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April 15, 2015

Mr. Timothy J. Kelly, P.E.
U.S. Army Corps of Engineers
Philadelphia District
Operations Project Manager
Philadelphia, PA 19072

Re: Letter of opinion

Dear Mr. Kelly:

At your request, I am writing this letter of opinion about the Pearce Creek Confined Disposal Facility in Maryland. After review of the Construction Plans and Specifications, I am of the opinion that this project is sound and ready for construction. This opinion is based on numerous e-mails, phone conversations and a site visit on March 12th, 2015. Photos of the site visit are as follows.

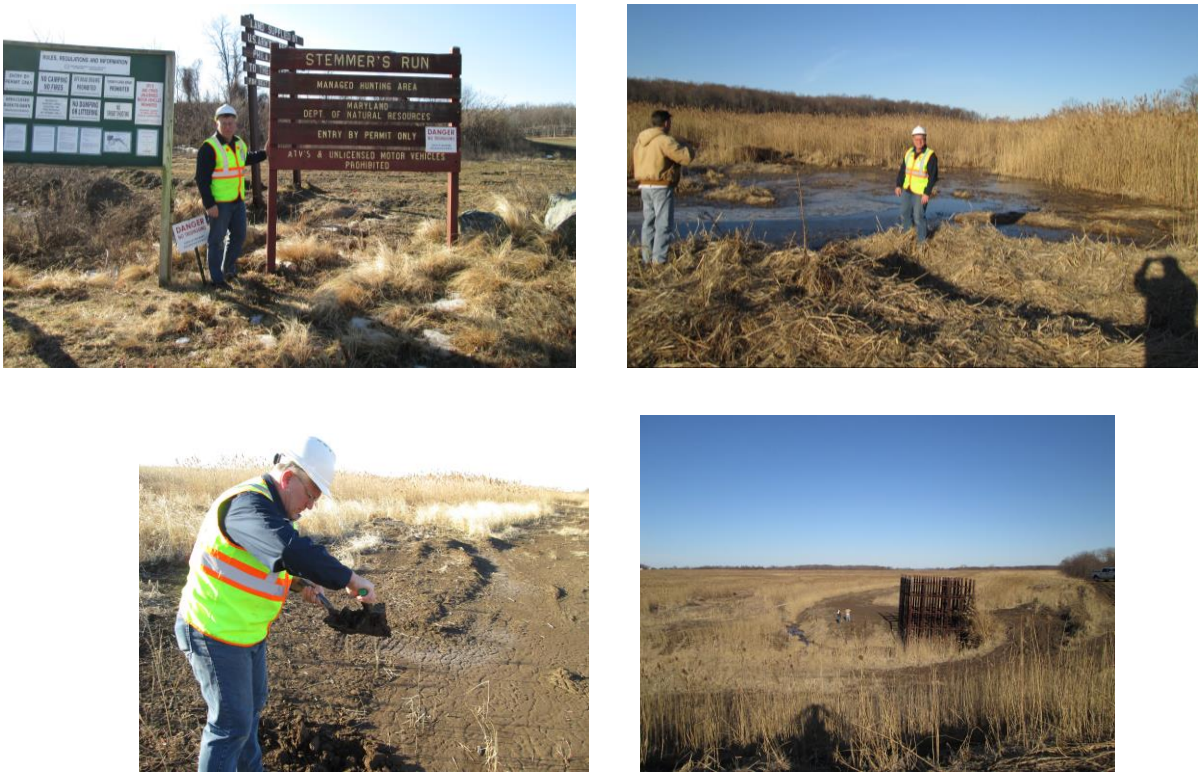


Figure 1. Pearce Creek Confined Disposal Facility Site Visit in Maryland

Let it be known that projects like this have been done in the past where liner systems have undergone total settlement of feet rather than inches. Four recent examples of such liner systems are as follows: The first is DSWA's Cherry Island Landfill just to the north of your project on the Delaware River. They used a different approach with wick drains and a reinforced geotextile mattress however they did undergo three feet of total settlement and still have action leakage rates under 20 gpad. Please understand that they are dealing with MSW instead of slurried dredge spoil. In addition, filling rates were quick relative to your project.

