

BULKHEAD MONITORING REPORT

**Morgan Creek Harbor
Isle of Palms, South Carolina**

July 29, 2013

Terracon Project No. 73055027

Prepared for:

Morgan Creek Harbor Association
Mt. Pleasant, South Carolina

Prepared by:

Terracon Consultants, Inc.
Columbia, South Carolina

Offices Nationwide
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Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

July 29, 2013

Morgan Creek Harbor Association
Property Management Services
1340-G Ben Sawyer Blvd.
Mt. Pleasant, South Carolina 29464

Attn: Ms. Laurie A. Schueler

Re: ***Bulkhead Monitoring Report***
Morgan Creek Harbor
Isle of Palms, South Carolina
Terracon Project No. 73055027

Dear Ms. Schueler:

Terracon Consultants, Inc. (Terracon) has completed an annual inspection of steel bulkhead at Morgan Creek Harbor and is submitting the findings herein. This work was performed in general accordance with the scope of work outlined in our proposal number 12090301-G.R1, dated August 13, 2004. Included in this report are a summary of data collected, our field observations, and our general assessment about the overall performance of bulkhead. Additional data are included in the Appendix.

A. REPORT SUMMARY

The coating of bulkhead was completed in late 2012 with the dredging being completed in early March of 2013. Overall the bulkhead is performing well considering its age and environmental factors. The measurements at reference markers indicate no abnormal movement of wall inward or outward and we did not notice any unusual wall distress. The newly finished coating is helping with rust and corrosion prevention and has also improved the overall appearance of wall.

The tie back at 47 Water Way Island (WWI) is missing its plate and tie rod. The trumpet housing remains in contact with the sheet pile, but the plate, nut and tie rod are all missing. Based on visual observations and the measurements of adjacent markers, we did not notice any apparent distress of wall. The backfill looked good with no subsidence noted in the area of missing tie back. The wall sections appeared to be in alignment with adjacent sections with no noticeable bulging or other form of distress.

Our observations were discussed with Ms. Laurie Schueler at the conclusion of field work. We informed Ms. Schueler that we would work with TIC (The Industrial Company) to prepare a repair plan for 47 WWI tie rod. TIC is familiar with bulkhead at Morgan Creek and installed the original tie rods.



B. SUMAARY OF FILED OBSERVATIONS

On April 19, 2013, Terracon Consultant Inc. (Terracon) personnel performed measurements of movements of the steel bulkhead and observed general conditions of the wall and its anchorage system. Observations of wall conditions were made from the easement behind the wall, floating docks and from the water side from a boat. A representative from Coastline Services, LLC (formally Dirt Cheap) accompanied us during these activities, which also provided and operated a boat for viewing the bulkhead from the water side. We should note that Mr. Bobbitt used to also accompany us during these inspections providing his opinion with respect to tie backs and the structural conditions of the bulkhead. Mr. Bobbitt retired after 2011 inspections and is no longer available to conduct these inspections.

Wall measurements were made at all reference plate locations. Measurements were made to the reference plates which were originally installed in March, 2005. All of the locations were measured during this inspection program, except as noted in the attached tables. The following is a summary of our observations from:

1. The wall appears to be performing well with minor exceptions. The wall measurements were taken during the morning hours on low tide on April 19, 2013. A woven metallic tape was used to measure the apparent wall movement (deflection). The ambient temperature during field measurements was in mid-70's.
2. The measurements of April 19, 2013 generally indicate no unusual or unacceptable wall movements (inward or outward) when compared to readings recorded on March 15, 2012 and past three year running average. Where no readings were available from the March 15, 2012 inspections, the measurements have been compared to previous available readings.
3. Several readings indicate possible inward (top moving toward land) and outward (top moving outward toward water) of about 0.01 (1/8 inches). The movement of this magnitude is considered to be within level of accuracy of measurements. Temperature and tide stages also affect the readings. We did not notice any apparent signs of distress or movement of the wall, wall cap, and backfill subsidence in the area of these measurements. Nevertheless, these locations will be observed and/or measured during the next scheduled inspection program.
4. Several areas of minor backfill subsidence were noted during our inspections. The subsidences are very minor in nature and appear to be due to the irrigation lines and/or yard inlets present in the area. These areas should be periodically inspected and filled as necessary. Consideration should also be given to locating future irrigation heads away from the bulkhead.
5. The wall measurements and other observations were made for the 10th time since the initial dredging was completed and for the 1st time since 2012/2013 dredging. It

