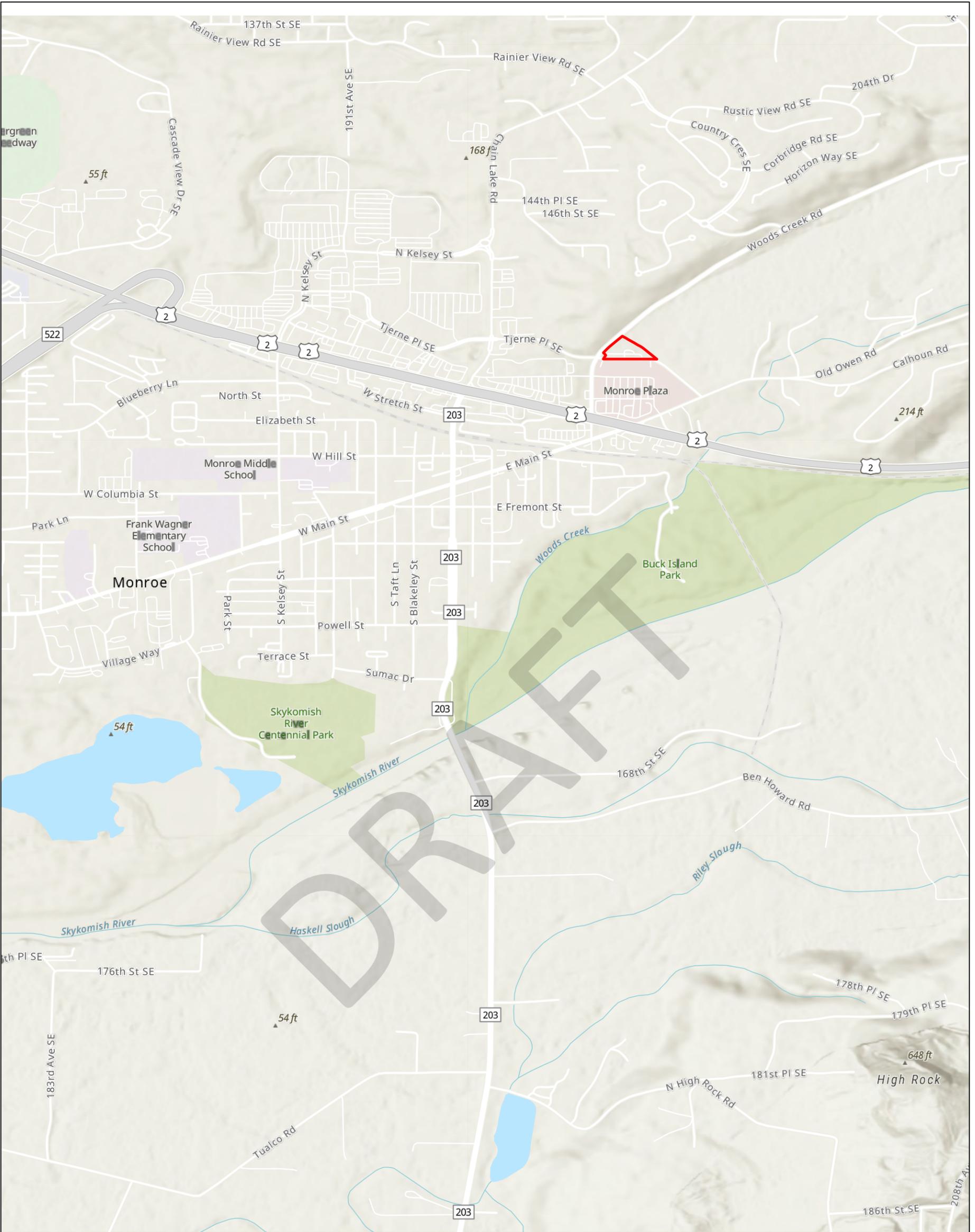
1. City of Monroe, 2024a. *Project Maps*, accessed 22 May, <https://www.monroewa.gov/650/Maps>.
2. City of Monroe, 2024b. *Monroe Municipal Code Title 22: Unified Development Regulations*, <https://monroe.municipal.codes/MMC/22>.
3. Cowardin, L.M., et al., 1979. *Classification of Wetlands and Deepwater Habitats of the United States*, (Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service, December).
4. Environmental Laboratory, 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, (Vicksburg, Mississippi: U.S. Army Engineer Waterways Experiment Station, January).
5. Hruby, T. and Yahnke, A., 2014. *Washington State Wetland Rating System for Western Washington*, 2014 Update, Version 2.0, Publication 23-06-009, October, <https://apps.ecology.wa.gov/publications/documents/1406030.pdf>.
6. Munsell Color, 2009. *Munsell Soil Color Charts*, Grand Rapids, MI.
7. Reed, P.B., Jr., 1988. *National List of Plant Species that Occur in Wetlands: National Summary*, U.S. Fish and Wildlife Service, Biological Report No. 88(24), p. 244.
8. State of Washington Department of Ecology (Ecology), 2016. *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State*, October 2016 Final Review, Publication No. 16-06-029, Olympia, Washington.
9. U.S. Army Corps of Engineers (USACE), 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coastal Regions*, Version 2.0, ed. J. S. Wakeley, et al., ERDC/CRREL TR-14-13, (Vicksburg, Mississippi: U.S. Army Engineer Research and Development Center, May).
10. U.S. Army Corps of Engineers (USACE), 2020. *National Wetland Plant List*, Version 3.5, accessed 22 May 2024, [https://cwbi-app.sec.usace.army.mil/nwpl\\_static/v34/home/home.html](https://cwbi-app.sec.usace.army.mil/nwpl_static/v34/home/home.html).
11. U.S. Army Corps of Engineers (USACE), 2023. *Antecedent Precipitation Tool*, Version 1.0.21., accessed 22 May 2024, <https://www.epa.gov/wotus/antecedent-precipitation-tool-apt#:~:text=The%20Antecedent%20Precipitation%20Tool%20%28APT%29%20is%20a%20desktop,other%20site-specific%20observations%20occurred%20under%20normal%20climatic%20conditions>.
12. U.S. Army Corps of Engineers (USACE), 2024. Email communication from Ryan Cohoit, 12 December.
13. U.S. Department of Agriculture (USDA), 2021. *National Agriculture Imagery Program*, Imagery for Spokane County collected July 2020, accessed 22 May 2024, <https://gis.apfo.usda.gov/arcgis/rest/services>.

14. U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), 2018. *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils*, Version 8.2, L.M. Vasilas, et al., eds.
15. U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), 2020. *Custom Soil Resource Report for Snohomish County, Washington*, Version 12, accessed 22 May 2024, <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/>.
16. U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), 2023. *Agricultural Applied Climate Information System (agACIS)*, Climatic Data for the Monroe Weather Station in Snohomish County, Washington, accessed 18 May 2024, <http://agacis.rcc-acis.org/>.
17. U.S. Environmental Protection Agency (EPA), 2012. *Level IV Ecoregions of EPA Region 10*, U.S. EPA National Health and Environmental Effects Research Laboratory (NHEERL), <https://www.epa.gov/eco-research/ecoregion-download-files-region#pane-10>
18. U.S. Fish and Wildlife Service (USFWS), 2024. *National Wetland Inventory Data for Washington*, accessed 22 May, <https://www.fws.gov/program/national-wetlands-inventory>.
19. U.S. Geological Survey (USGS), 2023. *National Hydrography Dataset*, accessed 22 May 2024, <https://viewer.nationalmap.gov/basic/?basemap=b1&category=nhd&title=NHD%20View>.
20. Washington Department of Fish & Wildlife (WDFW), 2024. Email communication from Ryan Shaw, 18 November.
21. Washington State Department of Natural Resources (DNR), 2024. *Hydrography Dataset*, GIS Open Data, accessed 22 May, <http://data-wadnr.opendata.arcgis.com/search?groupIds=f4ec961e570146fd8cc47baf291f895c>

[https://haleyaldrich.sharepoint.com/sites/OACServicesInc/Shared Documents/0211017\\_OAC SRFR Monroe WA Wetland Delin/Deliverables/2025-0204 HAI SRFR Monroe Aquatic Resource Report\\_D/2025\\_0205\\_HAI\\_SRFR\\_Aquatic Resources Report\\_D2.docx](https://haleyaldrich.sharepoint.com/sites/OACServicesInc/Shared Documents/0211017_OAC SRFR Monroe WA Wetland Delin/Deliverables/2025-0204 HAI SRFR Monroe Aquatic Resource Report_D/2025_0205_HAI_SRFR_Aquatic Resources Report_D2.docx)

DRAFT

FIGURES



**LEGEND**  
 **STUDY AREA**



01 0200  
 SCALE IN FEET

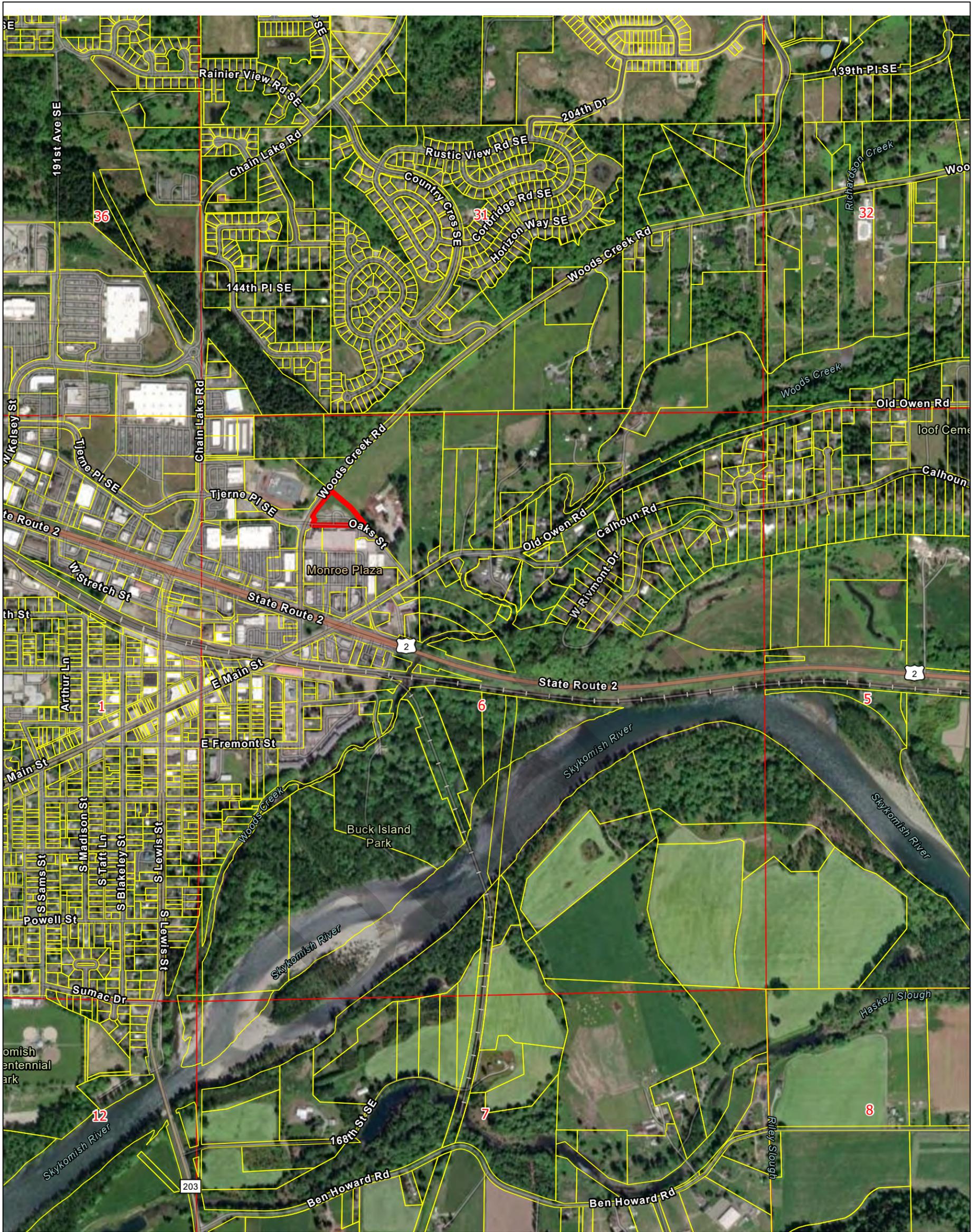
**HALEY  
 ALDRICH**

SRFR SITE 19959 OAKS STREET  
 OAC SERVICES  
 MONROE, WASHINGTON

VICINITY

FEBRUARY 2025

FIGURE 1



GIS FILE PATH: \\haley\aldrich\share\CF\Projects\0211007\GIS\SRFR\MONROE\SRFR\MONROE.aprx - USER: lchulias - LAST SAVED: 2/4/2025 11:10 PM

- LEGEND**
- STUDY AREA
  - PARCELS
  - PUBLIC LAND SURVEY SECTIONS



**HALEY  
ALDRICH**

SRFR SITE 19959 OAKS STREET  
OAC SERVICES  
MONROE, WASHINGTON

**STUDY AREA**

FEBRUARY 2025

**FIGURE 2**

GIS FILE PATH: \\halleyaldrich\share\CP\Projects\021007\GIS\SRFR MONROE\SRFR MONROE.aprx - USER: lchunas - LAST SAVED: 2/14/2025 11:10 PM



**LEGEND**

**STUDY AREA**

**NRCS SOIL MAP UNITS**

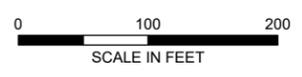
**WETLANDS**

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

**DNR WATER TYPE**

**F**

**Wetlands**



**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

**HALEY ALDRICH** SRFR SITE 19959 OAKS STREET  
OAC SERVICES  
MONROE, WASHINGTON

**DESKTOP REVIEW**

FEBRUARY 2025

**FIGURE 3**

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0211007\GIS\SRFR MONROE\SRFR MONROE.aprx - USER: lchulas - LAST SAVED: 2/4/2025 11:10 PM



**LEGEND**

- STUDY AREA
- STORMWATER DITCH
- SOIL PLOT TYPE**
- UPLAND
- WETLAND
- DELINEATED WETLAND



**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

**HALEY  
ALDRICH**

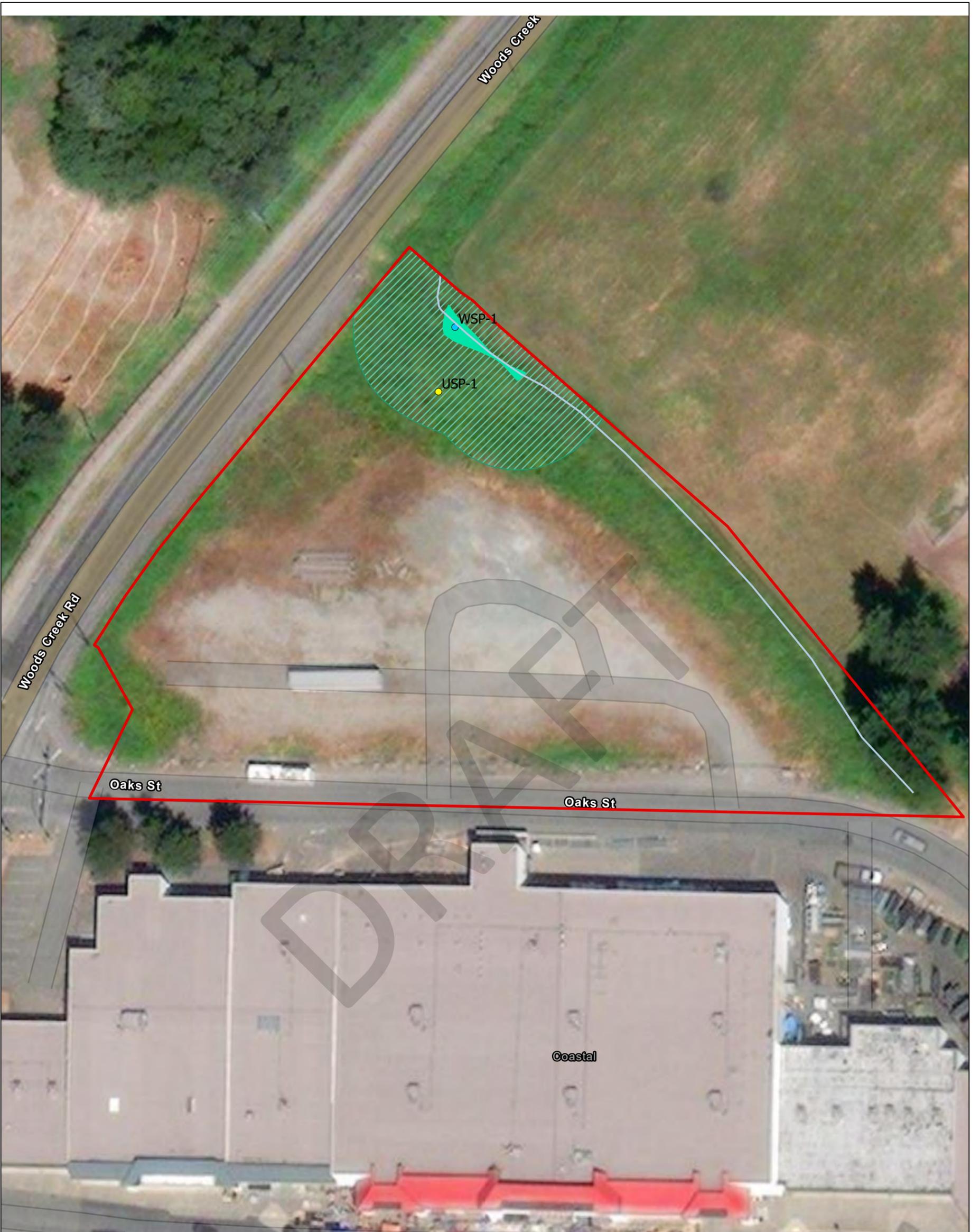
SRFR SITE 19959 OAKS STREET  
OAC SERVICES  
MONROE, WASHINGTON

**DELINEATED AQUATIC  
RESOURCES**

FEBRUARY 2025

**FIGURE 4**

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0211007\GIS\SRFR MONROE\SRFR MONROE.aprx - USER: lchulas - LAST SAVED: 2/4/2025 11:10 PM



**LEGEND**

**SOIL PLOTS**

- UPLAND
- WETLAND

— DELINEATED STREAM/STORMWATER DITCH

STUDY AREA

DELINEATED WETLAND

50 FT WETLAND BUFFER



**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.



SRFR SITE  
OAC SERVICES  
MONROE, WASHINGTON

**DELINEATED AQUATIC  
RESOURCES WITH BUFFERS**

FEBRUARY 2025

**FIGURE 5**

DRAFT

APPENDIX A  
USACE Wetland Determination Data Sheet

Project/Site: OAC-SRFR City/County: Monroe/Snohomis Sampling Date: 2024-05-15  
 Applicant/Owner: OAC-SRFR State: WA Sampling Point: WSP1  
 Investigator(s): Chutas, Fisher, Bangasser Section, Township, Range: S06 T27N R7E  
 Landform (hillside, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 2-5  
 Subregion (LRR): LRR A, MLRA 2 Lat: 47.861195 Long: -121.964381 Datum: WGS 84  
 Soil Map Unit Name: 7- Bellingham silty clay loam NWI classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No      (If no, explain in Remarks.)  
 Are Vegetation     , Soil     , or Hydrology      significantly disturbed? Are "Normal Circumstances" present? Yes X No       
 Are Vegetation     , Soil     , or Hydrology      naturally problematic? (If needed, explain any answers in Remarks.)

**SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.**

Hydrophytic Vegetation Present? Yes <u>x</u> No <u>    </u> Hydric Soil Present? Yes <u>X</u> No <u>    </u> Wetland Hydrology Present? Yes <u>X</u> No <u>    </u>	<b>Is the Sampled Area within a Wetland?</b> Yes <u>X</u> No <u>    </u>
Remarks:	

**VEGETATION – Use scientific names of plants.**

Tree Stratum (Plot size: <u>30</u> )	Absolute % Cover	Dominant Species?	Indicator Status																	
1. <u>Salix geyeriana</u>	5	Yes	FACW	<b>Dominance Test worksheet:</b> Number of Dominant Species That Are OBL, FACW, or FAC: <u>2</u> (A) Total Number of Dominant Species Across All Strata: <u>2</u> (B) Percent of Dominant Species That Are OBL, FACW, or FAC: <u>100.0%</u> (A/B)																
2. _____																				
3. _____																				
4. _____																				
5. _____																				
<u>5</u> =Total Cover				<b>Prevalence Index worksheet:</b> <table style="width:100%; border-collapse: collapse;"> <tr> <td style="text-align: right;">Total % Cover of:</td> <td style="text-align: center;">Multiply by:</td> </tr> <tr> <td>OBL species <u>0</u></td> <td>x 1 = <u>0</u></td> </tr> <tr> <td>FACW species <u>80</u></td> <td>x 2 = <u>160</u></td> </tr> <tr> <td>FAC species <u>25</u></td> <td>x 3 = <u>75</u></td> </tr> <tr> <td>FACU species <u>0</u></td> <td>x 4 = <u>0</u></td> </tr> <tr> <td>UPL species <u>0</u></td> <td>x 5 = <u>0</u></td> </tr> <tr> <td>Column Totals: <u>105</u> (A)</td> <td><u>235</u> (B)</td> </tr> <tr> <td colspan="2" style="text-align: center;">Prevalence Index = B/A = <u>2.24</u></td> </tr> </table>	Total % Cover of:	Multiply by:	OBL species <u>0</u>	x 1 = <u>0</u>	FACW species <u>80</u>	x 2 = <u>160</u>	FAC species <u>25</u>	x 3 = <u>75</u>	FACU species <u>0</u>	x 4 = <u>0</u>	UPL species <u>0</u>	x 5 = <u>0</u>	Column Totals: <u>105</u> (A)	<u>235</u> (B)	Prevalence Index = B/A = <u>2.24</u>	
Total % Cover of:	Multiply by:																			
OBL species <u>0</u>	x 1 = <u>0</u>																			
FACW species <u>80</u>	x 2 = <u>160</u>																			
FAC species <u>25</u>	x 3 = <u>75</u>																			
FACU species <u>0</u>	x 4 = <u>0</u>																			
UPL species <u>0</u>	x 5 = <u>0</u>																			
Column Totals: <u>105</u> (A)	<u>235</u> (B)																			
Prevalence Index = B/A = <u>2.24</u>																				
<u>5</u> =Total Cover																				
<b>Sapling/Shrub Stratum (Plot size: <u>5</u>)</b>																				
1. _____																				
2. _____																				
3. _____																				
4. _____																				
5. _____																				
<u>    </u> =Total Cover																				
<b>Herb Stratum (Plot size: <u>5</u>)</b>																				
1. <u>Phalaris arundinacea</u>	75	Yes	FACW	<b>Hydrophytic Vegetation Indicators:</b> <u>    </u> 1 - Rapid Test for Hydrophytic Vegetation <u>X</u> 2 - Dominance Test is >50% <u>X</u> 3 - Prevalence Index is ≤3.0 <sup>1</sup> <u>    </u> 4 - Morphological Adaptations <sup>1</sup> (Provide supporting data in Remarks or on a separate sheet) <u>    </u> 5 - Wetland Non-Vascular Plants <sup>1</sup> <u>    </u> Problematic Hydrophytic Vegetation <sup>1</sup> (Explain) <sup>1</sup> Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.																
2. <u>Juncus effusus</u>	15	No	FAC																	
3. <u>Athyrium cyclosum</u>	10	No	FAC																	
4. _____																				
5. _____																				
6. _____																				
7. _____																				
8. _____																				
9. _____																				
10. _____																				
11. _____																				
<u>100</u> =Total Cover																				
<b>Woody Vine Stratum (Plot size: <u>30</u>)</b>																				
1. _____																				
2. _____																				
<u>    </u> =Total Cover																				
% Bare Ground in Herb Stratum <u>    </u>																				

Remarks:

**SOIL**

Sampling Point: WSP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type <sup>1</sup>	Loc <sup>2</sup>		
0-4	10YR 3/3	100					Mucky Loam/Clay	with roots
4-7	10YR 4/1	60	7.5YR 4/6	40	C	M	Loamy/Clayey	Prominent redox concentrations
7-16	N 4/	100					Loamy/Clayey	

<sup>1</sup>Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. <sup>2</sup>Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)			Indicators for Problematic Hydric Soils <sup>3</sup> :		
<input type="checkbox"/> Histosol (A1)	<input type="checkbox"/> Sandy Gleyed Matrix (S4)	<input type="checkbox"/> 2 cm Muck (A10) (LRR A, E)			
<input type="checkbox"/> Histic Epipedon (A2)	<input type="checkbox"/> Sandy Redox (S5)	<input type="checkbox"/> Iron-Manganese Masses (F12) (LRR D)			
<input type="checkbox"/> Black Histic (A3)	<input type="checkbox"/> Stripped Matrix (S6)	<input type="checkbox"/> Red Parent Material (F21)			
<input type="checkbox"/> Hydrogen Sulfide (A4)	<input checked="" type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1)	<input type="checkbox"/> Very Shallow Dark Surface (F22)			
<input type="checkbox"/> 1 cm Muck (A9) (LRR D, G)	<input checked="" type="checkbox"/> Loamy Gleyed Matrix (F2)	<input type="checkbox"/> Other (Explain in Remarks)			
<input type="checkbox"/> Depleted Below Dark Surface (A11)	<input checked="" type="checkbox"/> Depleted Matrix (F3)				
<input type="checkbox"/> Thick Dark Surface (A12)	<input type="checkbox"/> Redox Dark Surface (F6)				
<input type="checkbox"/> Sandy Mucky Mineral (S1)	<input type="checkbox"/> Depleted Dark Surface (F7)				
<input type="checkbox"/> 2.5 cm Mucky Peat or Peat (S2) (LRR G)	<input checked="" type="checkbox"/> Redox Depressions (F8)				

<sup>3</sup>Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

<b>Restrictive Layer (if observed):</b> Type: _____ Depth (inches): _____	<b>Hydric Soil Present?</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
---	---

Remarks:

**HYDROLOGY**

Wetland Hydrology Indicators:		
Primary Indicators (minimum of one is required; check all that apply)		Secondary Indicators (2 or more required)
<input type="checkbox"/> Surface Water (A1)	<input type="checkbox"/> Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Drainage Patterns (B10)
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input checked="" type="checkbox"/> Saturation Visible on Aerial Imagery (C9)
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Oxidized Rhizospheres on Living Roots (C3)	<input checked="" type="checkbox"/> Geomorphic Position (D2)
<input type="checkbox"/> Drift Deposits (B3)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> Shallow Aquitard (D3)
<input type="checkbox"/> Algal Mat or Crust (B4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input checked="" type="checkbox"/> FAC-Neutral Test (D5)
<input type="checkbox"/> Iron Deposits (B5)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)
<input type="checkbox"/> Surface Soil Cracks (B6)	<input type="checkbox"/> Other (Explain in Remarks)	<input type="checkbox"/> Frost-Heave Hummocks (D7)
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)		
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)		

<b>Field Observations:</b> Surface Water Present?    Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (inches): _____ Water Table Present?    Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Depth (inches): <u>15</u> Saturation Present?    Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (inches): _____ (includes capillary fringe)	<b>Wetland Hydrology Present?</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
---	---

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Project/Site: OAC-SRFR City/County: Monroe/Snohomis Sampling Date: 2024-05-15  
 Applicant/Owner: OAC-SRFR State: WA Sampling Point: USP1  
 Investigator(s): Chutas, Fisher, Bangasser Section, Township, Range: S06 T27N R7E  
 Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): none Slope (%): 0-2%  
 Subregion (LRR): LRR A, MLRA 2 Lat: 47.86108134 Long: -121.96449587 Datum: WGS 84  
 Soil Map Unit Name: 7- Bellingham silty clay loam NWI classification: \_\_\_\_\_  
 Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No \_\_\_\_\_ (If no, explain in Remarks.)  
 Are Vegetation \_\_\_\_\_, Soil \_\_\_\_\_, or Hydrology \_\_\_\_\_ significantly disturbed? Are "Normal Circumstances" present? Yes X No \_\_\_\_\_  
 Are Vegetation \_\_\_\_\_, Soil \_\_\_\_\_, or Hydrology \_\_\_\_\_ naturally problematic? (If needed, explain any answers in Remarks.)

**SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.**

Hydrophytic Vegetation Present? Yes _____ No <u>X</u> Hydric Soil Present? Yes _____ No <u>X</u> Wetland Hydrology Present? Yes _____ No <u>X</u>	<b>Is the Sampled Area within a Wetland?</b> Yes <u>X</u> No _____
Remarks:	

**VEGETATION – Use scientific names of plants.**

Tree Stratum	(Plot size: <u>30</u> )	Absolute % Cover	Dominant Species?	Indicator Status																																	
1.	_____	_____	_____	_____	<b>Dominance Test worksheet:</b> Number of Dominant Species That Are OBL, FACW, or FAC: <u>1</u> (A) Total Number of Dominant Species Across All Strata: <u>3</u> (B) Percent of Dominant Species That Are OBL, FACW, or FAC: <u>33.3%</u> (A/B)																																
2.	_____	_____	_____	_____																																	
3.	_____	_____	_____	_____																																	
4.	_____	_____	_____	_____																																	
=Total Cover																																					
Sapling/Shrub Stratum	(Plot size: <u>5</u> )				<b>Prevalence Index worksheet:</b> <table style="width:100%; border-collapse: collapse; font-size: small;"> <tr> <td style="text-align: right;">Total % Cover of:</td> <td style="text-align: center;">_____</td> <td style="text-align: right;">Multiply by:</td> <td style="text-align: center;">_____</td> </tr> <tr> <td>OBL species</td> <td style="text-align: center;"><u>0</u></td> <td>x 1 =</td> <td style="text-align: center;"><u>0</u></td> </tr> <tr> <td>FACW species</td> <td style="text-align: center;"><u>5</u></td> <td>x 2 =</td> <td style="text-align: center;"><u>10</u></td> </tr> <tr> <td>FAC species</td> <td style="text-align: center;"><u>35</u></td> <td>x 3 =</td> <td style="text-align: center;"><u>105</u></td> </tr> <tr> <td>FACU species</td> <td style="text-align: center;"><u>35</u></td> <td>x 4 =</td> <td style="text-align: center;"><u>140</u></td> </tr> <tr> <td>UPL species</td> <td style="text-align: center;"><u>0</u></td> <td>x 5 =</td> <td style="text-align: center;"><u>0</u></td> </tr> <tr> <td>Column Totals:</td> <td style="text-align: center;"><u>75</u> (A)</td> <td></td> <td style="text-align: center;"><u>255</u> (B)</td> </tr> <tr> <td colspan="4">Prevalence Index = B/A = <u>3.40</u></td> </tr> </table>	Total % Cover of:	_____	Multiply by:	_____	OBL species	<u>0</u>	x 1 =	<u>0</u>	FACW species	<u>5</u>	x 2 =	<u>10</u>	FAC species	<u>35</u>	x 3 =	<u>105</u>	FACU species	<u>35</u>	x 4 =	<u>140</u>	UPL species	<u>0</u>	x 5 =	<u>0</u>	Column Totals:	<u>75</u> (A)		<u>255</u> (B)	Prevalence Index = B/A = <u>3.40</u>			
Total % Cover of:	_____	Multiply by:	_____																																		
OBL species	<u>0</u>	x 1 =	<u>0</u>																																		
FACW species	<u>5</u>	x 2 =	<u>10</u>																																		
FAC species	<u>35</u>	x 3 =	<u>105</u>																																		
FACU species	<u>35</u>	x 4 =	<u>140</u>																																		
UPL species	<u>0</u>	x 5 =	<u>0</u>																																		
Column Totals:	<u>75</u> (A)		<u>255</u> (B)																																		
Prevalence Index = B/A = <u>3.40</u>																																					
1.	<u>Rubus armeniacus</u>	<u>40</u>	Yes																																		
2.	<u>Salix pseudomonticola</u>	<u>5</u>	No	FACW																																	
3.	_____	_____	_____	_____																																	
4.	_____	_____	_____	_____																																	
5.	_____	_____	_____	_____																																	
=Total Cover																																					
Herb Stratum	(Plot size: <u>5</u> )				<b>Hydrophytic Vegetation Indicators:</b> ___ 1 - Rapid Test for Hydrophytic Vegetation ___ 2 - Dominance Test is >50% ___ 3 - Prevalence Index is ≤3.0 <sup>1</sup> ___ 4 - Morphological Adaptations <sup>1</sup> (Provide supporting data in Remarks or on a separate sheet) ___ 5 - Wetland Non-Vascular Plants <sup>1</sup> ___ Problematic Hydrophytic Vegetation <sup>1</sup> (Explain) <sup>1</sup> Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.																																
1.	<u>Tanacetum vulgare</u>	<u>30</u>	Yes	FACU																																	
2.	<u>Digitaria</u>	<u>20</u>	Yes	FAC																																	
3.	<u>Geranium californicum</u>	<u>10</u>	No	FAC																																	
4.	<u>Myosotis discolor</u>	<u>5</u>	No	FAC																																	
5.	<u>Taraxacum officinale</u>	<u>5</u>	No	FACU																																	
6.	_____	_____	_____	_____																																	
7.	_____	_____	_____	_____																																	
8.	_____	_____	_____	_____																																	
9.	_____	_____	_____	_____																																	
10.	_____	_____	_____	_____																																	
11.	_____	_____	_____	_____																																	
=Total Cover																																					
Woody Vine Stratum	(Plot size: <u>30</u> )				<b>Hydrophytic Vegetation Present?</b> Yes _____ No <u>X</u>																																
1.	_____	_____	_____	_____																																	
2.	_____	_____	_____	_____																																	
=Total Cover																																					
% Bare Ground in Herb Stratum _____																																					

Remarks:

**SOIL**

Sampling Point: USP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type <sup>1</sup>	Loc <sup>2</sup>		
0-7	10YR 3/2	100					Loamy/Clayey	with roots
7-17	10YR 3/3	99	10YR 5/8	1	C	M	Loamy/Clayey	with gravel

<sup>1</sup>Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. <sup>2</sup>Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)			Indicators for Problematic Hydric Soils <sup>3</sup> :		
<input type="checkbox"/> Histosol (A1)	<input type="checkbox"/> Sandy Gleyed Matrix (S4)	<input type="checkbox"/> 2 cm Muck (A10) (LRR A, E)			
<input type="checkbox"/> Histic Epipedon (A2)	<input type="checkbox"/> Sandy Redox (S5)	<input type="checkbox"/> Iron-Manganese Masses (F12) (LRR D)			
<input type="checkbox"/> Black Histic (A3)	<input type="checkbox"/> Stripped Matrix (S6)	<input type="checkbox"/> Red Parent Material (F21)			
<input type="checkbox"/> Hydrogen Sulfide (A4)	<input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1)	<input type="checkbox"/> Very Shallow Dark Surface (F22)			
<input type="checkbox"/> 1 cm Muck (A9) (LRR D, G)	<input type="checkbox"/> Loamy Gleyed Matrix (F2)	<input type="checkbox"/> Other (Explain in Remarks)			
<input type="checkbox"/> Depleted Below Dark Surface (A11)	<input type="checkbox"/> Depleted Matrix (F3)	<sup>3</sup> Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.			
<input type="checkbox"/> Thick Dark Surface (A12)	<input type="checkbox"/> Redox Dark Surface (F6)				
<input type="checkbox"/> Sandy Mucky Mineral (S1)	<input type="checkbox"/> Depleted Dark Surface (F7)				
<input type="checkbox"/> 2.5 cm Mucky Peat or Peat (S2) (LRR G)	<input type="checkbox"/> Redox Depressions (F8)				

<b>Restrictive Layer (if observed):</b> Type: _____ Depth (inches): _____	<b>Hydric Soil Present?</b> Yes _____ No <u>X</u>
---	---

Remarks:

**HYDROLOGY**

Wetland Hydrology Indicators:		
Primary Indicators (minimum of one is required; check all that apply)		Secondary Indicators (2 or more required)
<input type="checkbox"/> Surface Water (A1)	<input type="checkbox"/> Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Drainage Patterns (B10)
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Saturation Visible on Aerial Imagery (C9)
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Oxidized Rhizospheres on Living Roots (C3)	<input type="checkbox"/> Geomorphic Position (D2)
<input type="checkbox"/> Drift Deposits (B3)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> Shallow Aquitard (D3)
<input type="checkbox"/> Algal Mat or Crust (B4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input type="checkbox"/> FAC-Neutral Test (D5)
<input type="checkbox"/> Iron Deposits (B5)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)
<input type="checkbox"/> Surface Soil Cracks (B6)	<input type="checkbox"/> Other (Explain in Remarks)	<input type="checkbox"/> Frost-Heave Hummocks (D7)
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)		
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)		

<b>Field Observations:</b> Surface Water Present?    Yes _____ No <u>X</u> Depth (inches): _____ Water Table Present?      Yes _____ No <u>X</u> Depth (inches): _____ Saturation Present?        Yes _____ No <u>X</u> Depth (inches): _____ (includes capillary fringe)	<b>Wetland Hydrology Present?</b> Yes _____ No <u>X</u>
---	---

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

DRAFT

APPENDIX B  
Site Photographs

Aquatic Resources Report-Snohomish Regional Fire and Rescue  
Monroe, Washington  
File No. 0211017-000  
Date Photographs Taken: 15 May 2024

---



*Photo 1: Soil profile of WSP-1*



*Photo 2: Wetland vegetation looking northeast from WSP-1*



*Photo 3: Upland Vegetation looking north from USP-1*



*Photo 4: Stormwater ditch S1*



*Photo 5: Stormwater ditch S1; view is upstream looking North*



*Photo 6: Stormwater ditch S1 entering the stormwater inlet to concrete pipe at southeast corner of property*

Aquatic Resources Report-Snohomish Regional Fire and Rescue  
Monroe, Washington  
File No. 0211017-000  
Date Photographs Taken: 15 May 2024

---



*Photo 7: View north across property from south property boundary. Note lack of type F stream as indicated on DNR water type map*



*Photo 8: Current property use for trailer storage*

DRAFT

DRAFT

APPENDIX C  
NRCS Custom Soil Resource Report



United States  
Department of  
Agriculture

**NRCS**

Natural  
Resources  
Conservation  
Service

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

# Custom Soil Resource Report for Snohomish County Area, Washington



# Preface

---

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

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

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

DRAFT

# Contents

---

<b>Preface</b> .....	2
<b>How Soil Surveys Are Made</b> .....	5
<b>Soil Map</b> .....	8
Soil Map.....	9
Legend.....	10
Map Unit Legend.....	11
Map Unit Descriptions.....	11
Snohomish County Area, Washington.....	13
4—Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes.....	13
7—Bellingham silty clay loam.....	14
17—Everett very gravelly sandy loam, 0 to 8 percent slopes.....	16
55—Puget silty clay loam.....	17
66—Sultan silt loam.....	18
<b>References</b> .....	20

DRAFT

# How Soil Surveys Are Made

---

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

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

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

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

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

## Custom Soil Resource Report

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

## Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

DRAFT

# Soil Map

---

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

DRAFT

# Custom Soil Resource Report Soil Map



Map Scale: 1:2,910 if printed on A landscape (11" x 8.5") sheet.



### MAP LEGEND

**Area of Interest (AOI)**

 Area of Interest (AOI)

**Soils**

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

**Special Point Features**

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

**Water Features**

 Streams and Canals

**Transportation**

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

**Background**

 Aerial Photography

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Snohomish County Area, Washington  
 Survey Area Data: Version 25, Aug 29, 2023

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

Date(s) aerial images were photographed: Aug 6, 2022—Sep 8, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
4	Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes	5.8	17.3%
7	Bellingham silty clay loam	7.2	21.6%
17	Everett very gravelly sandy loam, 0 to 8 percent slopes	4.4	13.1%
55	Puget silty clay loam	10.5	31.5%
66	Sultan silt loam	5.5	16.5%
<b>Totals for Area of Interest</b>		<b>33.5</b>	<b>100.0%</b>

## Map Unit Descriptions

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

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

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

## Custom Soil Resource Report

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

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

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

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

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

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

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

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

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

## Snohomish County Area, Washington

### 4—Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2hyy  
*Elevation:* 50 to 800 feet  
*Mean annual precipitation:* 25 to 60 inches  
*Mean annual air temperature:* 48 to 52 degrees F  
*Frost-free period:* 180 to 220 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Alderwood and similar soils:* 60 percent  
*Everett and similar soils:* 25 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Alderwood

##### Setting

*Landform:* Till plains  
*Parent material:* Basal till

##### Typical profile

*H1 - 0 to 7 inches:* gravelly ashy sandy loam  
*H2 - 7 to 35 inches:* very gravelly ashy sandy loam  
*H3 - 35 to 60 inches:* gravelly sandy loam

##### Properties and qualities

*Slope:* 25 to 70 percent  
*Depth to restrictive feature:* 20 to 40 inches to densic material  
*Drainage class:* Moderately well drained  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)  
*Depth to water table:* About 18 to 36 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Low (about 3.0 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 7e  
*Hydrologic Soil Group:* B  
*Ecological site:* F002XA004WA - Puget Lowlands Forest  
*Hydric soil rating:* No

#### Description of Everett

##### Setting

*Landform:* Plains, terraces  
*Parent material:* Glacial outwash

##### Typical profile

*H1 - 0 to 6 inches:* gravelly ashy sandy loam  
*H2 - 6 to 18 inches:* very gravelly ashy sandy loam

## Custom Soil Resource Report

*H3 - 18 to 60 inches: extremely gravelly sand*

### **Properties and qualities**

*Slope: 25 to 70 percent*

*Depth to restrictive feature: 14 to 20 inches to strongly contrasting textural stratification*

*Drainage class: Somewhat excessively drained*

*Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)*

*Depth to water table: More than 80 inches*

*Frequency of flooding: None*

*Frequency of ponding: None*

*Available water supply, 0 to 60 inches: Very low (about 2.1 inches)*

### **Interpretive groups**

*Land capability classification (irrigated): None specified*

*Land capability classification (nonirrigated): 7e*

*Hydrologic Soil Group: A*

*Ecological site: F002XA004WA - Puget Lowlands Forest*

*Hydric soil rating: No*

### **Minor Components**

#### **Mckenna**

*Percent of map unit: 5 percent*

*Landform: Depressions*

*Other vegetative classification: Wet Soils (G002XN102WA)*

*Hydric soil rating: Yes*

#### **Norma, undrained**

*Percent of map unit: 5 percent*

*Landform: Depressions*

*Other vegetative classification: Wet Soils (G002XN102WA)*

*Hydric soil rating: Yes*

#### **Terric medisaprists, undrained**

*Percent of map unit: 5 percent*

*Landform: Depressions*

*Other vegetative classification: Wet Soils (G002XN102WA)*

*Hydric soil rating: Yes*

## **7—Bellingham silty clay loam**

### **Map Unit Setting**

*National map unit symbol: 2j00*

*Elevation: 0 to 820 feet*

*Mean annual precipitation: 35 to 60 inches*

*Mean annual air temperature: 50 degrees F*

*Frost-free period: 150 to 210 days*

*Farmland classification: Prime farmland if drained*

**Map Unit Composition**

*Bellingham, undrained, and similar soils: 85 percent*

*Minor components: 15 percent*

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

**Description of Bellingham, Undrained**

**Setting**

*Landform: Drainageways, depressions*

*Parent material: Alluvium over lacustrine deposits*

**Typical profile**

*H1 - 0 to 9 inches: silty clay loam*

*H2 - 9 to 60 inches: silty clay*

**Properties and qualities**

*Slope: 0 to 3 percent*

*Depth to restrictive feature: More than 80 inches*

*Drainage class: Poorly drained*

*Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)*

*Depth to water table: About 0 to 12 inches*

*Frequency of flooding: None*

*Frequency of ponding: Frequent*

*Available water supply, 0 to 60 inches: Very high (about 12.3 inches)*

**Interpretive groups**

*Land capability classification (irrigated): None specified*

*Land capability classification (nonirrigated): 5w*

*Hydrologic Soil Group: C/D*

*Ecological site: F002XA007WA - Puget Lowlands Wet Forest*

*Forage suitability group: Wet Soils (G002XN102WA)*

*Other vegetative classification: Wet Soils (G002XN102WA)*

*Hydric soil rating: Yes*

**Minor Components**

**Kitsap**

*Percent of map unit: 5 percent*

*Hydric soil rating: No*

**Bellingham, drained**

*Percent of map unit: 5 percent*

*Landform: Depressions*

*Other vegetative classification: Soils with Few Limitations (G002XN502WA)*

*Hydric soil rating: Yes*

**Terric medisaprists, undrained**

*Percent of map unit: 5 percent*

*Landform: Depressions*

*Other vegetative classification: Wet Soils (G002XN102WA)*

*Hydric soil rating: Yes*

## 17—Everett very gravelly sandy loam, 0 to 8 percent slopes

### Map Unit Setting

*National map unit symbol:* 2t629

*Elevation:* 30 to 900 feet

*Mean annual precipitation:* 35 to 91 inches

*Mean annual air temperature:* 48 to 52 degrees F

*Frost-free period:* 180 to 240 days

*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Everett and similar soils:* 80 percent

*Minor components:* 20 percent

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

### Description of Everett

#### Setting

*Landform:* Kames, moraines, eskers

*Landform position (two-dimensional):* Summit, shoulder

*Landform position (three-dimensional):* Interfluve, crest

*Down-slope shape:* Convex

*Across-slope shape:* Convex

*Parent material:* Sandy and gravelly glacial outwash

#### Typical profile

*O<sub>i</sub> - 0 to 1 inches:* slightly decomposed plant material

*A - 1 to 3 inches:* very gravelly sandy loam

*B<sub>w</sub> - 3 to 24 inches:* very gravelly sandy loam

*C<sub>1</sub> - 24 to 35 inches:* very gravelly loamy sand

*C<sub>2</sub> - 35 to 60 inches:* extremely cobbly coarse sand

#### Properties and qualities

*Slope:* 0 to 8 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Somewhat excessively drained

*Capacity of the most limiting layer to transmit water (K<sub>sat</sub>):* High (1.98 to 5.95 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water supply, 0 to 60 inches:* Low (about 3.2 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4s

*Hydrologic Soil Group:* A

*Ecological site:* F002XA004WA - Puget Lowlands Forest

*Forage suitability group:* Droughty Soils (G002XN402WA), Droughty Soils (G002XF403WA), Droughty Soils (G002XS401WA)

## Custom Soil Resource Report

*Other vegetative classification:* Droughty Soils (G002XN402WA), Droughty Soils (G002XF403WA), Droughty Soils (G002XS401WA)  
*Hydric soil rating:* No

### Minor Components

#### Alderwood

*Percent of map unit:* 10 percent  
*Landform:* Hills, ridges  
*Landform position (two-dimensional):* Summit  
*Landform position (three-dimensional):* Crest, talf  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

#### Indianola

*Percent of map unit:* 10 percent  
*Landform:* Terraces, kames, eskers  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

## 55—Puget silty clay loam

### Map Unit Setting

*National map unit symbol:* 2hzh  
*Elevation:* 10 to 650 feet  
*Mean annual precipitation:* 35 to 55 inches  
*Mean annual air temperature:* 48 to 50 degrees F  
*Frost-free period:* 160 to 180 days  
*Farmland classification:* Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

### Map Unit Composition

*Puget, drained, and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Puget, Drained

#### Setting

*Landform:* Flood plains  
*Parent material:* Alluvium

#### Typical profile

*H1 - 0 to 9 inches:* silty clay loam  
*H2 - 9 to 38 inches:* silty clay loam  
*H3 - 38 to 60 inches:* silty clay loam

## Custom Soil Resource Report

### Properties and qualities

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Poorly drained  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 24 to 47 inches  
*Frequency of flooding:* Rare  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* High (about 12.0 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2w  
*Hydrologic Soil Group:* C  
*Ecological site:* F002XA007WA - Puget Lowlands Wet Forest  
*Forage suitability group:* Soils with Few Limitations (G002XN502WA)  
*Other vegetative classification:* Soils with Few Limitations (G002XN502WA)  
*Hydric soil rating:* Yes

### Minor Components

#### **Puget, undrained**

*Percent of map unit:* 5 percent  
*Other vegetative classification:* Wet Soils (G002XN102WA)  
*Hydric soil rating:* Yes

#### **Sultan**

*Percent of map unit:* 4 percent  
*Hydric soil rating:* No

#### **Snohomish, undrained**

*Percent of map unit:* 3 percent  
*Landform:* Flood plains  
*Other vegetative classification:* Wet Soils (G002XN102WA)  
*Hydric soil rating:* Yes

#### **Sumas, undrained**

*Percent of map unit:* 3 percent  
*Landform:* Flood plains  
*Other vegetative classification:* Wet Soils (G002XN102WA)  
*Hydric soil rating:* Yes

## 66—Sultan silt loam

### Map Unit Setting

*National map unit symbol:* 2hzw  
*Elevation:* 0 to 820 feet  
*Mean annual precipitation:* 35 to 55 inches  
*Mean annual air temperature:* 50 degrees F  
*Frost-free period:* 150 to 200 days

## Custom Soil Resource Report

*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Sultan and similar soils:* 85 percent

*Minor components:* 5 percent

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

### Description of Sultan

#### Setting

*Landform:* Flood plains

*Parent material:* Alluvium

#### Typical profile

*H1 - 0 to 12 inches:* ashy silt loam

*H2 - 12 to 42 inches:* silty clay loam

*H3 - 42 to 60 inches:* stratified sand to silt loam

#### Properties and qualities

*Slope:* 0 to 2 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Moderately well drained

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)

*Depth to water table:* About 24 to 48 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water supply, 0 to 60 inches:* High (about 10.7 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3w

*Hydrologic Soil Group:* C

*Ecological site:* F002XA005WA - Puget Lowlands Moist Forest

*Forage suitability group:* Seasonally Wet Soils (G002XN202WA)

*Other vegetative classification:* Seasonally Wet Soils (G002XN202WA)

*Hydric soil rating:* No

### Minor Components

#### Puget, undrained

*Percent of map unit:* 5 percent

*Landform:* Flood plains

*Other vegetative classification:* Wet Soils (G002XN102WA)

*Hydric soil rating:* Yes

# References

---

- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
- Federal Register. July 13, 1994. Changes in hydric soils of the United States.
- Federal Register. September 18, 2002. Hydric soils of the United States.
- Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
- National Research Council. 1995. Wetlands: Characteristics and boundaries.
- Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_054262](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262)
- Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053577](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577)
- Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053580](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580)
- Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2\\_053374](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374)
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

## Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2\\_054242](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242)

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053624](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624)

