5 June 2003

Phillip J. Gleason, P.E.
Assistant Commissioner
The City of New York Department of Sanitation
Bureau of Waste Disposal
Waste Management – Engineering
44 Beaver Street
New York, NY 10004

Re: DSNY Fresh Kills Landfill
Contract #99G6848
Document No. 030-3209-09005-002
Task 3209 – Final Closure Plan

Dear Mr. Gleason:

Please find enclosed four copies (three bound and one unbound) of the Fresh Kills Landfill Final Closure Plan. A total of four copies of this document were sent today to the New York State Department of Environmental Conservation: two to Albany and two to Region 1.

Please do not hesitate to call me at 732-417-5858 if you have any questions or concerns.

Very truly yours,

WESTON SOLUTIONS OF NEW YORK, INC.

John B. Hinge
Task Manager

c: H. Wilkenson, File – DSNY
P. O'Connor, File - Weston

sanitation

BUREAU OF WASTE DISPOSAL
Waste Management - Engineering
44 Beaver Street, 9th Floor
New York, New York 10004

5 June 2003

Steven Hammond, P.E.
Director, Division of Solid and Hazardous Materials
New York State Department of Environmental Conservation
625 Broadway, 9th Floor
Albany, NY 12233-7258

Kenneth B. Brezner, P.E.
Deputy Regional Solid and Hazardous Materials Engineer
Division of Solid and Hazardous Materials
New York State Department of Environmental Conservation
Region 2
47-40 21st Street
Long Island City, NY 11101

Re: Fresh Kills Landfill Order on Consent
Case # D2-90001-89-03
Compliance Schedule Appendix A-15, Subject 14
Final Landfill Closure Plan

Dear Mr. Hammond and Mr. Brezner:

In accordance with Compliance Schedule Appendix A-15, Subject 14 of the Fresh Kills Landfill Order on Consent, please find enclosed the *Fresh Kills Landfill Final Closure Plan.* The enclosed document incorporates revisions outlined in the draft responses to comments sent to you to 9 May 2003. Two copies of the entire document are being provided to Albany and two are being provided to Region 2.

Final responses to New York State Department of Environmental Conservation (NYSDEC) comments are included as Attachment 1 to this letter. Based on a conference call with Dr. Gubbi Murthy of NYSDEC on 29 May 2003, the Final Cover Construction Schedule included as Figure 3-1 of the enclosed document has been left unchanged from the *Draft Final Landfill Closure Plan* submitted on 30 October 2003. As noted in the attached responses to comments, DSNY is revising the final cover design for Section 1/9 to use clean fill material for sub-base grading. During a meeting on 9 January 2003, DSNY and NYSDEC discussed a potential Consent Order modification to address changes to the closure plan. It is presumed that the closure construction schedules presented in the Final Cover Design Reports for Sections 1/9 and 6/7 will be modified under documents prescribed in the prospective Consent Order modification.

Please do not hesitate to contact me at (212) 837-8370 should you have any questions regarding this submittal.

Very truly yours,

New York City Department of Sanitation

Phillip J. Gleason, P.E.
Assistant Commissioner

PJG/JBH

C: With Enclosure:
T. Williams, NYSDEC Albany
G. Murthy– NYSDEC Region 2

C: Without Enclosure:
L. Olivia – NYSDEC Region 2
H. Rubinstein - NYC Dept. Of Law
M. Bellew – DSNY
R. Orlin – Deputy Commissioner, DSNY Legal Affairs

RESPONSES TO COMMENTS RECEIVED ON 5 MARCH 2003 FROM NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION DIVISION OF SOLID & HAZARDOUS MATERIALS REGION 2

ON "DRAFT FINAL LANDFILL CLOSURE PLAN, FRESH KILLS LANDFILL," SUBMITTED 30 OCTOBER 2002

1. **Page 2-3: 2.2.2 Leachate Containment System: Specify the fine grained geological units.**

   Response:

   Section 2, Overview of Facility Systems and Sitewide Components, is only intended to provide an overview of the various systems. Specific components of the leachate containment system at Section 1/9 and 6/7 are addressed in Sections 4.4.1 and 7.3.1, respectively. As stated in those sections, the cutoff walls at Sections 1/9 and 6/7 are keyed into the uppermost low-permeability strata, which are the glaciolacustrine clay and silt or cretaceous clay layers located in the overburden hydrostratigraphic unit.

2. **Page 2-9: 2.3.2.1 Engineered Controls: The term "interceptor vents" need clarification.**

   Response:

   As stated in the List of Preferred Terms included as Attachment 2 of the *Draft Final Landfill Closure Plan*, "LFG interceptor venting system" is the preferred term for to the stone-filled trenches along sections of the landfill perimeter that allow landfill gas to be released to the surface. On page 2-9, the term "interceptor vents" was incorrectly used rather than the preferred term, "interceptor venting system." Any references to "interceptor vents" will be corrected to "interceptor venting system" in the *Final* Final Closure Plan.

3. **Table 2-1: Reference ID R-5: "As Built of Landfill Gas Transmission Line and Fire Water System, Fresh Kills Landfill" has not been submitted to the NYSDEC ?**

   Response:

   Reference ID R-5, "As-Built of Landfill Gas Transmission Line and Fire Water System, Fresh Kills Landfill," will be provided to NYSDEC under separate cover.

4. **Page 3-4: 3.4.2: Vector Monitoring: Typo: Replace Deport to Report**

Response:

This typographical error will be corrected for the *Final* Final Closure Plan.

5. **Figure No. 3-1 Final Cover Construction Schedule; The horizontal block diagram across Section 1/9 and Section 6/7 is not clear. According to this schedule, the Leachate Control at Muldoon Ave. has been started in January 2002. A preconstruction meeting should be scheduled before the start of construction. Also, CQA, CQC and Health and Safety Plan documents should be submitted to DEC.**

Response:

As stated in Section 1.1, the *Final Landfill Closure Plan* is intended to provide brief, overview descriptions of each landfill system. Details of design and construction are included by reference to other specific Consent Order documents prepared for closure, such as the Final Cover Design Reports for each Landfill section; those reports are thereby included by reference as part of this document.

Detailed closure construction schedules for Landfill Sections 1/9 and 6/7 were provided in *Fresh Kills Landfill: Section 1/9 Final Cover Design Report* (Ref. No. U-14) and *Fresh Kills Landfill: Section 6/7 Final Cover Design Report* (Ref. No. M-11). Such details as submittals of CQA, CQC and Health and Safety Plan documents are addressed in these approved Final Cover Design Reports. The schedule included as Figure No. 3-1 was intended to be consistent with the schedules in the Final Cover Design Reports, except, as noted in Section 3.2, where changes were required as a result of placement of material from the World Trade Center at the Landfill. At the time that the *Draft Final Landfill Closure Plan* was submitted in October 2002, construction of leachate controls at Muldoon Avenue was projected to start in January 2003.

In accordance with *Modification #7, Compliance Schedule Appendix A-15* of the Consent Order, the Annual Landfill Closure Progress Report is the mechanism for reporting the status and schedule of closure construction activities. As stated in the Annual Landfill Closure Progress Report submitted on February 27, 2003, certain elements of Section 1/9 final cover construction work, including relocation of asbestos cells and modification of the leachate control system along Muldoon Avenue, were delayed pending a decision regarding a memorial for the attack on the World Trade Center. The City subsequently re-assessed its policy regarding placement of waste material adjacent to remains from the World Trade Center. Following this policy re-assessment, DSNY decided that final cover sub-base grading in Section 1/9 would be done with clean fill material.

During a meeting on January 9, 2003, DSNY and NYSDEC representatives discussed a potential Consent Order modification to address changes to the closure plan. It is presumed that the schedules presented in the Final Cover Design Reports for Sections 1/9 and 6/7 will

be modified under documents prescribed in the prospective Consent Order modification.

6. **Page 4-6: Storm Water Basin: The report states that the runoff from the lower side slopes on the east side of Section 1/9 is directed to outlet M and channeled into Arthur Kill. It should be channeled to Richmond Creek instead of Arthur Kill.**

Response:

The report incorrectly states that "runoff from the lower sideslopes on the *east* side of Section 1/9 is channeled directly into the Arthur Kill." It should have stated that runoff from the lower sideslopes on the *west* side of Section 1/9 is channeled directly into Arthur Kill. This correction will be incorporated into the *Final* Final Closure Plan. As stated on the same page, Outlet M discharges through a culvert under Rte. 440 and ultimately into Richmond Creek.

7. **Page 4-7: Typo – area to acre.**

Response:

This typographical error will be corrected for the *Final* Final Closure Plan.

8. **Drawing No. 19-9 – Section 1/9 Landfill Gas Details: It appears that the detail "Typical Type B, passive Gas Vent Detail" has not been submitted to NYSDEC earlier for review and approval. Give details of Type A and Type B Boot.**

Response:

The Typical Type B Passive Gas Vent Detail, in which a passive gas vent is connected to the active gas collection system, was included in the *Section 6/7 Final Cover Design Report* (Ref. No. M-11), but not in the *Section 1/9 Final Cover Design Report* (Ref. No. U-14). A note will be added to Drawing No. 19-9 stating that the Type B Passive Gas Vent Detail is for an optional connection of the passive gas vent to the active collection system. Type A and B boot details, which were included in the *Section 1/9 Final Cover Design Report* as Sheet No. 39, will be added to Drawing Nos. 19-9 and 67-8.

9. **Page 5-6: 5.5.1 Passive Duct Vents – It was stated that the LFG duct vents at Section 2/8 (at Section 3/4) may be used in lieu of a continuous gas venting layer. Please note that the LFG duct system has not been approved by NYSDEC.**

Response:

An application for variance from 6 NYCRR Part 360 Paragraph 2.13(p), LFG Passive Vents for Section 2/8 and 3/4, was submitted to Mr. Nosenchuck and Mr. Bruzzone of NYSDEC on September 22, 1997 by Joseph Lifrieri of Paulus, Sokolowski and Sartor Engineering, PC, on behalf of the Department of Sanitation. Based on NYSDEC's review, the variance request was submitted in conjunction with an active gas collection system that would be in operation at these Landfill sections until gas emissions fell below regulated thresholds. The variance was then submitted in conjunction with the Fresh Kills Landfill, Landfill Gas Flares Application to NYSDEC, dated April 1998 (Appendix FF), which resulted in DEC Permit No. 2-6403-00011/00063. Based on this review and acceptance under the permit application, the LFG duct vents in conjunction with the active gas collection system were approved by NYSDEC in lieu of a continuous gas venting layer. The text will be modified to include this added condition for variance approval.

10. **Page 7-1: 7.2.1 Final Cover – It was stated that final cover at Section 6/7 has been and will be installed in two stages. Please describe the "two stages" of installation of the final cover.**

Response:

Type VIII final cover was previously installed around the perimeter of Section 6/7 in conjunction with the leachate collection and containment system. As stated in 7.2.1, construction of all other final cover types (Types IV, Type V, Type VI, and Type VII) has not yet started. Future final cover construction will be in accordance with the schedule provided in Figure No. 3-1. A note explaining these two stages will be added to the first paragraph of Section 7.2.1.

11. **Drawing No. LF-1 – References, Legend and Symbols: Please clarify the term "Sand bentonite Wall".**

Response:

As stated in Section 4.4.1 and 7.3.1, the leachate containment system at Sections 1/9 and 6/7 consists of a soil bentonite or cement bentonite cutoff wall that extends around the perimeter of the section. Although Drawing No. LF-6 shows the entire perimeter wall as "cutoff wall," Drawing Nos. 19-10 and 67-9 differentiate between "cement bentonite wall" (i.e., the portion of the cutoff wall constructed of cement and bentonite) and "sand bentonite wall" (i.e., the portion of the cutoff wall constructed of sand and bentonite). The legends on Drawing Nos. LF-1, 19-10 and 67-9 will be changed from "sand bentonite wall" to "soil bentonite wall" to be consistent with the text.

12. Drawing No. LF-5 – Landfill Gas Migration Control....: The detail "LFG interceptor Venting System Detail" is not clear.

Response:

The "LFG Interceptor Venting System Detail" included on Drawing No. LF-5 is incorrect; it shows cover soil placed on top of the stone-filled trench. The corrected detail, showing stone extending to the surface and showing an optional vent pipe, will be included in the *Final* Final Closure Plan.

13. Drawing No. LF-12 (and Drawing No. 28-1) – Sitewide Index of Final Cover: Show the thickness of geomembrane in Type I and Type II sections.

Response:

Drawings No. LF-12 and 28-1 will be revised to show the 40-mil thickness of geomembrane in Type I and II final covers, as stated in Section 5.2 and shown on Table 2-2.

14. No. 19-2 – Section 1/9 and Final drainage plan and Drawing No. 67-2 – Section 6/7 Final cover Plan. At Section 6/7, several roads are proposed whereas at Section 1/9, no such service roads are shown. Please clarify.

Response:

Designs for roads at Sections 1/9 and 6/7, as shown on Drawing Nos. 19-2 and 67-2, were taken directly from the *Fresh Kills Landfill: Section 1/9 Final Cover Design Report* (Ref. No. U-14) and *Fresh Kills Landfill: Section 6/7 Final Cover Design Report* (Ref. No. M-11). The final cover design for Section 1/9 includes only one service road other than the perimeter road installed in conjunction with the leachate collection and containment system. The final cover design for Section 6/7 includes numerous service roads. The service road at Section 1/9 is identified on Drawing No. 19-2 as Type VI final cover. As shown on Drawing No. 19-3, Type VI final cover is for asphalt roads. For clarity, the service road at Section 1/9 will be added to Drawing No. 19-1, Final Grading Plan.

THE CITY OF NEW YORK
Department of Sanitation

Fresh Kills Landfill

Final Closure Plan

5 June 2003
Document No. 030-3209-09005-002

Prepared by:
Weston Solutions of New York, Inc.
205 Campus Drive
Edison, NJ 08837

FRESH KILLS LANDFILL

FINAL CLOSURE PLAN

Prepared for:

The City of New York Department of Sanitation
44 Beaver Street
New York, NY 10004

Contract No. 99G6848
Document No. 030-3209-09005-002

Prepared by:

Weston Solutions of New York, Inc.
205 Campus Drive
Edison, NJ 08837

5 June 2003

FRESH KILLS LANDFILL
FINAL CLOSURE PLAN

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67-9	Section 6/7 - Leachate Collection Plan
67-10	Section 6/7 - Leachate Containment Details
67-11	Section 6/7 - Leachate Collection Details

SECTION 1

INTRODUCTION

The Fresh Kills Landfill Final Closure Plan (FCP) has been prepared to meet the requirements of the Fresh Kills Order on Consent (NYSDEC Case # D2-9001-89-03, hereinafter referred to as the "Consent Order)) *Modification #7, Compliance Schedule Appendix A-15* and all other applicable regulatory requirements set forth in *6 NYCRR Part 360*. This document is in compliance with closure design, construction, and post-closure care requirements.

1.1 PURPOSE AND SCOPE OF DOCUMENT

The FCP provides plans and descriptions of facility structures and systems of the Fresh Kills Landfill (the Landfill) as they will exist following closure of the Landfill. For each landfill system, a brief, overview description is provided, but details of design and construction are included by reference to specific documents prepared for closure, such as the Final Cover Design Reports for each Landfill section. Brief descriptions of sitewide components, including the Fresh Kills Landfill Leachate Treatment Plant (FKLLTP) and landfill gas recovery facility, are provided in this FCP. Separate descriptions of each landfill section, addressing the final cover and drainage system, leachate controls, landfill gas migration controls, and landfill gas emission controls, are also provided in this FCP.

A comprehensive reference list is included as Attachment 1. The comprehensive reference list includes all documents referred to or used as source documents for the text and drawings of the FCP. The list continues the reference identification format used in the *Final 6 NYCRR Part 360 Permit Application for the Fresh Kills Landfill*, submitted 15 March 1996, and other documents. Separate reference tables are included in each section of this FCP. The tables are organized by FCP subsection; for each referenced document, the reference number, reference name, and information referenced in the subsection is provided.

A list of preferred terms is provided as Attachment 2. This list provides a consistent methodology for naming terms and identifying site features. Previous documents have been produced by different designers and have used different names and designations for facility components. The list presents preferred terms and also cites other terms by which the components have been described. Similarly, the FCP provides a consistent naming convention for all the final cover types used at the Fresh Kills Landfill. In several cases, previous closure documents (e.g., final cover design reports for Sections 2/8 and 1/9) used the same designation (e.g., Type 1) for different final cover types. The new final cover type designations, which are outlined in Section 2.1, are used consistently throughout this FCP.

A set of drawings is included with the FCP to satisfy regulatory requirements for a "site plan and a description of facility structures." These drawings, which are bound separately as Attachment 4, have been compiled from various source documents to show what the site will look like following completion of closure construction. The drawings will serve as a basis for management of the site during the post-closure period. Source documents for each drawing are listed on the drawing using the reference identification format used in Attachment 1; full citations for the references are provided on a reference sheet (Attachment 4, Sheet LF-1).

1.2 REGULATORY BASIS

This FCP is prepared in accordance with the Consent Order and 6 NYCRR Part 360. Under the requirements of "Final Landfill Closure Plan and Landfill Closure" of Consent Order Modification #7, Compliance Schedule Appendix A-15, the City shall submit a Final Landfill Closure Plan for the landfill and close the landfill, in accordance with applicable regulations and with the schedule specified in Subjects 13 and 14.

Consent Order and Part 360 requirements for the Final Landfill Closure Plan are described in this section. A regulatory matrix showing where each regulatory requirement is addressed in the FCP is included as Table1-1.

- **Consent Order Modification (Appendix A-15)**

The specific Consent Order requirements for a Final Landfill Closure Plan are as follows:

> *"The Respondent must submit a Final Landfill Closure Plan for the landfill and close the Landfill, in accordance with applicable regulations and with the schedule specified below. The plan must include a site plan and a description of facility structures; the final cover system; the landfill gas control system; leachate containment, collection, and treatment systems; a final end use plan including use of native vegetation for landscaping; and, as necessary, plans for vector control, gas control, including by reference those aspects of landfill gas control related to the on-site landfill gas recovery facility and landfill gas flares. The plan must address potential environmental impacts associated with the Landfill, and provide the following: estimates of the landfill area to be covered and an inventory of wastes in the landfill; a closure construction schedule that conforms with subdivision 360-2.15(d); and amended closure and post-closure monitoring and maintenance cost estimates, in accordance with section 360-2.19. The Final Landfill Closure Plan must meet the requirements for post-closure operation and maintenance defined in subdivision 360-2.15(k). The Final Cover Reports and Post-closure Monitoring and Maintenance Operations Manual developed in accordance with this Appendix A-15 shall be deemed a part of the Final Landfill Closure Plan as accepted."*

- **6 NYCRR Part 360**

Requirements for Final Landfill Closure Plans are provided in 6 NYCRR Part 360-2.15(c), "Final closure plan," which includes the following stipulations:

Table 1-1
Regulatory Matrix

Fresh Kills Landfill Final Closure Plan

Regulatory Requirement (360-2.15(c))	Consent Order Requirements	Section in Final Landfill Closure Plan
360-2.15(c) - Final Closure Plan **A approvable final closure plan must be in compliance with this subdivision.** **(1) The plan must:**	Plan must include the following:	
(I) Meet 360-2.15(b)(1) and (2), and 360-2.15(d) to (j)		***As Follows***
2.15(b)(1) - A site plan shows proposal final contours, property lines, storm water drainage systems, streams and water courses, roads, structures and if applicable, groundwater and leachate treatment systems, air pollution control and landfill gas recovery systems.	A site plan and a description of facility structures	Drawing Set - Attachment 4
2.15(b)(2) - Typical details of cap components and facility structures which comply with requirements set forth in this section.		***As Follows***
360-2.15(d)- Final Cover System	Final cover system	Section 2.1, Section 4.2, Section 5.2, Section 6.2, Section 7.2
360-2.15(e) - landfill gas control	Landfill gas control system	Section 2.3, Section 4.5, 4.6, Section 5.4, 5.5, Section 6.4, 6.5, Section 7.4, 7.5
360-2.15(f) - perimeter gas collection systems		Section 2.3.2, Section 4.5, Section 5.4, Section 6.4, Section 7.4
360-2.15(g) - Gas control using flares	As necessary, gas control plan should be included, including by reference those aspects of landfill gas control related to the on-site landfill gas recovery facility and landfill gas flares	Section 2.3.1.2, Section 4.6.2, Section 5.5.2, Section 6.5.2, Section 7.5.2
360-2.15(h) - Condensate from gas processing or control system		Section 2.3.1.2, Section 4.6.2, Section 5.5.2, Section 6.5.2, Section 7.5.2
360-2.15(i) - leachate collection system	Leachate containment, collection and treatment	Section 2.2, Section 4.4, Section 5.3, Section 6.3, Section 7.3
360-2.15(j) - vectors	As necessary, the vector control plan should be included.	Section 3.4.2
(ii) Meet 360-2.15(k), including post-closure monitoring and maintenance operations manual prepared accordance with 360-2.15(k)(7)	Meet the requirements for the post-closure operation and maintenance defined in subdivision 360-2.15(k)	Section 3.4.1
	A final end use plan including use of native vegetation for landscaping	Section 3.1
(iii) address unacceptable environmental impacts identified in the closure investigation report required in 2.15(a)(5)	Potential environmental impacts associated with the Landfill	Section 3.3
(iv) provide an estimate of the landfill area to be covered;	The following must be provided in the plan: Estimates of the landfill area to be covered;	Sections 4.1, 5.1, 6.1, and 7.1
(v) provide an estimate of the inventory of the wastes in the landfill	Inventory of wastes in the landfill.	Sections 4.1, 5.1, 6.1, and 7.1
(vi) provide a closure construction schedule which conforms with the requirements of subdivision (d) of this section	A closure construction schedule that conforms with subdivision 360-2.15(d)	Section 3.2
(vii) provide amended closure and post-closure monitoring and maintenance cost estimates, prepared in accordance with subdivisions 360-2.19(b) and (c) of this subpart	Amended closure and post-closure monitoring and maintenance cost estimates, in accordance with section 360-2.19	Section 3.5
360-2.19(b) - Financial Assurance for Closure		Section 3.5
360-2.19(c) - Financial Assurance for Post-Closure Care		Section 3.5
	The Final Cover Design Reports and Post-Closure Monitoring and Maintenance Operations manual developed accordance with this Order On Consent (Appendix A-15) shall be deemed a part of the Final Landfill Closure Plan as accepted.	P-C M&MOM (Ref. No. W-49), Final cover design reports for Section 1/9, 6/7, 2/8 and 3/4
	Milestone Date for Draft Final Closure Plan: September 1, 2002, with 60-day extension, milestone date is October 30, 2002.	

(1) The plan must:

(i) Meet the requirements of paragraph 360-2.15(b)(1) and (2), and 360-2.15(d) to (j);

(ii) Meet the requirements of subdivision (k) of this section, including post-closure monitoring and maintenance operations manual prepared in accordance with paragraph 360-2.15(k)(7) of this Subpart;

(iii) address unacceptable environmental impacts identified in the closure investigation report required in 2.15(a)(5) of this section;

(iv) provide an estimate of the landfill area to be covered;

(v) provide an estimate of the inventory of the wastes in the landfill;

(vi) provide a closure construction schedule which conforms with the requirements of subdivision (d) of this section; and

(vii) provide amended closure and post-closure monitoring and maintenance cost estimates, prepared in accordance with subdivisions 360-2.19(b) and (c) of this Subpart.

(2) Financial assurance for closure monitoring and maintenance are to be amended in accordance with subdivision 360-2.19(b) and (c) of this Subpart.

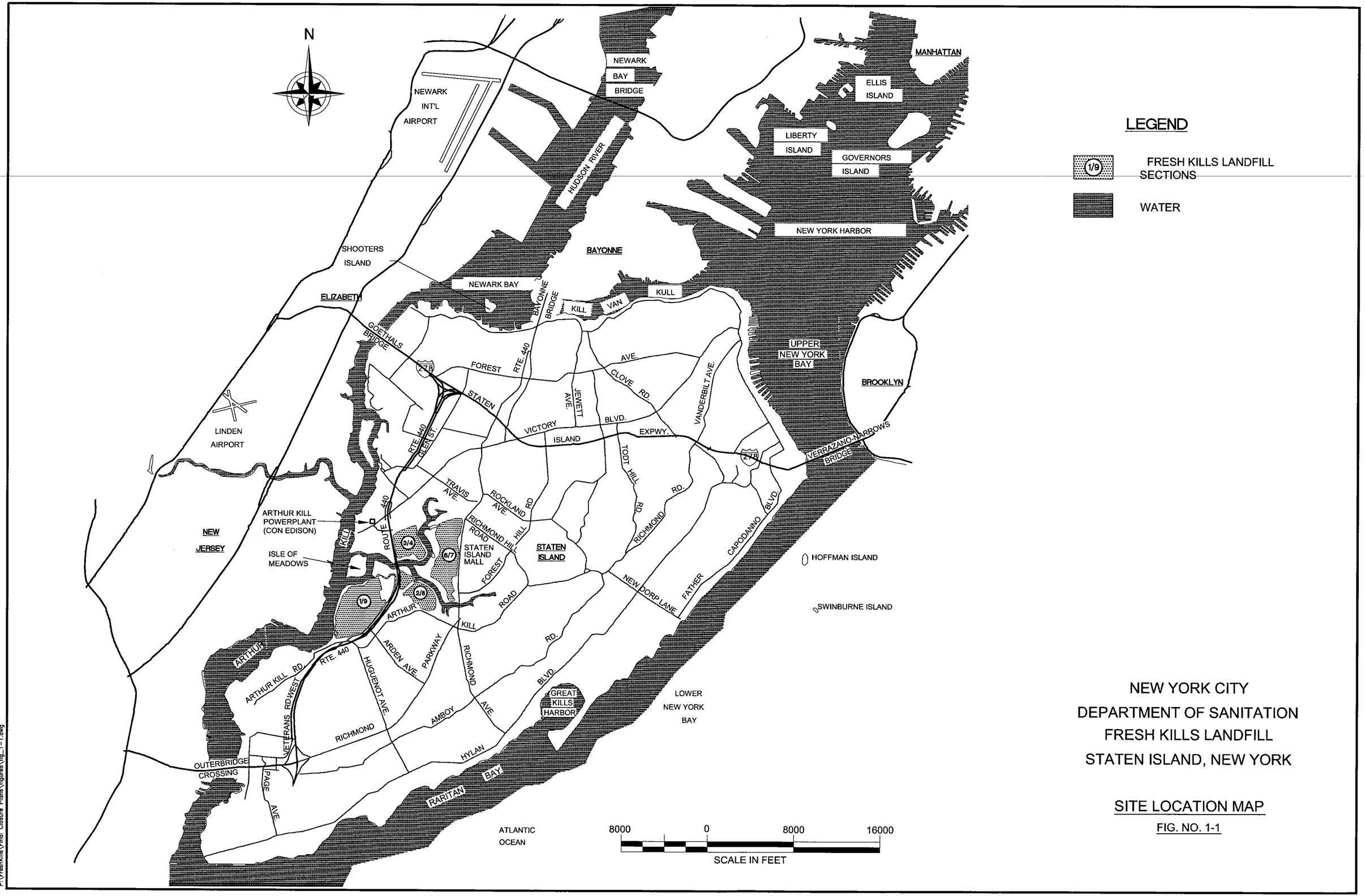
The complete text of 6 NYCRR 360-2.15 and 2.19, including all sections cited above, is included in Attachment 3, Applicable Excerpts from Regulations.

1.3 DOCUMENT ORGANIZATION

This FCP is organized to provide descriptions—either within the document or by reference—of landfill systems, facility management, maintenance operations, environmental monitoring, construction schedule, and financial assurance.

This FCP is organized into seven sections. The first three sections of the FCP provide background information, an overview of facility systems, a description of sitewide components, and information on various closure and post-closure issues. The next four sections provide separate descriptions of closure systems, including final cover and drainage, leachate control, landfill gas emission control, and landfill gas migration control for each of the Landfill's four solid waste management units, or sections. The four Landfill sections at the Fresh Kills Landfill are Section 1/9, Section 2/8, Section 3/4, and Section 6/7. See Fig. No. 1-1 (Site Location Map) and Fig. No. 1-2 (Site Plan) for locations of the Landfill sections.

The contents of the seven document sections are summarized below:



NEW YORK CITY
DEPARTMENT OF SANITATION
FRESH KILLS LANDFILL
STATEN ISLAND, NEW YORK

SITE LOCATION MAP
FIG. NO. 1-1

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Section 1: Introduction – Outlines the purpose and scope of the document, provides the regulatory basis, and describes organization of the document.

Section 2: Overview of Facility Systems and Sitewide Components – Provides an overview of the final cover and drainage system, the leachate control system, and the landfill gas control system, as well as a description of sitewide components, including the Fresh Kills Landfill Leachate Treatment Plant (FKLLTP) and landfill gas recovery facility.

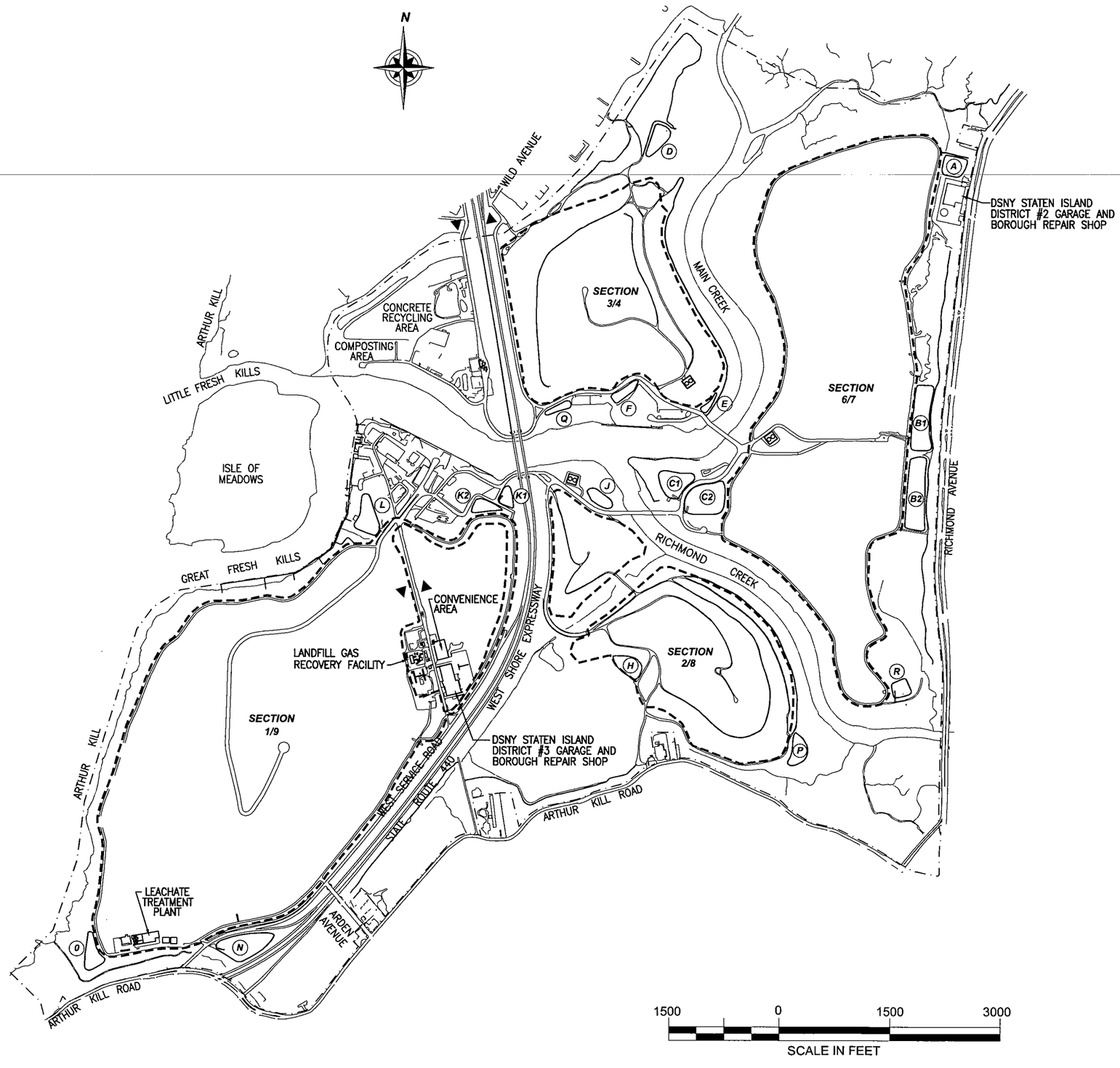
Section 3: Closure and Post-Closure Issues – Addresses various closure and post-closure issues, including end use, the closure construction schedule, the environmental monitoring program, post-closure operations and maintenance, and closure and post-closure cost estimates.

Section 4: Landfill Section 1/9 – Provides a site description and information on the final cover and drainage, leachate control, landfill gas emission control and landfill gas migration control systems at Section 1/9. A description of the reclamation area at Section 1/9 is also provided.

Section 5: Landfill Section 2/8 – Provides a site description and information on the final cover and drainage, leachate control, landfill gas emission control and landfill gas migration control systems at Section 2/8.

Section 6: Landfill Section 3/4 – Provides a site description and information on the final cover and drainage, leachate control, landfill gas emission control and landfill gas migration control systems at Section 3/4.

Section 7: Landfill Section 6/7 – Provides a site description and information on the final cover and drainage, leachate control, landfill gas emission control and landfill gas migration control systems at Section 6/7.



LEGEND

- LIMIT OF LANDFILL SOLID WASTE MANAGEMENT UNIT
- LANDFILL COMPLEX BOUNDARY
- STORMWATER BASIN AND DESIGNATION (E)
- LFG FLARE STATION
- ENTRANCE/EXIT

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FRESH KILLS LANDFILL
STATEN ISLAND, NEW YORK

SITE PLAN

FIG. NO. 1-2

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SECTION 2

OVERVIEW OF FACILITY SYSTEMS AND SITEWIDE COMPONENTS

Numerous systems have been constructed at the Fresh Kills Landfill that will continue to serve operational and environmental functions during the landfill closure and post-closure period. Each of these systems has specific components, activities, and controls. The purpose of this section is to briefly describe, in general, the primary function intended to be served by each system and the components that comprise the system. Sitewide components, including the Fresh Kills Landfill Leachate Treatment Plant (FKLLTP) and landfill gas recovery facility, are also described in this section.

