Leachate Management Plan

LEACHATE MANAGEMENT PLAN

Chesapeake Energy Center Ash Landfill – Permit #440

Dominion

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May 2014
Revised December 2015

130-0193

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1.0 GENERAL

This Leachate Management Plan for the Chesapeake Energy Center (CEC) Ash Landfill (Facility) has been prepared in accordance with Submission Instruction No. 7 (V. 01/2012). Leachate generation estimates were made using the Hydrologic Evaluation of Landfill Performance (HELP) model, version 3.07, as developed by the United States Environmental Protection Agency (USEPA). The major design change is to add a perimeter leachate collection system to the existing facility as part of the closure construction to collect existing seepage at the landfill's toe of slope.

1.1 Facility Description

The Facility is an existing ash landfill built on top of a former ash disposal pond. The site was developed as a landfill starting in 1985 with the reclamation of approximately 23 acres of the ash pond as lined landfill area. To construct the landfill on top of the solidified ash pond, a soil berm approximately 6 to 10 feet high was built to serve as the landfill containment structure and a 20-mil High Density Polyethylene (HDPE) geomembrane bottom liner was installed. No drainage layer or leachate collection system is known to have been installed. Maximum landfill exterior sideslopes of 6H:1V and a top elevation of 51 feet were specified.

A 1993 solid waste permit amendment increased the maximum top elevation to 89 feet and the 6:1 exterior sideslopes were retained. The facility is currently active, with approximately 5.5 acres of active disposal area and the remaining 17+/- acres under intermediate cover consisting of 12 inches of soil with vegetative cover. Seepage from the landfill currently flows through the ash fill and soil at the perimeter toe of slope and enters the perimeter stormwater channel system. The seepage comingles with stormwater and flows to the facility's sedimentation basin, where it is discharged through Outfall 002 into Deep Creek. Outfall 002 is permitted under Virginia Pollutant Discharge Elimination System (VPDES) Permit # VA0004081.

2.0 LEACHATE ESTIMATE

2.1 Leachate Quantity

To estimate the quantity of leachate generated by the Facility, the HELP model was used to simulate various operational stages of the landfill (open, intermediate cover, closed) over time. Details of the modeling and results are included in the attached calculations package titled "HELP Modeling" dated August 28, 2013. The quantity of leachate was calculated as a monthly average for the facility, and as an annual total under the anticipated near-closure and post-closure conditions.

The largest amount of leachate collected is anticipated to occur during the first year after installation of the perimeter leachate collection pipe and the flow rate will decrease over time as the ash mass drains. The closure cap geomembrane system will isolate the landfill mass from future precipitation; therefore, the leachate production rate will decrease over time and not be influenced by precipitation events post-closure. Table 1 displays the HELP modeled post-closure leachate generation volumes for the facility.

Table 1: CEC Landfill Post-Closure Leachate Volumes, Gallons (HELP Model)

Time Period	Year 1	Year 5	Year 10	Year 15	Year 20
Monthly Average	513,073	147,156	57,491	33,577	23,036
Annual	6,156,878	1,765,873	689,951	402,865	276,429

In observed practice, the HELP model tends to overestimate the volume and production rate of leachate produced in a landfill, and it will predict active leachate flow beyond 30 years post-closure. As a complementary method, Golder evaluated leachate flows using three additional models to predict an end state for leachate production at the landfill. Use of these models does not affect the design of the leachate collection system piping or pumps, it was used to predict a timeframe when leachate production may end following closure capping of the landfill. Details of the modeling are included in the attached calculations package titled "Leachate Flow Modeling" dated January 28, 2014. Table 2 displays the predicted "zero flow" points for each model.

Table 2: CEC Landfill Post-Closure Leachate "Zero Flow" Points

Model	Hooghougt	Darcy	Hydrus
Time, yrs	6.8	5.2	~6

2.2 Leachate Quality

The quality of leachate from the ash landfill facility is expected to be similar of that from other Dominion ash landfills. In general, the leachate from an ash landfill is nonhazardous, inorganic, and may contain dissolved metals such as calcium, magnesium, potassium and sodium. The pH of the leachate can vary from acidic (~ 4) to basic (~ 8.5). Ash landfill leachate typically does not have a noticeable odor and is generally colorless.