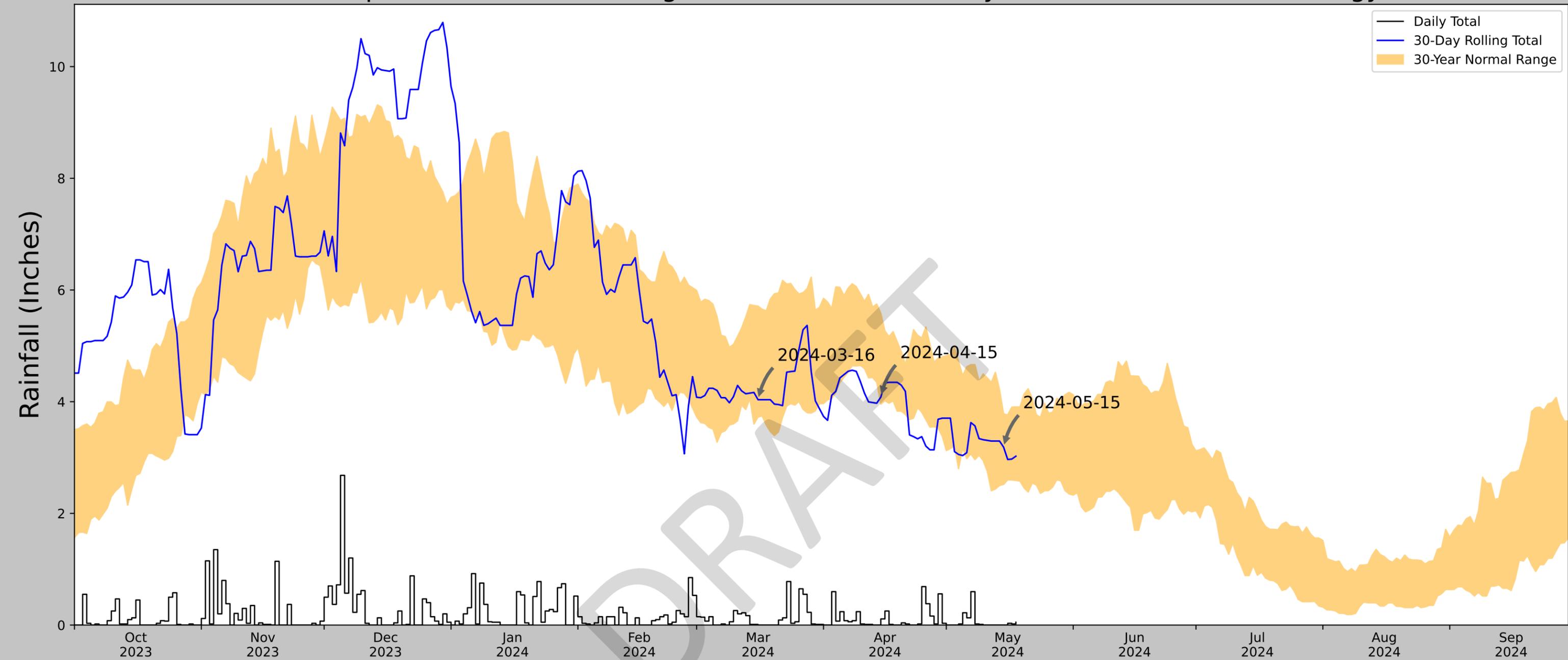
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_052290.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf)

DRAFT

DRAFT

APPENDIX D  
Antecedent Precipitation vs. Normal Range

# Antecedent Precipitation vs Normal Range based on NOAA's Daily Global Historical Climatology Network



Coordinates	47.861299, -121.964381
Observation Date	2024-05-15
Elevation (ft)	73.518
Drought Index (PDSI)	Moderate drought (2024-04)
WebWIMP H <sub>2</sub> O Balance	Wet Season

30 Days Ending	30 <sup>th</sup> %ile (in)	70 <sup>th</sup> %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2024-05-15	2.518504	3.780709	3.185039	Normal	2	3	6
2024-04-15	3.953937	5.583071	4.082677	Normal	2	2	4
2024-03-16	3.72441	5.711811	4.035433	Normal	2	1	2
Result							Normal Conditions - 12

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent
MONROE	47.8453, -121.9944	120.079	1.777	46.561	0.883	10966	88
MONROE 0.6 SE	47.8526, -121.9712	73.163	1.188	46.916	0.59	6	0
MONROE 1.8 NW	47.8785, -122.0066	128.937	2.363	8.858	1.084	4	2
DUVALL 0.8 WNW	47.7391, -121.9841	129.921	7.353	9.842	3.381	14	0
WOODINVILLE 0.9 ENE	47.7531, -122.0943	288.058	7.879	167.979	4.869	117	0
WOODINVILLE 1.7 SE	47.7295, -122.0836	217.848	9.009	97.769	4.935	7	0
SNOHOMISH 3.5 NNE	47.9641, -122.0572	255.906	8.708	135.827	5.101	1	0
STARTUP 1 E	47.8672, -121.7175	170.932	12.926	50.853	6.474	235	0
EVERETT	47.9753, -122.195	60.039	12.922	60.04	6.591	2	0



Figures and tables made by the  
Antecedent Precipitation Tool  
Version 2.0

Developed by:  
U.S. Army Corps of Engineers and  
U.S. Army Engineer Research and  
Development Center



DRAFT

APPENDIX E  
National Flood Hazard Layer FIRMette

# National Flood Hazard Layer FIRMette



121°58'10"W 47°51'51"N



1:6,000

121°57'33"W 47°51'27"N

Basemap Imagery Source: USGS National Map 2023

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- |                                    |  |  |
|------------------------------------|--|--|
| <b>SPECIAL FLOOD HAZARD AREAS</b>  |  | Without Base Flood Elevation (BFE)<br><i>Zone A, V, A99</i>  |
|                                    |  | With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>   |
|                                    |  | Regulatory Floodway  |
| <b>OTHER AREAS OF FLOOD HAZARD</b> |  | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i> |
|                                    |  | Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>  |
|                                    |  | Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>  |
|                                    |  | Area with Flood Risk due to Levee <i>Zone D</i>  |
| <b>OTHER AREAS</b>                 |  | NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>   |
|                                    |  | Effective LOMRs  |
| <b>GENERAL STRUCTURES</b>          |  | Area of Undetermined Flood Hazard <i>Zone D</i>  |
|                                    |  | Channel, Culvert, or Storm Sewer   |
| <b>OTHER FEATURES</b>              |  | Levee, Dike, or Floodwall  |
|                                    |  | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation  |
| <b>MAP PANELS</b>                  |  | 17.5 Coastal Transect  |
|                                    |  | Base Flood Elevation Line (BFE)  |
|                                    |  | Limit of Study   |
|                                    |  | Jurisdiction Boundary  |
|                                    |  | Coastal Transect Baseline  |
|                                    |  | Profile Baseline   |
| <b>MAP PANELS</b>                  |  | Digital Data Available   |
|                                    |  | No Digital Data Available  |
|                                    |  | Unmapped   |
|                                    |  | The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.                                     |



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **5/20/2024 at 11:03 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

DRAFT

APPENDIX F  
Wetland Rating Summary

Wetland name or number: SRFR Option 1

# RATING SUMMARY - Western Washington

Name of wetland (or ID#): SRFR Option 1 Date of site visit: 05/15/2024

Rated By: Lindsay Chutas Trained by Ecology? Yes  No  Date of Training: 11/10/2022

HGM Class used for rating: Riverine

Wetland has multiple HGM classes? Yes  No

NOTE: Form is not complete without the figures requested (figures can be combined).

Source of base aerial photo/map: Bing

OVERALL WETLAND CATEGORY: [Category IV] (based on functions  or special characteristics )

## 1. Category of wetland based on FUNCTIONS

- Category I - Total score = 23 - 27
- Category II - Total score = 20 - 22
- Category III - Total score = 16 - 19
- Category IV - Total score = 9 - 15

Score for each function based on three ratings (order of ratings is not important)

9 = H,H,H  
8 = H,H,M  
7 = H,H,L  
7 = H,M,M  
6 = H,M,L  
6 = M,M,M  
5 = H,L,L  
5 = M,M,L  
4 = M,L,L  
3 = L,L,L

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
Site Potential	L	L	L	
Landscape Potential	H	M	L	
Value	H	L	L	<b>Total</b>
<b>Score Based on Ratings</b>	<b>7</b>	<b>4</b>	<b>3</b>	<b>14</b>

## 2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	
Wetland of High Conservation Value	
Bog	
Forested	
Coastal Lagoon	
Interdunal	
None of the above	<b>Not Applicable</b>

**Wetland name or number:** SRFR Option 1

**Maps and figures required to answer questions correctly for Western Washington**

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Ponded depressions	R 1.1	
Boundary of area within 150 ft of the wetland ( <i>can be added to another figure</i> )	R 2.4	
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	
Width of unit vs. width of stream ( <i>can be added to another figure</i> )	R 4.1	
Map of the contributing basin	R 2.2, R 2.3, R 5.2	
1km Polygon: Area that extends 1km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	

DRAFT

Wetland name or number: SRFR Option 1

**RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS****Water Quality Functions** - Indicators that the site functions to improve water quality**R 1.0 Does the site have the potential to improve water quality?****R 1.1** What is the total area of surface depressions within the Riverine wetland that can trap sediments during a flooding event?

Depressions cover >75% area of wetland	points = 8	
Depressions cover >50% area of wetland	points = 4	
Depressions present but cover <50% area of wetland	points = 2	
No depressions present	points = 0	<b>Score: 0</b>

**R 1.2** What is the structure of plants in the wetland?

Trees or shrubs cover >66% area of the wetland	points = 8	
Trees or shrubs cover 33% - 66% of the area of the wetland	points = 6	
Ungrazed, herbaceous plants cover (>6in high) >66% area of the wetland	points = 6	
Ungrazed, herbaceous plants cover (>6in high) 33%-66% of the area of the wetland	points = 3	
Trees, shrubs, and ungrazed herbaceous plants cover <33% area of the wetland	points = 0	<b>Score: 3</b>

**Total for R 1:** **3****Rating of Site Potential**

[ ] 12-16 = H [ ] 6-11 = M [X] 0-5 = L

Record the rating on the first page

**R 2.0 Does the landscape have the potential to support the water quality function of the site?****R 2.1** Is the wetland within an incorporated city or within its UGA?

Yes	points = 2	
No	points = 0	<b>Score: 2</b>

**R 2.2** Does the contributing basin to the wetland include a UGA or incorporated area?

Yes	points = 1	
No	points = 0	<b>Score: 1</b>

**R 2.3** Does at least 10% of the contributing basin contain tilled fields, pastures, or forests that have been clearcut within the last 5 years?

Yes	points = 1	
No	points = 0	<b>Score: 1</b>

**R 2.4** Is >10% of the area within 150ft of the wetland in land uses that generate pollutants?

Yes	points = 1	
No	points = 0	<b>Score: 1</b>

**R 2.5** Are there other sources of pollutants coming into the wetland that are not listed in question R 2.1-R 2.4?

Yes	points = 1	
No	points = 0	<b>Score: 0</b>

**R 2.6** What are the other sources of pollutants coming into the wetland?**Total for R 2:** **5****Rating of Landscape Potential**

[X] 3-4 = H [ ] 1-2 = M [ ] 0 = L

Record the rating on the first page

**Wetland name or number:** SRFR Option 1

<b>R 3.0 Is the water quality improvement provided by the site valuable to society?</b>		
<b>R 3.1</b> <u>Is the wetland along a stream or river that is on the 303(d) list or on a tributary that drains to one within 1 mi?</u>		
Yes	points = 1	
No	points = 0	<b>Score: 0</b>
<b>R 3.2</b> <u>Is the wetland along a stream or river that has TMDL limits for nutrients, toxics, or pathogens?</u>		
Yes	points = 1	
No	points = 0	<b>Score: 1</b>
<b>R 3.3</b> <u>Has the site been identified in a watershed or local plan as important for maintaining water quality?</u>		
Yes	points = 2	
No	points = 0	<b>Score: 2</b>
<b>Total for R 3:</b>		<b>3</b>

**Rating of Value**

2-4 = H  1 = M  0 = L

*Record the rating on the first page*

<p><b><u>RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS</u></b></p> <p><b>Hydrologic Functions</b> - Indicators that the site functions to reduce flooding and stream degradation</p>		
<b>R 4.0 Does the site have the potential to reduce flooding and erosion?</b>		
<b>R 4.1</b> <u>What are the characteristics of the overbank storage the wetland provides?</u>		
If the ratio is more than 20	points = 9	
If the ratio is 10-20	points = 6	
If the ratio is 5-<10	points = 4	
If the ratio is 1-<5	points = 2	
If the ratio is < 1	points = 1	<b>Score: 1</b>
<b>R 4.2</b> <u>What are the characteristics of plants that slow down water velocities during floods?</u>		
Forest or shrubs cover >33% of the wetland area OR emergent plants cover >66% of the wetland area	points = 7	
Forest or shrubs cover >10% of the wetland area OR emergent plants cover >33% of the wetland area	points = 4	
Plants do not meet the above criteria	points = 0	<b>Score: 4</b>
<b>Total for R 4:</b>		<b>5</b>

**Rating of Site Potential**

12-16 = H  6-11 = M  0-5 = L

*Record the rating on the first page*

**Wetland name or number:** SRFR Option 1

<b>R 5.0 Does the landscape have the potential to support the hydrologic functions of the site?</b>		
<b>R 5.1</b> <u>Is the stream or river adjacent to the wetland downcut?</u>		
Yes	points = 0	
No	points = 1	<b>Score: 0</b>
<b>R 5.2</b> <u>Does the up-gradient watershed include a UGA or incorporated area?</u>		
Yes	points = 1	
No	points = 0	<b>Score: 1</b>
<b>R 5.3</b> <u>Is the up-gradient stream or river controlled by dams?</u>		
Yes	points = 0	
No	points = 1	<b>Score: 1</b>
<b>Total for R 5:</b>		<b>2</b>

**Rating of Landscape Potential**       3 = H  1-2 = M  0 = L      *Record the rating on the first page*

<b>R 6.0 Are the hydrologic functions provided by the site valuable to society?</b>		
<b>R 6.1</b> <u>What is the distance to the nearest areas downstream that have flooding problems?</u>		
The sub-basin immediately down-gradient of the wetland has flooding problems	points = 2	
Surface flooding problems are in a sub-basin farther down-gradient	points = 1	
No flooding problems anywhere downstream	points = 0	<b>Score: 0</b>
<b>R 6.2</b> <u>Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan?</u>		
Yes	points = 2	
No	points = 0	<b>Score: 0</b>
<b>Total for R 6:</b>		<b>0</b>

**Rating of Value**       2-4 = H  1 = M  0 = L      *Record the rating on the first page*

Wetland name or number: SRFR Option 1

## HABITAT FUNCTIONS

**These questions apply to wetlands of all HGM classes - Indicators that the site functions to provide important habitat**

### H 1.0 Does the wetland have the potential to provide habitat for many species?

#### H 1.1 What is the structure of the plant community?

- Aquatic Bed
- Emergent
- Scrub-shrub
- Forested
- Multiple strata within the Forested class (canopy, sub-canopy, shrubs, herbaceous, moss/ground cover)

4 structures or more	points = 4	
3 structures	points = 2	
2 structures	points = 1	
1 structure	points = 0	
No structures present	points = 0	<b>Score: 0</b>

#### H 1.2 What are the hydroperiods that meet the size thresholds in the wetland?

- Permanently flooded or inundated
- Seasonally flooded or inundated
- Occasionally flooded or inundated
- Saturated only
- Permanently flowing stream or river in, or adjacent to, the wetland
- Seasonally flowing stream in, or adjacent to, the wetland
- Lake Fringe wetland
- Freshwater Tidal wetland

4 or more types present	points = 3	
3 types present or Lake Fringe / Freshwater Tidal Fringe	points = 2	
2 types present	points = 1	
1 type present	points = 0	
None present	points = 0	<b>Score: 1</b>

#### H 1.3 What is the richness of the plant species in the wetland?

> 19 species	points = 2	
5-19 species	points = 1	
<5 species	points = 0	<b>Score: 0</b>

**Wetland name or number:** SRFR Option 1

<b>H 1.4</b> <u>What is the interspersion of habitats?</u>	
High	points = 3
Moderate	points = 2
Low	points = 1
None	points = 0
<b>Score: 0</b>	
<b>H 1.5</b> <u>What are the special habitat features in the wetland?</u>	
<input type="checkbox"/> Large, downed, woody debris within the wetland (>4in diameter and 6ft long).	
<input type="checkbox"/> Standing snags (dbh >4in) within the wetland	
<input type="checkbox"/> Undercut banks are present for at least 6.6ft (2m) and/or overhanging plants extend at least 3.3ft (1m) over open water or a stream (or ditch) in, or contiguous with the wetland, for at least 33ft (10m)	
<input type="checkbox"/> Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30 degree slope) OR signs of recent beaver activity are present (cut shrubs or trees that have not yet weathered where wood is exposed)	
<input type="checkbox"/> At least 0.25ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (structures for egg-laying by amphibians)	
<input type="checkbox"/> Invasive plants cover less than 25% of the wetland area in every stratum of plants (see H 1.1 for list of strata)	
6 habitats selected	points = 6
5 habitats selected	points = 5
4 habitats selected	points = 4
3 habitats selected	points = 3
2 habitats selected	points = 2
1 habitat selected	points = 1
No habitats selected	points = 0
<b>Score:</b>	
<b>Total for H 1: 1</b>	

**Rating of Site Potential**

[ ] 15-18 = H [ ] 7-14 = M [X] 0-6 = L

*Record the rating on the first page*

**H 2.0 Does the landscape have the potential to support habitat functions of the site?**

<b>H 2.1</b> <u>What is the percentage of accessible habitat within 1km of the wetland?</u>	
>33% of 1km Polygon	points = 3
20-33% of 1km Polygon	points = 2
10-19% of 1km Polygon	points = 1
<10% of 1km Polygon	points = 0
<b>Score: 0</b>	
<b>H 2.2</b> <u>What is the percentage of total habitat in a 1km polygon around the wetland?</u>	
Total habitat is >50% of the Polygon	points = 3
Total habitat is 10-50% of the Polygon and in 1-3 patches	points = 2
Total habitat is 10-50% of the Polygon and in >3 patches	points = 1
Total habitat is <10% of the Polygon	points = 0
<b>Score: 1</b>	

**Wetland name or number:** SRFR Option 1

<b>H 2.3</b> What is the land use intensity in the 1km polygon?		
50% of the Polygon is high intensity land use	points = -2	
<50% of the Polygon is high intensity land use	points = 0	<b>Score: -2</b>
<b>Total for H 2:</b>		<b>-1</b>

**Rating of Landscape Potential**

[ ] 4-6 = H [ ] 1-3 = M [X] 0 = L

Record the rating on the first page

**H 3.0 Is the habitat provided by the site valuable to society?**

<b>H 3.1</b> Does the site provide habitat for species valued in laws, regulations, or policies?		
<input type="checkbox"/> Aspen Stands		
<input type="checkbox"/> Biodiversity Areas and Corridors		
<input type="checkbox"/> Herbaceous Balds		
<input type="checkbox"/> Old-growth/Mature Forests		
<input type="checkbox"/> Oregon White Oak		
<input type="checkbox"/> Riparian		
<input type="checkbox"/> Westside Prarie		
<input type="checkbox"/> Fresh Deepwater		
<input type="checkbox"/> Instream		
<input type="checkbox"/> Nearshore (Coastal, Open Coast, Puget Sound)		
<input type="checkbox"/> Caves		
<input type="checkbox"/> Cliffs		
<input type="checkbox"/> Snags and Logs		
<input type="checkbox"/> Talus		
<b>The following criteria automatically score 2 points:</b>		
<input type="checkbox"/> The wetland provides habitat for Threatened or Endangered species		
<input type="checkbox"/> The wetland is mapped as a location for an individual WDFW priority species		
<input type="checkbox"/> The wetland is a Wetland of High Conservation Value		
<input type="checkbox"/> The wetland has been categorized as an important habitat site in a local plan		
The wetland has 3 or more WDFW priority habitats within 100m, or meets the criteria for societal value	points = 2	
The site has 1 or 2 WDFW priority habitats within 100m	points = 1	
The site does not meet any of the criteria for societal value	points = 0	<b>Score: 0</b>
<b>Total for H 3:</b>		<b>0</b>

**Rating of Value**

[ ] 2 = H [ ] 1 = M [X] 0 = L

Record the rating on the first page

Wetland name or number: SRFR Option 1

## CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

### SC 1.0 Estuarine Wetlands

**SC 1.1** Does the wetland meet all of the following criteria for Estuarine wetlands?

- The dominant water regime is tidal
- The wetland is vegetated
- The water salinity is greater than 0.5 ppt

Yes - Go to SC 1.2

No - Not an Estuarine Wetland

**Result:**

**SC 1.2** Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151?

Yes - Category I Estuarine Wetland

No - Go to SC 1.3

**Result:**

**SC 1.3** Is the wetland unit at least 1ac in size and meets at least two of the following three conditions?

- The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 10% cover of non-native plant species.
- At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland
- The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands.

Yes - Category I Estuarine Wetland

No - Category II Estuarine Wetland

**Result:**

### SC 2.0 Wetlands of High Conservation Value

**SC 2.1** Does the wetland overlap with any known or historical rare plant or rare & high-quality ecosystem polygons on the WNHP Data Explorer?

Yes - Category I Wetland of High Conservation Value

No - Go to SC 2.2

**Result:**

**SC 2.2** Does the wetland have a rare plant species, rare plant community, or high-quality common plant community that may qualify the site as a WHCV?

Yes - Category I Wetland of High Conservation Value

No - Not a Wetland of High Conservation Value

**Result:**

**Wetland name or number:** SRFR Option 1

### SC 3.0 Bogs

**SC 3.1** Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16in or more of the first 32in of the soil profile?

Yes - Go to SC 3.3

No - Go to SC 3.2

**Result:**

**SC 3.2** Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond?

Yes - Go to SC 3.3

No - Not a Bog Wetland

**Result:**

**SC 3.3** Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least 30% cover of plant species listed in the table provided in the instructions?

Yes - Category I Bog Wetland

No - Go to SC 3.4

**Result:**

**SC 3.4** Is an area with peats or mucks forested (>30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann Spruce, or western white pine AND any of the species (or combinations of species) listed in the table found in the instructions provide more than 30% of the cover under the canopy?

Yes - Category I Bog Wetland

No - Not a Bog Wetland

**Result:**

### SC 4.0 Forested Wetlands

**SC 4.1** Does the wetland have at least 1 contiguous acre of forest that meets one of the following criteria?

Old-growth forests

Mature forests

Yes - Category I Forested Wetland

No - Not a Forested Wetland

**Result:**

**Wetland name or number:** SRFR Option 1

### SC 5.0 Wetlands in Coastal Lagoons

**SC 5.1** Coastal Lagoons: Does the wetland meet all of the following criteria of a wetland in a coastal lagoon?

- The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or rocks
- The depression in which the wetland is located contains ponded water that is saline or brackish (>0.5 ppt) during most of the year in at least a portion of the open water area (measured near the bottom)
- The lagoon retains some of its surface water at low tide during spring tides

Yes - Go to SC 5.2

No - Not a Coastal Lagoon Wetland

**Result:**

**SC 5.2** Does the wetland meet all of the following three conditions?

- The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species).
- At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland.
- the wetland is larger than 0.10ac (4350 sqft)

Yes - Category I Coastal Lagoon

No - Category II Coastal Lagoon

**Result:**

### SC 6.0 Interdunal Wetlands

**SC 6.1** Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership WBUO)?

Yes - Go to SC 6.2

No - Not an Interdunal Wetland

**Result:**

**SC 6.2** Is the wetland 1ac or larger in size, or a mosaic that is 1ac or larger in size?

Wetland is larger than 1ac in size - Go to SC 6.3

Wetland is a mosaic larger than 1ac is size - Category II Interdunal Wetland

No - Go to SC 6.4

**Result:**

**SC 6.3** Does the wetland score 8 or 9 points for the habitat functions?

Yes - Category I Interdunal Wetland

No - Category II Interdunal Wetland

**Result:**

**SC 6.4** Is the wetland unit between 0.1ac and 1ac, or in a mosaic of wetlands that is between 0.1ac and 1ac in size?

Yes - Category III Interdunal Wetland

No - Category IV Interdunal Wetland

**Result:**

**Wetland name or number:** SRFR Option 1

**Category of wetland based on Special Characteristics**

If you answered No for all types, enter "Not Applicable" on Summary Form

**Final Category: Not  
Applicable**

DRAFT

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0211007\GIS\SRFR MONROE.aprx - USER: lchutas - LAST SAVED: 2/4/2025 11:10 PM



**LEGEND**

**COWARDIN CLASS NAME**

- EMERGENT
- OPEN WATER



**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.



SRFR SITE 19959 OAKS STREET  
OAC SERVICES  
MONROE, WASHINGTON

**WETLAND RATING  
COWARDIN CLASSES**

FEBRUARY 2025

**FIGURE 6**

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0211007\GIS\SRFR MONROE\SRFR MONROE.aprx - USER: lchulas - LAST SAVED: 2/4/2025 11:10 PM



**LEGEND**

- HYDROPERIOD CLASS NAME**
- PERMENANT STREAM
  - SATURATED ONLY



**NOTES**  
 1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

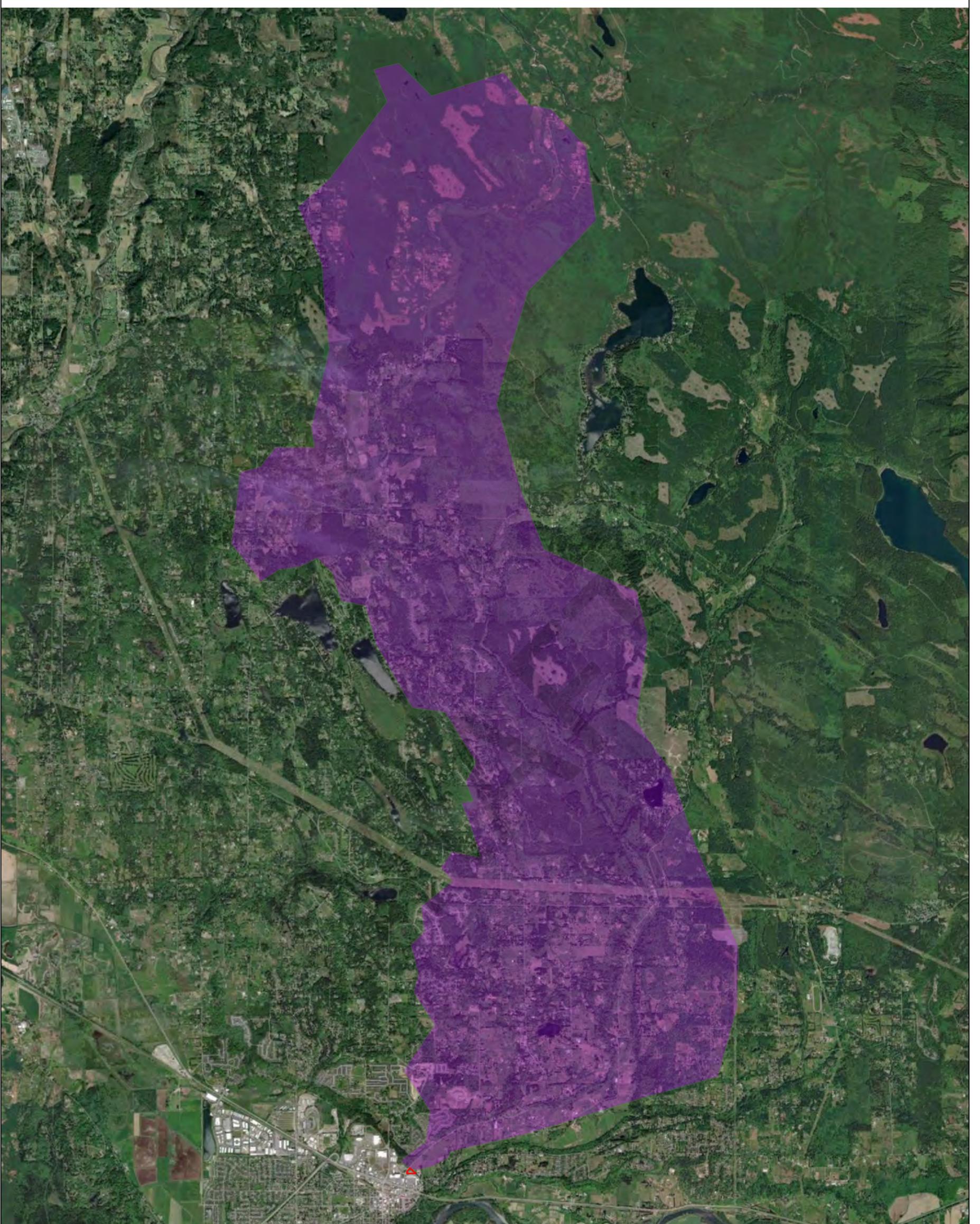
**HALEY ALDRICH**  
 SRFR SITE 19959 OAKS STREET  
 OAC SERVICES  
 MONROE, WASHINGTON