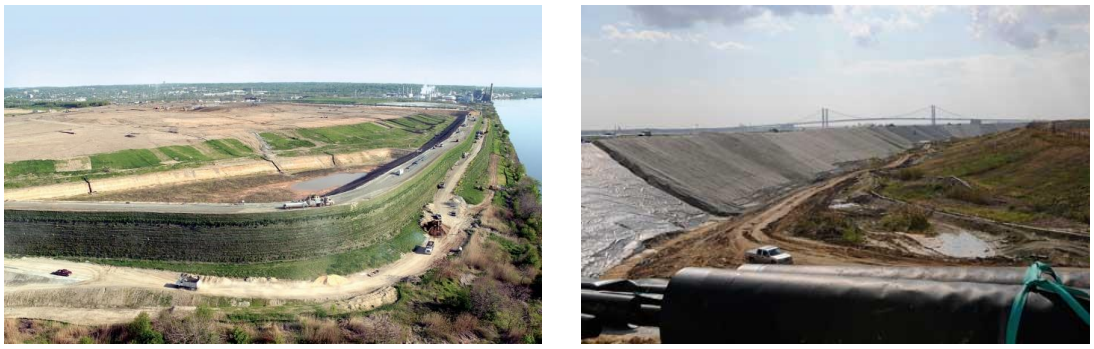


Figure 2. Site #1 Delaware Solid Waste Cherry Island Landfill Containment Wall

The second project is again on Cherry Island but it is the containment facility for DuPont's Edgemore Titanium Dioxide Sludge. The picture below shows a before and after construction photographs from approximately the same location on the western berm looking north. The LLDPE cover system had total settlement of greater than five feet in some locations and is still functioning well as of 2015.

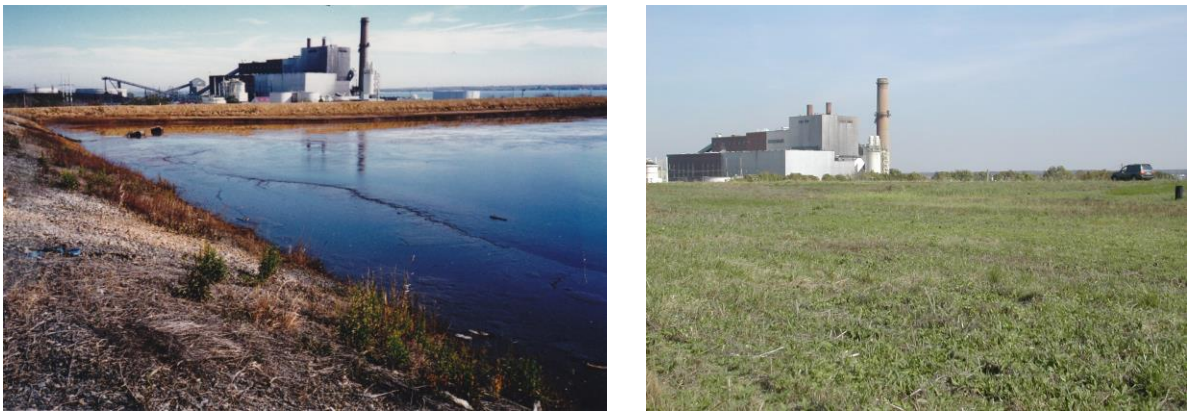


Figure 3. Site #2 DuPont Edgemore Titanius Dioxide Sludge Disposal Containment, i.e., Final Cover

The third site is one of the largest liner facilities constructed in the U.S.A. in 2012-2013. This 200 acre site was the John R. Doutt Upground Reservoir in Columbus Ohio. It is pictured below and has experienced 3 feet of settlement and is holding back a 20 foot head of water without issue.

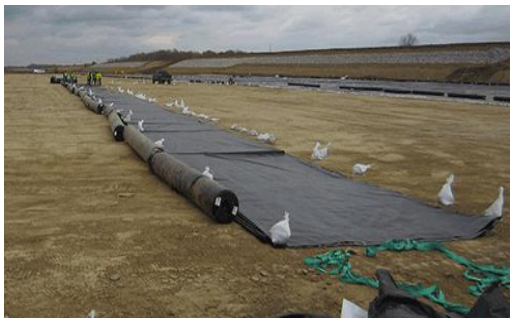



Figure 4. Site #3 John R. Doutt Upground Reservoir in Columbus, Ohio

The fourth site was completed in October of 2014 by the USACE ARMY Chicago District in Johns Mannville Waukegan, IL. It was a coal ash site that received a LLDPE liner. Placement of the soil over zero blow material was achieved by a long reach conveyor system as shown in Figure 5.


