Tolson & Associates, LLC

Phase III Engineering Report Tolson Rubble Landfill Crofton, Maryland

November 30, 2009

Project Number: 0100203

Environmental Resources Management 200 Harry S Truman Parkway Suite 400 Annapolis, Maryland 21401 Tolson & Associates, LLC

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The site of the proposed Tolson Rubble Landfill near Crofton, Maryland has been under consideration for the permitting, construction and operation of a state-ofthe-art construction and demolition debris landfill since the 1990's. Numerous studies have been completed at the property to assess the ability of the site setting to meet the standards established by the Maryland Department of the Environment (MDE) for such a facility. Through this process, the MDE approved, dated November 22, 2006, a Phase I General Information Report for the site after acceptance of the potential facility by Anne Arundel County into its Solid Waste Management Plan, as stipulated in correspondence dated August 28, 2002. Subsequently, a Phase II Site Geology Report was completed and conditionally approved by MDE dated May 4, 2007. The conditions of this approval were based on an agreement to install additional monitoring wells surrounding the proposed landfill footprint as well as the existing closed landfill on the site and, by agreement, to develop an integrated monitoring system for both facilities. These wells were installed in August 2007. The Phase III Engineering Report submitted herein is based on the concepts presented in the prior submittals and meets the standards and guidance established in COMAR 26.04.07. These documents supersede any other parallel documents submitted for the proposed facility

The proposed facility will principally serve the current and future needs of Anne Arundel County (County) for an in-County disposal facility for construction and demolition debris. No such facility is currently operating in the County. Further, it is the intent of Tolson to recycle materials received to the maximum extent possible, including wood products, masonry, metals and similar materials. The landfill will be developed in concert with restoration of prior mining activities for sand and gravel at the site, and therefore will efficiently and effectively restore the property while mining continues in other areas of the site.

The landfill has been designed to meet all of the technical standards established by MDE for such facilities, and further, meets or exceeds the standard of care for CDD landfills. The site will be completely lined and finally capped after closure in a projected 19 years with a multi-layer system of materials that will assure encapsulation of the waste. Leachate and landfill gas will be managed through off-site or on-site treatment and discharge. A comprehensive monitoring system has been established at the site and operating for approximately 15 years which indicates no release from the existing facility to the environment. The enhanced system will operate through the post-closure period for the landfill. Given the proximity to existing residential and commercial communities, the site has further been designed to consider traffic, noise, and visual impacts, and mitigate these impacts as necessary. Presented herein are the detailed components of a Phase III permit application document, including design and construction description, Technical Specifications, Permit Drawings, Construction Quality Assurance/Quality Control Plan, Operation and Maintenance Plan, Monitoring Plan, and Closure and Post-Closure Care Plans. The original version of the Phase III Engineering Report was submitted on September 12, 2007. The Report was revised based on comments issued by the MDE dated February 7, 2008 and comments on supplemental information issued on June 6, 2008, and resubmitted on September 8, 2008. This version of the Phase III Engineering Report has been updated to reflect comments issued by the MDE dated January 7, 2009, in accordance with the Response to Comments incorporated herein. The revised documents are consistent with the MDE standards and represent a commitment to an environmentally safe and responsible project.

In order to assist the reviewer of this document in locating specific regulatory requirements under the Code of Maryland Regulations (COMAR) 26.04.07.16 governing the issuance of a Phase III permit, a permit application checklist follows which details each requirement and its location in these documents. It should be noted that this application is comprised of three components, entitled:

- "Phase III Engineering Report";
- "Phase III Appendices"; and,
- "Phase III Permit Drawings".

Each of the above documents is referenced, as appropriate, in the checklist. The following abbreviations have been used:

<u>Letter Prefix</u>	Referenced Document
Е	Engineering Report
А	Appendices
PD	Permit Drawings

Α		Phase IIIEngineering Plans and Specifications. Ten complete sets of plans and engineering reports covering the proposed project, prepared, signed, and bearing the seal of a registered professional engineer shall be submitted to the Approving Authority. These plans and specifications shall include the following information in sufficient detail to permit a comprehensive review of the project:	
(1)		A map which designates the property boundaries, the actual area to be used for filling, and existing and proposed structures and on-site roads.	PD
(2)		A description of any vehicle weighing facilities, communications (telephones, radios), maintenance and equipment storage facilities, and water supply and sewerage systems. On-site water supply and sewerage systems shall be approved by the Approving Authority.	E - Section 4.2
(3)		A description of the:	
	(a)	Types of solid waste: (1) To be accepted, and (2) Not to be accepted	E - Section 4.1.1
	(b)	Area and population to be served by the facility.	E - Section 4.1.2
(4)		The anticipated quantities of solid waste to be accepted and the calculations used to determine the useful life of the facility.	E - Section 5.3.5 and A - Appendix C
(5)		Proposed methods of collecting and reporting data on the quantities and types of solid waste received and for revising facility life expectancy projections.	E - Section 8.0 and A - Appendix G
(6)		The volume and type of available cover material, the calculated volume of earth needed for periodic, intermediate, and final cover, the location of earth stockpiles, and provisions for saving topsoil for use as final cover.	E - Sections 5.6.1 and 9.2.9
(7)		Proposed means of controlling unauthorized access to the site.	E - Section 9.1.7 and A - Appendix G
(8)		Proposed operating procedures including:	
	(a)	Hours and days of operation;	E - Section 8.0 and A - Appendix G
	(b)	Number and types of equipment to be used;	E - Section 8.0 and A - Appendix G

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(c)	Number of employees and their duties;	E - Section 8.0 and A - Appendix G
(d)	Provisions for fire prevention and control;	E - Section 8.0 and A - Appendix G
(e)	Means of preventing public health hazards and nuisances from blowing paper, odors, rodents, vermin, noise, and dust; and	E - Section 8.0 and A - Appendix G
(f)	Proposed method of daily operation including wet weather operation.	E - Section 8.0 and A - Appendix G
(9)	The location and depth of solid waste cells and the sequence of filling.	E - Section 5.3 and PD
(10)	Natural or artificial screening to be used.	E - Section 4.4.5
(11)	Methods of controlling on-site drainage, drainage leaving the site, and drainage onto the site from adjoining areas. Erosion and sediment control provisions shall be approved by the local soil conservation district and satisfy the requirements of Environment Article, Title 4, Subtitle 1, and COMAR 26.09.01.	E - Section 5.5 and PD
(12)	A contingency plan for preventing or mitigating the pollution of the waters of this State.	E - Section 7.0 and 8.0 and A - Appendices F and G
(13)	Proposed methods for covering and stabilizing completed areas.	E - Section 9.2
(14)	A system for monitoring the quality of the waters of the State around and beneath the site, including the location and types of monitoring stations, and the methods of construction of monitoring wells. Wells shall be installed by a State licensed well driller in accordance with COMAR 26.04.04.	E - Section 7.0 and A - Appendix F
(15)	If the Department determines that contamination of waters of the State has occurred or is liable to occur as a result of operation of the landfill, the Approving Authority may:	
(a)	Require the permit holder to periodically collect and analyze ground water or surface waters at the permitted site and to submit the results to the Approving Authority;	
(b)	Specify the number and location of the sampling stations, the frequency of the analyses, the sampling and analyses procedures, the pollutants to be monitored, and the reporting period.	

26.04.07.16 Sanitary Landfills - Rubble Landfills - Phase III		Section of Phase III Permit Application
(16)	A schedule for implementing construction and implementation of the operation plans and engineering specifications once the refuse disposal permit has been issued.	PD
(17)	A landfill closure and post-closure plan to be followed over a period of not less than 5 years after application of final cover.	E - Sections 9.0 and 10.0
(18)	The name, address, and telephone number of the person or agency responsible for the maintenance and operation of the site. Changes to this information shall be submitted to the Approving Authority once effected.	E - Sections 9.1.6 and 10.4
(19)	An engineered design, as described in §C of this regulation, for a liner system and leachate collection system for the proposed rubble landfill based upon geotechnical information developed in Regulations .14 and .15 of this chapter.	E - Sections 5.1 and 5.2, A - Appendix C, and PD
(20)	A proposed method, engineering specifications, and plans for the collection, management, treatment, and disposal of leachate generated at the facility, including the calculations used to determine the estimated quantities of leachate to be generated, managed, stored, treated, and disposed.	E - Section 5.2, A - Appendix C, and PD
В	Phase IIIPlan Review. The plan review shall be conducted in accordance with the provisions of Regulation .08D of this chapter.	
С	Liner and Leachate Collection System.	
(1)	The design of the liner and leachate collection system shall comply with the minimum requirements of this section.	E - Sections 5.1 and 5.2, A - Appendix C, and PD
(2)	A liner system shall be designed, constructed, and installed to contain and facilitate the collection of leachate generated in the landfill in order to prevent the migration of pollutants out of the landfill to the adjacent subsurface soil, ground water, or surface water. A liner may be constructed of natural earthen materials excavated from the site or imported from another location. A liner may also be constructed of a synthetic or manufactured membrane material.	E - Section 5.1, A - Appendix C, and PD

(3)

(4)

26.04.07.16 Sanitary Landfills - Rubble Landfills - Phase III	

A liner system shall:

(a)	Be constructed of materials having sufficient strength and thickness to prevent failure from pressure gradients, physical contact with waste or leachate, climatic conditions, installation, or daily landfilling operation;	E - Section 5.1, A - Appendix C, and PD
(b)	Include a liner constructed with a minimum thickness of 1 foot of clay or other natural material having an in-place permeability of less than or equal to 1×10^{-7} centimeters/second, or one or more unreinforced synthetic membranes with a combined minimum thickness of 50 mil or a single reinforced synthetic membrane with a minimum thickness of 30 mil which has a permeability less than or equal to 1×10^{-10} centimeters/second;	E - Section 5.1, A - Appendix C, and PD
(c)	Include a liner installed over a prepared subbase, free of objects which could damage the liner material, with a minimum thickness of 2 feet and having a permeability less than or equal to 1 X 10 ⁻⁵ centimeters/second;	E - Section 5.1, A - Appendix C, and PD
(d)	Be installed to cover all surrounding earth likely to be in contact with the waste or leachate; and	E - Section 5.1 and PD
(e)	Be constructed with a minimum slope of 2 percent to facilitate the movement of leachate towards the leachate collection system and to prevent the ponding of leachate on the landfill floor.	E - Section 5.1 and PD
	Under $C(3)(c)$ of this regulation, the subbase shall be constructed to support the liner and be resistant to pressure gradients above and below the liner in order to prevent failure of the liner due to settlement, compression, uplift, puncturing, tearing, cutting, or landfilling operations.	E - Section 5.1, A - Appendix C, and PD

(5) Upon completion of the installation and testing, the liner and leachate collection system shall be covered with a minimum of 2 feet of sized gravel or other highly permeable material to provide for the free passage of leachate to the liner and to serve as a protective layer for the liner and leachate collection systems.

E - Section 5.2, A - Appendix C, and PD

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(6)		A liner system shall be located entirely above the composite high ground water elevation as determined in Regulation .15A(4) and the elevation of bedrock as determined in Regulation .15A(6) of this chapter. A minimum vertical buffer distance shall be required between the bedrock elevation or the maximum expected ground water elevation, whichever is higher, and the bottom of the liner system including the subbase as specified in this regulation, as follows:	E - Section 5.1 and PD
	(a)	Except as specified in §C(6)(b) of this regulation, the minimum vertical buffer distance shall be 3 feet;	
	(b)	In Queen Anne's, Talbot, Caroline, Dorchester, Wicomico, Somerset, and Worcester counties, the minimum vertical buffer distance shall be 1.5 feet unless otherwise specified by the Approving Authority, which shall establish a minimum vertical buffer distance of 1.5 to 3.0 feet.	
(7)		An engineered leachate collection and removal system, located immediately above the liner, shall be designed, constructed, operated, and maintained to collect and remove leachate from the landfill. The leachate collection and removal system shall be:	E - Section 5.2 and PD
	(a)	Constructed of materials that are chemically resistant to the waste managed in the landfill and the leachate expected to be generated;	E - Section 5.2 and PD
	(b)	Of sufficient strength and thickness to prevent collapse or failure from loadings applied by overlying wastes, waste cover materials, and equipment used for landfilling operations;	E - Section 5.2, A - Appendix C, and PD
	(c)	Designed and operated to function without clogging;	E - Section 5.2, A - Appendix C, and PD
	(d)	Designed and operated to ensure that the depth of leachate over the liner does not exceed 30 centimeters (1 foot); and	E - Section 5.2, A - Appendix C, and PD
	(e)	Designed to operate solely by the force of gravity in all areas where the system will directly underlie solid waste.	E - Section 5.2, A - Appendix C, and PD

2.1 GENERAL

Tolson & Associates, LLC (Tolson) is proposing to build and operate a landfill to dispose of rubble in Anne Arundel County, Maryland. The State of Maryland regulates landfills to prevent nuisances or hazards and to protect human health and the environment. The location, design, and operation of landfills is regulated by the Maryland Department of the Environment (MDE) through solid waste disposal permits issued and enforced under the authority of the Code of Maryland Solid Waste Management Regulations (COMAR 26.04.07). The permit process as stipulated in COMAR 26.04.07 for landfills consists of the preparation, submittal, review, and approval of four documents. The first, Refuse Disposal Permit Application, initiates the permit application process; the second, Phase I General Information Report, describes the site geologic and hydrogeologic characteristics in broad terms as well as the proposed site activities; the third, Phase II Site Geology Report, provides detailed geologic and hydrogeologic information pertaining to the proposed landfill site, and a conceptual design for the facility in order to assess the sites suitability for accepting waste materials in an environmentally safe manner; and the fourth, Phase III Engineering Report, provides engineering design and operating plans for the proposed facility in sufficient detail to permit a comprehensive review of the project. The purpose of this document is to provide the detailed engineering design and operational plans on behalf of Tolson for the Tolson Rubble Landfill facility as part of the Phase III Permit Application.

This Phase III of the permit application is based upon a Phase I General Information Report, dated March 20, 2003, submitted to the Maryland Department of the Environment (MDE) as well as a Phase II Site Geology Report also submitted to the MDE, dated November 1, 2006. The permit application hearing on the Phase I General Information Report was held on July 14, 2004. Among the data provided at that time, the Phase I report included documentation that the proposed landfill conforms to the Anne Arundel County Solid Waste Management Plan, as confirmed in correspondence dated August 28, 2002 for the Anne Arundel County Department of Public Works (Appendix A). The Phase I General Information Report was approved by the MDE in correspondence dated November 22, 2006, and the Phase II Site Geology Report was approved in a correspondence dated May 4, 2007 (Appendix A). At that time, authorization was given to proceed with the Phase III Engineering Report in accordance with COMAR 26.04.07.16.

2.2 PHASE III ENGINEERING REPORT

This application provides information in order to comply with COMAR 26.04.7.07, specifically §.16 (Landfills – Rubble Landfills – Phase III report). This Phase III Engineering Report will discuss the following principal areas of landfill design and operation:

<u>Facility Background</u>. Provides general information pertaining to the landfill background, description, and proposed development.

<u>Waste Characterization</u>. Provides information related to the source of solid waste to be generated for disposal, the types of wastes which are acceptable for disposal, and the expected quantities and life expectancy of the facility.

<u>Landfill Design</u>. Provides detailed engineering design documentation, including calculations and supporting data for the landfill design.

<u>Monitoring Plan.</u> Provides information pertaining to the monitoring activities to be performed throughout the life of the facility.

<u>Construction Information</u>. Provides information related to the construction of the proposed landfill, including construction quality assurance (CQA).

<u>Closure Plan.</u> Provides information on facility closure upon the cessation of waste disposal operations.

<u>Post-Closure Plan</u>. Provides information pertaining to the inspection, monitoring, and maintenance program to be established following closure of the facility.

<u>Operations and Maintenance</u>. Provides information on the procedures that the facility will follow for operation and maintenance throughout the active life of the landfill.

Drawings are provided as part of the Phase III Permit Application (see Appendix B) to graphically depict the plans, sections, and details which describe the design and development of the proposed landfill facility. These drawings are intended to present all major environmental features of the landfill throughout its development and closure; structural and other non-environmental or construction-related elements will be added at the time of construction of the various phases of the project.

2.3 PROJECT BACKGROUND

The proposed landfill (i.e., designated as the "Tolson Rubble Landfill") is located on Tax Map 36, Parcels 9, 10, and 239, which comprise the "site" for purposes of this project (see Figure 1, Phase II Site Geology Report). The site property is currently occupied by an operating sand and gravel mining, washing and distribution quarry and a previously closed, approximately 20-acre rubble landfill (Maryland State Permit 89-02-04-09A). The site is remotely located at the end of Capital Raceway Road off Maryland Route 3 in the northwestern sector of Crofton, Maryland (see Figure 1, Phase II Site Geology Report). The landfill footprint will occupy approximately 72-acres of the site, centered on coordinates: 39° 02′ 35″North, 76° 42′ 20″ West. The site is bounded by undisturbed vegetated and treed buffer area to the north and northwest, and undeveloped land to the northeast; the Little Patuxent River valley to the west and southwest; Capital Raceway Park and Evergreen Road to the south; and the Reliable Contracting Disposal Facility and open land to the east (see the aerial photograph presented as Figure 2, Phase II Site Geology Report). Beyond the buffer areas to the north and northeast and along Evergreen Road are residential communities.

The specific portion of the site to be developed as the Tolson Rubble Landfill is currently a quarry where sand and gravel deposits have been extracted for commercial use, in conformance with a mineral extraction permit issued by the Maryland Department of Natural Resources (MDNR) (Permit No. 78-SP-0087-F), effective on April 21, 1978. The quarry has removed overburden as well as commercial sand and gravel, stockpiling the overburden on-site for future use in the construction and operation of the landfill. The Phase II Site Geology Report fulfilled the requirements of COMAR 26.04.07 in that it integrated data relative to site-specific geology based on field investigations with the existing background information presented in the Phase I General Information Report. The Phase II Site Geology Report was conditionally approved on May 4, 2007. The conditions presented in the MDE approval included the installation of replacement monitoring wells for incorporation into the groundwater monitoring program proposed in this Phase III Engineering Report for the landfill. The data collected during the installation of these wells is included in Appendix A.

The Phase II Site Geology Report provided specific baseline data as required by the regulations as well as an interpretation of the data to assess the potential of the proposed site to comply with the intent of the technical requirements. This data and interpretation, in conjunction with proper engineering design, will produce an operating landfill which affords environmental protection.

3.1 TOPOGRAPHY

The site is located in rolling terrain which ranges in topographic elevation from approximately 60 feet amsl in the Little Patuxent River valley to 200 feet amsl near the northern quarry boundary. The center of the site has been disturbed through the mining operations, achieving an average floor elevation of approximately 120 feet amsl.

The present ground surface topography; surface features (i.e., tree lines, fence lines, pavement, structures and well locations) at the proposed landfill site were surveyed using aerial photogrammetric methods in August 2006. Mapping was completed with a 5-foot contour interval, and the results integrated into existing topographic mapping available from Anne Arundel County (see Figure 3, Phase II Site Geology Report). The ground surface elevations in undisturbed areas surrounding the current quarry configuration range from 150 feet (amsl) to 200 feet amsl, and the surface slopes gently to the southeast until descending to the elevation of the Little Patuxent River at approximately 60 feet amsl along the southwestern boundary of the site. Elevations in areas that have been quarried extend to a minimum elevation of 113 feet amsl, but typically range from 120 to 145 feet amsl.

3.2 GEOLOGIC SETTING

3.2.1 Regional Geology

The site lies within the Coastal Plain Physiographic Province. The sediments of the Coastal Plain consist of interbedded sands, silts, and gravels deposited unconformably over crystalline basement rock that dips in an eastwardly direction. These Coastal Plain sediments begin at the "fall-line", located approximately 20 miles to the west, and generally thicken to the east at a low angle. At the surface in the area of the site are Upper Cretaceous sediments of the Magothy Formation and Lower Cretaceous sediments of the Patapsco, Arundel Clay and Patuxent Formations of the Potomac Group. There are also Pleistocene Age Patuxent River Terrace deposits near the Patuxent River that lie unconformably on top of the Cretaceous sediments. A generalized lithology and the hydrologic characteristics of these geologic formations are summarized in the Phase II report.

