Gude Landfill Remediation Design
Basis of Design
Montgomery County, Maryland

30% Submission

Prepared for

Northeast Maryland Waste Disposal Authority and
Montgomery County Department of Environmental Protection
Division of Solid Waste Services
Montgomery County, Maryland

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
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(410) 584-7000

November 2018
EA Project No. 15646.01

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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Assessment of Corrective Measures
the Authority	Northeast Maryland Waste Disposal Authority
cfm	Cubic feet per minute
CMA	Corrective Measure Alternative
COMAR	Code of Maryland Regulations
the County	Montgomery County Department of Environmental Protection, Division of Solid Waste Services
EA	EA Engineering, Science, and Technology, Inc., PBC
EPA	U.S. Environmental Protection Agency
ft	Foot (feet)
in.	Inch(es)
the Landfill	Gude Landfill
LFG	Landfill gas
LFGE	Landfill gas-to-energy
MDE	Maryland Department of the Environment
M-NCPPC	Maryland-National Capital Park and Planning Commission
PVC	Polyvinyl chloride
RAOs	Remedial Action Objectives
scfm	Standard cubic feet per minute
TIS	Traffic Impact Study

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1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) has been contracted to provide engineering, permitting, and support services for addressing the Remedial Action Objectives (RAOs) at the Gude Landfill (the Landfill) in order to achieve compliance with the consent order for the Landfill (Maryland Department of the Environment [MDE] and Montgomery County 2013). This preliminary design report serves as the basis of design and documents the project objectives, assumptions, requirements, technical determinations, and overall decisions made or to be made in the development of the final design.

1.1 PROJECT OBJECTIVES

The consent order for the Landfill establishes the following RAOs for the Landfill:

- No exceedances of maximum contaminant levels, established by the U.S. Environmental Protection Agency (EPA) as limits for drinking water, in the groundwater at the Landfill property boundary or between the Landfill and adjacent streams

- No lower explosive limit exceedances for methane gas at the Landfill property boundary

- No non-stormwater discharges to the waters of the State.

EA developed an Assessment of Corrective Measures (ACM) Report (EA 2016) to identify a recommended Corrective Measure Alternative (CMA) for the Montgomery County Department of Environmental Protection, Division of Solid Waste Services (the County) to meet regulatory compliance requirements at the Landfill. Based on the results of the evaluation presented in the ACM Report, MDE approved the recommended CMA, toupee capping and additional landfill gas (LFG) collection. This CMA includes the following components:

- Toupee Capping of the top of the Landfill (inclusive of the Northwest, West, Southwest, South, and Southeast Areas), as well as the Landfill side-slopes in the Northwest and West Areas

- Additional LFG Collection in the Northwest, West, and Southwest Areas.

Landfill capping was selected as a corrective measure for the Landfill upper surface, as well as portions of the side-slopes of the Landfill, to address maximum contaminant level exceedances in groundwater, as well as leachate seeps and LFG lower explosive limit exceedances in the Northwest and West Areas. It is anticipated that the horizontal conveyance and header piping associated with the LFG collection system would be removed prior to regrading the upper surface of the Landfill and side-slopes. The LFG collection system would be removed prior to regrading the top of the Landfill and side-slopes. The LFG collection system would be reconstructed, including the installation of new extraction wells to provide additional control over gas migration along the property boundary that leads to lower explosive limit exceedances. The Toupee Cap would then be installed.

1.2 BACKGROUND

1.2.1 Site Location and Overview

The Landfill is located at 600 East Gude Drive, Rockville, Maryland 20850. The site is accessed at two (2) locations: East Gude Drive from the south-southwest and Southlawn Lane from the east-southeast.

The Landfill is currently owned and maintained by the County Department of Environmental Protection. The Landfill was used for the disposal of municipal solid waste and incinerator residues from 1964 to 1982. The Landfill property encompasses approximately one hundred sixty-two (162) acres, of which approximately one hundred forty (140) acres were used for waste disposal. An additional seventeen (17) acres of waste disposal area were delineated in 2009 on Maryland-National Capital Park and Planning Commission (M-NCPPC) property, beyond the northeastern property boundary of the Landfill. A land exchange between the County and M-NCPPC on October 21, 2014, transferred ownership of this additional waste disposal area to the County in exchange for a similar area of land without waste, which was transferred to M-NCPPC.

1.2.2 Site and Surrounding Area Land Use

The typical ground cover across the Landfill site is open grassy fields with patches of brushy vegetation and trees on most side slopes and along the perimeter borders of the Landfill. The existing LFG collection system, including the gas extraction system well heads and gas conveyance piping, is situated above grade on the Landfill's ground surface. The site also has a limited area on the top of the Landfill that was designated for flying model airplanes and a concrete pad near the Southlawn Lane facility entrance road that is used for managing storm-related debris.

The surrounding area and properties adjacent to the Landfill have mixed uses including parkland, industrial property, and residential development. Specifically, the adjacent land areas consist of:

- M-NCPPC land and Crabbs Branch Stream (north by northeast)
- Asphalt and cement production facilities, equipment storage yards, scrap metal recycling facilities, and Southlawn Lane (east by southeast)
- East Gude Drive, County Coalition for the Homeless shelter, Community Ministries of Rockville men's shelter, Washington Suburban Sanitary Commission property and Southlawn Branch Stream (southwest by south by southeast)
- Transcontinental (Williams Gas)/Columbia Gas natural gas pipeline right-of-way and the community of Derwood Station residential development (west by northwest).

1.2.3 Site History

The Landfill was constructed and operated prior to modern solid waste management disposal and facility design and closure standards that were implemented by EPA, under the Resource Conservation and Recovery Act. Therefore, the Landfill was not originally constructed with a geosynthetic liner or compacted clay bottom liner, a leachate collection system, an LFG collection system, or a stormwater management system. Reportedly, soil was used as daily cover during waste filling, and a two (2) foot (ft) (minimum) final layer of soil was reportedly placed over the waste mass during closure of the Landfill (in 1982) to support the vegetative cover.

Since 1982, the County has voluntarily, or through regulatory mandates, implemented and maintained Best Management Practices for pre-regulatory era landfills to ensure compliance with Code of Maryland Regulations (COMAR) requirements. These Best Management Practices include: soil and vegetative cover system installation, cover system maintenance, leachate seep repairs, LFG collection system installation and maintenance, water quality and LFG monitoring, and stormwater infrastructure improvements. The County currently maintains an active LFG collection system including: flares, a gas-to-energy system, over one hundred (100) gas extraction wells, and horizontal gas conveyance piping. A network of onsite and offsite groundwater monitoring wells; a network of onsite LFG monitoring wells; environmental monitoring programs for groundwater, surface water, and LFG; and stormwater are also maintained ~~at and~~ for the Landfill site.

1.3 ENVIRONMENTAL INFORMATION

1.3.1 Topography

The site topography of the Landfill is plateau-like and consists of gentle relief (i.e., slope) along the top of the waste-mass and sharp relief along the perimeter property boundary. The elevation along the top of the plateau gently slopes to the south, with localized mounds and depressions throughout. The side-slope falls sharply from the top of the waste-mass to elevations ranging from fifty-five (55) to ninety (90) ft below the plateau.

1.3.2 Geology

The Landfill is located in central Montgomery County, Maryland, within the upland section of the Piedmont Plateau physiographic province (Maryland Geological Survey 1968; Trapp and Horn 1997). The geology in the upland section of the Piedmont Plateau physiographic province primarily consists of metamorphic and igneous rock formations of Paleozoic and Precambrian age. The Piedmont Plateau is underlain by an assortment of phyllite, slate, marble, schist, gneiss, and gabbro formations. Unconsolidated material overlying bedrock is present at the surface in the vicinity of the Landfill site and extends twenty (20) to sixty (60) ft below ground surface. Based on available groundwater monitoring well construction logs from ATEC Associates Inc. (1988) and more recent boring logs (EA 2010 and 2011), the unconsolidated material consists primarily of silt and clay.

1.3.3 Hydrogeologic Setting

The uplands section of the Piedmont is underlain by three (3) principle types of bedrock aquifers: crystalline-rock and undifferentiated sedimentary-rock aquifers, aquifers in early Mesozoic basins, and carbonate-rock aquifers (Trapp and Horn 1997). The Landfill is underlain by the crystalline rock aquifer that extends over approximately eighty-six (86) percent of the Piedmont Plateau Physiographic Province. At the Landfill, the crystalline rock that comprises the regional aquifer is overlain by unconsolidated material consisting of interbedded silts and clays and saprolite. Recorded logs from onsite and offsite borings for the groundwater monitoring wells correlated well with these general geological descriptions.

