Measuring Elevation Change in Meadowlands Marshes Using Surface Elevation Tables (SETs) and Marker Horizons

Interim Report

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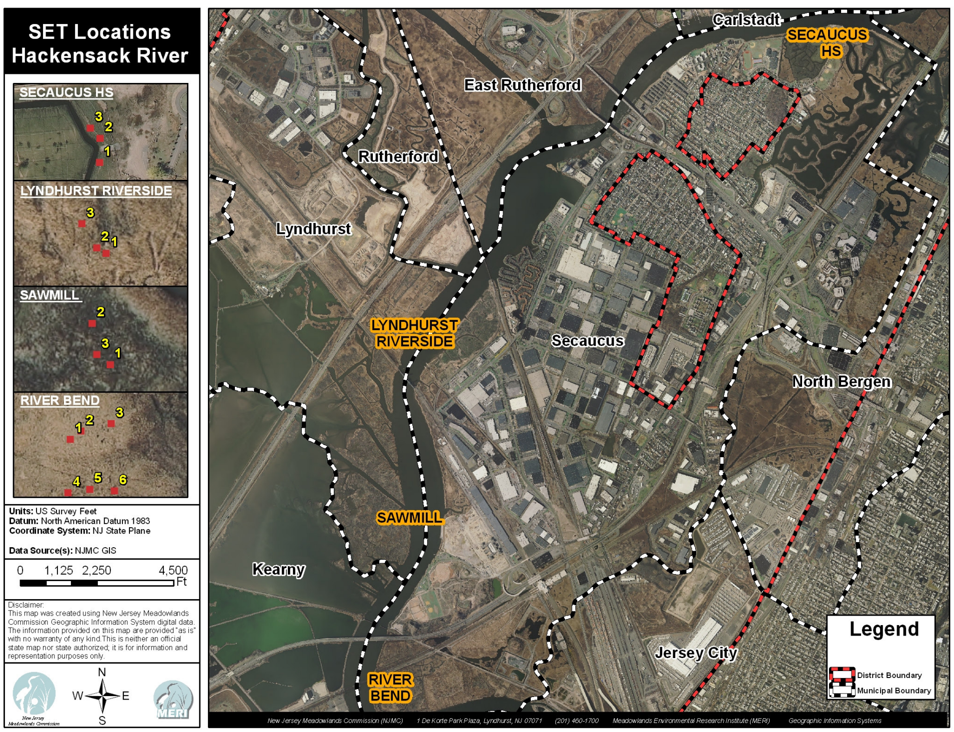
1.0 Introduction

The surface elevation table (SET) provides a constant plane in space from which the distance to a marsh surface can be measured by means of pins lowered to the surface (USGS 2010). During August of 2008, at five locations in the lower Hackensack River Meadowlands, benchmark rods were established, marker horizons of feldspar were emplaced and baseline readings were taken. Periodic monitoring will determine rates of accretion in marsh areas, and track and compare both shallow and deep subsidence. Each site was revisited and readings were taken in the spring of 2010. This report is a summary of those measurements.

Figure 1: Study Area



2.0 Materials and Methods

Locations were chosen to span several miles of tidal wetlands and represent different vegetation and marsh regimes. The five sites selected include a restored *Spartina alterniflora* low marsh (SHS), a *Spartina alterniflora* high marsh (SM), a *Spartina patens* dominated high marsh (RBP), a mixed *Spartina patens* and *Phragmites australis* high marsh (RBM) and a *Phragmites australis* dominated high marsh (LR). At each site, three replicate benchmarks were installed. At each benchmark, nine pins are lowered to the marsh surface. Readings are taken in each of four positions 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.

