ATTACHMENT E

**Department Memorandum, Juniper Ridge Landfill,
Landfill Liner Protective Systems,
November 8, 2010**

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MEMORANDUM

To: Cynthia W. Darling; Project Manager – Eastern Maine Regional Office

From: Amanda S. Wade, P.E.; Environmental Engineer – Technical Services (ASW)

Date: November 8, 2010

Subject: Juniper Ridge Landfill
Landfill Liner Protective Systems

On November 2, 2010, in response to the appeal filed jointly by PERC and MRC of DEP license #S-020711-WD-W-M, you asked us to provide you with the background information used by the Department's Technical Services Engineering Unit to evaluate the appropriateness of a material as part of a landfill liner protective system. As you are aware, Chapter 401.2.D.(4)(a)(vii), 401.2.D.(6) and 401.4.C.(12)(a) of the solid waste rules requires that a protective system be provided for the primary liner and leachate collection system for every new landfill cell constructed. A landfill liner system must include at least a composite liner consisting of a geomembrane and a barrier soil layer. The leachate collection system for a landfill is typically some combination of sand, stone, piping and geocomposite drainage material. The protective system is a layer of material placed on top of the leachate collection system to cover the entire footprint of a cell and is typically approximately 5 feet deep. The goal of this system is to protect the liner and leachate collection systems from damage due to freeze/thaw effects, erosion and puncture. Protective systems may consist of tire chips, soils, bark mulch or select waste as long as the waste is permitted for disposal at the landfill. Select waste is a component of a facility's waste stream that will meet the goals of the protective system outlined above.

Our discussion below relates to the suitability of select wastes for use as protective systems and provides the basis for our earlier recommendation that municipal solid waste (MSW) be used at the Juniper Ridge Landfill (JRL) for this purpose. For reference, MSW is also a large component of the protective systems placed at Waste Management's Crossroads Landfill in Norridgewock, the City of Bath Landfill, Tri-Community Landfill, the Presque Isle Landfill, and Hatch Hill Landfill in Augusta where they are licensed to accept MSW.

One of the benefits of using a select waste in place of a non-waste material as a component of the protective system is that it allows a facility to manage landfill capacity. For each acre of a new landfill cell, where 5 feet of a protective system is placed, assuming no consolidation factors due to compaction, 8,067 cubic yards of capacity is used. For JRL the typical, yearly constructed, landfill cell is approximately 6 acres in size. If a select waste were not chosen for this facility, this would amount to approximately 48,400 cubic yards of landfill capacity consumed by a non-waste material.

Based on the goals for this system, there are some wastes that are not appropriate for use due to a high risk for puncture of the geomembrane liner. These wastes include construction and demolition debris and oversized bulky waste. There is an obvious risk of damage to the liner system if a large piece of wood, or metal, were to be placed and compacted with the heavy equipment involved in landfill operations within 5 feet of the geomembrane.

Besides the risk for physical damage to a liner system there are other factors that are evaluated in determining waste suitability including, but not limited to; thermal properties, hydraulic conductivity, potential for providing erosion control, potential for blinding or clogging, potential to cause operational issues such as dust and odor, and the potential to impact gas generation. We have presented more detail on these properties below as well as some of the issues we have seen from using different select wastes at landfills throughout the state.

Thermal Properties

The material property that is often investigated first when choosing a select waste is its insulating value. In most cases, new landfill cells are constructed just prior to a facility needing additional capacity and may sit unused for a few months. The construction season for landfill liner systems is usually limited to warmer weather when proper soil compaction and geomembrane seaming can be most readily achieved. In Maine, that means that most of the construction is done in the summer and early fall. Once a cell is completed, if a facility is not ready to immediately utilize the capacity, there is a risk that damage to the compacted soil components of the liner system can occur due to freezing and thawing. This leaves the facility a limited amount of time to obtain enough material to protect the liner system from freezing. One of the characteristics of a material that impacts its insulating value, and determines how much of the material is needed, is the organic content. When using a material with little or no organic content such as soil a facility may need to place a 5 foot layer to achieve the same insulating value as placing a 1 foot layer of a highly organic material like bark mulch.

Hydraulic Conductivity

Since the protective layer is placed continuously across the cell bottom and will be sitting directly on top of the leachate collection system it is important that water can flow as freely as possible through any select waste chosen. For this reason facilities must find a waste material from their approved waste stream with a high hydraulic conductivity while still being cognizant of the risk for puncture. It is also important, since the protective layer is permanent, that the hydraulic conductivity of the select waste be sustainable and not easily impacted by compaction or waste decomposition over time.

