CleanHarbors
ENVIRONMENTAL SERVICES®

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APR 05 2010
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE
2010.01333

March 31, 2010

Mr. Dennis R. Downs
Executive Secretary
Utah Solid and Hazardous Waste Control Board
288 North 1460 West
Salt Lake City, UT 84116

RE: Class 3 Permit Modification Request
Module VI – Hazardous Waste Landfills
Clean Harbors Grassy Mountain, LLC., EPA ID No. UTD991301748

Dear Mr. Downs:

Pursuant to Utah Rule R315-3-4, Section 4.3 and 40 CFR 270.42(c), Clean Harbors Grassy Mountain, LLC (referred to hereafter as CHGM) hereby requests a Class 3 permit modification to modify the language in the Utah Department of Environmental Quality (UDEQ), "State-Issued Part B Permit"(Permit), Module VI-Hazardous Waste Landfills, Section VI.A.1. This Class 3 permit modification request includes changes outlined in section J.1. of Appendix I to § 270.42.

Condition VI.A.1. defines the maximum approximate volumes and the maximum average height of waste allowed in a landfill cell at the time of closure. The included Design Engineering Report, prepared by Hansen, Allen & Luce, Inc. (HAL) and Applied Geotechnical Engineering Consultants (AGEC) provides the geotechnical evaluation and engineering calculations for the proposed design modifications for vertical expansions of landfill cells B6 and 7. Based on this report, CHGM is requesting a modification to this condition of the Permit to increase the permitted waste disposal capacity of landfill cells B6 and 7. CHGM requests the following revised language be incorporated into the Part B Permit:

VI.A.1. *The Permittee shall only dispose of hazardous wastes in the following landfill cells and the rated capacities shall not exceed the following nominal volumes shown below, except as allowed in Condition VI.D.2. In addition, measuring from the top of the berm, the average height of waste will be less than or equal to the maximum allowed height of waste in the cell at closure as shown below. The Executive Secretary has the authority to require the Permittee to conduct a survey of the cell to verify compliance with this condition.*

Cell Number	*Capacity (Cubic Yards)1*	*Maximum height of waste above the berm at closure, feet above avg. berm height*
4	*535,500*	*26.41*
5	*510,300*	*31.27*
B/6	*1,053,500*	*45.99*
7	*1,135,000*	*61.09*

1 Volumes are approximate. The point of compliance is the height above the berm. The berm height is calculated by averaging elevations measured every 50 linear feet around the perimeter (berm) of the cell.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

If you have any questions, please contact Les Ashwood at (435) 884-8900.

Sincerely,

William F. Connors
Senior Vice President of Compliance
Clean Harbors Environmental Services, Inc.

Attachment/

cc: Ed Costomiris, UDEQ/DSHW
Francis Tran, EPA Region VIII
Myron Bateman, E.H.S., M.P.A., Health Officer, Tooele County Health Department.
David Nielsen, Director of Landfill Compliance, Buttonwillow, CA
Grassy Mountain File

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March 31, 2010

Mr. Stephen S. Tuber
Assistance Regional Administrator
EPA Region VIII
1595 Wynkoop Street
Denver, CO 80202-1129

RE: Request for Closure Design Modifications for Vertical Expansion of Landfill Cell B6
Clean Harbors Grassy Mountain, LLC., EPA ID No. UTD991301748

Dear Mr. Tuber:

Pursuant to the requirements of United States Environmental Protection Agency (USEPA) issued Coordinated Approval of TSCA/RCRA Landfill Cell B6-Condition 6, Clean Harbors Grassy Mountain, LLC. (referred to hereafter as CHGM) hereby requests approval from the Assistant Region Administrator for modifications to the closure design for landfill cell B6. CHGM submits this modification request to increase the disposal capacity for landfill cell B6.

The included Design Engineering Report, prepared by Hansen, Allen & Luce, Inc. (HAL) and Applied Geotechnical Engineering Consultants (AGEC) provides the geotechnical evaluation and engineering calculations for the proposed design modifications for vertical expansion of landfill cell B6. Based on this report, CHGM is requesting approval to increase the design capacity to approximately 1,053,500 cubic yards. This vertical expansion will increase the capacity of cell B6 by 461,500 cubic yards.

In accordance with the requirements of Approval Condition 6, this request is being submitted simultaneously to the Utah Department of Environmental Quality as a Class 3 modification to the CHGM State Issued Part B Permit. A copy of that Permit modification request is included with this request.

"Under civil and criminal penalties of law for the making or submission of false or fraudulent statements or representations (18 U.S.C. 1001 and 15 U.S.C.2615), I certify that the information contained in or accompanying this document is true, accurate, and complete. As to the identified section(s) of this document for which I cannot personally verify truth and accuracy, I certify as the company official having supervisory responsibility for the person who, acting under my direct instructions, made the verification that this information is true, accurate and complete."

If you have any questions, please call me at (435) 884-8900.

Sincerely,

William F. Connors
Senior Vice President of Compliance
Clean Harbors Environmental Services, Inc.

Attachment/

cc: Francis Tran, EPA Region VIII
Ed Costomiris, UDEQ/DSHW
Myron Bateman, E.H.S., M.P.A., Health Officer, Tooele County Health Department.
David Nielsen, Director of Landfill Compliance, Buttonwillow, CA
Grassy Mountain File

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2010.01333

CLEAN HARBORS GRASSY MOUNTAIN, LLC TOOELE COUNTY, UTAH

LANDFILL CELLS 6B AND 7 CLOSURE DESIGN MODIFICATIONS FOR VERTICAL EXPANSION

DESIGN ENGINEERING REPORT

(HAL PROJECT NO.: 064.82.100)

March 2010

HANSEN ALLEN & LUCE inc
ENGINEERS

RECEIVED
APR 05 2010
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

CLEAN HARBORS
GRASSY MOUNTAIN, LLC

LANDFILL CELLS 6B AND 7
CLOSURE DESIGN MODIFICATIONS
FOR VERTICAL EXPANSION

DESIGN ENGINEERING REPORT

PROFESSIONAL ENGINEER
3/2010
MARVIN E.
ALLEN
151898
STATE OF UTAH

Prepared by:

HANSEN, ALLEN & LUCE, INC.
Consulting Engineers
6771 South 900 East
Midvale, Utah 84047
(801) 566-5599

March 2010

TABLE OF CONTENTS

PAGE

CHAPTER I INTRODUCTION . . . . . I - 1

CHAPTER II BACKGROUND . . . . . II - 1
LANDFILL CELL 6B . . . . . II - 1
Landfill Cell Design . . . . . II - 1
Closure Cap Design . . . . . II - 1
LANDFILL CELL 7 . . . . . II - 2
Landfill Cell Design . . . . . II - 2
Closure Cap Design . . . . . II - 2

CHAPTER III MODIFIED CLOSURE DESIGN . . . . . III - 1
CLOSURE CAP CONFIGURATIONS . . . . . III - 1
LANDFILL CAPACITIES . . . . . III - 2
CLOSURE CAP DRAINAGE . . . . . III - 2
Hydrology . . . . . III - 2
Perimeter Ditch and Down Drain Design . . . . . III - 3
Erosion Protection . . . . . III - 3
LEACHATE WITHDRAWAL PIPES . . . . . III - 4
GEOTECHNICAL EVALUATIONS . . . . . III - 4
Stability . . . . . III - 4
Settlement . . . . . III - 5

CHAPTER IV CONCLUSIONS . . . . . IV - 1

EXHIBIT A - DESIGN DRAWINGS
EXHIBIT B - GEOTECHNICAL EVALUATION
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS
SEPTEMBER 28, 2009, Revised March 15, 2010
EXHIBIT C - ENGINEERING CALCULATIONS

CHAPTER I

INTRODUCTION

Clean Harbors Grassy Mountain, LLC (Clean Harbors) is interested in increasing the height and the top slope of the closure caps of Landfill Cells 6B and 7, which will provide an increase in the permitted waste capacities within each of the cells. Clean Harbors requested that Hansen, Allen & Luce, Inc. (HAL) provide engineering evaluations to determine the potential for closure design modification. Applied Geotechnical Engineering Consultants (AGEC) was retained to perform geotechnical stability analyses of the raised closure caps to ensure stability under static and seismic conditions. This report provides a summary of background information associated with the design of the landfills and closure caps, presents proposed design modifications, and provides a summary of results from the geotechnical evaluation and other engineering calculations for the proposed design modifications. The geotechnical evaluation and engineering calculations are to provide a basis for approval of a permit modification from the Utah Division of Solid and Hazardous Waste (DSHW) for the proposed design modifications.

CHAPTER II

BACKGROUND

LANDFILL CELL 6B

Landfill Cell Design

The original design of Landfill Cell B/6 was completed and presented in a design engineering report dated January 1992 as RCRA Landfill Cell 6, with an original design capacity of 493,300 cy. Revisions to the design were completed and presented in a design engineering report dated September 1992 which incorporated design modifications and discussions resulting from regulatory changes that were made to the rules in 1992. The September 1992 design modifications included a design change to lower the floor by a vertical distance of 5 feet, which changed the design capacity to approximately 592,000 cy. A report dated January 1993 provided information regarding the effects of groundwater on lowering the floor 5 feet from the original design. The current permitted capacity of 592,000 cy reflects acceptance of the September 1992 design and the January 1993 report.

After construction of Landfill Cell 6 (constructed in 1993), the permit was revised to allow disposal of TSCA wastes and the cell was given the designation of Landfill Cell B/6 or Landfill Cell 6B. Both references have been used for the landfill since it was permitted to receive TSCA waste.

Closure Cap Design

The original closure cap design used to determine the permitted waste capacity consisted of the following (from top to bottom):

4 inches of gravel armor erosion protection
2 feet of protective soil cover
8 oz. Non-woven geotextile filter fabric
geonet
60-mil HDPE geomembrane (textured on the 2H:1V perimeter slopes)
2 feet (minimum) of compacted clay liner

Original design slopes consisted of 2H:1V (horizontal to vertical) perimeter slopes around closure caps extending from the top of the cell embankments to the outside edge of the closure cap's top slope. The top slope consisted of 5 percent slopes from the top center to the outside edges of the caps and 0.63 percent cross slopes to provide a resultant slope of 0.7 percent in the perimeter drainage ditches.

Original drainage design from the closure cap includes six different drainage areas. Runoff from the six drainage areas collects in the perimeter ditches that convey runoff to six different down drains (or down spouts) that convey storm water from the top of the closure cap to the bottom toe of the cell embankments.

LANDFILL CELL 7

Landfill Cell Design

Design of RCRA Landfill Cell 7 was completed and presented in a design engineering reported dated December 1995 with an original design capacity of 645,100 cy. Construction of the cell was completed and construction documentation was submitted in November 1996. Engineering evaluations and geotechnical stability and settlement analyses were completed in December 2000, and were provided to the facility for a permit application to increase the capacity to 733,000 cubic yards by raising the height of the closure cap 2.18 feet and by replacing the compacted clay liner with GCL. This permit modification was approved by DSHW.

Closure Cap Design

The original closure cap design used to determine the permitted waste capacity consisted of the following (from top to bottom):

<u>On the top slopes</u>
4 inches of gravel armor erosion protection
24 inches of protective soil cover
8 oz. Non-woven geotextile filter fabric
geonet
60-mil HDPE geomembrane
geosynthetic clay liner (GCL)
six inches (minimum) of soil cushion

<u>On the perimeter slopes</u>
4 inches of gravel armor erosion protection
24 inches of protective soil cover
8 oz. Non-woven geotextile filter fabric
geonet
60-mil HDPE textured geomembrane
2 feet minimum of compacted clay liner (CCL)

Original design slopes consisted of 2H:1V (horizontal to vertical) perimeter slopes around closure caps extending from the top of the cell embankments to the outside edge of the top slope of the closure caps. The top slope consisted of 5 percent slopes from the top center to the outside edges of the caps and 0.63 percent cross slopes to provide a resultant slope of 0.7 percent in the perimeter drainage ditches.

Original drainage design from the closure cap includes four different drainage areas. Runoff from the four drainage areas collects in the perimeter ditches that convey runoff to four different down drains (or down spouts) that convey storm water from the top of the closure cap to the bottom toe of the cell embankments.

CHAPTER III

MODIFIED CLOSURE DESIGN

CLOSURE CAP CONFIGURATIONS

The proposed closure cap design for both Landfill Cell 6B and Landfill Cell 7 consists of the following from top to bottom (See Exhibit A for drawings):

On the top 10% slopes
4 inches of gravel armor erosion protection
24 inches of protective soil cover
Double sided geocomposite (consisting of 8 oz. Non-woven geotextile filter fabric bonded to both sides of geonet)
60-mil HDPE textured geomembrane
geosynthetic clay liner (GCL)
six inches (minimum) of soil cushion

On the perimeter 2H:1V slopes
4 inches of gravel armor erosion protection
24 inches of protective soil cover (compacted clay soil)
60-mil HDPE textured geomembrane
2 feet minimum of compacted clay liner (CCL)

Design slopes include 2H:1V (horizontal to vertical) perimeter slopes around closure cap extending from the top of the cell embankments to the outside edge of the top slope of the closure cap. The top slope consists of 10 percent slopes from the top center to the outside edges of the cap and 0.80 percent cross slopes to provide a resultant slope of 1.0 percent in the perimeter drainage ditches.

Landfill Cell 6B is designed to have a maximum vertical height of 28 feet from the top of the cell embankment to the top of the perimeter berms. Total vertical height at the center of the Cell 6B closure cap is 48.82 feet above the cell embankment. Landfill Cell 7 is designed to have a maximum vertical height of 29 feet from the top of the cell embankment to the top of the perimeter berms. Total vertical height at the center of the Cell 7 closure cap is 63.92 feet above the cell embankment. Landfill Cell 7 has a much higher center height because it is approximately 286 feet wider than Landfill Cell 6B which provides a greater distance of rise for the 10 percent slope.

The perimeter drainage ditches are V-shaped with a perimeter berm providing the outside 3H:1V slope and the 10 percent closure cap slope providing the inside side slope for the ditches. The perimeter ditches are designed to receive storm water runoff from the 10 percent cap slope areas and convey the runoff to down drains, which convey storm water to the bottom exterior toes of the landfill cell embankments.

LANDFILL CAPACITIES

Capacities of the landfill cells were determined using volume calculation routines within AutoCAD Civil 3D 2010 by Autodesk. Surfaces were built within AutoCAD, representing the surface of the protective soil cover above the bottom lining system within the cell and the top of the waste mound based on the modified closure cap design. These two surfaces were then defined to determine the capacity within the landfill cell using a grid spacing of 2 feet in both the north/south and the east/west directions. The modified capacity within Cell 6B is approximately 1,053,500 cubic yards and the modified capacity within Cell 7 is approximately 1,135,800 cubic yards.

CLOSURE CAP DRAINAGE

Hydrology

Runoff was estimated using the SCS curve number methodology and the unit hydrograph procedure developed by the USDA Soil Conservation Service. Hydrologic calculations are presented in Exhibit C. Rainfall depth for the 100-year, 24-hour precipitation event of 1.85 inches was obtained from Point Precipitation Frequency Estimates from NOAA Atlas 14 using the coordinates and elevations of the Grassy Mountain Facility.

A gravel road with hydrologic soil group B has a curve number of 85. The gravel armor erosion protective layer is not compacted, has less fines, and has greater storm water retention potential than a gravel road. Therefore, a curve number of 83 was estimated to conservatively represent the runoff conditions for the gravel armor surfaces.

Design of the perimeter drainage ditches and the down drains was based on using the largest drainage areas for Landfill Cells 6B and 7. Therefore, the drainage areas for Cells 6B and 7 were evaluated to determine the largest contributing area to the perimeter ditch and to the down drain. Runoff calculated on the largest areas was then used for for design of all perimeter ditches and for all down drains for both landfill cell closure caps.

The closure cap for landfill Cell 6B consists of six different drainage areas that collect and convey storm water runoff to six down drains (or down spouts) located around the perimeter of the closure cap. Four drainage areas are located at each of the four corners of the closure cap, and two of the drainage areas are located at the center of the north and south sides of the closure cap. The drainage areas at the center of the north and south sides each have areas of 79,000 square feet (1.814 acres) which are larger than the four drainage areas located at the corners of the closure cap. A single drainage area contributes runoff to a segment of the perimeter ditch and two of the center drainage areas (158,000 square feet or 3.627 acres) combine to contribute drainage to a single down drain.

The closure cap for Landfill Cell 7 is symmetrical such that four drainage areas are located in the corners of the closure cap and the drainage areas are all equal in size. The largest area contributing runoff to the perimeter ditches is 69,000 square feet (1.584 acres) and the largest area contributing runoff to a down drain is 138,000 square feet (3.168 acres).

Perimeter Ditch and Down Drain Design

Using 1.814 acres of area provides an estimated peak discharge of 1.16 cfs to the drainage ditches and using an area of 3.627 acres provides an estimated peak discharge of 2.32 cfs (i.e. 2 x 1.16 cfs) to the down drains. The perimeter ditches will convey 1.16 cfs with a flow depth of about 0.4 foot and a safety factor of about 1.5 against erosion of the gravel armor material in the perimeter ditches. An 18-inch diameter pipe will convey the 2.32 cfs with a headwater depth of 0.8 foot at the pipe inlet. Since the inlet boxes are 1.5 feet deep below the perimeter ditch flow lines, the headwater depth of 0.8 foot will not obstruct or back storm water in the perimeter ditches.

Erosion Protection

Erosion protection calculations were completed on the gravel armor material for both the 10 percent top slope and the 2H:1V perimeter slopes of the closure caps. These calculations were completed for the longest slopes (worst case conditions) represented for the closure caps of both cells. Results were then applied to all slopes on both of the closure caps. "Erosion and Sedimentation in Utah - A Guide for Control" published by the Utah Water Research Laboratory, February 1984, was used to determine the depth of the gravel armor needed for erosion protection. The maximum length of the 10 percent slopes for both cells is 361 feet and the maximum length of the 2H:1V slopes is 65 feet. Using these slope lengths, the minimum gravel armor thickness is 1 inch for the 10 percent slopes and 3 inches for the 2H:1V slopes.

Stephens method from NUREG/CR-4651was used to determine the minimum D_{50} size for the gravel armor material based on the estimated flow per foot of width across the gravel armor. The flow per unit width was calculated using the storm water discharge rate estimated for an acre of area for the closure caps. The longest slope length for the 10 percent slopes is 361 feet resulting in a width of 120 feet and the longest slope length for the 2H:1V slopes is 65 feet resulting in a width of 570 feet for corresponding one acre areas. Dividing that storm water discharge of 0.64 cfs per acre by 120 and by 570 gives a flow per unit width of 0.01 cfs per foot for the 10 percent slopes and 0.002 cfs per foot for the 2H:1V slopes. Concentration factors are not a component of NUREG/CR-4651 procedure, but are provided to show the types of flow concentration that may occur, beyond the safety factors already provided in the procedure, and still maintain erosion stability. The concentration factors were calculated assuming a D_{50} size of approximately 1 inch which is representative of the local gravel source historically used for the gravel armor. A D_{50} size of 1 inch will allow for additional flow concentrations of 20 times on the 10 percent slopes and of 3 times on the 2H:1V slopes and still maintain stability against erosion. An additional factor of 1.35, called Oliver's constant, was also applied to the flow rates as suggested in NUREG/CR-4651. Flow rates used for calculating the D_{50} size, after applying the factors discussed, are 0.27 cfs per foot for the 10 percent slopes and 0.008 cfs per foot for the 2H:1V slopes. Calculated minimum D_{50} sizes are 0.90 inch for the 10 percent slopes and 0.98 inch for the 2H:1V slopes.

The minimum gravel thickness should accommodate twice the D_{50} size rock which is about 2 inches. Applying erosion control procedures for determining gravel thickness and using criteria for establishing the D_{50} rock size results in minimum gravel thicknesses of 2 inches for the 10 percent slopes and 3 inches for the 2H:1V slopes.

The closure caps and cell embankments have historically received a gravel armor thickness of 4 inches (as is shown on the closure cap design drawings) due to the difficulty in consistently placing

less thickness of gravel armor with a D_{50} size of about 1 inch. Observations show no noticeable erosion where gravel armor has previously been placed on closure caps and embankment slopes. Therefore, it is recommended that the erosion control measures consist of a targeted 4 inches of gravel armor thickness on all surfaces with a minimum of 3 inches on the 2H:1V slopes and a minimum of 2 inches on the 10 percent slopes.

LEACHATE WITHDRAWAL PIPES

The leachate withdrawal pipes were evaluated to determine their structural integrity under the increased weight (or loading) resulting from the vertical expansion. High density polyethylene (HDPE) pipes with a standard dimension ratio (SDR) of 21 were installed in the landfills and were evaluated for wall crushing, wall buckling, and ring deflection. Calculations show the vertical expansion will not jeopardize the structural integrity of the leachate withdrawal pipes.

GEOTECHNICAL EVALUATIONS

Geotechnical stability and settlement evaluations were completed by Applied Geotechnical Engineering Consultants (AGEC) to determine the feasibility of increasing the closure cap height and are provided in a letter report dated September 28, 2009. The letter report in included in Exhibit B.

Results from these evaluations show that the closure cap for Landfill Cell 6B can be raised to a height of 28 feet and the closure cap height for Landfill Cell 7 can be raised to a height of 29 feet from the top of the landfill cell embankments to the top of the highest point of the perimeter berms around the closure caps and still maintain stability and the integrity of other engineering aspects of the landfill cell and the closure cap.

Stability

Stability analyses included evaluating the global stability of the landfill cells and underlying soil structures and local interface stability of the cap design layers using saturated conditions. Stability analyses were conducted assuming both static and seismic conditions.

Stability evaluations were based on a seismic event having a 90 percent probability of not being exceeded in a 250 year period. A bedrock acceleration of 0.15g was used resulting in a horizontal ground acceleration of 0.18g for the site, which was used in the stability analysis. Soil parameters used were obtained from reports of previous geotechnical studies at the site. Safety factors were determined under static and seismic conditions for the overall landfill including subsurface soils and for the closure cap side slopes. Results of the analysis are presented in Table III-1. The seismic analysis and resulting safety factors assume no deformation.

Infinite slope stability analyses were used to determine interface stability safety factors for the design components of the 2H:1V and the 10 percent slopes of the closure caps. Results from these analyses are also presented in Table III-1. The soil strength at the interface with the HDPE textured membrane on the 2H:1V slopes were evaluated to ensure that soil strength will not be exceeded. Slope stability safety factors using soil strengths are 3.6 under static conditions and 1.8 under seismic conditions using a slope length of 63 feet (representing the longest slope length or worst case scenario).

TABLE III-1
Minimum Landfill and Closure Cap Safety Factors for Stability of Landfill Cell 6B and Landfill Cell 7

Description	Safety Factor	
	Static	Seismic
Overall landfill slope stability, including subsurface soils	1.9	1.2
Closure cap slope stability	1.6	1.1
Interface slope stability on 2H:1V perimeter slopes using infinite slope analysis	1.8	1.3
Interface slope stability on top 10% slopes using infinite slope analysis	5.1	1.8

Note: Safety factors presented are minimum and are similar for Landfill Cells 6B and 7 combined.

Settlement

Calculations were performed considering the additional waste height and increase in final closure top slope. Settlement calculations were completed to provide a settlement profile and to determine the final slope of the cell floor after settlement. Subsurface soil profiles and conditions were obtained from previous geotechnical evaluations performed at the site.

Landfill Cell 6B had a design slope of 2.7 percent at the time of construction and is estimated to have a final floor slope of 2.2 percent after settlement and Landfill Cell 7 had a design slope of 2.3 percent at the time of construction and is estimated to have a final floor slope of 1.8 percent after settlement with the modified closure designs. The final floor slopes meet the regulatory minimum slope requirements of 1 percent.

CHAPTER IV

CONCLUSIONS

The Landfill Cell 6B and Landfill Cell 7 closure cap designs can be raised and modified as presented herein. The modified design is presented in the design drawings provided in Exhibit A and is summarized herein.

Layers (from the uppermost layer to the bottom layer) within the 10 percent top slopes and the 2H:1V perimeter slopes are provided below:

<u>10 Percent Top Slopes</u>
4 inches of gravel armor erosion protection
24 inches of protective soil cover
Double sided geocomposite (consisting of 8 oz. Non-woven geotextile filter fabric bonded to both sides of geonet)
60-mil HDPE textured geomembrane
geosynthetic clay liner (GCL)
six inches (minimum) of soil cushion

<u>2H:1V Perimeter Slopes</u>
4 inches of gravel armor erosion protection
24 inches of protective soil cover (compacted clay soil)
60-mil HDPE textured geomembrane
2 feet minimum of compacted clay liner (CCL)

Landfill Cell 6B is designed to have a maximum vertical height of 28 feet from the top of the cell embankment to the top of the perimeter berms. Total vertical height at the center of the Cell 6B closure cap is 48.82 feet above the cell embankment. Landfill Cell 7 is designed to have a maximum vertical height of 29 feet from the top of the cell embankment to the top of the perimeter berms. Total vertical height at the center of the Cell 7 closure cap is 63.92 feet above the cell embankment.

The perimeter drainage ditches are V-shaped with a perimeter berm providing the outside 3H:1V slope and the 10 percent closure cap slope providing the inside side slope for the ditches. The perimeter ditches are designed to receive storm water runoff from the 10 percent cap slope areas and convey the runoff to down drains which convey storm water to the bottom exterior toes of the landfill cell embankments.

The armor plating thickness (stone mulch) should be a minimum of 3 inches on the 2H:1V perimeter slopes and 2 inches on the 10% slopes. The target thickness of 4 inches provided on all surfaces in the design drawings allows for some grading tolerance during placement.

The modified capacity within Cell 6B is approximately 1,053,500 cubic yards and the modified capacity within Cell 7 is approximately 1,135,800 cubic yards. This vertical expansion will increase the capacity of Cells 6B and 7 by 461,500 cy and 402,800 cy, respectively.

EXHIBIT A

DESIGN DRAWINGS

CleanHarbors®
ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY

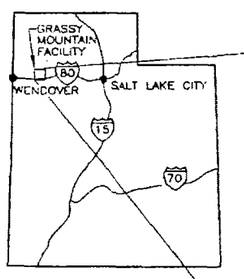
LANDFILL CELL 6B CLOSURE

MODIFIED DESIGN

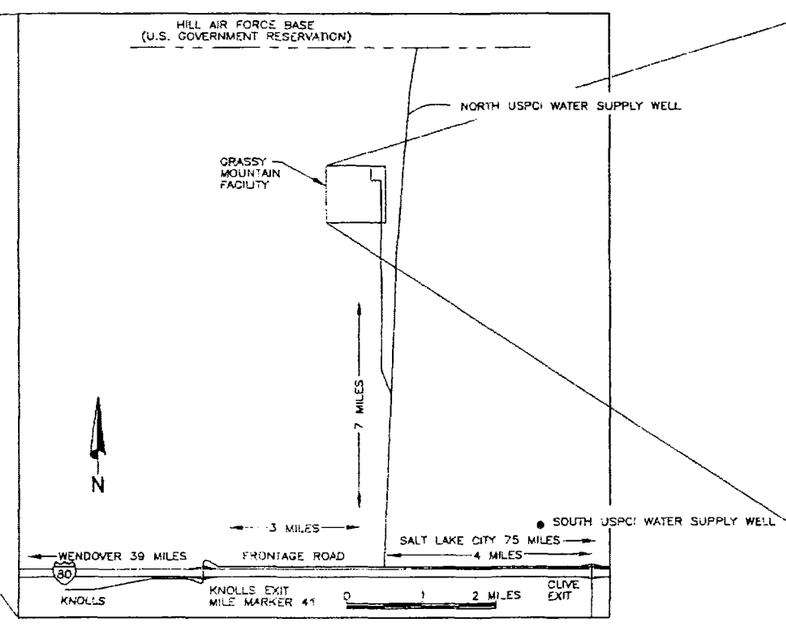
MARCH 2010

FACILITY LOCATION
KNOLLS, UTAH
Phone: (435) 884-8900

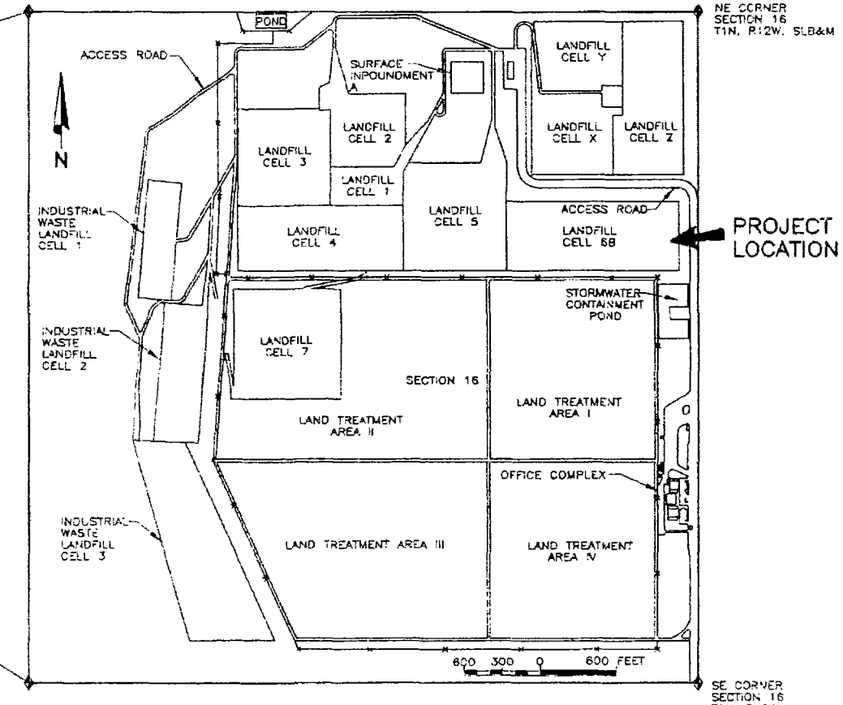
REGIONAL HEADQUARTERS
42 LONGWATER DRIVE
NORWELL, MA 02061
Phone: (781) 792-5000



STATE OF UTAH



VICINITY MAP



PROJECT LOCATION

PROFESSIONAL ENGINEER
3/9/10
NO. 151898
MARVIN E. ALLEN
STATE OF UTAH

WARSER ALLEN & LUCE inc
ENGINEERS
CONSULTANTS
ENGINEERS
Salt Lake City
Utah

FILE NAME: 08+ - CLEAN HARBORS\82.100 - CB6-C7 MOUNDING\CAD\CELL 6B\CURRENT DESIGN\068-1 CELL 6B COVER.DWG
FILE DATE: 3.9.2010 11:53:19 (CAH)

GENERAL NOTES

1. COORDINATES AND ELEVATIONS PROVIDED ARE BASED ON SITE SPECIFIC COORDINATE SYSTEM AND DATUM CONTROL.
2. ALL ELEVATIONS PROVIDED ARE BASED ON ORIGINAL EMBANKMENT DESIGN AND CONSTRUCTION ELEVATIONS. ADJUSTMENTS SHALL BE MADE PRIOR TO CLOSURE TO ACCOUNT FOR SETTLEMENT.

LINING SYSTEM SUBGRADES & SOIL FILL

1. ALL SURFACES PROVIDING SUBGRADES FOR LINING SYSTEMS SHALL BE PROOF ROLLED FOR SOFT AND/OR YIELDING SURFACES. SOFT AND/OR YIELDING SURFACES SHALL BE COMPACTED TO PROVIDE A FIRM SUBGRADE FOR LINING SYSTEMS.
2. ALL CLAY LINER MATERIALS SHALL BE COMPACTED TO 95% OF ASTM D-698 AT A MOISTURE CONTENT BETWEEN MINUS 2% AND PLUS 4% OF OPTIMUM. ALL CLAY LINER SHALL MEET THE REQUIRED PERMEABILITY OF 1 X 10-7 CM/SEC. A DEFLOCCULATING AGENT (SODIUM-TRIPOLY PHOSPHATE) MIXED WITH THE CLAY LINER AT A MINIMUM RATE OF 3.5 POUNDS PER 50 CUBIC FEET OF LOOSE MATERIAL IS TYPICALLY REQUIRED TO MEET THE REQUIRED PERMEABILITY. CLAY LINER SURFACES SHALL BE MAINTAINED UNTIL PLACEMENT OF OVERLYING GEOSYNTHETIC MATERIALS.
3. ALL FILL MATERIALS REQUIRING COMPACTION, ON THE PERIMETER SIDESLOPES, PIPE BACKFILL, AND OTHER DESIGNATED COMPACTION AREAS SHALL BE COMPACTED TO 95% OF ASTM D-698 AT A MOISTURE REQUIRED TO FACILITATE COMPACTION.
4. THE SUB-GRADE FOR THE GEOSYNTHETIC MATERIALS SHALL BE FREE OF PROTRUDING ROCKS AND DEBRIS THAT MAY POTENTIALLY CAUSE DAMAGE TO THE GEOSYNTHETIC MATERIALS. THE SUBGRADE SHALL ALSO BE ROLLED WITH A SMOOTH DRUM ROLLER TO LEAVE THE SURFACE SMOOTH.
5. BORROW SOURCES FOR 6-INCH THICK SAND AND 2-FOOT THICK PROCTECTIVE SOIL COVER LAYERS TO BE APPROVED BASED ON THE FOLLOWING TESTS USING LIQUID OBTAINED FROM SYNTHETIC LEACHATE PRODUCED USING BORROW SOURCE SOILS: 1. SCREENING CLAY PORTION OF GEOSYNTHETIC CLAY LINER FOR CHEMICAL COMPATIBILITY TO LIQUIDS (ASTM D6141); 2. SWELL INDEX (ASTM D5890); 3. FLUID LOSS TESTING (ASTM D5891); AND 4.HYDRAULIC CONDUCTIVITY (ASTM D6766 OR ASTM D5084) AS REQUIRED BY THE ENGINEER BASED ON RESULTS OF OTHER TESTING. MAXIMUM HYDRAULIC CONDUCTIVITY OF GCL SHALL MEET AN EQUIVALENCY OF A 2-FOOT THICK COMPACTED CLAY LINER WITH A HYDRAULIC CONDUCTIVITY OF 1X10-7 CM/SEC.
6. COMPACTED CLAY SOIL ON THE PERIMETER SLOPES HAS NO PERMEABILITY REQUIREMENT AND SHALL BE COMPACTED TO 95% OF ASDM D-698.

GENERAL GEOSYNTHETICS

1. MANUFACTURER'S CERTIFICATIONS SHALL BE PROVIDED FOR ALL RAW AND MANUFACTURED MATERIALS. CERTIFICATIONS SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S MATERIAL SPECIFICATIONS AND PROJECT CQA PLAN CRITERIA AND SHALL INCLUDE ALL TEST DATA FOR MATERIALS DELIVERED AND AT A MINIMUM, THE TEST FREQUENCIES DESIGNATED IN THE MANUFACTURER'S QUALITY ASSURANCE MANUALS AND SPECIFICATIONS AND THE PROJECT CQA PLAN.
2. ALL GEOSYNTHETIC MATERIALS SHALL BE LOADED, TRANSPORTED, OFF-LOADED, STORED, AND HANDLED IN ACCORDANCE WITH MANUFACTURER RECOMMENDATIONS.
3. AT A MINIMUM, ALL GEOSYNTHETIC MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND INSTALLATION GUIDES AND IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS AND CQA PLAN.
4. THE GEOSYNTHETIC INSTALLER SHALL PROVIDE A SUBGRADE ACCEPTANCE CERTIFICATION FOR ALL AREAS OF GCL DEPLOYMENT.

GEOSYNTHETIC CLAY LINER (GCL)

1. ALL GCL MATERIALS SHALL BE NEEDLE PUNCH REINFORCED.
2. GCL SHALL BE DEPLOYED WITH NON-WOVEN GEOTEXTILE SIDE UP.
3. ALL DEPLOYED GCL MATERIALS SHALL BE COVERED BY THE END OF EACH WORK DAY TO MINIMIZE EVAPORATION OF MOISTURE WITHIN THE BENTONITE AND TO PROTECT THE GCL MATERIALS FROM EXPOSURE TO RAINY AND SNOWY WEATHER.
4. SEAMING SHALL BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS, THE PROJECT SPECIFICATIONS, AND THE PROJECT CQA PLAN.
5. GCL MATERIALS THAT ARE MANUFACTURED TO PROVIDE SELF-SEALING SEAMS AND DO NOT REQUIRE A BENTONITE BEAD SHALL RECEIVE A BENTONITE BEAD WHEN THE SELF-SEALING DESIGN IS COMPROMISED ON THE ENDS OF PANELS AND WHERE THE SELF-SEALING GROOVE (IF PART OF THE SELF-SEALING DESIGN) HAS BEEN REMOVED FROM PARTIAL WIDTH ROLLS.
6. GCL MATERIALS THAT HAVE NOT BEEN MANUFACTURED TO PROVIDE SELF SEALING SEAMS SHALL RECEIVE A BENTONITE BEAD TO PROVIDE THE SEAM SEAL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

GEOMEMBRANE LINER

1. ALL GEOMEMBRANE MATERIALS SHALL BE TEXTURED ON BOTH SIDES.
2. NO GEOMEMBRANE MATERIALS SHALL BE DEPLOYED IN SUB-FREEZING TEMPERATURES UNLESS APPROVED BY OWNER WITH AN APPROVED COLD WEATHER DEPLOYMENT PLAN.
3. NO SEAMING SHALL BE ALLOWED IN SUB-FREEZING TEMPERATURES WITHOUT OWNER APPROVAL OF AN APPROPRIATE COLD WEATHER SEAMING PLAN AND ONLY AFTER PROPER DEMONSTRATION OF PRE-QUALIFIED TEST SEAMS.
4. FIELD TESTING AND QUALITY CONTROL SHALL FOLLOW, AT A MINIMUM, THE REQUIREMENTS PROVIDED IN THE MOST RECENT VERSION OF THE INTERNATIONAL ASSOCIATION OF GEOSYNTHETIC INSTALLERS HDPE AND LLDPE GEOMEMBRANE INSTALLATION SPECIFICATION, THE MANUFACTURERS INSTALLATION PROCEDURES, AND/OR THE PROJECT SPECIFICATIONS AND CQA PLAN, WHICHEVER IS MOST STRINGENT.

