Technical Memorandum

Date: September 26, 2025

To: Jeremy Kazio, Manager
Land Protection and PREP Programs
Piedmont Regional Office
Virginia Department of Environmental Quality

From: David Garrett, PE, Senior Project Manager

Project: 562325.0002

Subject: Variance Request - Green Ridge Recycling and Disposal Facility - Part B Permit Application – SWP 626

Statement of Purpose

This document is a variance request to 9VAC20-81-130.J.1.a. (c) regarding the minimum 2 percent slope requirement for leachate drainage. In support of the Green Ridge Recycling and Disposal Facility Part B landfill design, this variance request is to allow a 1 percent slope along the leachate collection trench/pipes. This document has been prepared in accordance with the requirements of 9VAC20-81-720 & 760. Within this document is key information to support the Applicant's position that the proposed design will provide adequate drainage for leachate removal throughout the life of the landfill, and in accordance with 9VAC20-81-720, *Variances to permitting requirements*, this variance request demonstrates that:

1. a. Strict application of the regulation to the facility will result in undue hardship that is caused by the applicant's particular situation.

   b. The alternate design or operation will result in a facility that is equally protective of human health and the environment as that provided for in the regulations; or

   c. Technical conditions exist that make a strict application of the regulation difficult to achieve; and
2. Granting the variance will not result in an unreasonable risk to public health or the environment.

Submission of Application - 9VAC20-81-760

a. Applicant's name and address:

Green Ridge Recycling and Disposal Facility, LLC
12230 Deer Grove Road
Midlothian, VA 32112

Responsible party:

Mr. Jerry Cifor, President and CEO
Jerry.cifor@myfairpoint.net
802-379-1575

b. A statement of applicant's interest in the proposed action.

The Applicant seeks to develop a lined Subtitle-D municipal solid waste landfill on a parcel of undeveloped land in eastern Cumberland County, Virgina. The proposed facility layout, shown in **Figure 1**, the footprint of the landfill is situated on the high ground of a broad, nominally north-south oriented ridge, which is dissected by numerous small drainage features oriented to the northeast and northwest. The design incorporates a perimeter embankment to contain an access road and appurtenances. The layout is constrained laterally by the drainage features and vertically by the groundwater and bedrock surfaces identified in the site investigations. The optimum geometry consists of 5 phases incorporating a common "herringbone" drainage configuration, with base grades leading to leachate collection trenches sloped at 2 percent (minimum). The leachate collection trenches lead to multiple sumps situated along the perimeter. Within Phases 1through 3, the leachate collection trenches were given a 1 percent slope, needed to maximize the landfill capacity given the site constraints; 2 percent grades in Phases 1 through 3 would result in a more complicated drainage pattern with more sumps and less access to the leachate pipes from the perimeter; elsewhere the leachate collection trenches meet or exceed the 2 percent requirement.

c. A description of the desired action and a citation to the regulation from which a variance is requested.

The Applicant requests a variance to 9VAC20-81-130. J. 1. a. (c) regarding the minimum 2 percent slope requirement for leachate drainage. This variance request is to allow a 1 percent slope along the leachate collection trench/pipes in Phases 1 through 3.

d. A description of the need and justification for the proposed action.

This variance is needed to maximize capacity within the given footprint considering the site constraints and to provide drainage patterns that facilitate leachate pipe access for cleaning with shorter runs of pipe, and to minimize the number of sumps required in Phases 1 through 3. The use of 2% slopes on the leachate collection trenches in these phases would require a branched pipe pattern that is less accessible for cleaning than the straight pipe runs afforded by 1 percent slopes. The use of 2 percent slopes in these phases would require more sumps, with more pumping equipment and higher maintenance requirements.

The variance is justified by the need for additional landfill capacity statewide. A demonstration of need was presented in the Part A Permit Application (conditionally approved by DEQ) that showed that the need for additional capacity is critical, therefore, maximizing the available capacity to be built is also critical. Given the timeframe for permitting new facilities, this landfill is on track to fulfill a critical near-future disposal need in the Commonwealth of Virginia.

