

Measuring Elevation Change in Berry's Creek Marshes Using Surface Elevation Tables (SETs) and Marker Horizons Meadowlands Environmental Research Institute (Fall 2012)

The SET (Sediment Elevation Table) provides a constant plane in space from which the distance to the sediment surface can be measured by means of pins lowered to the marsh surface (USGS 2010). Benchmark rods were established, marker horizons of feldspar were emplaced and baseline readings were taken at two locations in the Berry's Creek watershed during the spring of 2009. Each site was revisited and readings were taken in the fall of 2012. This report is a summary of those measurements.

Figure 1: Study Area



At each site, three replicate plots have been installed. At each plot, nine pins are lowered to the marsh surface. Readings are taken in each of four orientations resulting in a total of 108 measurements. At the time of each subsequent reading, results obtained from each pin are compared. The average of the resulting differences becomes one data point that represents the level of the marsh surface. To obtain a yearly rate, this value is divided by the number of days that have elapsed between establishment of the benchmark and the subsequent reading. Approximately three and a half years elapsed between the readings summarized in this report (Table 1).

Table 1: Time Elapsed Between Readings

Location	Initial Date	Subsequent Date	Days	Years
EDS-1, 2, 3	4/30/2009	12/12/2012	1322	3.62
WS-1, 2, 3	4/30/2009	11/30/2012	1310	3.59

Table 1 provides the dates for each reading and the time elapsed in days and years.

Table 2: Average Elevation Change (mm) – Fall 2012 Sampling

Eight Day Swamp		Walden Swamp	
All Platforms	52.17	All Platforms	80.38
Std Error	2.85	Std Error	9.46
EDS-1	54.5	WS-1	84.2
Std Error	16.35	Std Error	8.40
EDS-2	46.50	WS-2	94.53
Std Error	5.07	Std Error	8.40
EDS-3	55.5	WS-3	62.4
Std Error	4.6	Std Error	5.9
EDS-1 pos 2	65.3	WS-1 pos 2	100.0
EDS-1 pos 4	79.9	WS-1 pos 4	87.7
EDS-1 pos 6	6.4	WS-1 pos 6	60.4
EDS-1 pos 8	66.22	WS-1 pos 8	88.67
EDS-2 pos 2	43.33	WS-2 pos 2	110.22
EDS-2 pos 4	43.0	WS-2 pos 4	83.2
EDS-2 pos 6	61.33	WS-2 pos 6	77.11
EDS-2 pos 8	38.33	WS-2 pos 8	107.56
EDS-3 pos 1	43.7	WS-3 pos 2	51.2
EDS-3 pos 3	61.4	WS-3 pos 4	60.0
EDS-3 pos 5	64.2	WS-3 pos 6	78.9
EDS-3 pos 7	52.78	WS-3 pos 8	59.56

Table 2a: SETs Measurements – Fall 2012 sampling

Site	Marsh Type	Dominant Vegetation	Rate of Elevation Change (mm/yr)
Eight Day Swamp	High	Phragmites	14.40
Walden Swamp	High	Phragmites	22.40

Tables 2 and 2a are summaries of the changes in elevation measured at each location.

Table 2 contains the averages of elevation changes obtained at each of the three plots (EDS-1, EDS-2, EDS-3 for Eight Day Swamp and WS-1, WS-2, WS-3 for Walden Swamp) as well as at each of the 4 orientation positions. The averages of measurements from all 108 platforms at each site are also included in Table 2. The average of all the platforms is then divided by the time elapsed since the initial

date (Table 1) to derive the rate of elevation change in mm/yr (Table 2a). For the complete data set, please refer to Appendices at the end of this report.

Table 3: Average Accretion (mm) – Fall 2012 sampling

Eight Day Swamp		Walden Swamp	
All Platforms	20.78	All Platforms	33.67
Std Error	0.48	Std Error	3.00
EDS-1	21.67	WS-1	27.67
Std Error	0.50	Std Error	6.50
EDS-2	20.00	WS-2	36.67
Std Error	1.73	Std Error	3.33
EDS-3	20.67	WS-3	36.67
Std Error	6.00	Std Error	2.50
EDS-1		WS-1	
Plot A	20.0	Plot A	0.0
Plot B	23.0	Plot B	35.0
Plot C	22.0	Plot C	48.0
EDS-2		WS-2	
Plot A	23.0	Plot A	40.0
Plot B	20.0	Plot B	40.0
Plot C	17.0	Plot C	30.0
EDS-3		WS-3	
Plot A	12.0	Plot A	35.0
Plot B	24.0	Plot B	40.0
Plot C	26.0	Plot C	35.0