3.0 LEACHATE COLLECTION SYSTEM

3.1 Drainage System Design

As the existing facility does not have a drainage layer nor a collection system, a perimeter collection pipe will be installed within the lined perimeter of the facility to collect seepage from the landfill (Figure 1). The drainage system proposed is a six-inch diameter perforated HDPE pipe and geotextile-wrapped gravel drain installed on the interior of the ash fill perimeter berm. Installation of a leachate collection layer at the bottom of the liner system would be very difficult to construct due to the saturation of the ash in the landfill and the volume of ash that would have to be removed and dewatered to install such a system. The intent of this drainage system is to intercept the leachate at the perimeter and draw the leachate level down such that it enters the defined pipe system and does not seep out of the perimeter toe after closure.

The perforated collection pipes will consist of a 'high to low' configuration within the perimeter of the landfill, with 300 to 400 feet between high and low points. The perforated pipe will be installed at a minimum slope of 0.3%. At each low point, the pipe will transition to solid-wall pipe and then be booted through the bottom liner system and connect with solid conveyance pipe on the outside of the landfill boundary. The bottom liner will be repaired to restore containment integrity after the solid pipe penetration is installed. Six liner penetrations and repair locations are proposed.

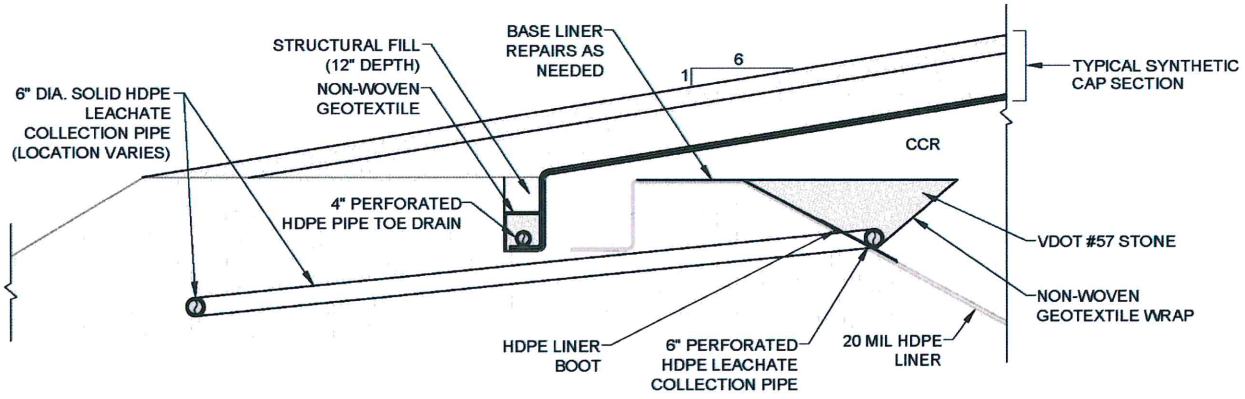

Figure 1 - Leachate Collection Pipe at Landfill Perimeter

3.1.1 Bearing Capacity of the Gravel Drainage System

The VDOT #57 stone envelope surrounding the 6" perforated pipe will be located at the toe of the landfill and will have approximately 2 to 3 feet of cover material placed on top of it (soil and/or CCR). The gravel has adequate strength to support the cap system.

3.1.2 Geotextile Wrap

The VDOT #57 stone in the gravel drainage system will be wrapped with a nonwoven geotextile to provide separation and filtration capacity and prevent the ash from migrating into the gravel and the

collection pipe. The geotextile shall have an Apparent Opening Size (AOS) of US Sieve #100 or smaller. A calculation package is attached for the sizing of the geotextile.