Table 1: SETs Locations

SETs Locations			
Location		Marsh Type	Dominant Vegetation
RBP	Riverbend Patens	High Marsh	*Spartina patens*
RBM	Riverbend Mixed	High Marsh	*Phragmites australis / Spartina patens*
SM	Sawmill	High Marsh	*Spartina alterniflora*
LR	Lyndhurst Riverside	High Marsh	*Phragmites australis*
SHS	Secaucus HS	Low Marsh	*Spartina alterniflora*

Feldspar horizons were emplaced inside three corners of each benchmark plot at the time each SET was established. One reading is taken at each horizon resulting in a total of nine values associated with each marsh; the average of all readings produces a summary value.

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 one and a half years elapsed between the readings summarized in this report. Table 2 provides the dates for each reading and the time elapsed in days and years.

Table 2: Time Elapsed Between Readings

Location	Initial Date	Subsequent Date	Days	Years
RBP and RBM	8/26/2008	5/20/2010	624	1.71
SM	8/28/2008	5/21/2010	623	1.71
LR	8/29/2008	5/21/2010	622	1.70
SHS-1	8/28/2008	4/29/2010	601	1.65
SHS-2	8/28/2008	6/4/2010	636	1.74
SHS-3	8/21/2008	4/29/2010	608	1.66

3.0 Results

Tables 3and 3a are summaries of the changes in elevation measured at each location. The complete data set is found in appendices at the end of the report. Values ranged from a subsidence rate of 5 mm/yr at Sawmill to a maximum rise in elevation of 10 mm/yr at Secaucus HS. The sites follow a trend of increasing rates of positive elevation change with distance from the mouth of the river (Sawmill is the exception).

Table 3: SETs Measurements 2008/2010

Site	Rate of Elevation Change (mm/yr)
Riverbend Patens	2.46
Riverbend Mixed	5.96
Sawmill	-4.56
Lyndhurst Riverside	8.87
Secaucus HS	10.0

Table 3a: Average Elevation Change (mm)

Riverbend Patens	
All Platforms	4.21
Std Error	2.95
RB-1	7.52
Std Error	2.03
RB-2	6.78
Std Error	1.40
RB-3	-1.67
Std Error	1.77
RB-1 pos 1	9.40
RB-1 pos 3	12.33
RB-1 pos 5	3.89
RB-1 pos 7	4.44
RB-2 pos 1	5.11
RB-2 pos 3	4.44
RB-2 pos 5	6.89
RB-2 pos 7	10.67
RB-3 pos 1	1.44
RB-3 pos 3	-2.44
RB-3 pos 5	-6.33
RB-3 pos 7	0.67

Riverbend Mixed	
All Platforms	10.20
Std Error	1.36
RB-4	12.67
Std Error	1.64
RB-5	9.92
Std Error	2.98
RB-6	8.00
Std Error	5.04
RB-4 pos 1	14.90
RB-4 pos 3	8.11
RB-4 pos 5	12.44
RB-4 pos 7	15.22
RB-5 pos 2	4.11
RB-5 pos 4	9.22
RB-5 pos 6	8.11
RB-5 pos 8	18.22
RB-6 pos 2	13.44
RB-6 pos 4	-6.78
RB-6 pos 6	15.22
RB-6 pos 8	10.11

Sawmill	
All Platforms	-7.80
Std Error	6.91
SM-1	-11.2
Std Error	7.61
SM-2	5.50
Std Error	5.21
SM-3	-17.7
Std Error	14.2
SM-1 pos 2	-26.6
SM-1 pos 4	-11.2
SM-1 pos 6	-16.4
SM-1 pos 8	9.56
SM-2 pos 1	-6.89
SM-2 pos 3	18.6
SM-2 pos 5	4.44
SM-2 pos 7	5.89
SM-3 pos 1	11.3
SM-3 pos 3	-24.4
SM-3 pos 5	-54.3
SM-3 pos 7	-3.44

Lyndhurst Riverside	
All Platforms	15.2
Std Error	5.17
LR-1	13.8
Std Error	5.96
LR-2	6.97
Std Error	5.07
LR-3	24.7
Std Error	10.4
LR-1 pos 1	9.56
LR-1 pos 3	0.67
LR-1 pos 5	29.0
LR-1 pos 7	16.0
LR-2 pos 1	14.0
LR-2 pos 3	-3.11
LR-2 pos 5	-0.22
LR-2 pos 7	17.2
LR-3 pos 1	7.67
LR-3 pos 3	35.4
LR-3 pos 5	48.9
LR-3 pos 7	6.89