Other sections of this report will address more specific details regarding closure and post-closure issues (Section 3), and more detailed descriptions for each Landfill section (Sections 4, 5, 6, and 7).

An overview of the following systems is provided in this section:

- Final Cover and Drainage System
- Leachate Control System
- Landfill Gas Control System

These system overview descriptions will include key components, primary functions served, and general information regarding important interdependencies for the landfill components, activities, and controls.

A description of the references cited in Section 2 is provided in Table 2-1.

2.1 FINAL COVER AND DRAINAGE SYSTEM

The overall function of the final cover system is to minimize infiltration of precipitation into the landfill, thereby limiting leachate generation. The final cover system will consist of up to five layers. Infiltration of precipitation is controlled by providing a hydraulic barrier layer (geomembrane or compacted clay layer) as part of the final cover system. The function of the layers above the barrier layer are to protect the hydraulic barrier layer and to divert runoff and infiltration away from the barrier layer. The top layer, which typically consists of vegetative cover but may also consist of asphalt or gravel road materials, is designed to direct runoff away from the landfill and control erosion of the cover. Stormwater controls and the drainage system are integrated into the final cover system to direct runoff away from the cover and to stormwater basins. Below the hydraulic barrier layer, a gas venting layer may be used to allow landfill gas generated within the landfill to move toward landfill gas vents or extraction wells. Final cover design and construction is governed by Part 360-2.15(d) and Appendices A-3 and A-15 of the

Table 2-1
List of References for Section 2: Overview of Facility Systems and Sitewide Components
Fresh Kills Landfill Final Closure Plan

FLCP Section	Section Title	Ref. ID	References	Referenced Information
2.1	Final Cover and Drainage System	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Volume A, Attachment 2 - maintenance and inspection procedures for the final cover and drainage systems
2.2	Leachate Control System	N-26	New York State Department of Environmental Conservation. April 1995. **Tidal Wetlands, Protection of Waters, Water Quality Certification, and State Pollution Discharge Elimination System (SPDES) Permit. NYSDEC Permit No. 2-6404-00275/00013-0. SPDES No. NY-0200867.**	Leachate treatment requirements
		O-1	O'Brien & Gere Engineers, Inc. August 8, 1994. **Engineering Report, Fresh Kills Landfill, Fresh Kills Leachate Treatment Plant.** Includes Errata issued February 3, 1995, Addendum No. 1 dated July 21, 1995, Addendum No. 2 dated February 25, 1996.	Engineering Report with detailed descriptions of the FKLLTP
		O-2	O'Brien & Gere Engineers, Inc. August 8, 1994. **Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Fresh Kills Leachate Treatment Plant.**	QA/QC plan for construction of FKLLTP
		O-8	O'Brien & Gere Engineers, Inc. March 1995. **Fresh Kills Landfill Leachate Treatment Plant, Staten Island, New York, Contract Drawings. Includes Addendum No. 3 dated April 25, 1995.**	Contract Drawings of FKLLTP
		O-12	O'Brien & Gere Engineers, Inc. January 1996. **Engineering Report for Veterans Avenue Leachate Treatment Plant (submitted with SPDES Permit Application July 19, 1991).**	Engineering Report - Veterans Ave. Leachate Treatment Plant
2.3	Landfill Gas Control System	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Volume C - Environmental Monitoring Program with detailed information on landfill gas migration monitoring and control Volume D with detailed description of the active LFG system and procedures for post-closure operations and maintenance of the system
		R-5	Rosewood Contracting Corp. July 3, 2001. **As-Built of Landfill Gas Transmission Line and Fire Water System, Fresh Kills Landfill.**	As-built drawings of the landfill gas transmission force main
		N-150	New York State Department of Environmental Conservation. April 1998. **Fresh Kills Landfill Gas Flare Stations Permit. NYSDEC Permit No. 2-6403-00011/00063.**	Variance approval for LFG duct vents at Sections 2/8 and 3/4.
		N-151	New York State Department of Environmental Conservation. November 2, 2001. **Fresh Kills Landfill Gas Recovery Facility NYSDEC Air Pollution Control – Title V Permit ID No. 2-6499-00029/00151.**	Detailed information on the landfill gas recovery facility
		N-152	New York State Department of Environmental Conservation. **Fresh Kills Landfill Gas Recovery Facility NYSDEC Air Pollution Control – Part 360 Permit ID No. 2-6499-00029/00175.**	Detailed information on the landfill gas recovery facility

Consent Order. Once the final cover system is installed, its maintenance during the post-closure period is governed by 6 NYCRR Part 360-2.15(k).

2.1.1 Final Cover System Components

The cover systems for all the landfill sections are composed of generally similar cover components of varying thickness and material. The final cover systems for all four sections of the Landfill are composed of the following common components in accordance with Part 360 requirements (from top to bottom):

- Top layer, consisting of vegetated topsoil with a minimum thickness of 6 inches or of gravel or asphalt pavement;
- Barrier protection material (BPM) layer, typically consisting of soil;
- Drainage layer (DNL), on steeper slopes, to control interstitial drainage;
- Hydraulic barrier layer, which may consist of either low-permeability soil (e.g., compacted clay) or geomembrane; and
- Gas venting layer (GVL), which may consist of a continuous geocomposite layer or a network of landfill gas ducts.

Infiltration into the top layer or barrier protection material layer is minimized by means of final grading. As stipulated in the regulations, minimum and maximum slopes are used to prevent ponding and ensure slope stability, respectively. Infiltration that does enter the top layer or barrier protection material layer is either released back into the air through evapotranspiration or collected and diverted through the drainage layer (if used), and discharged to a drainage swale. The hydraulic barrier layer prevents infiltration of precipitation and thus functions to minimize leachate generation.

Table 2-2 presents the 11 final cover types used throughout the Landfill, shows the components used in each final cover type, and provides the designations by which these types have been referred to in other documents. In several cases, previous closure documents (e.g., final cover design reports for Sections 2/8 and 1/9) used the same desigation (e.g., Type I) for different final cover types. The designations provided in Table 2-2 are used consistently throughout this FLCP.

2.1.2 Drainage System Components

Stormwater at the Landfill is controlled and conveyed by means of final grading, swales, culverts, downchutes, and stormwater basins. The functions of these structures are:

- To convey stormwater runoff from the landfill surface in a controlled manner through a series of drainage structures. Before stormwater is discharged into adjacent water bodies, the stormwater is retained in a stormwater basin to moderate peak flows and to allow soil particles (sediment) to settle out of suspension within the basin.

- To control erosion of the top layer of the final cover system and thus prevent damage to the underlying hydraulic barrier layer, which minimizes infiltration and leachate generation.

Table 2-2
Summary of Final Cover Types

Fresh Kills Landfill Final Closure Plan

Final Cover/Layer Information	Final Cover Type										
	I	**II**	**IIIA**	**IIIB**	**IIIC**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
Locations Where Used	Sections 2/8, 3/4 10% - 33% slopes	Sections 2/8, 3/4 Slopes <= 10%	Section 1/9, Southeast perimeter slope north of Arden Ave. Section 3/4, Some perimeter slopes	Sections 2/8, 3/4 Some perimeter slopes	Section 1/9 Southeast perimeter slope south of Arden Ave.	Sections 1/9, 6/7 Slopes > 15%	Sections 1/9, 6/7 Slopes <= 15%	Sections 1/9, 6/7 Asphalt roads	Sections 1/9, 6/7 Gravel roads	Sections 1/9, 6/7 Perimeter road	Section 1/9 Northern and eastern perimeter of reclamation area
Reference for Design	S-32 S-33 S-39 S-40	S-32 S-33 S-39 S-40	F-22 F-24	F-21, F-22	F-23	U-14 M-11	U-14 M-11	U-14 M-11	U-14 M-11	T-1 S-46	U-14
Designation in Reference	Type I (S-32, S-39) Alternative I (S-33, S-40)	Type II (S-32, S-39) Alternative V (S-33, S-40)	Type 2 (T-1)			Type I (U-14 and M-11)	Type II (U-14 and M-11)	Type IV (U-14 and M-11)	Type III (U-14 and M-11)	Final cover that includes 60 mil HDPE geomembrane (T-1)	Final cover installed at perimeter of reclamation area (U-14, Apps. D-2 and K)
Top Layer	6" topsoil and seeding	6" topsoil and seeding	6" topsoil and seeding	6" topsoil and seeding	12" topsoil and soil barrier protection material	6" topsoil and seeding	6" topsoil and seeding	4" asphalt; 6" crushed stone and gravel	6" gravel	6" topsoil and seeding (shoulder) *or* Type 1 or 2 pavement (roadway)	Topsoil and seeding 60" alternative final cover (max. permeability of 1.0×10^{-5} cm/sec)
Barrier Protection Material (BPM)	24" barrier protection material	24" barrier protection material	18"-24" soil barrier protection material	18" soil barrier protection material		24" soil barrier protection material	24" soil barrier protection material	Geotextile fabric protection layer 20" soil barrier protection layer	Geotextile fabric protection layer 24" soil barrier protection layer	24" soil barrier protection material	
Drainage Layer (DNL)	Geocomposite (HDPE drainage geonet with a non-woven geotextile on both sides)	------	------	------	------	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geotextile fabric protection layer	Geotextile fabric protection layer	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet		
Hydraulic Barrier Layer	40-mil textured HDPE geomembrane	40-mil smooth HDPE geomembrane	12" low-permeability barrier soil layer (1.0×10^{-7} cm/sec)	18" low-permeability barrier soil layer (1.0×10^{-7} cm/sec)	12" low-permeability barrier soil layer (1.0×10^{-7} cm/sec)	40-mil textured LLDPE geomembrane	40-mil textured LLDPE geomembrane	40-mil textured LLDPE geomembrane	40-mil textured LLDPE geomembrane	60-mil HDPE geomembrane	
Gas Venting Layer (GVL)	------	------	------	------	------	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	Geocomposite: geotextiles heat-bonded to both sides of a HDPE geonet	------	

FC table
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The drainage control components are integrated into the final cover and function to control stormwater flow from the landfill surface. Because of the impermeable nature of the final cover, stormwater that otherwise would infiltrate into the landfill must be conveyed by drainage structures. Erosion of the final cover is controlled by directing high-velocity runoff into stabilized swales on the top plateau area and on the sideslopes, and then into downchutes that convey the runoff to the stormwater basins. If this high-velocity runoff were not directed into the downchutes, but rather were allowed to continue to run down the slopes on top of the vegetative cover, extensive erosion damage could occur.

Locations of stormwater basins were constrained to areas outside of the limits of solid waste and to areas that had minimal impacts on wetlands. A major design criterion was to locate the basins in areas that would facilitate controlled drainage of as much landfill area as possible.

The objective of the drainage system is consistent across the entire Landfill, but specific permanent drainage control components used differ among the various Landfill sections. For example, at Sections 2/8 and 3/ 4, underground downchute pipes are used to convey stormwater from drainage swales to the stormwater basins. At Sections 1/9 and 6/7, gabion downchutes and drop-inlet boxes will be used for the same purpose. A cross-section of the typical drainage systems to be used at Sections 1/9 and 6/7 is illustrated in Fig. No. 2-1. A cross-section of the typical drainage systems used at Sections 2/8 and 3/4 is illustrated in Fig. No. 2-2. The components used for each of the Landfill sections are discussed in Sections 4 through 7. Maintenance and inspection procedures for the temporary and permanent drainage controls that have been installed are provided in the *Post-Closure Monitoring and Maintenance Operations Manual* (Ref. No.W-49).

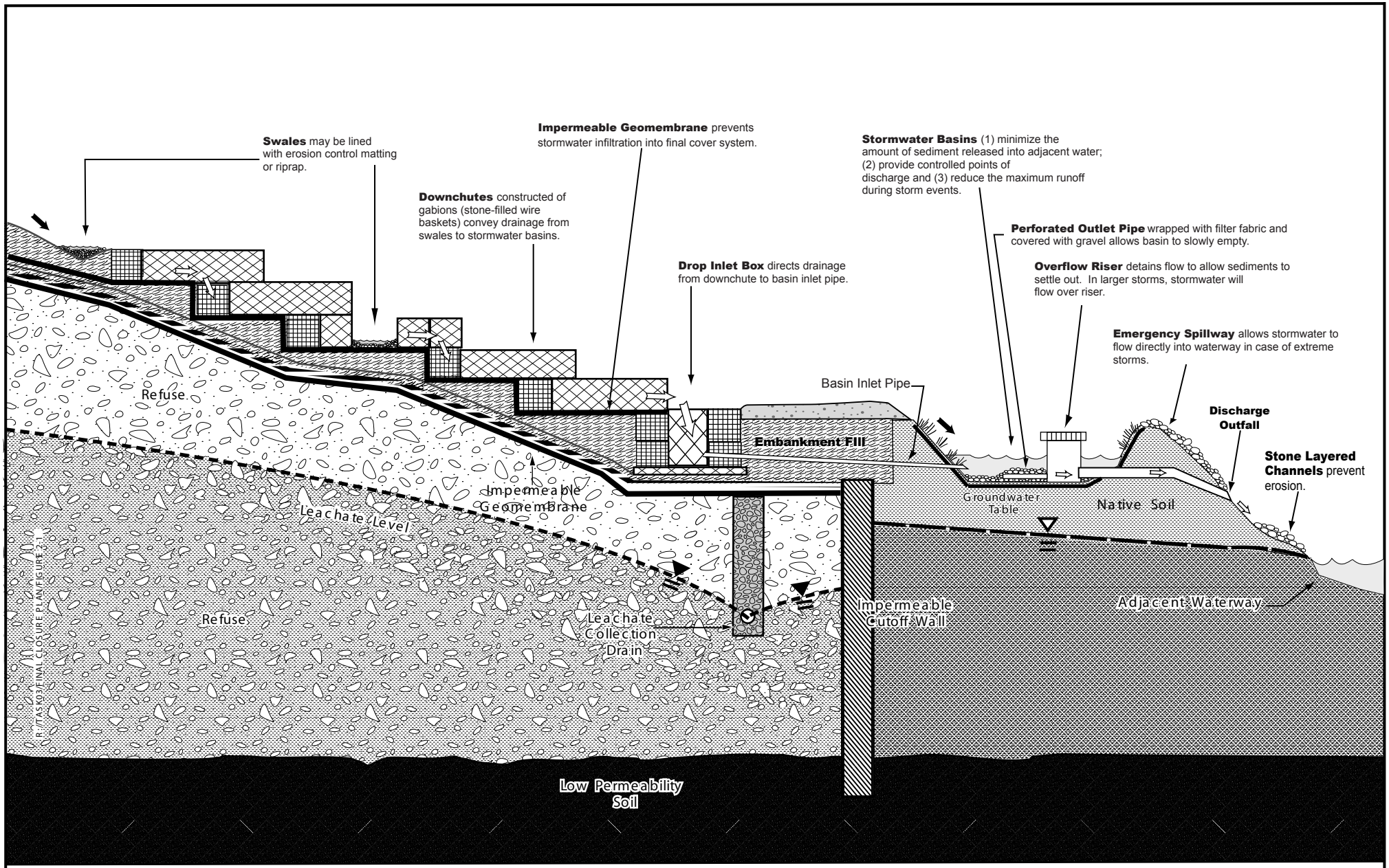
2.2 LEACHATE CONTROL SYSTEM

2.2.1 System Overview

The components of the leachate control system vary among the Landfill sections. At Sections 1/9 and 6/7, the leachate control system consists of a cutoff wall and a leachate collection drain with associated leachate collection pump stations located along the perimeter of both landfill sections. The leachate control system at Section 1/9 also will include a cutoff wall, leachate collection pump stations and a shallow drain located to the west of Muldoon Avenue along the northeastern perimeter of the main mound. In addition, a leachate collection well is located within the landfill gas recovery facility to control leachate in the area of the facility.

At Sections 2/8 and 3/4, the leachate control system includes leachate recovery wells at the top, partial perimeter drains, and leachate collection pump stations located along the partial perimeter drains.

Collected leachate from all landfill sections is conveyed through header pipes and force mains to the Fresh Kills Landfill Leachate Treatment Plant (FKLLTP). The FKLLTP, which is located in the southwestern end of Section 1/9, treats the collected leachate and discharges the effluent into the Arthur Kill through a subaqueous outfall. An overall site plan of the leachate control system is presented on Fig. No. 2-3.



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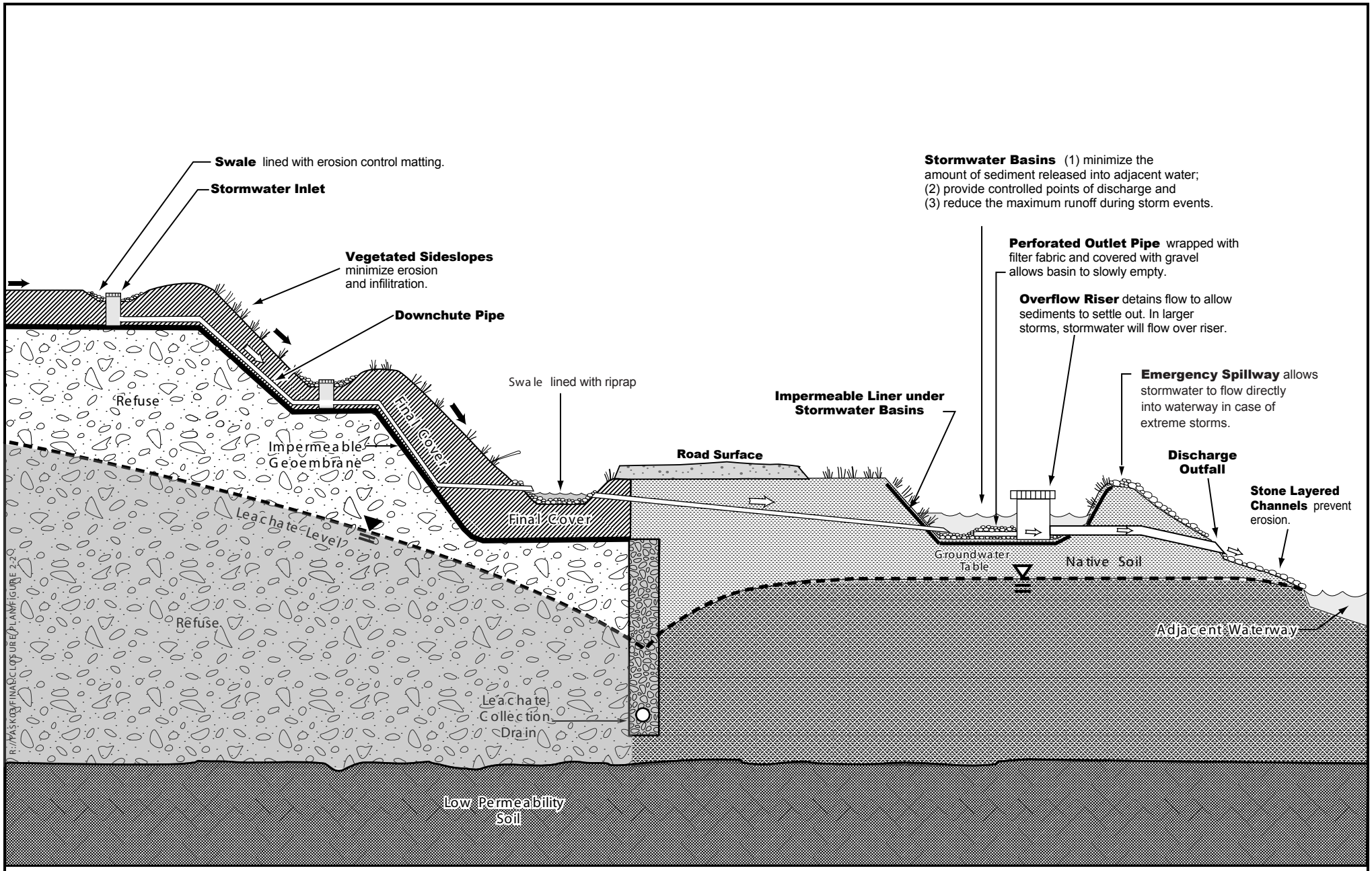
SURFACE WATER FLOW

FLOW IN STORMWATER MANAGEMENT SYSTEMS

FIG. NO. 2-1
CROSS-SECTION OF LANDFILL DRAINAGE SYSTEMS
Sections 1/9 and 6/7



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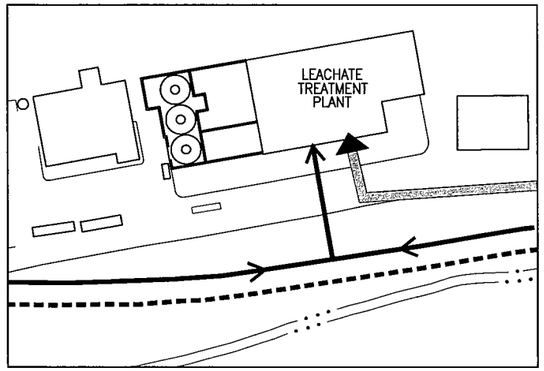
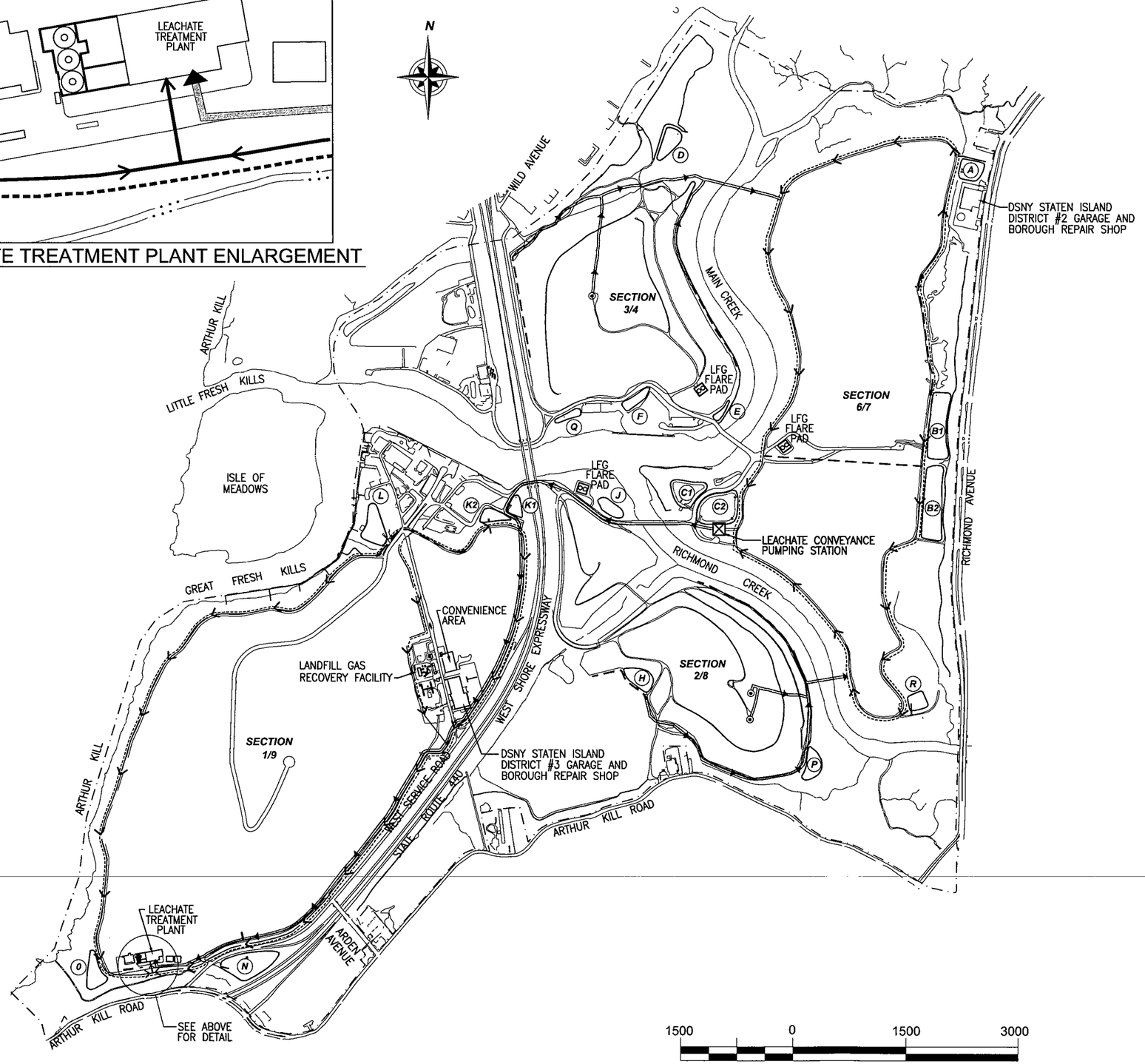
SURFACE WATER FLOW

FLOW IN STORMWATER MANAGEMENT SYSTEMS

FIG. NO. 2-2
CROSS-SECTION OF LANDFILL DRAINAGE SYSTEMS
Sections 2/8 and 3/4



LEACHATE TREATMENT PLANT ENLARGEMENT



LEGEND

- LANDFILL COMPLEX BOUNDARY
- STORMWATER BASIN AND DESIGNATION (E)
- LFG FLARE STATION
- CUTOFF WALL
- LEACHATE COLLECTION DRAIN
- LEACHATE FORCE MAIN
- LEACHATE COLLECTION HEADER AND DRAIN
- LEACHATE RECOVERY WELL
- LEACHATE CONVEYANCE PUMP STATION

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LEACHATE CONTROL SYSTEM:
OVERALL SITE PLAN

FIG. NO. 2-3

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2.2.2 Leachate Containment System

Cutoff walls constructed of soil bentonite or cement bentonite are located along the entire perimeters of Sections 1/9 and 6/7. The bottoms of the cutoff walls are keyed into underlying fine-grained geologic units. The purpose of the cutoff wall is to restrict the horizontal flow of water from outside the Landfill boundary into the leachate collection drain and to restrict the flow of leachate into the surrounding environment. The cutoff wall also provides containment for leachate during periods of temporary shutdown of the leachate collection or treatment systems.

Routine inspections are performed to ensure that no visible structural damage to the wall exists. The cutoff wall has no moving or mechanical parts and requires no routine maintenance. The effectiveness of the cutoff wall is monitored by measuring the water levels in hydraulic monitoring wells installed in pairs on each side of the cutoff wall.

2.2.3 Leachate Collection System

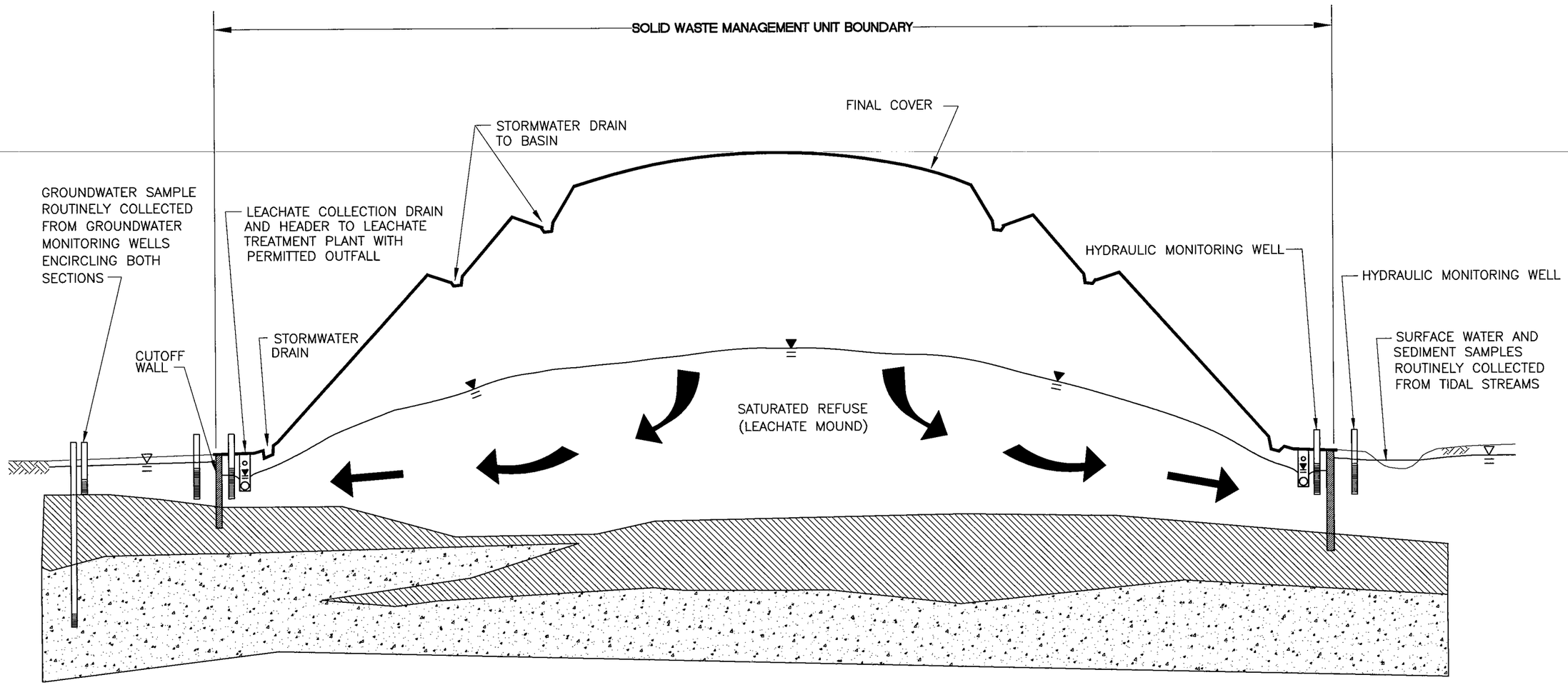
LEACHATE COLLECTION DRAINS (SECTIONS 1/9 AND 6/7)

At Sections 1/9 and 6/7, the leachate collection drain is located approximately 20 feet inside the cutoff wall. The drain consists of a stone-filled trench with a slotted corrugated high density polyethylene (HDPE) pipe. Leachate in the collection drain flows into a series of leachate collection pump stations, which pump the leachate to the leachate treatment plant. By pumping leachate from the leachate collection pump stations and the drain, the leachate level in the collection drain is lowered, resulting in an inward hydraulic gradient across the cutoff wall that precludes outward migration of leachate through the cutoff wall.

The cutoff walls and leachate collection drains used at Sections 1/9 and 6/7 are illustrated in Fig. No. 2-4.

PARTIAL PERIMETER DRAINS (SECTIONS 2/8 AND 3/4)

Partial perimeter drains, similar to those at Sections 1/9 and 6/7, are located at the toe of slope along selected perimeter segments of Sections 2/8 and 3/4. The effectiveness of the segments of leachate collection drain at Sections 2/8 and 3/4 located along Richmond and Main Creeks is monitored by measuring the water levels in monitoring piezometers installed in pairs on each side of the drain and by limited analytical testing of water samples taken at the monitoring piezometers and leachate collection pump stations.



LEGEND

- PREDOMINANT LEACHATE FLOW DIRECTION THROUGH REFUSE/FILL
- FINAL COVER
- LOW PERMEABILITY UNIT
- HIGH PERMEABILITY UNIT
- GROUNDWATER LEVEL
- LEACHATE LEVEL

NOTE:
1. THIS IS A CONCEPTUAL SCHEMATIC REPRESENTATION WHICH IS NOT DRAWN TO SCALE.

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LEACHATE CONTROL SYSTEMS:
SECTIONS 1/9 AND 6/7
FIG. NO. 2-4

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LEACHATE RECOVERY WELLS (SECTIONS 2/8 AND 3/4)

Leachate recovery wells are installed on the top of Landfill Sections 2/8 and 3/4. Two recovery wells are located at Section 2/8. One recovery well is located at Section 3/4. These leachate recovery wells collect leachate from the central portion of the refuse mounds at these landfill sections.

The partial perimeter drains and leachate recovery wells used at Sections 2/8 and 3/4 are illustrated in Fig. No. 2-5.

2.2.4 Leachate Conveyance System

The leachate conveyance system consists of leachate collection pump stations located along the leachate collection drains and header pipes and force mains that convey the collected leachate to the FKLLTP. Each leachate collection pump station consists of a wet well with a submersible leachate well pump. Level sensors installed in each pump station control the activation of the pump. At each leachate collection pump station, a sampling port, pressure gauge, check and ball valves and flow meter are located either in an aboveground enclosure or in an underground concrete vault, which extends to grade and is equipped with an access hatch for sampling and maintenance.

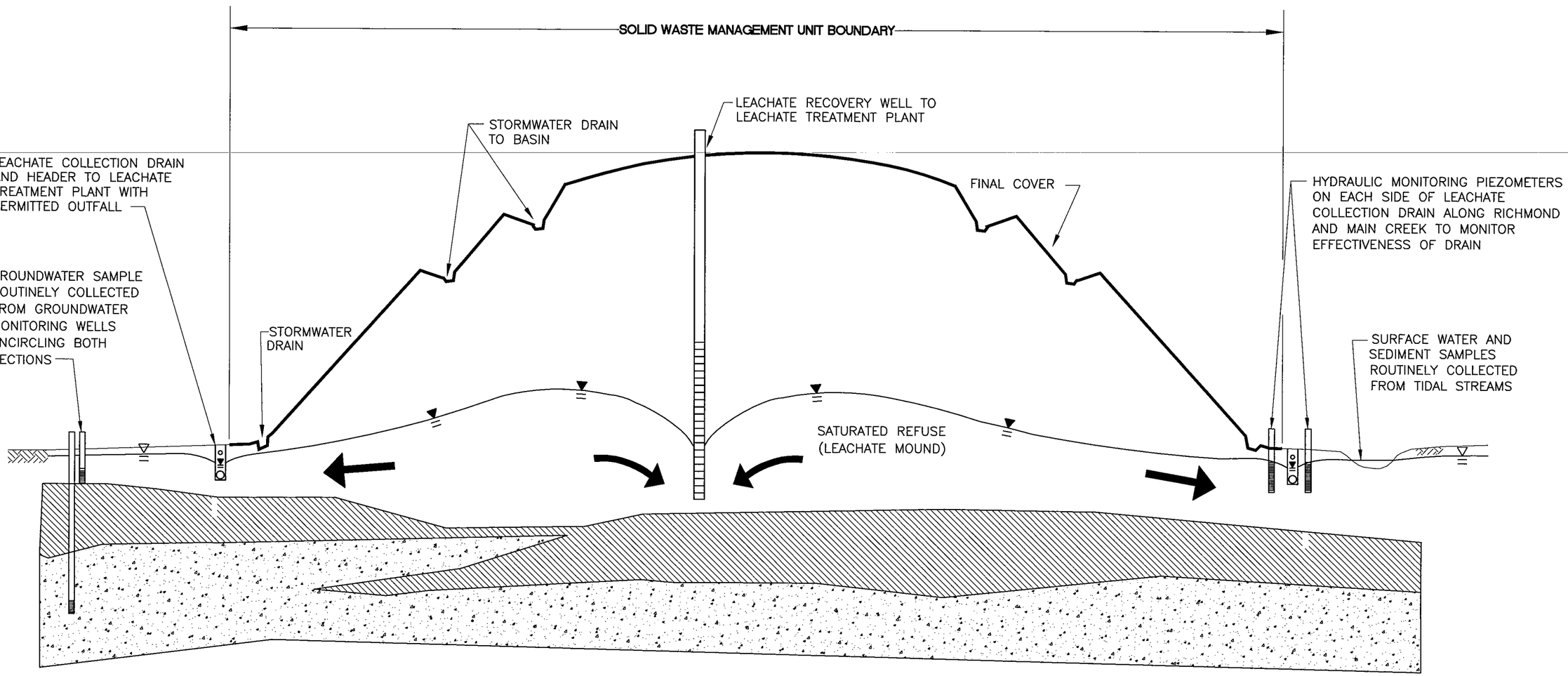
Leachate collected at the leachate collection pump stations is conveyed to the FKLLTP through leachate collection headers and force mains. The header pipe at Section 1/9 flows directly to the FKLLTP. The header pipes at Sections 2/8 and 3/4 cross beneath Richmond and Main Creeks, respectively, and connect into the header pipe for Section 6/7, which empties into the Section 6/7 leachate conveyance pump station. The leachate conveyance pump station conveys leachate to the FKLLTP through a leachate force main. The locations of the leachate collection headers and force main are shown on Fig No. 2-3.