Bulkhead Monitoring Report

Morgan Creek Harbor ■ Isle of Palms, South Carolina

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- appears that the recent dredging, at least to this time, has not negatively impacted the wall. We should note that wall was monitored during the most recent dredging and those readings are consistent with April 19, 2013 measurements.
6. Coating of wall has been completed. Phillips Industrial began a maintenance program in the form of pinhole repairs and touch ups. The work was halted due to dredging activities. It is important that pinholes are repaired in a timely manner to minimize its impact on the wall performance. Patch plates (6"x6" and 8"x8" sheet metal plates) have been used to seal pin-holes in the past and should continue be used to repair any additional pinholes identified during maintenance program. Continual maintenance is necessary to minimize the corrosion of the bulkhead.
 7. Tiebacks N4-184, N4-70, and N4-78, which had been repaired and backfilled previously appeared to be performing well as reported in the previous inspection reports. No water leakage and slippage were noted. Tieback N4-195, reported slipped since 2003, is essentially unchanged and the previous recommendations for repair are still applicable.
 8. The tie back at 47 Water Way Island (WWI) is missing its plate and tie rod. The trumpet housing remains in contact with sheet pile, but the plate, nut and tie rod are all missing. Based on a visual observation and the measurements of adjacent markers, we did not notice any apparent distress of wall. The backfill looked good with no subsidence noted. The wall appeared to be in alignment with adjacent sections with no noticeable bulging or other form of distress. Regardless, the tie back should be repaired at the earliest time possible. Terracon will coordinate the repair with a specialty contractor.
 9. We recommend that inspections of backfill conditions, flapper gates, etc. continue to be made by Coastline as these inspections are important to the long term performance of the bulkhead. Coastline is well qualified to do this work because they are familiar with the various issues related to the wall. Coastline reports should be sent to the Association and Terracon on a regular basis. The performance of the wall depends upon these inspections and must be performed on a regular basis. Coastline's 2012 inspection report is appended.
 10. The Association has a sizeable investment in the bulkhead, and in order to maintain it, periodic observations are necessary. It is recommended that continued maintenance along with periodic inspections continue to be conducted as it will help to extend the life of the bulkhead. Any unusual or suspicious conditions should be reported to Terracon immediately.

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Morgan Creek Harbor ■ Isle of Palms, South Carolina

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**B. CLOSURE**

Terracon appreciates providing this service to the Morgan Creek Harbor Association. If we can provide additional information or be of further service, we will be pleased to do so upon request.

Respectfully submitted,

Terracon Consultants, Inc.

Kevin Sohrabnia, P.E.
Senior Principal
SC Registration No. 16603

W. Kenneth Humphries, Ph.D., P.E.
Senior Consultant
SC Registration No. 3003

Attachments

Table 1 – Wall Measurements 4-19-2012

Photo Log

Coastline Services 2012 Inspection Report

Table 1 -Wall Measurements 4-19-2013

Table 1
MORGAN CREEK HARBOR - Bulkhead Wall Mesuremnts
April 19, 2013
Terracon Project No. 73055027

