Operations and Maintenance Manual

For

Residuals Management Unit-1

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SECTION 1.0

INTRODUCTION

This operations and maintenance manual for Residuals Management Unit-1 (RMU-1) is prepared in accordance with Condition F of Exhibit F (Supplement to Module VI),, of the CWM Sitewide Part 373 Permit[1]. The contents of this manual describe the general operation and maintenance of RMU-1. The primary document which regulates all operations associated with RMU-1 is the Sitewide Part 373 Permit.

There are four primary groups of requirements which directly impact the operations within RMU-1. Although the individual operators may not have a comprehensive knowledge of the formal permit and regulatory language, they are responsible for understanding and complying with those requirements which directly impact their job function. The four groups of requirements are the:

1) RMU-1 Operating Requirements
2) 6 NYCRR Part 373 Requirements
3) 40 CFR Part 264 Requirements
4) TSCA Approval Letter

A summary of these requirements as they apply to the persons working in RMU-1 are summarized below.

<u>RMU-1 Operating Requirements</u>

Operators working within RMU-1 must be aware of the operating and maintenance requirements found in the Sitewide Part 373 Permit which are summarized below:

- General Operating Requirements
- Waste Disposal Restrictions and Limitations
- Primary Leachate Collection
- Secondary Leachate Collection
- Cover Requirements
- Waste Placement
- Waste Surveys
- Run-on and Run-off
- Equipment in the Landfill

The Landfill Supervisor should have a working knowledge of these requirements and be able to communicate them to his/her staff. The Landfill Superintendent maintains a copy of the Sitewide Part 373 Permit.

[1] For a complete listing of the operating and maintenance requirements for RMU-1 see New York State Department of Environmental Conservation 6NYCRR Part 373 Sitewide Permit #9-2934-00022/00097, Schedule 1 of Module I and Module VI, issued August 21, 2013.

6 NYCRR Subpart 373-2 Regulations

Title 6 of the New York Codes, Rules and Regulations[1] give detailed requirements concerning Secure Land burial Facilities such as RMU-1. Requirements pertaining to the operations within RMU-1 include:

- maintaining a run-off management system to collect and control the water volume resulting from a 24-hour, 25-year storm,

- covering particulate matter subject to wind dispersal, and

- inspecting weekly (minimum) and after storms for:

  1) deterioration or malfunctions, or improper operation of run-on and run-off control systems,
  2) presence of liquids in leak detection systems,
  3) proper functioning of wind dispersal control systems,
  4) leachate collection and removal systems,

- other State requirements include subjects such as:

  1) ignitable or reactive wastes,
  2) liquid waste,
  3) F020, F021, F022, F023, F026 and F027 wastes,

40 CFR Part 264 Requirements

The Code of Federal Regulations, also list requirements similar to the State regulations. The State regulations will be the same as or more stringent than the Federal equivalent. Because NYS has authorization for the RCRA program including landfill operations, operators should be aware that Federal requirements do exist but primarily familiarize themselves with the Title 6 landfill regulations.[2]

TSCA Approval Letter

The disposal of PCB containing wastes regulated under 40 CFR Part 761 is authorized by an approval letter from USEPA, Region II. This document describes the types of PCB wastes

[1] The full text of these regulations can be found at 6 NYCRR Subpart 372-2, Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, Section 373-2.14.

[2] The text of the federal landfill regulations can be found at 40 CFR Part 264, Subpart N - Landfills, sections 264.300 through 264.317. Contact the EMD Department for more details if needed.

which may be disposed of in RMU-1. It also specifies certain monitoring and reporting requirements.

SECTION 2.0

GENERAL FACILITY CONDITIONS

2.1 RMU-1 DESIGN SUMMARY

RMU-1 is a 47-acre landfill which has been designed to provide an effective means of secure land disposal while safeguarding the environment. The major components of the landfill design are:

1. In-situ Glacial Till (Natural Soils).

2. Secondary Composite Liner.

   - 3 feet of compacted clay.
   - 80 mil HDPE (smooth Cells 1 through 6, textured Cells 7 through 14).

3. Secondary Leachate Collection System.

   - Geonet and Geotextile for Cells 1 through 6 and Geocomposite for Cells 7 through 14.
   - Leachate Collection Pipe Cells 7 through 14.
   - 1 foot of aggregate.
   - Geotextile.

4. Composite Primary Liner.

   - 1.5 feet of compacted clay.
   - 80 mil HDPE (smooth Cells 1 through 6, textured Cells 7 through 14).

5. Primary Leachate Collection System.

   - Geonet and Geotextile for Cells 1 through 6 and Geocomposite for Cells 7 through 14.
   - Leachate Collection Pipe Cells 7 through 14.
   - 1 foot of aggregate.
   - Geotextile.

6. Operations Layer - 1-foot thick stone.

7. Waste, daily and intermediate layers of cover.

* 6 inches of cover material over final waste surface

8. Final Cover – either a Compacted Clay or Geosynthetic Clay Liner (GCL) system.

Compacted Clay System

- 24 inches of compacted clay.
- 40 mil textured HDPE.
- Geocomposite layer.
- 30 inches of unclassified fill.
- 6 inches of topsoil with vegetative cover.

GCL System

- 6 inches of unclassified fill grading layer.
- GCL layer.
- 40 mil textured HDPE.
- Geocomposite layer.
- 18 inches of unclassified fill.
- 6 inches of topsoil with vegetative cover.

9. Leachate Collection System.

- Sumps.
- Riser vaults.
- Leachate piping.
- Leachate lift station.
- Pumps.
- Alarms.

10. Intercell Berms and Perimeter Berm.

11. Surface Water Control Structures.

- Diversion ditches.
- Stormwater detention basin.

12. Access Roads.

2.2 GENERAL WASTE ANALYSIS 6NYCRR Part 373-2.2.e

The facility is required to comply with Section 373-2.2(e) of the Title 6 New York Codes, Rules, and Regulations and follow the procedures described in the CWM Model City Facility Waste Analysis Plan (Sitewide Part 373 Permit, Attachment C).

All waste received at the facility will have been characterized prior to disposal in RMU-1. The record of analysis and load identification will be maintained as part of the Operating Record.

2.3 SECURITY 6NYCRR Parts 373-2.2.f.2 and f.3

The facility must comply with the applicable security provisions contained in 6NYCRR, Parts 373-2.2.f.2 and f.3. The site is in compliance with these provisions by maintaining:

- Fencing around entire facility.
- 24-hour guard service restricting unauthorized entry to the site.
- Placement of "Danger - Unauthorized Personnel Keep Out" signs.

2.4 INSPECTION REQUIREMENTS 6NYCRR Part 373-2.2.g

The facility must comply with 6NYCRR, Part 373-2.2.g with respect to inspections, and follow its own established Inspection Schedule and any subsequent, approved revisions. The facility must respond to any deterioration or malfunction discovered by an inspection. Records of inspections are kept on-site as required. The Inspection Plan is included as Attachment F of the Sitewide Part 373 Permit.

2.5 GENERAL REQUIREMENTS FOR IGNITABLE, REACTIVE, OR INCOMPATIBLE WASTES 6NYCRR Part 373-2.2(I

The facility is required to take appropriate precautions to prevent accidental ignition or reaction of ignitable or reactive waste, as stated in 6NYCRR, Section 373-2.2(I). The Landban regulations (Part 376) prohibit the direct landfill disposal of characteristically hazardous, ignitable (D001) and reactive (D003) hazardous wastes that do not meet the specific land disposal criteria.

In addition, waste screening in accordance with the WAP minimizes the potential for ignitable or reactive wastes arriving at RMU-1 without proper identification.

2.6 PREPAREDNESS AND PREVENTION 6NYCRR Part 373-2.3

2.6.1 Required Equipment

In compliance with 6NYCRR 373-2.3(c), this facility is equipped with (1) an internal communications or alarm system, (2) telephones capable of summoning emergency assistance, (3) portable fire extinguishers, and (4) water at adequate volume to supply fire equipment.

The site has an up-to-date Contingency Plan included as Attachment G of the Sitewide Part 373 Permit.

2.6.2 Access to Communications or Alarm System

The facility must maintain access to the communications or alarm system as required by 6NYCRR 373-2.3(e). In general, communication is maintained by two-way radio and telephone.

2.7 CONTINGENCY PLAN 6NYCRR Part 373-2.4

2.7.1 Implementation of Plan

The facility must comply with 6NYCRR 373-2.4 and follow the CWM Model City Facility Contingency Plan. The facility must immediately carry out the provisions of the CWM Model City Facility Contingency Plan and follow the emergency procedures described by 6NYCRR 373-2.4(g) whenever there is a fire, explosion, or release of hazardous waste or constituents that would require the implementation of the contingency plan.

After any event requiring implementation of the CWM Model City Facility Contingency Plan, the facility shall not resume hazardous waste management in the affected area until all equipment used during the contingency has been cleaned, recharged, or replaced, as appropriate.

2.7.2 Emergency Procedures

Whenever there is an imminent or actual emergency situation, the emergency coordinator must immediately activate internal alarms and notify the agencies if help is needed.

IMMINENT OR ACTUAL EMERGENCIES ARE REPORTED BY DIALING EXTENSION 0200 IMMEDIATELY.

2.8 RECORD KEEPING AND REPORTING 6NYCRR Part 373-2.5

2.8.1 Operating Record

The facility must maintain a written operating record at the facility in accordance with the applicable portions of 6NYCRR 373-2.5(c).

In compliance with 6NYCRR Part 373-2.14(f) and Conditions E.1.h.i.'(a)' and F.5.e of Exhibit F, of the Sitewide Part 373 Permit, CWM maintains, as a key portion of the computerized Waste Tracking System (WTS), the disposal location (3-D grid which includes the alphanumerical location and lift number of waste placed) and disposal date for each waste placed in RMU-1. The 3-D grid location for bulk loads is determined by assigned landfill personnel using a Global Positioning System (GPS) receiver linked with a hand held computer. Data collected by the hand held computer, including horizontal location (latitude and longitude or northing and easting), elevation, grid location, lift number (determined by reference table included in the GPS computer) and date/time of reading, will be archived daily for possible future reference. The disposal grid for bulk loads is updated periodically with additional GPS readings throughout the day based on the fill progression. Grid locations are then manually entered into the WTS for each bulk load. In addition, for containers (e.g., flatbed drum loads, macroencapsulation boxes) and miscellaneous large items (e.g., transformers), a specific GPS reading is taken and the data stored in the GPS computer along with the flatbed number or macrobox number. The grid location, as determined by the GPS, is then manually entered into the WTS for each of the containers.

The GPS device used must be capable of determining latitude and longitude to a minimum accuracy of 5 feet (1.5 meters), and elevation to a minimum accuracy of 12 feet (3.5 meters). The accuracy of the GPS device shall be checked on a monthly basis using a permanently surveyed benchmark located near the landfill. All waste disposal location data shall be kept as part of the Facility operating record, and provided to on-site NYSDEC staff upon request. In addition, this data shall be submitted to the NYSDEC in accordance with Condition I.1.b.ii of Exhibit F of the Sitewide Part 373 Permit.

2.8.2 Operating Manuals and Reports

The RMU-1 Operations Manual will be maintained and made available to all applicable CWM personnel.

All changes to this Operations Manual must be submitted in writing and approved by the NYSDEC prior to their implementation. Approved changes shall be transmitted to all copy holders of the Manual.

SECTION 3.0

LANDFILL OPERATING REQUIREMENTS

3.1 WASTE IDENTIFICATION

3.1.1 Waste Stream Approval

In general, the facility may dispose of waste streams that have been approved, in writing, in accordance with Condition E.1.b of Exhibit F of the Sitewide Part 373 Permit. Requests for waste stream approval must be submitted in a form acceptable to Region 9, in accordance with the CWM Model City Facility Waste Analysis Plan (Attachment C of the Sitewide Part 373 Permit).

3.1.2 Waste Disposal Restrictions

In general, wastes may be landfilled subject to the CWM Model City Facility Waste Analysis Plan and in accordance with Condition E of Exhibit F of the Sitewide Part 373 Permit.

Some highlighted requirements are as follows:

A. Waste that has the potential to become an airborne dust must be containerized or otherwise managed in accordance with the facility Fugitive Dust Control Plan, Attachment L of the Sitewide Part 373 Permit and the Memorandum of Understanding between CWM and NYSDEC dated March 16, 1992.

B. Prior to landfilling, soluble wastes are to be pre-treated to the extent feasible using the Permittee's on-site treatment facilities (such as Stabilization). Soluble wastes shall be placed in the landfill in such a way as to minimize pocketing of soluble material. In accordance with the Waste Analysis Plan, Section C-1.7, this is typically done by spreading the bulk waste thin. Containers containing common contaminant compounds that have a solubility in water at 25· C in excess of 10% by weight of the waste, shall be surrounded by insoluble waste when placed in the landfill. Soluble wastes could include nonhazardous salts such as sodium chloride and sodium sulfate. Disposal of soluble wastes must be approved through the waste approval program.

C. The Permittee shall use a code(s) identifying the intended method of disposal of each waste stream contained in drums. The current system utilizes a System Type (H) Code to identify the intended management method.

D. Disposal of Package Lab Chemicals (PLCs) in RMU-1 shall be as described in Section C-1 of the Waste Analysis Plan and condition E.1.e of Exhibit F.

E. profiles with a high pH or low pH are designated as "acid sensitive" ("AS") and "acid generating" ("AG"). A buffer zone, being at no time less than 50' (Condition E.1.d.iv D(4)(d) of Exhibit F of the Sitewide Part 373 Permit), except vertically in the Cell 9/10 transition zone shown below, will be used to keep AG and AS wastes separated from each other. The buffer zone will be comprised of material (i.e. waste, stone, cover material) not falling within the categories of AS or AG waste.

Specifically, the grid locations for the buffer zone, AS and AG areas will generally adhere to the following pattern throughout the fill progression of RMU-1:

Area	Cells 1/2	Cells 3/4	Cells 5/6	Cells 7/8		Cells 9/10 Lift 1-3	Cells 9/10 Lift 4	Cells 9/10 Lift 5+		Cells 11-14		Cells 11-14 Lift 1-4	Cells 11-14 Lift 5+
AS	A-F 1-7	A-F 8-13	A-F 14-20	A-N 22-29	A-F 21	O-T 22-29*	O-T 22-29*	P-T 19-29*	O 22-29	W-II 19-25	V 22-25	---	V 19-21
Buffer Zone	G 1-7	G 8-13	G 14-20	G-N 21	---	O-U 21**	O-U 18-21**	O-U 18**	O 19-21	V-II 18	V-EE 26	V 19-21	---
AG	H-L 1-7	H-L 8-13	H-N 14-20	---	---	O-U 14-20	O-U 14-17	O-U 14-17	---	V-II 14-17	V-EE 27-29	---	---

* and U 22-25 ** and U 26-29

Eventually, as the lifts rise and landfill space decreases, the segregation zones will decrease. However, at no time will the distance of separation between the AG and AS waste fall below 50 feet, except vertically in the Cell 9/10 transition zone. See **Attachment No. 1** for a figure of the grid marker locations.

3.2 OPERATIONAL REQUIREMENTS

3.2.1 General

The RMU-1 landfill will be operated in accordance with Condition F of Exhibit F of the Sitewide Part 373 Permit, chapter 5 of the Engineering Report and this Operations Manual. Therefore, all conditions referred to throughout this Manual are to be taken as if they were actual permit conditions. Refer to the Sitewide Part 373 Permit for additional specifics.

The location of RMU-1 within the CWM Model City Facility is shown on Drawing No. 2 and the subbase layout grades of the 14 cells that constitute the landfill is shown on Drawing No. 5.

3.2.2 Primary Leachate Collection

The facility is required to maintain and operate a primary leachate collection and removal system immediately above the primary liner to collect and remove leachate from the landfill (refer to RMU-1 Engineering Report).

According to the Record Drawing entitled Top of Primary Clay Liner for final construction of RMU-1, the top of sump elevation for each primary sump is as follows:

Sump	Elevation at Clay Liner	Compliance Level (1 foot above Clay Liner)
Primary Sump Cell 1	309.86 feet	310.86 feet
Primary Sump Cell 2	313.13 feet	314.13 feet
Primary Sump Cell 3	312.17 feet	313.17 feet
Primary Sump Cell 4	312.94 feet	313.94 feet
Primary Sump Cell 5	311.28 feet	312.28 feet
Primary Sump Cell 6	313.90 feet	314.90 feet
Primary Sump Cell 7	312.43 feet	313.43 feet
Primary Sump Cell 10	313.82 feet	314.82 feet
Primary Sump Cell 13	310.59 feet	311.59 feet
Primary Sump Cell 14	310.75 feet	311.75 feet

Specific pump types and sizes for the RMU-1 cells and lift station are specified in the Leachate Level Compliance Plan (LLCP) for the appropriate stage of fill progression.

In accordance with condition C.1.e of Exhibit D, must designate specific tanks in the Leachate Tank Farm (LTF) for the storage of RMU-1 leachate, SLF 12 leachate and other site waters that can be adequately treated without using the whole treatment train in the AWT facility. One tank will be designated for the storage of SLF 1-11 leachates and gate receipts; neither of these wastestreams may ever be added to the RMU-1 storage tank(s) CWM must maintain a minimum of 625,000 gallons total available (empty) tank capacity required by Condition C.1.d of Exhibit D of the Sitewide Part 373 Permit. If at any time the available (empty) tank volume is less than 625,000 gallons, CWM will implement the actions specified by Condition C.1.d of Exhibit D of the Sitewide Part 373 Permit (immediately notify DEC, obtain approval of a restoration plan, or treat or ship off-site 200,000 gallons per day), until such time as the required available storage capacity is restored.

3.2.3 Secondary Leachate Collection

RMU-1 Secondary Leachate Collection System requirements can be found in Condition H of Exhibit F of the Sitewide Part 373 Permit.

3.2.4 Waste Placement

In addition to those requirements found in this Manual, refer to the requirements for waste placement found in Condition F(5) of Exhibit F of the Sitewide Part 373 Permit.

3.2.4.1 Geosynthetic Liner/Primary Leachate Collection Pipe Protection and Waste Placement During First Lift

All first lifts in RMU-1 have been completed.

3.2.4.2 Geosynthetic Liner Protection and Temporary Roads

Care will be exercised in removing any temporary gravel roads to avoid damaging the liner. Prior to constructing temporary roads, a geotextile, plastic sheet or other material will be placed as marker to alert equipment operators that the operations layer is immediately below. To prevent ponding, if a non-permeable material is used, it must be cut up or removed upon removal of the stone roads. Temporary access roads will be removed and reused as feasible.

3.2.4.3 Winter Operations and Waste Placement in new Cells

No additional new cells are available in RMU-1.

3.2.4.4 Waste Placement for "Minimum Strength" Waste

The procedures for placement of waste defined as "minimum strength" (MS) waste, as determined by the waste strength curve required by Condition E.1.d.v of Exhibit F of the Sitewide Part 373 Permit are as follows:

1. The MS waste shall be spread in thin lifts and blended with other gradable wastes, such as soil. If the MS waste is not blended with other wastes, the MS waste shall be placed in a maximum nominal one foot thick horizontal lift approximately parallel to the base of the landfill.

2. The maximum volume of MS waste shall not exceed ten percent of the waste mass placed within the landfill in any given month. The amount of MS waste landfilled shall be reported to the NYSDEC on a monthly basis.

3. If any MS waste is profiled at greater than 200 tons per year, this will be noted in the Profile Approval Request (PAR) and a strategy for the placement of the MS waste in the landfill will be discussed with the NYSDEC On-site Monitors.

3.2.5 Cover Materials

Four categories of cover will be used during the active life of RMU-1, as defined below:

3.2.5.1 Definitions

"Daily cover" means a compacted layer of at least six inches of cover material that has been placed on all exposed solid waste, including hazardous waste, in a landfill at the end of each day of operation. (6NYCRR Part 370.2)

"Daily cover" also allows, as per Condition F.4.a of Exhibit F of the Sitewide Part 373 Permit, that other NYSDEC approved materials may also be used for daily cover.

"Intermediate cover" means a compacted layer of at least 12 inches of cover material. (6NYCRR Part 370.2)

"Cover material" means soil and or other suitable material acceptable to the department that is used to cover compacted solid waste, including hazardous waste, in a land disposal site. (6NYCRR Part 370.2)

"Final cover" means the cover material placed on all surfaces of a landfill where no additional refuse will be deposited within one year. These areas must be designed and constructed in accordance with the requirements of section 373-2.14 of this Title. (6NYCRR Part 370.2)

3.2.5.2 Cover Material Requirements

Cover material requirements of the Model City Facility are summarized below and listed by Condition F.4.a of Exhibit F of the Sitewide Part 373 Permit.

Cover material shall be applied on all exposed waste to sufficiently cover the waste at the end of each day of operation, unless otherwise approved in writing from the Region 9 NYSDEC Regional Hazardous Waste Engineer. Cover material will consist of graded granular material, synthetic cover, or other NYSDEC approved cover material.

A DEC approved spray-on type of cover material, as well as DEC approved geosynthetic cover material is currently used by operations personnel as a substitute to soil cover material.

3.2.5.3 Intermediate Cover

CWM may place intermediate cover over the waste mass in RMU-1 as an option to daily or final cover materials. It is CWM's intent not to use Intermediate Cover as it was previously used on the SLF-12 landfill. For RMU-1, CWM will practice the "Cap As You Go" method of Final Cover placement and eliminate the previous practice. However, if necessary, due to schedule constraints or other reasons, CWM may use Intermediate Cover, for short periods (i.e., for less than one year). Intermediate cover will only be placed in cases where there is not sufficient time left in a year's construction season (April 1 to November 30) to place final cover over the same area. In such cases where intermediate cover is placed on an area of waste, the placement of final cover will be completed during the immediate next calendar year, in accordance with Condition J of Exhibit F of the Sitewide Part 373 Permit, unless the NYSDEC approves a onetime extension not to exceed one (1) additional calendar year.

Generally, during an intermediate cover application, soil material may be applied to cover the final waste placed and to allow for the placement of final cover components. Intermediate cover may consist of soil and/or other suitable materials acceptable to the Department that is used to cover hazardous waste. The soil materials may consist of clay, general cover soils or, other materials as approved by the Department. “Intermediate Cover” means a compacted layer of at least 12 inches of cover material.

For a Compacted Clay final cover system, the waste mass will be brought to a grade no higher than six (6) inches below the Top of Waste Grades indicated on Drawing No. 11 in Attachment J, Appendix D-6, of the Sitewide Part 373 Permit prior to placing intermediate cover. For a GCL final cover system, the waste mass may be at, or below, the Top of Waste Grades indicated on Drawing No. 11a in Attachment J, Appendix D-6, of the Sitewide Part 373 Permit.

Clay intermediate cover of which portions will be incorporated into a Compacted Clay final cover system will consist of the same material as that of soil liner material in the Sitewide Part 373 Permit, Attachment J, Appendix D-8, QAM, Section 4.1, which also satisfies the requirements of Condition F.4.b of Exhibit F of the Sitewide Part 373 Permit. It will generally consist of soils with low hydraulic conductivity and will be clean, select material free of trash, excessive coarse particles, or other deleterious matter. Clay soils proposed for intermediate cover construction shall be classified according to the United Soil Classification System as CL or CH. Clay soils with organic content in excess of specifications, or soils classified as organic silt or clay (OL, OH) shall not be used and shall meet the requirements of the Sitewide Part 373 Permit, Attachment J, Appendix D-7, Technical Specifications, Section 02210, Part 2.01.C. Conformance testing for all clay soil shall meet the requirements of the Sitewide Part 373 Permit, Attachment J, Appendix D-8, QAM, Section 4.3.

Intermediate cover of which portions will be incorporated into the GCL final cover system will consist of the same material as that of protective soil cover, in the Sitewide Part 373 Permit, Attachment J, Appendix D-8, QAM, Section 8.0, which also satisfies the requirements of Condition F.4.b of Exhibit F of the Sitewide Part 373 Permit.

For a Compacted Clay final cover system, intermediate cover shall be placed in a single loose lift above the waste and compacted to a thickness of 12 inches within acceptable survey tolerance limits. The clay will be placed and compacted according to Test Pad Construction procedures (i.e. equivalent compaction equipment and number of passes). A trial test pad or area on the final waste surface may be conducted. Field testing of the intermediate clay cover, for six inch layer of clay placed above the Top of Waste Grades shall consist of moisture/density testing as defined for final cover clay soil in the RMU-1 permit. Laboratory testing for Shelby tube samples will not be required for clay placed as intermediate cover. The top of compacted intermediate cover surface shall be a least six (6) inches, within a survey tolerance of plus or minus 0.1 feet, above the Top of Waste Grades and will be covered with a temporary geomembrane. At the time of final cover placement, the temporary geomembrane shall be removed, the surface graded to remove any erosion rills, and adequately reworked to recompact the upper six inches of clay, according to the procedures in Attachment J, Appendices D-7 and D-8, of the Sitewide Part 373 Permit.

For GCL final cover system, intermediate cover shall be placed in a single loose lift above the waste and compacted to a thickness of 12 inches above the Top of Waste Grades indicated on Drawing No. 11a in Attachment J, Appendix D-6, of the Sitewide Part 373 Permit within acceptable survey tolerance limits. The top of compacted intermediate cover surface shall be a least twelve (12) inches, within a survey tolerance of plus or minus 0.1 feet, above the Top of Waste Grades and will be covered with a temporary geomembrane. At the time of final cover placement, the temporary geomembrane shall be removed, the upper six (6) inches of soil cover removed, and adequately reworked to meet the requirements in Attachment J, Appendices D-7 and D-8, of the Sitewide Part 373 Permit.

To avoid potential damage, intermediate clay cover will not be allowed to exist throughout the winter unless adequately protected. Protection of the intermediate clay cover will include a geomembrane if the intermediate clay is allowed to exist through the winter months. At the time of final cover placement, the temporary geomembrane, shall be removed. To incorporate the intermediate clay into a Compacted Clay final cover system, the top six (6) inches of clay will be reworked and retested to assure adequate clay permeability.

For a GCL final cover system, the top six (6) inches of intermediate cover will be removed and the lower six (6) inches will be proofrolled and used as the subbase for the GCL.

3.2.5.4 Inspection and Repair of Cover and Intermediate Cover

At the end of each operating day, the facility will have adequate on-site supplies of cover materials for application over exposed wastes. This will include soil type cover materials or other NYSDEC approved cover materials. Waste materials may only be used for cover material if specific waste streams are approved in writing by Region 9 NYSDEC.

During the daily site inspection of RMU-1, both by the trained RCRA inspector and by the NYSDEC monitoring staff, any cover concerns, will be brought to the attention of the Landfill Supervisor. Cover issues observed by the site inspector will be noted in the RMU-1 inspection portion of the Inspection Plan and addressed appropriately. During daily site inspections, the trained RCRA inspector will look for adequate cover and concerns such as holes, rips, tears, poorly anchored sheets, etc. which may appear in applied geosynthetic material. After a concern is noted, corrective action will be taken to correct the concern. Additional cover material will be applied as needed. If portions of intermediate cover have not been protected by geosynthetic material, any significant erosion will be addressed through the RCRA inspection and remedial work order process.

NOTE: In order to promote good drainage, waste may not be placed on top of the geosynthetic cover unless it is removed or cut such that there is not one large and continuous piece of geosynthetic cover between lifts along a working face.

3.2.5.5 "Cap As You Go" Final Cover

The Final Cover for RMU-1 is a liner system which consists of soil and geosynthetic components and will be constructed on landfill areas where no additional waste will be deposited.

As cells in RMU-1 reach final design waste capacity, CWM intends to place a final cover on these cells. This practice would reduce the area exposed to precipitation and help in reducing the amount of leachates produced. Since RMU-1 cells will be constructed, filled, and capped in stages over several years, a "cap as you go" final cover system will be used. As final cover is applied, the leading edge adjacent to operating cells will be tied into as operating cells also reach final waste grades. The cover system will progress sequentially until the entire landfill is filled and capped.

The Top of Vegetative cover grades are separated from the Top of Waste grades with a temporary liner interconnection which includes a separator geotextile and 2' minimum soil cover. Surface water runoff is directed away from the interconnection to keep contaminated liquids in the landfill. Detail 25 on Drawing 21 shows the waste slope will divert contaminated runoff away from the final capped areas to the Detention Basins. Trenches or channels in the waste at the leading edge of the final cover system may be constructed as needed to direct storm water away (see Attachment #4). As the final cover system progresses, the separator geotextile and temporary soil cover are removed for connection of the new cover layers.

The final cover will meet the requirements for liner materials in the Sitewide Part 373 Permit, Attachment J, i.e., Appendix D-8 (QAM), Appendix D-7 (Technical Specifications), and Appendix D-6 (Drawings). The final six (6) inches below the Top of Waste Grades will consist of compacted hazardous or non-hazardous select waste or compacted general fill materials. The select waste or fill material will be free of debris larger than 6 inches and be able to be compacted to a firm smooth surface. Approval of the final waste surface by NYSDEC and the CQA Engineer is required prior to beginning final cover installation.

The CQA Engineer will determine the suitability of the waste surface for clay or grading layer placement by, at a minimum:

1. Verification that a qualified land surveyor has verified all lines and grades.
2. Determine the suitability of the waste surface for clay or grading layer placement by continuous visual inspection during proof rolling. In locations where proof rolling is not practical (e.g., slopes steeper than 3H:1V), determine the suitability of the waste surface for clay or grading layer placement by visual inspection of the surface as prepared by backblading with a bulldozer. The waste surface must not exhibit excessive pumping which would compromise the surface's ability to support the final cover system. Final cover system loadings on the waste surface are significantly less than the liner system and waste loadings on the baseliner subbase. Therefore, the qualitative acceptance criteria utilized for determination of baseliner subbase suitability must be adjusted accordingly for determination of final waste surface suitability. The waste surface must not exhibit a potential for significant intermingling of waste and cover soil.