3.2.2 Local Geology

As presented in the Phase I report, the geologic map of Anne Arundel County illustrates that the western portion of the site contains surficial Quaternary sediments characterized by inter-stratified deposits of sands and gravels referred to in previous reports as the Patuxent River Terrace. These sediments lie unconformably above the Cretaceous sediments described below. However, most of these coarse sands and gravels, on the order of 20 to 70 feet in thickness at the site, have been removed during the mining activities at the site. On the northeastern third of the site are surficial deposits of the Magothy Formation, some of which have also been removed during mining activities. The lower area of the Magothy Formation is characterized by interbedded layers of sand and white to light gray clay, with some coarse gravel. Underlying both the Magothy Formation and the Patuxent River Terrace deposits are the Patapsco, Arundel, and Patuxent Formations of the Potomac Group. The Patapsco Formation contains alternating aquifers and confining units, whereas the Arundel Formation is a thick confining bed of clay and the Patuxent Formation consists of interbedded sands and clays.

3.2.3 Supplemental Investigation Activities

Thirty-five (35) monitoring wells (see Table 1, Appendix A) currently surround the site; fifteen (15) of these wells were associated with previous investigations, and were primarily located along the permitted periphery of the footprint of the quarry, and therefore the Tolson Rubble Landfill. Four (4) wells were installed as part of the original Phase II investigation (MW-15A and B, MW-16A and B),

twelve (12) additional wells have been installed to serve as supplemental/ replacement monitoring wells for the proposed groundwater monitoring network since submittal of the Phase II Site Geology Report.

The twelve (12) new borings were installed and completed as monitoring wells to establish a refined groundwater monitoring network for the proposed Tolson Rubble Landfill. Four (4) wells; i.e. MW-17A, MW-17B, MW-18A, and MW-18B, were installed upgradient from the current phase of the sand and gravel operation. Four (4) others; i.e. MW-19A, MW-19B, MW-20A and MW-20B, were installed downgradient and two (2), MW-8B and MW-22A, were installed crossgradient of the proposed landfill footprint. MW-21A and MW-21B were installed between the proposed Tolson Rubble Landfill and the closed Cunningham Rubble Landfill for the purposes of differentiating any releases form the two facilities. Shallow wells, denoted by the letter "A", ranged between 50 and 100 feet in depth. Deep wells, denoted by the letter "B", extended up to 208 feet in depth.

The placement of the new/replacement monitoring wells was designed to complete the monitoring network, described in more detail in Section 7.0, for the combined Tolson and Cunningham Rubble Landfills in both the near-surface unconfined aquifer and the deeper-confined aquifer. Five (5) of the new borings; i.e., MW-17A, MW-18A, MW19A, MW-20A and MW-22A, were completed to the top of the underlying confining unit, confirming its presence across the site. MW-17B, MW-19B, MW-20B, MW-21B, and MW-8B penetrated the confining unit, which was demonstrated to be greater than 30 feet thick in each of these borings. These borings were then completed as deep monitoring wells as described below. Boring logs from these field investigations are included in Appendix A; the boring logs from previous investigations at the site were included in the Phase II Site Geology Report-Appendix C, for reference. The boring logs include the lithologic descriptions of the various soil deposits encountered.

The twelve (12) new monitoring wells were completed with a 2-inch diameter Schedule 40 polyvinyl chloride (PVC) riser and slotted well screen placed in a 6-inch diameter open borehole. The well screen annulus was backfilled with a silica sand filter pack to at least two (2) feet above the well screen followed by a 2-foot thick bentonite plug to prevent water from infiltrating the borehole, and Portland cement grout to the ground surface. Monitoring wells MW-17A, MW-17B, MW-18A, MW-18B, MW-19A, MW-19B, MW-20A, MW-20B, MW-21A, MW-21B, MW-22, and MW-8B were finished with a protective steel well casing and cover, and set in a 2-foot by 2-foot concrete pad. Well construction logs for all twelve new monitoring wells are included in Appendix A.

3.2.4 Lithology

In general, the shallow soils at the Site are comprised of medium to coarse sands with some gravel and silt material. These soils were saturated at approximately 100 feet amsl; i.e., 10 to 15 feet below the proposed cell floor elevation in most areas. These saturated sediments create an unconfined aquifer above the thick confining unit of silt and clay that exists below the entire site.

The boring logs from previous investigations, as well as those from the supplemental investigation, were used to extend and update three of the existing cross sections (B-B', D-D' and E-E') as well as create a new cross section, F-F', to graphically depict the materials and deposits encountered. Figure 1 in Appendix A depicts the orientation of the cross sections in plan; the cross sections are presented as Figures 2 through 7 in Appendix A.

The stratigraphic units encountered are consistent across the site, as depicted on the cross sections. The upper sediments represent deposits associated with the Patuxent River Terrace, as well as some similar deposits of the Magothy Formation and the Potomac Group. These silts, sands, and gravels compose the upper unconfined aquifer in the area. The extensive continuous confining unit underlies the entire site, and is interpreted as a confining bed of the Potomac Group. Below this confining unit are several alternating layers of confined aquifers and confining units (aquitards).

3.3 HYDROGEOLOGIC SETTING

3.3.1 Regional Hydrogeology

As described in Section 2.2.1 of the Phase II Site Geology Report, there are three aquifers in the general area of the site, located within the Magothy, Patapsco, and Patuxent Formations. All three aquifers increase in thickness as they dip to the east-southeast. The majority of the Magothy Formation outcrops to the east of the Site and therefore does not exist beneath the proposed landfill footprint. As precipitation enters the ground surface, much of the shallow groundwater locally creates an unconfined aquifer that discharges to the nearest surface-water body. In the area near the Site, the upper unconfined groundwater flows toward the Little Patuxent River to the southwest. The water that does not enter the surface-water body enters the regional groundwater flow, which migrates to the southeast, drawn toward pumping well stations in Crofton and Annapolis that have created cones of depression within the Patapsco and the Patuxent Formations.

3.3.2 Local Hydrogeology

Groundwater at the site exists in two aquifers, the upper, unconfined aquifer and a deeper, confined aquifer beneath a dense confining layer that is continuous across the site. The upper, unconfined aquifer lies above the low-permeability silt and clay sediments that are a hydrologic confining unit for the deeper aquifer. Table 1, Appendix A indicates the monitoring wells installed at the site, many of which are part of the current groundwater-monitoring program for the closed rubble landfill (see Section 7.0). Monitoring wells MW-1A, MW-2B, MW- 4A, MW-5A, MW-7A, MW-8A, MW-9A, MW-10A, MW-11A, MW-12A, MW-13A, MW-14A, MW-15A, MW-16A, MW-17A, MW-18A, MW-19A, MW-20A, MW-21A, and MW-22A are all screened in the shallow, unconfined aquifer above the confining unit (see Figure 8, Appendix A). Groundwater in the shallow aquifer generally flows regionally toward the southeast, and locally southwesterly toward, and discharging to the Little Patuxent River (Figure 8, Appendix A).

Table 1, Appendix A also includes the monitoring wells that are screened in the deeper, confined aquifer: monitoring wells MW-1B, MW-2A, MW-3B, MW-4B, MW-5B, MW-7B, MW-11B, MW-15B, MW-16B, MW-8B, MW-17B, MW-18B, MW-19B, MW-20B, and MW-21B (Figure 9, Appendix A). Groundwater in the deeper aquifer also flows to the south-southwest beneath the site (Figure 9, Appendix A).

Local groundwater movement was evaluated using the hydraulic gradients and hydraulic conductivity of the aquifer units as presented in detail in the Phase II Site Geology Report. Hydraulic conductivity values, estimated from both slug tests and particle-size analyses, ranged from 0.5 to 20 feet/day. The geometric mean of these values was 2.86 feet/day. These hydraulic conductivity values aided in producing a projected groundwater velocity of 0.09 feet/day to 0.62 feet/day, which indicates that groundwater flows between 33 feet/year to 228 feet/year laterally in the shallow aquifer beneath the site.

The velocity of groundwater vertically across the confining unit is estimated to be 0.0014 ft/day or 0.53 ft/year. Over the thinnest section of the confining unit (30 feet) encountered at the site, the migration of contaminants would require an estimated 57 years to penetrate the confining unit and enter the deeper confined aquifer.

3.4 WATER QUALITY

3.4.1 Surface Water

Unlike groundwater quality data (see Section 3.5.2), limited historical surfacewater quality data is available for the Site. However, as discussed in Section 5.2, Section 5.5, and Appendix F, surface-water quality will be monitored at any discharge point from the stormwater management system or the leachate collection/treatment facility. Stormwater discharges will be monitored under the General Surface-Water Discharge Permit issued by the MDE for discharge to the Little Patuxent River. The frequency of surface-water sampling and analytical parameters to be monitored, if any, will be specified in that permit. Leachate will be sampled and analyzed in accordance with the industrial pretreatment discharge requirements of the receiving disposal facility to ensure that the concentration and constituents are compatible with the leachate treatment/waste water plant. In the event that leachate is treated on-site in the future and discharged to a surface-water body near the site, monitoring and reporting will be conducted in accordance with a National Pollutant Discharge Elimination System (NPDES) Permit issued for that facility.

3.4.2 Groundwater

A comprehensive explanation of groundwater quality at the site was presented in the Phase II report; however a summary is provided herein for background purposes. All of the groundwater data collected over the past 18 years at the site is available in the Phase II Site Geology Report-Appendix G.

The chemical water quality of the upper and lower aquifers has been measured periodically for 18 years (from 1989 to the present) as part of the Groundwater Management Plan for the closed rubble landfill. Field parameters, including pH, specific conductance, temperature, dissolved oxygen, and turbidity, have been measured semi-annually. Standard water-quality parameters, including alkalinity, total dissolved solids, hardness, chloride, sulfate, total organic carbon, chemical oxygen demand, ammonia, nitrate, and nitrite, were analyzed in the laboratory as a part of each event. Volatile organic compounds (VOCs) and twenty-two (22) target analyte list (TAL) metals (excluding aluminum) were also analyzed in the laboratory. For the Phase II report, the recent groundwater data, from 2000 to 2005, was examined as representing the most current condition. Several metals, namely manganese and iron, were repeatedly reported at concentrations above the national secondary drinking water standards (NSDWS) but most likely represent natural background levels, as is evidenced by their similar appearance in the upgradient as well as downgradient wells. No VOCs were reported above the national priority drinking water standards (NPDWS).

4.0 OPERATIONAL CRITERIA

4.1 STATEMENT OF NEED

This section provides a description of the landfill operating criteria as required by COMAR 26.04.07.16.

4.1.1 Waste Stream

The Tolson Rubble Landfill will be restricted to receiving only rubble waste (e.g., construction debris, land clearing debris, demolition debris), in conformance with COMAR 26.04.07.13B, and the Refuse Disposal Permit Application filed for the site dated July 30, 2002, and any final permit issued for the facility. Wastes excluded from disposal at the Tolson Rubble Landfill include, but are not limited to, the following:

- Controlled hazardous substances as specified by federal or state regulations.
- Liquid wastes or any waste containing free liquids as determined by the USEPA Method 9095 paint filter liquids tests as outlined in the USEPA publication SW-846 "Methods for Evaluating Solid Waste, Volume 1C: Laboratory Manual Physical/Chemical Methods." Third Edition, dated November 1986: (Wastes may not be frozen below 32°F).
- Special medial wastes as defined in COMAR 23.13.11.
- Radioactive materials, as defined in COMAR 23.12.01.
- Motor vehicles.
- Drums or tanks, unless empty and flattened or crushed with the ends removed.
- Animal carcasses resulting from medical research activities or the destruction of diseased animals.
- Untreated septage or sewage scavenger waste.
- Municipal solid waste, including refuse from households and street sweepings from governmental road operations.
- Batteries.
- Hot ashes.
- Other items that in the opinion of the Owner are not acceptable may also be rejected.

Asbestos will be accepted in accordance with the provisions of COMAR 26.04.07.13(5).

4.1.2 Service Area

The Tolson Rubble Landfill will receive rubble wastes (e.g., construction debris, land clearing debris, demolition debris) generated primarily within Anne Arundel County, Maryland. The facility is, however, not restricted and may also receive rubble wastes generated within adjacent counties (e.g., Baltimore County, Calvert County, Howard County, Prince George's County).

4.2 SITE INFRASTRUCTURE

4.2.1 Access Roads

The Tolson Rubble Landfill operating floor will be accessed via the existing sand/gravel haul road at the northern end of Capital Raceway Road. A new 16-foot wide gravel access road will be constructed along the western perimeter of the landfill connecting the existing haul road with the leachate storage tank/treatment area. This road will provide truck access for periodic loading of accumulated leachate. Additionally, access to the sediment basin for performance of maintenance activities (e.g. periodic sediment removal) will be obtained via this road will be extended to the northern corner of the landfill to facilitate access to the top of the landfill.

4.2.2 Facilities

A variety of facilities supporting the existing sand and gravel mining operation currently exist at the site, including an office building, maintenance building, and truck scale house. These existing facilities will also provide support during the operation of the proposed landfill. These landfill-pertinent facilities are all located near the entrance to the site. The office building will be used to store all records associated with the operation and maintenance of the landfill. The site superintendent's office, a telephone, bottled water, and a restroom will also be available in this facility. The maintenance building will be utilized for servicing small landfill operating equipment, as well as storing maintenance supplies and smaller back-up equipment (i.e. submersible pumps). One employee will be designated to work at this facility and will be responsible for the repair and preventative maintenance of landfill equipment. The scale house is located along the site access road and will be utilized to determine the quantity of materials brought to the site as well as to inspect loads in accordance with the Operation and Maintenance Plan. In addition to these existing facilities, a leachate management facility will be constructed to store leachate collected by the leachate collection system. The facility will initially consist of two 50,000 gallon storage tanks and associated containment, piping and delivery systems. While not included in the current design, it is anticipated that a wastewater treatment plant will be constructed in the future to permit on-site treatment and the discharge of leachate to a local surface-water receiving stream.

4.2.3 Utilities

Water, sewer, electric, and telephone services currently exist at the site in support of the existing sand and gravel mining operation. Water is supplied to the existing maintenance building and office building from a deep water well located approximately one-half mile south of the proposed rubble landfill. Sewage disposal for the maintenance building and office building is provided by 1,500 gallon septic tanks.

4.2.4 Communications

In addition to the telephone service at the existing office building, a two-way radio system will be utilized at the facility to facilitate communication between personnel throughout the landfill site.

4.3 LANDFILL DEVELOPMENT

The proposed Tolson Rubble Landfill will be constructed within the property boundaries depicted on Drawing No. G2, Appendix B. Landfill development will occur in four phases (Phase 1 through Phase 4). Development in each phase will be separated into a series of cells; a detailed discussion of the sequence of phase development is presented in Section 5.3.

In general, each phase will be prepared, including liner system and leachate management system construction, at the outset of the phase development. However, the phases will be operationally subdivided into cells for control purposes, particularly for the management of stormwater and leachate. Each cell will be interim-closed as it is completed, and each phase will be permanently closed to the extent possible as it is completed.

A gravity-flow leachate collection system will be installed within the floor of the landfill as the base phases are developed. The leachate collection system will consist of 24 inches of native sand/gravel, or an alternative material approved by MDE, over the liner system, and perforated interceptor-piping lines within the drainage material. The interceptor piping will consist of heavy-duty polyethylene piping laid in a swale or "valley" along the lowest point of the leachate management system to assure collection of the flow from the drainage material. The piping will be sloped toward a sump at the perimeter of the liner system.

Stormwater management is required during any project which modifies the existing topography. During all four phases of landfill development, site grading and the existing topography will direct enhanced stormwater flows to the boundaries of the landfill. Stormwater will ultimately be directed to the proposed sediment basin/stormwater management pond located along the western boundary of the landfill footprint and the sediment traps located along the southern boundary of the waste placement areas. Proposed stormwater diversion berms, terraces, downchutes, and associated perimeter drainage ditches will direct stormwater to the sediment basin/stormwater management pond and several sediment traps.

The liner system will include a geomembrane installed over a prepared subbase. The geomembrane will be constructed of 60-mil thick high density polyethylene (HDPE). The prepared subbase will have a minimum thickness of 24 inches and a permeability no greater than 1×10^{-5} cm/sec.

The ultimate waste disposal area, after filling is completed in Phases 1 through 4, will cover approximately 71.6 acres with an approximate maximum elevation of 230 feet amsl, which is 30 feet above the existing surrounding topography. This configuration yields approximately 6,780,920 cubic yards of total airspace within Phases 1 through 4. Based on the estimated disposal rate of 1,000 cubic yards per day, the disposal capacity of this landfill will extend through approximately the year 2031, assuming waste placement commences in 2009.

4.4 OPERATING PROCEDURES

4.4.1 Noise Impacts

4.4.1.1 Background

Sound propagation involves three principal components: a noise source, a receptor, and the transmission path. While two of these components, the noise source and the transmission path, are easily quantified (i.e. direct measurements or predictive calculations), the effects of noise to humans is the most difficult to determine due to the varying responses of humans to the same or similar noise patterns. The perception of sound (noise) by humans is very subjective, and as with odors and taste, it is very difficult to predict a response from one individual to another. To address the direct physical effects, such as hearing loss, and the less direct effects of interference with activities such as sleep and conversation, noise standards and criteria have been developed.

In 1974, the State of Maryland enacted regulations to limit the maximum allowable noise levels for receiving land use to protect the health, general welfare and property of the people of the state. These limits are set forth in COMAR, Title 26 Department of the Environment Subtitle 02 Occupational, industrial, and residential hazards Chapter 03 Control of Noise Pollution, and are as follows:

Maximum Allowable Noise Level (dBA)For Receiving Land Use Categories	Time	Sound Level Limit (dBA)
Residential	7 a.m 10 p.m. 10 p.m 7 a.m.	65 55
Commercial	7 a.m 10 p.m. 10 p.m 7 a.m.	67 62
Industrial	All times	75

Furthermore, the regulations require a 5 A-weighted decibel (dBA) reduction for each limit as set above for any source of sound which emits a prominent discrete tone. A prominent discrete tone is a sound which can be distinctly heard as a single pitch or a set of single pitches. The sound sources within the Tolson Rubble Landfill will not emit prominent discrete tones.

In addition, Anne Arundel County enacted regulations specifically for landfill and rubble and construction debris landfill operations. Article 18 Title 11 Paragraph 129 (10) states: "The sound level at any lot line may not exceed an average of 55 dBA or a peak of 60 dBA."

4.4.1.2 Previous Noise Study

In 2005, Scantek, Inc. conducted a noise study for the on-site sand and gravel operation. This operation, which is currently on-going, involves the use of construction and earthmoving equipment and off-road trucks. As a result, sound (noise) generated by these sources propagates to the nearby residents to the northeast. The study measured the maximum, FAST, A-weighted sound pressure level for the anticipated equipment to be used, as defined by MDE. Analysis and modeling of the sound propagation was performed using the computer modeling program, <u>CadnaA</u>, and concluded that the sound produced by the sand and gravel operation would be below the limits regulated by the State of Maryland and Anne Arundel County.

The results produced from this study represent a reasonable background baseline for the rubble landfill operation that will be conducted to the southwest of both the sand and gravel operation and most residences.

4.4.1.3 Source Defining

The sources of sound from the Tolson Rubble Landfill can be divided into two phases; the installation of the landfill systems and the daily landfill operations. Closing of the landfill is incorporated into the daily landfill operations. Additional sources from existing operations in the area, such as the racetrack and Maryland Route (Rte.) 3, are outside the realm of this study, and are not considered. Operations from the sand and gravel operation will only be considered for the receptors within the previous study.