The variance is also justified in that other states have adopted rules allowing leachate collection slopes that vary from 0.5 percent to 1 percent as well as rules that do not specify a minimum slope and stipulate performance-based criteria. Said criteria includes adequate flow capacity, which is demonstrated by calculations presented in the Part B application currently under review by Virginia DEQ, and supplemental information presented with this document. **Attachment 1** presents calculations concerning the capacity for 6-inch HDPE collection pipe to drain the worst-case volume of leachate and the velocity of the flow in the pipe for self-cleaning. **Attachment 2** presents a summary discussion of settlement calculations that show the facility will not experience a loss of drainage grade over its operational life. These calculations demonstrate that the proposed 1 percent leachate collection trench slopes in Phases 1 through 3 will be equally protective of human health and the environment as would these features constructed at 2 percent slopes.

e. The duration of the variance, if applicable.

   The duration of the variance will be the life of the landfill, including 25-30 years of operation and 30 years (minimum) of post-closure stages. The life of this facility is calculated at 50 – 60 years.

f. The potential impact of the variance on public health or the environment.

   The Applicant has demonstrated through calculations (provided in this document) that the LCS will function normally and in accordance with the Virginia Solid Waste Management Regulations (9VAC20-81-130) with 1 percent collector pipe slopes. There is no impact to public health or the environment with this variance.

g. Other information believed by the applicant to be pertinent; and

   The Applicant notes that, while a few states (including Virginia) adhere to the original US EPA guideline for a minimum 2 percent bottom slope on liner systems, at least 16 others have adopted rules that establish minimum slopes for leachate collection system piping (a refinement of the US EPA guideline) varying from 0.5 percent to 1 percent, including several that do not specify a minimum slope but require performance-based compliance for leachate flow and head on the liner. The LCS in landfills designed and constructed under such criteria have performed as well as those designed with a 2 percent slope.

h. The following statements signed by the applicant or his authorized representative:

"*I certify that I have personally examined and am familiar with the information submitted in this application and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment*."