2.2.5 Leachate Treatment Plant

The FKLLTP is located in the southwestern end of Section 1/9 (see Fig. No. 2-3). The collected leachate is conveyed to the plant and treated. Effluent from the plant is discharged into the Arthur Kill through a subaqueous outfall in accordance with the plant's State Pollution Discharge Elimination System (SPDES) Permit (SPDES No. NY-0200867). The FKLLTP consists of three 300,000 gpd treatment trains (the more recently constructed expansion plant) and two 75,000 gpd treatment trains (formerly the Veterans Avenue Leachate Treatment Plant [VALTP]). The FKLLTP has an average design capacity of 1,050,000 gallons per day (gpd) and a peak capacity of 1,325,000 gpd under NYSDEC Permit No. 2-6404-00275/00013-0.

The treatment system at the FKLLTP consists of the following major unit processes:

- Influent holding
- Sequencing batch reactors for biological treatment
- Metals precipitation
- Gravity clarification
- Sand filtration



LEGEND

- PREDOMINANT LEACHATE FLOW DIRECTION THROUGH REFUSE/FILL
- FINAL COVER
- LOW PERMEABILITY UNIT
- HIGH PERMEABILITY UNIT
- GROUNDWATER LEVEL
- LEACHATE LEVEL

NOTE:
1. THIS IS A CONCEPTUAL SCHEMATIC REPRESENTATION WHICH IS NOT DRAWN TO SCALE.

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LEACHATE CONTROL SYSTEMS:
SECTIONS 2/8 AND 3/4
FIG. NO. 2-5

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- Effluent pH adjustment
- Discharge through diffuser outfall

Detailed descriptions of the FKLLTP are provided in the *Engineering Report, Fresh Kills Landfill Leachate Treatment Plant* (Ref. No. O-1), which was submitted in August 1994. The *Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan* (Ref. No. O-2) was also submitted in August 1994 to meet the requirements of Consent Order Appendix A-4, Subject 15. Submitted with the SPDES permit application for the FKLLTP in January 1996 was the *Engineering Report for Veterans Avenue Leachate Treatment Plant, January 1996* (Ref. No. O-12). Contract drawings for the FKLLTP were provided in the *Fresh Kills Landfill Leachate Treatment Plan, Staten Island, New York Contract Drawings, March 1995* (Ref. No. O-8).

Operations and monitoring of the FKLLTP, the leachate collection pump stations in Sections 1/9, 6/7, 2/8 and 3/4, and the recovery wells at Sections 2/8 and 3/4 are controlled by a supervisory control and data acquisition (SCADA) system. The effectiveness of the leachate treatment plant is monitored by analytical testing of the influent and effluent performed in accordance with the requirements of the SPDES permit.

2.3 LANDFILL GAS CONTROL SYSTEM

The generation of landfill gas (LFG) is a natural process resulting from the decomposition of organic material in municipal solid waste. LFG is comprised mainly of methane, an explosive gas, and carbon dioxide, along with traces of other gases. Without controls, LFG will tend to migrate away from the Landfill within unsaturated soil layers, both vertically and horizontally. LFG also is a concern because of its odor and its effect on air quality—particularly the emission of methane, a "greenhouse gas" believed to contribute to global warming, and non-methane organic compounds (NMOC), which may be harmful to human health.

Landfill gas at the Fresh Kills Landfill is managed both to control emissions of methane and NMOC and to prevent off-site migration of LFG. Post-closure operations and maintenance of the landfill gas emissions management system are detailed in the *Operation and Maintenance Plan for Landfill Gas Collection and Control System*, which is included as Volume D of the *Post-Closure Monitoring and Maintenance Operations Manual* (Ref. No. W-49). The post-closure landfill gas migration monitoring program is detailed in *Volume C – Environmental Monitoring Plan* of the *Draft Post-Closure Monitoring and Maintenance Operations Manual*.

2.3.1 Landfill Gas Emissions Management System

Components of the landfill gas emissions management system are an active collection system, a flaring system, and a passive venting system. The active collection, flaring, and gas recovery systems will be operated during the post-closure period, in accordance with the requirements of 6 NYCRR Part 208. Passive vents will be closed while the active system is in operation; they will be opened only after the post-closure period or after methane generation has declined to the extent that the active gas collection system is no longer required.

2.3.1.1 Active Collection Systems

The active LFG system is designed to collect and combust LFG from the Landfill, in accordance with Federal and state emissions regulations. The primary elements of the system are as follows:

At each Landfill section:

- Active LFG extraction wells.
- Networks of interconnected piping, which convey the collected LFG to the flare stations and/or the landfill gas transmission main.
- Condensate tanks, which collect condensate at low points along the header pipe runs at each section.

Flare stations located at Sections 2/8, 3/4, and 6/7:

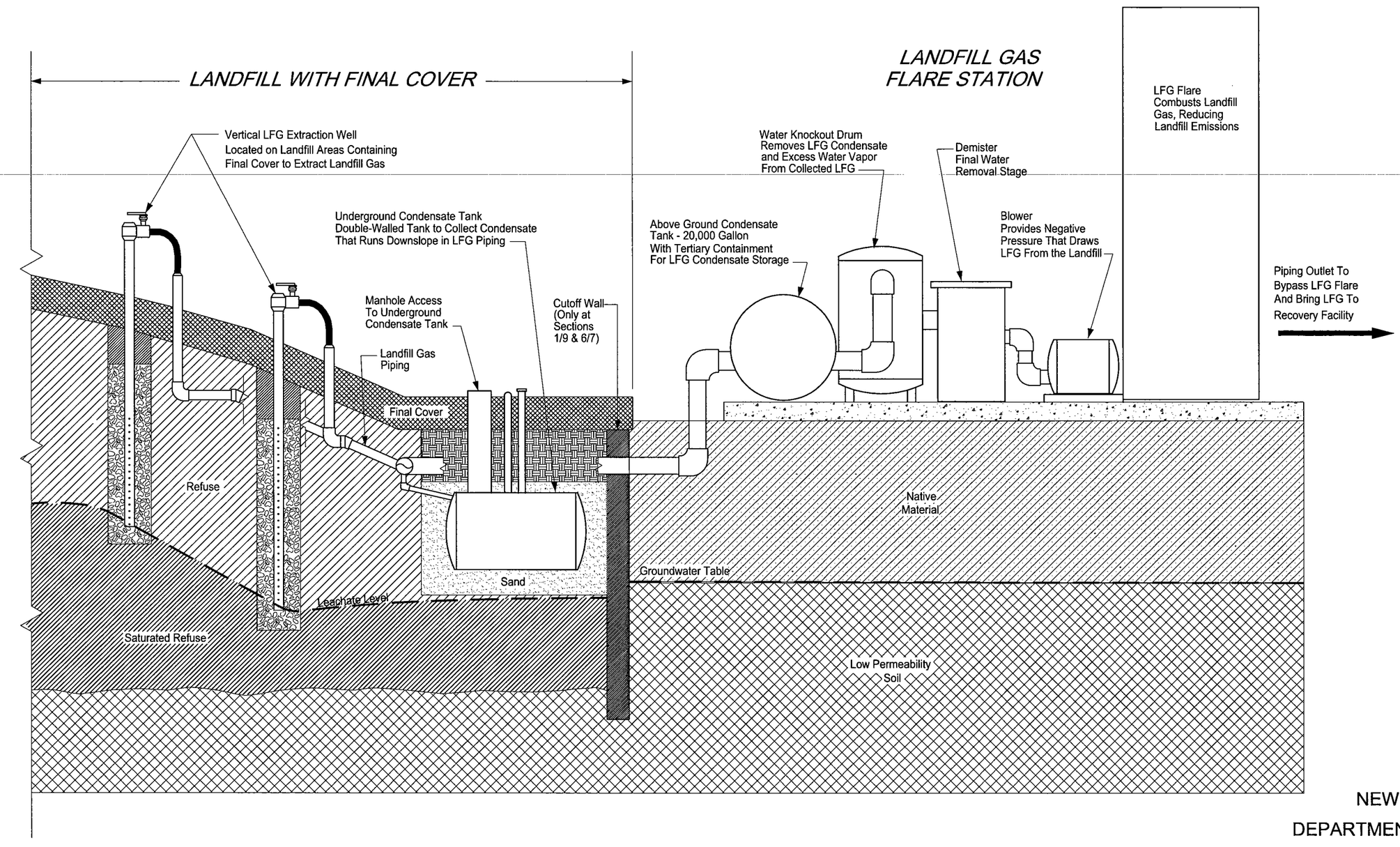
- LFG blowers, which provide the necessary vacuum to draw LFG from the LFG wellfield and convey it to the flare stations, from which it may be conveyed via the landfill gas transmission main to the LFG recovery facility.
- LFG flares, which combust the collected LFG.

A separately permitted landfill gas recovery facility located at Section 1/9 is used to recover and purify the collected landfill gas for commercial purposes.

These elements are illustrated in Fig. No. 2-6. A plan view of the landfill gas flaring and recovery systems is provided on Attachment 4, Sheet LF-4. A detailed description of the active LFG system and procedures for operations and maintenance of the system are presented in *Volume D* of the *Post-Closure Monitoring and Maintenance Operations Manual* (Ref. No. W-49).

2.3.1.2 Gas Recovery and Flaring Systems

LFG collected on site is processed through one of two methods in order to comply with regulatory requirements for emissions reduction. These methods are recovery and purification of the gas for use as fuel, and flaring, which is the combustion of LFG at high temperature resulting in the thermal destruction of NMOCs. All LFG collected from all four Landfill sections will be sent to the separately permitted landfill gas recovery facility. A landfill gas transmission main conveys collected gas from Sections 2/8, 3/4, and 6/7 to the landfill gas recovery facility. As-



NOTE:

1. THIS IS A CONCEPTUAL SCHEMATIC REPRESENTATION WHICH IS NOT DRAWN TO SCALE.

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FRESH KILLS LANDFILL
STATEN ISLAND, NEW YORK

ACTIVE LANDFILL GAS
(LFG) COLLECTION SYSTEM

FIG. NO. 2-6

P:\Freshkills\Final Closure Plans\Figures\Fig_2-6.dwg

built drawings of the landfill gas transmission main are included as *As-Built of Landfill Gas Transmission Line and Fire Water System* (Ref. No. R-5), submitted in July 2001. The landfill gas recovery facility is currently operated under NYSDEC Air Pollution Control – Title V Permit ID No. 2-6499-00029/00151 and Part 360 Permit ID No. 2-6499-00029/00175.

If the quantity of gas exceeds the capacity of the LFG recovery facility, or if the facility is shut down, collected LFG will be sent to the flare stations. At all sections except for Section 1/9, excess LFG that cannot be processed by the recovery facility will be combusted by the flare station at the section where the LFG is collected. Collected LFG from Section 1/9 can be directed to the flare stations via the landfill gas transmission main.

The modular flaring stations installed at Section 2/8, 3/4, and 6/7 combust the LFG and provide the necessary NMOC emissions reduction. These flaring stations contain the same basic components and can each process up to 10,000 standard cubic feet per minute (scfm) of LFG. The basic components at each modular flaring station include two flares, three exhauster/blowers, three demisters, a knockout tank, and an aboveground 20,000-gallon condensate storage tank. Three blowers located at each flaring station act to provide the necessary negative pressure within the piping and wells to draw the LFG through the system. At each of these flaring stations, when operating at capacity, only two blowers will operate at any given time with one blower on standby as a backup during the post-closure period.

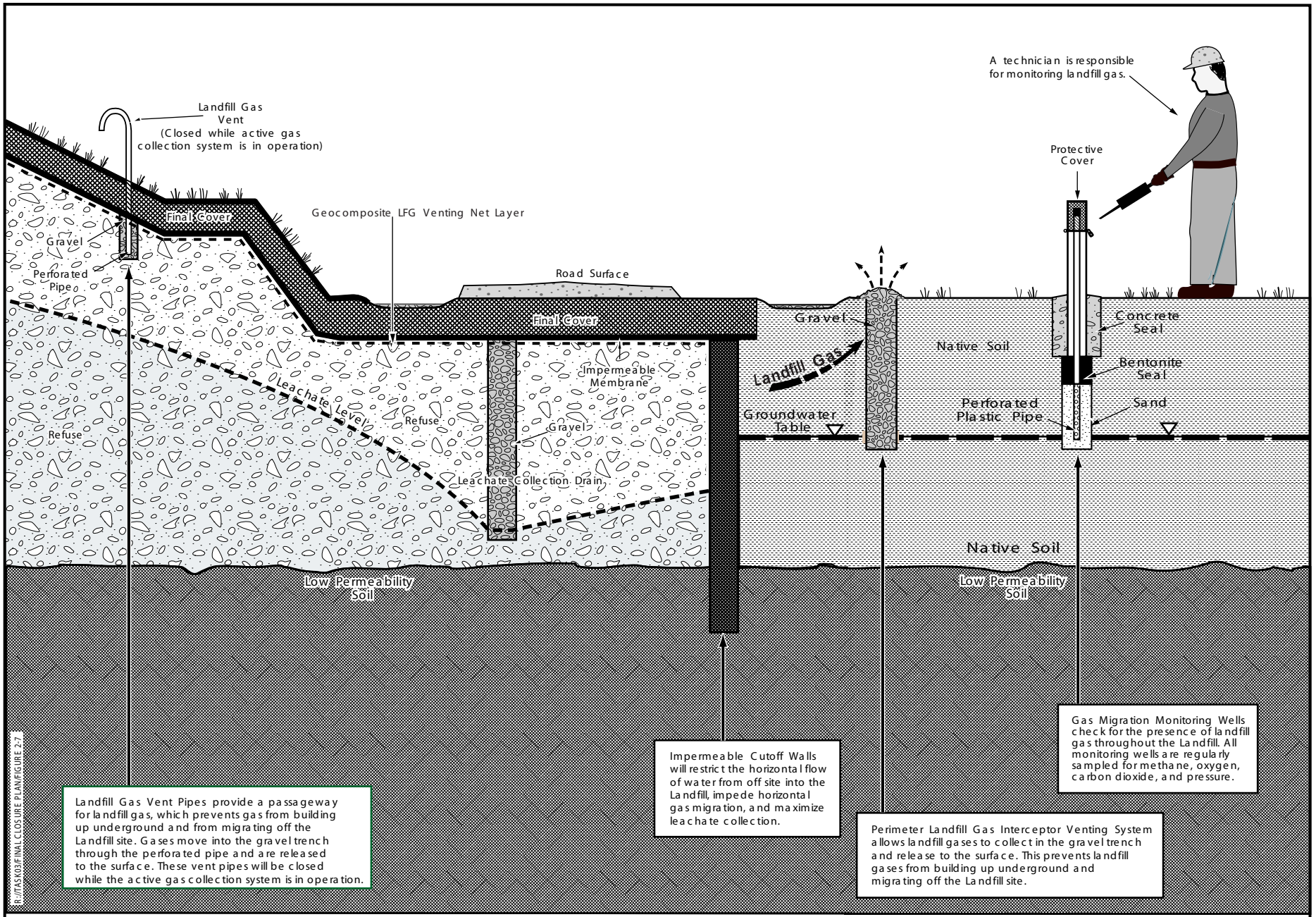
2.3.1.3 Passive Venting Systems

Passive venting systems have been installed to vent LFG at all four Landfill sections. As discussed above, these systems will be closed while the active system is in operation; they will be opened only after the post-closure period or after methane generation has declined to the extent that the active gas collection system is no longer required.

At Sections 1/9 and 6/7, in general, the passive venting system will consist of the following components:

- a geocomposite venting net layer installed beneath the geomembrane; and
- vents through the cap to provide for passive venting in the future.

The vents are to be installed at a density of one per acre. The geocomposite layer will consist of a geotextile heat-bonded to both sides of HDPE geonet drainage material. The venting layer will be installed in compliance with regulatory requirements of 6 NYCRR Part 360-2.15(e) and (f), which specify a 12-inch-thick layer of soil with a permeability of $1x10^{-3}$ cm/s or greater. The geocomposites used for this venting layer will have a permeability on the order of $1.0x10^{-1}$ cm/s. A cross-section of the passive LFG venting system to be installed at Sections 1/9 and 6/7 is presented in Fig. No. 2-7. A close-up illustration of typical final cover and landfill gas venting systems at Sections 1/9 and 6/7 is presented in Fig. No. 2-8.



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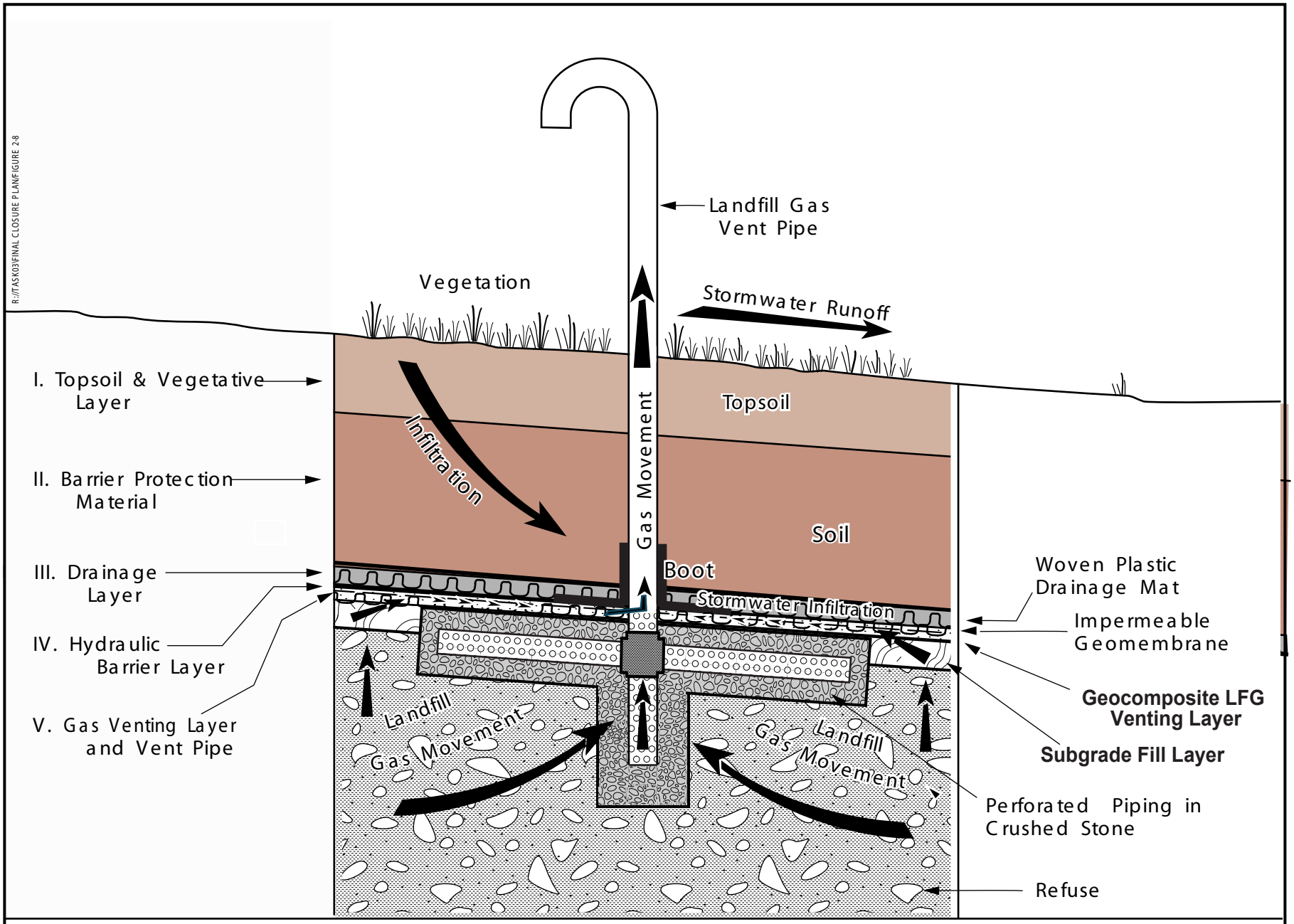
Fresh Kills Landfill Staten Island, New York

FIG. NO. 2-7
CROSS-SECTION OF THE LANDFILL
GAS VENTING SYSTEM
Sections 1/9 and 6/7



NEW YORK CITY DEPARTMENT OF SANITATION
Fresh Kills Landfill Staten Island, New York

FIG. NO. 2-8
FINAL COVER AND LANDFILL GAS VENTING SYSTEM
Sections 1/9 and 6/7

At Sections 2/8 and 3/4, a network of LFG duct vents was constructed along with placement of final cover. These duct vents consist of trenches cut into the existing intermediate cover and refuse. Within each of the stone-filled ducts is a perforated pipe that runs along the entire length of the duct to facilitate gas movement. These ducts are fully enclosed within a geotextile to prevent the intrusion of cover soil and refuse. The ducts are oriented perpendicularly to the final grading contours of each landfill section. Along these ducts, vertical riser vents are connected that will convey the LFG from the ducts through the landfill cover layer and into ambient air. To seal the penetration and preserve the integrity of the hydraulic barrier layer, the vertical riser vent is attached to the flexible geomembrane liner of the final cover by means of a geomembrane boot. A cross-section of a typical LFG duct vent installed at Sections 2/8 and 3/4 is presented in Fig. No. 2-9. A close-up illustration of typical final cover and landfill gas venting systems at Sections 2/8 and 3/4 is presented in Fig. No. 2-10.

An application for variance from 6 NYCRR Part 360-2.13(p) for the LFG duct vents was submitted to NYSDEC in conjunction with an active gas collection system that would be in operation at Sections 2/8 and 3/4 until gas emissions fell below regulated thresholds. The variance was then submitted in conjunction with the Fresh Kills Landfill, Landfill Gas Flares Application to NYSDEC, dated April 1998 (Appendix FF), which resulted in NYSDEC Permit No. 2-6403-00011/00063 (Ref. No. N-150). Based on this review and acceptance under the permit application, the LFG duct vents in conjunction with the active gas collection system were approved by NYSDEC in lieu of a continuous gas venting layer.

2.3.2 Landfill Gas Migration Management System

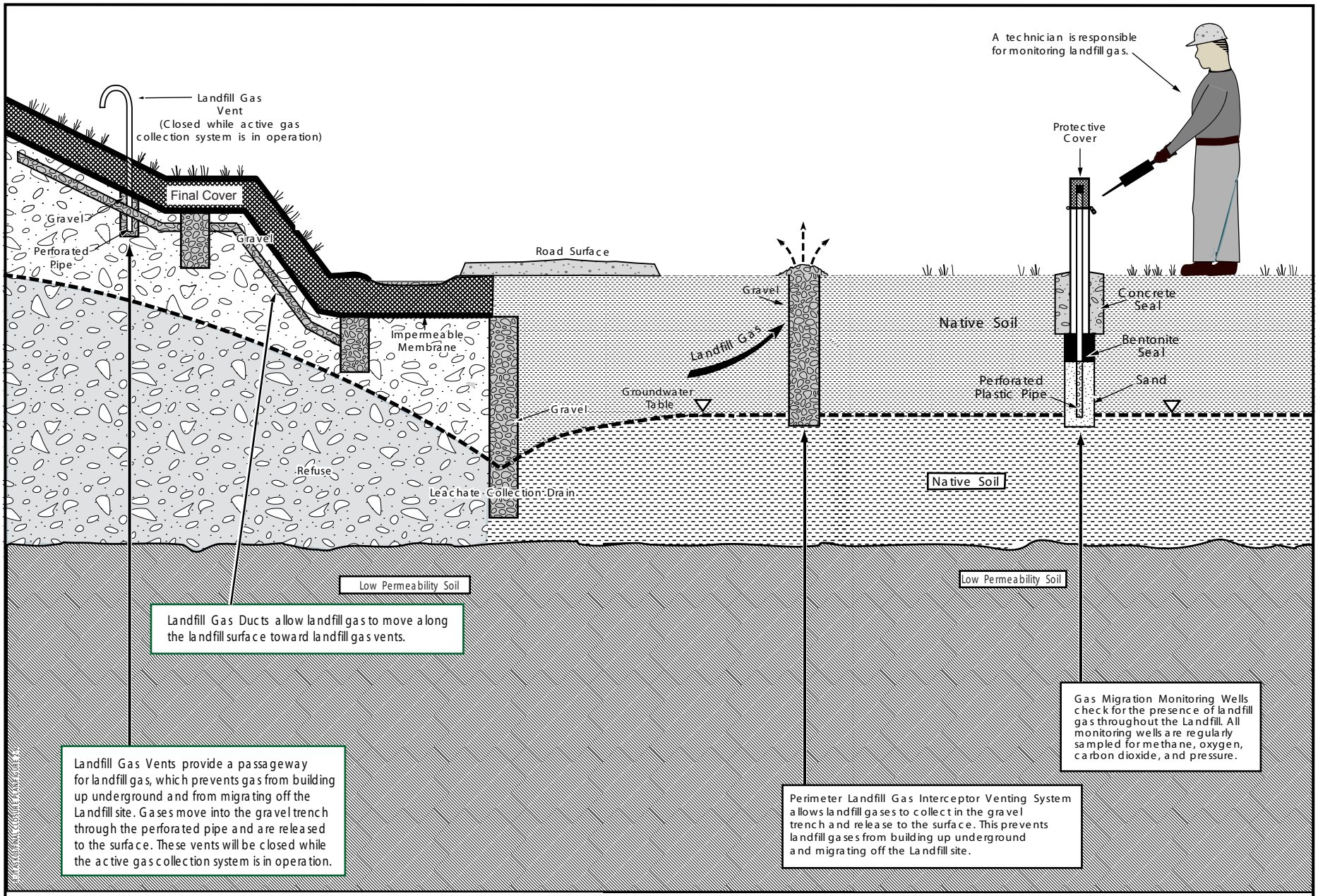
To prevent the off-site migration of LFG and the accumulation of LFG in both on-site and off-site structures, a LFG migration management system has been developed and implemented at the Landfill. In accordance with 6 NYCRR Part 360-2.17(f) and related regulations, the concentration of methane and other explosive gases generated by the Landfill shall not exceed:

a) 25 percent of the lower explosive limit for gases in facility structures on or off site, excluding gas control or recovery system components; and
b) the lower explosive limit for the gases at or beyond the property boundary.

The LFG migration management system consists of two programs: engineered controls (including the perimeter LFG interceptor venting system, utility seals, and the perimeter leachate collection and containment systems), and migration monitoring along the property boundary of the Landfill.

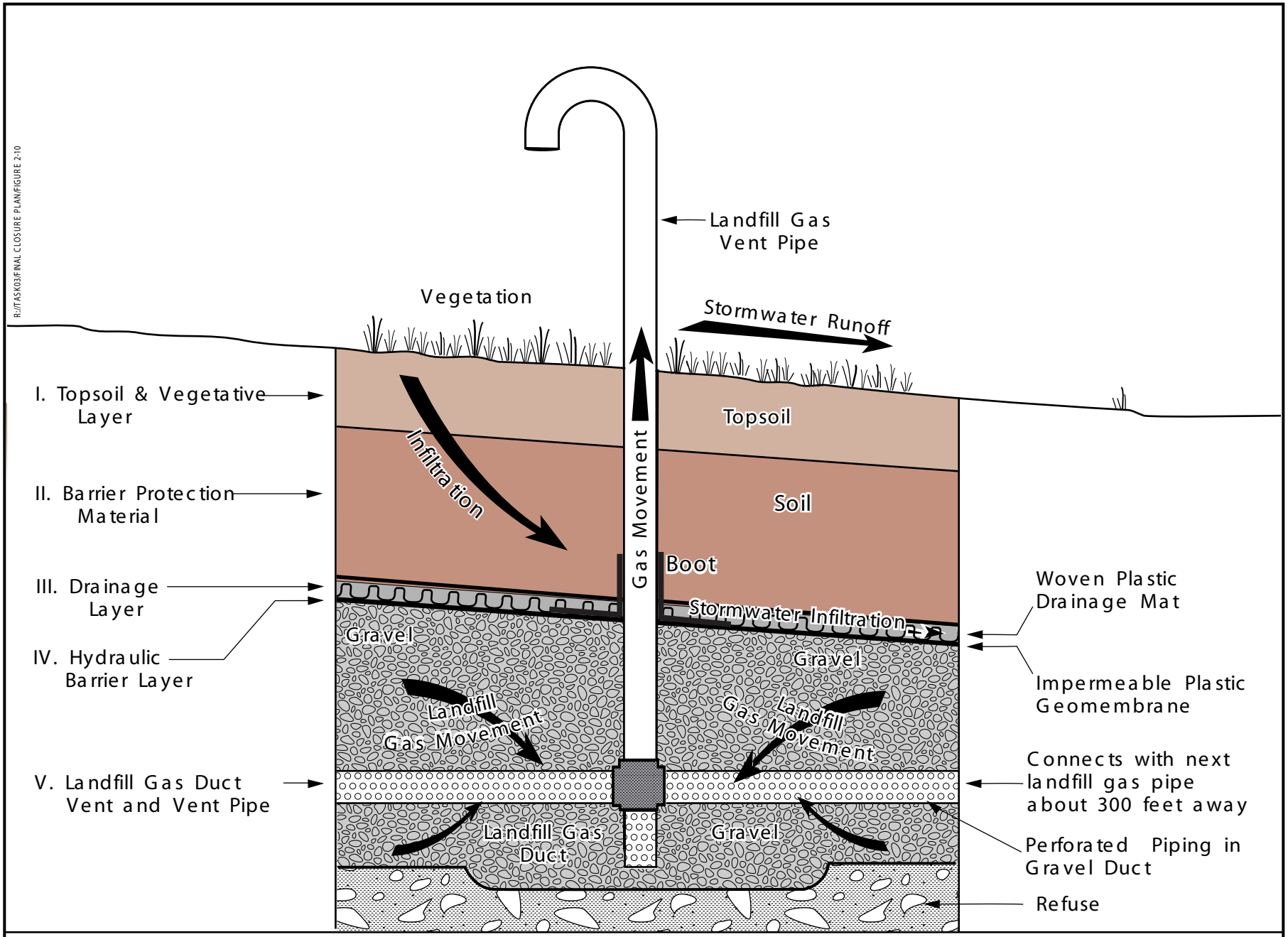
2.3.2.1 Engineered Controls

A perimeter LFG interceptor venting system is installed along the perimeter of the Landfill, except where adjacent water bodies provide a natural barrier to migration. Locations of the interceptor venting system are shown on Attachment 4, Sheet LF-5. The interceptor venting system is keyed into low-permeability soils or extended below the seasonal low groundwater table to form a barrier to off-site migration of LFG generated within the Landfill and to allow the LFG to vent passively. Where underground utilities may act as conduits for the LFG migration, utility seals are used to cut off the LFG from migrating along the utility conduits.



NEW YORK CITY DEPARTMENT OF SANITATION
Fresh Kills Landfill Staten Island, New York

FIG. NO. 2-9
CROSS-SECTION OF THE LANDFILL GAS VENTING SYSTEM
Sections 2/8 and 3/4



NEW YORK CITY DEPARTMENT OF SANITATION
Fresh Kills Landfill Staten Island, New York

FIG. NO. 2-10
FINAL COVER AND LANDFILL GAS VENTING SYSTEM
Sections 2/8 and 3/4

An additional feature at the Landfill that contributes to LFG migration control is the leachate containment system. This system includes low permeability cutoff walls keyed into low permeability soils or bedrock around the perimeter. Although the primary function of this system is to contain leachate, it also functions to control lateral migration of LFG.

2.3.2.2 Migration Monitoring

To evaluate the effectiveness of the engineered controls in deterring LFG migration and meeting the requirements of 6 NYCRR Part 360-2.15(k)(4) during the post-closure period, a post-closure landfill gas migration monitoring program has been developed. An array of LFG migration monitoring wells has been installed along the perimeter of the Landfill complex. The landfill gas migration monitoring program consists of the quarterly measurement of subsurface pressure and concentrations of methane, oxygen, and carbon dioxide as percent gas at these LFG migration monitoring wells. The locations of these wells are shown on Attachment 4, Sheet LF-5. In addition, structures at the Landfill are equipped with methane sensors, which are maintained and calibration on a quarterly basis. Details of the post-closure landfill gas migration monitoring program are presented in *Volume C* of the *Post-Closure Monitoring and Maintenance Operations Manual* (Ref. No. W-49). Contingency procedures to be followed when methane concentrations measured during migration monitoring exceed regulatory limits are presented in Volume C of this Manual.

SECTION 3

CLOSURE AND POST-CLOSURE ISSUES

This section addresses various closure and post-closure issues, including end use, the closure construction schedule, the environmental monitoring program, post-closure operations and maintenance, and closure and post-closure cost estimates. A description of the references cited in Section 3 is provided in Table 3-1.