3.1.3 Pipe Protection Design

The leachate collection pipe is proposed as a 6" diameter SDR-17 HDPE pipe. The pipe is to be surrounded in a gravel "burrito wrap" where the pipe is surrounded in VDOT #57 stone, which is wrapped with a nonwoven geotextile to prevent ash intrusion. The pipe perforations are 1/2", which is approximately the d_{50} gradation point for #57 stone, and therefore stone entry into the pipe is not a concern (see "Leachate Pipe Capacity" calculation package). The nonwoven geotextile of the burrito wrap shall have an AOS of at least US Sieve #100.

3.2 Leachate Collection Pipe

3.2.1 Pipe Capacity

Based on the peak daily flow rate from the HELP model, 19.8 gallons per minute (GPM) for the facility as a whole, a design peak flow of 59.4 GPM (3x model) was selected for design basis purposes. This flow was distributed according to contributing drainage pipe areas for calculation purposes. The 6" SDR-17 HPDE perforated pipe proposed has sufficient capacity to carry this flow. (See "Leachate Pipe Capacity" calculation package). Due to the lack of topographic relief at the existing site, the collection pipe will be installed in segments ranging from 300 to 400 feet long and with a minimum slope of 0.3%. The expected flow velocity in the perforated pipe will be as low as 0.94 ft/sec. Cleanouts will be installed at intervals around the perimeter of the closed landfill to facilitate pipe cleaning at predetermined intervals or when a decrease in flow is suspected.

The proposed perforation design has one row of 1/2" diameter holes per foot around the circumference of the pipe. This results in 4 perforations per linear foot of pipe and an approximate factor of safety of 228 for flow into the pipe through the perforations. Calculations are included in the "Leachate Pipe Capacity" calculations package.

3.2.2 Pipe Strength

Due to the relatively shallow burial depth (3 to 5 feet) and the construction of a stone envelope around the pipe, the 6" SDR-17 HDPE pipe is well within the manufacturer's recommended installation guidelines. No further analysis of the pipe strength was conducted.

4.0 LCS DESIGN STANDARD

The leachate collection system is designed to provide a drawdown of the leachate level in the landfill to a point at least one foot below the outer containment berm, as well as provide fixed collection points for the captured leachate.

5.0 LEACHATE REMOVAL SYSTEM

The leachate removal system is designed to collect the leachate at six points around the landfill and then flow by gravity to two points around the landfill. On the northeast corner of the landfill, an epoxy-lined concrete manhole sump will receive leachate from the west and north sides of the landfill. Leachate from the east and south sides will flow by gravity to an HDPE collection manhole near the low volume waste pond on the west side of the landfill. From the northeastern concrete sump, the leachate will be pumped into the gravity pipe leading to the HDPE collection manhole. From the collection manhole, leachate will flow into the low volume waste pond. A valve on the discharge side of the manhole will provide for emergency shutoff of the leachate flow if needed.

6.0 COLLECTION AND STORAGE UNITS

The leachate discharge pipe will discharge into an existing lined pond at the landfill called the "Low Volume Waste Pond." The pond is lined with a geomembrane liner that is topped with a protective fabric-formed concrete layer. This pond currently receives pumped flow from the Station's VPDES sumps and other sources. It is connected by an 18-inch gravity discharge pipe to the existing stormwater pond. Following Station decommissioning, flows from the station will cease.

The existing stormwater pond is an unlined pond formed by earthen embankments. It will be modified during the landfill closure construction project to add a 60-mil HDPE bottom liner system. After modification, the pond will be approximately 5.3 acres in plan area and have an approximate volume of 9.45 million gallons (29.3 Acre-feet) at the discharge riser crest (elevation 13.5). The finished pond bottom and top elevations are 12.5 and 19, respectively, giving a depth of 6.5 feet.

7.0 LEACHATE TREATMENT OR DISPOSAL

The collected leachate flows from the low volume waste pond into the stormwater pond where it mixes with the existing pond water volume and stormwater flows from the landfill. The large pond volume and long residence time serve as passive treatment prior to discharge through the pond's permitted outfall. This outfall (#002) is monitored under the Station's VPDES Permit # VA0004081.

8.0 LEACHATE RECIRCULATION

Leachate recirculation is not proposed at this landfill.

CALCULATIONS

Enclosure 3