Reference Plate No.	Station No.	Distance to Reference Plate March 10-11, 2005	Distance to Reference Plate February 5, 2009	Distance to Reference Plate February 4, 2010	Distance to Reference Plate March 22, 2011	Distance to Reference Plate March 15, 2012	Distance to Reference Plate April 19, 2013	Difference in feet since March 15, 2012	General Notes
1	60+75.00	52.42	-	52.43	52.44	52.44	52.44	0.00	
2	60+ 53.85	46.95	-	46.98	46.98	46.98	46.98	0.00	
3	59+53.93	56.90	-	56.90	56.91	56.92	56.91	(0.01)	
4	58+15.55	53.70	-	53.97	54.00	54.09	54.09	0.00	overgrown shrubs
4A	58+15.55	-	28.49	28.46	28.46	28.46	28.46	0.00	Note1
5	57+32.40	56.22	56.46	56.48	56.50	56.50	56.50	0.00	
5A	57+32.40	-	26.21	26.19	26.21	26.21	26.21	0.00	Note 1
6	55+02.48	54.10	-	54.12	54.13	54.13	-	-	shrubs, no reading
7	53+79.00	62.00	61.93	61.91	61.89	61.87	61.88	0.01	Note 2
8	52+54.00	63.90	63.87	-	-		-	-	Note 3
8A	52+54.00	-	-	27.44	27.46	27.46	-	-	no reading
8B	52+50.00						27.23	0.00	note 4
9	51+45.00	69.10	-	69.10	69.13	69.10	-	-	no reading, shrubs
9A	51+45.00		-	25.70	25.72	25.72	25.71	(0.01)	Note 1
10	50+08.42	63.80	63.76	63.78	63.81	63.81	63.81	0.00	
11	48+13.10	50.50	50.48	50.48	-		-	-	Note 3
11A	48+13.10	-	-	27.60	27.60	27.61	27.60	(0.01)	Note 5
12	46+45.00	28.40	-	28.40	28.42	28.41	28.41	0.00	Note 6
13	44+50.00	62.40	-	62.40	62.40	62.42	62.42	0.00	
14	43+50.00	47.50	-	-	-		-	-	Note 11
15	42+14.93	42.60	-	42.55	42.55	42.55	42.55	0.00	
16	41+25.11	43.60	-	43.61	43.61	43.61	43.62	0.01	
17	40+50.00	55.50	-	55.48	55.49	55.49	55.49	0.00	diff. to access
17A	40+50.00		44.51	44.51	44.49	44.49	44.49	0.00	To step column
18	40+00.00	137.50	-	137.50	137.50	137.44	-	-	no reading
18A(new)	39+78.00	-	-	44.50	-		-	-	Note 7
19	39+27.26	46.10	-	46.11	46.10	46.10	46.10	0.00	
20	38+34.69	44.90	-	44.91	44.85	44.85	-	-	No reading, note 8
21A	38+34.69				44.64	44.64	44.65	0.01	See note 9
21	37+43.83	49.60	-	49.61	49.61	49.61	49.61	0.00	

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22	37+00.00	51.60	51.60	51.60	51.60	51.60	51.59	(0.01)	
23	36+50.00	48.10	48.13	48.13	48.16	48.16	48.16	0.00	
24	35+50.00	42.40	-	42.44	42.45	-	-	-	Heavy shrubs
25	35+17.57	49.30	-	49.30	49.31	49.31	49.32	0.01	
26	34+44.28	47.00	-	46.99	47.00	47.01	47.00	(0.01)	
27	33+82.47	49.00	-	49.01	49.01	49.01	49.01	0.00	
28	33+37.63	46.20	-	46.20	46.21	46.20	46.20	0.00	
29	32+68.00	46.00	-	46.00	46.00	46.00	46.00	0.00	above spigot
30	31+91.55	47.00	47.10	47.10	47.12	47.12	-	-	shrubs, no reading
31	31+00.00	137.90	-	137.89	-	-	-	-	Note 10
32	30+39.00	45.40	-	45.38	45.39	45.39	-	-	
33	29+68.68	46.50	-	46.51	46.51	46.52	46.52	0.00	shrubs
34	28+63.00	45.80	-	45.77	45.79	45.79	45.78	(0.01)	
35	28+07.82	46.30	46.60	46.60	46.60	46.68	46.68	0.00	2nd Step, facial board
36	0+57.38	34.00	34.00	34.07	34.09	34.09	34.09	0.00	porch column
37	1+58.75	45.60	-	45.61	45.60	45.60	-	-	new const., note 10
38	2+89.23	44.00	-	43.95	43.95	43.95	43.96	0.01	
39	3+90.89	35.10	-	35.10	35.10	35.09	35.09	0.00	
40	5+17.00	41.00	41.10	41.10	41.09	41.09	41.09	0.00	
41	7+94.37	71.00	-	-	-	-	-	-	
41A	-	-	36.89	36.89	36.89	36.89	36.88	(0.01)	corner
42	9+20.00	60.30	-	60.30	60.31	60.31	60.31	0.00	
43	10+20.00	31.00	-	30.97	30.97	30.97	30.97	0.00	RT post
44	12+00.00	45.00	-	45.05	45.05	45.05	-	-	dirt pile, no reading
45A	13+10.00	-	36.77	36.77	36.77	36.77	36.77	0.00	
46	14+30.00	34.00	33.93	33.93	33.92	33.92	33.92	0.00	higher wall
47	15+10.00	63.70	63.70	63.70	-	-	-	-	
47A	15+10.00	-	-	-	-	35.71	35.71	0.00	Note 12
48	16+86.00	35.00	-	34.96	34.96	34.96	34.96	0.00	
49	17+71.90	52.10	52.07	52.07	52.08	52.08	52.08	0.00	left post steps