DRAINAGE COMPOSITE

1. DOUBLE-SIDED DRAINAGE COMPOSITE SHALL CONSIST OF 8OZ. NON-WOVEN GEOTEXTILE BONDED TO BOTH SIDES OF GEONET.
2. GEOMEMBRANE MATERIALS SHALL BE CLEANED OF DIRT AND DEBRIS PRIOR TO DEPLOYMENT OF DRAINAGE COMPOSITS.
3. DRAINAGE COMPOSITE SHALL BE FASTENED OR SECURED WITH HEAT BONDING, SEWING OR OTHER APPROVED METHOD, BETWEEN GEOTEXTILE FABRIC MATERIALS ALONG THE ENTIRE LENGTH OF THE SEAMS.
4. OVERLAPS OF SEAMS SHALL BE, AT A MINIMUM, THE DIMENSIONS RECOMMENDED BY THE MANUFACTURES.

PROTECTIVE SOIL COVER

1. CARE SHALL BE EXERCISED DURING PLACEMENT OF PROTECTIVE SOIL COVER MATERIALS. A MINIMUM COVER THICKNESS AS DESIGNATED IN THE PROJECT SPECIFICATIONS AND/OR THE PROJECT CQA PLAN SHALL BE MAINTAINED AT ALL TIMES BETWEEN THE TIRES OR TRACKS OF EQUIPMENT AND THE UNDERLYING GEOSYNTHETIC MATERIALS.
2. NO SHARP, ABRUPT, OR PIVOTING TURNS SHALL BE ALLOWED BY EQUIPMENT USED ABOVE THE PROTECTIVE SOIL COVER THAT MAY CAUSE SOIL DISPLACEMENT AND DAMAGE TO UNDERLYING GEOSYNTHETIC MATERIALS.
3. ANY WAVES OR WRINKLES THAT BEGIN TO FORM SHALL BE TRAPPED BY PLACING SUFFICIENT PROTECTIVE SOIL COVER BEYOND THE WAVES OR WRINKLES TO HOLD THEM IN PLACE AND KEEP THEM FROM COMBINING INTO LARGER WAVES OR WRINKLES.

GRAVEL ARMOR PLATING (STONE MULCH)

1. STONE MULCH SHALL BE PLACED TO A THICKNESS OF 4 INCHES ON ALL CLOSURE SURFACES. MINIMUM THICKNESS SHALL BE 2 INCHES ON 10% SLOPES AND 3 INCHES ON 2H:1V SLOPES.
2. MINIMUM D50 SIZE FOR STONE MULCH SHALL BE 0.98 INCH AND SHALL BE VERIFIED BY TESTING.

STORM DRAINAGE SYSTEM

1. ALL MANHOLES, LIDS, AND RINGS AND COVERS SHALL BE RATED FOR H20 LOADINGS.
2. RINGS AND COVERS AND GRATED COVERS SHALL PROVIDE A MINIMUM OPENING FOR ACCESS OF 30 INCHES.
3. GRATED COVERS SHALL BE USED FOR EMBANKMENT DRAINAGE DITCH INLETS
4. A 10' X 10' CONCRETE APRON SHALL BE PLACED AROUND ALL MANHOLE COVERS.
5. RIPRAP APRON AT CONCRETE BAFFLED OUTLETS TO EXTEND A MINIMUM DISTANCE OF 5 FEET, TO BE 12 INCHES THICK, AND HAVE A D_{50}=3".
6. TYPE L RIPRAP AND TYPE II FILTER TO EXTEND AT A RADIUS OF 14 FEET MINIMUM FROM THE DOWNSPOUT PIPE OUTLET (WHERE BAFFLED OUTLETS ARE NOT PROVIDED) AND TO CONSIST OF THE FOLLOWING GRADATIONS:

	% SMALLER BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	MEAN ROCK DIAMETER D_{50} (INCHES)
TYPE L RIPRAP	70-100	14	
	50-70	12	
	35-50	9	9
	2-10	3	

	U.S. STANDARD SIEVE SIZE	PERCENT PASSING BY WEIGHT
TYPE II GRANULAR FILTER	3-INCH	90-100
	3/4 INCH	35-90
	NO. 4	8-30
	NO. 15	0-10
	NO. 200	0-3

INDEX OF DRAWINGS

GENERAL

G6B-1 COVER SHEET
G6B-2 INDEX SHEET

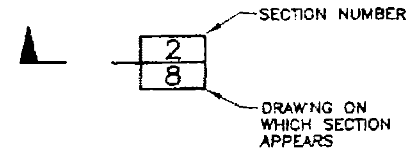
CIVIL-CELL 6B CLOSURE

C6B-1 WASTE GRADE PLAN
C6B-2 LINER SURFACE PLAN
C6B-3 FINAL CLOSURE PLAN
C6B-4 TYPICAL HIGH-LOW SECTIONS

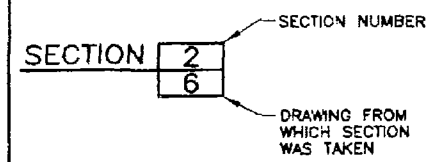
SECTION & DETAIL IDENTIFICATION

SECTION IDENTIFICATION

SECTION CUT ON DRAWING NO. 6 AND SHOWN ON DRAWING NO. 8
ON DRAWING NO. 6 THIS SECTION IS REFERENCED AS:

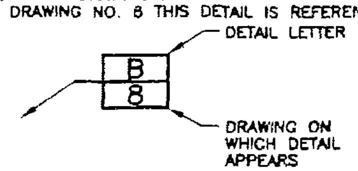


ON DRAWING NO. 8, THIS SECTION IS IDENTIFIED AS:

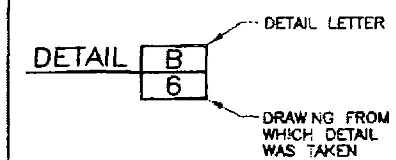


DETAIL IDENTIFICATION

DETAIL CALL-OUT ON DRAWING NO. 6 AND SHOWN ON DRAWING NO. 8
ON DRAWING NO. 6 THIS DETAIL IS REFERENCED AS:



ON DRAWING NO. 8, THIS DETAIL IS IDENTIFIED AS:



NOTES:

1. IF SECTION AND DETAILS ARE SHOWN ON THE SAME DRAWING AS SECTION CUTS AND SECTION OR DETAIL CALL-OUTS DRAWING NUMBER IS REPLACED BY A LINE.
2. DETAIL LETTERS "I" AND "O" NOT USED.

TABLE OF ABBREVIATIONS

●	AIR GAS VENT	MH	MANHOLE
@	AT	MIN.	MINIMUM
AVG.	AVERAGE	N.	NORTH
C.C.	CENTER TO CENTER	N.T.S.	NOT TO SCALE
℄	CENTER LINE	O.C.	ON CENTER
CLR.	CLEARANCE	PC	POINT OF CURVE
CONT.	CONTINUOUS	PI	POINT OF INTERSECTION
CPP	CORRUGATED POLYETHYLENE PIPE	PSI	POUND PER SQUARE INCH
DIA.	DIAMETER	PT	POINT OF TANGENT
DWG	DRAWING	REINF	REINFORCEMENT
E.	EAST	SDR	STANDARD DIMENSIONAL RATIO
EF	EACH FACE	SF	SQUARE FEET
EL.	ELEVATION	SQ.	SQUARE
E.W.	EACH WAY	STA.	STATION
FL	FLOW LINE	TL	TOP OF LINER
HDPE	HIGH DENSITY POLYETHYLENE	T.O.C.	TOP OF CONCRETE
ID	INSIDE DIAMETER	TYP.	TYPICAL
MAX.	MAXIMUM	UBC	UNTREATED BASE COURSE

PROFESSIONAL ENGINEER 3/9/10 NO. 151893 MARVINE ALLEN STATE OF UTAH

HARPER ALLEN & LUCE ENGINEERS — PROJECT ENGINEER

DESIGNED KCS	3					
DRAFTED CAH	2					
CHECKED MEA	1					
DATE MARCH 2010	NO.	DATE	REVISIONS	BY	APVD.	

SCALE: NOT TO SCALE

CleanHarbors ENVIRONMENTAL SERVICES, INC.

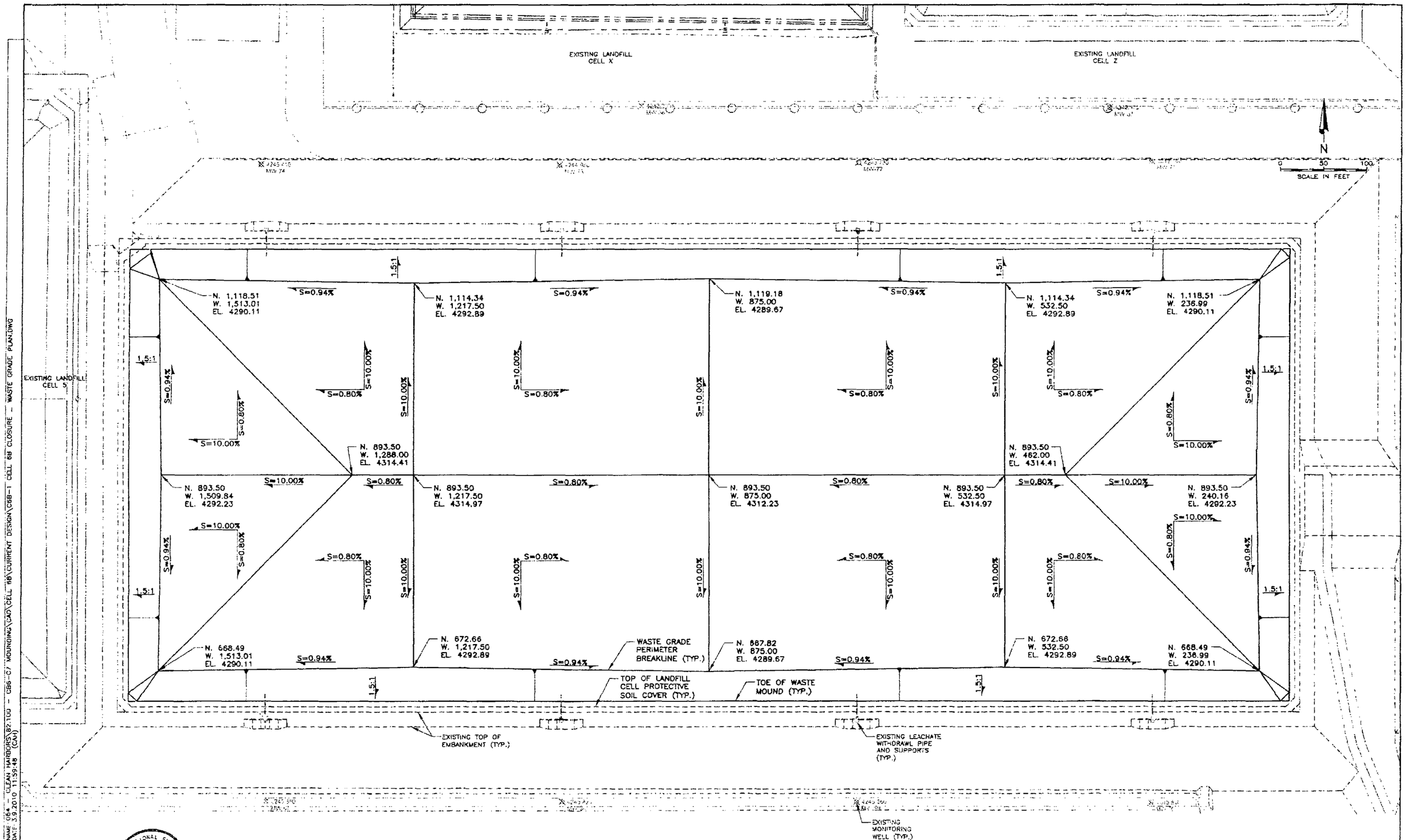
GRASSY MOUNTAIN FACILITY
LANDFILL CELL 6B - CLOSURE
INDEX SHEET

SHEET G6B-2

64.82.100

FILE NAME: 064 - CLEAN HARBORS\82.100 - C6B-C7 MOUNDING\CAD\CELL 6B\CURRENT DESIGN\G6B-2 CELL 6B INDEX_SHEET.DWG
FILE DATE: 3.9.2010 11:57:55 (CAH)

10/07 10



FILE NAME: C64 – CLEAN HARBORS\82.100 – C6B-C7 MOUNDING\CAD\CELL 6B\CURRENT DESIGN\C6B-1 CELL 6B CLOSURE – WASTE GRADE PLAN.DWG
FILE DATE: 3.9.2010 11:39:48 (CAH)

HARDER ELLER & LUCE INC. ENGINEERS

PROFESSIONAL ENGINEER 3/9/10 NO. 11888 MARVIN E. ALLEN

PROJECT ENGINEER

DESIGNED KCS	3				
DRAFTED CAH	2				
CHECKED MEA	1				
DATE MARCH 2010	NO.	DATE	REVISIONS	BY	APVD.

SCALE: AS SHOWN

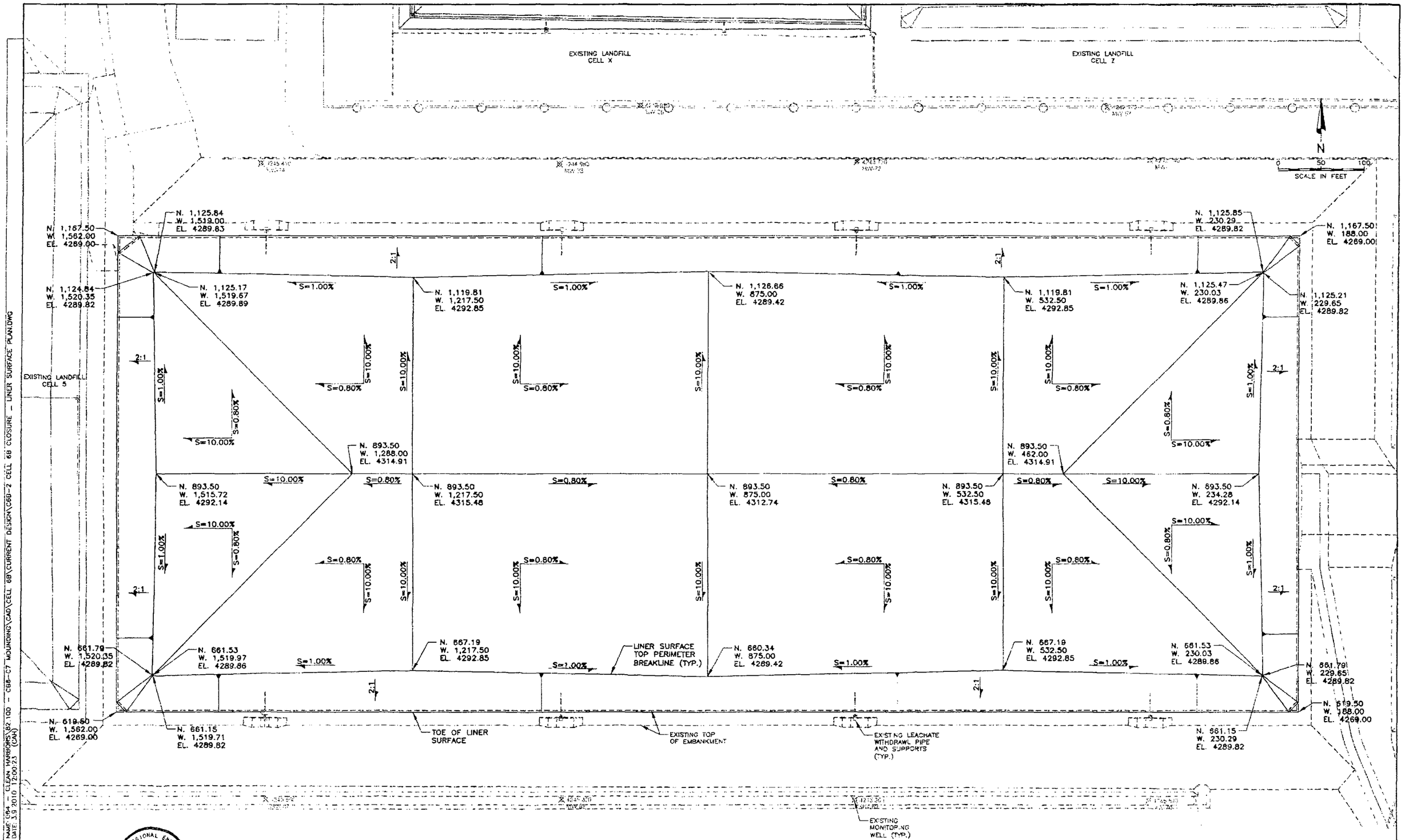
CleanHarbors® ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY
LANDFILL CELL 6B – CLOSURE
WASTE GRADE PLAN

SHEET C6B–1

54.82.100

10/07



FILE NAME: C6A — CLEAN HARBORS 82.100 — C6B-C7 MOUNDING\CAD\CELL 6B\CURRENT DESIGN\C6B-2 CELL 6B CLOSURE - LINER SURFACE PLAN.DWG
FILE DATE: 3.9.2010 12:00:23 (CAH)

PROFESSIONAL ENGINEER NO. 15186 MARVIN E. ALPER 3/9/10

HARDER ALPER & LUCE ENGINEERS	PROJECT ENGINEER	DESIGNED KCS	3				
		DRAFTED CAH	2				
		CHECKED MEA	1				
		DATE MARCH 2010	NO.	DATE	REVISIONS	BY	APVD.

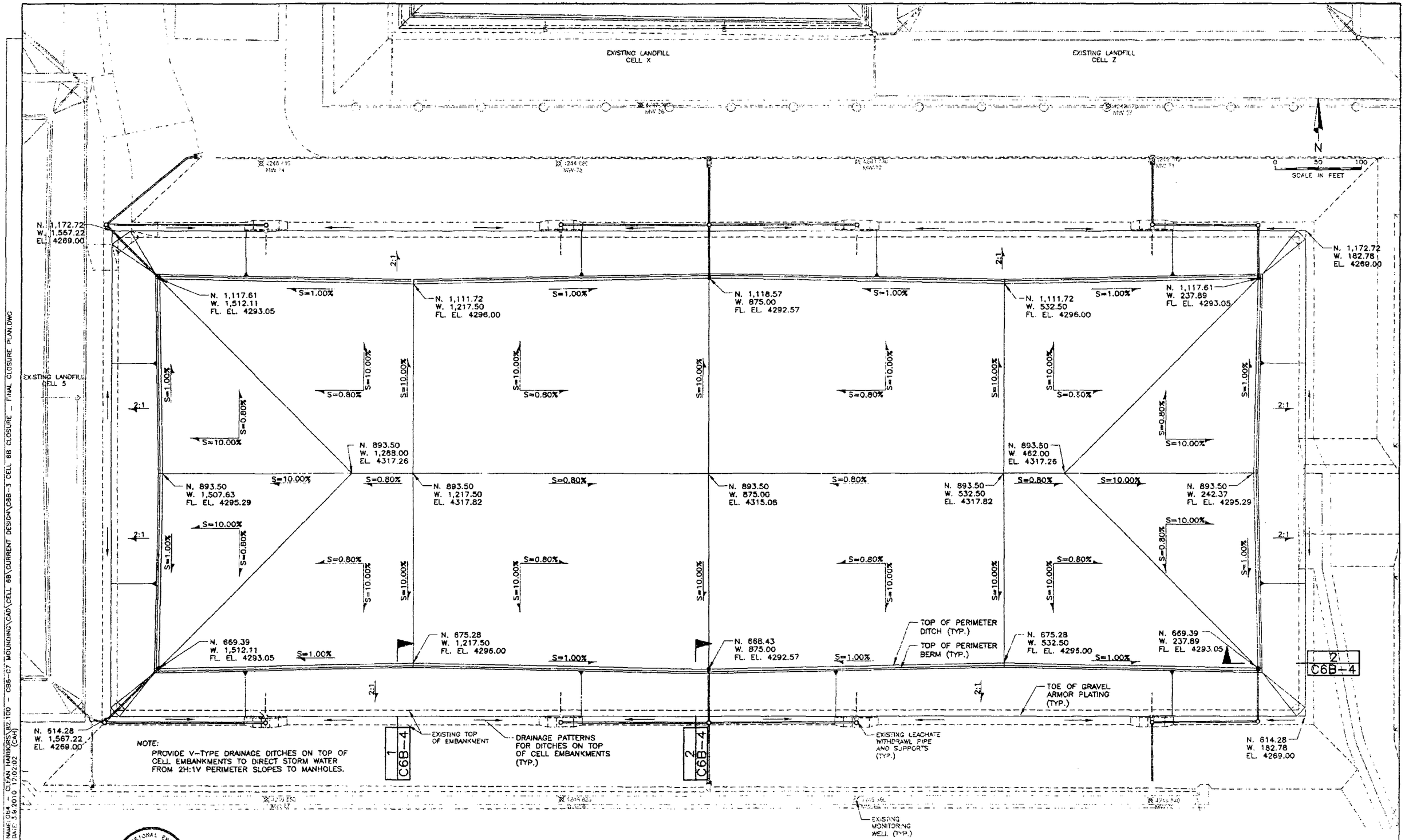
SCALE: AS SHOWN

Clean Harbors® ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY
LANDFILL CELL 6B – CLOSURE
LINER SURFACE PLAN

SHEET C6B-2

64.82.100



NOTE:
PROVIDE V-TYPE DRAINAGE DITCHES ON TOP OF CELL EMBANKMENTS TO DIRECT STORM WATER FROM 2H:1V PERIMETER SLOPES TO MANHOLES.

FILE NAME: 064 - CLEAN HARBORS\82.100 - C6B-C7 MOUNDING\CAD\CELL 6B\CURRENT DESIGN\C6B-3 CELL 6B CLOSURE - FINAL CLOSURE PLAN.DWG
FILE DATE: 3.9.2010 12:02:02 (CAH)

HANSEN ALLEN & LUCE ENGINEERS

PROFESSIONAL ENGINEER NO. 15189 MARVIN E. ALLEN

PROJECT ENGINEER

DESIGNED KCS	3				
DRAFTED CAH	2				
CHECKED MEA	1				
DATE MARCH 2010	NO.	DATE	REVISIONS	BY	APVD.

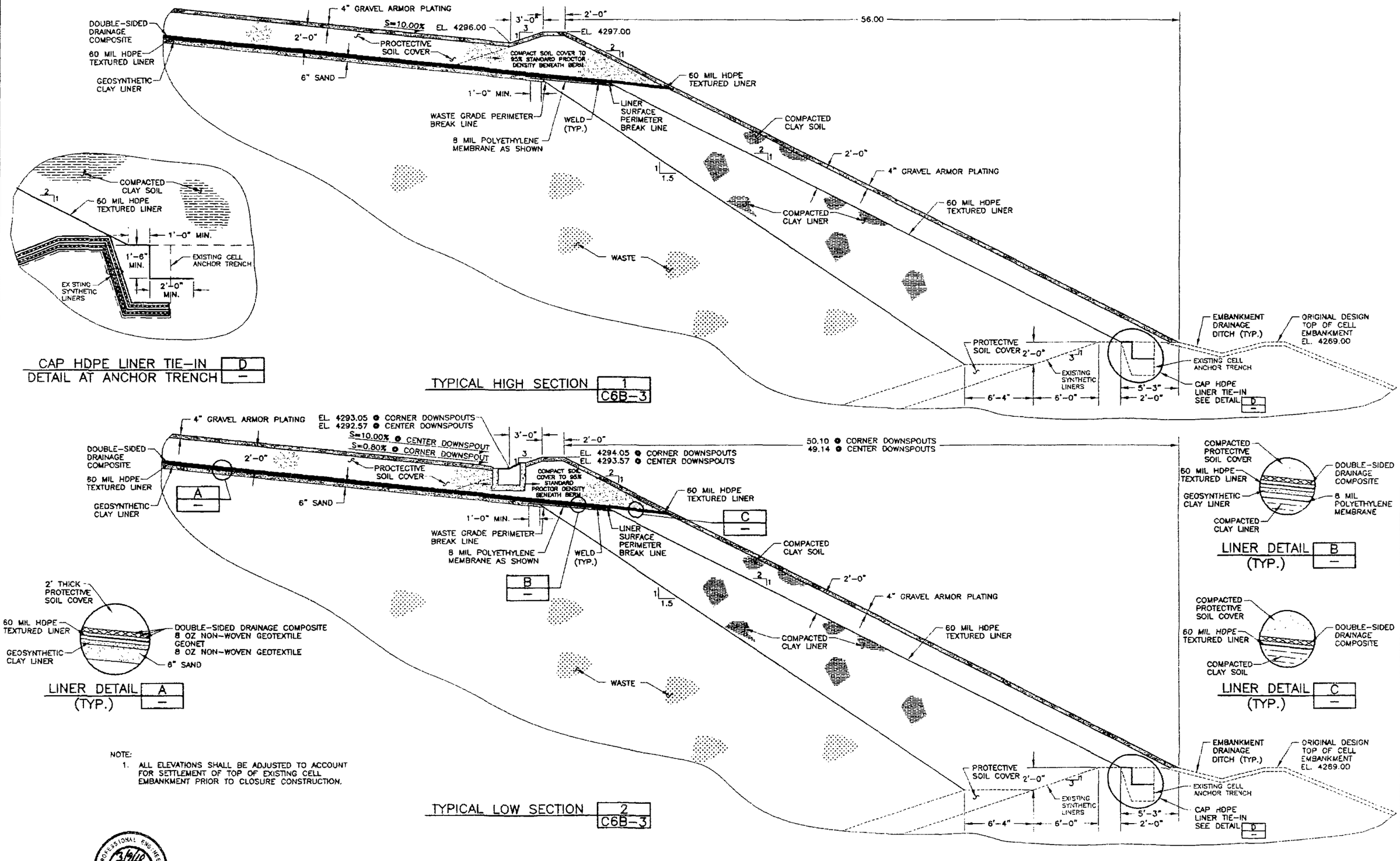
SCALE: AS SHOWN

CleanHarbors® ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY
LANDFILL CELL 6B - CLOSURE
FINAL CLOSURE PLAN

SHEET C6B-3

64.82.100



NOTE:

1. ALL ELEVATIONS SHALL BE ADJUSTED TO ACCOUNT FOR SETTLEMENT OF TOP OF EXISTING CELL EMBANKMENT PRIOR TO CLOSURE CONSTRUCTION.

FILE NAME: C84 - CLEAN HARBORS\82.100 - GMF-07 MOUNDING\CAD\CELL 6B\CURRENT DESIGN\C6B-4 CELL 6B TYP HIGH SECTIONS.DWG
PLOT DATE: 3.9.2010 12:02:37 (CAH)

HANSEN ALLEN & LUCE, INC. ENGINEERS

PROFESSIONAL ENGINEER 3/9/10 REG. NO. 13008 MARVIN E. ALLEN ALASKA

PROJECT ENGINEER

DESIGNED KCS	3			
DRAFTED CAH	2			
CHECKED MEA	1			
DATE MARCH 2010	NO.	DATE	REVISIONS	BY / APVD.

SCALE: NOT TO SCALE

Clean Harbors® ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY
LANDFILL CELL 6B - CLOSURE
TYPICAL HIGH-LOW SECTIONS

SHEET C6B-4

84.82.100

CleanHarbors®
ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY

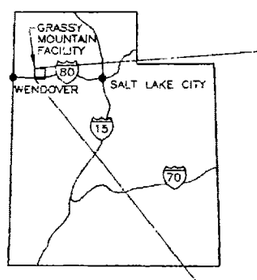
LANDFILL CELL 7 CLOSURE

MODIFIED DESIGN

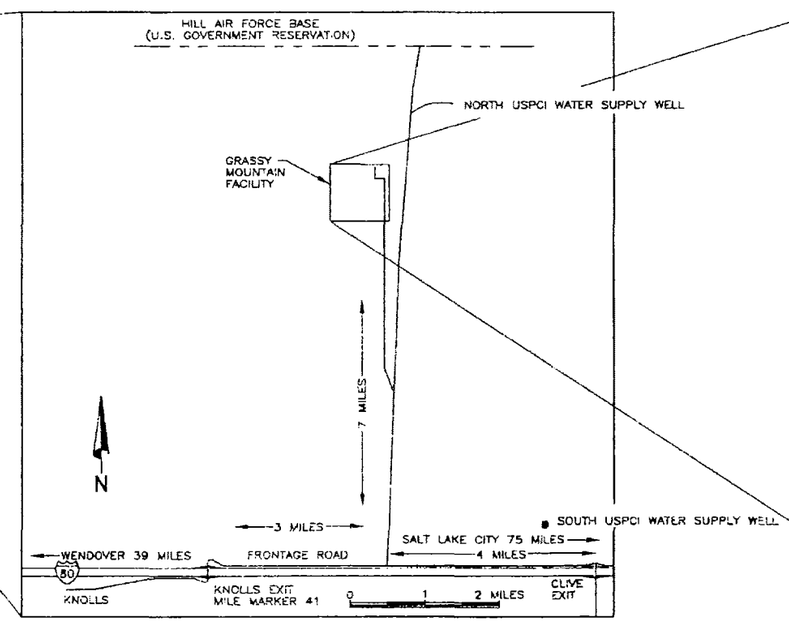
MARCH 2010

FACILITY LOCATION
KNOLLS, UTAH
Phone: (435) 884-8900

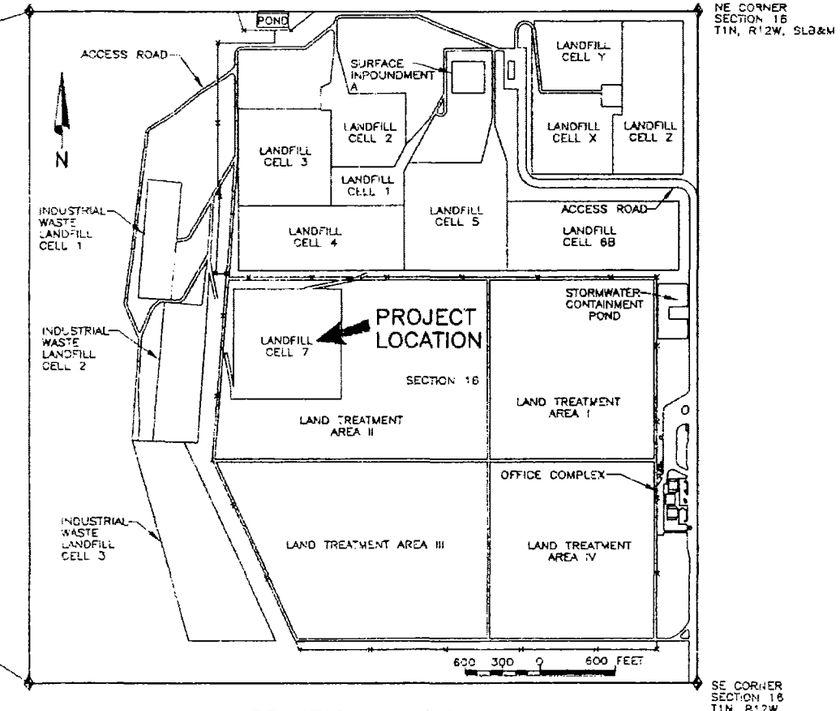
REGIONAL HEADQUARTERS
42 LONGWATER DRIVE
NORWELL, MA 02061
Phone: (781) 792-5000



STATE OF UTAH



VICINITY MAP



PROJECT LOCATION

PROFESSIONAL ENGINEER
3/9/10
NO. 151898
MARVIN E. ALLEN
STATE OF UTAH

MARVIN E. ALLEN & LUCE, INC.
CONSULTANTS
ENGINEERS
Salt Lake City
Utah

FILE NAME: 064 -- CLEAN HARBORS\82.100 -- CB6-C7 MOUNDING\CAD\CELL 7\CURRENT DESIGN\G7-1 CELL 7 COVER.DWG 1
FILE DATE: 3.9.2010 12:08:05 (CAI)

7/95

GENERAL NOTES

1. COORDINATES AND ELEVATIONS PROVIDED ARE BASED ON SITE SPECIFIC COORDINATE SYSTEM AND DATUM CONTROL.
2. ALL ELEVATIONS PROVIDED ARE BASED ON ORIGINAL EMBANKMENT DESIGN AND CONSTRUCTION ELEVATIONS. ADJUSTMENTS SHALL BE MADE PRIOR TO CLOSURE TO ACCOUNT FOR SETTLEMENT.

LINING SYSTEM SUBGRADES & SOIL FILL

1. ALL SURFACES PROVIDING SUBGRADES FOR LINING SYSTEMS SHALL BE PROOF ROLLED FOR SOFT AND/OR YIELDING SURFACES. SOFT AND/OR YIELDING SURFACES SHALL BE COMPACTED TO PROVIDE A FIRM SUBGRADE FOR LINING SYSTEMS.
2. ALL CLAY LINER MATERIALS SHALL BE COMPACTED TO 95% OF ASTM D-698 AT A MOISTURE CONTENT BETWEEN MINUS 2% AND PLUS 4% OF OPTIMUM. ALL CLAY LINER SHALL MEET THE REQUIRED PERMEABILITY OF 1 X 10-7 CM/SEC. A DEFLOCCULATING AGENT (SODIUM-TRIPOLY PHOSPHATE) MIXED WITH THE CLAY LINER AT A MINIMUM RATE OF 3.5 POUNDS PER 50 CUBIC FEET OF LOOSE MATERIAL IS TYPICALLY REQUIRED TO MEET THE REQUIRED PERMEABILITY. CLAY LINER SURFACES SHALL BE MAINTAINED UNTIL PLACEMENT OF OVERLYING GEOSYNTHETIC MATERIALS.
3. ALL FILL MATERIALS REQUIRING COMPACTION, ON THE PERIMETER SIDESLOPES, PIPE BACKFILL, AND OTHER DESIGNATED COMPACTION AREAS SHALL BE COMPACTED TO 95% OF ASTM D-698 AT A MOISTURE REQUIRED TO FACILITATE COMPACTION.
4. THE SUB-GRADE FOR THE GEOSYNTHETIC MATERIALS SHALL BE FREE OF PROTRUDING ROCKS AND DEBRIS THAT MAY POTENTIALLY CAUSE DAMAGE TO THE GEOSYNTHETIC MATERIALS. THE SUBGRADE SHALL ALSO BE ROLLED WITH A SMOOTH DRUM ROLLER TO LEAVE THE SURFACE SMOOTH.
5. BORROW SOURCES FOR 6-INCH THICK SAND AND 2-FOOT THICK PROCTECTIVE SOIL COVER LAYERS TO BE APPROVED BASED ON THE FOLLOWING TESTS USING LIQUID OBTAINED FROM SYNTHETIC LEACHATE PRODUCED USING BORROW SOURCE SOILS: 1. SCREENING CLAY PORTION OF GEOSYNTHETIC CLAY LINER FOR CHEMICAL COMPATIBILITY TO LIQUIDS (ASTM D6141); 2. SWELL INDEX (ASTM D5890); 3. FLUID LOSS TESTING (ASTM D5891); AND 4.HYDRAULIC CONDUCTIVITY (ASTM D6766 OR ASTM D5084) AS REQUIRED BY THE ENGINEER BASED ON RESULTS OF OTHER TESTING. MAXIMUM HYDRAULIC CONDUCTIVITY OF GCL SHALL MEET AN EQUIVALENCY OF A 2-FOOT THICK COMPACTED CLAY LINER WITH A HYDRAULIC CONDUCTIVITY OF 1X10-7 CM/SEC.
6. COMPACTED CLAY SOIL ON THE PERIMETER SLOPES HAS NO PERMEABILITY REQUIREMENT AND SHALL BE COMPACTED TO 95% OF ASDM D-698.

GENERAL GEOSYNTHETICS

1. MANUFACTURER'S CERTIFICATIONS SHALL BE PROVIDED FOR ALL RAW AND MANUFACTURED MATERIALS. CERTIFICATIONS SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S MATERIAL SPECIFICATIONS AND PROJECT CQA PLAN CRITERIA AND SHALL INCLUDE ALL TEST DATA FOR MATERIALS DELIVERED AND AT A MINIMUM, THE TEST FREQUENCIES DESIGNATED IN THE MANUFACTURER'S QUALITY ASSURANCE MANUALS AND SPECIFICATIONS AND THE PROJECT CQA PLAN.
2. ALL GEOSYNTHETIC MATERIALS SHALL BE LOADED, TRANSPORTED, OFF-LOADED, STORED, AND HANDLED IN ACCORDANCE WITH MANUFACTURER RECOMMENDATIONS.
3. AT A MINIMUM, ALL GEOSYNTHETIC MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND INSTALLATION GUIDES AND IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS AND CQA PLAN.
4. THE GEOSYNTHETIC INSTALLER SHALL PROVIDE A SUBGRADE ACCEPTANCE CERTIFICATION FOR ALL AREAS OF GCL DEPLOYMENT.

GEOSYNTHETIC CLAY LINER (GCL)

1. ALL GCL MATERIALS SHALL BE NEEDLE PUNCH REINFORCED.
2. GCL SHALL BE DEPLOYED WITH NON-WOVEN GEOTEXTILE SIDE UP.
3. ALL DEPLOYED GCL MATERIALS SHALL BE COVERED BY THE END OF EACH WORK DAY TO MINIMIZE EVAPORATION OF MOISTURE WITHIN THE BENTONITE AND TO PROTECT THE GCL MATERIALS FROM EXPOSURE TO RAINY AND SNOWY WEATHER.
4. SEAMING SHALL BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS, THE PROJECT SPECIFICATIONS, AND THE PROJECT CQA PLAN.
5. GCL MATERIALS THAT ARE MANUFACTURED TO PROVIDE SELF-SEALING SEAMS AND DO NOT REQUIRE A BENTONITE BEAD SHALL RECEIVE A BENTONITE BEAD WHEN THE SELF-SEALING DESIGN IS COMPROMISED ON THE ENDS OF PANELS AND WHERE THE SELF-SEALING GROOVE (IF PART OF THE SELF-SEALING DESIGN) HAS BEEN REMOVED FROM PARTIAL WIDTH ROLLS.
6. GCL MATERIALS THAT HAVE NOT BEEN MANUFACTURED TO PROVIDE SELF SEALING SEAMS SHALL RECEIVE A BENTONITE BEAD TO PROVIDE THE SEAM SEAL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

GEOMEMBRANE LINER

1. ALL GEOMEMBRANE MATERIALS SHALL BE TEXTURED ON BOTH SIDES.
2. NO GEOMEMBRANE MATERIALS SHALL BE DEPLOYED IN SUB-FREEZING TEMPERATURES UNLESS APPROVED BY OWNER WITH AN APPROVED COLD WEATHER DEPLOYMENT PLAN.
3. NO SEAMING SHALL BE ALLOWED IN SUB-FREEZING TEMPERATURES WITHOUT OWNER APPROVAL OF AN APPROPRIATE COLD WEATHER SEAMING PLAN AND ONLY AFTER PROPER DEMONSTRATION OF PRE-QUALIFIED TEST SEAMS.
4. FIELD TESTING AND QUALITY CONTROL SHALL FOLLOW, AT A MINIMUM, THE REQUIREMENTS PROVIDED IN THE MOST RECENT VERSION OF THE INTERNATIONAL ASSOCIATION OF GEOSYNTHETIC INSTALLERS HDPE AND LLDPE GEOMEMBRANE INSTALLATION SPECIFICATION, THE MANUFACTURERS INSTALLATION PROCEDURES, AND/OR THE PROJECT SPECIFICATIONS AND CQA PLAN, WHICHEVER IS MOST STRINGENT.

