# PROJECT XL
# FINAL PROJECT AGREEMENT

# FOR

# LANDFILL BIOREACTOR SYSTEMS

# KING GEORGE COUNTY LANDFILL AND RECYCLING CENTER
# AND
# MAPLEWOOD RECYCLING AND WASTE DISPOSAL FACILITY

# OPERATED BY
# USA WASTE of VIRGINIA, INC.

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# 1. INTRODUCTION TO THE AGREEMENT

## 1.1. Description of the Project and Its Purpose

This document contains the details of the Final Project Agreement (FPA) between USA Waste of Virginia, Inc., and King George Landfills, Inc., wholly owned subsidiaries of Waste Management, Inc. (WM) and the United States Environmental Protection Agency (USEPA) for implementing different bioreactor operations (involving the additions and/or recirculation of bulk liquids, including landfill leachate), at the Maplewood Recycling and Waste Disposal Facility in Amelia County, Virginia and King George County Landfill and Recycling Center in King George County, Virginia. This document also contains details of the project and the expected benefits of the project. The general locations of the two facilities are shown on Figure 1. WM's intent to pursue this project was initially communicated to Ms. Elizabeth Termini of the USEPA in a letter from the Virginia Department of Environmental Quality (VADEQ) dated 15 February 2000. As part of the project WM is requesting that USEPA grant regulatory relief from certain requirements of the Resource Conservation and Recovery Act (RCRA) that restrict application of bulk liquids in municipal solid waste landfills constructed with particular liner designs, as presented in Title 40 of the Code of Federal Regulations (40 CFR) Section 258.28.

Under this project, bioreactor programs would be implemented at the Maplewood Recycling and Waste Disposal Facility (Maplewood Landfill) and the King George County Landfill and Recycling Facility (King George County Landfill). The purposes of implementing the bioreactor programs 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 between the two different bioreactors 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 USEPA and the waste disposal industry with data concerning the use of bioreactor techniques at municipal solid waste (MSW) landfill sites throughout the United States.

In the remainder of this section, a description of the facilities is presented, contacts for the project are identified, and the organization of this Final Project Agreement (FPA) is described. In general, this FPA follows the organization provided in the

document entitled, *"Project XL: Best Practices for Proposal Development"* [USEPA, 1999] as well as published guidelines for FPA's. The information on Table 1 identifies the location where the specific requirements of the XL Program documents are addressed in this application.

## 1.2. Description of the Facility and Facility Operations/Community/ Geographic Area

The Maplewood Landfill is located in Amelia County, Virginia, approximately 30 miles southwest 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 is located in King George County, Virginia, approximately 50 miles north-northeast of Richmond, Virginia. The landfill liner area will 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.

Both the Maplewood Landfill and the King George County Landfill were constructed having geomembrane composite double-liner systems, with primary leachate collection and leak detection (secondary collection) layers. The liner systems for the two landfills are illustrated on Figure 2. Because these landfills were constructed having composite double-liner systems, they provide a high level of protection to the environment against potential impacts caused by leakage of leachate. While the liner designs do not meet the specified liner design requirements under RCRA (40 C.F.R. § 258.40(a)(2) and (b)) which a landfill presently is required to have in place for bulk liquids to be added (40C.F.R. § 258.28(a)(2)); the liners do meet or exceed the performance requirements for municipal solid waste landfills and have been shown to be equivalent to the specified liner requirements. For this reason, the project sponsors believe that these landfills are excellent candidates for the bioreactor programs that are proposed in this application. The proposed project has been discussed with potential stakholders, including the USEPA, VADEQ, WM, and the host counties, as well as the participants identified in Section 3.3. Letters of support for the project from the Amelia County and King George County Boards of Supervisors are attached in Appendix A.

## 1.3. Purpose of the Agreement

This FPA is a joint statement of the plans, intentions, and commitments of the USEPA, the Commonwealth of Virginia, and WM to carry out this project to be approved for implementation at the Maplewood and King George County Landfills.

The FPA does not create legal rights or obligations and is not an enforceable contract or a regulatory action such as a permit or a rule. This applies to both the substantive and the procedural provisions of this Agreement. While the parties to the Agreement fully intend to follow these procedures, they are not legally obligated to do so. For more detail, please refer to Section 6 (i.e., Legal Basis for the Project).

Federal and State flexibility and enforceable commitments described in this Agreement will be implemented and become effective through one or more legal implementing mechanisms, such as a site specific rule or permit amendment issued by the Commonwealth of Virginia.

All parties to this Agreement will strive for a high level of cooperation, communication, and coordination to assure successful, effective, and efficient implementation of the Agreement and the Project.

## 1.4. List of the Parties that Will Sign the Agreement

The Parties to this Final Project XL Agreement are the USEPA, WM, and the VADEQ.

## 1.5. List of the Project Contacts

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

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|---|---|
| | Post Office Box 10009<br>Richmond, Virginia 23219 |
| Project Manager: | Mr. James W. Stenborg, P.E.<br>Regional Engineer<br>Waste Management, Inc.<br>King George County Landfill<br>10376 Bullock Drive<br>King George, Virginia 22485<br>(540) 775-3123 |
| Maplewood Landfill Manager: | Mr. Lee Wilson<br>District Manager<br>Maplewood Recycling Waste Disposal Facility<br>20221 Maplewood Road<br>Jetersville, Virginia 23083 |
| King George County Landfill Manager: | Mr. Timothy J. Schotsch<br>District Manager<br>King George County Landfill<br>10376 Bullock Road<br>King George, Virginia, 22485 |
| Project Engineer: | Michael F. Houlihan, P.E.<br>Principal<br>GeoSyntec Consultants<br>10015 Old Columbia, Road, Suite A-200<br>Columbia, Maryland 21046 |
| Other Key Waste Management, Inc. Personnel: | John A. Baker<br>Director, Environmental Assessment and Technology |
| | Greg Cekander, P.E.<br>Vice President of Engineering |

# 2. DETAILED DESCRIPTION OF THE PROJECT

## 2.1 Summary of the Project

### 2.1.1 Overview

This project involves the operation of two landfills using bioreactor techniques for the purpose of evaluating the relative benefits of variable liquid application rates in a controlled manner. The viability and usefulness of these methods is supported by several other applications of bioreactor techniques throughout the United States. A summary of some of these projects is presented on Table 2 and the benefits of these technologies are summarized in Table 3. As part of the project, WM would be granted flexibility from the RCRA regulatory requirement that restricts application of bulk liquids in municipal solid waste landfills as specified in 40 CFR 258.28(a). In the past, the design goal of a "traditional" landfill was to minimize the quantity of water introduced into the landfill, thus minimizing leachate generation. The disadvantage to this approach is that the lack of liquid causes the biodegradation process to occur very slowly, thus leaving waste in a relatively undecomposed state for a long period. In this case, the liner system is potentially exposed to leachate for a relatively long period of time, and waste continues to be a potential source of groundwater contamination throughout the post-closure period.

Under the XL program, WM will operate the Maplewood Landfill and the King George County Landfill using bioreactor techniques. At the Maplewood landfill the project would involve addition of liquids (primarily leachate – for further information see section 2.2.1.2) The King George bioreactor will involve addition of leachate generated at this facility plus other liquids, such as non-hazardous liquid waste or stormwater (for further information see section 2.2.2.2.) A conceptual process diagram for a landfill bioreactor is presented on Figure 3. The Maplewood and King George County Landfills are located in the same geographic area and receive similar waste streams. Operating these landfills using two different liquid application rates will allow the relative performance and cost-saving benefits of the two bioreactor approaches to be compared. The waste received at these landfills is primarily municipal solid waste having a small percentage of non-biodegradable products (e.g., construction debris). 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 (such as liquid application).

### 2.1.2 Process Description – Maplewood Landfill Bioreactor

The landfill bioreactor program that would be implemented at the Maplewood Landfill involves application of leachate from the landfill and small quantities of other liquids (e.g., truck, tire waste water, wastewater treatment plant sludges, or stormwater) to the waste. The liquids will be applied over an approximate ten acre area at or near the surface of the landfill as it will exist in September, 2000. The primary purposes of recirculating leachate in this manner is to treat the leachate and to increase the rate of biological degradation of waste in a portion of the landfill where liquids are applied. The potential benefits of the bioreactor are presented in Table 3. Treatment of leachate occurs within the waste 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 4 show leachate quality improving over a period of about seven years at test cells operated by the Delaware Solid Waste Authority's Central Solid Waste Management Center (CSWMC). Recirculation of leachate can also result in accelerated generation of landfill gas; an example of accelerated landfill gas generation for the two test cells at CSWMC is presented on Figure 5. Further, at bioreactor landfills, substantial settlement of the waste typically can occur during the operating life of the landfill, thus 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, bioreactor processes reduce the time needed to achieve a stable waste mass after closure. Finally, because the waste mass is more stable, it has more potential end-uses.

### 2.1.3 Process Description – King George County Landfill Bioreactor

The bioreactor program that will be implemented at the King George County Landfill involves applying a quantity of liquid that is 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 to achieve the benefits identified in Table 3. 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.

At the King George County Landfill, 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 distribute leachate throughout the approximate 10-acre test area as uniformly as possible and to maintain the moisture content of waste at a level high enough to increase biodegradation. The total footprint is about 48 acres as of May 2000. The detailed design of the system is presented in the design report [GeoSyntec, 2000a]. 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 also referenced in Section 3 (i.e., Project XL Criteria) to describe the manner in which the proposed program complies with the Project requirements 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 typical 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 study area will be in the landfill's "Phase Development Areas" Phases 1, 2, 3, 4, and 11. In Phases 1 and 2, liquid will be applied in trenches; excavated beneath the surface of the landfill. The area in Phases 1 and 2 where liquids will be applied covers an area of about 10 acres. Phases 3, 4, and 11 will be used as control cells where no liquid will be applied; only rainwater that naturally falls and percolates beneath the landfill surface will enter the waste in these phases. 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 4,000,000 gallons per year);

- uniformly distribute leachate throughout the waste mass in the test (i.e., liquid application) area;

- minimize the potential for the occurrence of seeps by placing distribution structures at least 50 feet from the crests of outward 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 measured and documented; and

- manage landfill gas at all times, including during and following liquid application events, to ensure a full compliance with applicable air quality permit requirements, and rules and regulations including 40 CFR part 60 subpart WWW, (the MSW Landfills NSPS). An active landfill gas collection and control system is currently in operation at the site. The landfill gas collection and control system components will be enhanced if there is a potential to exceed the applicable air quality permit requirements, and rules and regulations.

- Minimize uncontrolled releases of landfill gas emissions

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., [1998.] 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

3,000,000 gallons of leachate in 1999, which was a relatively dry year. Under this XL project, between 3,000,000 and 4,000,000 gallons of liquid would be applied per year. The liquid application rate would be 10,960 gallons per day, based on an application rate of 4,000,000 gallons per year. A portion of the liquid added could consist of liquids other than leachate, if the leachate quantity is relatively low; such "other liquids" could include non-hazardous liquids such as waste water treatment plant sludges, stormwater or truck washwater.

- *Head on Liner*. The impact of the proposed liquid application activities on the depth of liquid (or thickness of "head"), 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 4,000,000 gallons per year is recirculated. The calculated thickness of head on the liner system is less than the regulatory maximum of 12 in.

- *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 (field 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 into the waste is calculated; the total application capacity equals the combined flowrate of six trenches. As shown in [GeoSyntec, 2000a], the total flowrate capacity of the group of trenches is calculated to be about 110,000 gallons per day, which is much greater than the proposed average rate of 10,960 gallons per day application rate.

- *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 later application to the trenches. Liquid will be collected and stored for application when conditions are appropriate (i.e., it is not raining). The storage capacity of the leachate tanks at the Maplewood Landfill is

approximately 500,000 gallons, which is the average 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 or cannot be recirculated. As a minimum, the tanks will need to store the quantity of leachate generated 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 [GeoSyntec, 2000a]. As a contingency, during times when leachate generation exceeds the rate of recirculation in and storage capacity, leachate can be hauled off-site.

- *Landfill Gas Control System*. A gas collection and control is particularly necessary at bioreactor landfills; this is because the gas generation rate in a bioreactor landfill is greater than without a bioreactor, due to the accelerated biodegradation of the waste. To be at least as protective of human health and the environment as the new source performance standards for municipal solid waste landfill (i.e., 40 CRF, part 60, subpart WWW) (the MSW Landfills NSPS), WM will continue to provide Subpart WWW-compliant landfill gas collection and monitoring, during and following the application of liquids. If odor problems or air quality problems occur, then the system will be expanded as needed (e.g., using additional extraction wells or trenches or by placing less permeable cover over affected areas). The system performance will be documented through routine monitoring of the landfill gas for the presence of methane and other constituents.

#### 2.2.1.3 Liquid Application System Construction

The liquid application system will be constructed using typical trench construction methods and other methods developed during the implementation of the program. The construction methods are described in detail the design report [GeoSyntec, 2000a]. The goals of the construction are as follows:

- 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;

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

- Minimize landfill gas emissions by maximizing collection and control through early installation and operation of a comprehensive collection and control system in the bioreactor cell during the construction of the liquid application system and throughout the life of the project.

- manage landfill gas at all times, including during and following liquid application events, to ensure full compliance with applicable air quality permit requirements, and rules and regulations including 40 CFF, part 60, subpart WWW) (the MSW Landfills NSPS). An active landfill gas collection and control system, is currently in operation at the site. The landfill gas collection and control system components will be enhanced if there is a potential to exceed the applicable air quality permit requirements, and rules and regulations.