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50	18+30.00	72.30	-	72.31	72.31	72.32	72.31	(0.01)	left corner
51	19+00.00	34.10	-	34.14	34.16	34.16	34.16	0.00	Corner post
52	19+62.55	45.30	-	45.23	45.25	45.24	45.24	0.00	
53	20+00.00	54.00	53.85	53.85	53.85	53.86	53.85	(0.01)	4 th column from north
54	20+50.00	43.90	-	43.90	43.89	43.90	43.90	0.00	
55	21+00.00	45.30	-	45.22	45.22	45.22	45.22	0.00	corner
56	21+50.00	54.80	54.87	54.87	54.86	54.86	54.85	(0.01)	
57	22+25.00	32.50	-	33.44	33.44	33.44	33.44	0.00	
58	23+00.00	39.90	-	39.87	39.87	39.87	39.87	0.00	By door
59	23+50.00	34.10	-	34.11	34.10	34.10	34.10	0.00	
60	24+25.00	34.20	-	34.20	34.20	34.20	34.20	0.00	

Table Notes:

- 1) *Measurements to the back of sidewalk*
- 2) No visual signs of wall movement or distress. Measurement may be off due to difficulty in locating the reference mark.
- 3) Could not establish reading due shrubs and other obstructions.
- 4) Measurement from back of the sidewalk at joint to station marker 52+50. Marker was established in 2013.
- 5) Measurement to the back of sidewalk, tangent to east side of fence post.
- 6) Measurements to the back of sidewalk at the construction joint.
- 7) Could not locate the marker. No reading was taken. No visual signs of wall distress at location.
- 8) House appears to have been painted. Marker on wood next to brick
- 9) marker on wooden fence.
- 10) No measurements taken.
- 11) *New marker to RT column of pool deck.*
- 12) *New marker to RT column of pool deck.*

General Notes

- *Positive numbers indicate outward (toward the water) and negative numbers (< >) indicate inward (toward land) movement.*
- *Measurements were taken at low tide, temperature in low seventies (≈ 70-75 ° F), very light wind.*
- *Measurements taken to bottom left corner of reference plate, unless noted otherwise.*
- *Measurements were taken using a 100' long woven metallic tape.*

Dashes “ – ” in the table indicates no measurements were made during this inspection

Photo Log 4-19-2013



Photo #1 – Typical wall condition where pinholes have been repaired and area re-coated



Photo #2 – Minor rust adjacent to patch plates, but overall look good



Photo #3 – Pinhole patch plate preparation (TYP). Note the patch plate has yet to be installed.



Photo #4 – Same as Photo #3. Additional pinholes adjacent to previously repaired pinholes.



Photo #5 – Pinholes to be patched.



Photo #6 – Closer view of pinholes. The area has been prepared, but patch plate has yet to be placed. G-dock



Photo #7 – Wall condition between G and H Docks. Some rust. Pinholes have formed, but have yet to be repaired.