DRAINAGE COMPOSITE

1. DOUBLE-SIDED DRAINAGE COMPOSITE SHALL CONSIST OF 8OZ. NON-WOVEN GEOTEXTILE BONDED TO BOTH SIDES OF GEONET.
2. GEOMEMBRANE MATERIALS SHALL BE CLEANED OF DIRT AND DEBRIS PRIOR TO DEPLOYMENT OF DRAINAGE COMPOSITS.
3. DRAINAGE COMPOSITE SHALL BE FASTENED OR SECURED WITH HEAT BONDING, SEWING OR OTHER APPROVED METHOD, BETWEEN GEOTEXTILE FABRIC MATERIALS ALONG THE ENTIRE LENGTH OF THE SEAMS.
4. OVERLAPS OF SEAMS SHALL BE, AT A MINIMUM, THE DIMENSIONS RECOMMENDED BY THE MANUFACTURES.

PROTECTIVE SOIL COVER

1. CARE SHALL BE EXERCISED DURING PLACEMENT OF PROTECTIVE SOIL COVER MATERIALS. A MINIMUM COVER THICKNESS AS DESIGNATED IN THE PROJECT SPECIFICATIONS AND/OR THE PROJECT CQA PLAN SHALL BE MAINTAINED AT ALL TIMES BETWEEN THE TIRES OR TRACKS OF EQUIPMENT AND THE UNDERLYING GEOSYNTHETIC MATERIALS.
2. NO SHARP, ABRUPT, OR PIVOTING TURNS SHALL BE ALLOWED BY EQUIPMENT USED ABOVE THE PROTECTIVE SOIL COVER THAT MAY CAUSE SOIL DISPLACEMENT AND DAMAGE TO UNDERLYING GEOSYNTHETIC MATERIALS.
3. ANY WAVES OR WRINKLES THAT BEGIN TO FORM SHALL BE TRAPPED BY PLACING SUFFICIENT PROTECTIVE SOIL COVER BEYOND THE WAVES OR WRINKLES TO HOLD THEM IN PLACE AND KEEP THEM FROM COMBINING INTO LARGER WAVES OR WRINKLES.

GRAVEL ARMOR PLATING (STONE MULCH)

1. STONE MULCH SHALL BE PLACED TO A THICKNESS OF 4 INCHES ON ALL CLOSURE SURFACES. MINIMUM THICKNESS SHALL BE 2 INCHES ON 10% SLOPES AND 3 INCHES ON 2H:1V SLOPES.
2. MINIMUM D50 SIZE FOR STONE MULCH SHALL BE 0.58 INCH AND SHALL BE VERIFIED BY TESTING.

STORM DRAINAGE SYSTEM

1. ALL MANHOLES, LIDS, AND RINGS AND COVERS SHALL BE RATED FOR H20 LOADINGS.
2. RINGS AND COVERS AND GRATED COVERS SHALL PROVIDE A MINIMUM OPENING FOR ACCESS OF 30 INCHES.
3. GRATED COVERS SHALL BE USED FOR EMBANKMENT DRAINAGE DITCH INLETS
4. A 10' X 10' CONCRETE APRON SHALL BE PLACED AROUND ALL MANHOLE COVERS.
5. RIPRAP APRON AT CONCRETE BAFFLED OUTLETS TO EXTEND A MINIMUM DISTANCE OF 5 FEET, TO BE 12 INCHES THICK, AND HAVE A D_{50}=3".
6. TYPE L RIPRAP AND TYPE II FILTER TO EXTEND AT A RADIUS OF 14 FEET MINIMUM FROM THE DOWNSPOUT PIPE OUTLET (WHERE BAFFLED OUTLETS ARE NOT PROVIDED) AND TO CONSIST OF THE FOLLOWING GRADATIONS:

	% SMALLER BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	MEAN ROCK DIAMETER D_{50} (INCHES)
TYPE L RIPRAP	70-100	14	
	50-70	12	
	35-50	9	9
	2-10	3	

	U.S. STANDARD SIEVE SIZE	PERCENT PASSING BY WEIGHT
TYPE II GRANULAR FILTER	3-INCH	90-100
	3/4 INCH	35-90
	NO. 4	8-30
	NO. 16	0-10
	NO. 200	0-3

INDEX OF DRAWINGS

GENERAL

G7-1 COVER SHEET

G7-2 INDEX SHEET

CIVIL-CELL 7 CLOSURE

C7-1 WASTE GRADE PLAN

C7-2 LINER SURFACE PLAN

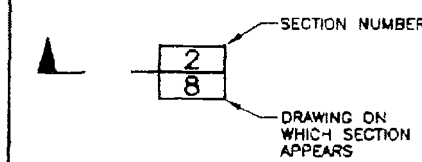
C7-3 FINAL CLOSURE PLAN

C7-4 TYPICAL HIGH-LOW SECTIONS

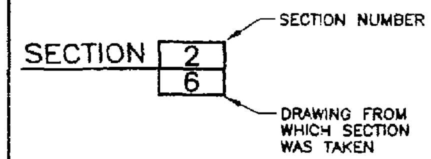
SECTION & DETAIL IDENTIFICATION

SECTION IDENTIFICATION

SECTION CUT ON DRAWING NO. 6 AND SHOWN ON DRAWING NO. 8
ON DRAWING NO. 6 THIS SECTION IS REFERENCED AS:

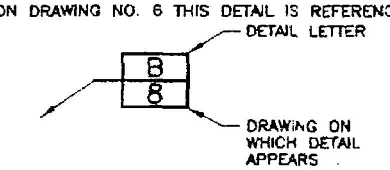


ON DRAWING NO. 8, THIS SECTION IS IDENTIFIED AS:

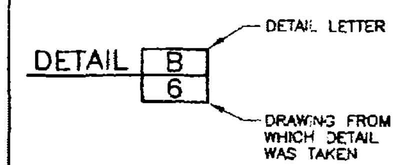


DETAIL IDENTIFICATION

DETAIL CALL-OUT ON DRAWING NO. 6 AND SHOWN ON DRAWING NO. 8
ON DRAWING NO. 6 THIS DETAIL IS REFERENCED AS:



ON DRAWING NO. 8, THIS DETAIL IS IDENTIFIED AS:



NOTES:
1. IF SECTION AND DETAILS ARE SHOWN ON THE SAME DRAWING AS SECTION CUTS AND SECTION OR DETAIL CALL-OUTS DRAWING NUMBER IS REPLACED BY A LINE.
2. DETAIL LETTERS "I" AND "O" NOT USED.

TABLE OF ABBREVIATIONS

●	=	AIR GAS VENT	MH	=	MANHOLE
@	=	AT	MIN.	=	MINIMUM
AVG.	=	AVERAGE	N.	=	NORTH
C.C.	=	CENTER TO CENTER	N.T.S.	=	NOT TO SCALE
℄	=	CENTER LINE	O.C.	=	ON CENTER
CLR.	=	CLEARANCE	PC	=	POINT OF CURVE
CONT.	=	CONTINUOUS	PI	=	POINT OF INTERSECTION
CPP	=	CORRUGATED POLYETHYLENE PIPE	PSI	=	POUND PER SQUARE INCH
DIA.	=	DIAMETER	PT	=	POINT OF TANGENT
DWG	=	DRAWING	REINF	=	REINFORCEMENT
E.	=	EAST	SDR	=	STANDARD DIMENSIONAL RATIO
EF	=	EACH FACE	SF	=	SQUARE FEET
EL.	=	ELEVATION	SQ.	=	SQUARE
E.W.	=	EACH WAY	STA.	=	STATION
FL	=	FLOW LINE	TL	=	TOP OF LINER
HDPE	=	HIGH DENSITY POLYETHYLENE	T.O.C.	=	TOP OF CONCRETE
ID	=	INSIDE DIAMETER	TYP.	=	TYPICAL
MAX.	=	MAXIMUM	UBC	=	UNTREATED BASE COURSE

PROFESSIONAL ENGINEER 3/9/10 MARVIN E. ALLEN

HANSEN ALLEN & LUCE INC. ENGINEERS — PROJECT ENGINEER

DESIGNED KCS	3				
DRAFTED CAH	2				
CHECKED MEA	1				
DATE MARCH 2010	NO.	DATE	REVISIONS	BY	APVD.

SCALE: NOT TO SCALE

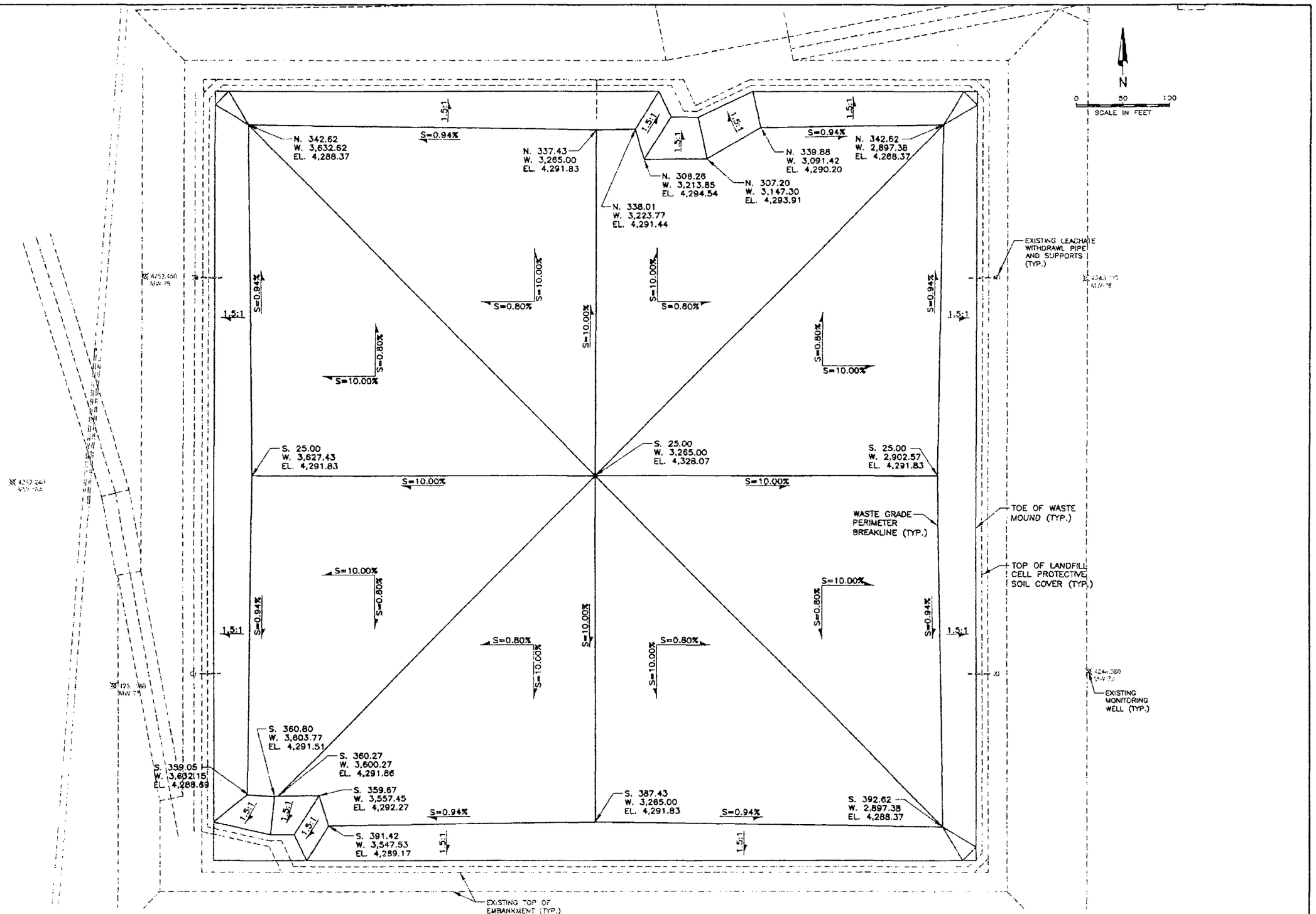
CleanHarbors ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY
LANDFILL CELL 7 - CLOSURE
INDEX SHEET

SHEET G7-2

84.82.100

FILE NAME: 064 - CLEAN HARBORS\82.100 - CB6-C7 MOUNDING\CAD\CELL 7\CURRENT DESIGN\G7-2 CELL 7 INDEX_SHEET.DWG
FILE DATE: 3.9.2010 12:07:38 (CAH)

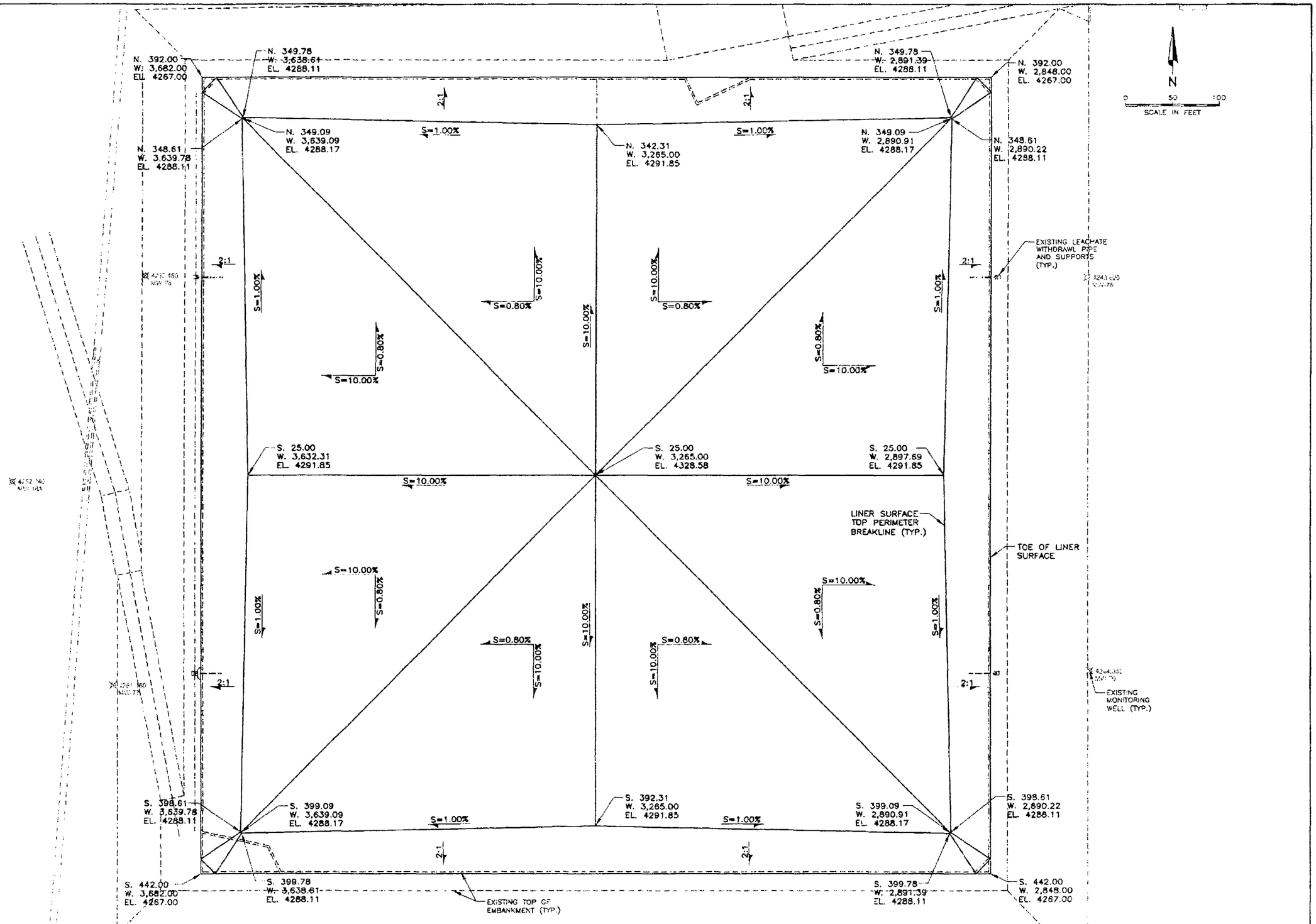


FILE NAME: 064 - CLEAN HARBORS\82.100 - CB6-C7 MOUNDING\CAD\CELL 7\CURRENT DESIGN\C7-1 CELL 7 CLOSURE _ WASTE GRADE PLAN.DWG
FILE DATE: 3.9.2010 12:08:31 (CAH)

PROFESSIONAL ENGINEER 3/9/10 NO. 151898 MARVIN E. ALLEN

HANSEN ALLEN & LUCAS ENGINEERS	PROJECT ENGINEER	DESIGNED KCS	3				SCALE AS SHOWN	CleanHarbors ENVIRONMENTAL SERVICES, INC.	GRASSY MOUNTAIN FACILITY LANDFILL CELL 7 – CLOSURE WASTE GRADE PLAN	SHEET C7–1
		DRAFTED CAH	2							
		CHECKED MEA	1							
		DATE MARCH 2010	NO.	DATE	REVISIONS	BY	APVD.			64.82.100

10/07



FILE NAME: C64 - CLEAN HARBORS\82.100 - C86-C7 MOUNDING\CAD\CELL 7\CURRENT DESIGN\C7-2 CELL 7 CLOSURE - LINER SURFACE PLAN.DWG
FILE DATE: 3.9.2010 12:09:24 (CAH)

HANSEN ALLEN & LUCE ENGINEERS

PROFESSIONAL ENGINEER 3/9/10 NO. 15188 NARVIE ALLEN STATE OF IDAHO

PROJECT ENGINEER

DESIGNED KCS	3				
DRAFTED CAH	2				
CHECKED MEA	1				
DATE MARCH 2010	NO.	DATE	REVISIONS	BY	APVD.

SCALE: AS SHOWN

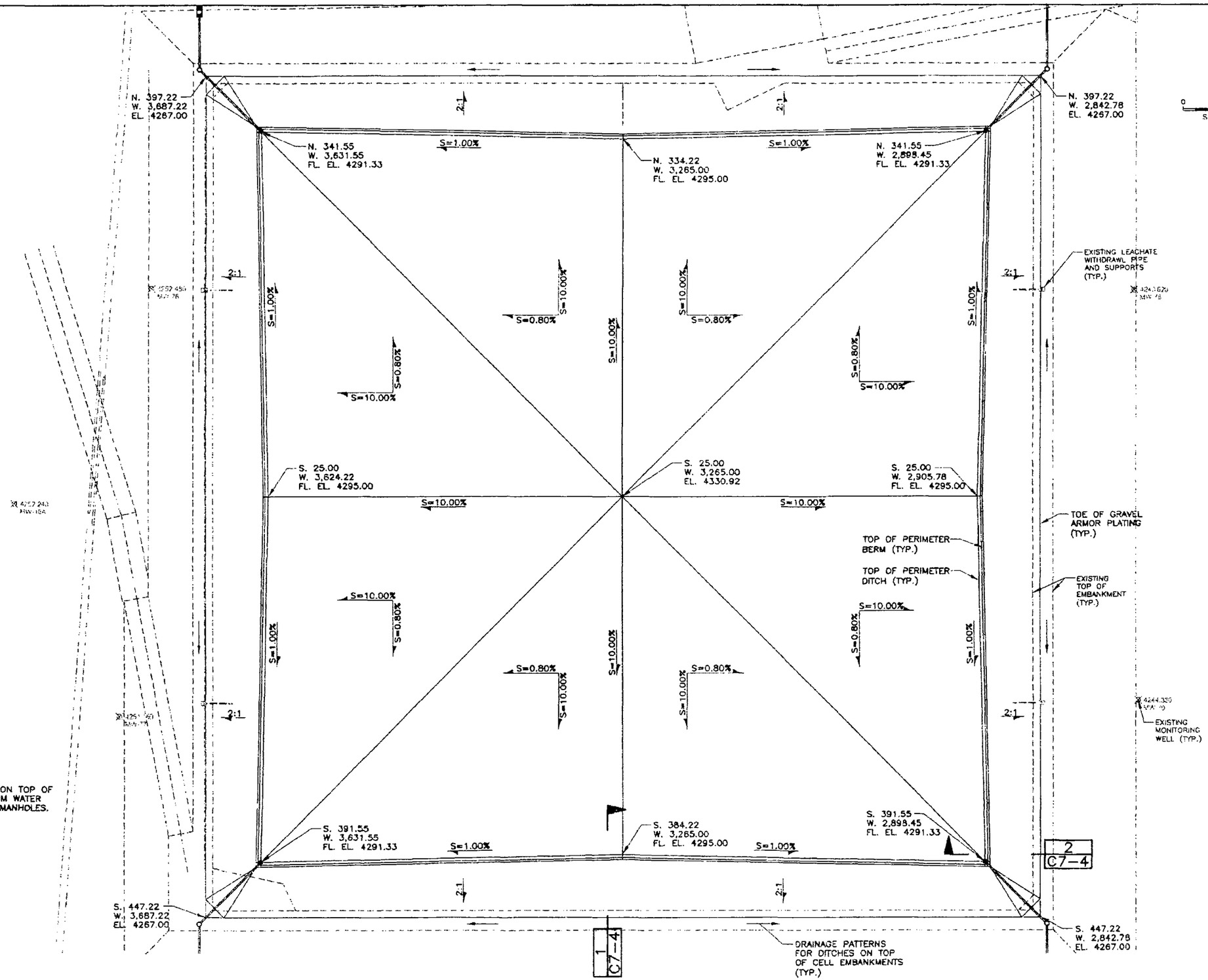
Clean Harbors® ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY
LANDFILL CELL 7 – CLOSURE
LINER SURFACE PLAN

SHEET C7-2

64.82.100

10/07



NOTE:
PROVIDE V-TYPE DRAINAGE DITCHES ON TOP OF CELL EMBANKMENTS TO DIRECT STORM WATER FROM 2H:1V PERIMETER SLOPES TO MANHOLES.

FILE NAME: 064 - CLEAN HARBORS\82.100 - CH6-C7 MOUNDING\CAD\CELL 7\CURRENT DESIGN\C7-3 CELL 7 CLOSURE - FINAL CLOSURE PLAN.DWG
FILE DATE: 3.9.2010 12:10:23 (CAH)

HANSEN ALLEN & LUCE ENGINEERS

PROFESSIONAL ENGINEER 3/9/10 NO. 15158 MARTIN ALLEN STATE OF UTAH

PROJECT ENGINEER

DESIGNED	KCS
DRAFTED	CAH
CHECKED	MEA
DATE	MARCH 2010

NO.	DATE	REVISIONS	BY	APVD.
3				
2				
1				

SCALE: AS SHOWN

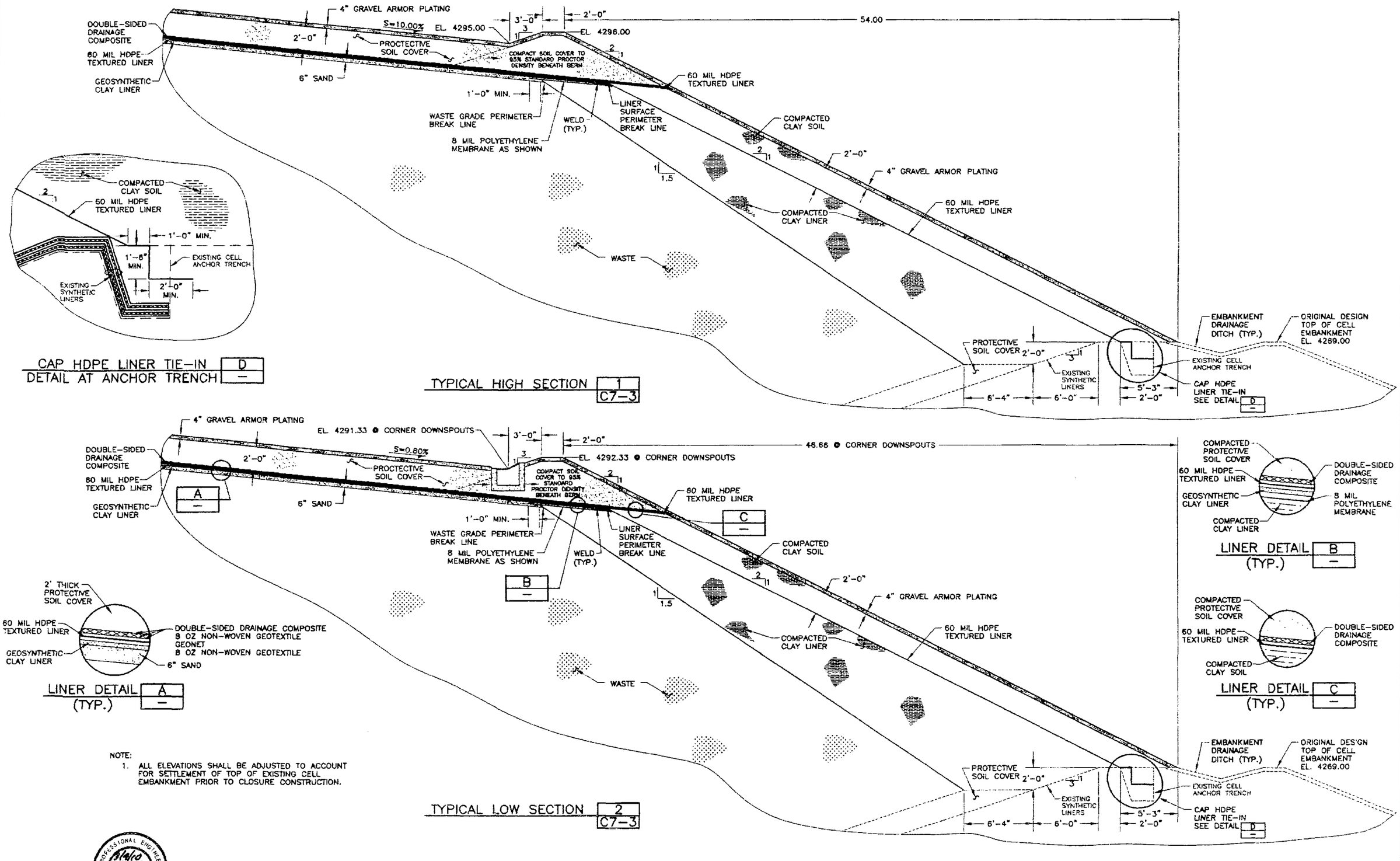
Clean Harbors ENVIRONMENTAL SERVICES, INC.

GRASSY MOUNTAIN FACILITY
LANDFILL CELL 7 - CLOSURE
FINAL CLOUSURE PLAN

SHEET C7-3

64.82.100

10/07



NOTE:

1. ALL ELEVATIONS SHALL BE ADJUSTED TO ACCOUNT FOR SETTLEMENT OF TOP OF EXISTING CELL EMBANKMENT PRIOR TO CLOSURE CONSTRUCTION.

HANSEN ALLEN & LUCE ENGINEERS	PROFESSIONAL ENGINEER NO. 5184 MARINE ALLEN 3/4/10	DESIGNED KCS	3			SCALE NOT TO SCALE	GRASSY MOUNTAIN FACILITY LANDFILL CELL 7 – CLOSURE TYPICAL HIGH–LOW SECTIONS
		DRAFTED CAH	2				
	PROJECT ENGINEER	CHECKED MEA	1				
		DATE MARCH 2010	NO.	DATE	REVISIONS	BY APVD.	SHEET C7-4

Clean Harbors® ENVIRONMENTAL SERVICES, INC.

84.82.100

FILE NAME: 964 – CLEAN HARBORS\82.100 – CBB-C7 MOUNING\CAD\CELL 7\CURRENT DESIGN\C7-4 CELL 7 TYP HIGH LOW SECTIONS.DWG
FILE DATE: 3.9.2010 12:11:28 (CAH)

10/07

EXHIBIT B

GEOTECHNICAL EVALUATION

APPLIED GEOTECHNICAL
ENGINEERING CONSULTANTS

SEPTEMBER 28, 2009
Revised March 15, 2010

Applied Geotechnical Engineering Consultants, Inc.

September 28, 2009
Revised March 15, 2010

Hansen, Allen and Luce, Inc.
6771 South 900 East
Midvale, UT 84047

Attention: Kent Staheli

Subject: Geotechnical Consultation
Cells 6 and 7 Waste Mounding
Grassy Mountain Facility
Tooele County, Utah
AGEC Project No. 1090175

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. was requested to evaluate the impact on settlement and stability if additional waste is placed in Cells 6 and 7 by raising the height and increasing the slope of the closure caps.

PREVIOUS STUDIES

AGEC previously conducted a geotechnical investigation for Landfill Cell 6 and presented our findings and recommendations in a report dated January 28,1992 under Project No. 11791. Waste mounding consisting of an additional 2½ feet of waste was previously evaluated by AGEC for Cell 6 as discussed in our letter dated January 22, 1993 under Project No. 10993.

AGEC previously conducted a geotechnical investigation for Landfill Cell 7 and we presented our findings and recommendations in a report dated December 12, 1995 under Project No. 45995.

SCOPE

We were requested to provide stability analysis and settlement analysis to consider raising the height of the waste in Landfill Cells 6 and 7 above the previously designed height. This increased height would include raising the height of the 2:1 slope of the cap and increasing the slope of the final closure.

600 West Sandy Parkway • Sandy, Utah 84070 • (801) 566-6399 • FAX (801) 566-6493

Stability analysis was conducted considering raising the waste height of the 2:1 slope by 20 feet and steepening the final closure slope from 5 percent to 10 percent.

Stability analysis included an evaluation of global stability of the landfill and underlying soil structure with the proposed additional waste in place. Local stability of the 2:1 cap slope and liner interface stability were also considered. Stability analysis was conducted assuming both static and seismic conditions.

Settlement calculations were performed considering the additional waste height and increase in final closure slope. The settlement calculations provide a settlement profile to estimate the final slope of the cell floor after settlement.

This letter has been prepared to present the results of our analysis and our recommendations relative to the waste mounding and increase in slope.

MODIFIED DESIGN

We understand that the modified design of the Landfill Cell 6 closure cap is as follows:

Perimeter	Slope:	2:1 (horizontal to vertical)
	Cover Cross-Section:	4" gravel armor plating
	(From top down)	2' compacted clay soil
		60 mil HDPE textured liner
		compacted clay liner
Top	Slope:	10 percent
	Cover Cross-Section:	4" gravel armor plating
	(From top down)	2' protective soil cover
		Double-sided drainage composite
		60 mil HDPE textured liner
		GCL
		6" soil cushion

The modified design of the Landfill Cell 7 closure cap is as follows:

Perimeter	Slope:	2:1 (horizontal to vertical)
	Cover Cross-Section:	same as Cell 6
Top	Slope:	10 percent
	Cover Cross-Section:	4" gravel armor plating
	(From top down)	2' protective soil cover
		double-sided drainage composite
		60 mil HDPE textured liner
		GCL
		6" soil cushion

EXISTING CONDITIONS

We understand that significant waste has been placed in Landfill Cells 6 and 7 and the cells are near capacity. Based on a discussion with the landfill operator we understand that the waste has consisted of the following:

Waste Material	Fraction
Soil Type Waste	60 to 70 percent
Steel (Pipe, Drums etc.)	15 to 20 percent
Wood, Paper, Plastics etc.	15 to 20 percent

We understand that waste has been placed with a Caterpillar D7 dozer and compacted with a Caterpillar 825 sheepsfoot compactor.

PROPOSED CONSTRUCTION

We understand that consideration is being given to increasing the capacity of Cells 6 and 7 by increasing the height of the 2 horizontal to 1 vertical perimeter slopes and steepening the top slopes of the closure caps.

We understand that since the time the cells were designed, there has been a change in the regulatory requirements for cell floor design allowing the floor slopes of the cells after differential settlement to be reduced from 2 percent to 1 percent. In addition, the understanding of seismic ground shaking expected for the area studies and the accepted practices for seismic analysis have changed.

WASTE CHARACTERIZATION

A description of the waste components placed in Landfill Cells 6 and 7 was provided by the facility manager as previously described.

Previous stability evaluations for Landfill Cells 6 and 7 have considered the waste to have a cohesive strength of 100 pounds per square foot and friction angles ranging from 20 to 25 degrees.

The waste characteristics for hazardous waste landfills are difficult to establish. However, recent information related to municipal solid waste landfills has indicated a cohesive strength of 300 psf and fiction angle of 36 degrees may be typical for waste landfills of similar composition (Bray et al., 2009). In our professional opinion, it is likely that the hazardous waste materials described as having been placed in Landfill Cells 6 and 7 have strength properties similar to or better than municipal solid waste. Therefore, the strength parameters used in our previous stability analysis have been conservative.

In considering the additional waste mounding and steepening of the final closure cap for Landfill Cells 6 and 7 we have assumed the waste to have a cohesive strength of 100 psf and a friction angle of 25 degrees which is consistent with the values previously used and in our opinion are conservative. Higher strengths are not needed to meet the current safety requirements.

SEISMIC CONSIDERATIONS

At the time of our previous stability analysis, a seismic event having a 90 percent probability of not being exceeded in 50 years was considered for design. With this seismic event and prior guidance documents, a factor of safety under seismic conditions of 1.3 was used.

Current practice for the design of municipal solid waste landfills considers a seismic event having a 90 percent probability of not being exceeded in a 250 year period (EPA, 1995). If the full peak horizontal ground acceleration is used in the analysis and a safety factor 1.0 or greater is obtained, it would be concluded that no significant ground deformation would be expected from the design seismic event.

A peak horizontal bedrock acceleration of 0.15g was used for our seismic analysis considering a seismic event with a 90 percent probability of not being exceeded in a 250 year period (Frankel, et al., 2002). This bedrock acceleration happens to correspond to the bedrock acceleration previously used which was based on the published maps available at that time for the more frequent seismic event. The seismic analysis previously performed indicates a horizontal ground acceleration of 0.18g for the site resulting from the bedrock acceleration of 0.15g. Therefore, a peak horizontal ground acceleration of 0.18g was used in our analysis.

A summary of the expected seismic ground shaking at the site based on current and previous information published by USGS is given below as well as stability safety factors considered:

Date of Seismic Data	Seismic Event**	Peak Acceleration (Bedrock)	Peak Acceleration (Site)	Factor of Safety
1993-1995	90 percent in 50 years	0.15g	0.18g	1.3
2002*	90 percent in 50 years	0.08g	not evaluated	N/A
2002*	90 percent in 250 years	0.15g	0.18g	1.0

* *2002 data is currently used by the 2006 building code.*
** *probability of not being exceeded in the time period indicated.*

STABILITY EVALUATION

The results of our stability evaluation considering raising the height of the 2:1 waste slope by 20 feet and increasing the slope of the final closure cap to 10 percent are presented on Figures 1 and 2. The soil parameters assumed for the analysis are based on information presented in the above-referenced geotechnical reports and from our previous consultation. The results of the analysis indicate a safety factor of 1.5 or greater under static conditions and 1.0 or greater under seismic conditions.

The presence of a pond in the vicinity of Landfill Cell 6 was considered in the analysis and was found to have no significant impact on the stability.

The results of the stability calculations are included in Appendix A for Landfill Cell 6 and Appendix B for Landfill Cell 7.

Interface material stability for the closure caps was considered. The findings indicate that a textured HDPE liner placed in contact with compacted clay for the 2:1 closure slope provides a suitable factor safety. For the 10 percent closure slope where a drainage net is in contact with the HDPE liner, it is recommended that a textured HDPE liner be used and that a welded composite of geotextile and geonet be used over the textured membrane to provide an adequate safety factor for stability. Interface stability calculations are included in Appendix C. The interface friction angles assumed consider saturated conditions.

SETTLEMENT

Settlement of the final closures of Landfill Cells 6 and 7 were evaluated considering the original design configuration and a 20-foot increase in waste mounding with 5 percent and 10 percent slopes for the closure caps. The results of the settlement analysis are presented on Figures 3 and 4. Settlement calculations are included in Appendix D.

Based on our evaluation of the settlement as it relates to differential settlement of the cell floor, the following slopes are calculated after the estimated differential settlement:

		Estimated Settlement			
Cell	Waste Closure	Crest (inches)	Sump (inches)	Floor Slope before Settlement (%)	Floor Slope after Settlement (%)
6	Current Design	71	64	2.7	2.4
6	20' mounding/ 5% cover slope	83	76	2.7	2.4
6	20' mounding/ 10% cover slope	89	77	2.7	2.2
7	Current Design	75	63	2.3	2.0
7	20' mounding/ 5% cover slope	86	74	2.3	2.0
7	20' mounding/ 10% cover slope	94	75	2.3	1.8

LIMITATIONS

This letter has been prepared in accordance with generally accepted geotechnical engineering practices in the area for the use of the client for design purposes. The findings and conclusions are based on subsurface conditions presented in the above-referenced reports and letter, our understanding of the proposed configuration of landfill closures and the assumed characteristics of the waste material. If the proposed construction or conditions are found to be different from those described above and in the above-referenced reports, we should be notified so that we can reevaluate our findings and conclusions.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

3/15/10

Jay R. McQuivey, P.E.

Reviewed by DRH, P.E., P.G.
JRM/dc
Enclosures

References

Bray, J.D., Zekkos, D., Kavazanjian, E., Anthanasopoulos, G.A. and Riemer, M.F., 2009; "Shear Strength of Municipal Solid Waste", Journal of Geotechnical and Geoenvironmental Engineering, Vol.135, No. 6, pp. 709-722.

EPA (1995), "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities", EPA/600/R-95/051.

