EXECUTIVE SUMMARY

This document contains an application for a Project XL program involving landfill bioreactor technology. Under the program, Waste Management of Virginia, Inc. (WM) proposes to implement bioreactor operations at two of its Virginia Landfills, Maplewood Recycling and Waste Disposal Facility (Maplewood Landfill) and King George County Landfill and Recycling Facility (King George County Landfill), respectively, in order to attain a number of environmental and cost saving benefits. The sponsors of the proposed XL project include WM, Virginia Department of Environmental Quality (VADEQ), Amelia County, and King George County. Under the XL program, WM is requesting that the United States Environmental Protection Agency (USEPA) grant regulatory flexibility from the requirement of the Resource Conservation and Recovery Act (RCRA) that prohibits application of bulk liquids in municipal solid waste landfills, as presented in Title 40 of the Code of Federal Regulations (40CFR) Section 258.28. In addition, WM requests VADEQ?s regulatory flexibility under Part V of Virginia Solid Waste Management Regulations for the same reason.

The purpose of this document is to address each of the requirements of the USEPA?s guidelines for XL project applications, as presented in the document entitled, ?Project XL: Best Practices for Proposal Development? [USEPA, 1999]. In the application, the many benefits of using bioreactor technology are described, including:

- accelerated biodegradation of waste in the landfill;
- increased production of landfill gas generation in the short-term and a shorter overall duration of landfill gas generation;
- increased leachate quality in the long term;
- accelerated biodegradation of potential contaminants in the landfill;
- potential for earlier re-use of landfill for beneficial end-uses;
- decreased settlement of the cover system after closure of the landfill.

The proposed program will evaluate the cost-effectiveness of the bioreactor operational practices in the Maplewood Landfill and King George County Landfill, respectively. The Maplewood Landfill is located in Amelia County, approximately 30 miles southwest of Richmond, Virginia. The landfill was constructed having a geomembrane double-liner system and leak detection system under all areas that have received waste. The King George County Landfill is located in King George County, approximately 50 miles north-northeast of Richmond, Virginia. The landfill was constructed having a double-composite liner system and leak detection system under all areas that have received waste. Throughout the program, the performance of the bioreactor systems will be documented and used to evaluate the biodegradation potentials of the waste materials in these sites, as well as the benefits and cost-effectiveness of different approaches to implementation of bioreactor technology. Because both landfills are located in a humid subtropical area, receive similar amounts of rainfall, and receive similar waste streams, the difference in the performance of the landfills should be attributable primarily to the different bioreactor practices employed at the sites.

1. INTRODUCTION

1.1 Overview of Application

This document contains Waste Management of Virginia, Inc.?s (WM?s) proposal for implementing different bioreactor operations at the Maplewood Recycling and Waste Disposal Facility and King George County Landfill and Recycling Center. The general locations of the facilities are shown on Figure 1. WM?s intent to pursue this project was initially communicated to Ms. Elizabeth Termini of the United States Environmental Protection Agency (USEPA) in a letter from the Virginia Department of Environmental Quality (VADEQ) dated 15 February 2000; a copy of this letter is presented in Appendix I. As part of the proposal, WM is requesting that the United States Environmental Protection Agency (USEPA) grant regulatory relief from the requirement of the Resource Conservation and Recovery Act (RCRA) that prohibits application of bulk liquids in municipal solid waste landfills, as presented in Title 40 of the Code of Federal Regulations (40 CFR) Section 258.28.

Under this proposal, bioreactor systems would be operated at the Maplewood Recycling and Waste Disposal Facility and the King George County Landfill and Recycling Center. The purposes of implementing the bioreactor projects would be to increase the rate of biodegradation in the landfills and to facilitate the management of leachate and other liquid wastes. The primary goal of the project would be to evaluate the relative improvement in landfill performance of the two different bioreactors that are proposed. It is expected that operation of these landfills as described in this proposal would result in several environmental and cost-saving benefits. It is also anticipated that the information obtained will provide the EPA and waste disposal industry with data supporting the use of bioreactors as an integral part of long-term operations at these and other MSW landfill sites.

In the remainder of this section of the Application, a description of the facilities is presented, contacts for the project are identified, and the organization of the proposal is described. In general, this proposal follows the organization provided in the document entitled, *?Project XL: Best Practices for Proposal Development?* [USEPA, 1999]; a copy of this document is provided in Appendix II and, on Table 1, the location is provided where the specific requirements of document are addressed in this application.

1.2 Description of Facilities and Surrounding Area

The Maplewood Recycling and Waste Disposal Facility (Maplewood) is located in Amelia County, Virginia, approximately 30 miles southeast of Richmond, Virginia. The landfill liner area will cover a total area of about 404 acres upon completion. Construction of the first phases started in 1992. Construction of the most recent phase was completed in 1997. The King George County Landfill and Recycling Center (King George) is located in King George County, Virginia, approximately 50 miles north-northeast of Richmond, Virginia. The landfill liner area will be cover about 290 acres upon completion. The first phase of liner system construction began in 1996. Construction of additional liner system area has been performed every year since 1996. The location of the Maplewood facility is shown on Figure 2 and the location of the King George facility is shown on Figure 3.

Both the Maplewood and King George landfills were constructed having geomembrane double-liner systems and leak detection layers. The liner systems for these two landfills are illustrated on Figure 4. Because these landfills were constructed having double-liner systems, they provide a high level of protection to the environment against potential impacts caused by leakage of leachate. The design for both landfills exceeds the requirements for municipal solid waste landfills contained in Title 40 of the Code of Federal Regulations, Part 258 (i.e., 40 CFR 258, or of Subtitle D). Therefore, these landfills are excellent candidates for the bioreactor programs that are proposed in this application. The proposed project has been discussed with involved parties, such as the USEPA, VADEQ, and the host counties, as well as the Direct Participants identified in Section 3.3. The parties agree that the project would be valuable, as demonstrated by letters of support for the project from the Amelia County and King George County Boards of Supervisors, copies of which are included in Appendix III.

1.3 Contact Information

The parties involved in the development and preparation of this proposal are identified below.

State Regulatory Liaison:	Mr. E. Paul Farrell Environmental Engineer Consultant Virginia Department of Environmental Quality 629 East Main Street Post Office Box 10009 Richmond, Virginia 23219
Project Manager:	Mr. James W. Stenborg, P.E. Waste Management, Inc. King George County Landfill 10376 Bullock Drive King George, Virginia 22485 (540) 775-3123
Maplewood Landfill and Recycling Facility Manager:	Mr. Lee Wilson, District Manager Charles City County Landfill 8000 Chambers Road Charles City, Virginia 23030

King George County Landfill

Manager:	Mr. Timothy J. Schotsch, District Manager King George County Landfill 10376 Bullock Road King George, Virginia, 22485
Project Engineer:	Michael F. Houlihan, P.E. Principal GeoSyntec Consultants 10015 Old Columbia, Road, Suite A-200 Columbia, Maryland 21046

Consistent with XL Program requirements, individuals from Amelia County and King George County, VADEQ, and other interested parties will be involved as the project progresses, as described in Section 3.3.