The installation of the landfill primarily consists of material and structure placement and soil grading for stormwater management features, drainage systems, and other features necessary for proper future operations. The majority of these operations will be conducted within the existing depressed areas, which will significantly decrease the propagation of sound to nearby receptors. The greatest propagation of sound will occur during installation at the landfill borders. At these locations equipment will be at a maximum elevation, reducing or eliminating the attenuation of sound from barriers.

Sources are defined with a maximum anticipated set of equipment operating concurrently at a maximum anticipated elevation and approximately 50 feet from the outer extent of operations. These sources have an assumed generation height of 6 feet, and are as follows:

- Dozer;
- Loader; and,
- Backhoe.

The daily landfill operation primarily consists of rubble unloading, transport, and soil covering. The locations of these activities will occur below the surrounding elevation for a majority of the landfill operating life. The propagation of sound will increase as the landfill elevation continues to increase until its final elevation is reached. The greatest propagation of sound will therefore occur at the final landfill elevations closest to the receptors. At these locations equipment will be at a maximum elevation, reducing or eliminating attenuation of sound from barriers.

Sources will be defined with a maximum anticipated set of equipment operating concurrently at a maximum anticipated elevation and at distances that would create the highest sound level to nearby receptors. These sources will have an assumed generation height of 6 feet, and are as follows:

- Dozer;
- Loader; and
- Haul Truck.

Most construction and landfill related equipment operates at a noise level between 75 and 90 dBA measured from a distance of 50 feet. As a general ruleof-thumb, noise levels from a point source such as construction equipment will attenuate 6 dBA per doubling of distance. As an example, if a dozer generates 85 dBA at 50 feet, the noise level at 100 feet under ideal conditions would be 79 dBA. This rate of attenuation is increased by soft soil conditions, heavy vegetation, and certain weather conditions; however, these factors are relatively minor and difficult to calculate, and therefore are not considered herein. The noise levels generated by the specific types of equipment to be used at the facility are as follows:

Equipment	Maximum Noise Level (dBA) at 50 feet	
Backhoe	80	
Bulldozer	85	
Loader	80	
Haul Truck	84	

Source: USEPA, 1971; "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances". NTID 300.1

4.4.1.4 Receptors

The sensitive receptors of interest for this study include the two residential zones to the northwest and northeast. The northwest zone is the Four Seasons development of single family houses. This zone is currently protected from visual and sound derived from the sand and gravel operation by a vegetated soil barrier. The barrier extends the full length of the northeast property boundary at elevations ranging from 220 to 240 feet above mean sea level. The northwest zone is a recently constructed multi-unit housing development. This zone is located as approximately the same elevation as the proposed landfill outer bounds with a valley located between. Attenuation, except as it occurs over standard distances, was assumed to be insignificant.

Receptors near the site have an assumed maximum height of 12 feet, the height of a second story, open window.

4.4.1.5 *Methods*

The propagation of sound from an originating source to a receptor is determined by three main factors: number of sources, distance, and impediments (as mentioned, weather conditions also affect propagation, but to a less significant and highly variable degree).

Sound pressure levels (SPL), or magnitude of noise levels, do not act in a cumulative manner; instead, the level is only slightly greater than the individual parts. For example, adding a second and third SPL of the same magnitude as the first will increase the resultant level by 3.0 dBA and 1.8 dBA, respectively. The reason for this is that numerical values for SPL are based upon a logarithmic scale. The following is a standard equation for the summation of SPLs:

$$L_{eq} = 10 \text{ Log} (\Sigma 10^{(\text{SPL}/10)}/\text{N})$$

where:

 L_{eq} = equivalent constant SPL that would be equal in sound energy to the varying SPL over the same time period

Sound will also dampen in a generally logarithmic manner over distance as friction within the air weakens the sound waves. The following equation determines the amount of attenuation over a set distance compared to a reference distance (d_r), and is equivalent to approximately 6 dBA doubling each distance:

 $20 \log_{10} (d/d_r)$

Sound travels in a line-of-sight manner and impediments such as a soil, concrete, or other solid structures of relative thickness will consequently cause significant dampening. The level of dampening depends on the height and angle of the barrier compared to the line-of-sight line between the source and receptor. Sound will still reach the receptor from waves traveling over and from reflection, but will be weaker for not having traveled in a direct pathway. The maximum attenuation from impediments is generally limited to approximately 25 dBA for modeling purposes.

4.4.1.6 *Results*

Data analysis was conducted to determine the maximum anticipated sound propagation sensed by the sensitive receptors. The source locations were individually located for each receptor based on distance and elevation (see Noise Calculations, Appendix C). Two daily operation locations were examined in reference to the Four Seasons residences to consider the varying height of the soil barrier. The results of the analysis are presented below:

Receptor	Maximum Noise Level (dBA)		
	Installation Scenario	Daily Operation Scenarios	
Four Seasons Single Family Residences	45.7	44.3 (a) and 45.6 (b)	
Four Seasons (Including mine sound source)	55.1	55.0 (a) and 55.1 (b)	
Multi-unit Housing	59.9	59.9	

a. Source location at maximum landfill elevation

b. Source location at medium elevation and distance

4.4.1.7 Conclusion

The maximum noise levels generated are below the peak values allowed by the State of Maryland (65 dBA) and Anne Arundel County (60 dB) for both receptor areas under worst-case scenarios. The multi-unit housing receptors may, however, experience sound levels above the average allowable limit of 55 dBA as specified by Anne Arundel County for short durations; however, it would not be reasonable to assume that the maximum anticipated equipment set would be working at the outer extent of the landfill either during installation or daily operation at full-power for more than a short period. Further, these episodes would occur during the workday when most receptors would not be available. In addition, while the multi-unit housing may experience sound levels nearly equal to the peak sound level allowed, it is anticipated that the forest buffer between the landfill and residences will adequately reduce these levels.

It should be noted that meeting these codes does not mean the sounds produced by these operations will be inaudible; however, they will be relatively low and only be of concern during daytime operating hours.

4.4.2 Traffic Movement Study

A limited traffic movement study was conducted to evaluate the additional traffic load and safe travel movement generated by tucks serving the Tolson Rubble Landfill. The primary traffic route for trucks associated with landfill activities is anticipated to use Rte. 3 and Capital Raceway Road, with lesser dependencies on Rtes. 424 and 450, and other local roadways. Capital Raceway Road is a private industrial access road with very low traffic loads and will not be significantly affected by the additional loadings. Rte. 3 is expected to face the largest impact as a result of the additional truck traffic. Surrounding roadways, including Rtes. 424, 450, and 50, and Interstate 97 may also experience additional traffic, but the aggregate effect is not expected to be noticeable. Specifically:

- The proposed landfill is located within the existing Cunningham Sand and Gravel operation, which provides aggregate for local construction activities. As a result, traffic patterns are expected to stay constant and similar, consisting of primarily truck traffic.
- The landfill is anticipated to accept 100 heavy trucks and 20 light trucks per day during the term of its operation; daily fluctuations are anticipated and will be driven by market and construction factors.
- The heavy trucks that will deliver rubble to the landfill have different traffic peaking characteristics compared to the standard traffic flow. The highest traffic times at the landfill will be between 10:00 a.m. and 4:00 p.m. Thus, much of the truck traffic will occur at times outside of the normal peak periods for commuter traffic and truck traffic at the sand and gravel operation, and will not contribute significantly to peak period traffic volumes.
- The sand and gravel operation has relocated immediately to the east. This operation is therefore now restricted to 2,500 truck trips per month (approximately 83 per day) by agreement with the community, and will therefore not experience a growth affect in concert with the landfill traffic in the future. The number of truck trips generated by former mining operations within the landfill area will only be replaced by the new sand and gravel operation.
- The average daily traffic load from the site is anticipated to be 203 vehicles, 183 of which are classified as Class 5 or greater, defined as vehicles with six or more tires.
- The Capital Raceway, which also utilizes the same access route, only adds significant traffic to the associated roadways during the evening hours of Friday through Sunday, including queuing along a majority of the one half-mile long Capital Raceway Road starting around 4:00 p.m.

4.4.2.1 Existing Traffic Conditions

The annual average daily traffic (AADT) volumes on routes to the existing sand and gravel operation are indicated in Appendix C-Nuisance Calculations, and represent 2006 statistics gathered by the Maryland Department of Transportation, State Highway Administration (MDOT SHA). The results represent the total number of vehicles that passed a given point, in both directions, through a 24-hour period. The counting station nearest to Capital Raceway Road is located approximately 0.2 mi north of the Rte. 450 Intersection, directly adjacent to the Capital Raceway Road T-intersection. The annual average weekend daily traffic (AAWDT) at that station is 77,060 vehicles, making it one of the most heavily traveled arterial sections in the area.

4.4.2.2 Vehicle Classification

Trucks comprise a relatively small portion of the total traffic for principal arterials, 5.52% as stated by the Maryland SHA. For purposes of this study, trucks are considered single unit or trailer vehicles with two or more axles and six or more tires. All other vehicles are classified as automobiles or multi-trailer trucks.

4.4.2.3 Area Traffic

The surrounding traffic is primarily commercial, industrial, business, and community related. There are significant industrial and commercial establishments located along the Rte. 3 highway. Demand on the highway peaks during morning and evening commuter rush hours, 6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m., respectively. A majority of the existing sand and gravel and proposed landfill operations will approach the site after the peak morning commuter period and will have ceased prior to the evening peak.

4.4.2.4 Level of Service

Level of Service (LoS) is a quantitative and qualitative measure of traffic flow on a given street or highway. LoS is affected by highway characteristics such as number of lanes, roadway widths, shoulder widths, traffic control devices, and geometric alignment. Six service levels (A-F) are used to describe the range in traffic congestion, where "A" represents the optimal operating conditions, freeflowing with unimpeded maneuverability, and F represents the most severe congestion and delays.

Rte. 3 is a multi-lane highway (principal arterial) with two or three lanes per direction, wide shoulders, and gently rolling terrain. The section of roadway within the vicinity of Capital Raceway Road is three lanes wide and includes exclusive turning lanes at high profile intersections. The highway is divided by a wide grass median, has a signalized intersection density of approximately 1 per mile, and a speed limit of 50 miles per hour (mph). Visibility is greater than a ¹/₂ mile in most locations.

Rte. 3 has a capacity of approximately 1,700 vehicles per hour per lane, as derived from the USDOT FHA and *Highways Capacity Manual* (HCM) for multilane highways. Assuming a minimum of six travel lanes and 60% "green" time at intersections, Rte. 3 should have a peak capacity of approximately 6,600 vehicles per hour (vph). In 2006, Rte. 3 experienced 6,165 vph during peak commuter times (8% of AAWDT) and approximately 4,000 vph (5% of AAWDT) during daytime non-peak hours. These loadings would represent service level E, marked by severe congestion and delays, and B, marked by reasonably unimpeded operations with slightly restricted maneuverability. These designations are representative of the observed existing conditions.

AADT on Rte. 3 at the counting station has increased by approximately 3 percent per year since 2000, with generally slower growth since 2003. Much of the additional traffic can be associated with increased residential and commercial development within the immediate vicinity, and thru-traffic to other principal arterials and highways.

4.4.2.5 Future Traffic Conditions

The Tolson Rubble Landfill would add approximately 100 heavy trucks per day and 20 light trucks from Monday to Friday during daytime non-peak hours. This addition would increase the Rte. 3 current loading by 28.4 vph on weekdays, with a 1.5 adjustment factor for heavy vehicles. This is approximately 0.7 percent increase over the existing conditions. Overall, the increased load associated with the landfill would not, therefore, significantly affect the stability of Rte. 3 and connecting arterials.

4.4.2.6 Safe Site Distances

Access to the Tolson Rubble Landfill is restricted to Capital Raceway Road, which can only be accessed from the southbound lane of Rte. 3. Rte. 3 has a 250foot exclusive turning lane to facilitate the safe travel of heavy loads entering Capital Raceway Road. The sight distance for traffic leaving Capital Raceway Road is approximately one-half mile, well in excess of safe sight standards.

Northbound traffic intended for the landfill will often use the access road, located between the Wendy's and Boston Market restaurant establishments, to reverse direction. Access points on the left-hand side of the northbound lane, including the specified access road, have an exclusive turning lane. The site distance from this access road is approximately 1,700 feet.

4.4.3 Fugitive Dust

The site has been a sand and gravel quarry for many years, and mining operations are continuing. Therefore, a significant portion of the land development aspects of the landfill construction; i.e., creating the excavation, has been completed. As a result, the initial construction of the landfill will be of minimal duration, and the major source of fugitive dust will be vehicular traffic on the unpaved site roads. During landfill operations, stockpiled construction materials, daily cover soil, and completed but not yet fully stabilized areas of the landfill cover will also present sources of fugitive dust. Daily watering of the
traveled roads and exposed soil surfaces will significantly decrease the volume of fugitive dust emitted. Additional dust control measures will include the stabilization of soil stockpiles and intermediate and final cover areas through the immediate establishment of vegetation. On this basis, it is estimated that approximately 22 tons of dust a year will be released during the landfill operation, based upon AP-42 emission factors. The majority of this dust (PM-10+) will deposit back within the landfill area. Thus, the implementation of operating plans for a new landfill will not present an additional burden on air quality.

4.4.4 Odors

It is anticipated that no noticeable odors will be produced by the operations at the Tolson Rubble Landfill. Since the landfill will only be accepting construction debris, the majority of which will consist of concrete, metal, and wood, gaseous production will be minimal. Gases that are produced during the lifespan of the landfill will be directly vented to the atmosphere from a system of passive air vents, resulting in a slow release that would rapidly disperse and dilute in the atmosphere.

4.4.5 Visual Impact

The existing state of the Tolson Rubble Landfill area is a large earthen depression below the visible line-of-sight of neighboring roadways and residential developments. As lifts are added to the landfill, the elevation of the land will rise to the anticipated final height of 230 feet above mean sea level (amsl). At this elevation, the landfill mound would remain hidden from the surrounding roadways and residences at the Four Seasons development as a result of the constructed earthen barrier. Further, the forested area between the landfill and northwestern residences is expected to eliminate the visual impact of the landfill for a majority of the residences. The final lifts of the landfill may become visible to certain residences in upper story locations where the forest is sparsest.

4.4.5.1 Visual Aspects

Landscape design affords a buffering from view of daily work activities while providing the additional benefit of expanding the establishment of a natural habitat. The goal of this discussion is to consider the requirements for: 1) screening daily vehicular traffic entering and exiting the proposed disposal area; 2) enlarging natural barriers between residential use areas and future disposal site activities; and, 3) constructing those proposed features that will mitigate noise and prohibit the visual awareness associated with disposal activities occurring on a daily basis. Of particular concern is the necessity to restrict noise and visual awareness associated with the proposed landfilling operations.

4.4.5.2 Four Seasons Community

Under a standing <u>Community Benefits Agreement (Agreement)</u> with the Four Seasons Community Association (Association), certain conditions, namely the *Specifications of the Berm* and *The Buffer Zone*, were established. These understandings set in motion the elementary basis for the visual barriers/screening plan currently in-place for the sand and gravel operation.

The constructed earthen berm creates a visual barrier and is compliant with the Agreement. As part of the Agreement, this berm will be forested in the future. The planting specifications of this berm are defined within the Agreement. However, the Agreement does not consider understory plantings, or plantings which, while providing color, visual interest, food and habitat sources for wildlife, address the more important issue of visual impairment, or the filling of voids created when only trees are planted. Incorporating native species of evergreen and deciduous trees is the first step in creating a visual barrier; to complete the buffer development process requires the utilization of native shrubs, groundcovers and grasses.

Currently, certain residences along Strawberry Way in the Piney Orchard subdivision of Four Seasons immediately adjoin the site. These residences are screened outside their western limit with prominent plantings (forested with predominantly deciduous growths) occurring on the eastern property boundary. As a design element, the existing screen would be considered opaque. That is, a screen or visual barrier which provides sight obstructions from ground elevation to a height of at least six feet, with intermittent visual obstructions from ground level to a height of 20 feet. To meet this opaque "test", the vegetative screening, at maturity, must block the sight line from one space into another in all seasons and otherwise exclude contact between competing land uses.

The opaque screen is a full screen that functions as a visual barrier typically found between residential and non-residential areas or other incompatible land uses. The general landscape guideline for such a visual block is:

- A mix of primarily evergreen trees and shrubs placed to form a continuous screen;
- At least 70 percent evergreen trees;
- Evergreen trees placed no more than 15 feet on center;
- Deciduous trees spaced no more than 20 feet on center;
- Evergreen shrubs spaced no more than four feet apart; and,
- Ground cover.



Between Spring and late Fall, visual observation into the site is greatly obscured by the existing forest buffer.



The greater portion of the existing buffer is comprised of deciduous trees and shrubs. However, deciduous species shed their leaves in the late Fall and Winter and will permit viewing pathways into the idle, non-used portion of the site. Existing evergreen trees on the western portion of the buffer retain limited limbing and then only on the upper most portion of the trunks having been blocked by the more dominant deciduous species.



As referenced earlier, the Association arrived at an Agreement whereby the property owner would provide additional visual (naturalized) blockage of the berm. Within this Agreement, tree species are specified along with plant location and spacing.



Dense foliage with the addition of more trees and understory plantings will add noise-absorbing elements to the forestation buffer and soften the visual appearance of the constructed berm.



Trees, shrubs and ground covers are the principal ingredients in the buffering plan. Selected varieties should be as few as necessary to satisfy the requirements of the buffer and should mirror both those established on site and those occurring within the immediate project area. The following is a partial listing of the more common and readily available native Maryland trees, shrubs and field grasses.

Common Name	Scientific Name	
Trees		
Maryland Deciduous		
Red Maple	Acer rubrum	
Black Cherry	Prunus serotina	
Sassafras	Sassafras albidum	
Red Mulberry	Morus rubra	
White Ash	Fraxinus americana	
Red, White, Pin Oak	Quercus sp.	
Hickory	Carya sp.	
Dogwood	Cornus sp.	
Maryland Evergreen		
Eastern Red Cedar	Juniperus virginiana	
Loblolly Pine	Pinus taeda	
White Pine	Pinus strobus	
Shrubs		
Huckleberries	Gaylussacia species	
Winter Berry	Ilex laevigata	
Witch Hazel	Hamamelis virginiana	
Mountain Laurel	Kalma latifolia	
Maple Leaf Viburnum	Viburnum acerifolium	
Bayberry	Myrica pensylvanica	
Wax Myrtle	Myrica cerifera	
Grasses and Covers		
Switch Grass	Panicum virgatum	
Salt Hay	Spartina patens	

4.5 MATERIALS RECYCLING

In addition to landfilling activities, recycling of various waste products will occur at the Tolson Rubble Landfill. Waste materials that may be considered for recycling/salvaging include wood products, concrete/asphalt/masonry, metal, and used tires. Any additional permits (e.g., air permits) required to conduct recycling/salvaging operations would be obtained, as necessary at the time when such operations are determined necessary and the equipment train is identified. Recycled wood products may be ground into wood chips or mulch. Concrete/asphalt/masonry materials may be crushed and re-used as recycled aggregate, stone for riprap, or asphalt mix. Tires will be shredded and marketed for potential beneficial re-use.

Waste materials that are deemed eligible for recycling will be identified at the landfill inspection point and the haul vehicle will be sent to the appropriate area of the facility where recycling operations are located. It is important to note that the projected landfill life expectancy does not consider the effect that this recycling of incoming waste materials will have on the landfill useful life. Therefore, assuming the projected waste disposal rates materialize, the projected landfill life expectancy is considered conservative.

5.1 LINER SYSTEM

5.1.1 General

The liner system for the Tolson Rubble landfill is designed to prevent the release and vertical migration of leachate into the environment. The proposed Tolson Rubble Landfill will encompass approximately 71.6 acres of disposal area, and will include four phases of development. Three of the four phases will coincide with liner placement.