2.2.1.4 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 the leachate quality in phase development areas with and without liquid addition over time;

- measure the total quantity of leachate collected in phases with and without liquid application and the quantity of leachate or other liquids applied in the test areas;

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

- monitor the ground surface of the entire site, including the liquid application area, for the presence of landfill gasses (i.e. methane, NMOCs, etc.,) to ensure that permit and regulatory limits are not exceeded, and evaluate the need for additional landfill gas collection components (i.e., wells and header pipe) during liquid application events to improve the effectiveness of the landfill gas collection system. (see section 3.1.2.4 Potential Environmental Impact to Air)

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

*Contingency Plan in the Event of a Failure of the Primary Liner System*

The primary liner system is underlain by a secondary liner and leachate collection system. A sump is located at the low point of this system and the sump is monitored for presence of liquid monthly. Liquid is collected and discharged regularly, and samples are collected to evaluate the source of the liquids. If the test results from the sampled liquid indicate that there is a leak in the primary liner system, then the need for a larger pump will be evaluated and the liquid level in the primary system will be evaluated and monitored to minimize the liquid depth above the primary liner and maintain less than 12 in. of head. The liner leakage rate will be evaluated and the leachate injection rate may be reduced, if necessary, to control the rate of the leakage.

*Contingency Plan in the Event of a Landfill Fire*

The proposed study will involve only the anaerobic decomposition of wastes. The potential for landfill fires to occur during anaerobic decomposition is much less than the potential from bioreactors using aerobic decomposition. Nonetheless, the potential for a landfill fire will be evaluated based on monitoring of the gas extraction wells. Because the test area is located where the waste is on the order of 50 feet or more in thickness, the primary cause for a fire would likely be from applying excessively high vacuum to the extraction wells. The test area is not accessible to the atmosphere except at the landfill surface.

The gas extraction wells will be monitored for parameters such as methane and oxygen concentration and gas temperature at the well head as required by Subpart WWW. This monitoring will be done on a monthly or more frequent basis. If 1)the methane concentration at a well head decreases, 2) oxygen concentration increases, or

3) if wellhead temperature increases significantly, this will be the first indication of uncontrolled waste composting or a potential fire. If any of these monitoring parameters changes significantly, and a potential fire is suspected, the control valve at the extraction well where the change is observed will be closed. The monitoring of the extraction well will continue for two weeks after the valve is closed. During this time, consideration will also be given to turning off extraction wells located near the well where changes were observed. If the readings at the extraction well have returned to normal, the valve will be reopened, and extraction will recommence.

If there is no increase in the methane or decrease in the oxygen concentration, or if the temperature continues to be significantly higher than historical readings at wells where a potential fire is suspected, a decision will be made as to whether to inject water or leachate should be put into the well to reestablish anaerobic conditions. Water, carbon dioxide, or leachate will be added to the well, if necessary. The proposed study will involve only the anaerobic approach to the landfill bioreactor. The potential for landfill fires to occur during anaerobic decomposition is much less than the potential from bioreactors using aerobic decomposition. The potential for a landfill fire will be evaluated based on monitoring of the gas extraction wells. Because the test area is located where the waste thickness is on the order of 50 feet or more in thickness, the primary cause for a fire would likely be from applying excessively high vacuum to the extraction wells. The test area is not accessible to the atmosphere except at the landfill surface.

The methods that will be used to monitor these parameters are described on Table 6. The monitoring parameters and frequency of monitoring are set forth in Table 6A. To organize the monitoring data, forms will be generated for use by operations personnel to collect and track this information. The surface test for methane concentration, which is used to determine collection efficiency and surface integrity, will be conducted according to the MSW Landfill NSPS surface monitoring requirements set forth in 40 CFR section 60.755(c).

### 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 phases of the landfill;
- range of liquid application rates or qualities to various trenches and potential 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 methane;
- relative performance of the trenches and evaluate an appropriate trench spacing that is needed to 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 landfill surface settlement is areas with and without liquid injection.

### 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 County Landfill is described below. In general, the system will be designed to distribute liquids as uniformly as possible throughout the test area of the waste mass, and to establish moisture contents within the test area at a level high enough to significantly increase biodegradation. The detailed design of the system is presented in King George design report [GeoSyntec, 2000b]. 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 requirements 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

A conceptual process flow diagram for operation of the bioreactor is presented on Figure 3. The overall study area will be established within the MSW Cells 2, 3, and 4 of the King George County Landfill. Liquid will be applied in Cell 3; Cells 2 and 4 will be the control cells in which no liquids will be applied. The overall study area, (i.e., Cells 2, 3, and 4) covers about 59 acres; the area in Cell 3 where the bioreactor program will be implemented covers an area of about 10 acres. Cell 1 is currently under construction (July 2000) and will be a future control area. The goals of the design for the bioreactor will be the following:

- recirculate all of the leachate generated at the facility (i.e., up to about 4,000,000 gallons per year plus additional liquid so that the total liquid application rate is about 8,000,000 gallons per year);

- uniformly distribute leachate throughout the waste mass in the test area (i.e., liquid application);

- 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 biodegradation by monitoring surface settlement by cell areas and noting which types of liquids have been applied in those areas;

- identify several leachate delivery options to simplify operations;

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

- manage landfill gas during liquid application events using at all times, including during and following liquid application events, to ensure full compliance with applicable air quality permits requirements, and rules and

regulations including 40 CFR part 60 subpart WWW (the MSW Landfills NSPS). As shown in thedesing report [Geosyntec 2000a] based on the age of its wastes, the provisions of 40 CFR Subpart WWW and other air quality regulations require that the King George Landfill have installed and are operating an active landfill gas collection system prior to the commencement of liquid addition, and to conduct subpart WWW-compliant landfill gas collection and monitoring, beginning no later than the first application of liquids. If odor problems or air quality problems occur, then the system will be adjusted or expanded as needed (e.g. using additional extraction wells or trenches or by placing less permeable cover over affected areas.) The system performance will be documented through routine monitoring of the landfill gas for the presence of methane and other constituents.

The manner in which these goals are addressed are summarized on Table 3. The design of the system will be based on analytical methods developed by Maier, et. al. [1998] as described in Section 4 of the design report [GeoSyntec, 2000b]. 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 County 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 between 7,000,000 and 8,000,000 gallons per year. Based on facility records for the past three years, the facility generates approximately 3,500,000 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 8,000,000 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 8,000,000 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 3,500,000 gallons/year of leachate is recirculated. The analysis is shown in Appendix A

to the design report [GeoSyntec, 2000b]. As shown in the Design Report [GeoSyntec 2000b], the resulting head on the liner system is predicted to be 10 in., which is less than the regulatory maximum thickness of 12 in.

- *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 King George County 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 (field 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 into the waste is calculated; the total application capacity equals the combined flowrate of all trenches. As shown in the design report [GeoSyntec, 2000b], the total flowrate capacity of the group of trenches is calculated to be about 110,000 gallons per day, which is much greater than the proposed 22,000 gallons per day maximum application rate.

- *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. Liquid will be collected and stored for application when conditions are appropriate (i.e., it is not raining). The storage capacity of the leachate tanks at the King George County Landfill and Recycling Center is approximately 500,000 gallons, which is the average 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 or cannot be recirculated. As a minimum, 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 the design report [GeoSyntec, 2000b].

- *Landfill Gas Control System*. A gas collection and control is particularly necessary at bioreactor landfills. The reason for this is that the gas generation rate in a bioreactor landfill is greater than without a bioreactor

because of the accelerated biodegradation of the waste. To be at least as protective of human health and the environment as the new source performance standards for municipal solid waste landfill (i.e., 40 CRF, part 60, subpart WWW) (the MSW Landfills NSPS), WM will provide Subpart WWW-compliant landfill gas collection and monitoring, during and following the application of liquids. If odor problems or air quality problems occur, then the system will be expanded as needed (e.g., using additional extraction wells or trenches or by placing less permeable cover over affected areas). The system performance will be documented through routine monitoring of the landfill gas for the presence of methane and other constituents least as protective of human health and the environment as the requirements of all applicable state and federal regulations and permits pertaining to air quality. As shown in the design report [GeoSyntec, 2000b] because the King George County Landfill must comply with the requirements of 40 CFR Subpart WWW, an active landfill gas collection system will be operated at all times including during liquid application events. The system performance will be documented through routine monitoring of the landfill gas for the presence of methane and other constituents.

#### 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 the design report. The goals of the construction methods presented in the design report 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.

- Minimize landfill gas emissions by maximizing collection and control through early comprehensive collection and control practices in the bioreactor cell throughout the life of the project.

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 generated in areas with and without liquid addition over time;
- measure the total quantity of leachate collected in areas with and without liquid application and the quantity of leachate or other liquids applied in the test areas;
- monitor the rate that leachate can be applied to the trenches without causing seeps or other potential operational problems;
- monitor the ground surface of the entire site, including the liquid application area, for the presence of landfill gasses (i.e. methane, NMOCs, etc.,) in excess of permit limits, and evaluate the need for additional landfill gas collection components (i.e., wells and header pipe) during and following liquid application events to improve the effectiveness of the landfill gas collection system; (See further discussion in section 3.1.2.4, Potential Environmental Impact to Air.)
- measure the settlement of the waste over the entire landfill area, including the liquid application area, this will include semi annual topographic surveys.

*Contingency Plan in the Event of Failure of the Liner System*

The primary liner system is underlain by a secondary liner and leachate collection system. A sump is located at the low point of this system and the sump is monitored for presence of liquid monthly. Liquid is collected and discharged regularly, and samples are collected to evaluate the source of the liquids. If the test results from the sampled liquid indicates that there is a leak in the primary liner system, then the need for a larger

pump will be evaluated and the liquid level in the primary system will be evaluated and monitored to minimize the liquid depth above the primary liner and maintain less than the required maximum 12" of head. The liner leakage rate will be evaluated and the leachate injection rate may be reduced, if necessary, to control the rate of the leakage.

*Contingency Plan in the Event of the a Landfill Fire*

The proposed study will involve only the anaerobic approach to the landfill bioreactor. The potential for landfill fires to occur during anaerobic decomposition is much less than the potential from bioreactors using aerobic decomposition. The potential for a landfill fire will be evaluated based on monitoring of the gas extraction wells. Because the test area is located where the waste is on the order of 50 feet or more in thickness, the primary cause for a fire would likely be from applying excessively high vacuum to the extraction wells. The test area is not accessible to the atmosphere except at the landfill surface.

The gas extraction wells will be monitored for parameters such as methane and oxygen concentration and gas temperature at the well head. This monitoring will be done on a monthly or more frequent basis. If the methane concentration at the well head decreases, oxygen concentration increases or if wellhead temperature increase significantly, this will be the first indication of a potential fire. If any of these monitoring parameters changes significantly, and a potential fire is suspected, the control at the extraction well where the change is observed will be closed. The monitoring of the extraction well will continue for two weeks after the valve is closed. During this time, consideration will also be given to turning off extraction wells located near the well where changes were observed. If the readings at the extraction well have returned to normal, the valve will be reopened, and extraction will recommence.

If there is no increase in the methane or decrease in the oxygen concentration, or if the temperature continues to significantly higher than historical readings, a decision will be made as to whether water or leachate should be put into the well to reestablish anaerobic conditions. Water, carbon dioxide, or leachate will be added to the well if necessary.

The methods that will be used to monitor these parameters are described in Table 6, and the parameters monitored are included in Table 6A. To simplify the monitoring of these parameters, forms will be generated for use by operations personnel in collecting and tracking this information. The surface test for methane concentration, which is used

to determine collection efficiency and surface integrity, will be conducted according to the MSW Landfill NSPS surface monitoring requirements set forth in 40 CFR section 60.755(c).

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 phases of the landfill;
- range of liquid application rates or qualities to various trenches and potential problems arising from certain application rates;
- early compliance with the requirements of the Air Quality Permit for the site, including monitoring the ground surface for the occurrence of methane
- relative performance of the trenches and evaluate an appropriate trench spacing that is needed to 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 landfill surface settlement is areas with and without liquid injection.

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 existing information on this project indicates that the environmental performance of the proposed bioreactor operations at the two sites will be at least as good, and likely better, than the performance would be expected in the absence of the project. While the addition of liquids will necessarily increase the amount of leachate passing through the waste over that which would be expected without liquids addition, the leachate will be fully controlled by maintaining less than 12 in. of head over the liner; moreover, this leachate will be re-circulated, rather than requiring off-site treatment and disposal. As described in Section 1.2, both the Maplewood and King George County Landfills were constructed with composite double-liner systems, which are highly efficient at preventing leakage of leachate from landfills. While implementation of the project is expected to result in an increase in the generation rate of landfill gas, including methane and nonmethane organic compounds, this gas will be collected and controlled through the use of an active gas collection and control system and flares at both sites. The parties recognize that the increased production of landfill gas may result in an increase in NOx emissions from the flares. NOx emissions will not, however, exceed the limits specified in WM's air quality permits. Moreover, WM is committed to exploring alternative uses for the collected gas, other than flaring.

These factors, discussed in detail below, show that the project taken as a whole will result in environmental impacts that will not be greater, and in fact will likely be less, than those that would be expected in the absence of the project

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, and is presented here for both the King George and Maplewood Landfills.

#### 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 impinge on groundwater. As described in Section 1.2, both the Maplewood and King George County Landfills were constructed having composite double-liner systems, which exceed the liner 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 12 in. as required by subtitle D RCRA, which has been verified by design calculations.