Secaucus HS	
All Platforms	16.6
Std Error	8.91
SHS-1	22.4
Std Error	7.94
SHS-2	-0.86
Std Error	9.63
SHS-3	28.3
Std Error	8.70
SHS-1 pos 1	20.4
SHS-1 pos 3	45.4
SHS-1 pos 5	12.1
SHS-1 pos 7	11.7
SHS-2 pos 2	-23.7
SHS-2 pos 4	7.56
SHS-2 pos 6	20.8
SHS-2 pos 8	-8.11
SHS-3 pos 2	45.0
SHS-3 pos 4	18.1
SHS-3 pos 6	41.0
SHS-3 pos 8	9.22

Tables 4 and 4a are summaries of the accretion measured by use of feldspar horizons emplaced at each benchmark location. Not all horizons produced recognizable accretion; where negligible material accumulated above the horizon, "0.0 accretion" is designated. All recoverable values are included in the calculation for accretion rate.

During this monitoring period, the marshes at Riverbend, Sawmill and one site at Secaucus HS did not exhibit measurable accretion. The trend displayed by the SETs was repeated using the feldspar horizons; the accretion rate increases with distance from the mouth of the river.

Table 4: Feldspar Horizon Measurements 2009/2010

Site	Positive Accretion (Percent)	Accretion Rate (mm/yr)
Riverbend Patens	0.0	0.0
Riverbend Mixed	0.0	0.0
Sawmill	0.0	0.0
Lyndhurst Riverside	89.0	0.28
Secaucus HS	83.0	1.21

Table 4a: Average Accretion (mm)

Riverbend Patens	
All Platforms	0.0
Std Error	0.0
RB-1	0.0
Std Error	0.0
RB-2	0.0
Std Error	0.0
RB-3	0.0
Std Error	0.0
RB-1	
A	0.0
B	0.0
C	0.0
RB-2	
A	0.0
B	0.0
C	0.0
RB-3	
A	0.0
B	0.0
C	0.0

Riverbend Mixed	
All Platforms	0.0
Std Error	0.0
RB-4	0.0
Std Error	0.0
RB-5	0.0
Std Error	0.0
RB-6	0.0
Std Error	0.0
RB-4	
A	0.0
B	0.0
C	0.0
RB-5	
A	0.0
B	0.0
C	0.0
RB-6	
A	0.0
B	0.0
C	0.0

Sawmill	
All Platforms	0.0
Std Error	0.0
SM-1	0.0
Std Error	0.0
SM-2	0.0
Std Error	0.0
SM-3	0.0
Std Error	0.0
SM-1	
A	0.0
B	0.0
C	0.0
SM-2	
A	0.0
B	0.0
C	0.0
SM-3	
A	0.0
B	0.0
C	0.0

Table 4a (Cont.): Average Accretion (mm)

Lyndhurst Riverside	
All Platforms	0.47
Std Error	0.07
LR-1	0.33
Std Error	0.17
LR-2	0.50
Std Error	0.00
LR-3	0.58
Std Error	0.22
LR-1	
A	0.0
B	0.5
C	0.5
LR-2	
A	0.5
B	0.5
C	0.5
LR-3	
A	0.3
B	0.5
C	1.0

Secaucus HS	
All Platforms	2.00
Std Error	0.20
SHS-1	0.00
Std Error	0.00
SHS-2	1.80
Std Error	1.17
SHS-3	2.21
Std Error	0.11
SHS-1	
A	0.0
B	0.0
C	0.0
SHS-2	
A	1.4
B	0.0
C	4.0
SHS-3	
A	2.3
B	2.0
C	2.4

4.0 Discussion

Elevation change measured by the SET is influenced by both surface and subsurface processes occurring within the soil profile (USGS 2010). The marker horizons reveal surface processes only. One can surmise the relative contribution of these processes by looking at the difference between the rates obtained by each.