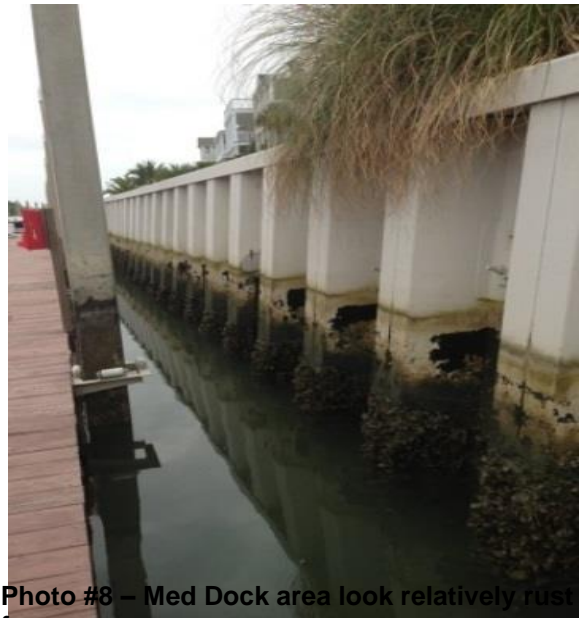


Photo #8 – Med Dock area look relatively rust free



Photo #9 – leaking anchor near marker 38+39



Photo #10 – Missing anchor at 47 Water Way



Photo #11 – Anchor slippage as reported in past inspections



Photo #12 – overgrown shrub adjacent to the wall. Marker 44+50



Photo #13 – Backfill subsidence near marker 48+50

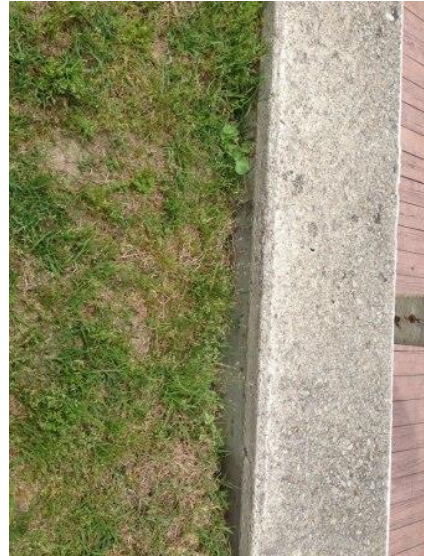


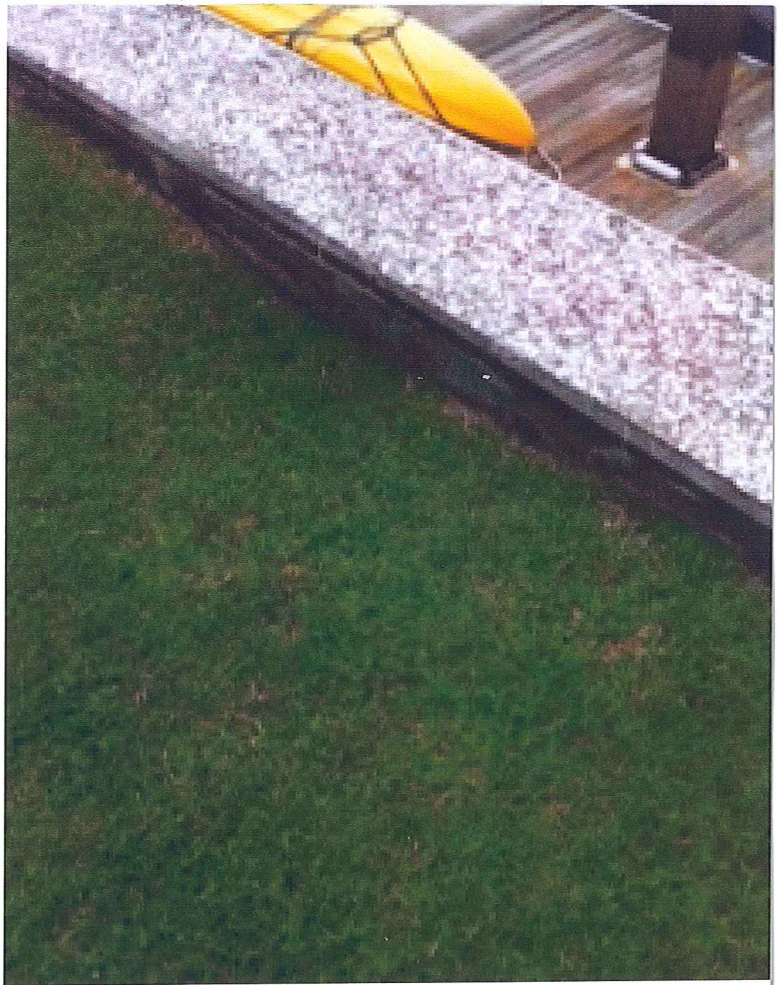
Photo #14 – Backfill subsidence near marker 43+00



Photo #15 – Temporary soil stockpile near the wall at marker 25+50.