Based on information from site boring logs and well gauging, groundwater is present in the unconsolidated material, as well as the bedrock at the Landfill site. The groundwater table is typically present in the unconsolidated material along the perimeter of the Landfill and under the Derwood Station development, at depths ranging from approximately three (3) to sixty (60) ft below ground surface. Groundwater recharge at the Landfill is variable and is primarily determined by precipitation and runoff. Topographic relief, unconsolidated material, and surface recharge variations created by the Landfill may significantly affect the groundwater flow.

Groundwater flow is highly dependent on the composition and grain size of the sediments, and therefore water likely moves more readily in the unconsolidated material than in the underlying bedrock. Groundwater in the bedrock (typically twenty [20] to sixty [60] ft below grade) is stored in, and moves through, fractures. No documentation of the degree of fracturing or orientation of bedrock fractures at the Landfill is available.

The site topography and the natural cover system (grassy surface and soil layer) of the Landfill may allow surface water infiltration. Some of the infiltrating water likely moves vertically into the bedrock, while a portion also moves laterally along the boundary between the unconsolidated material and the surface of the bedrock and discharges to nearby streams and surface depressions.

1.3.4 Groundwater Flow

Based on the data collected from new and existing groundwater monitoring wells, including temporary groundwater monitoring wells, the groundwater flow direction was inferred. The data indicated that groundwater flows in an easterly flow direction across the Landfill site, with minor northerly, northeasterly, and southeasterly flow components.

1.4 DESIGN CONTRACT REQUIREMENTS

As part of EA’s design contract, EA has developed plans to document the approach to different aspects of the project.

EA developed a project-specific Quality Management Plan based on its Corporate Quality Management Plan. This plan includes detailed roles and responsibilities for all levels of staff.

A project-specific Communication Plan has been developed to identify communications pathways throughout the project. This Plan will be updated as necessary through the life of the project.

EA has developed a Stakeholder Engagement Plan that includes a list of stakeholders from the County, the Northeast Maryland Waste Disposal Authority (the Authority), Gude Landfill Concerned Citizens, Derwood community, neighboring businesses, and regulatory personnel from MDE, M-NCPPC, and the Department of Permitting Services. The plan also includes a communication framework that is designed to continue to build community, share information, develop a framework of understanding, and obtain input on the project.

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2. PRE-DESIGN INVESTIGATION

2.1 SITE SPECIFIC HEALTH AND SAFETY PLAN

EA developed a site-specific Health and Safety Plan to address worker safety associated with planned field activities. A Site Safety Officer will be provided during all fieldwork performed during the course of the project. The Health and Safety Plan was prepared with the oversight by a Certified Industrial Hygienist and is in compliance with the Occupational Safety and Health Administration and EA's Corporate Health and Safety Plan. All field personnel are required to review the document and sign the review record located within the plan. The Site Safety Officer will also highlight the contents of the plan with field staff prior to beginning fieldwork as has historically been performed with work at the Landfill. The plan includes site communications, confined space avoidance, site hazards, personal protective equipment, and vehicle safety information, as required by the Occupational Safety and Health Administration.

2.2 SURVEY

EA's subcontractor, Wallace Montgomery, performed an aerial flyover and field-run topographic survey of the site in May/June 2018. This work is an update to the survey performed by Wallace Montgomery in 2015, and focuses on providing the most accurate existing conditions, for use in preparing the design documents and estimating material quantities. The aerial survey provided updated mapping for identifiable physical and topographic features, while the field-run survey supplemented items not completely captured by the aerial survey. The horizontal control for the project is relative to the North American Datum of 1983 and the vertical control is relative to the North American Vertical Datum of 1988. A copy of the sealed survey drawings is included in Attachment A.

2.3 UTILITY LOCATION

EA subcontracted Master Locators of Baltimore to provide utility designation and mapping services. Master Locators performed utility designation and mapping using electromagnetic and ground-penetrating radar. Master Locators identified natural gas, electric, communications, sanitary sewer, storm drainage, and water lines within the scope of work boundaries and approximate Landfill property line. A copy of the utility locating report is included in Attachment B.

2.4 GEOTECHNICAL INVESTIGATION

EA installed four (4) temporary piezometers in 2015 to verify the depth of waste and groundwater within the Landfill footprint in order to determine potential performance of toupee capping as the approved CMA. Cover soil ranged from five (5) to ten (10) ft in depth, with the majority consisting of brown, silty, median grain sandy fill. The more recent LFG extraction well logs also document varying depths of cover soil along the northwest slope, ranging from two (2) ft in some locations to greater than ten (10) ft in areas closer to the access road.

As part of the design of the toupee cap for the Landfill, a geotechnical investigation was required to obtain additional information to characterize the existing cover system, waste mass location (depth to waste), and subsurface conditions across the Landfill site.

The Robert B. Balter Company performed test pits across the Landfill to identify the thickness and properties of the existing cover soil. Bulk samples of representative soils were recovered for laboratory evaluation. Laboratory analysis included soil classification according to the Unified Soils Classification System, moisture content analysis, sieve gradation analysis, Atterberg limits determination, and modified Proctor tests. Existing cover soil thicknesses ranged from one and one-half (1.5) to eight (8) ft. The existing cover soils were found to consist of sand and silt mixtures, sand and clay mixtures, and clays. Discussion on how the results of the geotechnical investigation were used in the design is included in Section 4.5.1.

Borings may be performed at a later stage in design if geotechnical information is needed for foundation design for small structures or to obtain data for slope stability evaluations. A copy of the geotechnical evaluation report is included in Attachment C.

2.5 NATIONAL RESOURCE INVENTORY/FOREST STAND DELINEATION/ FOREST CONSERVATION PLAN

EA conducted a Natural Resource Inventory including a full Forest Stand Delineation and a Wetland Delineation to identify the existing resources at the project site and within the first two hundred (200) ft of adjoining land. Narratives were prepared to include discussion on the site conditions, methodology, site photographs, data forms, figures, and agency correspondence. The Forest Stand Delineation Report and the Wetland Delineation Report are included in Attachment D.

A Forest Conservation Plan will be developed to support the permitting and project review process following the guidelines provided by Montgomery County and the State of Maryland. The Forest Conservation Plan will address the forest resources within the project area to remain undisturbed and the mechanisms for their protection. The Forest Conservation Plan will also include details on the reforestation and/or afforestation requirements that may be associated with the proposed design.

2.6 TRAFFIC IMPACT STUDY

EA’s subcontractor T3 Design has been contracted to perform a Traffic Impact Study (TIS) for the project. This study includes data collection, analysis, preparation of a TIS, and preparation of a Traffic Control Plan narrative to be included in the Contract Documents. The TIS will document existing traffic conditions along Southlawn Lane and East Gude Drive near the Landfill. The TIS will also evaluate projected future traffic conditions and model the traffic impacts based on volume of construction vehicles for the remediation project activities. The TIS will be included as Attachment E in future design submittals.

2.7 LANDFILL GAS INVESTIGATION

The MDE-Approved CMA is for toupee capping and additional LFG collection, specifically identified in the Northwest, West, and Southwest Areas. In addition to areas identified for proposed LFG extraction wells, existing LFG extraction wells also need to be evaluated. The original LFG collection system and landfill gas-to-energy (LFGE) facility at the Gude Landfill became operational in 1985, with the enclosed flare installed in 2005, and expansion of the collection system occurring through 2008. The current LFGE system was connected to the grid in 2009, and subsequently ceased operations on June 1, 2017. EA reviewed the operational history, data, and issues with the system as part of the Nature and Extent Study. An LFG technical memorandum is included in Attachment F.

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3. APPLICABLE REGULATIONS

A Permit Compliance Report has been prepared to present the permits and approvals that are required for the project, the reviewing agencies for each permit, and a description of the permit application process with anticipated timelines. The Permit Compliance Report is included in Attachment G.

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4. DESIGN ELEMENTS

The following section details the assumptions, design considerations, and determinations associated with the Landfill remediation design.

4.1 STAGING AND STOCKPILE AREAS

Staging areas will be required to accommodate the contactor's office trailers, employee parking, and equipment and non-soil material storage. Stockpile areas will be required for soil and aggregate storage. There is not enough area for staging and stockpiling at the site outside of the limit of disturbance; therefore, these areas will be located on the Landfill.

Preliminary, initial staging and stockpile areas are identified on Drawing C-113. Additional staging and stockpile areas may be required to accommodate the phasing of the project and locations may change as the construction progresses. Re-locating staging and stockpile areas will increase the cost of the project, so the design will minimize the need to re-locate them.