3.1 END USE

Landscaping and end use plans were developed in accordance with 6 NYCRR Part 360-2.6 in conjunction with final cover design reports for the various sections. The landscaping plans incorporate an initial stabilization plan, installation of permanent ground cover, and a long-term plan for the placement of herbaceous and woody plant communities. Landscaping is an active part of the final cover system; not only does landscaping provide erosion control, but it also serves as a tool to assess final cover integrity, revealing landfill gas leaks as well as erosion problems.

End use of the Landfill property during the post-closure period will be in accordance with 6 NYCRR Part 360-2.15 (k)(9). This regulation stipulates that use of the property shall not disturb the integrity of the final cover, liners, or any other components of the containment system, or the function of the monitoring or environmental control systems, unless necessary to comply with the requirements of 360-2.20, which concerns corrective measures. Any change to end use of the Landfill will be a separate action under Part 360 and will be in accordance with 360-2.15(k)(9).

End uses for Section 2/8 and 3/4 primarily were addressed in *Final Closure Plan for Sections 2/8 and 3/4, Appendix A-3; Milestone 9, Order On Consent, Fresh Kills Landfill, May 18, 1992* (Ref. No. S-38). End use of Section 6/7 was provided in *Fresh Kills Landfill*: *Section 6/7 Final Cover Design Report, January 2001* (Ref. No. M-11). End use of Section 1/9 was addressed in *Fresh Kills Landfill*: *Section 1/9 Final Cover Design Report, January 2002* (Ref. No. U-14).

3.2 CLOSURE CONSTRUCTION SCHEDULE

Various components of the final cover and other systems for closure have been installed in various stages since before execution of the Consent Order in April 1990. Closure construction at Sections 2/8 and 3/ 4 has been completed. As-built drawings of final cover, drainage, and landfill gas extraction and venting systems at Section 2/8 were provided in *As-Built of Final Cover and Landfill Gas Extraction System – Section 2/8* (Ref. No. I-35), submitted in June 1997. As-built drawings of final cover, drainage, and landfill gas extraction and venting systems at Section 3/4 were provided in *As-Built of Final Cover and Landfill Gas Extraction System – Section 3/4* (Ref. No. P-39), submitted in June 1997.

Detailed closure construction schedules for Sections 6/7 and 1/9 were provided in *Fresh Kills Landfill*: *Section 6/7 Final Cover Design Report* (Ref. No. M-11) and *Fresh Kills Landfill*:

Table 3-1
List of References for Section 3: Closure and Post-Closure Issues
Fresh Kills Landfill Final Closure Plan

FLCP Section	Section Title	Ref ID	References	Referenced Information
3.1	End Use	S-38	SCS Engineers, P.C. May 18, 1992. **Final Closure Plan for Sections 2/8 and 3/4, Appendix A-3; Milestone 9; Order on Consent; Fresh Kills Landfill.**	End use for Sections 2/8 and 3/4
		M-11	Malcolm Pirnie, Inc. January 2001. **Fresh Kills Landfill: Section 6/7 Final Cover Design Report Appendix D: Engineering Plan**	End use for Section 6/7
		U-14	URS Corp. January 4, 2002. **Fresh Kills Landfill Section 1/9 Final Cover Design Report.**	End use for Section 1/9
3.2	Closure Construction Schedule	M-11	Malcolm Pirnie, Inc. January 2001. **Fresh Kills Landfill: Section 6/7 Final Cover Design Report.**	Construction schedule for Section 6/7 Final Cover
		U-14	URS Corp. January 4, 2002. **Fresh Kills Landfill Section 1/9 Final Cover Design Report.**	Construction schedule for Section 1/9 Final Cover
3.3	Environmental Monitoring Program	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Vol. C - Environmental Monitoring Program
3.4	Post-Closure Operations and Maintenance	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Vol. A - Post-Closure Monitoring and Maintenance Operations
3.5	Closure and Post-Closure Cost Estimate	W-47	Roy F. Weston of New York, Inc. April 2002. **Financial Assurance Plan.**	Closure and post-closure cost estimate
		W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Closure and post-closure financial assurance and requirements

Section 1/9 Final Cover Design Report (Ref. No. U-14). As a result of placement of material from the World Trade Center at the Landfill, the closure construction schedule has been revised.

Final cover construction at Section 1/9 will generally proceed according to the following sequence. If two activities are listed with the same number, they will be occur concurrently.

1. Asbestos relocation at the Reclamation Area
2. Construction of leachate controls along Muldoon Avenue
   Placement of final cover at Outfall M Catchment
3. Drainage swale preloading
4. Footprint consolidation/recontouring
5. Final cover placement (to be performed over five construction seasons)

A Gantt chart showing the approximate dates for each of these activities is included as Fig. No. 3-1.

Final cover construction at Section 6/7 will generally proceed according to the following sequence.

1. Final cover subbase grading/recontouring
2. Drainage swale preloading
3. Final cover placement (to be performed over five construction seasons)

A Gantt chart showing the approximate dates for each of these activities is included as Fig. No. 3-1.

The approximate number of acres of final cover to be constructed at each section during each construction phase is shown in the following table.

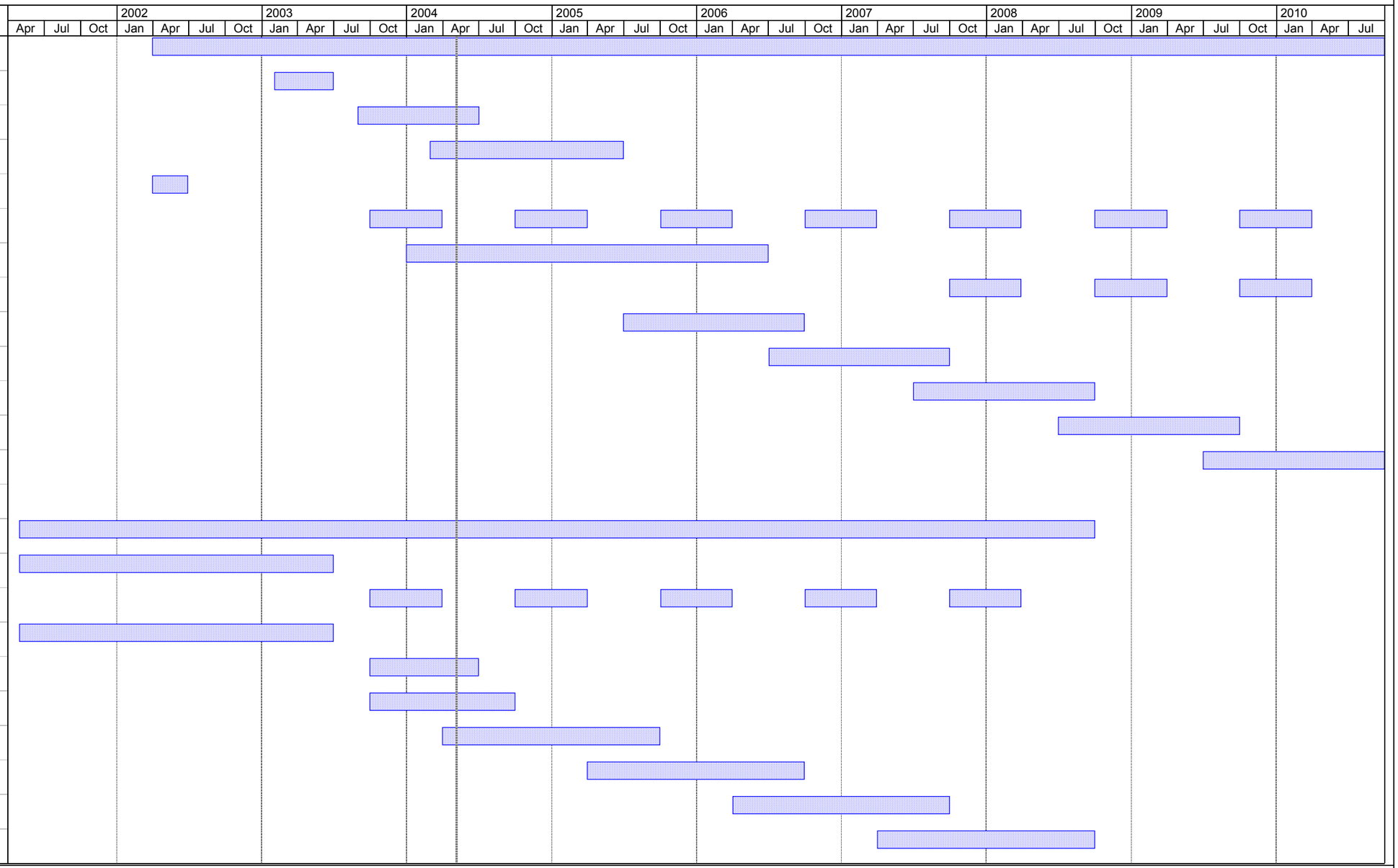
Fiscal Year	**Section 1/9 –acres**	**Section 6/7 – acres**
2004	28	35
2005	--	60
2006	70	62
2007	66	62
2008	60	60
2009	60	
2010	53	

3.3 ENVIRONMENTAL MONITORING PROGRAM

Environmental monitoring will be performed at Fresh Kills Landfill during the post-closure period. The post-closure Environmental Monitoring Plan (EMP), included as Volume C of the *Post-Closure Monitoring and Maintenance Operations Manual* (Ref. No. W-49), is consistent with the Order on Consent Compliance Schedule Appendix A-15.

FIG. NO. 3-1
FINAL COVER CONSTRUCTION SCHEDULE
FRESH KILLS LANDFILL FINAL CLOSURE PLAN

ID	Task Name
1	**SECTION 1/9**
2	Asbestos Relocation
3	Leachate Control (Muldoon Avenue)
4	Final Cover (Outfall M Catchment)
5	Drainage Swale Pre-Loading
6	Drainage Swale Pre-Loading
14	Footprint Consolidation/Recontouring
15	Footprint Consolidation/Recontouring
19	Final Cover Placement - Phase I (FY 2006)
20	Final Cover Placement - Phase II (FY 2007)
21	Final Cover Placement - Phase III (FY 2008)
22	Final Cover Placement - Phase IV (FY 2009)
23	Final Cover Placement - Phase V (FY 2010)
24	
25	**SECTION 6/7**
26	Final Cover Subbase Grading/Recontouring
27	Final Cover Subbase Grading/Recontouring
33	Drainage Swale Pre-Loading
34	Drainage Swale Pre-Loading
35	Final Cover Placement - Phase I (FY 2004)
36	Final Cover Placement - Phase II (FY 2005)
37	Final Cover Placement - Phase III (FY 2006)
38	Final Cover Placement - Phase IV (FY 2007)
39	Final Cover Placement - Phase V (FY 2008)



Project: Fnl_Cvr_Sched
Date: Wed 5/5/04

Task
Split
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Split
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
External Milestone
Deadline

The specific procedures to be followed to comply with the Order on Consent between the New York State Department of Environmental Conservation and the City of New York Department of Sanitation (DEC Case #D2-9001-89-03) and 6 NYCRR Part 360 2.15(k)(7) environmental monitoring requirements are described in the EMP. These procedures are specific to groundwater quality, surface water and sediment quality, and landfill gas migration monitoring. Hydraulic monitoring and well maintenance activities related to groundwater and landfill gas migration monitoring are also described. Record keeping and reporting requirements and contingency action levels and procedures are also addressed in the EMP.

Modifications to the environmental monitoring program will be implemented in accordance with 6 NYCRR Part 360-2.15(k)(4). Revisions to the EMP may be made through issuance of addenda, submittal of a partially (e.g., one section) or fully revised document, or submittal of revised supporting documents. The following programs are included in the EMP:

- **Groundwater Quality Monitoring Program**
  Groundwater monitoring will be performed quarterly on a rotating landfill section basis during an annual monitoring period. The annual monitoring period will be based on a calendar year. Each groundwater sample will be analyzed for routine or baseline plus previously detected expanded (baseline +) parameters.

  Monitoring of the shallow/refuse monitoring zone will be performed on a quarterly basis for baseline + parameters. The monitoring frequency of individual shallow/refuse monitoring wells will be biennial. Approximately half of the shallow/refuse monitoring wells will be sampled during each annual monitoring period.

  Within the intermediate depth and deep (bedrock) monitoring zones, sample collection will also be performed quarterly. Sections 1/9 and 2/8 monitoring wells will be sampled during the January and July sampling quarters and Sections 3/4 and 6/7 monitoring wells during the April and October sampling quarters. During the January and April sampling quarters, groundwater samples will be analyzed for routine parameters. During the July and October sampling quarters, groundwater samples will be analyzed for baseline + parameters.

  Groundwater samples will also be analyzed for geochemical solute and environmental isotope parameters. The intermediate depth and deep (bedrock) monitoring wells will be sampled annually and the shallow/refuse monitoring wells biennially for geochemical analysis. Groundwater samples for geochemical analysis will be collected during the January sampling quarter.

- **Surface Water and Sediment Quality Monitoring Program**
  Surface water and sediment quality monitoring will be performed during the July sampling quarter. This program will consist of surface water, sediment and benthic ecology monitoring. Surface water quality will be monitored annually and sediment quality and benthic ecology will be monitored biennially. The surface water and sediment samples will be analyzed for baseline + parameters. The benthic ecology samples will be analyzed for grain size, total organic carbon and total petroleum

hydrocarbons, and will be evaluated for the identification and enumeration of benthic organisms.

- **Landfill Gas Migration Monitoring Program**
  The landfill gas migration monitoring program will be performed quarterly. As also discussed in Section 2.3.2.2, the landfill gas migration monitoring program consists of the measurement of subsurface pressure and concentrations of methane, oxygen, and carbon dioxide as percent gas at landfill gas migration monitoring wells located along the perimeter of the Landfill complex. Structures at the Landfill will be equipped with methane sensors, which will be maintained and calibrated on a quarterly basis.

3.4 POST-CLOSURE OPERATION AND MAINTENANCE

3.4.1 Post-Closure Monitoring and Maintenance Operations Manual

The *Post-Closure Monitoring and Maintenance Operations Manual* (Ref. No. W-49—"the Manual") provides a description of overall management of the Landfill during the post–closure period. The Manual was prepared in accordance with the regulatory requirements of 6 NYCRR Part 360-2.15(k) and the Consent Order for monitoring, maintenance, reporting, and resources requirements. This Manual sets the performance standards and requirements under which the actual monitoring, maintenance, and reporting practices are to be carried out for the entire Landfill.

The Manual consists of four volumes:

- Volume A – Post-Closure Operations and Maintenance
- Volume B – Fresh Kills Landfill Leachate Treatment Plant and Containment and Collection System Operations and Maintenance Plan
- Volume C – Environmental Monitoring Plan
- Volume D – Operation and Maintenance Plan for Landfill Gas Collection and Control System

Contingency procedures for each Landfill system are addressed in the volume that discusses that system.

3.4.2 Vector Monitoring

Vector control services will be provided during closure construction in order to ensure that future vector populations are controlled during closure activities, as discussed in *Fresh Kills Landfill*: *Section 6/7 Final Cover Design Report* (Ref. No. M-11) and *Fresh Kills Landfill*: *Section 1/9 Final Cover Design Report* (Ref. No. U-14). When, in the course of closure construction, vector controls are deemed necessary, a licensed exterminator will be used to develop and implement vector control plans.

3.5 CLOSURE AND POST-CLOSURE COST ESTIMATES

Both 6 NYCRR Part 360-2.15(c) and Consent Order Appendix A-15 require that the Final Landfill Closure Plan include "amended closure and post-closure monitoring and maintenance cost estimates, prepared in accordance with Section 360-2.19." Section 360-2.19 addresses financial assurance criteria that must be satisfied to demonstrate that adequate funds will be readily available for the costs estimated for the closure, corrective measures, and post-closure care of the Landfill.

Closure and post-closure monitoring and maintenance cost estimates are provided in the *Fresh Kills Landfill Financial Assurance Plan (FAP)*, which is updated annually and will be submitted on an annual basis during the post-closure period. The most recent *Fresh Kills Landfill Financial Assurance Plan* was submitted in April 2002 (Ref. No. W-47). Financial assurance criteria and requirements are described more generally in Volume A, Section 7 of the *Post-Closure Monitoring and Maintenance Operations Manual* (Ref. No. W-49).

SECTION 4

LANDFILL SECTION 1/9

4.1 Site Description

Landfill Section 1/9, with a total area of 401 acres, is the largest of the four landfill sections and is located generally between Rte. 440 and Arthur Kill. Solid waste was delivered to Section 1/9 through March 2001. Section 1/9 was re-opened from September 2001 through June 2002 to receive remains from the attack on the World Trade Center. Fig. No. 1-2 shows the general location of Section 1/9 at the Fresh Kills Landfill.

An inventory of the waste received at Section 1/9 is provided in the Financial Assurance Plan (FAP) (Ref. No. W-47). The waste thickness at Section 1/9 is approximately 210 feet at its thickest point. The total in-place volume to be covered is estimated at 76.3 million cubic yards, based on *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14) with adjustments to account for receipt of remains from the attack on the World Trade Center. This volume consists predominantly of municipal solid waste, as well as some intermediate cover soil and material from the World Trade Center. Final cover has been placed along the perimeter and along portions of the lower eastern slope of this section. Remaining final cover placement is scheduled in accordance with the closure construction schedule presented in Section 3.2.

A landfill reclamation design has been prepared for Section 1/9 in accordance with the requirements of 6 NYCRR Part 360-2.18(d). The reclamation work plan is detailed in *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14) and is further discussed in Section 4.3.

4.2 Final Cover and Drainage Systems

4.2.1 Final Cover

Final cover at Section 1/9 has been and will be installed in several stages. All final cover installed at Section 1/9 has been or will be constructed in accordance with 6 NYCRR Part 360-2.15(d) or regulations applicable at the time of installation. A plan view of the eight different types of final cover is presented in Attachment 4, Sheet 19-2. The design details of the final cover types used at Section 1/9 are shown in Sheet 19-3. The final cover types used at Section 1/9 and at other Landfill sections are also presented in Table 2-2.

The eight final cover types at Section 1/9 are as follows:

Type IIIA

Type IIIA final cover is also referred to as Type 2 in *Construction As-Built Drawings: Fresh Kills Landfill Leachate Control Sitework and Appurtenances* (Ref. No. T-1). This cover type

Table 4-1
List of References for Section 4: Landfill Section 1/9
Fresh Kills Landfill Final Closure Plan

FLCP Section	Section Title	Ref ID	References	Referenced Information
4.1	Site Description	W-47	Roy F. Weston of New York, Inc. April 2002. **Financial Assurance Plan.**	An inventory of the waste received at Section 1/9
		U-14	URS Corp. January 4, 2002. **Fresh Kills Landfill Section 1/9 Final Cover Design Report.**	The total in-place volume to be covered at Section 1/9
4.2	Final Cover and Drainage Systems	T-1	Tully Construction/Munoz Engineering. Set No. 1, December 20, 1999, and Set No. 2, May 2000. **Construction As-Built Drawings Fresh Kills Landfill Leachate Control Sitework and Appurtenances Capital Project S111 and S197, Contract No. 9699566.**	As-built drawings for construction of perimeter road final cover at Section 1/9 (Type VIII in FLCP)
		S-46	Stone & Webster, Inc. May 1999. **Construction Certification Report for Fresh Kills Leachate Controls, Site Work and Appurtenances, Capital Project Project S111 and S197. PIN No. 9699566.**	Construction of perimeter road final cover at Section 1/9 (Type VIII in FLCP)
		F-23	Frederic R. Harris, Inc. August 1990. **Report on Final Cover Construction and Certification of Results, Section 1/9 – Veterans and Muldoon Avenues.**	Construction certification for final cover Types IIIC in FLCP
		F-24	Frederic R. Harris, Inc. April 1994. **Report on Upgrade of Final Cover Area, Section 1/9 – North of Arden Avenue.**	Construction certification for final cover Types IIIA in FLCP
		U-14	URS Corp. January 4, 2002. **Fresh Kills Landfill Section 1/9 Final Cover Design Report.**	Design details for final cover Types I (Type IV in FLCP), Type II (Type V in FLCP), Type III (Type VII in FLCP), Type IV (Type VI in FLCP), and final cover at perimeter of reclamation area (Type IX in FLCP) Detailed design of the drainage system and basis of the design
		W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Volume A and Attachment 2 - final cover inspection and maintenance procedures
4.3	Reclamation Area	U-14	URS Corp. January 4, 2002. **Fresh Kills Landfill Section 1/9 Final Cover Design Report.**	The reclamation plan for Section 1/9 in Appendices D-2 (drawings) and K (text)
4.4	Leachate Control	O-3	O'Brien & Gere Engineers, Inc. November 18, 1994. **Final Specifications, Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System**. Includes Errata issued February 3, 1995.	Final specifications of design details of the leachate collection and containment system at Section 1/9
		O-4	O'Brien & Gere Engineers, Inc. November 18, 1994. **Final Engineering Report, Fresh Kills Landfill, Section 1/9 Leachate Collection and Containment System**. Includes Errata issued February 3, 1995.	Final engineering report for design details of the leachate collection and containment system at Section 1/9
		O-6	O'Brien & Gere Engineers, Inc. November 18, 1994. **Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System**. Includes Errata issued February 3, 1995.	Construction QA/QC plan for Section 1/9 leachate collection and containment system.
		O-9	O'Brien & Gere Engineers, Inc. November, 1994. **Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System, Final Contract Drawings.** Includes Errata issued February 3, 1995.	Final contract drawings for Section 1/9 leachate collection and containment system
		O-11	O'Brien & Gere Engineers, Inc. January 1996. **Final Contract Drawings, Fresh Kills Landfill Leachate Control Site Work and Appurtenances**. PIN #82796RR00076.	Final contract drawings of leachate control site work and appurtenances at Section 1/9
		O-13	O'Brien & Gere Engineers, Inc. March, 1996. **Final Engineering Drawings, Fresh Kills Landfill Leachate Collection and Containment System, Sections 1/9 and 6/7.**	Final engineering drawings for Section 1/9 leachate collection and containment system
		O-14	O'Brien & Gere Engineers, Inc. March 4, 1996. **Final Engineering Report, Addendum No. 1, Fresh Kills Landfill, Section 1/9 and 6/7 Leachate Collection and Containment System.**	Addendum No. 1 to final engineering report for design details of the leachate collection and containment system at Sections 1/9
		T-1	Tully Construction/Munoz Engineering. Set No. 1, December 20, 1999, and Set No. 2, May 2000. **Construction As-Built Drawings Fresh Kills Landfill Leachate Control Sitework and Appurtenances Capital Project S111 and S197, Contract No. 9699566.**	Construction as-built drawings for leachate control sitework and appurtenances at Section 1/9
		S-46	Stone and Webster, Inc. May 1999. **Construciton Certification Report, Fresh Kills Leachate Control, Site Work and Appurtenances Capital Project S111 and S197. PIN No. 9699566.**	Construction certification report for the leachate controls at Section 1/9
		U-14	URS Corp. January 4, 2002. **Fresh Kills Landfill Section 1/9 Final Cover Design Report.**	Leachate controls along Muldoon Avenue adjacent to the reclamation area in Appendices D-2 (drawings) and K (text)
4.5	Landfill Gas Migration Control	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Vol. C - Environmental Monitoring Program - landfill migration control and monitoring
		J-1	JAB Construction. July 1993. **As-Built Drawings of the LFG Migration Control Project.**	Construction of the interceptor venting system
4.6	Landfill Gas Emission Control	U-14	URS Corp. January 4, 2002. **Fresh Kills Landfill Section 1/9 Final Cover Design Report**	Design details of the passive venting system and the active system at Section 1/9
		N-150	New York State Department of Environmental Conservation. April 1998. **Fresh Kills Landfill Gas Flare Stations Permit. NYSDEC Permit No. 2-6403-00011/00063.**	Design of the active LFG collection system at Section 1/9

was installed along the lower central-eastern sideslope of Section 1/9. Construction of Type IIIA final cover was detailed in *Report on Upgrade of Final Cover Area, Section 1/9 – North of Arden Avenue,* submitted in April 1994 (Ref. No. F-24).

The layers comprising Type IIIA final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) topsoil.
- *Barrier protection material:* 18-24-inch soil barrier protection layer.
- *Hydraulic barrier layer:* 12-inch low-permeability barrier soil with a maximum hydraulic conductivity of 1×10^{-7} cm/sec.

Type IIIC

Type IIIC final cover was installed along the lower southeastern sideslope of Section 1/9. Construction of Type IIIC final cover was detailed in *Report on Final Cover Construction and Certification of Results, Section 1/9 – Veterans and Muldoon Avenues*, submitted in August 1990 (Ref. No. F-23).

The layers comprising Type IIIC final cover, from top to bottom, are the following:

- *Top layer/Barrier protection material:* 12-inch topsoil and barrier protection material.
- *Hydraulic barrier layer:* 12-inch low-permeability barrier soil with a maximum hydraulic conductivity of 1×10^{-7} cm/sec.

Type IV

Type IV final cover is also referred to as Type I in *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14). This cover type will be used for slopes greater than 15 percent and less than or equal to 33 percent. Construction of this final cover type has not yet started.

The layers comprising Type IV final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geocomposite comprised of geotextiles heat-bonded to both sides of a HDPE geonet.
- *Hydraulic barrier layer:* 40-mil textured low linear density polyethylene (LLDPE) geomembrane.
- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type V

Type V final cover is also referred to as Type II in Ref. No. U-14. This cover type will be used on slopes greater than 4 percent and less than or equal to 15 percent. Construction of this final cover type has not yet started.

The layers comprising Type V final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geotextile fabric protection layer.
- *Hydraulic barrier layer:* 40-mil textured LLDPE geomembrane.
- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type VI

Type VI final cover is also referred to as Type IV in Ref. No. U-14. This cover type will be used for finished asphalt roads. Construction of this final cover type has not yet started.

The layers comprising Type VI final cover, from top to bottom, are the following:

- *Top layer:* 4-inch (min.) asphalt.
- *Top layer, continued:* 6-inch (min.) crushed stone and gravel.
- *Barrier protection material:* Geotextile fabric protection layer.
- *Barrier protection material:* 20-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geotextile fabric protection layer.
- *Hydraulic barrier layer:* 40-mil textured LLDPE geomembrane.
- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type VII

Type VII final cover is also referred to as Type III in Ref. No. U-14. This cover type will be used for finished gravel roads. Construction of this final cover type has not yet started.

The layers comprising Type VII final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) gravel.
- *Barrier protection material:* Geotextile fabric protection layer.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geocomposite comprised of geotextiles heat-bonded to both sides of a HDPE geonet.
- *Hydraulic barrier layer:* 40-mil textured LLDPE geomembrane.

- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type VIII

Type VIII final cover is also referred to as final cover that includes 60 mil HDPE geomembrane in Ref. No. T-1. This final cover type was installed around the perimeter of Section 1/9 in conjunction with the leachate collection and containment system. Type VIII final cover overlies the cutoff wall, leachate collection trench, and associated components. Construction of Type VIII final cover is detailed in the *Construction Certification Report for Fresh Kills Leachate Control, Site Work and Appurtenances* (Ref. No. S-46) and on the as-built drawings provided in *Construction As-Built Drawings: Fresh Kills Landfill Leachate Control Sitework and Appurtenances* (Ref. No. T-1), submitted in December 1999.

The layers comprising Type VIII final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) topsoil *or* Type 2 pavement.
- *Barrier protection material:* 24-inch (min) soil barrier protection layer.
- *Hydraulic barrier layer:* 60-mil HDPE geomembrane.
- 6-inch (min.) HDPE geomembrane bedding layer (Type 'D' Select Fill).

Type IX

Type IX final cover is also referred to as "final cover installed at perimeter of reclamation area" in Appendix D-2, *Engineering Plans: Reclamation Work Plan,* of Ref. U-14. This alternative final cover type, which is used along the perimeter of the reclamation area, is presented in detail in the Reclamation Work Plan (Appendix K of Ref. No. U-14). Type IX final cover consists of a 60-inch alternative final cover (with maximum permeability 1×10^{-5} cm/sec) overlying spoils or, at the bottom of slope, native sediment. Type IX ties into existing Type VIII final cover at the top of slope. A 2-inch-wide strip of ½" CDX Plywood is used as a protective cover at the limit of the existing Type VIII 60-mil HDPE geomembrane liner.

The monitoring and maintenance procedures for the final cover on Section 1/9 are outlined in Section 3 and Attachment 2 of the *Post-Closure Monitoring and Maintenance Operations Manual, Volume A* (Ref. No. W-49).

4.2.2 Drainage Structures

The final stormwater drainage system at Section 1/9 will consist of a series of swales, stepped gabion downchutes, drop-inlet boxes, culverts, inlet pipes and stormwater control basins. At Section 1/9 stormwater runoff (sheet or concentrated flow) from the top and sideslopes of the landfill will be collected by swales located on the sideslopes. Where service roads cross over swales, culverts will be provided under the road. Runoff collected at the swales will then be conveyed to the stepped gabion downchutes, from which it is routed to stormwater basin inlet pipes. Where necessary, drop-inlet boxes are used for vertical alignment. The drainage process is illustrated as follows:

Runoff → Swale → (Culvert) → Downchute → (Drop-Inlet Box) → Inlet Pipe → Basin → Outfall Structure

Detailed design of the drainage system and basis of the design is included in *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14). A final drainage plan is included as Attachment 4, Sheet 19-4. Final drainage details are presented in Attachment 4, Sheets 19-5, 19-6, and 19-7. The final grading plan is presented in Sheet 19-1.

Watersheds were delineated based on the final grading plan, taking into account the existing normal storage conditions of the stormwater control basins and drainage outlets. Six watersheds were identified for Section 1/9 and labeled according to the corresponding basin/outlet designation (e.g., Watershed N corresponds to Basin N). A drainage layout was developed for each watershed identifying swales, stepped gabion downchutes, drop-inlet boxes, culverts, inlet pipes, basins and/or outlets. A sub-drainage area was also identified for each swale. Detailed delineation is provided in *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref No. U-14). The 100-year, 24-hour storm event, based on final vegetated conditions, was used to design elements of the stormwater drainage system at Section 1/9. The 25-year, 24-hour storm event, based on bare soil conditions, was used to design soil erosion protection of the swales and final cap system.

Major components of the drainage structures at Section 1/9 include the following:

Swales The swales consist of trapezoidal channels located along the sideslopes of the landfill. In general, the channels have longitudinal slopes of 2 percent, but slopes vary from 1.0 to 6.5 percent at some locations. Near the perimeter of the Landfill, swale slopes are placed at a slope of 1 percent or less. Swales are created by placing embankment fill over the landfill cap. In general, the swales will be 3 feet deep (including 1 foot for settlement) and will have a bed width between 4 and 16 feet to accommodate the peak discharges corresponding to the 100-year, 24-hour storm event.

Culverts Road crossing culverts also will be needed for the stormwater drainage system. Culverts will consist of single or multiple corrugated metal pipe (CMP) designed to connect the swale in instances where the swale crosses a road. At several locations, culvert boxes are specified. The culvert sizes were determined such that they will prevent overtopping of the service roads and/or the landfill sideslopes.

Downchutes Stepped gabion downchutes will collect stormwater runoff from the swales and convey it to drop-inlet boxes. Layout of the downchutes is shown in Attachment 4, Sheet 19-4. The stepped gabion downchutes will have a rectangular cross-section with a depth of 3 feet and bottom widths from 3 to 12 feet. The downchute profile involves a nominal 3-foot drop and a near-horizontal channel section to accommodate the landfill slopes. Swales located at the top of the downchutes will discharge at the downchute floor invert elevation, while swales between the top and the bottom of the downchutes will discharge at least 1 foot above the downchute floor invert elevation.

Drop-Inlet Boxes Drop-inlet boxes will be built as part of the downchute structure to collect stormwater runoff from downchutes or from swales that are directly connected to the drop-inlet boxes. Drop-inlet boxes will be located between the toe of each downchute and the entrance of the inlet pipe for each stormwater basin.

Inlet Pipes Inlet pipes were placed at each basin during construction of the leachate containment system. These pipes were located and sized based on interim design and were provided to convey stormwater runoff through the leachate cutoff wall. The locations of these basin inlet pipes are fixed and, therefore, the stormwater drainage system layout is tied into these locations.

4.2.3 Stormwater Basins and Outfall Structures

The stormwater basins assocated with Section 1/9 are shown on Attachment 4, Sheets LF-3 and 19-4. The basins and outfall structures have three primary functions:

- to detain the stormwater runoff and thereby reduce its velocity prior to discharge;
- to allow sediment to settle out; and
- to provide for controlled discharge to receiving waterways.

The designations of the four stormwater control basins located around Section 1/9 are: K partitioned into K1 and K2, L, N, and O. In the final drainage design, delineation of watersheds was based on locations and storage conditions of existing stormwater basins and outlets. In addition to the watersheds based on the four stormwater basins, a fifth watershed, designated M, was included in the design for drainage directed to Outlet M. Runoff from the lower sideslopes on the west side of Section 1/9 is channeled directly into the Arthur Kill. This sixth watershed area has been designated watershed AK.

The basin outfall structure typically includes a 12-inch diameter lateral pipe at the bottom of the basin and a 36-inch diameter riser pipe. Where so installed, the lateral pipe is wrapped in a geotextile and covered with stone, and is designed to drain the basin on a continuous basis. The inlet to the riser is designed to drain the basin when a greater storm occurs. An emergency spillway is provided for storm events greater than the 100-year storm.

Basin K, consisting of Basins K1 and K2, is located northeast of Section 1/9 adjacent to Rte. 440 and immediately north of the reclamation area. Basin K discharges into the Fresh Kills waterway.

Basin L is located northwest of Section 1/9. The Basin L stormwater control system includes two holding ponds located on the east and west sides of Muldoon Avenue. Stormwater runoff collected in the Muldoon East holding pond is conveyed to the Muldoon West holding pond. Stormwater is pumped from the Muldoon West holding pond to Basin L, which then discharges into the Great Fresh Kills.

Outlet M is located to the east of Section 1/9, on the west side of the service road. Outlet M discharges through a culvert under Rte. 440 and ultimately into Richmond Creek.

Basin N is located southeast of Section 1/9, outside the property line and across Veterans Avenue West. The southeastern portion of Section 1/9 drains into Basin N. The area in which Basin N is located is under the jurisdiction of the New York State Department of Transportation (NYSDOT). DSNY has obtained the necessary authorization to use this area for a stormwater control basin. Basin N discharges through a culvert under Veterans Avenue West to a small tributary, south of Section 1/9, which then drains into the Arthur Kill.

Basin O is located at the southern tip of Section 1/9. Portions of the southwest end of Section 1/9 drain into Basin O, which, in turn, discharges into the Arthur Kill.