The CQA Engineer shall indicate to the Project Manager any waste surface locations which are found to be unsuitable for clay or grading layer placement. Such areas of the waste surface shall be repaired to meet the specifications described above. An acceptable method of repairing small, localized areas of excessive pumping is by placing geonet (or Designer approved equal) on the waste surface over the area of concern and extending a minimum of five feet beyond the area of concern prior to clay or grading layer placement. Every effort shall be made to avoid excavation and removal of waste.

For Compacted clay final cover system, the placement of final clay will be in conformance with the RMU-1 QAM or as demonstrated by an in-place test pad for the Final Cover system. Conformance testing for this clay shall meet the requirements of the Sitewide Part 373 Permit, Attachment J, Appendix D-8, QAM, Section 4.3. For GCL final cover system, the conformance testing and the placement of the grading layer composed of general fill will be in conformance with the Sitewide Part 373 Permit, Attachment J, Appendix D-8, QAM, RMU-1 Section 6.0. Installation of the geosynthetic and remaining soil portions of the final cover system shall be as described in the Sitewide Part 373 Permit, Attachment J, Appendix D-8, QAM, and Appendix D-6, Drawings.

At the time of final cover placement, any temporary geomembrane which has been placed shall be removed from intermediate cover. For Compacted Clay final cover system, the surface shall be graded to remove any erosion rills, and adequately reworked to recompact the upper six inches of clay, according to the procedures in Attachment J, Appendices D-7 and D-8, of the Sitewide Part 373 Permit. For a GCL final cover system, the top six (6) inches of intermediate cover will be removed and the lower six (6) inches will be proof rolled and used as the subbase for the GCL.

Surface water management during final cover construction shall focus on the restriction of sediment discharge from the work area. Except as described below, no surface water must be allowed to exit the landfill until a minimum of one (1) foot of intermediate cover soil and a temporary geomembrane has been placed. In the case of GCL Final Cover system installation, surface water may exit the landfill after placement of the 6-inch select fill layer, however within seven (7) days of such placement, the Permittee must install either a temporary geomembrane or the GCL and permanent geomembrane above the select fill layer.

3.2.5.7 Interim Storage of Stabilized Waste in the Secure Landfill

Procedures are in place to establish an interim storage process for waste awaiting strength testing results.

Waste material may require interim storage pending the results of strength testing prior to final disposal in the landfill. The procedures in place to store interim storage loads are summarized as follows:

- Prior to placing the interim storage load, a geosynthetic separation material or a stone layer with a minimum thickness of 2 inches will be placed over the interim storage area, as needed to segregate the load.

- The load is then placed over the storage area in a distinct interim storage pile, separate from other bulk waste loads and other wastes.

- Each such interim storage pile will have a flag or other marker displayed with an identifier(s) that correlates to the waste tracking information which indicates the specific waste in the pile and the date the pile was placed in the landfill..

- Daily cover will be applied to all interim storage piles on the date of their placement in the landfill and maintained for the duration of each pile's storage period.

- When the waste passes the testing requirements, it is placed in its disposal location.

3.2.5.7 Winter Operational Procedures

Primarily, geotextile material and spray-on cover will be used as cover material during the winter season. However, soil which has been pre-mixed with heavy equipment, thereby making it easy to spread, is also an excellent choice for cover material. It has been our experience that, even in freezing conditions, soil cover material can be used, as long as it has been worked sufficiently enough to allow for easy spreading.

Frozen sections of soil, not easily broken and gradable, will not be used as cover material.

3.2.6 Vehicle Access into Facility

Waste hauling vehicles enter the facility at the Plant Entrance on Balmer Road. This entrance is staffed with trained security officers 24 hours per day, 7 days per week. During the hours when waste materials may be received at the facility, the security officers perform physical and visual checks of paper work as well as the hauling vehicle.

3.2.6.1 Waste Vehicle Access into RMU-1 and Access Ramps

During typical operations of RMU-1, several vehicle types are used to transport waste, personnel, and operation equipment into the cell. The types of waste hauling vehicles include:

- Dump trailers
- Rolloff box transports
- Lugger box transports
- Flatbed trailers
- Lowboy trailers

Typical operation personnel access vehicles include:

- Pickups
- Triaxle dump trucks (daily cover and road gravel)
- Triaxle tank truck for leachate removal (ponded surface water)
- Maintenance truck for heavy equipment

Typical operation equipment include:

- Compactor
- Dozer
- Drum fork lift
- Track backhoe
- Wheel loader
- Spray-On truck

Operations equipment may be cleaned in the cell and driven out or hauled out on Lowboy trailers.

Given the variety of types of vehicles accessing RMU-1, it was determined that road legal, semi-trailer, waste hauling vehicles would control road design.

With this in mind the minimum required road slopes, width, curve radius and thickness to handle the vehicle lengths, weights, and multiple passes are presented within this Section.

The site may employ various truck route access road options for RMU-1 depending on time of year, adjacent construction, and which cell in RMU-1 is active. Other design options are acceptable depending on desired location providing the minimum design requirements are maintained.

It should be noted that these routes are applicable to all cells of RMU-1. For example, for filling in Cells 5 and 6 when 7 and 8 were under construction, the "over-the-berm" access Figure 2 may be employed, which allows vehicles to access the cell without having to construct a berm in adjacent unlined areas. From this design option, and the calculation sheet provided, the following construction guidance is presented:

- The incoming road ramp slope from the site roads will be between 8and 12 percent on incoming ramps and 12 percent on outgoing ramps.

- The minimum curve radius to be used for road construction is 45 feet.

- The minimum road width presented with is 15-feet and varies due to turning points and staging areas.

- Road construction material consists of gravel type material (e.g. run-of-crusher No. 2 gravel or equivalent) for the first 12" and then suitable on-site or off-site soil stockpile.

- Internal cell roads across the waste surface will be of a minimum of 12-feet wide and vary as to the location of the road (i.e., curves and unloading areas will be wider).

- Roads across the waste surface will be of a gravel type material (e.g. run-of-crusher No. 2 gravel or equivalent) and at least 12" thick.

If the initial access roads into the cell are installed on the operations layer, then the roads will be constructed on a layer of geotextile. This layer will act as a marker to show where the operations layer starts. Also, the geotextile will reduce maintenance of heavily traveled roads during inclement weather. Removal of the road to this marker will prevent damage of underlying liner system layers.

Once in the cell, vehicles may be staged on a dumping ramp for waste unloading for initial lifts. This will allow the waste filling to fan out from the ramp to allow greater access. Once waste is filled along the road, the initial gravel access roads can be removed and waste vehicles can drive on the waste.

For the operation of Cell 6, vehicles with a maximum equipment wheel pressure of 5 psi will not be allowed to drive over the Cell 6/10 temporary intercell berm. Also, temporary access ramps shall not be constructed over the Cell 6/10 berm.

Once the initial lift or waste placement progresses across the cell, the vehicle will drive into the cell and turn around. At this time, the cell access road can be steepened to match filling needs.

Initial access to cells may also be provided using a temporary ramp, such as the ones used for construction equipment access. Waste can be brought in through these ramps and placed into the cell corners. Stone ramps are then constructed at these corners after sufficient waste has been placed at these locations. The waste trucks may enter and exit through these ramps.

An asphalt high point across the entire width of each truck entrance and exit road constructed after October 30, 2002, shall be provided just inside the perimeter of the landfill liner system. In instances where the road crosses the transition between capped and uncapped areas, the high point will be constructed just beyond the uncapped area edge (i.e., within the capped area). This high point must be constructed and maintained at a height sufficient to insure that contaminated surface water remains within the landfill at all times. At any point where the width of this access road is insufficient for two way traffic (i.e., less than 24 feet), CWM will apply appropriate traffic controls, such as stop signs and radio communication.

During later stages of waste filling, the increasing elevations of the waste mass will prevent the use of traditional haul roads, which typically have encroached into the permitted waste envelop. A new landfill plateau access road was constructed on top of existing final cover areas so that the landfill final buildout may proceed without further restrictions imposed by vehicle access needs. The new single-lane width gravel road was constructed from the perimeter berm diagonally up the northern face of the landfill and onto the plateau. Other than topsoil removal within the road footprint, no other modifications were needed to the existing final cover to accommodate the road. The majority of the road was constructed of general fill and was surfaced with an 18-inch thick layer of crusher run, which was underlain with a woven geotextile. A guiderail will be included along the outside edge. This landfill plateau access road will remain in place as a permanent feature. Figure 1A of Attachment #4 shows access to RMU-1 active area by the permanent access road constructed over Phase III, IV, and VII Final Cover.

3.2.6.2 Waste Vehicle Decontamination

Vehicles or any other equipment which have entered a secure land burial facility or any area where they may come into direct contact with wastes, shall be inspected for gross contamination prior to leaving such an area.

Pressure washing of tires and equipment will be performed at the landfill truck wash station, located at the exit of the landfill, as necessary to prevent contamination of on-site roads. Additional decontamination may be required by the TSCA approval issued by USEPA. After all gross contaminants have been removed from the vehicle it is declared clean.

3.2.7 Fill Progression and Surface Water Management

Fill Progression and surface water management within RMU-1 limits include the following areas:

- constructed, non-active cells
- initial lifts
- waste placement below the perimeter berms, and
- waste placement above the perimeter berms

3.2.7.1 General Fill Progression and Surface Water Management

The general fill progression began in December 1994 with initial waste placement in Cell 1 and Cell 2 per Stage 1 of the filling plan. Waste placement in subsequent cells has progressed in general accordance with the RMU-1 Fill Plan shown on Figure 1 in Attachment No. 3. Slope stability analyses have been prepared to show that the permitted final build out elevation and differential waste heights (prior to operation of adjacent cells) are stable, i.e., Factor of Safety greater than 1.5 (refer to Appendices D-6 and D-7, respectively, of the RMU-1 Engineering Report). The latest fill progression plan for Cells 1 through 14 is dated August 2011 (revised November 2011) and is included as Figure 1 in Attachment No. 4. The fill progression includes the Phase I, II, III, IV, V, VI, and VII final capping areas and Detection Basin G or Phase I though VII final capping areas, proposed Phase VIII and IX final capping areas, and Detention Basin J and Detention Basin K, both of which are located in Cell 11/13.

The slope stability analysis for the final build out was based on 3 on 1 slopes and a waste friction angle of 13.5^{o}. This slope is maintained to the top plateau of the landfill and includes stability benches where needed. The final grades then extend to the maximum landfill height at a five percent slope. Waste placed on the five percent slope is outside the failure plane and does not contribute to the forces acting on the sloping surface.

The slope stability analysis of the landfill at final build out demonstrates that the differential waste heights for adjacent operating cells (e.g., cells 1 and 3) is less critical than the final build out stability. Waste placed to final build out elevations is typically outside the failure plane of adjacent operating cells and therefore does not contribute to the forces acting on the sloping surface. To ensure that the interior waste slope stability is maintained, waste will generally be placed in newly opened cells to the maximum permissible waste elevation prior to placing additional waste above the differential waste height in previous cells. For example, Stage 2 of the filling plan was substantially completed prior to commencing with Stage 3 of the filling plan for RMU-1. The rate of vertical waste placement in any given location within RMU-1 shall be no greater than 23 feet per month while not exceeding 100 feet annually. These operational limitations insure that landfill loading allows shear strengths to develop in the glaciolacustrine clay layer beneath the landfill which are necessary for its stability.

After construction is complete and prior to operation, the water collected within the cell will be managed as storm water in accordance with the Surface Water Sampling and Analysis Plan (Attachment M of the Sitewide Part 373 Permit). This includes water pumped out of the secondary system. Drainage within the active cells will be controlled to limit leachate production and prevent surface water that may have contacted waste from leaving the cell. Until the intermediate (if installed) or final cover is in place, surface water within active cells will be managed as leachate. This includes ponded surface water, leachate out of the primary sumps, and liquid out of the secondary sump (if contaminated). The liquid level above the primary liner must be maintained at a one foot maximum, except as allowed by the Sitewide Part 373 Permit, Condition F.3 of Exhibit F. In order to maintain the primary leachate level, there will be no restrictions on the numbers of primary pumps that may operate simultaneously. After intermediate or final cover is applied, surface water runoff will be managed in accordance with the Surface Water Sampling and Analysis Plan and permitted design.

Waste placement in Cells 1-14 shall progress towards the design waste grades depicted on Fill Progression Figure 1 dated August 2011 (revised November 2011), in Attachment #4 of this Manual. Waste placement in accordance with Figure 1 dated August 2011 (revised November 2011), in Attachment #4, provides adequate run-off containment for Detention Basins K, based on engineering calculations contained in the August 2011 (revised November 2011) Leachate Level Compliance Plan, and provides stable internal waste slopes based on stability analyses dated August 2011 (revised November 2011). Waste placed in Cells 1-14 below these contours shall be graded so that interior waste slopes are no steeper than those depicted in Department approved stability analyses. Also, interior waste slope set backs shall occur at elevations and have minimum horizontal dimensions which are in line with those depicted in Department approved stability analyses. Waste placed in Cells 1-14 shall at no time result in a drainage area for a given basin which would produce run-off from the 25-year, 24-hour storm event in excess of that basin's capacity, based on the methodologies presented in the engineering calculations dated August 2011 (revised November 2011).

CWM will perform inspections and topographical surveys of the waste mass that has not received final cover on a quarterly basis and at any other time requested by the Regional Solid and Hazardous Materials (RSHM) Engineer. The surveys will depict drainage areas for each infiltration zone and for each detention basin, and actual waste slope gradients and set back dimensions, based on survey grades, to demonstrate that the actual waste mass meets the requirements stipulated in the previous paragraph and the assumptions used in the applicable Leachate Level Compliance Plan. The surveys will also indicate the areas where the waste has reached final permitted waste grades prior to the installation of final cover. Topographic surveys of the waste mass in Cells 6, 7/8, 9/10, 11/13 & 12/14 shall be used to determine if the acreage of each infiltration drainage area or basin within these cells is at or below that depicted on Figure 1 dated October 2009 or August 2011 (revised November 2011) in Attachment #4, as appropriate. Until such time that the perimeter infiltration channels are entirely eliminated, the drainage areas from the quarterly waste surveys will be compared to the Fill Progression Figure 1 dated October 2009 in Attachment #4. Following that time and prior to full construction of the Basin K containment berm, the drainage area to Basin J will be compared to the Fill Progression Figure 1 dated August 2011 (revised November 2011) and the drainage area to Basin I will be compared to the Fill Progression Figure 1 dated October 2009. Once the Basin K containment berm is fully constructed, all the drainage areas will be compared to the Fill Progression Figure 1 dated August 2011 (revised November 2011).

If an infiltration or detention basin drainage area in a cell is determined by a survey to be greater in acreage than depicted on the appropriate Figure 1, CWM shall grade the waste as necessary to reduce the acreage of the affected drainage area to a size at or below the acreage depicted on that Figure 1. This grading shall be completed prior to the next quarterly waste mass survey, unless adverse winter weather conditions prevent waste grading and/or a transition from one fill progression to the next is underway and the required adjustments to the drainage areas cannot be completed in that timeframe. In either case, an extension shall be obtained from the Department. Subsequent survey(s) shall be used to confirm that the drainage area, or areas, in question has/have been reduced to at or below the size depicted on the appropriate Figure 1. In the case of an overage in drainage area(s) during transitional waste grading, the subsequent survey shall be used to demonstrate progress towards reducing the affected drainage area(s) even though full compliance with the appropriate Figure 1 may not be achieved in the elapsed time between the two surveys.

Phase VII Final Cover construction and installation of the southwest temporary downchute (Attachment #4, Figure 17) were completed in 2011 thereby reducing the volume of stormwater run off requiring management within the uncapped area of RMU-1. Therefore implementation of the August 2011 (revised November 2011) Figure 1 may commence. Transition from the fill Progression dated October 2009 to the August 2011 (revised November 2011) fill progression shall begin with the construction of final cover (Phases VIII and IX) at the perimeter of the landfill in Cells 11/13 and 12/14 which will eliminate the perimeter infiltration channels and Detention Basin H in those areas.

The size of the Phase VII Final Cover construction area was increased from that depicted on Figure 1 dated October 2009 to the area shown on Figure 1 August 2011 (revised November 2011) in Attachment #4. As filling nears final waste grades on the upper plateau east of the Phase VII Final Cover area, a temporary drainage ditch will be installed (Figure 19) to prevent the upper slope runoff from infiltrating or overtopping the constructed final cover on the west slope.

As final waste grades are achieved along the southern edge of RMU-1 Cells 13 and 14, 1-foot of cover is planned to be installed because the south perimeter infiltration channel cannot be maintained while this area is built out to final waste grade. Waste will be placed starting at the southwest corner of Cell 14 and proceed in approximately 50-foot fill zones in a counter-clockwise fashion. As each 50-foot zone is filled with waste to final waste grade, 1-foot of cover meeting the requirements of protective soil cover (Attachment J, Site-Wide Permit) will be immediately installed to allow stormwater runoff from that area to drain into the perimeter channel as non-contact stormwater runoff. Upon completion of a 50-foot section the area will be covered with temporary geomembrane. This will limit the inflow to the existing portion of the south perimeter infiltration channel to contact water only. Thus, the watershed to the infiltration channel is reduced as the infiltration channel is filled. Once the 1-foot cover has reached the eastern edge of the proposed Phase VIII Final Cover area, CWM will remove the temporary geomembrane and the upper 6-inches of cover (lower 6-inches will be used as the grading layer) and proceed with installation of final cover across the Phase VIII area. If there is not sufficient time remaining in the construction season (April 1 through November 30) the 1-foot cover soil and temporary geomembrane will be treated as intermediate cover and final cover will be installed in the following construction season.

Upon completion of Phase VIII Final Cover, a modified surface-water diversion berm in Cells 13 and 14 at the edge of Phase VIII Final Cover for management of contact stormwater runoff shall be constructed. The surface-water diversion berm will be constructed on the lower bench at the edge of the Phase VIII Final Cover as shown on Figure 21 in Attachment #4. Waste filling and cover installation in the proposed Phase IX Final Cover area will proceed in the same manner as procedures for Phase VIII. Additionally, cover construction at the perimeter of the landfill in Cell 11/13 (Phase IX) will require reconstruction of the truck route following cover installation so that the portion of the haul route downgradient of the lowermost surface water diversion berm can be considered clean and stormwater run off can be allowed to drain off that portion of the haul route and out of the landfill.

A design detail (i.e., cross section) for the waste haul road to be constructed over the final cover on the east side of the landfill showing the thickness of soil/road bed material above final cover geosynthetics, will be submitted for NYSDEC review and approval prior to haul road construction. The design detail submission will include bearing strength capacity calculations from the Design Engineer which demonstrates that the thickness of soil/road bed material is sufficient to support the maximum wheel loading from loaded haul trucks entering the landfill without damaging underlying final cover geosynthetics, with an appropriate factor of safety. The design detail and its supporting calculations will be incorporated into the RMU-1 O&M Manual. Following construction of the new waste haul road, a topographical survey will be performed to verify the constructed thickness of the soil/road bed material meets the design.

Alternative access to the active area of RMU-1 may be provided by a permanent access road constructed over Phase III, IV, and VII Final Cover. This permanent road will be constructed by first removing the 6-inches of topsoil from the protective soil cover of the Final Cover followed by installation of appropriate soil from onsite or offsite soil stockpiles and installation of a 18-inches of road base consisting of crushed stone. The design detail submission includes bearing strength capacity calculations from the Design Engineer which demonstrates that the thickness of soil/road bed material is sufficient to support the maximum wheel loading from loaded haul trucks entering the landfill without damaging underlying final cover geosynthetics, with an appropriate factor of safety. The design detail and its supporting calculations are incorporated into the RMU-1 O&M Manual as Attachment #5.

The equipment/vehicle decontamination area will be relocated upgradient from its current location to the intersection of the truck route and the lowermost surface-water diversion berm. This allows for decontamination of exiting vehicles to occur before the vehicles cross onto the Phase IX final cover. Washwater from decontamination activities will drain to the southern edge of the truck route and into a sediment trap located on the side slope of the truck route. Washwater overflow from the sediment trap will drain into Detention Basin J.

An alternate location of the equipment/vehicle decontamination area will be provided if the permanent access road is constructed over Phase III, IV, and VII Final Cover as shown on Figure 1a of Attachment 4. This will allow for decontamination of exiting vehicles to occur before the vehicles cross onto the Phase III, IV, and VII Final Cover. Washwater from decontamination activities will drain to the eastern edge of the truck route and into a drainage ditch lined with sediment controls specified in Section 6.0. Washwater will flow from the truck wash area into Detention Basin I or K.

Prior to transition from Basins H and I to Basins J and K, the basin liners will be perforated or removed. The new Detention Basin J will be constructed as part of the elimination of the existing Detention Basin H. By placing waste in the existing detention basin with approximately a 2H:1V slope gradient towards the interior of the landfill, the newly placed waste will form a depression against the existing waste mass. Pumps will be maintained in the depression to manage stormwater during the transition. Eventually, this depression will form Detention Basin J. The new Detention Basin K will be similarly constructed by continuing waste placement with an inward slope gradient to control the size of the drainage area to the downgradient Detention Basin J.

Detention Basins J and K will be lined and equipped with submersible pumps having automated level controls. The pump in Detention Basin J is designed to discharge approximately 67 gpm to Detention Basin K once the liquid elevation in Detention Basin J reaches elevation 347.75 feet (i.e., 1 foot above the basin low point). The pump(s) in Detention Basin K is/are designed to discharge approximately 1,032 gpm to tank T-165 once the liquid elevation in Detention Basin K reaches elevation 366.38 feet (i.e., 1.5 foot above the basin low point). To maintain compliance with permit conditions regarding detention basin liquid elevations, an additional 0.5 foot of liquid shall be removed from Detention Basin K with the pump(s) by manually overriding the automatic level control until 1 foot or less liquid remains in the basin.

Piping used to transfer contact storm water (i.e. leachate) from within the landfill to Tank T-165 or the Primary Leachate Riser Vault which passes over landfill final cover areas, will be installed to meet the ancillary equipment requirements stipulated by 6NYCRR 373-2.10(d)(6) of the regulations. Piping installed over landfill final cover areas will be inspected for leaks daily.

The surveys of the waste mass shall also be used to evaluate the size of the detention basin drainage area in comparison to the respective acreage as depicted on Figure 1. If the detention basin drainage area is determined by a survey to be greater in acreage than depicted on Figure 1, CWM shall either grade the waste as necessary to reduce the acreage of the detention basin drainage area to a size at or below the acreage depicted on Figure 1, **or** submit with the waste mass survey, revised basin capacity calculations for Department approval. Such basin capacity calculations must be performed in accordance with the procedures and assumptions in the approved RMU-1 Leachate Level Compliance Plan, must reflect the as-built basin capacity and actual basin drainage area size, and must demonstrate that a minimum freeboard of 1.0 feet will be maintained. If CWM does not submit or the Department does not approve revised basin capacity calculations, the above indicated waste grading shall be completed prior to the next quarterly waste mass survey, unless adverse winter weather conditions prevent waste grading and an extension is approved by the Department.

The above inspections/surveys shall be submitted to the NYSDEC within thirty (30) days after completing the quarterly inspection/survey and within thirty (30) days of completing any RSHM Engineer requested inspection/survey.

<u>Post Phase IX Final Cover and Through Phase X Final Cover</u>

Anticipated final cover phasing (Phases X, XI, and XII) are shown on Figure 2 of the LLCP. To achieve waste grades at the middle and upper slopes on the south side of the landfill, final cover must be installed on the lower slope (Phase VIII) as described above. Additionally, temporary downchutes will be installed to manage non-contact water (stormwater) from the final cover area such that this stormwater does not drain into uncapped areas of the landfill. With the installation of Phase VIII final cover, the upgradient portions of the southern waste face will be built out to final waste grade in preparation for Phase X final cover. During this time, the drainage patterns are expected to remain as modeled in this LLCP.

Once the Phase X final cover is installed, the remaining uncapped area of the plateau to the west of the north-south ridgeline will be unable to gravity drain to the basins on the eastern side of the landfill. To allow this water to drain to the east where it can be contained in a basin and/or pumped to tank T-165, a ditch will be installed in an east-west orientation across the ridgeline of the landfill. This temporary feature will be excavated into the waste surface and will allow contact stormwater runoff to gravity drain to the east side of the landfill. Although the exact location of this feature will depend on waste grading conditions in place at the time, the required capacity of this ditch has been estimated and a minimum cross sectional geometry defined in Attachment 5 of Appendix A of the August 2011 (revised November 2011) LLCP . It may be necessary to move this ditch to accommodate waste placement but the minimum geometry will be utilized regardless of the ditch location. This ditch will remain in service until the installation of Phase XI final cover.

Several non-contact stormwater runoff features will be designed and constructed along with the Phase X final cover. Specifically, a diversion berm constructed of soil will be installed along the eastern edge of the cover on the landfill plateau. This temporary diversion feature will direct non-contact stormwater runoff to the south and into a temporary downchute pipe that will run down the south face of the landfill and carry the water out of the landfill. Additional temporary downchute pipes will be constructed at the same location to divert non-contact stormwater runoff in the two surface-water diversion berms away from the uncapped area and out of the landfill. Once these downchute pipes are installed, the temporary downchute pipes at the southwest corner of the landfill (Cell 14) may be dismantled so that the surface-water diversion berms flow continuously to the newly installed downchute pipes at the eastern edge of the Phase X final cover. Alternatively, the southwest downchute pipes may remain in service to reduce the flowrate to the new downchute pipes.

Fill progression beyond those shown on Figure 1 (August 2011, revised November 2011) shall not be performed until final cover is installed on Phase VIII, Phase IX, and Phase X areas. Upon installation of Phase VIII, Phase IX, and Phase X Final Covers, approximately 6.4 acres of waste area will be remaining to be closed with final cover (Phases XI and XII).

Based on previous engineering evaluations, tank T-165 provides storage capacity for approximately 11.1 acres of contact water from the active areas of the landfill. Therefore, significant detention basins will not be constructed for late stages of waste placement (i.e., following final capping of Phase VIII, IX, and X areas). Pumps within Basins J and K will be progressively moved to the low points within the basins during filling of the basins. Sumps will be constructed as necessary at the low points of the remaining portions of the basins or the low points on the waste benches so that adequate head can be maintained for pump operation. Lost storage capacity within the basins will be made up by the capacity of tank T-165.

Drainage to the basins and low points on the waste benches during fill progression will be verified quarterly and during the daily RCRA inspection. The RCRA inspector will note any low points containing water greater than 12-inches. Any drainage deficiencies noted during the daily RCRA inspections and/or the quarterly surveys related to drainage will be corrected within 7-days.

Post Phase X Final Cover and Through Landfill Closure

Construction of Phase X final cover is estimated to leave approximately 6.4 acres of the landfill uncapped. The majority of the non-contact stormwater runoff will be diverted away from the uncapped area, which will minimize the required size of contact stormwater runoff features. Consequently, Detention Basins J and K will be slowly filled once replacement features are constructed further to the north (see below for further discussion on the replacement features). The filling of the detention basins will allow buildout to final waste grade everywhere except in the alignment of the truck route and where the replacement contact water management features are located.

Upon filling the access road on the upper plateau reaching final waste grades in the Phase XI Final Cover area the final cover will be installed. A diversion berm constructed of soil will be installed along the eastern edge of the cover on the landfill plateau. This temporary diversion feature will direct non-contact stormwater runoff to the north to the upper surfacewater diversion berm completed in the Phase VII Final Cover area on the east slope.

Detention basins will be replaced with depressions along the alignment of the surface-water diversion berms on the eastern face of the landfill. The depths and widths of the depressions will be minimized to lessen their effect on achieving final waste grades in upgradient areas. These depressions will serve as collection points for contact stormwater runoff and will be equipped with pumps and float switches to allow automatic operation once the liquid depth exceeds 1 foot. The pumps in the depressions on the lower and upper surface-water diversion berms will discharge to the middle surface-water diversion berm at 67 gpm which, in turn, will discharge to tank T-165 at 1,032 gpm. Depressions constructed during late stage filling will be operated in accordance with the Detection Basin operating conditions with the exception that the depressions will not be lined.

The required size of these depressions will depend on the drainage area to each feature and the capacity of the pumps. Stormwater routing calculations, similar to those performed for Detention Basins J and K in the LLCP, have been performed to estimate the required sizes of the depressions. It is noted that these calculations are preliminary in nature because the sizes of the contributing watersheds have been estimated. These calculations will be performed during the quarterly waste surveys that are required by Module VI, Condition H.1 of the Sitewide Part 373 Permit to verify that the depressions are capable of managing the predicted runoff from the existing watersheds in place at those times. The depressions will be required to comply with the same Permit conditions as detention basins with the exception that the depressions will not be lined. The depressions will thus be sized to provide a minimum freeboard of 1 foot.

The existing lower truck route will be maintained throughout the filling of Detention Basins J and K and creation of the depressions discussed above. At that point, the majority of the remaining airspace (other than the amount that must be preserved for the depressions) will be within the truck route footprint. The truck route will be eliminated by placing waste near the upgradient end and progressing downslope to the edge of the Phase IX final cover. Once the truck route is eliminated, the remaining airspace will likely be filled using off-road dump trucks capable of climbing the steeper grades that will be necessary at that time.

Lastly, the depressions will be eliminated by controlled waste placement similar to what is planned for the south infiltration channel in the current fill progression design. However, because the surface-water diversions berms drain to the north, the depressions will need to be filled starting at the northern ends. As waste is placed in approximately 50- foot-long zones along the depressions, soil cover will be installed over the newly placed waste and the upgradient slope (to the next upgradient surface-water diversion berm) so that the runoff from that newly covered area may be allowed to drain out of the landfill. This allows the drainage areas to the depressions to be reduced in concert with the filling of the depressions. The waste filling and soil cover installation will continue to progress to the south until the eastern edge of Phase X final cover is reached.