4.2 GRADING AND DRAINAGE

Based on the results of the evaluation presented in the ACM Report, the approved CMA is toupee capping and additional LFG collection. Toupee capping would decrease the volume of leachate generated due to the reduction of infiltration on the top of the Landfill.

To meet the RAOs for LFG migration and leachate seep control, the capping system will extend along the northwest and west slopes of the Landfill. The Landfill waste currently extends to the property boundary on the northwest and west sides; therefore, to accommodate the landfill cap and to provide for vehicular access, drainage control, and tree planting along the northwest and west slopes, waste relocation and regrading will be required in this area. The design drawings illustrate the intended cross-section and grading required along the slope.

The remaining perimeter of the Landfill, on the north, east, and south sides, consists of steep slopes with dense tree cover, both of which significantly reduce rainwater infiltration potential, thus reducing potential leachate generation. These slopes will not be disturbed during construction. This is consistent with the approved CMA presented in the ACM Report.

Waste relocated from the northwest slope will be placed on top of the Landfill to improve the existing drainage. MDE has previously indicated that reconfiguration of waste onsite is acceptable as part of this project. Additional grading and relocation of waste will be required to meet the proposed grades and promote adequate drainage. Proposed grading is shown on the drawings. A primary consideration in developing the grading was balancing the cut and fill to minimize the need to bring soil from offsite to meet the proposed grades. Regrading onsite material is more sustainable and less costly than hauling in soil from offsite.

The Landfill grading will improve drainage on top of the Landfill by increasing the slopes from the existing condition to the final condition. Analysis of the existing and proposed grades is shown in Figure 1 and Figure 2, respectively. Table 1 presents the reduction of flatter slope areas from the existing condition to the final condition.

Table 1 Slope Areas

Slope Range	Existing (square feet)	Proposed (square feet)	Reduction in Area (percent)
Slope Area Between 0% and 1%	452,444	54,134	88
Slope Area Between 1% and 2%	901,909	261,835	71
Slope Area Between 2% and 3%	1,089,640	767,304	30
Slope Area Between 3% and 4%	1,058,397	705,336	33
Total			
Slope Area Between 0% and 4%	3,502,390	1,788,609	49

The grading approach considers existing drainage patterns. The grading has been developed such that the pre-development runoff characteristics are maintained to the greatest extent practicable after development. Further discussion on drainage and stormwater management is included in Section 4.12.

The County requested that the grading plan include space for a potential, future operational area after the closure cap is constructed. Additional discussion on the operational area is included in Section 4.6.

4.2.1 Slope Stability

A global slope stability analysis will be performed in future design phases to ensure the regraded northwest slope will be stable during and after construction. The proposed grading and cap construction included in the current design will not have an impact on the stability of slopes around the remaining perimeter of the Landfill.

4.3 CONSTRUCTION PHASING

The design will include a phased construction approach. Grading will be limited to twenty (20)-acre areas based on the limit imposed by the *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control*. Preliminary phases are shown in Drawing C-112 in the Contract Drawings. The proposed phases have been defined based on balancing cut and fill of onsite material as described in Section 4.3.1. During continued development of the design, project phasing will also consider removal of the existing landfill gas piping and installation of new piping and other factors.

4.3.1 Earthwork Balance

The proposed grading plan requires both excavation and fill. The grading plan has been optimized to balance the excavation and fill quantities below the cap geosynthetics to the greatest extent practicable. There are several areas where waste will be excavated. Table 2 provides the excavation and fill volumes below the cap geosynthetics for each phase.

Table 2 Estimated Excavation and Fill Volumes Under Cap Geosynthetics

Phase	Area (acres)	Approximate Excavation (cubic yards)	Approximate Fill (cubic yards)	Net Volume (cubic yards)
1	8.92	16,500	17,200	700 (Fill)
2	17.84	34,100	33,100	1,000 (Cut)
3	13.05	33,400	32,600	800 (Cut)
4	18.36	38,000	36,400	1,600 (Cut)
5	19.94	66,300	63,600	2,700 (Cut)
6	13.89	34,300	26,000	7,000 (Cut)

4.4 WASTE HANDLING

Care must be taken during waste handling to prevent the spread of leachate and to minimize odors and dust. The specifications will provide detailed requirements for waste handling, which will include daily covering of waste with tarps or a minimum of six (6) inches of soil, management of any leachate encountered, management of odors and dust, and waste grading and compaction requirements.

4.5 CLOSURE CAP

The objective of the Landfill closure cap design is to minimize the impact of the Landfill on the surrounding environment to the greatest extent possible. Landfill capping will minimize the infiltration of stormwater through the waste and the potential migration of Landfill leachate and gas. The cross-section for the proposed Landfill cap is depicted on Contract Drawing C-501. The components, building up from the subgrade, are described in the following sections.

4.5.1 Subgrade

Based on the geotechnical evaluation performed by the Robert B. Balter Company, existing cover soil thicknesses at the test pit locations ranged from one and one-half (1.5) to eight (8) ft. The test pits indicating cover soil thickness greater than two (2) ft were isolated; therefore, it was determined that it would not be cost-effective to require the contractor to excavate excess, existing soil cover for use in the closure construction.

The existing soil cover will be reconfigured to accommodate waste relocation and grading. The existing ground will be cleared and grubbed before grading commences. The contractor will be required to excavate existing cover soil in areas where waste excavation will occur and stockpile that soil to re-cover the waste after it is graded and compacted.

A minimum of one (1) ft of subgrade will be provided over all areas of regraded waste before the cap geosynthetics are placed. The subgrade will be compacted to serve as a stable base for the cap section. Subgrade grading plans are included in the drawings.

4.5.2 Geotextile

An XX-ounce nonwoven needle-punched geotextile will be placed between the subgrade and geomembrane. While not required by COMAR, this layer provides a higher interface friction angle with the subgrade and serves to protect the geomembrane from puncture.

An example geomembrane puncture resistance calculation that will be used to determine the appropriate geotextile is included in the geosynthetics calculations in Attachment H. The calculation will be provided for the specified geosynthetics in future design submittals.

4.5.3 Geomembrane

The geomembrane serves as the impermeable barrier of the cap to prevent transfer of materials both into and out of the closed Landfill. COMAR 26.04.07.21 requires a low-permeability layer within the closure cap and specifies that when using a synthetic material as the cap's low permeability layer, the material must have a minimum thickness of twenty (20) mil and a maximum permeability of 1×10^{-10} centimeters per second. A forty (40)-mil textured linear low-density polyethylene geomembrane is specified in the design to satisfy this requirement due to its thickness, low permeability, high friction angle, interface cohesion, and durability.

It is imperative that the geomembrane not be punctured when installing the closure cap as this will cause unacceptable material transfer between the Landfill and the exterior environment. Procedures for care during the installation of closure cap materials during construction and minimum puncture strength requirements will be specified in the Technical Specifications.

4.5.4 Geocomposite Drainage Layer

A drainage layer is required in a closure cap to provide a means for water that infiltrates through the cover soil to be conveyed to an outlet to prevent an unacceptable buildup of pore pressure within the cover soil. Increased pore pressure can create instability between cap components and cover soil and lead to sloughing. COMAR 26.14.07.21 requires that a drainage layer be installed immediately above the low-permeability layer and allows for filter fabrics and drainage blankets to be used for this purpose.

An example geocomposite capacity calculation is included in the geosynthetics calculations in Attachment H. Multiple calculations will be prepared in future design submittals to evaluate the geocomposite capacity at various locations of the closure cap.

4.5.5 Vegetative Support Soil

COMAR 26.04.07.21 states that a minimum of two (2) ft of earthen cover shall be placed over the drainage layer with a minimum cover slope of four (4) percent. The material is required to contain sufficient organic material and nutrients to sustain a vegetative cover over time. A vegetative support soil layer of thickness one (1) ft eight (8) inches (in.) with a four (4)-in. layer of topsoil is specified in the design.

To ensure that the geocomposite drainage layer does not become clogged by the vegetative support soil, the vegetative support soil grain size must be specified based on the apparent opening size of the geocomposite. An example calculation is included in the geosynthetics calculations in Attachment H.

4.5.6 Vegetative Stabilization

COMAR 26.04.07.21 requires that within thirty (30) days after the final earthen cover has been installed, the area shall be vegetatively stabilized using a perennial cover species recommended by the Soil Conservation District. Seed mixes for permanent vegetative stabilization will be defined in future design submittals and are expected to include native meadow and wildflower species over most of the landfill area.

4.5.7 Closure Cap Stability

Capping materials were selected to ensure the long-term stability of the cap between all of the interfaces of the various cap components. A veneer slope stability analysis was performed to confirm an adequate factor of safety using infinite slope and finite slope theory for the closure cap configuration. The critical interfaces were evaluated on the longest slopes of the Landfill.

