

Measuring Elevation Change in Berry's Creek Marshes Using Surface Elevation Tables (SETs) and Marker Horizons Meadowlands Environmental Research Institute (Spring 2014)

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 spring of 2014. 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 five 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	4/23/2014	1818	4.98
WS-1, 2, 3	4/30/2009	4/28/2014	1824	5.00

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

Table 2: Average Elevation Change (mm) – Spring 2014 Sampling

Eight Day Swamp		Walden Swamp	
All Platforms	57.99	All Platforms	91.78
Std Error	3.70	Std Error	12.76
EDS-1	63.0	WS-1	84.3
Std Error	11.42	Std Error	5.31
EDS-2	50.75	WS-2	116.67
Std Error	7.96	Std Error	6.26
EDS-3	60.3	WS-3	74.4
Std Error	6.4	Std Error	3.2
EDS-1 pos 2	81.6	WS-1 pos 2	87.2
EDS-1 pos 4	80.0	WS-1 pos 4	77.6
EDS-1 pos 6	33.0	WS-1 pos 6	74.3
EDS-1 pos 8	57.33	WS-1 pos 8	97.89
EDS-2 pos 2	33.67	WS-2 pos 2	127.33
EDS-2 pos 4	49.9	WS-2 pos 4	104.2
EDS-2 pos 6	72.11	WS-2 pos 6	107.56
EDS-2 pos 8	47.33	WS-2 pos 8	127.56
EDS-3 pos 1	65.9	WS-3 pos 2	70.7
EDS-3 pos 3	75.0	WS-3 pos 4	71.1
EDS-3 pos 5	53.8	WS-3 pos 6	84.1
EDS-3 pos 7	46.33	WS-3 pos 8	71.78

Table 2a: SETs Measurements – Spring 2014 sampling

Site	Marsh Type	Dominant Vegetation	Rate of Elevation Change (mm/yr)
Eight Day Swamp	High	Phragmites	11.64
Walden Swamp	High	Phragmites	18.37

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) – Spring 2014 sampling

Eight Day Swamp		Walden Swamp	
All Platforms	30.11	All Platforms	39.56
Std Error	3.44	Std Error	1.75
EDS-1	37.00	WS-1	38.33
Std Error	7.00	Std Error	0.00
EDS-2	26.67	WS-2	43.00
Std Error	1.67	Std Error	0.00
EDS-3	26.67	WS-3	37.33
Std Error	0.00	Std Error	9.00
EDS-1		WS-1	
Plot A	35.0	Plot A	35.0
Plot B	45.0	Plot B	40.0
Plot C	31.0	Plot C	40.0
EDS-2		WS-2	
Plot A	30.0	Plot A	NA
Plot B	25.0	Plot B	NA
Plot C	25.0	Plot C	43.0
EDS-3		WS-3	
Plot A	25.0	Plot A	27.0
Plot B	25.0	Plot B	45.0
Plot C	30.0	Plot C	40.0

Table 3a: Feldspar Horizon Measurements – Spring 2014 sampling

Site	Positive Accretion (Percent)	Accretion Rate (mm/yr)
Eight Day Swamp	100	6.05
Walden Swamp	78	7.92

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, “NA 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 Spring 2014

Eight Day Swamp							
Days	0	378	566	736	935	1322	1819
Sample Date	4/30/2009	5/13/2010	11/17/2010	5/6/2011	11/21/2011	12/12/2012	4/23/2014
Elevation Rate mm/yr	0	19.07	25.24	18.67	15.60	14.40	11.64
Accretion Rate mm/yr	0	5.92	7.20	5.68	8.30	5.74	6.05

Walden Swamp							
Days	0	378	566	736	945	1310	1824
Sample Date	4/30/2009	5/13/2010	11/17/2010	5/6/2011	12/1/2011	11/30/2012	4/28/2014
Elevation Rate mm/yr	0	40.27	41.21	32.82	31.94	22.40	18.37
Accretion Rate mm/yr	0	3.77	12.20	8.40	12.60	9.38	7.92

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.

