

# BULKHEAD INSPECTION REPORT

**2596 Southeast 13<sup>TH</sup> Court  
City of Pompano Beach**

**June 2012**



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## **BULKHEAD INSPECTION REPORT**

**Location:** 2596 Southeast 13<sup>th</sup> Court  
City of Pompano Beach

**Waterway:** Intracoastal Waterway (ICWW)

**Field Personnel:** Mark Bolchoz, P.E.  
John O'Brien

**Engineer of Record:** William T. Sadler Jr., P.E., P.S.M.

**Date of Field Observations:** April 11, 2012

**Date of Report:** June 6, 2012

### **Discussion:**

Pursuant to the request of the City of Pompano Beach, Sea Diversified, Inc. (SDI), conducted an inspection of a bulkhead at a City park located at the easterly terminus of Southeast 13<sup>th</sup> Court along the west side of the Intracoastal Waterway (ICWW) in Pompano Beach, Florida. Field work consisted of topographic data collection by survey technicians and visual observations of existing conditions by engineering staff under the direction and supervision of a Professional Engineer. Field work was conducted during the month of April 2012.

### **Description:**

The bulkhead measures approximately 148 feet in length and parallels the ICWW in a general north – south direction. The exposed height (seaward berm to top of cap) of the bulkhead ranges from approximately 5'-6" at the south end to approximately 7'-0" at the northern terminus. The bulkhead abuts residential bulkheads on both the south and north sides of the park facility. (Plates A – D)

The bulkhead is comprised of vertical concrete panels approximately 10' in width supported laterally by 12" inch square prestressed concrete king and batter piles. ( Plate E) The bulkhead has an integral concrete cap, 3'-6" in width by 12" deep with top of cap elevation of 3.40' NAVD. The concrete panel thickness and depth of panel embedment, as well as the length and type of concrete king and batter piles (strength of concrete, size and number of strands) is unknown. Additionally, the construction characteristics of the concrete panels and cap are unknown. Along the bulkhead there is an aluminum railing, 3'-4" in height with post embedded and grouted into the upper face of the concrete cap. Landward along the entire length of the bulkhead there is a brick paver walkway, 9' in width that abuts the backside of the concrete cap. Beyond the paver walkway the site generally consists of grass and natural landscape extending to the asphalt cul-de-sac of Southeast 13<sup>th</sup> Court. Other park features include overhead lighting, park benches and trash receptacles. (Plate F)

### **Observations:**

The bulkhead was observed both topside and waterside for evidence of failure and general deterioration with specific focus on the following:



#### Horizontal and Vertical Alignment (“Plumbness”)

- Check One: Leaning or rotation of the bulkhead cap in a waterward direction. This would be an indication of lateral support failure (tie-backs or king / batter piles), failure of the cap or excessive surcharge loading.
- Check Two: Toe “kick” or rotation of the bulkhead at or below the mud line in a waterward direction. This would generally indicate failure of the bulkhead foundation or support piles or poor embedment of the bulkhead vertical panels caused by improper design / construction practices or excessive erosion / scouring at the base of the wall.

#### Major Cracking and Spalling:

- Major cracks or spalls in the concrete cap, vertical concrete panels and/or king / batter piles. Major cracking would generally indicate that the bulkhead or components, thereof, have been loaded beyond their capacity, salt water intrusion has caused deterioration of internal steel components or the structure has simply reached its life expectancy. Other possible causes of major cracks could be a result of direct impact from external forces (waves, vessels or floating debris) or upland point / surcharge loads (vehicles, maintenance vehicles, trees, hydrostatic pressure).

#### Backfill and Settlement

- Loss of backfill or settlement on the landward side of the bulkhead. This would be an indication that the backfill material is escaping through joints or cracks in the bulkhead or beneath the vertical panels of the bulkhead. Leaks or breaks in upland pipes from pools, irrigation systems or water, sewer or drainage systems can pronounce loss of backfill.

#### **Findings:**

#### Horizontal and Vertical Alignment (“Plumbness”)

The bulkhead structure was observed to be straight and plumb with no visual evidence that there has been any movement of the wall from its original constructed position.