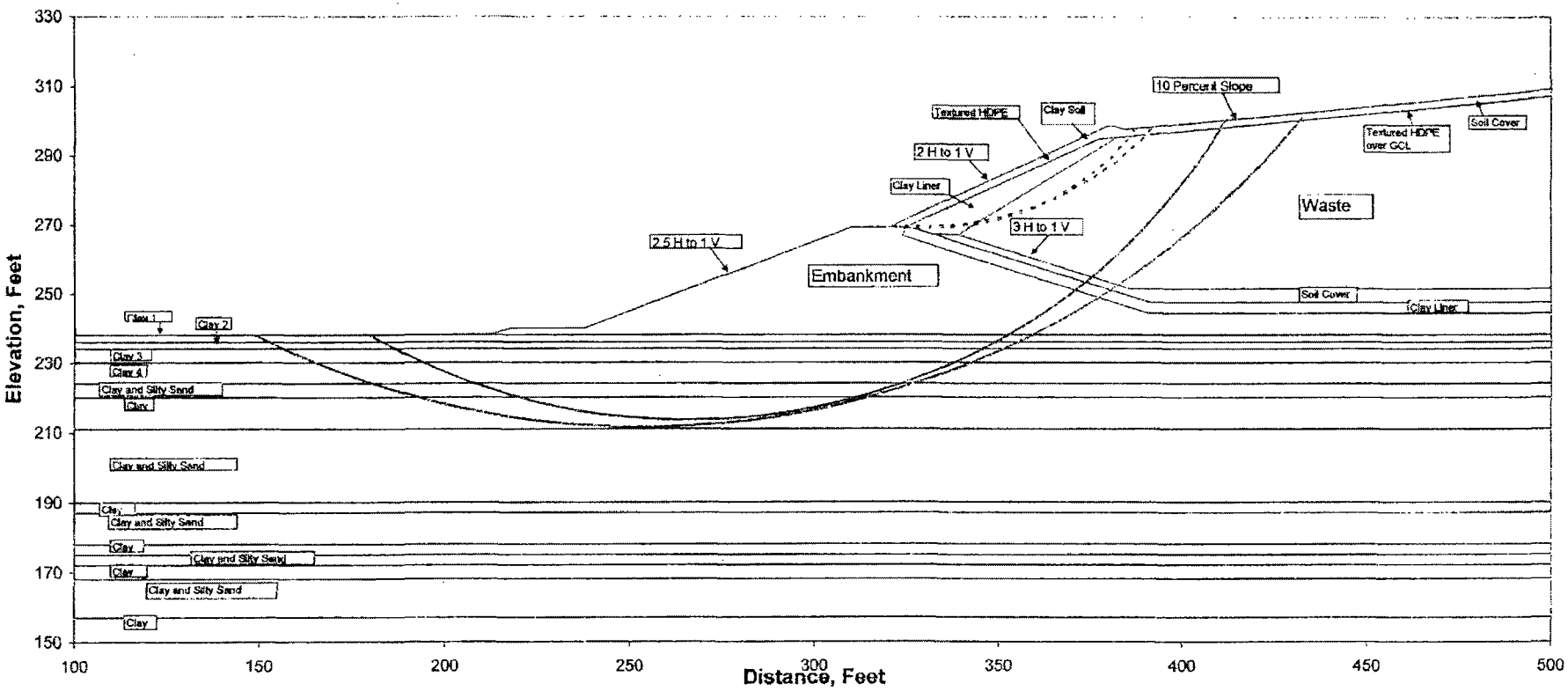
Frankel, A., Peterson, M., Mueller, C., Haller, K., Wheeler, R., Leyendecker, E.,Wesson, R., Harmsen, S., Cramer, C., Perkins, D. and Rukstales, K., 2002; Documentation for the 2002 Update of the National Seismic Hazard maps, U.S. Geological Survey, Open-file Report 02-420.

Kavazanjian, E. and Matasovic, N.; "Seismic Design of Mixed and Hazardous Waste Landfills", Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics and Symposium in Honor of Professor W.D. Liam Finn, San Diego, California, March 26-31, 2001.

Cell 6 Stability Analysis Summary

Soil Parameters							
Material	Density	Long Term		Material	Density	Long Term	
	(pcf)	phi (deg)	c(psf)		(pcf)	phi (deg)	c(psf)
Soil Cover	120	28	100	Clay	110	27	200
Landfill	120	25	100	Clay and Silty Sand	110	30	200
Clay Liner	110	28	270	Clay	110	27	200
Embankment Fill	130	32	400	Clay and Silty Sand	110	30	200
Clay (1)	130	30	200	Clay	110	27	200
Clay (2)	120	30	200	Clay and Silty Sand	110	30	200
Clay (3)	110	30	200	Clay	110	27	200
Clay (4)	110	27	200	Clay and Silty Sand	110	30	200
Clay and Silty Sand	110	30	200	Clay	110	27	200

Stability Results		
Failure Surface	Safety Factor	Condition
	1.93	Static
	1.61	Static
	1.19	Seismic
	1.11	Seismic



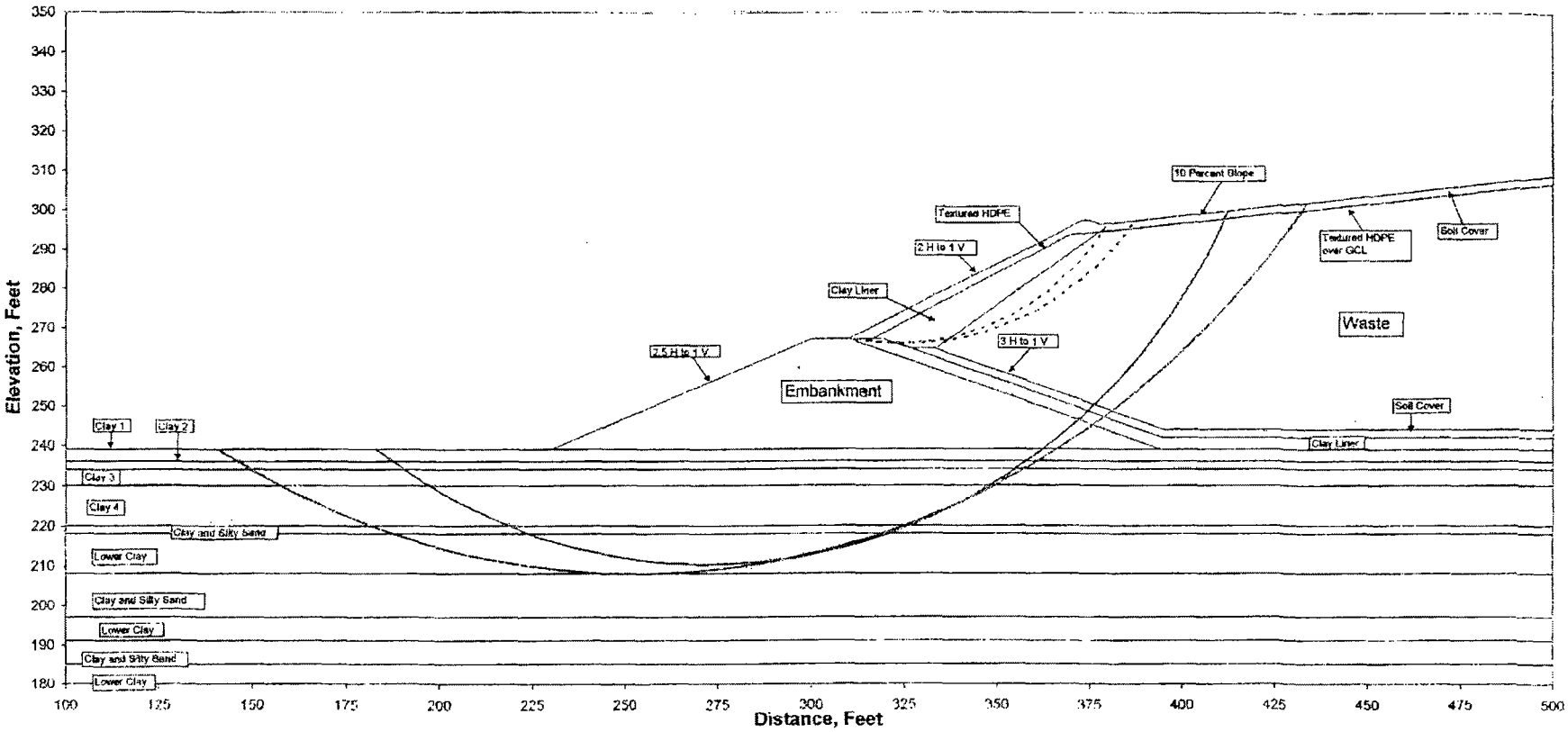
AGEC Project No.1090175

Figure 1

Cell 7 Stability Analysis Summary

Soil Parameters			
Material	Density	Long Term	
	(pcf)	phi (deg)	c(psf)
Soil Cover	110	28	100
Landfill	120	25	100
Clay Liner	110	28	270
Embankment Fill	130	34	400
Clay (1)	130	30	200
Clay (2)	120	30	200
Clay (3)	110	30	200
Clay (4)	110	27	200
Clay & Silty Sand	110	30	200
Lower Clay	110	27	200

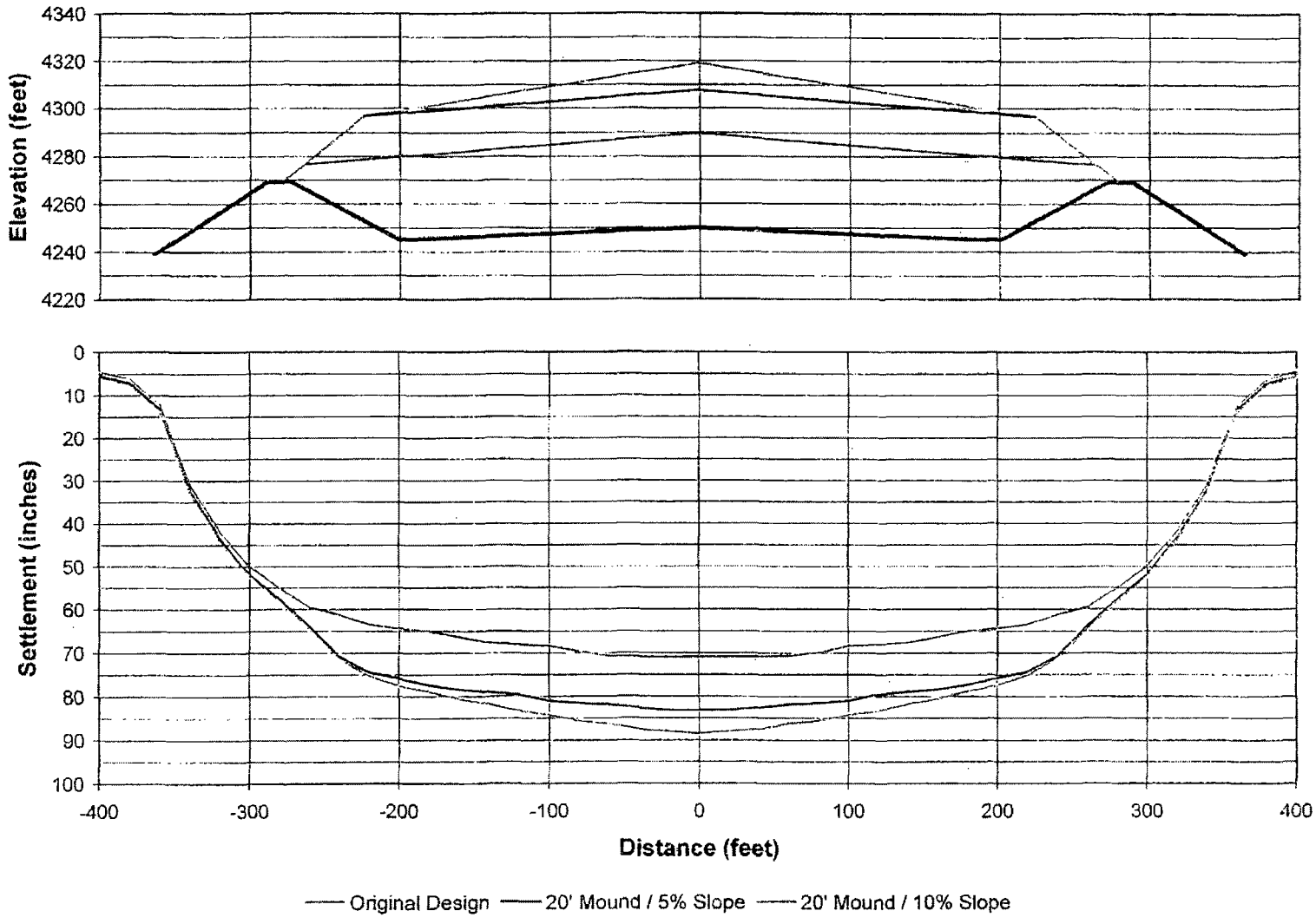
Stability Results		
Failure Surface	Safety Factor	Condition
	1.98	Static
	1.64	Static
	1.20	Seismic
	1.13	Seismic



AGEC Project No.1090175

Figure 2

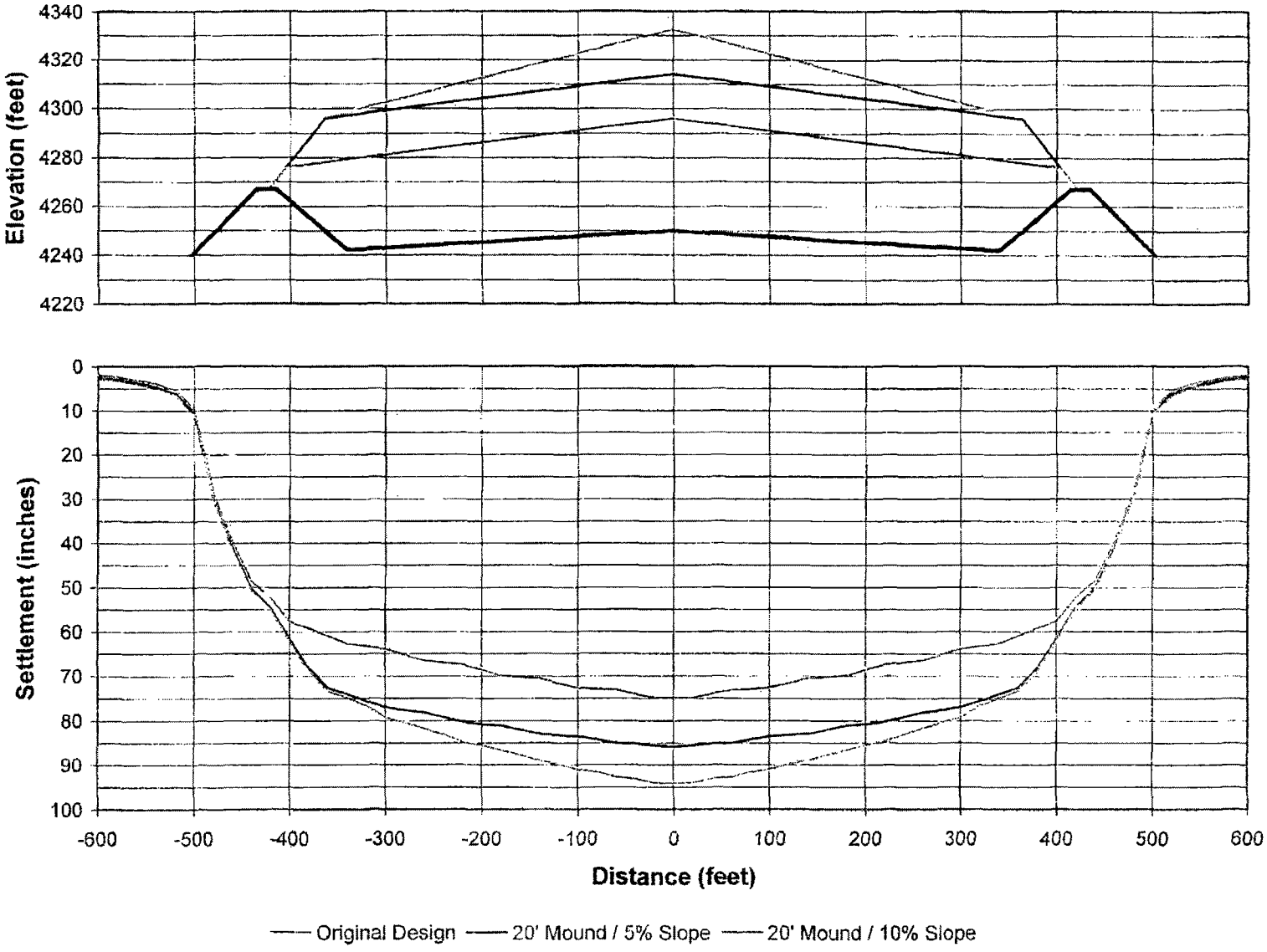
Cell 6 Settlement



AGEC Project No. 1090175

Figure 3

Cell 7 Settlement



AGEC Project No. 1090175

Figure 4

Appendix A

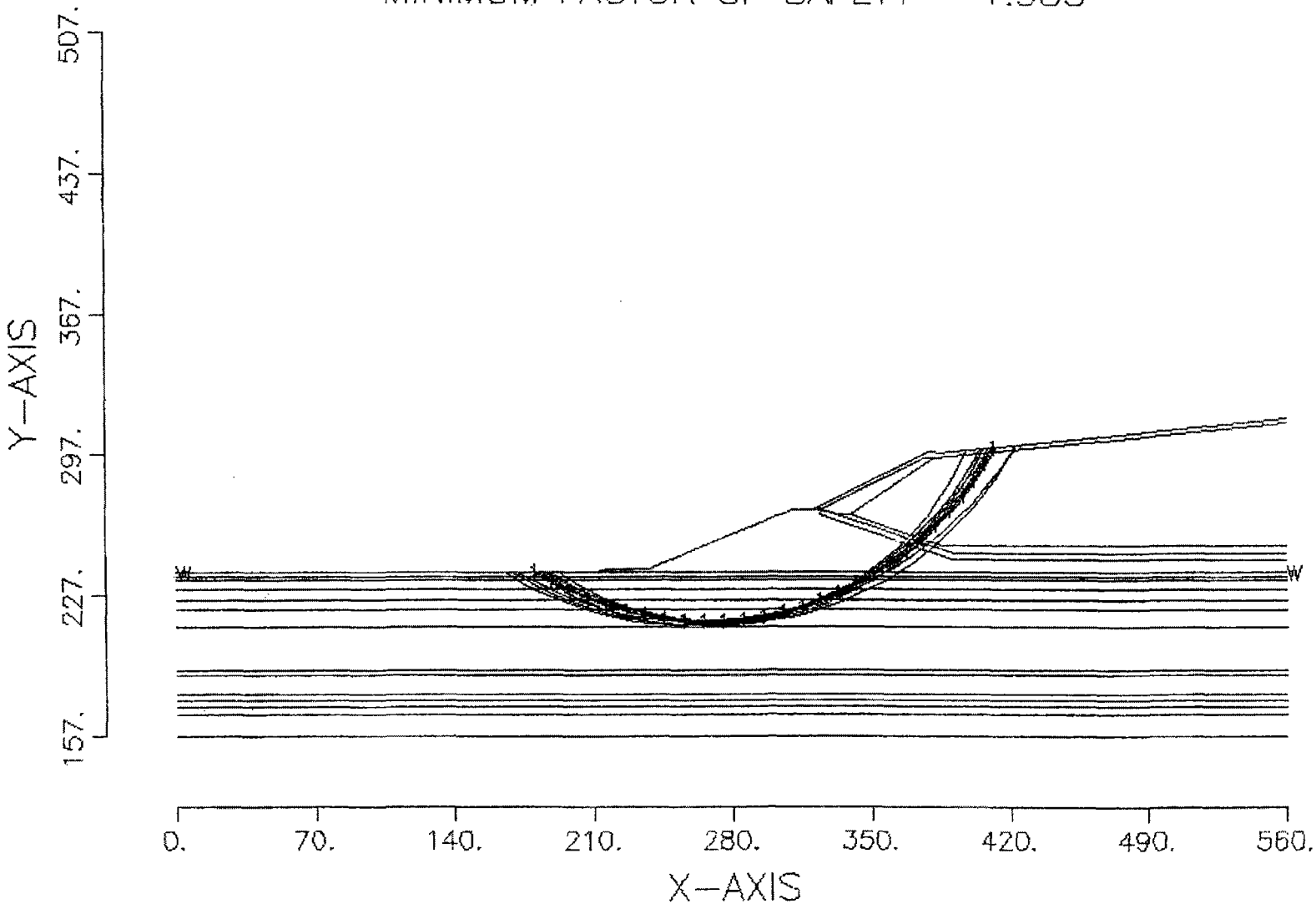
Landfill Cell 6 Stability Printouts

AGEC
Midvale UT s/n5206

3/1/10

CELL 6/LT/STATIC/SOUTH/WASTE +20'

2500SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.933



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 6/LT/STATIC/SOUTH/WASTE +20'

BOUNDARY COORDINATES

9 TOP BOUNDARIES
38 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	238.00	211.50	238.00	5
2	211.50	238.00	217.50	240.00	3
3	217.50	240.00	237.50	240.00	3
4	237.50	240.00	310.00	269.00	3
5	310.00	269.00	320.20	269.00	3
6	320.20	269.00	379.40	298.60	1
7	379.40	298.60	381.40	298.60	1
8	381.40	298.60	384.40	297.60	1
9	384.40	297.60	560.00	315.16	1
10	320.20	269.00	324.70	269.00	3
11	324.70	269.00	377.10	295.20	2
12	377.10	295.20	382.00	295.30	2
13	382.00	295.30	560.00	313.16	4
14	323.90	266.70	324.70	269.00	2
15	324.70	269.00	328.10	268.50	2
16	328.10	268.50	332.70	267.00	2
17	332.70	267.00	339.00	267.00	1
18	339.00	267.00	382.00	295.30	4
19	339.00	267.00	385.80	251.40	1
20	385.80	251.40	560.00	251.40	1
21	332.70	267.00	391.50	247.40	2
22	391.50	247.40	560.00	247.40	2
23	323.90	266.70	391.10	244.30	3
24	391.10	244.30	560.00	244.30	3
25	211.50	238.00	560.00	238.00	5
26	.00	236.00	560.00	236.00	6
27	.00	234.00	560.00	234.00	7
28	.00	230.00	560.00	230.00	8
29	.00	224.00	560.00	224.00	9
30	.00	220.00	560.00	220.00	10
31	.00	211.00	560.00	211.00	11
32	.00	190.00	560.00	190.00	12
33	.00	187.00	560.00	187.00	13
34	.00	178.00	560.00	178.00	14
35	.00	175.00	560.00	175.00	15
36	.00	172.00	560.00	172.00	16
37	.00	168.00	560.00	168.00	17
38	.00	157.00	560.00	157.00	18

ISOTROPIC SOIL PARAMETERS

18 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.

1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	32.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1
9	110.0	110.0	200.0	30.0	.00	.0	1
10	110.0	110.0	200.0	27.0	.00	.0	1
11	110.0	110.0	200.0	30.0	.00	.0	1
12	110.0	110.0	200.0	27.0	.00	.0	1
13	110.0	110.0	200.0	30.0	.00	.0	1
14	110.0	110.0	200.0	27.0	.00	.0	1
15	110.0	110.0	200.0	30.0	.00	.0	1
16	110.0	110.0	200.0	27.0	.00	.0	1
17	110.0	110.0	200.0	30.0	.00	.0	1
18	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	560.00	234.00

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 100.00
AND X = 200.00

EACH SURFACE TERMINATES BETWEEN X = 330.00
AND X = 450.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y =150.00

10.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.933

X-CENTER = 266.12
Y-CENTER = 378.89
RADIUS = 165.34

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	179.59	238.00	-29.82
2	188.27	233.03	-26.36
3	197.23	228.59	-22.89
4	206.44	224.70	-19.42
5	215.87	221.37	-15.96
6	225.49	218.62	-12.49
7	235.25	216.46	-9.03
8	245.13	214.89	-5.56
9	255.08	213.92	-2.10
10	265.07	213.56	1.37
11	275.07	213.79	4.84
12	285.03	214.64	8.30
13	294.93	216.08	11.77
14	304.72	218.12	15.23
15	314.37	220.75	18.70
16	323.84	223.95	22.17
17	333.10	227.73	25.63
18	342.12	232.05	29.10
19	350.85	236.92	32.56
20	359.28	242.30	36.03
21	367.37	248.18	39.50
22	375.09	254.54	42.96
23	382.40	261.36	46.43
24	389.30	268.60	49.89
25	395.74	276.25	53.36
26	401.71	284.27	56.82
27	407.18	292.64	60.29
28	411.56	300.32	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	181.34	3.49	453.58	.00	.00	918.56	690.39
2	184.83	3.49	1325.83	.00	.00	2131.63	1052.67
3	187.42	1.70	939.68	.00	59.41	1375.16	613.13
4	191.32	6.11	4725.61	.00	1057.88	5358.29	2305.62
5	195.80	2.85	2901.73	.00	934.49	2837.52	1077.08
6	201.83	9.21	12062.21	.00	4591.12	10058.36	3685.61
7	207.43	1.98	3089.10	.00	1263.20	2302.91	823.97
8	209.96	3.08	5113.39	.00	2149.19	3791.29	1470.24
9	213.69	4.37	8302.25	.00	3429.94	6194.96	2329.72
10	216.69	1.63	3483.29	.00	1359.00	2530.11	930.81
11	219.08	3.17	7131.17	.00	2786.38	5169.68	1884.94
12	223.08	4.82	11444.69	.00	4592.40	8067.34	2644.63
13	230.37	9.76	25096.49	.00	10270.55	16635.27	5419.06
14	236.37	2.25	6096.46	.00	2519.38	3852.29	1251.06
15	241.31	7.63	22829.57	.00	8915.62	14953.31	4740.03
16	250.10	9.95	35538.91	.00	12226.88	24201.93	7413.38
17	260.08	9.99	41599.24	.00	12643.31	29304.20	8758.17
18	270.07	10.00	46850.73	.00	12682.77	33972.40	9988.55
19	280.05	9.96	51305.55	.00	12345.08	38204.27	11103.93
20	289.98	9.90	54814.00	.00	11631.54	41996.79	12103.52
21	299.82	9.79	57364.98	.00	10544.68	45346.49	12986.38
22	307.36	5.28	32006.77	.00	5177.98	25975.75	7412.64
23	310.81	1.62	9857.00	.00	1487.49	8099.87	2308.28
24	312.99	2.75	16577.77	.00	2423.09	13574.12	4348.76
25	317.28	5.83	34291.43	.00	4712.48	28403.21	9119.72
26	322.02	3.64	21151.09	.00	2555.94	17836.36	5724.34
27	323.87	.06	355.32	.00	41.03	303.01	97.28

28	323.92	.05	291.86	.00	33.63	248.96	79.92
29	324.32	.75	4375.95	.00	497.73	3786.70	1081.85
30	326.40	3.40	19791.48	.00	2062.23	17296.66	4938.64
31	330.40	4.60	26841.55	.00	2285.00	23920.69	6818.57
32	332.90	.40	2339.22	.00	171.35	2109.79	600.78
33	335.47	4.74	27671.96	.00	1683.40	25520.81	7269.84
34	338.42	1.16	6798.35	.00	299.77	6277.06	2008.23
35	340.56	3.12	18223.17	.00	581.00	17020.67	5440.82
36	343.86	3.50	20463.11	.00	243.04	19675.04	6290.04
37	347.41	3.59	20953.59	.00	.00	20359.32	6505.82
38	350.03	1.65	9558.99	.00	.00	9287.45	2968.71
39	351.70	1.70	9790.04	.00	.00	9643.82	3088.37
40	355.92	6.73	38146.04	.00	.00	36642.05	13496.52
41	363.33	8.09	43966.30	.00	.00	42798.87	15903.07
42	369.11	3.48	18117.18	.00	.00	17931.36	6729.34
43	372.25	2.79	14200.01	.00	.00	14661.26	4538.02
44	374.36	1.44	7242.40	.00	.00	7585.93	2183.15
45	375.26	.34	1696.04	.00	.00	1827.18	526.60
46	376.26	1.67	8259.90	.00	.00	9126.59	2319.75
47	378.25	2.30	11133.26	.00	.00	12299.08	3129.25
48	380.40	2.00	9366.05	.00	.00	10343.31	2636.29
49	381.70	.60	2720.45	.00	.00	3003.28	766.84
50	382.20	.40	1802.39	.00	.00	1989.41	508.44
51	383.40	2.00	8508.94	.00	.00	9722.32	2494.91
52	386.85	4.90	18696.95	.00	.00	21330.95	5512.76
53	392.52	6.44	20089.24	.00	.00	23764.23	6249.48
54	398.72	5.97	13443.01	.00	.00	16483.82	4493.36
55	404.44	5.47	7318.95	.00	.00	9192.37	2734.58
56	408.75	3.14	1747.70	.00	.00	2075.31	828.02
57	410.94	1.24	152.66	.00	.00	54.70	144.55

1

AGEC
Midvale UT s/n5206

FAILURE SURFACE # 2 SPECIFIED BY 29 COORDINATE POINTS

SAFETY FACTOR = 1.935

X-CENTER = 260.54
Y-CENTER = 386.38
RADIUS = 174.14

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	169.39	238.00	-29.92
2	178.06	233.01	-26.62
3	187.00	228.53	-23.33
4	196.18	224.57	-20.04
5	205.57	221.14	-16.75
6	215.15	218.26	-13.46
7	224.87	215.93	-10.17
8	234.72	214.17	-6.88
9	244.64	212.97	-3.59
10	254.62	212.34	-.30
11	264.62	212.29	2.99
12	274.61	212.81	6.28
13	284.55	213.91	9.57
14	294.41	215.57	12.86
15	304.16	217.79	16.15
16	313.77	220.58	19.44
17	323.19	223.91	22.73
18	332.42	227.77	26.03
19	341.40	232.16	29.32
20	350.12	237.05	32.61
21	358.55	242.44	35.90
22	366.65	248.31	39.19
23	374.40	254.62	42.48

24	381.77	261.38	45.77
25	388.75	268.54	49.06
26	395.30	276.10	52.35
27	401.41	284.01	55.64
28	407.05	292.27	58.93
29	411.92	300.35	

1

AGEC
Midvale UT s/n5206

FAILURE SURFACE # 3 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.935

X-CENTER = 265.39
Y-CENTER = 369.87
RADIUS = 156.22

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	181.63	238.00	-30.59
2	190.24	232.91	-26.92
3	199.16	228.38	-23.25
4	208.35	224.44	-19.58
5	217.77	221.08	-15.92
6	227.38	218.34	-12.25
7	237.16	216.22	-8.58
8	247.04	214.73	-4.91
9	257.01	213.87	-1.24
10	267.01	213.66	2.43
11	277.00	214.08	6.09
12	286.94	215.14	9.76
13	296.80	216.84	13.43
14	306.52	219.16	17.10
15	316.08	222.10	20.77
16	325.43	225.64	24.43
17	334.53	229.78	28.10
18	343.36	234.49	31.77
19	351.86	239.76	35.44
20	360.00	245.56	39.11
21	367.76	251.86	42.78
22	375.10	258.65	46.44
23	381.99	265.90	50.11
24	388.41	273.57	53.78
25	394.32	281.64	57.45
26	399.70	290.07	61.12
27	404.53	298.83	64.78
28	404.91	299.65	

1

AGEC
Midvale UT s/n5206

FAILURE SURFACE # 4 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.937

X-CENTER = 269.91
Y-CENTER = 376.26
RADIUS = 161.88

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	185.71	238.00	-29.57
2	194.41	233.07	-26.03
3	203.40	228.68	-22.49
4	212.64	224.85	-18.95

5	222.10	221.60	-15.41
6	231.74	218.95	-11.87
7	241.52	216.89	-8.33
8	251.42	215.44	-4.79
9	261.38	214.61	-1.25
10	271.38	214.39	2.29
11	281.37	214.79	5.83
12	291.32	215.81	9.37
13	301.19	217.44	12.91
14	310.93	219.67	16.45
15	320.52	222.50	19.99
16	329.92	225.92	23.53
17	339.09	229.91	27.07
18	347.99	234.47	30.61
19	356.60	239.56	34.15
20	364.88	245.17	37.69
21	372.79	251.29	41.23
22	380.31	257.88	44.77
23	387.41	264.92	48.31
24	394.06	272.39	51.85
25	400.24	280.25	55.39
26	405.91	288.48	58.93
27	411.07	297.05	62.47
28	412.84	300.44	

1

AGEC
Midvale UT s/n5206

FAILURE SURFACE # 5 SPECIFIED BY 30 COORDINATE POINTS

SAFETY FACTOR = 1.939

X-CENTER = 257.98
Y-CENTER = 387.90
RADIUS = 176.23

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	165.31	238.00	-30.10
2	173.96	232.98	-26.85
3	182.88	228.47	-23.60
4	192.04	224.47	-20.35
5	201.42	220.99	-17.09
6	210.98	218.05	-13.84
7	220.69	215.66	-10.59
8	230.52	213.82	-7.34
9	240.44	212.54	-4.09
10	250.41	211.83	-.84
11	260.41	211.68	2.42
12	270.40	212.10	5.67
13	280.35	213.09	8.92
14	290.23	214.64	12.17
15	300.01	216.75	15.42
16	309.65	219.41	18.67
17	319.12	222.61	21.93
18	328.40	226.35	25.18
19	337.45	230.60	28.43
20	346.24	235.36	31.68
21	354.75	240.61	34.93
22	362.95	246.34	38.19
23	370.81	252.52	41.44
24	378.30	259.14	44.69
25	385.41	266.17	47.94
26	392.11	273.60	51.19
27	398.38	281.39	54.44
28	404.20	289.52	57.70
29	409.54	297.98	60.95

30	410.80	300.24

1
AGEC
Midvale UT s/n5206

FAILURE SURFACE # 6 SPECIFIED BY 29 COORDINATE POINTS

SAFETY FACTOR = 1.939

X-CENTER = 273.59
Y-CENTER = 381.13
RADIUS = 169.03

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	183.57	238.00	-30.44
2	192.30	232.93	-27.05
3	201.20	228.39	23.66
4	210.36	224.37	-20.27
5	219.74	220.91	-16.88
6	229.31	218.00	-13.49
7	239.03	215.67	-10.10
8	248.88	213.92	-6.71
9	258.81	212.75	-3.32
10	268.79	212.17	.07
11	278.79	212.18	3.46
12	288.78	212.78	6.85
13	298.70	213.98	10.24
14	308.55	215.76	13.63
15	318.26	218.11	17.02
16	327.83	221.04	20.41
17	337.20	224.53	23.80
18	346.35	228.56	27.19
19	355.24	233.13	30.58
20	363.85	238.22	33.97
21	372.14	243.81	37.36
22	380.09	249.88	40.75
23	387.67	256.40	44.14
24	394.84	263.37	47.53
25	401.60	270.75	50.92
26	407.90	278.51	54.31
27	413.73	286.63	57.70
28	419.08	295.08	61.09
29	422.57	301.42	

1
AGEC
Midvale UT s/n5206

FAILURE SURFACE # 7 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.939

X-CENTER = 269.34
Y-CENTER = 367.76
RADIUS = 153.28

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	187.76	238.00	-30.29
2	196.39	232.96	-26.55
3	205.34	228.49	-22.81
4	214.55	224.61	-19.07
5	224.01	221.34	-15.33
6	233.65	218.70	-11.59
7	243.45	216.69	-7.86
8	253.35	215.32	-4.12

9	263.33	214.60	-.38
10	273.33	214.54	3.36
11	283.31	215.12	7.10
12	293.23	216.36	10.84
13	303.05	218.24	14.58
14	312.73	220.76	18.31
15	322.22	223.90	22.05
16	331.49	227.65	25.79
17	340.50	232.00	29.53
18	349.20	236.93	33.27
19	357.56	242.42	37.01
20	365.54	248.44	40.75
21	373.12	254.97	44.49
22	380.25	261.97	48.22
23	386.92	269.43	51.96
24	393.08	277.31	55.70
25	398.71	285.57	59.44
26	403.80	294.18	63.18
27	406.65	299.83	

1

AGEC
Midvale UT s/n5206

FAILURE SURFACE # 8 SPECIFIED BY 30 COORDINATE POINTS

SAFETY FACTOR = 1.941

X-CENTER = 264.50
Y-CENTER = 399.66
RADIUS = 186.54

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	171.43	238.00	-28.39
2	180.23	233.24	-25.32
3	189.27	228.97	-22.25
4	198.52	225.18	-19.18
5	207.97	221.90	-16.11
6	217.57	219.12	-13.04
7	227.32	216.87	-9.96
8	237.16	215.14	-6.89
9	247.09	213.94	-3.82
10	257.07	213.27	-.75
11	267.07	213.14	2.32
12	277.06	213.54	5.40
13	287.02	214.48	8.47
14	296.91	215.96	11.54
15	306.71	217.96	14.61
16	316.38	220.48	17.68
17	325.91	223.52	20.76
18	335.26	227.06	23.83
19	344.41	231.10	26.90
20	353.33	235.63	29.97
21	361.99	240.62	33.04
22	370.37	246.07	36.11
23	378.45	251.97	39.19
24	386.20	258.29	42.26
25	393.60	265.01	45.33
26	400.63	272.12	48.40
27	407.27	279.60	51.47
28	413.50	287.43	54.55
29	419.30	295.57	57.62
30	423.04	301.46	

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AGEC
Midvale UT s/n5206

FAILURE SURFACE # 9 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.943

X-CENTER = 264.00
Y-CENTER = 357.35
RADIUS = 146.19

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	179.59	238.00	-33.31
2	187.95	232.51	-29.39
3	196.66	227.60	-25.47
4	205.69	223.30	-21.55
5	214.99	219.63	-17.63
6	224.52	216.60	-13.71
7	234.24	214.23	-9.79
8	244.09	212.53	-5.87
9	254.04	211.51	-1.95
10	264.03	211.17	1.97
11	274.03	211.51	5.89
12	283.97	212.54	9.81
13	293.83	214.24	13.73
14	303.54	216.61	17.65
15	313.07	219.65	21.57
16	322.37	223.32	25.49
17	331.40	227.63	29.41
18	340.11	232.54	33.33
19	348.46	238.03	37.25
20	356.42	244.09	41.17
21	363.95	250.67	45.09
22	371.01	257.75	49.01
23	377.57	265.30	52.93
24	383.60	273.28	56.85
25	389.06	281.65	60.77
26	393.95	290.38	64.69
27	398.00	298.96	