EA has designed the capping system with a minimum factor of safety of one and one-half (1.5) for slope stability for each interface as is typical for projects of this nature and magnitude. An example calculation for the stability of the Landfill cap is included in the geosynthetics calculations in Attachment H.

4.6 OPERATIONAL AREA

The County is considering implementing a yard trim storage and processing facility at the Landfill after closure. The grading plan includes an approximate three and one-half (3.5)-acre area at one (1) percent slope on top of the Landfill on the east side of Incinerator Lane for the potential future operational area. Space is provided for future weigh scale facilities. This area will be paved for use in all weather conditions and the pavement will serve as the impermeable layer on this portion of the Landfill.

An area of approximately four (4) acres with slopes ranging from one (1) percent to five (5) percent is provided to the north of the paved area for extra capacity for yard trim that may be required following storm events. A paved access road will connect the two (2) areas. Vehicles will be able to bypass the paved area to access the north storage area. A concept layout of the operational area is shown in Figure 3. This concept was used to determine the size and grading of the potential operational area that will be incorporated into the Landfill closure.

4.7 ACCESS ROADS

Vehicular access will be required for the potential operational area and for general maintenance and monitoring activities after the Landfill is capped. The proposed design maintains existing access roads to the greatest extent practicable and additional roads have been added to provide access across the Landfill. Some site features, like LFG wells, may be accessed over turf areas to minimize the extent of more permanent access roads, which cause more stormwater runoff and are more expensive.

The design includes relocation of Incinerator Lane to the west side of Pond 3 to reduce the road grade and to provide room for expansion of Pond 3. The longitudinal slope of Incinerator Lane was designed to not exceed seven (7) percent to accommodate the potential traffic accessing a future yard trim facility. Incinerator Lane will be paved from Southlawn Lane to the north of the potential operational area to provide a reliable, all-weather surface that can be plowed during snow events, if desired.

The remaining access roads that will not be used for the potential operational area will be constructed of pervious pavement to minimize runoff from rain events and provide a more sustainable option than impervious gravel or asphalt. Use of pervious pavement will also eliminate the need to provide additional stormwater quality treatment for the access roads.

4.8 LANDFILL GAS MANAGEMENT

4.8.1 Existing System Description

The existing LFG management system at the Landfill consists of a network of vertical LFG extraction wells, with mainly above-grade polyvinyl chloride (PVC) conveyance piping. There are three (3) known sumps within the system for the collection of condensate, which are periodically pumped out, as necessary. The original LFG collection system and LFGE facility at the Landfill became operational in 1985, with the enclosed flare installed in 2005, and expansion of the collection system occurring through 2008. The current LFGE system was installed and connected to the grid in 2009, and subsequently ceased operations on June 1, 2017. LFG is currently managed by the two enclosed flares installed in 2005. Details regarding the existing LFG management system are presented in Attachment F.

4.8.2 Anticipated LFG Production

EA used the EPA Landfill Gas Emissions Model (LandGEM) to estimate LFG production to be used as the design basis. This information was used as the basis for determining the required well spacing and the locations for proposed LFG extraction wells. Based on the historical waste disposal records and estimates provided by the County during the preparation of the ACM, the anticipated LFG production was determined. Records indicate that the Landfill received five and sixteen one-hundredths (5.16) million tons of waste throughout its operational years (1965 to 1982). A conservative capture efficiency of seventy-five (75) percent was assumed for the EPA LandGEM analysis, which is included in Attachment F.

In the analysis, projected future LFG flow rates range from four hundred seventy-five (475) to sixty (60) cubic feet per minute (cfm) from calendar year 2018 to 2070, with an approximate mean value of two hundred one (201) cfm (Figure 4).

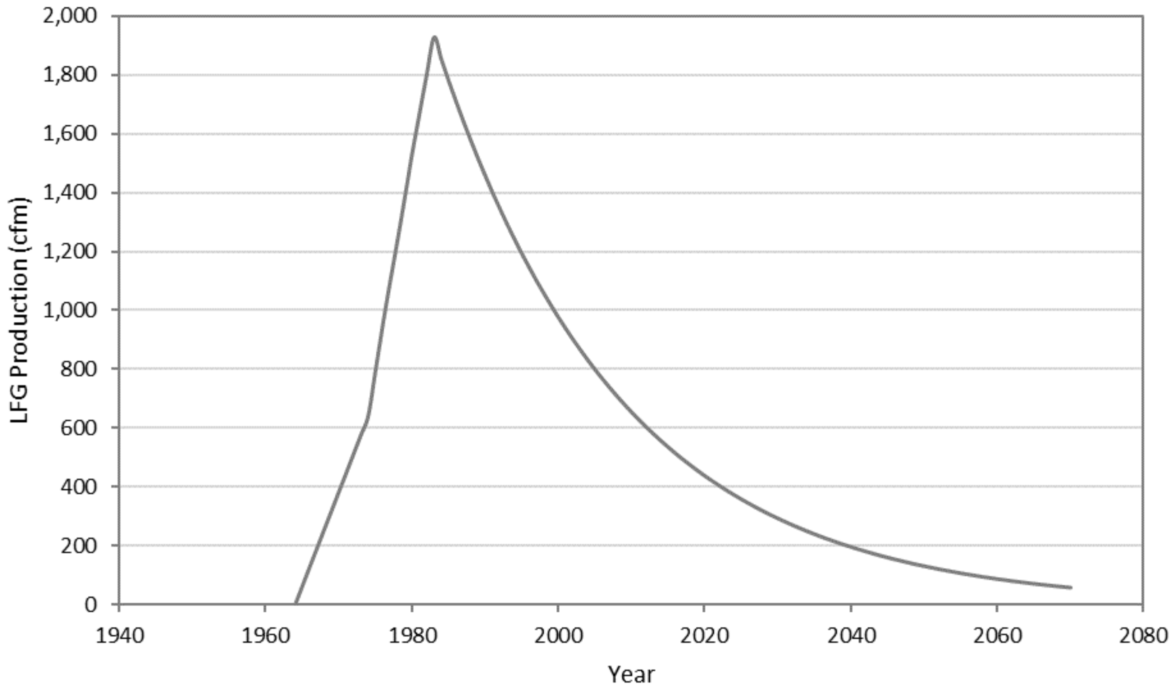

Figure 4 Projected LFG Production from LandGEM Model

Based on the LandGEM results, peak LFG production (one thousand nine hundred twenty-five [1,925] cfm) occurred in 1983, approximately a year after the Landfill stopped accepting waste. The average LFG collection observed from November 2017 to April 2018 was five hundred seven (507) standard cubic feet per minute (scfm). Due to the general agreement with the LandGEM model, an LFG production value of five hundred seven (507) scfm was utilized for the design basis.

4.8.3 System Design Details

The proposed LFG management system will consist of the following primary components:

- Extraction wells (existing and proposed) with well heads for monitoring and control
- New below-grade collection system piping (including laterals and header piping)
- New condensate drains
- Existing blower-flare facility with:
  - Enclosed flares
  - Blowers (primary and standby)
  - Condensate knockout.

The existing LFG management system at the Landfill consists of a network of vertical LFG extraction wells, with mainly above-grade PVC conveyance piping. A substantial portion of the existing extraction well network and collection system of Landfill has been compromised due to the infrastructure age, waste settlement, and above-grade piping, which has been exposed to weather throughout the years. The existing collection system header and lateral piping will be demolished as the collection system will be re-designed and replaced with below-grade collection system piping to be connected with the existing enclosed flare system. The existing condensate sumps within the Landfill will be abandoned and new condensate drains will be installed.

4.8.4 Landfill Gas Extraction Well Network

There is currently a total of one hundred fifteen (115) LFG extraction wells located at the Landfill, one hundred four (104) of which are monitored monthly for LFG quality. Based on the existing well locations, available methane content, and radius of influence calculation, sixty-two (62) wells were identified to be utilized after modification (Table 3) and fifty-three (53) existing extraction wells are scheduled for abandonment (Table 4).

Details of existing extraction wells to be abandoned and modified are provided in Attachment F.