Based on a comparative cost analysis of the liner systems approved for use in a rubble landfill (COMAR 26.04.07.16), the liner system to be installed for the Tolson Rubble Landfill will include a non-reinforced geomembrane installed over a prepared subbase. The geomembrane will be constructed of nonreinforced, 60-mil thick high density polyethylene (HDPE). The prepared subbase will have a minimum thickness of 24 inches and a permeability of less than or equal to 1×10^{-5} cm/sec. The geomembrane will be covered with 24 inches of native sand/gravel, or an alternative material approved by MDE, with sufficient permeability to promote positive drainage, and overlain by a nonwoven geotextile. A non-woven geotextile will also be installed between the HDPE geomembrane and the overlying drainage layer to prevent abrasion or penetration damage to the geomembrane. The liner system will cover all surrounding earth likely to contact the waste or leachate, and will be installed with a minimum slope of two (2) percent toward the leachate collection system to assure preventing leachate ponding on the cell floor. The prepared soil subbase will provide uniform foundation support for the overlying liner and assure that a minimum three-foot separation (isolation) distance between the water table and/or underlying bedrock and the bottom of the liner system is achieved and maintained.

5.1.2 Liner System Design

The bottom liner system will be constructed during development of three of the four proposed phases, and will consist of the following materials and systems, discussed in ascending elevation:

 A prepared subbase consisting of native materials with a minimum thickness of 24 inches and a permeability less than or equal to 1 x 10⁻⁵ cm/sec. Soil will be placed in 8-inch thick loose lifts and will be

compacted to greater than 90 percent of the maximum density obtainable in accordance with the American Society for Testing and Materials (ASTM), D-1557 Test Designation (Modified Proctor). This lift thickness is generally accepted for subbase layer construction to allow proper compaction of each lift. However, a test pad will be utilized to confirm performance of the material in-place prior to full-scale implementation. Compaction will be performed through at least two passes with a sheepsfoot or segmented-pad roller. When the surface of any compacted lift is too smooth to bond properly with the successive lift, the lift surface will be scarified before the succeeding lift is placed. Subbase material will be compacted on the side slopes of interior or perimeter berms using roller compactors or hydraulic "jumping jack" compactors. Subbase material on side slopes will be subject to the same Construction Quality Assurance/Quality Control (CQA/QC) requirements as subbase material placed in all other areas. Subbase material will be placed on side slopes after the berms have been constructed with compacted structural fill material.

- A 60-mil thick HDPE geomembrane serving as the primary, relativelyimpermeable barrier to prevent the migration of leachate into the underlying soils and groundwater. The liner systems between phases of landfill construction will be bonded together by extrusion welding the extended HDPE geomembrane from the previously installed phase(s) to the newly-constructed phase. This will result in a continuous liner between all of the phases. The HDPE geomembrane will be placed above the prepared subbase in all locations. A non-woven geotextile will be installed between the HDPE geomembrane and the overlying native sand/gravel drainage layer (see below) to prevent abrasion or penetration damage to the geomembrane.
- A 24-inch thick leachate collection layer constructed with native sand/gravel, or an alternative geosynthetic material approved by MDE in specific application areas. This collection layer will provide pathways for the adequate drainage of leachate to the leachate collection piping; waste will be placed directly over this drainage layer. However, a non-woven geotextile will be installed between the waste and the drainage layer to prevent clogging. The leachate collection layer will be placed as soon as possible after the geomembrane installation to limit degradation of the geomembrane due to wind, sunlight, or other environmental factors, and protect against tears, rips, and other physical damage. A minimum fourfoot thickness of select processed waste will be placed immediately above the leachate collection layer to provide additional protection for the geomembrane. Select processed waste will consist of material that is free of metal, boards, or other protruding objects that may puncture the geomembrane liner in lengths greater than 2 feet. A geocomposite

consisting of a geonet bonded on both sides to a non-woven geotextile will serve as a the leachate collection layer on the 2:1 (horizontal to vertical) side slopes.

Earthen berms will be constructed with structural fill exhibiting physical characteristics similar to the prepared subbase, placed in 8-inch thick loose lifts and compacted to greater than 95 percent of the Modified Proctor density. A typical detail depicting the liner system in the landfill is presented on Drawing No. P18, Appendix B.

5.1.3 Liner Foundation

The subsurface conditions at the Tolson Rubble Landfill consist of naturally occurring sands and clays which vary in thickness from 3 feet to 30 feet, underlain by slate/argillite bedrock. Construction of the liner system over the existing terrain will be accomplished by first clearing and grubbing vegetation as necessary that may have accumulated in the mined area. Next, the subbase will be graded to the design contours specified on the Drawings. Elevations will be achieved through the placement of subbase material obtained from on-site. The fill will be placed in loose lifts not-to exceed 8-inches thick, and compacted to greater than 90 percent of the Modified Proctor density.

Due to the physical characteristics of the in-situ, surficial foundation soils, the maximum total consolidation is expected to be minimal. Consolidation of these soils will occur over the life of the landfill slowly and continually as the load, i.e. waste, is applied, and until the maximum is reached during the post-closure care period. The soils are laterally fairly consistent, which will tend to minimize local differential settlements, and coarse-grained, which will generally accelerate the consolidation time and result in an increased density and therefore strength of the foundation.

5.1.4 Liner Strength

The geomembrane, as a component of the relatively impermeable barrier system, must be sufficiently strong to withstand the stresses caused by installation, hydrostatic forces, strength losses due to temperature variations, foundation settlement, and construction and operational loadings. For these reasons, high density polyethylene (HDPE) was selected as the liner material since it is semi-flexible, puncture resistant, and generally exhibits high physical strength characteristics. In addition, HDPE is less susceptible to degradation from exposure to ultraviolet light rays, and more chemically resistant that other similar synthetic materials. The liner material will be similar to GSETM HD manufactured by GSE Lining Technology, Inc. of Houston, Texas. A similar HDPE geomembrane, 60-mil thick, will be incorporated into the final cover system.

Bottom heave and blow-out of a geomembrane occurs when hydrostatic upward pressures acting on the membrane exceed the material strength characteristics. The bottom liner system elevation (including subbase) will be maintained at a minimum of three feet above the seasonal high groundwater elevation. The leachate collection system is designed to rapidly remove and prevent any generated leachate from building an excessive (i.e. greater than one-foot) head on the liner system. With the establishment of these fluid management systems, hydrostatic forces are not anticipated to affect the structural integrity of the geomembrane.

5.1.5 Chemical Characteristics and Compatibility

The liner system will consist of a prepared subbase layer overlain by a 60-mil smooth geomembrane on the cell floor and 60-mil textured geomembrane on the internal side slopes. HDPE piping will be used to collect and transmit generated leachate which accumulates in the drainage layer. Each of these components is mutually compatible and exhibit a similar resistance to substances placed in contact with them since each utilizes a polyethylene resin as a base.

All geomembrane, piping, and geocomposite will be manufactured from a highdensity polyethylene (HDPE) resin, which is resistant to many chemical constituents. HDPE is primarily inert, resistant to adsorption and swelling, and provides good overall chemical and long-term weather resistance. For these reasons, HDPE is superior to other currently available synthetic materials in this application. Certain chemicals could plausibly have a varying effect on polyethylene, such as: heterocyclic aldehydes, secondary amines, nitric acid, ketones, ethers, hydrocarbons, and halogenated hydrocarbons. These compounds are not, however, components of the waste stream to be disposed in the landfill; therefore, based upon the available information pertaining to the waste characteristics of the anticipated waste stream, no negative effect on the geomembrane, geocomposite, or polyethylene piping is expected.

The prepared subbase layer will consist of fine-grained soils. Protection of this layer for waste compatibility purposes is provided by the overlying geomembrane. In the unanticipated event that the geomembrane would fail, leachate could come into contact with the underlying soil layer. However, the waste placed in the landfill facility will not contain any hazardous wastes, and will not contain organic solvents of low molecular weight (hydrocarbons and halogenated hydrocarbons) which research investigations have indicated can have a significant potential for adverse affects on clay. Similarly, the waste will not contain high strength caustic materials which research indicates have the potential to permanently alter the structural and physical properties of clay, thereby substantially increasing the permeability. Therefore, the anticipated type of leachate generated should not adversely impact the integrity of the prepared subbase layer.

5.1.6 Engineering Analysis

5.1.6.1 Differential Settlement Effect on Liner System

Differential settlement in the prepared subbase and the underlying, existing site soil due to the load caused by the overlying waste could affect the HDPE geomembrane and the leachate collection and transmission system. Calculations were performed in order to determine the differential settlement across several locations in the landfill, including the point of highest waste and, therefore, the greatest expected load (see Appendix C).

5.1.6.1.1 Slope Change Effect on the Leachate Collection System

In order to determine if the differential waste settlement will affect the leachate collection system, the change in liner system slopes was calculated between four points. In order to calculate settlement underneath the liner system, compression indices of the subbase and the underlying, existing site soil were first calculated. Using these compression indices, settlement at each point, depending on overlying waste thickness, was calculated.

For the purpose of this calculation, it was assumed that all areas in the bottom of the landfill would settle depending on the amount of expected load immediately above. As expected, the highest calculated settlement, 8.02 feet, was found at the point exhibiting the greatest combined waste and subgrade fill soil thickness. The lowest settlement, 3.17 feet, was found at the toe of the landfill floor, which is the point with the least thickness of waste. Using these settlement values, new slopes were calculated from one point to the other and compared to slope values from prior to settlement. The greatest negative change in slope was calculated at approximately 0.37%. As a result, a region of the landfill floor will be constructed at a minimum slope of 2.40% to compensate for this additional settlement and ensure proper performance of the leachate collection system after landfill base settlement has occurred.

5.1.6.1.2 Slope Change Effect on the Landfill HDPE Geomembrane

In order to determine if differential waste settlement will affect the HDPE geomembrane in the landfill liner, the elongation on the liner must be calculated. Of the three most critical sections selected for evaluation, the greatest elongation calculated was approximately 0.044%, occurring at the greatest slope change of 2.21%. HDPE geomembranes similar to the material to be incorporated into the landfill liner system exhibit an elongation before failure at up to 12% at yield. Therefore, liner elongation is not a concern.

5.1.6.2 Bearing Strength of Prepared Subbase Layer

Bearing capacity is the theoretical maximum pressure which can be supported by the soil foundation before failing. In order to determine whether the prepared subbase will fail, a calculation for the greatest expected load must first be performed. Assuming the unit weight of the waste is conservatively 92.6 pounds per cubic foot (2,500 pounds per cubic yard compacted in-place) and a maximum waste thickness of 95 feet, along with 5-foot thick soil/geosynthetic material cap at approximately 110 pounds per cubic foot, the maximum surcharge load on the subbase layer was calculated to be 9,347 pounds per square foot (psf) (Appendix C). According to previously tabulated values, the allowable bearing capacity for the prepared subbase, assuming an inorganic silty clay with some sand and gravel, is approximately 12,000 psf. This bearing capacity is above the calculated greatest expected load. Therefore, the prepared subbase is expected to be stable.

5.1.6.3 *Physical Stresses on the HDPE Geomembrane*

Several calculations have been prepared regarding the liner, and its parameters, for the Tolson Rubble Landfill. Initially, the anchor trench capacity was determined with respect to the strength properties of the HDPE geomembrane to determine if failure would occur. It was determined that the geomembrane would pull out, rather than rip, due to the liner tensile strength being far greater than tension due to passive earth pressure. If failure at the anchor trench were to occur, geomembrane pull out is readily corrected. Also, a comparison of the anchor trench capacity to the down-drag force was performed in order to measure trench efficiency. The corresponding factor of safety for the anchor trench efficiency was determined to be adequate (3.77). Using the same down-drag force, it was confirmed that the liner can withstand down-drag during and after waste displacement with a sufficient factor of safety (8.13) (Appendix C).

Additionally, strain requirements over the long, steep side slope were satisfied due to the noted interface friction angles being greater than the proposed slope angle. The ability of the 60-mil HDPE geomembrane component of the cover system was then determined to be able to support its own weight due to a computed negative tensile force (i.e., the HDPE geomembrane was determined to not be in tension). Calculations were then performed to verify the installation stresses on the 60-mil HDPE geomembrane. By using values for comparable landfill compaction equipment, it was established that the factor of safety is satisfied and that loading will not damage the geomembrane. Finally, it was found that there would be minimal operating stresses on the geomembrane as a result of the interface friction angle being greater than the proposed slope angle (Appendix C).

5.1.6.4 Differential Settlement Effect on Existing Landfill Cover System

Differential settlement calculations were performed to assess the stability and magnitude of settlement of the existing landfill 20-mil PVC geomembrane cover and the proposed 60-mil HDPE geomembrane liner, and the affect on the proposed leachate collection and transmission system where they will be overlain by the proposed landfill. In order to determine the differential settlement, the change in slope of the existing landfill cover was calculated between three points. As expected, the maximum calculated settlement, 4.38 feet, was found at the location with the greatest combined thickness of proposed and existing waste. The lowest settlement, 2.13 feet, was found at the perimeter of the existing floor, which is the point where there is no existing, underlying waste. Using these settlement values, new slopes were calculated from one point to the other and compared to the slope values from prior to settlement. The highest change in slope was calculated at approximately 2.01%. However, as the constructed landfill floor slope is 15% in this vicinity, this change in slope will have a negligible effect (reducing the effective slope to approximately 13%) on leachate flow, and will, therefore, not alter the performance of the leachate collection system.

In order to determine if differential waste settlement will affect the existing landfill PVC geomembrane cover or the proposed HDPE geomembrane liner, the elongation on the liner was calculated. Of the three sections identified for the calculations, the highest elongation determined was approximately 0.03% at the highest slope change of 2.01% (as identified above). PVC geomembranes similar to the material incorporated into the existing landfill cover system exhibits an elongation up to 20% at yield. Therefore, elongation of the existing landfill cover at 0.03% is significantly less than at yield and represents no concern. Additionally, even in the event that the existing PVC geomembrane cover was to fail, the proposed HDPE geomembrane liner would provide a secondary cap preventing percolation into the existing landfill. As an added level of protection against failure of the existing PVC geomembrane cover, a geosynthetic clay liner (GCL) strip will be installed between the existing PVC geomembrane cover and the proposed HDPE geomembrane liner (reference detail P1903 on Drawing No. P19, Appendix B).

5.2 LEACHATE COLLECTION SYSTEM

5.2.1 General

The leachate collection system will remove excess liquid collected from within the waste during cell development and transport the liquid to a centralized collection area for final management. Removal of the liquid captured above the liner system will minimize the potential for a release to the environment, consequently minimizing the potential for adverse impacts to the public and environmental health.

Liquid produced as a result of direct precipitation onto waste in an open phase will be collected in the leachate collection system and transported off-site for final treatment. Precipitation intercepted by an inactive phase, unused portion of an active phase, or a phase that has been temporarily closed will be diverted to the stormwater management system.

A gravity-flow leachate collection system will be installed within the floor of the proposed landfill as the cells are initially developed. The leachate collection system will consist of 24 inches of native sand/gravel, or alternative material approved by MDE, placed over the liner system and leachate collection laterals within the drainage material. The leachate collection laterals will consist of heavy-duty polyethylene (HDPE) piping laid in a swale or "valley" along the lowest point of the leachate management system to assure collection of the flow from the drainage material. The leachate collection laterals will consist of 6-inch diameter perforated HDPE piping spaced at 200-foot intervals as depicted on Drawing No. P9, Appendix B. The leachate collection laterals will discharge into a header pipe, which is sloped toward a sump at the perimeter of the liner system. The header pipe will be constructed of non-perforated 6-inch diameter HDPE pipe. One sump will be provided to extract leachate collected from all phases of the landfill. The leachate collection sump will be lined with an 80-mil thick HDPE geomembrane. To protect against a pipe failure or an ineffective pipe connection discharging leachate into the underlying aquifer, all leachate transfer piping will be double-walled HDPE after exiting the landfill cell.

Leachate will be pumped from the collection sump to a wet well and then to one of two, double-walled 50,000-gallon aboveground storage tanks where it will remain until it is transported off-site for disposal. The storage tanks will provide approximately 5 days of storage during the construction of Phase 1 based on an average leachate generation rate of 18,811 gallons-per-day. The storage tanks will be installed within a spill containment basin to prevent leachate from impacting the surrounding soils or groundwater in the event of a spill or leak. Pumping of leachate from the leachate collection sump to the wet well will be accomplished by two of three submersible pumps – a primary pump and a secondary pump – specifically designed for pumping leachate. The third pump will be standby in the event of a pump failure or during periods of maintenance. The primary and secondary pumps will operate in a lead/lag condition with the combined capacity of both pumps exceeding the peak daily flow rate. Controls will be included such that pump operation can be automatically alternated between the two pumps. If necessary, the secondary pump will operate concurrently with the primary pump during periods of unusually high flow. The tertiary pump will also function as a backup pump in the event the primary and/or secondary pump fails. If necessary, the leachate pumps may be removed from the collection sump by detaching an elbow fitting on the force main at the top of the side slope riser and the blind flange at the top of the riser pipe and pulling the pumps up the side slope riser. Pumping of leachate from the wet well to the storage tanks will be accomplished by two submersible pumps located at the base of the leachate collection wet well. When the liquid level in the leachate collection wet well reaches a pre-determined level, the "lead" pump will commence pumping and will continue to pump until the liquid level falls to a lower pre-determined level. If the liquid level rises above the lead pump-start level, a secondary level switch will transmit a signal to the control panel triggering the "lag" pump to commence pumping. If the liquid level continues to rise after the lag pump begins operating, a tertiary level switch will transmit a signal to the control panel to sound an alarm indicating a hydraulic backup condition. The alarm would be audible at the wet well, and would also sound in the landfill office. The alarm will be programmed to call the emergency coordinator residence telephone number if the landfill office alarm is not acknowledged. The alarm would also be programmed to be activated in the event of a power failure, pump failure, unauthorized entry, or general pump station malfunction.

5.2.2 Leachate System Design

The maximum volume of leachate generated over the life of the landfill was calculated based on precipitation rates, in-place waste volumes, duration of operation of an open phase, and leachate infiltration/percolation time through the waste. The Hydrologic Evaluation of Landfill Performance (HELP) model, version 3.07, developed by the Environmental Laboratory, U.S. Army Corps of Engineers Waterways Experiment Station for the USEPA-Risk Reduction Engineering Laboratory, was utilized in the evaluation of leachate generation at different stages of waste placement operations to determine the maximum generation volume.

The leachate generation rates established from the HELP model were determined based on HELP-calculated peak monthly flows for final phase waste elevations. The depth of waste modeled for each phase was based on the maximum thickness of waste which would be placed in each phase (Appendix C). A maximum area of 10,000 square feet of open landfill phase was analyzed for each cell. At the current waste generation rate, 10,000 square feet of landfill area filled with one lift of waste (eight feet) will accommodate the disposal of construction debris for two and one-half weeks at the projected waste stream receipt rate. During actual disposal operations, the working face of the landfill would be maintained across a significantly smaller area.

A porosity of 0.4 volume/volume was estimated for the construction debris waste and utilized in the HELP model to calculate leachate generation rates. This porosity was projected through a correlation with the properties of standard riprap material, and is adjudged to therefore represent a worst-case scenario. The hydraulic conductivity of the construction debris waste was estimated to be 3.0×10^{-1} cm/sec, which is similar to the standard hydraulic conductivity value for "gravel" as provided by the HELP model. The hydraulic conductivity of the material used in the drainage layer was estimated to be 1.0×10^{-2} cm/sec, which is representative of a medium sand.

Predicting daily leachate volumes throughout the life of the landfill is necessary to verify that the capacity of the leachate collection system is sized to adequately handle the expected requirements. The computed peak monthly leachate generation over the operating life of the landfill occurred during waste placement in Phase 3. Under these conditions, the maximum average daily volume of leachate is 56,256 gallons per day (gpd). The HELP Model calculations are included in Appendix C.