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AGEC
Midvale UT s/n5206

FAILURE SURFACE #10 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.943

X-CENTER = 274.23
Y-CENTER = 360.47
RADIUS = 147.61

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	191.84	238.00	-31.99
2	200.32	232.70	-28.11
3	209.14	227.99	-24.22
4	218.26	223.89	-20.34
5	227.64	220.41	-16.46
6	237.23	217.58	-12.58
7	246.99	215.40	-8.70
8	256.87	213.89	-4.81
9	266.84	213.05	-.93
10	276.83	212.89	2.95
11	286.82	213.40	6.83
12	296.75	214.59	10.72
13	306.58	216.45	14.60
14	316.25	218.97	18.48
15	325.74	222.14	22.36

16	334.98	225.95	26.25
17	343.95	230.37	30.13
18	352.60	235.39	34.01
19	360.89	240.98	37.89
20	368.78	247.12	41.78
21	376.24	253.79	45.66
22	383.23	260.94	49.54
23	389.72	268.55	53.42
24	395.68	276.58	57.31
25	401.08	284.99	61.19
26	405.90	293.76	65.07
27	408.82	300.04	

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          Y            A     X     I     S

         157.00    227.00    297.00    367.00    437.00    507.00

X         .00 *-****--*****-------+---------+---------+---------+
              .
              -
              -
              -
              -
       70.00 +
              -
              -
              -           ..
              -         ....
              -        .....
A    140.00 +       ......
              -     .......
              -    .......5
              -   .......21
              -   ......213
              -  ......514.
X    210.00 +  ......21.*
              -  .....210.*
              - ......14..*
              - ......14...
              - ......1....
              - ......1.....
I    280.00 + ......1.....
              -  .....13.....
              -  .....61......
              -   .....1......*
              -   .....61.....*.
              -    .....11....*..
S    350.00 +    .....613.......
              -     ......11......
              -      .....6413....*
              -       .....*41139.*
              -        ...**.641139
              -         ....6811.
     420.00 +           .......66
              -              ........
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              -                    .
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     490.00 +
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     560.00 * ****  ******        **
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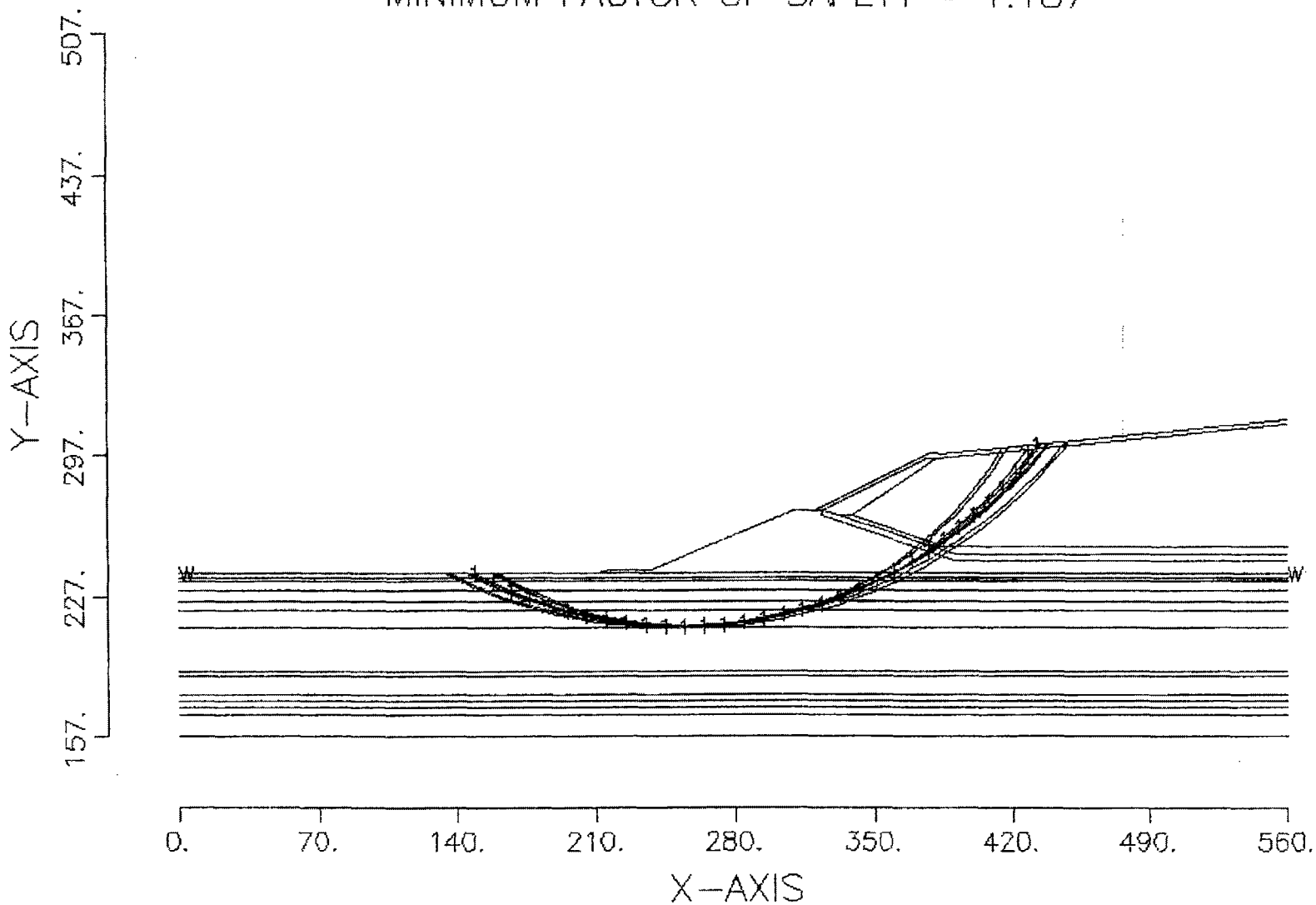
AGEC
Midvale UT s/n5206

3/1/10

CELL 6/LT/SEISMIC/SOUTH/WASTE +20'

2500SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.187



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 6/LT/SEISMIC/SOUTH/WASTE +20'

BOUNDARY COORDINATES

9 TOP BOUNDARIES
38 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	238.00	211.50	238.00	5
2	211.50	238.00	217.50	240.00	3
3	217.50	240.00	237.50	240.00	3
4	237.50	240.00	310.00	269.00	3
5	310.00	369.00	320.20	269.00	3
6	320.20	269.00	379.40	298.60	1
7	379.40	298.60	381.40	298.60	1
8	381.40	298.60	384.40	297.60	1
9	384.40	297.60	560.00	315.16	1
10	320.20	269.00	324.70	269.00	3
11	324.70	269.00	377.10	295.20	2
12	377.10	295.20	382.00	295.30	2
13	382.00	295.30	560.00	313.16	4
14	323.90	266.70	324.70	269.00	2
15	324.70	269.00	328.10	268.50	2
16	328.10	268.50	332.70	267.00	2
17	332.70	267.00	339.00	267.00	1
18	339.00	267.00	382.00	295.30	4
19	339.00	267.00	385.80	251.40	1
20	385.80	251.40	560.00	251.40	1
21	332.70	267.00	391.50	247.40	2
22	391.50	247.40	560.00	247.40	2
23	323.90	266.70	391.10	244.30	3
24	391.10	244.30	560.00	244.30	3
25	211.50	238.00	560.00	238.00	5
26	.00	236.00	560.00	236.00	6
27	.00	234.00	560.00	234.00	7
28	.00	230.00	560.00	230.00	8
29	.00	224.00	560.00	224.00	9
30	.00	220.00	560.00	220.00	10
31	.00	211.00	560.00	211.00	11
32	.00	190.00	560.00	190.00	12
33	.00	187.00	560.00	187.00	13
34	.00	178.00	560.00	178.00	14
35	.00	175.00	560.00	175.00	15
36	.00	172.00	560.00	172.00	16
37	.00	168.00	560.00	168.00	17
38	.00	157.00	560.00	157.00	18

ISOTROPIC SOIL PARAMETERS

18 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.
1	120.0	120.0	100.0	28.0	.00	.0	1

2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	32.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1
9	110.0	110.0	200.0	30.0	.00	.0	1
10	110.0	110.0	200.0	27.0	.00	.0	1
11	110.0	110.0	200.0	30.0	.00	.0	1
12	110.0	110.0	200.0	27.0	.00	.0	1
13	110.0	110.0	200.0	30.0	.00	.0	1
14	110.0	110.0	200.0	27.0	.00	.0	1
15	110.0	110.0	200.0	30.0	.00	.0	1
16	110.0	110.0	200.0	27.0	.00	.0	1
17	110.0	110.0	200.0	30.0	.00	.0	1
18	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	560.00	234.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .180 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 100.00
AND X = 200.00

EACH SURFACE TERMINATES BETWEEN X = 330.00
AND X = 450.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y =150.00

10.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 33 COORDINATE POINTS

SAFETY FACTOR = 1.187

X-CENTER = 254.08
Y-CENTER = 433.35
RADIUS = 221.82

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	148.98	238.00	-26.99
2	157.89	233.46	-24.41
3	167.00	229.33	-21.82
4	176.28	225.61	-19.24
5	185.72	222.32	-16.66
6	195.30	219.45	-14.07
7	205.00	217.02	-11.49
8	214.80	215.03	-8.91
9	224.68	213.48	-6.32
10	234.62	212.38	-3.74
11	244.60	211.73	-1.16
12	254.60	211.52	1.43
13	264.59	211.77	4.01
14	274.57	212.47	6.59
15	284.50	213.62	9.17
16	294.38	215.21	11.76
17	304.17	217.25	14.34
18	313.85	219.73	16.92
19	323.42	222.64	19.51
20	332.85	225.98	22.09
21	342.11	229.74	24.67
22	351.20	233.91	27.26
23	360.09	238.49	29.84
24	368.76	243.47	32.42
25	377.21	248.83	35.01
26	385.40	254.57	37.59
27	393.32	260.67	40.17
28	400.96	267.12	42.75
29	408.30	273.91	45.34
30	415.33	281.02	47.92
31	422.04	288.44	50.50
32	428.40	295.16	53.09
33	433.14	302.47	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	150.94	3.93	510.54	.00	.00	1264.12	1357.23
2	154.87	3.93	1492.34	.00	.00	2728.62	2069.44
3	157.36	1.06	559.55	.00	19.90	943.40	658.54

4	161.71	7.63	5719.40	.00	1186.31	7358.40	4990.07
5	166.26	1.48	1442.28	.00	438.58	1576.07	949.58
6	171.64	9.28	11308.52	.00	4073.82	10604.63	6236.06
7	178.59	4.62	6984.09	.00	2807.94	5736.26	3286.52
8	183.31	4.82	8158.42	.00	3453.73	6609.19	4074.28
9	189.60	7.75	14816.54	.00	6479.52	10992.88	6708.35
10	194.39	1.83	3795.26	.00	1704.47	2700.16	1481.26
11	200.15	9.70	21670.18	.00	9836.89	14484.46	7901.25
12	208.25	6.50	15855.90	.00	7298.04	9979.77	5400.15
13	213.15	3.30	8657.57	.00	3918.99	5511.88	2933.37
14	216.15	2.70	7584.73	.00	3268.48	4804.04	2521.84
15	221.09	7.18	21224.78	.00	9053.10	13532.91	7032.86
16	229.65	9.94	30590.80	.00	13148.28	18706.18	9713.17
17	236.06	2.88	9065.06	.00	3909.49	5357.01	2785.22
18	241.05	7.10	23920.55	.00	9785.98	14675.80	7497.33
19	249.60	10.00	38496.04	.00	13962.03	24790.88	12324.66
20	259.60	10.00	43663.34	.00	13947.45	29373.75	14291.58
21	269.58	9.98	48230.04	.00	13651.71	33568.90	16092.10
22	279.54	9.93	52161.85	.00	13075.46	37384.70	17729.80
23	289.44	9.87	55431.88	.00	12219.83	40828.11	19207.68
24	299.27	9.79	58021.23	.00	11086.59	43905.32	20528.39
25	307.08	5.83	35810.71	.00	6012.59	27655.99	12884.07
26	311.93	3.85	23721.79	.00	3665.41	18606.40	8655.95
27	314.30	.89	5422.91	.00	821.68	4244.63	1978.69
28	317.47	5.45	32608.75	.00	4685.23	25355.39	13291.29
29	321.81	3.22	19104.60	.00	2490.07	15075.85	7899.00
30	323.66	.48	2859.81	.00	357.09	2257.63	1183.43
31	324.30	.80	4772.69	.00	585.17	3776.82	1979.73
32	325.98	2.56	15265.13	.00	1772.33	12164.48	6373.57
33	327.68	.84	5013.75	.00	547.12	4096.05	1907.92
34	330.40	4.60	27608.53	.00	2706.57	22822.00	10617.11
35	332.77	.15	889.09	.00	78.62	742.39	345.00
36	335.92	6.15	37202.73	.00	2805.98	31417.44	14602.63
37	340.56	3.11	18960.26	.00	1025.76	16357.51	7586.56
38	342.40	.57	3463.75	.00	160.70	3009.44	1396.67
39	346.94	8.52	52384.09	.00	1195.30	45549.93	23731.51
40	351.28	.17	1030.49	.00	.50	913.54	475.87
41	353.31	3.88	23969.77	.00	.00	21258.51	11074.17
42	357.19	3.88	23877.10	.00	.00	21175.15	11033.63
43	359.61	.96	5875.27	.00	.00	5052.02	3022.43
44	364.43	8.67	52516.63	.00	.00	45018.43	27064.69
45	372.93	8.34	49030.68	.00	.00	41947.81	25406.29
46	377.15	.11	610.82	.00	.00	522.23	317.06
47	377.25	.10	560.84	.00	.00	479.86	292.50
48	378.35	2.10	12097.46	.00	.00	10932.30	5478.63
49	379.92	1.03	5902.06	.00	.00	5332.49	2674.50
50	380.92	.97	5479.67	.00	.00	5039.38	2356.69
51	381.70	.60	3348.42	.00	.00	3078.95	1440.69
52	382.23	.46	2550.42	.00	.00	2344.88	1097.76
53	383.43	1.94	10401.14	.00	.00	9849.32	4067.94
54	384.90	1.00	5194.41	.00	.00	4917.19	2033.90
55	389.36	7.92	38490.66	.00	.00	36799.05	15296.49
56	397.14	7.64	32075.75	.00	.00	30990.21	13014.86
57	404.63	7.34	25650.14	.00	.00	25055.40	10683.75
58	411.82	7.03	19298.50	.00	.00	19036.31	8319.53
59	418.68	6.70	13106.59	.00	.00	12978.59	5940.14
60	425.22	6.36	7160.30	.00	.00	6932.29	3565.24
61	429.94	3.08	1459.27	.00	.00	1217.26	910.74
62	432.31	1.66	203.46	.00	.00	18.11	240.86

FAILURE SURFACE # 2 SPECIFIED BY 33 COORDINATE POINTS

SAFETY FACTOR = 1.189

X-CENTER = 254.44
Y-CENTER = 438.39
RADIUS = 226.45

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	148.98	238.00	-26.49
2	157.93	233.54	-23.96
3	167.07	229.48	-21.43
4	176.38	225.83	-18.90
5	185.84	222.59	-16.37
6	195.43	219.77	-13.84
7	205.14	217.38	-11.31
8	214.95	215.42	-8.78
9	224.83	213.89	-6.25
10	234.77	212.80	-3.72
11	244.75	212.15	-1.19
12	254.75	211.95	1.34
13	264.75	212.18	3.87
14	274.72	212.86	6.40
15	284.66	213.97	8.93
16	294.54	215.52	11.46
17	304.34	217.51	14.00
18	314.04	219.93	16.53
19	323.63	222.77	19.06
20	333.08	226.04	21.59
21	342.38	229.72	24.12
22	351.51	233.80	26.65
23	360.45	238.29	29.18
24	369.18	243.16	31.71
25	377.68	248.42	34.24
26	385.95	254.05	36.77
27	393.96	260.03	39.30
28	401.70	266.37	41.83
29	409.15	273.04	44.36
30	416.30	280.03	46.89
31	423.14	287.33	49.42
32	429.64	294.92	51.95
33	435.76	302.74	

FAILURE SURFACE # 3 SPECIFIED BY 32 COORDINATE POINTS

SAFETY FACTOR = 1.189

X-CENTER = 257.99
Y-CENTER = 420.67
RADIUS = 208.65

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	157.14	238.00	-27.53
2	166.01	233.38	-24.78
3	175.09	229.19	-22.04
4	184.36	225.43	-19.29
5	193.80	222.13	-16.54
6	203.38	219.28	-13.80
7	213.10	216.90	-11.05
8	222.91	214.98	-8.30
9	232.81	213.54	-5.56
10	242.76	212.57	-2.81
11	252.75	212.08	-.06
12	262.75	212.07	2.68
13	272.74	212.54	5.43
14	282.69	213.48	8.17
15	292.59	214.90	10.92
16	302.41	216.80	13.67
17	312.13	219.16	16.41
18	321.72	221.99	19.16
19	331.16	225.27	21.91
20	340.44	229.00	24.65

21	349.53	233.17	27.40
22	358.41	237.77	30.14
23	367.06	242.79	32.89
24	375.45	248.22	35.64
25	383.58	254.05	38.38
26	391.42	260.26	41.13
27	398.95	266.84	43.88
28	406.16	273.77	46.62
29	413.03	281.04	49.37
30	419.54	288.63	52.11
31	425.68	296.52	54.86
32	429.62	302.12	

FAILURE SURFACE # 4 SPECIFIED BY 35 COORDINATE POINTS

SAFETY FACTOR = 1.190

X-CENTER = 258.29
Y-CENTER = 455.00
RADIUS = 243.90

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	146.94	238.00	-25.99
2	155.93	233.62	-23.64
3	165.09	229.61	-21.29
4	174.41	225.98	-18.94
5	183.86	222.73	-16.59
6	193.45	219.88	-14.24
7	203.14	217.42	-11.89
8	212.93	215.35	-9.54
9	222.79	213.70	-7.19
10	232.71	212.44	-4.85
11	242.67	211.60	-2.50
12	252.66	211.16	-.15
13	262.66	211.14	2.20
14	272.66	211.52	4.55
15	282.63	212.32	6.90
16	292.55	213.52	9.25
17	302.42	215.13	11.60
18	312.22	217.14	13.95
19	321.92	219.55	16.30
20	331.52	222.35	18.65
21	341.00	225.55	21.00
22	350.33	229.13	23.35
23	359.51	233.10	25.70
24	368.52	237.43	28.05
25	377.35	242.14	30.40
26	385.98	247.20	32.74
27	394.39	252.60	35.09
28	402.57	258.35	37.44
29	410.51	264.43	39.79
30	418.19	270.83	42.14
31	425.61	277.54	44.49
32	432.74	284.55	46.84
33	439.58	291.85	49.19
34	446.12	299.41	51.54
35	449.88	304.15	

FAILURE SURFACE # 5 SPECIFIED BY 35 COORDINATE POINTS

SAFETY FACTOR = 1.190

X-CENTER = 246.90
Y-CENTER = 459.81

RADIUS = 248.58

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	134.69	238.00	-25.68
2	143.71	233.67	-23.38
3	152.89	229.70	-21.07
4	162.22	226.10	-18.77
5	171.69	222.89	-16.46
6	181.28	220.05	-14.16
7	190.97	217.61	-11.85
8	200.76	215.55	-9.55
9	210.62	213.90	-7.24
10	220.54	212.64	-4.93
11	230.50	211.78	-2.63
12	240.49	211.32	-.32
13	250.49	211.26	1.98
14	260.49	211.61	4.29
15	270.46	212.35	6.59
16	280.39	213.50	8.90
17	290.27	215.05	11.20
18	300.08	216.99	13.51
19	309.81	219.33	15.81
20	319.43	222.05	18.12
21	328.93	225.16	20.42
22	338.30	228.65	22.73
23	347.53	232.51	25.03
24	356.59	236.74	27.34
25	365.47	241.34	29.64
26	374.16	246.28	31.95
27	382.65	251.57	34.25
28	390.91	257.20	36.56
29	398.95	263.16	38.86
30	406.73	269.43	41.17
31	414.26	276.01	43.47
32	421.52	282.89	45.78
33	428.49	290.06	48.08
34	435.17	297.50	50.39
35	439.84	303.14	

FAILURE SURFACE # 6 SPECIFIED BY 35 COORDINATE POINTS

SAFETY FACTOR = 1.190

X-CENTER = 248.03
Y-CENTER = 458.12
RADIUS = 246.65

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	136.74	238.00	-25.66
2	145.75	233.67	-23.34
3	154.93	229.71	-21.01
4	164.27	226.12	-18.69
5	173.74	222.92	-16.37
6	183.33	220.10	-14.04
7	193.03	217.67	-11.72
8	202.83	215.64	-9.40
9	212.69	214.01	-7.08
10	222.62	212.78	-4.75
11	232.58	211.95	-2.43
12	242.57	211.52	-.11
13	252.57	211.51	2.22
14	262.56	211.89	4.54
15	272.53	212.68	6.86

16	282.46	213.88	9.19
17	292.33	215.48	11.51
18	302.13	217.47	13.83
19	311.84	219.86	16.16
20	321.45	222.64	18.48
21	330.93	225.81	20.80
22	340.28	229.36	23.12
23	349.48	233.29	25.45
24	358.51	237.59	27.77
25	367.35	242.25	30.09
26	376.01	247.26	32.42
27	384.45	252.62	34.74
28	392.67	258.32	37.06
29	400.64	264.35	39.39
30	408.37	270.69	41.71
31	415.84	277.35	44.03
32	423.03	284.30	46.36
33	429.93	291.54	48.68
34	436.53	299.05	51.00
35	439.85	303.15	

FAILURE SURFACE # 7 SPECIFIED BY 34 COORDINATE POINTS

SAFETY FACTOR = 1.190

X-CENTER = 252.46
Y-CENTER = 447.78
RADIUS = 235.75

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	144.90	238.00	-25.93
2	153.89	233.63	-23.50
3	163.06	229.64	-21.07
4	172.39	226.04	-18.64
5	181.87	222.85	-16.21
6	191.47	220.06	-13.78
7	201.18	217.68	-11.35
8	210.99	215.71	-8.92
9	220.87	214.16	-6.49
10	230.80	213.03	-4.06
11	240.78	212.32	-1.63
12	250.77	212.04	.81
13	260.77	212.18	3.24
14	270.76	212.74	5.67
15	280.71	213.73	8.10
16	290.61	215.14	10.53
17	300.44	216.97	12.96
18	310.19	219.21	15.39
19	319.83	221.86	17.82
20	329.35	224.92	20.25
21	338.73	228.38	22.68
22	347.96	232.24	25.11
23	357.01	236.48	27.54
24	365.88	241.11	29.97
25	374.54	246.10	32.40
26	382.98	251.46	34.83
27	391.19	257.17	37.26
28	399.15	263.23	39.70
29	406.84	269.62	42.13
30	414.26	276.32	44.56
31	421.39	283.34	46.99
32	428.21	290.65	49.42
33	434.71	298.25	51.85
34	438.45	303.01	

FAILURE SURFACE # 8 SPECIFIED BY 36 COORDINATE POINTS

SAFETY FACTOR = 1.191

X-CENTER = 250.82
Y-CENTER = 467.08
RADIUS = 255.91

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	136.74	238.00	-25.35
2	145.77	233.72	-23.12
3	154.97	229.79	-20.88
4	164.31	226.23	-18.64
5	173.79	223.03	-16.40
6	183.38	220.21	-14.16
7	193.08	217.76	-11.92
8	202.86	215.70	-9.68
9	212.72	214.02	-7.44
10	222.64	212.72	-5.20
11	232.59	211.81	-2.96
12	242.58	211.30	-.72
13	252.58	211.17	1.51
14	262.58	211.44	3.75
15	272.56	212.09	5.99
16	282.50	213.13	8.23
17	292.40	214.57	10.47
18	302.23	216.38	12.71
19	311.99	218.58	14.95
20	321.65	221.16	17.19
21	331.20	224.12	19.43
22	340.63	227.44	21.67
23	349.93	231.14	23.90
24	359.07	235.19	26.14
25	368.04	239.59	28.38
26	376.84	244.35	30.62
27	385.45	249.44	32.86
28	393.85	254.87	35.10
29	402.03	260.62	37.34
30	409.98	266.68	39.58
31	417.69	273.05	41.82
32	425.14	279.72	44.06
33	432.33	286.68	46.30
34	439.24	293.90	48.53
35	445.86	301.40	50.77
36	447.94	303.95	

FAILURE SURFACE # 9 SPECIFIED BY 31 COORDINATE POINTS

SAFETY FACTOR = 1.191

X-CENTER = 255.91
Y-CENTER = 398.48
RADIUS = 187.38

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	159.18	238.00	-29.55
2	167.88	233.07	-26.49
3	176.83	228.61	-23.43
4	186.01	224.63	-20.38
5	195.38	221.15	-17.32
6	204.93	218.17	-14.26
7	214.62	215.71	-11.20

8	224.43	213.77	-8.14
9	234.33	212.35	-5.09
10	244.29	211.46	-2.03
11	254.28	211.11	1.03
12	264.28	211.29	4.09
13	274.26	212.00	7.15
14	284.18	213.25	10.21
15	294.02	215.02	13.26
16	303.75	217.31	16.32
17	313.35	220.12	19.38
18	322.78	223.44	22.44
19	332.03	227.26	25.50
20	341.05	231.56	28.56
21	349.84	236.34	31.61
22	358.35	241.59	34.67
23	366.58	247.27	37.73
24	374.49	253.39	40.79
25	382.06	259.93	43.85
26	389.27	266.85	46.90
27	396.10	274.16	49.96
28	402.54	281.81	53.02
29	408.55	289.80	56.08
30	414.13	298.10	59.14
31	415.70	300.73	

FAILURE SURFACE #10 SPECIFIED BY 31 COORDINATE POINTS

SAFETY FACTOR = 1.191

X-CENTER = 257.73
Y-CENTER = 400.66
RADIUS = 189.13

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	161.23	238.00	-29.17
2	169.96	233.13	-26.14
3	178.93	228.72	-23.11
4	188.13	224.80	-20.08
5	197.52	221.36	-17.05
6	207.09	218.43	-14.02
7	216.79	216.01	-10.99
8	226.60	214.10	-7.96
9	236.51	212.72	-4.93
10	246.47	211.86	-1.90
11	256.47	211.53	1.13
12	266.46	211.73	4.16
13	276.44	212.45	7.19
14	286.36	213.71	10.22
15	296.20	215.48	13.25
16	305.93	217.77	16.28
17	315.53	220.58	19.31
18	324.97	223.88	22.34
19	334.22	227.68	25.37
20	343.26	231.97	28.40
21	352.05	236.72	31.43
22	360.58	241.94	34.46
23	368.83	247.60	37.49
24	376.76	253.68	40.52
25	384.37	260.18	43.55
26	391.61	267.07	46.58
27	398.49	274.33	49.61
28	404.97	281.95	52.64
29	411.04	289.90	55.67
30	416.68	298.15	58.70
31	418.41	301.00	

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          Y           A     X     I     S

         157.00    227.00    297.00    367.00    437.00    507.00

X       .00 *-*****-*****-------+---------+---------+---------+
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            -       .....
A   140.00 +      ....55
            -    ....541
            -   .....119
            -  .....510.
            -  .....13..
            - .....51...
X   210.00 + .....11..*
            - .....1...*
            - ......1...*
            - ......1....
            - ......1....
            - ......1.....
I   280.00 + ......1.....
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            -  .....41......
            -   .....1......*
            -   .....13.....*.
            -    .....19....*..
S   350.00 +    .....41........
            -    .....419......
            -     ....4119.....*
            -      .....*199...*
            -       ...**4119...
            -        ....4451399.
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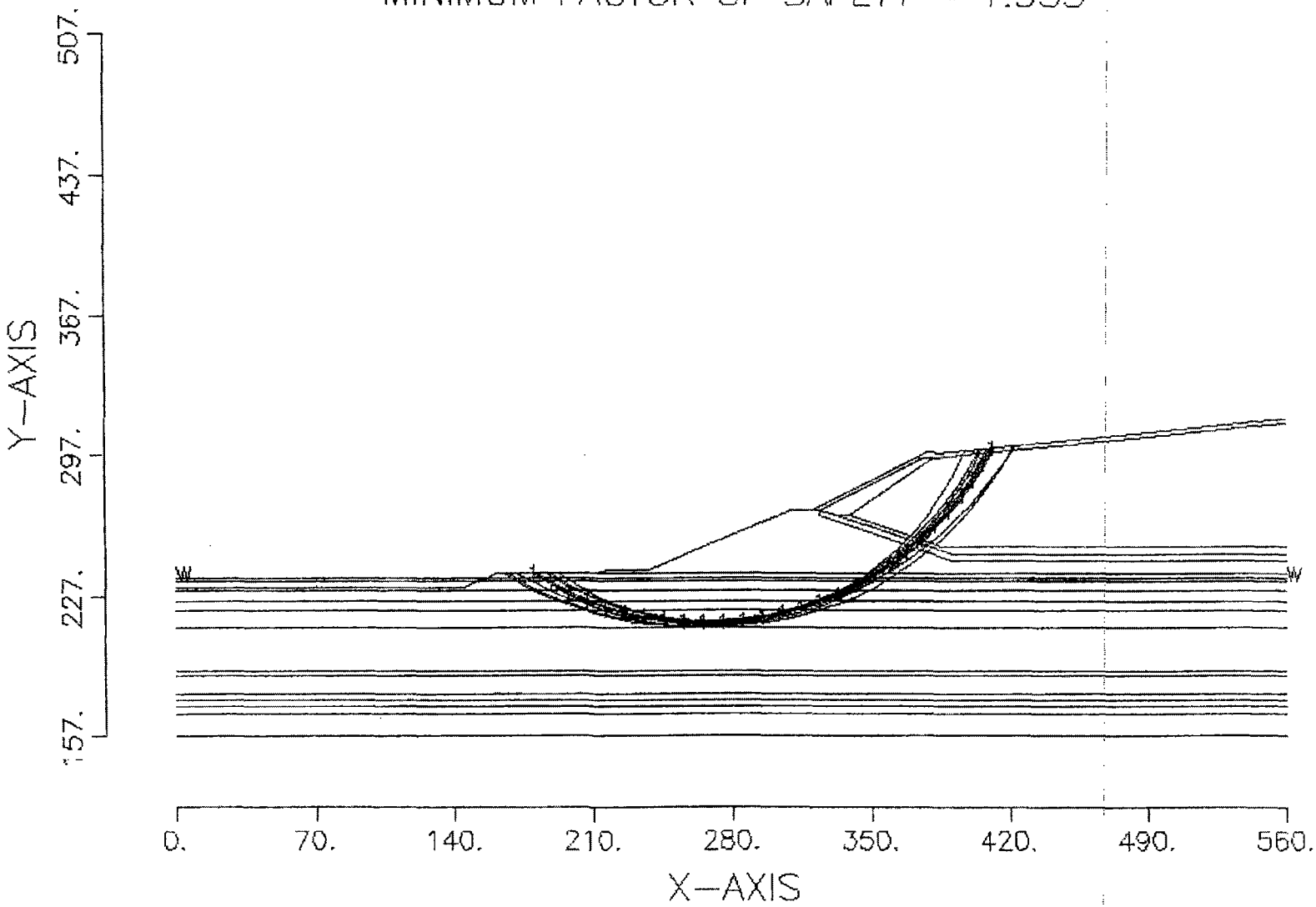
AGEC
Midvale UT s/n5206

CELL 6/LT/STATIC/POND/WASTE +20'

2500 SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.933



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 6/LT/STATIC/POND/WASTE +20'

BOUNDARY COORDINATES

13 TOP BOUNDARIES
42 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	231.50	145.25	231.50	7
2	145.25	231.50	151.50	234.00	7
3	151.50	234.00	156.50	236.00	6
4	156.50	236.00	161.50	238.00	5
5	161.50	238.00	211.50	238.00	5
6	211.50	238.00	217.50	240.00	3
7	217.50	240.00	237.50	240.00	3
8	237.50	240.00	310.00	269.00	3
9	310.00	269.00	320.20	269.00	3
10	320.20	269.00	379.40	298.60	1
11	379.40	298.60	381.40	298.60	1
12	381.40	298.60	384.40	297.60	1
13	384.40	297.60	560.00	315.16	1
14	320.20	269.00	324.70	269.00	3
15	324.70	269.00	377.10	295.20	2
16	377.10	295.20	382.00	295.30	2
17	382.00	295.30	560.00	313.16	4
18	323.90	266.70	324.70	269.00	2
19	324.70	269.00	328.10	268.50	2
20	328.10	268.50	332.70	267.00	2
21	332.70	267.00	339.00	267.00	1
22	339.00	267.00	382.00	295.30	4
23	339.00	267.00	385.80	251.40	1
24	385.80	251.40	560.00	251.40	1
25	332.70	267.00	391.50	247.40	2
26	391.50	247.40	560.00	247.40	2
27	323.90	266.70	391.10	244.30	3
28	391.10	244.30	560.00	244.30	3
29	211.50	238.00	560.00	238.00	5
30	.00	236.00	560.00	236.00	6
31	.00	234.00	560.00	234.00	7
32	.00	230.00	560.00	230.00	8
33	.00	224.00	560.00	224.00	9
34	.00	220.00	560.00	220.00	10
35	.00	211.00	560.00	211.00	11
36	.00	190.00	560.00	190.00	12
37	.00	187.00	560.00	187.00	13
38	.00	178.00	560.00	178.00	14
39	.00	175.00	560.00	175.00	15
40	.00	172.00	560.00	172.00	16
41	.00	168.00	560.00	168.00	17
42	.00	157.00	560.00	157.00	18

ISOTROPIC SOIL PARAMETERS

18 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.
1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	32.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1
9	110.0	110.0	200.0	30.0	.00	.0	1
10	110.0	110.0	200.0	27.0	.00	.0	1
11	110.0	110.0	200.0	30.0	.00	.0	1
12	110.0	110.0	200.0	27.0	.00	.0	1
13	110.0	110.0	200.0	30.0	.00	.0	1
14	110.0	110.0	200.0	27.0	.00	.0	1
15	110.0	110.0	200.0	30.0	.00	.0	1
16	110.0	110.0	200.0	27.0	.00	.0	1
17	110.0	110.0	200.0	30.0	.00	.0	1
18	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	560.00	234.00

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 100.00
AND X = 200.00

EACH SURFACE TERMINATES BETWEEN X = 330.00
AND X = 450.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00

10.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.933

X-CENTER = 266.12
Y-CENTER = 378.89
RADIUS = 165.34

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	179.59	238.00	-29.82
2	188.27	233.03	-26.36
3	197.23	228.59	-22.89
4	206.44	224.70	-19.42
5	215.87	221.37	-15.96
6	225.49	218.62	-12.49
7	235.25	216.46	-9.03
8	245.13	214.89	-5.56
9	255.08	213.92	-2.10
10	265.07	213.56	1.37
11	275.07	213.79	4.84
12	285.03	214.64	8.30
13	294.93	216.08	11.77
14	304.72	218.12	15.23
15	314.37	220.75	18.70
16	323.84	223.95	22.17
17	333.10	227.73	25.63
18	342.12	232.05	29.10
19	350.85	236.92	32.56
20	359.28	242.30	36.03
21	367.37	248.18	39.50
22	375.09	254.54	42.96
23	382.40	261.36	46.43
24	389.30	268.60	49.89
25	395.74	276.25	53.36
26	401.71	284.27	56.82
27	407.18	292.64	60.29
28	411.56	300.32	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	181.34	3.49	453.58	.00	.00	918.56	690.39
2	184.83	3.49	1325.83	.00	.00	2131.63	1052.67
3	187.42	1.70	939.68	.00	59.41	1375.16	613.13
4	191.32	6.11	4725.61	.00	1057.88	5358.29	2305.62
5	195.80	2.85	2901.73	.00	934.49	2837.52	1077.08
6	201.83	9.21	12062.21	.00	4591.12	10058.36	3685.61
7	207.43	1.98	3089.10	.00	1263.20	2302.91	823.97
8	209.96	3.08	5113.39	.00	2149.19	3791.29	1470.24
9	213.69	4.37	8302.25	.00	3429.94	6194.96	2329.72
10	216.69	1.63	3483.29	.00	1359.00	2530.11	930.81
11	219.08	3.17	7131.17	.00	2786.38	5169.68	1884.94
12	223.08	4.82	11444.69	.00	4592.40	8067.34	2644.63
13	230.37	9.76	25096.49	.00	10270.55	16635.27	5419.06
14	236.37	2.25	6096.46	.00	2519.38	3852.29	1251.06

15	241.31	7.63	22839.57	.00	8915.62	14953.31	4740.03
16	250.10	9.95	35538.91	.00	12226.88	24201.93	7413.38
17	260.08	9.99	41599.24	.00	12643.31	29304.20	8758.17
18	270.07	10.00	46880.73	.00	12682.77	33972.40	9988.55
19	280.05	9.96	51305.55	.00	12345.08	38204.27	11103.93
20	289.98	9.90	54814.00	.00	11631.54	41996.79	12103.52
21	299.82	9.79	57364.98	.00	10544.68	45346.49	12986.38
22	307.36	5.28	32006.77	.00	5177.98	25975.75	7412.64
23	310.81	1.62	9857.00	.00	1487.49	8099.87	2308.28
24	312.99	2.75	16577.77	.00	2423.09	13574.12	4348.76
25	317.28	5.83	34291.43	.00	4712.48	28403.21	9119.72
26	322.02	3.64	21151.09	.00	2555.94	17836.36	5724.34
27	323.87	.06	355.32	.00	41.03	303.01	97.28
28	323.92	.05	291.86	.00	33.63	248.96	79.92
29	324.32	.75	4375.95	.00	497.73	3786.70	1081.85
30	326.40	3.40	19791.48	.00	2062.23	17296.66	4938.64
31	330.40	4.60	26841.55	.00	2285.00	23920.69	6818.57
32	332.90	.40	2339.22	.00	171.35	2109.79	600.78
33	335.47	4.74	27671.96	.00	1683.40	25520.81	7269.84
34	338.42	1.16	6798.35	.00	299.77	6277.06	2008.23
35	340.56	3.12	18223.17	.00	581.00	17020.67	5440.82
36	343.86	3.50	20463.11	.00	243.04	19675.04	6290.04
37	347.41	3.59	20953.59	.00	.00	20359.32	6505.82
38	350.03	1.65	9558.99	.00	.00	9287.45	2968.71
39	351.70	1.70	9790.04	.00	.00	9643.82	3088.37
40	355.92	6.73	38146.04	.00	.00	36642.05	13496.52
41	363.33	8.09	43966.30	.00	.00	42798.87	15903.07
42	369.11	3.48	18117.18	.00	.00	17931.36	6729.34
43	372.25	2.79	14200.01	.00	.00	14661.26	4538.02
44	374.36	1.44	7242.40	.00	.00	7585.93	2183.15
45	375.26	.34	1696.04	.00	.00	1827.18	526.60
46	376.26	1.67	8259.90	.00	.00	9126.59	2319.75
47	378.25	2.30	11133.26	.00	.00	12299.08	3129.25
48	380.40	2.00	9366.05	.00	.00	10343.31	2636.29
49	381.70	.60	2720.45	.00	.00	3003.28	766.84
50	382.20	.40	1802.39	.00	.00	1989.41	508.44
51	383.40	2.00	8508.94	.00	.00	9722.32	2494.91
52	386.85	4.90	18696.95	.00	.00	21330.95	5512.76
53	392.52	6.44	20089.24	.00	.00	23764.23	6249.48
54	398.72	5.97	13443.01	.00	.00	16483.82	4493.36
55	404.44	5.47	7318.95	.00	.00	9192.37	2734.58
56	408.75	3.14	1747.70	.00	.00	2075.31	828.02
57	410.94	1.24	152.66	.00	.00	54.70	144.55