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

At Lyndhurst Riverside and Secaucus HS, the marsh elevation change measured by the SET was an order of magnitude higher than the accretion that was recorded. This would indicate that subsurface processes predominate. The rate of positive change measured by the SET could have been caused by swelling of the marsh surface due to root growth and water storage in the subsurface. Cahoon et al., (1995) proposed changes in water storage and in the volume of the root zone related to seasonal patterns of plant production as an explanation for elevation change in a Louisiana marsh.

The Riverbend marsh had two benchmarks located in differing vegetation regimes. The first high marsh dominated by *Spartina patens* yielded a lower positive change in elevation than the location mixed with *Phragmites australis*.

The subsidence recorded at Sawmill was an exceptional case among the marshes monitored. With no measurable sediment accretion and vegetation dominated by *Spartina alterniflora*, both surface and subsurface processes could be contributing to this result. This marsh, situated in the high energy region of the river did not exhibit deposition.

The results suggest that the surface processes that control accretion, sediment deposition and erosion, are influenced by the dissipation of tidal energy as distance from the mouth of the river increases. Subsurface processes such as root growth are dependent on the elevation of the marsh surface and the dominant vegetation.

Elevation change measured using SETs on the south shore of Long Island at Fire Island from 2002 to 2007 ranged from an increase of 2.0 mm y^{-1} to a decline of -1.0 mm y^{-1} (Roman et. al. 2007). These values are somewhat lower, but the same order of magnitude, as the values obtained in the Hackensack River marshes.

In the same study, accretion measured using feldspar horizons ranged from 2.1 mm y^{-1} to 3.7 mm y^{-1} (Roman et. al. 2007). This is approximately two times higher then the rate exhibited at Secaucus High School, and ten times higher then the rate at Lyndhurst Riverside.

While it is tempting to try 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)

5.0 Conclusions

The installation of the surface elevation tables and feldspar horizons provided an accurate method for determining changes in the marshes of the Hackensack River. The data derived during the period covered in this report suggest surface and subsurface processes are at work; and the two methods indicate the relative contribution of each. A longer timescale is necessary to confirm these initial observations.

References

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Appendix 1: Riverbend Patens Surface Elevation Table Readings (mm)

RB-1					RB-2					RB-3				
Position	Pin	8/26/2008	5/20/2010	Difference	Position	Pin	8/26/2008	5/20/2010	Difference	Position	Pin	8/26/2008	5/20/2010	Difference
1	1	197	224	27	1	1	145	160	15	1	1	192	197	5
	2	227	235	8		2	150	150	0		2	179	185	6
	3	213	228	15		3	157	168	11		3	180	187	7
	4	230	236	6		4	159	168	9		4	188	184	-4
	5	228	238	10		5	160	155	-5		5	174	179	5
	6	222	222	0		6	160	172	12		6	177	161	-16
	7	208	236	28		7	163	164	1		7	164	162	-2
	8	226	237	11		8	161	151	-10		8	158	153	-5
	9	232	220	-12		9	150	163	13		9	161	178	17
3	1	201	235	34	3	1	158	154	-4	3	1	167	178	11
	2	203	220	17		2	155	168	13		2	196	189	-7
	3	211	208	-3		3	157	160	3		3	175	175	0
	4	218	216	-2		4	143	169	26		4	182	167	-15
	5	202	221	19		5	160	165	5		5	180	180	0
	6	220	234	14		6	162	152	-10		6	192	183	-9
	7	221	230	9		7	160	170	10		7	173	181	8
	8	223	228	5		8	165	169	4		8	191	191	0
	9	214	232	18		9	166	159	-7		9	191	181	-10
5	1	215	211	-4	5	1	162	178	16	5	1	187	177	-10
	2	208	209	1		2	165	169	4		2	195	215	20
	3	214	204	-10		3	157	167	10		3	195	195	0
	4	208	230	22		4	158	165	7		4	204	196	-8
	5	216	225	9		5	155	165	10		5	193	191	-2
	6	221	229	8		6	161	167	6		6	199	185	-14
	7	219	225	6		7	143	137	-6		7	200	180	-20
	8	216	208	-8		8	161	173	12		8	185	154	-31
	9	227	238	11		9	165	168	3		9	152	160	8
7	1	216	229	13	7	1	160	180	20	7	1	130	145	15
	2	213	219	6		2	154	164	10		2	178	178	0
	3	215	228	13		3	156	160	4		3	179	170	-9
	4	216	224	8		4	155	165	10		4	195	195	0
	5	221	210	-11		5	156	166	10		5	176	179	3
	6	216	226	10		6	155	175	20		6	193	189	-4
	7	212	204	-8		7	154	159	5		7	195	186	-9
	8	217	221	4		8	153	156	3		8	192	201	9
	9	212	217	5		9	151	165	14		9	191	192	1