Coastline Services, Inc. 2012 Inspection Report

8 + 67



60+42

Halfway House



20 + 10



19 + 70

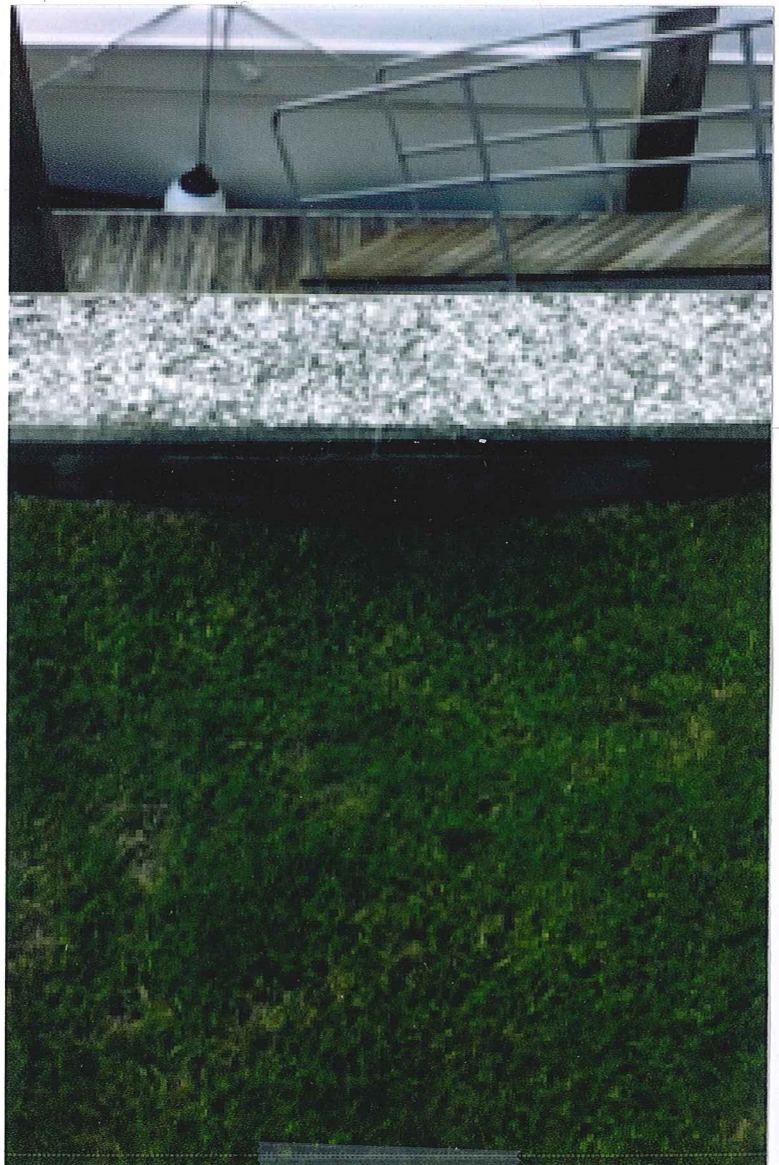


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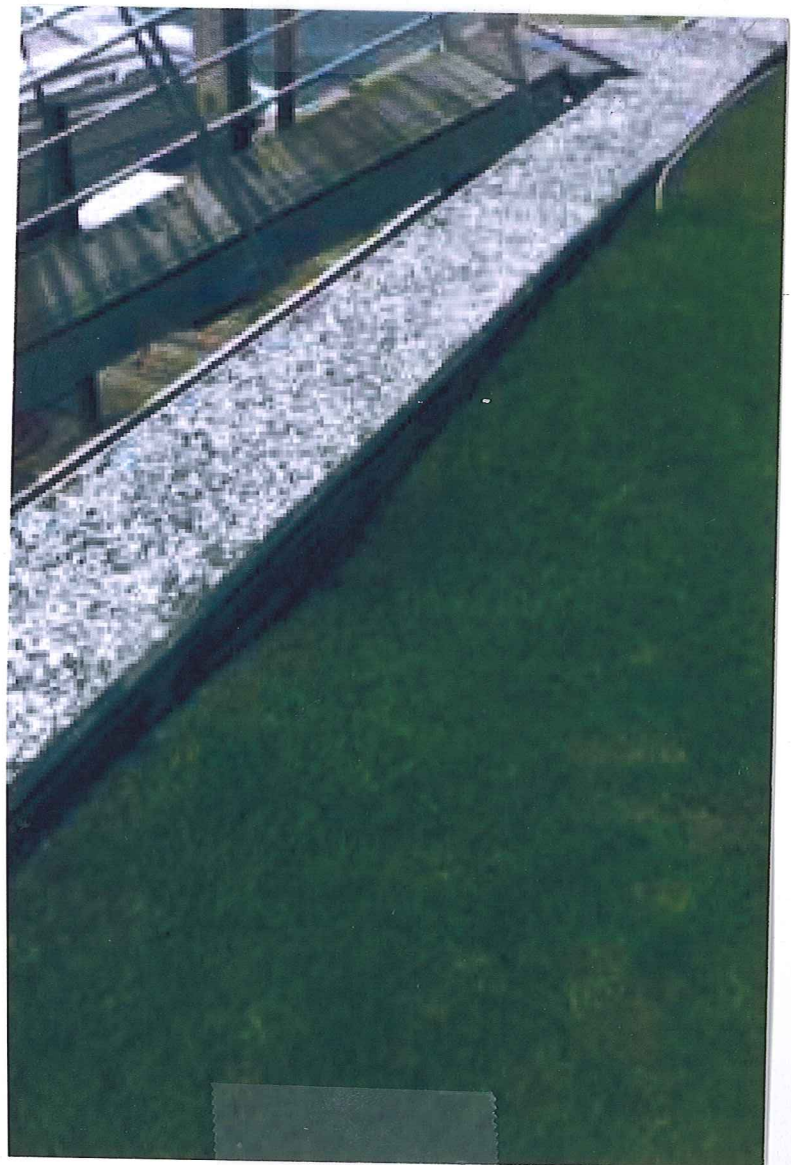
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14 + 90



15 + 98



Coastline Services, LLC

6057 Mossey Grove Lane

Awendaw, SC 29429

Inspection of Morgan Creek Harbor Seawall

October 10, 2012

Property Management Services

Attn: Laurie Schueler

1340-G Ben Sawyer Boulevard

Mount Pleasant, SC 29464-4582

Laurie,

This quarter's inspection took place over the course of two days: Thursday, September 7th, Friday September 8th. It was performed by Ed Cox and Gary Bell, of Coastline Services, LLC. The south side of the marina was inspected on the 7th, and the north side of the marina on the 8th.

Several locations of soil subsidence were located, and a few medium and large on the Waterway Island or north side. The other small areas of subsidence were in front of the tee box that crosses the waterway, next to the bridge.

An important point to note is that no areas that were filled last quarter were observed to have sunken again.

The concrete cap expansion joints all worked as designed, with all showing signs of expansion and contraction.

