Data Report:
Falls City Hydrology: High Resolution Seismic Refraction
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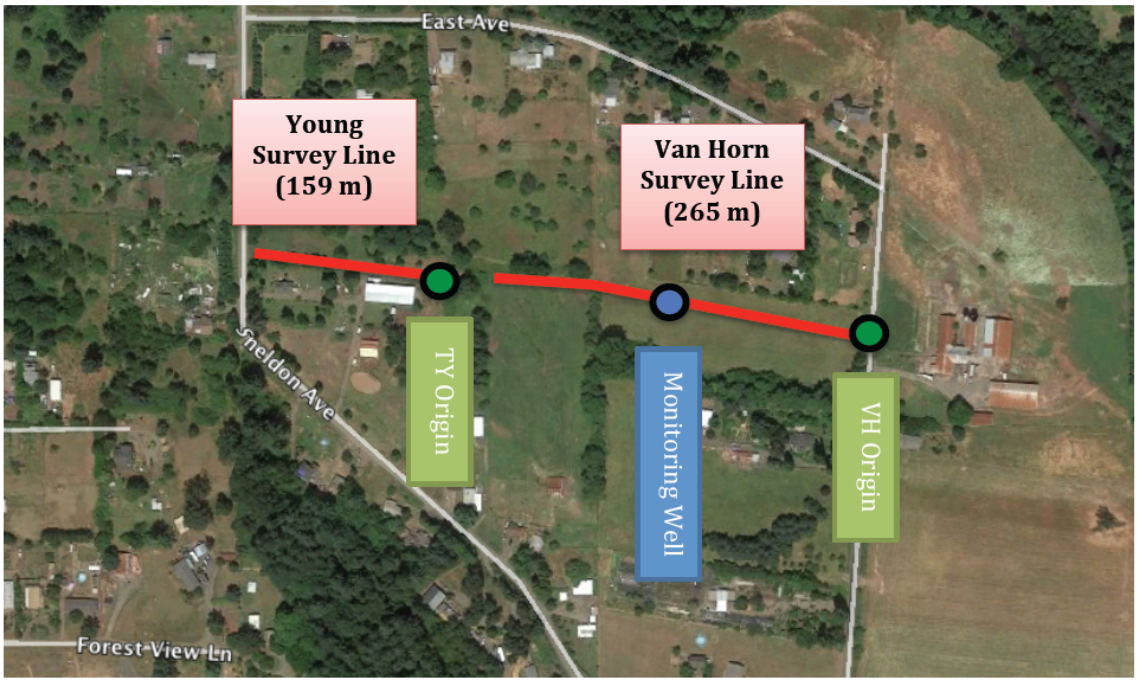
Objective: As part of an MS thesis project for Joe Kemper to study the hydrology of Falls City, Oregon, located on the eastern edge of the Coast Range adjacent to the Willamette Valley, a seismic refraction survey was conducted to determine depth to hydrologic basement beneath a neighborhood that has been plagued by frequent flooding. Landowners and local middle school science students, as well as Oregon State University graduate students, assisted with data acquisition. The objective of the project is to understand the causes for the flooding (thought to be shallow basement and a water table that rises nearly to the surface during the rainy season), and to help organize an effective community response. See page 4 for an article in the local press describing the objectives in more detail.

Data were acquired over 3 days and have been processed as 2 lines (Fig. 1). The 48-channel cable was deployed twice for the VH survey and once for the TY survey. The seismic source was hammer blows on a rectangular steel plate. All geophone and source positions are given in file FC_SurveyData.xlsx in units of meters measured along and perpendicular to the line. Elevations of each source and receiver point are also given in this file.

The 48 channels for each shot are in a separate segd file. Raw data for the 114 sources are in directory "1000." Processed data are in directory "1000_workspace," with data with geometry information in the headers found in TY_Survey/TY_GEOedit and VH_Survey/VH_GEOedit. See file "readme.txt" for more information on the directory structure. See file *FC_SurveyData.xlsx* for receiver and source geometry.