When liquids are applied to the landfill, there is a possibility that an increased quantity of leachate will reach the leachate collection system. Leachate head levels on the liner may also increase. However, as presented in Section 4.3 of the design reports [GeoSyntec, 2000a and 2000b] when additional liquids are applied, the thickness of leachate will not exceed 12 in. In reality, applying liquids to the waste above the leachate collection system will enhance the biodegradation process in the landfills, which cause more water to be consumed by landfill gas generation. This further reduces the amount of liquid that can 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 at the Landfill

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. Some seeps are likely to occur at landfills regardless of how well the landfill is designed and operated. Surface water is colleceted and monitored prior to discharge, 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.

Potential impacts that could be caused by seeps are and will continue to be promptly mitigated 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 will continue to be implemented throughout the XL Project. Further, because of the ongoing project, site personnel will be particularly advised to 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, either landfill gas would have to be released from the landfill in an uncontrolled manner or increased quantities of oxides of nitrogen would need to be released from the on-site flares or other combustion control devices. For the Maplewood Landfill, active landfill gas control systems have been constructed and are currently preventing releases of gas in excess of regulatory limits. An active gas collection and control system will be installed at the King George County Landfill on or before the addition of liquids under this program. The gas collection and control systems will be expanded and upgraded, including in the area of liquids addition, if routine monitoring shows it to be necessary. Such additional controls will be installed if necessary to meet the landfills' air quality permit criteria and NSPS (40 CFR Part 60 Subpart WWW.) Therefore, the potential impact of the facility to air under the project should not exceed the potential impact of the landfill in the absence of the XL Project.

The landfill gas will be collected and controlled through the use of internal combustion engines, flares or other approved combustion devices. Implementation of the project will likely result in the increased production of landfill gas, which will result in an increase in NOx emissions from the flares. NOx emissions will not, however, exceed the limits specified in WM's air permits. Moreover, WM is commited to exploring alternative uses for the collected gas, other than flaring.

### 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 [USEPA, 1999] 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 will eventually 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 (see Figure 4). 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 and protection for the proposed project as 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 potential 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; and (iii) 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 in place to minimize its potential for impacting groundwater quality without adversely impacting the other environmental protection features of the facility.

- *Improvement in Environmental Conditions that are Priorities to Stakeholders*. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Landfill and the King George County Landfill 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. Routine groundwater monitoring is, and will continue to be, performed to verify containment.

#### 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 surface water environmental impacts 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 pollutants in the leachate (i.e., 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 County 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 Landfill and the King George County Landfill, 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.

3.1.2.4 Potential Environmental Impact to Air

The proposed project will provide environmental performance that is superior to the air environmental impact baseline 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 in the bioreactor cell during the operating, closure, and post-closure periods at both landfills. The most current version of each facility's Air Quality Permits (including the part WWW NSPS requirements) will be used as the criteria for determining if the gas collection and control system needs modfication. Under this project, landfill gas will likely be generated at an initially higher rate in the area where additional liquid is inputted as compared to other areas. The bioreactor cell may require additional active gas collection system components, such as wells and header piping in those affected areas. As more gas is produced and collection structures are added, the collection efficiency will be improved. Therefore, under this project, less gas is likely to be released from the landfill surface to the atmosphere than if the project were not implemented, particularly in the landfills' later years.

  As discussed earlier, the landfill gas, including in the areas affected by the liquids addition, will be collected and controlled in the bioreactor cell soon after the start of liquid addition through the use of flares. Implementation of the project will likely result in an increase in the rate of landfill gas produced, and there may be an increase in NOx emissions from the flares. NOx emissions will not, however, exceed the limits specified in WM's existing air permits. 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 on the landfill. By using leachate in the bioreactor, fuel consumption and vehicle emissions will be drastically reduced or eliminated as compared to a project performed outside of XL where leachate would be hauled off site. 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 distances of about 2 to 3 miles. Thus, a substantial long-term improvement in environmental performance for the proposed project will be recognized as compared to a facility operated outside of an XL project.

- *Pollution Prevention or Source Reduction.* Fugitive emissions will be reduced because components of the gas collection and control systems will be instituted earlier than would othersie be the case, particularly with respect to the King George Landfill. Additionally, at both landfills the accelerated decomposition of waste will accordingly less of the time in which the waste can be a source of landfill gas.

- *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 NMOCs. As described in the first item above, the proposed project will exceed this standard because more landfill gas would be generated and collected in a shorter period of time under the XL Program than outside the XL Program. The waste mass will more quickly be exhausted of its potential to generate gas, and more quickly approach a time when emissions are less the 50 Mg per year. Therefore, the environmental performance of the project will be more protective than the industry standard.

  Early gas collection and control is necessary at bioreactor landfills because the site in essence is rapidly "aging" the waste so that it "behaves" as if it is much older. The result of this rapid "aging" is more complete biodegradation of the waste resulting in the generation of a larger quantity of landfill gas at a more rapid rate (sooner after waste placement in the landfill.) To be at least

as protective of human health and the environment as the new source performance standards for municipal solid waste landfill (i.e., 40 CRF, part 60, subpart WWW)(the MSW Landfills NSPS), the following will be provided at both sites: (i) monitoring as required in the NSPS rules for MSW landfills; (ii) beginning monitoring sooner than the rule requires, since waste at bioreactor landfills generates more gas sooner after waste placement; and (iii) continuing the specified monitoring for the duration of the project.

- *Improvement in Environmental Conditions that are Priorities to Stakeholders*. Based on discussions between the applicant, the VADEQ, and the host communities for the Maplewood Landfill and the King George County Landfill, 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.

### 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 Table 6 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 avoidance of potential operational problems that could cause an impact to the environment. The measurements identified on Table 6 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 operation period, 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 methane 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 by WM. A preliminary outline of a typical semi-annual report of monitoring is presented on Table 7.

## 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, for landfills where leachate is recirculated less costly treatment techniques will be used in the long term if leachate eventually has to be taken off site

for treatment and disposal. 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 during post-closure (after the final cover has been placed over the waste), making it difficult and impractical 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. Also, the waste mass becomes more stable sooner and better suited for end-use during post-closure. 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 fees paid on a "per ton" basis.

*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 commonly generated as a result of the cleanup of old tire piles in the Commonwealth of Virginia. When a beneficial use of tires such as this is available, a portion of the processing cost from the cleanup of tirepiles is paid by the VADEQ because of the beneficial end use. 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 project that involves collection of landfill gas and beneficial use such as generating of energy 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 relatively small quantity of gas per year may not be candidates for an energy recovery project due to an insufficient quantity to make the project cost-effective. 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 (such as in recirculating and bioreactor landfills) more gas is available in the short-term for energy recovery projects. With the increased rate of landfill gas being generated, energy recovery projects will be more economically feasible.

*Earlier Availability for Re-Use of Site*

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

*Reduced Settlement and Strain on Final Cover System*

There is less potential for damage to the final cover system by settlement because more of the potential settlement occurs in recirculating and bioreactor landfills before the final cover system is constructed. This has a direct impact on the cost of the post-closure operation and maintenance activities. Because the final cover system will experience less settlement, the long-term containment of the final cover system is improved.

*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 potential cover damage due to settlement; and (iii) decreased potential for groundwater degradation and, therefore, lower potential for the need for groundwater remediation. These benefits all result in lower post-closure care

costs for recirculation or bioreactor landfills as compared to non-recirculating and non-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 as compared to non-bioreactor landfills.

*Comparison Between Approaches to Bioreactor Technology*

A significant 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. This comparison can be made within the site itself from areas with and without liquid injection, and between the two sites. As previously described, the Maplewood Landfill would receive up to 4,000,000 gallons per year of liquid in a nominal 10-acre area. The King George County Landfill would receive as much as 8,000,000 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 evaluated by comparing the results from the two.

## 3.3 Stakeholder Involvement

### 3.3.1 General Information

*Primary participants* include the regulatory community of USEPA and VADEQ, and WM, local community councils and government officials, and interested members of the public. USEPA and VADEQ have had considerable influence on the details of the project proposal and will continue their active involvement during the implementation phase.

*Interested parties* have demonstrated some interests in the project, yet do not wish to actively participate in project development and implementation. Interested parties will usually want be kept informed of project development and progress, and may wish to attend public meetings and contribute their comments in written or verbal form.

*Members of the general public* will, most likely, not become actively involved in project development and implementation. Although not actively involved, members will

be provided with project information through the local media and central information repository. Members of the general public have the opportunity to participate more actively if they choose to do so.

A *Final Project Agreement* (FPA) is an agreement between the USEPA and the Sponsors stating the purpose and requirements of the project and how the project is to be implemented and evaluated. It is completed through a cooperative effort between the USEPA, Sponsors, and the Stakeholders.

A *permit amendment* amends an existing permit for a landfill. There are specific regulatory and technical requirements that must be met for a successful permit amendment. There are prescriptive public participation requirements. A landfill is typically permitted under 9 VAC 20-80-250 and 9 VAC 20-80-500 of the Virginia Solid Waste Management Regulations (VSWMR) and by the Code of Virginia, §10.1-1400 *et seq*. However, because the bioreactor projects are not typical at landfills the permits will be amended under VSWMR, 9 VAC 20-80-480.G which allows for an experimental permit for innovative treatment technologies.

### 3.3.2 First Contact and Subsequent Meetings

- Public Meeting on 1 August 2000 (King George County) and 2 August 2000 (Amelia County) to solicit comments from the public on the intent of the Sponsors to participate in Project XL.

- Public Meetings the week of 4 September 2000 to discuss the draft FPA with the citizens.

- Public Meeting and Hearing 16 October 2000 (King George County) and 17 October 2000 (Amelia County) to discuss the Draft Permit Amendments for the landfills.

A kickoff meeting was held on 1 August 2000 for King George County and 2 August 2000 for Amelia County. Both meetings were held at 7:00 p.m. A copy of the advertisements are provided in Appendix VI and include project information, contact information, and repository information. The public will have about 10 to 15 days to respond with comments after the public meeting is held. Participants may become

actively involved at the time of the meetings in the continuing process or be put on a mailing list to receive periodic information. Another public meeting may be held a few weeks later to solicit additional participants and comments. As part of the VADEQ's permitting process, a public hearing must be held on each of the draft permit amendments. Details of the public hearing process are provided below. It is anticipated that the public hearings for each of the draft permits will most likely occur the week of 16 October 2000. At the second meetings, the Draft FPA will be made available for review and comment. As the FPA is revised and amended, it will be made available at subsequent meetings and at the local library. The availability of the FPA will be advertised prior to the public hearings held by the VADEQ.

### 3.3.3 County Endorsement

The Counties of Amelia and King George endorse the respective projects as evidence by letters of support. These landfills have not had major opposition but, rather, had public support. Conditions of the host agreements provide benefits to the residents of both counties through revenue and jobs. The respective projects under Project XL would not affect the host agreements, thus the Counties would continue to receive these benefits. Thus, any Stakeholder opposition in these counties is anticipated to be minimal. However, the sponsors will publish an advertisement describing the desired projects as discussed above. An additional advertisement will be part of the VADEQ's public participation process as outlined below.

### 3.3.4 State Public Participation Requirements

Before VADEQ issues a permit amendment, it holds a public hearing in the locality to solicit comments on the draft permit from concerned citizens. The public hearing is advertised in the local paper. The public hearing is held a minimum of 30 days from the date of the advertisement. Public comment period begins the day of advertisement and ends 15 days after the public hearing is held. Furthermore, the VADEQ has a standardized mailing list of state agencies to whom a draft permit or notice of draft permit is sent to solicit comments. The VADEQ evaluates the comments and prepares a public response document. The VADEQ Director then decides within 30 days after the close of comment period whether or not to issue the permit. Conditions may be imposed due to additional state requirements or as a result of public comment. In the initial

stages of permitting, the applicant notifies all of the adjacent property owners of his intent to modify or expand the landfill. In this notification, the project is described and contact information is provided. The citizens can comment on the project at this stage or at any other stage of the permitting process until the permit has been issued.

Since both landfills have a valid permit, the VADEQ intends to amend the permit to allow the bioreactor systems as an experimental process. The major amendments would be advertised and open to comment as described above. The details of the respective projects would be outlined in the advertisements along with contact information and document viewing locations. It is anticipated this would help identify additional Stakeholders.

### 3.3.5 Expert Technical Reviewers and Commenters

There will be specific experts and technical advisors who will review the FPA and make appropriate comments on its technical adequacy and regulatory compliance. Some of these Stakeholders have already been contacted by the Sponsors and have agreed, in part, to review the project. They include faculty members from Virginia Polytechnic Institute and State University (Virginia Tech) and North Carolina State University. Specific individuals are not named in this report because, depending upon availability, they may change over the course of the review time. Other third-party expert reviewers may include Waste Policy Institute, EMCON, and Richardsons and Associates. They will be contacted and offered the opportunity to review and comment.

### 3.3.6 Getting the Word Out

The public hearings as required by the VADEQ will be supplemented with additional Stakeholder meetings, as necessary. A partial mailing list is attached. The mailing list would be updated as necessary to include private citizens and other interested parties. Periodically, progress reports and other relevant information will be distributed. Mail would be sent on a recurring date or as information is made available. If desired, the Sponsors will provide site tours and briefings to better educate the Stakeholders. Transcripts and video tape recordings of all public meetings and hearings will be maintained at the repositories.