4.3 Reclamation Area

The landfill reclamation design was prepared for Section 1/9 in accordance with the requirements of 6 NYCRR Part 360-2.18(d). The reclamation plan is detailed in Appendices D-2 (drawings) and K (report) of *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14). The landfill reclamation project involves removing spoils from a 61-acre area in the northern portion of Section 1/9 (the footprint consolidation area, or FCA) and transferring the spoils to the main mound in Section 1/9. The reclamation project is planned for the following reasons:

- A substantial amount of fill is needed to bring the main mound in Section 1/9 to the required subgrade before placement of final cover; reclamation will provide the contouring fill necessary to achieve the final cover subgrade, thereby expediting final cover construction; and
- DSNY wants to make a portion of landfill Section 1/9 available for beneficial end use and development.

Existing elevations in the reclaimed area range from 8 feet at the perimeter to 62 feet at the peak of the mound. Maximum thickness of spoils is approximately 70 feet. A total of approximately 3.3 millions cubic yards of material, including spoils, asbestos-containing material (ACM), native sediment, and daily and intermediate cover soil will be removed during excavation. Of the estimated 2.9 millions cubic yards of spoils to be removed, approximately 2.2 million cubic yards of spoils is located above the water table. The remaining 0.7 million cubic yards is saturated material. In addition, a minimum of 1 foot and up to 2 feet of underlying native sediments (approximately 115,000 cubic yards) will be removed from within the FCA. A minimum thickness of 5 feet of backfill will be placed within the excavation area. The material excavated from the reclaimed area will be used as contour fill at the main mound, which will be closed by placement of final cover.

Currently, there is a leachate collection and containment system that includes a cutoff wall and a leachate collection drain located along the eastern and northern perimeter of the FCA. Spoils excavation will occur in the FCA such that the integrity of the existing leachate collection and containment system will be maintained and such that the cut slope of the excavation will be stable without shoring and bracing requirements. The remaining in-place volume of spoils either is under final cover associated with the existing leachate collection and containment system or will be covered with Type IX alternative final cover. The area encompassed by the spoils left in

place in conjunction with the leachate collection and containment system (including the perimeter road) is about 3 acres.

The cut slope for the excavation will begin at the edge of the existing perimeter road and will continue at a three-horizontal-to-one-vertical slope to the bottom of existing spoils. Excavating in this manner leaves a wedge of spoils in place from the perimeter access road to the bottom of the spoils excavation. The length of cut slope varies from 30 feet to 120 feet depending on the thickness of the spoils. The area encompassed by the cut slope excavation is approximately 8 acres.

After the completion of spoils excavation activities, the FCA will be backfilled with soil and stormwater management controls will be installed. The proposed final grading plan provides for overland flow to the existing Muldoon East holding pond in the northwest portion of the FCA, Basins K-1 and K-2 in the northeastern portion of the FCA, and to the culvert in the southeast portion of the FCA. To promote vegetation, the excavated and backfilled area of the FCA will be covered with 6 inches of planting soil and then seeded.

4.4 Leachate Control

The existing leachate control and management system at Section 1/9 consists of a cutoff wall and a leachate collection drain located along the perimeter of the landfill section, with associated leachate collection pump stations. Design details of the leachate collection and containment system were completed in 1994 and submitted to meet Consent Order A-4, Subject 15; the submissions included *Final Engineering Report for Section 1/9 Leachate Collection and Containment System* (Ref. No. O-4), *Final Specifications* (Ref. No. O-3), *Final Construction Quality Assurance/Construction Quality Control for Sections 1/9 and 6/7* (Ref. No. O-6), and *Final Contract Drawings* (Ref. No. O-9). *Addendum No.1 to the Final Engineering Report* was prepared in March 1994 (Ref. No. O-14). In addition to the above documents, *Final Contract Drawings Fresh Kills Landfill Leachate Control Site Work and Appurtenances* (Ref. No. O-13) and *Final Engineering Drawings* (Ref No. O-11) were prepared in 1996 for construction of the leachate control system at Section 1/9. Construction of the leachate controls at Section 1/9 is detailed in the *Construction Certification Report for Fresh Kills Leachate Control, Site Work and Appurtenances* (Ref. No. S-46) and on the as-built drawings provided in *Construction As-Built Drawings: Fresh Kills Landfill Leachate Control Sitework and Appurtenances* (Ref. No. T-1), submitted in December 1999. The design for additional leachate controls to be installed west of Muldoon Avenue adjacent to the reclamation area are provided in Appendices D-2 (drawings) and K (report) of *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14).

The leachate collection plan for Section 1/9 is provided in Attachment 4, Sheet 19-10. Leachate containment and collection details are presented on Sheets 19-11 and 19-12, respectively.

4.4.1 Leachate Containment System

The leachate containment system at Section 1/9 consists of a soil bentonite or cement bentonite cutoff wall that extends around the perimeter of the section. An additional section of cutoff wall is planned west of Muldoon Avenue along the northeastern perimeter of the main mound. The cutoff wall provides containment for leachate and minimizes the amount of water from adjacent groundwater aquifers entering the leachate collection system. The cutoff walls were installed 3 feet into the uppermost low-permeability strata, which are the glaciolacustrine clay and silt or cretaceous clay layers located in the overburden hydrostratigraphic unit. These fine-grained geologic units under the Landfill, which are 10 to 55 feet below grade, provide the anchors for the cutoff wall. The vertical hydraulic conductivity of these clays and silts varies from $1x10^{-6}$ to $1x10^{-8}$ cm/sec. Together, the fine-grained deposits and the cutoff wall system form a physical and hydraulic barrier to contain the shallow, horizontal flow of leachate, and to reduce infiltration of shallow groundwater from outside the cutoff wall.

The placement of the cutoff wall was designed to maintain a maximum leachate level of 2 feet below the Mean Low Water (MLW) elevation. The leachate collection system will induce a gradient inward from the cutoff wall, thus minimizing hydraulic pressure on the interior of the wall and maximizing leachate recovery around the perimeter of the landfill. Because groundwater elevation on the outside of the cutoff wall will always be equal to or greater than MLW, the design results in a minimum hydraulic gradient of 2 feet between the inside and outside of the cutoff wall.

4.4.2 Leachate Collection and Conveyance System

The leachate collection and conveyance system at Section 1/9 consists of the following components:

- **Leachate Collection Drains**

  The locations of the collection drains are shown on Attachment 4, Sheet 19-10. Details are shown on Sheet 19-11. Each drain consists of a minimum 3-foot-wide trench backfilled with granular materials to promote leachate infiltration. A slotted HDPE pipe placed above the bottom of the trench conveys the collected leachate to the collection wells. The collection drain is located between the Landfill toe of slope and the Landfill side of the soil/cement-bentonite cutoff wall.

  The depth of the leachate collection drain varies as shown on the as-built drawings (Ref. No. T-1). As designed, the system induces a gradient inward toward the trench from the cutoff walls, thus minimizing hydraulic pressure and maximizing leachate recovery. Therefore, if a leak occurs in the cutoff wall, the fluid would flow towards the Landfill since groundwater outside the Landfill is higher in elevation. This provides an additional measure to protect public health, safety, and the environment, and to ensure the protection of natural resources.

- **Leachate Collection Pump Stations**

  Leachate collection pump stations are located along the leachate collection drains. In addition, a leachate collection well will be located within the landfill gas recovery facility to control leachate in the area of the facility. Each leachate collection pump station consists of a wet well with a submersible leachate well pump. The pump transfers the leachate from the well into the perimeter header conveyance piping system, which leads to the Fresh Kills Landfill Leachate Treatment Plant. The locations of the pump stations are shown on Attachment 4, Sheet 19-10; corresponding details are shown on Sheet 19-12.

  Each collection well, along with a sampling port, pressure gauge, flow meter, and check and ball valves, is located in a HDPE geomembrane-lined concrete vault. This concrete vault extends to grade and is equipped with an access hatch for sampling and maintenance needs. The pumping wells consist of a 24-inch-diameter polyvinyl chloride (PVC) well casing/screening in which a submersible stainless steel leachate well pump is located. The wells are installed at an elevation that induces the inward flow of leachate into the collection system.

  Level sensors installed in each pump station control the flow of leachate from the wet well to the FKLLTP. In automatic mode, a high-level sensor in the wet well will activate the pump, and the submersible pump will discharge the leachate to the header pipe until the leachate level falls below the low-level sensor point. Leachate flow rates can also be manually adjusted to achieve acceptable leachate levels. The status (on/off), pumping rate, time of pumping, level set points, and 24-hour operational history of each pumping station are transmitted to the central control room of the FKLLTP via the Supervisory Control and Automated Data Acquisition (SCADA) system.

- **Header Pipes**

  Each leachate collection header pipe is located within the backfilled collection drain trench, above the drain pipe. The header pipes have been designed to bypass each collection well pumping station at a 45-degree angle and then return to the collection drain. The location of the leachate collection header pipes and manholes are presented on Attachment 4, Sheet 19-10; corresponding details shown on Sheet 19-12.

  The header pipes from Section 1/9 convey the flow of leachate directly to the influent splitter box of the FKLLTP for distribution to the treatment plant's holding compartment. Combination air release valves and drains have been designed into the collection headers to ensure proper operation and to drain the pipes for maintenance purposes. Manholes have been placed every 1,000 to 1,500 feet along the header pipe route and include isolation valves, vacuum relief/air release valves, and drain valve locations.

  The manholes are equipped with high-level floats, which are tied into the SCADA controls and will notify the operator if leachate or groundwater collects in the manhole. Manholes are located within the leachate collection and containment system work

platform. This platform is located above the 100-year floodplain, thus allowing for continued operations of the systems during severe weather conditions.

- **Hydraulic Monitoring**

  Pairs of hydraulic monitoring wells for Section 1/9, installed on either side of the cutoff wall and collection drain, are used to monitor the hydraulic performance of the leachate collection and containment system.

4.5 Landfill Gas Migration Controls

The LFG migration management system at Section 1/9 consists of two programs: engineered controls (including the perimeter LFG interceptor venting system, utility seals, and perimeter leachate collection and containment systems) and migration monitoring along the property boundary. LFG migration monitoring is detailed in the *Post-Closure Monitoring and Maintenance Operations Manual* (P-C M&MOM) (Ref. No. W-49).

The perimeter LFG interceptor venting system (also known as interceptor trenches or perimeter vent trenches) is installed along portions of the perimeter of Section 1/9 as shown on Attachment 4, Sheet 19-8. The interceptor venting system is located on the west side of Route 440 at the northern end of Section 1/9, with a length of 2,035 linear feet. The interceptor venting system is keyed into low-permeability soils or typically extended 2 feet below the seasonal low groundwater table to form an effective barrier to cut off the lateral, off-site migration of LFG generated within the landfill and to allow the LFG to vent passively before migrating off site. The interceptor venting system was installed in accordance with 6 NYCRR Part 360-2.15(e) and (f). Construction of the interceptor venting system is detailed in *As-Built Drawings of the LFG Migration Control Project* (Ref. No. J-1).

The LFG migration monitoring program consists of the measurement of subsurface pressure and concentrations of methane, oxygen, carbon dioxide as percent gas at LFG migration monitoring wells located along portions of the perimeter of Section 1/9. LFG migration monitoring will be performed in accordance with the *Draft Post-Closure Monitoring and Maintenance Operations Manual* and will typically be conducted on a quarterly basis. The locations of the migration monitoring wells are shown on Attachment 4, Sheet 19-8. Structures at the landfill are equipped with methane sensors, which are maintained and calibrated on a quarterly basis.

4.6 Landfill Gas Emission Controls

Landfill gas emission controls at Section 1/9 include an active collection system and a passive venting system. In addition, the separately permitted LFG recovery facility described in Section 2.3 is located at Section 1/9.

The active collection, flaring, and gas recovery systems are currently in operation and will be operated during the post-closure period in accordance with the requirements of 6 NYCRR Part 208. Passive vents will remain closed while the active system is in operation; they will be

opened only after the post-closure period or after methane generation has declined to the extent that the active gas collection system is no longer required.

4.6.1 Passive Vents

The passive venting system at Section 1/9 will consist of the following main components:

- a geocomposite gas venting net layer installed beneath the geomembrane; and
- vents through the cap to provide for passive venting in the future.

The gas venting layer will be constructed of geocomposite, consisting of a geotextile heat-bonded to both sides of HDPE geonet drainage material. The venting layer will be installed in compliance with regulatory requirements of 6 NYCRR Part 360-2.15(e) and 2.13(p), which specify a 12-inch-thick layer of soil with a permeability of $1x10^{-3}$ cm/s or greater. The geocomposites used for this venting layer will have permeability on the order of $1.0x10^{-1}$ cm/s. The vents will be installed at a density of one per acre during construction of final cover. A cross-section of the passive LFG vents to be installed at Sections 1/9 is illustrated on Attachment 4, Sheet 19-9. Design details of the passive venting system at Section 1/9 are provided in *The Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14).

As noted above, the vents will remain closed while the active collection, flaring, and gas recovery systems are in operation.

4.6.2 Active Collection System

The active LFG collection system consists of several components that are involved in collecting LFG and transferring it to the necessary locations for processing or combustion. The basic system layout consists of extraction wells to collect the LFG, a piping system to convey the LFG to the landfill gas recovery facility, and the recovery facility.

Design of the active LFG collection system at Section 1/9 was provided for in supporting documents for the facility LFG flaring permit (NYSDEC Permit No. 2-6403-00011/00063). Design of the active system is also presented in Appendix D (drawings) of the *Fresh Kills Landfill Section 1/9 Final Cover Design Report* (Ref. No. U-14). A plan of LFG extraction wells and header pipes is provided on Attachment 4, Sheet 19-8. Typical details of the LFG collection system are provided on Sheet 19-9.

The primary components of the Section 1/9 active LFG collection system include the following:

- **Vertical LFG Extraction Wells**

  Approximately 370 active gas extraction wells are proposed for Section 1/9. These vertical LFG extraction wells each consist of a variable length of 6-inch diameter perforated HDPE pipe backfilled with gravel to ease LFG infiltration. A minimum 20-foot length of solid HDPE well casing extends from the top of the perforated casing to a varying height above final cap grade. Each well has an active gas collection wellhead including a section of flexible hose for connection to an HDPE lateral riser. Details of typical extraction wells are shown on Attachment 4, Sheet 19-9.

- **Piping and Header System**

  The LFG is drawn from the wells and piping system by use of a negative pressure induced throughout the system by blowers located at the LFG recovery facility. The network of interconnected piping includes lateral collection pipe for transmission of gas from extraction well to adjacent collection header and gas collection headers for transport of collected gas from the lateral collection pipes and transmission to the LFG recovery facility.

  Condensate, which flows downslope within the system due to gravity, is collected in condensate tanks. These condensate tanks prevent the condensate, which is potentially hazardous, from entering the groundwater. Condensate is periodically removed from these tanks and brought to a permitted wastewater treatment facility.

All gas collected through the extraction wells at Section 1/9 is sent to the separately permitted LFG recovery facility located at Section 1/9, where the gas is purified for use as fuel. If the quantity of gas collected exceeds the capacity of the LFG recovery facility, or the facility is shut down, collected LFG from Section 1/9 will be conveyed via the LFG transmission main to the enclosed flares located at Sections 2/8, 3/4, and 6/7. LFG is collected and processed in order to meet all applicable emissions standards.

SECTION 5

LANDFILL SECTION 2/8

5.1 Site Description

Section 2/8, with a total area of 139 acres, is located generally between Rte. 440 and Richmond Creek. This section of the Landfill last received waste in June 1993. Construction of the final cover and drainage systems at Section 2/8 has been completed. As shown in the *Financial Assurance Plan* (Ref. No. W-47), the total capacity of Section 2/8 is 16,502,000 cubic yards, consisting primarily of municipal solid waste.

Section 2/8 consists of two main mounds, which are separated by a tributary of Richmond Creek: a smaller northern mound with an area of slightly more than 29 acres and a larger southern mound with an area of approximately 109 acres. Fig. No. 1-2 shows the general location of Section 2/8 at the Fresh Kills Landfill.

5.2 Final Cover and Drainage Systems

5.2.1 Final Cover

The installation of the final cover system for Section 2/8 has been completed. Final cover was installed in two main stages: the lower sideslopes of the main mound received final cover in 1989, and the remainder of Section 2/8 received final cover in the mid-1990s. All final cover installed at Section 2/8 was designed and constructed in accordance with 6 NYCRR Part 360-2.15(d) or regulations applicable at the time of installation. The final cover plan and sections are presented in Attachment 4, Sheet 28-1. The final cover types used at Section 2/8 and at other Landfill sections are also presented in Table 2-2.

The three final cover types at Section 2/8 are as follows:

Type I

Type I final cover is also referred to as Type I in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8* (Ref. No. S-32) and *Engineering Report, Section 2/8 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-39), submitted in March 1994. This cover type was installed during the mid-1990s on sideslopes of Section 2/8 (slopes greater than 10 percent and less than or equal to 33 percent).

The layers comprising Type I final cover, from top to bottom, are the following:

- *Top layer:* 6-inch topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geocomposite comprised of geotextiles heat-bonded to both sides of a geonet.

Table 5-1
List of References for Section 5: Landfill Section 2/8
Fresh Kills Landfill Final Closure Plan

FLCP Section	Section Title	Ref ID	References	Referenced Information
5.1	Site Description	W-47	Roy F. Weston of New York, Inc. April 2002. **Financial Assurance Plan.**	An inventory of the waste received at Section 2/8
5.2	Final Cover and Drainage Systems	F-21	Frederic R. Harris, Inc. March 1990. **Final Cover Construction and Certification Results - Section 2/8, 1989 Construction Season, Report Volume I.**	Construction of the clay final cover (Type IIIB in FLCP) installed along lower sideslopes of the south mound at Section 2/8
		S-38	SCS Engineers, P.C. May 18, 1992. **Final Closure Plan for Sections 2/8 and 3/4, Appendix A-3; Milestone 9; Order on Consent; Fresh Kills Landfill.**	Several alternatives of the final cover system (Types I and II) for the remainder of Section 2/8 Initial drainage features at Section 2/8
		S-32	SCS Engineers, P.C. March 15, 1994. **Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8**.	Final design details (Types I and II) of the final cover system at Section 2/8 Detailed design of the drainage system
		S-39	SCS Engineers, P.C. March 15, 1994. **Engineering Report, Section 2/8 Final Cover and Landfill Gas Extraction System Construction Documents**.	Engineering report of final cover system (Types I and II) at Section 2/8 Engineering report for detailed design of the drainage system and basis of the design
5.3	Leachate Control	O-15	O'Brien & Gere Engineers, Inc. March 4, 1996. **Addendum 3, Fresh Kills Leachate Control Site Work and Appurtenances.**	Design of the recovery wells and the initial sections of partial perimeter drains at Section 2/8
		O-16	O'Brien & Gere Engineers, Inc. March 1, 1996. **Engineering Report, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems.**	Engineering report for design of the recovery wells and the initial sections of partial perimeter drains at Section 2/8
		O-17	O'Brien & Gere Engineers, Inc. March 1, 1996. **Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems.**	Construction Quality Assurance/Quality Control (CQA/CQC) Plan for design of the recovery wells and the initial sections of partial perimeter drains at Section 2/8
		S-46	Stone and Webster, Inc. May 1999. **Construction Certification Report, Fresh Kills Leachate Controls, Site Work and Appurtenances Capital Project S111 and S197. PIN No. 9699566.**	Certification report for construction of recovery wells and the first sections of partial perimeter drains at Section 2/8
		T-1	Tully Construction/Munoz Engineering. Set No. 1, December 20, 1999 and Set No. 2, May 2000. **Construction As-Built Drawings Fresh Kills Landfill Leachate Control Sitework and Appurtenances Capital Project S111 and S197, Contract No. 9699566.**	Construction as-built drawings of recovery wells and the first sections of partial perimeter drains at Section 2/8
		I-36	IT Corporation. June 2000 Revised January 2001. **Final Engineering Plans, Fresh Kills Landfill Supplemental Leachate Controls at Sections 2/8 and 3/4.**	The design for additional perimeter drains at Section 2/8
5.4	Landfill Gas Migration Control	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Vol. C - Environmental Monitoring Program - landfill migration control and monitoring
		J-1	JAB Construction. July 1993. **As-Built Drawings of the LFG Migration Control Project.**	Construction of the interceptor venting system
5.5	Landfill Gas Emission Control	S-32	SCS Engineers, P.C. March 15, 1994. **Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8.**	Design of the passive vents, extraction wells and piping system at Section 2/8
		S-39	SCS Engineers, P.C. March 15, 1994. **Engineering Report, Section 2/8 Final Cover and Landfill Gas Extraction System Construction Documents**.	Engineering report for design of the passive vents, extraction wells and piping system at Section 2/8
		N-150	New York State Department of Environmental Conservation. April 1998. **Fresh Kills Landfill Gas Flare Stations Air Permit. NYSDEC Permit No. 2-6403-00011/00063.**	Design of the LFG flare pad and flare station at Section 2/8; variance approval for LFG duct vents at Section 2/8

- *Hydraulic barrier layer:* 40-mil textured HDPE geomembrane.
- 6-inch layer of Type II Cover Soil.

Type II

Type II final cover is also referred to as Type II in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8* (Ref. No. S-32) and *Engineering Report, Section 2/8 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-39), submitted in March 1994. This cover type was installed during the mid-1990s on top portions of Section 2/8 (slopes less than or equal to 10 percent).

The layers comprising Type II final cover, from top to bottom, are the following:

- *Top layer:* 6-inch topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Hydraulic barrier layer:* 40-mil smooth HDPE geomembrane.
- 6-inch layer of Type II Cover Soil.

Type IIIB

Type IIIB final cover was installed along the lower sideslopes of the south mound of Section 2/8. Construction of Type IIIB final cover was detailed in *Final Cover Construction and Certification Results – Section 2/8, 1989 Construction Season* (Ref. No. F-21), which was submitted to NYSDEC in March 1990.

The layers comprising Type IIIB final cover, from top to bottom, are the following:

- *Top layer:* 6-inch topsoil.
- *Barrier protection material:* 18-inch soil barrier protection layer.
- *Hydraulic barrier layer:* 18-inch low-permeability barrier soil with a maximum hydraulic conductivity of 1×10^{-7} cm/sec.

The maintenance and inspection procedures for the final cover on Section 2/8 are outlined in Section 3 and Attachment 2 of the *Post-Closure Monitoring and Maintenance Operations Manual, Volume A* (Ref. No. W-49).

5.2.2 Drainage Structures

The stormwater and drainage system for Section 2/8 has been designed to collect and convey stormwater off the landfill cover, to collect sediment, and to discharge stormwater into surrounding waterways in a controlled manner. Stormwater on the landfill cover is collected by drainage swales that are located at intervals of approximately every 50 vertical feet. Swales are graded at a minimum slope of 2 percent and discharge at the low point to downchute pipes that run perpendicular to the contours. Stormwater is then conveyed through downchute pipes to the stormwater basin intake. Runoff enters the downchute pipes through slotted inlets. Drop manholes are used as connectors for vertical and horizontal alignment of downchute pipes. A

plan of the drainage system at Section 2/8 is provided in Attachment 4, Sheet 28-2. Details of the various drainage structures are shown on Sheet 28-3.

Detailed design of the drainage system and basis of the design was presented in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8* (Ref. No. S-32) and *Engineering Report, Section 2/8 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-39).

Where design velocities are low, swales are lined with grass and erosion control material. For swales with greater design velocities, riprap lining was used. The type of lining material used in each drainage swale is shown on Attachment 4, Sheet 28-3. The downchute pipes for Section 2/8 are constructed of HDPE.

5.2.3 Stormwater Basins and Outfall Structures

Stormwater basins receive stormwater from the drainage swales and downchute pipes, and discharge the stormwater at a controlled flow rate to a receiving waterway. Stormwater basins that receive runoff from Section 2/8 include Basins H, J, and P. The locations of these basins are shown on Attachment 4, Sheet 28-2.

The stormwater basins and outfall structures are sized to detain the runoff from a 25-year, 24-hour storm and to control flow from a 100-year, 24-hour storm. The basin outfall structure typically includes a 12-inch-diameter lateral pipe at the bottom of the basin and a 36-inch-diameter riser pipe. Where so installed, the lateral pipe is wrapped in a geotextile and covered with stone, and is designed to drain the basin on a continuous basis. The inlet to the riser is set above the 25-year storm elevation and is designed to drain each basin when a greater storm occurs. An emergency spillway is provided for storm events greater than the 100-year storm. The basin berms were constructed at 3-to-1 side slopes, with a 10-foot-wide top of berm and a 1-foot freeboard.

Basin H is located west of the southern mound of Section 2/8. Most of the western side of the southern mound drains into Basin H, which discharges into freshwater wetlands to the west of Section 2/8.

Basin J is located north of the northern mound of Section 2/8. The northern mound drains to Basin J, which discharges into Richmond Creek.

Basin P, located adjacent to the southeast tip of the southern mound of Section 2/8, drains the eastern and southern portions of the southern mound. Basin P discharges into Richmond Creek.

5.3 Leachate Control

Leachate Collection and Conveyance System

The leachate collection and conveyance system for Section 2/8 consists of the following components:

- Recovery Wells
- Partial Perimeter Drains and Pump Stations
- Force Mains

Locations of leachate recovery wells and partial perimeter drain at Section 2/8 are shown on Attachment 4, Sheet 28-7. Details of the leachate collection and conveyance system are provided on Sheet 28-8. Design of the recovery wells and the initial sections of partial perimeter drains was presented in final contract documents, including *Addendum 3 of the Fresh Kills Leachate Control, Site Work, and Appurtenances Contract* (Ref. No. O-15), the *Engineering Report, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems* (Ref. No. O-16), and the *Final Construction Quality Assurance/Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems* (Ref. No. O-17). The design for additional perimeter drains was provided in *Final Engineering Plans, Fresh Kills Landfill Supplemental Leachate Controls at Sections 2/8 and 3/4* (Ref. No. I-36). Construction of the recovery wells and the first set of perimeter drains was documented in *Construction Certification Report for Fresh Kills Leachate Control, Site Work and Appurtenances* (Ref. No. S-46) and on the as-built drawings provided in *Construction As-Built Drawings: Fresh Kills Landfill Leachate Control Sitework and Appurtenances* (Ref. No. T-1), submitted in December 1999.

- **Recovery Wells**

  Leachate recovery wells, which consist of a submersible pump and stainless steel well screen and casing, are located on top plateau areas of the landfill and extract leachate from deep within the landfill mound. The pumped leachate is conveyed to a force main, which then joins the force main for the perimeter leachate collection drain.

- **Partial Perimeter Drains and Pump Stations**

  Leachate collection drains are designed to collect leachate at the toe of slope along selected segments of the Section 2/8 perimeter. Each drain consists of a stone-filled trench with slotted corrugated HDPE pipe. Leachate in the collection drain flows into a series of leachate collection pump stations. Each leachate collection pump station consists of a wet well with a submersible leachate well pump. Level sensors installed in each pump station control the activation of the pump. The pumps are of stainless steel construction to provide reliable service in their potentially corrosive environments. At each leachate collection pump station, a sampling port, pressure gauge, check and ball

valves and flow meter are located either in an aboveground enclosure or in an underground concrete vault, which extends to grade and is equipped with an access hatch for sampling and maintenance.

The effectiveness of the segments of leachate collection drain at Section 2/8 located along Richmond Creek is monitored by measuring the water levels in monitoring piezometers installed in pairs on each side of the drain and by limited analytical testing of water samples taken at the monitoring piezometers and leachate collection pump stations.

- **Force Mains**

Leachate collected at the leachate collection pump stations is conveyed to the FKLLTP through leachate collection headers and force mains. The header at Section 2/8 crosses beneath Richmond Creek and connects into the header for Section 6/7, which empties into the Section 6/7 leachate conveyance pump station. The leachate conveyance pump station conveys leachate to the FKLLTP through a leachate force main. The locations of the leachate collection headers at Section 2/8 are shown on Attachment 4, Sheet 28-7. The location of the force mains connecting the Section 2/8 leachate collection system to the Section 6/7 header and to the FKLLTP is shown on Fig. No. 2-3.

5.4 Landfill Gas Migration Controls

The LFG migration management system at Section 2/8 consists of two programs: engineered controls (including the perimeter LFG interceptor venting system, utility seals, and the perimeter leachate collection system) and migration monitoring along the property boundary. LFG migration monitoring is detailed in the *Post-Closure Monitoring, and Maintenance Operations Manual* (Ref. No. W-49).

The perimeter LFG interceptor venting system (also known as interceptor trenches or perimeter vent trenches) is installed along portions of the perimeter of Section 2/8 as shown on Attachment 4, Sheet 28-5. The interceptor venting system at Section 2/8 includes an 9,010-linear-foot segment located South of Section 2/8 along Arthur Kill Road and a 2,230-linear-foot segment located on the east side of Route 440 between Section 2/8 and Section 1/9. The interceptor venting system is keyed into low-permeability soils or typically extended 2 feet below the seasonal low groundwater table to form an effective barrier to cut off the lateral, off-site migration of LFG generated within the landfill and to allow the LFG to vent passively before migrating off site. The interceptor venting system was installed in accordance with 6 NYCRR Part 360-2.15(e) and (f). Construction of the interceptor venting system is detailed in *As-Built Drawings of the LFG Migration Control Project* (Ref. No. J-1).

The LFG migration monitoring program consists of the measurement of subsurface pressure and concentrations of methane, oxygen, carbon dioxide as percent gas at LFG migration monitoring wells located along portions of the perimeter of Section 2/8. LFG migration monitoring will be performed in accordance with the *Draft Post-Closure Monitoring and Maintenance Operations Manual* and will typically be conducted on a quarterly basis. The locations of the migration

monitoring wells are shown on Attachment 4, Sheet 28-5. Structures at the landfill are equipped with methane sensors, which are maintained and calibrated on a quarterly basis.

5.5 Landfill Gas Emission Controls

LFG emission controls at Section 2/8 include an active collection system, a passive venting system, and an LFG flare pad and flare station. The active collection, flaring, and gas recovery systems are currently in operation and will be operated during the post-closure period in accordance with the requirements of 6 NYCRR Part 208. Passive vents will remain closed while the active system is in operation; they will be opened only after the post-closure period or after methane generation has declined to the extent that the active gas collection system is no longer required.

5.5.1 Passive Duct Vents

Passive LFG controls at Section 2/8 of the Fresh Kills Landfill consist of duct vents installed as part of the final cover system. Design of the duct vents was provided in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8* (Ref. No. S-32) and *Engineering Report, Section 2/8 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-39). The landfill gas venting plan is included as Attachment 4, Sheet 28-5. Details of the duct vents are presented on Sheet 28-6.

These duct vents consist of trenches cut into the existing intermediate cover and refuse. Within each of the stone-filled ducts is a perforated pipe that runs along the entire length of the duct to facilitate gas movement. These ducts are fully enclosed within a geotextile to prevent the intrusion of cover soil and refuse. The ducts are oriented perpendicular to the final grading contours of each landfill section. Along these ducts, vertical riser vents are connected that will convey the LFG from the ducts through the landfill cover layer and into ambient air. To seal the penetration and preserve the integrity of the hydraulic barrier layer, the vertical riser vent is attached to the flexible geomembrane liner of the final cover by means of a geomembrane boot.

An application for variance from 6 NYCRR Part 360-2.13(p) for the LFG duct vents was submitted to NYSDEC in conjunction with an active gas collection system that would be in operation at Sections 2/8 and 3/4 until gas emissions fell below regulated thresholds. The variance was then submitted in conjunction with the Fresh Kills Landfill, Landfill Gas Flares Application to NYSDEC, dated April 1998 (Appendix FF), which resulted in NYSDEC Permit No. 2-6403-00011/00063 (Ref. No. N-150). Based on this review and acceptance under the permit application, the LFG duct vents in conjunction with the active gas collection system were approved by NYSDEC in lieu of a continuous gas venting layer.

5.5.2 Active Collection System

The active LFG collection system consists of several components that are involved in collecting LFG and transferring it to the necessary locations for processing or combustion. The basic system layout at Section 2/8 consists of extraction wells to collect the LFG, a piping system to convey the LFG to the flare station or LFG recovery facility, and an LFG flare pad and flare station located adjacent to Basin J.

Design of the extraction wells and piping system was provided in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8* (Ref. No. S-32) and *Engineering Report, Section 2/8 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-39). Design of the LFG flare pad and flare station at Section 2/8 was provided for in supporting documents for the facility LFG flaring permit (NYSDEC Permit No. 2-6403-00011/00063). A plan of the LFG collection system is provided as Attachment 4, Sheet 28-4. Typical details of the LFG collection system are provided on Sheet 28-6.

- **Vertical LFG Extraction Wells**

  Approximately 56 vertical extraction wells were constructed in Section 2/8 of the Landfill after cessation of waste disposal in 1993. These vertical LFG extraction wells each consist of a 6-inch HDPE pipe surrounded by aggregate backfill to ease LFG infiltration. The wells extend through the final cover and protrude approximately 15 feet to 50 feet into the waste depending upon their location within the Landfill. The bottom two-thirds of the pipe is perforated to allow the LFG to pass through; the top portion of the well casing (a minimum of 20-foot length) is solid and contains no perforations. Access to each well is provided through a 48-inch manhole with a removable manhole top.

  To seal the penetration and preserve the integrity of the hydraulic barrier layer, a geosynthetic boot is installed to seal the above-grade well casing to the geomembrane of the final cover, and a 40-inch-thick bentonite seal is placed above the backfilled gravel.

  Blowers located at the LFG flare station provide a negative pressure at each wellhead that causes the well to extract LFG from the Landfill. The wellheads are connected to lateral pipes that convey LFG to the flaring station via above-grade flexible piping capable of withstanding landfill settling.

- **Piping and Header System**

  Each of the vertical LFG extraction wells within the system is connected to a series of pipes. Lateral pipes, connected directly to the wellheads, convey the gas to header pipes. The header pipes are arranged in a loop around the perimeter of the Landfill section and lead to the flare station.

  In order to ensure that the condensate does not pool in sections of the piping, and to remove the condensate from the system, the collector pipes connecting the well laterals to

the header pipes are typically installed at a 3 percent slope. Condensate flows downslope within the system due to gravity. Drip legs, attached to the low points of these pipes, lead downslope to condensate tanks. These condensate tanks collect the condensate flowing into them, preventing the condensate, which is potentially hazardous, from entering the groundwater. Condensate is periodically removed from these tanks and brought to a permitted wastewater treatment facility.