Data picks and models derived using *plotrefa* software provided with the PASSCAL field computer are also found in these directories. Final P-wave models obtained through first-arrival tomography are shown on pg. 4.



- **Location:** Falls City, OR. Monitoring well at 44.860342, -123.426111

- **Yamhill formation**: Eocene siltstone and sandstone layers. Geologic maps indicate that bluff is formed by Yamhill formation, but I have found no outcrops. Adjacent riverbed is also formed by Yamhill formation.

- **Holocene/Pleistocene Alluvium**: Paleo-flood plain. River is now approx. 10 meters below flood plain – not connected.

- **Profile of subsurface at monitoring well.**
  - 0.0-0.5 meters; Missoula Flood silt/clay soil.
  - 0.5-4.0 meters; clay rich alluvium with well-rounded gravels and cobbles.
  - 4.0 – 5.0 meters; weathered siltstone (yamhill formation)
  - 5.0 - 200 meters; siltstone (Yamhill Formation)

Figure 1. Experimental layout. A summary of the geologic setting and a downhole summary of the geology at the borehole are also given.

Appendix A is a printout of the information in file FC_SurveyData. Geophone coordinates on the left; source information is on the right. See Figure 1 for the layout.

Listing of readme.txt in directory 1000_workspace:

Summary File
C:\1000_workspace\Falls City Hydro Summary - This is a map and summary of survey.

Data Directory
C:\1000 - uneditted refraction data

C:\1000_workspace - contains data with corrected geometry, first arrival picks, and model results

C:\1000_workspace\VH_survey - contains corrected, picked, and modeled data from Van Horn Property (see FC_Surveyoverview.pdf)

VH_survey\VH_GEOedit - contains data with corrected geometry
VH_survey\VH_PICKedit - .vs files with first arrival picks
VH_survey\VH_Model1 - results from tomographic inversion
VH_survey\VH_Model2 - results from tomographic inversion
VH_survey\VH_Model3 - results from tomographic inversion

C:\1000_workspace\TY_Survey - contains corrected, picked, and modeled data from Young Property (see FC_Surveyoverview.pdf)

TY_Survey\TY_GEOedit - contains data with corrected geometry
TY_Survey\TY_PICKedit - .vs files with first arrival picks
TY_Survey\TY_model1 - results from tomographic inversion
TY_Survey\TY_model2 - results from tomographic inversion

Geometry Files

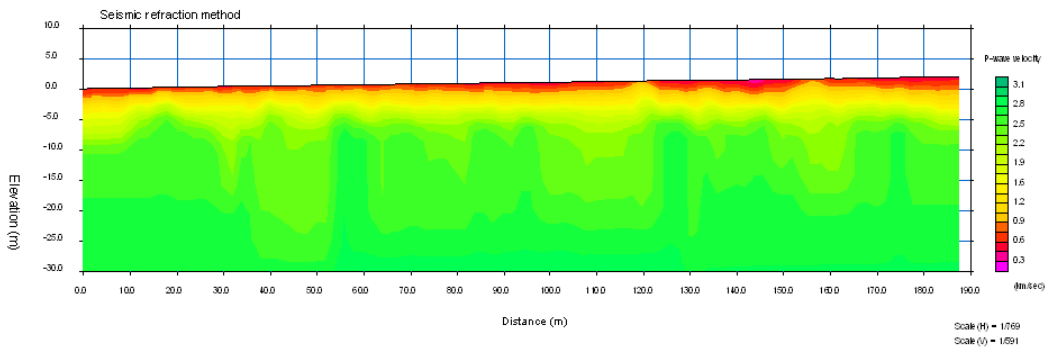
C:\1000_workspace\FC_SurveyData.xlsx - compiled geophone and shotpoint geometries.