5.2.3 Maximum Head of Leachate

To reduce hydrostatic pressure imposed by ponded leachate on the liner system, the leachate collection system in each phase is designed to maintain the depth of leachate on the geomembrane liner below one-foot (30 centimeters). The leachate collection system will include a 24-inch thick drainage layer constructed from native sand/gravel material, or an alternative material approved by MDE, exhibiting an average permeability greater than 1.0×10^{-2} cm/sec and a 6-inch diameter perforated polyethylene collection pipe system. The liner system will be sloped toward the collection pipe at a minimum slope of 2 percent. The net slope along the flow path of the gravity drained leachate will range from 2.0 to 10.0 percent.

The U.S. Environmental Protection Agency (USEPA), SW-869 Manual, "Landfill and Surface Impoundment Performances Evaluation," April 1983, was used as an aid in determining the anticipated head of leachate to be impounded above the liner system. From this document, the following equation was used to calculate the maximum head of leachate on the liner:

$$h_{\text{max}} = (L/2)[(e/k_{dl} + \tan^2 a)^{1/2} - \tan a]$$

where:

h _{max}	= maximum head of leachate on the liner (feet).
L	= distance between perforated collection lines. The equation is based on a series of parallel leachate collection laterals located in valleys on the floor of the phase, with ridge lines located parallel to and midway between the laterals. Therefore, the maximum distance the leachate travels is equal to one-half the distance between laterals used in the equation, L/2.
e	= maximum quantity of leachate generated calculated from the HELP model (3.50 10 ⁻⁷ in/sec during the construction of Phases 1 through 4).
k _d	 coefficient of permeability of the drainage layer (0.0039 in/sec for medium sand drainage material).
a	effective liner slope angle (0.57°; assuming conservative slope of 1 percent)

This calculation yields a leachate depth, h_{max} of 0.38 feet for the maximum leachate generation rate encountered during the construction of Phase 4. Therefore, the leachate collection system as designed will meet the requirement for maintaining less than one-foot of hydrostatic head over the liner system. Design calculations for the maximum head of leachate are presented in Appendix C.

5.2.4 Leachate Collection Piping

To ensure that the leachate collection piping will operate effectively over the landfill design life, material characteristics of the piping were analyzed. The pipe material must be sufficiently strong to withstand the static pressure of the overlying waste and dynamic pressures induced by operational equipment; it must be chemically resistant to leachate produced by the wastes; and, be designated to operate without clogging.

Corrugated HDPE pipe has several properties that make it a suitable structural material for use in this type of buried application. Among the most important of these are the high strain modulus of the material, its stress-relaxation properties under constant strain, and the longitudinal flexibility of the pipe. Buried conduits, in combination with bedding and backfill materials, are designed to perform as load-bearing structures. The relative stiffness of the pipe determines the extent to which the pipeline participates in supporting the applied load. As the load from the overlying waste is applied, the flexible ring of polyethylene pipe will deflect and the gravel envelope surrounding the pipe will predominate in supporting the load. By increasing the static load, the gravel will arch and will increasingly support the load.

An analysis was performed to determine whether the 6-inch diameter, perforated HDPE leachate collection piping would support the loads applied by the overlying waste. The USEPA SW-870 manual, "Lining of Waste Impoundment and Disposal Facilities," March 1983, was used as a guidance document. The Modified Iowa Formula was used to calculate deflection:

$$y = D_L \frac{KWR^3}{EI + 0.061E'R^3}$$

where:

- y = horizontal and vertical deflection of the pipe (inches)
- D_L = deflection lag factor, generally a conservative value of 1.5, compensating for the lag of time-dependent behavior of the soil/pipe system (dimensionless)
- K = dimensionless bedding constant, reflects support the pipe receives from the bottom of the trench. A conservative value of 0.1 is generally utilized.
- W = vertical load acting on the pipe per unit of pipe length (pounds per inch). The maximum vertical load at the landfill is 586 lb/in; this occurs over a portion of Phase 4.
- R = mean radius of the pipe (3.025 inches)
- E = modules of elasticity of the pipe materials (71,000 pounds per square inch [psi] at 140° F).
- I = moment of inertia of the pipe wall per unit of length (0.008 inch⁴/inch).
- E' = modulus of passive soil resistance (2,000 psi for coarse-grained soils with no fines, compacted to less than 85 percent of Standard Proctor density).

Solving the equation yields a deflection of 0.63 inches, which is approximately 10 percent of the pipe diameter, which is consistent with the maximum deflection recommended by the manufacturer. It should be noted that this is a conservative estimate of deflection; loadings will be less over other areas of the system, thereby producing less deflection; nevertheless, the piping will be inspected after the initial placement of waste in each of the three construction phases to ensure that crushing has not occurred.

Testing of the chemical resistance properties of the polyethylene was performed by the manufacturer of the polyethylene pipe. Tests were conducted using standard procedures outlined in ASTM D-543, "Standard Test Method for Resistance of Plastics to Chemical Reagents". The test results reveal that the following substances can affect the integrity of the material though absorption: hydrocarbons, chlorinated hydrocarbons, and gasoline. The result of this absorption is softening and swelling which tends to weaken the material. The manufacturer noted that as soon as the chemicals are removed, the polyethylene assumed its original properties. Nitric and sulfuric acids, chlorine gas, and liquid bromine chemically attack the polyethylene; damage in this case is permanent. It should be noted, however, that materials such as these will not be placed in the landfill. Therefore, based on the available information pertaining to waste characteristics of anticipated disposed material, no negative effect on the polyethylene piping is expected. A complete list of chemical compatibilities for polyethylene pipe is included in Appendix C.

5.2.5 Clogging

Leachate collection piping will be installed in rounded to sub-rounded bedding material (i.e., No. 57 stone) that is wrapped in a non-woven geotextile. The perforations in the six-inch diameter HDPE piping will be ¼-inch wide. To prevent passage of material into the collection piping and potential clogging, the pipe will be wrapped with a non-woven geotextile. As a result, clogging should not be a concern.

In the unlikely event clogging does occur, and in order to perform periodic inspections, a clean-out access line will be connected to the northern end of both perforated leachate interceptor pipe. These access lines will allow closed-circuit television monitoring of the condition of the pipe, cleaning, and minor physical repairs without excavation. If required, cleaning can be performed by flushing the system with large quantities of clean water or by utilizing a high pressure water jet pipe cleaning apparatus.

5.2.6 Hydraulic Conductivity Analysis of Leachate Collection Layer

As discussed in Section 5.2.3, a drainage material exhibiting a hydraulic conductivity greater than 1.0×10^{-2} cm/sec will be suitable for ensuring that the maximum leachate head on the liner is maintained at less than one-foot. A medium to coarse sand material should be capable of providing the required minimum hydraulic conductivity. Testing will be performed to ensure that the proposed drainage material is capable of providing the required minimum hydraulic conductivity.

5.3 PHASE AND CELL DEVELOPMENT PLAN

Waste will be placed in each phase according to the Cell Development Plan included in the Permit Drawings (Appendix B) and as described in the following sections. Waste placement will be separated into four phases, constructed in numerical order. Waste placement will further be separated into cells within each phase. Each cell is designed to provide a maximum of 900,000 cubic yards of airspace capacity, which corresponds with approximately three years of waste generation at the estimated waste generation rate. (Again, it should be noted that recycling has not been considered here, and the actual life of each cell may likely be several years longer.) Each of the four phases consists of two cells, A and B. The duration of waste disposal capacity will change within each cell between lifts as the fill gains height and the final grades limit the lateral extent. Waste placement within each cell will commence with the construction of an initial lift, approximately eight feet in thickness, and will proceed from lift to lift within each cell until all of the cells within Phase 1 have been constructed to a uniform height. The cells will be constructed, by lift, in alphabetical order. Waste will be placed within the cells in iterative maximum eight-foot thick lifts. The landfill operator may elect to alternate the placement of waste between lifts in the two cells within a given phase. However, the top of waste grades for a given phase will be achieved prior to commencing filling operations in a subsequent phase (i.e., Phase 1 will be completed prior to initiating Phase 2). Phase 4 will be constructed over the top of the previous three phases. The filling method for each phase is further discussed below.

A temporary stormwater isolation berm will be constructed between the active portion of a cell and that portion of the cell that has yet to receive waste (preactive) (reference Drawing No. P17, Appendix B). Further, a temporary stormwater barrier layer, consisting of soil or plastic cover, will be placed over the liner system in the pre-active portion of the cell to minimize the infiltration of stormwater into the leachate collection system. Portable pumps will be used to remove accumulated water from behind the berm and convey it to the stormwater management system. The stormwater isolation berm and barrier layer will be periodically relocated as waste placement progresses throughout each cell and phase.

Individual cell information, including waste thickness, airspace capacity, waste capacity, and cell life are presented in Appendix C.

5.3.1 Phase 1 Waste Placement Plan

Waste will be placed in Phase 1 in alphabetical order of the cells. Waste placement in Phase 1 will continue until the top of waste grades depicted on Drawing No. P3 in Appendix B are achieved. Waste side slopes in Phase 1 will not exceed 4:1 (horizontal to vertical). Appendix B presents a schematic of the waste placement methodology for Phase 1.

5.3.2 Phase 2 Waste Placement Plan

Phase 2 is subdivided into two cells, Cell A and Cell B; waste will be placed in each cell in alphabetical order. Cells will be filled from the west, or lower elevation, to the east, or higher elevation. Waste placement in Phase 2 will continue until the top of waste grades depicted on Drawing No. P4 in Appendix B are achieved. Waste side slopes in Phase 2 will not exceed 4:1.

5.3.3 Phase 3 Waste Placement Plan

Phase 3 is subdivided into two cells, Cell A and Cell B; waste will be placed in each cell in alphabetical order. The cells will be filled from the east, or lower elevation, to the west, or higher elevation. Waste placement in Phase 3 will continue until the top of waste grades depicted on Drawing No. P5 in Appendix B are achieved. Waste side slopes in Phase 3 will not exceed 4:1.

5.3.4 Phase 4 Waste Placement Plan

Phase 4 consists of two cells, Cell A and Cell B, and will be constructed above the final contours of Phases 1, 2, and 3 in alphabetical order. Cell development will begin along the southern border of the phase and proceed northward until the extent of the cell is reached. Waste placement in Phase 4 will continue until the top of waste grades depicted on Drawing No. P6 in Appendix B are achieved. Waste side slopes in Phase 4 will not exceed 4:1.

The top of Phase 4 will be graded to a minimum four percent top slope to direct stormwater drainage to the various conveyance features. At the highest elevation, the waste in Phase 4 will be approximately 100 feet thick. Stormwater barrier layers and isolation berms will be constructed in Phase 4, as needed, to minimize the infiltration of stormwater into the leachate collection system.

5.3.5 Capacity Analysis

The total airspace capacity of the completed Tolson Rubble Landfill is approximately 5,762,060 cubic yards, resulting in an estimated landfill life of approximately 19 years. This life expectancy projection does not consider, however, the loss of airspace due to daily, intermediate and other periodic cover material or variations in waste stream generation within the service area of the facility. Additionally, any reduction in disposal rate as a result of material recycling/salvaging (e.g., concrete) is not considered in the life expectancy projection. On this basis, the table below summarizes the available airspace and projected life for each of the four phases; variances from these projections during operations is expected.

Phase	Airspace (Cubic Yards)	Projected Life (Years)
1	932,240	3.1
2	1,645,990	5.4
3	1,221,920	4.0
4	1,961,910	6.4

The airspace volumes for each phase were calculated using the volume calculation feature available in the AutoCAD software. Top of waste grades for each phase were compared to the respective top of liner system grades to generate the airspace volumes. Hand calculations were employed to verify these calculations. The life expectancy calculations are presented in Appendix C.

5.4 GAS MANAGEMENT SYSTEM

Landfill gas can be explosive in elevated concentrations or cause degraded ambient air quality. The waste stream for the Tolson Rubble Landfill will consist of only non-hazardous rubble waste (e.g., construction debris, land clearing debris, demolition debris) which upon decomposition will produce methane, hydrogen sulfide and other gases, but only in limited quantities.

Potential maximum levels of landfill gas emissions were calculated to determine whether an active or passive landfill gas management system would be required (Appendix C). Since there are no applicable, final landfill gas standards and guidelines for a construction and demolition debris landfill, municipal solid waste (MSW) landfill standards and guidelines were utilized to establish an upper bound based on a waste stream comparison. The MSW guidelines establish a regulatory limit of 55 tons, or 50 mega grams per year (Mg/yr) for non-methane organic compounds (NMOCs) (COMAR 26.11.19.20.G). New and existing MSW landfills with emissions that equal or exceed 50 Mg/yr are required to design and operate an active gas collection system and a control device to reduce NMOCs in the collected gas by 98 percent by weight using best demonstrated technology.

A landfill air emissions estimation model, developed for the USEPA Office of Research and Development, National Risk Management Laboratory and the Clean Air Technology Center was used to perform calculations. The Landfill Gas Emissions Model (LandGEM) is an estimation tool that can be used to estimate emission rates for total landfill gas, methane, carbon dioxide, non-methane organic compounds, and individual air pollutants from municipal solid waste landfills.

Parameters used in the LandGEM model include a methane generation rate constant (k) equal to 0.02/yr, an NMOC concentration of 298 parts-per-million volume) ppmv as hexane, and a methane generation capacity (L₀) equal to 50 m³/ Mg. The in-place waste volume was calculated to be approximately 5,762,060 cubic yards (cy). With an assumed density of 2,500 lbs/cy, this translates to approximately 7,202,575 short tons of total waste, or an average waste acceptance rate of 379,083 short tons per year. The average waste acceptance rate was based on the in-place waste volume, divided by the total life of the landfill (19 years). A peak NMOC concentration of approximately 14.6 Mg/year one year after closure was therefore predicted by the model. (It should be noted that with recycling, this rate of disposal is conservative, and therefore overestimates both the quantity of waste placed, and the landfill gas generated in any given year.) NMOC concentrations after closure of the landfill, during the post-closure period, suggested a downward trend in gas generation. Calculations and LandGEM results are provided in Appendix C.

Based on the limited volume of gas generation predicted by the model, a passive vent system comprised of perforated header pipes and gas vents is appropriate. The configuration of the passive gas system is nevertheless based on theoretical calculations and will be confirmed at the time of closure. The gas venting system will consist of a series of 6-inch diameter, HDPE vents placed about 300-feet apart on a 6-inch diameter perforated HDPE header pipe (see Drawing No. P7, Appendix B). Header pipes will be placed approximately 300-feet apart at an angle to the final contours of the waste, and will be installed after waste placement activities cease, but before the final cover system is constructed. The vents will be placed within borings approximately three-feet in diameter, and backfilled with rounded or sub-rounded gravel (No. 57 stone). Each vent will be advanced to an elevation equal to approximately five feet below the cover system

at the vent location; each vent will be screened from the top of waste placement to 6-inches above the bottom of the boring. A landfill gas vent installation schedule is presented on Drawing No. P18, Appendix B. The rounded/subrounded gravel in the boring will enhance the permeability of the area surrounding the extraction vents. If landfill gas concentrations exceed regulatory levels either at the points of emission or in the soil-gas surrounding the landfill, as determined through quarterly landfill gas monitoring, the passive vent system will be converted to an active gas collection system in order to extract and destroy the generated gas until emissions levels subside, allowing reversion to a passive system.

5.5 STORMWATER MANAGEMENT AND SOIL EROSION AND SEDIMENT CONTROL

5.5.1 General

Stormwater management and erosion and sediment controls will be installed at the site prior to construction, and will be maintained, monitored, and adjusted throughout the life of the landfill. These include a sediment basin/stormwater management pond, sediment traps, stormwater conveyance channels, downchutes, downslope ditches, silt fence, rock riprap, and Reno mattresses/gabions. The methods used in analyzing and designing the stormwater management and erosion and sediment control system are consistent with the methods prescribed by the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) and the Maryland Department of the Environment (MDE). The design calculations are presented in Appendix C.

5.5.2 Soil Erosion and Sediment Control

Erosion and sediment control measures, both permanent and temporary, have been designed for the landfill. Temporary controls include the use of silt fencing and stormwater isolation berms. These temporary controls will manage stormwater run-off, run-on, and erosion throughout the entire construction period during which the site is not stabilized and the quantity of run-off and erosion are the greatest. Permanent controls will include the perimeter stormwater conveyance channels, downchutes, downslope ditches, stormwater control terraces/benches, a sediment basin/stormwater management pond, sediment traps, and the establishment of permanent vegetation.

Prior to any construction, the appropriate erosion and sediment control devices will be installed. As construction continues, the erosion and sediment control devices will be relocated, reconstructed, and maintained to ensure adequate protection. Silt fence will be installed at all locations downgradient of disturbed areas to prevent the off-site migration of sediment. A sediment basin and sediment traps will be constructed to provide sediment retention. The sediment basin will additionally serve as a stormwater management pond subsequent to stabilization of the site and provide water quality control as well as attenuation of peak discharges. Likewise, the sediment traps will serve as water quality impoundments subsequent to stabilization of the site and provide the required water quality control.

The sediment basin has been designed in accordance with the Standards and Specifications for Sediment Basins outlined in the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control. Additionally, the basin was designed in accordance with the MD Pond 378 Design Standard since the basin will be in operation for longer than 36 months. The sediment basin/stormwater management pond outlet structure (weir spillway) was designed using the USDA NRCS TR-20 computer program. A combination of plunge pools and an overflow conveyance channel are utilized to convey the discharge from the sediment basin/stormwater management pond spillway to the unnamed stream that discharges to the Little Patuxent River. Sediment basin design calculations are presented in Appendix C. The sediment traps have been designed in accordance with the Standards and Specifications for Sediment Traps outlined in the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control. Upon completion of construction, the entire site will be seeded, mulched, and fertilized to promote the establishment of permanent vegetation. A full stand of vegetation will reduce storm water run-off and the potential for erosion.

Construction specifications as well as details for sediment basin appurtenances are depicted on the Drawings.

5.5.3 Stormwater Management Conveyance Practices

A network of stormwater conveyance structures has been designed to direct stormwater from the landfill to the designated discharge locations. The network includes perimeter conveyance channels, downchutes, downslope ditches, berms, culverts, and terraces/benches. Permanent stormwater conveyance structures have been designed with sufficient capacity to convey all stormwater run-off generated by the 25-year, 24-hour storm event to the sediment basin/stormwater management pond and the sediment traps/water quality impoundments.

To minimize the quantity of leachate generated in the operating phase, temporary stormwater isolation berms will be utilized during the waste filling process. These berms will segregate run-off from "clean" areas and exposed waste areas. Temporary berms will be constructed inside the active phase upgradient from the exposed waste areas and will divert stormwater to the landfill perimeter. The stormwater will be pumped from the bottom of the berm and discharged to the perimeter conveyance channels.

Permanent stormwater conveyance structures include perimeter conveyance channels, downchutes, downslope ditches, culverts, and terraces/benches. Downslope ditches were designed to convey run-off from terraces to the perimeter conveyance channels. The perimeter channels convey stormwater to the sediment basin/stormwater management pond and the sediment traps/water quality impoundments. The construction of permanent stormwater conveyance structures will be staggered to coincide with the construction of each phase. A combination of plunge pools and an overflow conveyance channel are utilized to convey the discharge from the sediment basin/stormwater management pond spillway to the unnamed stream that discharges to the Little Patuxent River.

The conveyance structures were designed using peak discharges obtained through use of the USDA NRCS Win TR-55 computer program. Stormwater analyses for all channels, ditches, and terraces were conducted using a spreadsheet version of Manning's equation. All terraces were designed to provide a minimum of 0.5 feet of freeboard and all channels and ditches provide a minimum freeboard of 1.0 feet. Shear stress and velocity were evaluated for all stormwater conveyance structures using procedures outlined in the Federal Highway Administration (FHWA) Hydraulic Engineering Circular (HEC) 11 and 15. These methods were used to determine the appropriate lining required such that the conveyance structure would not erode during the design flow event. The FHWA HY8 computer program was used to design the culvert located at the sediment basin/stormwater management pond outfall. Design calculations for the stormwater conveyance structures are presented in Appendix C. Details for the stormwater conveyance structures are depicted on the Drawings (Appendix B).