Table 3 Schedule of Existing LFG Extraction Wells to be Modified

No.	Well ID	Northing	Easting	No.	Well ID	Northing	Easting
1	EW 1	524685.00	1271739.00	32	EW 75	524731.77	1272784.69
2	EW 2	524876.02	1271974.08	33	EW 76	524633.45	1272904.48
3	EW 5	525493.34	1272811.88	34	EW 101	524811.95	1271412.16
4	EW 10	525795.74	1272803.67	35	EW 102	524886.23	1271542.61
5	EW 15	525548.12	1273428.12	36	EW 103	524988.85	1271598.64
6	EW 17	525256.92	1273728.72	37	EW 104	525060.49	1271733.51
7	EW 18	525149.25	1274038.96	38	EW 108	525497.90	1272169.22
8	EW 21	524593.90	1271512.61	39	EW 109	525603.00	1272277.00
9	EW 22	524521.95	1271711.42	40	EW 110	525704.87	1272360.68
10	EW 23	524570.40	1272053.18	41	EW 111	525817.47	1272488.84
11	EW 24	524386.03	1272325.10	42	EW 112	525904.52	1272583.62
12	EW 25	524503.28	1273291.42	43	EW 113	526003.53	1272672.42
13	EW 26	524732.78	1272290.61	44	EW 119	525066.49	1271720.56
14	EW 27	524593.89	1272608.79	45	EW 122	525648.32	1272307.35
15	EW 29	524439.03	1272706.65	46	EW 126	525400.00	1272123.00
16	EW 30	524454.54	1272924.70	47	EW 130	525607.48	1272377.21
17	EW 31	524286.07	1273115.03	48	EW 132	524839.30	1271688.74
18	EW 32	524277.02	1273460.89	49	EW 138	524482.57	1271602.48
19	EW 34	524765.29	1273183.56	50	EW-139	524356.49	1271498.22
20	EW 35	524679.16	1273420.41	51	EW 140	524314.20	1271664.08
21	EW 36	525153.10	1272841.37	52	EW 141	524384.66	1271789.23
22	EW 37	525060.72	1273123.93	53	EW 142	524254.14	1271849.23
23	EW 38	524957.57	1273418.77	54	EW 143	524561.48	1271885.04
24	EW 39	525372.84	1273110.22	55	EW 144	524420.34	1271993.64
25	EW 51	524763.79	1272055.46	56	EW 145	524487.09	1272143.46
26	EW 52	524891.63	1272170.36	57	EW 146	524322.43	1272154.10
27	EW 54	524766.93	1272474.42	58	EW 149	524184.59	1272615.25
28	EW 57	524919.03	1272744.09	59	EW 152	525204.40	1272228.67
29	EW 71	524968.25	1272111.23	60	EW 156	525404.89	1272115.48
30	EW 72	524916.85	1272370.37	61	EW-158	525501.48	1272460.86
31	EW 73	525063.91	1272423.74	62	EW-159	524359.07	1273253.66

Table 4 Schedule of LFG Extraction Wells to be Abandoned

No.	Well ID	Northing	Easting	No.	Well ID	Northing	Easting
1	EW 3(a)	525075.99	1272253.00	28	EW 114(a)	526101.61	1272780.92
2	EW 4(a)	525283.77	1272528.88	29	EW 115	526192.18	1272873.96
3	EW 6(a)	525701.57	1273090.18	30	EW 116(a)	526318.49	1272986.92
4	EW 7(a)	525846.59	1273424.41	31	EW 117	524967.94	1271555.75
5	EW-9(a)	525547.12	1272540.42	32	EW 118	525001.19	1271605.01
6	EW 11(a)	526021.70	1272991.79	33	EW 120	525207.25	1271930.45
7	EW 12(a)	526216.87	1273096.54	34	EW 121	525323.59	1272075.20
8	EW 13	526061.43	1273237.95	35	EW 123	525383.41	1272110.40
9	EW 14(a)	526177.00	1273268.00	36	EW 124	525421.31	1272125.05
10	EW 16(a)	525259.00	1273410.00	37	EW 125	525359.90	1272145.69
11	EW 19(a)	525112.14	1274359.13	38	EW 127	525429.53	1272155.44
12	EW 20(a)	524988.08	1274602.77	39	EW 128	525456.40	1272230.71
13	EW 28	524972.00	1272609.00	40	EW 129	525521.55	1272311.17
14	EW 40(b)	524912.83	1273900.40	41	EW 131	524778.92	1271581.48
15	EW 41(b)	524914.46	1274173.29	42	EW 133(a)	525247.40	1271902.41
16	EW 43(b)	524687.94	1274382.92	43	EW 134(a)	525198.95	1271831.40
17	EW 44(b)	524718.77	1274594.03	44	EW 135(a)	524680.07	1271210.08
18	EW 49	524314.94	1272707.70	45	EW 136	524314.94	1272707.70
19	EW 50	524691.93	1271877.94	46	EW 137	524517.92	1271409.51
20	EW 59	524713.10	1273141.80	47	EW 147(a)	524204.05	1272209.54
21	EW 62	525373.34	1272925.64	48	EW 148	524200.75	1272394.25
22	EW 70	524798.39	1271853.88	49	EW 150	525482.26	1272466.00
23	EW 74	524839.17	1272607.41	50	EW 151	524360.16	1273265.13
24	EW 100(a)	524720.11	1271278.73	51	EW 153	525204.17	1272380.01
25	EW 105	525164.44	1271858.58	52	EW 154	524300.58	1271811.07
26	EW 106(a)	525249.97	1271981.61	53	EW 157(a)	525186.72	1271888.13
27	EW 107	525336.35	1272096.28				

(a) Wells with the potential to be utilized in LFG collection system; therefore, further investigation will be performed before the sixty (60) percent design submission.
(b) Extraction wells EW-40, EW-41, EW-43, and EW-44 were decommissioned in February 2018.

There are approximately twenty (20) wells listed in the Table 4 with low methane that will be investigated further for reuse prior to the next design submission. The existing and proposed LFG extraction wells will have flow control valves and will be connected to a common collection system header.

The placement of the existing extraction wells typically ranges from every two hundred (200) to five hundred (500) ft in triangular orientation. Well spacing was compared to a calculated radius of influence. Utilizing the current LFG production rate, total waste placement, and average well depth, the approximate radius of influence was calculated (Attachment I). The radius of influence was calculated utilizing an EPA method based on the New Source Performance Standard Background Information Document, Appendix E, dated 1991, and was based on the LFG production of five hundred seven (507) scfm. The calculated radius of influence was then used to calculate the well spacing. This calculation yielded a spacing range of three hundred eighteen (318) to seven hundred seven (707) ft. Based on the calculated radius of influence range and considering the LFG extraction capacity with the cost of the system, a spacing of approximately three hundred fifty (350) ft was chosen. Extraction wells will be placed so that the radius of influence is tangential to the perimeter to control any LFG migration off of the waste boundary and also in the interior of the Landfill to control LFG emissions and promote cap stability. Based on the calculated spacing requirement, a total of twenty (20) new extraction wells are required (Table 5). Figure 5 depicts the LFG system layout with the estimated radius of influence for each well and Drawing C-163 provides the layout in the Contract Documents.

Table 5 Schedule of Proposed LFG Extraction Wells

No.	Proposed Well ID	Northing	Easting
1	EW-160	524586.47	1273707.04
2	EW-161	524853.77	1273464.33
3	EW-162	525091.03	1273676.83
4	EW-163	524769.63	1273902.07
5	EW-164	524539.82	1274111.36
6	EW-165	524715.93	1274434.03
7	EW-166	524976.94	1274709.79
8	EW-167	525043.10	1274358.85
9	EW-168	524927.29	1272561.50
10	EW-169	524842.59	1274184.38
11	EW-170	524679.56	1271210.97
12	EW-171	525259.10	1271986.88
13	EW-172	525285.81	1272519.08
14	EW-173	525701.57	1273090.18
15	EW-174	525846.59	1273424.41
16	EW-175	526184.88	1273272.68
17	EW-176	526313.17	1272989.82
18	EW-177	526212.45	1273098.98
19	EW-178	526020.67	1272995.94
20	EW-179	525261.14	1273409.30

The vertical extraction wells will be constructed of high density polyethylene. The bottom portion of the wells will be placed in the waste and is perforated to provide a preferential pathway. The upper portion, minimum twenty (20) ft, of the well will be constructed of solid pipe casing to prevent non-LFG intrusion. The perforated interval will be surrounded in the boring with a filter pack or non-calcareous (i.e., non-chemically reactive) aggregate. A bentonite seal will be placed just above the filter pack, native soil or common borrow will be placed and compacted above the filter pack seal, and a membrane boot seal will be created around the geomembrane.

A wellhead will be used to connect the extraction well to the below grade collection system. The wellhead provides for flow adjustment, gas monitoring, flow measurement, and leachate extraction, if needed.

Details of the extraction wells and well heads are provided on Drawing C-503.