C:\1000_workspace\TY_Survey\TY_geophoneelevations - geophone elevation file for Young survey

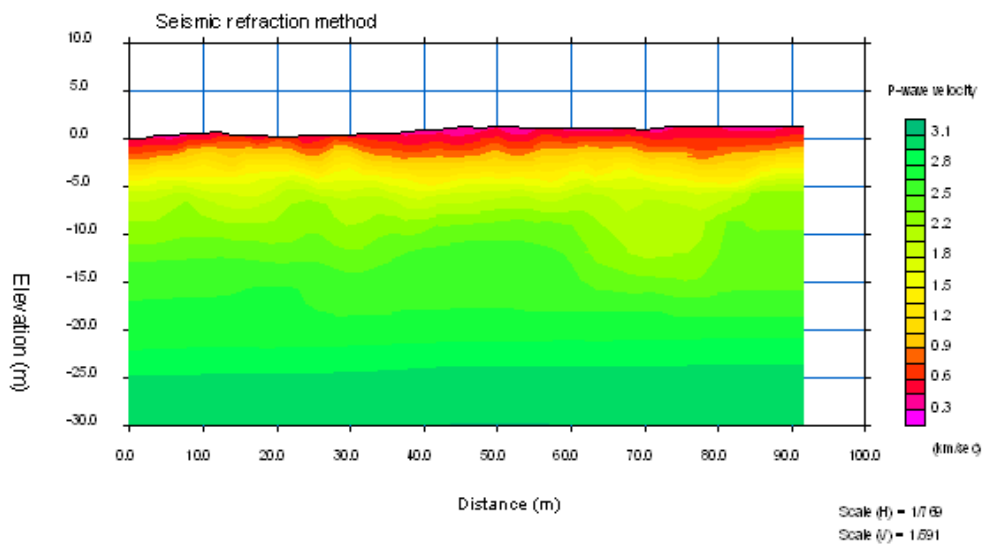
C:\1000_workspace\VH_Survey\VH_geophoneelevations - geophone elevation file for Van horn Survey

Note: geophone elevations entered while operating Plotrefa.

VH_survey first arrival P-wave model:



TY_survey first arrival P-wave model:



[Article on the project from the Polk County Itemizer-Observer, October 7, 2015; by Jolene Guzman]

OSU Students Dig to Bottom of Flooding

FALLS CITY — Every winter those living in a square mile zone near Sheldon Avenue in Falls City experience frequent and sudden flooding.
#
Thanks to more than 18 months of detective work on the part of Oregon State University students, namely Joe Kemper, residents are closer to finding a cause.
#
Kemper, a master's degree candidate in the field of water resources engineering, is using the project as his thesis subject. He hopes to find feasible fixes for residents who have been dealing with the problem for decades.

#
Last winter was mild, so landowners were spared significant problems, but that hasn't always been true.
#
"In years past, roads were covered and septic tanks quit functioning," he said.
#
About a year ago, OSU dug a well in the middle of the flood zone to monitor ground water levels through the rainy season. Kemper said when sensors were placed in the well, the water was 12 feet below the surface. That rose to about 2 feet below the surface by the end of December. At that point, any major rain event could trigger flooding.
#
"What we found was that it's a combination of surface water and ground water (causing floods)," Kemper said.
#
Kemper is now applying the data to the properties affected by the seasonal deluges. The well, plus radar testing to map the bedrock in the area, will give property owners options to mitigate the flooding temporarily.
#
"It's October; the rains are coming," Kemper said. "I would like to help find low impact, cheap ways to resolve the problem short term."
#
Tracy Young is one such landowner. She's lived off Sheldon Avenue for eight years and has had flooding problems each year.
#
Water falling on the hills above her house is channeled on to her property, so it doesn't take much rainfall to cause a problem. She said Kemper is mapping the bedrock on her property to find ways to redirect the water.
#
"We are trying to find out why it fills up with ground water so quickly," she said. "Now we are going to find out where the sandstone layer is that prevents the water from going deeper."
#
Kemper will finish his report this spring and his objective is to provide the data necessary for the city or landowners to apply to state agencies for funding to install long-term fixes.
#
"You could throw money at the problem and find a solution, but the city doesn't have $200,000 to spend and neither do the landowners," he said. "Our main goal is to create a booklet of options based on scientific observations."
#
Kemper said that part of the project — the engineering and science — has been enlightening, but he's learned the most from working with city residents. He said people in Falls City have put plenty of time into the project, including Falls City High School students who assisted with field work.
#
"Good science is great at finding solutions," he said. (But) "involving the community affected is the best way to get results."