Surface water generated by the 25 year, 24 hour rainfall event will be managed from the active areas as outlined in Attachment #4.

3.2.7.2 Intermediate Cover Progression

As final waste heights are reached, the intermediate cover as described in Section 3.2.5.4 may be constructed over the waste. At this time, the runoff will be considered noncontact water and routed off of the landfill through the use of the terraces and ditches described in the surface water management plan.

3.2.7.3 Final Capping

As part of final capping activities, the permanent surface water management features will be constructed and runoff will be managed in accordance with the RMU-1 storm water management plan.

3.2.7.4 Surface Water Management from Non-Active Cells Adjacent to Active Cells

Surface water management from future cell areas adjacent to the cell separation of a complete cell will be controlled by project specific grading and, if necessary, manual pumping.

Detail 11, Drawing 19 of the permit set shows that the subbase grade of the future cell will be lower than the completed liner system of the constructed cell berm. This berm will prevent surface water from leaving the cell. Water levels will be maintained below the intercell berm height by pumping. The pump locations will be maintained for all weather access and managed as precipitation dictates.

The area within RMU-1 but outside the berm will be graded to drain away from the constructed cells. This area will gravity drain or be pumped into the site drainage system.

3.2.8 Safety and Environmental

Several safety procedures are available for landfill operations. REFER TO THE CWM HEALTH AND SAFETY MANUAL WHICH IS AVAILABLE FOR FURTHER INFORMATION. Detailed safety procedures can be found in the Health and Safety Department. It is expected that each landfill employee will be well versed in these procedures and follow them as needed.

It is expected that proper PPE will be worn by all persons who are within the operational cells or adjacent non-operational cells. The level of protection required by workers in cells adjacent to active cells will primarily be determined on a case-by-case basis with Health and Safety and Environmental oversight. If it is determined that level C-PPE is not required in the non-operational cells, then the following procedures will be used to protect workers against exposure from active cells.

A. If unusual odors are present or particulate matter is seen escaping from active cells, all affected workers in adjacent non-active cells will stop working and exit the adjacent non-active cell.

B. The Health & Safety or Environmental Department may be summoned to perform air monitoring.

C. A determination will be made as to the increased level of protection needed for some or all workers in the adjacent cells, if any.

D. Work will not resume until all concerns have been addressed.

Alternatively, a routine air monitoring program could be employed during active construction periods. Once a decision is made to maintain a certain level of PPE, the authority to downgrade to another level of protection can only be given by the Model City on-site Health and Safety Department.

3.2.9 Management of Wind Dispersal and Odor Control

The main potential of wind dispersal of particulate materials from the facility will be dust generation along the facility haul roads. As weather conditions warrant and permit, roads are sprayed with water during operational hours to control dust. The landfill activities which involve containers are not readily subject to wind dispersal. Bulk waste will be sprayed with water for dust control, stabilized or otherwise managed as necessary to control dusting. In addition, the Model City Fugitive Dust Control Plan provides the operational procedures necessary to control fugitive dust emissions, and is incorporated by reference to this manual.

Currently, odor control at the landfill is not a common area of concern due to the stable nature and low organic content of wastes places in the unit. If a concern is presented that a particular waste stream may emit odors, a notation that the waste should be covered immediately is made on waste tracking documentation and it is presented to the landfill operators who will cover the waste material immediately so as to limit or prevent odors.

RMU-1 perimeter fencing is used to discourage unauthorized entry to the active areas and will be used to trap windblown material. Unauthorized entry is prevented by restricting access to the active portions to the waste haul roads. Landfill personnel monitor entry and exit at these locations. Temporary fencing will also be utilized between active cells and adjacent non-active cells. Facility personnel will be directed to pick-up any wind blown material that may be trapped against the perimeter fence.

SECTION 4.0

MAINTENANCE REQUIREMENTS

4.1 GENERAL

The facility is required to perform routine and on-going maintenance and repairs of the landfill disposal unit. This work will take the form of:

A. Routine Inspections
B. Soil, Berm and Vegetative Cover Maintenance
C. Pump, Pipeline and Electrical System/Controls Maintenance and Testing

The CWM Model City facility will submit engineering plans and specifications for major repairs, as necessary, and will expeditiously perform required repairs agreed upon by the Facility and the NYSDEC.

4.2 ROUTINE INSPECTIONS

The inspection program for RMU-1 is described in Section 2.4.

4.3 SOIL, BERM, AND VEGETATIVE COVER

The facility is required to maintain and repair as necessary, the berms, soils, and vegetative cover of RMU-1 as described in the Post Closure Plan, Attachment I of the Sitewide Part 373 Permit.

4.4 PUMPS, PIPELINE, AND ELECTRIC

With respect to maintenance of the various systems associated with pumping, transfer and conveyance of leachate, checks of the transfer lines are required. Checks must include the secondary containment piping using the leak detection system (check for presence of liquids, integrity and correctness of operation).

The leachate transfer lines associated with RMU-1 are to be tested utilizing the methods and procedures presented in Attachment D, Appendix D-3, Section VIII, of the Sitewide Part 373 Permit.

The primary leachate collection pipe installed in Cells 7 through 14 will be flushed and checked for integrity after construction is completed and prior to waste placement. It will also be flushed after completion of the first lift of waste over the pipe, but not later than the start of the third lift over any section of the pipe.

The procedures for jet washing the pipe are as follows:

- The field personnel will gain access to the primary leachate collection pipe from the primary cleanout in the riser vault.

- A flexible hose with a self advancing nozzle will be snaked down the cleanout into the perforated pipe.

- A hydroflush will be performed by discharging high pressure water through the nozzle which will be advanced the entire length of the leachate collection pipe. The water will be pumped by the primary leachate collection pump when it accumulates in the primary sump.

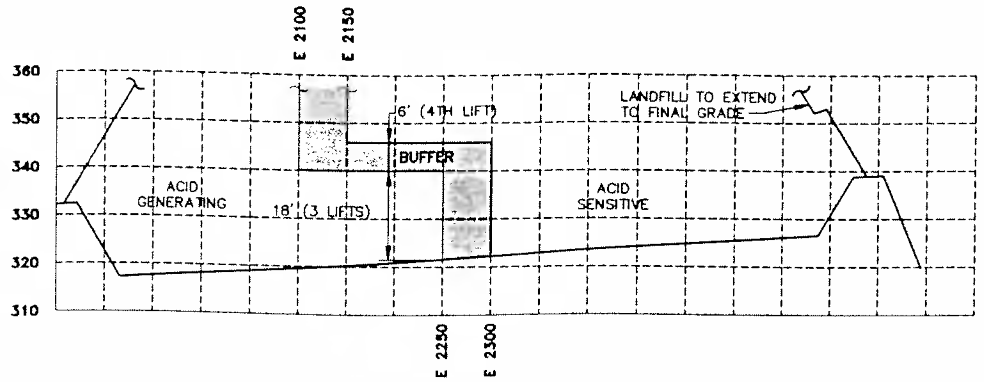
- The length of the leachate collection pipe, including the length of its side slope cleanout, shall be determined from as-built documentation and compared to the length of the flexible hose advancement to identify any possible pipe obstructions.

- The NYSDEC on-site monitors shall be notified 24 hours prior to the flushing of the leachate collection lines.

4.5 RMU-1 LEACHATE LIFT STATION

The equipment and facilities that make up the RMU-1 Leachate Lift Station and transfer piping have been selected according to NYSDEC approved drawings and specifications. Operation and maintenance pumps will be in accordance with manufacturers recommendations and past performance of the pump.

ATTACHMENT #1
PROPOSED GRID MARKER LOCATIONS &
ACID SENSITIVE AND ACID GENERATING LOCATION



CROSS SECTION A

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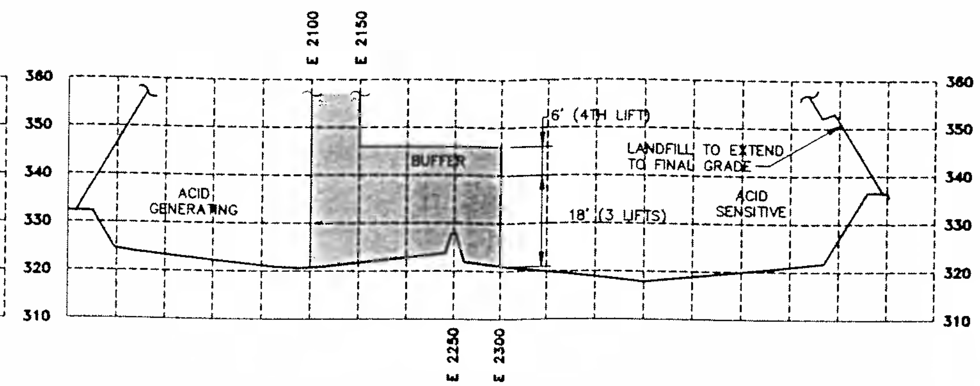

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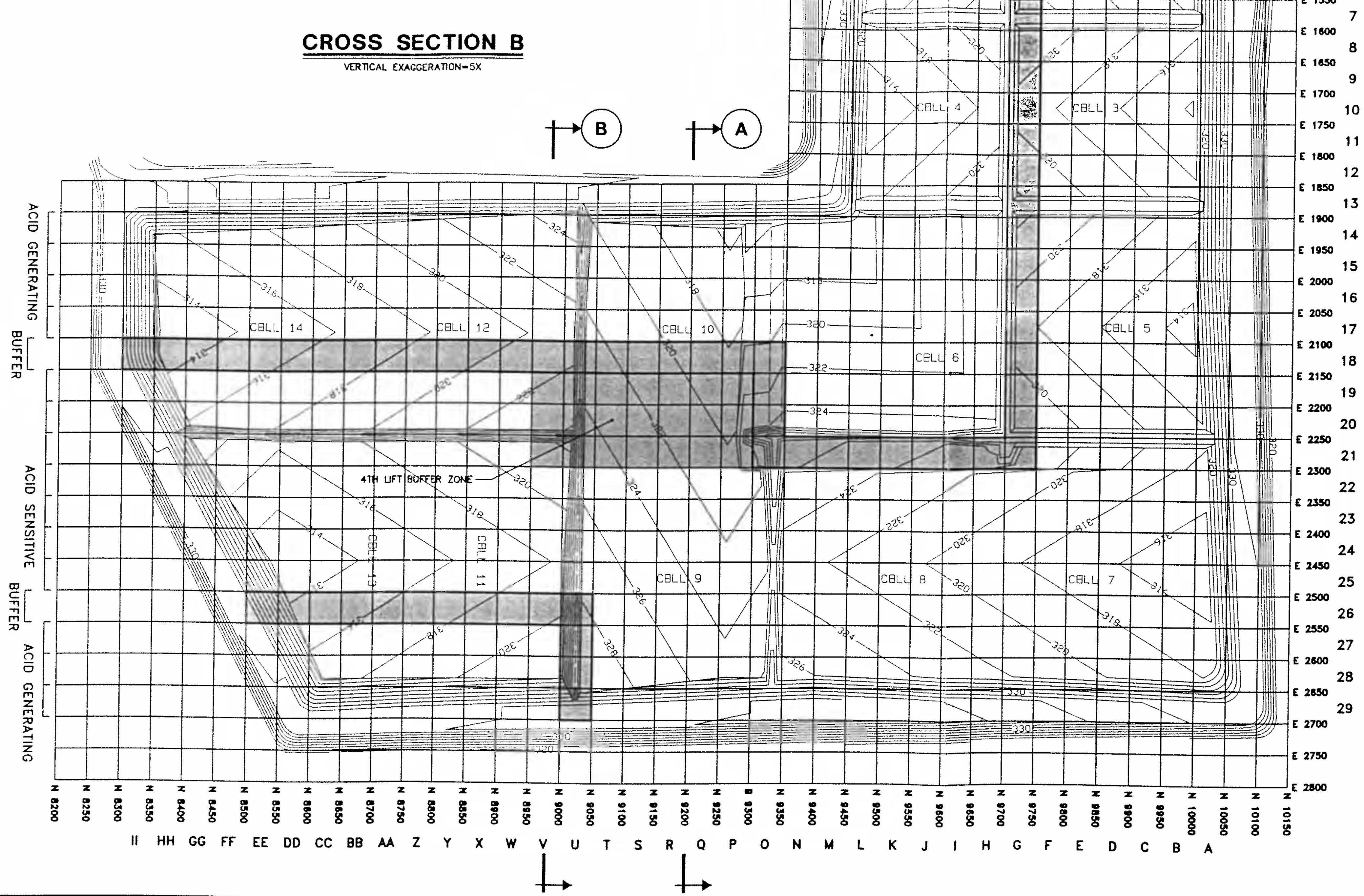


LEGEND

BUFFER ZONE

L: ON=*, OFF=REF
P: PAGESET/PLT-CDL
11/22/02 SYR-54-GMS GMS NES
05018020/05018G01.DWG

Graphic Scale
100' 0 100' 200'
1"=100'

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

No.	Date	Revisions	Init

Project Mgr.
Designed by
Drawn by
Checked by
Prof. Eng.
PE License

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

CWM CHEMICAL SERVICES, LLC • MODEL CITY, NEW YORK
RESIDUALS MANAGEMENT UNIT 1

LIMITS OF PLACEMENT ACID SENSITIVE & GENERATING MATERIALS

File Number
05018

Date
NOVEMBER 2002

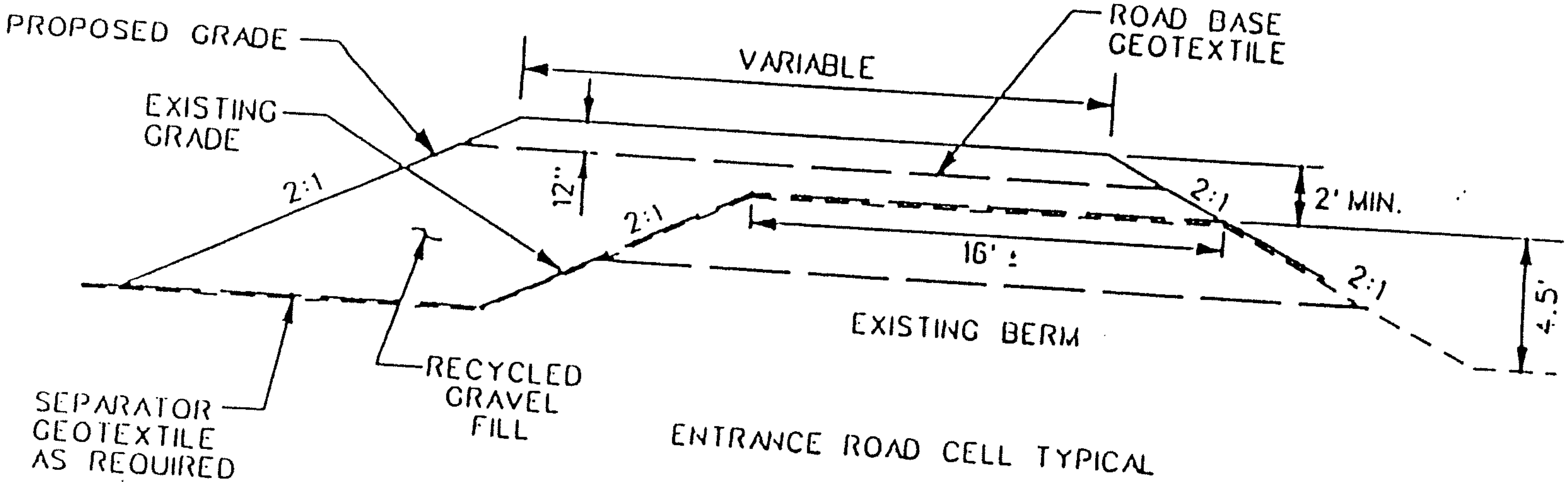
Blasland, Bouck & Lee, Inc.
Corporate Headquarters
6723 Towpath Road
Syracuse, NY 13214
315-446-9120

1

ATTACHMENT #2
TRUCK ROUTES

Figure 1 has been deleted. Truck routes into RMU-1 are shown on Figure 1 of Attachment #4.

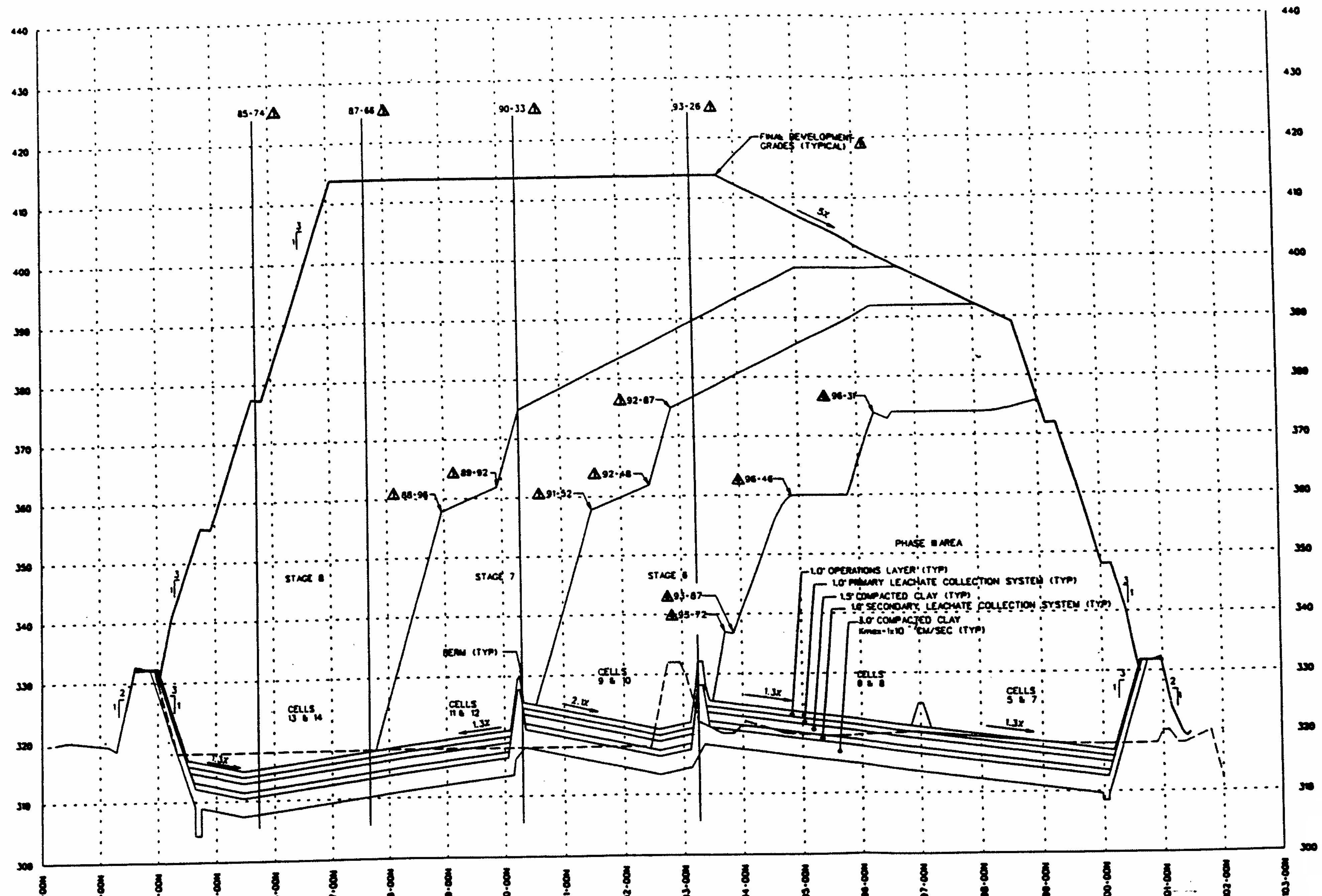
ATTACHMENT #3
STAGING CROSS SECTIONS AT 23-+25E AND 97+50N



ENTRANCE ROAD CELL TYPICAL

BERM SECTION
NTS

RUST ENVIRONMENT & INFRASTRUCTURE	REV.	DATE	DESCRIPTION
SIGNATURE	DATE: NOVEMBER, 1996		PROJECT NO. 39044 — SCALE: AS SHOWN
DATE	DES BY: NLM		PROJECT: RESIDUAL MANAGEMENT UNIT 1
	DRN BY: VPR		SHEET TITLE:
	CHK BY: NLM		BERM SECTION
	REV BY: CPB		
	APP BY: CPB		
	CWM CHEMICAL SERVICES, INC. MODEL CITY FACILITY NIAGARA COUNTY		SHEET 1 OF 1 — DRAWING NO.



CROSS SECTION 23+25E

NOTES:
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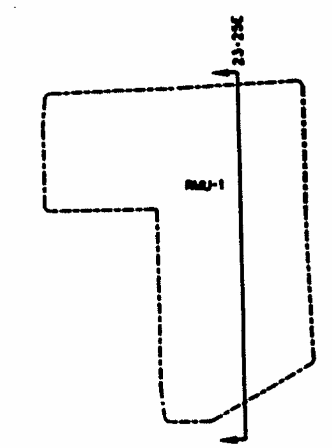
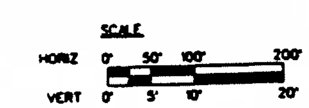


CROSS SECTIONS LOCATION PLAN



SOURCE: SEC DONOHUE, INC., NOVEMBER 1992, RMU-1 FILLING PLAN, MODEL CITY FACILITY, CWM CHEMICAL SERVICES, INC.

REV	DATE	DESCRIPTION	DR BY	APP BY
5	4-99	MODIFY FOR VERTICAL ENHANCEMENT GRADES	FAS	CPB
4	10-97	MODIFY CELL 6 BASIN	FAS	CPB
3	8-97	MODIFY CELLS 7 AND 8	FAS	CPB
2	11-96	MODIFY CELL 8 SEQUENCE	FAS	CPB
1	3-96	ADD NOTES AND ANNOTATION	CPB	CPB

RUST ENVIRONMENT & INFRASTRUCTURE

SIGNATURE

DATE

DATE:	AUGUST 1997
DES BY	BRJ/TJP
DRN BY	FLD
CHK BY	MGR
REV BY	TJB
APP BY	GRM

PROJECT NO. 39888 DATE FEBRUARY 1991

PROJECT: RESIDUALS MANAGEMENT UNIT 1

DRAWING TITLE: CROSS SECTIONS 23+25E

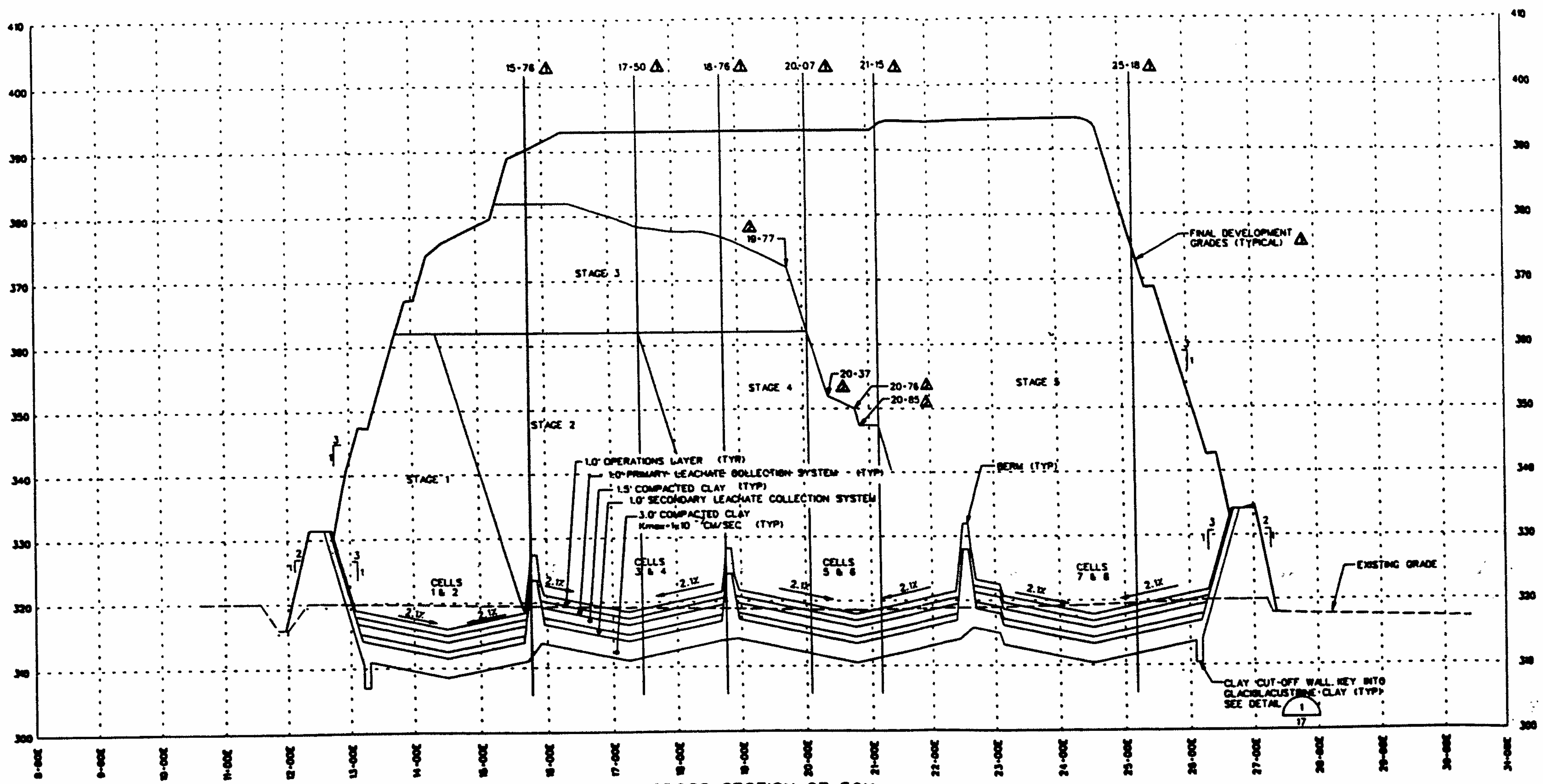
CWM CHEMICAL SERVICES, INC.
MODEL CITY, NIAGARA COUNTY, NEW YORK

FILE NO.

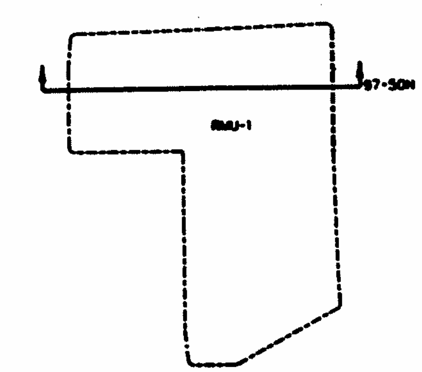
DRAWING NO.

FIGURE 1

△ NOTES:
1. THIS STAGING HAS BEEN DEVELOPED FROM SECTION 3.2.7.1 STABILITY ANALYSES FOR GENERAL FILL PROGRESSION AND SURFACE WATER MANAGEMENT OF THIS O&M MANUAL.



CROSS SECTION 97+50N



CROSS SECTIONS LOCATION PLAN

SCALE
HORIZ 0' 50' 100' 200'
VERT 0' 5' 10' 20'

SOURCE: SEC DONOHUE, INC., NOVEMBER 1992, RMU-1 FILLING PLAN, MODEL CITY FACILITY, CWM CHEMICAL SERVICES, INC.

RUST

SIGNATURE

DATE

REV	DATE	DESCRIPTION	DR BY	APP BY
△	4-99	MODIFY FOR VERTICAL ENHANCEMENT GRADES	FAS	CPB
△	10-97	MODIFY CELL 6 BASIN	FAS	CPB
△	8-97	MODIFY CELLS 7 AND 8	FAS	CPB
△	11-96	MODIFY CELL 6 SEQUENCE	FAS	CPB
△	3-96	ADD NOTES AND ANNOTATION	CPB	CPB

DATE: AUGUST 1997
PROJECT NO. 39065 DATE FEBRUARY 1991
PROJECT: RESIDUALS MANAGEMENT UNIT 1

DES BY	BRJ/TJP
DRN BY	FLD
CHK BY	MGR
REV BY	TJB
APP BY	GRM

DRAWING TITLE
CROSS SECTION 97+50E

CWM CHEMICAL SERVICES, INC.
MODEL CITY, NIAGARA COUNTY, NEW YORK

FILE NO.
DRAWING NO.
FIGURE 1A

ATTACHMENT #4
TYPICAL SURFACE WATER CONTROL AND CALCULATIONS

ACTIVE CELL SURFACE WATER MANAGEMENT

Surface water generated by the 25-year, 24-hour rainfall event will be managed from the active areas. Surface water management features and strategies will be discussed for the following four conditions:

- Constructed, non-active cells;
- initial lifts below intercell berms;
- waste placement below the perimeter berms; and
- waste placement above perimeter berms.

Typical surface water management features for controlling runoff resulting from the 25-year, 24-hour rainfall event have been presented in Figures 6 through 14. Surface water management for stages of waste fill has been evaluated in detail with Figure 1 showing drainage subareas. The following discussion presents the typical fill progression and surface water management features that would be common for all cells.

1.0 Constructed, Non-active Cells

After initial construction, but prior to operation, the surface water within constructed, non-active cells will be managed as non-contact, storm water. The primary leachate extraction pump may be used to discharge accumulated water to the site drainage system.

When water from precipitation collects within non-active cells and a liquid level greater than one foot above the low point of the primary liner is observed, the water must be pumped or otherwise transferred to reduce the level to less than one foot within seven days. However, NYSDEC personnel may require that the water in the non-active cell be pumped at any time.

2.0 Initial Lifts, Waste Placement Below Intercell Berms

All initial lifts and waste placement below the intercell berms for RMU-1 has been completed. The NYSDEC has removed conditions from the permit pertaining to initial waste placement in the RMU-1 cells.