### 3.3.7 Repository Information

An official record of the project will be maintained by the Sponsors at 629 East Main Street, Richmond, VA, 22129 c/o Paul Farrell, (804) 698-4214. A mirror set will be maintained within each county at the local library. The address for the library in Amelia County is: the James Hamner Memorial Library, 16351 Dunn Street Amelia, Virginia 23002 and the file will be entitled "Amelia County Landfill, Maplewood Site, Project XL". The address for the library in King George County is: L.F. Smoot Lewis Memorial Library, 9533 Kings Highway, King George, Virginia 22485, and the file will be entitled "King George County Landfill Project XL".

### 3.3.8 Stakeholder Meetings and FOIA

Once the Stakeholders have been clearly identified, the Sponsors will periodically meet with the representative of each group or the entire group to discuss issues of concern and to disseminate information. Other members of the groups may personally voice a concern or receive progress reports during the planned public meetings. All information is public domain. Any information that is not currently in the repository may be obtained through a "freedom of information act" (FOIA). To facilitate informational requests, all FOIA request will be placed on a fast-track. It must still meet all of the legal requirements of a FOIA but the information will be provided in a timely manner. The information requested will then be put in the repositories for future reference.

### 3.3.9 Nationwide Solicitation

To solicit additional Stakeholder involvement, the Sponsors will contact nationwide professional and citizen groups that may have an interest in bioreactor technology. The Solid Waste Association of North America has monthly publications to disseminate information to its members. Periodically, the Sponsors may attend national workshops or seminars. These meetings would be an ideal forum to present the merits of the individual projects and to actively recruit Stakeholders.

### 3.3.10 Stakeholders Shaping the Process

The initial meetings will solicit comments and provide information to the public in order for them to the make an informed opinion of the process. The Stakeholders may, at any time, provide to the Sponsors comments on the Proposal. However, in order to create an enforceable document, the comments must be incorporated into the final permit required by the VADEQ. During the VADEQ public participation process, the VADEQ responds to the comments through a public response document. Conditions may be imposed due to additional VADEQ requirements or as a result of public comment. The permit is an enforceable document under the Virginia Solid Waste Management Act. Public comments shape the final permit.

### 3.4 Innovation and Pollution Prevention

The proposed project provides a high level of innovation for managing leachate and environmental quality at a MSW landfill. Although not a new technology, leachate recirculation and other bioreactor technologies are not widely used at MSW landfills in the United StatesThis may be due in part to a lack of data that demonstrates the benefits of the technologies and information on how to best apply these technologies. Current state and Federal regulations also create some limitations. This XL project is intended to provide data to further demonstrate the benefits of leachate recirculation and other 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 utilized and 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.

## 3.5 Transferability

WM believes that the type of technology to be tested in this project should be useful at most operating MSW landfills in the United States. The technology is expected to yield substantial economic and environmental benefits for nearly all regions of the U.S. Although this project focuses on the effects of liquids additions to MSWLFs in an area with particular geological features and climate, WM expects this project to produce information that is useful throughout the country.

## 3.6 Feasibility

Leachate recirculation and bioreactor technologies have been used at several other waste disposal facilities, as presented on Table 2. Based on the successful applications of these technologies and operational experience at other facilities, the proposed project is feasible.

## 3.7 Evaluation, Monitoring, and Accountability

### 3.7.1 Accountability

The two landfills involved in this demonstration project operate under their respective Commonwealth of Virginia solid waste and air quality permits. Each permit is an enforceable document that carries civil penalties for major violations. The Director of the VADEQ has the authority to revoke the permit if necessary. However, there have been no Notices of Violation at either site.

The parties intend to implement as enforceable commitments, federal and state regulatory flexibility, monitoring, record-keeping, and reporting provisions of this FPA through a site-specific rule and a Federally Enforceable State Operating Permit (FESOP). The legal mechanisms that would apply to this project include a FESOP for gas collection and monitoring, and a site-specific rule for liquid additions. The VADEQ is the regulatory agency that has permitting authority for both landfills. The FESOP would contain enforceable parameters and requirements with respect to NSPS-compliant gas collection and monitoring prior to liquid additions and/or leachate recirculation, whichever occurs first. The FESOP would require a public notice and comment period. In addition, USEPA will be issuing a proposed rule for liquid additions at both landfills. This rule would also require a public comment period. Either

the FESOP or the site-specific rule (as appropriate) would contain the project monitoring and reporting requirements listed in sections 2.2.1.4, 2.2.1.5, 2.2.2.4, and 2.2.2.5, Table 6 and 6A and would require that WM provide semi-annual reporting of the monitoring data to stakeholders and regulators in order to facilitate project evaluation. USEPA, VADEQ, State, and other appropriate regulatory agencies will assess the project annually based on all information submitted. USEPA will post WM's project data on its Project XL webpage semi-annually.

### 3.7.2 Tracking, Reporting, and Evaluation

Data collection, evaluation, and reporting requirements are identified in Section 2 and Table 6 and 6A. In general, for each facility, the data collection and analysis requirements of the XL Program features will be reported semiannually to the EPA and VADEQ as described in Section 3.7.1 or as otherwise required by the legal implementing mechanisms. Sections 2.2.1.4 and 2.2.2.4 discuss the monitoring parameters for this project.

### 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 WM and the operation of the facilities will be modified to attempt to better achieve expected goals.

## 3.8 Shifting 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 do not transfer pollutants from one 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 monitoring 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 reduced risk of potential impacts from releases of leachate or landfill gas to the environment.

# 4. DESCRIPTION OF THE REQUESTED FLEXIBILITY AND IMPLEMENTING MECHANISMS

## 4.1 Requested Flexibility

As part of the proposal, WM is requesting that the USEPA grant regulatory flexibility from the requirement of the RCRA that prohibits application of bulk liquids in MSW landfills, as presented in 40 CFR 258.28. This specific regulation deals with the application of liquids in the following manner:

- it restricts recirculation of leachate to landfills that have a liner system that has a 60-mil thick geomembrane overlying a 2-ft thick layer of clay having a hydraulic conductivity no greater than $1x10^{-7}$ cm/sec; and

- it prohibits the placement of liquid wastes other than leachate in any 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 nonhazardous liquid wastes (e.g., leachate, stormwater, gray water, septic waste, etc.). The Maplewood Landfill currently has an active landfill gas collection system that is in operation; if odor problems or air quality problems occur, then the system will be expanded as needed (e.g., using additional extraction wells or trenches or by placing less permeable cover and affected areas). As part of this project, WM has agreed to design and construct an active landfill gas collection and control system at the King George Landfill prior to the commencement of liquids addition, and to conduct Subpart WWW-compliant landfill gas collection and monitoring concurrent with such liquids addition.

## 4.2 Legal Implementing Mechanisms

Federal

To implement this Project, EPA intends to take the following steps:

EPA expects to propose for public comment and promulgate a site-specific rule amending 40 CFR 258.28 for the Maplewood and King George County Landfills. This site-specific rule will describe the project requirements and any other aspects of the rulemaking. It is expected that the site-specific rule will provide for Withdrawal or Termination and a Post-Project Compliance Period consistent with Section 7, and will address the Transfer procedures included in Section 9. The standards and reporting requirements set forth in Section 2 and Table 6 and 6A (and any attachments to this FPA) will be implemented in this site-specific rulemakingand/or the Federally Enforceable State Permit (as appropriate) will implement the standards and reporting requiremements set forth in section 2 and Table 6 and 6A.

Specifically, EPA expects to grant flexibility from the RCRA requirements that 1) restrict the recirculation of leachate in a MSWLF unless it has a composite liner designed as prescribed in the design standard in 40 CFR 258.40(a)(2), and 2) restricts the application of bulk liquids other than the landfill's leachate (and gas condensate) in MSWLF waste landfills (40 CFR Section 258.28.)

Commonwealth of Virginia

The Commonwealth of Virginia under its relevant authority expects to modify or issue any permits necessary to implement this FPA.

Specifically, in accordance with 9 VAC 20-80-480.G, *"The director may issue an experimental facility permit for any solid waste treatment facility which proposes to utilize an innovative and experimental solid waste treatment technology or process…",* Maplewood and King George County Landfill, will submit permit amendment applications to obtain experimental permits for the proposed bioreactor landfill areas. Specific criteria will be developed by the Office of Solid Waste Permitting at VADEQ to guide the design, operation, and construction of bioreactor landfills. The staff in the office will review the experimental permit application from different aspects including

local certification, design, construction, operation, closure, variance, finance assurance, and public participation.

In the current permits, both facilities hold a variance to the requirements of 9 VAC 20-80-250.B.9, which addresses requirements for liner systems; as shown on Figure 2, both landfills were constructed having double-liner system but neither landfill has a composite liner consisting of a geomembrane underlain by a two-foot thick layer of clay having a hydraulic conductivity of 1 x 10-7 cm/sec, as required by RCRA Subtitle D and VSWMR.Under the current federal and state regulations, the facilities must file variance petitions for recirculating leachate within landfills underlain by alternate liner systems. In addition, both facilties must submit an additional variance petition to the VADEQ for introducing bulk liquids into the proposed bioreactor landfill area.

If the permit applications are found to be administratively complete and technically acceptable, draft permits will be developed by the VADEQ. The permit issuance procedure will follow 9 VAC 20-80-500.E, in which a public notice of the draft permit shall be made and a public hearing shall be held subsequently. The VADEQ director will make a final decision to the permit, to deny a permit or to amend the draft permit within 30 days of the close of the hearing comment period.

In accordance with 9 VAC 20-80-480.G, an experimental permit shall provide for operation of the facility for no longer than one calendar year unless renewed as provided in 9 VAC 20-80-480.G.3 which stipulates that the permit may be renewed no more than three times with each renewal for a period of not more than one calendar year each time it is renewed.

At this point, amendments to stormwater permits are not anticipated for either facility. However, the VADEQ Office of Waste Permitting will work with other permitting groups if any amendments on air or stormwater become necessary.

The Commonwealth of Virginia under its relevant authority expects to modify any permits necessary to implement this FPA.

General

Except as provided in any rule(s), compliance order(s), permit provisions or other implementing mechanisms that may be adopted to implement the Project, the parties do not intend that this FPA will modify or otherwise alter the applicability of existing or future laws or regulations to the Maplewood or King George County Landfills.

By signing this FPA, USEPA, the Commonwealth of Virginia and its local authorities acknowledge and agree that they have the respective authorities and discretion to enter into this FPA and to implement the provisions of this project, to the extent appropriate.

WM Waste Management will submit an application to the VADEQ requesting that VADEQ issue a Federally Enforceable State Operating Permit ("FESOP") VADEQ in consultation with EPA, expects to issue a FESOP which incorporates all of the landfill gas monitoring requirements specified in section 2 and table 6A of this agreement and contains adequate provisions to ensure that landfill gas is collected and controlled in accordance with the requirements of 40 CFR part 60, subpart WWW - Standards of Performance for Municipal Solid Waste Landfills. VADEQ will work with WM to ensure that the FESOP is issued in a timely manner.

## 4.3 Compliance and Enforcement History

VADEQ has the regulatory authorities over Maplewood and King George County Landfill. Staff at the VADEQ conduct air, waste, and wastewater inspections at the two facilities on a regular basis. The compliance and enforcement history of the facilities has been reviewed for this particular application.

***King George County Landfill***

- *Waste Inspection.* Conducted monthly by the VADEQ's Northern Virginia Regional Office. The VADEQ has reviewed the most recent 12 monthly inspection reports. The overall rating for each inspection is satisfactory. No Notice of Violation has been issued.

- *Air Inspection.* In 1990, the USEPA established an Operating Permit Program under Title V (40 CFR Part 70) of the Federal Clean Air Act (CAA). Title V is an operating permit program, enforced through federal and state rules, requiring compilation of an air emissions inventory, identification of applicable regulations, and certifications of compliance. This facility has submitted a Title V permit application to the VADEQ and the approval is pending. However, the facility was issued a State Operating Permit and is inspected annually by the VADEQ's Fredericksburg Satellite Office. The applicable regulations include New Source Performance

Standards (NSPS) and State Implementation Plan (SIP). The review on the recent annual inspection reports indicates that the facility is in good standing with the applicable regulations.

- *Stormwater Inspection.* The leachate generated in this facility is hauled to and treated in a public owned wastewater treatment facility. The facility is exempt from the requirements of the Virginia Pollutant Discharge Elimination System (VPDES) permit for its stormwater run-off control. Stormwater is monitored in accordance with an agreement between WM and King George County. The run-off stormwater is collected into sedimentation basins via conveyance channels before being discharged to natural waterways. Diversion channels were constructed to minimize stormwater run-on.

***Maplewood Landfill***

- *Waste Inspection*. The waste inspection is conducted monthly by the VADEQ's Piedmont Regional Office. The VADEQ has reviewed the most recent 12 inspection reports. The overall rating for each inspection is satisfactory. No Notice of Violation has been issued.

- *Air Inspection.* Same as King George County Landfill, the facility submitted a Title V permit application and the approval is pending. However, the facility holds a valid new Source Review (NSR) permit and the air inspection is conducted once a year by the VADEQ's Lynchburg Satellite Office. The inspection reports for the past three years have been reviewed by the VADEQ. The results of the three reports indicate that the facility has been in compliance with the applicable regulations which include NSPS and SIP.

- *Stormwater Inspection.* Currently, leachate generated from this facility is collected and temporarily stored in the storage tanks on site. The leachate is then hauled to a treatment facility for further treatment. Direct discharge of leachate to surface water is prohibited in this facility. The facility has a VPDES permit for its stormwater run-off control. Perimeter diversion and collection channels are constructed for run-off and run-off storm water

control respectively. The run-off stormwater enters to sedimentation basins before being discharged to surface waterway.