Geophone Number	Distance From Origin (m)	Survey Filename	Height (m)	Notes	File Name	Shot Point Site #	Survey ID	Distance from Spread (m)	Distance From Origin (m)	Perpen. Offset (m)	Spread	Notes
1	0.00	A0002	0.0000	Origin	3.dat	1		-	-	-	1	test shot, shot located @ 6 m in program ie not true location
2	1.88	A0003	0.063m		4.dat	1	SMASH01	0.665	0.665	0.00	1	
3	3.93	A0004	0.076m		5.dat	2	SMASH02	5.822	5.822	0.67	1	
4	5.88	A0005	0.069m		6.dat	3	SMASH03	12.03	12.03	0.60	1	
5	7.92	A0006	0.130m		7.dat	4	SMASH04	18.085	18.085	0.73	1	
6	9.83	A0007	0.100m		8.dat	5	SMASH05	23.902	23.902	0.50	1	Cow adjacent to channel 1
7	11.88	A0008	0.133m		9.dat	6	SMASH06	29.965	29.965	0.62	1	
8	13.89	A0009	0.226m		10.dat	7	SMASH07	35.827	35.827	0.65	1	
9	15.83	A0010	0.375m		11.dat	8	SMASH08	41.84	41.84	0.73	1	41.9m entered on program
10	17.82	A0011	0.371m	Duplicate point A0012	12.dat	9	SMASH09	47.814	47.814	0.89	1	
11	19.87	A0013	0.374m		13.dat	10	SMASH10	53.828	53.828	0.61	1	
12	21.87	A0014	0.276m		14.dat	11	SMASH11	59.967	59.967	0.94	1	
13	23.87	A0015	0.281m		15.dat	12	SMASH12	65.94	65.94	0.68	1	
14	25.93	A0016	0.334m		16.dat	13	SMASH13	71.716	71.716	0.87	1	
15	27.84	A0017	0.418m		17.dat	14	SMASH14	77.729	77.729	0.81	1	
16	29.84	A0018	0.496m		18.dat	15	SMASH15	83.609	83.609	1.00	1	
17	31.87	A0019	0.515m		19.dat	16	SMASH16	89.63	89.63	-	1	missed plate - glancing blow
18	33.83	A0020	0.495m		20.dat	16	SMASH16	89.63	89.63	1.18	1	redo in same location
19	35.84	A0021	0.509m		21.dat	17	SMASH17	95.69	95.69	1.02	1	1st shot past spread
20	37.82	A0022	0.606m		22.dat	17	SMASH17	95.69	95.69	-	1	Past spread - 3 stack
21	39.85	A0023	0.580m		23.dat	18	SMASH18	101.822	101.822	1.34	1	3 stack
22	41.83	A0024	0.582m		24.dat	19	SMASH19	107.727	107.727	1.47	1	3 stack
23	43.81	A0025	0.607m		25.dat	20	SMASH20	113.94	113.94	0.95	1	3 stack
24	45.84	A0026	0.649m		26.dat	21	SMASH21	119.854	119.854	1.14	1	3 stack
25	47.82	A0027	0.639m		27.dat	22	SMASH22	125.816	125.816	0.90	1	3 stack
26	49.83	A0028	0.686m		28.dat	23	SMASH23	131.835	131.835	0.63	1	3 stack
27	51.82	A0029	0.677m		29.dat	24	SMASH24	137.783	137.783	1.07	1	3 stack
28	53.80	A0030	0.697m		30.dat	25	SMASH25	143.802	143.802	0.82	1	10 stack
29	55.83	A0031	0.762m		31.dat	26	SMASH26	149.823	149.823	0.77	1	3 stack - signal weak
30	57.80	A0032	0.789m		32.dat	26	SMASH26	149.823	149.823	0.82	1	3 stack - repeat
31	59.83	A0033	0.782m		33.dat	27	SMASH27	155.765	155.765	0.82	1	3 stack
32	61.81	A0034	0.795m		34.dat	28	SMASH28	161.814	161.814	0.57	1	3 stack
33	63.82	A0035	0.782m		35.dat	29	SMASH29	167.723	167.723	0.74	1	3 stack
34	65.79	A0036	0.821m		36.dat	30	SMASH30	173.822	173.822	0.58	1	3 stack
35	67.81	A0037	0.871m		38.dat	3	SMASH03	-81.663	12.03	(see above)	2	Do not use - half of geodes off
36	69.80	A0038	0.883m		39.dat	4	SMASH04	-75.608	18.085	(see above)	2	Do not use - half of geodes off
37	71.80	A0039	0.880m		40.dat	5	SMASH05	-69.791	23.902	(see above)	2	Do not use - half of geodes off
38	73.83	A0040	0.925m		41.dat	6	SMASH06	-63.728	29.965	(see above)	2	Do not use - half of geodes off
39	75.68	A0041	0.954m		42.dat	3	SMASH03	-81.663	12.03	(see above)	2	
40	77.66	A0042	0.933m		43.dat	4	SMASH04	-75.608	18.085	(see above)	2	
41	79.69	A0043	0.935m		44.dat	5	SMASH05	-69.791	23.902	(see above)	2	
42	81.64	A0044	0.973m		45.dat	6	SMASH06	-63.728	29.965	(see above)	2	
43	83.68	A0045	0.981m		46.dat	7	SMASH07	-57.866	35.827	(see above)	2	
44	85.67	A0046	1.012m		47.dat	8	SMASH08	-51.853	41.84	(see above)	2	
45	87.67	A0047	1.025m		48.dat	9	SMASH09	-45.879	47.814	(see above)	2	
46	89.67	A0048	1.053m		49.dat	10	SMASH10	-39.865	53.828	(see above)	2	
47	91.67	A0049	1.079m		50.dat	11	SMASH11	-33.726	59.967	(see above)	2	
48	93.69	A0050	1.086m		51.dat	12	SMASH12	-27.753	65.94	(see above)	2	
					52.dat	13	SMASH13	-21.977	71.716	(see above)	2	
49	95.73	A0050.5	1.105m	Point was interpolated, should be the first g	53.dat	14	SMASH14	-15.964	77.729	(see above)	2	
50	97.78	A0051	1.124m		54.dat	15	SMASH15	-10.084	83.609	(see above)	2	
51	99.72	A0052	1.152m		55.dat	16	SMASH16	-4.063	89.63	(see above)	2	