3.0 Waste Placement Below The Perimeter Berms

After the initial two lifts, the waste will be below the perimeter berm elevations, but above the intercell berms. The waste filling surface will be sloped toward the side slopes of the perimeter berm (Figure 7). Cover material will be placed on slopes adjacent to the intercell berm and will be placed to allow a trapezoidal channel to remain inside the berm as illustrated in Figure 8. At this time, waste could be placed to form the waste berms that are used to construct the detention basins. When the waste slope height approaches the perimeter berm elevations a "V-notch" channel (Figure 6) will be excavated in the interior waste slope or the final waste bench will be constructed to direct the runoff to the detention basins.

A maximum waste slope of 2 on 1 will be used to construct the various storm water management features. The temporary 2 on 1 waste slope will tie into the designed 3 on 1 waste slope and will not be extended to the maximum allowable elevations. Prior to placing an intermediate or final cover over a cell, all 2 on 1 slopes will be brought to final grades.

During this phase of filling, waste could be placed over the intercell berm between previously filled cells and more recently activated cells. The maximum interior waste slope of 3 on 1 in previously filled cells will be maintained during Stage 2. The waste filling surface will be sloped toward the side slopes of the perimeter berm so that runoff from the cells will continue to be directed towards the appropriate detention basins.

4.0 Waste Placement Above The Perimeter Berms

Generally, the filling plan will progress in horizontal lifts and wastes will be placed at approximately 3 on 1 slopes, following the final grading plan. The surface of the lift will slope to the interior of the cell and then towards the nearest vertical riser (Figure 9). Runoff from the waste side slopes will be collected in the various surface water management features and directed towards the detention basins. Some of this runoff will percolate in to the perimeter side slope leachate collection layer.

The perimeter channels (Figure 10) along the side slopes will be developed once the fill height is above the perimeter berm elevation. The perimeter berm channels are used to direct runoff to the appropriate detention basins.

The majority of the storm water management features will be constructed shortly after the waste height exceeds the perimeter berm elevations. These features have sufficient capacity to store runoff from the 25-year, 24-hour storm throughout the filling operations. As filling progresses above the perimeter berms, the elevation of the first maintenance terrace will be exceeded (Figure 11). In general, the terraces slope towards a low point that corresponds with the location of final grade down flumes. Outfalls will need to be constructed in the terraces above the intercell berms to direct runoff to the appropriate detention basin.

Throughout filling operations, runoff will be directed towards the appropriate detention basin until an intermediate or final cover is placed over cells or portions of the cells.

5.0 General Guidelines for Storm Water Management

In general, stormwater management in active filled cells will consist of detention basins. The detention basins will be designed to store the 25 year - 24 hour storm which is approximately 4 inches. The general design approach for stormwater management for each stage of waste fill is as follows:

1. Develop a drainage subarea map for the particular stage of waste fill. Prepare hydrology calculations using the Soil Conservation Service (SCS) TR-55 or TR-20 method to determine the stormwater flows from each subarea to the subarea outlet and to determine the run-off trench/channel flow capacities for the 25 year-24 hour design storm (4.0 inches).

2. Using SCS TR-20 or TR-55 determine the combined inflow hydrograph from the subareas to the detention basins to calculate the required basin capacities.

3. Prepare a channel schedule showing applicable design information (i.e., channel geometry, slope).

4. Prepare detention basin flood routing calculations to show the 25 year-24 hour design storm peak inflow, peak liquid elevation and available freeboard.

As this manual shows, surface water management will transition as the cells are filled and covered. Also, the location and sizes of the surface water management features may vary from cell to cell. Surface water management features will be constructed based on grade tables that will be developed on a cell specific basis. In some cases, final waste benches will be constructed to direct the surface water runoff. The following rules can be applied to the entire landfill:

- Stormwater runoff will be preferentially routed to detention basins so as to minimize the infiltration rate in each cell. Drainage area sizes for each stage of fill progression are shown on the associated Leachate Level Compliance Plan.

- Perimeter channels (Figure 10) can be used to direct runoff to detention basins and provide some direct infiltration to the primary leachate collection system. A maximum side slope of 2 on 1 will be maintained for all newly constructed channels. Twelve (12) inches of freeboard will be provided and water will infiltrate into the side slope collection system.

- "V-notch" channels (Figure 6) can be constructed on the interior waste slopes and areas of the new cell construction to direct runoff to the detention basins. A maximum side slope of 1.5 on 1 is allowable for these shallow channels. Six (6) inches of freeboard will be provided. Culverts may be installed if access over a "V-notch" channel is desired.
- Trapezoidal channels (Figure 8) can be constructed between the intercell berm and the "V-notch" channel for conveyance to the detention basins. A maximum side slope of 2 on 1 will be maintained for all newly constructed channels. Twelve (12) inches of freeboard will be provided and water will infiltrate into the side slope collection system.
- Temporary downchute pipes (Figure 14) can be constructed to direct runoff from upper waste slope benches to the perimeter channels.

- Prior to constructing final cover on lower waste slopes where the upper slope remains active, a diversionary berm (Figure 15) will be installed to prevent the upper slope runoff from infiltrating or overtopping the subsequently constructed final cover on the lower slope.
- Detention basins can be constructed adjacent to the perimeter berms or, if waste berms are utilized, adjacent to the intercell berms. A maximum side slope of 2 on 1 will be maintained for the detention basins. One (1) foot of freeboard will be provided and the water will be temporarily stored until it is pumped for treatment when adequate capacity exists.
- Portable pumps will be used to transfer collected liquids from the detention basins to the primary leachate transfer piping in the riser vaults or to tank T-165. After exceeding a depth of 12" in the detention basin, the liquid will be pumped to return to a maximum 12" depth within 7 days after first exceeding 12". No pumping is required when there is ice or snow in the basin or tank T-165. An extension of the 7 day period may be granted by the NYSDEC provided that CWM demonstrates that the liquid volume resulting from precipitation and/or snow melt exceeds the run-off volume from a 24-hour, 25 year storm event.
- Waste slopes below the grade of perimeter berms will be sloped to the inside perimeter of the cell or to the vertical riser backfill to minimize surface water ponding.
- Waste slopes above the grade of perimeter berms will be sloped inward.
- French drains and vertical drainage columns may be used to reduce surface ponding in the active area.

Culverts will be installed as indicated on Figure 1. Single or multiple culverts different from those indicated on Figure 1 may be installed at the depicted locations, as long as their single or combined capacity is equivalent or greater than those depicted in Figure 1 (e.g., 2, 12 inch culverts, instead of 1, 16 inch culvert), and their equivalencies are confirmed during waste mass inspections/surveys. Alternate culvert configurations will be presented to NYSDEC for approval prior to construction. As old culverts are abandoned, they will either be filled in place, crushed in placed, removed and crushed for landfill disposal or removed and reused elsewhere in the landfill.

6.0 Surface Water Management Design for Cells 1 Through 14

In accordance with the RMU-1 Leachate Level Compliance Plan, approved by the NYSDEC April 24, 1997, methodology for storm water management was developed and is used as the basis for attached Figure 1. Hydrology calculations were prepared to determine the peak discharge into each detention basin. As shown on Figure 1, the following detention basins were evaluated:

- Detention Basins H and I in Cell 11/13 (Figure 1, dated October 2009).
- Detention Basins J and K in Cell 11/13 (Figure 1, dated August 2011, revised November 2011).

A hydrology summary for the detention basin showing the drainage area acreage, SCS curve number, time of concentration, 25 yr-24 hr precipitation and peak discharge for the 25 year - 24 hour design storm is shown on Table 1.

The detention basin design summary, developed from the flood routing calculations, is shown on Table 2. Table 2 shows the contributing drainage area; basin bottom and top elevations; the peak inflow; peak liquid elevation and available freeboard. Table 2 also shows the peak liquid elevation and available freeboard when the basin has 1.0 ft. of liquid accumulated on the bottom at the start of the storm. The detention basin is designed to retain the 25 year-24 hour design storm.

Detention basins will be lined with a temporary geosynthetic liner to minimize siltation and allow for the pumping of leachate accumulated in the basin to the leachate transfer system. The lining of the basins is a temporary measure and the liners will be shredded or removed prior to disposing waste in the basin. The temporary waste slopes for the basins are shown to be stable with respect to circular or sliding block failure.

The detention basins are designed to allow runoff to be pumped down to within at least 12 inches of the bottom of the basin. The basin bottom will be sloped at a minimum of 0.5 percent to the low area where a portable pump will be located for leachate evacuation.

A topographical survey shall be performed during waste placement in the area of V-notch and trapezoidal infiltration channels to verify that waste is graded so that the actual dimensions (length, depth and base width [trapezoidal]) of these channels conform to the minimum design dimensions on Figures 1, 8 & 10 in this attachment. The conformation of channel depth should be based on the documented as-built elevations of the primary liner at each point of measurement along the berm. The resultant topographic surveys shall be presented to on-site DEC staff for review as they are completed for each channel.

For each detention basin which is constructed, Model City shall perform an as-built survey of the constructed basin to demonstrate that the basin provides adequate run-off containment based on engineering calculations. These surveys should indicate that the basin has been constructed in general accordance with Figure 1, of this attachment, and that the basin has been lined up to, or above, the top elevation indicated on Table 2 of this attachment around its entire perimeter. For Detention Basin H, the survey will also confirm that the entire basin is horizontally within the interior slope of the landfill's primary liner system. CWM shall submit the as-built survey for each basin to the NYSDEC within thirty (30) days of the completion of basin construction.

Run-off into Detention Basin I will be allowed to accumulate during the storm event to allow maximum utilization of the RMU-1 leachate transfer system for removal of leachate from within the primary leachate collection system. Following abatement of the storm, portable pumps will be used to remove collected liquid from the basins and discharge directly to the primary leachate transfer system (force mains) through a quick connection at the leachate vault. The portable pumps and piping used to convey leachate from the detention basins to the riser vaults should be adequately sized and have their flow rates properly set to convey the flows required by the Leachate Level Compliance Plan (i.e., 160 gpm for Basin I shown on the October 2009 Figure 1). The pumps and piping used to convey leachate from the detention basins to the riser vaults should be placed within the active landfill cell, unless otherwise provided with secondary containment.

Run-off into Detention Basin H will be managed by two pumps. Pump 1 will be installed inside the basin and will be sized (approximately 33 gpm) to control normal inflow. Pump 1 will be provided with level control to automatically operate when the liquid in Basin H reaches elevation 323.31 feet (i.e., 1 foot above the low point of the basin) and turn off when the liquid in the basin returns below that level. Pump 1 will discharge into the primary leachate forcemain at the Cell 11/13 riser vault. Pump 2 will be installed inside the basin and sized (approximately 67 gpm) to control flow that can not be managed by Pump 1 alone, e.g., large storm events. Pump 2 will be provided with level control to automatically operate when the liquid in Basin H reaches elevation 328.00 feet (i.e., approximately 2 feet below the invert elevation of the incoming south perimeter channel which feeds Basin H).

At the onset of freezing conditions, the two Detention Basin H pumps and level controls will be removed. Both pumps will be kept available for quick replacement into the basin when needed to remove pumpable liquids, i.e., rain or thaw events, as identified by daily RCRA inspections or landfill personnel. Alternatively, when pumpable liquids are identified, the suction hose from the Detention Basin I pump could be used to remove the liquids. In the worst case, if liquids exceeded the lowest lined crest elevation of Detention Basin H, the liquids would overflow into the south perimeter channel and remain within the landfill.

Run-off into Detention Basin J will be managed by a pump capable of providing an approximate 67 gpm discharge rate to Detention Basin K. This pump will be provided with a level control to automatically operate when the liquid depth in Basin J reaches 1 foot or more and turn off when the liquid in the basin returns below that level. Run-off into Detention Basin K will be managed by a pump(s) capable of providing an approximate 1,032 gpm discharge rate to tank T-165. This pump will be provided with a level control to automatically operate when the liquid depth in Basin K reaches 1.5 foot or more and turn off when the liquid in the basin returns below that level. To maintain compliance with permit conditions regarding detention basin liquid elevations, an additional 0.5 foot of liquid shall be removed from Detention Basin K with the pump(s) by manually overriding the automatic level control until 1 foot or less liquid remains in the basin.

To route non-contact stormwater runoff from capped areas out of the landfill and prevent it from draining into uncapped areas or causing other operational issues, several temporary drainage features will be installed, including the following:

- Upon installation of final cover on the lower slope of the south and east sides as shown on Figures 1 (August 2011, revised November 2011) and 16 (August 2011) of Attachment #4, a temporary downchute pipe shall be installed near the southeast corner to manage non-contact stormwater from the cover. Additionally, the interim drainage ditch in the cover area shall be constructed according to Figure 18 (August 2011) of Attachment #4 if intermediate cover is installed.
- As filling nears final waste grades on the upper plateau east of the Phase VII Final Cover area, a temporary drainage ditch will be installed (Figure 19) to prevent the upper slope runoff from infiltrating or overtopping the constructed final cover on the west slope.
- Upon completion of Phase VIII Final Cover, a modified surface-water diversion berm in Cells 13 and 14 at the edge of Phase VIII Final Cover for management of contact stormwater runoff shall be constructed. The surface-water diversion berm will be constructed on the lower bench at the edge of the Phase VIII Final Cover as shown on Figure 21 in Attachment #4.

The following conditions/recommendations as indicated in Section 6.0 of the November 2011 LLCP are required for the transition from the 2009 LLCP to the 2011 LLCP:

- Phase VII Final Cover has been installed and a temporary downchute to manage non-contact water from the final cover area as shown on Figure 17 has been installed at the southwest corner of the landfill (Figure 1).
- The August 2011 (revised November 2011) RMU-1 Leachate Level Compliance Plan indicates that the banks of the ditch segment upstream of P9 Culvert 1 and the ditch segment upstream of P9 Culvert 2, must be increased to accommodate culvert flow without overtopping the existing ditch banks. These ditch segments will be modified to provide the minimum top of bank elevations determined in the August 2011 (revised November 2011) Leachate Level Compliance Plan. A detail of the ditch modifications is provided in Figure 20 of Attachment 4.
- Replace the RMU-1 lift station pump with an identical Godwin GSP300HV pump, if possible. If an alternative pump must be used due to the GSP300HV being unavailable, perform an instrumented in-service flowrate capacity test of the new pump to verify that the capacity exceeds not only the 188 gpm peak flow associated with this proposed fill progression but also the 330 gpm peak flow identified in the September 9, 2011, RMU-1 lift station capacity evaluation prepared by ARCADIS.
- Construct Phases VIII and IX final cover, consisting of approximately 2.5 acres, as shown on Drawings 1 and 2.

- Upon completion of Phase VIII and IX Final Cover, install new haul road above Phase IX Final Cover. The equipment/vehicle decontamination area will be relocated upgradient from its current location to the intersection of the truck route and the lowermost surface-water diversion berm. This allows for decontamination of exiting vehicles to occur before the vehicles cross onto the Phase IX final cover. Washwater from decontamination activities will drain to the southern edge of the truck route and into a sediment trap located on the side slope of the truck route. Washwater overflow from the sediment trap will drain into Detention Basin J.

- As perimeter infiltration channels in Cells 9/10, 11/13, and 12/14 are filled in to accommodate Phases VIII and IX final cover construction, remove large pumps from primary sumps and replace with small pumps, similar to other closed cells in RMU-1. Until that time, maintain the same pump configurations as indicated in December 2009 LLCP.
- Install a new pump in Detention Basin J and associated piping to provide approximately 67 gpm flow rate from the basin to the upgradient Detention Basin K whenever the liquid elevation in Detention Basin J is equal to or greater than 347.75 feet (i.e., 1-foot above the low point of the basin floor).
- Install a new pump in Detention Basin K and associated piping to provide approximately 1,032 gpm flow rate from the basin to Tank T-165 whenever the liquid elevation in Detention Basin K is equal to or greater than 366.38 feet (i.e., 1.5 feet above the low point of the basin floor).

Implementation of these conditions/recommendations will be documented in the Quarterly Landfill Survey Reports. Upon installation of Phase VIII, Phase IX, and Phase X Final Covers, approximately 6.4 acres of area will be remaining to be closed with installation of final cover.

Based on previous engineering evaluations, tank T-165 provides storage capacity for approximately 11.1 acres of contact water from the active areas of the landfill. Detention basins will be replaced with depressions along the alignment of the surface-water diversion berms on the eastern face of the landfill. The depths and widths of the depressions will be minimized to lessen their effect on achieving final waste grades in upgradient areas. These depressions will serve as collection points for contact stormwater runoff and will be equipped with pumps and float switches to allow automatic operation once the liquid depth exceeds 1 foot. The pumps in the depressions on the lower and upper surface-water diversion berms will discharge to the middle surface-water diversion berm at 67 gpm which, in turn, will discharge to tank T-165 at 1,032 gpm. Depressions constructed during late stage filling will be operated in accordance with the Detection Basin operating conditions with the exception that the depressions will not be lined.

Model City will perform temporary erosion and sedimentation control measures to reduce the sediment loading on the detention basins and perimeter channels when needed. Temporary erosion and sedimentation control standards and specifications are included in the New York Guidelines for Urban Erosion and Sediment Control. The following temporary measures can be used by Model City on the waste surface to reduce the sediment loading:

- Straw Bale dike;
- Silt fence; and,

- Rock check dam.

At a minimum, Model City could place rock check dams at the exit of all channels discharging into the detention basins and place silt fence at the base of slopes that have shown erosion during rain events. Straw bale dikes will be placed in channels, as necessary, to reduce the runoff velocity and increase the deposition of the transported sediment load.

An 18-inch diameter perforated pipe will be installed along the invert of the Cell 9/10 intermediate channel adjacent to Cell 12/14 prior to waste placement across this channel, as shown on Figure 13 of this attachment. The perforated pipe will allow stormwater to continue to flow towards the western end of the channel where it can infiltrate into the operations layer and overflow into Cell 12/14 via the low point in the cell separation berm, as necessary. Sediment controls will be installed in the Cell 9/10 intermediate channel just upgradient of the entrance to the pipe. The controls shall be no higher than 1.0 feet below the crest of the primary liner on the adjacent Cell 9/10 and Cell 11/13 separation berm, so that any back up of stormwater will not overflow into Cell 11/13 prior to Cell 11/13 being approved for waste placement. Once Cell 11/13 is approved for waste placement, these sediment controls and the perforated pipe will no longer be required and the pipe will be left in place.

A collection vessel will be installed adjacent to the east exit road inside the landfill to manage truck wash waters and trap sediment. Water from this vessel will overflow to a stone area which will discharge through sediment controls, e.g., straw bale dike, to the perimeter infiltration channel or detection basin. Sediment which accumulates in the collection vessel and stone overflow area will be removed at least monthly, or at a frequency necessary to minimize sediment carryover into the infiltration channel.

An alternate location of the equipment/vehicle decontamination area will be provided if the permanent access road is constructed over Phase III, IV, and VII Final Cover as shown on Figure 1a of Attachment 4. This will allow for decontamination of exiting vehicles to occur before the vehicles cross onto the Phase III, IV, and VII Final Cover. Washwater from decontamination activities will drain to the eastern edge of the truck route and into a drainage ditch lined with sediment controls, e.g., straw bale dike. Washwater will flow from the truck wash area into Detention Basin I or K.

Upon observation of sediment on the operations stone within any infiltration channel which is considered by CWM personnel or NYSDEC On-site staff as adversely affecting the channel's ability to control surface water, CWM will remove the sediment from the identified infiltration channel as soon as practical. Such removal should include the excavation of any operations stone which appears to contain sediment from the waste. Operations stone should be removed with care so as to not damage the underlying liner system, and should be replaced with new operations stone to original channel grades.

TABLE 1

MODEL CITY - RMU-1

OPERATIONS AND MAINTENANCE MANUAL

DETENTION BASIN HYDROLOGY SUMMARY

DETENTION BASIN	DRAINAGE AREA (ACRES)	CURVE NUMBER (CN)	TIME OF CONCENTRATION (Tc)	25 YR, 24 HR PRECIPITATION (IN)	25 YR, 24 HR STORM PEAK DISCHARGE (CFS)
BASIN H (1)	1.76	90	0.1	4”	22.47
BASIN I (1)	14.86	90	0.1	4”	73.53
BASIN J (2)	2.20	90	0.1	4”	10.89
BASIN K (2)	7.69	90	0.1	4”	38.05

(1) As shown on October 2009 Fill Progression Plan.

(2) As shown on August 2011 (Revised November 2011) Fill Progression Plan.

Revised November 2013

TABLE 2

MODEL CITY - RMU-1

OPERATIONS AND MAINTENANCE MANUAL

DETENTION BASIN SCHEDULE

DETENTION BASIN	DRAINAGE AREA (ACRES)	BASIN BOTTOM ELEVATION (FT)	BASIN TOP ELEVATION (FT)	25 YR, 24 HR PEAK INFLOW (CFS)	PEAK LIQUID ELEVATION (FT) (1)	AVAILABLE FREEBOARD (FT) (1)	PEAK LIQUID ELEVATION (FT) (2)	AVAILABLE FREEBOARD (FT) (2)
BASIN H (3)	1.76	322.31	330.09 (4)	22.47	328.36	1.73	328.36	1.73
BASIN I (3)	14.86	334.10	351.62	73.53	349.30	2.32	249.35	2.27
BASIN J (5)	2.20	346.75	352.52	10.89	351.25	1.27	351.25	1.27
BASIN K (5)	7.69	364.88	374.40	38.20	371.01	3.39	371.01	3.39

(1) Assume no liquid in basin at start of storm event.

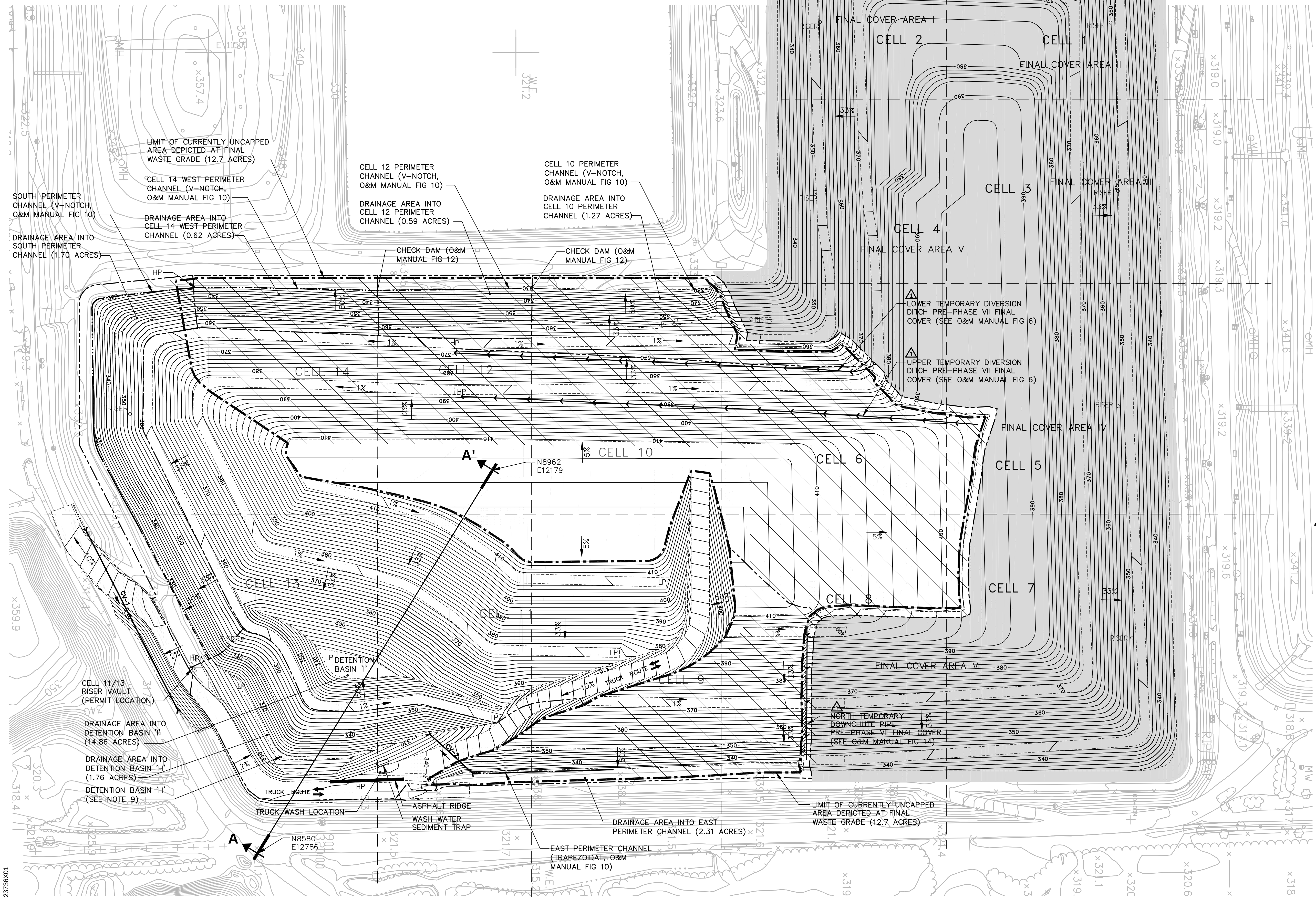
(2) Assume 1 ft. of liquid in basin at start of storm event.

2

(3) As shown on October 2009 Fill Progression Plan.

(4) The lowest lined crest elevation of the south perimeter channel which connects to Basin H through an open channel.

(5) As shown on August 2011 (revised November 2011) Fill Progression Plan.



LEGEND

- EXISTING FINAL COVER AREA (SEE NOTE 4)
- PROPOSED PHASE VII FINAL COVER AREA (SEE NOTE 5)
- 340 INDEX ELEVATION CONTOUR
- INTERMEDIATE ELEVATION CONTOUR
- GRADE BREAK
- PERIMETER INFILTRATION CHANNEL
- LIMIT OF DRAINAGE AREA
- LIMIT OF FINAL WASTE GRADE
- CELL DIVIDE
- 95+00N COORDINATE GRID (SEE NOTE 2)
- INTERIM DRAINAGE FEATURE AND FLOW DIRECTION
- CV-1 EXISTING TEMPORARY CULVERT TO BE RETAINED (SEE CULVERT TABLE AND NOTES 7 AND 8)
- N8962 E12179 SLOPE STABILITY CROSS SECTION
- HP HIGH POINT
- LP LOW POINT

NOTES:

1. BASE MAP FEATURES OUTSIDE PERMITTED LIMIT OF WASTE COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 5/31/01 (AIR SURVEY CORP. PROJECT NO. 71010503)
2. COORDINATES REFER TO CWM PLANT SITE GRID.
3. CONTOUR INTERVAL EQUALS 2 FEET.
4. GRADES WITHIN EXISTING FINAL COVER AREAS REPRESENT PERMITTED TOP OF WASTE. FINAL COVER LIMIT REPRESENTS APPROXIMATE EDGE OF FULL COVER THICKNESS BASED ON QUARTERLY WASTE SURVEYS.
5. GRADES WITHIN PROPOSED PHASE VII FINAL COVER AREA REPRESENT PERMITTED TOP OF WASTE, EXCEPT ALONG LANDFILL PERIMETER WHERE THE NEED FOR INFILTRATION CHANNELS DOES NOT ALLOW FOR CONSTRUCTION OF PERMITTED TOP OF WASTE GRADES UNTIL FINAL COVER. PHASE VII FINAL COVER AREA INCLUDES APPROXIMATELY 10.6 ACRES.
6. PROPOSED WASTE GRADES AND INTERIM DRAINAGE FEATURES TO BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE RMU-1 OPERATIONS & MAINTENANCE MANUAL WHERE APPLICABLE.
7. THE CULVERT TABLE INDICATES REQUIRED CONFIGURATIONS FOR EXISTING CULVERT LOCATIONS. THE CONFIGURATIONS INDICATED IN THE CULVERT TABLE ARE BASED ON THE ANTICIPATED PEAK FLOWRATES ASSOCIATED WITH THIS GRADING PLAN. ALTERNATIVE CULVERT CONFIGURATIONS MAY BE SUBSTITUTED FOR THOSE INDICATED IN THE TABLE ASSUMING THEY PROVIDE EQUAL OR GREATER HYDRAULIC CAPACITY. ALTERNATIVE CULVERT CONFIGURATIONS WILL BE SUBMITTED TO THE NYSDEC FOR APPROVAL PRIOR TO CONSTRUCTION.
8. CULVERTS MAY BE EITHER CORRUGATED METAL PIPE OR CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE).
9. DETENTION BASIN H IS LOCATED WITHIN THE LIMITS OF THE RMU-1 LINER SYSTEM.

CULVERT TABLE

CULVERT ID	NUMBER/SIZE (IN.)	MIN. SLOPE (%)
CV-1	2/18	0.25%
CV-2	3/18	1.5%

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XREFS: 23736X01 IMAGES: PROJECTNAME: ----

80' 0 80' 160'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
2	8/11	REVISED PHASE VII COVER LIMIT AND TEMPORARY DIVERSION BERMS	BMS	
1	12/09	ADDED TEMPORARY DIVERSION BERM CALLOUTS	PHB	

Professional Engineer's Name: JOSEPH MOLINA III		
Professional Engineer's No.: NY 072644		
State: NY	Date Signed	Project Mgr.: BMS
Designed by: BMS	Drawn by: GMS	Checked by: PHB

ARCADIS

ARCADIS U.S., INC.