**WETLAND RATING  
 HYDROPERIODS**

FEBRUARY 2025

**FIGURE 7**

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0211007\GIS\SRFR MONROE\SRFR MONROE.aprx - USER: lchulias - LAST SAVED: 2/4/2025 11:10 PM



**LEGEND**

-  STUDY AREA
-  CONTRIBUTING BASIN



200  
SCALE IN FEET

**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.



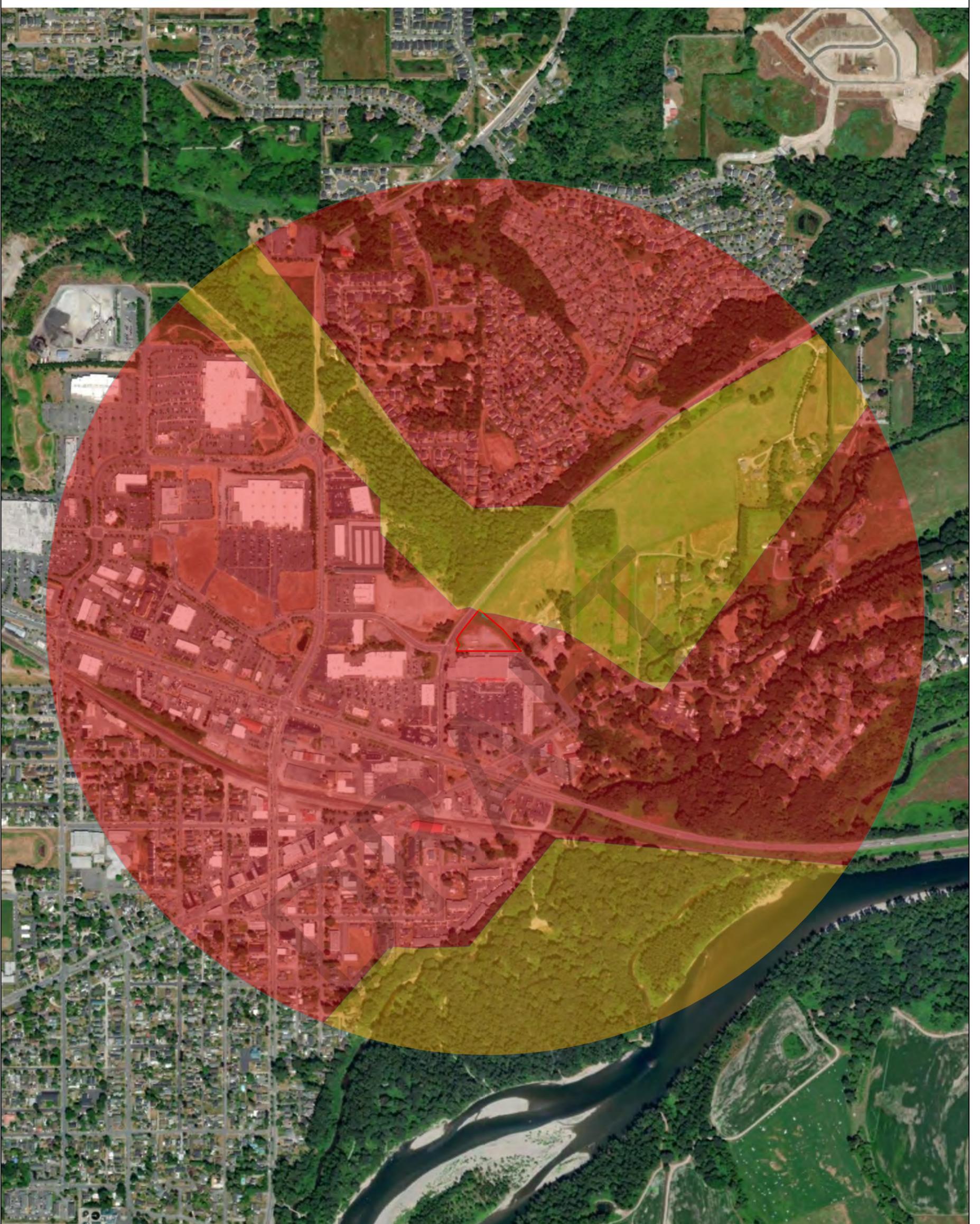
SRFR SITE 19959 OAKS STREET  
OAC SERVICES  
MONROE, WASHINGTON

**WETLAND RATING  
CONTRIBUTING BASIN**

FEBRUARY 2025

**FIGURE 8**

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0211007\GIS\SRFR\_MONROE.aprx -- USER: ichtutas -- LAST SAVED: 2/4/2025 11:10 PM



**LEGEND**

**HABITAT CLASS INTENSITY**

-  **HIGH INTENSITY**
-  **LOW/MODERATE INTENSITY-NOT ACCESSIBLE**
-  **WETLAND**
-  **STUDY AREA**



010000  
SCALE IN FEET

**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.



SRFR SITE 19959 OAKS STREET  
OAC SERVICES  
MONROE, WASHINGTON

**WETLAND RATING  
HABITAT ACCESSIBILITY**

FEBRUARY 2025

**FIGURE 9**

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0211007\GIS\SRFR\_MONROE.aprx - USER: ichutas - LAST SAVED: 2/4/2025 11:10 PM



**LEGEND**

- DELINEATED WETLAND**
- BUFFER DISTANCE**
- 100 FT**
- 150 FT**
- 1 KM**
- 250 FT**



0 100200  
SCALE IN FEET

**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.



SRFR SITE 19959 OAKS STREET  
OAC SERVICES  
MONROE, WASHINGTON

**WETLAND RATING  
BUFFER AREAS**

FEBRUARY 2025

**FIGURE 10**

# TECHNICAL MEMORANDUM

**Project:** Snohomish Regional Fire & Rescue – Station 32  
19959 Oaks Street, Monroe, WA

**Subject:** Transportation Assessment

**Date:** August 7, 2025

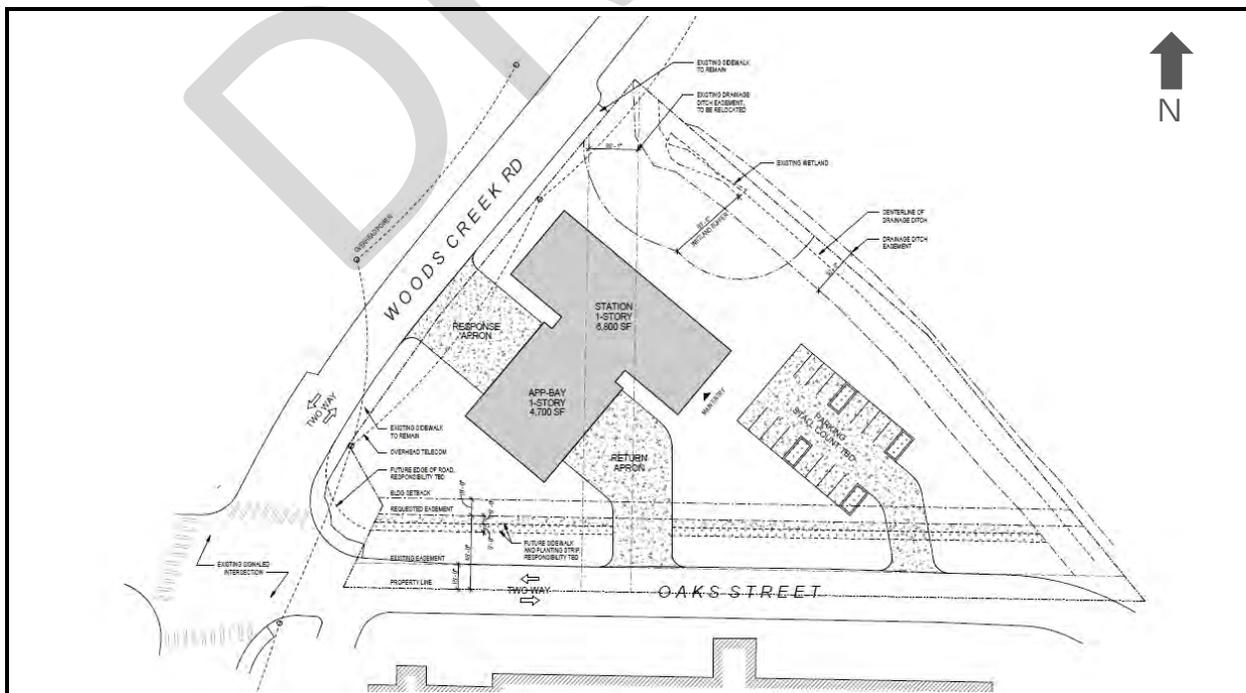
**Author:** Marni C. Heffron, PE, PTOE, Principal

Snohomish Regional Fire and Rescue (SRFR) is proposing to relocate Fire Station (FS) 32 in Monroe, WA from its existing location, at 22122 132<sup>nd</sup> Street SE, to a new site at 19959 Oaks Street, which is closer to US Highway 2 and the Monroe town center. This memorandum assesses the transportation effects of the proposed projects, and evaluates various emergency traffic control needs at and near the site.

## 1. Project Description

FS 32 is proposed to be located on a triangular-shaped site with frontage on two streets: Oaks Street along the south side of the site and Woods Creek Road along the northwest side of the site. The new station would have a drive-thru equipment bay with access from Oaks Street and the egress to Woods Creek Road. The driveways on each side of the bay are referred to as the “Return Apron” (entrance) and “Response Apron” (exit). The station is being designed to accommodate seven (7) staff at a time who work in 24-hour shifts; the shift change occurs each day between 7:00 and 8:00 A.M. This would be an increase in staff compared to the existing FS 32, which has three people on each shift. A staff parking lot, with 14 to 16 stalls is proposed southeast of the station building, with a separate access driveway on Oaks Street. Figure 1 shows a conceptual plan of the proposed FS 32 site.

Figure 1. FS 32 Conceptual Site Plan



Source: Miller/Hull, 30% Design, July 2025.

## 2. Trip Generation

FS 32 would have seven staff on site at a time, with a shift change every 24 hours between 7:00 and 8:00 A.M. During that time period, and assuming all staff drive themselves to and from the site, the station would generate 14 vehicle trips (7 in and 7 out). Emergency calls can occur at any time, but the vehicle trips associated with those are not included in the trip generation estimate since those vehicles create their own traffic control (with lights and sirens) to enter and exit the site if needed. Occasional service trips such as supply delivery and waste pick-up would also be generated, but are also expected to be sporadic and not occur during the shift change time.

## 3. Street Operations

Woods Creek Road connects to US Highway 2 less than 800 feet south of the site. However, southbound movements at that unsignalized intersection are physically restricted to right turns only by curbing in the center of Highway 2. Vehicles are allowed to turn left and right from Highway 2 onto Woods Creek Road, but crossing movements to and from the south side of the highway are prohibited. Therefore, any emergency calls or staff trips destined to the east on Highway 2 or to areas south of Highway 2 would need to travel east on Oaks Street from the station and then southwest on Old Owen Road to reach the signalized intersection with Highway 2. A relatively small number of trips would have to use this alternative route. It is unlikely that trips destined to and from the west on Highway 2 would use this route since it is about 0.25 miles longer than the direct connection via Woods Creek Road.

The adjacent intersection at Woods Creed Road / Oaks Street / Tjerne Place SE is signalized. It is recommended that the signal be updated to allow for emergency pre-emption when equipment is leaving FS 32 to clear any southbound queue approaching that intersection and prevent northbound traffic from passing the station driveway. Emergency-traffic control at the site driveway is evaluated in the next section.

## 4. Emergency Vehicle Control at Site Driveway

Traffic control at the site driveway must comply with the *Manual on Uniform Traffic Control Devices (MUTCD)*.<sup>1</sup> Chapters 4M and 4N of the 11<sup>th</sup> Edition MUTCD describe various options for emergency vehicle access. Chapter 2C describes advance warning sign options. Three options, listed below, were evaluated for FS 32.

1. **Emergency traffic-control signal (Emergency Vehicle Signal, or EVS)** – This is a special traffic control signal that directs all conflicting traffic to stop in order to permit the driver of an authorized emergency vehicle to proceed into the roadway. It may be installed at locations that do not meet other traffic signal warrants.
2. **Hybrid beacon for emergency-vehicle access (Hybrid Beacon)** – This beacon would have two red lights over one yellow light. It will be “dark” until activated for emergency egress, when it will first flash yellow, then alternate-flash the two red beacons. It must be paired with warning signs.
3. **Emergency vehicle sign with supplemental Warning Beacon (Warning Sign with Beacon)** – This device pairs standard Emergency Vehicle warning signage with flashing Warning Beacons that are activated from a fire station.

The guidance for the signal control measures states that they should meet warrants, which are based on the traffic and geometric conditions of the roadway where the driveway is located. The applicable warrants are described and evaluated in the following section.

<sup>1</sup> Federal Highway Administration, 11<sup>th</sup> Edition, December 2023.

## 4.1. Emergency Vehicle Signal Warrants

### MUTCD Guidance

An EVS gives right-of-way to authorized emergency vehicles at driveways or streets accessing emergency responder stations such as fire, ambulance, or police stations. The MUTCD Section 4M.01 provides the following guidance:

*If a traffic control signal is not justified under the signal warrants of Chapter 4C and if gaps in traffic are not adequate to permit the timely entrance of emergency vehicles, or the stopping sight distance for vehicles approaching on the major street is insufficient for emergency vehicles, installing an emergency-vehicle traffic control signal should be considered.*

*The sight distance determination should be based on the location of the visibility obstruction for the critical approach lane for each street or drive and the posted or statutory speed limit or 85th-percentile speed on the major street, whichever is higher.*

With only four station fleet vehicles, FS 32 would not generate enough traffic to meet any of the MUTCD's traffic volume-based signalization warrants (Warrants 1-4). Therefore, the application of an EVS relies on inadequate gaps in traffic or inadequacy of stopping sight distance (SSD) for vehicles approaching the station. However, MUTCD does not provide guidance in the interpretation of "gap adequacy," which may reduce this choice to opinion or judgment. Guidance from other sources were researched to determine if there are traffic volume thresholds that would substitute for gap analysis, which is described in the next section.

### Emergency Vehicle Signal Warrant Guidelines Other than MUTCD

As noted above, warrants for a traditional traffic signal would not be met for the project, therefore other sources were researched. The *Oregon Department of Transportation Traffic Signal Policy and Guidelines Section 6.1 Emergency Traffic Signals*<sup>2</sup> provides the following minimum Average Daily Traffic (ADT) and sight distance thresholds that would motivate an EVS installation.

- An EVS would be warranted at two-lane highways with an ADT equal to or more than 8,850 vehicles, and four-lane highways with ADT equal to or more than 10,600 vehicles. These thresholds of ADT are applicable if the posted speed limit is equal to or less than 40 mph and the location is not in an isolated community with a population of less than 10,000. Monroe's population in 2023 was about 19,700.<sup>3</sup>
- In terms of sight distance, different thresholds for various speeds are provided. ODOT recommends a minimum sight distance of 260 feet on a 35-mph road.

<sup>2</sup> Oregon Department of Transportation Traffic Signal Policy and Guidelines (2024), <https://www.oregon.gov/odot/Engineering/Documents/TrafficStandards/Traffic-Signal-Policy-Guidelines.pdf>

<sup>3</sup> US Census Bureau, accessed July 2025.

**4.2. Minimum Sight Distance for Woods Creek Road**

Woods Creek Road is relatively flat along the site’s frontage between Oaks Street and the Response Apron, and then has about a 5% uphill slope north of the apron that crests near the north property line.

Based on equations published in a *Policy on Geometric Design of Highways and Streets*<sup>4</sup> for a 35-mph roadway at a 5% downgrade, minimum stop sight distance for southbound vehicles is approximately 265 feet. For northbound vehicles approaching on a flat grade, the minimum stopping sight distance is 245 feet. These values are in line with ODO T guidelines, which recommend a minimum sight distance of 260 feet for speeds of 35 mph. Typically, stopping sight distance is measured to a 6-inch object in the path of an approaching motorist. However, for this condition, the object would be an emergency vehicle at least 7-feet high entering the roadway. An approaching motorist with an eye height of 3.5 feet would be able to see over the crest of the hill to see the vehicle. The road section is nearly straight and is not affected by horizontal curves.

**4.3. Emergency Signal Warrant Analysis for FS 32**

FS 32 would have its Response Apron (exit) on Woods Creek Road approximately 165-feet from the Oaks Street/Tjerne Place SE intersection (from the edge of crosswalk to the center of the apron). At that location, Woods Creed Road has one lane in each direction and a posted speed limit of 35 mph.

The EVS warrant analysis utilizes a 24-hour traffic count performed on Woods Creek Road north of County Crescent Boulevard in June 2022.<sup>5</sup> It provided Average Weekday Daily Traffic (AWDT) as well as AM and PM peak hour volumes. The Washington State Department of Transportation’s (WSDOT) *Short Count Factoring Guide*<sup>6</sup> has a list of adjustment factors to convert an AWDT taken in any month into an Average Annual Daily Traffic (AADT) value. The factor for a “Rural, Non-Interstate, Non-Recreational” road in the West part of the state is 0.89.

Table 1 summarizes the 2022 traffic volumes by direction. The AADT on Woods Creek Road is estimated to be 7,425 vehicles per day.

**Table 1. Traffic Volumes on Woods Creek Road (June 7, 2022)**

	Average Weekday Daily Traffic (AWDT)	Annual Average Daily Traffic (AADT)	Weekday AM Peak Hour	Weekday PM Peak Hour
Northbound	4,108	3,656	373	302
Southbound	4,235	3,769	202	450
<b>Total</b>	<b>8,342</b>	<b>7,425</b>	<b>575</b>	<b>752</b>

a. Traffic Count performed by IDAX Data Solutions, June 7, 2022 on Woods Creek Road east of Country Crescent Boulevard. Northbound past the FS 32 site would be eastbound at the count location.  
 b. Applies WSDOT Adjustment Factor of 0.89 which reflects category “SFG-05: Rural, Non-Interstate, Non-Recreational West.” Conversion factors based on WSDOT state-wide data from 2022, 2023 and 2024.

Based on ODOT guidelines, an EVS would not be warranted at the FS 32 Response Apron location since the AADT is below the recommended threshold of 8,850. Even with growth in background traffic, the volume would not exceed the threshold when the station is expected to open in 2026.

<sup>4</sup> American Association of State Highways and Transportation Officials’ (AASHTO), 7<sup>th</sup> Edition, 2018.  
<sup>5</sup> Traffic count performed by IDAX Data Solutions, June 7, 2022.  
<sup>6</sup> Washington State Department of Transportation, March 2025. <https://wsdot.wa.gov/sites/default/files/2024-02/Short-Count-Factoring-Guide-2024.pdf>

#### 4.4. Hybrid Beacon for Emergency-Vehicle Access

MUTCD Chapter 4N presents guidance for Hybrid Beacons for Emergency-Vehicle Access. The guidance is listed below.

*Emergency-vehicle hybrid beacons should only be used when all of the following criteria are satisfied:*

- A. *The conditions justifying an emergency-vehicle traffic control signal (see Section 4M.01) are met;*
- B. *An engineering study, considering the road width, approach speeds, and other pertinent factors, determines that emergency-vehicle hybrid beacons can be designed and located in compliance with the requirements contained in this Chapter and in Section 4S.01, such that they effectively warn and control traffic at the location; and*
- C. *The location is not at or within 100 feet from an intersection or driveway where the side road or driveway is controlled by a STOP or YIELD sign.*

A hybrid beacon would be an option for FS 32 in the future if traffic volumes were to increase above the 8,500 AADT level; however, the current volumes and two-lane roadway configuration do not warrant it. As noted in the following section, an advance warning beacon for southbound traffic on Woods Creek Road is recommended.

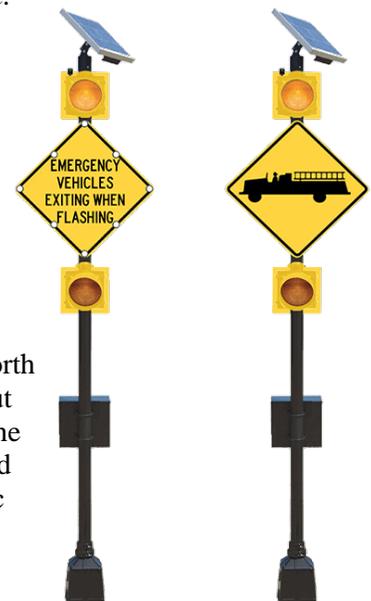
#### 4.5. Emergency Vehicle Sign with Supplemental Warning Beacon

MUTCD Section 2C.54 states that,

*The Emergency Vehicle (W11-8) sign, or a word message sign indicating the type of emergency vehicle (such as rescue squad), may be used in advance of the emergency-vehicle station when no emergency-vehicle traffic control signal is present. A Warning Beacon (see Section 4S.03) may be used with any Vehicular Traffic Warning sign to indicate specific periods when the condition or activity is present or is likely to be present, or to provide enhanced sign conspicuity. A supplemental WHEN FLASHING (W16-13P) plaque (see Figure 2C-16) may be used with any Vehicular Traffic Warning sign that is supplemented with a Warning Beacon to indicate specific periods when the condition or activity is present or is likely to be present.*

Two example W11-8 signs with beacons are shown at right. While not required by the MUTCD for locations with no emergency-vehicle traffic control signal, implementation of Emergency Vehicle signs would call driver attention to the possibility of the need to yield to emergency vehicles. More recent advancements in technology would allow for these beacons to be activated by SRFR employees or by the emergency vehicles themselves.

Even though adequate minimum sight distance to the FS 32 Response Apron would exist, a supplemental warning beacon is recommended for southbound Woods Creek Road approaching the station since motorists arriving from the north on Woods Creek Road or Wagner Road may have traveled several miles without encountering any other traffic control that would require the motorist to stop. The warning beacon is described in the following section. The sign should be located about 300 feet north of the Response Apron. If the adjacent intersection's traffic signal can be pre-empted to prevent northbound traffic at the Response Apron, then no supplemental warning sign would be needed for northbound traffic.



## 5. Transportation Impact Fee

The City of Monroe assesses a Transportation Impact Fee to new development projects per Monroe Municipal Code (MCC) §3.54.130. The rate sheet does not include a Fire Station use. Therefore, MCC §3.54.130.C. would apply, which states, “For uses that are not identified in the fees established by subsection (B) of this section, the city engineer shall calculate the impact fee amount using the methodology employed in the Transportation Impact Fee Rate Study Update Methodology.”

The City updated its fees in April 2025 based on the *Transportation Impact Fee Update Methodology*.<sup>7</sup> That memorandum derived the impact fee of \$3,749.39 per PM peak hour person trip. As described above, FS 32 is expected to generate up to 14 AM peak hour trips associated with the once-daily shift change, but would generate zero (0) PM peak hour trips. Therefore, the project should not be assessed any transportation impact fee.

## 6. Parking

Peak parking demand would occur during the shift change each morning. The worst case would occur if all seven of the incoming staff arrived at the start of the shift while the seven staff from the prior shift were all still at the site. A total of 14 stalls would be needed to accommodate the shift change. Fewer stalls would be needed if the shift change is staggered. During all but the morning shift-change period, seven of the spaces would be available for non-staff or visitor use. The on-site parking lot should be sized to accommodate the shift change.

## 7. Summary

FS 32 is expected to have very little impact on the near-site transportation system. It would generate few non-emergency trips associated with staff and services. The peak trip generation would occur during once-per-day shift change in the morning, with up to 14 trips (7 in, 7 out) between 7:00 and 8:00 A.M.; it would generate no staff trips during the PM peak hour. The few AM peak hour trips are not expected to adversely affect area traffic operations. Since the City’s Transportation Impact Fee is based on PM peak hour trips, the project’s fee would be \$0.

The Response Apron would not warrant an Emergency Vehicle Signal. However, an Emergency Vehicle Sign with Supplemental Warning Beacon is recommended for southbound Woods Creek Road, and should be placed about 300 feet north of the Response Apron. The sign can be activated by SRFR staff or with vehicle detection on the apron. In addition, the adjacent traffic signal at Woods Creek Road/Oaks Street should be upgraded with emergency pre-emption that would flush southbound traffic before emergency vehicles leave the site and hold all northbound traffic on Woods Creek Road. The pre-emption could utilize the same manual or vehicle detection as the emergency beacon.

Peak parking would also occur during the daily shift change when up to 14 vehicles could be parked on site simultaneously. The on-site parking lot should be sized to accommodate the shift change.

MCH/tsm

SRFR FS 32 (Monroe) - Transportation Assessment - FINAL - 08-07-2025.docx

<sup>7</sup> Transpo Group, March 2025.