52	101.78	A0053	1.157m	
53	103.78	A0054	1.176m	
54	105.79	A0055	1.194m	
55	107.83	A0056	1.199m	
56	109.97	A0057	1.279m	
57	111.73	A0058	1.297m	
58	113.79	A0059	1.325m	
59	115.73	A0060	1.335m	
60	117.84	A0061	1.336m	
61	119.71	A0062	1.359m	
62	121.70	A0063	1.369m	
63	123.83	A0064	1.394m	
64	125.91	A0065	1.437m	
65	127.86	A0066	1.419m	
66	129.79	A0067	1.437m	
67	131.74	A0068	1.449m	
68	133.75	A0069	1.469m	
69	135.78	A0070	1.466m	
70	137.71	A0071	1.495m	
71	139.77	A0072	1.492m	
72	141.75	A0073	1.526m	
73	143.73	A0074	1.582m	
74	145.80	A0075	1.625m	
75	147.73	A0076	1.667m	
76	149.74	A0077	1.636m	
77	151.80	A0078	1.597m	
78	153.74	A0079	1.597m	
79	155.73	A0080	1.687m	Adjacent to well
80	157.77	A0081	1.677m	
81	159.72	A0082	1.726m	
82	161.75	A0083	1.702m	
83	163.72	A0084	1.733m	
84	165.71	A0085	1.736m	
85	167.70		1.746m	Average of hidden values
86	169.84	A0088	1.815m	
87	171.80	A0089	1.946m	
88	173.74	A0090	1.940m	
89	175.78	A0091	1.959m	
90	177.72	A0092	1.998m	
91	179.82	A0093	2.021m	
92	181.68	A0094	2.076m	
93	183.69	A0095	2.077m	
94	185.69	A0096	2.100m	
95	187.72	A0097	2.126m	
96	189.73	A0098	2.185m	