FAILURE SURFACE # 2 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.935

X-CENTER = 264.32
Y-CENTER = 371.51
RADIUS = 158.13

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	179.59	238.00	-30.59
2	188.20	232.91	-26.96
3	197.11	228.38	-23.34
4	206.30	224.41	-19.72
5	215.71	221.04	-16.09
6	225.32	218.27	-12.47
7	235.08	216.11	-8.85
8	244.96	214.57	-5.22
9	254.92	213.66	-1.60
10	264.92	213.38	2.03
11	274.91	213.74	5.65
12	284.86	214.72	9.27

13	294.73	216.33	12.90
14	304.48	218.57	16.52
15	314.07	221.41	20.15
16	323.45	224.85	23.77
17	332.61	228.88	27.39
18	341.48	233.49	31.02
19	350.05	238.64	34.64
20	358.28	244.32	38.27
21	366.13	250.52	41.89
22	373.58	257.19	45.51
23	380.59	264.33	49.14
24	387.13	271.89	52.76
25	393.18	279.85	56.39
26	398.71	288.18	60.01
27	403.71	296.84	63.63
28	405.12	299.67	

FAILURE SURFACE # 3 SPECIFIED BY 30 COORDINATE POINTS

SAFETY FACTOR = 1.936

X-CENTER = 259.46
Y-CENTER = 388.06
RADIUS = 176.08

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	167.35	238.00	-29.92
2	176.02	233.01	-26.66
3	184.95	228.53	-23.41
4	194.13	224.55	-20.15
5	203.52	221.11	-16.90
6	213.08	218.20	-13.64
7	222.80	215.84	-10.39
8	232.64	214.04	-7.13
9	242.56	212.80	-3.88
10	252.54	212.12	-.63
11	262.54	212.01	2.63
12	272.53	212.47	5.88
13	282.47	213.50	9.14
14	292.35	215.08	12.39
15	302.11	217.23	15.65
16	311.74	219.93	18.90
17	321.21	223.17	22.16
18	330.47	226.94	25.41
19	339.50	231.23	28.66
20	348.27	236.02	31.92
21	356.76	241.31	35.17
22	364.94	247.07	38.43
23	372.77	253.29	41.68
24	380.24	259.94	44.94
25	387.32	267.00	48.19
26	393.98	274.45	51.45
27	400.22	282.27	54.70
28	406.00	290.44	57.95
29	411.30	298.91	61.21
30	412.10	300.37	

FAILURE SURFACE # 4 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.937

X-CENTER = 269.91
Y-CENTER = 376.26
RADIUS = 161.88

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	185.71	238.00	-29.57
2	194.41	233.07	-26.03
3	203.40	228.68	-22.49
4	212.64	224.85	-18.95
5	222.10	221.60	-15.41
6	231.74	218.95	-11.87
7	241.52	216.89	-8.33
8	251.42	215.44	-4.79
9	261.38	214.61	-1.25
10	271.38	214.39	2.29
11	281.37	214.79	5.83
12	291.32	215.81	9.37
13	301.19	217.44	12.91
14	310.93	219.67	16.45
15	320.52	222.50	19.99
16	329.92	225.92	23.53
17	339.09	229.91	27.07
18	347.99	234.47	30.61
19	356.60	239.56	34.15
20	364.88	245.17	37.69
21	372.79	251.29	41.23
22	380.31	257.88	44.77
23	387.41	264.92	48.31
24	394.06	272.39	51.85
25	400.24	280.25	55.39
26	405.91	288.48	58.93
27	411.07	297.05	62.47
28	412.84	300.44	

FAILURE SURFACE # 5 SPECIFIED BY 29 COORDINATE POINTS

SAFETY FACTOR = 1.937

X-CENTER = 272.50
Y-CENTER = 382.75
RADIUS = 170.91

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	181.63	238.00	-30.44
2	190.25	232.93	-27.09
3	199.16	228.38	-23.74
4	208.31	224.35	-20.38
5	217.69	220.87	-17.03
6	227.25	217.94	-13.68
7	236.96	215.58	-10.32
8	246.80	213.79	-6.97
9	256.73	212.57	-3.62
10	266.71	211.94	-.27
11	276.71	211.89	3.09
12	286.69	212.43	6.44
13	296.63	213.55	9.79
14	306.48	215.26	13.15
15	316.22	217.53	16.50
16	325.81	220.37	19.85
17	335.22	223.77	23.20
18	344.41	227.71	26.56
19	353.35	232.18	29.91
20	362.02	237.16	33.26
21	370.38	242.65	36.62
22	378.41	248.61	39.97
23	386.07	255.04	43.32
24	393.35	261.90	46.67

25	400.21	269.17	50.03
26	406.63	276.83	53.38
27	412.60	284.86	56.73
28	418.08	293.22	60.09
29	422.81	301.44	

FAILURE SURFACE # 6 SPECIFIED BY 30 COORDINATE POINTS

SAFETY FACTOR = 1.939

X-CENTER = 257.98
Y-CENTER = 387.90
RADIUS = 176.23

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	165.31	238.00	-30.10
2	173.96	232.98	-26.85
3	182.88	228.47	-23.60
4	192.04	224.47	-20.35
5	201.42	220.99	-17.09
6	210.98	218.05	-13.84
7	220.69	215.66	-10.59
8	230.52	213.82	-7.34
9	240.44	212.54	-4.09
10	250.41	211.83	-.84
11	260.41	211.68	2.42
12	270.40	212.10	5.67
13	280.35	213.09	8.92
14	290.23	214.64	12.17
15	300.01	216.75	15.42
16	309.65	219.41	18.67
17	319.12	222.61	21.93
18	328.40	226.35	25.18
19	337.45	230.60	28.43
20	346.24	235.36	31.68
21	354.75	240.61	34.93
22	362.95	246.34	38.19
23	370.81	252.52	41.44
24	378.30	259.14	44.69
25	385.41	266.17	47.94
26	392.11	273.60	51.19
27	398.38	281.39	54.44
28	404.20	289.52	57.70
29	409.54	297.98	60.95
30	410.80	300.24	

FAILURE SURFACE # 7 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.939

X-CENTER = 269.34
Y-CENTER = 367.76
RADIUS = 153.28

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	187.76	238.00	-30.29
2	196.39	232.96	-26.55
3	205.34	228.49	-22.81
4	214.55	224.61	-19.07
5	224.01	221.34	-15.33
6	233.65	218.70	-11.59
7	243.45	216.69	-7.86

8	253.35	215.32	-4.12
9	263.33	214.60	-.38
10	273.33	214.54	3.36
11	283.31	215.12	7.10
12	293.23	216.36	10.84
13	303.05	218.24	14.58
14	312.73	220.76	18.31
15	322.22	223.90	22.05
16	331.49	227.65	25.79
17	340.50	232.00	29.53
18	349.20	236.93	33.27
19	357.56	242.42	37.01
20	365.54	248.44	40.75
21	373.12	254.97	44.49
22	380.25	261.97	48.22
23	386.92	269.43	51.96
24	393.08	277.31	55.70
25	398.71	285.57	59.44
26	403.80	294.18	63.18
27	406.65	299.83	

FAILURE SURFACE # 8 SPECIFIED BY 30 COORDINATE POINTS

SAFETY FACTOR = 1.941

X-CENTER = 264.50
Y-CENTER = 399.66
RADIUS = 186.54

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	171.43	238.00	-28.39
2	180.23	233.24	-25.32
3	189.27	228.97	-22.25
4	198.52	225.18	-19.18
5	207.97	221.90	-16.11
6	217.57	219.12	-13.04
7	227.32	216.87	-9.96
8	237.16	215.14	-6.89
9	247.09	213.94	-3.82
10	257.07	213.27	-.75
11	267.07	213.14	2.32
12	277.06	213.54	5.40
13	287.02	214.48	8.47
14	296.91	215.96	11.54
15	306.71	217.96	14.61
16	316.38	220.48	17.68
17	325.91	223.52	20.76
18	335.26	227.06	23.83
19	344.41	231.10	26.90
20	353.33	235.63	29.97
21	361.99	240.62	33.04
22	370.37	246.07	36.11
23	378.45	251.97	39.19
24	386.20	258.29	42.26
25	393.60	265.01	45.33
26	400.63	272.12	48.40
27	407.27	279.60	51.47
28	413.50	287.43	54.55
29	419.30	295.57	57.62
30	423.04	301.46	

FAILURE SURFACE # 9 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.943

X-CENTER = 264.00
Y-CENTER = 357.35
RADIUS = 146.19

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	179.59	238.00	-33.31
2	187.95	232.51	-29.39
3	196.66	227.60	-25.47
4	205.69	223.30	-21.55
5	214.99	219.63	-17.63
6	224.52	216.60	-13.71
7	234.24	214.23	-9.79
8	244.09	212.53	-5.87
9	254.04	211.51	-1.95
10	264.03	211.17	1.97
11	274.03	211.51	5.89
12	283.97	212.54	9.81
13	293.83	214.24	13.73
14	303.54	216.61	17.65
15	313.07	219.65	21.57
16	322.37	223.32	25.49
17	331.40	227.63	29.41
18	340.11	232.54	33.33
19	348.46	238.03	37.25
20	356.42	244.09	41.17
21	363.95	250.67	45.09
22	371.01	257.75	49.01
23	377.57	265.30	52.93
24	383.60	273.28	56.85
25	389.06	281.65	60.77
26	393.95	290.38	64.69
27	398.00	298.96	

FAILURE SURFACE #10 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.943

X-CENTER = 274.23
Y-CENTER = 360.47
RADIUS = 147.61

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	191.84	238.00	-31.99
2	200.32	232.70	-28.11
3	209.14	227.99	-24.22
4	218.26	223.89	-20.34
5	227.64	220.41	-16.46
6	237.23	217.58	-12.58
7	246.99	215.40	-8.70
8	256.87	213.89	-4.81
9	266.84	213.05	-.93
10	276.83	212.89	2.95
11	286.82	213.40	6.83
12	296.75	214.59	10.72
13	306.58	216.45	14.60
14	316.25	218.97	18.48
15	325.74	222.14	22.36
16	334.98	225.95	26.25
17	343.95	230.37	30.13
18	352.60	235.39	34.01
19	360.89	240.98	37.89
20	368.78	247.12	41.78
21	376.24	253.79	45.66

22	383.23	260.94	49.54
23	389.72	268.55	53.42
24	395.68	276.58	57.31
25	401.08	284.99	61.19
26	405.90	293.76	65.07
27	408.82	300.04	

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          Y            A     X     I     S

         157.00    227.00    297.00    367.00    437.00    507.00

X        .00 *-****--****--------+---------+---------+---------+
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             -
      70.00 +
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             -          ..
             -        ....
             -       .....
A    140.00 +      .....*
             -    ......*
             -   ........*
             -  ........31
             -  .......314
             - .......314.
X    210.00 + .......21.*
             - ......310.*
             -.......14..*
             -.......14...
             -.......1.....
             -.......1.....
I    280.00 + ......1.....
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             - ......51......
             -  ......1......*
             -  ......31.....*.
             -   ......11....*..
S    350.00 +    .....512.......
             -    ......511......
             -     ......5416....*
             -      ......*41199.*
             -        ...**.541129
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     420.00 +           .......585
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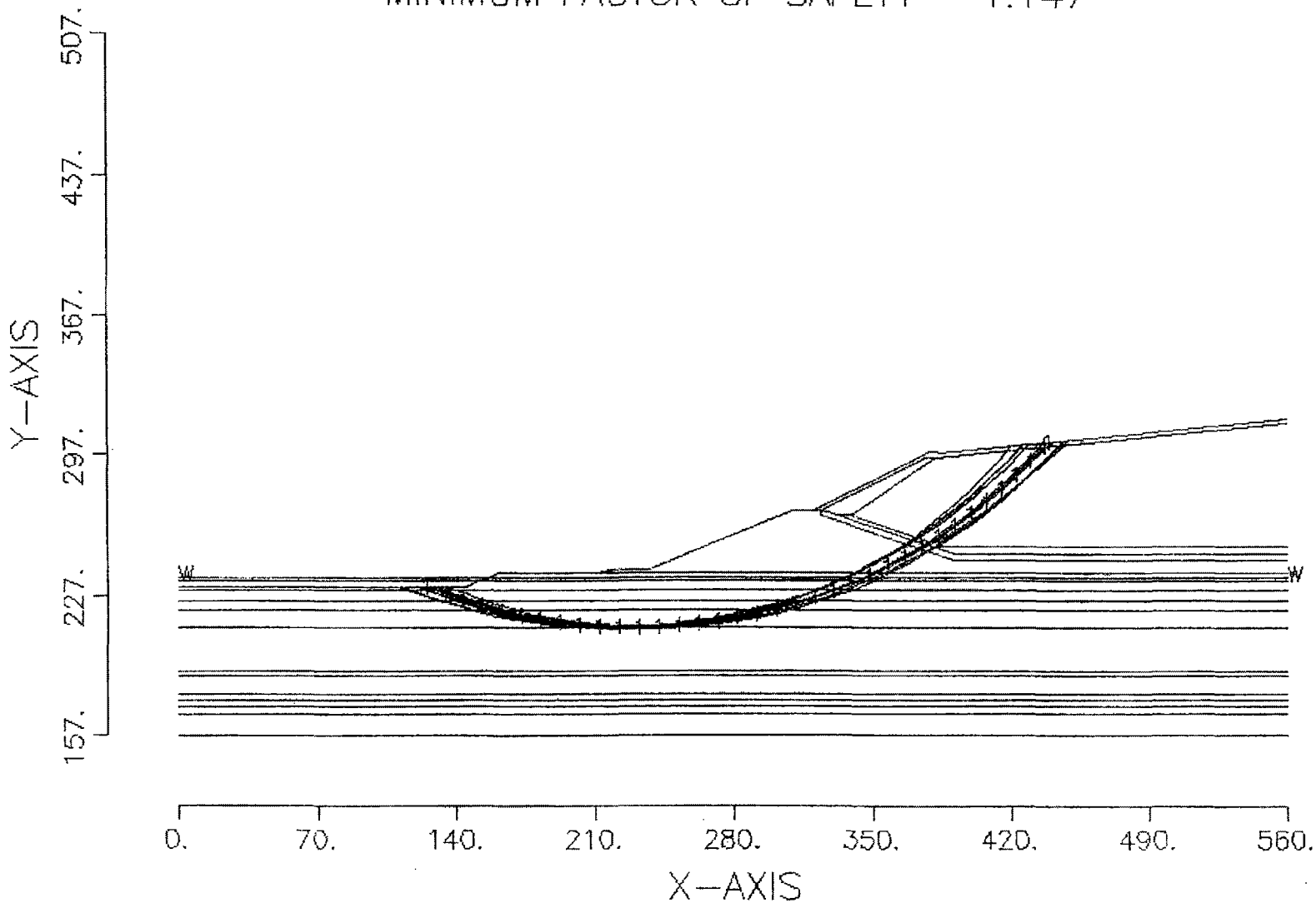
AGEC
Midvale UT s/n5206

3/1/10

CELL 6/LT/SEISMIC/POND/WASTE +20'

2500 SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.147



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 6/LT/SEISMIC/POND/WASTE +20'

BOUNDARY COORDINATES

13 TOP BOUNDARIES
42 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	231.50	145.25	231.50	7
2	145.25	231.50	151.50	234.00	7
3	151.50	234.00	156.50	236.00	6
4	156.50	236.00	161.50	238.00	5
5	161.50	238.00	211.50	238.00	5
6	211.50	238.00	217.50	240.00	3
7	217.50	240.00	237.50	240.00	3
8	237.50	240.00	310.00	269.00	3
9	310.00	269.00	320.20	269.00	3
10	320.20	269.00	379.40	298.60	1
11	379.40	298.60	381.40	298.60	1
12	381.40	298.60	384.40	297.60	1
13	384.40	297.60	560.00	315.16	1
14	320.20	269.00	324.70	269.00	3
15	324.70	269.00	377.10	295.20	2
16	377.10	295.20	382.00	295.30	2
17	382.00	295.30	560.00	313.16	4
18	323.90	266.70	324.70	269.00	2
19	324.70	269.00	328.10	268.50	2
20	328.10	268.50	332.70	267.00	2
21	332.70	267.00	339.00	267.00	1
22	339.00	267.00	382.00	295.30	4
23	339.00	267.00	385.80	251.40	1
24	385.80	251.40	560.00	251.40	1
25	332.70	267.00	391.50	247.40	2
26	391.50	247.40	560.00	247.40	2
27	323.90	266.70	391.10	244.30	3
28	391.10	244.30	560.00	244.30	3
29	211.50	238.00	560.00	238.00	5
30	.00	236.00	560.00	236.00	6
31	.00	234.00	560.00	234.00	7
32	.00	230.00	560.00	230.00	8
33	.00	224.00	560.00	224.00	9
34	.00	220.00	560.00	220.00	10
35	.00	211.00	560.00	211.00	11
36	.00	190.00	560.00	190.00	12
37	.00	187.00	560.00	187.00	13
38	.00	178.00	560.00	178.00	14
39	.00	175.00	560.00	175.00	15
40	.00	172.00	560.00	172.00	16
41	.00	168.00	560.00	168.00	17
42	.00	157.00	560.00	157.00	18

ISOTROPIC SOIL PARAMETERS

18 TYPE(S) OF SOIL

SOIL	TOTAL	SATURATED	COHESION	FRICTION	PORE	PRESSURE	PIEZOMETRIC

TYPE NO.	UNIT WT.	UNIT WT.	INTERCEPT	ANGLE (DEG)	PRESSURE PARAMETER	CONSTANT	SURFACE NO.
1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	32.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1
9	110.0	110.0	200.0	30.0	.00	.0	1
10	110.0	110.0	200.0	27.0	.00	.0	1
11	110.0	110.0	200.0	30.0	.00	.0	1
12	110.0	110.0	200.0	27.0	.00	.0	1
13	110.0	110.0	200.0	30.0	.00	.0	1
14	110.0	110.0	200.0	27.0	.00	.0	1
15	110.0	110.0	200.0	30.0	.00	.0	1
16	110.0	110.0	200.0	27.0	.00	.0	1
17	110.0	110.0	200.0	30.0	.00	.0	1
18	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	560.00	234.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .180 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 100.00
AND X = 200.00

EACH SURFACE TERMINATES BETWEEN X = 330.00
AND X = 450.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00

10.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 36 COORDINATE POINTS

SAFETY FACTOR = 1.147

X-CENTER = 230.12
Y-CENTER = 493.91
RADIUS = 282.88

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	124.49	231.50	-20.91
2	133.83	227.93	-18.89
3	143.29	224.69	-16.86
4	152.86	221.79	-14.84
5	162.53	219.23	-12.81
6	172.28	217.01	-10.79
7	182.10	215.14	-8.76
8	191.99	213.62	-6.74
9	201.92	212.45	-4.71
10	211.88	211.63	-2.68
11	221.87	211.16	-.66
12	231.87	211.04	1.37
13	241.87	211.28	3.39
14	251.85	211.87	5.42
15	261.81	212.82	7.44
16	271.72	214.11	9.47
17	281.59	215.76	11.49
18	291.39	217.75	13.52
19	301.11	220.09	15.55
20	310.74	222.77	17.57
21	320.28	225.79	19.60
22	329.70	229.14	21.62
23	338.99	232.83	23.65
24	348.15	236.84	25.67
25	357.17	241.17	27.70
26	366.02	245.82	29.73
27	374.71	250.78	31.75
28	383.21	256.04	33.78
29	391.52	261.60	35.80
30	399.63	267.45	37.83
31	407.53	273.58	39.85
32	415.21	279.99	41.88
33	422.65	286.67	43.90
34	429.86	293.60	45.93
35	436.81	300.78	47.96
36	438.85	303.05	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	126.45	3.93	402.33	.00	852.17	636.63	1053.46

2	131.12	5.42	1618.49	.00	1821.59	1447.87	1654.66
3	138.56	9.46	5589.14	.00	4797.57	3852.17	3455.93
4	144.27	1.96	1568.40	.00	1225.50	971.34	788.31
5	145.41	.33	278.53	.00	213.41	171.05	135.96
6	148.54	5.92	6444.78	.00	4207.22	3907.89	3046.80
7	152.18	1.36	1843.86	.00	1066.54	1103.95	804.25
8	154.68	3.64	5632.28	.00	2979.31	3486.10	2411.54
9	158.06	3.13	5678.98	.00	2742.90	3786.54	2470.89
10	160.56	1.87	3779.57	.00	1722.11	2581.19	1484.81
11	162.01	1.03	2171.75	.00	972.40	1500.05	852.31
12	167.40	9.75	21905.95	.00	9907.58	14410.61	8147.65
13	177.19	9.82	24277.59	.00	11183.36	15145.35	8474.13
14	187.05	9.88	26271.15	.00	12242.48	15681.47	8712.37
15	196.95	9.93	27870.36	.00	13083.61	16027.52	8866.13
16	206.71	9.58	27924.70	.00	13167.62	15559.45	8590.87
17	211.69	.38	1140.74	.00	538.09	635.31	349.57
18	214.69	5.62	17487.28	.00	7895.26	9862.65	5363.09
19	219.69	4.37	14263.69	.00	6212.73	8274.81	4440.61
20	226.87	10.00	32788.51	.00	14289.98	18615.83	10016.26
21	234.69	5.63	18446.16	.00	8040.23	10278.76	5549.22
22	239.68	4.37	14763.66	.00	6211.17	8448.91	4516.74
23	246.86	9.98	37068.64	.00	13992.32	22446.70	11718.54
24	256.83	9.96	41287.48	.00	13513.09	26670.20	13595.27
25	266.77	9.92	45024.65	.00	12814.27	30589.24	15336.72
26	276.66	9.86	48265.86	.00	11896.77	34209.48	16945.40
27	286.49	9.80	51000.15	.00	10761.70	37535.73	18423.45
28	296.06	9.36	51173.53	.00	9082.65	38980.84	18999.92
29	300.93	.37	2047.49	.00	327.87	1571.88	857.12
30	305.55	8.89	50615.31	.00	7298.97	39287.58	21391.14
31	310.37	.74	4295.46	.00	545.91	3399.10	1846.09
32	312.69	3.89	22163.81	.00	2702.94	17525.82	9536.05
33	317.42	5.57	30799.86	.00	3322.38	25126.68	12183.64
34	320.24	.08	418.30	.00	41.42	344.43	167.13
35	322.09	3.62	19838.98	.00	1816.14	16408.06	7961.82
36	324.30	.80	4397.05	.00	359.30	3674.12	1780.74
37	326.40	3.40	18681.09	.00	1358.63	15754.57	7630.14
38	328.90	1.60	8815.02	.00	544.28	7518.05	3636.50
39	330.78	2.17	11980.36	.00	644.14	10272.58	4971.17
40	332.28	.84	4627.84	.00	215.12	3918.75	2129.93
41	335.85	6.29	35021.36	.00	1022.92	30161.57	16367.44
42	339.00	.01	33.60	.00	.48	29.25	15.87
43	340.34	2.67	14986.12	.00	106.69	13134.35	7122.50
44	343.96	4.57	25712.02	.00	.00	22686.37	12292.38
45	347.20	1.91	10793.34	.00	.00	9523.57	5159.32
46	349.36	2.42	13640.40	.00	.00	12004.11	6512.19
47	353.87	6.59	37065.74	.00	.00	31616.69	19781.76
48	361.59	8.85	49251.57	.00	.00	41828.14	26282.55
49	369.80	7.57	41291.28	.00	.00	34940.89	22079.96
50	374.15	1.12	6039.89	.00	.00	5362.18	2789.81
51	375.87	2.33	12590.45	.00	.00	11194.21	5836.88
52	377.07	.06	332.73	.00	.00	301.00	145.90
53	378.17	2.14	11540.44	.00	.00	10439.69	5060.78
54	379.32	.16	839.55	.00	.00	780.88	333.58
55	380.40	2.00	10611.38	.00	.00	9868.47	4218.29
56	381.70	.60	3123.29	.00	.00	2904.06	1242.52
57	382.60	1.21	6168.36	.00	.00	5734.18	2455.84
58	383.80	1.19	5913.66	.00	.00	5527.43	2372.83
59	387.96	7.12	33101.58	.00	.00	30914.78	13319.10
60	395.58	8.11	33279.63	.00	.00	31240.61	13576.61
61	403.58	7.90	27490.19	.00	.00	25936.98	11419.80
62	411.37	7.68	21659.37	.00	.00	20520.01	9216.90
63	418.93	7.45	15837.40	.00	.00	15014.51	6978.00
64	426.25	7.20	10075.31	.00	.00	9446.89	4713.83
65	433.33	6.96	4424.84	.00	.00	3845.45	2435.92
66	436.82	.02	3.71	.00	.00	2.31	2.90
67	437.84	2.02	247.87	.00	.00	51.46	287.37

FAILURE SURFACE # 2 SPECIFIED BY 35 COORDINATE POINTS

SAFETY FACTOR = 1.147

X-CENTER = 223.38
Y-CENTER = 482.16
RADIUS = 270.98

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	120.41	231.50	-21.28
2	129.73	227.87	-19.16
3	139.17	224.59	-17.05
4	148.73	221.66	-14.93
5	158.40	219.08	-12.82
6	168.15	216.86	-10.70
7	177.97	215.00	-8.59
8	187.86	213.51	-6.48
9	197.80	212.38	-4.36
10	207.77	211.62	-2.25
11	217.76	211.23	-.13
12	227.76	211.21	1.98
13	237.75	211.55	4.10
14	247.73	212.27	6.21
15	257.67	213.35	8.33
16	267.56	214.80	10.44
17	277.40	216.61	12.55
18	287.16	218.78	14.67
19	296.83	221.32	16.78
20	306.41	224.20	18.90
21	315.87	227.44	21.01
22	325.20	231.03	23.13
23	334.40	234.96	25.24
24	343.45	239.22	27.36
25	352.33	243.81	29.47
26	361.03	248.73	31.58
27	369.55	253.97	33.70
28	377.87	259.52	35.81
29	385.98	265.37	37.93
30	393.87	271.52	40.04
31	401.52	277.95	42.16
32	408.94	284.66	44.27
33	416.10	291.64	46.39
34	423.00	298.88	48.50
35	425.50	301.71	

FAILURE SURFACE # 3 SPECIFIED BY 37 COORDINATE POINTS

SAFETY FACTOR = 1.149

X-CENTER = 232.56
Y-CENTER = 506.15
RADIUS = 295.15

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	124.49	231.50	-20.51
2	133.86	228.00	-18.57
3	143.34	224.81	-16.63
4	152.92	221.95	-14.68
5	162.59	219.42	-12.74
6	172.35	217.21	-10.80
7	182.17	215.34	-8.86
8	192.05	213.80	-6.92
9	201.98	212.59	-4.98

10	211.94	211.72	-3.04
11	221.92	211.20	-1.09
12	231.92	211.00	.85
13	241.92	211.15	2.79
14	251.91	211.64	4.73
15	261.88	212.46	6.67
16	271.81	213.62	8.61
17	281.69	215.12	10.55
18	291.53	216.95	12.50
19	301.29	219.12	14.44
20	310.97	221.61	16.38
21	320.57	224.43	18.32
22	330.06	227.57	20.26
23	339.44	231.04	22.20
24	348.70	234.82	24.14
25	357.83	238.91	26.08
26	366.81	243.30	28.03
27	375.63	248.00	29.97
28	384.30	253.00	31.91
29	392.79	258.28	33.85
30	401.09	263.85	35.79
31	409.20	269.70	37.73
32	417.11	275.82	39.67
33	424.81	282.20	41.62
34	432.28	288.85	43.56
35	439.53	295.74	45.50
36	446.54	302.87	47.44
37	447.50	303.91	

FAILURE SURFACE # 4 SPECIFIED BY 33 COORDINATE POINTS

SAFETY FACTOR = 1.150

X-CENTER = 228.85
Y-CENTER = 460.23
RADIUS = 248.94

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	130.61	231.50	-22.09
2	139.88	227.74	-19.79
3	149.29	224.35	-17.49
4	158.83	221.35	-15.19
5	168.48	218.73	-12.89
6	178.22	216.50	-10.58
7	188.05	214.66	-8.28
8	197.95	213.22	-5.98
9	207.90	212.18	-3.68
10	217.88	211.54	-1.38
11	227.87	211.30	.92
12	237.87	211.46	3.23
13	247.86	212.02	5.53
14	257.81	212.98	7.83
15	267.72	214.35	10.13
16	277.56	216.11	12.43
17	287.32	218.26	14.74
18	297.00	220.80	17.04
19	306.56	223.73	19.34
20	315.99	227.04	21.64
21	325.29	230.73	23.94
22	334.43	234.79	26.24
23	343.40	239.21	28.55
24	352.18	243.99	30.85
25	360.77	249.12	33.15
26	369.14	254.59	35.45
27	377.28	260.39	37.75

28	385.19	266.51	40.05
29	392.85	272.94	42.36
30	400.24	279.68	44.66
31	407.35	286.71	46.96
32	414.17	294.02	49.26
33	420.35	301.20	

FAILURE SURFACE # 5 SPECIFIED BY 36 COORDINATE POINTS

SAFETY FACTOR = 1.151

X-CENTER = 239.16
Y-CENTER = 489.00
RADIUS = 277.88

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	134.69	231.50	-21.05
2	144.03	227.91	-18.99
3	153.48	224.65	-16.93
4	163.05	221.74	-14.87
5	172.71	219.18	-12.80
6	182.47	216.96	-10.74
7	192.29	315.10	-8.68
8	202.18	213.59	-6.62
9	212.11	212.44	-4.56
10	222.08	211.64	-2.49
11	232.07	211.21	-.43
12	242.07	211.13	1.63
13	252.06	211.42	3.69
14	262.04	212.06	5.75
15	271.99	213.06	7.82
16	281.90	214.42	9.88
17	291.75	216.14	11.94
18	301.54	218.21	14.00
19	311.24	220.63	16.06
20	320.85	223.39	18.13
21	330.35	226.51	20.19
22	339.74	229.96	22.25
23	348.99	233.74	24.31
24	358.11	237.86	26.37
25	367.07	242.30	28.44
26	375.86	247.06	30.50
27	384.48	252.14	32.56
28	392.90	257.52	34.62
29	401.13	263.20	36.68
30	409.15	269.18	38.75
31	416.95	275.44	40.81
32	424.52	281.97	42.87
33	431.85	288.77	44.93
34	438.93	295.84	46.99
35	445.75	303.15	49.05
36	446.30	303.79	

FAILURE SURFACE # 6 SPECIFIED BY 36 COORDINATE POINTS

SAFETY FACTOR = 1.152

X-CENTER = 230.98
Y-CENTER = 497.72
RADIUS = 285.98

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)

1	126.53	231.50	-20.42
2	135.90	228.01	-18.42
3	145.39	224.85	-16.41
4	154.98	222.03	-14.41
5	164.67	219.54	-12.41
6	174.44	217.39	-10.40
7	184.27	215.58	-8.40
8	194.16	214.12	-6.39
9	204.10	213.01	-4.39
10	214.07	212.24	-2.39
11	224.06	211.83	-.38
12	234.06	211.76	1.62
13	244.06	212.04	3.62
14	254.04	212.68	5.63
15	263.99	213.66	7.63
16	273.90	214.98	9.63
17	283.76	216.66	11.64
18	293.56	218.67	13.64
19	303.27	221.03	15.64
20	312.90	223.73	17.65
21	322.43	226.76	19.65
22	331.85	230.12	21.66
23	341.14	233.81	23.66
24	350.30	237.83	25.66
25	359.32	242.16	27.67
26	368.17	246.80	29.67
27	376.86	251.75	31.67
28	385.37	257.00	33.68
29	393.70	262.55	35.68
30	401.82	268.38	37.68
31	409.73	274.49	39.69
32	417.43	280.88	41.69
33	424.90	287.53	43.69
34	432.13	294.44	45.70
35	439.11	301.59	47.70
36	440.59	303.22	

FAILURE SURFACE # 7 SPECIFIED BY 35 COORDINATE POINTS

SAFETY FACTOR = 1.152

X-CENTER = 223.38
Y-CENTER = 492.10
RADIUS = 280.21

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	120.41	231.50	-20.54
2	129.77	227.99	-18.49
3	139.26	224.82	-16.45
4	148.85	221.99	-14.40
5	158.53	219.50	-12.36
6	168.30	217.36	-10.31
7	178.14	215.57	-8.27
8	188.04	214.13	-6.22
9	197.98	213.05	-4.18
10	207.95	212.32	-2.13
11	217.94	211.95	-.09
12	227.94	211.93	1.96
13	237.94	212.27	4.00
14	247.91	212.97	6.05
15	257.86	214.03	8.09
16	267.76	215.43	10.14
17	277.60	217.19	12.18
18	287.38	219.30	14.23
19	297.07	221.76	16.27

20	306.67	224.56	18.32
21	316.16	227.71	20.36
22	325.54	231.19	22.41
23	334.78	235.00	24.45
24	343.89	239.14	26.50
25	352.84	243.60	28.54
26	361.62	248.38	30.59
27	370.23	253.46	32.63
28	378.65	258.86	34.68
29	386.87	264.55	36.72
30	394.89	270.52	38.77
31	402.69	276.79	40.81
32	410.26	283.32	42.86
33	417.59	290.12	44.90
34	424.67	297.18	46.95
35	429.25	302.09	

FAILURE SURFACE # 8 SPECIFIED BY 38 COORDINATE POINTS

SAFETY FACTOR = 1.154

X-CENTER = 222.48
Y-CENTER = 534.88
RADIUS = 323.49

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	110.20	231.50	-19.42
2	119.64	228.17	-17.65
3	129.16	225.14	-15.88
4	138.78	222.41	-14.11
5	148.48	219.97	-12.34
6	158.25	217.83	-10.57
7	168.08	216.00	-8.79
8	177.96	214.47	-7.02
9	187.89	213.25	-5.25
10	197.85	212.33	-3.48
11	207.83	211.72	-1.71
12	217.82	211.43	.06
13	227.82	211.44	1.83
14	237.82	211.76	3.60
15	247.80	212.38	5.38
16	257.75	213.32	7.15
17	267.68	214.57	8.92
18	277.56	216.12	10.69
19	287.38	217.97	12.46
20	297.15	220.13	14.23
21	306.84	222.59	16.00
22	316.45	225.34	17.77
23	325.98	228.40	19.55
24	335.40	231.74	21.32
25	344.71	235.38	23.09
26	353.91	239.30	24.86
27	362.99	243.50	26.63
28	371.93	247.98	28.40
29	380.72	252.74	30.17
30	389.37	257.77	31.94
31	397.85	263.06	33.72
32	406.17	268.61	35.49
33	414.31	274.41	37.26
34	422.27	280.47	39.03
35	430.04	286.77	40.80
36	437.61	293.30	42.57
37	444.98	300.06	44.34
38	449.07	304.07	

FAILURE SURFACE # 9 SPECIFIED BY 36 COORDINATE POINTS

SAFETY FACTOR = 1.155

X-CENTER = 218.81
Y-CENTER = 492.82
RADIUS = 282.21

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	112.25	231.50	-21.17
2	121.57	227.89	-19.14
3	131.02	224.61	-17.11
4	140.58	221.67	-15.08
5	150.23	219.07	-13.05
6	159.97	216.81	-11.02
7	169.79	214.90	-8.99
8	179.67	213.33	-6.96
9	189.59	212.12	-4.93
10	199.55	211.26	-2.90
11	209.54	210.76	-.87
12	219.54	210.61	1.16
13	229.54	210.81	3.19
14	239.52	211.37	5.22
15	249.48	212.28	7.25
16	259.40	213.54	9.28
17	269.27	215.15	11.31
18	279.08	217.12	13.35
19	288.81	219.42	15.38
20	298.45	222.08	17.41
21	307.99	225.07	19.44
22	317.42	228.39	21.47
23	326.73	232.05	23.50
24	335.90	236.04	25.53
25	344.92	240.35	27.56
26	353.79	244.98	29.59
27	362.48	249.91	31.62
28	371.00	255.16	33.65
29	379.32	260.70	35.68
30	387.45	266.53	37.71
31	395.36	272.65	39.74
32	403.05	279.04	41.77
33	410.50	285.70	43.80
34	417.72	292.62	45.83
35	424.69	299.80	47.86
36	426.51	301.81	

FAILURE SURFACE #10 SPECIFIED BY 36 COORDINATE POINTS

SAFETY FACTOR = 1.155

X-CENTER = 228.06
Y-CENTER = 491.31
RADIUS = 281.23

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	120.41	231.50	-21.49
2	129.71	227.84	-19.45
3	139.14	224.51	-17.41
4	148.68	221.51	-15.37
5	158.33	218.86	-13.34
6	168.06	216.56	-11.30
7	177.86	214.60	-9.26
8	187.73	212.99	-7.22

9	197.65	211.73	-5.19
10	207.61	210.83	-3.15
11	217.60	210.28	-1.11
12	227.60	210.08	.92
13	237.59	210.24	2.96
14	247.58	210.76	5.00
15	257.54	211.63	7.04
16	267.47	212.86	9.07
17	277.34	214.43	11.11
18	287.15	216.36	13.15
19	296.89	218.64	15.19
20	306.54	221.26	17.22
21	316.10	224.22	19.26
22	325.54	227.52	21.30
23	334.85	231.15	23.34
24	344.03	235.11	25.37
25	353.07	239.39	27.41
26	361.95	244.00	29.45
27	370.65	248.91	31.49
28	379.18	254.14	33.52
29	387.52	259.66	35.56
30	395.65	265.48	37.60
31	403.58	271.58	39.64
32	411.28	277.96	41.67
33	418.75	284.61	43.71
34	425.98	291.52	45.75
35	432.95	298.68	47.79
36	436.72	302.83	