Several ramps in the Dock Houses were observed to be 1-2" below the wall cap, which could be a trip hazard. We recommend re-setting the ramps, by lifting them up and re-packing material underneath them. This will bring the top of the ramp flush with the wall cap again.

There are still quite a few areas where landscaping, hedges, and/or trees are growing up against the wall. Many areas have been cut back from last quarter, so access along the top of the wall was better. The areas that have plant interference have been noted in the accompanying report data.

It is still recommended to have all landscaping cut back or removed from the immediate proximity of the wall.

Suggestions for repair have been included in the report, adjacent to their corresponding issues.

Please feel free to contact us any time with questions or concerns.

Thank You,


Coastline Services, LLC

Ed Cox

(843)860-7333

dirtflyed@yahoo.com

Coastline Services, LLC

Landmark	Reference Plate	Location	Status	Notes/Recommendations
Morgan Cove Halfway House	1	60+75		
		60+42	Near halfway house. Small depression against wall.	Depression needs filling
		60+15		
Dock B Enclosure		57+00	Ramp to gangplank sunken, small trip hazard	Raise ramp to level of cap.
		56+46		
		56+35		
		56+01		
		55+78		
		55+43		
Dock C Enclosure		55+14	Ramp to gangplank sunken, small trip hazard	Raise ramp to level of cap.
		54+87		
		53+64		
		53+37		
		53+07		
		52+73		
		52+50		
		52+18		
		52+07		
		52+00	Deep subsidence hole found.	Excavate to find cause, repair problem.