1.4 Organization of This Proposal

In this application document, the information needed to evaluate the proposed project is presented. This application was prepared to address the specific information requirements identified in the document entitled, ?*Project XL: Best Practices for Proposal Development*?, published by the USEPA and dated 18 November 1999 [USEPA, 1999]. The remaining sections of this application are organized as follows:

in Section 2, a detailed description of the proposed XL Project as it relates to each site is presented, including the features that will be constructed and the operations procedures that will be implemented during the project;

in Section 3, the Project XL criteria are identified and the manner in which the proposed project meets each of the criteria is described;

in Section 4, requested regulatory relief is identified;

in Section 5, compliance with the revised regulatory criteria are described and the manner in which the revised permit conditions will be monitored are described;

in Section 6, the proposed schedule for the project is presented; and

in Section 7, references used in this application are presented.

2. PROJECT DESCRIPTION

2.1 Overview of Project

2.1.1 General

This project relates to the operation of two landfills as bioreactors for the purpose of evaluating the relative benefits of the addition of liquids in a controlled manner. The viability of these methods is supported by several other applications of the bioreactor technology throughout the United States; a summary of some of these projects is presented on Table 2 and the benefits of these technologies are summarized on Table 3. As part of the project, WM is requesting that USEPA grant regulatory relief from the requirement of the Resource Conservation and Recovery Act (RCRA) that prohibits application of bulk liquids in municipal solid waste landfills, as presented in Title 40 of the Code of Federal Regulations (40 CFR) Section 258.28. The design goal of a ?traditional? landfill is to minimize the quantity of water introduced into the landfill, thus minimizing leachate generation quantity. The disadvantage to this approach is that the lack of liquid causes the biodegradation process to occur very slowly, leaving waste in its original, undecomposed state for a long period. In this case, waste continues to be a potential source of groundwater contamination throughout the post-closure period. Because biodegradation occurs slowly, the liner system is exposed to leachate for a long period of time.

Under the XL program, WM proposes to operate the Maplewood Landfill and the King George County Landfill as bioreactor landfills. The Maplewood bioreactor will involve addition of only leachate generated at the facility; the King George bioreactor will involve addition of leachate generated at this facility plus other liquids. A conceptual process diagram for a landfill bioreactor is presented on Figure 5. The Maplewood and King George landfills are located in the same geographic area and receive similar waste streams. Operating these landfills under two different methods will allow the relative performance and cost saving benefits of the two different bioreactor approaches to be compared. Further, the waste received at these landfills is primarily municipal solid waste having an extremely small percentage of non-degradable products (e.g., construction debris); WM and

VADEQ understand that this makes this proposed program unique among the bioreactor programs currently being considered by USEPA for Program XL. In the absence of Project XL, these landfills would continue to operate under currently permitted procedures, which do not include the use of bioreactor technologies.

2.1.2 Process Description - Maplewood Landfill Bioreactor

The landfill bioreactor proposed for the Maplewood Landfill involves application of leachate from the landfill and small quantities of other liquids to the waste that is in the landfill. The purposes of recirculating leachate in this manner will be to treat the leachate and to enhance biological degradation of waste in a portion of the landfill. Treatment of leachate occurs when the microbes that naturally exist in the landfill consume portions of the leachate and waste material. Several studies (including some described in Table 2) have shown that leachate quality improves over time when leachate is recirculated on a regular basis. As an example, Table 4 and Figure 6 show leachate quality improving over a period of about seven years at the test cells at Delaware Solid Waste Authority?s Central Solid Waste Management Center (CSWMC). Recirculation of leachate also results in accelerated generation of landfill gas; an example of accelerated landfill gas generation for the two test cells at CSWMC is presented on Figure 7. Further, at bioreactor landfills, substantial settlement of the waste typically occurs during the operating life of the landfill stabilizing the waste mass and reducing the need for long-term maintenance during the post-closure care period. This settlement can significantly increase the usable waste disposal capacity compared to the facility?s original design capacity. Most importantly, it reduces the time needed to achieve a stable waste mass after closure.

2.1.3 Process Description - King George County Landfill Bioreactor

The bioreactor program proposed for the King George County Landfill involves applying a quantity of liquid at a rate about twice that applied at the Maplewood Landfill. In this landfill bioreactor, conditions will be established that are intended to significantly increase the rate of degradation of waste during the operating life of the landfill. Although the process of recirculating leachate provides much of the moisture needed to maximize biological degradation of waste, studies have shown that the quantity of liquid needed to maximize biodegradation is much greater than the quantity of leachate generated at most landfills (see Section 2.2.2.2). At this site, sources of liquid other than leachate will be used to supply the additional quantity of liquid needed; these sources may include stormwater, wastewater treatment sludges, or other biota-rich liquid wastes. For this project, a controlled amount of leachate, stormwater, and non-hazardous liquid wastes will be added to the bioreactor test area, as discussed in Section 2.2.2.

2.2 Specific Project Elements

2.2.1 Maplewood Landfill Bioreactor System

2.2.1.1 Overview

In this section, the proposed bioreactor system for the Maplewood Landfill is described. In general, the system is designed to primarily distribute leachate uniformly throughout the test area as uniformly as possible and to maintain the moisture content of waste at a level high enough to increase biodegradation. The detailed design of the system is presented in Appendix IV. In this section, a brief summary of the design is presented to illustrate the features of the proposed project; the information presented in this section is used in Section 3 (i.e., Project XL Criteria) to describe the manner in which the proposed program complies with the Project XL requirement of superior environmental performance. First, in Section 2.2.1.2, the bioreactor system layout and design is described. In Section 2.2.1.3, the proposed methods for construction of the system are described. Finally, in Sections 2.2.1.4 and 2.2.1.5, proposed methods for monitoring and data analysis/reporting are described.

2.2.1.2 Bioreactor System Layout and Design

The proposed layout of the bioreactor is presented on Figure 8. As shown on the figure, the system will be established within the Phases 1, 2, 3, 4, and 11 cells of the Maplewood Landfill. In the Phases 1, 2, 3, and 4 cells, liquid will be applied in trenches; Phase 11 will be used as a test cell and no liquid will be applied. The goals of the design for the system will be the following:

- recirculate all of the leachate generated at the facility (i.e., up to about 4 million gallons per year);

- uniformly distribute leachate throughout the waste mass in the test area;

minimize the potential for the occurrence of seeps by placing distribution structures at least 100 feet from the crests of slopes;

evaluate the relative effectiveness of different horizontal trench designs for uniformly distributing leachate throughout the waste mass;

identify several leachate delivery options to simplify operations;

provide monitoring features within the horizontal trenches so that liquid head and distribution rate within the trenches can be monitored effectively; and

monitor the landfill gas generation rate during liquid application events and respond accordingly.