Table 3a: Feldspar Horizon Measurements – Fall 2012 sampling

Site	Positive Accretion (Percent)	Accretion Rate (mm/yr)
Eight Day Swamp	100	5.74
Walden Swamp	89	9.38

Tables 3 and 3a are summaries of the accretion measured by use of feldspar horizons emplaced at each benchmark location

Feldspar horizons were emplaced inside three corners of each benchmark plot. The sediment between the white feldspar marker and the horizon is measured. One reading is taken at each of the three corners resulting in a total of nine values associated with each marsh; the average of all readings produces a summary value (Table 3a). Not all horizons produced recognizable accretion; it is possible

that the feldspar cannot be found and will need to be replaced and a new data set generated. Where negligible material accumulated above the horizon, “0.0 accretion” is designated. All recoverable values are included in the calculation for accretion rate.

To obtain a yearly rate, this value is divided by the number of days that have elapsed between establishment of the benchmark and the subsequent reading. Approximately three and a half years elapsed between the readings summarized in this report. Table 1 provides the dates for each reading and the time elapsed in days and years.

Table 4: Elevation Rate and Accretion Rate – Spring 2009 to Fall 2012

Eight Day Swamp						
Days	0	378	566	736	935	1322
Sample Date	4/30/2009	5/13/2010	11/17/2010	5/6/2011	11/21/2011	12/12/2012
Elevation Rate mm/yr	0	19.07	25.24	18.67	15.60	14.40
Accretion Rate mm/yr	0	5.92	7.20	5.68	8.30	5.74

Walden Swamp						
Days	0	378	566	736	945	1310
Sample Date	4/30/2009	5/13/2010	11/17/2010	5/6/2011	12/1/2011	11/30/2012
Elevation Rate mm/yr	0	40.27	41.21	32.82	31.94	22.40
Accretion Rate mm/yr	0	3.77	12.20	8.40	12.60	9.38

Table 4 shows the yearly accretion and elevation rate for every sampling event.

Table 5: Marsh Processes (USGS 2010)

SURFACE PROCESSES:
1) Sediment deposition
2) Sediment erosion
SUBSURFACE PROCESSES:
3) Root Growth
4) Decomposition
5) Porewater Flux
6) Compaction

Table 5 explains both surface and subsurface interactions (USGS, 2010).

Discussion

While it is tempting to draw conclusions from this data set, one must acknowledge that marsh sediment processes take place slowly over long periods of time; to quote Jim Lynch, USGS SETs methodology expert, "...It will take a long time to get enough data to see what's going on."(2010, personal communication)

Table 5 shows both surface and subsurface processes that can affect both the elevation and accretion rates. Elevation is affected by the surface and subsurface processes while the accretion is only affected by the surface processes.

According to table 4, both Eight Day Swamp and Walden Swamp are slowly decreasing in elevation rate. The accretion rates are also decreasing each year most likely due to compaction of the surface.

At the end of October 2012, a little over a month before the measurement were taken, Hurricane Sandy caused a 5 to 6 foot storm surge across the entire region. The pressure of the water on top of the surface caused the compaction of the top layers of the marsh.

Conclusion

In the years to come, the rates of accretion and elevation change will continue to drop as seen in table 4 and then stabilize. These two sites are well over the initial readings taken in 2009, but it is still too early to form any real conclusions from the present data.

References

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Appendix 1: Eight Day Swamp Surface Elevation Table Readings (mm)