Attachment B  
*Site Plans*

DRAFT

**COUGHLIN  
 PORTER  
 LUNDEEN**

2ND + SENeca BUILDING 1191  
 SECOND AVENUE SUITE 1100  
 SEATTLE, WA 98101  
 (206) 343-0460 www.cplinc.com



**SRFR FIRE  
 STATION 32**

19959 OAKS ST  
 MONROE, WA 98272

SUBMITTAL

**30% DESIGN**

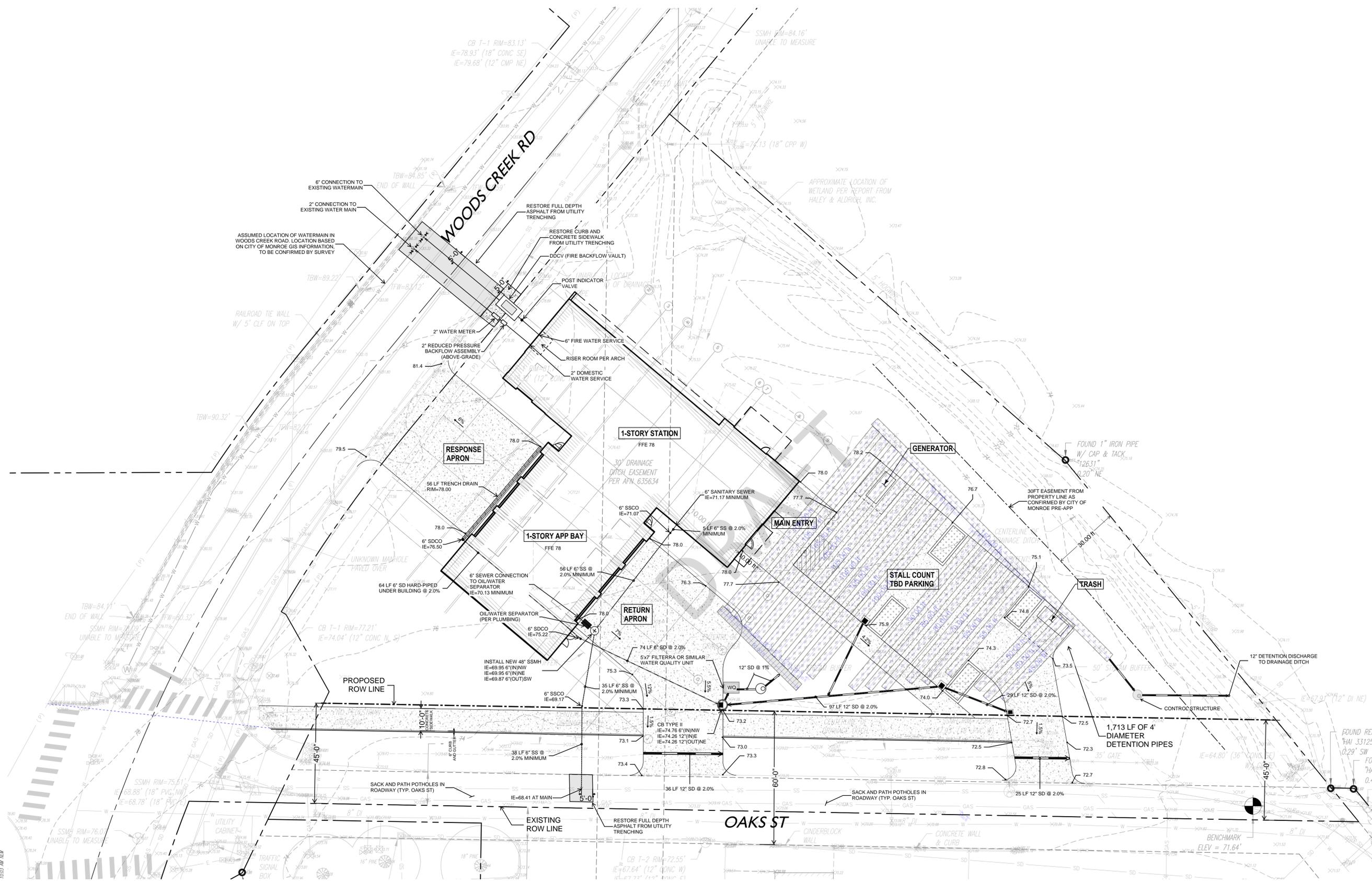
AUGUST 14, 2025

REVISIONS		
No.	Description	Date

Drawn: JL  
 Checked: JSS  
 MJH Proj No.: A24.0158.00  
 Issue Date: 08/14/25

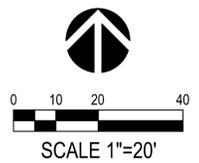
SHEET

**CIVIL SITE PLAN  
 C100**



**Legend**

	PROPERTY LINE		12" DI W	WATER MAIN
	ASPHALT PAVEMENT		FH/FDC	FH/FDC/PIV/VALVE
	CONCRETE PAVEMENT		W	WATER VAULT/METER
	GRAVEL		8" SS @ xx%	SANITARY SEWER
	CONCRETE RETAINING WALL		SSMH	SANITARY MH/CO
	CONCRETE CURB		8" SD @ xx%	STORM DRAINAGE PIPE
	CONTOUR (INDEX)		YDC/CO/IB/CS 2MH	
	CONTOUR			



I:\projects\2024\C100\C100-3301\3301\_Site.dwg 8/11/2025 10:01 AM ALM

Attachment C  
*NRCS Soil Classifications*

DRAFT

## Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

*Hydrologic soil group* is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

*Group A.* Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

*Group B.* Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

*Group C.* Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

*Group D.* Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Depth* to the upper and lower boundaries of each layer is indicated.

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

*Classification* of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Percentage of rock fragments* larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

*Liquid limit and plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

DRAFT

## Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk "\*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

DRAFT

Engineering Properties--Snohomish County Area, Washington														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
4--Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes														
Alderwood	60	B	0-7	Gravelly ashy sandy loam	GM, SM	A-1, A-2	0- 0- 0	0- 3- 5	55-63-70	50-58-65	35-45-55	20-25-30	15-20-25	NP-3 -5
			7-35	Very gravelly loam, very gravelly ashy sandy loam, very cobbly sandy loam	GM, SM	A-1, A-2	0- 0- 0	0-18- 35	40-55-70	35-48-60	20-35-50	10-23-35	15-20-25	NP-3 -5
			35-60	Gravelly sandy loam	GM, SM	A-1, A-2	0- 0- 0	0- 3- 5	55-63-70	50-58-65	35-45-55	20-25-30	15-20-25	NP-3 -5
Everett	25	A	0-6	Gravelly ashy sandy loam	SM	A-1, A-2	0- 0- 0	0- 5- 10	65-75-85	50-63-75	30-40-50	10-23-35	15-18-20	NP-3 -5
			6-18	Very gravelly ashy sandy loam, extremely gravelly sandy loam, very gravelly loam	GM, GP-GM	A-1	0- 0- 0	5- 8- 10	30-45-60	20-35-50	10-20-30	5-15- 25	20-25-30	NP-3 -5
			18-60	Very gravelly coarse sand, very gravelly loamy sand, extremely gravelly sand	GP, GP-GM	A-1	0- 0- 0	5-13- 20	25-38-50	15-30-45	5-15- 25	0- 5- 10	0-7 -14	NP
7--Bellingham silty clay loam														
Bellingham, undrained	85	C/D	0-9	Silty clay loam	MH, ML	A-7	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	60-80-100	40-48-55	15-20-25
			9-60	Silty clay, clay, silty clay loam	CH, CL	A-7	0- 0- 0	0- 0- 0	100-100-100	95-98-100	95-98-100	85-93-100	45-55-65	20-30-40

Engineering Properties--Snohomish County Area, Washington														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
55--Puget silty clay loam														
Puget, drained	85	C	0-9	Silty clay loam	CL, ML	A-6, A-7	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	95-98-1 00	85-90- 95	35-40 -45	10-15-2 0
			9-38	Silty clay loam, silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	95-98-1 00	85-90- 95	25-33 -40	5-13-20
			38-60	Silty clay loam, silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	95-98-1 00	85-90- 95	25-33 -40	5-13-20

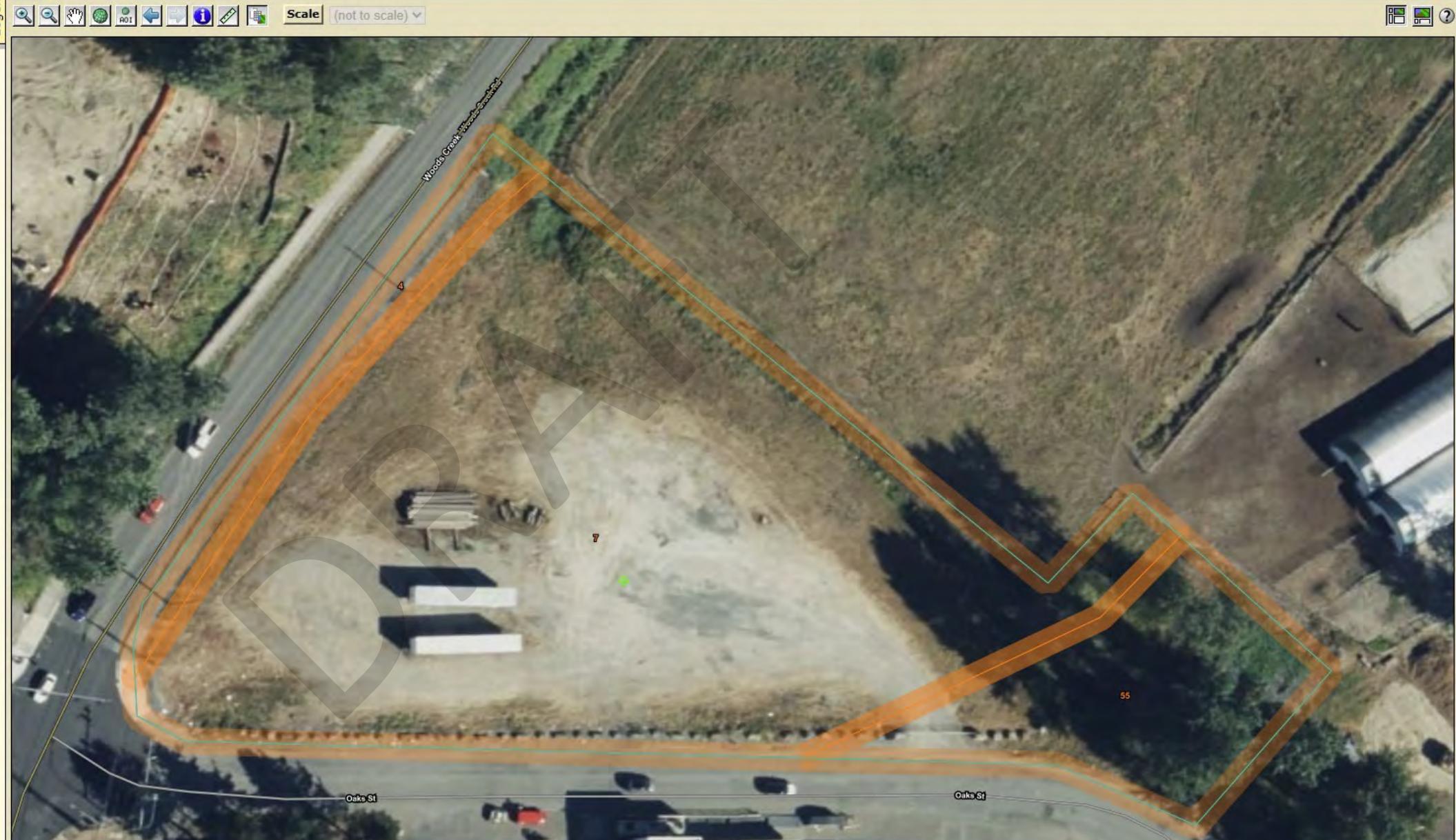
### Data Source Information

Soil Survey Area: Snohomish County Area, Washington  
 Survey Area Data: Version 26, Aug 27, 2024

**Map Unit Legend**

Snohomish County Area, Washington (WA661)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
4	Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes	0.1	5.1%
7	Bellingham silty clay loam	1.8	79.5%
55	Puget silty clay loam	0.3	15.5%
<b>Totals for Area of Interest</b>		<b>2.2</b>	<b>100.0%</b>



Attachment D  
*FEMA Floodplain*

DRAFT

# National Flood Hazard Layer FIRMMette



121°58'11"W 47°51'51"N



121°57'33"W 47°51'27"N

Basemap Imagery Source: USGS National Map 2023

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- |                                    |  |  |
|------------------------------------|--|--|
| <b>SPECIAL FLOOD HAZARD AREAS</b>  |  | Without Base Flood Elevation (BFE)<br><i>Zone A, V, A99</i>  |
|                                    |  | With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>   |
|                                    |  | Regulatory Floodway  |
| <b>OTHER AREAS OF FLOOD HAZARD</b> |  | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i> |
|                                    |  | Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>  |
|                                    |  | Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>  |
|                                    |  | Area with Flood Risk due to Levee <i>Zone D</i>  |
| <b>OTHER AREAS</b>                 |  | NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>   |
|                                    |  | Effective LOMRs  |
| <b>GENERAL STRUCTURES</b>          |  | Area of Undetermined Flood Hazard <i>Zone D</i>  |
|                                    |  | Channel, Culvert, or Storm Sewer   |
|                                    |  | Levee, Dike, or Floodwall  |
| <b>OTHER FEATURES</b>              |  | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation  |
|                                    |  | 17.5   |
|                                    |  | Coastal Transect   |
|                                    |  | Base Flood Elevation Line (BFE)  |
|                                    |  | Limit of Study   |
| <b>MAP PANELS</b>                  |  | Jurisdiction Boundary  |
|                                    |  | Coastal Transect Baseline  |
|                                    |  | Profile Baseline   |
|                                    |  | Hydrographic Feature   |
|                                    |  | Digital Data Available   |
|                                    |  | No Digital Data Available  |
|                                    |  | Unmapped   |
|                                    |  | The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.                                     |



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/21/2025 at 10:09 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Attachment E  
*Priority Species & Habitats*

DRAFT



# United States Department of the Interior



FISH AND WILDLIFE SERVICE  
Washington Fish And Wildlife Office  
1009 College St Se  
Ste 215  
Lacey, WA 98503-1249  
Phone: (360) 753-9440 Fax: (360) 753-9405

In Reply Refer To:

09/10/2025 18:26:01 UTC

Project Code: 2025-0147607

Project Name: SRFR 32 Monroe

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2))

(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

<https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf>

**Migratory Birds:** In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see <https://www.fws.gov/program/migratory-bird-permit/what-we-do>.

It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see <https://www.fws.gov/library/collections/threats-birds>.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit <https://www.fws.gov/partner/council-conservation-migratory-birds>.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

## OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

**Washington Fish And Wildlife Office**

1009 College St Se

Ste 215

Lacey, WA 98503-1249

(360) 753-9440

DRAFT

## PROJECT SUMMARY

Project Code: 2025-0147607

Project Name: SRFR 32 Monroe

Project Type: Government / Municipal (Non-Military) Construction

Project Description: The Site is currently undeveloped with no structures; however, the site has been previously disturbed with stormwater rerouting efforts and associated clearing and regrading activities. The Site currently has compacted gravel and compacted soil surface over a large portion of the lot. A wetland exists in the north corner of the Site with a 50-foot required setback. There is also a stormwater ditch, approximately 18 feet below grade that runs north to south. The proposed project would include the construction of a new, single-story building for the SRFR Fire Station 32 and associated access, parking areas, and landscaping.

Project Location:

The approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/@47.860854599999996,-121.96437461329174,14z>



Counties: Snohomish County, Washington

## ENDANGERED SPECIES ACT SPECIES

There is a total of 6 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries<sup>1</sup>, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

- 
1. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

DRAFT

**BIRDS**

NAME	STATUS
<p>Marbled Murrelet <i>Brachyramphus marmoratus</i></p> <p>Population: U.S.A. (CA, OR, WA)</p> <p>There is <b>final</b> critical habitat for this species. Your location does not overlap the critical habitat.</p> <p>Species profile: <a href="https://ecos.fws.gov/ecp/species/4467">https://ecos.fws.gov/ecp/species/4467</a></p> <p>General project design guidelines:  <a href="https://ipac.ecosphere.fws.gov/project/GQ2R5UNLRBEVZLHSIZMGUGNM4M/documents/generated/10153.pdf">https://ipac.ecosphere.fws.gov/project/GQ2R5UNLRBEVZLHSIZMGUGNM4M/documents/generated/10153.pdf</a></p>	Threatened
<p>Yellow-billed Cuckoo <i>Coccyzus americanus</i></p> <p>Population: Western U.S. DPS</p> <p>There is <b>final</b> critical habitat for this species. Your location does not overlap the critical habitat.</p> <p>Species profile: <a href="https://ecos.fws.gov/ecp/species/3911">https://ecos.fws.gov/ecp/species/3911</a></p>	Threatened

**REPTILES**

NAME	STATUS
<p>Northwestern Pond Turtle <i>Actinemys marmorata</i></p> <p>No critical habitat has been designated for this species.</p> <p>Species profile: <a href="https://ecos.fws.gov/ecp/species/1111">https://ecos.fws.gov/ecp/species/1111</a></p>	Proposed Threatened

**FISHES**

NAME	STATUS
<p>Bull Trout <i>Salvelinus confluentus</i></p> <p>Population: U.S.A., coterminous, lower 48 states</p> <p>There is <b>final</b> critical habitat for this species. Your location does not overlap the critical habitat.</p> <p>Species profile: <a href="https://ecos.fws.gov/ecp/species/8212">https://ecos.fws.gov/ecp/species/8212</a></p> <p>General project design guidelines:  <a href="https://ipac.ecosphere.fws.gov/project/GQ2R5UNLRBEVZLHSIZMGUGNM4M/documents/generated/10149.pdf">https://ipac.ecosphere.fws.gov/project/GQ2R5UNLRBEVZLHSIZMGUGNM4M/documents/generated/10149.pdf</a></p>	Threatened

**INSECTS**

NAME	STATUS
<p>Monarch Butterfly <i>Danaus plexippus</i></p> <p>There is <b>proposed</b> critical habitat for this species. Your location does not overlap the critical habitat.</p> <p>Species profile: <a href="https://ecos.fws.gov/ecp/species/9743">https://ecos.fws.gov/ecp/species/9743</a></p>	Proposed Threatened
<p>Suckley's Cuckoo Bumble Bee <i>Bombus suckleyi</i></p> <p>Population:</p> <p>No critical habitat has been designated for this species.</p> <p>Species profile: <a href="https://ecos.fws.gov/ecp/species/10885">https://ecos.fws.gov/ecp/species/10885</a></p>	Proposed Endangered

## **CRITICAL HABITATS**

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

DRAFT

## **IPAC USER CONTACT INFORMATION**

Agency: Private Entity  
Name: Lindsay Chutas  
Address: 505 W. Riverside, Suite 450  
City: Spokane  
State: WA  
Zip: 99201  
Email: lchutas@haleyaldrich.com  
Phone: 2064094394

DRAFT



▼ Address, Place, WRIA, Cou 🔍



300ft  
-121.95477 47.85751 Degrees

Travelers Park

Woods Creek

Attachment F  
*Landscape Concept Narrative*

DRAFT

## FS32 Landscape Concept Narrative – Project Options Aligned with Code Compliance

The proposed landscape concept for Fire Station 32 (FS32) embraces the unique transitional location between Monroe’s commercial zone and the agricultural/rural edge of unincorporated Snohomish County. The site is envisioned as a composition of **three distinct landscape zones**—each tailored to support fire station functions while satisfying Monroe’s Municipal Code landscape requirements.

### The Apron Garden

#### *Utility with Presence*

**The Apron Garden** is where performance meets presentation—the highly functional front-of-house zone that supports fire apparatus movement while providing the public face of the station. Anchored by the apparatus bay and framed by drive aprons, this zone balances hard-working surfaces with intentional, low-profile landscaping that reinforces the station’s identity and curb appeal.

Despite its rugged use, **The Apron Garden** is not an afterthought. It integrates:

- **Durable, structured plantings** that withstand heat, runoff, and constant vehicle traffic
- **Low-maintenance ornamental grasses and evergreen shrubs** to soften edges without obstructing sightlines
- **Clean lines and seasonal interest** to convey order, pride, and professionalism

This space is seen first and most often—by staff, by neighbors, and by those passing through town. It represents the station’s outward expression: tough, tidy, and always ready. **The Apron Garden** is where the station stands at attention.

#### **Code Compliance Response:**

- **Type III Landscaping Buffers** are applied along vehicle access points and drive aprons to meet screening and softening requirements without interfering with sightlines or maneuverability.
  - **Blank Wall Landscape Treatment** break up large vertical surfaces with layered vegetation, trellises, or vertical accents—adding depth and visual rhythm along the most visible architectural edge
- **Optional Enhancements:**

- Use durable, drought-tolerant grass blends or stabilized meadow seed mixes that align with the rugged character while satisfying planting coverage requirements.
- Integrate low-profile evergreen shrubs with strong root structures to reduce erosion near paved edges.

## **The Hearth**

### *The Heart of the Station*

This zone represents the social and civic soul of the fire station, the place where crews transition from duty to daily life. As both a symbolic and functional extension of the living quarters, **The Hearth** blends structured plantings with human-scaled space. Here, landscaping supports a sense of comfort, rest, and belonging.

In addition to foundation plantings and street presence, **The Hearth** may include:

- **An outdoor living patio** for grilling, dining, or informal gatherings
- **Flexible lawn or paved areas** for stretching, bodyweight workouts, or downtime
- **Shade trees and seating elements** to provide comfort and privacy from public view

This zone creates a livable outdoor environment—a literal and figurative “hearth”—where firefighters can recharge between calls, build camaraderie, and stay physically and mentally well.

- **Code Compliance Response:**
  - **Type I Landscaping (5' buffer)** to screen trash and utilities.
  - **Foundation Landscaping** meets the requirement to screen building foundations and transition from vertical to horizontal planes at building edges.
  - **Type IV** parking lot landscaping. 1 tree per 4 parking stalls.
  - **Type II** perimeter parking lot screening.
  - **Type III** frontage/entry landscaping.
  - **Street Trees**

## **Field's Edge**

### *Where the Built Meets the Wild*

**Field's Edge** marks the natural, agricultural transition at the perimeter of the site—where the fire station gives way to open landscapes, wetlands, and the rural edge of unincorporated

Snohomish County. This zone embraces a softer, more ecological design language, reinforcing the site's role as a threshold between urban infrastructure and natural systems.

Drawing from the surrounding environmental context, this area features:

- **Native plantings and loose, informal forms** that evoke meadow edges, hedgerows, and seasonal rural landscapes
- **Low-maintenance, drought-tolerant species** that support habitat value and visual continuity with nearby open lands

With its subdued, resilient plant palette and flowing structure, the **Field's Edge** provides a soft visual and ecological buffer—an intentional seam between the ordered civic landscape and the wild beyond. It's both a retreat for the eyes and a reminder of the region's natural roots.

- **Code Compliance Response:**
  - **Preserved Existing Vegetation** within the wetland and its buffer maintains compliance with critical area protection.

DRAFT

Attachment G  
*Toxics*

DRAFT

# What's in My Neighborhood: Toxics Cleanup

Home

Filters

Help

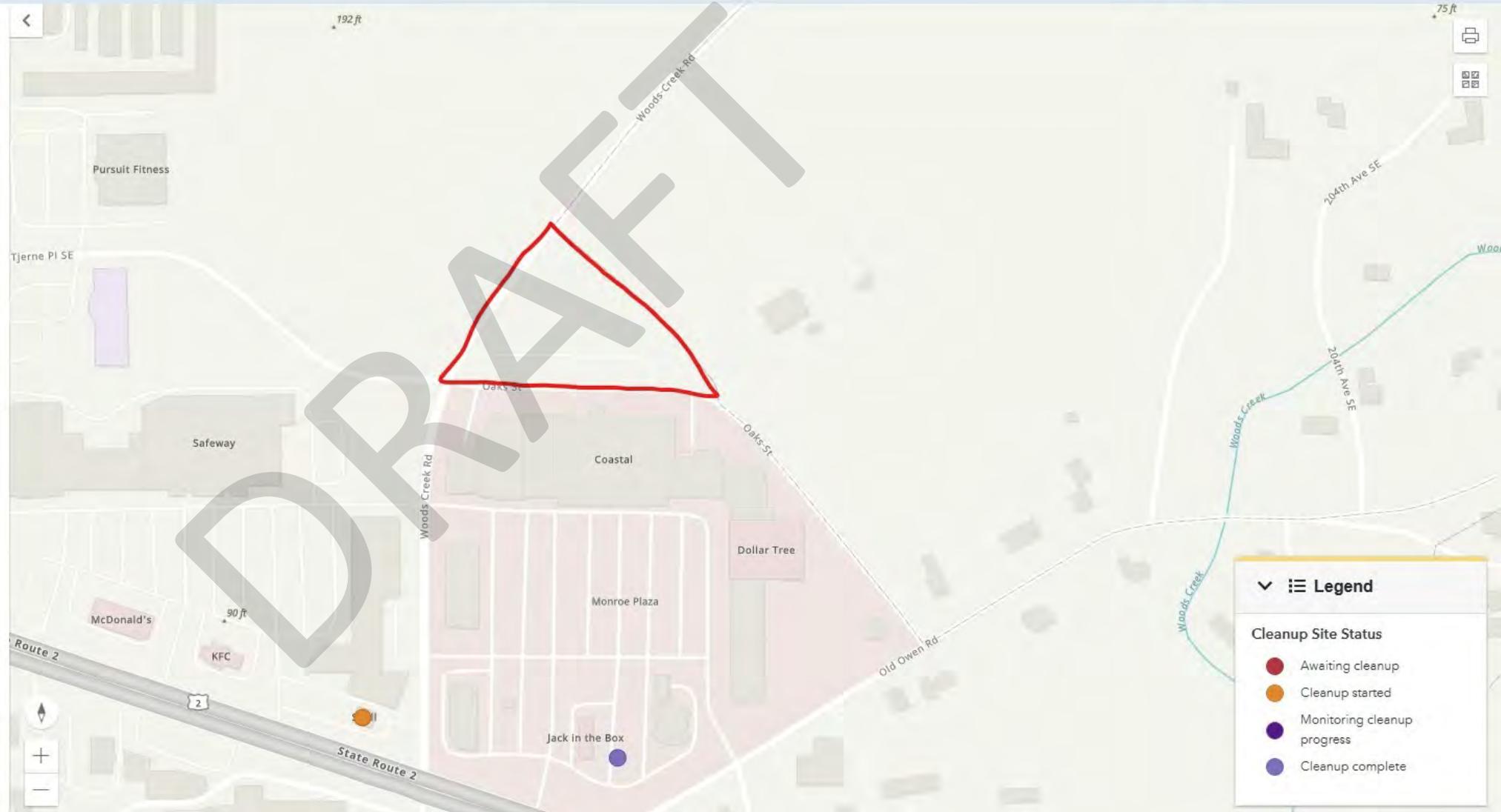
Monroe, WA, USA (✕) 🔍 Radius  Off

Cleanup sites on map 2

Filters

Export

Site Name?	CSID?	Go
Red Barn Service Station	1175	📍
Smith & Carlson Property	8419	📍



Attachment H  
*City of Monroe Comprehensive Plan*

DRAFT

Downtown Monroe  
Source: Provided by the City of Monroe





# 3 LAND USE

## Introduction

The Monroe 2044 Comprehensive Plan’s Vision and Guiding Principles conceptualizes how Monroe wants to grow and develop over time. The Monroe community was clear in its desire to be a place where local businesses thrive, where there are housing options for everyone, and where public spaces are connected by safe bicycle and pedestrian facilities.