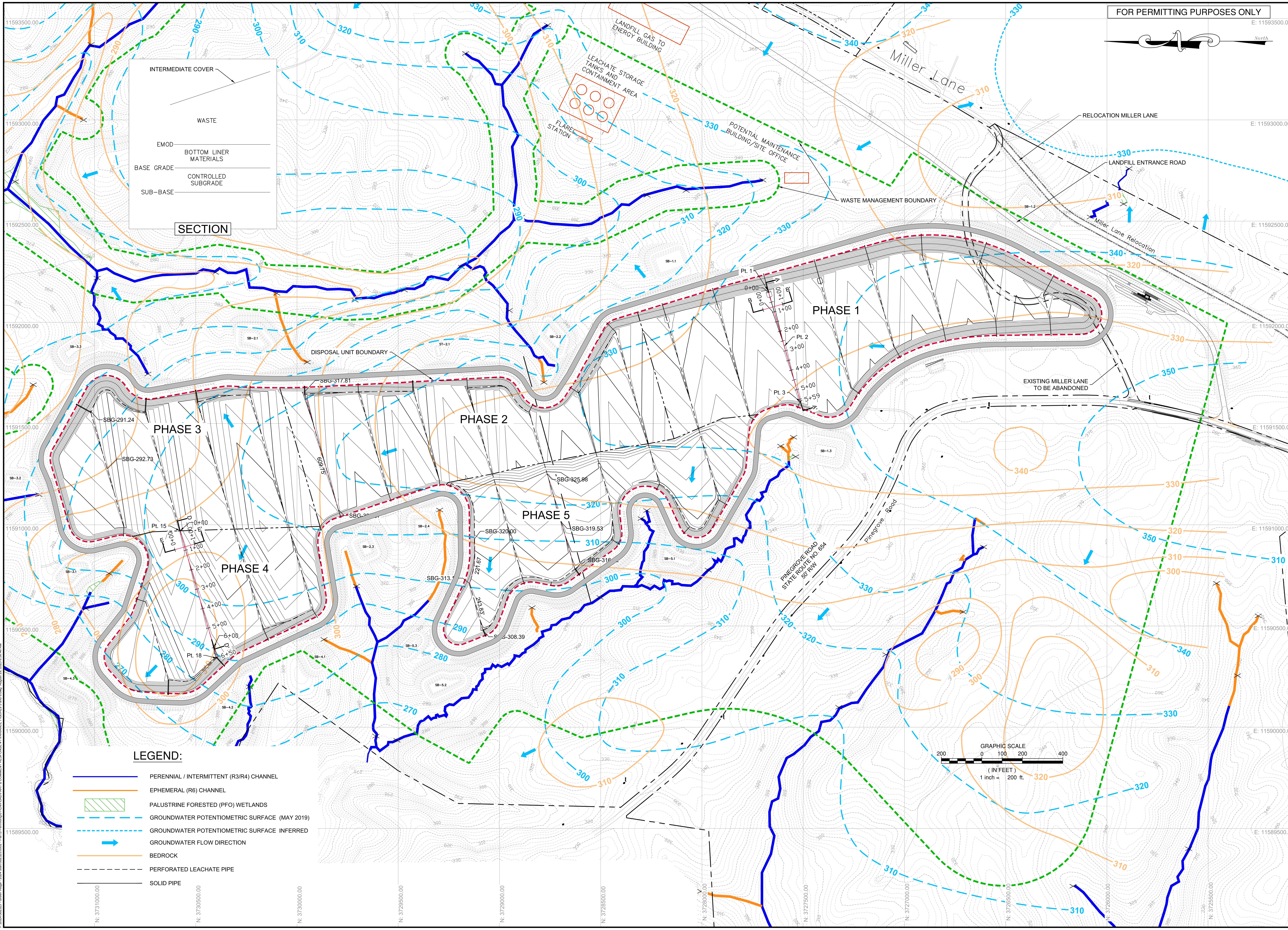
Signed____________________________

Dated September 26, 2025

COMMONWEALTH OF VIRGINIA
David Garrett
Lic. No. 69487
PROFESSIONAL ENGINEER

Attachments: Figure 1 – Overall EMOD Grade and Top of Bedrock/Potentiometric Surface
Attachment 1 – Capacity Calculations
Attachment 2 – Settlement Calculations

FOR PERMITTING PURPOSES ONLY



OVERALL EMOD GRADE AND TOP OF BEDROCK / POTENTIOMETRIC SURFACE

PART B PERMIT APPLICATION - VARIANCE REQUEST
GREEN RIDGE RECYCLING AND DISPOSAL FACILITY

CUMBERLAND COUNTY, VIRGINIA

TRC ENGINEERS, INC.

1030 Wilmer Avenue, Suite 100
Richmond, VA 23227
804-264-2228 Fax: 804-264-8773
www.trccompanies.com

REVISIONS

DESIGNED BY:	-
DRAWN BY:	JR
CHECKED BY:	-
SCALE:	1" = 200'
DATE:	AUGUST 2025
PROJECT NUMBER:	562325.0002.0000

FIGURE 1

Attachment 1
Capacity Calculations

999 Fourier Dr., Suite 101 (53717) Madison, WI 608.826.3600

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Green Ridge Landfill	M. Amstadt	8/25/2025	N. Slater	8/26/2025	562325.0002.0000

LEACHATE TRENCH CAPACITY CALCULATION

Purpose:

The purpose of this calculation is to verify that the proposed pipe within the trench has sufficient capacity to drain the worst-case volume of liquid that is anticipated to enter any of the proposed Phases assuming a 1 percent slope.

Methodology:

The Manning's Formula [Q=(1.49/n)*A*R^(2/3)*S^(1/2)], was used to calculate the flow (Q) of the liquid capable of being transported by the proposed 6-inch diameter pipe in cubic feet per second (CFS). "n" represents Manning's Roughness Coefficient, or the friction applied to the flow by the pipe. The "n" value in Manning's Formula is approximately 0.009 for polyethylene (PE) pipe (Lindeburg 1992). "A" represents the flow area in square feet, "R" represents the hydraulic radius of the pipe in feet, and "S" represents the pipe slope in feet over feet.