# 5. DISCUSSION OF INTENTIONS AND COMMITMENTS FOR IMPLEMENTING THE PROJECT

## 5.1 Intentions and Commitments

WM would like to operate the areas identified in Section 1 as controlled bioreactor landfills to attain a number of superior environmental and cost savings benefits. The county is committed to working with federal, state, and local governments to demonstrate, with regulatory flexibility, how a bioreactor landfill can attain more desirable environmental results than a conventional landfill.

## 5.2 Waste Management's Intentions and Commitments

Enforceable:
WM will comply with all applicable environmental requirements during implementation of this Project.

WM will establish a record keeping system to ensure compliance, as well as accurate reporting of monitoring data from Table 6.

As discussed in section 4.2 (Legal Implementing Mechanism) WM will submit an application to the VDEQ requesting the issuance of a FESOP.

WM intends to provide accurate data for the proposed bioreactor landfill. This data should enable EPA and the State to develop or modify regulatory requirements for identified parameters, such as those identified in Table 6 and 6A of this FPA.

Voluntary:

WM is committed to working with federal, state, and local governments to demonstrate, with regulatory flexibility, how a bioreactor landfill can attain more desirable environmental results than a conventional landfill.

WM intends to continue to provide resources to maintain the schedules set forth in this FPA.

**EPA's, Commonwealth of Virginia, and other Local Regulatory Agency's Intentions and Commitments**

As discussed in section 4.2 (Legal Implementing Mechanism) EPA intends to propose and issue a site-specific rule, amending 40 CFR Part 258.28, that applies specifically to the the two sites.

The State and other local governing regulatory agencies will assist the XL Project Team in understanding all applicable regulatory and/or permitting requirements for the Project, and evaluate any need for regulatory flexibility openly with the Team.

USEPA and the other regulatory agencies will review and assess annual and periodic reports submitted by Waste Management.

USEPA will review the Project to determine whether it results in superior environmental performance.

The State and other local regulatory agencies will assist USEPA in reviewing the Project to determine whether it results in superior environmental performance.

## 5.3 Project XL Performance Targets

See Table 6, Superior Environmental Performance.

## 5.4 Proposed Schedule and Milestones

This project will be developed and implemented over a time period necessary to complete its desired major objectives, beginning from the date that the final legal mechanism becomes effective, unless it is terminated earlier or extended by agreement of all Project Signatories. An expected timeline is shown on Figure 6.

## 5.5 Project Tracking, Reporting and Evaluation

The project tracking, reporting and evaluation will be accomplished for project sponsors including WM in accordance with, among other things, WM requests and the reporting requirements set forth by this FPA and other requirements set forth by

VADEQ. The topics tracked, reported and evaluated have been referred to above in Section 5.4 and summarized in Figure 6.

## 5.6 Periodic Review by the Parties to the Agreement

The Parties will hold periodic performance review conferences to assess their progress in implementing this Project. Unless they agree otherwise, the date for those conferences will be concurrent with annual Stakeholder Meetings. No later than 30 days following a periodic performance review conference, WM will provide a summary of the minutes of that conference to all Direct Stakeholders. Any other comments of participating Stakeholders will be reported to WM.

## 5.7 Duration

This Agreement will remain in effect for 10 years after signing, unless the Project ends at an earlier date, as provided under Section 8 (Amendments or Modifications), Section 11 (Withdrawal or Termination), or Section 9 (Transfer of Project Benefits and Responsibilities). The implementing mechanism(s) will address withdrawal or termination conditions and procedures (as described in Section 11). This Project will not extend past the agreed upon date, and WM will comply with all applicable requirements following this date (as described in Section 12), unless all parties agree to an amendment to the Project term (as provided in Section 8).

# 6. LEGAL BASIS FOR THE PROJECT

## 6.1 Authority to Enter Into the Agreement

By signing this Agreement, all signatories acknowledge and agree that they have the respective authorities, discretion, and resources to enter into this Agreement and to implement all applicable provisions of this Project, as described in this Agreement.

## 6.2 Legal Effect of the Agreement

This Agreement states the intentions of the Parties with respect to WM's XL Project. The Parties have stated their intentions seriously and in good faith, and expect to carry out their stated intentions. This Agreement in itself does not create or modify legal rights or obligations, is not a contract or a regulatory action, such as a permit or a rule, and is not legally binding or enforceable against any Party. Rather, it expresses the plans and intentions of the Parties without making those plans and intentions binding requirements. This applies to the provisions of this Agreement that concern procedural as well as substantive matters. Thus, for example, the Agreement establishes procedures that the parties intend to follow with respect to dispute resolution and termination (see Sections 10 and 11). However, while the parties fully intend to adhere to these procedures, they are not legally obligated to do so.

EPA intends to propose for public comment a site specific rule making needed to implement this Project. Any rules, permit modifications or legal mechanisms that implement this Project will be effective and enforceable as provided under applicable law.

This Agreement is not a "final agency action" by EPA because it does not create or modify legal rights or obligations and is not legally enforceable. This Agreement itself is not subject to judicial review or enforcement. Nothing any Party does or does not do that deviates from a provision of this Agreement, or that is alleged to deviate from a provision of this Agreement, can serve as the sole basis for any claim for damages, compensation or other relief against any Party.

## 6.3 Other Laws or Regulations That May Apply

Except as provided in the legal implementing mechanisms for this Project, the parties do not intend that this FAP will modify any other existing or future laws or regulations.

## 6.4 Retention of Rights to Other Legal Remedies

Except as expressly provided in the legal implementing mechanisms described in Section IV, nothing in this Agreement affects or limits, WM's, the VADEQ's, or any other signatory's legal rights. These rights include legal, equitable, civil, criminal or administrative claims or other relief regarding the enforcement of present or future applicable federal and state laws, rules, regulations or permits with respect to the facility.

Although WM does not intend to challenge agency actions implementing the Project (including any rule amendments or adoptions, permit actions, or other action) that are consistent with this Agreement, WM reserves any right it may have to appeal or otherwise challenge any USEPA, Commonwealth of Virginia, or local agency action to implement the Project. With regard to the legal implementing mechanisms, nothing in this Agreement is intended to limit WM's right to administrative or judicial appeal or review of those legal mechanisms, in accordance with the applicable procedures for such review.

## 7. UNAVOIDABLE DELAY DURING PROJECT IMPLEMENTATION

"Unavoidable delay" (for purposes of this Agreement) means any event beyond the control of any Party that causes delays or prevents the implementation of the Project described in this Agreement, despite the Parties' best efforts to put their intentions into effect. An unavoidable delay can be caused by, for example, a fire or acts of war.

When any event occurs that may delay or prevent the implementation of this Project, whether or not it is avoidable, the Party to this Agreement who knows about it will immediately provide notice to the remaining Parties. Within ten days after that initial notice, the Party should confirm the event in writing. The confirming notice should include: (i) the reason for the delay; (ii) the anticipated duration; (iii) all actions taken to prevent or minimize the delay; and (iv) why the delay was considered unavoidable, accompanied by appropriate documentation.

If the Parties, agree that the delay is unavoidable, then relevant parts of the project schedule (see Section 5) will be extended to cover the time period lost due to the delay. If they agree, they will also document their agreement in a written amendment to this Agreement. If the Parties don't agree, then they will follow the provisions for Dispute Resolution outlined below.

This section applies only to provisions of this Agreement that are not implemented by legal implementing mechanisms. Legal mechanisms, such as permit provisions or rules, will be subject to modification or enforcement as provided under applicable law.

## 8. AMENDMENTS OR MODIFICATIONS TO THE AGREEMENT

This Project is an experiment designed to test new approaches to environmental protection and there is a degree of uncertainty regarding the environmental benefits and costs associated with activities to be undertaken in this Project. Therefore, it may be appropriate to amend this Agreement at some point during its duration.

This FPA may be amended by mutual agreement of all parties at any time during the duration of the Project. The parties recognize that amendments to this Agreement may also necessitate modification of legal implementation mechanisms or may require development of new implementation mechanisms. If the Agreement is amended, WM and USEPA expect to work together with other regulatory bodies and stakeholders to identify and pursue any necessary modifications or additions to the implementation mechanisms in accordance with applicable procedures (including public notice and comment). If the parties agree to make a substantial amendment to this Agreement, the general public will receive notice of the amendment and be given an opportunity to participate in the process, as appropriate.

In determining whether to amend the Agreement, the parties will evaluate whether the proposed amendment meets Project XL acceptance criteria and any other relevant considerations agreed upon by the parties. All parties to the Agreement will meet within ninety (90) days following submission of any amendment proposal (or within a shorter or longer period if all parties agree) to discuss evaluation of the proposed amendment. If all parties support the proposed amendment, the parties will (after appropriate stakeholder involvement) amend the agreement.

## 9. TRANSFER OF PROJECT BENEFITS AND RESPONSIBILITIES TO A NEW OWNER AND/OR OPERATOR

The parties expect that the implementing mechanisms will allow for a transfer of WM's benefits and responsibilities under the Project to any future owner and/or operator upon request of WM and the new owner and/or operator, provided that the following conditions are met:

A. WM will provide written notice of any such proposed transfer to the USEPA, the Commonwealth of Virginia (VADEQ and any other appropriate state agencies) and all applicable local agencies at least 90 days before the effective date of the transfer.

The notice is expected to include identification of the proposed new owner and/or operator, a description of its financial and technical capability to assume the obligations associated with the Project, and a statement of the new owner and/or operator's intention to take over the responsibilities in the XL Project of the existing owner and/or operator.

B. Within 45 days of receipt of the written notice, the parties expect that USEPA, WM, VADEQ, and all applicable local agencies in consultation with all stakeholders, will determine whether: (i) the new owner and/or operator has demonstrated adequate capability to meet USEPA's requirements for carrying out the XL Project; (ii) is willing to take over the responsibilities in the XL Project of the existing owner and/or operator; and (iii) is otherwise an appropriate Project XL partner. Other relevant factors, including the new owner and/or operator's record of compliance with Federal, state and local environmental requirements, may be considered as well. It is expected that the implementation mechanism will provide that, so long as the demonstration has been made to the satisfaction and unreviewable discretion of USEPA, VADEQ, and all applicable local agencies and upon consideration of other relevant factors, the FPA will be modified to allow the proposed transferee to assume the rights and obligations of WM. In the event that the transfer is disapproved by any agency, withdrawal or termination may be initiated, as provided in Section 11.

It will be necessary to modify the Agreement to reflect the new owner and/or operator and it may also be necessary for USEPA, VADEQ, and all applicable local agencies to amend appropriate rules, permits, or other implementing mechanisms (subject to applicable public notice and comment) to transfer the legal rights and obligations of WM under this Project to the proposed new owner and/or operator. The rights and obligations of this project remain with WM prior to their final, legal transfer to the proposed transferee.

## 10. PROCESS FOR RESOLVING DISPUTES

Any dispute which arises under or with respect to this Agreement will be subject to informal negotiations between the parties to the Agreement. The period of informal negotiations will not exceed 20 calendar days from the time the dispute is first documented, unless that period is extended by a written agreement of the parties to the dispute. The dispute will be considered documented when one party sends a written Notice of Dispute to the other parties.

If the parties cannot resolve a dispute through informal negotiations, the parties may invoke non-binding mediation by describing the dispute with a proposal for resolution in a letter to the Regional Administrator for USEPA Region 3, with a copy to all parties. The Regional Administrator will serve as the non-binding mediator and may request an informal mediation meeting to attempt to resolve the dispute. He or she will then issue a written opinion that will be non-binding and does not constitute a final WM action. If this effort is not successful, the parties still have the option to terminate or withdraw from the Agreement, as set forth in Section 11 below.

## 11. WITHDRAWAL FROM OR TERMINATION OF THE AGREEMENT

### 11.1 Expectations

Although this Agreement is not legally binding and any party may withdraw from the Agreement at any time, it is the desire of the parties that it should remain in effect through the expected duration of 10 years, and be implemented as fully as possible unless one of the conditions below occur:

1. Failure by any party to: (i) comply with the provisions of the enforceable implementing mechanisms for this Project; or (ii) act in accordance with the provisions of this Agreement. The assessment of the failure will take its nature and duration into account.

2. Failure of any party to disclose material facts during development of the Agreement.

3. Failure of the Project to provide superior environmental performance consistent with the provisions of this Agreement.

4. Enactment or promulgation of any environmental, health or safety law or regulation after execution of the Agreement, which renders the Project legally, technically or economically impracticable.

5. Decision by an agency to reject the transfer of the Project to a new owner or operator of the facility.

In addition, USEPA and VADEQ do not intend to withdraw from the Agreement if WM does not act in accordance with this Agreement or its implementation mechanisms, unless the actions constitute a substantial failure to act consistently with intentions expressed in this Agreement and its implementing mechanisms. The decision to withdraw will, of course, take the failure's nature and duration into account.

WM will be given notice and a reasonable opportunity to remedy any "substantial failure" before WM's withdrawal. If there is a disagreement between the parties over whether a "substantial failure" exists, the parties will use the dispute resolution mechanism identified in Section 10 of this Agreement. WM, the USEPA, and all

applicable local agencies retain their discretion to use existing enforcement authorities, including withdrawal or termination of this Project, as appropriate. WM retains any existing rights or abilities to defend itself against any enforcement actions, in accordance with applicable procedures.