CWM CHEMICAL SERVICES, LLC • MODEL CITY, NEW YORK
RESIDUALS MANAGEMENT UNIT 1

FILL PROGRESSION AND TRUCK ROUTES CELLS 1 THRU 14 - FINAL SEQUENCE PHASE 2

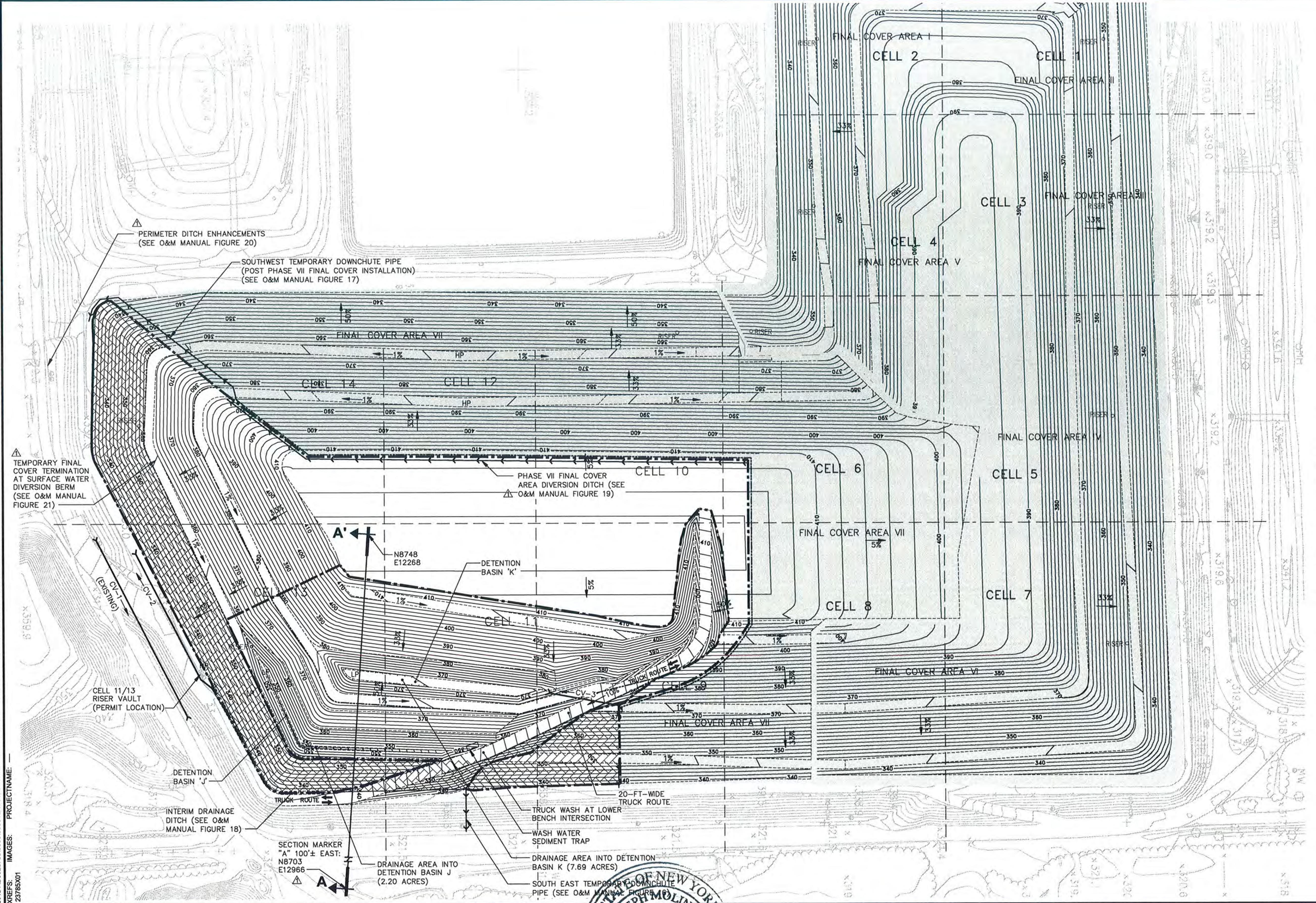
GENERAL

ARCADIS Project No.
B0023726.0000.00003

Date
OCTOBER 2009

ARCADIS
6723 TOWPATH ROAD
SYRACUSE, NEW YORK
315-446-9120

1



LEGEND

- EXISTING FINAL COVER AREA (SEE NOTES 4 AND 5)
- PROPOSED COVER AREA
- —340— INDEX ELEVATION CONTOUR
- INTERMEDIATE ELEVATION CONTOUR
- GRADE BREAK
- LIMIT OF DRAINAGE AREA
- LIMIT OF CURRENTLY UNCAPPED AREA DEPICTED AT FINAL WASTE GRADE
- CELL DIVIDE
- 95+00N COORDINATE GRID (SEE NOTE 2)
- INTERIM DRAINAGE FEATURE AND FLOW DIRECTION
- CV-1 TEMPORARY CULVERT (SEE CULVERT TABLE AND NOTES 7 AND 8)
- N8962 E12179 SLOPE STABILITY CROSS SECTION
- HP HIGH POINT
- LP LOW POINT

NOTES:

1. BASE MAP FEATURES OUTSIDE PERMITTED LIMIT OF WASTE COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 5/31/01 (AIR SURVEY CORP. PROJECT NO. 71010503)
2. COORDINATES REFER TO CWM PLANT SITE GRID.
3. CONTOUR INTERVAL EQUALS 2 FEET.
4. GRADES WITHIN EXISTING FINAL COVER AREAS REPRESENT PERMITTED TOP OF WASTE. FINAL COVER LIMIT REPRESENTS APPROXIMATE EDGE OF FULL COVER THICKNESS BASED ON QUARTERLY WASTE SURVEYS.
5. GRADES WITHIN PROPOSED PHASE VII FINAL COVER AREA REPRESENT PERMITTED TOP OF WASTE.
6. PROPOSED WASTE GRADES AND INTERIM DRAINAGE FEATURES TO BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE RMU-1 OPERATIONS & MAINTENANCE MANUAL WHERE APPLICABLE.
7. THE CULVERT TABLE INDICATES REQUIRED CONFIGURATIONS FOR EXISTING AND PROPOSED CULVERT LOCATIONS. CULVERT CV-1 IS EXISTING AND IS TO BE RETAINED. ALL OTHER TEMPORARY CULVERTS ARE PROPOSED. THE CONFIGURATIONS INDICATED IN THE CULVERT TABLE ARE BASED ON THE ANTICIPATED PEAK FLOWRATES ASSOCIATED WITH THIS GRADING PLAN. ALTERNATIVE CULVERT CONFIGURATIONS MAY BE SUBSTITUTED FOR THOSE INDICATED IN THE TABLE ASSUMING THEY PROVIDE EQUAL OR GREATER HYDRAULIC CAPACITY. ALTERNATIVE CULVERT CONFIGURATIONS WILL BE SUBMITTED TO THE NYSDEC FOR APPROVAL PRIOR TO CONSTRUCTION.
8. PROPOSED CULVERTS CV-2 AND CV-3 MAY BE EITHER CORRUGATED METAL PIPE OR CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE).

CULVERT TABLE

CULVERT ID	NUMBER/SIZE (IN.)	MIN. SLOPE (%)
CV-1	2/18	0.25%
CV-2	1/18	1.0%
CV-3	2/18	0.5%

CITY: SYRACUSE DIV/GROUP: 141 DB: JHR GMS LD: PIC: PM: TM: LYR:ON=*;OFF=REF
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XREFS: 23785X01 IMAGES: PROJECTNAME: —

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THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
1	11/11	REVISED SECTION COORDINATE & ADDED INTERIM DRAINAGE FEATURES	PTO	BMS

Professional Engineer's Name: JOSEPH MOLINA III
Professional Engineer's No.: NY 072644
State: NY | Date Signed: 11/17/11 | Project Mgr: BMS
Designed by: BMS/PTO | Drawn by: GMS | Checked by: PHB

STATE OF NEW YORK · JOSEPH MOLINA III · 072644 · LICENSED PROFESSIONAL ENGINEER

ARCADIS

ARCADIS U.S., INC.

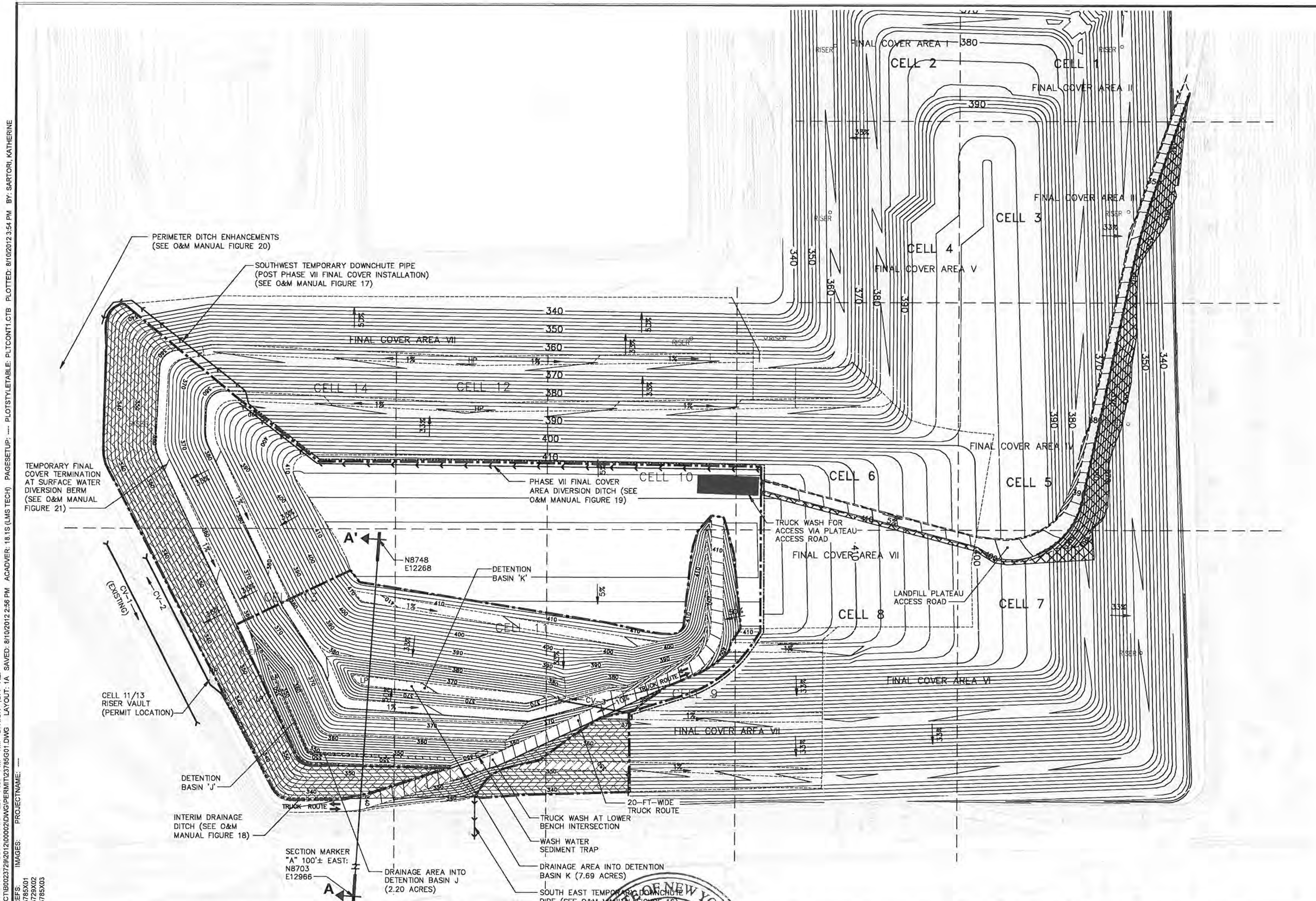
CWM CHEMICAL SERVICES, LLC • MODEL CITY, NEW YORK
RESIDUALS MANAGEMENT UNIT 1

FILL PROGRESSION AND TRUCK ROUTES CELLS 1 THRU 14 - FINAL SEQUENCE PHASE 3

GENERAL

ARCADIS Project No. B0023785.0000.00002
Date: AUGUST 2011
ARCADIS
6723 TOWPATH ROAD
SYRACUSE, NEW YORK
315-446-9120

1



LEGEND

- EXISTING FINAL COVER AREA (SEE NOTE 4)
- PROPOSED COVER AREA
- 340 INDEX ELEVATION CONTOUR
- INTERMEDIATE ELEVATION CONTOUR
- GRADE BREAK
- LIMIT OF DRAINAGE AREA
- LIMIT OF CURRENTLY UNCAPPED AREA DEPICTED AT FINAL WASTE GRADE
- CELL DIVIDE
- COORDINATE GRID (SEE NOTE 2)
- INTERIM DRAINAGE FEATURE AND FLOW DIRECTION
- CV-1 TEMPORARY CULVERT (SEE CULVERT TABLE AND NOTES 6 AND 7)
- N8962 E12179 SLOPE STABILITY CROSS SECTION
- HP HIGH POINT
- LP LOW POINT
- PERMANENT EROSION CONTROL MAT

NOTES:

1. BASE MAP FEATURES OUTSIDE PERMITTED LIMIT OF WASTE COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 5/31/01 (AIR SURVEY CORP. PROJECT NO. 71010503)
2. COORDINATES REFER TO CWM PLANT SITE GRID.
3. CONTOUR INTERVAL EQUALS 2 FEET.
4. GRADES WITHIN EXISTING FINAL COVER AREAS REPRESENT PERMITTED FINAL COVER GRADES. FINAL COVER LIMIT REPRESENTS APPROXIMATE EDGE OF FULL COVER THICKNESS BASED ON QUARTERLY WASTE SURVEYS.
5. PROPOSED WASTE GRADES AND INTERIM DRAINAGE FEATURES TO BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE RMU-1 OPERATIONS & MAINTENANCE MANUAL WHERE APPLICABLE.
6. THE CULVERT TABLE INDICATES REQUIRED CONFIGURATIONS FOR EXISTING AND PROPOSED CULVERT LOCATIONS. CULVERT CV-1 IS EXISTING AND IS TO BE RETAINED. ALL OTHER TEMPORARY CULVERTS ARE PROPOSED. THE CONFIGURATIONS INDICATED IN THE CULVERT TABLE ARE BASED ON THE ANTICIPATED PEAK FLOWRATES ASSOCIATED WITH THIS GRADING PLAN. ALTERNATIVE CULVERT CONFIGURATIONS MAY BE SUBSTITUTED FOR THOSE INDICATED IN THE TABLE ASSUMING THEY PROVIDE EQUAL OR GREATER HYDRAULIC CAPACITY. ALTERNATIVE CULVERT CONFIGURATIONS WILL BE SUBMITTED TO THE NYSDEC FOR APPROVAL PRIOR TO CONSTRUCTION.
7. PROPOSED CULVERTS CV-2 AND CV-3 MAY BE EITHER CORRUGATED METAL PIPE OR CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE).

CULVERT TABLE

CULVERT ID	NUMBER/SIZE (IN.)	MIN. SLOPE (%)
CV-1	2/18	0.25%
CV-2	1/18	1.0%
CV-3	2/18	0.5%

80' 0 80' 160'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JOSEPH MOLINA III
Professional Engineer's No.: NY 072644
State: NY | Date Signed: 8/13/12 | Project Mgr.: BMS
Designed by: BMS/PTO | Drawn by: GMS | Checked by: PHB

STATE OF NEW YORK · JOSEPH MOLINA III · 072644 · LICENSED PROFESSIONAL ENGINEER

ARCADIS
ARCADIS U.S., INC.

CWM CHEMICAL SERVICES, LLC • MODEL CITY, NEW YORK
RESIDUALS MANAGEMENT UNIT 1

FILL PROGRESSION AND TRUCK ROUTES CELLS 1 THRU 14 - FINAL SEQUENCE PHASE 3 WITH LANDFILL PLATEAU ACCESS ROAD

GENERAL

ARCADIS Project No. B0023785.0000.00002
Date: AUGUST 2012
ARCADIS
6723 TOWPATH ROAD
SYRACUSE, NEW YORK
315-446-9120

1A

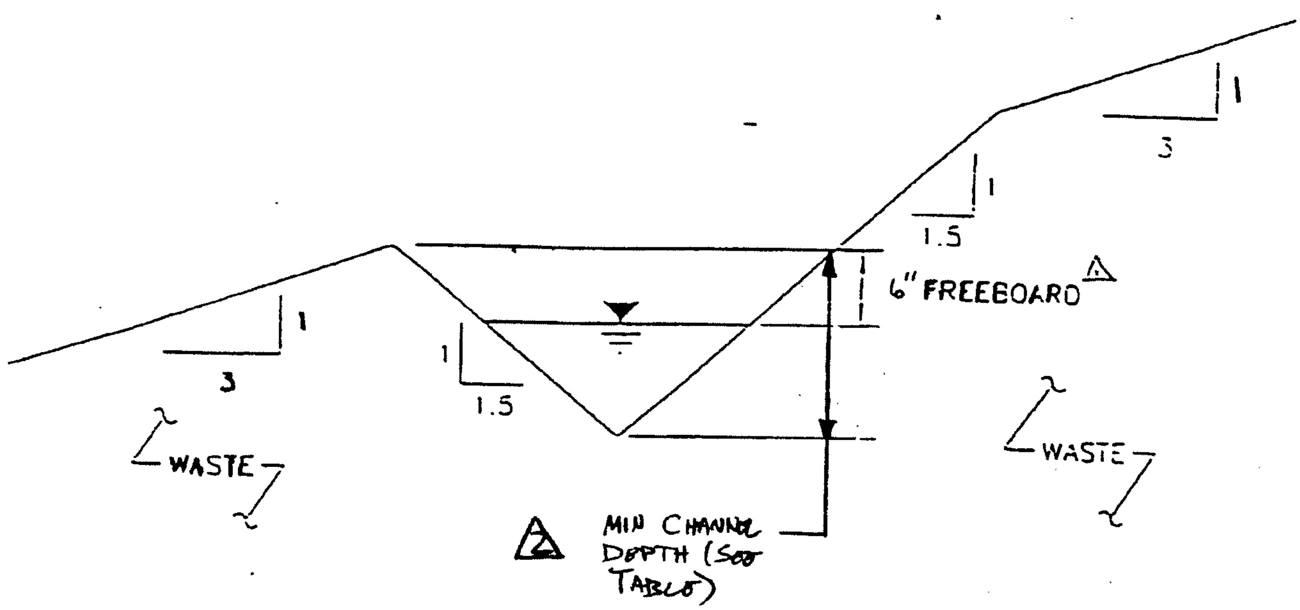
Figures 2 through 5 have been deleted.
These figures were specific for Cells 1 through 4 and are obsolete.

ATTACHMENT #5

LANDFILL PLATEAU ACCESS ROAD DESIGN CALCULATIONS

CHANNEL SCHEDULE

CHANNEL	MIN DEPTH (FT)
LOWER DIVERSION DITCH	1.5'
UPPER DIVERSION DITCH	2.5'



TYPICAL V–NOTCH CHANNEL

NOT TO SCALE

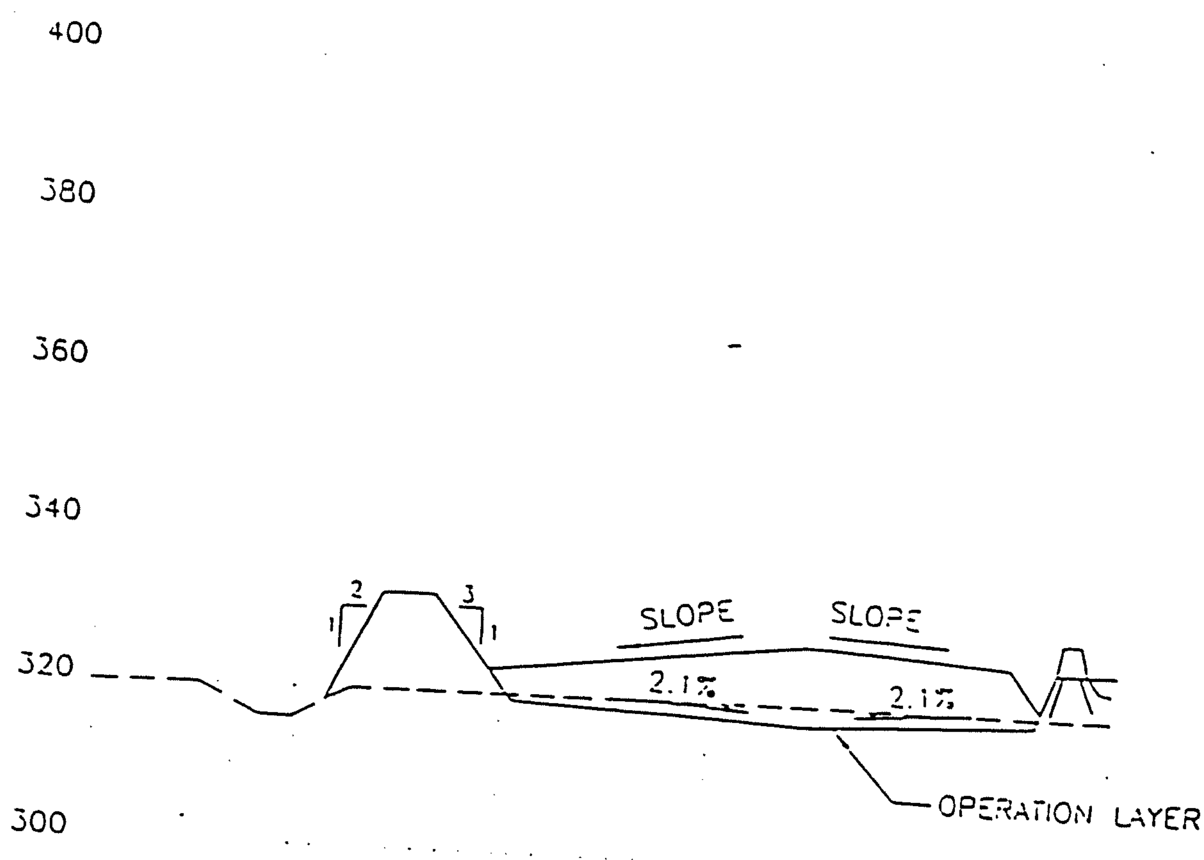
REVISED 12/07 ARCADIS BBL

REVISED 3/96 CG

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 6

CWM CHEMICAL SERVICES, INC.
MODEL CITY, NEW YORK

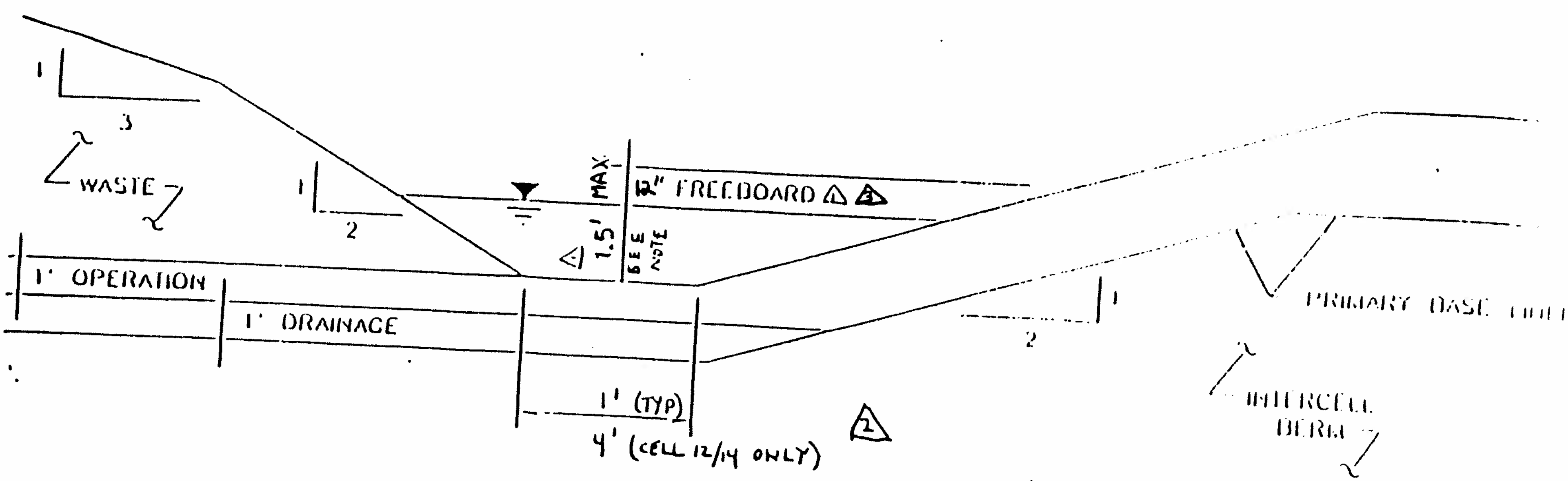


TYPICAL CROSS SECTION FOR
WASTE PLACEMENT BELOW PERIMETER BERM

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 7

CWM CHEMICAL SERVICES, INC.



TYPICAL TRAPEZOIDAL CHANNEL

NOT TO SCALE

3 REVISED 8/01 JBH

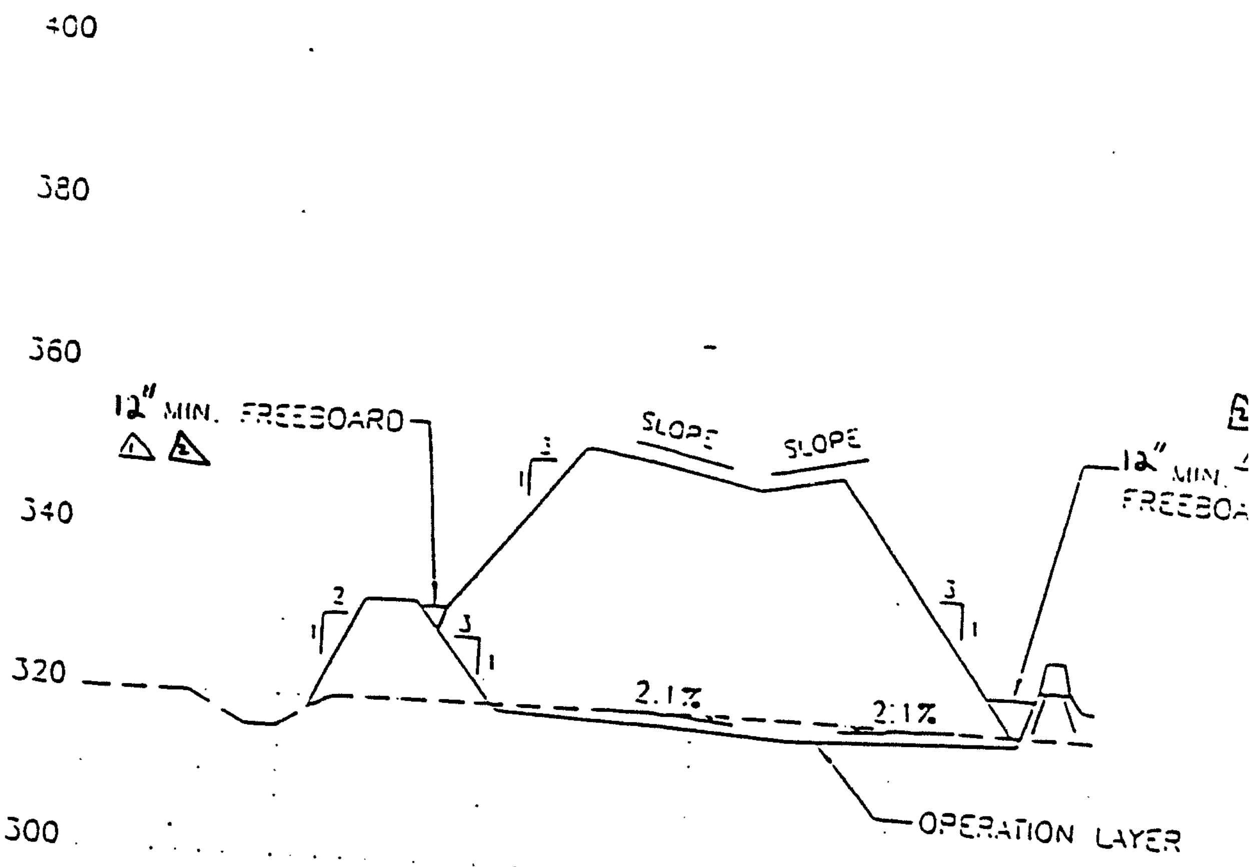
2 REVISED 6/01 JBH

1 REVISED 3/96

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 8

CWM CHEMICAL SERVICES, INC.