Plot		EDS-1			Plot		EDS-2			Plot		EDS-3		
Position	Ptn	4/30/2009	12/12/2012	Difference	Position	Ptn	4/30/2009	12/12/2012	Difference	Position	Ptn	5/1/2009	12/12/2012	Difference
2	1	91	99	8	2	1	56	80	24	1	1	64	140	76
	2	45	116	71		2	68	99	31		2	64	129	65
	3	42	124	82		3	71	106	35		3	111	130	19
	4	40	154	114		4	67	95	28		4	102	139	37
	5	83	146	63		5	85	96	11		5	107	136	29
	6	65	117	52		6	65	120	55		6	113	150	37
	7	70	130	60		7	61	120	59		7	103	149	46
	8	65	137	72		8	70	146	76		8	101	137	36
	9	50	116	66		9	53	124	71		9	81	129	48
4	1	21	117	96	4	1	43	98	55	3	1	54	142	88
	2	21	115	94		2	65	122	57		2	90	149	59
	3	38	115	77		3	67	94	27		3	80	155	75
	4	50	103	53		4	65	100	35		4	56	138	82
	5	58	103	45		5	60	125	65		5	80	130	50
	6	48	124	76		6	75	90	15		6	75	131	56
	7	13	121	108		7	75	106	31		7	86	128	42
	8	60	151	91		8	68	115	47		8	76	140	64
	9	60	139	79		9	64	119	55		9	80	117	37
6	1	60	127	67	6	1	30	75	45	5	1	82	128	46
	2	118	112	-6		2	24	105	81		2	79	139	60
	3	134	98	-36		3	20	103	83		3	87	146	59
	4	105	112	7		4	37	89	52		4	89	152	63
	5	123	102	-21		5	48	110	62		5	89	160	71
	6	123	109	-14		6	42	118	76		6	95	152	57
	7	52	91	39		7	49	108	59		7	97	160	63
	8	55	95	40		8	46	88	42		8	92	150	58
	9	112	94	-18		9	62	114	52		9	60	161	101
8	1	55	124	69	8	1	74	111	37	7	1	100	132	32
	2	60	138	78		2	62	114	52		2	98	147	49
	3	65	132	67		3	64	95	31		3	93	154	61
	4	64	142	78		4	51	97	46		4	78	135	57
	5	66	143	77		5	74	111	37		5	80	112	32
	6	62	130	68		6	76	91	15		6	80	147	67
	7	60	110	50		7	63	104	41		7	97	142	45
	8	58	111	53		8	62	101	39		8	80	140	60
	9	63	119	56		9	50	97	47		9	77	149	72

Appendix 2: Walden Swamp Surface Elevation Table Readings (mm)

Plot	WS-1				Plot	WS-2				Plot	WS-3				35 mm	
Position	Pin	4/30/2009	11/30/2012	Difference	Position	Pin	4/30/2009	11/30/2012	Difference	Position	Pin	4/30/2009	11/30/2012	offset	Difference	
2	1	42	155	113	2	1	179	234	55	1	1	110	121	156	46	
	2	53	161	108		2	156	212	56		2	96	128	163	67	
	3	61	158	97		3	150	227	77		3	112	119	154	42	
	4	121	182	61		4	69	235	166		4	109	119	154	45	
	5	25	188	163		5	223	278	55		5	94	100	135	41	
	6	45	158	113		6	155	253	98		6	112	96	131	19	
	7	50	147	97		7	123	270	147		7	90	137	172	82	
	8	40	153	113		8	83	272	189		8	112	132	167	55	
	9	100	135	35		9	117	266	149		9	97	126	161	64	
4	1	51	128	77	4	1	176	190	14	3	1	112	130	165	53	
	2	71	127	56		2	156	210	54		2	118	127	162	44	
	3	87	127	40		3	172	254	82		3	115	119	154	39	
	4	52	119	67		4	82	241	159		4	127	136	171	44	
	5	63	136	73		5	192	245	53		5	101	133	168	67	
	6	67	162	95		6	127	247	120		6	88	110	145	57	
	7	41	156	115		7	175	247	72		7	98	135	170	72	
	8	33	159	126		8	144	257	113		8	75	137	172	97	
	9	12	152	140		9	157	239	82		9	80	112	147	67	
6	1	43	130	87	6	1	230	242	12	5	1	106	152	187	81	
	2	80	143	63		2	200	281	81		2	106	144	179	73	
	3	87	154	67		3	155	249	94		3	98	139	174	76	
	4	78	141	63		4	195	237	42		4	96	115	150	54	
	5	95	157	62		5	115	252	137		5	96	132	167	71	
	6	92	158	66		6	140	219	79		6	85	126	161	76	
	7	80	135	55		7	118	245	127		7	96	132	167	71	
	8	90	121	31		8	170	236	66		8	65	135	170	105	
	9	70	120	50		9	150	206	56		9	71	139	174	103	
8	1	73	162	89	8	1	172	235	63	7	1	68	125	160	92	
	2	73	155	82		2	230	253	23		2	69	110	145	76	
	3	81	138	57		3	170	250	80		3	78	130	165	87	
	4	70	169	99		4	94	256	162		4	116	140	175	59	
	5	80	167	87		5	120	252	132		5	52	106	141	89	
	6	45	148	103		6	110	258	148		6	93	99	134	41	
	7	50	146	96		7	136	260	124		7	164	104	139	-25	
	8	80	163	83		8	100	262	162		8	75	97	132	57	
	9	55	157	102		9	195	269	74		9	95	120	155	60	

*The 35 mm offset means it is 35 mm higher than the SET benchmark rods installation elevation and it is used in calculating the difference.