- **LFG Flare Pad and Station**

  A modular flare station has been installed at Section 2/8 to combust the LFG and provide the necessary NMOC emissions reduction. This flare station can process up to 10,000 standard cubic feet per minute (scfm) of LFG. The basic components of the flare station include two flares, three exhauster/blowers, three demisters, a knockout tank, and an aboveground 20,000-gallon condensate storage tank.

  The flare station is built on a structural concrete pad supported by piles. At Section 2/8, the flare pad is located outside the limit of final cover.

  LFG entering the flare station is drawn first through a condensate knockout tank and then through demisters. Condensate removed by the knockout tank and demisters is conveyed to the aboveground condensate storage tank. Three blowers located at each flaring station act to provide the necessary negative pressure within the piping and wells to draw the LFG through the system. When operating at capacity, only two blowers will operate at any given time with one blower on standby as a backup during the post-closure period.

  After the LFG is drawn through the blowers it can be directed either to the flares or through the landfill gas transmission main to the separately permitted LFG recovery facility located at Section 1/9. The two flares located at the Section 2/8 flare station are each enclosed in a steel stack approximately 50 feet tall. The flares provide reductions in volatile organic compounds (VOC), NMOC, and hydrogen sulfide (H_2S) of at least 98 percent.

All LFG extracted from Section 2/8 is sent via the landfill gas transmission main to the LFG recovery facility located at Section 1/9, where the gas is purified for use as fuel. If the quantity of gas collected exceeds the capacity of the LFG recovery facility, or the facility is shut down, collected LFG from Section 2/8 will be combusted at the Section 2/8 flare station.

SECTION 6

LANDFILL SECTION 3/4

6.1 Site Description

Section 3/4, with a total area of 142 acres, is located generally between Rte. 440 and Main Creek. This section of the Landfill last received waste in November 1992. Construction of the final cover and drainage systems at Section 3/4 has been completed. As shown in the *Financial Assurance Plan* (Ref. No. W-47), the total capacity of Section 3/4 is 19,882,000 cubic yards, consisting primarily of municipal solid waste. Fig. No. 1-2 shows the general location of Section 3/4 at the Fresh Kills Landfill.

6.2 Final Cover and Drainage Systems

6.2.1 Final Cover

The installation of the final cover system for Section 3/4 has been completed. Final cover was installed in two main stages: portions of the lower sideslopes received final cover in 1988 through 1990, and the remainder of Section 3/4 received final cover in the mid-1990s. All final cover installed at Section 3/4 was designed and constructed in accordance with 6 NYCRR Part 360-2.15(d) or regulations applicable at the time of installation. The final cover plan and sections are presented in Attachment 4, Sheet 34-1. The final cover types used at Section 3/4 and at other Landfill sections are also presented in Table 2-2.

The four final cover types at Section 3/4 are as follows:

Type I

Type I final cover is also referred to as Alternative I in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4* (Ref. No. S-33) and *Engineering Report, Section 3/4 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-40), submitted in 1993. This cover type was installed during the mid-1990s on sideslopes of Section 3/4 (slopes greater than 10 percent and less than or equal to 33 percent).

The layers comprising Type I final cover, from top to bottom, are the following:

- *Top layer:* 6-inch topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geocomposite comprised of geotextiles heat-bonded to both sides of a geonet.
- *Hydraulic barrier layer:* 40-mil textured HDPE geomembrane.
- 6-inch layer of Type II Cover Soil.

Table 6-1
List of References for Section 6: Landfill Section 3/4
Fresh Kills Landfill Final Closure Plan

FLCP Section	Section Title	Ref ID	References	Referenced Information
6.1	**Site Description**	W-47	Roy F. Weston of New York, Inc. April 2002. **Financial Assurance Plan.**	An inventory of the waste received at Section 3/4
6.2	Final Cover and Drainage Systems	F-22	Frederic R. Harris, Inc. July 1990. **Final Cover Construction and Certification Results - Section 3/4, 1988, 1989, 1990 Construction Seasons, Report Volume I.**	Final Cover Construction and Certification Results of the clay final cover (Types IIIA and IIIB in FLCP) installed along lower sideslopes at Section 3/4
		S-38	SCS Engineers, P.C. May 18, 1992. **Final Closure Plan for Sections 2/8 and 3/4, Appendix A-3; Milestone 9; Order on Consent; Fresh Kills Landfill.**	Several alternatives of the final cover system for the remainder of Section 3/4 Initial drainage features at Section 3/4
		S-33	SCS Engineers, P.C. March 12, 1993. **Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4.**	Final design details of final cover (Type I and II) for Section 3/4 Detailed design of the drainage system
		S-40	SCS Engineers, P.C. May 17, 1993. **Engineering Report, Section 3/4 Final Cover and Landfill Gas Extraction System Construction Documents**.	Engineering report for Types I and II final cover at Section 3/4 Detailed design of the drainage system and basis of the design
6.3	Leachate Control	O-15	O'Brien & Gere Engineers, Inc. March 4, 1996. **Addendum 3, Fresh Kills Landfill Leachate Control Site Work and Appurtenances.**	Design of the recovery wells and the initial sections of partial perimeter drains at Section 3/4
		O-16	O'Brien & Gere Engineers, Inc. March 1, 1996. **Engineering Report, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems.**	Engineering report for design of the recovery wells and the initial sections of partial perimeter drains at Section 3/4
		O-17	O'Brien & Gere Engineers, Inc. March 1, 1996. **Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems.**	Construction Quality Assurance/Quality Control (CQA/CQC) Plan for design of the recovery wells and the initial sections of partial perimeter drains at Section 3/4
		S-46	Stone and Webster, Inc. May 1999. **Construction Certification Report, Fresh Kills Leachate Control, Site Work and Appurtenances Capital Project S111 and S197. PIN No. 9699566.**	Certification report for construction of recovery wells and the first sections of partial perimeter drains at Section 3/4
		T-1	Tully Construction/Munoz Engineering. Set No. 1, December 20, 1999 and Set No. 2, May 2000. **Construction As-Built Drawings Fresh Kills Landfill Leachate Control Sitework and Appurtenances Capital Project S111 and S197, Contract No. 9699566.**	Construction as-built drawings of recovery wells and the first sections of partial perimeter drains at Section 3/4
		I-36	IT Corporation. June 2000 Revised January 2001. **Final Engineering Plans, Fresh Kills Landfill Supplemental Leachate Controls at Sections 2/8 and 3/4.**	The design for additional perimeter drains at Section 3/4
6.4	Landfill Gas Migration Control	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Vol. C - Environmental Monitoring Program - landfill migration control and monitoring
		J-1	JAB Construction. July 1993. **As-Built Drawings of the LFG Migration Control Project.**	Construction of the interceptor venting system
6.5	Landfill Gas Emission Control	S-33	SCS Engineers, P.C. March 12, 1993. **Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4.**	Design of the extraction wells and piping system at Section 3/4
		S-40	SCS Engineers, P.C. May 17, 1993 **Engineering Report, Section 3/4 Final Cover and Gas Extraction System Construction Documents.**	Engineering report for design of the extraction wells and piping system at Section 3/4
		N-150	New York State Department of Environmental Conservation. April 1998. **Fresh Kills Landfill Gas Flare Stations Permit. NYSDEC Permit No. 2-6403-00011/00063.**	Design of the LFG flare pad and flare station at Section 3/4; variance approval for LFG duct vents at Section 3/4

Type II

Type II final cover is also referred to as Alternative V in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4* (Ref. No. S-33) and *Engineering Report, Section 3/4 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-40), submitted in 1993. This cover type was installed during the mid-1990s on top portions of Section 3/4 (slopes less than or equal to 10 percent).

The layers comprising Type II final cover, from top to bottom, are the following:

- *Top layer:* 6-inch topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Hydraulic barrier layer:* 40-mil smooth HDPE geomembrane.
- 6-inch layer of Type II Cover Soil.

Type IIIA

Type IIIA final cover was installed along the lower sideslopes of Section 3/4. Construction of Type IIIA final cover was detailed in *Final Cover Construction and Certification Results – Section 3/4, 1988, 1989, 1990 Construction Season* (Ref. No. F-22), which was prepared and submitted to NYSDEC in July 1990.

The layers comprising Type IIIA final cover, from top to bottom, are the following:

- *Top layer:* 6-inch topsoil.
- *Barrier protection material:* 18-24-inch soil barrier protection layer.
- *Hydraulic barrier layer:* 12-inch low-permeability barrier soil with a maximum hydraulic conductivity of 1×10^{-7} cm/sec.

Type IIIB

Type IIIB final cover was installed along the lower sideslopes of Section 3/4. Construction of Type IIIB final cover was detailed in *Final Cover Construction and Certification Results – Section 3/4, 1988, 1989, 1990 Construction Season* (Ref. No. F-22), which was prepared and submitted to NYSDEC in July 1990.

The layers comprising Type IIIB final cover, from top to bottom, are the following:

- *Top layer:* 6-inch topsoil.
- *Barrier protection material:* 18-24-inch soil barrier protection layer.
- *Hydraulic barrier layer:* 18-inch low-permeability barrier soil with a maximum hydraulic conductivity of 1×10^{-7} cm/sec.

The maintenance and inspection procedures for the final cover on Section 3/4 are outlined in Section 3 and Attachment 2 of the *Post-Closure Monitoring and Maintenance Operations Manual, Volume A* (Ref. No. W-49).

6.2.2 Drainage Structures

The stormwater and drainage system for Section 3/4 has been designed to collect and convey stormwater off the landfill cover, to collect sediment, and to discharge stormwater into surrounding waterways in a controlled manner. Stormwater on the landfill cover is collected by drainage swales that are located at intervals of approximately every 50 vertical feet. Drainage swales are graded at a minimum slope of 2 percent and discharge at the low point to downchute pipes that run perpendicular to the contours. Stormwater is then conveyed through downchute pipes to the stormwater basin intake. Runoff enters the downchute pipes through slotted inlets. Drop manholes are used as connectors for vertical and horizontal alignment of downchute pipes. A plan of the drainage system at Section 3/4 is provided in Attachment 4, Sheet 34-2. Details of the various drainage structures are shown on Sheet 34-3.

Detailed design of the drainage system and basis of the design was presented in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4* (Ref. No. S-33) and *Engineering Report, Section 3/4 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-40).

Where design velocities are low, the drainage swales are lined with grass and erosion control material. For swales with greater design velocities, geosynthetic or riprap lining was used. The type of lining material used in each drainage swale is shown on Attachment 4, Sheet 34-3. The downchute pipes for Section 3/4 are constructed of HDPE, with the exception of one gabion downchute that flows into Basin F.

6.2.3 Stormwater Basins and Outfall Structures

Stormwater basins receive stormwater from the drainage swales and downchute pipes, and discharge the stormwater at a controlled flow rate to a receiving waterway. Stormwater basins that receive runoff from Section 3/4 include Basins D, E, F, and Q. The locations of these basins are shown on Attachment 4, Sheet 34-2.

The stormwater basins and outfall structures are sized to detain the runoff from a 25-year, 24-hour storm and to control flow from a 100-year, 24-hour storm. The basin outfall structure typically includes a 12-inch-diameter lateral pipe at the bottom of the basin and a 36-inch-diameter riser pipe. Where so installed, the lateral pipe is wrapped in a geotextile and covered with stone, and is designed to drain the basin on a continuous basis. The inlet to the riser is set above the 25-year storm elevation and is designed to drain each basin when a greater storm occurs. An emergency spillway is provided for storm events greater than the 100-year storm. The basin berms were constructed at 3-to-1 side slopes, with a 10-foot-wide top of berm and a 1-foot freeboard.

Basin D is located north of Section 3/4. The northern portion of Section 3/4 drains into Basin D, which discharges into Main Creek.

Basin E is located near the southeast end of Section 3/4. The lower sideslopes of the southeast portion of Section 3/4 drain into Basin E, which discharges into Main Creek.

Basin F, located south of the southern end of Section 3/4, drains the lower sideslopes of the southern end of Section 3/4. Basin F discharges into Fresh Kills.

Basin Q is located south of the southwest end of Section 3/4. The southwestern portion of Section 3/4 drains into Basin Q, which discharges into Fresh Kills.

6.3 Leachate Control

Leachate Collection and Conveyance System

The leachate collection and conveyance system for Section 3/4 consists of the following components:

- Recovery Wells
- Partial Perimeter Drains and Pump Stations
- Force Mains

Locations of leachate recovery wells and partial perimeter drains at Section 3/4 are shown on Attachment 4, Sheet 34-7. Details of the leachate collection and conveyance system are provided on Sheet 34-8. Design of the recovery wells and the initial sections of partial perimeter drains was presented in final contract documents, including *Addendum 3 of the Fresh Kills Leachate Control, Site Work, and Appurtenances Contract* (Ref. No. O-15), the *Engineering Report, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems* (Ref. No. O-16), and the *Final Construction Quality Assurance/Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems* (Ref. No. O-17). The design for additional perimeter drains was provided in *Final Engineering Plans, Fresh Kills Landfill Supplemental Leachate Controls at Sections 2/8 and 3/4* (Ref. No. I-36). Construction of the recovery wells and the first set of perimeter drains was documented in *Construction Certification Report for Fresh Kills Leachate Control, Site Work and Appurtenances* (Ref. No. S-46) and on the as-built drawings provided in *Construction As-Built Drawings: Fresh Kills Landfill Leachate Control Sitework and Appurtenances* (Ref. No. T-1), submitted in December 1999.

- **Recovery Wells**

  Leachate recovery wells, which consist of a submersible pump and stainless steel well screen and casing, are located on top plateau areas of the landfill and extract leachate from deep within the landfill mound. The pumped leachate is conveyed to a force main, which then joins the force main for the perimeter leachate collection drain.

- **Partial Perimeter Drains and Pump Stations**

  Leachate collection drains are designed to collect leachate at the toe of slope along selected segments of the Section 3/4 perimeter. Each drain consists of a stone-filled trench with slotted corrugated HDPE pipe. Leachate in the collection drain flows into a series of leachate collection pump stations. Each leachate collection pump station consists of a wet well with a submersible leachate well pump. Level sensors installed in each pump station control the activation of the pump. The pumps are of stainless steel construction to provide reliable service in their potentially corrosive environments. At each leachate collection pump station, a sampling port, pressure gauge, check and ball valves and flow meter are located either in an aboveground enclosure or in an underground concrete vault, which extends to grade and is equipped with an access hatch for sampling and maintenance.

  The effectiveness of the segments of leachate collection drain at Section 3/4 located along Main Creek is monitored by measuring the water levels in monitoring piezometers installed in pairs on each side of the drain and by limited analytical testing of water samples taken at the monitoring piezometers and leachate collection pump stations.

- **Force Mains**

  Leachate collected at the leachate collection pump stations is conveyed to the FKLLTP through leachate collection headers and force mains. The header at Section 3/4 crosses beneath Main Creek and connects into the header for Section 6/7, which empties into the Section 6/7 leachate conveyance pump station. The leachate conveyance pump station conveys leachate to the FKLLTP through a leachate force main. The locations of the leachate collection headers at Section 3/4 are shown on Attachment 4, Sheet 34-7. The locations of the force mains connecting the Section 3/4 leachate collection system to the Section 6/7 header and to the FKLLTP are shown on Fig. No. 2-3 and Sheet LF-6.

6.4 Landfill Gas Migration Controls

The LFG migration management system at Section 3/4 consists of two programs: engineered controls (including the perimeter LFG interceptor vents, utility seals, and the perimeter leachate collection systems) and migration monitoring along the property boundary. LFG migration monitoring is detailed in the *Post-Closure Monitoring, and Maintenance Operations Manual* (Ref. No. W-49)

The perimeter LFG interceptor venting system (also known as interceptor trenches or perimeter vent trenches) are installed along portions of the perimeter of Section 3/4 as shown on Attachment 4, Sheet 34-5. The interceptor venting system at Section 3/4, with a total length of 6,390 linear feet, is located on the east side of Route 440 and north of Section 3/4, running generally parallel to Victory Boulevard. The interceptor venting system is keyed into low-permeability soils or typically extended 2 feet below the seasonal low groundwater table to form an effective barrier to cut off the lateral, off-site migration of LFG generated within the landfill and to allow the LFG to vent passively before migrating off site. The interceptor venting system

was installed in accordance with 6 NYCRR Part 360-2.15(e) and (f). Construction of the interceptor venting system is detailed in *As-Built Drawings of the LFG Migration Control Project* (Ref. No. J-1). In addition, where underground utilities may be impacted or may act as conduits for the LFG, utility seals are used to cut off the LFG from migrating along the utility conduits. Locations of the utility seals are also shown on Attachment 4, Sheet 34-5.

The LFG migration monitoring program consists of the measurement of subsurface pressure and concentrations of methane, oxygen, and carbon dioxide as percent gas at LFG migration monitoring wells located along portions of the perimeter of Section 3/4. LFG migration monitoring will be performed in accordance with the *Draft Post-Closure Monitoring and Maintenance Operations Manual* and will typically be conducted on a quarterly basis. The locations of the migration monitoring wells are shown on Attachment 4, Sheet 34-5. Structures at the landfill are equipped with methane sensors, which are maintained and calibrated on a quarterly basis.

6.5 Landfill Gas Emission Controls

LFG emission controls at Section 3/4 include an active collection system, a passive venting system, and an LFG flare pad and flare station. The active collection, flaring, and gas recovery systems are currently in operation and will be operated during the post-closure period in accordance with the requirements of 6 NYCRR Part 208. Passive vents will remain closed while the active system is in operation; they will be opened only after the post-closure period or after methane generation has declined to the extent that the active gas collection system is no longer required.

6.5.1 Passive Duct Vents

Passive LFG controls at Section 3/4 of the Fresh Kills Landfill consist of duct vents installed as part of the final cover system. Design of the duct vents was provided in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4* (Ref. No. S-33) and *Engineering Report, Section 3/4 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-40). The landfill gas venting plan is included as Attachment 4, Sheet 34-5. Details of the duct vents are presented on Sheet 34-6.

These duct vents consist of trenches cut into the existing intermediate cover and refuse. Within each of the stone-filled ducts is a perforated pipe that runs along the entire length of the duct to facilitate gas movement. These ducts are fully enclosed within a geotextile to prevent the intrusion of cover soil and refuse. The ducts are oriented perpendicular to the final grading contours of each landfill section. Along these ducts, vertical riser vents are connected that will convey the LFG from the ducts through the landfill cover layer and into ambient air. To seal the penetration and preserve the integrity of the hydraulic barrier layer, the vertical riser vent is attached to the flexible geomembrane liner of the final cover by means of a geomembrane boot.

An application for variance from 6 NYCRR Part 360-2.13(p) for the LFG duct vents was submitted to NYSDEC in conjunction with an active gas collection system that would be in operation at Sections 2/8 and 3/4 until gas emissions fell below regulated thresholds. The variance was then submitted in conjunction with the Fresh Kills Landfill, Landfill Gas Flares Application to NYSDEC, dated April 1998 (Appendix FF), which resulted in NYSDEC Permit No. 2-6403-00011/00063 (Ref. No. N-150). Based on this review and acceptance under the permit application, the LFG duct vents in conjunction with the active gas collection system were approved by NYSDEC in lieu of a continuous gas venting layer.

6.5.2 Active Collection System

The active LFG collection system consists of several components that are involved in collecting LFG and transferring it to the necessary locations for processing or combustion. The basic system layout at Section 3/4 consists of extraction wells to collect the LFG, a piping system to convey the LFG to the flare station or LFG recovery facility, and an LFG flare pad and flare station located in the southeast corner of the section.

Design of the extraction wells and piping system was provided in the *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4* (Ref. No. S-33) and *Engineering Report, Section 3/4 Final Cover and Gas Extraction System Construction Documents* (Ref. No. S-40). Design of the LFG flare pad and flare station at Section 3/4 was provided for in supporting documents for the facility LFG flaring permit (NYSDEC Permit No. 2-6403-00011/00063). A plan of the LFG collection system is provided as Attachment 4, Sheet 34-4. Typical details of the LFG collection system are provided on Sheet 34-6.

- **Vertical LFG Extraction Wells**

  Approximately 103 vertical extraction wells were constructed in Section 3/4 of the Landfill after cessation of waste disposal in 1992. These vertical LFG extraction wells each consist of a 6-inch HDPE pipe surrounded by aggregate backfill to facilitate LFG infiltration. The wells extend through the final cover and protrude approximately 15 feet to 50 feet into the waste depending upon their location within the Landfill. The bottom two-thirds of the pipe is perforated to allow the LFG to pass through; the top portion of the well casing (a minimum 20-foot length) is solid and contains no perforations. Access to each well is provided through a 48-inch manhole with a removable manhole top.

  To seal the penetration and preserve the integrity of the hydraulic barrier layer, a geosynthetic boot is installed to seal the above-grade well casing to the geomembrane of the final cover, and a 40-inch-thick bentonite seal is placed above the backfilled gravel.

  Blowers located at the LFG flare station provide a negative pressure at each wellhead that causes the well to extract LFG from the Landfill. The wellheads are connected to lateral pipes that convey LFG to the flaring stations via above-grade flexible piping capable of withstanding landfill settling.

- **Piping and Header System**

  Each of the vertical LFG extraction wells within the system is connected to a series of pipes. Lateral pipes, connected directly to the wellheads, convey the gas to header pipes. The header pipes are arranged in a loop around the perimeter of the Landfill section and lead to the flare station.

  In order to ensure that the condensate does not pool in sections of the piping, and to remove the condensate from the system, the collector pipes connecting the well laterals to the header pipes are typically installed at a 3 percent slope. Condensate flows downslope within the system due to gravity. Drip legs, attached to the low points of these pipes, lead downslope to condensate tanks. These condensate tanks collect the condensate flowing into them, preventing the condensate, which is potentially hazardous, from entering the groundwater. Condensate is periodically removed from these tanks and brought to a permitted wastewater treatment facility.

- **LFG Flare Pad and Station**

  A modular flare station has been installed at Section 3/4 to combust the LFG and provide the necessary NMOC emissions reduction. This flare station can process up to 10,000 standard cubic feet per minute (scfm) of LFG. The basic components of the flare station include two flares, three exhauster/blowers, three demisters, a knockout tank, and an aboveground 20,000-gallon condensate storage tank.

  The flare station is built on a structural concrete pad supported by piles. At Section 3/4, the flare pad is located within the limit of final cover, such that the flare pad is underlain by refuse. As a precaution to deal with forces applied by landfill settling, flexible piping and joints were installed between station components.

  LFG entering the flare station is drawn first through a condensate knockout tank and then through demisters. Condensate removed by the knockout tank and demisters is conveyed to the aboveground condensate storage tank. Three blowers located at each flaring station act to provide the necessary negative pressure within the piping and wells to draw the LFG through the system. When operating at capacity, only two blowers will operate at any given time with one blower on standby as a backup during the post-closure period.

  After the LFG is drawn through the blowers it can be directed either to the flares or through the landfill gas transmission main to the separately permitted LFG recovery facility located at Section 1/9. The two flares located at the flare station are each enclosed in a steel stack approximately 50 feet tall. The flares provide reductions in volatile organic compounds (VOC), NMOC, and hydrogen sulfide (H_2S) of at least 98 percent.

All LFG extracted from Section 3/4 is sent via the landfill gas transmission main to the LFG recovery facility located at Section 1/9, where the gas is purified for use as fuel. If the quantity of gas collected exceeds the capacity of the LFG recovery facility, or the facility is shut down, collected LFG from Section 3/4 will be combusted at the Section 3/4 flare station.

SECTION 7

LANDFILL SECTION 6/7

7.1 Site Description

Section 6/7, with a total area of 305 acres, is the second largest of the four landfill sections and is located generally between Richmond Avenue and Main/Richmond Creeks. This section of the Landfill last received waste in June 1999. Fig. No. 1-2 shows the general location of Section 6/7 at the Fresh Kills Landfill.

As shown in the *Financial Assurance Plan* (Ref. No. W-47), the total capacity of Section 6/7 is 32,630,617 cubic yards, consisting primarily of municipal solid waste. The waste thickness at Section 1/9 is approximately 125 feet at its thickest point, based on *The Fresh Kills Landfill Section 6/7 Final Cover Report* (Ref. No. M-11).

Final cover has been placed along the perimeter of this section. Remaining final cover placement is scheduled in accordance with the closure construction schedule presented in Section 3.2.

7.2 Final Cover and Drainage System

7.2.1 Final Cover

Final cover at Section 6/7 has been and will be installed in two stages. A strip of final cover was installed around the perimeter of Section 6/7 in conjunction with construction of the leachate collection and containment system; final cover on the remaining portions of Section 6/7 has not yet been installed. All final cover installed at Section 6/7 has been or will be constructed in accordance with 6 NYCRR Part 360-2.15(d). A plan view of the five different types of final cover is presented in Attachment 4, Sheet 67-2. The design details of the final cover types used at Section 6/7 are shown in Sheet 67-3. The final cover types used at Section 6/7 and at other Landfill sections are also presented in Table 2-2.

The five final cover types at Section 6/7 are as follows:

Type IV

Type IV final cover is also referred to as Type I in *The Fresh Kills Landfill Section 6/7 Final Cover Design Report* (Ref. No. M-11). This cover type will be used for slopes greater than 15 percent and less than or equal to 33 percent. Construction of this final cover type has not yet started.

The layers comprising Type IV final cover, from top to bottom, are the following:

Table 7-1
List of References for Section 7: Landfill Section 6/7
Fresh Kills Landfill Final Closure Plan

FLCP Section	Section Title	Ref ID	References	Referenced Information
7.1	Site Description	W-47	Roy F. Weston of New York, Inc. April 2002. **Financial Assurance Plan.**	An inventory of the waste received at Section 6/7
		M-11	Malcolm Pirnie, Inc. January 2001. **Fresh Kills Landfill: Section 6/7 Final Cover Design Report Appendix D: Engineering Plan.**	The waste thickness at Section 6/7
7.2	Final Cover and Drainage Systems	T-1	Tully Construction/Munoz Engineering. Set No. 1, December 20, 1999 and Set No. 2, May 2000. **Construction As-Built Drawings Fresh Kills Landfill Leachate Control Sitework and Appurtenances Capital Project S111 and S197, Contract No. 9699566.**	As-built drawings for construction of perimeter road final cover at Section 6/7 (Type VIII in FLCP)
		S-46	Stone and Webster, Inc. May 1999. **Construction Certification Report, Fresh Kills Leachate Controls, Site Work and Appurtenances Capital Project S111 and S197. PIN No. 9699566.**	Construction of perimeter road final cover at Section 6/7 (Type VIII in FLCP)
		M-11	Malcolm Pirnie, Inc. January 2001. **Fresh Kills Landfill: Section 6/7 Final Cover Design Report Appendix D: Engineering Plan.**	Design details for final cover Types I (Type IV in FLCP), Type II (Type V in FLCP), Type III (Type VII in FLCP), Type IV (Type VI in FLCP), and final cover at perimeter of reclamation area (Type IX in FLCP) Detailed design of the drainage system and basis of the design
		W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Volume A and Attachment 2 - the maintenance and inspection procedures for the final cover on Section 6/7
7.3	Leachate Control	O-3	O'Brien & Gere Engineers, Inc. November 18, 1994. **Final Specifications, Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System**. Includes Errata issued February 3, 1995.	Design details of the leachate collection and containment system at Section 6/7
		O-5	O'Brien & Gere Engineers, Inc. November 18, 1994. **Final Engineering Report, Fresh Kills Landfill, Sections 6/7 Leachate Collection and Containment System**. Includes Errata issued February 3, 1995.	Final engineering report for design details of the leachate collection and containment system at Section 6/7
		O-6	O'Brien & Gere Engineers, Inc. November 18, 1994. **Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System** Includes Errata issued February 3, 1995.	Construction QA/QC for design details of the leachate collection and containment system at Section 6/7
		O-9	O'Brien & Gere Engineers, Inc. November 1994. **Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System, Final Contract Drawings.** Includes Errata issued February 3, 1995.	Final contract drawings for design details of the leachate collection and containment system at Section 6/7
		O-11	O'Brien & Gere Engineers, Inc. January 1996. **Final Contract Drawings Fresh Kills Landfill Leachate Control Site Work and Appurtenances**. P.I.N. #82796RR00076.	Final contract drawings for construction of the leachate control system at Section 6/7
		O-13	O'Brien & Gere Engineers, Inc. March, 1996. **Final Engineering Drawings, Fresh Kills Landfill Leachate Collection and Containment System, Sections 1/9 and 6/7.**	Final engineering drawings for construction of the leachate control system at Section 6/7
		O-14	O'Brien & Gere Engineers, Incorporated. March 4, 1996. **Final Engineering Report, Addendum No. 1, Fresh Kills Landfill, Section 1/9 and 6/7 Leachate Collection and Containment System.**	Addendum No. 1 to the final engineering report for construction of the leachate control system at Section 6/7
		S-46	Stone and Webster, Inc. May 1999. **Construction Certification Report, Fresh Kills Leachate Control, Site Work and Appurtenances Capital Project S111 and S197. PIN No. 9699566.**	Construction certification report for construction of the leachate controls at Section 6/7
		T-1	Tully Construction/Munoz Engineering. Set No. 1, December 20, 1999 and Set No. 2, May 2000. **Construction As-Built Drawings Fresh Kills Landfill Leachate Control Sitework and Appurtenances Capital Project S111 and S197, Contract No. 9699566.**	As-built drawings for construction of the leachate controls at Section 6/7
7.4	Landfill Gas Migration Control	W-49	Weston Solutions of New York, Inc. December 13, 2002. **Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.**	Vol. C - Environmental Monitoring Program - landfill migration control and monitoring
		J-1	JAB Construction. July 1993. **As-Built Drawings of the LFG Migration Control Project.**	Construction of the interceptor venting system
7.5	Landfill Gas Emission Control	M-11	Malcolm Pirnie, Inc. January 2001. **Fresh Kills Landfill: Section 6/7 Final Cover Design Report Appendix D: Engineering Plan.**	Design details of the passive venting system and the active systemat at Section 6/7
		N-150	New York State Department of Environmental Conservation. April 1998. **Fresh Kills Landfill Gas Flare Stations Permit. NYSDEC Permit No. 2-6403-00011/00063.**	Design of the LFG flare pad and flare station at Section 3/4

- *Top layer:* 6-inch (min.) topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geocomposite comprised of geotextiles heat-bonded to both sides of a HDPE geonet.
- *Hydraulic barrier layer:* 40-mil textured low linear density polyethylene (LLDPE) geomembrane.
- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type V

Type V final cover is also referred to as Type II in Ref. No. M-11. This cover type will be used on slopes greater than 4 percent and less than or equal to 15 percent. Construction of this final cover type has not yet started.

The layers comprising Type V final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) topsoil.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geotextile fabric protection layer.
- *Hydraulic barrier layer:* 40-mil textured LLDPE geomembrane.
- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type VI

Type VI final cover is also referred to as Type IV in Ref. No. M-11. This cover type will be used for finished asphalt roads. Construction of this final cover type has not yet started.

The layers comprising Type VI final cover, from top to bottom, are the following:

- *Top layer:* 4-inch (min.) asphalt layer.
- *Top layer, continued:* 6-inch (min.) crushed stone gravel.
- *Barrier protection material:* Geotextile fabric protection layer.
- *Barrier protection material:* 20-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geotextile fabric protection layer.
- *Hydraulic barrier layer:* 40-mil textured LLDPE geomembrane.
- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type VII

Type VII final cover is also referred to as Type III in Ref. No. M-11. This cover type will be used for finished gravel roads. Construction of this final cover type has not yet started.

The layers comprising Type VII final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) gravel layer.
- *Barrier protection material:* Geotextile fabric protection layer.
- *Barrier protection material:* 24-inch (min.) soil barrier protection layer.
- *Drainage layer:* Geocomposite comprised of geotextiles heat-bonded to both sides of a HDPE geonet.
- *Hydraulic barrier layer:* 40-mil textured LLDPE geomembrane.
- *Gas venting layer:* Geocomposite gas venting net comprised of geotextiles heat-bonded to both sides of a HDPE geonet.

Type VIII

Type VIII final cover is also referred to as final cover that includes 60 mil HDPE geomembrane in Ref. No. T-1. This final cover type was installed around the perimeter of Section 6/7 in conjunction with the leachate collection and containment system. Type VIII final cover overlies the cutoff wall, leachate collection trench, and associated components. Construction of Type VIII final cover is detailed in the *Construction Certification Report for Fresh Kills Leachate Control, Site Work and Appurtenances* (Ref. No. S-46) and on the as-built drawings provided in *Construction As-Built Drawings: Fresh Kills Landfill Leachate Control Sitework and Appurtenances* (Ref. No. T-1), submitted in December 1999.

The layers comprising Type VIII final cover, from top to bottom, are the following:

- *Top layer:* 6-inch (min.) topsoil layer *or* Type 2 pavement.
- *Barrier protection material:* 24-inch (min) soil barrier protection layer.
- *Hydraulic barrier layer:* 60-mil HDPE geomembrane.
- 6-inch (min.) HDPE geomembrane bedding layer (Type 'D' Select Fill).

The monitoring and maintenance procedures for the final cover on Section 6/7 are outlined in Section 3 and Attachment 2 of the *Post-Closure Monitoring and Maintenance Operations Manual, Volume A* (Ref. No. W-49).

7.2.2 Drainage Structures

The final stormwater drainage system at Section 6/7 will consist of a series of swales, stepped gabion downchutes, drop-inlet boxes, culverts, inlet pipes and stormwater control basins. At Section 6/7 stormwater runoff (sheet or concentrated flow) from the top and sideslopes of the landfill will be collected by swales located on the sideslopes. Where service roads intersect swales, culverts will be provided under the road. Runoff collected at the swales will then be conveyed to the stepped gabion downchutes, from which it is routed to stormwater basin inlet

pipes. Where necessary, drop-inlet boxes are used for vertical alignment. The drainage process is illustrated as follows:

Runoff → Swale → (Culvert) → Downchute → Drop-Inlet Box → Inlet Pipe → Basin → Outfall Structure

Detailed design of the drainage system and basis of the design is included in *The Fresh Kills Landfill Section 6/7 Final Cover Design Report* (Ref. No. M-11). A final drainage plan is included as Attachment 4, Sheet 67-4. Final drainage details are presented in Sheets 67-5 and 67-6. The final grading plan is presented in Sheet 67-1.