The Land Use Element identifies how that vision translates into future development and supporting services, documented in a Future Land Use Map (**Figure 3.4**), and supported by land use polices and actions. It is the primary element that guides the Zoning Map and development regulations to implement the goals, policies and actions adopted in this Comprehensive Plan. See **Appendix 3-A: Land Use Capacity Analysis**, for the general location, intensity, and future capacities in the Monroe UGA, which is hereby incorporated by reference. General location and distribution of uses, current and future population densities, and building intensities can be seen in more detail in **Appendix 3-A**.

## Relationship to Other Plans

The Land Use Element guides growth within the Monroe City Limits and recommends how growth should occur in the City’s Urban Growth Area until those areas are annexed.

This chapter was prepared in accordance with Section 36.70A.070 of Washington’s GMA and aligns with Snohomish County’s Countywide Planning Policies (CPPs) and Puget Sound Regional Council’s VISION 2050.



### Other Land Use Requirements from Washington’s GMA

This element must also address issues such as:

- Protection of groundwater used for public water supplies
- Consideration of environmental justice
- Planning approaches that promote physical activity and reduce vehicle miles traveled
- Draining, flooding, and stormwater runoff
- Wildfire risk

*Photo Source - Provided by the City of Monroe, Belonging 2023*



# Land Inventory and Existing Conditions

Monroe continues to grow. **Table 3.1** describes the existing land uses by general land use category. Substantial residential development has occurred north of US 2, typically as detached residential homes, where existing zoning allows larger lot sizes and often translates into more expensive homes. Areas south of US 2, particularly around 154th St SE, feature a mix of detached and attached residential homes including apartments, condominiums, and other housing types. Development in these areas is often on smaller lots.

**Table 3.1 - EXISTING LAND USE TYPE**

Category	Acres	Percent
Detached Residential	1,820	46.0
Attached Residential	92	2.3
Commercial	346	8.7
Mixed Use	167	4.2
Industrial	193	4.9
Others*	1,335	33.8
Total	3,953	100.0

\* Includes institutional, open space, parks, and transportation.

Source: 2021 Snohomish County Buildable Lands Report

## Urban Development

Monroe’s Historic Downtown is a vibrant center where locals come together to support local businesses. Surrounded by older neighborhoods, it boasts some of the city's

most walkable streets, with essential services nearby. Plans for areas like North Kelsey aim to mix businesses, offices, and homes.

While residential development has not yet occurred as planned, commercial uses have been constructed along US 2 where the majority of large-format retail and services are located.

## Residential Development

Approximately 46 percent of Monroe's land is developed as detached homes, showing a strong focus on detached residential development types. Mixed-use development and attached residential uses make up a smaller percentage of the existing residential land use pattern in Monroe.

## Underserved Neighborhoods

As infill development occurs, some areas of Monroe may see higher rates of development, particularly historically underserved areas of the city. This includes less affluent areas, particularly those south of US 2. Communities here often face challenges such as limited access to essential resources like grocery stores, healthcare, and educational opportunities. These challenges are often compounded by lower levels of education and household incomes. Addressing these disparities by prioritizing investments in the most underserved areas would not only align with regional, countywide, and state goals, but also reflect Imagine Monroe's commitment to inclusive development.



## Employment

Major employment centers are primarily in areas developed for commercial and industrial uses; however, Monroe is unique among cities in that a large portion of employment occurs at the state's Monroe Correctional Complex. Many residents live in Monroe and commute to work in nearby cities like Everett, Bothell, Redmond, and Bellevue. This dual role highlights Monroe's importance in the regional economy (see Chapter 5: Economic Development). Ensuring a balance between housing and jobs is essential for Monroe's growth.



Carnation Condensery Steamstack  
Source: SounderBruce

## Existing Development Patterns

Monroe's development patterns have been influenced by its transportation system and natural features. While Monroe continues to grow and change, these features continue to influence development in the city. Existing development patterns are illustrated in **Figure 3.1**. These include:

- **The "Regional Benefit" area** is a part of Monroe that is home to key facilities serving the wider Sky Valley, including the North Kelsey shopping area, a bustling hub with stores, entertainment options, restaurants, and hotels. The City's vision for North Kelsey includes a walkable village, boosting the commercial area's vitality, and benefiting the community socially, economically, and environmentally. Additionally, there are the fairgrounds, Fryelands industrial parks, and Lake Tye. The Fryelands Industrial Area is vital for employment and the economy, hosting various manufacturing and distribution facilities, attracting new businesses and jobs to Monroe.
- **The "West Monroe" area** includes nearby neighborhoods and development situated south of US 2 and north of SR 522, excluding the Fryelands industrial park. Policies in this zone prioritize enhancing connectivity and promoting infill opportunities to promote sustainable growth and community cohesion.



- **The “Central Monroe” area** includes nearby neighborhoods and developments south of US 2 and east of SR 522. It is focused on connectivity, revitalizing the Main Street corridor and downtown into a vibrant mixed-use hub, infill opportunities west of downtown, and strengthening connections to the scenic Skykomish River, enriching the community's natural and recreational amenities.

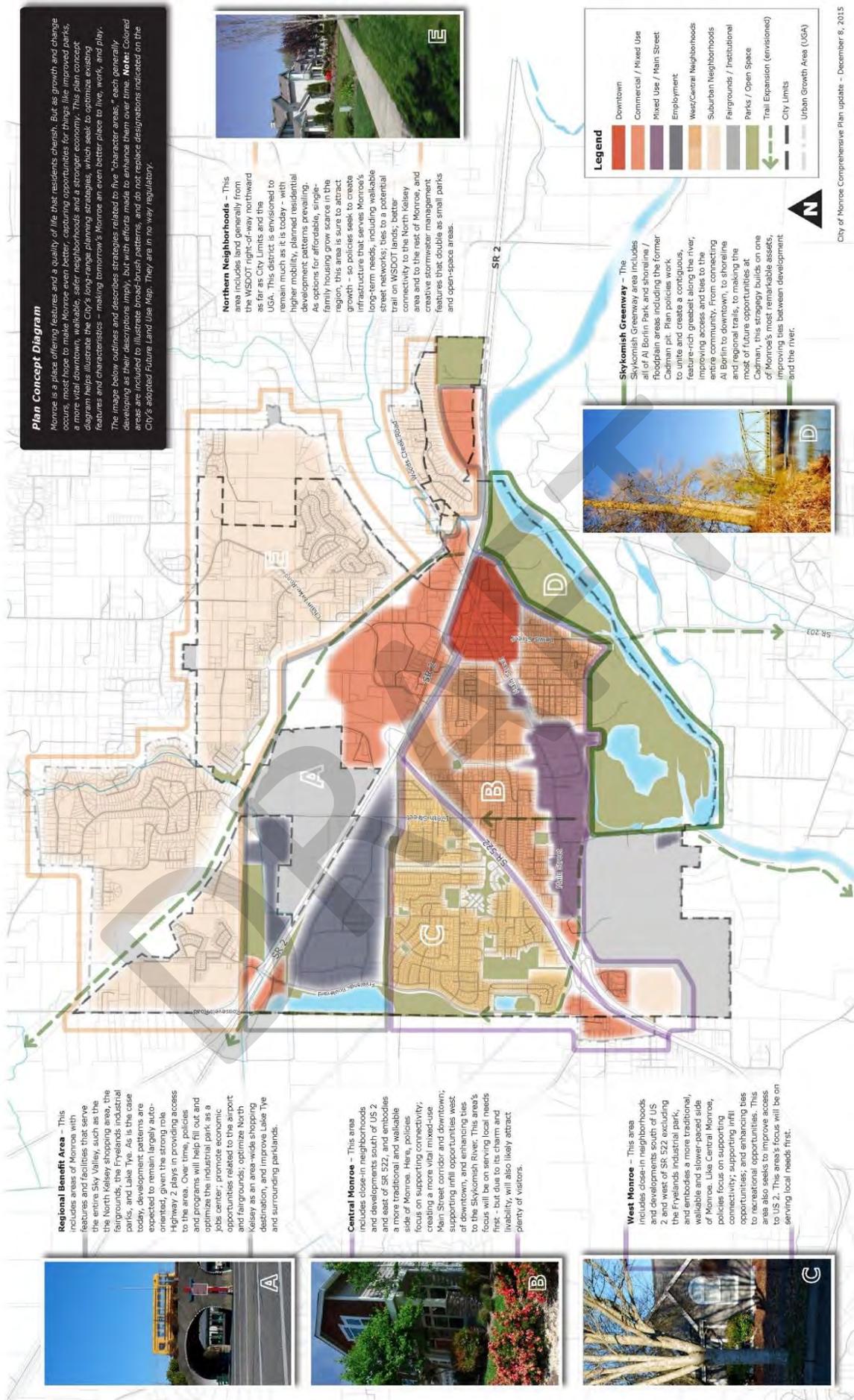
Downtown Monroe, the city's historic center, embodies a lively mix of businesses, restaurants, and cultural attractions essential to Monroe's identity. Serving as the community's central gathering place since its inception, Downtown has played a pivotal role in shaping the city's urban landscape.

- **The “Skykomish Greenway”** is an area in Monroe that includes all of Al Borlin Park and shoreline/floodplain areas, including the Cadman site.

The City aims to create a continuous, feature-rich greenbelt park along the river, enhancing access and connections to the entire community. This strategy, from linking Al Borlin Park to downtown, improving access to shoreline and regional trails, capitalizes on one of Monroe's most unique assets. The City desires to strengthen ties to this beautiful open space gem while prioritizing the protection and enhancement of natural areas to shape how and where development occurs.

- **The “Northern Neighborhoods” area** extends from the WSDOT bypass right-of-way northward to the UGA. This area presents an opportunity to offer affordable and diverse housing options for the community, focusing on creating a walkable, safe, and connected street network, integrating with trails, and improving access to services and facilities.

**Figure 3.1 - DEVELOPMENT CONCEPT**



Plan Concept Diagram illustrates many of Monroe's policies to enhance valued features and characteristics, (identifying five main 'character areas' with concepts for each. This diagram is provided for illustration purposes only, and does not replace adopted land use designations. (Image source: City of Monroe, Studio Cascade)



## Future Land Use

### Projected Growth

The Monroe City Limits and UGA, illustrated in **Figure 3.2**, are projected to accommodate a total of 26,276 residents by 2044, supported by approximately 2,600 new housing units (see **Table 3.2**). Employment opportunities are also projected to grow, with approximately 2,400 new jobs by 2044.

Increasing population will lead to a greater demand for housing, requiring the construction of new housing units for Monroe’s growing and changing population.

With population growth comes the need for more opportunities and infrastructure to maintain the level of service and for public facilities such as schools, parks, open spaces, and community spaces.

A wide variety of housing types are needed beyond the current residential trend of detached homes, townhouses, and apartment buildings. New developments should consider more options such as accessory dwelling units (ADUs), duplexes, triplexes, townhomes, and mixed-use projects to meet various housing needs of the community.

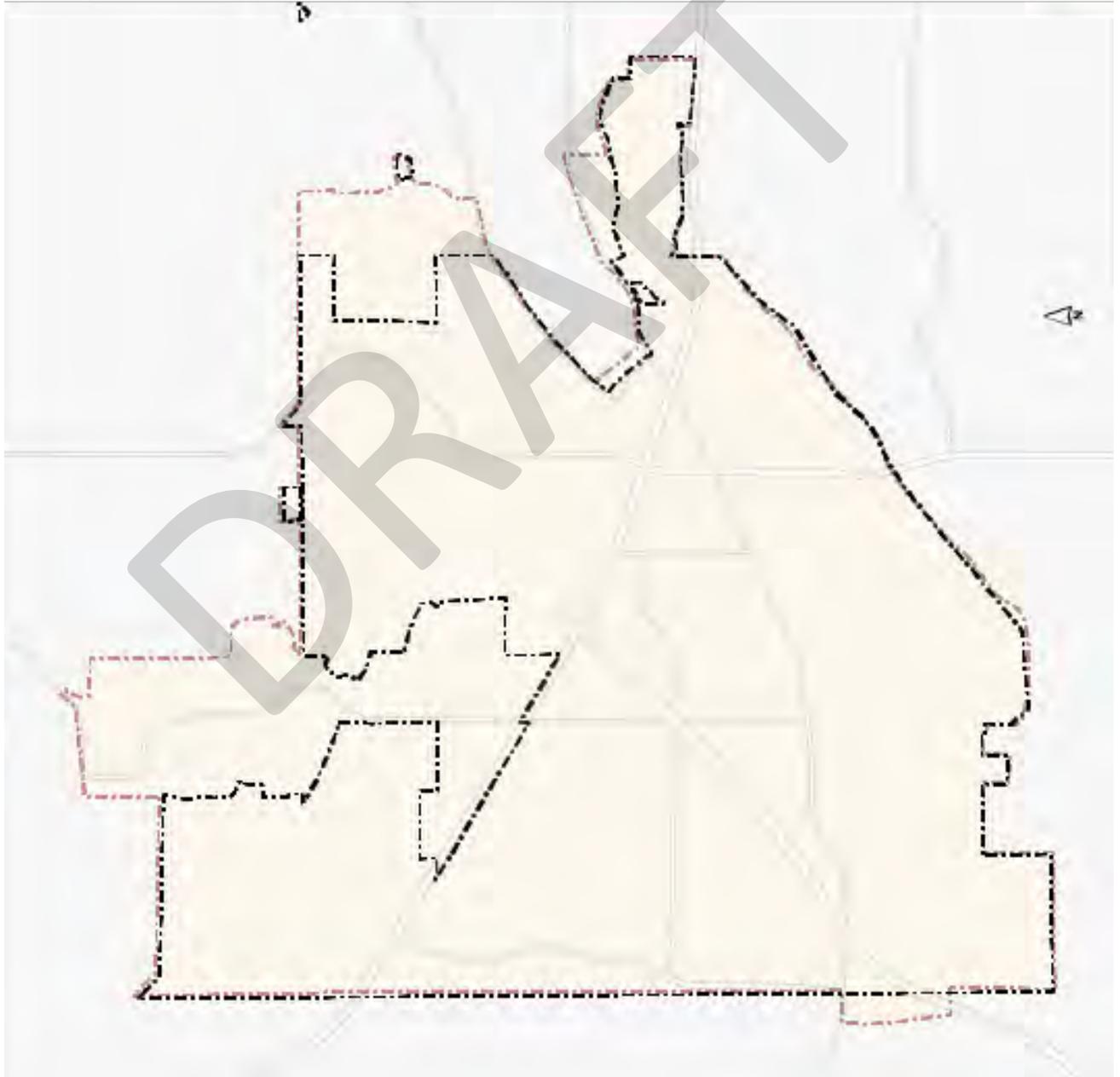
**Table 3.2 - GROWTH ALLOCATION BY 2044**

	Population in 2020	Population by 2044	Increase
Monroe City	19,699	24,302	4,603
Unincorporated UGA	1,567	1,974	407
Total	21,266	26,276	5,010
	Housing units in 2020	Housing units by 2044	Increase
Monroe City	6,163	8,379	2,216
Unincorporated UGA	551	758	207
Total	6,714	9,138*	2,424*
	Employment in 2020	Employment by 2044	Increase
Monroe City	10,096	12,420	2,324
Unincorporated UGA	164	241	77
Total	10,260	12,660*	2,400*

Source: Snohomish County Buildable Lands Report, 2021 and 2023

\* Totals may be different due to rounding.

**Figure 3.2 - MONROE URBAN GROWTH AREA (UGA)**



**City of Monroe  
2024 Comprehensive Plan Update**

- UGA
- City Limits



## Desired Future Land Use Patterns

Monroe's future initiatives will focus on revitalizing key areas, enhancing residential access to services, and increasing housing diversity. These initiatives include transforming key locations like North Kelsey and introducing mixed-use zoning along major thoroughfares, such as along 179th Avenue SE, and developing community focused nodes for mixed-use development. Other initiatives include enhancing residential access to amenities promoting physical activity and reducing vehicle miles, improving Downtown's vibrancy, and expanding and diversifying housing options to meet the diverse needs of the community (See Chapters 4: Transportation and Chapter 7: PROS, as well as **Appendices 7-A and 7-B** for more detailed information on physical activity, vehicle miles, and multimodal LOS goals, which is hereby incorporated by reference). All areas of Monroe may see at least minor changes in how growth occurs over time, including:

- **Incorporating middle housing into detached residential areas.** All detached residential zones in Monroe will allow, at a minimum, accessory dwelling units and duplexes to provide flexibility for various housing types that diversify Monroe's housing stock. It also meets State requirements for permitting more housing types in detached residential zones.
- **Expanding housing opportunities to meet various community needs.** New mixed-use and higher density housing will be permitted along with existing



### Washington Department of Fish and Wildlife: Habitat At Home Program

This program through WDFW explores alternative ways to connect residents to green spaces and nature. As the City looks towards new ways to accommodate growth, it's important to not lose these spaces, and to continue to positively engage with the wildlife habitats in Monroe. WDFW offers guidance on various habitats for spaces of varying sizes.

To learn more about the program, visit <https://wdfw.wa.gov/species-habitats/living/habitat-at-home>, and for more information on how the City will review drainage, flooding, and stormwater runoff see **Chapter 10 and Appendix 10-B**, which is hereby incorporated by reference.

*Photo Source: Connor Neander, Habitat at home, WDFW, <https://wdfw.wa.gov/species-habitats/living/habitat-at-home>*



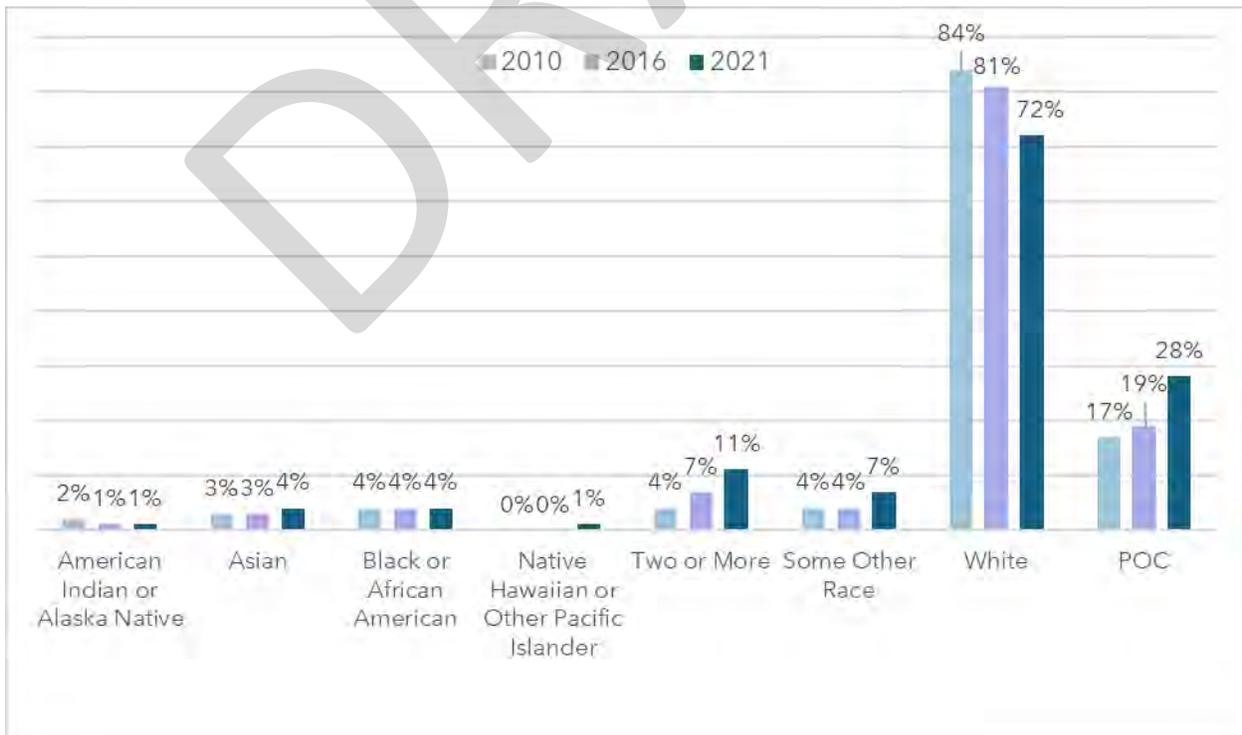
commercial services to create a dynamic and interconnected community. This type of development will be paired with increased bicycle and pedestrian connectivity. **Figure 3.3** also demonstrates that Monroe is becoming increasingly diverse. As we look towards the future, it will be important to capture the needs of various communities to ensure that everyone’s needs are met.

- **Increasing residential and mixed-use development in the North Kelsey area.** Plans for North Kelsey include reimagining the area with multifamily and mixed-use development in addition to the commercial development that has been constructed. Future land uses

in this area will focus on residential and mixed-use development that is supported by improved pedestrian and bicycle amenities to make it easier to get around by foot and on bike. This includes improving connections across US 2 into Downtown and surrounding areas.

- **Adding mixed-use development that serves local neighborhoods.** Mixed-use development will be introduced along 179th Avenue SE and in the northwest and southwest edges of Monroe to providing locally serving commercial services and more housing options.

**Figure 3.3 - RACE AND ETHNICITY CHANGES OVER TIME**



Source: American Community Survey, 5-year estimates (DP05), 2010, 2016, and 2020



- Creating neighborhood-serving nodes in residential areas.** Where feasible, integrate small-scale retail and mixed-use along Chain Lake Road to serve neighborhood needs.
- Increasing development Downtown.** Downtown will continue to be a central hub of activity in Monroe, reflecting the historic nature of Main Street but with increased housing and mixed-use development to increase walkability for residents to support local businesses.
- Updating zoning to permit mixed-use and residential uses.** While future land use designations will not change along US-2 or in other areas such as Downtown and along Main Street, zoning modifications will occur in those areas to permit mixed use and residential uses.

[Future Land Use Map](#)

The Future Land Use Map (FLUM), as shown in **Figure 3.4**, illustrates the direction for land

use over the next 20 years that meets the projected growth targets (**Table 3.3**). The Future Land Use designations identify general land use categories and the zoning classifications to implement Imagine Monroe and accommodate the growth allocations.

Development regulations (e.g., zoning) must be consistent with the FLUM. The FLUM is intended to satisfy the needs of an increasing population and employment base by providing for a range of residential, mixed-use, commercial, and industrial land to meet anticipated demand while also protecting natural features and critical areas. Land use needs are likely to change over the next two decades as population growth demands additional housing and employment opportunities. Despite this growth, Monroe desires to retain the essential feeling and attributes that define Monroe. This means planning for growth and managing its impacts to ensure Monroe remains a great place to live.

**Table 3.3 - FUTURE LAND USE CAPACITY**

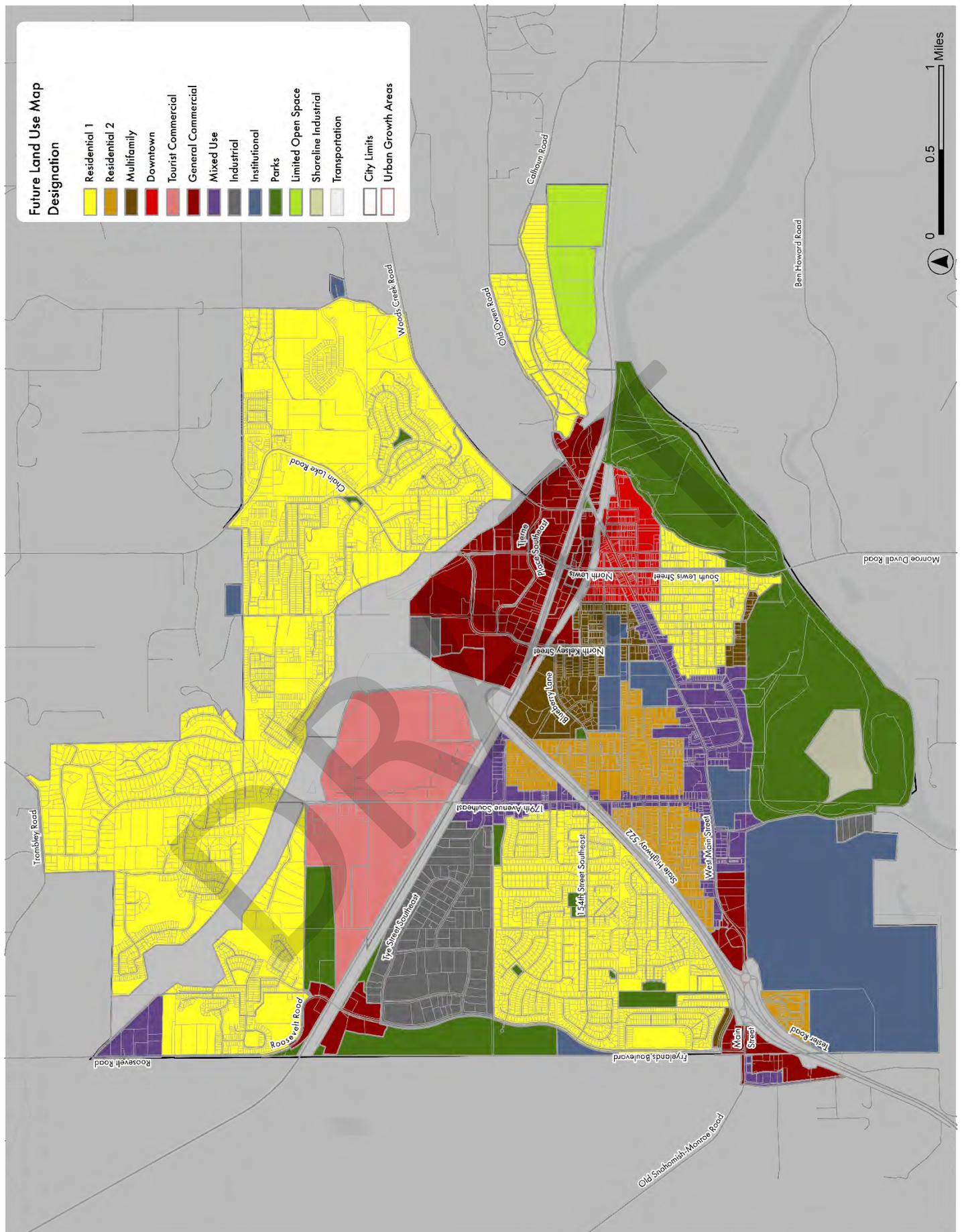
	Housing units in 2020	Housing units by 2044	Increase	Future Land Use Capacity
Monroe City	6,163	8,379	2,216	2,357*
Unincorporated UGA	551	758	207	479
Total	6,714	9,138**	2,424**	2,836
	Employment in 2020	Employment by 2044	Increase	Future Land Use Capacity
Monroe City	10,096	12,420	2,324	2,626
Unincorporated UGA	164	241	77	109
Total	10,260	12,660**	2,400**	2,735

\* The City of Monroe is responsible for meeting housing unit allocations within the Monroe City Limits. These numbers do not include pending and permitted projects, which roughly total 1,000 units.