4.8.5 Landfill Gas Collection System Piping

The existing LFG collection system is currently positioned on the surface of the Landfill and has been susceptible to damage caused by weather and waste settlement. Buried collection system piping within the Landfill closure cap will provide a better solution to the prevailing issues, given that the Landfill settlement and appropriate slope will be considered in the design for the collection system. The buried LFG collection system will be placed just above the closure cap drainage layer to allow for maintenance without impacting the cap geosynthetics. Trenching details for both inside and outside of the Landfill cap are provided on Drawing C-503.

The layout of the collection piping is designed to target a minimum three (3) percent slope throughout the system to allow for effective condensate drainage. All extraction wells will be connected by lateral pipes and a perimeter looped header pipe. The looped header provides the advantage of self-equalizing or balancing of the vacuum and flow as well as allowing operating personnel to pull LFG from either direction, thus providing flexibility in situations of blockages or header repair. The LFG wells that are located outside of the Landfill cap are on an extended lateral from the looped header and will require condensate management, likely with a condensate drain. The LFG piping will be constructed of SDR 17 high-density polyethylene for its durability and agility in underground installations.

Pipe sizing and pressure drop calculations will be provided with the sixty (60) percent design submittal.

4.8.6 Landfill Gas Condensate Collection

As LFG is extracted from the Landfill and transported through the LFG collection system, it gradually cools and a liquid (condensate) is formed. The LFG condensate is primarily made up of water and typically contains minimal quantities of volatile and miscible compounds and can have similar composition to leachate. The layout of the LFG piping is designed to maintain positive drainage to condensate traps in low-lying areas. Where possible, the pipe network is designed so the condensate runs with the flow of the LFG to minimize pipe surging.

It is EA's understanding that condensate is currently managed with the use of two (2) sumps and a self-draining condensate trap within the LFG collection system well field, as well as a condensate knockout at the blower skid that drains to a below-grade condensate sump within the fenced area for the enclosed flares.

LFG condensate production calculations will be performed for worst case scenarios for both summer and winter months and will be provided in Attachment I during future design phases.

4.8.7 Blower-Flare Facility

A blower applies the required vacuum on the LFG collection system and supplies the required discharge pressure for the flare. The amount of vacuum required depends on the size of the LFG collection system and typically varies from forty (40) to sixty (60) in. of water column. The amount of pressure required is governed by the flare burner configuration and typically varies from ten (10) to twenty (20) in. of water column.

As presented in the LFG Investigation technical memorandum, the existing facility has three (3) twenty (20)-horsepower blowers in operation, each rated for six hundred (600) scfm at sixty (60) in. of water column that are utilized to convey LFG from the collection system to two (2) enclosed flares. The enclosed flares are each rated for six hundred (600) scfm at fifty (50) percent methane. If the methane concentration drops below thirty (30) percent, propane, which is stored onsite, can be used to supplement the LFG. The existing permit to construct and the as-built drawings for the enclosed flares are included in Attachment F. As part of the LFGE project, a butterfly valve and line were installed to direct LFG to the pretreatment skid associated with the LFGE system. It is EA's understanding that this valve was closed June 1, 2017, as part of the LFGE plant shutdown that occurred.

The existing blower/flare station is located at the Gude Drive entrance of the Landfill, adjacent to the LFGE facility that is no longer in use. The blowers were designed to function under a range of conditions that may result due to changes in LFG composition and flow rate. Based on the existing blower/flare facility's capacity (six hundred [600] scfm), location, and current LFG production rate (five hundred seven [507] scfm), it is assumed that the existing facility is capable of managing LFG from the new LFG collection system. However, a more detailed evaluation of the blower/flare facility's capacity will be provided with future design submissions.

4.9 GROUNDWATER MONITORING WELLS

The existing groundwater monitoring network for the Landfill consists of thirty-nine (39) groundwater monitoring wells. The project specifications will require the contractor to protect the existing groundwater monitoring wells during construction. It is assumed the remaining groundwater monitoring wells proposed as part of the ACM will be constructed following construction under a separate contract.

4.10 ENVIRONMENTAL ASSESSMENT REPORT

An Environmental Assessment Report will be developed to describe possible environmental impacts resulting from construction activities. Potential construction impacts include traffic, dust, noise, odor, LFG migration, leachate, stormwater runoff, fuel storage, and safety. The environmental assessment will identify potential measures to minimize, mitigate, and eliminate the potential impacts and/or compensate for their impact. Relevant resources, current and potential land uses, and potential positive and negative impacts will be described at a level of detail that will enable decision-makers to make informed choices. The Environmental Assessment Report will be included as Attachment J in future design submittals.

4.11 EROSION AND SEDIMENT CONTROL

Erosion on construction sites can be a significant source of sediment pollution to nearby bodies of water. As a result, there are regulations that require construction activities to employ adequate controls to limit the amount of sediment traveling offsite through runoff. This is accomplished through conveying sediment-laden runoff through filtering or sediment-trapping practices prior to discharge offsite. All erosion and sediment control facilities are required to meet design and maintenance criteria as outlined in the *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control*.

Erosion and sediment controls will be evaluated in future design submittals.

4.12 STORMWATER MANAGEMENT

Stormwater management is necessary to mitigate the effects of development on the receiving stream system. A stormwater management design must ensure mitigation through practices described in the *2000 Maryland Stormwater Design Manual* as amended and with Montgomery County design requirements based on Chapter 19 of the Montgomery County Code. Environmental Site Design features must be used to the maximum extent practicable to reduce stream erosion, pollution, and flooding. Pre-development runoff characteristics must be maintained as nearly as possible.

EA analyzed existing drainage conditions and used this information to develop a stormwater management design. Both quantity and quality control will be required for stormwater management. A stormwater management report documenting the design is included in Attachment K.

4.13 SETTLEMENT MONITORING PLAN

The surface of the Landfill continues to settle as pockets of waste decompose and the waste above it ravels and shifts, adjusting to constantly changing pressures. Settlement of a waste mass like Gude Landfill cannot be predicted with typical geotechnical investigation and analysis techniques because the waste mass is heterogeneous and its properties cannot be sufficiently measured to accurately estimate the varying settlement across the Landfill. EA will develop a Settlement Monitoring Plan in future design submittals to document the settlement of the Landfill during the closure construction and into the post-closure period, if the County chooses to do so. The plan will establish procedures that the contractor must follow. The plan will likely include the placement of settlement plates at key locations across the top of the Landfill and procedures for measuring the elevations of the plates over time. The locations will be chosen to monitor potential changes to drainage patterns and potential stresses in the Landfill capping system components.

4.14 FUTURE LAND USE EVALUATION

In addition to the operational area discussed in Section 4.6, future land uses may include passive recreational facilities and renewable energy development. EA's subcontractor Floura Teeter will develop a Comparative Analysis of potential land use activities. Floura Teeter will research the allowed land use and permitting requirements which could potentially create barriers or conflicts. The results of this research will be incorporated into the Comparative Analysis. The Comparative Analysis of activities will include a ranking system and will focus on passive recreational, renewable energy, and operational activities.

Following selection of land use activities for further investigation and analyses, Floura Teeter will advance the design of the approved preliminary plan, select materials, and develop details that are consistent with the Authority/County's goals and design intent for use in the preparation of a Summary Report. The Summary Report will provide conceptual layout drawings, graphics, details, and preliminary construction cost estimates for the selected land use activities.

5. POST-CLOSURE CARE PLAN

A Post Closure Care Plan was developed to ensure the facility is maintained in compliance with COMAR 26.04.07.22 and 40 Code of Federal Regulations Subpart 258.61(a). The Post-Closure Care Plan includes LFG management, groundwater monitoring, required maintenance, recordkeeping, and operations activities. Maintenance and operational activities include the maintenance of security, cover system, stormwater management structures, and LFG collection system. Monitoring activities include the monitoring of the groundwater monitoring well network, LFG monitoring probe network, surface water, and an inspection plan for the Landfill cover system.

The plan also includes standard monitoring forms and associated training to assist in ensuring the appropriate records for the Landfill post-closure maintenance and monitoring are kept per COMAR 26.04.07.22. The Post-Closure Care Plan is included in Attachment L.

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6. PHASING/ INCREMENTAL FUNDING

Future design submittals may include the separation of closure cap construction into phases based on County-specified budget constraints. The County will determine how the construction project will be funded and funding may be made available on a fiscal year basis.

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7. BID FORMAT

7.1 CONTRACTOR PROCUREMENT

The Authority and County are considering a two (2)-step procurement process that will include selection of a short-list of contractors based on qualifications, experience, and similar factors. Those selected contractors would then have the opportunity to provide a price proposal to perform the remediation as defined in the Contract Documents.

7.2 BID ITEMS

EA will develop a list of bid items in future design submittals.