Watersheds were delineated based on the final grading plan, taking into account the existing normal storage conditions of the stormwater control basins and drainage outlets. Five watersheds were identified for Section 6/7 and labeled according to the corresponding basin/outlet designation (e.g., Watershed A corresponds to Basin A). A drainage layout was developed for each watershed identifying swales, stepped gabion downchutes, drop-inlet boxes, culverts, inlet pipes, and basins. A sub-drainage area was also identified for each swale. Detailed delineation is provided in *The Fresh Kills Landfill Section 6/7 Final Cover Design Report* (Ref No. M-11). The 100-year, 24-hour storm event, based on final vegetated conditions, was used as the design storm for the closure of Section 6/7.

Major components of the drainage structures at Section 6/7 include the following:

Swales The swales consist of trapezoidal channels located along the sideslopes of the landfill. Swales on the landfill slopes were placed at longitudinal slopes that vary from 0.5 percent at the base of Section 6/7 to 4.5 percent at the upper areas of the section. The shallow swale slopes at the landfill base are needed to minimize runoff originated near the perimeter of the landfill that otherwise would discharge directly into the tidal and freshwater wetlands. Swales are created by placing embankment fill over the landfill cap. In general, the swales will be 3 feet deep (including 1 foot for settlement), and the bottom width will vary between 4 and 20 feet to accommodate the peak discharges corresponding to the 100-year, 24-hour storm event.

Culverts Road crossing culverts also will be needed for the stormwater drainage system. Culverts will consist of single or multiple corrugated metal pipe (CMP) designed to connect the swale in instances where the swale crosses a road. At several locations, culvert boxes are specified. The culvert sizes were determined such that they will prevent overtopping of the service roads and/or the landfill sideslopes.

Downchutes Stepped gabion downchutes will collect stormwater runoff from the swales and convey it to drop-inlet boxes. Layout of the downchutes is shown in Attachment 4, Sheet 67-4. The stepped gabion downchutes will have a rectangular cross-section with a depth of 3 feet and bottom widths from 3 to 9 feet. The downchute profile involves a nominal 3-foot drop and a near-horizontal channel section to accommodate the landfill slopes. Swales located at the top of the downchutes will discharge at the downchute floor invert elevation, while swales between the top and the bottom of the downchutes will discharge at least 1 foot above the downchute floor invert elevation.

Drop-Inlet Boxes Drop-inlet boxes will be built as part of the downchute structure to collect stormwater runoff from downchutes or from swales that are directly connected to the drop-inlet boxes. Drop-inlet boxes will be located between the toe of each downchute and the entrance of the inlet pipe for each stormwater basin.

Inlet Pipes Inlet pipes were placed at each basin during construction of the leachate containment system. These pipes were located and sized based on previous design and were provided to convey stormwater runoff through the leachate cutoff wall. The locations of these basin inlet pipes are fixed and, therefore, the stormwater drainage system layout is tied into these locations.

7.2.3 Stormwater Basins and Outfall Structures

The stormwater basins associated with Section 6/7 are shown on Attachment 4, Sheets LF-3 and 67-4. The basins and outfall structures have three primary functions:

- to detain the stormwater runoff and thereby reduce its velocity prior to discharge;
- to allow sediment to settle out; and
- to provide for controlled discharge to receiving waterways.

The designations of the five stormwater control basins located around Section 6/7 are: A, B1, B2, C partitioned into C1 and C2, and R. In the final drainage design, delineation of watersheds was based on locations and storage conditions of existing stormwater basins and outlets.

The basin outfall structure typically includes a 12-inch diameter lateral pipe at the bottom of the basin and a 36-inch diameter riser pipe. Where so installed, the lateral pipe is wrapped in a geotextile and covered with stone, and is designed to drain the basin on a continuous basis. The inlet to the riser is designed to drain the basin when a greater storm occurs. An emergency spillway is provided for storm events greater than the 100-year storm. Under normal conditions (i.e., lateral pipe, riser pipe, and emergency spillway all in full capacity conveyance condition), the routed runoff volume from the watershed generated by the 100-year, 24-hour storm event will be contained within the basins with a minimum of 1 foot of freeboard.

Basin A is located northeast of Section 6/7. The northern portion of Section 6/7 drains into Basin A, which, in turn, discharges into Main Creek.

Basins B1 and B2 were designed as wet ponds to improve the conditions of the existing freshwater wetlands. The wet ponds are designed to have an upper and a lower storage area. The lower area will be flooded on a nearly permanent basis to provide the best possible hydrological conditions for maintaining a freshwater wetland ecosystem. The upper storage area will be flooded only during runoff accumulation from large storms.

Basins B1 and B2 are connected via a horizontal corrugated metal pipe culvert. A single outfall structure in B1 controls the water level in both basins. Aquatic ecosystems are promoted in Basins B1 and B2 to provide organic and nutrient removal and transformation from stormwater runoff, and to provide improved aesthetics in and around the basin.

Basins C1 and C2 are located on the west side of Section 6/7. These two basins are connected via a culvert under the adjacent service road. Flows from C2 discharge to C1, which, in turn, discharges into the Fresh Kills. Basin C2 was added to manage the excess stormwater runoff occurring during operations.

Basin R is located at the southern tip of Section 6/7. The southern area of Section 6/7 drains into Basin R. Basin R discharges into Richmond Creek.

7.3 Leachate Control

The existing leachate control and management system at Section 6/7 consists of a cutoff wall and a leachate collection drain located along the perimeter of the landfill section with associated leachate collection pump stations. Design details of the leachate collection and containment system were completed in 1994 and submitted to meet Consent Order A-4, Subject 15; the submissions included *Final Engineering Report for Section 6/7 Leachate Collection and Containment System* (Ref. No. O-5), *Final Specifications* (Ref. No. O-3), *Final Construction Quality Assurance/Construction Quality Control for Sections 1/9 and 6/7* (Ref. No. O-6), and *Final Contract Drawings* (Ref. No. O-9). *Addendum No. 1 to the Final Engineering Report* was prepared in March 1994 (Ref. No. O-14). In addition to the above documents, *Final Contract Drawings Fresh Kills Landfill Leachate Control Site Work and Appurtenances* (Ref. No. O-13) and *Final Engineering Drawings* (Ref No. O-11) were prepared in 1996 for construction of the leachate control system at Section 6/7. Construction of the leachate controls at Section 6/7 is detailed in detailed in the *Construction Certification Report for Fresh Kills Leachate Control, Site Work and Appurtenances* (Ref. No. S-46) and on the as-built drawings provided in *Construction As-Built Drawings: Fresh Kills Landfill Leachate Control Sitework and Appurtenances* (Ref. No. T-1), submitted in December 1999.

The leachate collection plan for Section 6/7 is provided as Attachment 4, Sheet 67-9. Leachate collection and containment details are presented on Sheets 67-10 and 67-11, respectively.

7.3.1 Leachate Containment System

The leachate containment system at Section 6/7 consists of a soil bentonite or cement bentonite cutoff wall that extends around the perimeter of the section. The cutoff wall provides containment for leachate and minimizes the amount of water from adjacent groundwater aquifers entering the leachate collection system. The cutoff walls were installed 3 feet into the uppermost low-permeability strata, which are the glaciolacustrine clay and silt or cretaceous clay layers located in the overburden hydrostratigraphic unit. These fine-grained geologic units under the Landfill, which are 10 to 55 feet below grade, provide the anchors for the cutoff wall. The vertical hydraulic conductivity of these clays and silts varies from $1x10^{-6}$ to $1x10^{-8}$ cm/sec. Together, the fine-grained deposits and the cutoff wall system form a physical and hydraulic barrier to contain the shallow, horizontal flow of leachate, and to reduce infiltration of shallow groundwater from outside the cutoff wall.

The placement of the cutoff wall was designed to maintain a maximum leachate level of 2 feet below the Mean Low Water (MLW) elevation. The leachate collection system will induce a gradient inward from the cutoff wall, thus minimizing hydraulic pressure on the interior of the wall and maximizing leachate recovery around the perimeter of the landfill. Because groundwater elevation on the outside of the cutoff wall will always be equal to or greater than MLW, the design results in a minimum hydraulic gradient of 2 feet between the inside and outside of the cutoff wall.

7.3.2 Leachate Collection and Conveyance System

The leachate collection and conveyance system at Section 6/7 consists of the following components:

- **Leachate Collection Drains**

  The locations of the collection drains are shown on Attachment 4, Sheet 67-9. Each drain consists of a minimum of 3-foot-wide trench backfilled with granular materials to promote leachate infiltration. A slotted HDPE pipe placed above the bottom of the trench conveys the collected leachate to the collection wells. The collection drain is located between the Landfill toe of slope and the Landfill side of the soil/cement-bentonite cutoff wall.

The depth of the leachate collection drain varies as shown on the as-built drawings (Ref. No. T-1). As designed, the system induces a gradient inward toward the trench from the cutoff walls, thus minimizing hydraulic pressure and maximizing leachate recovery. Therefore, if a leak occurs in the cutoff wall, the fluid would flow towards the Landfill since groundwater outside the Landfill is higher in elevation. This provides an additional measure to protect public health, safety, and the environment, and to ensure the protection of natural resources.

- **Leachate Collection Pump Stations**

  Leachate collection pump stations are located along the leachate collection drains. Each leachate collection pump station consists of a wet well with a submersible leachate well pump. The pump transfers the leachate from the well into the perimeter header conveyance piping system, which is connected via a force main to the Fresh Kills Landfill Leachate Treatment Plant. The locations of the pump stations are shown on Attachment 4, Sheet 67-9; corresponding details are shown on Sheet 67-10.

  Each collection well, along with a sampling port, pressure gauge, flow meter, and check and ball valves, is located in a HDPE geomembrane-lined concrete vault. This concrete vault extends to grade and is equipped with an access hatch for sampling and maintenance needs. The pumping wells consist of a 24-inch-diameter PVC well casing/screening in which a submersible stainless steel leachate well pump is located. The wells are installed at an elevation that induces the inward flow of leachate into the collection system.

Level sensors installed in each pump station control the flow of leachate from the wet well to the FKLLTP. In automatic mode, a high-level sensor in the wet well will activate the pump, and the submersible pump will discharge the leachate to the header pipe until the leachate level falls below the low-level sensor point. Leachate flow rates can also be manually adjusted to achieve acceptable leachate levels. The status (on/off), pumping rate, time of pumping, level set points, and 24-hour operational history of each pumping station are transmitted to the central control room of the FKLLTP via the SCADA system.

- **Leachate Collection Headers**

  Each leachate collection header is located within the backfilled collection drain trench, above the drain pipe. The header pipes have been designed to bypass each collection well pumping station at a 45-degree angle and then return to the collection drain. The location of the leachate collection headers and manholes are presented on Attachment 4, Sheet 67-9; corresponding details shown on Sheet 67-11.

The flow from Section 6/7 is conveyed to a wet well and pump station located just west of the section, referred to as the leachate conveyance pump station. From the leachate conveyance pump station, leachate is pumped through a force main to the FKLLTP. Combination air release valves and drains have been designed into the collection headers to ensure proper operation and to drain the pipes for maintenance purposes. Manholes have been placed every 1,000 to 1,500 feet along the header pipe route and include isolation valves, vacuum relief/air release valves, and drain valve locations.

The manholes are equipped with high-level floats, which are tied into the SCADA controls and will notify the operator if leachate or groundwater collects in the manhole. Manholes are located within the leachate collection and containment system work platform. This platform is located above the 100-year floodplain, thus allowing for continued operations of the systems during severe weather conditions.

- **Leachate Force Main**

  The leachate force main, which is enclosed in an outer containment pipe, includes a leak detection system installed within the containment pipe at 300-ft intervals. The leak detection system is monitored by the SCADA system and records the time, date, and location where liquid is detected. For protection, the force main and the collection header pipes have a minimum of 4 feet of cover. Steel piping is used for bridge crossings to limit the contraction and expansion of the exposed area.

- **Hydraulic Monitoring**

  Pairs of hydraulic monitoring piezometers for Section 6/7, installed on either side of the cutoff wall and collection drain, are used to monitor the hydraulic performance of the leachate collection and containment system.

7.4 Landfill Gas Migration Controls

The LFG migration management system at Section 6/7 consists of two programs: engineered controls (including the perimeter LFG interceptor venting system, utility seals, and the perimeter leachate collection and containment systems) and migration monitoring along the property boundary. LFG migration monitoring is detailed in the *Post-Closure Monitoring, and Maintenance Operations Manual* (Ref. No. W-49).

The perimeter LFG interceptor venting system (also known as interceptor trenches or perimeter vent trenches) is installed along portions of the perimeter of Section 6/7, as shown on Attachment 4, Sheet 67-7. The interceptor venting system is located along Richmond Avenue on the eastern side of Section 6/7, with a length of 5,760 linear feet. The interceptor venting system is keyed into low-permeability soils or extended below the seasonal low groundwater table to form an effective barrier to cut off the lateral, off-site migration of LFG generated within the landfill and to allow the LFG to vent passively before migrating off site. The interceptor venting system was installed in accordance with 6 NYCRR Part 360-2.15(e) and (f). Construction of the interceptor venting system is detailed in *As-Built Drawings of the LFG Migration Control Project* (Ref. No. J-1). In addition, where underground utilities may be impacted or may act as conduits for the LFG, utility seals are used to cut off the LFG from migrating along the utility conduits. Locations of the utility seals are also shown on Attachment 4, Sheet 67-7.

The LFG migration monitoring program consists of the measurement of subsurface pressure and concentrations of methane, oxygen, carbon dioxide as percent gas at LFG migration monitoring wells located along portions of the perimeter of Section 6/7. LFG migration monitoring will be performed in accordance with the *Draft Post-Closure Monitoring and Maintenance Operations Manual* and will typically be conducted on a quarterly basis. The locations of the migration monitoring wells are shown on Attachment 4, Sheet 67-7. Structures at the landfill are equipped with methane sensors, which are maintained and calibrated on a quarterly basis.

7.5 Landfill Gas Emission Controls

Landfill gas emission controls at Section 6/7 include an active collection system, a passive venting system, and an LFG flare pad and flare station. The active collection, flaring, and gas recovery systems are currently in operation and will be operated during the post-closure period in accordance with the requirements of 6 NYCRR Part 208. Passive vents will remain closed while the active system is in operation; they will be opened only after the post-closure period or after methane generation has declined to the extent that the active gas collection system is no longer required.

7.5.1 Passive Vents

The passive venting system at Section 6/7 will consist of the following main components:

- a geocomposite gas venting net layer installed beneath the geomembrane; and
- vents through the cap to provide for passive venting in the future.

The gas venting layer will be constructed of geocomposite, consisting of a geotextile heat-bonded to both sides of HDPE geonet drainage material. The venting layer will be installed in compliance with regulatory requirements of 6 NYCRR Part 360-2.15(e) and 2.13(p), which specify a 12-inch-thick layer of soil with a permeability of $1x10^{-3}$ cm/s or greater. The geocomposites used for this venting layer will have permeability on the order of $1.0x10^{-1}$ cm/s. The vents will be installed at a density of one per acre during construction of final cover. A cross-section of the passive LFG vents to be installed at Sections 6/7 is illustrated on Attachment 4, Sheet 67-8. Design details of the passive venting system at Section 6/7 are provided in *The Fresh Kills Landfill Section 6/7 Final Cover Design Report* (Ref. No. M-11).

As noted above, the vents will remain closed while the active collection, flaring, and gas recovery systems are in operation.

7.5.2 Active Collection System

The active LFG collection system consists of several components that are involved in collecting LFG and transferring it to the necessary locations for processing or combustion. The basic system layout at Section 6/7 consists of extraction wells to collect the LFG, a piping system to convey the LFG to the flare station or LFG recovery facility, and an LFG flare pad and flare station located on the west side of the section.

Design of the active LFG collection system, the LFG flare pad, and the flare station at Section 6/7 was provided for in supporting documents for the facility LFG flaring permit (NYSDEC Permit No. 2-6403-00011/00063). Design of the active system is also presented in the *Fresh Kills Landfill Section 6/7 Final Cover Design Report* (Ref. No. M-11). A plan of LFG extraction wells and header pipes is provided on Attachment 4, Sheet 67-7. Typical details of the LFG collection system are provided on Sheet 67-8.

The primary components of the Section 6/7 active LFG collection system include the following:

- **Vertical LFG Extraction Wells**

  Approximately 268 active gas extraction wells are included in the Section 6/7 gas collection system. These vertical LFG extraction wells each consist of a variable length of 6-inch diameter perforated HDPE pipe backfilled with gravel to ease LFG infiltration. A minimum 20-foot length of solid HDPE well casing extends from the top of the perforated casing to a varying height above final cap grade. Each well has an active gas collection wellhead including a section of flexible hose for connection to an HDPE lateral riser. Details of typical extraction wells are shown on Attachment 4, Sheet 67-8.

- **Piping and Header System**

  The LFG is drawn from the wells and piping system by use of a negative pressure induced throughout the system by blowers located at the LFG flare stations. The network of interconnected piping includes lateral collection pipe for transmission of gas from extraction well to adjacent collection header and gas collection headers for transport of

collected gas from the lateral collection pipes and transmission to the LFG recovery facility.

Condensate, which flows downslope within the system due to gravity, is collected in condensate tanks. These condensate tanks prevent the condensate, which is potentially hazardous, from entering the groundwater. Condensate is periodically removed from these tanks and brought to a permitted wastewater treatment facility.

- **LFG Flare Pad and Station**

  A modular flare station has been installed at Section 6/7 to combust the LFG and provide the necessary NMOC emissions reduction. This flare station can process up to 10,000 standard cubic feet per minute (scfm) of LFG. The basic components of the flare station include two flares, three exhauster/blowers, three demisters, a knockout tank, and an aboveground 20,000-gallon condensate storage tank.

  The flare station is built on a structural concrete pad supported by piles. At Section 6/7, the flare pad is located within the limit of final cover, such that the flare pad is underlain by refuse. The flare pad is connected to the final cover system by a batten strip connection which essentially consists of a steel plate, a neoprene strip, the geomembrane, another layer of neoprene and another steel plate, connected to the concrete pad using expansion bolts. The batten strip connection is inspected quarterly. The inspection focuses on whether or not settlement has damaged the geomembrane/flare pad connection, and whether or not stress is being imposed onto the geomembrane.

  LFG entering the flare station is drawn first through a condensate knockout tank and then through demisters. Condensate removed by the knockout tank and demisters is conveyed to the aboveground condensate storage tank. Three blowers located at each flaring station act to provide the necessary negative pressure within the piping and wells to draw the LFG through the system. When operating at capacity, only two blowers will operate at any given time with one blower on standby as a backup during the post-closure period.

  After the LFG is drawn through the blowers it can be directed either to the flares or through an outlet port to the separately permitted LFG recovery facility located at Section 1/9. The two flares located at the flare station are each enclosed in a steel stack approximately 50 feet tall. The flares provide reductions in volatile organic compounds (VOC), NMOC, and hydrogen sulfide (H_2S) of at least 98 percent.

All LFG extracted from Section 6/7 is sent via the landfill gas transmission main to the LFG recovery facility located at Section 1/9, where the gas is purified for use as fuel. If the quantity of gas collected exceeds the capacity of the LFG recovery facility, or the facility is shut down, collected LFG from Section 6/7 will be combusted at the Section 6/7 flare station.

ATTACHMENT 1

REFERENCE LIST

Doc. No.	Title
A-2	Air Survey Corp. December 2001. *Aerial Photography and Topographic Survey.*
F-21	Frederic R. Harris, Inc. March 1990. *Final Cover Construction and Certification Results - Section 2/8, 1989 Construction Season, Report Volume I.*
F-22	Frederic R. Harris, Inc. July 1990. *Final Cover Construction and Certification Results - Section 3/4, 1988, 1989, 1990 Construction Seasons, Report Volume I.*
F-23	Frederic R. Harris, Inc. August 1990. *Report on Final Cover Construction and Certification of Results, Section 1/9 – Veterans and Muldoon Avenues.*
F-24	Frederic R. Harris, Inc. April 1994. *Report on Upgrade of Final Cover Area, Section 1/9 – North of Arden Avenue.*
I-12	IT Corp. December 1993. *Final Surface Water and Sediment Report.*
I-35	Interstate Industrial Corp. June 18, 1997. *As-Built of Final Cover and Landfill Gas Extraction System - Section 2/8. Capital Proj. S-197-242, Contract No. 9458165.*
I-36	IT Corporation. June 2000 Revised January 2001. *Final Engineering Plans, Fresh Kills Landfill Supplemental Leachate Controls at Section 2/8 and 3/4.*
J-1	JAB Construction. July 1993. *As-Built Drawings of the LFG Migration Control Project.*
M-11	Malcolm Pirnie, Inc. January 2001. *Fresh Kills Landfill: Section 6/7 Final Cover Design Report Appendix D: Engineering Plan.*
N-26	New York State Department of Environmental Conservation. April 1995. *Tidal Wetlands, Protection of Waters, Water Quality Certification, and State Pollution Discharge Elimination System (SPDES) Permit. NYSDEC Permit No. 2-6404-00275/00013-0. SPDES No. NY-0200867.*
N-148	City of New York Department of City Planning. 2002. *NYC (Staten Island) Zoning Maps Nos. 20, 26, 27, 32, 33.*
N-149	City of New York Department of City Planning. May 2002. *Zoning Handbook: A Guide to New York City's Zoning Resolution.*

ATTACHMENT 1

REFERENCE LIST
(Continued)

Doc. No.	Title

N-150 New York State Department of Environmental Conservation. April 1998. *Fresh Kills Landfill Gas Flare Stations Permit. NYSDEC Permit No. 2-6403-00011/00063.*

N-151 New York State Department of Environmental Conservation. November 2, 2001. *Fresh Kills Landfill Gas Recovery Facility NYSDEC Air Pollution Control – Title V Permit ID No. 2-6499-00029/00151.*

N-152 New York State Department of Environmental Conservation. *Fresh Kills Landfill Gas Recovery Facility NYSDEC Air Pollution Control – Part 360 Permit ID No. 2-6499-00029/00175.*

N-153 City of New York. October 2001. *City Environmental Quality Review Technical Manual.*

N-154 New York City Landmarks Preservation Commission. 1998. *Guide to New York City Landmarks, Second Edition.*

O-1 O'Brien & Gere Engineers, Inc. August 8, 1994. *Engineering Report, Fresh Kills Landfill, Fresh Kills Leachate Treatment Plant.* Includes Errata issued February 3, 1995, Addendum No. 1 dated July 21, 1995, Addendum No. 2 dated February 25, 1996.

O-2 O'Brien & Gere Engineers, Inc. August 8, 1994. *Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Fresh Kills Leachate Treatment Plant.*

O-3 O'Brien & Gere Engineers, Inc. November 18, 1994. *Final Specifications, Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System.* Includes Errata issued February 3, 1995.

O-4 O'Brien & Gere Engineers, Inc. November 18, 1994. *Final Engineering Report, Fresh Kills Landfill, Sections 1/9 Leachate Collection and Containment System.* Includes Errata issued February 3, 1995.

O-5 O'Brien & Gere Engineers, Inc. November 18, 1994. *Final Engineering Report, Fresh Kills Landfill, Sections 6/7 Leachate Collection and Containment System.* Includes Errata issued February 3, 1995.

O-6 O'Brien & Gere Engineers, Inc. November 18, 1994. *Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections*

ATTACHMENT 1

REFERENCE LIST
(Continued)

Doc. No.	Title
	1/9 and 6/7 Leachate Collection and Containment System. Includes Errata issued February 3, 1995.
O-8	O'Brien & Gere Engineers, Inc. March 1995. *Fresh Kills Landfill Leachate Treatment Plant, Staten Island, New York, Contract Drawings*. Includes Addendum No. 3 dated April 25, 1995.
O-9	O'Brien & Gere Engineers, Inc. November 1994. *Fresh Kills Landfill, Sections 1/9 and 6/7 Leachate Collection and Containment System, Final Contract Drawings*. Includes Errata issued February 3, 1995.
O-11	O'Brien & Gere Engineers, Inc. January 1996. *Final Contract Drawings, Fresh Kills Landfill Leachate Control Site Work and Appurtenances. PIN #82796RR00076.*
O-12	O'Brien & Gere Engineers, Inc. January 1996. *Engineering Report for Veterans Avenue Leachate Treatment Plant* (submitted with SPDES Permit Application July 19, 1991).
O-13	O'Brien & Gere Engineers, Inc. March, 1996. *Final Engineering Drawings, Fresh Kills Landfill Leachate Collection and Containment System, Sections 1/9 and 6/7*.
O-14	O'Brien & Gere Engineers, Inc. March 4, 1996. *Final Engineering Report, Addendum No. 1, Fresh Kills Landfill, Section 1/9 and 6/7 Leachate Collection and Containment System.*
O-15	O'Brien & Gere Engineers, Inc. March 4, 1996. Addendum 3, *Fresh Kills Landfill Leachate Control Site Work and Appurtenances.*
O-16	O'Brien & Gere Engineers, Inc. March 1, 1996. *Engineering Report, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems.*
O-17	O'Brien & Gere Engineers, Inc. March 1, 1996. *Final Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan, Fresh Kills Landfill, Sections 2/8 and 3/4 Leachate Recovery and Collection Systems.*
P-39	Petosa Bros., Inc. June 30, 1997. *As-Built of Final Cover and Gas Extraction System - Section 3/4. Capital Proj. S197-242, Contract No. 9327735.*
R-5	Rosewood Contracting Corp. July 3, 2001. *As-Built of Landfill Gas Transmission Line and Fire Water System, Fresh Kills Landfill.*

ATTACHMENT 1

REFERENCE LIST
(Continued)

Doc. No.	Title
R-17	Rajakaruna and Ettlinger, P.C. June 19, 2001. *Map of Property Fresh Kills Landfill, Staten Island, NY.*
S-32	SCS Engineers, P.C. March 15, 1994. *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 2/8.*
S-33	SCS Engineers, P.C. March 12, 1993. *Fresh Kills Landfill Final Cover and Landfill Gas Extraction System for Section 3/4.*
S-38	SCS Engineers, P.C. May 18, 1992. *Final Closure Plan for Sections 2/8 and 3/4, Appendix A-3; Milestone 9; Order on Consent; Fresh Kills Landfill.*
S-39	SCS Engineers, P.C. March 15, 1994. *Engineering Report, Section 2/8 Final Cover and Landfill Gas Extraction System Construction Documents.*
S-40	SCS Engineers, P.C. May 17, 1993. *Engineering Report, Section 3/4 Final Cover and Landfill Gas Extraction System Construction Documents.*
S-46	Stone & Webster, Inc. May 1999. *Construction Certification Report, Fresh Kills Leachate Controls, Site Work and Appurtenances, Capital Project S111 and S197. PIN No. 9699566.*
T-1	Tully Construction/Munoz Engineering. Set No. 1, December 20, 1999, and Set No. 2, May 2000. *Construction As-Built Drawings Fresh Kills Landfill Leachate Control Sitework and Appurtenances Capital Project S111 and S197, Contract No. 9699566.*
U-14	URS Corp. January 4, 2002. *Fresh Kills Landfill Section 1/9 Final Cover Design Report Appendix D: Engineering Plans, Overall Conceptual Design, URS Corp,. January 4, 2002. Appendix D-2: Engineering Plans, Reclamation Work Plan, IT Corp. December 20, 2001.*
U-56	United States Bureau of the Census. 2000. *Map PL-1 Population Density by Census Tract, Staten Island, 2000, 2000 Census Public Law 94-171 File.*
W-47	Roy F. Weston of New York, Inc. April 2002. *Financial Assurance Plan.*
W-49	Weston Solutions of New York, Inc. December 13, 2002. *Fresh Kills Landfill: Post-Closure Monitoring and Maintenance Operations Manual.*

ATTACHMENT 2

LIST OF PREFERRED TERMS

This list is intended to provide a consistent methodology for naming terms and identifying site features. Previous documents have been produced by different designers and may have used different names and designations for facility components. The list presents preferred terms and cites other terms by which the components have been described.

Preferred Term	**"Also Known As" Term**
Barrier Protection Material	Barrier Protection Layer
Basin Intake	Basin Inlet, Intake Structure
Condensate Tank	Underground Storage Tank
Culvert	Culvert Pipe
Cutoff Wall	Cement-Bentonite Wall Slurry Wall Soil-Bentonite Wall
Downchute *(Sections 1/9 and 6/7 only)*	Downchute Gabion Gabion Downchute
Downchute Pipe *(Sections 2/8 and 3/4 only)*	Drainage Pipe HDPE Pipe Pipe Downchute
Emergency Spillway	100-Year Spillway Overflow Spillway
Erosion Control Material	Anchor Mat, Erosion Control Matting
Final Cover	Cap
FKLLTP (Fresh Kills Landfill Leachate Treatment Plant)	Leachate Treatment Plant
Geomembrane	HDPE Geomembrane LLDPE Geomembrane Plastic Cap
Leachate Collection Drain	Leachate Collection Trench
Leachate Collection Header	Header Pipe Leachate Collection Pipe
Leachate Collection Pump Station	Leachate Collection Well
Leachate Control System	Leachate Management System
Leachate Conveyance Pump Station	Section 6/7 Leachate Transmission Pumping Station Section 6/7 Pumping Station
Leachate Force Main	Leachate Transmission Line
Leachate Recovery Well	Leachate Extraction Well Deep Extraction Well Deep Leachate Pumping Well

ATTACHMENT 2

LIST OF PREFERRED TERMS
(Continued)

Preferred Term	**"Also Known As" Term**
LFG	Landfill Gas LFGas
LFG Duct Vent *(Sections 2/8 and 3/4 only)*	Goose Neck Pipe J Pipe Vent Pipe
LFG Extraction Well	LFG Well Gas Collection Well
LFG Flare Station	LFG Flare Pad Active Gas Collection Flare Pad and Flare
LFG Header Pipe	LFG Extraction Header Pipe LFG Collection Header
LFG Header Valve	Butterfly Valve Valve
LFG Interceptor Venting System	LFG Vent Trench LFG Interceptor Trench Horizontal Trench
LFG Migration Monitoring Well	Gas Migration Well LFG Monitoring Probe LFG Monitoring Well
LFG Transmission Main (LGTM)	Landfill Gas Transmission Line
Outfall	Diffuser Outfall Subaqueous Outfall
Outlet Pipe	Basin Outlet Outlet Outtake
Passive Gas Vent *(Sections 1/9 and 6/7 only)*	Goose Neck Pipe J Pipe Vent Pipe
Reclamation Area	Footprint Consolidation Area Reclaimed Area Truckfill
Service Road	Access Road Haul Road Landfill Road Maintenance Road Perimeter Road

ATTACHMENT 2

LIST OF PREFERRED TERMS
(Continued)

Preferred Term	"Also Known As" Term
Slotted Inlet *(Sections 2/8 and 3/4 only)*	Inlet Inlet Structure Drain Inlet Slotted Manhole Riser
Solid Waste Management Unit Boundary	Landfill Section Boundary Landfill Section Limit Limit of Final Cover Limit of Spoils
Stormwater Basin	Detention Basin Drainage Basin Retention Basin Sedimentation Basin Stormwater Control Basin Storm Water Control Basin
Swale	Bench Channel Drainage Channel Drainage Swale Swale/Bench

ATTACHMENT 3

APPLICABLE EXCERPTS FROM REGULATIONS

NYCRR Part 360-2.15

Landfill Closure and Post-Closure Criteria

NEW YORK ENVIRONMENT CODIFIED REGULATIONS

Title 6 - Department of Environmental Conservation
Chapter IV - Quality Services
Subchapter B - Solid Wastes
[1 of 3]Part 360 - Solid Waste Management Facilities

Subpart 360-2 — Landfills

§360-2.15 Landfill closure and post-closure criteria.

[N.Y. St. Reg., 07/17/2002]

In addition to the requirements of Part 208 of this Title, Subpart 360-1 of this Part, and sections 360-2.13 and 360-2.17 of this Subpart,, all landfills subject to regulation under this Part must conform to the requirements for closure and post-closure care set forth in this section. For existing sites where this information is known through previous efforts (such as monitoring of the facility during its operating life), some or all of the requirements of subdivision (a) of this section may be waived upon approval of the department. For landfills subject to the requirements of Part 208 of this Title, some or all of the requirements of subdivisions (d) through (g) of this section may be waived upon approval of the department.

(a) Closure site investigation. To ensure that an adequate final closure plan is developed, the nature and extent of current and potential release or migration of contaminants from the site must be defined. The minimum elements of a site investigation are as follows:

(1) A hydrogeologic investigation performed using the methods described in section 360-2.11 of this Subpart that must, at a minimum:

(i) define the geologic and hydrogeologic conditions of the uppermost aquifer, and, as required by the department, any other units in the critical stratigraphic section which may be impacted by the facility;

(ii) establish a long-term monitoring well network in the uppermost aquifer, and other units necessary to protect public health and the environment, to monitor the effects of facility closure or remediation; and

(iii) analyze the initial round of samples in each monitoring point for baseline parameters. If contamination is detected the department may require additional sampling and analysis as specified in section 360-2.11 of this Subpart.

(2) An explosive gas investigation must be performed to determine whether the site meets the requirements of subdivision 360-2.17 (f) of this Subpart. The explosive gas investigation must include at least three rounds of subsurface explosive gas monitoring. This must be performed along a perimeter outside the waste mass but within the property boundary. Monitoring must be performed at 100 foot maximum intervals, if temporary sampling locations are used, or at 400 foot maximum intervals, if permanent gas monitoring wells are constructed. Initial monitoring should be performed when atmospheric pressure and wind velocity are low and ideally when the ground surface has been wet or frozen for several days and monitoring must be done below the wet or frozen zone. The intent of this investigation must be to:

(i) identify the presence and concentration of explosive gases at or near the landfill, including at the property line, in all on-site structures, and in potentially impacted off-site structures;

(ii) determine the extent of actual or potential gas migration off-site; and

(iii) identify the applicable soil stratigraphy beneath and around the landfill.

(3) A surface leachate investigation must be performed. This investigation must identify the presence of uncontrolled leachate at, or emanating from, the landfill; document any instances where fugitive leachate from the landfill is discharging into local surface waters; and characterize the chemical constituents of surface leachate for baseline parameters. The surface leachate investigation must be performed when groundwater levels are at seasonal high elevations or at such other times as specified by the department.

(4) A vector investigation must be performed to identify the presence of any vectors at the landfill, including, but not limited to, rodents, insects, and birds.

(5) Upon completion of the closure site investigation, the data must be compiled and presented in a closure investigation report. The report, which must be completed and submitted to the department at least 180 days before last receipt of waste, must include a summary that describes the environmental conditions including, but not limited to, general site conditions, land use, soil conditions, hydrogeologic characteristics, surface and groundwater quality, presence and migration of explosive gas and surface leachate and vector populations. Landfill owners or operators or their consultants should have preliminary discussions with the appropriate regional solid waste engineer to review the specific landfill considerations and findings of the closure investigation.