56.dat	17	SMASH17	1.997	95.69	(see above)	2	
57.dat	18	SMASH18	8.129	101.822	(see above)	2	
58.dat	19	SMASH19	14.034	107.727	(see above)	2	
59.dat	20	SMASH20	20.247	113.94	(see above)	2	
60.dat	21	SMASH21	26.161	119.854	(see above)	2	
61.dat	22	SMASH22	32.123	125.816	(see above)	2	
62.dat	23	SMASH23	38.142	131.835	(see above)	2	3 stack
63.dat	24	SMASH24	44.09	137.783	(see above)	2	3 stack
64.dat	25	SMASH25	50.109	143.802	(see above)	2	trigger broke, redo
65.dat	25	SMASH25	50.109	143.802	(see above)	2	3 stack
66.dat	26	SMASH26	56.13	149.823	(see above)	2	3 stack
67.dat	32	SMASH27	62.072	155.765	(see above)	2	3 stack, trigger malfunction so redo
68.dat	32	SMASH27	62.072	155.765	(see above)	2	3 stack
69.dat	38	SMASH28	68.121	161.814	(see above)	2	3 stack
70.dat	44	SMASH29	74.03	167.723	(see above)	2	3 stack
71.dat	45	SMASH30	80.129	173.822	(see above)	2	3 stack
72.dat	46	SMASH31	86.02	179.713	0.713	2	3 stack
73.dat	47	SMASH32	92.005	185.698	0.685	2	3 stack
74.dat	48	SMASH33	97.94	191.633	0.899	2	3 stack
75.dat	49	SMASH34	104.11	197.803	1.097	2	3 stack
76.dat	50	SMASH36	109.688	203.381	-	2	3 stack
77.dat	51	SMASH37	115.662	209.355	0.457	2	3 stack
78.dat	52	SMASH38	121.618	215.311	0.555	2	3 stack
79.dat	53	SMASH40	127.644	221.337	1.15	2	3 stack
80.dat	54	SMASH43	133.573	227.266	1.414	2	3 stack
81.dat	55	SMASH44	139.717	233.41	-	2	3 stack
82.dat	56	SMASH45	145.535	239.228	-	2	3 stack
83.dat	57	SMASH44	151.454	245.147	-	2	3 stack
84.dat	58	SMASH45	157.439	251.132	-	2	3 stack
85.dat	59	SMASH46	163.437	257.13	-	2	3 stack, extrapolated
86.dat	60	SMASH47	169.436	263.129	-	2	3 stack, extrapolated