Appendix 2: Riverbend Mixed Surface Elevation Table Readings (mm)

RB-4					RB-5					RB-6				
Position	Pin	8/26/2008	5/20/2010	Difference	Position	Pin	8/26/2008	5/20/2010	Difference	Position	Pin	8/26/2008	5/20/2010	Difference
1	1	196	213	17	2	1	148	162	14	2	1	180	188	8
	2	196	202	6		2	136	138	2		2	189	189	0
	3	100	201	101		3	146	144	-2		3	186	186	0
	4	196	192	-4		4	164	141	-23		4	177	172	-5
	5	186	197	11		5	161	141	-20		5	185	198	13
	6	206	197	-9		6	106	131	25		6	181	205	24
	7	212	208	-4		7	136	154	18		7	189	205	16
	8	190	204	14		8	155	159	4		8	178	198	20
	9	180	195	15		9	149	168	19		9	149	194	45
3	1	190	198	8	4	1	153	155	2	4	1	173	166	-7
	2	192	190	-2		2	137	180	43		2	182	188	6
	3	196	195	-1		3	134	181	47		3	168	169	1
	4	194	190	-4		4	140	143	3		4	177	149	-28
	5	183	200	17		5	141	148	7		5	176	152	-24
	6	193	205	12		6	160	153	-7		6	185	179	-6
	7	198	216	18		7	159	151	-8		7	181	185	4
	8	190	206	16		8	144	144	0		8	192	193	1
	9	190	199	9		9	149	145	-4		9	187	179	-8
5	1	198	218	20	6	1	141	169	28	6	1	178	159	-19
	2	172	199	27		2	164	161	-3		2	176	176	0
	3	195	198	3		3	149	151	2		3	149	181	32
	4	189	210	21		4	163	175	12		4	154	183	29
	5	198	208	10		5	162	175	13		5	151	179	28
	6	204	222	18		6	160	154	-6		6	161	169	8
	7	209	220	11		7	162	175	13		7	168	200	32
	8	208	217	9		8	176	182	6		8	178	173	-5
	9	177	170	-7		9	170	178	8		9	148	180	32
7	1	193	219	26	8	1	138	160	22	8	1	134	156	22
	2	203	211	8		2	142	155	13		2	161	164	3
	3	201	220	19		3	145	141	-4		3	163	159	-4
	4	197	215	18		4	68	119	51		4	178	198	20
	5	201	208	7		5	126	136	10		5	175	200	25
	6	202	220	18		6	141	150	9		6	191	199	8
	7	199	204	5		7	139	136	-3		7	192	201	9
	8	190	214	24		8	120	157	37		8	193	184	-9
	9	203	215	12		9	124	153	29		9	188	205	17

Appendix 3: Sawmill Surface Elevation Table Readings (mm)