The manner in which these goals are addressed in this application are summarized on Table 5. The design of the Maplewood bioreactor system is based on analytical methods developed by Maier, et al. al, [1998], as described in Section 4 of Appendix IV. In general, the design was developed based on the following considerations.

Leachate Application Quantity and Rate. As described above, the goal for the Maplewood Landfill is to recirculate as much leachate as is generated at the facility. Based on facility records, the facility generated approximately 3,700,000 gallons of leachate in 1999. Under this XL program, between 3,500,000 and 4,000,000 gallons of liquid would be applied per year. The liquid application rate would be 10,137 gallons per day, based on an application rate of 4 million gallons per year. A portion of the liquid added (i.e., less than 500,000 gallons per year) could consist of liquids other than leachate.

Head on Liner. The impact of the proposed liquid application activities on the depth of liquid on the liner system was evaluated using the HELP model. First, the hydrologic evaluation was performed assuming that no liquid is applied; then, the evaluation was performed for the liquid application condition under the conservative assumption that all of the leachate generated at the facility is recirculated. The analysis is shown in Appendix A to Attachment IV. As shown in this appendix, the resulting thickness of head on the liner system (ten inches) is less than the regulatory maximum of twelve inches.

Application Capacity of System. The ?application capacity? of the system is the amount of liquid that can be expected to flow by gravity from all of the trenches. For the Maplewood Landfill, this quantity has been estimated using the methodology described by Maier [1998]. This method involves estimating the moisture content of the waste (typically 15 to 25 percent without liquid application), the hydraulic properties of the waste, the moisture retention capacity of the waste (typically 40 percent), and the head of liquid on the trench. Using this information, the flowrate of liquid out of one trench will be calculated; the application capacity equals the combined flowrate of all trenches. As shown in Attachment IV, the total flowrate capacity of the group of trenches is calculated to be 115,068 gallons per day, which is much greater than the 10,500 gallons per day maximum average application rate. Conceptual design details for leachate recirculation trenches are presented in Figure 9.

Leachate Storage Capacity of On-Site Structures. It is important that the on-site leachate storage structures have enough capacity to store leachate that is needed for future application to the trenches. The storage capacity of the leachate tanks at the Maplewood Recycling and Waste Disposal Facility is approximately 500,000 gallons, which is the amount of leachate generated over a period of about two months. During operation of the bioreactor system, leachate storage structures will be used to temporarily store leachate at times when it is not being recirculated. Therefore, the tanks will need to store the quantity of leachate operated over a period of several days; this is much less time than the approximately two months of storage capacity at the site. Therefore, the facility has adequate leachate storage capacity for operation of the bioreactor system as designed in Appendix IV.

Landfill Gas Control System. To meet the requirements of Section 3.2.1.4 (Potential

Environmental Impact to Air), it is important that the landfill be operated in a manner that meets the air quality requirements of all applicable state and Federal permits. As shown in Appendix IV, because the Maplewood Landfill must comply with the requirements of 40 CFR Subpart WWW, an active landfill gas collection system will be operated during all liquid application events. The actual efficiency of the system will be demonstrated through routine monitoring of the presence of methane and non-methane organic compounds, which will be performed as required in the facility?s Title V permit.

2.2.1.3 Liquid Application System Construction

The liquid application system will be constructed using typical trench construction methods. The construction methods are described in detail in Section 5 of Appendix IV. The goals of the construction methods presented in Appendix IV are:

provide commonly used methods that can be implemented by landfill personnel or earthwork contractors during normal operations;

use materials of construction that are readily available, inexpensive, and resistant to degradation by the pressures and chemical constituents present in the landfill; and

minimize the occurrence of odors or other nuisances during construction of the liquids application system.

Typical construction details are shown on Figure 9. As shown on the details, the construction methods are based on typical construction methods and use materials of construction that are readily available.

2.2.1.4 Monitoring

To verify that the goals of the program and the Final Project Agreement are met, the system will be monitored. The specific goals of the monitoring program will be to:

measure leachate quality in areas with or without liquid addition with time;

measure the total quantity of leachate collected and the quantity of leachate or other liquids applied;

monitor the rate that leachate can be applied to the trenches without causing seeps or other potential operational problems;

visually monitor the ground surface of the entire site, including the liquid application area, for the presence of landfill gas components (i.e., methane) during liquid application events as a measure of the effectiveness of the landfill gas collection system; and

measure the settlement of the waste over the entire landfill area, including the liquid application area, this will include semi annual topographic surveys.

The methods that will be used to monitor these parameters are described on Table 6. To simplify the monitoring of these parameters, forms will be generated for use by operations personnel to collect and track this information.

2.2.1.5 Data Analysis and Reporting

The data collected during monitoring events described in Section 2.2.1.4 will be analyzed for the following trends:

changes in leachate quality on an annual basis;

- relationship between total quantity of leachate generated and liquid applied in the various areas of the site;
- range of liquid application rates to various trenches and any problems arising from certain application rates;
- compliance with the requirements of the Air Quality Permit for the site, including monitoring the ground surface for the occurrence of non-methane organic compounds (NMOCs);
- relative performance of the trenches and evaluate whether a closer trench spacing is needed to more uniformly distribute leachate throughout the waste mass;
- occurrence of seeps and whether they are attributable to operation of the liquid application system; and
- quantity of settlement of waste and total waste disposal quantity gained through settlement.

The manner in which these data will be summarized and reported is described in Section 3.1.3.

2.2.2 King George County Landfill Bioreactor System

2.2.2.1 Overview

In this section, the proposed landfill bioreactor system for the King George Landfill is described. In general, the system will be designed to distribute liquids as uniformly as possible throughout the waste mass and to maintain moisture contents within the waste at a level high enough to significantly increase biodegradation. The detailed design of the system is presented in Appendix V. In this section, a brief summary of the design is presented to illustrate the features of the proposed project; the information presented in this section is used in Section 3 (i.e., Project XL Criteria) to describe the manner in which the proposed program complies with the Project XL requirement of superior environmental performance. First, the landfill bioreactor system layout and design is described; then, in Section 2.2.2.3, the typical methods for construction of the system are described. Finally, in Sections 2.2.2.4 and 2.2.2.5, proposed methods for monitoring and data analysis/reporting are described.

2.2.2.2 Bioreactor System Layout and Design

The proposed layout of the bioreactor liquid application system is presented on Figure 10 and a conceptual process flow diagram for operation of the bioreactor is presented on Figure 5. As shown on the figures, the study area will be established within the MSW Cells 2, 3, and 4 of King George Landfill. Liquid will be applied in Cells 3 and 4; Cell 2 will be the control cell in which no liquids will be applied. The goals of the design for the bioreactor will be the following:

- uniformly distribute leachate and other liquids throughout the waste mass in the test area;
- minimize the potential for the occurrence of seeps by placing distribution structures at least 50 feet from the crests of slopes;

evaluate the relative effectiveness of liquids in promoting degradation, to the extent possible, by tracking settlement by area and noting which types of liquids have been applied in those areas;

provide several leachate delivery options to simplify operations; and

provide monitoring features within the liquid application structures so that leachate head and distribution rate within the trenches can be monitored effectively.