		51+92		
		51+72		
		51+60		
		51+34		
Dock E Enclosure		51+09	Ramp to gangplank sunken, trip hazard.	Raise ramp to level of cap.
		51+01		
		50+66		
		50+34		
		50+10		
		49+84		
		49+51		
Dock F Enclosure		49+40	Ramp to gangplank sunken, small trip hazard	Raise ramp to level of cap.
		48+92		
		48+60		
		48+32		
		48+01		
		47+83	Ramp sunken, creating a trip hazard.	Raise ramp to level of cap.
		47+45		
		47+13		
		46+54		

		46+24		
		46+05		
		45+46		
		45+38		
		45+06		
		44+78		
		44+51		
		43+92		
		43+03	3" subsidence	fill with topsoil
		42+72		
		42+46		
		41+23		
		40+94		
		40+63		
		40+36		
		40+04		
		39+79		
		39+75		
		39+13		
		38+85		

	38+54		
	38+26		
	38+00	Oleander blocking access.	Morgan Cove #38. Cut back, relocate.
	37+55	Oleander blocking access.	Morgan Cove #38. Cut back, relocate.
	37+46		
	37+35		
	37+04		
	36+13		
	36+00	Landscaping planted against wall cap. Growing over wall.	Cut back/relocate.
	35+75	Palm tree directly against wall, growing over it. Small cracks found against tree trunk.	Morgan Cove #33. Tree should be relocated.
Morgan Cove #32		Inaccessible. Massive vegetation blocking.	Cut back/relocate.
Morgan Cove #31		Sinkhole under pavers worse than last quarter. Pavers falling in more, adjacent bluestone tile cracked.	Remove tiles, backfill/compact with masonry sand, replace tiles.
	34+04		
	33+11	Subsidence under pavers.	Remove pavers, backfill/compact, replace pavers.
	33+06		
	33+02	Small area of subsidence	Backfill, compact
	32+86		
	32+55		
	31+95		
	31+64		

	31+35		
	30+76		
Morgan Cove #22	30+71	Landscaping still majorly contacting wall, preventing access.	Morgan Cove #22. Cut back/relocate.
	30+12		
	29+55		
	29+50	Small area of subsidence at gangway.	Investigate for cause, correct issue. Backfill, compact.
	28+35		
	27+14		
Morgan Creek Bridge			
	00+50		
	01+00		
	01+07		
	02+00		
	02+74		
	03+01		
	03+32		
	03+60		
	04+09		
	04+20		

	04+49		
	04+80		
	05+09		
	05+40		
	05+68		
	05+73		
	05+98		
	06+09		
	06+28		
	06+58		
	06+71		
	06+87		
	07+00	*Plate missing*	
	07+20		
	07+48		
	08+08		
	08+67		
	08+94	Subsidence hole, needs filling with topsoil.	Fill w/topsoil, compact.
	08+98	Slight subsidence	Fill w/topsoil, compact.
	09+29		

	09+58		
	09+98	Slight subsidence	fill w/topsoil, compact.
	10+48		
	10+80		
	11+05		
	11+35		
	11+54		
	11+95		
	12+24		
	12+54		
	12+84		
	13+20	Slight subsidence	Fill w/topsoil, compact.
	14+52		
	14+90	Medium subsidence, see pictures	Fill w/topsoil, compact.
	15+21		
	15+98	Medium subsidence, see pictures	Fill w/topsoil, compact.
	16+68		
	16+99		
	17+30		
	17+59		

		17+89		
		18+19		
		18+49		
		18+80		
		19+09		
		19+18		
		19+39		
		19+67		
		19+70	Medium subsidence, see pictures	Fill w/topsoil, compact.
		20+10	Large subsidence, see pictures	Fill w/topsoil, compact.
		20+96		
		21+01		
		21+21		
		21+59		
		21+94		
		22+22		
		22+27		
		22+40	Medium subsidence, see pictures	Fill w/topsoil, compact.