#### Major Cracking and Spalling:

Based on topside visual observations, the bulkhead appeared to be structurally sound with no visual signs of major structural cracks in the concrete cap with the exception of the northerly return wall at the tie-in point to the adjacent residential concrete bulkhead structure. (Plate G) It is apparent the cracks could be a result of differential movement between the abutting bulkheads, impacts caused by the addition of the concrete wall / planter or aluminum railing, loss of backfill material at the point of adjoining bulkhead intersection and / or poor design / construction.

The in-water inspection revealed several cracks and spalls in several of the king and batter piles, which are referenced on the plans accompanying this report. (Plates H – K). Cracks were not observed to be at a level of severity to indicate structural failure, however should be addressed and monitored in accordance with the recommendations included in this report. It is noted that major cracks are considered, herein as a crack being greater than 1/8-inch in width.



Cracks and missing grout material were observed in areas of previous repair work along the edges and faces of batter piles and along the vertical joints between king piles and concrete bulkhead panels. (Plates I, L and M) It is evident that grout material was used to repair damaged piles, which was probably caused by the pile driving operations during the construction of the bulkhead. For piles driven using a drop hammer, this damage is typically isolated to the upper end of the pile at the immediate point of impact. Any chips or damage to the top edges of the pile will generally be confined and hidden within the cast-in-place concrete cap or cut off in cases where the pile is not driven to grade. If the damage extends below the bottom edge of the cap, a common practice is to repair the pile using a concrete grout or hydraulic cement material. This repair work was evidenced at several of the batter piles and in certain cases the grout material had cracked or dislodged from the pile exposing the damaged portion of pile. There was no visual evidence, however that the deterioration of the repair grout material jeopardized the structural adequacy of the pile. Overall, the extent of cracking and missing grout material was minimal.

Grout material was observed along the vertical joint between the king piles and concrete panels, a common practice to seal the inherent gap at this structural interface to prohibit the loss of sediments from behind the bulkhead. Overall, throughout the length of the bulkhead, this joint material was in good condition with only isolated signs of cracking, dislodging and / or grout material loss. (Plate L) As there was no visual evidence of sediment build-up along the base of the bulkhead indicative of significant material escaping from behind the wall into the waterway, it is apparent that the king pile – panel seals were generally functioning as intended.

A predominate area of noticeable deterioration of the bulkhead was along the northerly return section at the abutment or tie-in point to the adjacent residential bulkhead to the north of the Park. This junction shows evidence of being repeatedly patched, with significant buildup of cement and mortar at the point of intersection. The existing patches were weak and easily displaced, and significant cracking was observed in the concrete cap. (Plates N and O) It is evident that the deterioration of the seal between the adjoining bulkheads had reached a point that backfill material was escaping from behind the wall into the waterway resulting in settlement of the paver block walkway at this location. This loss of backfill material may also be the cause of cracks in the small concrete block wall and landward edge of the concrete cap. Immediately adjacent to this area, a small section of paver blocks had been removed and what appeared to be new sand added to fill the voids resulting from the loss of material. (Plate G)

In-water inspection of the south tie-in to the adjacent bulkhead revealed no evidence of failure or major deterioration although it did not appear that this joint had been sealed along the seaward face allowing a small gap or void between the adjoining walls. (Plate P) There was no evidence that any material had escaped through the void indicating that the joint in the walls may have been sealed from the backside or some other means of prohibiting sand loss had been used such as the installation of a geotextile fabric material.

#### Backfill and Settlement

The landward side of the bulkhead was visually inspected to assess any signs of holes or settlement immediately adjacent to the backside of the concrete cap indicative of loss of backfill material through the joints between king piles and concrete panels or resulting from undermining. The paver block walkway was observed to have several areas of indentation and low spots throughout, however with the exception of the very north corner of the bulkhead (discussed above) there were no specific areas of immediate concern. The slight indentations and isolated low spots are more indicative of minor ground settlement over time or



perhaps prior loss of material that had been restored as part of previous bulkhead maintenance work. It is also possible the slight indentations or minor settlement of the walkway could have been caused by a migration and loss of sediments through the voids in the north corner of the bulkhead.