The design of the system will be based on analytical methods developed by Maier, et al. al [1998] as described in Section 4 of Appendix V. In general the design was based on the following primary considerations.

Liquid Application Quantity and Rate. As described above, the goal for the King George Landfill is to recirculate as much leachate as is generated at the facility and to apply additional liquid to make the total amount of liquid applied equal to about 8 million gallons per year. Based on facility records for the past three years, the facility generates approximately 3.5 million gallons of leachate per year. Based on estimates of stormwater runoff quantities and the storage capacity of the stormwater management ponds at the site, approximately 8 million gallons or more of stormwater can be made available for application to the landfill waste. The liquid application rate would be, on average, about 22,000 gallons per day based on an estimated application rate of 8 million gallons per year.

Head on Liner. The impact of the proposed liquid application activities on the head of liquid on the liner system was evaluated using the HELP model. First, the hydrologic evaluation was performed assuming that no leachate is recirculated; then, the evaluation was performed for the leachate recirculation condition under the conservative assumption that all of the leachate generated at the facility is recirculated. The analysis is shown in Appendix A to Appendix V. As shown in this attachment, the resulting head on the liner system of ten inches is less than the regulatory maximum thickness of twelve inches.

Application Capacity of Liquids Distribution System. The application capacity of the liquid distribution system is the amount of liquid that can be expected to flow by gravity from all of the trenches or wells. This quantity has been estimated using the methodology described by Maier [1998]. As shown in Appendix V, the total flowrate capacity of the King George Landfill is much greater than 22,000 gallons per day.

Leachate Storage Capacity of On-Site Structures. It is important that the on-site leachate and stormwater storage structures have enough capacity to store the quantities of leachate and stormwater that are needed for future application to the trenches or wells. The storage capacity of the leachate tanks at King George Landfill and Recycling Center is 500,000 gallons, and the wet-storage capacity of the stormwater management ponds is more than 8 million gallons. Therefore, the facility has adequate leachate and stormwater storage capacity for operation of the liquid application system as designed in Appendix IV.

Landfill Gas Control System. To meet the requirements of Section 3.2.1.4 (Potential environmental impact to Air), it is important that the landfill be designed to provide collection of landfill gas during liquid application events. As shown in Appendix V, because the King George landfill must comply with the active landfill gas management requirements of 40 CFR Subpart WWW, an active landfill gas collection system will be operated during all liquid application events. The performance of the system will be demonstrated through routine monitoring of the presence of methane and non-methane organic compounds, which will be performed as required in the facility?s air quality permits.

2.2.2.3 Bioreactor Liquids Application System Construction

The liquid application system will be constructed using typical trench construction methods. The construction methods are described in detail in Section 5 of Appendix V. The goals of the construction methods presented in Appendix V are:

provide commonly used methods that can be implemented by landfill personnel or earthwork contractors during normal operations;

use materials of construction that are readily available, inexpensive, and resistant to the degradation by the pressures and chemical constituents present in the landfill; and

control odors or other nuisances during construction of the liquids application system.

Typical details of construction for the various elements of the liquids application are shown on Figure 9. As shown on the details, the construction methods are based on typical trench construction methods and use materials of construction that are readily available.

2.2.2.4 Monitoring

To verify that the goals of the program and the enforceable component of the Final Project Agreement are met, the leachate recirculation system will be monitored. The specific goals of the monitoring program will be to:

measure leachate quality;

track the total quantity of leachate collected and the quantity of leachate and other liquids applied;

in accordance with the requirements of the permit for the King George Landfill and Recycling Facility, monitor landfill gas emissions to verify compliance with the non-methane organic compound (NMOC) concentration limits of the permit;

track the rate that liquid can be applied to the trenches without causing seeps or other operational problems;

continue to monitor the ground surface of the entire site, including the area near the liquid application area, for the presence and concentrations of landfill gas components (i.e., methane) during liquid application events as a measure of the effectiveness of the landfill gas collection system; and

measure the settlement of the waste over the entire landfill area, including the bioreactor and control areas, as well as the apparent increase in density of waste throughout the duration of the bioreactor program.

The methods that will be used to monitor these parameters are described on Table 8. To simplify the monitoring of these parameters, forms will be generated for use by operations personnel in collecting and tracking this information.

2.2.2.5 Data Analysis and Reporting

The data collected during monitoring events described in Section 2.2.2.4 will be analyzed for the following trends:

changes in leachate quality on an annual basis;

relationship between total quantity of leachate generated and liquid applied in the test area;

range of liquid application rates to trenches and any methods needed to attain certain application rates;

evaluate the relative performance of the trenches and evaluate whether a closer trench spacing is needed to uniformly distribute leachate throughout the waste mass;

occurrence of seeps and whether they are attributable to the liquid application system; and

quantity of settlement of waste and estimate of total waste disposal quantity gained through settlement.

The manner in which these data will be summarized and reported is described in Section 3.1.3.

3. PROJECT XL CRITERIA

3.1 Superior Environmental Performance

3.1.1 Tier 1: Is the Project Equivalent?

3.1.1.1 Overview

The criteria for Superior Environmental Performance are identified and described in the Best Practices Guidelines [USEPA, 1999], a copy of which is presented in Appendix II. As shown in Section III.A of that document, the applicant must demonstrate that the proposed project is equivalent, in terms of environmental protection, to a similar program performed within applicable regulations outside the XL Project. The Best Practices Guidelines require a two-tiered approach to this demonstration. The first tier of the demonstration requires that the applicant quantitatively demonstrate that the proposed project results in a potential environmental impact that is equal to or less than what would occur if the project complied with all environmental regulations. The potential impacts are quantified in terms of the by-products (particularly those generated by operations related to the proposed project) that are released to the environment. For the Maplewood and King George County Landfills, by-products of facility operations include leachate and landfill gas. Leachate can be released to the environment either below ground (i.e., through the liner system) to groundwater or above ground (i.e., through the surface of the landfill) to surface water. Landfill gas can be released to the environment through the liner system or through the sides or top of the landfill. Environmental media that could be impacted include groundwater, surface water, and air. Therefore, the Tier 1 evaluation presented in this section is focused on equivalent potential impacts to these three media.

3.1.1.2 Potential Impact to Groundwater

For an environmental impact to occur to groundwater, leachate would have to migrate through the liner system of the landfill, flow vertically through the unsaturated zone, and then impinges on groundwater. As described in Section 1.2, both the Maplewood and King George County Landfills were constructed having double-liner systems, which exceed the performance standard of Subtitle D. These liner systems are highly efficient at preventing leakage of leachate from the landfill. The leachate collection systems of both landfills were designed to limit the thickness of leachate on the underlying liner to no more than one foot (0.3 m).