Geo phone Number	Distance From Origin (m)	Distance Above Origin (m)	Survey Filename	Notes
1	0.00	0	TRACY01	New Origin
2	1.85	0.053	TRACY02	
3	3.90	0.27	TRACY03	
4	5.90	0.393	TRACY04	
5	7.92	0.62	TRACY05	
6	9.88	0.555	TRACY06	
7	11.87	0.685	TRACY07	
8	13.80	0.466	TRACY08	
9	15.89	0.447	TRACY09	
10	17.82	0.285	TRACY10	
11	19.86	0.195	TRACY11	
12	21.83	0.198	TRACY12	
13	23.85	0.277	TRACY13	
14	25.86	0.311	TRACY14	
15	27.81	0.385	TRACY15	
16	29.80	0.309	TRACY16	
17	31.78	0.538	TRACY17	
18	33.81	0.629	TRACY18	
19	35.79	0.64	TRACY19	
20	37.81	0.818	TRACY20	Duplicate of 20 and 21
21	39.75	0.922	TRACY21.5	Interpolation because of missing survey
22	41.68	0.999	TRACY22	
23	43.84	1.134	TRACY23	
24	45.71	1.234	TRACY24	
25	47.85	1.149	TRACY25	
26	49.84	1.18	TRACY25.5	Interpolated between 25/26, missing su
27	51.82	1.211	TRACY26	
28	53.85	1.171	TRACY27	
29	55.88	1.056	TRACY28	
30	57.76	1.124	TRACY29	
31	59.77	1.093	TRACY30	
32	61.85	1.155	TRACY31	
33	63.65	1.043	TRACY32	
34	65.70	1.049	TRACY33	
35	67.73	1.079	TRACY34	
36	69.77	0.99	TRACY35	
37	71.66	1.075	TRACY36	
38	73.87	1.195	TRACY37	
39	75.77	1.265	TRACY38	
40	77.92	1.251	TRACY39	
41	79.90	1.309	TRACY40	
42	81.79	1.298	TRACY41	
43	83.82	1.269	TRACY42	
44	85.67	1.263	TRACY43	
45	87.78	1.219	TRACY44	
46	89.76	1.305	TRACY45	
47	91.67	1.29	TRACY46	
48	93.71	1.393	TRACY47	

File Name	Shot Point Site #	Survey ID	Distance from Origin (m)	Perp. Offset (m)	Spread	Notes
87.dat	101	SMASH47	0.29	0.29	3	3 Stack
88.dat	102	SMASH48/4	5.93	0.981	3	3 stack, duplicate survey points
89.dat	103	SMASH50	11.79	1.007	3	3 Stack
90.dat	104	SMASH51	17.83	0.599	3	3 Stack
91.dat	105	SMASH52	23.89	-	3	3 Stack
92.dat	106	SMASH53	29.98	-	3	3 Stack
93.dat	107	SMASH54	35.93	1.075	3	3 Stack
94.dat	108	SMASH55	41.79	1	3	3 Stack
95.dat	109	SMASH56	47.49	0.957	3	3 Stack, dog walking disrupting data
96.dat	109	SMASH56	47.49	0.957	3	3 Stack, redo
97.dat	111	SMASH57	54.10	0.684	3	3 Stack
98.dat	112	SMASH58	59.40	-	3	3 Stack
99.dat	113	SMASH59	65.83	0.988	3	3 Stack
100.dat	114	SMASH60	71.57	0.572	3	3 Stack
101.dat	115	SMASH61	77.78	0.419	3	3 Stack
102.dat	116	SMASH62	83.91	-	3	3 Stack
103.dat	117	SMASH63	90.11	0.576	3	3 Stack
104.dat	118	SMASH64	95.45	0.561	3	3 Stack, mislabeled @ 102, and joe walking off the end of the geophone section
105.dat	119	SMASH65	101.60	-	3	3 Stack
106.dat	120	SMASH65	101.60	-	3	3 Stack,
107.dat	121	SMASH66	107.62	-	3	3 Stack
108.dat	122	SMASH67	113.65	-	3	3 Stack
109.dat	123	SMASH68	119.61	-	3	3 Stack
110.dat	124	SMASH69	125.55	-	3	3 Stack, this distance is editted 1 ft from surveyed because of tree obstruction
111.dat	125	SMASH70	131.58	-	3	3 Stack, trigger broke and replaced
112.dat	126	SMASH70.5	137.63	-	3	3 Stack, interpolated between 70 and 71
113.dat	127	SMASH71	143.69	-	3	3 Stack
114.dat	128	SMASH72	149.63	-	3	3 Stack