Lockheed Martin Corporation
6801 Rockledge Drive MP: CCT-246
Bethesda, MD 20817
Telephone 301-548-2209

February 5, 2020

VIA PRIVATE CARRIER

Brian Dietz
Land Restoration Program
Land and Materials Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230

Subject: Transmittal of the Technical Memorandum: Outfall Sealing East End of Blocks D and F
Lockheed Martin Corporation – Middle River Complex
2323 Eastern Boulevard, Middle River, Baltimore County, Maryland

Dear Mr. Dietz,

For your information and records, please find enclosed two hard copies of the above-referenced document. This technical memorandum refers to the bulkhead walls along Dark Head Cove in Block D and Block F at the Middle River Complex in Middle, River, Maryland.

Please let me know if you have any questions. My office phone is (301) 548-2209.

Sincerely,

Thomas D. Blackman
Project Lead, Environmental Remediation

cc: (via email without enclosure)
Gary Schold, MDE
Mark Mank, MDE
Christine Kline, Lockheed Martin
Norman Varney, Lockheed Martin
Dave Brown, MRAS
Tom Green, LMCPI
Michael Martin, Tetra Tech
Cannon Silver, CDM Smith

cc: (via mail with enclosure)
Budd Zahn, MRAS

cc: (via Secure Information Exchange)
Jann Richardson, Lockheed Martin
Scott Heinlein, LMCPI
Christopher Keller, LMCPI
Glen Harriel, LMCPI

TETRA TECH

MEMO

To:	Tom Blackman (Lockheed Martin)
Cc:	Steve McGee, Steve Ernst, Dan Sullivan, Katie Young, Cannon Silver, Michael Martin, Senda Ozkan
From:	Michael Byle
Date:	February 5, 2020
Subject:	Outfall Sealing East End of Blocks D and F

Since completion of the bulkhead walls along Dark Head Cove in Block D and Block F, settlement of the granular fill has been noted. This has primarily been attributed to loss of granular fill through openings in the original sheet piling. In the anticipation that these losses would stabilize as the existing voids became filled, it was decided to restore the settled areas with additional granular fill and restore the surface as needed with additional granular fill should settlments recur. For the majority of the walls, the settlement of the granular fill has been small, on the order of a few inches, except in the immediate areas surrounding Outfalls OF-0005W and OF-00X. Recent inspections in April 2019 after grade restoration in March 2019, indicate areas of granular fill loss to depths greater than 24-inches immediately adjacent to outfalls OF-0005W and OF-00X.

Figure 1 - Recess in anular concrete at OF-00X

Discussion:

Observations of the outfall penetrations indicate that the concrete surrounding the corrugated HDPE pipe appears to be displaced and cracked. Probing in the cove adjacent these outlets indicates the presence of mounded granular soil that appears to be consistent with the volumes of material lost surrounding the culvert. Inspection of the inverts of the pipes is not possible, since they are partially submerged, but it appears likely that the conditions observed for the exposed portions are representative of the full circumference of the pipe.

Based on these observations, it appears that tidal action is flushing granular fill through openings around the circumference of the pipes at the two outfalls. The openings appear to be the result of fracturing and displacement of the concrete where it adjoins the steel wall components. Because the area over the pipes consists of concrete cast to the sloping granular fill surface, the concrete is in a trapezoidal shape and the granular fill loss is occurring in an hour-glass fashion concentrated along the contact between the granular fill and the concrete. This results in the surface expression appearing as a sinkhole several feet off the centerline of each pipe.

Tetra Tech, Inc.
One Oxford Valley, Suite 200, Langhorne, PA 19047
Tel 215.702.4113 Fax 215.702.4045 tetratech.com

In order to abate the continuing loss of granular fill, several options may be considered. These include sealing of the openings, immobilizing the granular fill surrounding the opening, or using coarser fill to prevent material loss. Sealing of the anulus around the the pipes could be accomplished either by installing a mechanical seal from the water or injecting a sealant. The granular fill may be immobilized by injecting a urethane grout to cement soil particles together and seal openings in the anular space surrounding the pipe. The granular fill could be modified by excavation and replacement of the existing fill, or by backfilling the current openings with a coarser fill on a periodic basis until the material is transported to the openings and bridges across them.

Figure 2 - Granular Fill loss at OF-005W

While any of these measures are technically feasible, only three of approaches are considered practical: installing a mechanical seal, injection of urethane grout sealant, and renourishment with coarser granular fill.

Mechanical Seal Option: Installing a mechanical seal would require fabrication of a plate with an elastomeric seal and bolting that plate to compress the seal to the pipe. The bolts would require drilling and tapping into the existing steel plate above and below water and would likely require divers to complete. Alternately, the plate could be fitted with injection ports and welded or bolted to the existing steel wall and sealant could be injected through the ports. For the welded alternative, the existing coating would have to be removed for welding and restored afterward, which would be difficult underwater.

Urethane Grouting Option: Of these three approaches, the simplest and most likely to achieve positive results in the near term would be the urethane grouting option. This would be completed by drilling small diameter holes through the pipe to intersect the gap between the concrete and steel and injecting grout to solidify the granular fill and seal openings. This may be accomplished either working from a watercraft or possibly from ladders with scaffold brackets.

Renourishment Option: Gravel renourishment would be simple process that would use coarser stone size (VDOT #57) to backfill any subisidence within 20 feet of the culverts. While the finer granular fill would continue to erode through the anulus, it would be replaced with coarse material that would eventually reach the openings surrounding the pipe and bridge over them preventing further erosion. This would likely take considerable time and periodic replenishment. The granular fill below the culvert invert surrounding the weep holes would remain unaffected, since the only materials to be replaced would be those around and above the openings in the anulus surrounding the outfalls.

Cost Comparison

The lowest initial cost option would be the renourishment option. The effort would be similar to the recent releveling of the bulkhead fill, but would simply use a coarser fill material. The total cost would depend on the length of time it takes for the granular fill to be eroded and replaced with coarser stone. This might take several years. Assuming three years to stabilize with two nourishment events per year at $2000 per event, the total cost would be expected to be on the order of $8000, but could be higher depending on the rate of erosion.

Grouting would have as similar total cost, though it would be a one time event. It is expected that the pipe openings would be accessed by ladder supported scaffold set into the cove from the top of the bulkhead. The work would require one day of setup and two days of field work by a three man and less than two gallons of urethane grout. The grouting contractor cost for this should be on the order of $6000.

The mechanical seal option would be expected to be much higher to include design and fabrication of the plates, support vessels, divers, lifting equipment, etc. The cost would be expected to be in the range of $15,000 to $20,000.

Recommendations:

Based on the above discussion, the recommended approach is the Urethane Grouting Option, since it has the potential to provide an immediate repair. In order to complete this repair, it will be necessary to fill the existing openings prior to grouting to prevent the grout from flowing up the hole. The repair should be made by drilling holes through the existing HDPE pipes to intersect the gap between the concrete and steel wall structure. Grout should be injected at low pressure through multiple ports set in the wall of the pipe. Confirmation of successful sealing will be evidenced by grout appearance through openings in the anular concrete and from upper injection ports during injection at lower ports. The grout is expected to migrate upward, so grouting should begin at the invert of the pipe working toward the top.

If drilling through the pipe wall fails to intersect the gap/contact between the concrete and steel, an alternative approach would be to drill through the steel, tap the holes and install injection ports. The holes would be sealed with a marine sealant after the injection ports are removed. Grouting would be performed in the same sequence as for drilling through the pipe wall.