When liquids are applied to the landfill, there is a possibility that an increased quantity of leachate (due to the application of additional liquids) will reach the leachate collection system. However, as shown in Section 4.3 of the designs in Appendices IV and V, when additional liquids are applied, the thickness of leachate will not exceed one foot (0.3 m). In reality, applying liquids will enhance the biological processes in the landfills resulting in more water consumption, further reducing the amount of liquid that will reach the liner. For these reasons, the potential impact to groundwater will not exceed the potential environmental impact if the project were not implemented.

3.1.1.3 Potential Impact to Surface Water

For an impact to occur to surface water, leachate would have to migrate laterally from the landfill surface to an aboveground portion of the landfill sideslope and then flow downslope to a receiving waterbody. Seeps typically occur at landfills regardless of how well the landfill is designed. There is no quantitative method to estimate the potential environmental impact to surface water caused by seeps. The surface of the landfill will be visually monitored for potential seepage areas. However, based on the operating records of the Maplewood and King George County Landfills, impacts to surface water that are attributable to seeps are mitigated before they become a problem.

Potential impacts that could be caused by seeps are limited at the Maplewood and King George County Landfills through a program of seep detection through visual inspections and of maintenance to quickly repair seeps after they are identified. This program of inspections and maintenance would be implemented throughout the XL Project to limit seep outbreaks. Further, because of the ongoing project, site personnel will be more sensitive to the potential for seeps. Therefore, the potential environmental impact of the facility to surface water under the XL Project will at least be equal to or less than the potential environmental impact of a similar project not performed under XL.

3.1.1.4 Potential Impact to Air

For an impact to occur to air, landfill gas would have to be released from the landfill in an uncontrolled manner. For the Maplewood and King George County Landfills, active landfill gas control systems have been constructed and are currently preventing releases of gas in excess of regulatory limits. The gas collection and control systems will be upgraded as needed, based on the results of routine monitoring, to control any additional gas that would be generated during liquid application. Therefore, the potential impact of the facility to air under the project will not exceed the potential impact of a similar project not performed under XL.

3.1.2 Tier 2: Superior Environmental Performance

3.1.2.1 Overview

The second tier for the evaluation for Superior Environmental Performance requires that the applicant demonstrate that the proposed project will result in an environmental performance that exceeds the levels of equivalence established for Tier 1. In the remainder of this section, quantitative and qualitative factors are described to demonstrate that the project represents a level of environmental performance beyond the standard for equivalence presented in Section 3.1.1.

3.1.2.2 Potential Environmental Impact to Groundwater

The proposed project will provide environmental performance that is superior to the baseline of potential environmental impacts to groundwater defined in Section 3.1.1.2 in several aspects. The five criteria used to evaluate superior performance in protecting groundwater quality, as identified in Section III.A.2 of the Best Practices Guidelines in Appendix II, are identified below, and the manner in which superior environmental performance will be measured is provided in Section 3.1.3.

Improvements to Tier 1 Benchmarks. The Tier 1 benchmark is based on the quantity of leachate that could be released to groundwater and, as shown in Section 3.1.1.2, the proposed project is equivalent. In fact, because more liquid is consumed in a bioreactor landfill than a non-bioreactor landfill, leachate quantity at the site may actually be less under the proposed project. In addition to leachate quantity, leachate quality is an equally important factor in evaluating the potential for impacts to groundwater quality. In bioreactor landfills, the quality of leachate over the long term is substantially better than the quality of leachate at non-bioreactor landfills, as demonstrated in Sections 2.2 and 2.3. Further, the improvement in quality will occur sooner in the life of the landfill when the reliability of the leachate containment system (i.e., the liner) is at its highest level. These factors result in a substantial long-term improvement in environmental performance for the proposed project compared to a facility operated outside of the project.

Pollution Prevention or Source Reduction. Bioreactor landfills substantially reduce the source of contamination in landfills and, thereby, significantly contribute to pollution prevention. As described in Section 2, the primary environmental threat to groundwater and surface-water quality in MSW landfills is organic constituents within the landfilled waste. By accelerating the biodegradation of these wastes, the organic constituents that represent the primary environmental threat are degraded, resulting in a reduction in the source of contamination and corresponding prevention of potential pollution.

Environmental Performance More Protective than the Industry Standard. The Industry Standard for protection of groundwater resources at MSW landfills in Virginia is characterized by: (i) screening waste that is received at the facility to prevent the disposal of wastes that could adversely impact groundwater quality; (ii) containing leachate within landfills by constructing effective liner systems; (ii) minimizing the formation of leachate by preventing the addition of liquids during the active life of the landfill and constructing a low-permeability cover after filling is completed to prevent the formation of leachate. The Industry Standard does not include treating waste to minimize its long-term potential to impact groundwater quality. Under the proposed project, waste would be treated to minimize its potential for impacting groundwater quality without adversely impacting the other environmental protection features of the facilities.

Improvement in Environmental Conditions that are Priorities to Stakeholders. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Recycling and Landfill Facility and the King George Landfill and Recycling Center, groundwater-related issues that are priorities to stakeholders include (among others) minimizing the long-term threat to groundwater quality. This project provides a substantial improvement to the performance of the existing facilities by treating the waste in the landfills and, thereby, minimizing the potential for waste to present a long-term threat to groundwater quality.

Community Concerns. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Recycling and Landfill Facility and the King George Landfill and Recycling Center, community concerns related to groundwater quality are the same as those identified in the previous bullet and are addressed through long-term treatment of waste using the bioreactor process.

3.1.2.3 Potential Impact to Surface Water

The proposed project will provide environmental performance that is superior in respect to the baseline of potential impacts to surface water defined in Section 3.1.1.3 in several aspects. The five criteria used to evaluate superior performance in protecting surface-water quality are identified below, and the manner in which superior environmental performance will be measured is described in Section 3.1.3.

Improvements to Tier 1 Benchmarks. The Tier 1 benchmark for potential environmental impact to surface water is minimizing the occurrence of seeps and, as shown in Section 3.1.1.3, the proposed project is equivalent in this regard. In addition, less leachate would be routed from the facility to the publicly owned treatment works (POTW), where as much as five percent of the pollutants in wastewater are typically released to surface-water bodies. Reducing the quantity of liquid sent from the facility to the POTW will correspondingly decrease the pollutant load to streams caused by discharges of residue from wastewater treatment plants. Further, surface water used in the bioreactor would reduce the quantity of stormwater routed off site, which would reduce off-site erosion and sedimentation impacts. In these manners, the project represents an improvement to the Tier 1 benchmarks presented in Section 3.1.1.3.

Pollution Prevention or Source Reduction. By using leachate to treat waste in the landfill, the source of contamination (i.e., the incidental contaminants that are present in a landfill) is reduced and pollution is prevented. This results in superior environmental performance for protection of surface-water resources by eliminating the source of seeps and groundwater contamination, which can result in surface-water contamination in locations where groundwater discharges to surface water.