To determine the flow velocity in the pipe the following equation was used:

$$\mathrm{V}=\mathrm{Q}/\mathrm{A}$$

Q = flow rate in the pipe
A = Area of the pipe

To determine the flow into a single orifice the following equation was used:

$$Q=Cd*A*\sqrt{2}gh$$

Q = flow rate for a single orifice
Cd = Coefficient of discharge
A = Area of the orifice
G = Gravity (32.2 ft/sec^2)
h = hydraulic head

Assumptions:

The following assumptions were used to perform the calculation:

- The pipe will be a 6-inch diameter polyethylene pipe
- The pipe orifice diameter is 0.5 inches
- The slope of the pipe will be 1 percent

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Green Ridge Landfill	M. Amstadt	8/25/2025	N. Slater	8/26/2025	562325.0002.0000

- The coefficient of discharge is 0.6 for a sharp-edged orifice
- The hydraulic head is 1 foot
- The maximum volume of liquid that will need to be handled by the pipe is equivalent to the maximum worst-case scenario of leachate generation (10,714 gallons per day), as determined by the Hydrologic Evaluation of Landfill Performance (HELP) model

Findings and Conclusions:

Based on the attached calculations the proposed 6-inch diameter pipe is capable of transporting approximately 0.813 CFS (525,420 gallons per day) at a 1 percent slope, which is more than adequate for its intended use. The velocity is approximately 4.14 ft/sec, which is greater than the recommended 2 ft/sec.

The calculations indicate that each orifice is capable of allowing 0.0066 CFS to enter the pipe, thus with four orifices per foot, the pipe perforations are sufficient to allow flow into the pipe.

References:

Lindeburg, M. 1992. Civil Engineering Reference Manual for the PE Exam. Professional Publications Inc.

Calculations

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PROJECT / PROPOSAL NAME: Green Ridge Landfill		
SUBJECT: Green Ridge Landfill Leachate Trench Piping Sizing		
PREPARED/UPDATED BY: N. Slater	DATE: 8/21/2025	PROJECT / PROPOSAL NO.
CHECKED BY: M. Amstadt	DATE: 8/21/2025	562325.0002.0000

LEACHATE COLLECTION PIPE SIZING CALCULATIONS

WORST CASE LEACHATE GENERATION:

Open Conditions: 10,714 gallons/day = 7.4 gallons/min

CONVERSION TO FLOW RATE IN CFS:

10,714 gal/day 0.017 cfs

MANNING'S EQUATION

Q=(1.49/n)*A*R^(2/3)*S^(1/2)

Q=Flow Rate, cfs
n=Manning's Roughness Coefficient
A=Flow Area, sf
R=Hydraulic Radius, ft
S=Pipe Slope, ft/ft

UNCONFINED FLOW RATE IN A FULL 6" DIAMETER HDPE PIPE AT 1% SLOPE USING MANNING'S EQUATION

A = 0.20 sf
R = 0.125 ft
S = 0.01 ft/ft
n = 0.009

Q = 0.813 cfs

0.813 cfs > 0.017 cfs
Pipe size is adequate at 1% slope

UNCONFINED FLOW RATE IN A FULL 6" DIAMETER HDPE PIPE AT 2% SLOPE USING MANNING'S EQUATION

A = 0.20 sf
R = 0.125 ft
S = 0.02 ft/ft
n = 0.009

Q = 1.149 cfs

1.149 cfs > 0.017 cfs
Pipe size is adequate at 2% slope

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PROJECT / PROPOSAL NAME: Green Ridge Landfill		
SUBJECT: Green Ridge Landfill Leachate Trench Piping Sizing		
PREPARED/UPDATED BY: M. Amstadt	DATE: 8/21/2025	PROJECT / PROPOSAL NO.
CHECKED BY: D. Garrett	DATE: 8/21/2025	562325.0002.0000

LEACHATE COLLECTION PIPE VELOCITY CALCULATION

VELOCITY EQUATION

V=Q/A

Q=Flow Rate, cfs
A=Flow Area, sf

V = 0.813/0.1963 = 4.14 ft/sec

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PROJECT / PROPOSAL NAME: Green Ridge Landfill		
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PREPARED/UPDATED BY: M. Amstadt	DATE: 8/25/2025	PROJECT / PROPOSAL NO.
CHECKED BY: N. Slater	DATE: 8/26/2025	562325.0002.0000