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8. ANTICIPATED CONSTRUCTION SCHEDULE

A construction schedule has been developed and will be revised as the design progresses. The schedule is intended to provide an overall sense of possible construction duration. Actual detailed workflows may vary from this generalized schedule. The schedule is based on very preliminary construction phasing that will be discussed and refined during the design process. The schedule does not explicitly show winter shutdown periods, but some work will be difficult during winter months and shutdowns should be considered in future discussions regarding contracting.

The construction schedule is included in Attachment M.

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9. REFERENCES

ATEC Associates. 1988. Well Construction Logs for Groundwater Monitoring Wells at Gude Landfill.

EA Engineering, Science, and Technology, Inc. (EA). 2010. *Gude Landfill Nature and Extent Study Report*. November.

———. 2011. *Gude Landfill, Nature and Extent Study Report Amendment No. 1*. November.

———. 2016. *Gude Landfill Assessment of Corrective Measures*. April.

Maryland Geological Survey. 1968. *Geologic Map of Maryland, Montgomery County, Maryland.*

Maryland Department of the Environment (MDE) and Montgomery County. 2013. Consent Order (Gude Landfill). MDE Case Number CO-11-SW-036. 28 May.

Maryland Department of the Environment (MDE). 2011. *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control*.

Montgomery County Code. Chapter 19. Article II. *Stormwater Management*.

Trapp, H. and M.A. Horn. 1997. *Groundwater Atlas of the United States.* U.S. Geological Survey.

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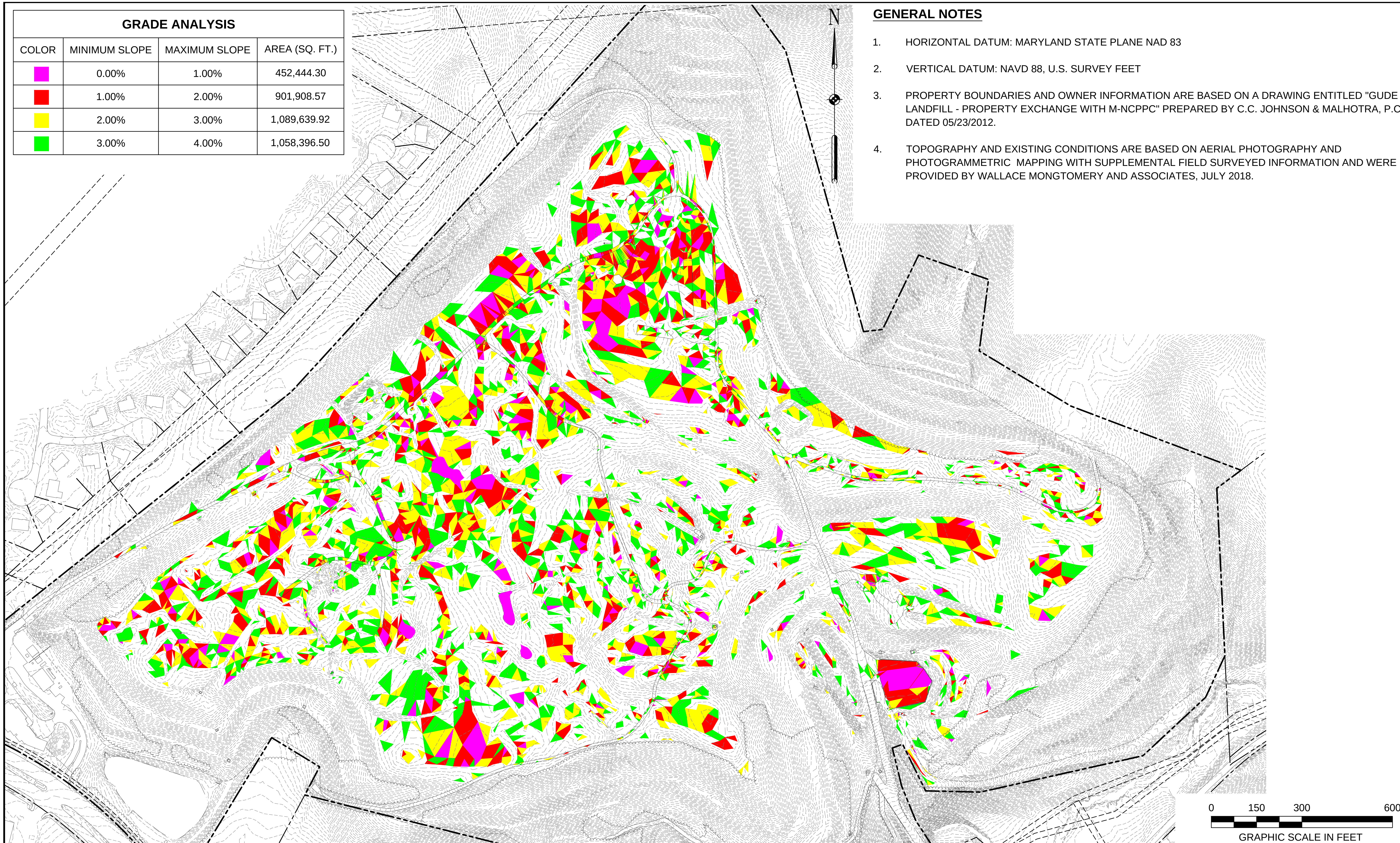
GRADE ANALYSIS

COLOR	MINIMUM SLOPE	MAXIMUM SLOPE	AREA (SQ. FT.)
Magenta	0.00%	1.00%	452,444.30
Red	1.00%	2.00%	901,908.57
Yellow	2.00%	3.00%	1,089,639.92
Green	3.00%	4.00%	1,058,396.50

GENERAL NOTES

1. HORIZONTAL DATUM: MARYLAND STATE PLANE NAD 83
2. VERTICAL DATUM: NAVD 88, U.S. SURVEY FEET
3. PROPERTY BOUNDARIES AND OWNER INFORMATION ARE BASED ON A DRAWING ENTITLED "GUDE LANDFILL - PROPERTY EXCHANGE WITH M-NCPPC" PREPARED BY C.C. JOHNSON & MALHOTRA, P.C., DATED 05/23/2012.
4. TOPOGRAPHY AND EXISTING CONDITIONS ARE BASED ON AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRIC MAPPING WITH SUPPLEMENTAL FIELD SURVEYED INFORMATION AND WERE PROVIDED BY WALLACE MONGTOMERY AND ASSOCIATES, JULY 2018.



EA Engineering, Science, and Technology, Inc., PBC
Hunt Valley Center
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031
(410) 584-7000

PROJECT NUMBER:	DESIGNED BY:	DRAWN BY:	FIGURE:
1564601	KEF / SMB	SMB	1
DATE:	CHECKED BY:	PROJECT MGR.:	SHEET NUMBER:
NOVEMBER 2018	LJO	MJG	-

GUDE LANDFILL REMEDIATION DESIGN
NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY
BASIS OF DESIGN REPORT
MONTGOMERY COUNTY, MARYLAND

FIGURE 1: EXISTING GRADES ANALYSIS

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GRADE ANALYSIS

COLOR	MINIMUM SLOPE	MAXIMUM SLOPE	AREA (SQ. FT.)
Magenta	0.00%	1.00%	54,134.39
Red	1.00%	2.00%	261,834.54
Yellow	2.00%	3.00%	767,303.72
Green	3.00%	4.00%	705,335.66