## 11.2 Procedures

The parties agree that the following procedures will be used to withdraw from or terminate the Project before expiration of the Project term. They also agree that the implementing mechanism(s) will provide for withdrawal or termination consistent with these procedures.

1. Any party that wants to terminate or withdraw from the Project is expected to provide written notice to the other parties at least sixty days before the withdrawal or termination.

2. If requested by any party during the sixty day period noted above, the dispute resolution proceedings described in this Agreement may be initiated to resolve any dispute relating to the intended withdrawal or termination. If, following any dispute resolution or informal discussion, a party still desires to withdraw or terminate, that party will provide written notice of final withdrawal or termination to the other parties.

3. If any agency withdraws or terminates its participation in the Agreement, the remaining agencies will consult with WM to determine whether the Agreement should be continued in a modified form, consistent with applicable federal or State law, or whether it should be terminated.

4. The procedures described in this section apply only to the decision to withdraw or terminate participation in this Agreement. Procedures to be used in modifying or rescinding any legal implementing mechanisms will be governed by the terms of those legal mechanisms and applicable law. It may be necessary to invoke the implementing mechanism's provisions that end authorization for the Project (called "sunset provisions") in the event of withdrawal or termination.

# 12. COMPLIANCE AFTER THE PROJECT IS OVER

## 12.1 Introduction

The parties intend that there be an orderly return to compliance upon completion, withdrawal from, or termination of the Project, as follows:

## 12.2. Orderly Return to Compliance with Otherwise Applicable Regulations if the Project Term is Completed

If, after an evaluation, the Project is terminated because the term has ended, then WM will return to compliance with all applicable requirements by the end of the Project term, unless the Project is amended or modified in accordance with Section 8 of this Agreement (Amendments or Modifications). WM is expected to anticipate and plan for all activities to return to compliance sufficiently in advance of the end of the Project term. WM may request a meeting with the USEPA, and all applicable local agencies to discuss the timing and nature of any actions that they will be required to take. The parties should meet within thirty days of receipt of WM's written request for such a discussion. At and following such a meeting, the parties should discuss in reasonable, good faith, which of the requirements deferred under this Project will apply after termination of the Project.

## 12.3 Orderly Return to Compliance with Otherwise Applicable Regulations in the Event of Early Withdrawal or Termination

In the event of a withdrawal or termination not based on the end of the Project term and where WM has made efforts in good faith, the parties to the Agreement will determine an interim compliance period to provide sufficient time for WM to return to compliance with any regulations deferred under the Project. The interim compliance period will extend from the date on which WM, the Commonwealth of Virginia, and all applicable local agencies provides written notice of final withdrawal or termination of the Project, in accordance with Section 11 of this Project Agreement. By the end of the interim compliance period, WM will comply with the applicable deferred standards set forth in 40 CFR Part 258.28. During the interim compliance period, WM, the Commonwealth of Virginia, and any applicable local agency may issue an order,

permit, or other legally enforceable mechanism establishing a schedule for WM to return to compliance with otherwise applicable regulations as soon as practicable. This schedule cannot extend beyond six months from the date of withdrawal or termination. WM intends to be in compliance with all applicable Federal, State, and local requirements as soon as is practicable, as will be set forth in the new schedule.

## 13. SIGNATORIES AND EFFECTIVE DATE

_____

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Waste Management, Inc.

_____

Paul Farrell
Virginia Department of Environmental Quality

_____

Bradley M. Campbell
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## 14. REFERENCES

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

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**TABLE 1**
**PROJECT XL CRITERIA: EVALUATION SUMMARY**

| CRITERION | DOES PROPOSED PROGRAM MEET REQUIREMENT? | LOCATION IN APPLICATION WHERE REQUIREMENT IS ADDRESSED |
|---|---|---|
| A. Superior Environmental Performance | | |
| a. Tier 1: Project Equivalence | yes | 3.1.1 |
| b. Tier 2: Superior Environmental Performance | yes | 3.1.2 |
| c. Measurement of Environmental Performance | yes | 3.1.3 |
| B. Flexibility and Other Benefits | yes | 3.2 |
| C. Stakeholder Involvement | yes | 3.3 |
| D. Innovation in Pollution Prevention | yes | 3.4 |
| E. Transferability | yes | 3.5 |
| F. Feasibility | yes | 3.6 |
| G. Evaluation, Monitoring, and Accountability | yes | 3.7 |
| H. Shifting of Risk Burden | yes | 3.8 |

**Reference: USEPA [1999]**

# TABLE 2
# SUMMARY OF FIELD-SCALE LEACHATE RECIRCULATION AND BIOREACTOR PROJECTS

| LOCATION AND ERENCES | TYPE OF PROJECT | DESCRIPTION OF LANDFILL AND PERMITTED RECIRCULATION PRAC |
|---|---|---|
| nd<br>ıdfill<br>[aris, 1985] | Field-Scale Study | • 6.2-acre cell used as leachate recycle area.<br>• Approximate 6-acre control area.<br>• Cell lined with 100-mil HDPE with leachate collection system.<br>• 13 ft of pulverized refuse placed in cells.<br>• Leachate redistributed by spray pipe networks laid on top of refuse.<br>• Furrows later dug into surface to reduce ponding.<br>• Recirculation and monitoring period approximately 3 years.<br>• 36,000 gallons of leachate storage available. |
| Waste Authority<br>ste Management Center<br>ware | Field-Scale Study | • Leachate recycle in 2 full-scale landfill cells.<br>• 9-acre cell using recharge wells.<br>• 18-acre cell using four wells and traveling spray irrigation system.<br>• Total leachate storage capacity of 40,000 gallons.<br>• Cells lined with 30-mil PVC synthetic liner with leachate collection systems.<br>• Average refuse depth in cells is 30 ft. |
| y Landfill<br>.<br>erson, 1986] | Full-Scale Operations with Study | • Three 10-acre leachate recycle cells.<br>• 20-mil PVC used to line cells along with leachate collection systems.<br>• Various leachate recycle strategies attempted but not detailed.<br>• Authors observed recharge wells to work best.<br>• Eight years of data collection included flow measurement (collect and recycle); rainfall conditions (monthly); and quarterly leachate quality monitoring. |
| ill<br>Florida<br><br>1996] | Full-Scale Operations with Study | • Composite lined area is 27 ac (10.9 ha).<br>• Waste was first accepted in Spring 1988.<br>• Receives 10,000 tons/month (9,070 Mg/month) of MSW.<br>• Maximum waste thickness will be 65 ft (20 m).<br>• Permitted to recirculate up to 60,000 gal/day (227 $m^3$/day).<br>• Storage tank capacity is 360,000 gal (1,364 $m^3$).<br>• From 1990-1992, over 8 million gal (30,000 $m^3$) of leachate was pumped into infiltration pon<br>• In 1993, began using horizontal injection trenches (horizontal spacing of 50 ft (15 m), vertica (6 m)).<br>• From March through September 1993, injected 200,000 to 780,000 gal/month (757 to 2,9 leachate into a total of 17 injection trenches. |
| Facility<br>y, Maryland | Full-Scale Operations | • Lined area consists of four 17-ac (6.9-ha) cells.<br>• Began operating in 1990.<br>• Maximum fill height will be 90 ft (27 m).<br>• Receives 200 tons/day (181 Mg/day) of MSW.<br>• Storage tank capacity is 400,000 gal (1,514 $m^3$).<br>• Leachate is recirculated using one vertical discharge well for each 2-ac (0.8-ha) area. |

| LOCATION AND ERENCES | TYPE OF PROJECT | DESCRIPTION OF LANDFILL AND PERMITTED RECIRCULATION PRAC |
|---|---|---|
| l<br>, Florida | Full-Scale Operations | • Current lined area is 7 ac (2.8 ha), with plans to expand to 22 ac (8.9 ha).<br>• Began operating in 1992.<br>• Maximum fill height will be 54 ft (16.5 m).<br>• Receives 120 tons/day (109 Mg/day) of MSW.<br>• Aeration lagoon capacity is 50,000 gal (189 $m^3$).<br>• Permitted to recirculate using surface ponds or spraying, provided spraying is limited to a at any one location. |
| fill<br>Georgia | Full-Scale Operations | • The ultimate lined area will be 40 ac (16 ha).<br>• Individual cells, 3.5 to 4 ac (1.5 to 1.6 ha) in area, are constructed approximately every 7<br>• Maximum fill height will be approximately 60 ft (18 m).<br>• Receives 600 ton/day (544 Mg/day) of MSW.<br>• Lagoon capacity is 821,000 gal (3,100 $m^3$ ).<br>• Horizontal leachate injection trenches are constructed on top of each waste lift; the trenches is abandoned when each new lift of trenches is constructed.<br>• Cover soil is removed prior to subsequent waste placement. |
| ashington Valley Secure<br><br>ampshire | Full-Scale Operations | • Composed of eight hydraulically separated double-lined cells, each 0.75 to 1.0 ac (0.3 to<br>• Receives 10,000 to 15,000 tons/yr (9,070 to 13,600 Mg/yr) of MSW<br>• Storage tank capacity is 10,000 gal (38 $m^3$).<br>• Filling began in January 1992, and was temporarily discontinued in November 1993.<br>• Leachate was recirculated primarily by pre-wetting using a fire hose and also using a pipe in a shallow excavation in daily cover. |
| onal Solid Waste<br>hority Landfill | Full-Scale Operations | • Consists of three hydraulically separated cells totaling 22 ac (8 ha) in area.<br>• Final waste height will be approximately 50 ft (15 m).<br>• Receives 350 tons/day (318 Mg/day) of MSW.<br>• Aeration lagoon capacity is 2.4 million gal (9,085 $m^3$).<br>• Leachate is injected using a movable vertical injection system consisting of 12 10-ft (3-m black iron probes inserted into the landfill and connected to a manifold.<br>• The system stays in one location for 2 to 8 days.<br>• Leachate is injected at a pressure of 45 psi (310 kPa).<br>• At the completion of each of the four planned lifts, horizontal trenches will be constru radiating from a central distribution box. Each lift of trenches will be abandoned when tl of trenches is constructed. |
| s<br>, Missouri | Full-Scale Operations | • Ultimate fill area will be 75 ac (30 ha).<br>• Maximum fill height will be 85 ft (26 m).<br>• Receives 300 tons/day (272 Mg/day) of MSW.<br>• Lagoon storage capacity is 867,800 gal (3,280 $m^3$).<br>• Leachate recirculation will be performed using vertical discharge wells located at 200-ft (<br>• Leachate will be managed using two lagoons: the first lagoon will collect leachate u reduces leachate strength significantly, at which time leachate will be diverted to the se used to irrigate closed areas of the landfill. |

| LOCATION AND ERENCES | TYPE OF PROJECT | DESCRIPTION OF LANDFILL AND PERMITTED RECIRCULATION PRAC |
|---|---|---|
| l<br>New York | Full-Scale Operations with Study | • The bioreactor research project involves three hydraulically separated double comp varying from 5.4 to 7.4 ac (2.2 to 3 ha) in area.<br>• One cell serves as a control (i.e., no recirculation); two different horizontal leachate inje used in the other two cells.<br>• Cell 2 has horseshoe-shaped injection trenches at three elevations, and a storage tank ca gal (76 $m^3$).<br>• Cell 3 has horizontal trenches at two elevations containing pre-fabricated infiltrators, ar capacity of 20,000 gal (76 $m^3$).<br>• The relative moisture content of the waste will be monitored using gypsum blocks located |
| Vaste Authority<br>Waste Management<br><br>Delaware<br>ki, 1996] | Full-Scale Operations | • Leachate was recirculated in Cells 1 and 2 using vertical injection wells from 1985 to 199<br>• For Cell 3, a horizontal integrated leachate recirculation and landfill gas extraction syster of separate injection and extraction trenches will be installed every 20 ft (3 m) vertically. |
| nty Landfill<br>nty, Virginia<br>e Permit No. 531] | Full-Scale Operations | • Leachate is injected into horizontal trenches filled with shredded tires.<br>• The landfill is operated by USA Waste. |
| ill<br>, Georgia<br>Waste Permit No. 028- | Full-Scale Operations | • Leachate is injected into horizontal trenches.<br>• The landfill is operated by USA Waste. |
| ndfill<br>ssee<br>Waste Permit No. SNL- | Full-Scale Operations | • Leachate is sprayed into the working face.<br>• The landfill is operated by USA Waste. |
| dfill<br>ssee<br>l Waste Permit Number 8 EXT] | Full-Scale Operations | • Leachate is sprayed into the working face.<br>• The landfill is operated by USA Waste. |
| on Landfill<br>ucky<br>Waste Permit Number | Full-Scale Operations | • Leachate is sprayed into the working face.<br>• The landfill is operated by USA Waste. |

**TABLE 3**
**SUMMARY OF BENEFITS FOR LANDFILL BIOREACTORS**

| |
|---|
| Decreased Leachate Management Costs |
| Landfill Life Extension and/or Reduced Landfill Use |
| Reduced Duration of Leachate Production |
| Reduced Duration of Landfill Gas Generation |
| Improved Leachate Quality in Long-Term |
| Decreased Long-Term Threat of Leachate to the Environment |
| Increased Total Landfill Gas Generation Quantity |
| More Complete Degradation of Waste During Period of Active Waste Disposal |
| Maximizing Landfill Gas Control and minimizing fugitive methane and VOC emissions through early collection and control |

**TABLE 4**
**LEACHATE QUALITY IMPROVEMENT ILLUSTRATION:**
**CENTRAL SOLID WASTE MANAGEMENT CENTER, KENT COUNTY, DELAWARE**

| PARAMETER | CONVENTIONAL | RECIRCULATING |
|---|---|---|
| **Iron (mg/L)** | 20 - 21,000 | 4 - 1,095 |
| **BOD (mg/L)** | 20 - 40,000 | 12 - 28,000 |
| **COD (mg/L)** | 500 - 60,000 | 20 - 34,560 |
| **Ammonia (mg/L)** | 30 - 300 | 6 - 1,850 |
| **Chloride (mg/L)** | 100 - 5,000 | 9 - 1,884 |
| **Zinc (mg/L)** | 6 - 370 | 0.1 – 66 |

Source: Watson, R. [1995].