LEACHATE COLLECTION PIPE ORIFICE CALCULATION

ORIFICE CALCULATION

Q=Cd*A*2gh^(1/2)

Q=Flow Rate, cfs
Cd=Coefficient of Discharge
A=Flow Area, sf
g=Gravity
h=Hydraulic head

ORIFICE FLOW RATE FOR A 0.5-INCH DIAMETER HOLE

A =	0.0014	sf
Cd=	0.6	
g=	32.2	ft/sec^2
h=	1	ft
Q =	0.0066	cfs

Attachment 2
Settlement Calculations

SETTLEMENT ANALYSIS FOR 1 PERCENT LEACHATE TRENCH

Figure 1 in this document below, shows the Green Ridge landfill layout as conditionally approved in Part A. In general, one technical support position for the variance request is based on settlement calculations that show the leachate lines at critical locations will maintain positive drainage after settlement. Soil is a nonhomogeneous porous material where deformation (settlement) may occur by a change in the stress conditions. Vertical stress at the midpoint of a horizon of interest is determined as the product of the depth of the point and the unit weights of the overlying materials. Because the proposed footprint of the landfill is located within a region with uneven topography consisting of several ridges and valleys, the proposed landfill design requires highly variable amounts of cut as well as some areas of fill from existing grades to establish the base grades. The removal of the overburden to achieve the desired base grades results in a reduction in the current overburden stress, while the weight of the waste will cause a stress increase in the foundation soils that may induce settlement. The net vertical stress increase within the subgrade soils has been calculated (at critical points of interest) to include removal of preexisting overburden stress and adding the vertical stress resulting from the weight of the landfill waste.

The complete settlement analyses for the Green Ridge Landfill are included in the Part B Permit Application package, in PTB Attachment VI – Design Report. The following provides a summary of the calculations and conclusions from the Design Report.

At the Green Ridge facility, the horizons of interest are defined by varying degrees of weathering in a residual soil profile (not sedimentary stratigraphy). The foundation soils mostly consist of elastic silt and silty sand, which tend to compress quickly (immediate settlement) as the surface load increases. Based on a review of the boring logs and the expected excavation of in situ materials, it is anticipated that immediate settlement will occur during or soon after filling operations. The in situ soils were not conducive to conventional sampling and laboratory testing of consolidation properties (too sandy), so elastic settlement was considered.

TRC performed a settlement analysis at critical points along select leachate collection pipes, selected based on the height of the waste material, length between each point, steepness of the leachate collection pipe slope, and subsurface conditions encountered. A total of 14 points were evaluated, shown in Figure 1 below. Existing and anticipated future vertical stresses at each point were estimated based on the existing ground surface elevation, proposed top of leachate collection system drainage layer, and proposed final waste grade.