Environmental Performance More Protective than the Industry Standard. The Industry Standard for surface-water protection is based on the use of standard stormwater management practices and mitigation of occasional seeps. In addition, by applying stormwater to waste, fewer adverse impacts to off-site receiving streams will be expected during the operating life of the landfill. Therefore, by applying leachate and stormwater, the environmental performance of the Maplewood and King George Landfills will exceed the Industry Standard for surface-water protection.

Improvement in Environmental Conditions that are Priorities to Stakeholders. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Recycling and Landfill Facility and the King George Landfill and Recycling Center, surface-water related issues that are priorities to stakeholders include (among others) protecting surface-water resources from impacts by leachate. This project addresses this concern by providing monitoring and operational procedures for preventing impact to surface-water resources by seeps.

Community Concerns. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Recycling and Landfill Facility and the King George Landfill and Recycling Center, community concerns related to surface-water quality include the items identified in the immediately preceding bullet and are satisfied through compliance with existing permit conditions.

3.1.2.4 Potential Environmental Impact to Air

The proposed project will provide environmental performance that is superior to the baseline of potential environmental impact to air defined in Section 3.1.1.4 in several aspects.

Improvements to Tier 1 Benchmarks. The Tier 1 benchmark for potential environmental impact to air is to control landfill gas in a manner consistent with the requirements of State and Federal air quality permits. As described in Section 3.1.1.4, the proposed project meets this standard by providing landfill gas collection and control during the operating, closure, and post-closure periods. Under this project, landfill gas will likely be generated in the area where additional liquid is input at an accelerated rate as compared to other areas. This will increase the gas generation rate and may require additional active gas collection components, such as wells and header piping. As more gas is produced and collection structures are added, the collection efficiency will be improved. Therefore, under this project, less gas will be released from the landfill surface to the atmosphere than if the project were not implemented. In addition, the Tier 1 benchmark will be improved because there will be less impacts from leachate hauling trucks. Leachate is currently being transported from the landfills via truck to wastewater treatment plants. These trucks consume fuel, and there are vehicle emissions associated with this fuel consumption. If leachate is discharged (i.e., recirculated) into the waste, it will either be pumped using closed piping systems or hauled, using trucks, to the various discharge points into the landfill. By using leachate in the bioreactor, fuel consumption and vehicle emissions will be drastically reduced or eliminated compared to a project performed outside of XL. Emissions from on-site trucks (if they are used) will be reduced because haul distances to the treatment facilities are typically more than 50 miles as compared to on-site hauling of about 2 to 3 miles. Thus, a substantial long-term improvement in environmental performance for the proposed project compared to a facility operated outside of the project.

Pollution Prevention or Source Reduction. The practice of collecting and treating landfill gas throughout the operating period will result in a significant decrease in uncontrolled discharge of landfill gas and, therefore, represents a substantial improvement in the level of pollution prevention provided by the facilities.

Environmental Performance More Protective than the Industry Standard. The Industry Standard for landfill gas management in Virginia involves providing active collection and control of landfill gas at landfills that have the potential to generate more than 50 Mg per year of non-methane organic compounds. As described in the first item above, the proposed project will exceed this standard because more landfill gas would be generated and collected during the time when active gas collection controls are required, resulting in more gas collected in a shorter period of time under the XL Program than outside the XL Program. Therefore, the environmental performance of the project will be more protective than the industry standard.

Improvement in Environmental Conditions that are Priorities to Stakeholders. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Recycling and Landfill Facility and the King George Landfill and Recycling Center, air-related issues that are priorities to stakeholders include (among others) preventing odor problems. This project provides a substantial improvement to the performance of the existing facilities by collecting landfill gas during the active period of filling. Therefore, even though the landfills may have higher gas generation rates under the XL Project than those sites outside of the XL Project, the proposed project represents an improvement on a key environmental condition of high priority to stakeholders.

Community Concerns. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Recycling and Landfill Facility and the King George Landfill and Recycling Center, community concerns related to groundwater quality include those identified above and are addressed through existing permit conditions and bioreactor design, construction, and operational methods.

3.1.3 How Environmental Performance Will Be Measured

Environmental performance will be measured throughout the project to demonstrate the environmental benefits described in Sections 3.1.1 and 3.1.2. In particular, measurements will be made of eight elements of the project as identified on Tables 6 and 7, as well as the manner in which they will be measured. Most of the eight elements are dependent on the same variables, including rate of biological activity and prevention of operational problems that could cause an impact to the environment. The measurements identified on Tables 6 and 7 will be used to make a determination of superior environmental performance compared to non-recirculating and non-bioreactor landfills as follows.

Reduced Impacts to Groundwater Quality. If leachate quality improves over a period of several years or if a trend of improving leachate quality is evident after the initial 2- to 3-year period of decline, then it will be concluded that improved leachate quality represents a reduced impact to the liner and leachate collection system and long-term groundwater quality.

Reduced Impacts to Surface-Water Quality. If no significant increase in the occurrence of seeps occurs during the project compared to the occurrence of seeps at non-bioreactor landfills, then it will be concluded that the liquid application methods are acceptable and there are no potential adverse impacts to surface-water quality.

Reduced Impacts to Air Quality. Potential impacts to air quality will be reduced if: (i) waste degradation rates increase significantly, as determined by surveys before and after recirculation or bioreactor activities occur; (ii) the landfill gas management system is routinely monitored, maintained, and operated throughout the period of the project; and (iii) no significant odors occur or surface emissions are detected during the project. The improvements associated with not having to haul leachate will be recognized immediately. Environmental performance will be monitored as described in Sections 2.2.1.5 and 2.2.2.5, and the results of the monitoring will be presented semiannually to VADEQ. A preliminary outline of a typical semi-annual report of monitoring is presented on Table 8.

3.2 Other Potential Benefits

The proposed XL Project is expected to result in several additional benefits. These benefits all result from the accelerated biological degradation that occurs at recirculating and bioreactor landfills. The benefits are identified below, along with an indication of the nature of the benefit.

Decreased Leachate Management Costs

Because leachate quality is better at recirculating and bioreactor landfills than at non-recirculating or non-bioreactor landfills, the total amount of leachate needs to be treated is reduced because some of the leachate is consumed in the biological reactions in the landfill. Also less costly treatment techniques will be used in the long term if leachate eventually has to be taken off site for treatment and disposal, for landfills where leachate is recirculated. Therefore, recirculating and bioreactor landfills require less cost to manage leachate than non-recirculating or non-bioreactor landfills.

Increased Waste Disposal Capacity

The increased rate of biodegradation at recirculating and bioreactor landfills results in substantial settlement of waste during the landfills active life. In contrast, at non-recirculating or non-bioreactor landfills, most waste settlement occurs after the final cover has been placed over the waste, making it difficult and expensive to reclaim the disposal capacity gained through settlement. At recirculating and bioreactor landfills, a significant amount of settlement can occur during the active life of the landfill, making it possible to reclaim the disposal capacity gained due to settlement. A substantial benefit of increased waste disposal capacity is the ability to delay or avoid siting a new waste disposal facility, a benefit that has a large quantitative economic benefit and a high qualitative benefit. Further, with additional disposal capacity, the host communities will receive additional revenue from royalties owed.