Some of the wastes we have seen used in the past that have caused drainage issues include paper mill and waste water treatment plant sludges and some ashes. We have seen instability issues at some of the paper mill landfills in the state, where the majority of the wastes are sludge and ash, which were caused by the build up of water pressures within the waste due to an inability of the leachate to drain into the leachate collection system. This has led to slope failures and leachate breakouts that resulted in releases to the environment.

Erosion Control

Many landfill cell liner systems incorporate a slope in the design. When this occurs it is especially important to consider erosion control when choosing a select waste. Because sideslopes are often one of the last sections of the cell to be covered with waste it is often the case that this portion of the liner and leachate collection system remain unused for more than a year. For this reason select wastes with soil-like properties, such as contaminated soil and ash, which can be easily eroded during rain events should not be chosen.

Blinding or Clogging

When considering a select waste it is also important to question whether there is a potential for the waste to cause blinding or clogging of the leachate collection system. Blinding can occur when a thin layer of fine material settles on top of the leachate collection drainage media blocking the voids that would allow for drainage of leachate. Clogging can occur when fines enter the drainage media and fill the internal voids throughout the depth of the media. Clogging can also be caused by chemical and/or biological reactions.

The wastes we have seen that have been responsible for some of the most significant issues with blinding and clogging are ash and front end process residues (FEPR). Though it may not seem evident that ash and/or FEPR could cause issues, we have seen that ash, when placed as part of the protective layer, can

become solidified on top of the leachate collection system preventing leachate from draining down through it. FEPR, when placed as the protective layer, quickly decomposes and can form a uniform restrictive layer that blinds the leachate collection system. Both of these wastes also contain fines that can cause clogging of the leachate collection system. We have observed both of these conditions at the Pine Tree Landfill (PTL) in Hampden where the leachate collection sumps for Phases VI (where ash and FEPR were used together as a protective layer) and VIII-C (where FEPR alone was used as a protective layer) had to be excavated and repaired because leachate was not draining properly.

Operational Concerns

Another important property we consider in our evaluation is whether there are operational concerns from stockpiling or using wastes as a select lift. Will the material create dust or odors, for example? As I have stated above, for a facility like JRL it is typical to require as much as 48,400 cubic yards of select waste material for use in a very short period of time. This would require the facility to stockpile some wastes for months to ensure that they were prepared when the time arrived for placement.

We have seen at PTL and JRL that wastes like FEPR are odorous and both facilities have received odor complaints due to FEPR placement in the past. Department staff have also observed the placement of FEPR at PTL after it had been stockpiled for select lift placement and note that there were significant odors from this practice. We have also seen that ash can create a dust issue at a facility if it is allowed to dry out in the sun and wind and is not covered regularly.

Effects on Gas Production

While direct odors from the waste are a concern to the facility so are the odors that may be caused due to gas production. With this in mind, the facility has to look at the potential impacts a waste stream may have on their gas production and whether they can have effective gas extraction in place early enough to limit offsite impacts.

We have seen at the Bath Landfill, for example, that using materials like construction and demolition debris fines in a thick layer directly on the leachate collection system can increase hydrogen sulfide production and cause significant odors and potential health issues for surrounding neighbors.

JRL Liner System and Waste Streams

At JRL a new cell is constructed annually. The cell is, on average, 6 acres in size and its liner system, in accordance with the facility license, is comprised of a sand and pipe underdrain system, 2 feet of compacted clay, a geosynthetic clay liner, and an 80 mil textured high density polyethylene geomembrane. The leachate collection system is comprised of a geocomposite drainage layer and 1 foot of sand with piping surrounded by stone. These systems need to be protected from freeze/thaw effects, erosion, and puncture, in accordance with the rules, in order to maintain their integrity.

JRL is licensed to accept a variety of wastes for disposal. Based on their 2009 annual report, their waste stream included 24.8% ash, 19.7% construction and demolition debris, 16% FEPR, 13.3% sludge, 9.7% oversized bulky wastes, 8.8% wood fines, and 4.1% municipal solid waste (MSW) bypass. The remainder of components of their waste stream was less than 1% each. When these wastes are blended together and placed in accordance with the facility's operations manual they form a very stable waste mass. However, based on the information presented above, each of the components, except for the MSW bypass, when utilized as part of the protective layer can be problematic for the facility.

Summary

Taking all of the above information into consideration, the select waste we see used most frequently at commercial and municipal landfills in Maine, where a variety of wastes are accepted for disposal, as the largest constituent of the protective layer is municipal solid waste (MSW). Experience has shown that MSW has the appropriate characteristics to support its use in the protection of the liner and leachate collection system. For these reasons we recommended its use as a select waste at JRL.

Please feel free to contact me with any questions or comments.

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