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          Y            A     X     I     S

          157.00    227.00    297.00    367.00    437.00    507.00

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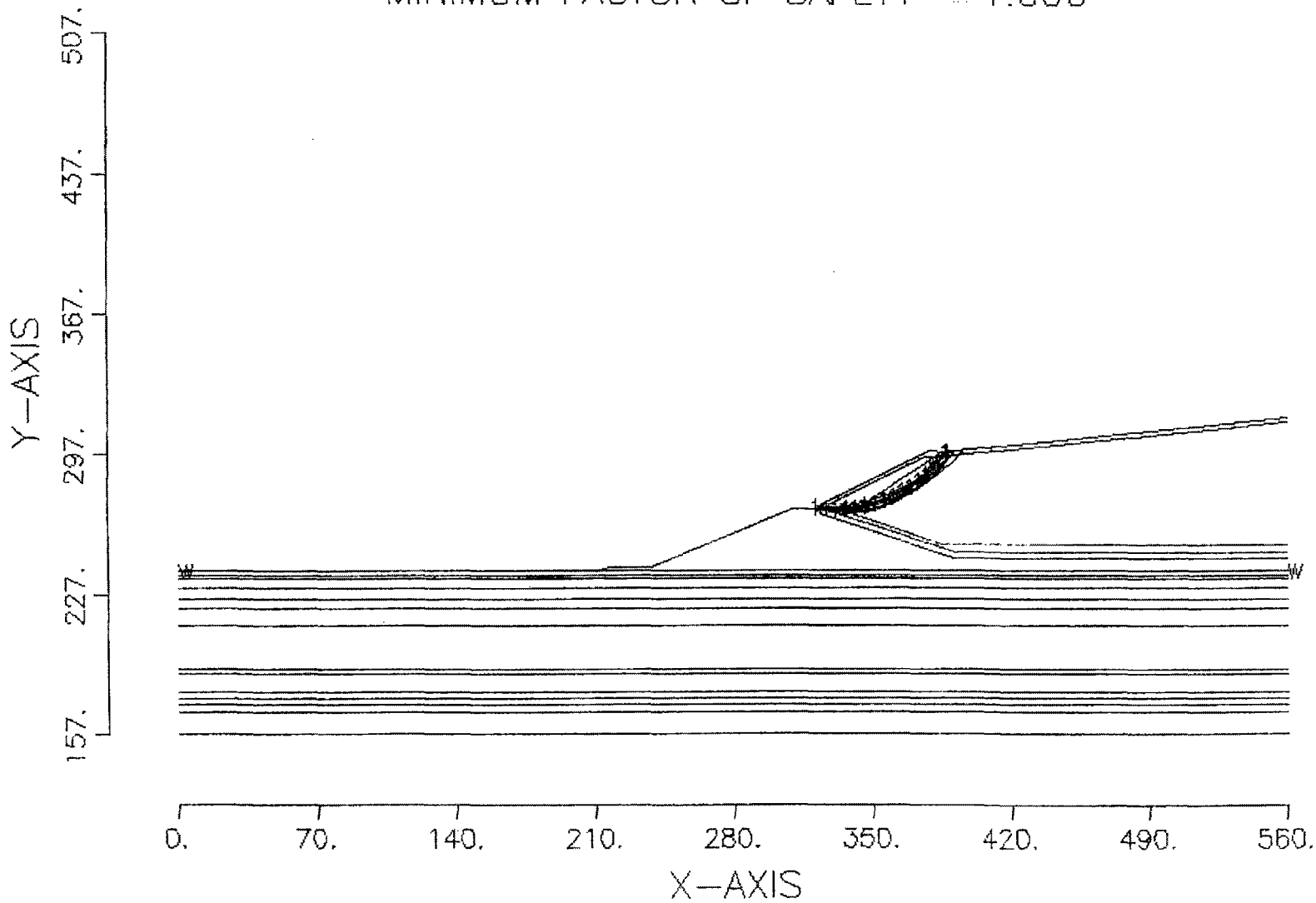
             -
             -          .8
             -        ..82
             -       ...11
A    140.00 +      ...81*
             -     ....24*
             -    ....81..*
             -   .....21...
             -   .....15...
             - ......1....
X    210.00 + ......1...*
             - ......1...*
             -.......1...*
             -.......1....
             -.......1.....
             -.......1.....
I    280.00 + ......12....
             - ......51.....
             - .......12.....
             -  ......11.....*
             -  ......512....*
             -   ......512...*..
S    350.00 +    ......129......
             -    .......11......
             -     .......122....*
             -      ......*124...*
             -        ...**31124..
             -         ......3124..
     420.00 +           .....31122
             -             .....311
             -                ..831
             -                    .
             -
             -
     490.00 +
             -
             -
             -
             -
             -
     560.00 * ****  ******        **
```

AGEC
Midvale UT s/n5206

3/1/10

CELL 6/LT/STATIC/SOUTH/WASTE +20'

2500 SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.606



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 6/LT/STATIC/SOUTH/WASTE +20'

BOUNDARY COORDINATES

9 TOP BOUNDARIES
38 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	238.00	211.50	238.00	5
2	211.50	238.00	217.50	240.00	3
3	217.50	240.00	237.50	240.00	3
4	237.50	240.00	310.00	269.00	3
5	310.00	269.00	320.20	269.00	3
6	320.20	269.00	379.40	298.60	1
7	379.40	298.60	381.40	298.60	1
8	381.40	298.60	384.40	297.60	1
9	384.40	297.60	560.00	315.16	1
10	320.20	269.00	324.70	269.00	3
11	324.70	269.00	377.10	295.20	2
12	377.10	295.20	382.00	295.30	2
13	382.00	295.30	560.00	313.16	4
14	323.90	266.70	324.70	269.00	2
15	324.70	269.00	328.10	268.50	2
16	328.10	268.50	332.70	267.00	2
17	332.70	267.00	339.00	267.00	1
18	339.00	267.00	382.00	295.30	4
19	339.00	267.00	385.80	251.40	1
20	385.80	251.40	560.00	251.40	1
21	332.70	267.00	391.50	247.40	2
22	391.50	247.40	560.00	247.40	2
23	323.90	266.70	391.10	244.30	3
24	391.10	244.30	560.00	244.30	3
25	211.50	238.00	560.00	238.00	5
26	.00	236.00	560.00	236.00	6
27	.00	234.00	560.00	234.00	7
28	.00	230.00	560.00	230.00	8
29	.00	224.00	560.00	224.00	9
30	.00	220.00	560.00	220.00	10
31	.00	211.00	560.00	211.00	11
32	.00	190.00	560.00	190.00	12
33	.00	187.00	560.00	187.00	13
34	.00	178.00	560.00	178.00	14
35	.00	175.00	560.00	175.00	15
36	.00	172.00	560.00	172.00	16
37	.00	168.00	560.00	168.00	17
38	.00	157.00	560.00	157.00	18

ISOTROPIC SOIL PARAMETERS

18 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.
1	120.0	120.0	100.0	28.0	.00	.0	1

2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	32.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1
9	110.0	110.0	200.0	30.0	.00	.0	1
10	110.0	110.0	200.0	27.0	.00	.0	1
11	110.0	110.0	200.0	30.0	.00	.0	1
12	110.0	110.0	200.0	27.0	.00	.0	1
13	110.0	110.0	200.0	30.0	.00	.0	1
14	110.0	110.0	200.0	27.0	.00	.0	1
15	110.0	110.0	200.0	30.0	.00	.0	1
16	110.0	110.0	200.0	27.0	.00	.0	1
17	110.0	110.0	200.0	30.0	.00	.0	1
18	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	560.00	234.00

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 300.00
AND X = 335.00

EACH SURFACE TERMINATES BETWEEN X = 370.00
AND X = 420.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y =150.00

5.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED.. THEY ARE ORDERED - MOST CRITICAL FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.606

X-CENTER = 331.65
Y-CENTER = 336.81
RADIUS = 67.97

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-6.54
2	326.40	269.05	-2.32
3	331.39	268.84	1.89
4	336.39	269.01	6.11
5	341.36	269.54	10.32
6	346.28	270.44	14.54
7	351.12	271.69	18.75
8	355.86	273.30	22.97
9	360.46	275.25	27.19
10	364.91	277.53	31.40
11	369.17	280.14	35.62
12	373.24	283.05	39.83
13	377.08	286.25	44.05
14	380.67	289.73	48.26
15	384.00	293.46	52.48
16	387.05	297.43	56.69
17	387.35	297.90	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	323.26	3.66	494.20	.00	.00	544.39	409.61
2	325.74	1.31	410.53	.00	.00	455.85	371.99
3	328.89	5.00	2532.31	.00	.00	2603.46	1702.29
4	333.89	5.00	3916.66	.00	.00	3848.94	2114.58
5	338.88	4.97	5068.88	.00	.00	4836.56	2441.51
6	342.40	2.07	2408.11	.00	.00	2247.78	1097.79
7	344.86	2.85	3578.13	.00	.00	3423.15	1174.05
8	348.70	4.84	6709.51	.00	.00	6371.07	2160.87
9	353.49	4.73	7145.96	.00	.00	6773.30	2277.64
10	358.16	4.60	7288.94	.00	.00	6931.76	2323.65
11	362.68	4.45	7151.35	.00	.00	6857.12	2301.98
12	367.04	4.27	6755.29	.00	.00	6561.59	2216.18
13	371.21	4.06	6131.23	.00	.00	6059.03	2070.28
14	375.16	3.84	5317.64	.00	.00	5365.70	1869.00
15	377.09	.02	28.43	.00	.00	29.47	10.43
16	378.25	2.30	2881.12	.00	.00	2979.14	1064.09
17	380.04	1.27	1432.12	.00	.00	1472.41	537.65
18	381.04	.73	734.64	.00	.00	775.03	293.07
19	381.70	.60	547.37	.00	.00	572.90	222.43
20	383.00	2.00	1375.02	.00	.00	1400.13	593.58
21	384.20	.40	189.05	.00	.00	186.67	95.01
22	385.05	1.30	442.23	.00	.00	401.51	249.25
23	386.37	1.35	201.95	.00	.00	106.32	172.98
24	387.20	.31	8.10	.00	.00	-25.55	26.48

FAILURE SURFACE # 2 SPECIFIED BY 16 COORDINATE POINTS

SAFETY FACTOR = 1.622

X-CENTER = 334.18
Y-CENTER = 330.16

RADIUS = 60.41

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	323.57	270.69	-7.74
2	328.53	270.01	-3.00
3	333.52	269.75	1.75
4	338.52	269.90	6.49
5	343.49	270.47	11.23
6	348.39	271.44	15.98
7	353.20	272.82	20.72
8	357.87	274.59	25.47
9	362.39	276.74	30.21
10	366.71	279.25	34.95
11	370.81	282.12	39.70
12	374.65	285.31	44.44
13	378.22	288.81	49.18
14	381.49	292.60	53.93
15	384.44	296.64	58.67
16	385.06	297.67	

FAILURE SURFACE # 3 SPECIFIED BY 16 COORDINATE POINTS

SAFETY FACTOR = 1.623

X-CENTER = 336.42
Y-CENTER = 327.25
RADIUS = 58.51

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	322.86	270.33	-10.95
2	327.77	269.38	-6.05
3	332.74	268.85	-1.16
4	337.74	268.75	3.74
5	342.73	269.08	8.64
6	347.67	269.83	13.54
7	352.53	271.00	18.44
8	357.28	272.58	23.33
9	361.87	274.56	28.23
10	366.27	276.93	33.13
11	370.46	279.66	38.03
12	374.40	282.74	42.93
13	378.06	286.14	47.82
14	381.42	289.85	52.72
15	384.44	293.83	57.62
16	387.00	297.86	

FAILURE SURFACE # 4 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.629

X-CENTER = 329.23
Y-CENTER = 351.59
RADIUS = 82.34

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-3.70
2	326.42	269.29	-.22
3	331.42	269.27	3.26
4	336.41	269.56	6.74
5	341.38	270.14	10.22

6	346.30	271.03	13.70
7	351.15	272.22	17.18
8	355.93	273.69	20.66
9	360.61	275.46	24.14
10	365.17	277.50	27.62
11	369.60	279.82	31.10
12	373.88	282.40	34.58
13	378.00	285.24	38.06
14	381.94	288.32	41.54
15	385.68	291.64	45.02
16	389.22	295.17	48.50
17	392.04	298.36	

FAILURE SURFACE # 5 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.641

X-CENTER = 325.34
Y-CENTER = 354.66
RADIUS = 85.13

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-.95
2	326.43	269.53	2.42
3	331.42	269.74	5.78
4	336.40	270.25	9.15
5	341.34	271.04	12.51
6	346.22	272.12	15.88
7	351.03	273.49	19.24
8	355.75	275.14	22.61
9	360.36	277.06	25.97
10	364.86	279.25	29.34
11	369.22	281.70	32.71
12	373.42	284.40	36.07
13	377.46	287.35	39.44
14	381.33	290.52	42.80
15	384.99	293.92	46.17
16	388.46	297.53	49.53
17	388.90	298.05	

FAILURE SURFACE # 6 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.645

X-CENTER = 338.25
Y-CENTER = 328.44
RADIUS = 60.65

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	322.14	269.97	-13.04
2	327.01	268.84	-8.32
3	331.96	268.12	-3.59
4	336.95	267.81	1.13
5	341.95	267.91	5.86
6	346.93	268.42	10.58
7	351.84	269.34	15.31
8	356.66	270.66	20.03
9	361.36	272.37	24.76
10	365.90	274.46	29.48
11	370.25	276.92	34.21
12	374.39	279.73	38.93
13	378.28	282.88	43.66

14	381.89	286.33	48.38
15	385.22	290.07	53.11
16	388.22	294.06	57.83
17	390.85	298.24	

FAILURE SURFACE # 7 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.648

X-CENTER = 330.98
Y-CENTER = 334.46
RADIUS = 66.38

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	320.00	269.00	-7.36
2	324.96	268.36	-3.05
3	329.95	268.09	1.27
4	334.95	268.20	5.59
5	339.93	268.69	9.91
6	344.85	269.55	14.22
7	349.70	270.78	18.54
8	354.44	272.37	22.86
9	359.05	274.31	27.17
10	363.50	276.59	31.49
11	367.76	279.21	35.81
12	371.81	282.13	40.12
13	375.64	285.35	44.44
14	379.21	288.86	48.76
15	382.50	292.61	53.08
16	385.51	296.61	57.39
17	386.26	297.79	

FAILURE SURFACE # 8 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.649

X-CENTER = 338.00
Y-CENTER = 321.23
RADIUS = 54.21

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-15.15
2	326.26	268.31	-9.87
3	331.18	267.45	-4.58
4	336.17	267.05	.71
5	341.17	267.11	5.99
6	346.14	267.63	11.28
7	351.04	268.61	16.56
8	355.83	270.04	21.85
9	360.47	271.90	27.14
10	364.92	274.18	32.43
11	369.14	276.86	37.71
12	373.10	279.92	43.00
13	376.76	283.33	48.28
14	380.08	287.06	53.57
15	383.05	291.08	58.86
16	385.64	295.36	64.14
17	386.84	297.84	

FAILURE SURFACE # 9 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.649

X-CENTER = 332.34
Y-CENTER = 352.18
RADIUS = 83.29

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-5.81
2	326.40	269.11	-2.37
3	331.40	268.90	1.07
4	336.40	269.00	4.51
5	341.38	269.39	7.95
6	346.33	270.08	11.39
7	351.24	271.07	14.83
8	356.07	272.35	18.27
9	360.82	273.92	21.72
10	365.46	275.77	25.16
11	369.99	277.89	28.60
12	374.38	280.29	32.04
13	378.62	282.94	35.48
14	382.69	285.84	38.92
15	386.58	288.98	42.36
16	390.27	292.35	45.80
17	393.76	295.93	49.24
18	396.21	298.78	

FAILURE SURFACE #10 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.655

X-CENTER = 339.42
Y-CENTER = 325.93
RADIUS = 57.48

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	323.57	270.69	-13.52
2	328.43	269.52	-8.53
3	333.38	268.78	-3.55
4	338.37	268.47	1.44
5	343.37	268.59	6.43
6	348.34	269.15	11.41
7	353.24	270.14	16.40
8	358.03	271.55	21.38
9	362.69	273.38	26.37
10	367.17	275.60	31.35
11	371.44	278.20	36.34
12	375.47	281.16	41.33
13	379.22	284.46	46.31
14	382.68	288.08	51.30
15	385.80	291.98	56.28
16	388.58	296.14	61.27
17	389.67	298.13	

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          Y            A     X     I     S

         157.00    227.00    297.00    367.00    437.00    507.00
X          .00 *-*****--*****-------+---------+-------- +---------+
               -
               -
               -
               -
               -
        70.00 +
               -
               -
               -
               -
               -
A     140.00 +
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               -
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               -
               -
X     210.00 +            *
               -           *
               -           *
               -
               -
               -
I     280.00 +
               -
               -              ...
               -             ...*
               -             ...*.
               -            ....*.
S     350.00 +            ....12.
               -           ....61..
               -            ....612*
               -            *....61*
               -           **......4
               -                ......
      420.00 +                   ....
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               -
               -
      490.00 +
               -
               -
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               -
               -
      560.00 * ****  ******        **
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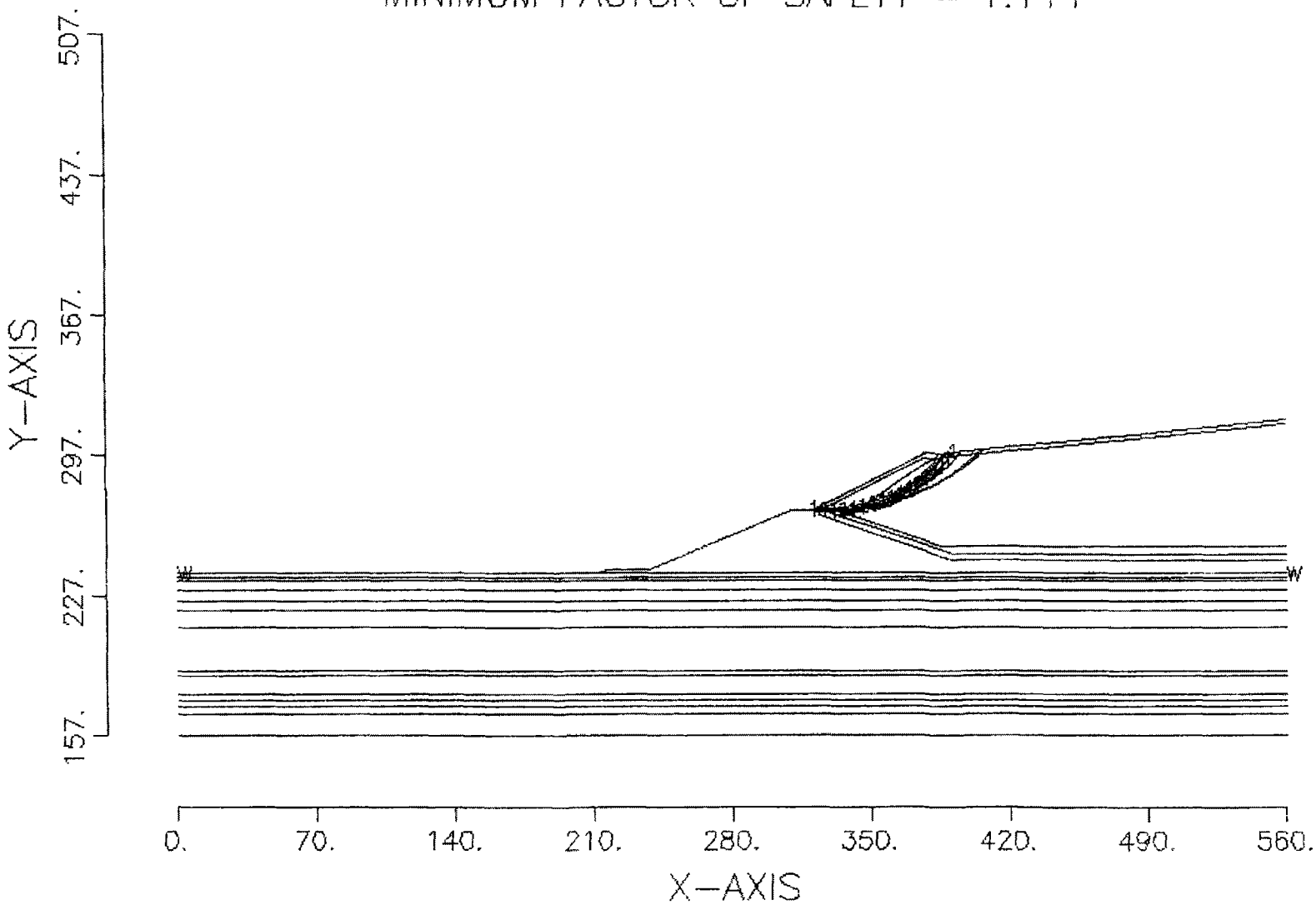
AGEC
Midvale UT s/n5206

5/1/10

CELL 6/LT/SEISMIC/SOUTH/WASTE +20'

2500SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.111



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 6/LT/SEISMIC/SOUTH/WASTE +20'

BOUNDARY COORDINATES

9 TOP BOUNDARIES
38 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	238.00	211.50	238.00	5
2	211.50	238.00	217.50	240.00	3
3	217.50	240.00	237.50	240.00	3
4	237.50	240.00	310.00	269.00	3
5	310.00	269.00	320.20	269.00	3
6	320.20	269.00	379.40	298.60	1
7	379.40	298.60	381.40	298.60	1
8	381.40	298.60	384.40	297.60	1
9	384.40	297.60	560.00	315.16	1
10	320.20	269.00	324.70	269.00	3
11	324.70	269.00	377.10	295.20	2
12	377.10	295.20	382.00	295.30	2
13	382.00	295.30	560.00	313.16	4
14	323.90	266.70	324.70	269.00	2
15	324.70	269.00	328.10	268.50	2
16	328.10	268.50	332.70	267.00	2
17	332.70	267.00	339.00	267.00	1
18	339.00	267.00	382.00	295.30	4
19	339.00	267.00	385.80	251.40	1
20	385.80	251.40	560.00	251.40	1
21	332.70	267.00	391.50	247.40	2
22	391.50	247.40	560.00	247.40	2
23	323.90	266.70	391.10	244.30	3
24	391.10	244.30	560.00	244.30	3
25	211.50	238.00	560.00	238.00	5
26	.00	236.00	560.00	236.00	6
27	.00	234.00	560.00	234.00	7
28	.00	230.00	560.00	230.00	8
29	.00	224.00	560.00	224.00	9
30	.00	220.00	560.00	220.00	10
31	.00	211.00	560.00	211.00	11
32	.00	190.00	560.00	190.00	12
33	.00	187.00	560.00	187.00	13
34	.00	178.00	560.00	178.00	14
35	.00	175.00	560.00	175.00	15
36	.00	172.00	560.00	172.00	16
37	.00	168.00	560.00	168.00	17
38	.00	157.00	560.00	157.00	18

ISOTROPIC SOIL PARAMETERS

18 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.

1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	32.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1
9	110.0	110.0	200.0	30.0	.00	.0	1
10	110.0	110.0	200.0	27.0	.00	.0	1
11	110.0	110.0	200.0	30.0	.00	.0	1
12	110.0	110.0	200.0	27.0	.00	.0	1
13	110.0	110.0	200.0	30.0	.00	.0	1
14	110.0	110.0	200.0	27.0	.00	.0	1
15	110.0	110.0	200.0	30.0	.00	.0	1
16	110.0	110.0	200.0	27.0	.00	.0	1
17	110.0	110.0	200.0	30.0	.00	.0	1
18	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	560.00	234.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .180 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 300.00
AND X = 335.00

EACH SURFACE TERMINATES BETWEEN X = 370.00
AND X = 420.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y =150.00

5.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.111

X-CENTER = 329.23
Y-CENTER = 351.59
RADIUS = 82.34

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-3.70
2	326.42	269.29	-.22
3	331.42	269.27	3.26
4	336.41	269.56	6.74
5	341.38	270.14	10.22
6	346.30	271.03	13.70
7	351.15	272.22	17.18
8	355.93	273.69	20.66
9	360.61	275.46	24.14
10	365.17	277.50	27.62
11	369.60	279.82	31.10
12	373.88	282.40	34.58
13	378.00	285.24	38.06
14	381.94	288.32	41.54
15	385.68	291.64	45.02
16	389.22	295.17	48.50
17	392.04	298.36	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	323.42	3.99	537.99	.00	.00	580.26	637.00
2	325.92	1.00	302.55	.00	.00	329.16	402.07
3	328.92	5.00	2354.62	.00	.00	2363.51	2345.72
4	333.91	4.99	3649.52	.00	.00	3490.99	2885.18
5	338.89	4.97	4751.84	.00	.00	4392.85	3316.71
6	343.03	3.31	3704.01	.00	.00	3329.21	2409.85
7	345.49	1.61	1949.97	.00	.00	1817.34	909.98
8	348.73	4.86	6414.66	.00	.00	5890.27	2921.62
9	353.54	4.78	6962.27	.00	.00	6327.43	3105.06
10	358.27	4.68	7271.13	.00	.00	6562.80	3203.83
11	362.89	4.56	7346.90	.00	.00	6606.86	3222.32
12	367.39	4.43	7200.61	.00	.00	6470.60	3165.14
13	371.74	4.28	6848.31	.00	.00	6165.69	3037.19
14	375.49	3.22	4959.86	.00	.00	4484.60	2233.28
15	377.55	.90	1352.76	.00	.00	1221.73	611.16
16	378.70	1.40	2062.48	.00	.00	1877.43	947.67
17	380.40	2.00	2735.21	.00	.00	2480.05	1269.25
18	381.67	.54	670.41	.00	.00	604.64	315.23
19	381.97	.06	74.63	.00	.00	67.88	35.92
20	383.20	2.40	2465.19	.00	.00	2214.56	1217.80

21	385.04	1.28	1013.42	.00	.00	887.55	526.42
22	387.45	3.53	1908.07	.00	.00	1583.95	1114.60
23	389.63	.82	245.72	.00	.00	165.65	181.53
24	391.04	2.00	246.52	.00	.00	42.52	291.55

FAILURE SURFACE # 2 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.112

X-CENTER = 332.34
Y-CENTER = 352.18
RADIUS = 83.29

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-5.81
2	326.40	269.11	-2.37
3	331.40	268.90	1.07
4	336.40	269.00	4.51
5	341.38	269.39	7.95
6	346.33	270.08	11.39
7	351.24	271.07	14.83
8	356.07	272.35	18.27
9	360.82	273.92	21.72
10	365.46	275.77	25.16
11	369.99	277.89	28.60
12	374.38	280.29	32.04
13	378.62	282.94	35.48
14	382.69	285.84	38.92
15	386.58	288.98	42.36
16	390.27	292.35	45.80
17	393.76	295.93	49.24
18	396.21	298.78	

FAILURE SURFACE # 3 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.114

X-CENTER = 331.65
Y-CENTER = 336.81
RADIUS = 67.97

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-6.54
2	326.40	269.05	-2.32
3	331.39	268.84	1.89
4	336.39	269.01	6.11
5	341.36	269.54	10.32
6	346.28	270.44	14.54
7	351.12	271.69	18.75
8	355.86	273.30	22.97
9	360.46	275.25	27.19
10	364.91	277.53	31.40
11	369.17	280.14	35.62
12	373.24	283.05	39.83
13	377.08	286.25	44.05
14	380.67	289.73	48.26
15	384.00	293.46	52.48
16	387.05	297.43	56.69
17	387.35	297.90	

FAILURE SURFACE # 4 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.129

X-CENTER = 325.34
Y-CENTER = 354.66
RADIUS = 85.13

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-.95
2	326.43	269.53	2.42
3	331.42	269.74	5.78
4	336.40	270.25	9.15
5	341.34	271.04	12.51
6	346.22	272.12	15.88
7	351.03	273.49	19.24
8	355.75	275.14	22.61
9	360.36	277.06	25.97
10	364.86	279.25	29.34
11	369.22	281.70	32.71
12	373.42	284.40	36.07
13	377.46	287.35	39.44
14	381.33	290.52	42.80
15	384.99	293.92	46.17
16	388.46	297.53	49.53
17	388.90	298.05	

FAILURE SURFACE # 5 SPECIFIED BY 16 COORDINATE POINTS

SAFETY FACTOR = 1.129

X-CENTER = 336.42
Y-CENTER = 327.25
RADIUS = 58.51

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	322.86	270.33	-10.95
2	327.77	269.38	-6.05
3	332.74	268.85	-1.16
4	337.74	268.75	3.74
5	342.73	269.08	8.64
6	347.67	269.83	13.54
7	352.53	271.00	18.44
8	357.28	272.58	23.33
9	361.87	274.56	28.23
10	366.27	276.93	33.13
11	370.46	279.66	38.03
12	374.40	282.74	42.93
13	378.06	286.14	47.82
14	381.42	289.85	52.72
15	384.44	293.83	57.62
16	387.00	297.86	

FAILURE SURFACE # 6 SPECIFIED BY 16 COORDINATE POINTS

SAFETY FACTOR = 1.133

X-CENTER = 334.18
Y-CENTER = 330.16
RADIUS = 60.41

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	323.57	270.69	-7.74
2	328.53	270.01	-3.00
3	333.52	269.75	1.75
4	338.52	269.90	6.49

5	343.49	270.47	11.23
6	348.39	271.44	15.98
7	353.20	272.82	20.72
8	357.87	274.59	25.47
9	362.39	276.74	30.21
10	366.71	279.25	34.95
11	370.81	282.12	39.70
12	374.65	285.31	44.44
13	378.22	288.81	49.18
14	381.49	292.60	53.93
15	384.44	296.64	58.67
16	385.06	297.67	

FAILURE SURFACE # 7 SPECIFIED BY 20 COORDINATE POINTS

SAFETY FACTOR = 1.134

X-CENTER = 331.59
Y-CENTER = 373.74
RADIUS = 105.05

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	320.72	269.26	-4.58
2	325.70	268.86	-1.85
3	330.70	268.70	.88
4	335.70	268.77	3.61
5	340.69	269.09	6.33
6	345.66	269.64	9.06
7	350.59	270.43	11.79
8	355.49	271.45	14.51
9	360.33	272.70	17.24
10	365.10	274.18	19.97
11	369.80	275.89	22.70
12	374.42	277.82	25.42
13	378.93	279.97	28.15
14	383.34	282.33	30.88
15	387.63	284.89	33.61
16	391.80	287.66	36.33
17	395.82	290.62	39.06
18	399.71	293.77	41.79
19	403.43	297.10	44.51
20	406.15	299.78	

FAILURE SURFACE # 8 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.134

X-CENTER = 338.25
Y-CENTER = 328.44
RADIUS = 60.65

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	322.14	269.97	-13.04
2	327.01	268.84	-8.32
3	331.96	268.12	-3.59
4	336.95	267.81	1.13
5	341.95	267.91	5.86
6	346.93	268.42	10.58
7	351.84	269.34	15.31
8	356.66	270.66	20.03
9	361.36	272.37	24.76
10	365.90	274.46	29.48
11	370.25	276.92	34.21
12	374.39	279.73	38.93

13	378.28	282.88	43.66
14	381.89	286.33	48.38
15	385.22	290.07	53.11
16	388.22	294.06	57.83
17	390.85	298.24	

FAILURE SURFACE # 9 SPECIFIED BY 20 COORDINATE POINTS

SAFETY FACTOR = 1.139

X-CENTER = 330.53
Y-CENTER = 382.40
RADIUS = 113.15

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	321.43	269.61	-3.35
2	326.42	269.32	-.81
3	331.42	269.25	1.72
4	336.42	269.40	4.25
5	341.40	269.77	6.78
6	346.37	270.36	9.32
7	351.30	271.17	11.85
8	356.20	272.20	14.38
9	361.04	273.44	16.91
10	365.82	274.90	19.44
11	370.54	276.56	21.98
12	375.18	278.43	24.51
13	379.73	280.50	27.04
14	384.18	282.78	29.57
15	388.53	285.25	32.10
16	392.76	287.90	34.64
17	396.88	290.74	37.17
18	400.86	293.76	39.70
19	404.71	296.96	42.23
20	408.02	299.96	

FAILURE SURFACE #10 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.139

X-CENTER = 332.82
Y-CENTER = 340.56
RADIUS = 72.70

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	320.00	269.00	-8.18
2	324.95	268.29	-4.24
3	329.94	267.92	-.30
4	334.94	267.89	3.64
5	339.93	268.21	7.58
6	344.88	268.87	11.52
7	349.78	269.87	15.46
8	354.60	271.20	19.40
9	359.32	272.86	23.35
10	363.91	274.84	27.29
11	368.35	277.14	31.23
12	372.63	279.73	35.17
13	376.71	282.61	39.11
14	380.59	285.76	43.05
15	384.25	289.17	46.99
16	387.66	292.83	50.93
17	390.81	296.71	54.87
18	391.96	298.36	

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          Y            A     X     I     S

          157.00    227.00    297.00    367.00    437.00    507.00

X        .00 *-****--*****- -----+---------+---------+---------+
             -
             -
             -
             -
             -
      70.00 +
             -
             -
             -
             -
             -
             -
A    140.00 +
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             -
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X    210.00 +            *
             -           *
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I    280.00 +
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             -            ....*.
S    350.00 +            ....14.
             -           ....21..
             -            ....214*
             -            *....21*
             -           **.....71
             -                ....7.
     420.00 +                   ....
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     490.00 +
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     560.00 * ****  ******        **
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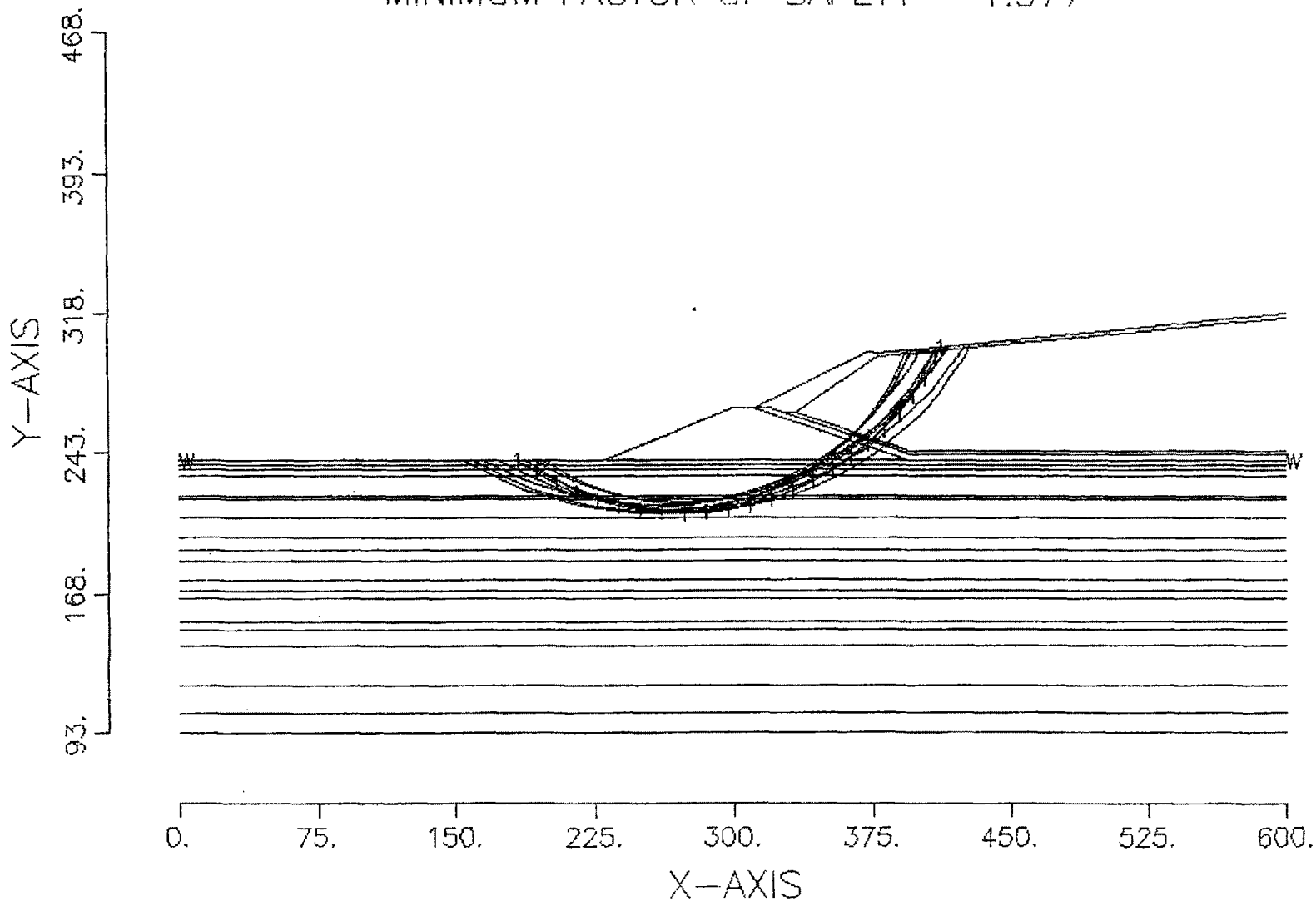
Appendix B

Landfill Cell 7 Stability Printouts

AGEC
Midvale UT s/n5206

CELL 7/LT/STATIC/WASTE +20

2500 SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.977



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 7/LT/STATIC/WASTE +20

BOUNDARY COORDINATES

9 TOP BOUNDARIES
39 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	239.00	230.00	239.00	5
2	230.00	239.00	300.00	267.00	3
3	300.00	267.00	310.50	267.00	3
4	310.50	267.00	312.50	267.00	2
5	312.50	267.00	365.90	293.70	2
6	365.90	293.70	373.10	297.30	1
7	373.10	297.30	375.10	297.30	1
8	375.10	297.30	378.10	296.30	1
9	378.10	296.30	600.00	318.50	1
10	312.50	267.00	319.70	267.00	2
11	319.70	267.00	327.20	264.50	2
12	327.20	264.50	333.60	264.50	1
13	333.60	264.50	378.50	295.00	4
14	378.50	295.00	600.00	316.50	4
15	333.60	264.50	395.30	244.00	1
16	395.30	244.00	600.00	244.00	1
17	327.20	264.50	395.00	242.00	2
18	395.00	242.00	600.00	242.00	2
19	310.50	267.00	394.50	239.00	3
20	230.00	239.00	394.50	239.00	5
21	394.50	239.00	600.00	239.00	5
22	.00	236.00	600.00	236.00	6
23	.00	234.00	600.00	234.00	7
24	.00	230.00	600.00	230.00	8
25	.00	220.00	600.00	220.00	7
26	.00	218.00	600.00	218.00	8
27	.00	208.00	600.00	208.00	7
28	.00	197.00	600.00	197.00	8
29	.00	191.00	600.00	191.00	7
30	.00	185.00	600.00	185.00	8
31	.00	175.00	600.00	175.00	7
32	.00	169.00	600.00	169.00	8
33	.00	165.00	600.00	165.00	7
34	.00	153.00	600.00	153.00	8
35	.00	149.00	600.00	149.00	7
36	.00	140.00	600.00	140.00	8
37	.00	119.00	600.00	119.00	7
38	.00	104.00	600.00	104.00	8
39	.00	93.00	600.00	93.00	7

ISOTROPIC SOIL PARAMETERS

8 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.

1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	34.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	600.00	234.00

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00
AND X = 230.00

EACH SURFACE TERMINATES BETWEEN X = 300.00
AND X = 600.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00

12.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 24 COORDINATE POINTS

SAFETY FACTOR = 1.977

X-CENTER = 272.70
Y-CENTER = 364.49
RADIUS = 154.21

POINT	X-SURF	Y-SURF	ALPHA