\*\*Totals may be different due to rounding.

Source: Snohomish County Buildable Lands Report, 2021 and 2023

**Figure 3.4 - FUTURE LAND USE MAP (FLUM)**





**Table 3.4 - FUTURE LAND USE MAP CLASSIFICATIONS**

*Unless otherwise specified, photos were provided by the City of Monroe or MIG, Inc.*

Residential 1		
	Characteristics	Residential 1 neighborhoods allow for detached residential development, including middle housing options. Middle housing is typically ADUs, townhomes, and duplexes. Supporting uses typically include community spaces such as parks and other recreational facilities.
	Specifications	Density: Maximum 7 units per acre Lot Size: Range from 6,000 square feet to 9,000 square feet
	Transportation	Neighborhood streets that accommodate private vehicles with sidewalks for pedestrians. Bicycles typically share the street, except on busier roads where dedicated facilities are assumed.
	Uses	Primary: Detached and attached residential units Secondary: Civic uses, such as community spaces, parks, recreational facilities
	Building Types	Detached residential, duplexes, townhomes, and ADUs
	Zoning	R7
Residential 2		
	Characteristics	Residential 2 neighborhoods are generally east of SR 522, south of US 2, north of Main Street, and west of King Street. This designation allows for higher density housing types, including attached housing such as townhomes on parcels larger than 6,000 square feet, maintaining consistency in infill lots while introducing more compact housing on larger sites.
	Specifications	Density: Maximum 15 units per acre Lot Size: None, project must meet bulk standards
	Transportation	Walkable street grid with pedestrian and bicycle facilities. May be served by transit.
	Uses	Primary: Attached residential Secondary: Civic uses, such as community spaces, parks, recreational facilities
	Building Types	Duplexes, triplexes, fourplexes, apartments, condominiums, townhomes, and detached housing.
	Zoning	R15



## Multifamily Residential



Characteristics	Multifamily Residential areas offer diverse housing options, located where urban amenities are already in place. Typically situated along minor arterials and collectors and near business hubs, these areas support a high activity community life. This classification can often include specialized housing like senior living and affordable units.
Specifications	Density: Maximum 25 units per acre Lot Size: None, project must meet bulk standards
Transportation	Walkable street grid with pedestrian and bicycle facilities. May be served by transit.
Uses	Primary: Attached Residential Secondary: Civic uses, such as community spaces, parks, recreational facilities
Building Types	Duplexes, triplexes, fourplexes, apartments, condominiums, and townhomes
Zoning	R25

## Downtown Commercial



Characteristics	Downtown is a pedestrian-friendly commercial hub with retail, entertainment, and service establishments, supported by mixed-use and residential development. Residential spaces, often integrated above or behind the main commercial areas, provide easy access to goods and services. Downtown Commercial uses typically do not include (or cater to) automobile-dependent uses.
Specifications	Density: 11 to 20 dwelling units per acre Lot Size: None, project must meet bulk standards
Transportation	Walkable street grid with high quality pedestrian and bicycle facilities. May be served by transit.
Uses	Primary: Retail, commercial, office, restaurant, mixed-use and multifamily residential Secondary: Civic uses, parking
Building Types	Historic buildings (1-2 stories) with residential or office on the second story. Mixed-use and multifamily buildings (3-4 stories) adjacent to historic Main Street.
Zoning	DC-RN, DC-HM, DC-ED, and DC-DTP



## Tourist Commercial

 	Characteristics	Tourist Commercial caters to visitors, offering a variety of services and amenities such as retail stores, dining establishments, lodging options, and entertainment venues. With direct access to transportation options and unique regional facilities such as event venues and cultural sites, this district serves as a dynamic hub for both commerce and leisure activities.
	Specifications	Density: N/A Lot Size: None, projects must meet the Floor Area Ratios and bulk standards
	Transportation	Served by major arterials and transit. Should be served by transit and bicycle facilities
	Uses	Primary: Large format retail, lodging, restaurants, entertainment, event spaces Secondary: Open space, parking
	Building Types	Large format retail and hospitality services
	Zoning	TC

## General Commercial

 	Characteristics	General Commercial areas include indoor retail, dining, entertainment, and businesses catering to consumer needs and services. Outdoor merchandise displays are often permitted and are typically auto oriented. This classification also extends to office-based services like banking, medical clinics, legal, and real estate services.
	Specifications	Density: N/A Lot Size: None, projects must meet bulk standards
	Transportation	Served by major arterials to access parking. May include transit services.
	Uses	Primary: Large format retail, lodging, restaurants, entertainment, events Secondary: Open space, parking
	Building Types	Large format retail, strip commercial, gas stations and other highway adjacent land uses.
	Zoning	GC, NK/TP-O, IT



Mixed-Use		
 	Characteristics	Mixed-use areas are densely populated locations that can blend commercial, office, and institutional spaces with attached residential units. These uses can be housed in a single building or separate buildings on the same property. Mixed use areas can be larger developments, are also serve as locally serving commercial locations with adjacent existing or new residential development.
	Specifications	Density: 8- 25 du/ac (varies by type of zone) Lot Size: Varies
	Transportation	Walkable street grid with high quality pedestrian and bicycle facilities with connections to broader pedestrian and bicycle connections. May be served by transit.
	Uses	Primary: Retail, commercial, office, restaurant, multifamily residential Secondary: Civic uses, parks
	Building Types	Up to six stories (depending on zone) with retail on the ground floor, with residential units above or adjacent to commercial (depending on zone).
	Zoning	MG, MM, MN

Industrial		
 	Characteristics	Industrial areas support industrial activities such as manufacturing, processing, wholesaling, warehousing, and distribution centers. This area supports industrial operations while potentially accommodating additional small-scale commercial activities.
	Specifications	Density: N/A Lot Size: 5,000 SF
	Transportation	Roads able to accommodate large vehicles with access to major arterials.
	Uses	Primary: Manufacturing, warehousing, storage, industrial parks, automotive repair, and similar industries Secondary: Parking, office, & limited commercial uses
	Building Types	1-2 story large footprint buildings with varied forms
	Zoning	LI, GI, and FC-O



## Shoreline Industrial

	Characteristics	Shoreline Industrial is solely for properties hosting the Cadman gravel operation, allowing gravel mining and processing. This designation caters to shoreline areas for industrial purposes, ensuring compatibility with existing operations while safeguarding environmental integrity.
	Specifications	Density: N/A Lot Size: 5,000 SF
	Transportation	Roads able to accommodate large vehicles.
	Uses	Primary: Mining and processing operations Secondary: N/A
	Building Types	NA
	Zoning	SI

Sources: Google Maps

## Institutional

	Characteristics	Institutional areas encompass city, county, state, federal, and special purpose district owned and operated facilities situated within Monroe's City Limits or its UGA. These public facilities comprise entities such as the Washington State Department of Corrections Monroe Complex, public libraries, City Hall, schools, and other educational institutions.
	Specifications	Density: N/A Lot Size: 5,000 SF
	Transportation	Varies by location, and access to transit is preferred
	Uses	Primary: Public buildings, parks, community spaces, publicly owned facilities Secondary: N/A
	Building Types	Varies by location
	Zoning	IN

Sources: Sno-Isle Libraries (<https://www.sno-isle.org/>) and The Washington Department of Corrections ([Monroe Correctional Complex \(MCC\)](#) | [Washington State Department of Corrections](#))



**Parks**



Characteristics	Parks provide the community with public spaces used for recreation and/or natural open space and is preserved and maintained by the City.
Specifications	Density: N/A Lot Size: N/A
Transportation	Varies by location and access to transit is preferred.
Uses	Primary: Parks and recreation Secondary: Parking
Building Types	Publicly owned facilities and open space
Zoning	P

**Limited Open Space**



Characteristics	Limited Open Space areas are defined by their extremely low-intensity development, often attributed to limited access to essential services and potential impacts to critical areas. These areas offer opportunities to enhance recreational amenities and establish connections to existing or planned trail networks and other open space systems.
Specifications	Density: 1 dwelling per 5 acres Lot Size: N/A
Transportation	
Uses	Primary: Limited detached residential and outbuildings, open space, publicly owned facilities Secondary: N/A
Building Types	Varies by location
Zoning	LS



## Goals, Policies, and Action Items

Goals and policies described in the Land Use Element set the direction for implementing the Imagine Monroe Vision while also meeting required regional and County policy direction. Goals and policies strive to preserve Monroe's unique story and character while fostering efficient and equitable land use decisions, increasing economic resilience, and enhancing the City's livability. Land use policies identify and prioritize how decisions can inform decision-making for equitable investments in infrastructure and programs that contribute to vibrant neighborhoods, and environmental protection.



*Aerial view of Monroe  
Source: Provided by the City of Monroe*



Photo Source: MIG, Inc.

## Goal 3.1

Support and manage development that supports the Imagine Monroe Vision.



Policy	Action Item	
3.1.1		Identify and promote the development of neighborhood commercial centers that emphasize the need for services for historically marginalized neighborhoods.
3.1.2		Identify and integrate other master or community plans that support a connected and accessible Monroe.
	<b>3.1.2.1</b>	<i>Coordinate with Snohomish County to identify outcomes of the Fairgrounds Master Planning process.</i>
	<b>3.1.2.2</b>	<i>Develop an implementation strategy for the Fryelands Industrial Area and the Health Services District.</i>
3.1.3		Consider potential residential or employment displacement as part of meeting County growth targets to reduce the potential impact or disproportionate burdens on marginalized communities.
3.1.4		Periodically update the existing Development Code and Design Standards to be consistent with new district or subarea plans.



	<b>3.1.4.1</b>	<i>Develop zoning regulations to require new development in the Downtown area to include integrated parking facilities.</i>
	<b>3.1.4.2</b>	<i>Utilize noise regulations for zoning districts that could produce high levels of noise pollution to prevent adverse noise impacts to adjacent land uses.</i>
	<b>3.1.4.3</b>	<i>Update the urban design requirements for infill development, including residential and mixed-use development.</i>
	<b>3.1.4.4</b>	<i>Evaluate existing design standards, including those applying to the Downtown Commercial Zone, related to the orientation of public, commercial and residential structures to the street. The evaluation should also include consistency with regional and state requirements.</i>
	<b>3.1.4.5</b>	<i>Implement incentives, such as permit streamlining, impact fee waivers, land swaps and other strategies to increase the amount of high density residential and mixed-use housing near retail, health-care services, parks, and transportation routes. Incentives should prioritize the provision of affordable housing for those earning less than 80 percent of the Average Median Income (AMI).</i>
	<b>3.1.4.6</b>	<i>Create a new chapter within the Development Code that identifies methods to incentivize various development types, such as clustering, parks and open space provisions and other strategies that support compact and walkable development.</i>
3.1.5		Develop a cultural resources and historic preservation program that considers pre-colonization and contributions of marginalized communities, in addition to more recent settlement patterns and development.



3.1.6		Establish and maintain opportunities for the community to practice a variety of urban agriculture throughout neighborhoods and projects, such as P-patches, community gardens, as well as rooftop and home gardens on private property.
	<b>3.1.6.1</b>	<i>Adopt zoning regulations that establish community or home gardens as a permitted use in appropriate locations, and eliminate any zoning, design standard, or other restrictions on home gardens and edible landscaping imposed on residential properties, including detached residential, multifamily, and residential mixed use.</i>
	<b>3.1.6.2</b>	<i>Adopt zoning regulations that establish urban farms as a conditional use in appropriate locations. Urban farms are compatible with all land use designations, with some restrictions in Critical Areas and Industrial Areas.</i>
3.1.7		Designate adequate lands to meet existing and future land needs of the City.
	<b>3.1.7.1</b>	<i>Regulatory and administrative actions regarding land use and as adopted by the Comprehensive Plan shall not unconstitutionally infringe upon private property rights or result in the unconstitutional taking of private property.</i>
	<b>3.1.7.2</b>	<i>Amendments made to land use will balance the rights of property owners and tribal lands with the other GMA goals.</i>
	<b>3.1.7.3</b>	<i>Facilitate the siting of organic material management facilities to ensure adequate capacity exists for the processing of organic materials now and in the future.</i>
3.1.8		Apply appropriate airport overlay zone to area surrounding First Air Field through development standards.



Photo Source: Provided by the City of Monroe

## Goal 3.2

Create places that provide housing, retail, and urban services that are accessible without a car.



Policy	Action Item	
3.2.1		<p>Prioritize urban development in Monroe in the Downtown and North Kelsey areas to implement existing Urban Centers Plans.</p>
	<p><b>3.2.1.1</b></p>	<p><i>Update the Downtown Urban Centers Plan, including site and urban design requirements related to development, parks, parking, transportation, and adjacent land uses. The updated plan should include:</i></p> <ul style="list-style-type: none"> <li>a. <i>Standards for transportation and pedestrian-scale lighting</i></li> <li>b. <i>Land uses, such as affordable housing at various income levels.</i></li> <li>c. <i>Building heights, bulk, and design</i></li> <li>d. <i>Mobility</i></li> <li>e. <i>Parks and public spaces</i></li> <li>f. <i>Parking</i></li> <li>g. <i>Sustainability and low impact development</i></li> </ul>



	<p><b>3.2.1.2</b></p>	<p><i>Update the North Kelsey Master Plan to incorporate new mixed-use, high density residential uses for diverse incomes, and pedestrian and bicycle connectivity. The updated plan should address:</i></p> <ul style="list-style-type: none"> <li><i>a. Land uses, such as affordable housing at various income levels.</i></li> <li><i>b. Building heights, bulk, and design</i></li> <li><i>c. Mobility</i></li> <li><i>d. Parks and public spaces</i></li> <li><i>e. Parking</i></li> <li><i>f. Sustainability and low impact development</i></li> </ul>
	<p><b>3.2.1.3</b></p>	<p><i>Develop a land use and urban design corridor plan for the US 2 corridor within the Monroe City Limits. This corridor plan should focus on multimodal accessibility and redevelopment of auto-oriented commercial into more walkable urban development.</i></p>
	<p><b>3.2.1.4</b></p>	<p><i>Update zoning along US-2 to allow a more diverse mix of uses in addition to general commercial, including mixed-use and multifamily residential in defined areas along the corridor.</i></p>
	<p><b>3.2.1.5</b></p>	<p><i>Update zoning Downtown and along Main Street to permit mixed-use and multifamily development, if not already permitted through existing zoning</i></p>



Photo Source: Provided by the City of Monroe

## Goal 3.3

Connect land use with a multimodal transportation system and employ programs that focus on creating walkable and vibrant neighborhoods.



Policy	Action Item	
3.3.1		Integrate parking facilities in the Downtown area with pedestrian, bicycle, and transit circulation.
3.3.2		Promote land use patterns, such as compact urban development, which facilitates linked trips where someone can park once and access multiple services, businesses, and residential uses without multiple trips by single-occupancy vehicles.
3.3.4		Direct new development to those areas where adequate transportation facilities exist or will be provided as defined in the City-adopted transportation plan. Future development locations should also consider areas where transportation services have not been provided but could benefit historically under-invested neighborhoods and areas.
3.3.4		Require commute trip reduction program for new development for employers of over 100 employees. Smaller employers should be encouraged to voluntarily participate.



Photo Source: Provided by the City of Monroe

## Goal 3.4

Manage open space and natural habitats to improve the environment, reduce conflicts with development, and prevent the creation of, or worsening of environmental health disparities in the community.



Policy	Action Item	
3.4.1		Increase opportunities to implement and prioritize low-impact development standards with Monroe.
	<b>3.4.1.1</b>	<i>Promote the use of native landscaping plants and materials, while considering existing infrastructure, urban environment constraints, and other factors necessary to consider for plantings.</i>
	<b>3.4.1.2</b>	<i>Consider reestablishing Planned Residential Development standards that include options to preserve open spaces through techniques such as conservation easements and density bonuses.</i>
	<b>3.4.1.3</b>	<i>Revise Development Code regulations to include standards and incentives to increase the implementation of Low-Impact Development watershed management techniques.</i>



3.4.2		Review and update building and development codes on an ongoing basis, incorporating the best and latest standards for development in critical areas.
3.4.3		Reduce damage in Monroe from flooding.
	<b>3.4.3.1</b>	<i>Update the Development Code to require development within in the floodplain to show that it will not have an impact on downstream development from an increase in flooding.</i>
	<b>3.4.3.2</b>	<i>Require special site plan review of proposed development in geological and flood hazard areas.</i>
	<b>3.4.3.3</b>	<i>Retain larger Riparian Management Zones (RMZ), as well as wetlands and their associated buffers to capitalize on the ecosystem services these resources provide. (See chapter 10 for more information on RMZs).</i>
	<b>3.4.3.4</b>	<i>Maintain eligibility for Federal Hazard Mitigation Grants.</i>
	<b>3.4.3.5</b>	<i>Participate in the National Flood Insurance Program Community Rating System.</i>
3.4.4		<p>Evaluate wildfire risks within the Monroe UGA, assess the international code council's wildland urban interface code as adopted by the Washington legislature and consistent with the International Wildland-Urban Interface Code, and adopt appropriate regulations for the City of Monroe to reduce the wildfire risks to lives and property through land use planning tools such as:</p> <ul style="list-style-type: none"> <li>a. Separating human development from wildfire-prone or high-risk areas</li> </ul>



		b. Creating community resilience and preparedness through fire-adaptation measures
<b>3.4.5</b>		Reduce environmental justice impacts by providing special consideration, such as additional outreach and impact analysis, related to residents that may be vulnerable to noise, air pollution, and other environmental impacts created through planning and land management activities.

DRAFT



Photo Source: Provided by the City of Monroe

## Goal 3.5

Balance future annexation interest with protection of the natural environment.



Policy	Action Item	
3.5.1		Ensure that future annexations consider equitable outcomes for all current and future residents, including requirements for middle housing, public multimodal access, public access to open spaces and natural areas.
	<b>3.5.1.1</b>	<i>Evaluate how proposed annexations align with policies regarding the preservation of natural features and open spaces.</i>
	<b>3.5.1.2</b>	<i>Conduct a cost/benefit analysis when considering annexation.</i>
	<b>3.5.1.3</b>	<i>Consider pre-annexation sub-area planning for the unincorporated portions of Monroe’s UGA, with requirements that an analysis is completed of how the proposal meets the policy framework. .</i>



3.5.2		Create an annexation process that meets the City's Imagine Monroe Vision and provides housing opportunities for those at varied income levels.
	<b>3.5.2.1</b>	<i>Update the Development Code to require future annexations to include middle housing as part of the development proposal, including affordable opportunities for people making less than 80 percent AMI to either own or rent housing.</i>
	<b>3.5.2.2</b>	<i>Update the Development Code to require future annexations to develop with more than detached residential through higher zoning densities, incorporating various densities of residential uses, as feasible, to increase the types of housing in Monroe.</i>
3.5.3		Coordinate with Snohomish County on all annexations.



Photo Source: MIG, Inc.

## Goal 3.6

Encourage cooperation and collaboration between government entities and the community to ensure effective and transparent governance and land use.



Policy	Action Item	
3.6.1		Conduct routine evaluations to assess the effectiveness and alignment of goals, policies, and design standards.
	<b>3.6.1.1</b>	<i>Increase opportunities for the Monroe community by publicizing opportunities to take part in conversations about City-related business and ongoing planning efforts, including periodic updates to the Monroe 2044 Comprehensive Plan and other functional plans.</i>
3.6.2		Regularly review and assess the permitting process to optimize resource utilization and staff capacity, ensuring effectiveness and continuous improvement.
	<b>3.6.2.1</b>	<i>Make City licensing and permitting regulations and procedures coherent, fair, and expedient through the use of permit tracking software.</i>
	<b>3.6.2.2</b>	<i>Coordinate licensing and permitting procedures with inspections by other government agencies, if any, to eliminate duplication of efforts.</i>



3.6.3		Coordinate with tribal entities in regional and local planning, optimizing mutual benefits and positive impacts growth may have within and outside of tribal lands.
	<b>3.6.3.1</b>	<i>Protect tribal reservation lands from encroachment by incompatible land uses and development on adjacent land.</i>
3.6.4		Promote and honor government-to-government relationships with federally recognized tribes; ensuring substantial opportunities for tribal governments to review the City of Monroe’s Comprehensive Plan updates.

DRAFT

Lake Tye Park and Fryelands Elementary School  
Source: Provided by the City of Monroe

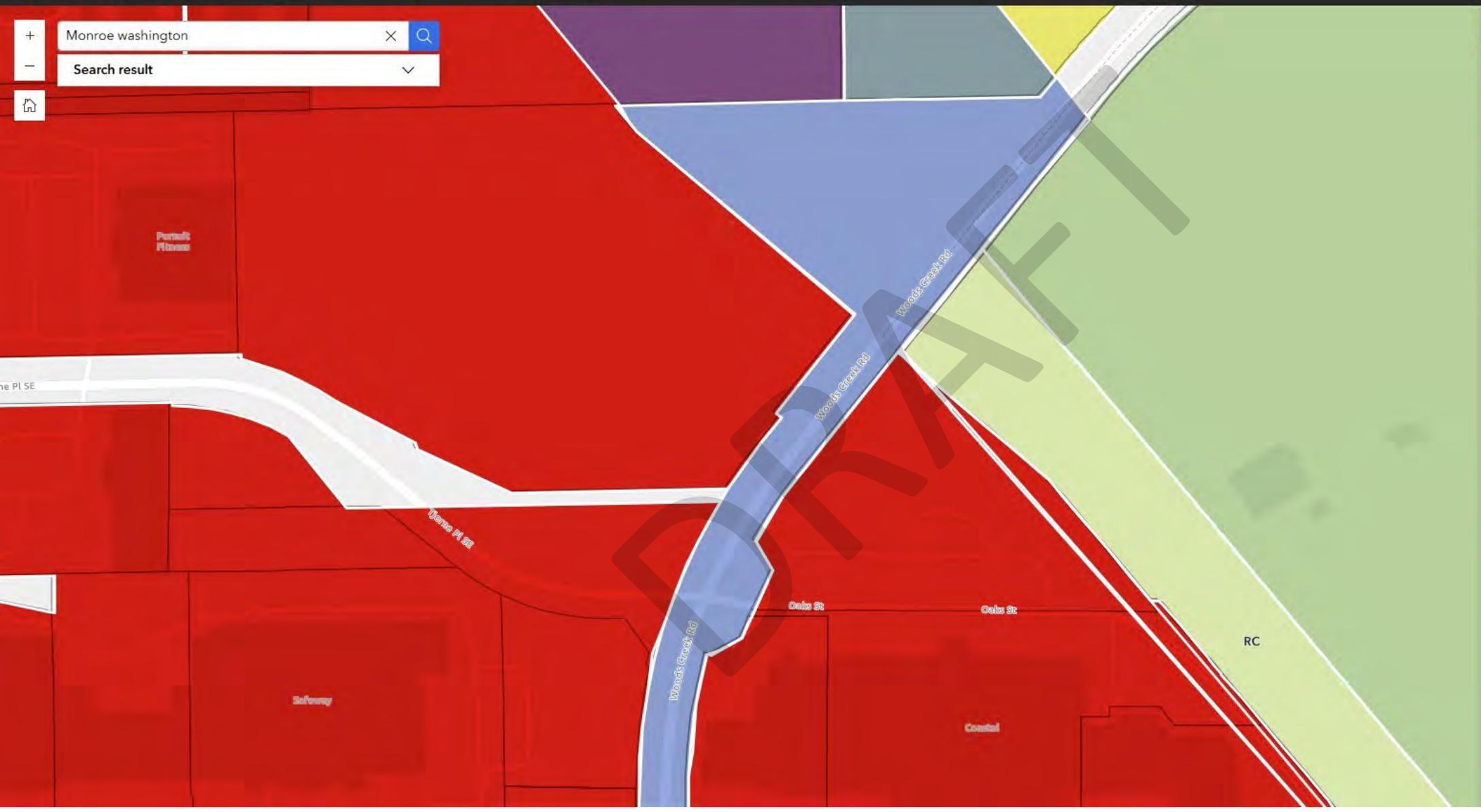


Attachment I  
*Washington State Zoning Atlas*  
(WAZA)