### **Summary:**

In summary, based on site observations, it is SDI's opinion that the bulkhead structure is in reasonably good condition with no areas of immediate and major concern. The cracks, evidenced primarily in several of the concrete batter piles, did not appear to be signs of existing bulkhead failure. However, several cracks were significant and should be repaired and subsequently monitored to ensure the cracking does not progress and possibly lead to severe structural issues and failure of the bulkhead's lateral support system. The northerly section of the bulkhead, specifically at the point of intersection with the adjacent bulkhead to the north, is an area that should be addressed promptly to avoid further failure of the concrete cap and loss of backfill material. The noticeable cracks in the concrete cap and seepage of backfill between the adjoining bulkheads at this location do not jeopardize the overall structural adequacy of the bulkhead, but if not addressed will cause further settlement of the ground behind the bulkhead and subsidence of the paver brick walkway. Repairs to the batter piles and north return wall should be implemented in accordance with the recommendations provided, herein and as depicted on the plans accompanying this report.

### **Recommendations:**

Accompanying this report is a plan that details the extent of recommended repairs to the bulkhead. Referencing this plan, recommended repairs include the following:

Task One: Check, clean, repair and re-seal all joints between king piles and concrete panels using a hydraulic cement material, as necessary. Total number of king piles to check and re-seal is eighteen (18). Chip and remove all existing loose and damaged grout material prior to re-sealing. Sealing shall extend from underside of concrete cap to 12" below the berm line.

Task Two: North abutment (tie-in) to adjacent bulkhead.

Step One: Chip and remove all broken and loose grout and concrete material along the joint between the two walls. Seal with hydraulic cement extending from the underside of the concrete cap to 12" below the berm line.

Step Two: Excavate backfill material from behind the wall at the point of intersection of the two adjoining walls. Care shall be taken not to undermine the foundation supporting the block wall / planter that extends westerly from the bulkhead. The objective is to expose the joint between the two walls as deep as possible in order to add a geotextile fabric material serving as a secondary measure of prohibiting seepage of backfill material into the waterway. Replace backfill material, adding additional as necessary and compact using a light weight vibratory compaction machine. A low volume / low pressure water jet system shall be used to wash sand into any voids that may exist in the area of repair. Reference plan for details.

Step Three: Sawcut, chip and remove section of damaged cap maintaining the aluminum railing post in position. Sawcut and remove concrete to a depth that exposes the steel reinforcing steel without damaging the steel. If the cracks in the cap extend beneath the steel rebar (assuming there is steel reinforcing in this section of cap), chip and remove concrete to the full limits of cracking. Add and / or replace damaged rebar as per the direction of the Engineer, then form and re-pour concrete using a minimum 4000 psi , 0.40



water/cement ratio concrete mix design. A proper bonding agent shall be used between existing and new concrete. Finish to match existing and undamaged section of cap as reasonably possible.

Task Three: South abutment (tie-in) to adjacent bulkhead.

Chip and remove all broken and loose grout, concrete material and debris along the joint between the two walls including the underside of the cap. Seal all joints and gaps with hydraulic cement extending from the underside of the concrete cap to 12" below the berm line.

Task Four: Damaged King and Batter Piles

Step One: Chip and remove all broken and loose grout material used to repair piles as part of previous maintenance work. Re-grout area to match undamaged section of pile. Use forms as necessary to ensure uniformity of patch.

Step Two: Sawcut as practical, clean and epoxy inject all cracks exceeding 1/16" in width. At a minimum this will include three batter piles and one king pile as identified on the plan.

Task Five: Other Miscellaneous Repairs to Face of Bulkhead

Clean and apply hydraulic cement to joints around the upper side of king and batter piles and underside of the cap. Chip and remove remnants of timber form material as necessary to facilitate a proper seal and adhesion of the grout material. Clean and patch any cracks in the concrete panels using hydraulic cement material. Trowel smooth. Epoxy inject all cracks that exceed 1/16" in width before applying grout material.

Task Six: Paver Block Restoration

Remove park benches, trash receptacles and temporarily store. Remove all paver blocks and carefully stack beyond the limits of the existing walkway being careful not to damage the individual bricks. Add clean, granular sand material, re-grade and compact using hand-operated vibratory compaction machinery. Place sand and grade such that the top elevation of the replaced paver blocks are level with the top elevation of the concrete bulkhead cap to match current grades. Replace paver blocks under the direction of the City or Engineer. Pressure clean as required by the City and reinstall park benches and trash receptacles.