GENERAL NOTES

1. HORIZONTAL DATUM: MARYLAND STATE PLANE NAD 83
2. VERTICAL DATUM: NAVD 88, U.S. SURVEY FEET
3. PROPERTY BOUNDARIES AND OWNER INFORMATION ARE BASED ON A DRAWING ENTITLED "GUDE LANDFILL - PROPERTY EXCHANGE WITH M-NCPPC" PREPARED BY C.C. JOHNSON & MALHOTRA, P.C., DATED 05/23/2012.
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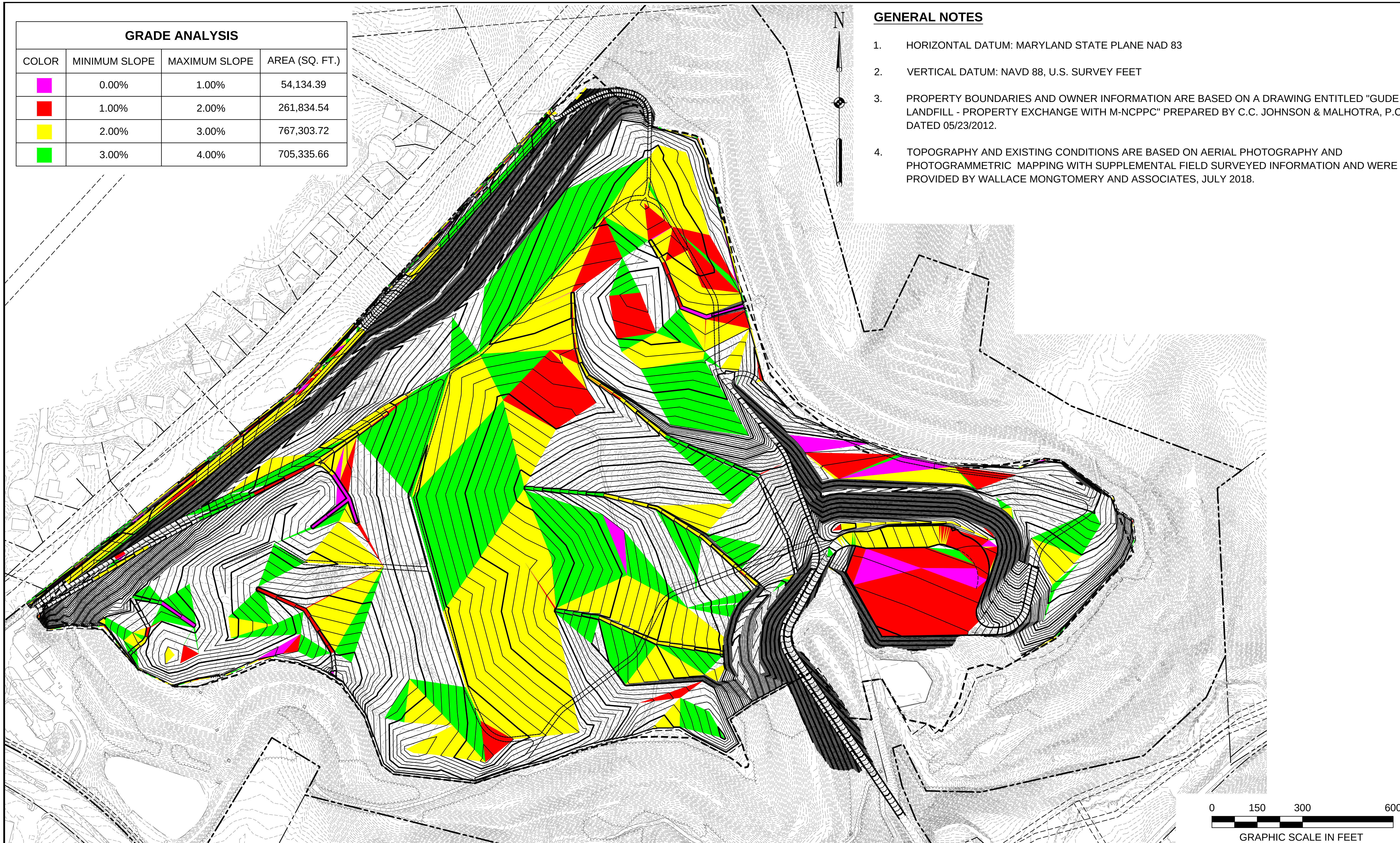

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PROJECT NUMBER:	DESIGNED BY:	DRAWN BY:	FIGURE:
1564601	KEF / SMB	SMB	2
DATE:	CHECKED BY:	PROJECT MGR.:	SHEET NUMBER:
NOVEMBER 2018	LJO	MJG	-

GUDE LANDFILL REMEDIATION DESIGN
NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY
BASIS OF DESIGN REPORT
MONTGOMERY COUNTY, MARYLAND

FIGURE 2: PROPOSED GRADES ANALYSIS

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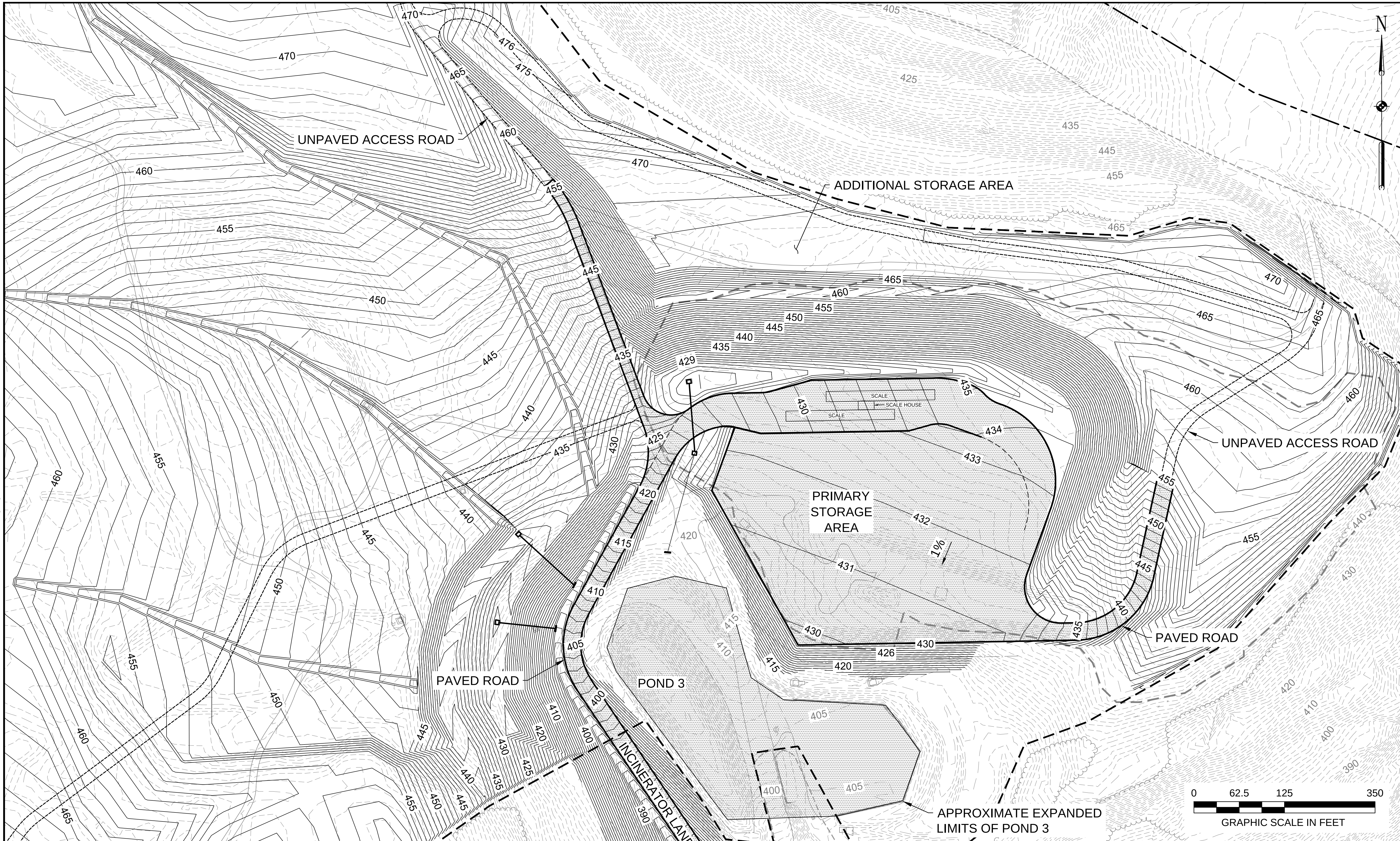

FILE PATH: Q:\PROJECTS\1564601 - GUDE LF DESIGN\CAD\PRODUCTION\FIGURES\1564601 - FIGURE 3.DWG [F-3] 12/20/16

EA Engineering, Science, and Technology, Inc., PBC Hunt Valley Center 225 Schilling Circle, Suite 400 Hunt Valley, Maryland 21031 (410) 584-7000	PROJECT NUMBER: 1564601	DESIGNED BY: KEF/SMB	DRAWN BY: CAG	FIGURE: 3	GUDE LANDFILL REMEDIATION DESIGN NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY MONTGOMERY COUNTY, MARYLAND	FIGURE 3: CONCEPT OPERATIONAL AREA
	DATE: NOVEMBER 2018	CHECKED BY: LJO	PROJECT MGR.: MJG	SHEET NUMBER: -		

REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION

DESIGNED BY: SS

DRAWN BY: SS

CHECKED BY: LJO

PROJECT MANAGER: MJG

GUDE LANDFILL REMEDIATION DESIGN
NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY

MONGTOMERY COUNTY, MARYLAND

FIGURE 5: LANDFILL GAS RADIUS OF INFLUENCE

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Figure 5

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