DRAFT

+ Monroe washington X

- Search result V



Legend

ArcGIS World Geocoding Service

Zoning Attributes

Classification

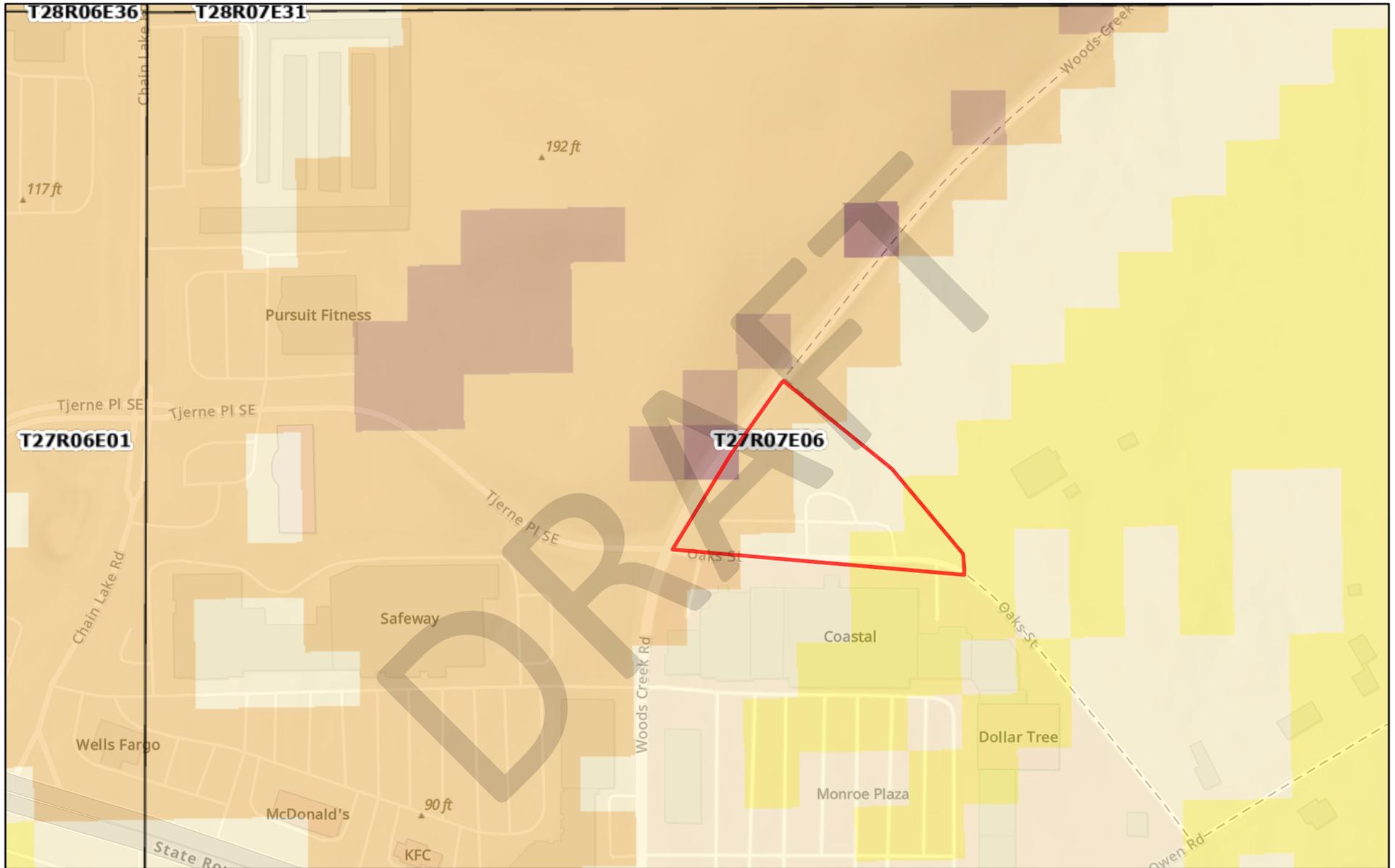
General Classification

- Rural
- Low-Intensity Residential
- Multi-unit Residential
- Commercial
- Mixed Use
- Industrial
- Military
- Natural Resource Lands
- Open Space
- Public/Semi-public
- Tribal Lands
- Undesignated
- Unknown

Attachment J  
*Washington Information System for Architectural &  
Archaeological Records Data (WISAARD)*

DRAFT

# Monroe SRF 32 Wisgaard



8/19/2025

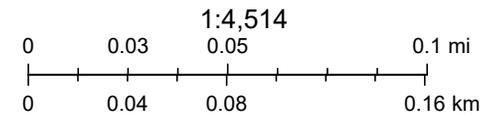
Sections  
Risk Level

2 - Survey Contingent Upon Project Parameters: Moderately Low Risk (Color: Burnt Orange)

3 - Survey Recommended: Moderate Risk (Color: Orange)

4 - Survey Highly Advised: High Risk (Color: Pale Yellow)

5 - Survey Highly Advised: Very High Risk (Color: Brightest Yellow/Canary Yellow)



Esri Community Maps Contributors, WA State Parks GIS, © OpenStreetMap, Microsoft, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/





# INADVERTENT DISCOVERY PLAN

## PLAN AND PROCEDURES FOR THE DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS

To request ADA accommodation, including materials in a format for the visually impaired, call Ecology at 360-407-6000 or visit <https://ecology.wa.gov/accessibility>. People with impaired hearing may call Washington Relay Service at 711. People with a speech disability may call TTY at 877-833-6341.

Site Name(s):  Location:

Project Lead/Organization:  County:

*If this Inadvertent Discovery Plan (IDP) is for multiple (batched) projects, ensure the location information covers all project areas.*

### 1. INTRODUCTION

The IDP outlines procedures to perform in the event of a discovery of archaeological materials or human remains, in accordance with applicable state and federal laws. An IDP is required, as part of Agency Terms and Conditions for all grants and loans, for any project that creates disturbance above or below the ground. An IDP is not a substitute for a formal cultural resource review (Executive 21-02 or Section 106).

Once completed, **the IDP should always be kept at the project site** during all project activities. All staff, contractors, and volunteers should be familiar with its contents and know where to find it.

### 2. CULTURAL RESOURCE DISCOVERIES

A cultural resource discovery could be prehistoric or historic. Examples include (see images for further examples):

- An accumulation of shell, burned rocks, or other food related materials.
- Bones, intact or in small pieces.
- An area of charcoal or very dark stained soil with artifacts.
- Stone tools or waste flakes (for example, an arrowhead or stone chips).
- Modified or stripped trees, often cedar or aspen, or other modified natural features, such as rock drawings.
- Agricultural or logging materials that appear older than 50 years. These could include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, and many other items.
- Clusters of tin cans or bottles, or other debris that appear older than 50 years.
- Old munitions casings. **Always assume these are live and never touch or move.**
- Buried railroad tracks, decking, foundations, or other industrial materials.
- Remnants of homesteading. These could include bricks, nails, household items, toys, food containers, and other items associated with homes or farming sites.

The above list does not cover every possible cultural resource. When in doubt, assume the material is a cultural resource.

### 3. ON-SITE RESPONSIBILITIES

If any employee, contractor, or subcontractor believes that they have uncovered cultural resources or human remains at any point in the project, take the following steps to **Stop-Protect-Notify**. **If you suspect that the discovery includes human remains, also follow Sections 5 and 6.**

#### STEP A: Stop Work.

All work must stop immediately in the vicinity of the discovery.

#### STEP B: Protect the Discovery.

Leave the discovery and the surrounding area untouched and create a clear, identifiable, and wide boundary (30 feet or larger) with temporary fencing, flagging, stakes, or other clear markings. Provide protection and ensure integrity of the discovery until cleared by the Department of Archaeological and Historical Preservation (DAHP) or a licensed, professional archaeologist.

Do not permit vehicles, equipment, or unauthorized personnel to traverse the discovery site. Do not allow work to resume within the boundary until the requirements of this IDP are met.

#### STEP C: Notify Project Archaeologist (if applicable).

If the project has an archaeologist, notify that person. If there is a monitoring plan in place, the archaeologist will follow the outlined procedure.

#### STEP D: Notify Project and Washington Department of Ecology (Ecology) contacts.

##### Project Lead Contacts

###### Primary Contact

Name:   
Organization:   
Phone:   
Email:

###### Alternate Contact

Name:   
Organization:   
Phone:   
Email:

##### Ecology Contacts (completed by Ecology Project Manager)

###### Ecology Project Manager

Name:   
Program:   
Phone:   
Email:

###### Alternate or Cultural Resource Contact

Name:   
Program:   
Phone:   
Email:

**STEP E: Ecology will notify DAHP.**

Once notified, the Ecology Cultural Resource Contact or the Ecology Project Manager will contact DAHP to report and confirm the discovery. To avoid delay, the Project Lead/Organization will contact DAHP if they are not able to reach Ecology.

DAHP will provide the steps to assist with identification. DAHP, Ecology, and Tribal representatives may coordinate a site visit following any necessary safety protocols. DAHP may also inform the Project Lead/Organization and Ecology of additional steps to further protect the site.

**Do not continue work until DAHP has issued an approval for work to proceed in the area of, or near, the discovery.**

DAHP Contacts:

Name: Rob Whitlam, PhD  
Title: State Archaeologist  
Cell: 360-890-2615  
Email: [Rob.Whitlam@dahp.wa.gov](mailto:Rob.Whitlam@dahp.wa.gov)  
Main Office: 360-586-3065

**Human Remains/Bones:**

Name: Guy Tasa, PhD  
Title: State Anthropologist  
Cell: 360-790-1633 (24/7)  
Email: [Guy.Tasa@dahp.wa.gov](mailto:Guy.Tasa@dahp.wa.gov)

**4. TRIBAL CONTACTS**

In the event cultural resources are discovered, the following tribes will be contacted. See Section 10 for Additional Resources.

Tribe:	<input type="text"/>	Tribe:	<input type="text"/>
Name:	<input type="text"/>	Name:	<input type="text"/>
Title:	<input type="text"/>	Title:	<input type="text"/>
Phone:	<input type="text"/>	Phone:	<input type="text"/>
Email:	<input type="text"/>	Email:	<input type="text"/>
Tribe:	<input type="text"/>	Tribe:	<input type="text"/>
Name:	<input type="text"/>	Name:	<input type="text"/>
Title:	<input type="text"/>	Title:	<input type="text"/>
Phone:	<input type="text"/>	Phone:	<input type="text"/>
Email:	<input type="text"/>	Email:	<input type="text"/>

Please provide contact information for additional tribes within your project area, if needed, in Section 11.

**5. FURTHER CONTACTS (if applicable)**

If the discovery is confirmed by DAHP as a cultural or archaeological resource, or as human remains, and there is a partnering federal or state agency, Ecology or the Project Lead/Organization will ensure the partnering agency is immediately notified.

Federal Agency:

Agency:

Name:

Title:

Phone:

Email:

State Agency:

Agency:

Name:

Title:

Phone:

Email:

**6. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL MATERIAL**

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Follow the steps under **Stop-Protect-Notify**. For specific instructions on how to handle a human remains discovery, see: [RCW 68.50.645: Skeletal human remains—Duty to notify—Ground disturbing activities—Coroner determination—Definitions](#).

**Suggestion:** If you are unsure whether the discovery is human bone or not, contact Guy Tasa with DAHP, for identification and next steps. Do not pick up the discovery.

Guy Tasa, PhD State Physical Anthropologist

[Guy.Tasa@dahp.wa.gov](mailto:Guy.Tasa@dahp.wa.gov)

(360) 790-1633 (Cell/Office)

For discoveries that are confirmed or suspected human remains, follow these steps:

1. Notify law enforcement and the Medical Examiner/Coroner using the contacts below. **Do not call 911** unless it is the only number available to you.

Enter contact information below (required):

- Local Medical Examiner or Coroner name and phone:

- Local Law Enforcement main name and phone:

- Local Non-Emergency phone number (911 if without a non-emergency number):

2. The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human or if the discovery site constitutes a crime scene and will notify DAHP.
3. **DO NOT speak with the media, allow photography or disturbance of the remains, or release any information about the discovery on social media.**
4. If the remains are determined to be non-forensic, Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed by others or disturbed.

Further activities:

- Per [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#), DAHP will have jurisdiction over non-forensic human remains. Ecology staff will participate in consultation. Organizations may also participate in consultation.
- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#).
- When consultation and documentation activities are complete, work in the discovery area may resume as described in Section 8.

If the project occurs on federal lands (such as a national forest or park or a military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) apply and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on non-federal lands, the Project Lead/Organization will comply with applicable state and federal laws, and the above protocol.

## **7. DOCUMENTATION OF ARCHAEOLOGICAL MATERIALS**

Archaeological resources discovered during construction are protected by state law [RCW 27.53](#) and assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal Determination of Eligibility is made.

The Project Lead/Organization must ensure that proper documentation and field assessment are made of all discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and the archaeologist.

The archaeologist will record all prehistoric and historic cultural material discovered during project construction on a standard DAHP archaeological site or isolate inventory form. They will photograph site overviews, features, and artifacts and prepare stratigraphic profiles and soil/sediment descriptions for minimal subsurface exposures. They will document discovery locations on scaled site plans and site location maps.

Cultural features, horizons, and artifacts detected in buried sediments may require the archaeologist to conduct further evaluation using hand-dug test units. They will excavate units in a controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. They may also use a test unit or trench excavation to determine if an intact occupation surface is present. They will only use test units when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. They will conduct excavations using standard archaeological techniques to precisely document the location of cultural deposits, artifacts, and features.

The archaeologist will record spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock for each unit on a standard form. They will complete test excavation unit level forms, which will include plan maps for each excavation level and artifact counts and material types, number, and vertical provenience (depth below

surface and stratum association where applicable) for all recovered artifacts. They will draw a stratigraphic profile for at least one wall of each test excavation unit.

The archaeologist will screen sediments excavated for purposes of cultural resources investigation through 1/8-inch mesh, unless soil conditions warrant 1/4-inch mesh.

The archaeologist will analyze, catalogue, and temporarily curate all prehistoric and historic artifacts collected from the surface and from probes and excavation units. The ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology, and the affected tribe(s).

Within 90 days of concluding fieldwork, the archaeologist will provide a technical report describing any and all monitoring and resultant archaeological excavations to the Project Lead/Organization, who will forward the report to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s) for review and comment.

If assessment activities expose human remains (burials, isolated teeth, or bones), the archaeologist and Project Lead/Organization will follow the process described in **Section 6**.

## **8. PROCEEDING WITH WORK**

The Project Lead/Organization shall work with the archaeologist, DAHP, and affected tribe(s) to determine the appropriate discovery boundary and where work can continue.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Lead/Organization, DAHP, any affected tribe(s), Ecology, and the federal agencies (if any) determine that compliance with state and federal laws is complete.

## **9. ORGANIZATION RESPONSIBILITY**

The Project Lead/Organization is responsible for ensuring:

- This IDP has complete and accurate information.
- This IDP is immediately available to all field staff at the sites and available by request to any party.
- This IDP is implemented to address any discovery at the site.
- That all field staff, contractors, and volunteers are instructed on how to implement this IDP.

## **10. ADDITIONAL RESOURCES**

### **Informative Video**

Ecology recommends that all project staff, contractors, and volunteers view this informative video explaining the value of IDP protocol and what to do in the event of a discovery. The target audience is anyone working on the project who could unexpectedly find cultural resources or human remains while excavating or digging. The video is also posted on DAHP's inadvertent discovery language website.

[Ecology's IDP Video](https://www.youtube.com/watch?v=ioX-4cXfbDY) (<https://www.youtube.com/watch?v=ioX-4cXfbDY>)

## Informational Resources

[DAHP \(https://dahp.wa.gov\)](https://dahp.wa.gov)

[Washington State Archeology \(DAHP 2003\)](https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf)

[\(https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch\\_0.pdf\)](https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf)

[Association of Washington Archaeologists \(https://www.archaeologyinwashington.com\)](https://www.archaeologyinwashington.com)

## Potentially Interested Tribes

[Interactive Map of Tribes by Area](https://dahp.wa.gov/archaeology/tribal-consultation-information)

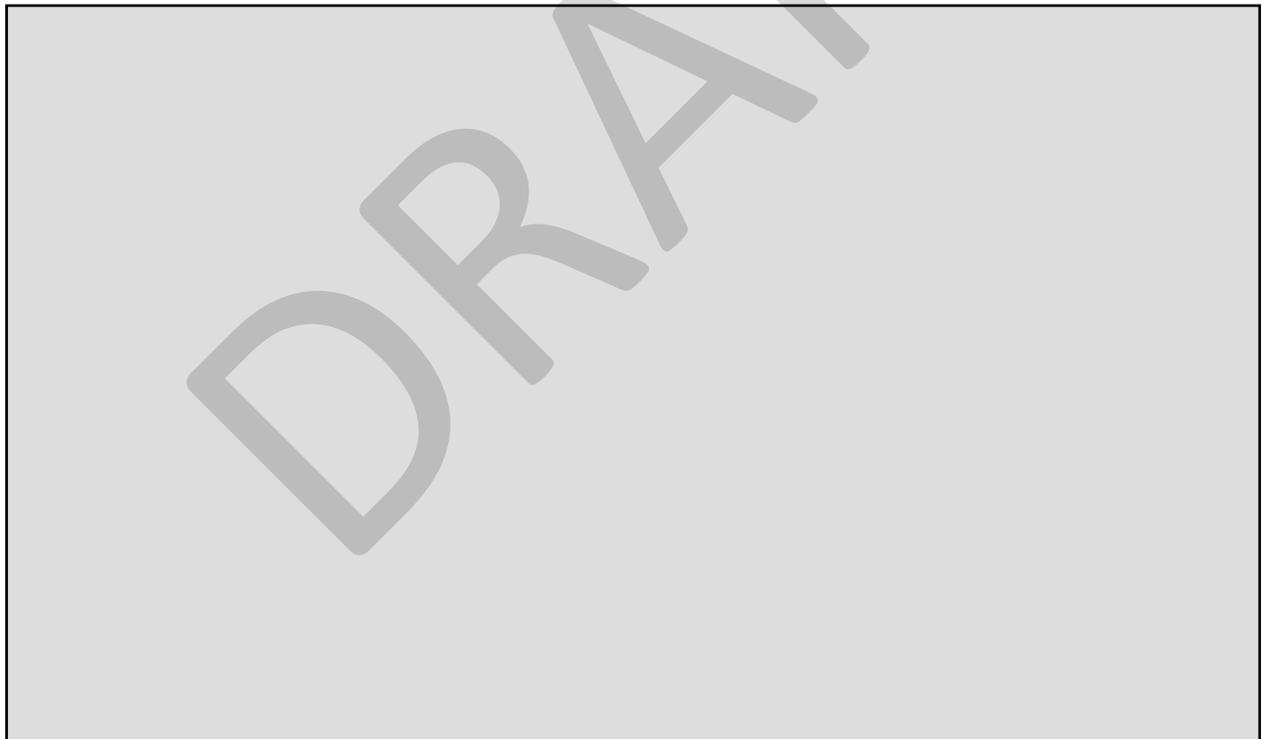
[\(https://dahp.wa.gov/archaeology/tribal-consultation-information\)](https://dahp.wa.gov/archaeology/tribal-consultation-information)

[WSDOT Tribal Contact Website](https://wsdot.wa.gov/tribal/TribalContacts.htm)

[\(https://wsdot.wa.gov/tribal/TribalContacts.htm\)](https://wsdot.wa.gov/tribal/TribalContacts.htm)

## 11. ADDITIONAL INFORMATION

Please add any additional contact information or other information needed within this IDP.



**Implement the IDP if you see...**

**Chipped stone artifacts.**

Examples are:

- Glass-like material.
- Angular material.
- “Unusual” material or shape for the area.
- Regularity of flaking.
- Variability of size.



*Stone artifacts from Oregon.*



*Stone artifacts from Washington.*



*Biface-knife, scraper, or pre-form found in NE Washington. Thought to be a well knapped object of great antiquity. Courtesy of Methow Salmon Rec. Foundation.*

## Implement the IDP if you see...

### Ground stone artifacts.

Examples are:

- Unusual or unnatural shapes or unusual stone.
- Striations or scratching.
- Etching, perforations, or pecking.
- Regularity in modifications.
- Variability of size, function, or complexity.



Above: Fishing Weight - credit [CRITFC Treaty Fishing Rights website](#).



Artifacts from unknown locations (left and right images).

**Implement the IDP if you see...**

**Bone or shell artifacts, tools, or beads.**

Examples are:

- Smooth or carved materials.
- Unusual shape.
- Pointed as if used as a tool.
- Wedge shaped like a “shoehorn”.
- Variability of size.
- Beads from shell (‘dentalium’) or tusk.



Upper Left: Bone Awls from Oregon.

Upper Center: Bone Wedge from California.

Upper Right: Plateau dentalium choker and bracelet, from Nez Perce National Historical Park, 19th century, made using Antalis pretiosa shells Credit: Nez Perce - Nez Perce National Historical Park, NEPE 8762, [Public Domain](#).

Above: Tooth Pendants. Right: Bone Pendants. Both from Oregon and Washington.



## Implement the IDP if you see...

### Culturally modified trees, fiber, or wood artifacts.

Examples are:

- Trees with bark stripped or peeled, carvings, axe cuts, de-limbing, wood removal, and other human modifications.
- Fiber or wood artifacts in a wet environment.
- Variability of size, function, and complexity.



Left and Below: *Culturally modified tree and an old carving on an aspen (Courtesy of DAHP).*

Right, Top to Bottom: *Artifacts from Mud Bay, Olympia: Toy war club, two strand cedar rope, wet basketry.*



## Implement the IDP if you see...

### Strange, different, or interesting looking dirt, rocks, or shells.

Human activities leave traces in the ground that may or may not have artifacts associated with them. Examples are:

- “Unusual” accumulations of rock (especially fire-cracked rock).
- “Unusual” shaped accumulations of rock (such as a shape similar to a fire ring).
- Charcoal or charcoal-stained soils, burnt-looking soils, or soil that has a “layer cake” appearance.
- Accumulations of shell, bones, or artifacts. Shells may be crushed.
- Look for the “unusual” or out of place (for example, rock piles in areas with otherwise few rocks).



*Shell Midden pocket in modern fill discovered in sewer trench.*



*Underground oven. Courtesy of DAHP.*

*Shell midden with fire cracked rock.*



*Hearth excavated near Hamilton, WA.*

**Implement the IDP if you see...**

**Historic period artifacts (historic archaeology considered older than 50 years).**

Examples are:

- Agricultural or logging equipment. May include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, etc.
- Domestic items including square or wire nails, amethyst colored glass, or painted stoneware.



Left: Top to Bottom: *Willow pattern serving bowl and slip joint pocket knife discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.*



Right: *Collections of historic artifacts discovered during excavations in eastern Washington cities.*



**Implement the IDP if you see...**

**Historic period artifacts (historic archaeology considered older than 50 years).**

Examples are:

- Railway tokens, coins, and buttons.
- Spectacles, toys, clothing, and personal items.
- Items helping to understand a culture or identity.
- Food containers and dishware.



Main Image: *Dishes, bottles, workboot found at the North Shore Japanese bath house (ofuro) site, Courtesy Bob Muckle, Archaeologist, Capilano University, B.C. This is an example of an above ground resource.*



Right, from Top to Bottom: *Coins, token, spectacles and Montgomery Ward pitchfork toy discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.*



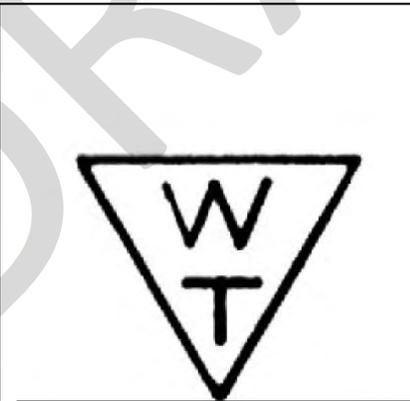
**Implement the IDP if you see...**

- Old munition casings – if you see ammunition of any type – ***always assume they are live and never touch or move!***
- Tin cans or glass bottles with an older manufacturer's technique – maker's mark, distinct colors such as turquoise, or an older method of opening the container.



Far Left: .303 British cartridge found by a WCC planting crew on Skagit River. Don't ever touch something like this!  
Left: Maker's mark on bottom of old bottle.

Right: Old beer can found in Oregon. ACME was owned by Olympia Brewery. Courtesy of Heather Simmons.



Logo employed by Whithall Tatum & Co. between 1924 to 1938 (Lockhart et al. 2016).



Can opening dates, courtesy of W.M. Schroeder.

Implement the IDP if you see...

You see historic foundations or buried structures.

Examples are:

- Foundations.
- Railroad and trolley tracks.
- Remnants of structures.



Counter Clockwise, Left to Right: *Historic structure 45KI924, in WSDOT right of way for SR99 tunnel. Remnants of Smith Cove shantytown (45-KI-1200) discovered during Ecology CSO excavation, City of Spokane historic trolley tracks uncovered during stormwater project, intact foundation of historic home that survived the Great Ellensburg Fire of July 4, 1889, uncovered beneath parking lot in Ellensburg.*

## Implement the IDP if you see...

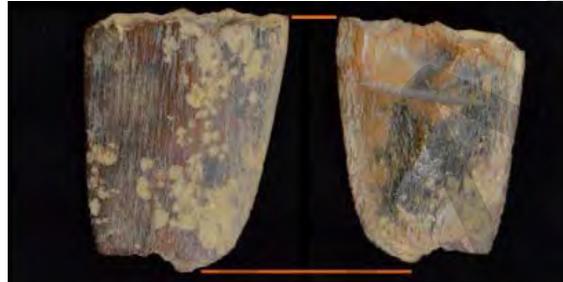
### Potential human remains.

Examples are:

- Grave headstones that appear to be older than 50 years.
- Bones or bone tools--intact or in small pieces. It can be difficult to differentiate animal from human so they must be identified by an expert.
- These are all examples of animal bones and are not human.

Center: *Bone wedge tool, courtesy of Smith Cove Shantytown excavation (45KI1200).*

*Other images (Top Right, Bottom Left, and Bottom) Center: Courtesy of DAHP.*



Directly Above: This is a real discovery at an Ecology sewer project site.

*What would you do if you found these items at a site? Who would be the first person you would call?*

*Hint: Read the plan!*