Task Seven (Alternative) – As a secondary measure to control the seepage of backfill, expose the joints, check and install a continuous layer of geotextile fabric along the backside of the bulkhead, as necessary. This work shall be done after removal of the paver blocks. Fabric to be installed from the top elevation of the cap to the approximate level of the outer berm line as practical. Replace backfill and proceed with Task Six.

**Conclusion:**

The site observations, report preparation and recommendations herein have been prepared under the direct supervision of a State of Florida Professional Engineer.

Site observations were limited to areas and structure components readily visible. Underground, soil or other unknown conditions could alter the conclusions and recommendations of this report. Recommendations were developed based on experience and judgment of likely causes of conditions observed. If additional information regarding the seawall structure becomes known, including historical or existing site conditions, we reserve the right to amend the conclusions and recommendations of this report.



**Signed:**

A handwritten signature in blue ink, appearing to be "W. T. Sadler, Jr.", written over a horizontal line. To the right of the signature, the date "7-31-12" is handwritten in blue ink.

William T. Sadler, Jr., P.E.  
President  
Sea Diversified, Inc.  
Florida Registration Number 41184



**Plate A**  
**View South**



**Plate B**  
**Abutting South Bulkhead**



**Plate C**  
**Abutting North Bulkhead**



**Plate D**  
**North terminus of bulkhead**



**Plate E**  
**Typical concrete panel supported by king and batter pile**  
**(Pile Group No. One – See Plan)**



**Plate F**  
**View North – Upland Site Features**



**Plate G**  
**Crack in Upper Face of Concrete Cap at North Return Wall**



**Plate H**  
**Crack in North Face of Concrete Batter Pile**  
**(Batter Pile Number 7 – See Plan)**



**Plate I**  
**Crack in North Face of Batter Pile along Back Edge and**  
**Damage / Missing Grout at Upper Edge**  
**(Batter Pile No. 6 – See Plan)**



**Plate J**  
**Minor Crack in King Pile**  
**(King Pile No. 4 – See Plan)**



**Plate K**  
**Crack in North Face of Batter Piles along Upper Back Edge**  
**(Batter Pile No. 1 – See Plan)**



**Plate L**  
**Missing Grout Material - Typical**



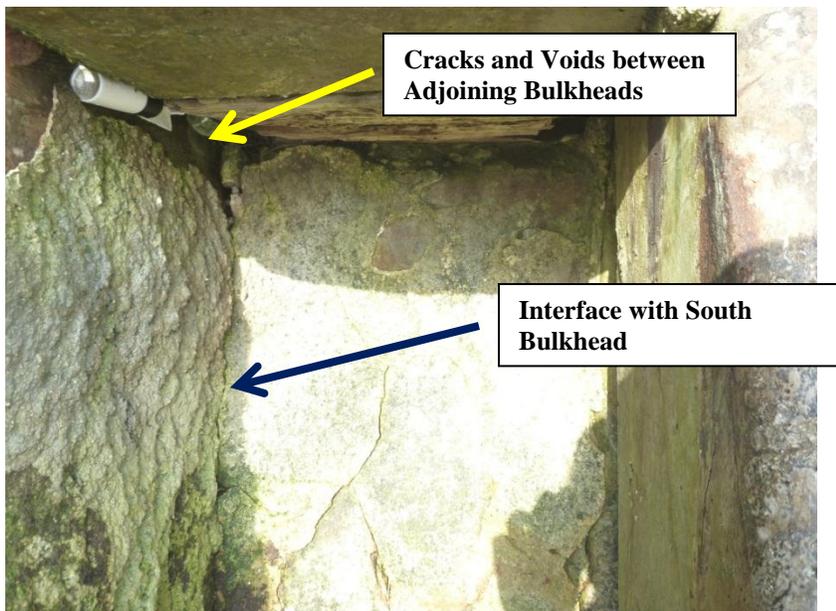
**Plate M**  
**Missing Grout Material at Previously Repaired**  
**Batter Pile – (Batter Pile No. 6 – See Plan)**



**Plate N**  
**Failing Joint at Interface with North Residential Bulkhead**



**Plate O**  
**Significant Cracks at Interface with North Abutting Bulkhead**



**Plate P**  
**Intersection with South Abutting Residential Bulkhead**