(b) Conceptual closure plan. Complete applications to construct and operate a new landfill, or an expansion to an existing landfill; and complete renewal applications must contain a conceptual closure plan prepared in conformance with the provisions of this subdivision. Landfills that are active on the effective date of this Part must submit the information described in paragraph (3) and (4) of this subdivision to the department on the effective date of this Part. The conceptual closure plan will describe the steps necessary to close the landfill at any point during its active life, in accordance with the requirements of subdivisions (b) and (c) of this section. It shall, at a minimum, include the following:

(1) a site plan which shows proposed final contours, property lines, storm water drainage systems, streams and water courses, roads, structures and, if applicable, groundwater and leachate treatment systems, air pollution control and landfill gas recovery systems;

(2) typical details of cap components and facility structures which comply with requirements set forth in this section;

(3) an estimate of the largest active portion of the landfill that will require a final cover at any time during the active life of the landfill;

(4) an estimate of the maximum inventory of wastes ever on site during the active life of the landfill;

(5) sufficient information upon which to base closure and post-closure monitoring and maintenance cost estimates as required in subdivisions 360-2.19(b) and (c) of this Subpart. This information shall include:

(i) estimates of material, quantities and costs;

(ii) estimates of cost of each major final cover component and structure; and

(iii) estimates of post-closure monitoring and maintenance costs based on the requirements set forth in subdivision (k) of this section.

(c) Final closure plan. An approvable final closure plan must be submitted to the department within 60 days before the last receipt of waste, within 60 days before the last day of the operating permit, or in accordance with permit requirements, whichever is earlier, and must be in compliance with this subdivision.

(1) The plan must:

(i) meet the requirements of paragraphs 360-2.15(b)(1) and (2), and subdivisions (d)-(j) of this section;

(ii) meet the requirements of subdivision (k) of this section, including the post-closure monitoring and maintenance operations manual prepared in accordance with paragraph 360-2.15(k)(7) of this Subpart;

(iii) address unacceptable environmental impacts identified in the closure investigation report required in paragraph 2.15(a)(5) of this section;

(iv) provide an estimate of the landfill area to be covered;

(v) provide an estimate of the inventory of wastes in the landfill;

(vi) provide a closure construction schedule which conforms with the requirements of subdivision (d) of this section; and

(vii) provide amended closure and post-closure monitoring and maintenance cost estimates, prepared in accordance with subdivisions 360-2.19(b) and (c) of this Subpart.

(2) Financial assurance for closure monitoring and maintenance are to be amended in accordance with subdivision 360-2.19(b) and (c) of this Subpart.

(d) Final cover system. At a minimum, the final cover must consist of a layered system meeting the following requirements:

(1) the bottom layer of a final cover system must consist of a gas venting layer meeting the requirements of subdivision 360-2.13(p) of this Subpart; and

(2) the gas venting layer shall be overlain by the following:

(i) for landfills that meet the requirements of clause 360-1.7(a)(3)(viii) (a) of this Part either a low permeability soil cover barrier layer meeting the requirements of subdivision 360-2.13(q) of this Subpart, or geomembrane cover meeting the requirements of subdivision 360-2.13(r) of this Subpart, or a cover meeting the requirements of subparagraph 360-2.15(d)(2)(ii) of this paragraph; or

(ii) for landfills meeting the requirements of clause 360-1.7(a)(3)(viii) (b) of this Part, a composite cover consisting of a low permeability soil barrier cover layer and geomembrane cover meeting the requirements of subdivisions 360-2.13(s) of this Subpart;

(3) the low permeability soil barrier cover layer, geomembrane cover, or composite cover layer shall be overlain by either a barrier protection layer meeting the requirements of subparagraph 360-2.13(q)(2)(iii), or subparagraph 360-2.13(r)(2)(iii) of this Subpart; and

(4) the barrier protection layer shall be overlain by a topsoil layer meeting the requirements of 360-2.13(t) of this

Subpart.

(5) alternative individual components of the final cover system that meet the equivalent design provisions of 360-2.13(w) of this Subpart may also be used.

(6) The owner or operator must complete landfill closure activities in accordance with the final closure plan prepared in accordance with subdivision (c) of this section within 210 days following last receipt of waste, or within a time frame deemed acceptable by the department.

(7) Closure construction certification report. A construction certification report must be submitted to the department within 45 days after the completion of landfill closure construction for approval and file record. This report must include the results of all construction quality assurance and construction quality control testing required in subdivisions 360-2.13(p)-(t) of this Subpart and documentation of any failed test results, descriptions of procedures used to correct the improperly installed material, and statements of all retesting performed. In addition, the construction certification report must contain as-built drawings noting any deviation from the approved final closure plans.

(e) Landfill gas control. Landfill gas control systems must be designed to prevent the migration of concentrated amounts of landfill gases off-site. Gas venting systems are necessary for all landfills upon closure and must be designed and constructed in accordance with the requirements of subdivision 360-2.13(p) of this Subpart. These systems must prevent the accumulation of gas at greater than 25 percent of the lower explosive limit in structures on-site and off-site; prevent damage to vegetation both on the final cover and off-site; and control objectionable odors due to any gas emissions.

(f) Perimeter gas collection systems. Perimeter gas collection systems must be installed if landfill gases are found to pose a hazard to health, safety, or property. Perimeter gas collection systems must be designed and constructed in accordance with the requirements of this subdivision along with any other provisions required by the department. A perimeter gas collection system must consist of either:

(1) trenches keyed into a low permeability soil, a bedrock layer, or the seasonally low groundwater table, which can effectively cut off the lateral migration of gas; or

(2) gas wells screened in the unsaturated zone to the seasonably low water table or low permeability soil/bedrock layer that are spaced along the perimeter of the landfill to sufficiently prevent gas migration.

(g) Gas control using flares. All gas control systems which utilize flares must be designed in accordance with any applicable requirements of Parts 201 and 212 of this Title.

(h) Condensate from gas processing or control systems. Condensate generated and collected from gas processing or control systems must not be recirculated into the landfill unless it is demonstrated that the landfill has a department approved liner and leachate collection and removal system, and providing it is demonstrated that the landfill is operating in compliance with the provisions of section 360-2.17 of this Subpart, and prior written approval is obtained from the department. Otherwise, the condensate must be appropriately disposed of by other means.

(i) Leachate collection system. If required by the department, a leachate collection system must be constructed to control leachate outbreaks that could adversely affect the landfill cover or threaten surface waters. If the collection system includes the construction and operation of a leachate storage facility, such facility must be designed, constructed, and operated in accordance with the requirements of Subpart 360-6 of this Part.

(j) Vectors. If, through the site closure investigation report, vector problems are identified, an appropriate remediation program must be implemented. The vector remediation program must be implemented to mitigate vector problems before cessation of waste disposal occurs at the landfill.

(k) Post-closure operation and maintenance. For a landfill subject to closure, a provision must be included in the property deed indicating the period of time during which the property has been used as a landfill, describing the wastes contained within and noting that records of the facility have been filed with the department. The deed must also reference a map which shall be filed with the county clerk and which will clearly indicate the limits of the landfilled areas within the property boundary. The deed must also indicate that the use of the site is restricted pursuant to the provisions of paragraph (9) of this subdivision.

(1) For landfills that are without a department approved plan for closure where the maximum slope of 33 percent was exceeded before December 31, 1988, the landfill may be closed with slopes exceeding 33 percent if supported by a slope stability analysis, which must be submitted to the department, and providing the following are met:

(i) final grades must not exceed 50 percent for more than a 20 feet vertical rise; and

(ii) for longer slopes, run-off diversion terraces must be constructed at vertical intervals not exceeding 20 feet. The terraces must be designed to intercept run-off for diversion to appropriately spaced drainage ways leading off the landfill slopes. All terrace and drainage way slopes must be at least four percent.

(2) Drainage control structures must be designed, graded, and maintained to prevent ponding and erosion to the cover. The surface drainage system must be designed and constructed to protect the cover from, at a minimum, the peak discharge of a 24-hour, 25-year frequency storm.

(3) Soil cover integrity, slopes, cover vegetation, drainage structures, and gas venting structures must be maintained during the period of post-closure monitoring and maintenance, or as required by the department.

(4) Environmental and facility monitoring points including gas monitoring points must be maintained and sampled during the post-closure period for a minimum of 30 years. Post closure explosive gas monitoring must be performed at least quarterly to determine if the facility meets the requirements of 360-2.17(f) of this Subpart. If this monitoring shows explosive gas levels in excess of the lower explosive limit at the property boundary or in excess of the 25 percent of the lower explosive limit within any structures, appropriate actions must be taken and the department must be notified. Annual summary reports must be submitted to the department describing the results of the maintenance, monitoring and/or sampling for the environmental and facility monitoring points. Annual baseline and quarterly routine monitoring must be performed on groundwater, surface water, and leachate samples for a minimum period of five years. After this five-year period, the permittee may request that the department modify the sampling and analysis requirements.

(5) Maintenance and operation of the leachate collection system are required during the post-closure period and the method of leachate treatment or disposal must be addressed for as long as leachate is capable of adversely impacting the environment. The department may waive this requirement when the owner demonstrates that leachate no longer poses a threat to human health or the environment.

(6) A vegetative cover must be established and maintained on all exposed final cover material within four months after placement. If this cannot be achieved due to seasonal constraints, measures must be taken to ensure the integrity of the final cover system before the establishment of vegetative cover.

(7) A comprehensive post-closure monitoring and maintenance operations manual is required. This document shall provide all information needed to effectively monitor and maintain the facility for the entire post-closure period.

Minimum components of this manual include:

(i) description of type, location, sampling and sample preservation methodology, and recordkeeping and reporting requirements for all environmental monitoring activities. The monitoring plan shall conform to paragraph (4) of this subdivision;

(ii) description of all environmental control systems including:

(a) process control monitoring types, locations, recordkeeping and reporting requirements. Leachate management activities shall include recording of the total volume of leachate stored and removed from the facility, sampling and analysis, and proper maintenance;

(b) environmental control maintenance requirements including description, type, frequency, and recordkeeping;

(iii) description of types, location and frequency of all other facility maintenance activities including:

(a) maintaining the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, maintaining the appropriate vegetative cover, and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(b) maintaining the leachate collection system in accordance with subdivision (i) of this section;

(c) maintaining and operating the gas control and monitoring systems in accordance with the requirements of subdivision 360-2.17(f) of this Subpart; and

(d) recordkeeping and reporting requirements.

(iv) description of resource requirements including:

(a) minimum personnel qualifications and numbers; and

(b) minimum equipment needs;

(v) a contingency plan which shall include:

(a) responses to problems that have a reasonable likelihood of occurrence including, but not limited to, major erosion problems, significant differential settlement, and fire;

(b) action levels above which identified environmental monitoring, environmental control, or maintenance problems require prompt action by the owner and notification to the department; and

(c) a summary of any corrective measures that must be done to be in accordance with section 360-2.20 of this Subpart;

(vi) name, address and telephone number of the person or office to contact on post-closure monitoring and maintenance, and corrective measure concerns during the post-closure period;

(vii) a summary of financial assurance criteria concerns that must be addressed to remain in compliance with the provisions of subdivisions 360-2.19(c) and (d) of this Subpart. This includes:

(a) submittal to the department of annual adjustments to cost estimates of post-closure care and corrective measures; and

(b) notification to the department of increases in post-closure care costs and corrective measure costs; and

(viii) a description of the planned uses of the property during the post-closure period. Planned uses shall be in compliance with paragraph (9) of this subdivision.

(8) Quarterly inspections and inspections after major rainfall events (5-year storms) shall be performed on all facility components during the minimum 30-year post-closure period, unless specific department approval is given to eliminate some or all of these requirements, to ensure that the facility is functioning as intended. The results of those inspections shall be submitted to the department as part of a registration renewal report as described in paragraph 360-2.15(1)(4) of this section, or more frequently, if deemed appropriate by the department.

(9) A description of the planned uses of the property during and after the post-closure period is required. Use of the property shall not disturb the integrity of the final cover, liners, or any other components of the containment system, or the function of the monitoring or environmental control systems, unless necessary to comply with the requirements of section 360-2.20 of this Subpart. The department will approve any other disturbance if the owner or operator demonstrates that disturbance of the final cover, liner or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment.

(l) Closure and post-closure registration report.

(1) The owner or operator of a closing facility must register with the department at least one year before the facility is scheduled to cease accepting waste. The owner or operator must register on a form prescribed by the department.

(2) The registration must be renewed every five years until the department determines that the post-closure monitoring and maintenance period for the facility has ended.

(3) The initial registration report must include: the facility's name, address and telephone number; the owner's name, address and telephone number, and the name, address and telephone number of the person who will be responsible for closure and post-closure care of the facility, and other information deemed necessary by the department.

(4) Subsequent registration reports must also include the following information:

(i) a certification that the facility complies with all applicable closure and post-closure criteria contained in section 360-2.15, financial assurance criteria contained in section 360-2.19, and corrective measures report criteria contained in section 360-2.20 of this Subpart; and

(ii) any other information which the department determines to be necessary to protect the public health and welfare and the environment or natural resources.

(5) A registration issued pursuant to this subdivision is transferable only upon prior written approval of the department and a demonstration that the prospective transferee will be able to comply with all applicable laws, regulations and requirements.

NYCRR Part 360-2.19

Financial Assurance Criteria

NEW YORK ENVIRONMENT CODIFIED REGULATIONS

Title 6 - Department of Environmental Conservation
Chapter IV - Quality Services
Subchapter B - Solid Wastes
[1 of 3]Part 360 - Solid Waste Management Facilities

Subpart 360-2 — Landfills

§360-2.19 Financial assurance criteria.

(a) Applicability and effective date.

(1) The requirements of this section do not apply to owners and operators of landfills who are State or federal government entities whose debts and liabilities are the debts and liabilities of a State or the United States.

(2) For municipal solid waste landfills that receive solid waste after October 9, 1993, the effective date of this section is April 9, 1997.

(3) A third party, for the purposes of this section, is a party who is neither a parent nor a subsidiary of the owner or operator.

(b) Financial assurance for closure.

(1) The owner or operator must have a detailed written estimate, in current dollars, of the cost of hiring a third party to close the largest active portion of the landfill requiring a final cover as required under section 360-2.15 of this Subpart at any time during the active life in accordance with the closure plan. This cost estimate must be approved by the department.

(i) At a minimum, the cost estimate must equal the cost of closing the largest active portion of the landfill requiring a final cover at any time during the active life when the extent and manner of its operation would make closure the most expensive, as indicated by its closure plan (see section 360-2.15 of this Subpart).

(ii) During the active life of the landfill, the owner or operator must annually adjust the closure cost estimate for inflation and submit a copy of the adjusted estimate to the department.

(iii) The owner or operator must notify the department and increase the closure cost estimate and the amount of financial assurance provided under paragraph (2) of this subdivision if changes in inflation, the closure plan, or landfill conditions increase the maximum cost of closure at any time during the remaining active life.

(iv) If approved by the department, the owner or operator may reduce the closure cost estimate and the amount of financial assurance provided under paragraph (2) of this subdivision if the cost estimate exceeds the maximum cost of closure at any time during the remaining active life of the landfill. The justification for the reduction of the closure cost estimate and a copy of the revised financial assurance documentation must be submitted to the department.

(2) The owner or operator of each landfill must establish financial assurance for closure of the landfill in compliance with subdivision (e) of this section. The owner or operator must provide continuous coverage for closure until released from financial assurance requirements by demonstrating compliance with section 360-2.15 of this Subpart.

(c) Financial assurance for post-closure care.

(1) The owner or operator must have a detailed written estimate, in current dollars, of the cost of hiring a third party to conduct post-closure care for the landfill in compliance with the final closure plan developed under Section 360-2.15 of this Subpart. The post-closure cost estimate used to demonstrate financial assurance in paragraph (2) of this subdivision must account for the total costs of conducting post-closure care, including annual and periodic costs as described in the final closure plan over the entire post-closure care period. This post-closure care cost estimate must be approved by the department.

(i) At a minimum, the cost estimate for post-closure care must be based on the most expensive costs of post-closure care during the post-closure care period.

(ii) During the active life of the landfill and during the post-closure care period, the owner or operator must annually adjust the post-closure cost estimate for inflation and submit a copy of the adjusted estimate to the department.

(iii) The owner or operator must notify the department and increase the post-closure care cost estimate and the amount of financial assurance provided under paragraph (2) of this subdivision if changes in inflation, the post-closure plan, or landfill conditions increase the maximum costs of post-closure care.

(iv) If approved in advance by the department in writing, the owner or operator may reduce the post-closure cost estimate and the amount of financial assurance provided under paragraph (2) of this subdivision if the cost estimate exceeds the maximum costs of post-closure care remaining over the post-closure care period. The justification for the reduction of the post-closure cost estimate and a copy of the revised financial assurance documentation must be submitted to the department.

(2) The owner or operator of each landfill must establish, in a manner in accordance with subdivision (e) of this section, financial assurance for the costs of post-closure care as required under section 360-2.15 of this Subpart. The owner or operator must provide continuous coverage for post-closure care until released from financial assurance requirements for post-closure care by demonstrating compliance with subdivision 360-2.15 of this Subpart.

(3) Unless otherwise specifically approved in advance by the department in writing, a trust fund or a solid waste management facility reserve fund must be established for post-closure care. The trust fund must be established in a manner that allows the department to direct the trustee to hire a third party to conduct post-closure care if the owner fails to comply.

(d) Financial assurance for corrective measures.

(1) An owner or operator of a landfill required to undertake corrective measures pursuant to section 360-2.20 of this Subpart must have a detailed written estimate, in current dollars, of the cost of hiring a third party to perform the corrective measures in accordance with the program required under section 360-2.20 of this Subpart. The cost estimate must account for the total costs of corrective measures as described in the plan for the entire corrective measures period. The cost estimate must be approved by the department.

(i) The owner or operator must annually adjust the estimate for inflation until the corrective measures are completed in accordance with section 360-2.20 of this Subpart and submit a copy of the adjusted estimate to the department for approval.

(ii) The owner or operator must notify the department and increase the corrective measures cost estimate and the

amount of financial assurance provided under paragraph (2) of this subdivision if changes in inflation, the corrective measures program, or landfill conditions increase the maximum costs of corrective measures.

(iii) If approved in advance by the department in writing, the owner or operator may reduce the amount of the corrective measures cost estimate and the amount of financial assurance provided under paragraph (2) of this subdivision if the cost estimate exceeds the maximum remaining costs of corrective measures. The justification for the reduction of the corrective measures cost estimate and a copy of the revised financial assurance documentation must be submitted to the department.

(2) The owner or operator of each landfill required to undertake corrective measures under section 360-2.20 of this Subpart must establish, in accordance with subdivision (e) of this section, financial assurance for the most recent corrective measures program. The owner or operator must provide continuous coverage for corrective measures until released from financial assurance requirements for corrective measures by demonstrating compliance with section 360-2.20 of this Subpart.

(e) Allowable financial assurance mechanisms. Allowable financial assurance mechanisms must be acceptable to the department and the mechanisms used to demonstrate financial assurance under this section must ensure that the funds necessary to meet the costs of closure, post-closure care, and corrective measures for known releases will be available whenever they are needed. Except where indicated otherwise, owners and operators must choose from the options specified in paragraphs (1)-(11) of this subdivision.

(1) Trust fund.

(i) An owner or operator may satisfy the requirements of this subdivision by establishing a trust fund which conforms to the requirements of this paragraph. The trustee must be an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a federal or State agency. An original, signed duplicate of the trust agreement must be submitted to the department.

(ii) Payments into the trust fund shall be made annually by the owner or operator over the term of the initial permit (for new landfills) or over the remaining operating life of the active portion of the landfill or over the next 10 years of operation of that active portion (for existing landfills), whichever is shorter, in the case of a trust fund for closure or post-closure care, or over one-half of the estimated length of the corrective measures program in the case of corrective measures for known releases. This is referred to as the pay-in period.

(iii) For a trust fund used to demonstrate financial assurance for closure and post-closure care, the first payment into the fund shall be at least equal to the current cost estimate for closure or post-closure care, except as provided in paragraph (11) of this subdivision, divided by the number of years in the pay-in period as defined in subparagraph (ii) of this paragraph. The amount of subsequent payments must be determined by the following formula:

$$\text{Next Payment} = \frac{CE - CV}{Y}$$

where CE is the cost estimate for closure or post-closure care (updated for inflation or other changes), CV is the current value of the trust fund, and Y is the number of years remaining in the pay-in period.

(iv) For a trust fund used to demonstrate financial assurance for corrective measures, the first payment into the trust fund must be at least equal to one-half of the current cost estimate for corrective measures, except as provided in paragraph (11) of this subdivision, divided by the number of years in the corrective measures pay-in period as defined in subparagraph (ii) of this paragraph. The amount of subsequent payments must be determined by the following formula:

$$\text{Next Payment} = \frac{RB - CV}{Y}$$

where RB is the most recent estimate of the required trust fund balance for corrective measures (i.e., the total costs that will be incurred during the second half of the corrective measures period), CV is the current value of the trust fund, and Y is the number of years remaining in the pay-in period.

(v) Except as provided herein, the initial payment into the trust fund must be made 60 days before the initial receipt of waste or before April 9, 1997, whichever is later, in the case of closure and post-closure care, or no later than 120 days after the corrective measures remedy has been selected in accordance with the requirements of section 360-2.20 of this Subpart. In the case of closure and post-closure for landfills requiring financial assurance under section 360-2.14(a) of this Subpart and sections 360-7.4 and 360-8.6 of this Part, the initial payment must be made 60 days prior to the initial receipt of waste (for new facilities) or permit renewal.

(vi) If the owner or operator establishes a trust fund after having used one or more alternate mechanisms specified in this section, the initial payment into the trust fund must be at least the amount that the fund would contain if the trust fund were established initially and annual payments made according to the specifications of this paragraph and paragraph (11) of this subdivision, as applicable.

(vii) The owner or operator, or other person authorized to conduct closure, post-closure care, or corrective measures activities may request reimbursement from the trustee for these expenditures by submitting itemized bills and supporting documentation to the department. If approved, the department will instruct the trustee to make reimbursements in those amounts the department specifies in writing. Requests for reimbursement will be granted only if sufficient funds are remaining in the trust fund to cover the remaining costs of closure, post-closure care, or corrective measures. The owner or operator must notify the department that reimbursement has been received.

(viii) The trust fund may be terminated by the owner or operator only if approved in advance by the department in writing and the owner or operator substitutes alternate financial assurance as specified in this section or if the owner or operator is no longer required to demonstrate financial responsibility in accordance with the requirements of paragraphs (b)(2), (c)(2) or (d)(2) of this section.

(2) Surety bond guaranteeing payment or performance.

(i) An owner or operator may demonstrate financial assurance for closure or post-closure care by obtaining a payment or performance surety bond which conforms to the requirements of this paragraph. An owner or operator may demonstrate financial assurance for corrective measures by obtaining a performance bond which conforms to the requirements of this paragraph. Except as provided herein, the bond must be effective 60 days before the initial receipt of waste or before April 9, 1997, whichever is later, in the case of closure and post-closure care, or no later

than 120 days after the corrective measures remedy has been selected in accordance with the requirements of section 360-2.20 of this Subpart. In the case of closure and post-closure care for landfills requiring financial assurance under section 360-2.14(a) of this Subpart and sections 360-7.4 and 360-8.6 of this Part, the bond must be effective 60 days prior to the initial receipt of waste (for new facilities) or permit renewal. The owner or operator must submit the bond to the department. The surety company issuing the bond must, at a minimum, be among those listed as acceptable sureties on federal bonds in Circular 570 of the U.S. Department of the Treasury. (see section 360-1.3 of this Part).

(ii) The penal sum of the bond must be an amount at least equal to the current closure, post-closure care, or corrective measures cost estimate, whichever is applicable, except as provided in paragraph (11) of this subdivision.

(iii) Under the terms of the bond, the surety will become liable on the bond obligation when the owner or operator fails to perform as guaranteed by the bond, or fails to provide alternate financial assurance as specified in this section and obtain the department's written approval of the assurance provided within 90 days after receipt, by both the owner or operator and the department, of a notice of cancellation of the bond from the surety.

(iv) The owner or operator must establish a standby trust fund. The standby trust fund must meet the requirements of paragraph (1) of this subdivision except the requirements for initial payment and subsequent annual payments specified in subparagraphs (ii)-(v) of that paragraph.

(v) Payments made under the terms of the bond will be deposited by the surety directly into the standby trust fund. Payments from the trust fund must be approved in advance by the department in writing.

(vi) Under the terms of the bond, the surety may cancel the bond by sending notice of cancellation by certified mail to the owner and operator and to the department 120 days in advance of cancellation. If the surety cancels the bond, the owner or operator must obtain alternate financial assurance as specified in this section.

(vii) The owner or operator may cancel the bond only if approved in advance by the department in writing and alternate financial assurance is substituted as specified in this section or if the owner or operator is no longer required to demonstrate financial responsibility in accordance with paragraphs (b)(2), (c)(2) or (d)(2) of this section.

(3) Letter of credit.

(i) An owner or operator may satisfy the requirements of this section by obtaining an irrevocable standby letter of credit that conforms to the requirements of this paragraph. Except as provided herein, the letter of credit must be effective 60 days before the initial receipt of waste or before April 9, 1997, whichever is later, in the case of closure and post-closure care, or no later than 120 days after the corrective measures remedy has been selected in accordance with the requirements of section 360-2.20 of this Subpart. In the case of closure and post-closure care for landfills requiring financial assurance under section 360-2.14(a) of this Subpart and sections 360-7.4 and 360-8.6 of this Part, the letter of credit must be effective 60 days prior to the initial receipt of waste (for new facilities) or permit renewal. The owner or operator must submit the letter of credit to the department. The issuing institution must be an entity that has the authority to issue letters of credit and whose letter-of-credit operations are regulated and examined by a federal or State agency.

(ii) The letter of credit must be accompanied by a letter from the owner or operator referring to the letter of credit by number, issuing institution, and date, and providing the following information: name and address of the facility and the amount of funds assured must be included with the letter of credit that is submitted to the department.

(iii) The letter of credit must be irrevocable and issued for a period of at least one year in an amount at least equal to the current cost estimate for closure, post-closure care or corrective measures, whichever is applicable, except as provided in paragraph (11) of this subdivision. The letter of credit must provide that the expiration date will be automatically extended for a period of at least one year unless the issuing institution has cancelled the letter of credit by sending notice of cancellation by certified mail to the owner and operator and to the department 120 days in advance of cancellation. If the letter of credit is cancelled by the issuing institution, the owner or operator must obtain alternate financial assurance.

(iv) The owner or operator may cancel the letter of credit only if approved in advance by the department in writing and alternate financial assurance is substituted as specified in this section or if the owner or operator is released from the requirements of this section in accordance with paragraphs (b)(2), (c)(2) or (d)(2) of this section.

(v) An owner or operator who uses a letter of credit to satisfy the requirements of this subdivision may also be required to establish a standby trust fund. Under the terms of the letter of credit, all amounts paid pursuant to a draft by the department will be made in accordance with instructions from the department. The standby trust fund, if required, must meet the requirements of paragraph (1) of this subdivision, except for initial payment and subsequent annual payments specified in subparagraphs (ii)-(v) of that paragraph.

(vi) Following a determination pursuant to section 360-2.15 and 360-2.20 of this Subpart that the owner or operator has failed to perform when required to do so, the department may draw on the letter of credit.

(vii) If the owner or operator does not establish alternate financial assurance as specified in this subdivision and obtain written approval of such alternate assurance from the department within 90 days after receipt, by both the owner or operator and the department, of a notice from the issuing institution that it has decided not to extend the letter of credit beyond the current expiration date, the department will draw on the letter of credit. The department may delay the drawing if the issuing institution grants an extension of the term of credit. During the last 30 days of any such extension the department will draw on the letter of credit if the owner or operator has failed to provide alternate financial assurance as specified in this subdivision and obtain written approval of such assurance from the department.

(4) Insurance.

(i) An owner or operator may demonstrate financial assurance for closure and post-closure care by obtaining insurance which conforms to the requirements of this paragraph. Except as provided herein, the insurance must be effective 60 days before the initial receipt of waste or before April 9, 1997, whichever is later. For landfills requiring financial assurance under section 360-2.14(a) of this Subpart and sections 360-7.4 and 360-8.6 of this Part, the insurance must be effective 60 days prior to the initial receipt of waste (for new facilities) or permit renewal. At a minimum, the insurer must be authorized by the superintendent of the New York State Department of Insurance to conduct the business of insurance or eligible to provide insurance as an excess or surplus lines insurer, in New York State. The owner or operator must submit the certificate of insurance and a copy of the insurance policy to the department.

(ii) The closure or post-closure care insurance policy must guarantee that funds will be available to close the landfill whenever final closure occurs or to provide post-closure care for the landfill whenever the post-closure care period begins, whichever is applicable. The policy must also guarantee that once closure or post-closure care begins, the insurer will be responsible for the paying out of funds to the owner or operator or other person authorized to conduct closure or post-closure care upon the direction of the department, up to an amount equal to the face amount of the policy.

(iii) The insurance policy must be issued for a face amount at least equal to the current cost estimate for closure or post-closure care, whichever is applicable, except as provided in paragraph (11) of this subdivision. Face amount means the total amount the insurer is obligated to pay under the policy. Actual payments by the insurer will not change the face amount, although the insurer's future liability will be lowered by the amount of the payments.

(iv) An owner or operator, or any other person authorized to conduct closure or post-closure care, may receive reimbursements for closure or post-closure expenditures, whichever is applicable. Requests for reimbursement must be approved in advance by the department in writing and will be granted only if the remaining value of the policy is sufficient to cover the remaining costs of closure or post-closure care, and if justification and documentation of the cost is submitted to the department. The owner or operator must notify the department that reimbursement has been received.

(v) Each policy must contain a provision allowing assignment of the policy to a successor owner or operator. Such assignment may be conditional upon consent of the insurer, provided that such consent is not unreasonably refused.

(vi) The insurance policy must provide that the insurer may not cancel, terminate or fail to renew the policy except for failure to pay the premium. The automatic renewal of the policy must, at a minimum, provide the insured with the option of renewal at the face amount of the expiring policy. If there is a failure to pay the premium, the insurer may cancel the policy by sending notice of cancellation by certified mail to the owner and operator and to the department 120 days in advance of cancellation. If the insurer cancels the policy, the owner or operator must obtain alternate financial assurance as specified in this section.

(vii) For insurance policies providing coverage for post-closure care, commencing on the date that liability to make payments pursuant to the policy accrues, the insurer will thereafter annually increase the face amount of the policy. Such increase must be equivalent to the face amount of the policy, less any payments made, multiplied by an amount equivalent to 85 percent of the most recent investment rate or of the equivalent coupon-issue yield announced by the US Department of the Treasury for 26-week treasury securities.

(viii) The owner or operator may cancel the insurance policy only if approved in advance by the department in writing and alternate financial assurance is substituted as specified in this section or if the owner or operator, is no longer required to demonstrate financial responsibility in accordance with the requirements of paragraphs (b)(2), (c)(2) or (d)(2) of this section.

(5) Corporate financial test. [Reserved]

(6) Local government financial test. [Reserved]

(7) Corporate guarantee. [Reserved]

(8) Local government guarantee. [Reserved]

(9) State-approved mechanism. An owner or operator may satisfy the requirements of this section by obtaining any other mechanism that meets the criteria specified in paragraph (12) of this subdivision, and that is approved in advance by the department in writing.

(i) A capital reserve fund or a solid waste management facility reserve fund established and funded pursuant to General Municipal Law meets these criteria provided the pay-in period is consistent with paragraph (1) of this subdivision.

(ii) The financial test and corporate guarantee for closure under section 373-2.8(d)(5) meets these criteria, provided

the substantive requirements of section 373-2.8(d)(5) of this Title are met. No revenue-oriented facilities will be allowed to use this financial assurance mechanism.

(10) State assumption of responsibility. If the department either assumes legal responsibility for an owner or operator's compliance with the closure, post-closure care and/or corrective measures requirements of this Part, or assures that the funds will be available from State sources to cover the requirements, the owner or operator will be in compliance with the requirements of this subdivision. Any State assumption of responsibility must meet the criteria specified in paragraph (12) of this subdivision.

(11) Use of multiple financial mechanisms. An owner or operator may satisfy the requirements of this subdivision by establishing more than one financial mechanism per facility. The mechanisms must be as specified in paragraphs (1)-(10) of this subdivision, except that it is the combination of mechanisms, rather than the single mechanism, which must provide financial assurance for an amount at least equal to the current cost estimate for closure, post-closure care or corrective measures, whichever is applicable. The financial test and a guarantee provided by a corporate parent, sibling, or grandparent may not be combined if the financial statements of the two firms are consolidated. Use of a mechanism for financial assurance of both closure and post-closure care may be acceptable if approved in advance by the department in writing. The amount of funds available through the mechanism must be no less than the sum of funds that would be available if a separate mechanism had been established and maintained for financial assurance of closure and post-closure care.

(12) The language of the mechanisms listed in paragraphs (1) - (11) of this subdivision must ensure that the instruments satisfy the following criteria:

(i) The financial assurance mechanisms must ensure that the amount of funds assured is sufficient to cover the costs of closure, post-closure care, and corrective measures for known releases when needed,

(ii) The financial assurance mechanisms must ensure that funds will be available in a timely fashion when needed,

(iii) Except as provided herein, the financial assurance mechanisms must be obtained by the owner or operator by April 9, 1997 or 60 days prior to the initial receipt of solid waste, whichever is later, in the case of closure and post-closure care, and no later that 120 days after the corrective measures remedy has been selected in accordance with the requirements of section 360-2.20 of this Subpart, until the owner or operator is released from the financial assurance requirements under subdivisions (b)-(d) of this section. In the case of closure and post-closure care for landfills requiring financial assurance under section 360-2.14(a) of this Subpart and sections 360-7.4 and 360-8.6 of this Part, the financial assurance mechanism must be effective 60 days prior to the initial receipt of waste (for new facilities) or permit renewal.

(iv) The financial assurance mechanisms must be legally valid, binding, and enforceable under State and federal law.

(v) Section 373-2.8 of this Title provides additional guidance on criteria and wording of financial assurance mechanisms that the department will consider in assessing the acceptability of financial assurance mechanisms.

(vi) No revenue-oriented facility will be allowed to use the financial test or corporate guarantee for closure or post-closure care. Revenue oriented facility means any facility for which a majority of both its operating revenues and profits after tax at that facility for the prior three years and for the current and next year have been and are expected to be attributable to the landfilling of solid waste.