SM-1					SM-2					SM-3				
Position	Pin	8/28/2008	5/21/2010	Difference	Position	Pin	8/28/2008	5/21/2010	Difference	Position	Pin	8/28/2008	5/21/2010	Difference
2	1	171	174	3	1	1	119	125	6	1	1	205	176	-29
	2	178	158	-20		2	114	130	16		2	176	185	9
	3	170	159	-11		3	145	110	-35		3	196	182	-14
	4	172	135	-37		4	162	123	-39		4	175	209	34
	5	144	135	-9		5	152	165	13		5	206	210	4
	6	234	82	-152		6	152	160	8		6	219	246	27
	7	169	164	-5		7	117	123	6		7	205	234	29
	8	182	175	-7		8	144	109	-35		8	207	239	32
	9	202	173	-29		9	135	133	-2		9	238	248	10
4	1	70	104	34	3	1	149	150	1	3	1	218	130	-88
	2	127	110	-17		2	135	105	-30		2	203	172	-31
	3	127	119	-8		3	85	129	44		3	200	175	-25
	4	155	128	-27		4	111	140	29		4	213	168	-45
	5	160	89	-71		5	91	178	87		5	240	225	-15
	6	156	142	-14		6	140	170	30		6	226	202	-24
	7	161	150	-11		7	150	150	0		7	203	218	15
	8	166	165	-1		8	153	144	-9		8	222	194	-28
	9	167	181	14		9	140	155	15		9	203	224	21
6	1	164	145	-19	5	1	156	148	-8	5	1	230	180	-50
	2	35	128	93		2	150	175	25		2	215	183	-32
	3	149	107	-42		3	145	159	14		3	215	159	-56
	4	146	100	-46		4	156	161	5		4	218	138	-80
	5	109	77	-32		5	143	140	-3		5	225	165	-60
	6	134	88	-46		6	157	165	8		6	225	172	-53
	7	151	115	-36		7	175	174	-1		7	215	169	-46
	8	121	116	-5		8	176	179	3		8	216	179	-37
	9	130	115	-15		9	160	157	-3		9	228	153	-75
8	1	155	156	1	7	1	115	81	-34	7	1	232	215	-17
	2	172	179	7		2	92	101	9		2	226	207	-19
	3	153	158	5		3	100	122	22		3	205	188	-17
	4	122	116	-6		4	132	110	-22		4	167	200	33
	5	57	51	-6		5	107	114	7		5	210	234	24
	6	129	115	-14		6	116	155	39		6	185	157	-28
	7	50	126	76		7	164	170	6		7	200	229	29
	8	146	173	27		8	144	162	18		8	206	184	-22
	9	187	183	-4		9	155	163	8		9	147	133	-14

Appendix 4: Lyndhurst Riverside Surface Elevation Table Readings (mm)

LR-1					LR-2					LR-3				
Position	Pin	8/29/2008	5/21/2010	Difference	Position	Pin	8/29/2008	5/21/2010	Difference	Position	Pin	8/29/2008	5/21/2010	Difference
1	1	218	246	28	1	1	116	128	12	1	1	226	215	-11
	2	241	236	-5		2	90	115	25		2	219	222	3
	3	244	241	-3		3	55	106	51		3	219	219	0
	4	248	253	5		4	64	109	45		4	215	211	-4
	5	231	256	25		5	103	117	14		5	183	219	36
	6	223	235	12		6	114	114	0		6	234	232	-2
	7	239	240	1		7	113	123	10		7	208	255	47
	8	228	228	0		8	188	165	-23		8	225	215	-10
	9	217	240	23		9	168	160	-8		9	215	225	10
3	1	234	245	11	3	1	175	149	-26	3	1	162	190	28
	2	210	241	31		2	179	161	-18		2	193	207	14
	3	237	241	4		3	102	143	41		3	184	194	10
	4	233	236	3		4	137	128	-9		4	118	170	52
	5	242	224	-18		5	150	134	-16		5	153	192	39
	6	236	229	-7		6	82	130	48		6	137	172	35
	7	258	249	-9		7	125	128	3		7	138	160	22
	8	230	215	-15		8	185	146	-39		8	145	178	33
	9	225	231	6		9	207	195	-12		9	95	181	86
5	1	122	224	102	5	1	190	169	-21	5	1	195	178	-17
	2	182	223	41		2	150	151	1		2	174	188	14
	3	210	226	16		3	166	151	-15		3	134	180	46
	4	151	233	82		4	135	165	30		4	145	163	18
	5	210	219	9		5	137	137	0		5	72	176	104
	6	224	212	-12		6	148	142	-6		6	120	178	58
	7	208	220	12		7	145	117	-28		7	97	190	93
	8	206	219	13		8	122	139	17		8	131	187	56
	9	197	195	-2		9	130	150	20		9	114	182	68
7	1	212	219	7	7	1	135	127	-8	7	1	165	174	9
	2	219	221	2		2	123	144	21		2	175	208	33
	3	213	229	16		3	135	143	8		3	222	212	-10
	4	211	220	9		4	116	125	9		4	216	212	-4
	5	200	224	24		5	100	111	11		5	205	202	-3
	6	205	239	34		6	98	119	21		6	220	208	-12
	7	207	220	13		7	110	155	45		7	169	205	36
	8	227	230	3		8	115	146	31		8	199	211	12
	9	190	226	36		9	115	132	17		9	196	197	1