Figure 5. Site #4 USACE Chicago District John Mannville, Waukegan, IL Coal Ash Failure

There are also many examples of landfill cover systems that undergo considerable total settlement. For example, GROWS-TRRF landfills on the Delaware River next to Tullytown, PA regularly have total settlement of 15% and still function as designed. The big issue in our discussion should not be if the liner system can accommodate total settlement, it can, but rather how much differential settlement it can handle. I tried to construct a crude fence post diagram of the stratigraphy below the Pearce Creek Confined Disposal Facility. It appears to be uniform silts and sands and is relatively competent.

After initial review of the plans and specifications for the Pearce Creek Confined Disposal Facility for the US Army Corps of Engineers (USACOE), Philadelphia District, I only had minor suggestions. However after discussion with you and the DePasquale brothers and receipt of the letter from Jay Sakai of MDE, this is going to be a bit more complex. I will try to shed some light on Mr. Sakai's fifteen (15) comments in his letter dated January 28, 2015 below;

1. The first concern is the potential for horizontal movement ……

This is slope stability analysis both local and global. I assume you have done this for the entire Pearce Creek Confined Disposal Facility (PCCDF) and identified the critical dike cross-section. Particularly at the southern side of the facility where borrow material will be removed from the toe of the dike. Such analysis is beyond the scope of this opinion. However, the facility was active for five years (from 1988 to 1993) and did not have dike instability issues. In addition, there was no observed sign of slope instability at the site visit.

In regards to Mr. Sakai's reference to "Load Casting" comment, I assume he is worried about the possibility of liquefaction. It is envisioned that the USACOE will fill the PCCDF slowly and monitor the pore water pressure in the dikes so that this will not be an issue.

2. The Corps must demonstrate the ability to monitor……

   Your settlement plates are in the right places to monitor total settlement of the liner system. As discussed with Robert M. Koerner, Ph.D., P.E., we can help you with wire extensometers in several critical sections as needed to address the issue of differential settlement. They have been used in the past on several similar projects for the U.S. EPA risk reduction laboratory and others.

3. The Corps must provide a liner construction quality assurance and ……

   It appears MDE did not have the USACOE geomembrane specification for their review, as all standard liner QA/QC requirements are in the USACOE specification.

4. The Corps must provide a detail construction plan……

   It appears that MDE wants to manage liner placement. You might want to ask a liner contractor about such interactions. It could be problematic to give too much detail if the actual construction is radically different than the construction plan as a result of weather, earthwork, and material deliver delays, etc. However, the USACOE specification has a submittal requirement for a panel layout, so a Government furnished layout may not be necessary.

5. Part of implementing a QA/QC Plan involves the role of construction inspection…..

   It appears that MDE wants the Corps to hire an outside consultant (Golder, AECOM, CEC etc.) to implement the QA/QC plan. The project specification has qualification requirements to cover this concern.

6. The Corps must provide conceptual remedial plan should groundwater….

   This one could be of major consequences. The consolidation water expelled by filling the disposal facility could contain a number of different constituents as a result of its

proximity to the C & D canal (industry) and naturally decaying elements in the alluvial deposits underlying the liner system. We now have the ability to monitor groundwater beyond the ppm level and I am not sure that the background for the PCCDF can be adequately defined. I was impressed with the groundwater well array that I observed while on-site. However, I question which constituents will be monitored and how limits will be set for this concern.

7. The corps must reassess the liner based on a denser dredge material…

   The calculations provides by Richard DePasquale shared with us on March 11, 2015, show that a 40 mil LLDPE geomembrane is adequate for the PCCDF following guidance given in RMK's D w GS 6th Edition. This assumes puncture protection geotextiles are used top and bottom of the geomembrane.

8. The Corps will need to reassess the perimeter dike slope stability analysis….

   Mr. Sakai is correct in this concern but it is very conservative. The Corp can over-build the critical dike section with reinforcement and erosion control materials as necessary or slow down filling operations in the PCCDF. In addition, the dikes will be monitored with piezometers to satisfy this concern.

9. The Corps must provide an analysis of the liner integrity due to the effect of the liner's attachment to the sluice…..

   This is a major and valid point. The mechanical attachment of a geomembrane to a rigid body is difficult where significant settlement is anticipated. As discussed during the site visit, flexible connection should be considered for pipe penetrations, anchor trenches and connections to rigid structures like the sluice. Break-away connection like horizontal run outs instead of conventional anchor trench should be considered. In addition, accordion pleated pipe boots, with much slack, should be considered. Such connections are common designs in seismically active areas and are commercially available in standard sizes.