**TABLE 5**
**DESIGN GOALS FOR BIOREACTOR LANDFILLS**

| GOAL | APPROACH FOR ACHIEVING GOAL |
|---|---|
| 1. Apply liquid in a quantity of 3,000,000 to 4,000,000 gallons per year at Maplewood and 7,000,000 to 8,000,000 gallons per year at King George. | Design trenches to have a liquid application capacity of at least 8,000,000 gallons for the Maplewood Landfill and 8,000,000 gallons for the King George Landfill. |
| 2. Minimize Seeps | • Apply liquid at least 50 ft from edge of waste<br>• Inspect landfill weekly for the presence of seeps<br>• Repair seeps as quickly as possible |
| 3. Provide several liquid delivery options | Provide different approaches for delivering liquid to the working face (e.g., pumped directly from leachate storage tanks or stormwater pond, temporarily stored in tanks near the working face, etc.). |
| 4. Uniformly distribute liquid throughout waste | Design leachate application trenches in a configuration that maximizes amount of waste affected by recirculated leachate. |
| 5. Minimize uncontrolled release of landfill gas | Design and install a landfill gas collection system that can be operated throughout the period of this XL program. |
| 6. Monitor performance of bioreactor program | Monitor performance of bioreactor program and report results of monitoring program semi-annually to USEPA. |

**TABLE 6**
**METHODS FOR MEASURING ENVIRONMENTAL PERFORMANCE OF LANDFILL BIOREACTOR PROGRAM**

| CRITERIA | DESCRIPTION | APPLICATION |
|---|---|---|
| Settlement | Measurement of total settlement of surface of waste over a period of time | Compare the surveyed elevation of the top surface of the bioreactor before bioreactor operation to the elevation during and after bioreactor operation |
| Leachate Quantity | Total volume of leachate collected from bioreactor cell | Measure leachate quantity from flowmeters in leachate riser houses located at each bioreactor cell |
| Leachate Quality | Chemical characteristics of leachate collected from a bioreactor cell | Perform Laboratory analysis of the chemical characteristics of leachate from bioreactor cells |
| In-Place Density | Unit weight of waste in a bioreactor cell | Divide the total weight of waste placed in a bioreactor cell (based on scale records) by the total surveyed volume of the waste (i.e., difference in elevation between the bottom and the top of the bioreactor cell) |
| Odors | Potential complaints of odors from site | Track frequency of odor complaints during and after liquids application events |
| Seeps | Breakouts of leachate on sideslopes | Track occurrence of seeps and correlate them to liquids application events |
| Operational Problems | Assess operational efficiency caused by liquids application | Monitor the working face for occurrences of operational problems caused by liquids applications |
| Leachate Collection Systems | Liquid quantity occurring in the detection zone | Compare liquid flowrate in detection zone during liquids application period to flowrate in detection zone before liquids application period |
| Air Quality | Measure emissions of releases of landfill gas | Verify that permit-specified air quality standards are not being exceeded and, if necessary, assure landfill gas collection and/or treatment system to restore compliance |

## TABLE 6A – SPECIFIC CHARACTERISTICS MONITORED

| Monitoring Parameter | Frequency | Description |
|---|---|---|
| Leachate from 10-acre Test Cell:<br>• PH<br>• Conductivity<br>• Dissolved Oxygen<br>• Dissolved Solids<br>• Biochemical Oxygen Demand<br>• Chemical Oxygen Demand<br>• Organic Carbon<br>• Nutrients($NH_3$, TKN, TP)<br>• Common Ions<br>• Heavy Metals<br>• Organic Priority Pollutants<br>• Flow rate | <br>• Monthly<br>• Monthly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly, Quarterly<br>• Monthly | Leachate samples will be collected from the 10-acre test cell (aerobic or anaerobic) sump and tested. For the first six months tests will be done monthly and the next six months will be done quarterly. After the first year, tests will be done semi-annually (with the exception of pH, conductivity, and flow rate which will continue to be monitored on a monthly basis as required by the VADEQ. In some cases, leachate monitoring may be done on a more frequent basis, depending on the need for the data. |
| Leachate from Storage Tanks:<br>• All parameters Identified above. | • Quarterly | |
| Landfill Gas:<br>• $CH_4$, $CO_2$, $O_2$, and $N_2$<br>• Gas temperature at well head<br>• Hydrogen sulfide<br>• NMOCs, VOCs<br>• Surface test for methane concentration | <br>• Monthly<br>• Monthly<br>• Quarterly, Semi-annually<br>• Quarterly, Semi-annually<br>• Quarterly<br>• Monthly | Landfill gas will be tested routinely from the gas extraction wells on the entire landfill. For the first year, tests will be done quarterly and for the following years some test |

| Monitoring Parameter | Frequency | Description |
|---|---|---|
| • $N_2O$ (for aerobic)<br>• Flow rate | • Monthly | frequencies will be changed to semi-annually or as otherwise required in the FESOP with the VADEQ for early gas collection, control, and monitoring. The surface test for methane concentration which is used to determine collection efficiency and surface integrity will be conducted according to NSPS surface monitoring requirements in 40 CFR section 60.755 (c). |
| Solid Waste Stabilization and Decomposition, 4 test borings per year, 3 samples per boring (sample intervals approximately 5 - 10 ft., 25 - 30 ft:, 45 - 50 ft.):<br>• Landfill surface topographic survey<br>• Moisture Content<br>• Biochemical Methane Potential<br>• Cellulose<br>• Lignin<br>• Hemi-cellulose<br>• Volatile Solids<br>• pH | • Annually<br>• Annually<br>• Annually<br>• Annually<br>• Annually<br>• Annually | To determine the total percent change in volume over time, an annual topographic survey will be done on the top surface of each cell. |

| Monitoring Parameter | Frequency | Description |
|---|---|---|
| | | |

**TABLE 7**
**PRELIMINARY OUTLIINE FOR PROJECT XL SEMI-ANNUAL REPORT**

. INTRODUCTION

- 1.1 Terms of Reference
- 1.2 Background
- 1.3 Organization

2. SAMPLING AND ANALYSIS ACTIVITIES

- 2.1 Field Sampling Activities
  - 2.1.1 Leachate Quality
  - 2.1.2 Landfill Gas Quality
  - 2.1.3 Surface Sampling for Landfill Gas
- 2.2 Laboratory Analysis Program
  - 2.2.1 Leachate Quality
  - 2.2.2 Landfill Gas Quality
- 2.3 Other Data
  - 2.3.1 Waste Receipt Quantity
  - 2.3.2 Precipitation

Appendix A: Field Sampling Logs
Appendix B: Laboratory Test Results

**TABLE 8**
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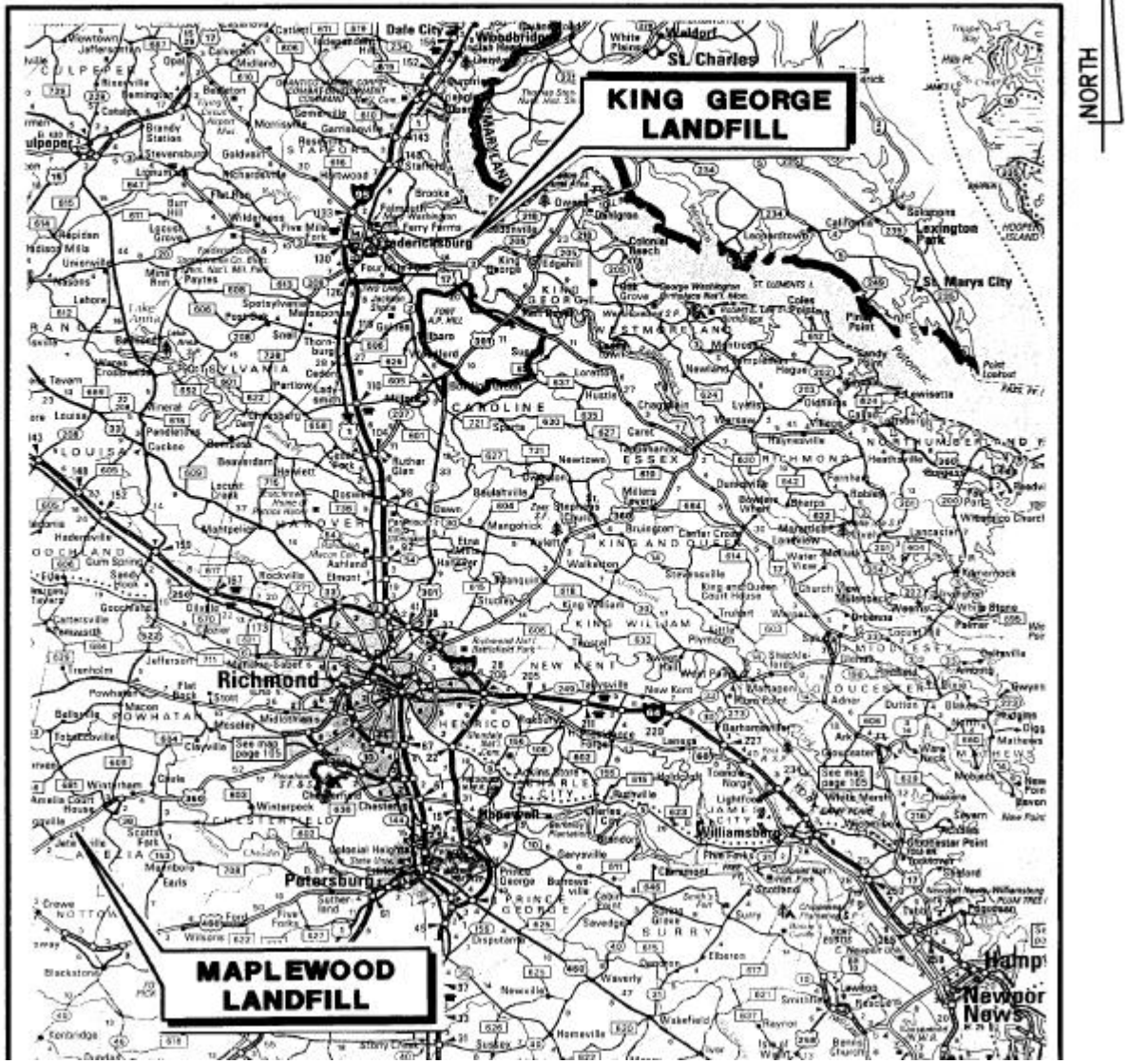
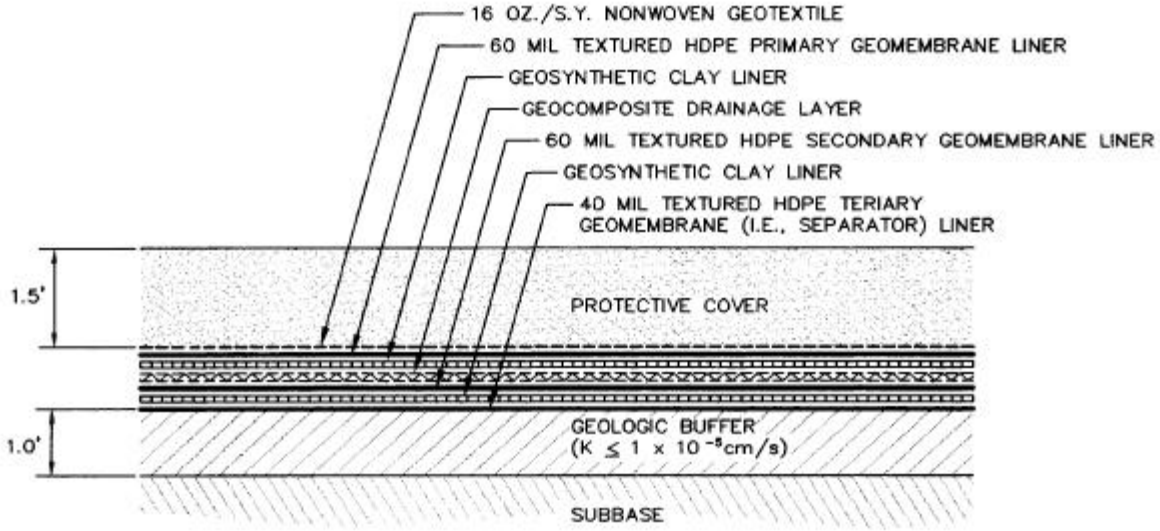
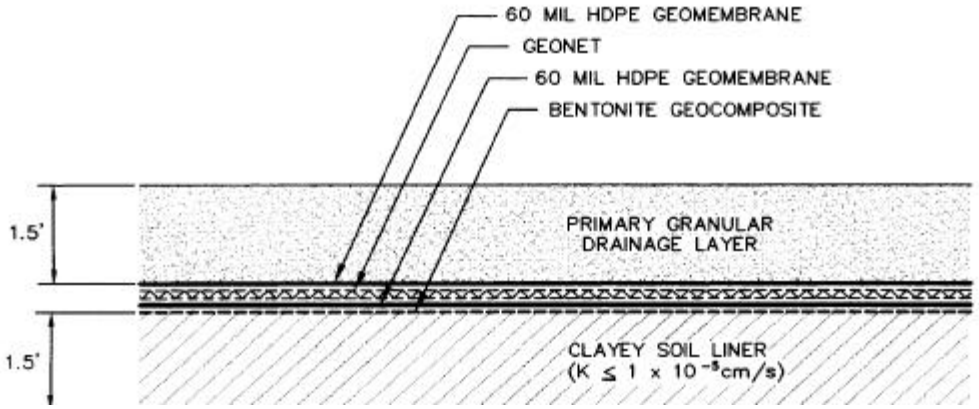
# PROJECT LOCATION MAP
## KING GEORGE COUNTY LANDFILL AND RECYCLING CENTER
## AND
## MAPLEWOOD RECYCLING AND WASTE DISPOSAL FACILITY