Appendix 5: Secaucus HS Surface Elevation Table Readings (mm)

SHS-1					SHS-2					SHS-3				
Position	Pin	8/28/2008	4/29/2010	Difference	Position	Pin	8/28/2008	6/4/2010	Difference	Position	Pin	8/21/2008	4/29/2010	Difference
1	1	154	187	33	2	1	122	138	16	2	1	177	210	33
	2	158	183	25		2	90	135	45		2	165	207	42
	3	172	184	12		3	174	126	-48		3	160	207	47
	4	160	178	18		4	164	112	-52		4	168	216	48
	5	183	185	2		5	127	98	-29		5	160	210	50
	6	172	199	27		6	155	95	-60		6	170	212	42
	7	178	182	4		7	147	96	-51		7	165	207	42
	8	170	186	16		8	90	86	-4		8	170	216	46
	9	150	197	47		9	136	106	-30		9	130	185	55
3	1	142	184	42	4	1	141	154	13	4	1	182	213	31
	2	127	200	73		2	144	155	11		2	175	208	33
	3	134	204	70		3	156	155	-1		3	174	200	26
	4	165	200	35		4	132	160	28		4	165	191	26
	5	176	184	8		5	130	147	17		5	175	205	30
	6	156	196	40		6	135	134	-1		6	174	181	7
	7	148	218	70		7	116	125	9		7	175	186	11
	8	167	212	45		8	118	117	-1		8	177	176	-1
	9	163	189	26		9	120	113	-7		9	175	175	0
5	1	170	185	15	6	1	146	154	8	6	1	180	182	2
	2	173	173	0		2	145	165	20		2	149	204	55
	3	171	186	15		3	152	165	13		3	155	204	49
	4	178	200	22		4	150	165	15		4	174	203	29
	5	181	180	-1		5	156	170	14		5	160	205	45
	6	165	200	35		6	155	168	13		6	135	205	70
	7	182	195	13		7	140	169	29		7	135	189	54
	8	185	190	5		8	120	154	34		8	148	196	48
	9	180	185	5		9	114	155	41		9	170	187	17
7	1	187	195	8	8	1	129	152	23	8	1	191	195	4
	2	183	203	20		2	187	181	-6		2	175	182	7
	3	184	189	5		3	232	165	-67		3	175	207	32
	4	178	208	30		4	180	192	12		4	188	210	22
	5	185	190	5		5	174	166	-8		5	183	190	7
	6	199	190	-9		6	158	170	12		6	190	196	6
	7	182	194	12		7	190	183	-7		7	185	196	11
	8	186	208	22		8	186	164	-22		8	200	182	-18
	9	197	209	12		9	175	165	-10		9	175	187	12