Increased Use of Recycled Materials

The materials to be used as the drainage media in the liquid application structure will typically include coarse aggregate or other suitable recyclable materials such as tire shreds. Tire shreds are generated as a result of the cleanup of old tire piles in the State of Virginia. When a beneficial use of tires such as this is available, the cleanup of tirepiles is encouraged by the State of Virginia Department of Environmental Quality for end use opportunities. The tire cleanup program is funded by a tax on the purchase of new tires.

Improved Economics of Energy Recovery Project Feasibility

Energy recovery from landfill gas is a feasible technology that involves collection of landfill gas and beneficial use of the gas for generation of power, either by direct generation of electricity or by burning the gas as an alternative energy source. The economic feasibility of such energy recovery projects is a function of the reliability of the quantity of landfill gas that can be generated during the life of the project. For example, landfills that generate a small quantity of gas per year may not be candidates for an energy recovery project due to the economics of initial energy production. Even if the total quantity of landfill gas generated over the life of the facility is very large, certain projects may not be economical if the gas generation rate is relatively low. Because increased levels of biodegradation cause higher gas generation rates in recirculating and bioreactor landfills, more gas is available in the short-term for energy recovery projects. Therefore, by increasing the rate at which landfill gas is generated, energy recovery projects will be more feasible.

Earlier Re-Use of Site

Less settlement occurs during the post-closure period at recirculating and bioreactor landfills. These landfills represent a reduced potential impact to environmental quality as stated above in the application. Thus, there are more potential options for using the site during and after the post-closure period.

Reduced Settlement and Strain of Final Cover System

There is less potential for damage to the cover system by settlement because most of the settlement in recirculating and bioreactor landfills occurs before the final cover system is constructed. This has a direct impact on the cost of the post-closure operation and maintenance activities.

Decreased Post-Closure Care Costs

Because waste is stabilized more quickly in recirculating and bioreactor landfills, several long-term benefits occur as described in this section, including: (i) shorter time that leachate will need to be managed and, therefore, shorter period of leachate management system operation and leachate treatment; (ii) shorter duration of landfill gas generation and, therefore, shorter period of landfill gas management system operation; reduced settlement during the post-closure period and, therefore, decreased maintenance costs for repairing cover damage due to settlement; and (iv) decreased potential for groundwater degradation and, therefore, lower potential for the need for groundwater remediation. These benefits all result on lower post-closure care costs for recirculation or bioreactor landfills than non-recirculating or bioreactor landfills. Based on studies performed by Shaw and Knight [2000], the estimated savings in post-closure operation and maintenance costs for bioreactor landfills is in the range of 40 to 60 percent compared to non-bioreactor landfills.

Comparison Between Approaches to Bioreactor Technology

A substantial technological benefit of this project is that it would allow for a direct comparison between the performance of bioreactor landfills operated with varying amounts of liquid introduced into the waste mass. As previously described, the Maplewood Landfill would receive up to 4 million gallons per year of liquid in a nominal 10-acre disposal area. The King George Landfill would receive as much as 8 million gallons per year of liquid in approximately the same area. Because the landfills are located in the same area of the country, receive similar amounts of precipitation, and receive similar waste streams, the relative impact of liquid quantity on waste decomposition can be quantitatively evaluated by comparing the results of the two programs.

3.3 <u>Stakeholder Involvement</u>

There are numerous potential stakeholders in the proposed project. The individual stakeholders are identified below.

Participant	Reason for Involvement
Direct Participants	
United States Environmental Protection Agency	Federal Regulator
Virginia Department of Environmental Quality	State Regulator
King George County, Virginia	Host Community
Amelia County, Virginia	Host Community
Waste Management, Inc.	Owner/Operator of Sites
Interested Parties	
c. Amelia County Landfill Advisory Committee	c. Local Advisory Committee
c. King George County Waste Advisory Committee	c.Local Advisory Committee
c. Virginia Polytechnic Institute and State University	
c. North Carolina State University	
c. GeoSyntec Consultants	c.Technical Consultant

- Technical Consultant
- Design Consultant

Affected Parties

- Citizens of King George County, Virginia
- Citizens of Amelia County, Virginia
- Citizens of the Commonwealth of Virginia
- Host County
- Host County
- Host State

It is understood that the general public will be informed of any action or change relating to the State solid waste permit during the public participation phase of the permitting process.

3.4 Innovation or Pollution Prevention

The proposed project provides a high level of innovation for managing leachate and environmental quality at a MSW landfill. Although not new technologies, leachate recirculation and bioreactor technologies are not widely used at MSW landfills in the United States. The applicant and the direct participants believe that this is due, in part, to a lack of data that demonstrates the benefits of the technologies. The proposed XL project described in this application is intended to provide data to further demonstrate the benefits of leachate recirculation and bioreactor technology.

In addition to being innovative, leachate recirculation and bioreactor technologies represent a significant advancement in reducing potential pollution from MSW landfills. The key pollution prevention aspects of these technologies are: (i) retention and treatment of leachate in the landfill, where it is well contained and can be processed or treated in a secure environment; (ii) decreased impacts to air quality through the use of landfill gas collection system through the operating life of the facility in areas where biodegradation is being promoted; and (iii) increased rate of stabilization of waste, which results in improved leachate quality in the long term and a smaller potential for impacts to groundwater quality.

C 3.5 Transferability

The approaches described in this application have an outstanding degree of transferability. The technologies that will be demonstrated during this project can be used at most operating MSW landfills in the United States. Therefore, by applying the findings of this project and other leachate recirculation projects, owners and operators of MSW landfills across the United States can achieve improved, superior environmental performance in terms of groundwater protection, surface-water protection, and air protection. In addition, substantial cost-saving benefits can be realized resulting from increased disposal capacity, decreased leachate management costs, and decreased post-closure costs.

C 3.6 Feasibility

Leachate recirculation and bioreactor technologies have been used at numerous other waste disposal facilities, as demonstrated on Table 3. Based on the successful applications of these technologies at other facilities, the proposed project is feasible.

C 3.7 Evaluation, Monitoring, and Accountability

C 3.7.1 Accountability

The two landfills operate under their respective Virginia solid waste permits. Each permit is an enforceable document that carries civil penalties for major violations. The Director of VADEQ has the authority to revoke the permit if necessary. However, there have been no notices of violation at either site.

WM proposes to provide accountability of site environmental compliance through a voluntary commitment to achieve the project goals defined in Section 3.1.1. In general, the voluntary commitment that WM offers is to maintain the level of environmental protection provided by the current design and permit for the facility. In the event that the terms of the Final Project Agreement are not satisfied, then WM will discontinue the bioreactor programs at the subject landfills. The terms of the Final Project Agreement may be incorporated into the amended permits as conditions in order to provide an enforceable document. Failure to achieve the stipulated goals would be referred to the respective VADEQ Regional Compliance and Enforcement Staff for review and action.