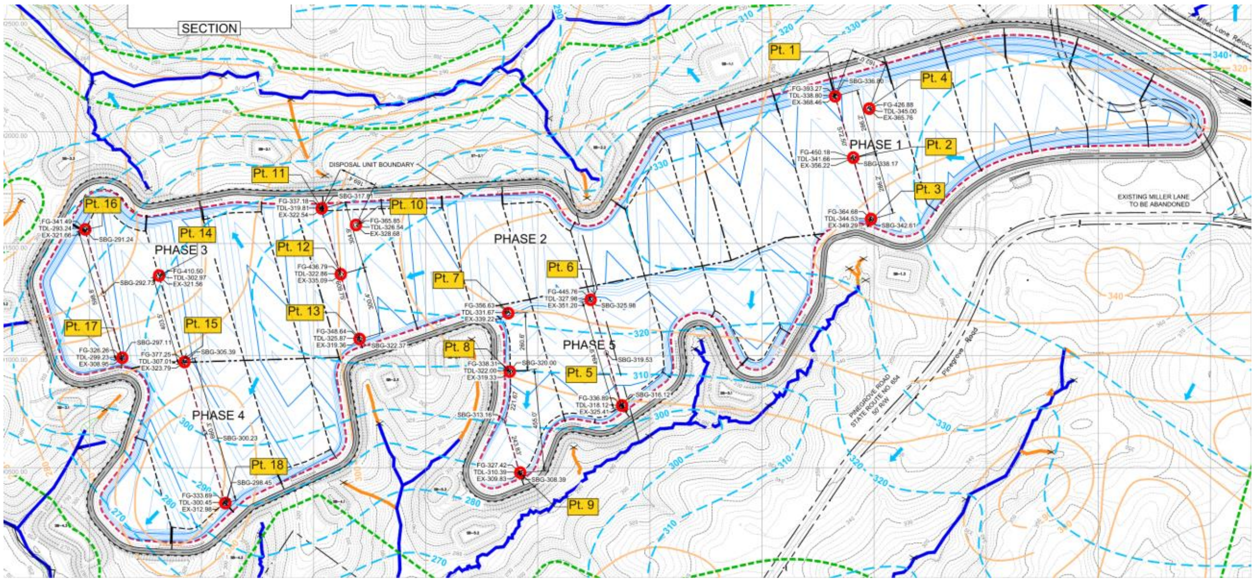

Figure 1: Points Selected for Settlement Calculation

The following table provides a summary of the settlement calculations for the points shown in the above figure. It is noted that points 4 and 10 are not along the leachate trenches, as indicated by the pre-settlement percent slope greater than 1%; additionally, the leachate trench at points 7, 8, and 9 has a pre-settlement percent slope greater than 1% based on the topography. As stated above, the full settlement calculations are provided in Attachment VI – Design Report.

POINT	TOP OF CONTROLLED SUBGRADE ELEVATION (ft) PRE-SETTLEMENT	PRIMARY (ELASTIC RECOMPRESSION) CONSOLIDATION (ft)	LENGTH (ft)	TOP OF CONTROLLED SUBGRADE ELEVATION (ft) POST-SETTLEMENT	LEACHATE COLLECTION SYSTEM SLOPE (%)	
					PRE-SETTLEMENT	POST-SETTLEMENT
2	340.66	0.20	286	340.46	1.00	0.94
1	337.80	0.03		337.77		
4	344.00	0.16	162	343.84	3.83	3.75
1	337.80	0.03		337.77		
3	343.61	0.11	286	343.50	1.03	1.06
2	340.66	0.20		340.46		
6	326.98	0.11	495	326.87	1.99	1.98
5	317.12	0.03		317.09		
7	330.67	0.05	261	330.62	3.70	3.72
8	321.00	0.08		320.92		
8	321.00	0.08	455	320.92	2.55	2.55
9	309.39	0.08		309.31		
10	325.54	0.25	169	325.29	3.98	3.92
11	318.81	0.14		318.67		
12	321.86	0.36	305	321.50	1.00	0.93
11	318.81	0.14		318.67		
13	324.87	0.30	300	324.57	1.00	1.02
12	321.86	0.36		321.50		
15	306.01	0.14	404	305.87	1.00	1.03
14	301.97	0.26		301.71		
15	306.01	0.14	660	305.87	0.99	0.98
18	299.45	0.03		299.42		
17	298.23	0.02	599	298.21	1.00	1.00
16	292.24	0.01		292.23		

*From Pt. 3 to Pt. 1 slope is 1.02% presettlement, 1.00% postsettlement
**From Pt. 13 to Pt. 11 slope is 1.00% presettlement, 1.00% postsettlement

Conclusion

As shown in the table, for those points that are along the leachate lines with a pre-settlement slope of 1% (worst case), all the resulting post-settlement slopes have a less than one-tenth percentage reduction in slope, while some actually have an increase in the post-settlement slope. These indicate that settlement of the landfill base will not impact the flow of leachate to the sumps.

Based on the settlement analyses conducted that shows the designed 1% slope for the leachate trench maintains less than 1 foot of head on the liner and positive drainage throughout the total expected settlement period for the landfill, a variance to the design per VAC20-81-130.J.1.a.(c) (which requires a minimum 2% slope of the bottom liner system) is herein supported. The settlement analyses provides support for the criteria that a variance should be equally protective of human health and the environment as positive drainage is maintained, which allows leachate to continue to be collected from the landfill as required.