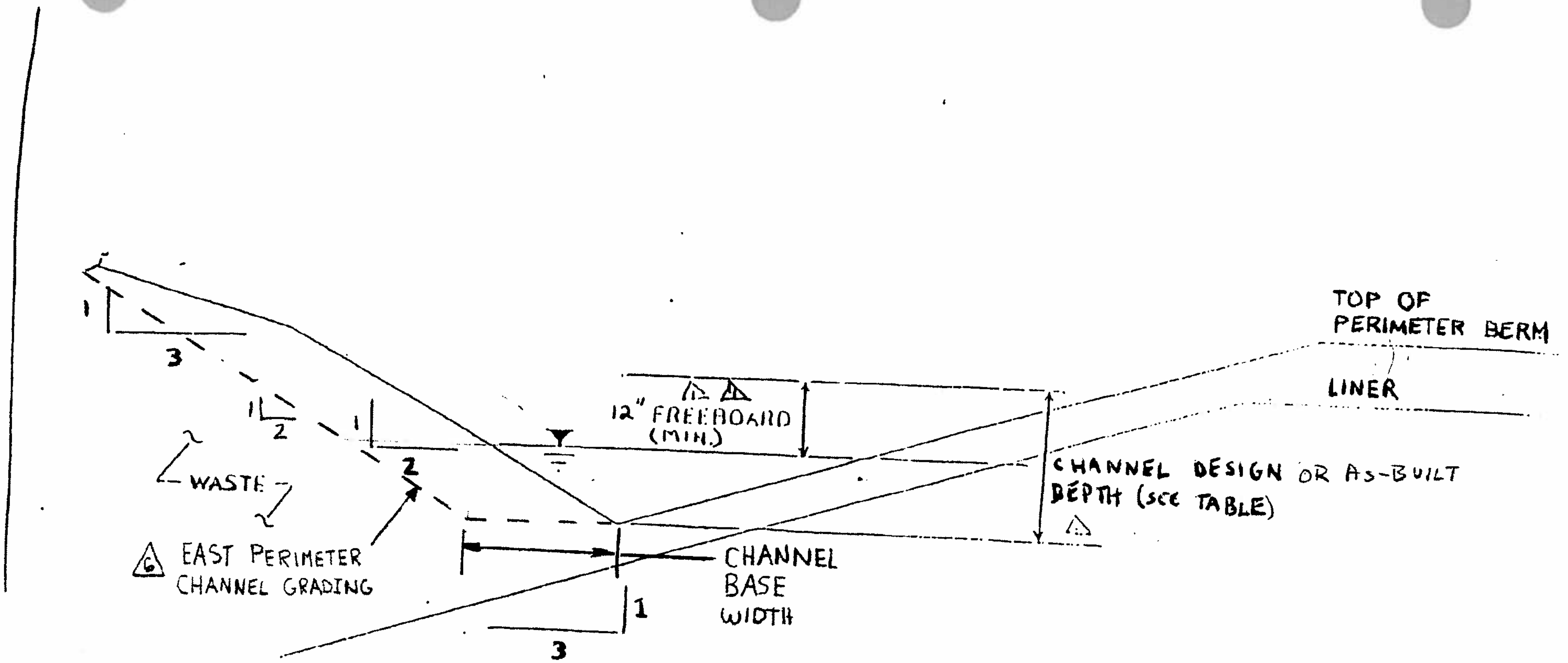


TYPICAL CROSS SECTION
FOR ABOVE PERIMETER BERM

2 REVISED 8/01 JBH
1 REVISED 3/96 CB

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 9



TYPICAL PERIMETER CHANNEL

NOT TO SCALE

NOTES:

1. CHANNELS IN CELLS 4, 6, 7 AND A PORTION OF 8 HAVE BEEN FILLED AND CAPPED AND HAVE BEEN REMOVED FROM THE CHANNEL SCHEDULE.

Channel Schedule

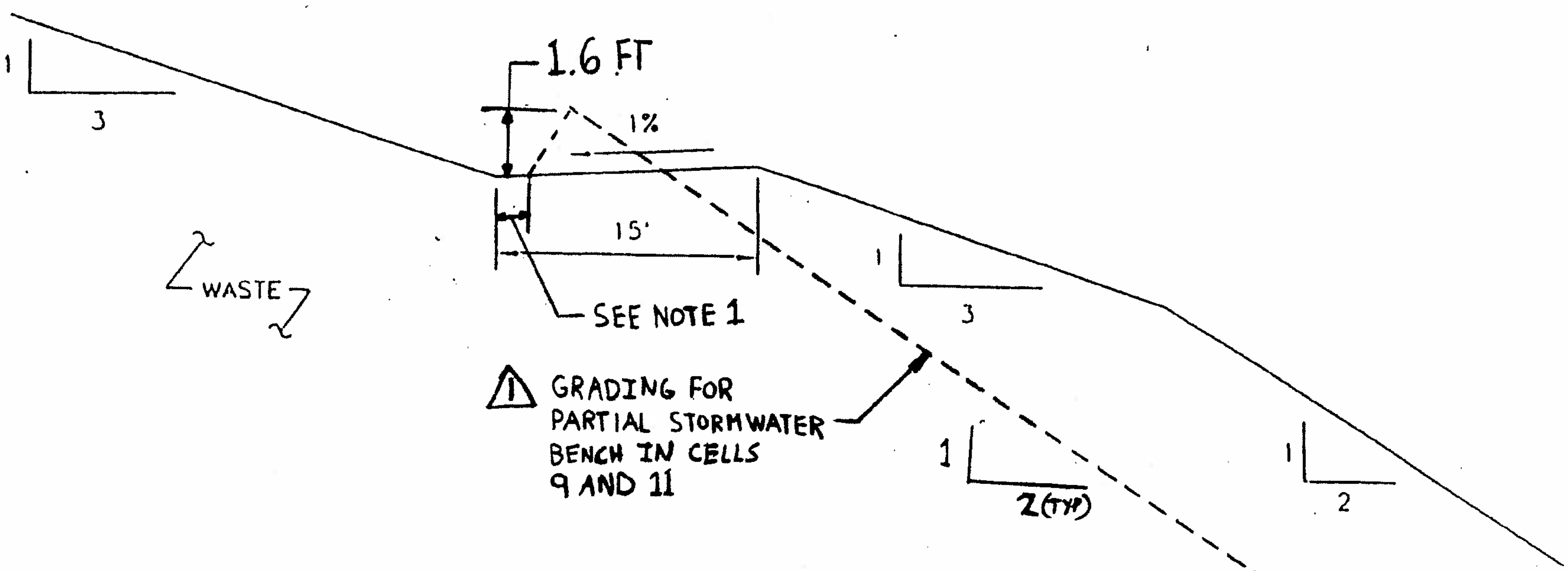
Perimeter Channel	Channel Depth (ft)	Channel Base Width (ft)
10	3.69 (As-Built)	0
12	2.65 (As-Built)	0
14 West	3.50 (As-Built)	0
East	2.30 (Design)	2
South	2.61 (As-Built)	0

RUST ENVIRONMENT & INFRASTRUCTURE

6 Revised 12/07 ARCADIS BBL
5 REVISED 11/02 JBH
4 REVISED 8/01 JBH
3 REVISED 6/01 JBH
2 REVISED 6/99 KM/JBN
1 REVISED 1/96 CB

FIGURE 10

CWM CHEMICAL SERVICES, INC.
MODEL CITY NEW YORK



TYPICAL MAINTENANCE TERRACE

NOT TO SCALE

NOTE:

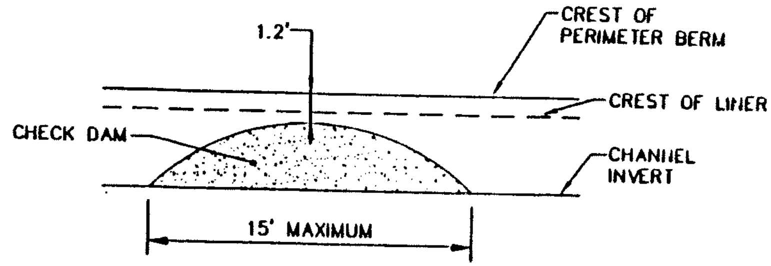
1. THE BASEWIDTH OF THE PARTIAL BENCH VARIES ALONG ITS LENGTH TO ZERO (V-NOTCH CHANNEL) AT THE NORTHERN END.

REVISED 12/07 ARCADIS BBL

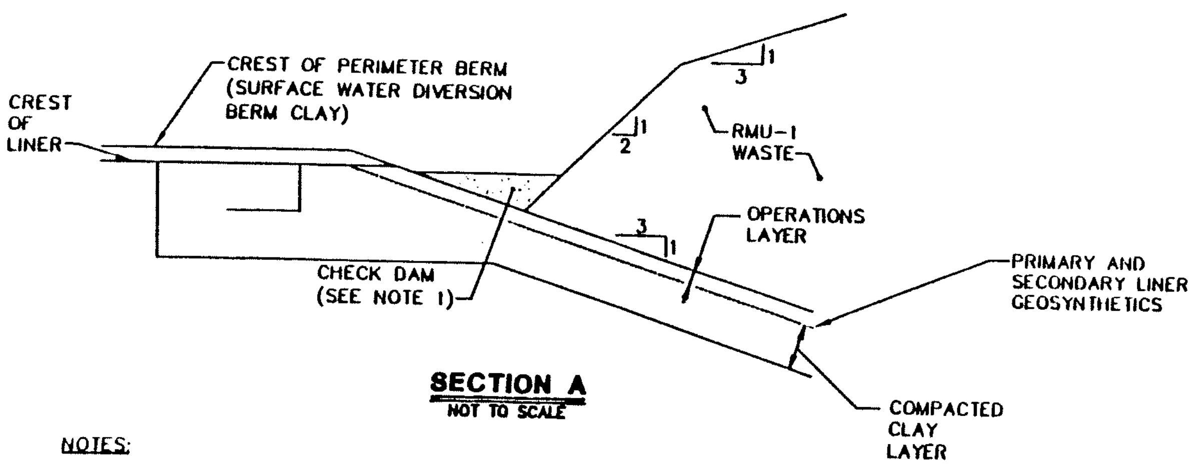
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 11

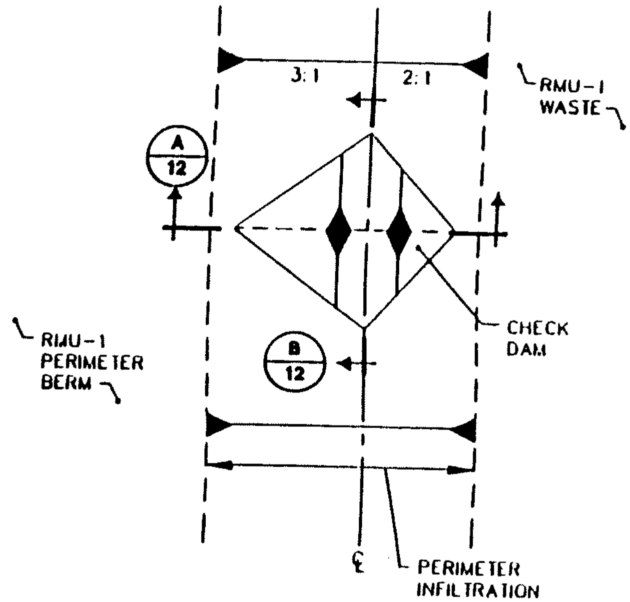
CWM CHEMICAL SERVICES, INC.
MODEL CITY, NEW YORK



SECTION B
NOT TO SCALE



SECTION A
NOT TO SCALE



PLAN
NOT TO SCALE

NOTES:

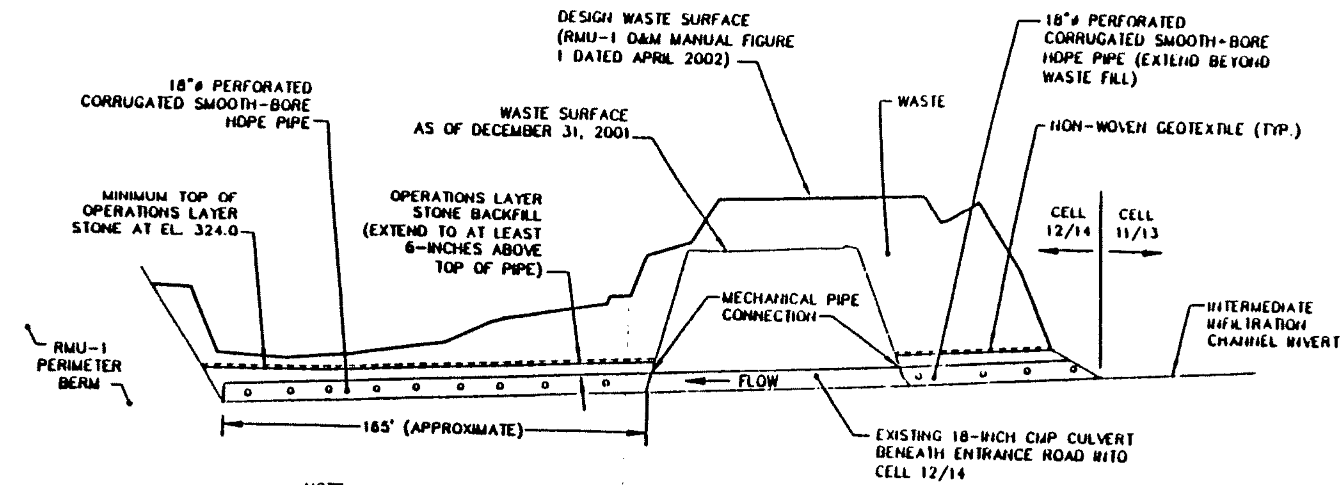
1. CHECK DAM TO BE CONSTRUCTED WITH OPERATIONS LAYER MATERIAL. SEE FIGURE 1 IN RMU-1 O&M MANUAL FOR CHECK DAM LOCATIONS.

CWM CHEMICAL SERVICES, LLC
MODEL CITY, NEW YORK
RMU-1 OPERATIONS & MAINTENANCE MANUAL

INFILTRATION CHANNEL
CHECK DAM

BBL

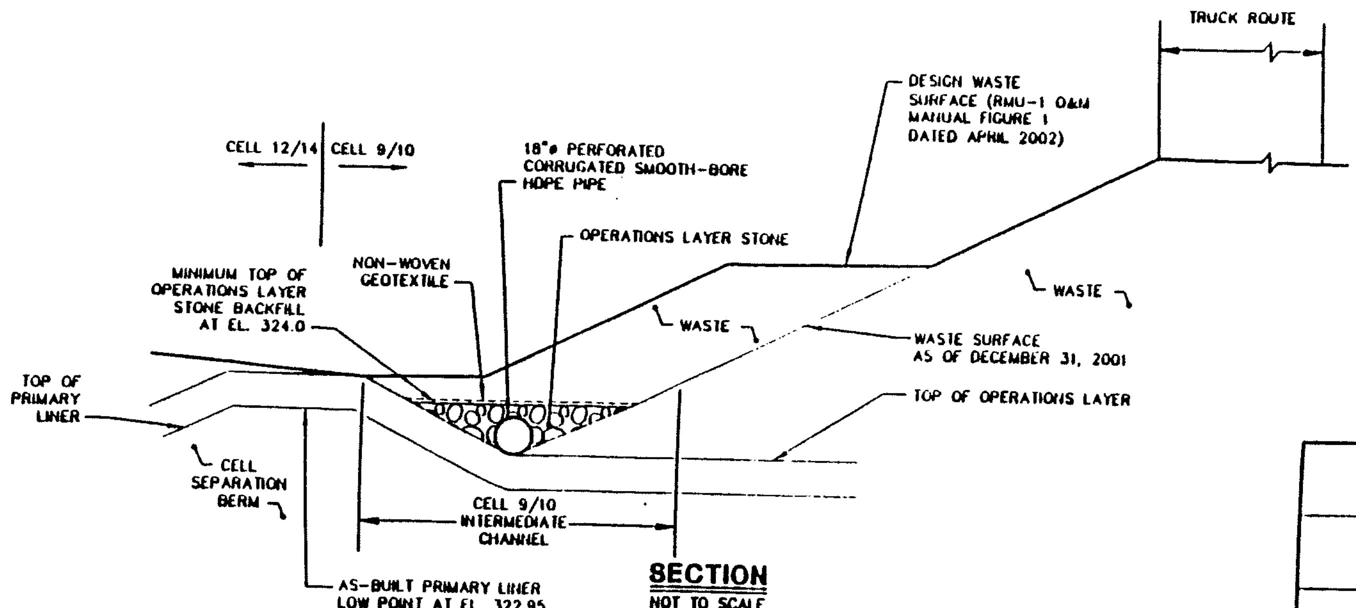
FIGURE 12



NOTE:

1. PROFILE IS TAKEN LOOKING NORTH THROUGH THE CELL 9/10 INTERMEDIATE INFILTRATION CHANNEL.

PROFILE
NOT TO SCALE



SECTION
NOT TO SCALE

CWM CHEMICAL SERVICES, LLC
MODEL CITY, NEW YORK
RMU-1 OPERATIONS & MAINTENANCE MANUAL

PERFORATED PIPE IN CELL 9/10 INTERMEDIATE INFILTRATION CHANNEL

BBL

FIGURE 13

ARCADIS BBL

SUBJECT: RMU-1 O&M MANUAL

TEMPORARY DOWNCHUTE PIPE DETAIL

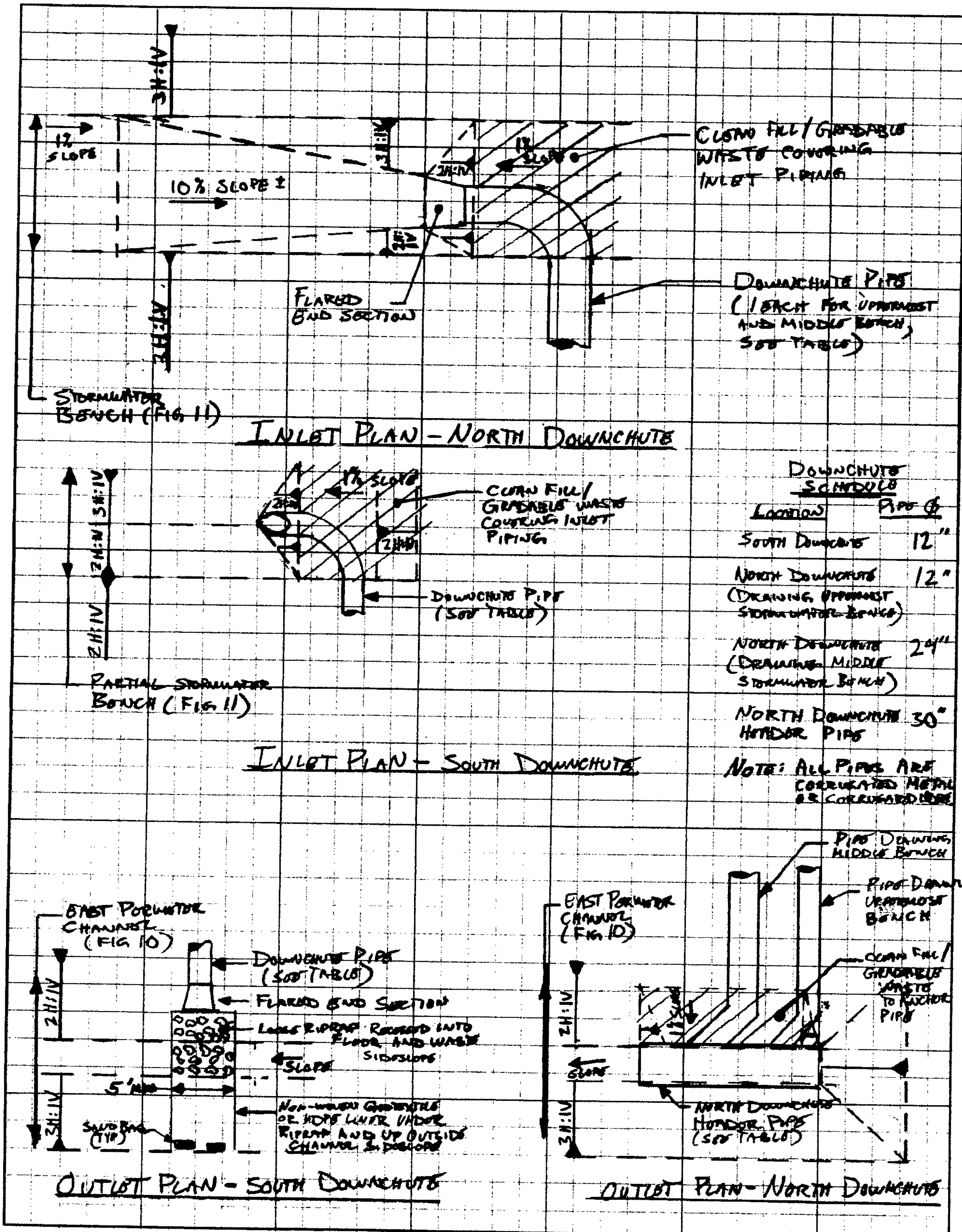
JOB NO: 05106

BY: BMS DATE: 12/07

CHKD: DATE:

NOT TO SCALE

FIG 14



CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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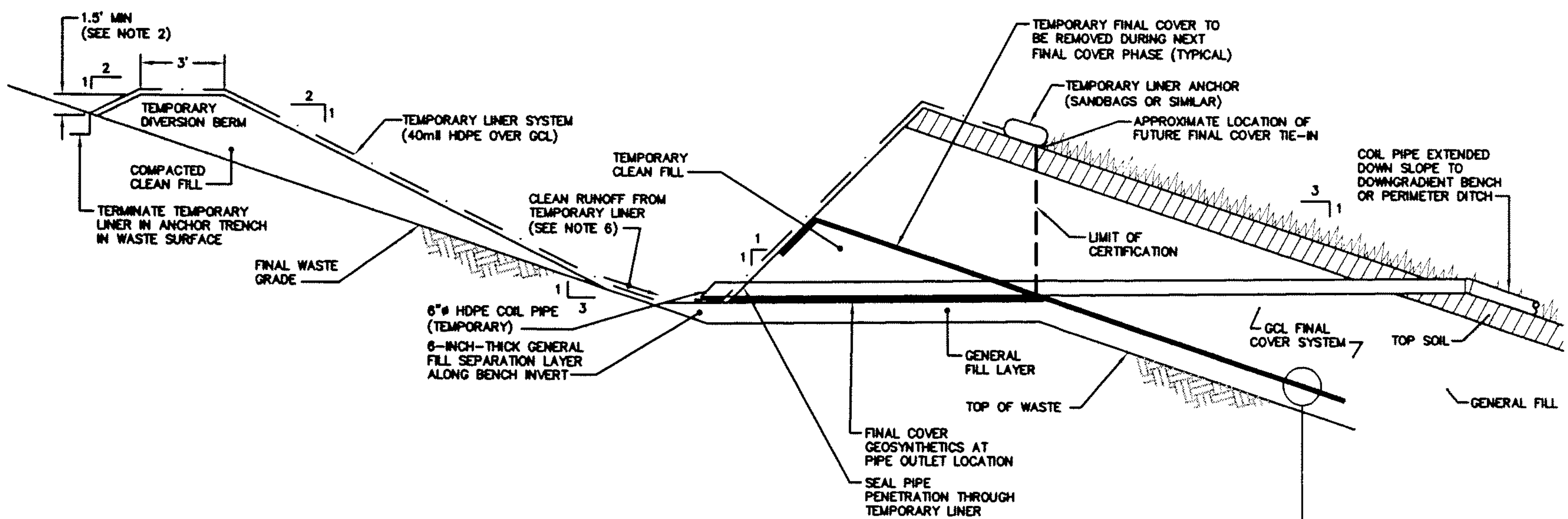
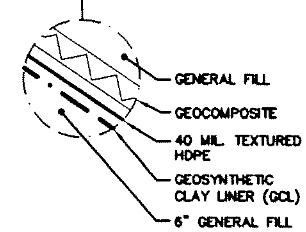




GENERAL NOTES:

1. DETAIL APPLIES TO UPGRADIENT EDGES OF FINAL COVER TEMPORARY TERMINATION.
2. DIVERSION BERM DIVERTS CONTACT WATER RUNOFF AWAY FROM FINAL COVER SYSTEM TERMINATION AND TOWARDS CONTACT WATER MANAGEMENT FEATURES WITHIN UNCAPPED LIMIT OF RMU-1.
3. MINIMUM SLOPE OF CHANNEL FORMED BY DIVERSION BERM IS 1%.
4. MAXIMUM ALLOWABLE FLOW DEPTH IS 1.0' BASED ON PROVIDING 0.5' FREEBOARD.
5. DIVERSION BERM HEIGHT IS BASED ON WORST-CASE WATERSHED FOR PHASE VII FINAL COVER AREA.
6. CLEAN RUNOFF FROM TEMPORARY LINER TO BE DIRECTED OFF LANDFILL TO EXISTING SURFACE WATER MANAGEMENT SYSTEM.

TEMPORARY DIVERSION BERM DETAIL AT FINAL COVER TERMINATION

NOT TO SCALE

CWM CHEMICAL SERVICES, LLC
MODEL CITY, NEW YORK
RMU-1 OPERATIONS AND MAINTENANCE MANUAL

TEMPORARY DIVERSION BERM DETAIL

ARCADIS

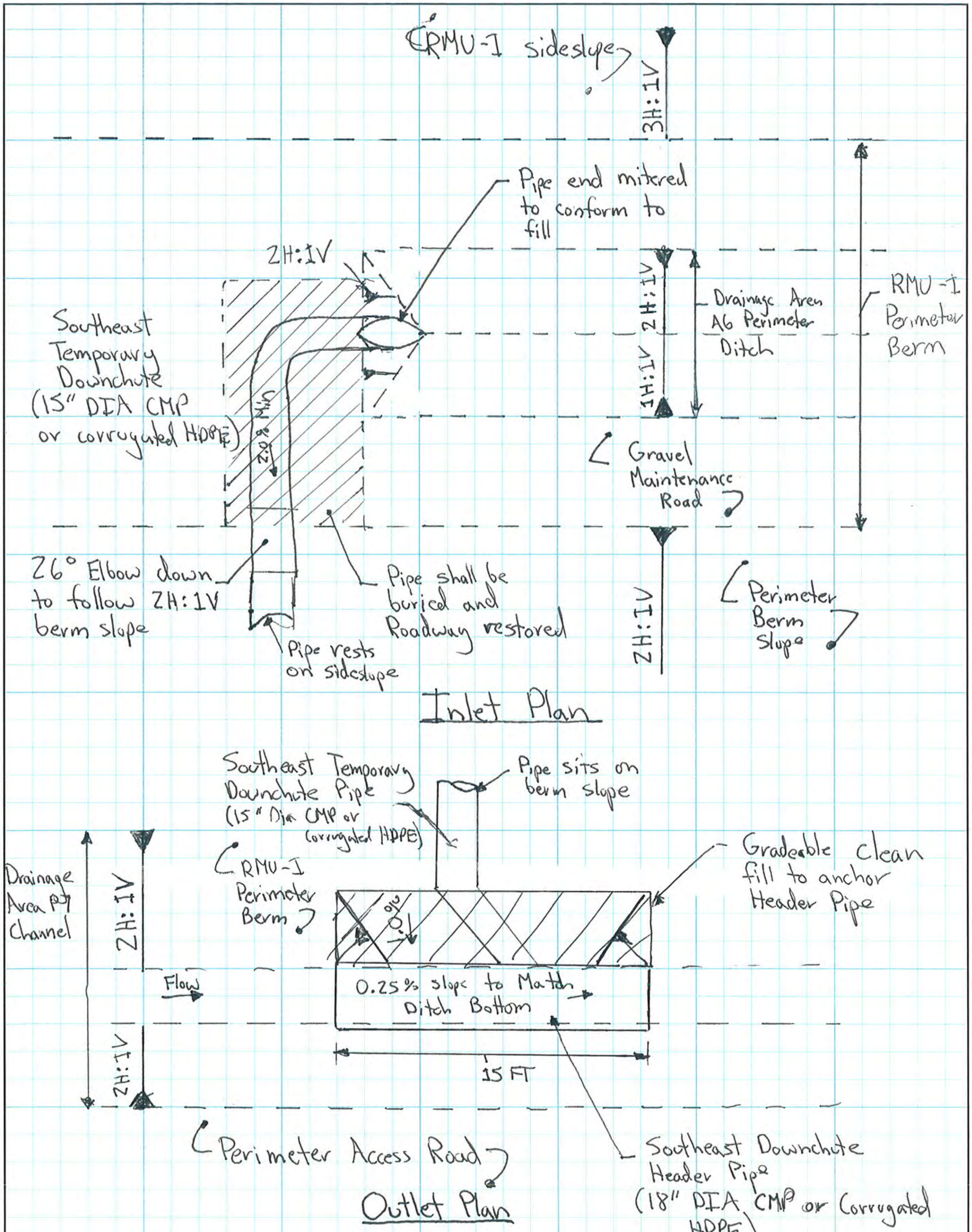
FIGURE
15

ARCADIS BBL

SUBJECT: RMU-I O+M Manual
Southeast Temporary Downchute
JOB NO: 23785

BY: PTO DATE: 8/5/11
CHKD: DATE:

FIG 16



ARCADIS BBL

SUBJECT: RMU-I O+M Manual

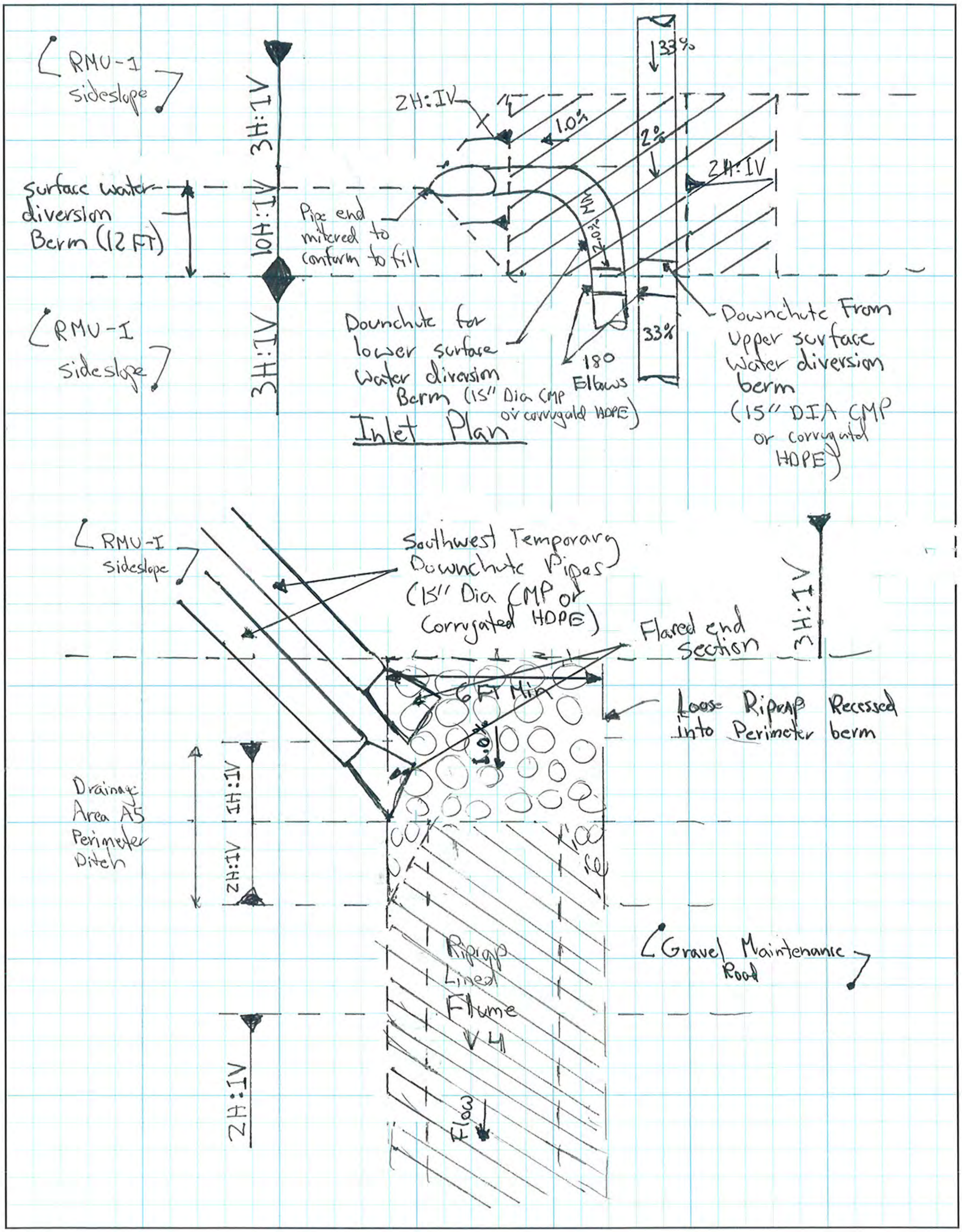
Southwest Temporary Downchute

JOB NO: 23785

BY: PTO DATE: 8/2/11

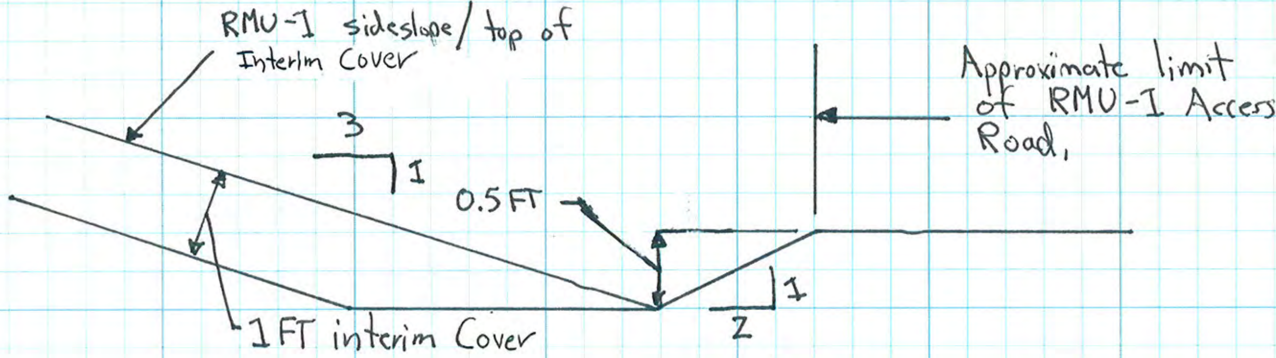
CHKD: DATE:

FIG 17



ARCADIS BBL

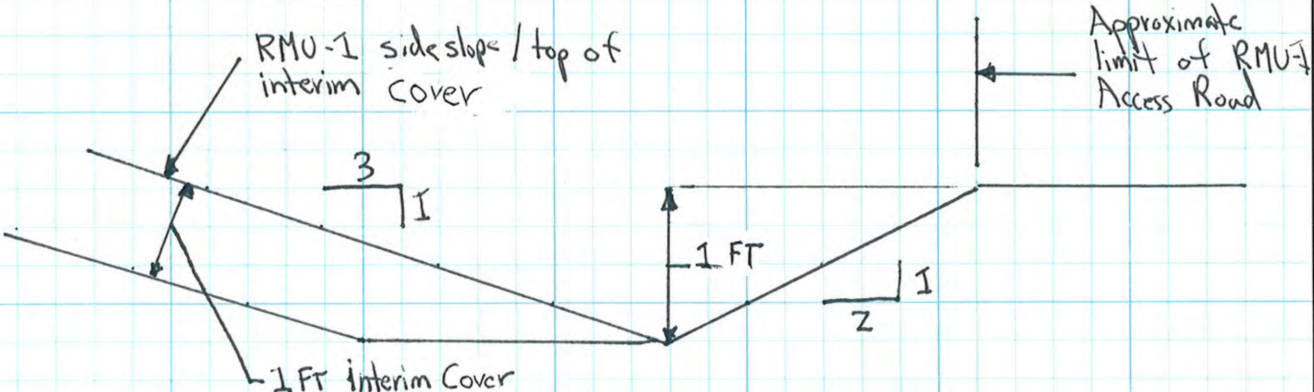
SUBJECT: RMU-1 O+M Manual	BY: PTO	DATE: 8/1/11	FIG 18
Interim Drainage Ditch Detail	CHKD:	DATE:	
JOB NO: 23785	Not to Scale		



Segment 1

Notes:

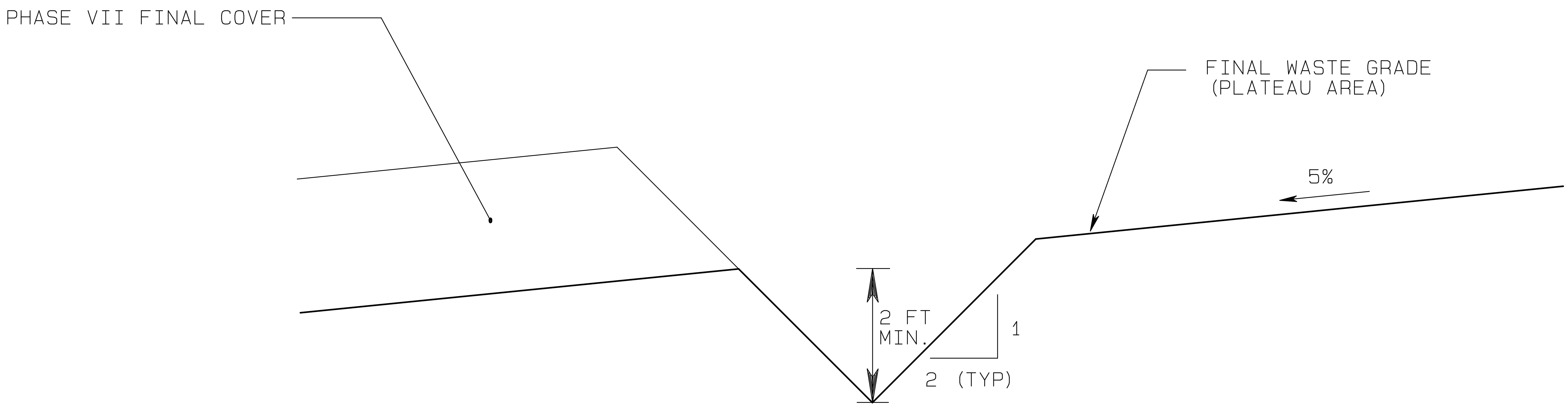
1. Ditch shall be lined with a Geosynthetic.
2. Ditch longitudinal slope is 10 percent.



Segment 2

Notes:

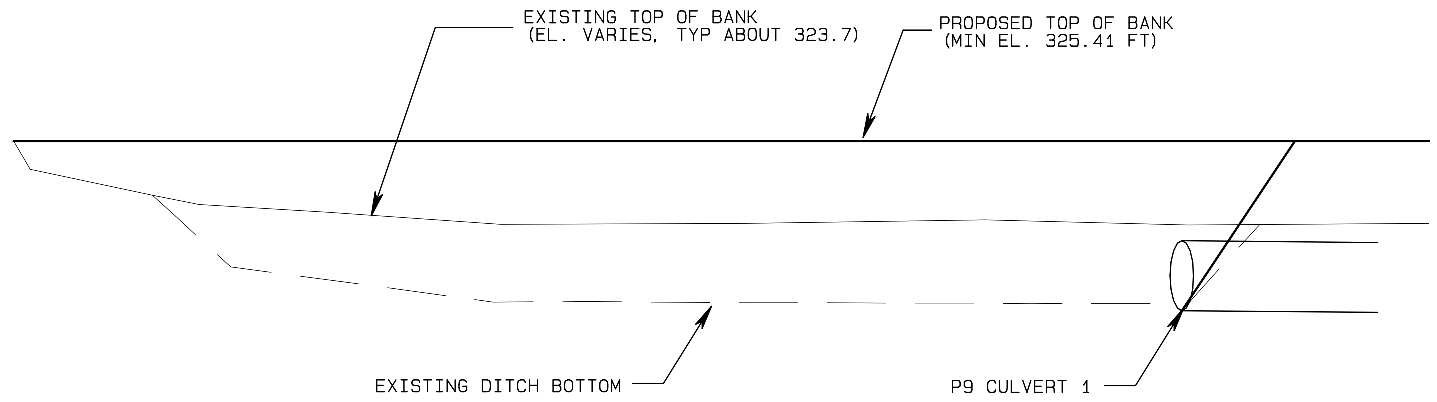
1. Ditch shall be lined with a Geosynthetic.
2. Ditch longitudinal slope is 0.3 percent.



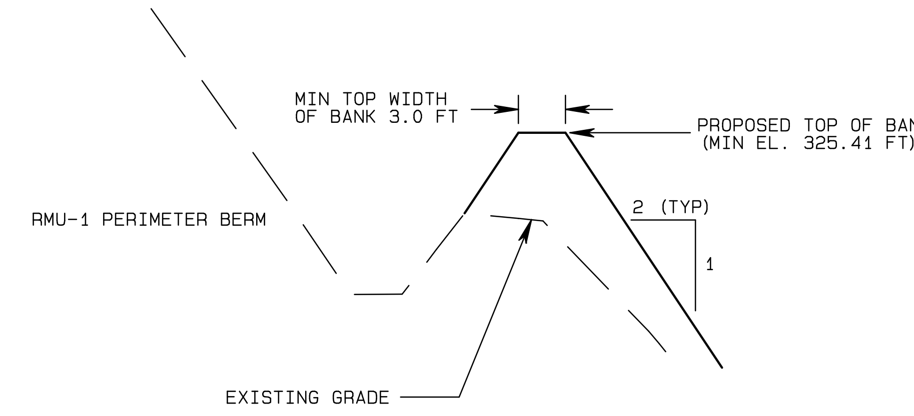
NOTE:

1. DITCH SHALL HAVE A MINIMUM BED SLOPE OF 0.5 PERCENT.

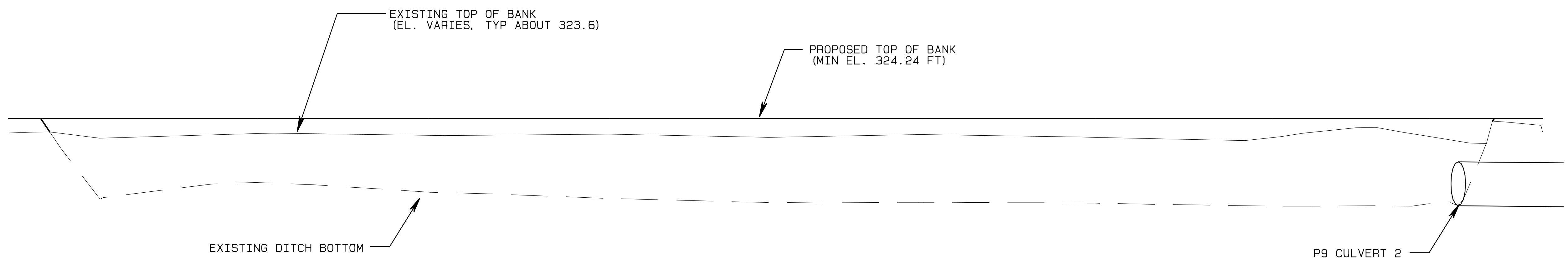
ARCADIS	RMU-1 O&M MANUAL SHEET TITLE: PHASE VII FINAL COVER AREA DIVERSION DITCH PROJECT LOCATION: MODEL CITY, NEW YORK PROJECT NO: B0023785 DATE: 11/15/11 BY: BMS/NWF	FIGURE 19



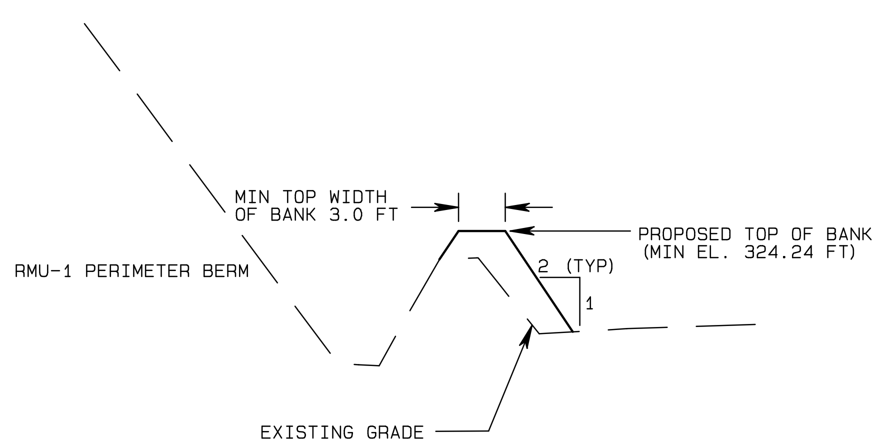
PROFILE OF DITCH UPSTREAM OF P9 CULVERT 1



TYPICAL CROSS SECTION UPSTREAM OF P9 CULVERT 1



PROFILE OF DITCH UPSTREAM OF P9 CULVERT 2



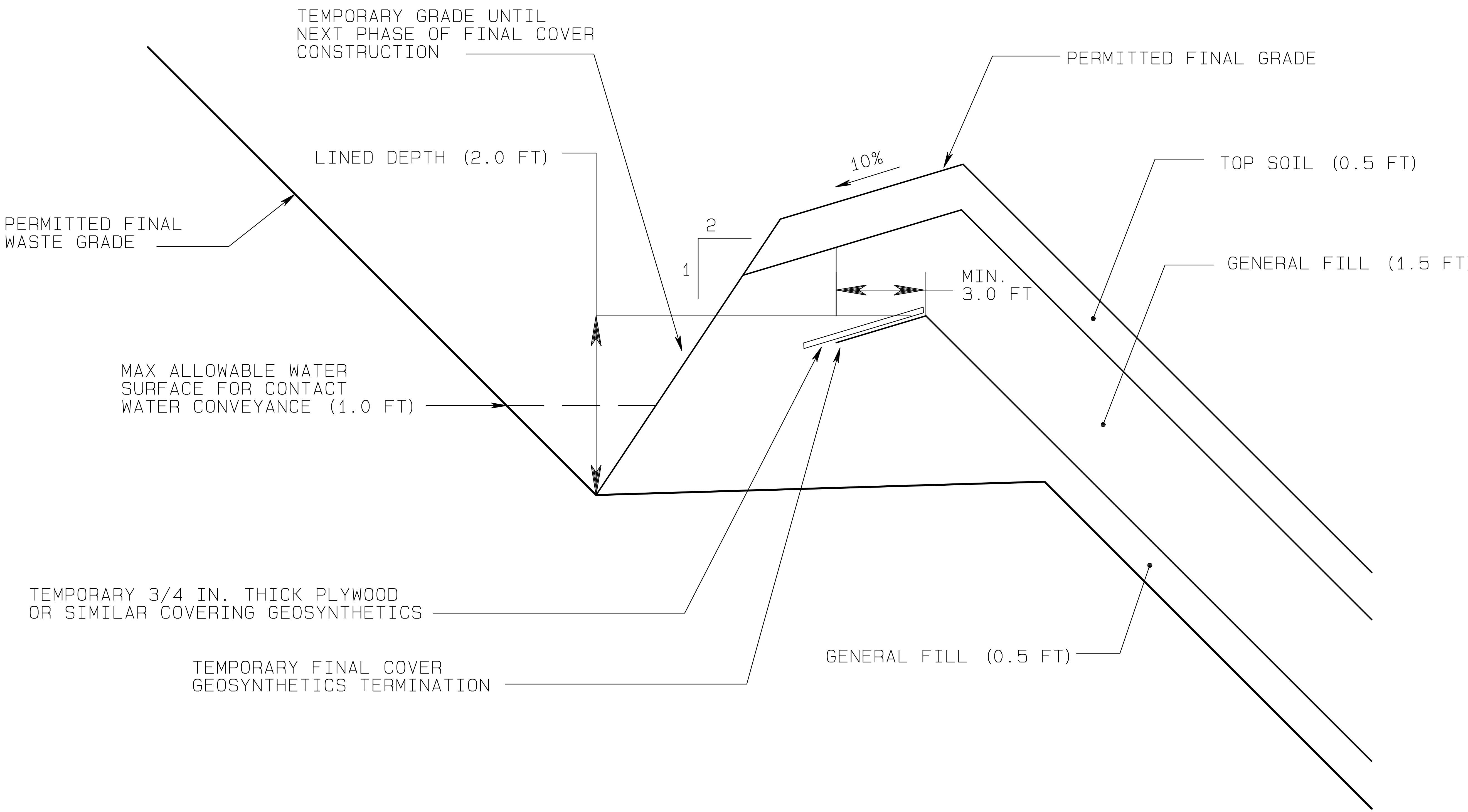
TYPICAL CROSS SECTION UPSTREAM OF P9 CULVERT 2

ARCADIS

RMU-1 O&M MANUAL
SHEET TITLE: PERIMETER DITCH ENHANCEMENTS
PROJECT LOCATION: MODEL CITY, NEW YORK
PROJECT NO: B0023785
DATE: 11/16/11 BY: BMS/NWF

FIGURE

20



ARCADIS

RMU-1 O&M MANUAL
SHEET TITLE: TEMPORARY FINAL COVER TERMINATION AT SURFACE WATER DIVERSION BERM
PROJECT LOCATION: MODEL CITY, NEW YORK
PROJECT NO: B0023785
DATE: 11/21/11 BY: BMS/NWF

FIGURE 21

ATTACHMENT #5
LANDFILL PLATEAU ACCESS ROAD DESIGN CALCULATIONS

Calculation Sheet

Client: **CWM Chemical Services, LLC**

Project Location: **Model City, New York**

Project: **RMU-1 Plateau Access Road Design** **Project No.:** **B0023729.2012**

Subject: **Access Road Design Calculations**

Prepared By: **BMS** **Date:** **August 2012**

Reviewed By: **PHB** **Date:** **August 2012**

Checked By: **PHB** **Date:** **August 2012**

OBJECTIVE:

Demonstrate that the proposed landfill plateau access road cross-section can accommodate the anticipated truck traffic volume and loads. Evaluate the puncture potential for the final cover geomembrane due to isolated stones in the overlying general fill and considering the added loads associated with the proposed access road.

REFERENCES:

1. RMU-1 Permit Drawing No. 12-a entitled “Top of Vegetated Cover Grades,” ARCADIS, August 2012.

2. RMU-1 Permit Drawing No. 23A entitled “Landfill Plateau Access Road Details,” ARCADIS, August 2012.

3. Propex, Inc., Roadways and Civil Engineering (RACE) with Geotextiles. Version 1.3. Computer Software. (output attached)

4. GSE Lining Technology, Inc., GSE Geomembrane Protection Design Manual. First Edition. (portions attached)

5. Das, Braja M., Principles of Geotechnical Engineering. Second Edition. PWS-KENT Publishing Company, 1990, pp.196. (Attached)

ASSUMPTIONS:

1. A new permanent road is proposed along the northern face and on the plateau of RMU-1 to allow waste hauling trucks and other vehicles access to the landfill’s plateau. The road will be constructed over the existing final cover system.

2. The proposed access road will be constructed by removing the existing 6-inch-thick topsoil layer of the final cover from within the road footprint, installing a woven geotextile, and installing an 18-inch-thick layer of New York State Department of Transportation #2 crusher run. In final cover areas with compacted clay, the total soil and aggregate thickness over the final cover geosynthetics will be 4 feet at a minimum (2.5-foot-thick general fill layer + 1.5-foot-thick crusher run layer = 4.0 feet). In final cover areas with geosynthetic clay liner (GCL), the total soil and aggregate thickness over the final cover geosynthetics will be 3 feet at a minimum (1.5-foot-thick general fill layer + 1.5-foot-thick crusher run layer = 3.0 feet).

Calculation Sheet

3. The ability of the proposed access road section to accommodate the anticipated vehicle traffic is assessed using Reference 3, which is a computer software package for the design of unpaved roads with geotextile beneath the road surface material. The assumed design axle load is 40,000 pounds based on that of an HS-25 truck. The number of design passes is 50,000 based on approximately 250,000 cubic yards (cy) of airspace remaining in RMU-1 and an assumed loaded truck capacity of approximately 20 cy per truck (i.e., 12,500 loaded trucks). Although the design of the HS-25 vehicle only has two single axles loaded at 40,000 pounds each, a typical semi has two tandem axles (four axles total) loaded equally. Each truck is, therefore, assumed to create four passes at the design load, for a total of 48,500 design axle passes (rounded to 50,000 for this analysis). It is noted that the assumed configuration represents a worst-case condition because it considers a higher than typical axle load based on an HS-25 load distribution and an axle count based on typical highway semis. The analysis is, therefore, conservative.

4. The puncture potential of the final cover geomembrane is determined using a procedure in Reference 4 and by comparing the at-depth increase in normal load on the geosynthetics to the maximum allowable normal load based on the thickness of the geomembrane, the weight of the non-woven geotextiles above the geomembrane, the maximum particle size in the general fill, and other factors.

5. The typical maximum particle size in the general fill of the final cover is approximately 2 inches based on a review of particle size distribution testing data contained in certification reports for Final Cover Phases I-III, IV, and VII.

6. The increase in normal load on the final cover geosynthetics for the assessment of puncture potential is determined using Reference 5, which accounts for the dissipation of the ground contact pressure due to burial depth.

7. The final cover geocomposite is composed of a geonet between two layers of non-woven geotextile, each with a mass per unit area of 6 ounces per square yards (oz/yd^2) (according to the RMU-1 technical specifications for geotextile). Because there are two layers of this geotextile, collectively, they are assumed to provide equivalent puncture protection of a single layer of 12 oz/yd^2 geotextile. It is noted that the void space created by the geonet core provides further cushioning but this effect is not considered herein. Thus, the degree of puncture protection provided by the geocomposite, as determined in this assessment, is conservatively low.

CALCULATIONS:

1. Road Section Design Assessment

The assumed vehicle loading for the proposed access road is discussed in Assumption 3. Reference 3 is used to determine the required aggregate layer thickness based on the design vehicle loading, the number of design passes, the aggregate characteristics, and the shear strength of the subgrade beneath the woven geotextile. The shear strength of the subgrade is assumed to be 2,400 pounds per square feet based on the requirements for general fill in the RMU-1 technical specifications. Output from Reference 3 (included as Attachment 1) indicates that a minimum 6-inch-thick aggregate layer is required over the woven geotextile. As indicated in Assumption 2, the proposed road section provides 18 inches of aggregate, which is three times the minimum required thickness. Additionally, the specified woven geotextile to be used in the road construction is one of the products recommended by Reference 3. The proposed road section is, therefore, deemed adequate to accommodate the anticipated vehicle loading.

Calculation Sheet

2. Puncture Potential of Final Cover Geomembrane

As discussed in Assumption 4, the puncture potential of the final cover geomembrane due to isolated stones in the general fill layer in the final cover can be assessed by comparing the estimated increase in normal load at the depth of the geosynthetics and the maximum allowable normal load for the geomembrane. Because the at-depth pressure increase caused by surface loads decreases with increasing burial depth, the worst-case condition will occur where the geomembrane has the shallowest burial depth with respect to the design road surface. As indicated in Assumption 2, this occurs in the GCL final cover area on the landfill plateau, where the burial depth is 3 feet. Charts in Reference 5 are used to determine the at-depth increase in normal stress as a function of burial depth, ground contact pressure, and ground contact area as follows:

Assumed ground contact pressure, q = 80 pounds per square inch (psi) (equal to tire inflation pressure) x 1.1 (impact factor) = 88 psi

Footprint of circular loaded area beneath a set of dual tires = ½ design axle load/tire inflation pressure = 20,000 pounds/80 psi = 250 in^2

Radius of circular loaded area, R = (250 $in^2/\pi)^{1/2}$ = 8.9 in

Burial depth, z = 36 in (minimum, Assumption 2)

z/R = 4.0

Δp/q = 0.08 (from chart in Reference 5)

At-depth increase in normal stress, Δp, = 88 psi x 0.08 = 7.0 psi (maximum)

The pressure due to burial beneath 3 feet of soil is approximately 2.7 psi (3 feet x 130 pounds per cubic foot). Thus, the total normal load experienced by the geomembrane beneath the proposed road is approximately 9.7 psi or 66.9 kPa.

Reference 4 is used to evaluate the puncture potential of the geomembrane as follows:

$$p_{allow} = \left[450\frac{M}{H'^2}\right]\left[\frac{1}{MF_{PS}xFS_{CR}xFS_{CBD}}\right] - 1.3x10^5(1.5-t)H'^{-2.4}$$

Where:

p_{allow} = allowable normal pressure on geomembrane (kPa)
M = mass per unit area of nonwoven cushion geotextile (g/m^2) = 12 oz/yd^2 = 405 g/m^2
H' = effective protrusion height (mm) = H x MF_{PD}
H = protrusion height (mm) = 0.5 x max particle size = 1 in = 25 mm
MF_{PD} = modification factor for packing density = 1.0 for isolated stones
MF_{PS} = modification factor for protrusion shape = 0.5 for subangular/subrounded
FS_{CR} = factor of safety for creep of geotextile and geomembrane = 1.4
FS_{CBD} = factor of safety for chemical and biological degradation = 1.0 for burial in clean soil
t = geomembrane thickness (mm) = 40 mil = 1.0 mm

Calculation Sheet

Thus:

p_{allow} = 388 kPa

Because the expected at-depth increase in normal load is estimated to be 66.9 kPa, a factor of safety of approximately 5.8 is expected.

SUMMARY:

The proposed road section contains approximately three times the minimum required thickness of aggregate. Thus, the proposed access road section can accommodate the anticipated design vehicle loads. An evaluation of the puncture potential for the final cover geomembrane indicates that a minimum factor of safety of 5.8 is achieved with the proposed access road design and the estimated maximum particle size in the final cover general fill layer. The puncture potential evaluation is considered conservative because it does not account for the additional cushioning provided by the geonet core of the geocomposite.

ARCADIS

Attachment 1

Road Section Design

Roadways And Civil Engineering (R.A.C.E.) with Geotextiles,
Version 1.3
by Propex Inc.

Designer:

Client: **CWM Chemical Services**

Project Name: **RMU-1 Plateau Access Road**

Project Number:

Date: **August 2012**

Comments:

Input:

Subgrade:

CBR (soaked): 4.25 %
Shear Strength: 17 PSI
Subgrade has exececessive moisture: No

Vehicle Data:

Axles: Tandem
Axle Load: 40000 lbs
Wheels: Dual
Wheel Load: 24000 lbs
Contact Length: 20 in
Contact Pressure: 80 PSI
Number of Design Passes: 50000

Aggregate:

Material: Crushed Medium Hard Rock
CBR Range: 60-80 %
AASHTO Coefficient: 0.12
TEF: 0.85,
Aggregate Angularity: Angular
Lift Thickness: 12 in
Aggregate Size: 1.5 in
Aggregate Cost: 20 $/Ton
Implace Density: 130 lbs/ft3

Installation Conditions:

Soil Condition: Fine grained soils with smooth surface
Level of Monitoring: Close supervision
Geotextile Panels: Overlapped

Design Results:

Calculated Permissible Stress:
Without Geotextile: 47.6 PSI
With Geotextile: 85.0 PSI
Calculated Design Aggregate Section Thickness:
Without Geotextile: 12.3 in
With Geotextile: 6.0 in
Calculated Section Unit Cost:
Without Geotextile: 11.97 yd²
With Geotextile: 5.85 yd²

This cost is for stone only, for geotextile cost, please contact your propex Regional Sales Manager, as may be found under "Contact Us" on our website, www.geotextile.com or call us at (800) 621-1273. Our Regional Manager can help you contact your local distributor for geotextile costs and availability. For rough estimates, geotextiles used in this application can range in installed cost from about $0.70 to $1.80 per square yard.

Recommended Geotextile Products

Geotex 401, Geotex 200ST

Product Descriptions

Geotex 401: Nonwoven polypropylene needle-punched geotextile. Meets AASHTO M 288 Class 3 Nonwoven Geotextile requirements. Advantages include better filtration with a higher water flow rate, a higher coefficient of friction against soil and road base aggregate. Maximum width is 15 feet. For a generically stated product specification in downloadable Rich Text format, refer to Guideline Specifications - Separation/Stabilization "AASHTO M 288 Class 3 Nonwoven Geotextile" under Applicable Documents or under R.A.C.E. Software at www.geotextile.com. It is recommended that the maximum width geotextile be used to improve installation quality control.

Geotex 200ST: Woven polypropylene geotextile made from slit tape machine direction (warp) yarns and fibrillated yarns in the cross-machine (fill) direction. Meets AASHTO M 288 Class 3 Woven Geotextile Requirements. Maximum widths up to 17.5 feet.

For a generically stated product specification in downloadable Rich Text format, refer to Guideline Specifications - Separation/Stabilization "AASHTO M 288 Class 3 Woven Geotextile" under Applicable Documents or under R.A.C.E. Software at www.geotextile.com. It is recommended that the maximum width geotextile be used to improve installation quality control.