C 3.7.2 Tracking, Reporting, and Evaluation

Data collection, evaluation, and reporting requirements are identified in Section 2. In general, for each facility, the data collection and analysis requirements of the XL Program features will be reported semiannually to the VADEQ as described in Section 3.1.3 or as otherwise required by VADEQ.

C 3.7.3 Failure to Meet Expected Performance Levels

In the event that the expected levels of performance are not achieved, then the bioreactor programs will be reviewed with the VADEQ and the operation of the facilities will be modified to attempt to better achieve expected goals.

C 3.8 Shifting Burden of Risk of Burden

WM does not propose to shift the burden of any of the risks associated with operating the landfills as a result of this project. In particular, any risk of failure of the proposed leachate recirculation or bioreactor systems will be borne by WM. The risks that could be shifted include: (i) impacts to media; (ii) impacts to disadvantaged communities; and (iii) financial burden of post-closure care or operation. The proposed project does not represent a shift of risk burden because: (i) the technologies involved to not transfer pollutants from and environmental media to another; (ii) there are no disadvantaged communities near the two sites; and (iii) WM will continue to assume the financial burden of all operations and post-closure care for the facilities. In fact, the proposed project results in decreased overall risk associated with waste management because, in the long term, the accelerated biodegradation provided by the project results in a smaller risk of impacts from releases of leachate or landfill gas to the environment.

c 4. REQUESTED FLEXIBILITY

As part of the proposal, WM is requesting that the United States Environmental Protection Agency (USEPA) grant regulatory flexibility from the requirement of the Resource Conservation and Recovery Act (RCRA) that prohibits application of bulk liquids in municipal solid waste landfills, as presented in Title 40 of the Code of Federal Regulations (40 CFR) Section 258.28. This specific regulation deals with the application of liquids (leachate, water, gray water, septic waste, etc.) in the following manner:

- c. It restricts recirculation of leachate to landfills that have a liner system that has a 60-mil thick geomembrane overlying a 2-ft (0.6-m) thick layer of clay having a hydraulic conductivity no greater than $1x10^{-7}$ cm/sec; and
- c. It prohibits the placement of liquid wastes in a MSW landfill.

As described in Section 2, liquids are needed to enhance the biological degradation of waste in the landfills. Therefore, WM proposes to add liquids to both landfills and to add certain liquid wastes to the King George County Landfill. Further, both the Maplewood and King George County Landfills have liner systems that are superior in performance to the liner system described in the first item above, but neither liner system meets the exact specification of the liner system identified above. Because such addition of liquids is prohibited at landfills having the type of liner system that was constructed at the Maplewood and King George County Landfills, flexibility is needed from the requirements of 40 CFR 258.28 to proceed with the project.

c 5. COMPLIANCE AND ENFORCEMENT PROFILE

Currently, VADEQ is reviewing the history of waste, air, and water permit compliance at both facilities. At the time of this application, the review has not been completed but preliminary results indicate that Waste Management, Inc. has not had any violations since opening Maplewood Landfill in 1993 and King George Landfill in 1996. Furthermore, there are no current or pending compliance issues. Both landfills are typically inspected monthly by VADEQ waste inspectors, and are inspected annually or semiannually by air and water inspectors. Further, each landfill is inspected daily by County personnel. VADEQ staff review semi-annual and annual groundwater, surface water, and gas monitoring reports. As a company, Waste Management of Virginia has an excellent overall compliance history.

C

6. SCHEDULE INFORMATION

The actual time over which production and monitoring would occurs is three years. The XL cells will operate under a Virginia Experimental Permit Amendment that expires after four years. The permit would begin when construction of the liquid application structures begins; thus the time is needed beyond the 3-year monitoring period to install the initial trenches and gas management structures. It is anticipated that the existing surface-water discharge or air-quality permits will not have to be amended. Report writing will occur contemporaneous with the final stages of the project.

In order to amend the current solid waste permits, VADEQ must hold public hearings in the respective localities. It is anticipated that the VADEQ?s public participation requirement for both landfills will be satisfied simultaneously. There are also public participation requirements under the XL Project. Waste Management does not anticipate needing to amend the existing surface-water discharge or air-quality permits.

A project schedule is provided on Figure 11, including several major milestones. The milestones are based upon an assumed project start date of 18 May 2000. The main point to consider is the duration of each task rather than the actual calendar date. WM will prepare a more detailed schedule of subtasks when additional information becomes available. Some of the major milestones to consider are: EPA?s review of final proposal; the permitting requirements of VADEQ; negotiations of the FPA with EPA; the installation of the trenches and gas management structures; production stages and monitoring; closure; and report writing.

C 7. REFERENCES

Gou, V. and Guzzone, B., *?State Survey on Leachate Recirculation and Landfill Bioreactors?*, Solid Waste Association of North America, 1997.

Maier, T.B., *?Analysis Procedures for Design of Leachate Recirculation Systems?*, Proceedings of the 3rd Annual SWANA Landfill Symposium, Palm Beach Gardens, Florida, June, 1998.

Maier, T.B., Steinhauser, E.S., Vasuki, N.C., and Poland, F.G., *?Integrated Leachate and Landfill Gas Management?*, proceedings of the Fifth International Landfill Symposium, Cagliari, Italy, October, 1995, pp. 53-66.

Maier, T.B., Vasuki, N.C., *?Expected Benefits of a Full-Scale Bioreactor Landfill?*, proceedings of Wastecon 1996, Portland, Oregon, September, 1996, pp. 179-195.

Reinhart, D.R., and Al-Yousfi, A.B., *?The Impact of Leachate Recirculation on Municipal Solid Waste Landfill Operating Characteristics?*, Waste Management and Research, Vol. 14, August, 1996, pp. 337-346.

Reinhart, D.R., *?Full-Scale Experiences with Leachate Recirculating Landfills: Case Studies?*, Waste Management and Research, Volume 14, No. 4, pp. 347-365, August, 1996.

Schroeder, P.R., McEnroe, B.M., Peyton, R.L., and Sjostrom, J.W., *?The Hydrologic Evaluation of Landfill Performance (HELP) Model, Vol. III, User?s Guide for Version 2.05,?* 1988.

Shaw, P.A., and Knight, A.J., *?Quantitative Analysis of Potential Savings and Earnings by Implementing a Bioreactor Landfill?*, proceedings of WasteTech 2000, Orlando, Florida, March 2000.

Vasuki, N.C., *?Leachate Generation in a Lined Landfill: A Case Study of the Central Solid Waste Facility at Sandtown, DE?*, 41st Purdue University Industrial Waste Conference Proceedings, 1986.

Vasuki, N.C., *?Landfill Test Cells?*, Delaware Solid Waste Authority, 1991.

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