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	4/23/2014	Difference	Position	Ptn	4/30/2009	4/23/2014	Difference	Position	Ptn	5/1/2009	4/23/2014	Difference
2	1	91	150	59	2	1	56	105	49	2	1	64	138	74
	2	45	140	95		2	68	114	46		2	64	168	104
	3	42	144	102		3	71	142	71		3	111	166	55
	4	40	192	152		4	67	107	40		4	102	166	64
	5	83	143	60		5	85	119	34		5	107	164	57
	6	65	111	46		6	65	72	7		6	113	164	51
	7	70	157	87		7	61	113	52		7	103	157	54
	8	65	98	33		8	70	77	7		8	101	160	59
	9	50	150	100		9	53	50	-3		9	81	156	75
4	1	21	125	104	4	1	43	104	61	4	1	54	124	70
	2	21	116	95		2	65	102	37		2	90	167	77
	3	38	184	146		3	67	90	23		3	80	139	59
	4	50	112	62		4	65	105	40		4	56	135	79
	5	58	110	52		5	60	156	96		5	80	173	93
	6	48	125	77		6	75	144	69		6	75	157	82
	7	13	112	99		7	75	124	49		7	86	150	64
	8	60	109	49		8	68	102	34		8	76	155	79
	9	60	96	36		9	64	104	40		9	80	152	72
6	1	60	146	86	6	1	30	100	70	6	1	82	150	68
	2	118	134	16		2	24	120	96		2	79	145	66
	3	134	148	14		3	20	120	100		3	87	134	47
	4	105	120	15		4	37	121	84		4	89	115	26
	5	123	120	-3		5	48	140	92		5	89	135	46
	6	123	130	7		6	42	135	93		6	95	152	57
	7	52	120	68		7	49	110	61		7	97	139	42
	8	55	125	70		8	46	96	50		8	92	139	47
	9	112	136	24		9	62	65	3		9	60	145	85
8	1	55	111	56	8	1	74	102	28	8	1	100	139	39
	2	60	115	55		2	62	115	53		2	98	134	36
	3	65	126	61		3	64	101	37		3	93	130	37
	4	64	121	57		4	51	102	51		4	78	131	53
	5	66	125	59		5	74	116	42		5	80	145	65
	6	62	114	52		6	76	116	40		6	80	152	72
	7	60	170	110		7	63	123	60		7	97	140	43
	8	58	94	36		8	62	110	48		8	80	132	52
	9	63	93	30		9	50	117	67		9	77	97	20

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

Plot	WS-1				Plot	WS-2				Plot	WS-3			35 mm	
Position	Pn	4/30/2009	4/28/2014	Difference	Position	Pn	4/30/2009	4/28/2014	Difference	Position	Pn	4/30/2009	4/28/2014	offset	Difference
2	1	42	131	89	2	1	179	268	89	1	1	110	147	182	72
	2	53	130	77		2	156	261	105		2	96	161	196	100
	3	61	145	84		3	150	262	112		3	112	145	180	68
	4	121	175	54		4	69	275	206		4	109	136	171	62
	5	25	178	153		5	223	302	79		5	94	116	151	57
	6	45	169	124		6	155	270	115		6	112	140	175	63
	7	50	122	72		7	123	250	127		7	90	153	188	98
	8	40	142	102		8	83	254	171		8	112	120	155	43
	9	100	130	30		9	117	259	142		9	97	135	170	73
4	1	51	135	84	4	1	176	265	89	3	1	112	128	163	51
	2	71	162	91		2	156	240	84		2	118	131	166	48
	3	87	131	44		3	172	240	68		3	115	160	195	80
	4	52	113	61		4	82	266	184		4	127	142	177	50
	5	63	130	67		5	192	265	73		5	101	144	179	78
	6	67	129	62		6	127	274	147		6	88	126	161	73
	7	41	125	84		7	175	256	81		7	98	149	184	86
	8	33	124	91		8	144	266	122		8	75	136	171	96
	9	12	126	114		9	157	247	90		9	80	123	158	78
6	1	43	152	109	6	1	230	237	7	5	1	106	155	190	84
	2	80	154	74		2	200	270	70		2	106	140	175	69
	3	87	141	54		3	155	235	80		3	98	139	174	76
	4	78	192	114		4	195	280	85		4	96	136	171	75
	5	95	161	66		5	115	295	180		5	96	149	184	88
	6	92	149	57		6	140	299	159		6	85	121	156	71
	7	80	135	55		7	118	287	169		7	96	141	176	80
	8	90	151	61		8	170	275	105		8	65	150	185	120
	9	70	149	79		9	150	263	113		9	71	130	165	94
8	1	73	147	74	8	1	172	275	103	7	1	68	111	146	78
	2	73	130	57		2	230	278	48		2	69	113	148	79
	3	81	172	91		3	170	252	82		3	78	142	177	99
	4	70	162	92		4	94	277	183		4	116	130	165	49
	5	80	167	87		5	120	275	155		5	52	111	146	94
	6	45	170	125		6	110	287	177		6	93	135	170	77
	7	50	178	128		7	136	263	127		7	164	118	153	-11
	8	80	180	100		8	100	292	192		8	75	140	175	100
	9	55	182	127		9	195	276	81		9	95	141	176	81

*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.