5.5.4 Stormwater Management Quantity/Quality Control

The 2000 Maryland Stormwater Design Manual (Design Manual) provides that all new development projects consider five stormwater sizing criteria – water quality volume, recharge volume, channel protection storage volume, overbank flood protection volume, and extreme flood volume. The first two criteria are typically referred to as water quality criteria and the remaining criteria are typically referred to as water quantity criteria. These five criteria are used to design stormwater BMPs for all new projects. Additionally, the Design Manual provides that only water quality control is required for redevelopment projects. Further, water quantity control is typically not required where runoff is discharged to a tidally influenced water body (in this case, the Little Patuxent River). Specifically, for redevelopment projects, either the existing impervious Site area must be reduced by 20 percent or water quality control must be provided for 20 percent of the existing impervious Site area. Redevelopment projects are defined as development on a site where there is an existing industrial, commercial, institutional, or multi-family use. It is believed that the proposed Tolson Rubble Landfill project meets the definition of redevelopment and, therefore, either a reduction in impervious area or water quality treatment is required. The Site currently contains no impervious area and no impervious area will exist in the post-developed condition. However, Section 2.1 of the Design Manual requires that a minimum of 0.2 inches per acre of water quality volume be provided for all sites with less than 15 percent impervious area. In order to meet this requirement, calculations were performed to verify that 0.2 inches per acre of water quality volume will be provided for 20 percent of the Site. The required water quality control will be provided by the sediment traps/water quality impoundments, sediment basin/stormwater management pond, and plunge pools.

Following closure of the landfill and permanent stabilization of the Site, the sediment basin/stormwater management pond and plunge pool outfall system will provide water quality control, and the sediment traps will serve as water quality impoundments. The sediment basin/stormwater management pond and plunge pool outfall system will treat the runoff from approximately 60 acres, or 70 percent of the Site. The sediment traps each treat a portion of the runoff from the remaining 24 acres of drainage area. The sediment basin/stormwater management pond and plunge pool outfall system was designed to discharge the peak flow rate for the 2-year, 24-hour storm to the unnamed stream at a non-erosive velocity. Water quality calculations are presented in Appendix C.

5.6 SLOPE STABILITY ANALYSIS

An analysis of the most critical landfill side slope was performed using the computer software STABL for Windows 2.0; the results are discussed below and presented in Appendix C. STABL is a Windows-based program which uses the PCSTABL slope stability analysis program developed by Purdue University as an engine. It allows static and pseudo-static calculations using Bishop's Simplified, Janbu's, and Spencer's methods, and a variety of different slip surfaces. It also allows for the use of tiebacks, soil nails, and geosynthetics. The side slope was evaluated for sliding failure using Janbu's Sliding Block Method and for deep-seated circular failure using Bishop's Simplified Method.

The soil and geosynthetic parameters used represent approximations based upon past geotechnical and landfill experience as well as site-specific data, and are considered conservative for this purpose. The parameters used in the analyses are presented in Appendix C. Calculations were also performed to determine the minimum shear strength parameters for the liner and cover system components that would result in a factor of safety of 1.5. A graph of the minimum friction angles versus cohesion values is presented in Appendix C.

Each component interface was analyzed to determine the critical interface of the landfill side slopes. The interface of the non-woven geotextile and the 60-mil smooth HDPE geomembrane in the cover system was determined to be critical with cohesion and friction values of 0 pounds per square foot (psf) and 10°, respectively. An infinite slope analysis was performed revealing a factor of safety of 1.969 and 1.964 for deep-seated circular and sliding block failure, respectively, exceeding the generally accepted design factor of safety of 1.5 (results are presented in Appendix C).

A pseudo-static analysis of the landfill side slope was also performed using STABL. An earthquake horizontal and vertical acceleration of 0.04 to 0.1 g is the probabilistic risk in the State of Maryland. An acceleration of 0.1 g was selected as the most extreme case parameter to incorporate into the model. An infinite slope analysis was again performed revealing a factor of safety of 1.326 and 1.322 for deep-seated circular and sliding block failure, respectively, exceeding the generally accepted design factor of safety of 1.0 (Appendix C).

Another static analysis was performed for the eastern side slope between the current mining operation and the proposed future landfill side slope. With the mining operation removing soil to the east of the landfill, a critical slope was determined for the berm between the landfill and the open excavation. Results indicate that there is a possibility the berm will fail if the slope on the side of the excavation is steeper than 2:1. An infinite slope analysis on a 2:1 side slope revealed a factor of safety of 1.072 and 1.071 for deep-seated circular and sliding block failure, respectively (Appendix C). Based on these results, it will be necessary to ensure that the side slopes adjacent to the proposed landfill in the area currently being excavated are graded to 2:1 or flatter prior to commencing landfilling operations.

5.7 COVER SYSTEM

5.7.1 Cover Materials

A minimum of six (6) inches of soil, or an alternative material if subsequently approved by MDE, will be used for periodic cover after waste placement to control vectors, fires, odors, blowing litter, and scavenging as well as minimize the infiltration of stormwater into the leachate collection system. Soil compaction will occur immediately after lift placement to minimize fugitive dust emissions. Daily cover soils would be excavated from on-site borrow sources and stockpiled at a location near the working face of the operating phase. The stockpile will be of sufficient quantity for at least 10 operating days in order to assure that no disruption in service occurs. All cover materials will be free of putrescible material, solid waste, tree stumps, logs, rocks, construction debris, frozen soil, and other deleterious material.

If not properly controlled, dust can be a health hazard to operating personnel, and a cause of excessive equipment wear. Whenever dust conditions prevail, roadways and exposed soil surfaces will be sprinkled with water. The main entrance road leading to the landfill, and on-site roadways, will be treated with water, or calcium chloride, whichever is determined to be most effective. All areas subject to traffic, including areas traversed by trucks or earthmoving equipment used for hauling and spreading cover material, will be sprinkled with water, if required, for dust control.

Intermediate soil cover will be applied to waste placement areas no later than 30 days following completion of each lift. The intermediate cover will be a total of 12 inches thick and comprised of compacted soils excavated from on-site borrow sources. All soil cover materials will be free of putrescible material, solid waste, tree stumps, logs, rocks, construction debris, frozen soil, and other deleterious material. Areas inactive for greater than 180 days will be seeded with grasses to minimize soil erosion.

5.7.2 Final Cover System

The final cover system will be constructed on those areas of the landfill which attain final elevation, and will be constructed as phases are completed on areas which will not receive subsequent filling. The cover system is comprised of the following components presented in ascending order:

- *A two-foot thick layer of final cover soil material.* The function of this layer is to provide an interim cover until construction of the final cover system.
- *A* 60-mil high-density polyethylene geomembrane. This geomembrane will effectively minimize and/or eliminate any infiltration of precipitation into the underlying waste and will exhibit a coefficient of permeability less than or equal to 1 x 10⁻⁷ cm/sec. The geomembrane will be textured on both sides to ensure slope stability in the areas exhibiting 4:1 side slopes.
- A non-woven geotextile fabric which provides an apparent opening size (AOS) no finer than U.S Standard Sieve No. 100 and no coarser than the U.S. Standard Sieve No. 70. The function of this geotextile fabric layer is to protect the underlying geomembrane from rips, tears, and/or punctures resulting from direct contact with the overlying drainage layer material.

- A 12-inch thick drainage layer constructed with native sand/gravel, or an alternative material subsequently approved by MDE, which will provide a coefficient of permeability greater than 5 x 10⁻¹ cm/sec. The function of the drainage layer is to divert infiltrating surface water from the barrier layer of the final cover system.
- A non-woven geotextile fabric which provides an apparent opening size (AOS) no finer than U.S Standard Sieve No. 100 and no coarser than the U.S. Standard Sieve No. 70. The function of this geotextile fabric layer is to prevent clogging of the underlying drainage layer with the material used to construct the overlying protective cover layer, and to provide a barrier for minimizing the depth of root penetration.
- *A 20-inch thick protective cover layer, consisting of protective cover soil.* The function of the protective cover layer is to eliminate the exposure of the drainage layer and barrier layer to frost penetration, thereby ensuring the integrity of the final cover system.
- A maximum four-inch thick vegetative cover layer consisting of topsoil to be established and maintained on the final cover system within a minimum of four months after placement of the protective layer.
- Seeding to establish vegetative cover.

5.7.3 Waste Settlement Effect on the Landfill Cover System

Over time, waste settlement in a landfill can cause HDPE geomembranes in the landfill cover system to fail. Calculations were performed in order to determine whether the differential settlement or the maximum localized settlement of the waste would cause the HDPE geomembrane in the landfill cap to tear.

5.7.3.1 Differential Waste Settlement Effect

In order to determine if differential waste settlement will affect the HDPE geomembrane in the landfill cap, the maximum elongation must be calculated. Assuming the maximum elongation occurs between the points where the waste depth is greatest and the distance to the edge of the landfill (the point where the least settlement will occur) is shortest.

By the time the landfill cap is placed, most settlement of subbase and existing site soils will have occurred, so for the purpose of this calculation, this settlement will not be considered further. Using a secondary consolidation equation along with the height of waste and the age of the landfill as input, it was determined that the maximum settlement of 13.0 feet would occur at the location of greatest waste thickness (see Appendix C). The shortest distance from this point to the edge of the landfill is approximately 240 feet (ft). Along this distance, elongation of the

liner is calculated to be approximately 0.15 percent. According to the HDPE geomembrane manufacturer specifications, the allowable elongation is 12 percent at yield. This is much greater than the calculated elongation assumed from the greatest waste depth to the edge of the landfill, and is, therefore, not a concern.

5.7.3.2 Localized Waste Settlement Effect

In order to determine if localized waste settlement will have an effect on the HDPE geomembrane in the cover system, a localized distance of 10 feet was selected. As mentioned in the previous section, a maximum settlement of 13.0 feet was already determined. Using an allowable elongation of 700 percent at break (from manufacturer specifications for smooth HDPE geomembrane), and the selected localized distance, an allowable settlement of 79 feet is calculated (see Appendix C). This allowable settlement is much greater than the previously calculated maximum settlement of 13.0 feet and is, therefore, not a concern.

This section discusses the Construction Quality Assurance (CQA) Program which will be implemented throughout the construction of the Tolson Rubble Landfill. A Construction Quality Assurance/Quality Control Plan and detailed Technical Specifications are provided in Appendices D and E, respectively. Overall construction quality assurance/quality control (CQA/QC) will be provided under the direction of a registered professional engineer in the State of Maryland who will oversee inspections throughout the construction period, and will incorporate the activities performed by the construction contractor as well as the direction of the third-party independent reviewer. The frequency of inspections will be provided as deemed appropriate, but at a minimum will occur weekly throughout the construction period. The final CQA/QC approval will be provided through certification by a registered professional engineer in the State of Maryland that the Tolson Rubble Landfill was constructed in accordance with the approved Phase III Engineering Report, and all applicable regulations.

Implementation, documentation, oversight, and management of the CQA plan is dependent on the involvement of the landfill owner, the MDE, CQA personnel, CQA inspectors, the CQA manager, the contractor, the CQC manager, and the construction crews. An organization chart and a description of the training requirements and the responsibilities of these parties are provided in the CQA/CQC Plan in Appendix D.

6.1 SITE PREPARATION

6.1.1 General

Site preparation for construction of this facility will include such activities as a final aerial or supplemental topographic survey, establishment of control benchmarks, clearing and grubbing undisturbed areas to be subjected to construction, and, where necessary, establishment of sediment and erosion control structures; i.e., silt fences, straw bale dikes and temporary diversion ditches, and site grading and filling to establish preliminary subgrade elevations.

6.1.2 Aerial Survey

Prior to the commencement of any site preparation or construction activities, an aerial survey will be conducted to establish the most current site grades given the active mining activities on-going at the site. As an alternative the current survey may be supplemented in active areas with topographic mapping to achieve a similar result. This survey will be conducted in accordance with National Map Accuracy Standards and will be the basis for all construction and operation.

6.1.3 Control Benchmarks

A minimum of three permanent benchmarks will be established at the facility for use in survey control throughout the life of the landfill. The benchmarks will be located in areas of the site which will not be disturbed during the construction, operation, and closure phases of the landfill. Both horizontal and vertical control will be established at each benchmark.

6.1.4 Clearing and Grubbing

Clearing of vegetation; e.g., grass, tress, bushes, and grubbing of roots and stumps will be required over a limited portion of the site prior to beginning construction. Materials cleared and grubbed will be stockpiled and later either recycled or disposed in the landfill as part of the operations. Clearing will be required in those areas necessary to provide an adequate and safe operating area and to achieve the necessary conditions for the efficient operation of construction equipment.

It is the intended to clear at one time only those areas necessary to perform the required construction activities for individual phase development. This approach will minimize disturbance to the site.

6.1.5 Erosion and Sediment Control Practices

With the initiation of clearing activities, and throughout the construction phase of the landfill, proper sedimentation and erosion control practices will be established. These control practices will be instituted to provide protection against possible sedimentation and erosion problems which could result in offsite environmental degradation, or the potential failure of the environmental protection features of the landfill design.

Generally, sedimentation and erosion controls are established through the use of silt fences and straw bale dikes, and temporary diversion ditches or swales. Silt fences and straw bales are used to retard the surface-water flow and to trap sediment. Temporary diversion structures function to limit the volume of sediment exiting the construction area as a result of surface-water runoff across the disturbed areas. Surface water collected in the temporary diversion ditches and swales will be directed to the sediment traps or the sediment basin/stormwater management pond.

6.1.6 Site Grading

Site grading will entail the redistribution of existing stockpiled materials in order to achieve the required foundation grades. Approximately 440,000 cubic yards of material are currently stockpiled at the site. Additionally, approximately 913,366 cubic yards of material will be generated as a result of additional excavation necessary to achieve the required liner system grades. Approximately 723,179 cubic yards of this excavated/stockpiled material will be used as fill material during the construction of the liner system, and/or to achieve the final floor and sidewall configurations. Additionally, soil materials will be compacted in order to establish adequate bearing capacity for the construction of the liner system.

6.2 CONSTRUCTION

6.2.1 General

Construction of a waste disposal facility consists of three major phases of development. The initial construction phase consists of the facility construction, including construction of the foundation, subbase, liner system, stormwater control structures, leachate management system, access roads, and ancillary support facilities, as required. The second construction phase consists of the construction of disposal cells as waste is placed. The third construction phase is closure with the final cover system.

6.2.2 Initial Construction

As previously discussed, initial construction of the Tolson Rubble Landfill includes the implementation of those portions of the facility required to be in place prior to the initiation of waste disposal operations. Initial construction items include the subbase foundation, subbase, liner system, leachate management system, stormwater management system, roadways, and ancillary support facilities for Phase 1 operations. Stormwater control structures will be constructed as part of the initial clearing operation and will include stormwater berms and ditches, silt fences, sediment traps, and the sediment basin. The design for these structures is presented in Section 5.5. Access roadways will consist of compacted soil and crushed stone or gravelsurfaced roads used for access within the active disposal area, and to facilities such as the sediment basin/traps and the leachate collection tanks.

The subbase, liner system, and leachate collection system will be constructed as a unit. The subbase will be constructed first in accordance with the design parameters discussed in Section 5.1. The purpose of the subbase is to provide a stable foundation for the construction of the liner system and overlying leachate collection system. The liner system will be constructed over the subbase. As presented in Section 5.1, the liner system will consist of a 60-mil HDPE geomembrane. Over the liner system will be the leachate collection system as presented in Section 5.2. Design features for these systems are presented on the Drawings in Appendix B.

6.2.3 Phase Development

The disposal of waste in the landfill will consist of a total of four operational phases, each constructed of cells arranged in vertical lifts and arranged in a logical lateral pattern or progression. A total of eight individual cells will be constructed. Drawing Nos. P3 through P6 in Appendix B depict the phased development of the landfill and Drawing No. P8 indicates the general direction of cell development and progression.

Each individual cell will be constructed with an approximate working face of no more than 10,000 square feet. The waste will be off-loaded, spread, and compacted in maximum four-foot thick layers, with each lift not to exceed a maximum height of eight (8) feet.

At the end of each third day of operation, the exposed waste will be covered with soil ("periodic" or "daily" cover).

Any portion of the active phase that will be inactive for 30 days or more will be covered with a minimum of 12 inches of compacted, fine-grained soil as an intermediate cover layer. This soil is readily available on-site from stockpiles of mining overburden. Further, portions of a phase which will be inactive for greater than 180 days will be graded to promote surface-water runoff and vegetated and/or mulched with a temporary seed mix to enhance sedimentation and erosion control. Any area of the landfill filled to its approved height will receive final cover as described in Section 5.7.

As each phase approaches its design capacity, initial construction activities will begin for the subsequent phase. The construction of subsequent phases will be appropriately timed to provide continuity in the filling operations sequence between phases. Each phase of the landfill will be enclosed along the perimeter with containment berms. The berms will be constructed as a controlled fill with common borrow material placed in 8-inch thick, loose lifts. Each lift will be compacted to a minimum of 90 percent of the maximum Modified Proctor density, in accordance with ASTM D-1557, with the moisture content at or wet of optimum. The final cover system will key into the liner system to provide the continuous envelopment of the waste and flow pathways for leachate through the collection layers. This will result in a totally enclosed waste unit bordered underneath by the impermeable liner system, and above by the impermeable final cover system.

6.3 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

CQA/QC can be divided into two major categories: 1) that for the materials to be incorporated into the construction; and, 2) that for the construction procedures to be employed in the construction of the Tolson Rubble Landfill. Both are discussed in the following sections and in Appendix D.

6.3.1 General

Overall CQA/QC for landfill construction will be provided under the direction of an independent CQA Officer. The CQA Officer will be a registered professional engineer in the State of Maryland who will supervise inspections throughout the construction period. The frequency of inspections will be provided in accordance with the final construction contract specifications, but at a minimum will occur weekly throughout the construction period. Final CQA/QC approval will be provided by certification that the landfill was constructed in accordance with the approved permit, applicable regulations and Technical Specifications (Appendix E). CQA/QC will be accomplished through the review of approved shop drawings, the testing of construction materials and verification of compliance with the Technical Specifications, Contract Drawings, approved shop drawings, State of Maryland regulations, and other applicable permit requirements.

CQA/QC can be divided into two major categories: 1) the materials to be incorporated into the landfill construction, including the liner and final cover systems and the leachate and gas management systems; and, 2) the construction procedures to be employed in the construction of the landfill. Both topics are discussed in the following sections.
6.3.2 CQA/QC of Construction Materials

CQA/QC for the construction materials to be incorporated into the landfill construction will be accomplished through field and laboratory testing of the materials. Field testing is discussed in the following section addressing CQA/QC for construction inspection. Laboratory testing will involve performing the tests required by the Technical Specifications (Appendix E) and the MDE regulations. Tests will also be performed in accordance with manufacturer specifications for materials, such as geomembrane, geocomposite, and geotextile. Where applicable, tests will be performed in conformance with the ASTM and other industry standards. The CQA/QC Plan for the oversight and certification of the Tolson Rubble Landfill is included in Appendix D.

Prior to the arrival of the materials at the site, the construction contractor will submit samples, certified test reports, and/or manufacturer data to the approving authority for review and acceptance. The submission of transmittals will be accomplished in a timely manner to facilitate adequate review time. Upon arrival at the site, the contractor will verify the compliance of construction materials with the approved shop drawings and the technical specifications. Any materials conflicting with the approved shop drawings and the technical specifications will be rejected. Storage of construction materials will be in accordance with the manufacturer recommendations, and as permitted by the Technical Specifications and construction documents (Appendix E)

6.3.3 CQA/QC of Construction Procedures

Field testing will involve performing all tests required in the Technical Specifications, the CQA/QC Plan, manufacturer specifications and any tests specified in the MDE regulations. Where applicable, tests will be performed to adhere to the ASTM or other industry standards. The construction contractor will also provide a copy of all survey data immediately after measurement to ensure that proper elevations and slopes are achieved. The results and certifications from the laboratory and field testing program will be available for review at the Tolson Rubble Landfill office.