10. The August 18, 2014 letter from the Department to the Corps….

    As seen at the site visit as shown in Figure 7, large aggregate and shells were observed in the dredged material particularly by the inlet pipes. Puncture of the geomembrane is a very valid concern and this issue needs to be address during construction and operation of the PCCDF. However, please realize that precautions are being taken to protect the geomembrane puncture with geotextiles on both sides. In addition, the project specifications require that the subgrade will be prepared with protrusions no greater than 0.5 inch and soil particles no greater than 1.5 inch diameter next to the liner system. The initial filling operation over the liner system will also be control by prescreening the initial dredge lift to no particle greater than 1.5 inch diameter.

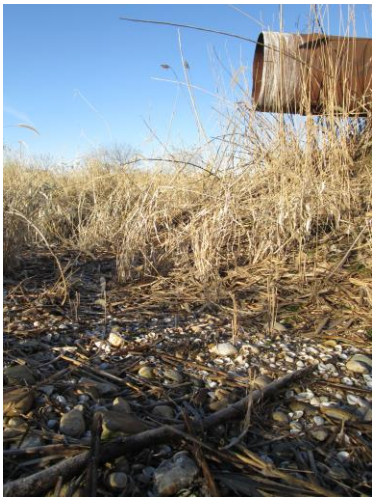



Figure 7. Examples of Site Soil and Shells at Project Site

11. The Corp's September 9, 2014 response letter #7 ….

    Subgrade preparation is thoroughly covered in the project specifications and does in fact require the use of a smooth drum roller as final preparation prior to geosynthetic placement. The foundation soil will be rough graded and then compacted with a sheep's foot roller. Just before geosynthetic placement a smooth steel drum roller will be used to proof roll the subgrade prior to geosynthetic placement so that a smooth surface can be obtained and good contact with the textile can be assured.

12. The Corp's September 9, 2014 letter #9 response ….

    Very similar to Item number 8 addressed above. It should be clearly stated that dike stability is beyond the scope of this opinion and it is certainly critical to the success of this project. In addition, some level of instrumentation of critical dike sections are anticipated and are commonplace for projects of this size and scope. It should also be stated that he factor of safety for dike stability will be significantly helped by gradual filling of the PCCDF.

13. The Ground water Monitoring plan contained several deficiencies…….

    It appears that the MDE is treating the PPCDDF as a landfill. The points raised in this concern are beyond my expertise. However, with the ability to monitor groundwater beyond the ppm level and background characterization of the groundwater near the PCCDF illusive, this concern will be difficult to close without compromise between the stakeholders.

14. The Corps must submit a well abandonment narrative……

I am assuming that all 243 homes receiving public water have a well and that each needs to be closed. This is in addition to the monitoring well array which will not be abandoned. Typically the process is as follows

STEP 1: Pumps, drop-pipes, pump rods, packers, wire, check valves, and all other debris or obstructions must be removed from the well. Registered well drilling contractors have the knowledge and proper equipment to perform this very important task.

STEP 2: The well depth and diameter must be measured in order to calculate the necessary amount of plugging material. Also, different well types (i.e. dug, drilled, driven) that terminate in different geologic formations (i.e. rock, drift) require different types of plugging material and different plugging methods**.** The water well record has this information.

STEP 3: The well is plugged by a registered well drilling contractor.

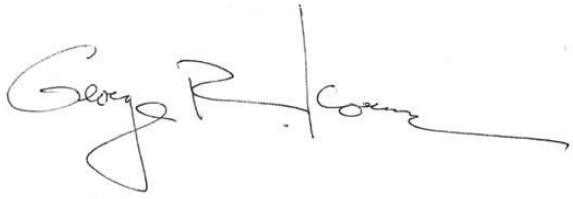
STEP 4: An Abandoned Well Plugging Record is completed and submitted to the local health department, the well owner, and to MDE within 60 days upon completion of the well plugging project.

15. The Corps must acknowledge in writing that any change to the drawings….

I am very sure that the Corps and MDE will be communicating regularly prior to and during construction of this project. If the Institute can be of assistance in moving this important project forward we will be glad to help.

If you have any questions or need further information, please do not hesitate to call me at either home (610) 667-4271 or work (610) 522-8440.

Respectfully,



George R. Koerner, Ph.D., P.E. & CQA
Director