Information, Availability and Cost

For additional help with your project, such as distributor locations, geotextile properties or rough pricing; you may wish to contact your Propex Regional Manager as may be located for your area under "Contact Us" on our website, www.geotextile.com.

Attachment 2

Geomembrane Puncture
Potential References

in the figure) = $qr\,dr\,d\alpha$. The vertical stress, dp, at point A due to the load on the elementary area (which may be assumed to be a concentrated load) can be obtained from Eq. (6.11):

$$dp = \frac{3(qr\,dr\,d\alpha)}{2\pi}\frac{z^3}{(r^2+z^2)^{5/2}} \tag{6.23}$$

The increase of stress at A due to the entire loaded area can be found by integrating Eq. (6.23), or

$$\Delta p = \int dp = \int_{\alpha=0}^{\alpha=2\pi}\int_{r=0}^{r=R}\frac{3q}{2\pi}\frac{z^3 r}{(r^2+z^2)^{5/2}}\,dr\,d\alpha$$

So

$$\boxed{\Delta p = q\left\{1-\frac{1}{[(R/z)^2+1]^{3/2}}\right\}} \tag{6.24}$$

The variation of $\Delta p/q$ with z/R as obtained from Eq. (6.24) is given in Table 6.3. A plot of this is also shown in Figure 6.15. The value of Δp decreases rapidly with depth; and, at $z = 5R$, it is about 6% of q, which is the intensity of pressure at the ground surface.

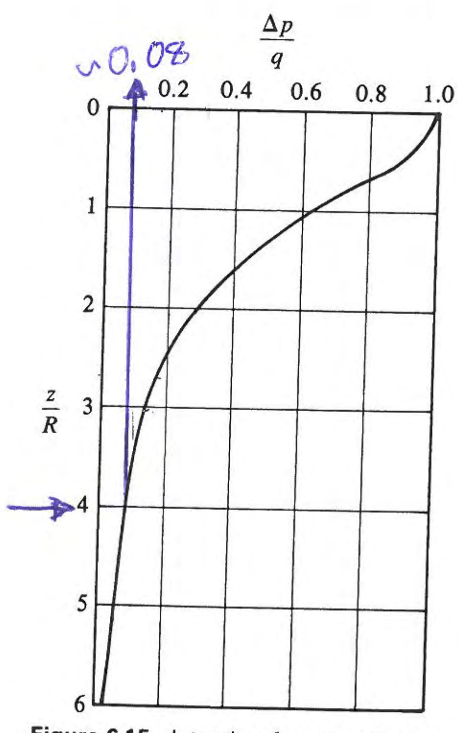


Figure 6.15 Intensity of stress under the center of a uniformly loaded flexible area

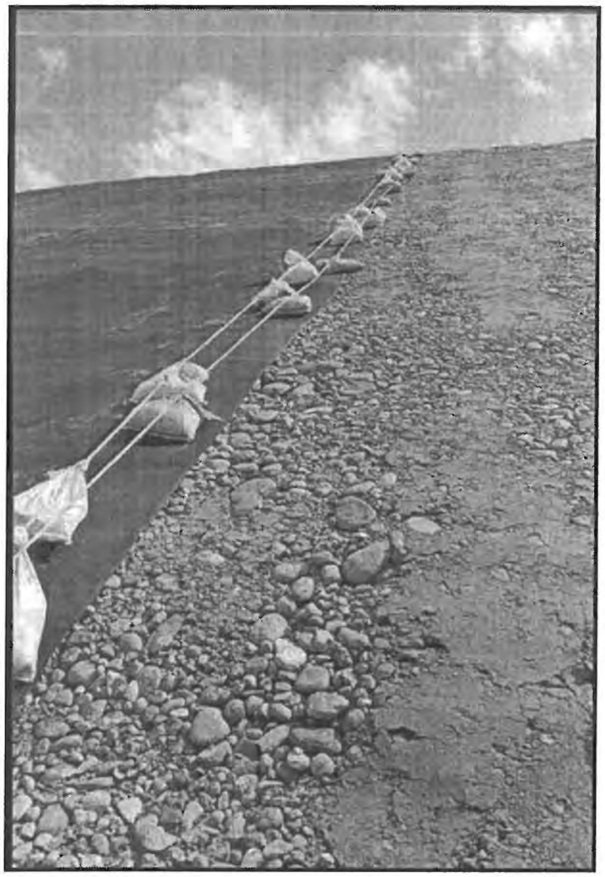
Geomembrane Protection Design Manual

Co-Authors:

Dhani Narejo, Ph.D.
GSE Lining Technology, Inc.
and
Greg Corcoran, P.E.
GeoSyntec Consultants, Inc.

First Edition

Geomembrane Protection Design Manual



Co-Authors:
Dhani Narejo, Ph.D.
GSE Lining Technology, Inc.
and
Greg Corcoran, P.E.
Geosyntec Consultants, Inc.

First Edition

Design recommendations provided in Table 3.2 are based on studies reported in the literature and authors own experience with protection requirements for HDPE geomembranes.

Table 3.2 Mass per Unit Area of Nonwoven Needlepunched Geotextile Recommended for Geomembrane Protection During Installation.

Maximum Stone Size		Mass per Unit Area	
(mm)	(inch)	(g/m^2)	(oz/sq. yard)
≤ 12	≤ 0.5	≥ 335	≥ 10
≤ 25	≤ 1.0	≥ 405	≥ 12
≤ 38	≤ 1.5	≥ 540	≥ 16
≤ 50	≤ 2.0	≥ 1080	≥ 32

3.2 Protecting Geomembrane from Puncture Due to Static Loads

The equations presented in this section were derived based on extensive quasi-performance and performance puncture testing. The final empirical relationship presented at the end of this chapter was obtained as follows:

a) An empirical equation relating truncated cone height and mass per unit area of a nonwoven needlepunched geotextile used as protection for a 1.5 mm (60 mil) HDPE geomembrane was obtained from Hydrostatic Truncated Cone Puncture Tests performed according to ASTM procedure D 5514.
b) The basic equation in (a) above was modified for the influence of geomembrane thickness.
c) The equation in step (b) above was modified for the influence of creep of the geomembrane and geotextiles.
d) The effect of type of overburden stress (hydrostatic vs. geostatic) on the equation in (c) above was evaluated.
e) The equation obtained from step (d) above was then adjusted for protrusion shape and arrangement.
f) Finally, the equation was modified for chemical and biological degradation of geomembranes and protection geotextiles.

All of the above work was performed by the author and other researchers at the Geosynthetic Institute, Drexel University, PA, using geotextiles from a number of different manufacturers. Thus the geotextile performance and the resulting design equations are representative of nonwoven needlepunched geotextiles manufactured and supplied in the US. The following sections provide details of each of the above steps.

3.2.1 Basic Equation

The failure pressure of a 1.5 mm (60 mil) thick HDPE geomembrane in Truncated Cone Puncture Test (ASTM D 5514) is related to the cone height H (mm) and the mass per unit area of a nonwoven needle punched protection geotextile M (grams/m^2) as indicated in Figure 3.1 (Narejo, et. al., 1996). The same relationship can be expressed mathematically as:

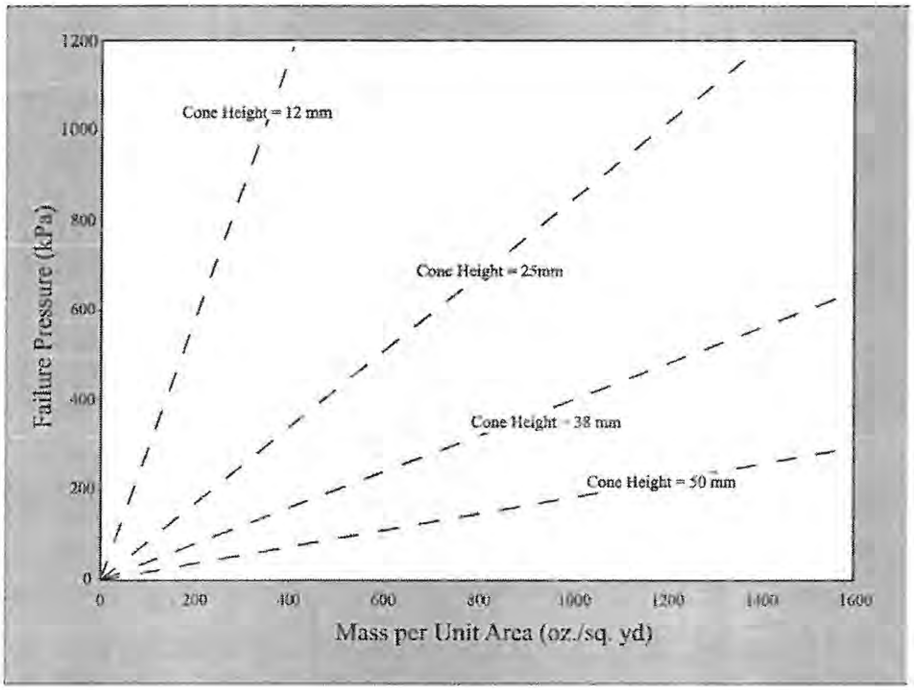


Figure 3.1 Short Term Test Results Obtained from Hydrostatic Truncated Cone Puncture Testing (Narejo et. al., 1996).

$$p_{1.5mm} = 450\frac{M}{H^2} \tag{3.1}$$

Equation (3.1) is valid only for the following conditions:

a) hydrostatic pressure applied at the rate of 7 kPa (1 psi) per minute,
b) a 1.5 mm (60 mil) HDPE geomembrane, and
c) truncated cones used as protrusions, as indicated in Figure 1.2 (b).

Obviously, conditions on actual projects are always different from the test conditions used to derive Equation 3.1. Therefore, the equation must be modified to make it applicable to the design conditions typically encountered in the field. The following sections propose modifications to the above equation to derive the final empirical design equation.

3.2.1.1 Effect of Geomembrane Thickness

The influence of the geomembrane thickness on the failure pressures is indicated in Figure 3.2. It can be seen from the figure that the influence of geomembrane thickness on failure pressures is small above a cone height of 25 mm. However, geomembrane thickness becomes significant as cone height decreases below 25 mm. The failure pressure per unit thickness of the geomembranes (kPa/mm) is plotted in Figure 3.3 against cone height. The equation of the curve in Figure 3.3 can be written as:

Rate of change of failure pressure (kPa/mm) = $1.3x10^5$ (Cone Height in mm)$^{-2.4}$ (3.3)

Equation 3.3 can also be written as:

$$\frac{p_{1.5mm} - p_t}{1.5 - t} = 1.3x10^5 (H)^{-2.4} \tag{3.4}$$

Where, $p_{1.5\,mm}$ = failure pressure for 1.5 thick HDPE geomembrane, from Equation 3.1(kPa),

p_t = geomembrane truncated cone failure pressure at a thickness t (kPa),
t = geomembrane thickness (mm), and
H = effective protrusion height (mm).

Substituting the value of $p_{1.5mm}$ in the above equation, and re-arranging:

$$p_t = 450\frac{M}{H^2} - 1.3x10^5 (1.5 - t)(H)^{-2.4} \tag{3.5}$$

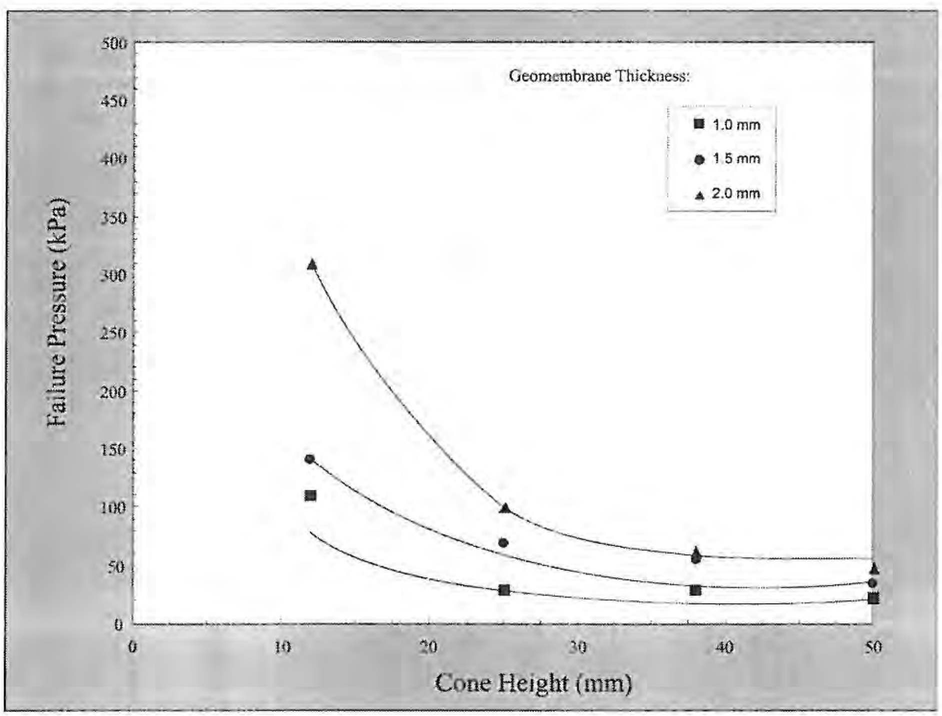


Figure 3.2 Influence of Geomembrane Thickness on Failure Pressures (Narejo et. al., 1996).

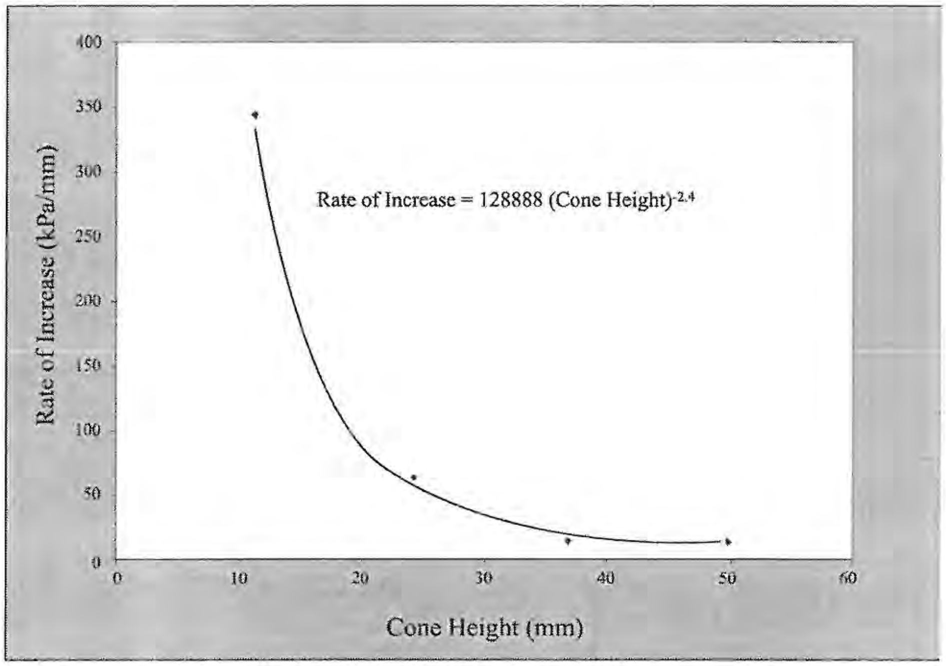


Figure 3.3 Rate of Change of Geomembrane Failure Pressure at Various Cone Heights.

$$\text{or, } p_{allow} = 450\frac{M}{H^2} - 1.3x10^5(1.5-t)H^{-2.4} \qquad (3.6)$$

Note that Equation (3.6) reduces to Equation 3.1 for a geomembrane thickness of 1.5 mm. For other geomembrane thicknesses, there is small, and in many cases negligible, influence of geomembrane thickness on failure pressures. Therefore, the thickness effect in Equation 3.6 is ignored for further derivations. In those cases where a design engineer must consider the influence of thickness, the final equation can easily be modified using Equation 3.6. This is illustrated in a design example in Chapter 5.

3.2.1.2 Modification for Geotextile and Geomembrane Creep

As mentioned previously, Equation 3.1 is based on short term testing lasting only a few hours. Geomembranes and geotextiles are viscoelastic in nature. This means that time to failure is a function of rate of application of stress. To account for the effect of rate of application of stress on Equation 3.1, creep puncture tests were conducted using the same setup as short term hydrostatic truncated cone puncture test (ASTM D 5514). However, instead of increasing the pressure at the rate of 7 kPa per minute to failure, only a certain fraction of the failure pressure was applied and maintained. At this constant pressure, the time required to obtain a geomembrane puncture was noted. As an example, for a cone height of 25 mm and a protection nonwoven needlepunched geotextile of 270 grams/m^2, Figure 3.1 indicates an approximate failure pressure of 220 kPa when tested in accordance with ASTM D 5514 using short term conditions. A pressure of 75% (165 kPa), 50% (110 kPa), 25% (55 kPa) and 12% (26 kPa), respectively was applied to obtain the curve provided in Figure 3.4. It is seen that the curve is asymptotic to the x-axis at a pressure of approximately 10%. Thus for the conditions represented in Figure 3.4, only 10% of short term pressure, or 22 kPa, can be applied to prevent failure of the geomembrane over the life of a typical civil engineering project. This translates into a creep factor of safety, FS_{CR}, of 10. The test was repeated at various cone heights, pressures and protection geotextiles to obtain the types of curve provided in Figure 3.4. On the basis of puncture creep data, factors of safety for creep are provided in Table 3.3. To account for geotextile and geomembrane creep, Equation (3.1) is modified as follows:

$$p_{allow} = \left[450\frac{M}{H^2}\right]\left[\frac{1}{FS_{CR}}\right] \tag{3.7}$$

Where, FS_{CR} = factor of safety for creep of geotextiles and geomembranes in puncture mode as given in Table 3.3.

Equation (3.7) provides long-term failure pressure for HDPE geomembrane over truncated cones (manufactured protrusions) in an inert environment.

3.2.1.3 Effect of Type of Pressure

Equation (3.7) is based on hydrostatic (water) pressure testing. A number of applications, including landfills, utilize waste or soil as the overburden medium. In such cases, the nature of the overburden pressure is geostatic rather than hydrostatic. To address this concern, a number of tests were performed using geostatic (soil) pressure (Narejo, et. al., 1996). Table 3.4 provides the data with geostatic pressure.

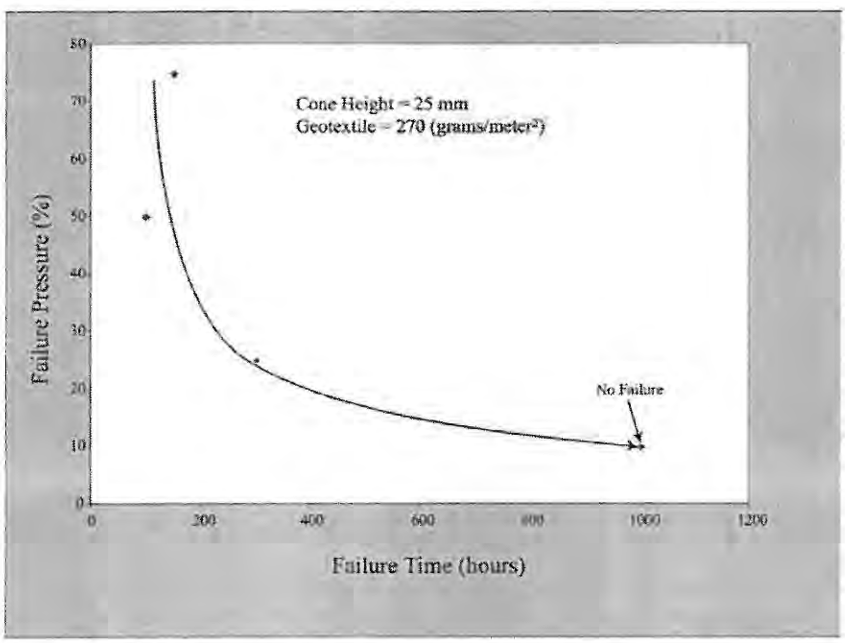


Figure 3.4 Graphical Explanation of Creep Factors of Safety.

Table 3.3 Factors of Safety for Creep Obtained from Long Term Puncture Testing (Modified from Narejo et. al., 1996).

NW-NP Geotextile Mass		**Effective Protrusion Height (mm)**		
g/m^2	oz./sq. yard	**≤38 (1.5")**	**≤25 (1.0")**	**≤12 (0.5")**
None	None	N/R	N/R	N/R
270	8	N/R	N/R	>1.5
335	10	N/R	N/R	1.4
405	12	N/R	N/R	1.4
540	16	N/R	1.5	1.3
675	20	N/R	1.4	1.2
810	24	1.5	1.3	1.2
950	28	1.4	1.3	1.1
1100	32	1.3	1.2	1.1
2000	60	1.2	1.1	1.0

Note: Values in shaded rows are extrapolated; NW-NP = Nonwoven Needlepunched; N/R = Not Recommended

Table 3.4 Geostatic Failure Pressures for a 1.5 mm HDPE Geomembrane with Various Nonwoven Needlepunched Geotextiles (from Narejo, et. al., 1996).

Geotextile Mass		**Failure Pressure (kPa) at Various Protrusion Heights**			
(g/m^2)	**($oz./yard^2$)**	**50 mm (2.0")**	**38 mm (1.5")**	**25 mm (1.0")**	**12 mm (0.5")**
None	None	240	310	450	700
270	8	380	510	>700	>700
540	16	580	>700	>700	>700
1080	32	>700	>700	>700	>700

A comparison of geostatic failure pressures (Table 3.4) with hydrostatic pressure in Figure 3.1 indicates an approximate advantage factor of 6 with the soil as the overburden medium. The higher failure pressures with soil are likely the result of soil arching. As the hydrostatic medium results in lower failure pressure, the design method based on hydrostatic testing is conservative. The authors recommend ignoring the influence of soil arching when making the design calculations for soil or waste overburden medium. Probably, in the future, after further research and testing, the influence of soil arching may be incorporated in Equation 3.7 through a modification factor. Presently, Equation 3.7 is recommended for use irrespective of type overburden medium.

3.2.1.4 Effect of Protrusion Shape and Arrangement

Equation (3.7) was derived on the basis of tests performed using truncated cones as indicated in Figure 1.2 (b). For the equation to be applicable to practical design cases, it must be modified to account for shape and arrangement of soil, aggregate or stones as discussed in Chapter 2. This was accomplished by performing tests on angular, sub-rounded and rounded stones of various sizes placed in the same manner as the truncated cones. The failure pressures thus obtained are provided in Figure 3.5. The geomembrane failure pressures are seen to decrease with an increase in angularity of the stones. On the basis of the test data in Figure 3.5, the modification factors to be incorporated in Equation 3.7 are provided in Table 3.5 (Narejo, et. al., 1996).

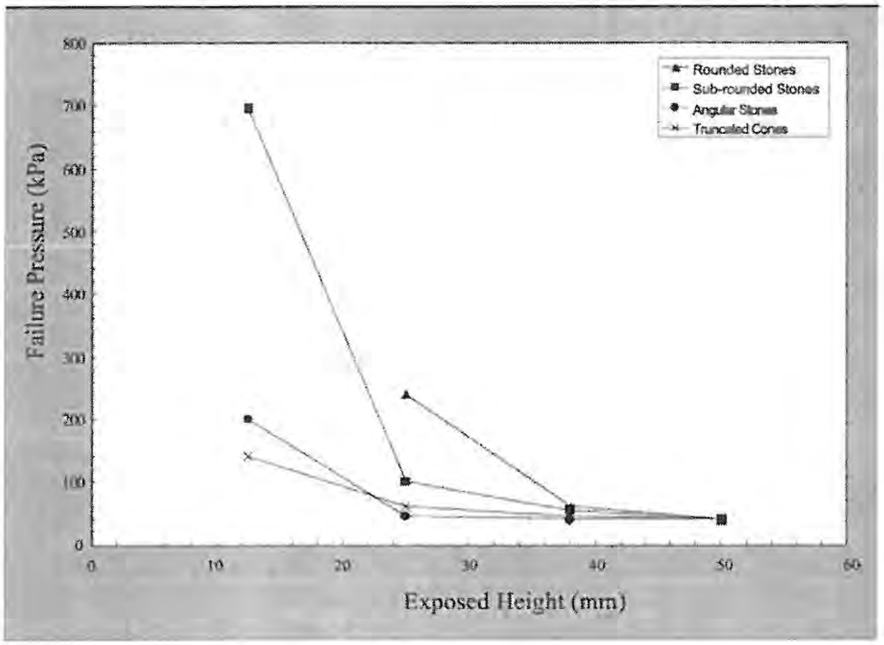


Figure 3.5 Influence of Stone Shape on Geomembrane Failure Pressures.

Table 3.5 Modification Factors for Shape of Stones.

Stone Shape	Modification Factor MF_{PS}
Angular	1.0
Subangular and subrounded	0.5
Rounded	0.25

To incorporate the effect of particle shape, Equation (3.7) can be modified as follows:

$$p_{allow} = \left[450\frac{M}{H^2}\right]\left[\frac{1}{MF_{PS} x FS_{CR}}\right] \tag{3.8}$$

Where, MF_{PS} = modification factor for particle shape.

Equation (3.8) represents the condition of isolated protrusions acting more or less independent of each other. This would be representative of an isolated stone protruding from a surface such as insitu soil or compacted clay liner. In some cases protrusions are placed so close together that their interaction can not be ignored. This is the case, for example, with a drainage layer placed on top of a geomembrane. To determine the influence of closely packed protrusions on geomembrane puncture, a number of tests were performed with AASHTO #3, 57 and 8 aggregate. For this purpose the truncated cones shown in Figure 1.2(b) were replaced by an aggregate layer. To the limit of the equipment, no failure of the geomembrane was noticed even without any protection geotextile. However, geomembrane yield was assumed to be the criteria for failure. Table 3.6 compares the truncated cone failure pressures from Figure 3.1 with yield pressures obtained in this case. It is seen that yield pressures with a layered soil are much higher than failure pressures with individualized stones in Figure 3.1.

The grouping advantage, as indicated in Table 3.6, is incorporated in Equation 3.8 by using a modification factor for packing density, MF_{PD}. Equation 3.8 can be written as:

$$p_{allow} = \left[450\frac{M}{H'^2}\right]\left[\frac{1}{MF_{PS}xFS_{CR}}\right] \tag{3.8a}$$

Table 3.6 A Comparison of Geomembrane Failure Pressures with Truncated Cones and Assemblage of Stones.

HPTC Puncture Test		Performance Puncture Test with Assemblage of Stones			
Cone Height mm (in)	**Failure Pressure (kPa)**	**AASHTO Stone No**	**d_{50} (mm)**	**d_{max} (mm)**	**Yield Pressure (kPa)**
50 (2.0)	35	3	38	50	70
38 (1.5)	55	57	12	38	170
25 (1.0)	69	8	10	25	690

Where,

H' = Effective protrusion size = $HxMF_{PD}$
H= Maximum protrusion size
MF_{PD} = Modification factor for packing density
= 1.0 for isolated stones
= 0.5 for packed stones

3.2.1.5 Effect of Biological and Chemical Degradation

Biological degradation is generally not a concern for polypropylene and polyester geotextiles and HDPE geomembranes. Therefore, effectively a factor of safety of 1.0 can be used for biological degradation.

Chemical degradation is a function of type and concentration of chemicals. A factor of safety of 1.0 to 2.0 has been suggested in the literature with a value of 2.0 applicable to aggressive environments and a value of 1.0 to more inert usage conditions (Koerner, 1998). For example, for potable water ponds and canal liners a value of 1.0 may be used. For containment of brine or diluted acids, a value of 2.0 is generally proposed. For landfill leachate an intermediate value of 1.5 is generally proposed. The reader is recommended to use these values with adequate caution and engineering judgment. Equation 3.8 may be modified for chemical and biological degradation as follows:

$$p_{allow} = \left[450\frac{M}{H'^2}\right]\left[\frac{1}{MF_{PS} x FS_{CR} x FS_{CBD}}\right] \tag{3.9}$$

Where, FS_{CBD} = factor of safety for chemical and biological degradation.

Equation 3.9 is the final relationship for the calculation of allowable overburden pressure for an geomembrane protected by a nonwoven needlepunched geotextile of mass per unit area M grams/m^2. All terms in the equation and their values have been discussed in the forgoing sections.

3.3 Global Factor of Safety

A global factor of safety against the puncture of a geomembrane can be defined by Equation 3.10.

$$FS = \frac{p_{allow}}{p_{reqd}} \tag{3.10}$$

Where, p_{allow} = as defined in Equation 3.9, and p_{reqd} is the site-specific overburden pressure discussed in Section 2.3.

The objective of a successful design method for protection of geomembranes should be to prevent the geomembrane puncture over the design life of a geomembrane liner system. This requires the use of a suitable value for global factor of safety in Equation 3.10 to offset the effect of various uncertainties in design, testing and installation. The authors suggest using a value of 3 in Equation 3.10 as a reasonable value against an actual puncture, defined as a hole, in the geomembrane.

It is well known that HDPE geomembranes yield much earlier in the stress-strain curve than the actual rupture (see stress-strain curves for various geomembranes in Chapter 2). Thus, although a global factor of safety of 3 in Equation 3.10 will prevent an actual puncture, it is quite possible that the yield of the geomembrane would still take place. Thus, much higher values of global factors of safety need to be used to ensure that the yield of the geomembrane over the design life is prevented. Koerner, et. al. (1996) performed theoretical analysis of yield of geomembrane and compared it with failure pressures from truncated cone puncture test. On the basis of this analysis, they suggest using global factors of safety against yield provided in Table 3.7.

Table 3.7 Proposed Values of Global Factors of Safety (modified from Koerner, et. al., 1996).

Effective Protrusion Height (mm)	Minimum Global Factor of Safety Against Yield	Minimum Global Factor of Safety Against Puncture
6	3.0	3
12	4.5	3
25	7.0	3
38	10.0	3