Construction and installation inspections will be performed under the direction of a professional engineer registered in the State of Maryland, or by a construction inspector under the direct supervision of the registered professional engineer. Field inspection will be performed visually to verify that the landfill components are installed and constructed in accordance with the Technical Specifications and all applicable regulations. Field inspection reports will be executed daily and made available for review at the Tolson Rubble Landfill office.

6.3.4 Construction Certification

Upon completion of the construction, a certification report will be prepared to document all construction activities performed during the Tolson Rubble Landfill construction. The report will include, but not be limited to, the following information: 1) construction inspection reports; 2) results of field testing; 3) documentation of deviations from the approved design; 4) a certified statement attesting to the truth and accuracy of the certification report, to the best of the knowledge of the signatory; and, 5) Record Drawings, which include "as-built" drawings and any deviations from the approved design with explanations documented in the report. The certification report will be submitted to the MDE for review, comment, and acceptance.

A summary of the planned monitoring program for the Tolson Rubble Landfill is presented in the Monitoring Plan provided in Appendix F. The Monitoring Plan will ensure the protection of human health and the environment throughout the active closure and post-closure periods. The complete Monitoring Plan provides a description of the monitoring system, the sampling and analysis program, and associated Quality Assurance/Quality Control (QA/QC) procedures for groundwater, surface-water, leachate, and landfill gas monitoring. The majority of the groundwater monitoring network has been established, and operational for over 15 years as part of the closed Cunningham Rubble Landfill monitoring plan, which has provided valuable background and historic data. However, the monitoring plan for the Tolson Rubble Landfill includes an expanded network of newly-installed wells (Appendix A) that will provide a more robust and spatially complete monitoring program capable of monitoring the Tolson Rubble Landfill and the former landfill in a combined system.

A summary of planned operation and maintenance procedures is presented in the Operation and Maintenance Plan (O&M Plan) provided in Appendix G. These procedures ensure that the landfill is operated and maintained in an environmentally-sound, cost-effective, and reliable manner throughout the active closure and post-closure periods. The operating procedures describe the inspection and placement plan for waste disposal, along with outlining operating details for the stormwater, leachate and landfill gas management systems. The maintenance procedures prescribe the necessary steps to provide a wellmaintained waste disposal facility by placing emphasis on preventive maintenance. In addition, information is presented relative to the means for preventing hazards, and describing the safety, training, record-keeping, and environmental monitoring programs to ensure a safe and efficient facility.

9.1 CLOSURE PLAN

This section addresses closure procedures to be instituted upon the cessation of waste disposal operations at the landfill. The purpose of this plan is to demonstrate an understanding of the federal, state, and local requirements for landfill closure and is commit to meeting those requirements. The plan covers the time from the final acceptance of waste to the time when the plan requirements have been met and certified by an independent registered professional engineer. This plan has been developed in accordance with 40 CFR §258.60 and COMAR 26.04.07.

9.1.1 Schedule and Description

Final closure of the landfill will involve construction of the cover system where partial closure has not already been completed (see Section 9.1.3). Details of the cover system design are presented in subsequent sections. Unless Tolson receives an extension from the MDE, landfill closure will begin within 24 months of the final acceptance of waste. The projected life expectancy of the landfill is approximately 19 years (Section 4.3) without consideration of expected recycling opportunities. Therefore, it is expected that closure activities will commence in 2029 unless recycling or the waste stream volume are altered. Because the exact date of the final acceptance of waste is not known, the closure schedule will be discussed in relative terms.

As required by COMAR 26.07.04.21, final closure activities will be completed not later than 36 months after final receipt of waste unless an alternative schedule is approved by the MDE. The multi-phase landfill development presents the operational sequences proposed for the landfill. The development of this facility will be phased and integrated so that at certain times, one phase will be in operation while other phases are being constructed.

Partial closure will occur within 24 months of reaching final grade in a particular phase. Partial closure will include construction of the cover system for that portion of the landfill. After the cover system has been constructed, post-closure care (inspection, maintenance, and monitoring activities) will begin for that portion of the landfill. Construction, operation, and partial closure will continue in all of the remaining landfill phases until all of the proposed landfill phases achieve the final design construction. At that time, the entire facility will begin final closure. The leachate collection tanks will remain in use for as long as leachate flows from the landfill. Although the exact rate of leachate flow after landfill closure is unknown, the leachate collection tank is projected to remain in place through a post-closure period of 30 years. Upon the cessation of waste disposal operations, written notification will be provided to the MDE stating the actual date on which the acceptance of waste at the landfill will cease. An updated closure plan will be submitted to the MDE at least 180 calendar days before final closure is expected to be initiated. Following closure, the MDE will be notified that certification by a registered professional engineer verifying closure has been placed in the operating record.

9.1.2 Performance Standard

This closure plan was developed to assure that the landfill will be closed in a manner that minimizes further maintenance, controls the post-closure release of waste, waste constituents, leachate, contaminated precipitation, or waste decomposition products to the groundwater, surface waters, or the atmosphere. The facility will be closed in a manner that complies with the applicable closure provisions of 40 CFR §258.60, COMAR 26.04.07, and any conditions imposed in the permit which is the subject of this application. These performance standards will be met through the proper design and construction of the final cover and proper implementation of the closure plan. The post-closure plan (see Section 10.0) provides for future maintenance and monitoring of the facility for a period of 30 years after final closure certification.

9.1.3 Partial Closure

Any area which has not received waste for a period of one month or more will receive intermediate cover, compacted to a thickness of not less than one-foot. Intermediate cover material will be soil or other suitable material which provides an adequate level of environmental protection. Any section of the landfill which is covered with intermediate cover will subsequently remain inactive until an overlying phase is constructed.

Final cover will be applied to any point in the fill within 90 days of receiving the final waste volume, or when a given area achieves final elevation. Final cover will consist of on-site borrow material compacted to a total thickness of not less than two feet to provide an adequate level of environmental protection. Both intermediate cover and final cover will be uniformly compacted and graded to:

- Minimize run-off onto the fill area of the landfill;
- Prevent erosion and ponding within the fill areas; and,
- Drain water from the surface of the landfill.

Within 24 months of any point achieving final grade, the cover system outlined in Section 5.7 will be constructed on that portion of the fill. The cover system used for closure complies with the requirements for final cover of land disposal facilities as provided in 40 CFR §258.60 and COMAR 26.04.07.21. A request for partial closure will be submitted of any areas of the facility which receive final cover, grading, and vegetation in accordance with this closure plan prior to the cessation of site operations. For such partial closure, a certification statement, signed by a registered professional engineer and a representative of the Tolson Rubble Landfill stating that the partial closure was performed in accordance with the approved closure plan and the standards of 40 CFR §258.60 and COMAR 26.04.07.21, will be provided to the MDE.

9.1.4 Closure During Operating Life

Should the need arise to close the landfill prior to reaching disposal capacity, a determination will be made by site owner, an independent registered professional engineer, MDE, and any other involved parties, of the time period and extent to which the facility should be closed. If the entire facility is to be inactive for a period of more than 90 days, the active areas will be temporarily closed with procedures similar to those used for the final cover of inactive areas. Any exposed waste will be covered with a minimum of two feet of compacted final cover. The entire internal area of each section would be uniformly graded to promote run-off from the area.

If the landfill is to be permanently closed, a permit modification request will be submitted to the MDE for review which includes revised final contours. Upon acceptance of the revised final contour plan by the MDE, the partially completed areas will be completed as necessary, and procedures for ultimate closure will be instituted. The landfill will be closed as specified in the final closure plan.

9.1.5 *Certification of Closure*

Certification by both the site owner and an independent registered professional engineer will be submitted to the MDE that the landfill has been closed in accordance with the specifications of the approved closure plan. Record drawings of the entire landfill facility will be submitted as part of the certification. The professional engineer or his/her authorized inspector will conduct weekly inspections during implementation of the closure plan to verify that closure activities are being performed accordingly, and to serve as documentation for the closure certification.

9.1.6 *Contact for Final Closure*

A qualified and adequate staff will be maintained to administer activities during the closure period. This staff will be responsible for the site inspection, site monitoring and storage and updating of the facility closure plans. A complete listing of the names and addresses of personnel and regulatory agencies who receive a copy of the closure plan will be maintained by operating staff at the facility office. Information concerning changes or modifications to the plan will be distributed to the listed parties.

The following individual is currently designated to be contacted regarding closure care:

Name:	Ms. Joy Faithful
Address:	Tolson & Associates, LLC
	Post Office Box 3698
	Crofton, Maryland 21114
	Telephone: 410-359-3311

9.1.7 *Restricted Access Assurance*

The property will be secured with chain-link fence, vehicular obstructions and dense vegetation and topographic constraints. These features will prevent vehicular access and discourage pedestrian traffic across the closed facility.

9.2 FINAL COVER SYSTEM

9.2.1 General

The following sections present the information and details for the engineering design and implementation of the closure plan, which was designed to adhere to the Resource Conservation and Recovery Act (RCRA) - Subtitle D solid waste regulations and the State of Maryland Solid Waste Regulations (COMAR 26.04.07) as they pertain to the closure of a landfill facility (COMAR 26.04.07.21).

9.2.2 Final Contour Plan

The final contours to be generated through the construction of the landfill were configured to promote the run-off of precipitation and establishment of vegetation while eliminating ponding and soil erosion. The final contours exhibit maximum side slopes of 25 percent (4 horizontal to 1 vertical) and a minimum of four (4) percent top slope with the highest elevation being 230 feet above mean sea level. Section 5.6, Stability Analysis, presents information and data confirming the stability of the landfill configuration.

Surface-water conveyance benches are provided around the landfill structure as part of the final contour plan (Drawing No. P7, Appendix B). These benches promote the stability of the waste pile and also control the run-off of precipitation from the final cover, thus minimizing infiltration. The benches will also aid in the control of potential erosion. The design and details for the surface-water management system are presented in Section 5.5.

9.2.3 Cover System Design

The final cover system to be constructed over the landfill was designed to meet or exceed the minimum cover requirements specified in COMAR 26.04.07.21. The cover system is composed of the following layers, in ascending order:

- <u>Porous Rubble Waste/Gas Venting Layer</u>: A one-foot thick layer of porous processed waste will be installed immediately below the final cover layer. This layer will function as a gas venting layer that promotes the movement of landfill gas to the gas vents.
- *<u>Final Cover Layer</u>:* A two-foot thick layer of final cover soil material will be installed to provide an interim cover until construction of the final cover system.
- <u>Barrier Layer</u>: A 60-mil high-density polyethylene (HDPE) geomembrane will effectively minimize and/or eliminate any infiltration of precipitation into the underlying waste and will exhibit a coefficient of permeability less than or equal to 1 x 10⁻⁷ cm/sec. The geomembrane will be textured on both sides to ensure slope stability in the areas exhibiting 4:1 side slopes.
- <u>Barrier Protection Layer</u>: A non-woven geotextile fabric which provides an apparent opening size (AOS) no finer than U.S Standard Sieve No. 100 and no coarser than the U.S. Standard Sieve No. 70 will protect the underlying geomembrane from rips, tears, and/or punctures resulting from direct contact with the overlying drainage layer material.

- <u>Drainage Layer</u>: A 12-inch thick drainage layer constructed with native sand/gravel, or an alternative material subsequently approved by MDE, which will provide a coefficient of permeability greater than 5 x 10⁻¹ cm/sec will be provided to divert infiltrating surface water from the barrier layer of the final cover system.
- *Filter Layer:* A non-woven geotextile fabric which provides an apparent opening size (AOS) no finer than U.S Standard Sieve No. 100 and no coarser than the U.S. Standard Sieve No. 70will be provided to prevent clogging of the underlying drainage layer with the material used to construct the overlying protective cover layer, and to provide a barrier for minimizing the depth of root penetration.
- *Protective Cover Layer*: A 20-inch thick protective cover layer, consisting of protective cover soil will be provided to eliminate the exposure of the drainage layer and barrier layer to frost penetration, thereby ensuring the integrity of the final cover system.
- *Vegetative Cover Layer:* A maximum four (4)-inch thick vegetative cover layer consisting of topsoil will be established and maintained on the final cover system within a minimum of four months after placement of the protective layer.
- <u>Seeding</u>: Seeding to establish vegetation will be performed in accordance with the seeding specification presented on Drawing No. E23, Appendix B.

Typical details depicting the final cover configuration to be constructed over the landfill are presented on Drawing No. P19, Appendix B.

In order to facilitate the drainage of infiltrated surface-water from the cover system and minimize the amount of head on the geomembrane, a drainage layer consisting of native sand/gravel, or an alternative material subsequently approved by MDE, has been incorporated into the final cover system. The drainage layer material will exhibit an equivalent hydraulic conductivity (coefficient of permeability) of at least 5.0×10^{-1} cm/sec, which is representative of a sand-gravel mixture.

The drainage layer is designed to maintain the depth of infiltrated water on therelatively-impermeable layer to a maximum of one-foot. The Hydrologic Evaluation of Landfill Performance (HELP) Model was used to verify the adequacy of the drainage layer material and project the actual amount of head on the barrier layer. The HELP model predicted that the peak daily depth of water above the geomembrane barrier layer resulting from the peak daily storm event will be 10.1 inches. HELP Model calculations are presented in Appendix C.

9.2.4 Vegetation

Seeding, fertilizing, and mulching will be performed to adhere to the requirements of the USDA, NRCS and the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control, or as otherwise approved by the MDE for amendments such as sludge. Within an appropriate time after construction of the cover, seeding will be performed by personnel experienced and qualified in the work required, utilizing equipment such as a fertilizer spreader and cyclone seeder, or a hydro-seeder (slurry including fertilizer and seed), with a mulching machine utilized for the application of mulch. Seed will be labeled in accordance with USDA regulations under the Federal Seed Act and furnished in sealed standard containers. The seed type and application rate will depend on the season of the year in which the seed will be applied and must meet the requirements of the Maryland State Seed Law. Mulch will be used on all disturbed areas; the mulch will be spread uniformly by hand or mechanical means. Wood cellulose fibers may be used for anchoring the straw, providing a fiber binder is mixed with the fiber.

9.2.4.1 Temporary Seeding

Temporary seeding will be performed in accordance with the Anne Arundel Soil Conservation District Details and Specifications for Vegetative Establishment, presented on Drawing No. E26, Appendix B. Temporary seeding will occur when the final grades have been achieved and the final cover layer has been placed. Temporary seeding will be performed to preserve the integrity of earthen structures to control sediment and erosion including the landfill side slopes, perimeter ditches and sediment control structures. Temporary vegetative cover consists of annual plants which sprout rapidly and survive for only one growing season.

9.2.4.2 Permanent Seeding

Permanent seeding will be performed in accordance with the Anne Arundel Soil Conservation District Details and Specifications for Vegetative Establishment, presented on Drawing No. E26, Appendix B. Permanent seeding will occur after placement of the vegetative cover layer. Permanent seeding will be performed to establish a perennial vegetative cover on the disturbed areas thereby minimizing potential erosion and sediment problems. Factors affecting permanent seeding include climate, soils, topography, and land use.

9.2.5 Mulching

Mulching will be performed in accordance with the Anne Arundel Soil Conservation District Details and Specifications for Vegetative Establishment, presented on Drawing No. E26, Appendix B. Mulching will foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold. Areas permanently seeded will be mulched immediately following seeding. Organic mulch materials, such as straw, wood chips, bark and wood fiber will be used as effective mulch materials. Chemical soil stabilizers or soil binders will be used to bind organic mulches together. Nets and mats will also be used to hold mulches to the soil surface in highly erosionprone areas.

9.2.6 Design of Key System for the Cap

An important design consideration for waste disposal facilities is the manner in which the liner system, leachate collection system and the final cover system will be interconnected. It is imperative to design a "key" by which each of the landfill components are tied together in order to provide a continuous impermeable barrier, resulting in encapsulation by both the liner and cover systems.

The key system for the landfill incorporates a perimeter berm. This berm allows for dovetailing the final cover system with the landfill liner system. The interconnection of these two units provides the continuous impermeable barrier. The use of a perimeter berm also provides a mechanism for a smooth transition between the final cover of the landfill and the existing grades outside of the landfill.

9.2.7 Slope Stability Analysis

A final development cross-section of the landfill cover system was evaluated to ensure the stability of the landfill slopes. The cross-section represents the critical section of the landfill incorporating the maximum height of the landfill, the longest slope length, and the steepest slope (4 horizontal to 1 vertical). To be conservative, the stability analysis was conducted without the presence of benches; one bench will actually be constructed on each slope to further increase stability in addition to its primary function of surface-water management.

The following cover components were analyzed for failure using the STABL computer model: vegetative cover soil, protective cover soil, drainage layer, drainage layer/textured HDPE geomembrane interface, textured HDPE geomembrane/final cover interface, and the final cover. The strength parameters used in the analysis were based on site information, available technical publications, engineering judgment, and past experience. Every cover

system component surpassed the 1.5 factor of safety requirement. Therefore, the cap system is considered stable. Reference Section 5.6 for further discussion of the slope stability analysis.

9.2.8 Barrier Layer Integrity

To ensure the integrity of the relatively-impermeable barrier layer, penetrations from rubble debris, pipes, roots, and frost as well as cracking from differential settlement have been addressed as part of the design process. As part of the gas management system, passive gas vents will penetrate the barrier layer. These pipes will be fitted with HDPE boot sleeves that will be both extrusion welded and clamped to the riser and header pipe. The HDPE boot sleeves will also be welded to the HDPE geomembrane to assure minimizing releases. A typical landfill gas vent detail is presented on Drawing No. P18, Appendix B.

The design thickness (two feet) of the protective cover layer, including a minimum four inches of topsoil, will constitute an adequate depth to prevent the penetration of roots and frost beyond the relatively-impermeable barrier layer. The maximum depth of frost penetration at the site is fifteen (15) inches according to USEPA Document EPA/625/4-89/022, entitled Requirements for Hazardous Waste Landfill Design, Construction and Closure, August 1989. Although the facility is a rubble waste, not hazardous waste landfill, this reference provides useful frost-penetration information which is applicable.

Settlement of the landfill foundation and waste pile has been determined. The design calculations presented in Appendix C predict a maximum settlement of 13.0 feet. This settlement is the maximum long-term settlement from secondary consolidation with the weight of the cover included. Considering that the landfill life is approximately 19 years, it is expected that the settlement in the foundation due to waste deposition has been completed at closure.

Total in-place waste settlement across the entire landfill may reach up to 14 percent of the maximum height of waste placement. This settlement is due to several factors, including: degree of compaction; waste decomposition; self-weight of the waste; removal of leachate; and, construction of the final cover system. Most of the waste consolidation will occur before or during construction of the final cover system, with a lesser amount occurring after construction activities are completed. Post-construction consolidation generally occurs as a whole across the entire landfill, but also is manifested as small depressions where localized settlement is greater than the surrounding vicinity. The effect of total settlement across the entire landfill on the HDPE geomembrane will be minimal, as indicated by the design calculations presented in Appendix C.

Although total settlement at the crown of the landfill is projected to be 13.0 feet, there may be localized settlement or small depressions across the surface of the landfill where settlement is greater; this could create potentially higher stresses on the geomembrane than those calculated to occur due to total settlement. An estimation of the effects of localized settlement is given in Appendix C. For this site, a localized area of settlement was assumed to have a length of 10 feet. Over this length, a settlement of 79 feet is necessary to cause HDPE geomembrane tearing. This magnitude of settlement is unlikely considering that the maximum settlement was calculated to be only 13.0 feet.

9.2.9 Final Cover Availability and Suitability

Final cover materials required to construct the final cover system will include common borrow for the protective cover layer and final cover layer, topsoil for the vegetated layer, and sand/gravel for the drainage layer. These materials are available both on-site and from material suppliers within the area. The suitability of these materials for use in the cover system construction will be determined through the construction quality control testing programs outlined in Section 9.2.10.2. No materials will be incorporated into the construction of the cover system which do not meet or exceed the material requirements presented in the regulations.