## CELL BASE LINER SYSTEMS

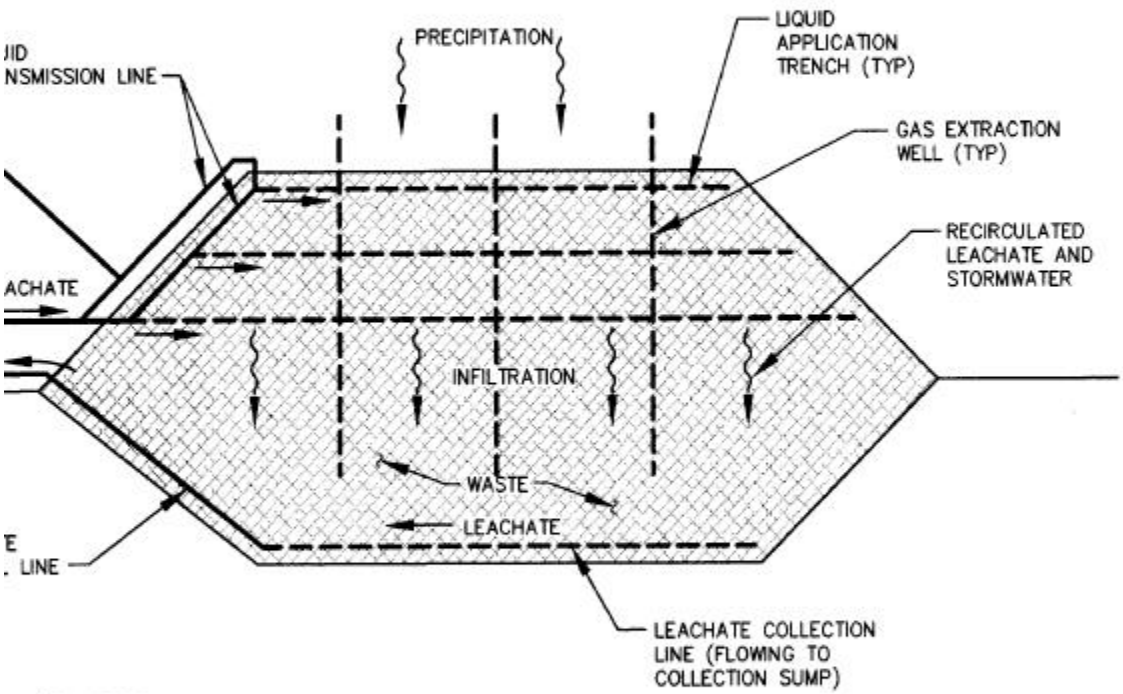



## KING GEORGE COUNTY LANDFILL AND RECYCLING CENTER



# PROCESS FLOW DIAGRAM – BIOREACTOR

UNTY LANDFILL AND RECYCLING CENTER – KING GEORGE COUNTY, VIRGINIA
AND
RECYCLING AND WASTE DISPOSAL FACILITY – AMELIA COUNTY, VIRGINIA

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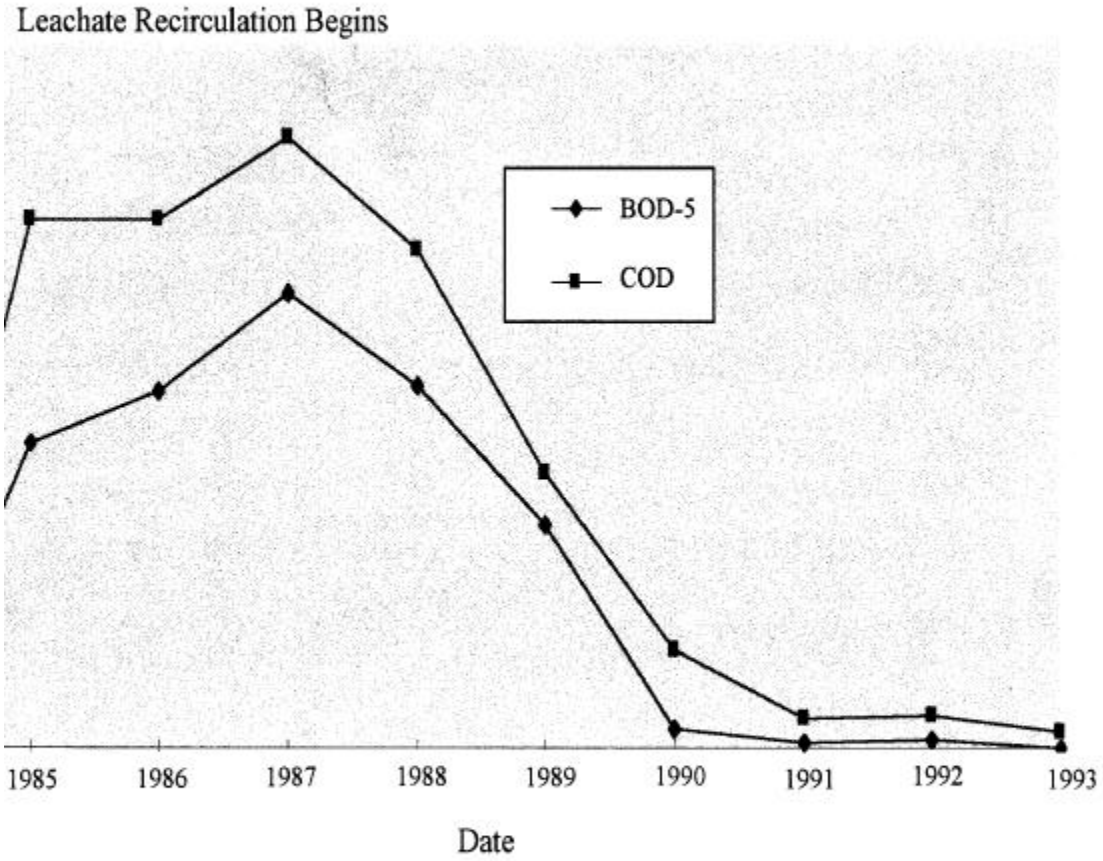
|---|---|
| FIGURE NO. | 3 |
| PROJECT NO. | ME0169 |
| DOCUMENT NO. | |
| FILE NO. | 0169P007 |

PICAL EXAMPLE: IMPROVEMENT IN LEACHATE QUALITY

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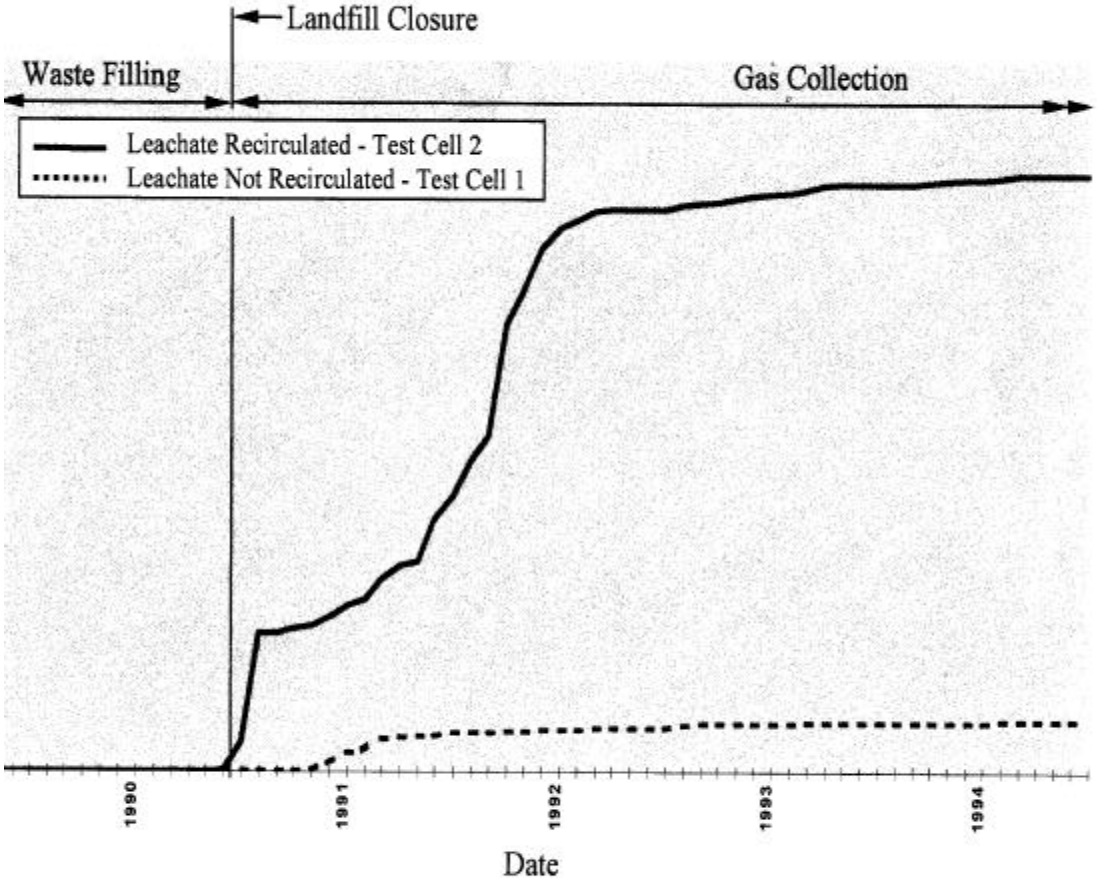
| FIGURE NO. | 4 |
| PROJECT NO. | ME0169 |
| DOCUMENT NO. | |
| FILE NO. | 0169P003 |

## TYPICAL EXAMPLE: CUMULATIVE GAS GENERATION

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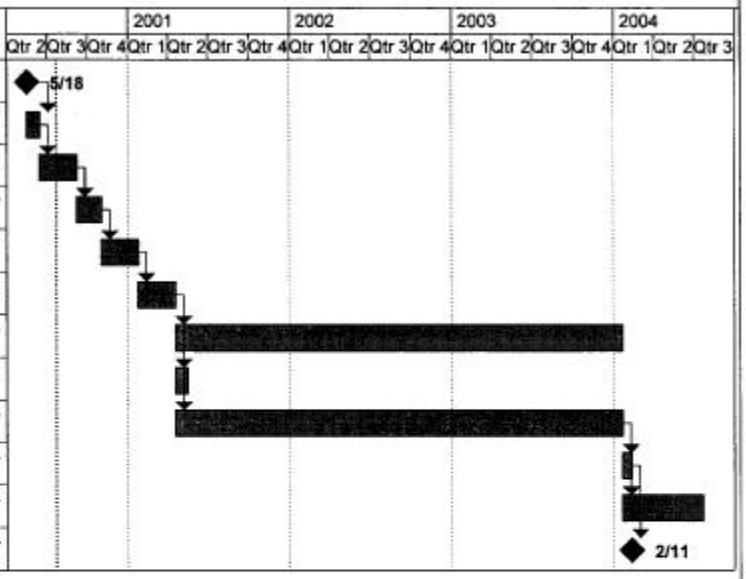
| FIGURE NO. | 5 |
| PROJECT NO. | ME0169 |
| DOCUMENT NO. | |
| FILE NO. | 0169P003 |

# PRELIMINARY PROJECT SCHEDULE

## PROJECT XL LANDFILL BIOREACTORS
## MAPLEWOOD AND KING GEORGE LANDFILLS, VIRGINIA

| | Duration | Start | Finish |
|---|---|---|---|
| | 0 days | Thu 5/18/00 | Thu 5/18/00 |
| | 4 wks | Thu 5/18/00 | Wed 6/14/00 |
| | 12 wks | Thu 6/15/00 | Wed 9/6/00 |
| | 8 wks | Thu 9/7/00 | Wed 11/1/00 |
| | 12 wks | Thu 11/2/00 | Wed 1/24/01 |
| | 12 wks | Thu 1/25/01 | Wed 4/18/01 |
| | 144 wks | Thu 4/19/01 | Wed 1/21/04 |
| | 4 wks | Thu 4/19/01 | Wed 5/16/01 |
| | 144 wks | Thu 4/19/01 | Wed 1/21/04 |
| | 3 wks | Thu 1/22/04 | Wed 2/11/04 |
| | 26 wks | Thu 1/22/04 | Wed 7/21/04 |
| | 0 days | Wed 2/11/04 | Wed 2/11/04 |




sk — Summary — Rolled Up Progress
lit — Rolled Up Task — External Tasks
ogress — Rolled Up Split — Project Summary
lestone — Rolled Up Milestone

Page 1

FIGURE 6