9.2.10 Construction Quality Assurance/Quality Control

9.2.10.1 General

Overall quality assurance/quality control for the final cover system will be provided under the direction of a Construction Quality Assurance (CQA) Manager (see Appendix D) who will be an independent, registered professional engineer licensed to practice engineering in the State of Maryland, and who will supervise inspections during the implementation of the closure. Inspections will be conducted as deemed necessary, but at a minimum will be performed weekly throughout the construction period. Final QA/QC approval will be provided by certification that the landfill was closed in accordance with the approved closure plan and applicable regulations.

CQA/QC for the final cover system is divided into two major categories; QA/QC will be required for materials to be incorporated into the final cover system, and for procedures to be employed in the construction of the final cover system. These categories are discussed in Sections 9.2.10.2 and 9.2.10.3, respectively. CQA/QC for materials to be incorporated into the final cover system will be accomplished through field and laboratory testing. Field testing is utilized to confirm that materials delivered to the site conform to the materials approved for use, as discussed in the following section addressing CQA/QC field testing during construction. Laboratory testing will involve performing tests required by the Technical Specifications to ensure that proposed materials conform within the limits delineated in the Technical Specifications. Where applicable, tests will be performed according to ASTM standards. Laboratory tests will determine, at a minimum, the following parameters for suitability of each component of final cover system construction:

- Hydraulic Barrier Geomembrane:
 - Geomembrane materials will be tested by the manufacturer at the time of production, with test certifications supplied to the CQA Manager at the time of material acceptance at the site;
 - Geomembrane materials will be delivered to the site with the proper chemical resistance certifications stating specific resistance to chemicals and other solid waste materials. Specific tests for the geomembrane will depend on the type of material used;
- Drainage Medium Sand/Gravel:
 - Materials will be sampled at the rate of one sample every 2,500 cubic yards of material;
 - Specific tests will include, but not be limited to, moisture content (ASTM D-2216), soil classification (ASTM D-2487), particle size analysis (ASTM D-422), hydraulic conductivity (ASTM D-2434), and moisture-density relationship (ASTM D-698);
- Geotextile:
 - Testing will be conducted at the frequency of one per lot, or a minimum of one round of testing every 50,000 square feet;
 - Specific tests will include, but not be limited to, flow rate (ASTM D-4491); permeability (ASTM D 4491); trapezoidal tear strength (ASTM D-4533); grab elongation (ASTM D-4632); fabric weight (ASTM D-3776); puncture strength (ASTM D-4833) and apparent opening size (ASTM D-4751);

- Protective Cover Layer:
 - Testing will be conducted at the frequency of once every 5,000 cubic yards;
 - Specific tests will include, but not be limited to, particle-size analysis (ASTM D-422), moisture content (ASTM D-2216), Atterberg Limits (ASTM D-4318), and soil classification (ASTM D-2487);
- Vegetative Layer:
 - Testing will be conducted at the frequency of once every 2,000 cubic yards; and,
 - Specific tests will include, but not be limited to, particle-size analysis (ASTM D-422), organic content analyses (USDA Circular #757), soluble salts (ASTM D-4542), and pH test (ASTM D-4972).

9.2.10.3 CQA/QC for Cover System Field Testing

CQA/QC for the installation and construction of the cover system will involve field inspection and field testing of materials. Field testing will involve performing all tests required by the Technical Specifications and manufacturer specifications to ensure the materials delivered to the site conform to the materials approved for use. Where applicable, the tests will be performed in accordance with ASTM standards. Field tests will include the following:

- Hydraulic Barrier Geomembrane:
 - field testing will be performed in accordance with the manufacturer-specified frequencies and methods;
 - each seaming apparatus in use each day will perform peel and shear tests on scrap pieces of material at the beginning of each seaming period;
 - destructive testing using fragment pieces of material will be performed every 4 hours of operation for each piece of equipment. Welds will be tested for every 500 feet of seam length; and,
 - non-destructive testing of field seams will be performed on 100 percent of the seam length.

9.2.10.4 CQA/QC for Cover System Inspection

Installation and construction inspection will be performed by the CQA Manager, or by a construction inspector under his direct supervision. Field inspection will be performed to visually verify that the final cover system is installed and constructed in accordance with the final design specifications and regulations. Field inspection reports will be executed daily and made available for review at the site. These inspections will include the following elements for each component of the final cover system construction:

- Hydraulic Barrier Geomembrane:
 - Proper underlying layer preparation, panel layout and overlap, seaming, and performance of seam tests, as specified;
- Drainage Medium Sand/Gravel:
 - Proper placement, performance of required tests, and achievement of final grade, as specified;
- Geotextile:
 - Sufficient panel overlap and covering of the geomembrane and drainage layer, as specified;
- Protective Cover Layer:
 - Proper placement, performance of required tests, and achievement of final grade, as specified; and,
- Vegetative Layer:
 - Proper placement, performance of required tests, achievement of final grade and proper seeding, as specified.

Visual inspection will be continually performed during the placement of soil and geosynthetic materials to prevent significant differences in the material used for construction purposes. The results and certifications from the laboratory and field test programs will be available for review at the site during construction activities and will be included in the closure certification report.

9.2.10.5 Cover Construction Certification

Upon completion of the final cover system construction, a certification will be submitted to the MDE by an independent, professional engineer registered in the State of Maryland that the landfill has been closed in accordance with the specifications of the approved closure plan. Project record drawings for the landfill, including the limits of cover placement, will be submitted as part of the certification. The professional engineer or construction inspector, under the direct supervision of the professional engineer will conduct weekly inspections during implementation of the closure plan to verify that closure activities are being performed accordingly, and to serve as documentation for the closure certification. The certification report will include, but not be limited to the following information:

- Construction inspection reports;
- Results of manufacturer testing an manufacturer certification;
- Results of field testing;
- Documentation of deviations from the permitted design and compliance with the design specifications;
- A notarized statement attesting to the truth and accuracy of the certification report to the best of the knowledge of the professional engineer; and,
- Project record drawings, including "as-built" drawings for major cover construction components, which document the limits of cover placement indicating any deviations from the permitted design with explanations documented in the report.

A site inspection by the MDE will be requested when the final design configuration has been established, before the installation of the geomembrane component of the final cover system. The purpose of this site inspection is to allow the MDE to make a determination as to whether or not the facility has been constructed in compliance with the regulations and the approved closure permit application before the final phases of final cover system construction proceed.

9.3 NOTICE TO AUTHORITY AND DEED NOTIFICATION

Written notification will be provided to the MDE at least 180 days prior to the cessation of waste disposal that the landfill will be closed in accordance with the schedule presented in Section 9.1.1. It is anticipated that the final closure activities can be accomplished within 36 months after receiving the final waste.

A certification of deed notation will be provided to the MDE that a notation has been recorded on the deed to the property. The notation will inform any potential purchaser that the land has been used as a landfill facility and its use is restricted under 40 CFR §258.61(c)(3).

This restriction includes any uses that would interfere with maintaining the integrity and effectiveness of the final cover system. A copy of the deed notation as recorded will be filed with the MDE.

9.4 CLOSURE COST ESTIMATE AND FINANCIAL ASSURANCE

In accordance with 40 CFR §258.71, an opinion of probable cost associated with implementing the final closure has been prepared using current (2009) dollars. The total opinion of probable cost to close the Tolson Rubble Landfill is approximately \$8,950,000 (see Appendix H).

The Tolson Rubble Landfill will be owned and operated internally, and used for commercial disposal purposes. Tolson & Associates, LLC are fully aware of the importance of financial assurance. As outlined in 40 CFR §258.74, financial assurance will be provided through corporate guarantees (state-approved mechanisms). Continuous coverage for closure will be provided until a release from the financial assurance requirements by demonstrating compliance with 40 CFR §258.60(h) and (i).

9.5 CLOSURE CONTINGENCY

If the Tolson Rubble Landfill is required to cease operations prior to achieving the final design contours, a request will be submitted to the MDE to modify the approved final design contours to comply with the design criteria established in this application and to provide final contours which blend into the existing topography while maintaining the established leachate collection system, stormwater management system, and the environmental monitoring program. Upon approval of the design modifications, the landfill would be closed and post-closure activities would be initiated. Post-closure care of the landfill will be performed for a period of 30 years after the date of completing closure activities, or for as long as leachate is generated, whichever is later. Post-closure care will consist of the monitoring and maintenance of the surface-water management system, landfill gas and leachate management systems, groundwater monitoring system, and integrity and effectiveness of the final cover system. Site inspections, reporting, and monitoring will be performed during the post-closure period as discussed in the following sections. At the end of the post-closure period, an independent, professional engineer registered in the State of Maryland will certify that the post-closure care has been completed in accordance with the plan.

10.1 POST-CLOSURE ACTIVITIES

10.1.1 Security

10.1.1.1 Entry Control

The landfill facility is currently surrounded by an eight-foot high, aluminumcoated chain-link fence. Signs will be posted at approximate intervals of 400 feet stating that the site is private property and that no trespassing is permitted.

10.1.2 Inspections

To ensure the integrity of the closure activities and the monitoring and management systems, scheduled site inspections will be performed. The site inspections will be performed by a qualified inspector assigned to inspect the items and systems previously listed. The inspections will be conducted twice a year during each year of the post-closure care period.

Inspection observations will be recorded in a log book, with copies of all postclosure inspection logs, and maintained on file at the facility office for the entire 30-year post-closure period, at a minimum. Included with the inspection logs will be a summary and schedule for any activities necessary to maintain compliance with the directives for post-closure care presented in the approved closure plan. The results of the inspection will also be reported to the MDE within 60 days of the inspection. The following sections provide a summary of activities to be performed during the bi-annual site inspections for the various monitoring and management systems.

10.1.2.1 Surface-Water Management System

Inspection of the surface-water management system will include, but not be limited to, the following items:

- Run-on and run-off diversion channels:
 - o obstructions to flow,
 - o erosion,
 - o excessive siltation,
 - o settlement/subsidence,
 - o inadequate vegetation, and,
 - loose or missing coarse aggregate (if utilized);
- Culverts:
 - o clogging,
 - o obstructions to flow,
 - o erosion of cover material, and,
 - o corrosion and deterioration; and,
- Sedimentation structures:
 - o dam integrity (if utilized),
 - o sedimentation build-up,
 - o embankment erosion,
 - o embankment settlement, and,
 - proper functioning of spillways.

10.1.2.2 Landfill Gas Management System

Inspection of the landfill gas management system will include, but not be limited to the following items:

- Gas venting wells and monitoring wells identification;
- Clogging of gas venting wells;
- Construction materials corrosion and deterioration;
- Cracked or broken gas venting wells and monitoring probes; and,
- Presence of flame or heat waves.

10.1.2.3 Leachate Collection System

Inspection of the leachate collection system will include, but not be limited to the following:

- Clogged lines;
- Broken or collapsed lines;
- Manholes:
 - o cracks, deterioration, spalling,
 - o proper pump operation,
 - o proper float switch operation,
 - proper valve operation;
 - emergency alarm operation;
- Storage Tanks:
 - o cracks, deterioration; and,
 - o berm condition.

10.1.2.4 Groundwater Monitoring

Inspection of the groundwater monitoring system will include, but not be limited to the following items:

- Monitoring well identification;
- Locks on monitoring well casings;
- Well subsidence;
- Cracked well casing;
- Blockages in casing; and,
- Construction material corrosion and deterioration.

10.1.2.5 Final Cover System

Inspection of the final cover system will include, but not be limited to the following items:

- Erosion;
- Settlement/subsidence;
- Adequate vegetation;
- Surface-water ponding;
- Landfill gas odor; and,
- Leachate seeps.

10.1.2.6 Site Security

Inspection of the site security features will include, but not be limited to the following items:

- Locks:
 - proper function;
 - o presence or absence;
 - o corrosion;
 - o damage;
- Fencing:
 - corrosion;
 - o damage;
- Signs:
 - presence or absence; and,
 - o quality of lettering (readability).

10.1.2.7 Miscellaneous Items

Inspection of the miscellaneous items will include, but not be limited to the following features:

- General site maintenance; and,
- Integrity of reference benchmarks.

10.2 MONITORING AND MAINTENANCE REQUIREMENTS

10.2.1 Groundwater

Groundwater monitoring during the post-closure period will continue similar to closure period monitoring (see Section 7.0) for the entire 30-year post-closure monitoring period unless shortened or otherwise modified and approved by the MDE. The techniques for sample collection, preservation, shipment, analysis, and chain-of-custody control are described in the CQA/CQC Plan. Tolson will maintain records of the analyses, evaluations, and associated static water-level surface elevations throughout the post-closure care period.

10.2.2 Leachate

Leachate will be sampled in accordance with the discharge permit to be obtained from the leachate final receiving facility (POTW WTP).

10.2.3 Landfill Gas

Quarterly, with the potential to become bi-annual, landfill gas monitoring during the post-closure period will occur as described in the Monitoring Plan.

10.2.4 *Post-Closure Maintenance Activities*

Post-closure maintenance will include the repair of security control devices, erosion or cracking of the final cover system, settlement depressions and runon/run-off control structures, maintenance of leachate and gas management systems, and replacement of groundwater monitoring wells. If, during the course of the bi-annual site inspections, an issue is discovered, the situation will be assessed and appropriate remedial responses will be initiated within 30 days of their observance; the severity of the situation will be assessed to determine if notification of applicable MDE and local agencies is required or warranted.

The methods and ultimate results of the remediation will be recorded in the inspection report as follow-up documentation. The following sections describe the preventative and corrective maintenance needs for various systems and structures potentially requiring repair (e.g., security control devices, final cover system, leachate and gas management systems, and run-on and run-off control structures).

10.2.5 Repair of Security Control Devices

Security control devices, including gates, locks, fences and signs, will be repaired or replaced promptly as warranted.

10.2.6 Repair of Erosion or Cracking of Final Cover

The landfill cover system has been designed to prevent erosion of the final cover. Erosion of the cover is prevented through the maintenance of a dense vegetative cover over the entire cover as well as proper design of side slopes. Eroded portions of the cover system or those areas where surface cracking has occurred will be repaired promptly through the placement of two feet of a fill material capable of promoting vegetative growth. The repaired area will be reseeded and maintained so that dense vegetative growth is promoted; any area of the cover system that lacks sufficient vegetation will be reseeded.

10.2.7 Repair of Settlement Depressions

Settlement depressions in the cover will be repaired promptly upon discovery. Repairs will include re-grading, the addition of fill material, and re-vegetation as necessary to prevent ponding of water on the surface. Depressions will be backfilled to the approved closure elevation with fill material capable of promoting vegetative growth, reseeded, and maintained so that vegetative growth occurs. The repaired area will be re-seeded and maintained to foster dense vegetative growth.

10.2.8 Repair of Run-On and Run-Off Control Structures

Breaches in the run-on and run-off control structures will be repaired promptly upon discovery. Repairs will include re-grading, removal of excessive siltation or obstructions to flow, additions of fill material to eliminate eroded areas, cleaning or replacement of culverts, and re-vegetation as necessary to prevent disruption of the stormwater management system.

10.2.9 Maintenance of Leachate Control System

The leachate collection/transmission system will be inspected for blockages on a bi-annual basis during the scheduled site inspections. Access to the leachate collection pipes will be provided through the clean-out pipes. Structural damage to piping or manholes will be repaired immediately, and any excess sedimentation deposits will be removed.

10.2.10 Maintenance of Gas Venting Wells and Monitoring Wells/Points

The condition of the gas venting wells will be inspected during the bi-annual inspection. The condition of each well will be noted in the inspection log and any well which is found to be extensively damaged or unable to perform as designed will be repaired/replaced. Additionally, the gas venting wells will be monitored for methane and hydrogen sulfide concentration as outlined in Section 7.0.

The perimeter groundwater monitoring wells used for headspace gas monitoring and the perimeter soil-gas monitoring points will be inspected during each quarterly gas sampling event. Structural damage to any well cover will be repaired, if possible. If a well cover is extensively damaged, the condition of the well casing will be examined to determine if the well is suitable for continued use. The well cover will be repaired or replaced if the well casing is not cracked, blocked, or otherwise rendered unusable; the well will be abandoned in accordance with MDE regulations if the integrity of the well is compromised due to well casing damage, subsidence, a cracked well casing, or other degradation.

The abandoned well will be replaced with a new groundwater monitoring well. Installation will be in accordance with MDE requirements. The sample/core log and well construction log will be provided to the MDE.

10.2.11 Maintenance of Groundwater Monitoring System

The groundwater monitoring system will be inspected on a bi-annual basis during the scheduled site inspections, as discussed in Section 10.1.2.4. The groundwater monitoring well covers will be similar to the gas monitoring well covers, so the description of groundwater monitoring well inspection and maintenance in Section 10.2.10 is similar for both well types. Damage to any well cover will be assessed to determine the effect on the function of the monitoring well. The groundwater monitoring well cover will be repaired or replaced if the well casing is not cracked, blocked, or otherwise rendered unusable.

The well will be abandoned in accordance with MDE regulations if the integrity of the well is compromised due to well casing damage, subsidence, a cracked well casing, or other degradation. The abandoned well will be replaced with a new groundwater monitoring well.

10.3 AGENCY NOTIFICATION

Upon completion of the 30-year post-closure period, or a lesser or extended period, the MDE will be notified by written certification that the Tolson Rubble Landfill has completed post-closure activities in accordance with Maryland waste management regulations.

10.4 CONTACT FOR POST-CLOSURE CARE

A qualified and adequate staff will be maintained to administer activities during the post-closure care period. This staff will be responsible for the site inspection, site monitoring, and storage and updating of the facility post-closure plans. A complete list of the names and addresses of personnel and regulatory agencies who receive a copy of the closure plan will be maintained. Information concerning changes or modifications to the plan will be routinely distributed to the listed parties.

The following individual is currently designated to be contacted regarding postclosure care:

Name:	Ms. Joy Faithful
Address:	Tolson & Associates, LLC
	Post Office Box 3698
	Crofton, Maryland 21114
Telephone:	410-359-3311

10.5 POST-CLOSURE PERSONNEL TRAINING

Tolson will assure that personnel responsible for the operation, inspection, monitoring, and maintenance programs are qualified to perform these functions throughout the post-closure period, as follows:

- <u>Operation</u>: Landfill personnel will be selected who possess the skills required for post-closure maintenance and monitoring activities in accordance with MDE regulations.
- <u>Inspection</u>: The site inspections will be performed by a qualified inspector who possesses knowledge of the operation of the systems to be inspected.
- <u>Monitoring</u>: The monitoring programs established during the closure of the landfill will continue throughout the post-closure period. Techniques for sample collection, preservation and shipment, analysis and chain-ofcustody control will be continued for the post-closure monitoring programs. Parameters for analysis may be modified with fewer or additional parameters, which could be required under assessment monitoring, to be determined throughout the monitoring period. All monitoring and collection of samples will be performed by a qualified individual having knowledge of proper techniques required to sample the various systems.
- <u>Maintenance</u>: Landfill personnel will be selected who possess the skills required for post-closure site maintenance in accordance with MDE regulations.

10.6 PLANNED USES OF PROPERTY

The Tolson Rubble Landfill property will be maintained after closure as undeveloped, vegetated open space. Additionally, there is currently no intent for public re-use of the site following post-closure activities.

10.7 POST-CLOSURE COST ESTIMATE AND FINANCIAL ASSURANCE

In accordance with 40 CFR §258.72, an opinion of probable cost associated with post-closure has been prepared using current (2009) dollars. The total opinion of probable cost for post-closure activities at the Tolson Rubble Landfill is \$106,500 per year (Appendix H).

The Tolson Rubble Landfill will be owned and operated by Tolson & Associates, LLC for their exclusive use. Tolson is fully aware of the importance of financial assurance. As outlined in 40 CFR §258.74, financial assurance will be provided for through corporate guarantees (a state-approved mechanism). Continuous coverage for post-closure care will be provided the facility is released from the financial assurance requirements by demonstrating compliance with 40 CFR §258.61(e).