NO.			(DEG)
1	183.06	239.00	-33.31
2	193.09	232.41	-28.85
3	203.60	226.52	-24.39
4	214.53	221.66	-19.93
5	225.81	217.57	-15.47
6	237.38	214.37	-11.01
7	249.16	212.08	-6.55
8	261.08	210.71	-2.09
9	273.07	210.37	2.37
10	285.06	210.77	6.83
11	296.97	212.19	11.29
12	308.74	214.54	15.75
13	320.29	217.80	20.20
14	331.55	221.94	24.66
15	342.46	226.95	29.12
16	352.94	232.79	33.58
17	362.94	239.43	38.04
18	372.39	246.82	42.50
19	381.24	254.93	46.96
20	389.43	263.70	51.42
21	396.91	273.08	55.88
22	403.64	283.02	60.34
23	409.58	293.45	64.80
24	412.54	299.75	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	185.34	4.57	890.24	.00	.00	1767.52	1068.69
2	189.15	3.04	1552.21	.00	.00	2597.93	1126.99
3	191.88	2.42	1736.02	.00	143.64	2630.95	1061.12
4	195.28	4.37	4100.94	.00	871.08	4873.25	1928.20
5	200.53	6.14	7706.34	.00	2487.43	7810.12	2721.29
6	209.07	10.93	18736.58	.00	7381.76	15559.44	5223.49
7	216.82	4.59	9538.51	.00	4011.10	6965.06	2288.68
8	221.88	5.52	12575.31	.00	5491.43	9059.59	3238.88
9	225.22	1.18	2839.55	.00	1266.16	1985.77	638.33
10	227.91	4.19	10475.31	.00	4612.45	6868.35	2209.62
11	233.69	7.38	21158.93	.00	8886.32	14302.70	4459.97
12	243.27	11.78	42462.79	.00	15555.50	29415.23	8794.11
13	255.12	11.92	52724.00	.00	16926.44	37390.51	10849.34
14	267.07	11.99	61683.68	.00	17603.25	44585.91	12703.59
15	279.06	11.99	69110.45	.00	17581.85	50994.38	14355.04
16	291.02	11.91	74825.19	.00	16862.35	56605.59	15801.05
17	298.49	3.03	19843.56	.00	4141.09	15247.33	4241.39
18	304.37	8.74	56875.00	.00	11308.03	44233.70	12300.66
19	309.62	1.76	11224.34	.00	2190.01	8781.76	2447.86
20	311.50	2.00	12636.25	.00	2422.14	9926.28	2768.19
21	316.10	7.20	45668.27	.00	8114.33	36471.14	10155.28
22	320.00	.59	3790.26	.00	624.26	3072.97	854.04
23	320.56	.55	3511.36	.00	585.76	2862.65	796.68
24	323.56	5.43	35004.02	.00	5420.26	28590.92	8934.38
25	326.74	.93	5994.19	.00	852.44	5021.76	1394.02
26	329.38	4.35	28267.35	.00	3721.44	23954.88	6642.33
27	332.58	2.05	13346.05	.00	1628.70	11581.99	3212.53
28	338.03	8.86	58071.52	.00	5524.68	51794.80	14333.45
29	345.19	5.47	36030.68	.00	2159.90	33869.54	9361.91
30	350.44	5.01	32904.43	.00	932.00	31316.66	9724.62
31	353.85	1.82	11922.27	.00	82.44	11794.95	3665.24
32	356.27	3.01	19586.65	.00	.00	19489.52	6056.72
33	360.03	4.52	28951.20	.00	.00	28803.17	8959.20
34	362.62	.65	4091.64	.00	.00	3919.51	1493.94
35	364.42	2.96	18549.71	.00	.00	18121.07	6942.73
36	368.94	6.08	37308.70	.00	.00	36426.75	13989.10

37	372.19	.41	2434.73	.00	.00	2508.53	745.04
38	372.74	.71	4250.11	.00	.00	4528.15	1349.47
39	373.82	1.44	8457.01	.00	.00	9007.54	2688.20
40	374.82	.56	3268.01	.00	.00	3527.83	987.42
41	375.66	1.12	6375.75	.00	.00	6881.52	1927.65
42	377.16	1.88	10226.30	.00	.00	11308.79	2795.81
43	378.30	.40	2115.76	.00	.00	2339.11	579.10
44	379.87	2.74	14049.70	.00	.00	15528.76	3849.99
45	385.33	8.19	37057.35	.00	.00	42830.06	10708.01
46	393.17	7.48	26413.42	.00	.00	32104.40	8178.46
47	400.27	6.73	16532.32	.00	.00	21199.03	5606.52
48	406.61	5.94	7781.77	.00	.00	10366.58	3051.78
49	410.70	2.25	1006.59	.00	.00	1195.81	549.76
50	412.19	.71	61.38	.00	.00	-22.44	78.40

FAILURE SURFACE # 2 SPECIFIED BY 23 COORDINATE POINTS

SAFETY FACTOR = 1.982

X-CENTER = 274.39
Y-CENTER = 359.95
RADIUS = 148.78

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	187.76	239.00	-33.30
2	197.79	232.41	-28.68
3	208.31	226.65	-24.06
4	219.27	221.76	-19.43
5	230.59	217.77	-14.81
6	242.19	214.70	-10.19
7	254.00	212.58	-5.57
8	265.94	211.41	-.94
9	277.94	211.22	3.68
10	289.92	211.99	8.30
11	301.73	213.72	12.92
12	313.49	216.40	17.55
13	324.93	220.02	22.17
14	336.04	224.55	26.79
15	346.73	229.96	31.41
16	356.99	236.21	36.04
17	366.70	243.27	40.66
18	375.80	251.09	45.28
19	384.24	259.62	49.91
20	391.97	268.80	54.53
21	398.94	278.57	59.15
22	405.09	288.87	63.77
23	410.34	299.53	

FAILURE SURFACE # 3 SPECIFIED BY 24 COORDINATE POINTS

SAFETY FACTOR = 1.985

X-CENTER = 259.81
Y-CENTER = 375.72
RADIUS = 161.59

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	173.67	239.00	-30.08
2	184.06	232.99	-25.83
3	194.86	227.76	-21.57
4	206.02	223.35	-17.32
5	217.47	219.77	-13.06
6	229.16	217.06	-8.80
7	241.02	215.23	-4.55

8	252.99	214.27	-.29
9	264.99	214.21	3.96
10	276.96	215.04	8.22
11	288.82	216.76	12.48
12	300.55	219.35	16.73
13	312.04	222.81	20.99
14	323.25	227.10	25.24
15	334.10	232.22	29.50
16	344.54	238.13	33.75
17	354.52	244.80	38.01
18	363.98	252.19	42.27
19	372.86	260.26	46.52
20	381.11	268.97	50.78
21	388.70	278.26	55.03
22	395.58	288.10	59.29
23	401.71	298.41	63.55
24	401.84	298.67	

FAILURE SURFACE # 4 SPECIFIED BY 22 COORDINATE POINTS

SAFETY FACTOR = 1.991

X-CENTER = 268.45
Y-CENTER = 347.88
RADIUS = 135.53

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	187.76	239.00	-34.01
2	197.70	232.29	-28.93
3	208.21	226.48	-23.86
4	219.18	221.63	-18.78
5	230.54	217.77	-13.71
6	242.20	214.92	-8.63
7	254.06	213.12	-3.56
8	266.04	212.38	1.52
9	278.04	212.69	6.59
10	289.96	214.07	11.67
11	301.71	216.50	16.74
12	313.20	219.96	21.82
13	324.34	224.42	26.89
14	335.04	229.84	31.97
15	345.22	236.20	37.04
16	354.80	243.43	42.12
17	363.70	251.47	47.19
18	371.86	260.28	52.27
19	379.20	269.77	57.34
20	385.68	279.87	62.42
21	391.23	290.51	67.49
22	394.31	297.92	

FAILURE SURFACE # 5 SPECIFIED BY 26 COORDINATE POINTS

SAFETY FACTOR = 1.991

X-CENTER = 257.36
Y-CENTER = 398.53
RADIUS = 187.11

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	159.59	239.00	-29.67
2	170.02	233.06	-25.99
3	180.81	227.80	-22.31
4	191.91	223.25	-18.64
5	203.28	219.41	-14.96

6	214.87	216.31	-11.29
7	226.64	213.96	-7.61
8	238.53	212.37	-3.94
9	250.50	211.55	-.26
10	262.50	211.49	3.41
11	274.48	212.21	7.09
12	286.39	213.69	10.76
13	298.18	215.93	14.44
14	309.80	218.92	18.11
15	321.21	222.65	21.79
16	332.35	227.11	25.46
17	343.18	232.26	29.14
18	353.67	238.11	32.81
19	363.75	244.61	36.49
20	373.40	251.75	40.16
21	382.57	259.49	43.84
22	391.22	267.80	47.51
23	399.33	276.65	51.19
24	406.85	286.00	54.86
25	413.76	295.81	58.54
26	416.40	300.13	

FAILURE SURFACE # 6 SPECIFIED BY 25 COORDINATE POINTS

SAFETY FACTOR = 1.993

X-CENTER = 277.06
Y-CENTER = 386.22
RADIUS = 174.67

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	183.06	239.00	-30.59
2	193.39	232.89	-26.65
3	204.12	227.51	-22.71
4	215.19	222.88	-18.78
5	226.55	219.01	-14.84
6	238.15	215.94	-10.90
7	249.93	213.67	-6.97
8	261.84	212.22	-3.03
9	273.83	211.58	.91
10	285.82	211.77	4.84
11	297.78	212.78	8.78
12	309.64	214.62	12.72
13	321.35	217.26	16.66
14	332.84	220.70	20.59
15	344.08	224.92	24.53
16	354.99	229.90	28.47
17	365.54	235.62	32.40
18	375.67	242.05	36.34
19	385.34	249.16	40.28
20	394.49	256.92	44.21
21	403.10	265.29	48.15
22	411.10	274.23	52.09
23	418.48	283.69	56.02
24	425.18	293.64	59.96
25	429.70	301.46	

FAILURE SURFACE # 7 SPECIFIED BY 23 COORDINATE POINTS

SAFETY FACTOR = 1.995

X-CENTER = 272.98
Y-CENTER = 371.05
RADIUS = 154.66

POINT	X-SURF	Y-SURF	ALPHA

NO.			(DEG)
1	192.45	239.00	-29.15
2	202.93	233.15	-24.71
3	213.83	228.14	-20.26
4	225.09	223.98	-15.81
5	236.63	220.71	-11.37
6	248.40	218.35	-6.92
7	260.31	216.90	-2.47
8	272.30	216.38	1.97
9	284.29	216.80	6.42
10	296.22	218.14	10.87
11	308.00	220.40	15.31
12	319.58	223.57	19.76
13	330.87	227.63	24.21
14	341.82	232.55	28.65
15	352.35	238.30	33.10
16	362.40	244.86	37.55
17	371.91	252.17	41.99
18	380.83	260.20	46.44
19	389.10	268.89	50.89
20	396.67	278.20	55.33
21	403.50	288.07	59.78
22	409.54	298.44	64.23
23	410.05	299.50	

FAILURE SURFACE # 8 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 2.000

X-CENTER = 258.28
Y-CENTER = 411.02
RADIUS = 200.69

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	154.90	239.00	-29.29
2	165.36	233.13	-25.86
3	176.16	227.89	-22.44
4	187.25	223.31	-19.01
5	198.60	219.40	-15.59
6	210.16	216.18	-12.16
7	221.89	213.65	-8.73
8	233.75	211.83	-5.31
9	245.70	210.72	-1.88
10	257.69	210.33	1.55
11	269.69	210.65	4.97
12	281.64	211.69	8.40
13	293.51	213.44	11.83
14	305.26	215.90	15.25
15	316.84	219.06	18.68
16	328.20	222.90	22.10
17	339.32	227.42	25.53
18	350.15	232.59	28.96
19	360.65	238.40	32.38
20	370.78	244.83	35.81
21	380.52	251.85	39.24
22	389.81	259.44	42.66
23	398.63	267.57	46.09
24	406.96	276.22	49.52
25	414.75	285.34	52.94
26	421.98	294.92	56.37
27	426.09	301.10	

FAILURE SURFACE # 9 SPECIFIED BY 25 COORDINATE POINTS

SAFETY FACTOR = 2.001

X-CENTER = 257.42
Y-CENTER = 405.92
RADIUS = 191.15

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	164.29	239.00	-27.36
2	174.94	233.49	-23.76
3	185.93	228.65	-20.16
4	197.19	224.51	-16.57
5	208.69	221.09	-12.97
6	220.39	218.40	-9.37
7	232.23	216.45	-5.77
8	244.17	215.24	-2.18
9	256.16	214.78	1.42
10	268.15	215.08	5.02
11	280.11	216.13	8.62
12	291.97	217.93	12.21
13	303.70	220.47	15.81
14	315.25	223.74	19.41
15	326.56	227.72	23.01
16	337.61	232.41	26.60
17	348.34	237.79	30.20
18	358.71	243.83	33.80
19	368.68	250.50	37.40
20	378.22	257.79	40.99
21	387.27	265.66	44.59
22	395.82	274.09	48.19
23	403.82	283.03	51.79
24	411.24	292.46	55.39
25	416.55	300.15	

FAILURE SURFACE #10 SPECIFIED BY 21 COORDINATE POINTS

SAFETY FACTOR = 2.003

X-CENTER = 272.89
Y-CENTER = 349.97
RADIUS = 134.35

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	197.14	239.00	-31.76
2	207.35	232.68	-26.64
3	218.07	227.30	-21.52
4	229.24	222.90	-16.40
5	240.75	219.51	-11.28
6	252.52	217.17	-6.16
7	264.45	215.88	-1.04
8	276.45	215.66	4.08
9	288.42	216.52	9.20
10	300.26	218.43	14.32
11	311.89	221.40	19.44
12	323.20	225.39	24.56
13	334.12	230.38	29.67
14	344.55	236.32	34.79
15	354.40	243.17	39.91
16	363.60	250.87	45.03
17	372.08	259.36	50.15
18	379.77	268.57	55.27
19	386.61	278.43	60.39
20	392.54	288.87	65.51
21	396.78	298.17	

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          Y            A     X     I     S

          93.00    168.00    243.00    318.00    393.00    468.00
X        .00 **-*--***-******-***+---------+---------+---------+
             -                 ...
             -                ....
             -               .....
             -             .......
             -            ........
      75.00 +             ........
             -           .........
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             -       ............
             -      .............
A    150.00 +      ............8
             -     .............5
             -     ............53
             -     ...........591
             -    ............312
             -    ...........5120
X    225.00 +    ...........51.*
             -   ............17...
             -   ............17...
             -   ............17....
             -   ............1......
             -   ............13.....
I    300.00 +   ............13.....*
             -    ...........13.....*.
             -    ............13....*.
             -    ............113...*..
             -    .............213......
             -     .............213.....*
S    375.00 +     ..............61134..*
             -      ..............621.34.
             -      ............**.661123
             -       ................66511
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             -        ....................
     450.00 +         ....................
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     525.00 +              ..............
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     600.00 ** *  *** ****** ****       ..*
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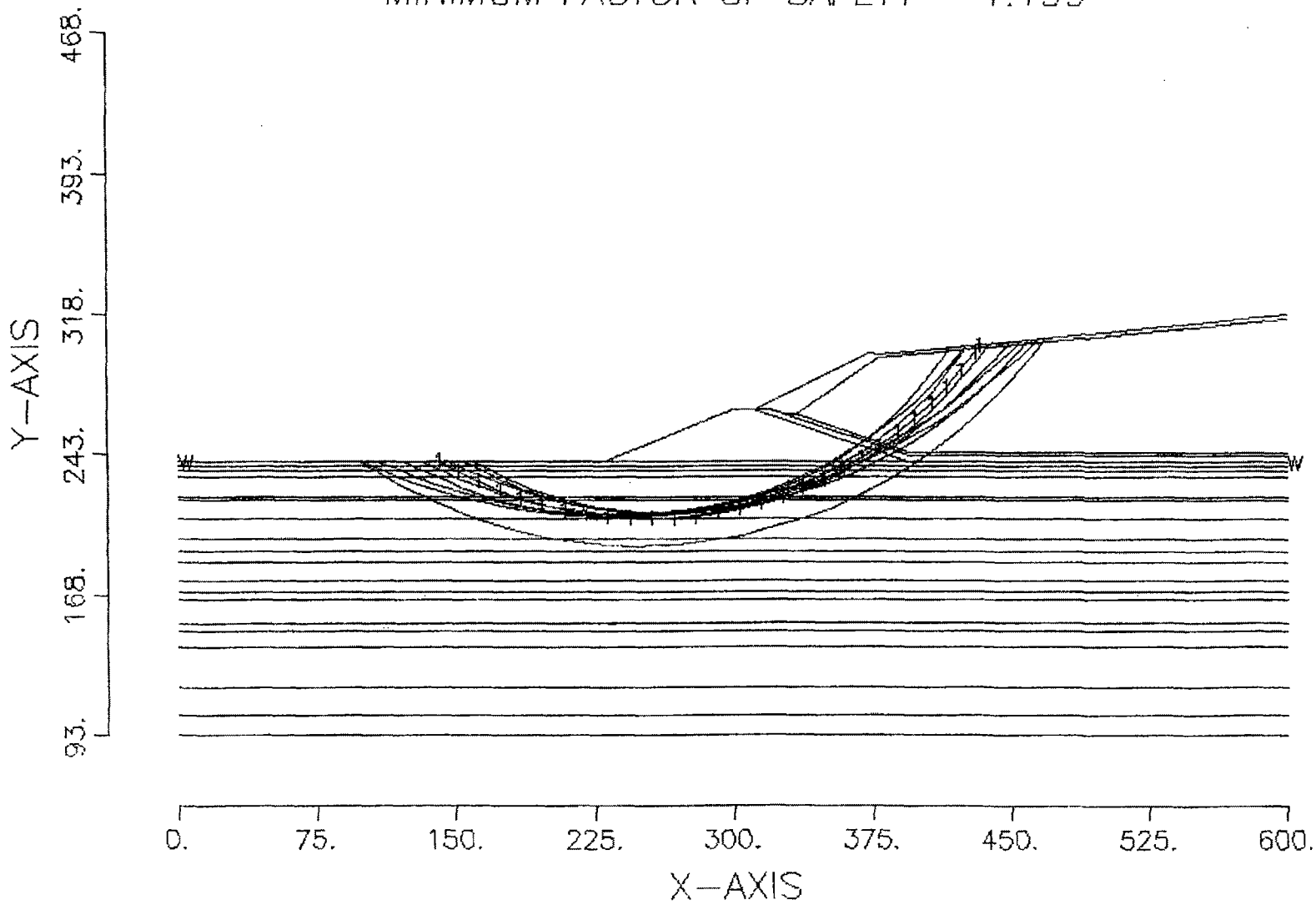
AGEC
Midvale UT s/n5206

CELL 7/LT/SEISMIC/WASTE +20

2500 SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.199



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 7/LT/SEISMIC/WASTE +20

BOUNDARY COORDINATES

9 TOP BOUNDARIES
39 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	239.00	230.00	239.00	5
2	230.00	239.00	300.00	267.00	3
3	300.00	267.00	310.50	267.00	3
4	310.50	267.00	312.50	267.00	2
5	312.50	267.00	365.90	293.70	2
6	365.90	293.70	373.10	297.30	1
7	373.10	297.30	375.10	297.30	1
8	375.10	297.30	378.10	296.30	1
9	378.10	296.30	600.00	318.50	1
10	312.50	267.00	319.70	267.00	2
11	319.70	267.00	327.20	264.50	2
12	327.20	264.50	333.60	264.50	1
13	333.60	264.50	378.50	295.00	4
14	378.50	295.00	600.00	316.50	4
15	333.60	264.50	395.30	244.00	1
16	395.30	244.00	600.00	244.00	1
17	327.20	264.50	395.00	242.00	2
18	395.00	242.00	600.00	242.00	2
19	310.50	267.00	394.50	239.00	3
20	230.00	239.00	394.50	239.00	5
21	394.50	239.00	600.00	239.00	5
22	.00	236.00	600.00	236.00	6
23	.00	234.00	600.00	234.00	7
24	.00	230.00	600.00	230.00	8
25	.00	220.00	600.00	220.00	7
26	.00	218.00	600.00	218.00	8
27	.00	208.00	600.00	208.00	7
28	.00	197.00	600.00	197.00	8
29	.00	191.00	600.00	191.00	7
30	.00	185.00	600.00	185.00	8
31	.00	175.00	600.00	175.00	7
32	.00	169.00	600.00	169.00	8
33	.00	165.00	600.00	165.00	7
34	.00	153.00	600.00	153.00	8
35	.00	149.00	600.00	149.00	7
36	.00	140.00	600.00	140.00	8
37	.00	119.00	600.00	119.00	7
38	.00	104.00	600.00	104.00	8
39	.00	93.00	600.00	93.00	7

ISOTROPIC SOIL PARAMETERS

8 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.

1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	34.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	600.00	234.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .180 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00
AND X = 230.00

EACH SURFACE TERMINATES BETWEEN X = 300.00
AND X = 600.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00

12.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 29 COORDINATE POINTS

SAFETY FACTOR = 1.199

X-CENTER = 253.45
Y-CENTER = 428.24
RADIUS = 220.22

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	140.82	239.00	-29.20
2	151.29	233.15	-26.08
3	162.07	227.87	-22.95
4	173.12	223.19	-19.83
5	184.41	219.12	-16.71
6	195.90	215.67	-13.59
7	207.57	212.85	-10.46
8	219.37	210.67	-7.34
9	231.27	209.14	-4.22
10	243.24	208.25	-1.10
11	255.23	208.03	2.03
12	267.23	208.45	5.15
13	279.18	209.53	8.27
14	291.05	211.25	11.39
15	302.82	213.62	14.52
16	314.43	216.63	17.64
17	325.87	220.27	20.76
18	337.09	224.52	23.88
19	348.06	229.38	27.01
20	358.75	234.83	30.13
21	369.13	240.85	33.25
22	379.17	247.43	36.37
23	388.83	254.55	39.50
24	398.09	262.18	42.62
25	406.92	270.30	45.74
26	415.30	278.90	48.86
27	423.19	287.94	51.99
28	430.58	297.39	55.11
29	433.70	301.86	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	143.50	5.37	1046.76	.00	.00	2425.22	2193.89
2	147.97	3.58	1825.13	.00	.00	3383.78	2313.56
3	150.53	1.53	1034.73	.00	46.66	1781.39	1150.02
4	154.51	6.43	5765.85	.00	1083.86	7745.19	4923.99
5	159.90	4.35	5164.34	.00	1530.65	5826.28	3284.31
6	167.60	11.05	17255.31	.00	6341.62	16153.14	8867.37
7	177.54	8.85	17647.22	.00	7280.47	14225.83	7615.44
8	183.19	2.44	5413.69	.00	2337.53	4324.70	2515.55
9	186.27	3.73	8686.33	.00	3752.73	6443.08	3752.78
10	192.02	7.76	19547.83	.00	8681.25	13908.83	7263.68
11	201.73	11.66	32675.76	.00	14781.14	21530.82	11153.00
12	213.47	11.80	36301.52	.00	16652.56	22390.27	11518.28
13	224.68	10.63	34787.69	.00	16065.60	20354.76	10439.84
14	230.63	1.27	4297.41	.00	1977.09	2521.40	1284.95
15	237.25	11.97	45362.68	.00	18947.36	27550.12	13711.32
16	249.23	12.00	53687.55	.00	19363.89	34653.80	16730.53
17	261.23	11.99	61015.81	.00	19291.06	41074.59	19459.50
18	273.20	11.95	67261.51	.00	18729.12	46831.16	21906.16
19	285.12	11.88	72357.33	.00	17679.65	51938.29	24076.79
20	295.53	8.95	57624.69	.00	12442.12	42402.44	19544.59

21	301.41	2.82	18425.47	.00	3703.71	13812.56	6349.89
22	306.66	7.68	49192.16	.00	9599.67	36819.95	16973.39
23	311.50	2.00	12514.98	.00	2337.06	9460.31	4365.49
24	313.47	1.93	12065.73	.00	2195.49	9172.48	4231.63
25	316.59	4.31	27086.18	.00	4704.86	20682.79	9544.51
26	319.22	.96	6073.56	.00	996.46	4616.38	2391.34
27	322.36	5.33	33933.75	.00	5181.60	26128.51	13516.45
28	325.45	.84	5376.73	.00	761.85	4258.00	1956.63
29	326.53	1.33	8542.38	.00	1197.42	6759.12	3110.24
30	330.40	6.40	41306.63	.00	5131.75	33252.78	15274.96
31	335.34	3.49	22736.92	.00	2361.71	18704.44	8572.40
32	342.58	10.97	72395.09	.00	5279.32	61445.21	28117.43
33	348.67	1.22	8107.85	.00	367.93	7081.86	3238.14
34	353.21	7.85	52298.84	.00	1099.36	45647.09	23453.09
35	357.94	1.62	10835.43	.00	.00	9640.31	4946.89
36	359.76	2.02	13446.26	.00	.00	11973.87	6156.17
37	363.34	5.13	33846.00	.00	.00	30136.10	15502.26
38	365.92	.04	285.33	.00	.00	254.07	130.66
39	367.54	3.19	21053.39	.00	.00	17811.83	11252.15
40	371.12	3.97	25842.87	.00	.00	21816.44	13857.72
41	374.10	2.00	12737.23	.00	.00	10744.19	6843.08
42	375.45	.71	4432.21	.00	.00	3735.82	2385.58
43	376.96	2.29	13881.07	.00	.00	12546.08	6180.97
44	378.30	.40	2371.25	.00	.00	2141.97	1057.74
45	378.74	.49	2886.81	.00	.00	2607.39	1288.15
46	379.08	.18	1052.81	.00	.00	966.24	446.40
47	380.07	1.80	10483.77	.00	.00	9710.60	4493.89
48	384.90	7.86	42736.18	.00	.00	40791.20	16680.55
49	393.46	9.26	43863.13	.00	.00	42417.77	17500.23
50	402.51	8.83	34438.81	.00	.00	33786.10	14142.77
51	411.11	8.37	25125.03	.00	.00	24995.98	10723.67
52	419.24	7.89	16102.76	.00	.00	16142.97	7280.12
53	426.89	7.39	7553.01	.00	.00	7334.16	3853.75
54	431.58	1.99	676.86	.00	.00	492.09	482.02
55	433.14	1.13	101.36	.00	.00	-35.53	148.36

FAILURE SURFACE # 2 SPECIFIED BY 31 COORDINATE POINTS

SAFETY FACTOR = 1.203

X-CENTER = 251.06
Y-CENTER = 467.11
RADIUS = 257.57

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	131.43	239.00	-26.34
2	142.18	233.68	-23.67
3	153.17	228.86	-21.00
4	164.38	224.56	-18.33
5	175.77	220.78	-15.66
6	187.32	217.54	-12.99
7	199.02	214.85	-10.32
8	210.82	212.70	-7.65
9	222.71	211.10	-4.98
10	234.67	210.06	-2.31
11	246.66	209.57	.36
12	258.66	209.65	3.03
13	270.64	210.28	5.70
14	282.58	211.47	8.37
15	294.46	213.22	11.03
16	306.23	215.51	13.70
17	317.89	218.36	16.37
18	329.40	221.74	19.04
19	340.75	225.65	21.71
20	351.90	230.09	24.38
21	362.83	235.05	27.05

22	373.51	240.51	29.72
23	383.93	246.46	32.39
24	394.07	252.88	35.06
25	403.89	259.78	37.73
26	413.38	267.12	40.40
27	422.52	274.90	43.07
28	431.29	283.09	45.74
29	439.66	291.69	48.41
30	447.63	300.66	51.08
31	449.91	303.48	

FAILURE SURFACE # 3 SPECIFIED BY 29 COORDINATE POINTS

SAFETY FACTOR = 1.204

X-CENTER = 255.26
Y-CENTER = 433.44
RADIUS = 225.62

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	140.82	239.00	-28.96
2	151.32	233.19	-25.91
3	162.11	227.95	-22.86
4	173.17	223.29	-19.81
5	184.46	219.22	-16.76
6	195.95	215.76	-13.72
7	207.61	212.91	-10.67
8	219.40	210.69	-7.62
9	231.29	209.10	-4.57
10	243.25	208.14	-1.53
11	255.25	207.82	1.52
12	267.25	208.14	4.57
13	279.21	209.10	7.62
14	291.10	210.69	10.67
15	302.89	212.91	13.71
16	314.55	215.75	16.76
17	326.04	219.21	19.81
18	337.33	223.28	22.86
19	348.39	227.94	25.90
20	359.18	233.18	28.95
21	369.68	238.99	32.00
22	379.86	245.35	35.05
23	389.69	252.24	38.10
24	399.13	259.65	41.14
25	408.17	267.54	44.19
26	416.77	275.91	47.24
27	424.92	284.72	50.29
28	432.58	293.95	53.33
29	438.86	302.38	

FAILURE SURFACE # 4 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.206

X-CENTER = 258.28
Y-CENTER = 411.02
RADIUS = 200.69

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	154.90	239.00	-29.29
2	165.36	233.13	-25.86
3	176.16	227.89	-22.44
4	187.25	223.31	-19.01
5	198.60	219.40	-15.59

6	210.16	216.18	-12.16
7	221.89	213.65	-8.73
8	233.75	211.83	-5.31
9	245.70	210.72	-1.88
10	257.69	210.33	1.55
11	269.69	210.65	4.97
12	281.64	211.69	8.40
13	293.51	213.44	11.83
14	305.26	215.90	15.25
15	316.84	219.06	18.68
16	328.20	222.90	22.10
17	339.32	227.42	25.53
18	350.15	232.59	28.96
19	360.65	238.40	32.38
20	370.78	244.83	35.81
21	380.52	251.85	39.24
22	389.81	259.44	42.66
23	398.63	267.57	46.09
24	406.96	276.22	49.52
25	414.75	285.34	52.94
26	421.98	294.92	56.37
27	426.09	301.10	

FAILURE SURFACE # 5 SPECIFIED BY 30 COORDINATE POINTS

SAFETY FACTOR = 1.209

X-CENTER = 261.87
Y-CENTER = 468.53
RADIUS = 257.34

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	145.51	239.00	-25.55
2	156.34	233.82	-22.88
3	167.39	229.16	-20.20
4	178.66	225.02	-17.53
5	190.10	221.40	-14.86
6	201.70	218.32	-12.19
7	213.43	215.79	-9.52
8	225.26	213.81	-6.84
9	237.18	212.38	-4.17
10	249.14	211.50	-1.50
11	261.14	211.19	1.17
12	273.14	211.44	3.84
13	285.11	212.24	6.52
14	297.03	213.60	9.19
15	308.88	215.52	11.86
16	320.62	217.98	14.53
17	332.24	221.00	17.20
18	343.70	224.54	19.88
19	354.99	228.62	22.55
20	366.07	233.23	25.22
21	376.93	238.34	27.89
22	387.53	243.95	30.56
23	397.86	250.06	33.24
24	407.90	256.63	35.91
25	417.62	263.67	38.58
26	427.00	271.15	41.25
27	436.02	279.07	43.92
28	444.67	287.39	46.60
29	452.91	296.11	49.27
30	460.14	304.51	

FAILURE SURFACE # 6 SPECIFIED BY 30 COORDINATE POINTS

SAFETY FACTOR = 1.212

X-CENTER = 237.75
Y-CENTER = 445.99
RADIUS = 237.14

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	122.04	239.00	-27.76
2	132.66	233.41	-24.86
3	143.55	228.37	-21.96
4	154.68	223.88	-19.06
5	166.02	219.96	-16.16
6	177.55	216.62	-13.26
7	189.23	213.87	-10.36
8	201.03	211.71	-7.46
9	212.93	210.16	-4.56
10	224.89	209.20	-1.66
11	236.89	208.86	1.24
12	246.88	209.12	4.14
13	260.85	209.98	7.04
14	272.76	211.45	9.94
15	284.58	213.52	12.84
16	296.28	216.19	15.74
17	307.83	219.45	18.64
18	319.20	223.28	21.54
19	330.37	227.69	24.44
20	341.29	232.65	27.34
21	351.95	238.16	30.24
22	362.32	244.20	33.14
23	372.37	250.76	36.04
24	382.07	257.82	38.94
25	391.40	265.36	41.84
26	400.34	273.37	44.74
27	408.87	281.81	47.63
28	416.96	290.68	50.53
29	424.59	299.95	53.43
30	425.39	301.03	

FAILURE SURFACE # 7 SPECIFIED BY 26 COORDINATE POINTS

SAFETY FACTOR = 1.213

X-CENTER = 257.36
Y-CENTER = 398.53
RADIUS = 187.11

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	159.59	239.00	-29.67
2	170.02	233.06	-25.99
3	180.81	227.80	-22.31
4	191.91	223.25	-18.64
5	203.28	219.41	-14.96
6	214.87	216.31	-11.29
7	226.64	213.96	-7.61
8	238.53	212.37	-3.94
9	250.50	211.55	-.26
10	262.50	211.49	3.41
11	274.48	212.21	7.09
12	286.39	213.69	10.76
13	298.18	215.93	14.44
14	309.80	218.92	18.11
15	321.21	222.65	21.79
16	332.35	227.11	25.46
17	343.18	232.26	29.14

18	353.67	238.11	32.81
19	363.75	244.61	36.49
20	373.40	251.75	40.16
21	382.57	259.49	43.84
22	391.22	267.80	47.51
23	399.33	276.65	51.19
24	406.85	286.00	54.86
25	413.76	295.81	58.54
26	416.40	300.13	

FAILURE SURFACE # 8 SPECIFIED BY 36 COORDINATE POINTS

SAFETY FACTOR = 1.220

X-CENTER = 249.17
Y-CENTER = 465.83
RADIUS = 272.27

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	98.57	239.00	-32.32
2	108.71	232.58	-29.79
3	119.13	226.62	-27.27
4	129.79	221.12	-24.74
5	140.69	216.10	-22.22
6	151.80	211.56	-19.69
7	163.10	207.52	-17.17
8	174.56	203.98	-14.64
9	186.18	200.95	-12.11
10	197.91	198.43	-9.59
11	209.74	196.43	-7.06
12	221.65	194.95	-4.54
13	233.61	194.00	-2.01
14	245.60	193.58	.51
15	257.60	193.69	3.04
16	269.59	194.33	5.56
17	281.53	195.49	8.09
18	293.41	197.18	10.61
19	305.21	199.39	13.14
20	316.89	202.12	15.67
21	328.45	205.36	18.19
22	339.85	209.10	20.72
23	351.07	213.35	23.24
24	362.10	218.08	25.77
25	372.90	223.30	28.29
26	383.47	228.99	30.82
27	393.77	235.14	33.34
28	403.80	241.73	35.87
29	413.52	248.76	38.39
30	422.93	256.22	40.92
31	432.00	264.08	43.45
32	440.71	272.33	45.97
33	449.05	280.96	48.50
34	457.00	289.94	51.02
35	464.55	299.27	53.55
36	469.08	305.40	

FAILURE SURFACE # 9 SPECIFIED BY 33 COORDINATE POINTS

SAFETY FACTOR = 1.221

X-CENTER = 236.75
Y-CENTER = 512.66
RADIUS = 302.45

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)

1	107.96	239.00	-24.07
2	118.92	234.11	-21.79
3	130.06	229.65	-19.52
4	141.37	225.64	-17.25
5	152.83	222.08	-14.97
6	164.42	218.98	-12.70
7	176.13	216.35	-10.43
8	187.93	214.18	-8.15
9	199.81	212.47	-5.88
10	211.75	211.24	-3.60
11	223.72	210.49	-1.33
12	235.72	210.21	.94
13	247.72	210.41	3.22
14	259.70	211.08	5.49
15	271.64	212.23	7.76
16	283.53	213.85	10.04
17	295.35	215.94	12.31
18	307.07	218.50	14.58
19	318.69	221.52	16.86
20	330.17	225.00	19.13
21	341.51	228.93	21.40
22	352.68	233.31	23.68
23	363.67	238.13	25.95
24	374.46	243.38	28.22
25	385.04	249.06	30.50
26	395.38	255.15	32.77
27	405.47	261.64	35.04
28	415.29	268.53	37.32
29	424.83	275.81	39.59
30	434.08	283.45	41.86
31	443.02	291.46	44.14
32	451.63	299.82	46.41
33	455.67	304.06	

FAILURE SURFACE #10 SPECIFIED BY 35 COORDINATE POINTS

SAFETY FACTOR = 1.221

X-CENTER = 234.80
Y-CENTER = 534.54
RADIUS = 325.43

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	98.57	239.00	-23.69
2	109.56	234.18	-21.58
3	120.72	229.77	-19.46
4	132.03	225.77	-17.35
5	143.49	222.19	-15.24
6	155.07	219.03	-13.13
7	166.75	216.31	-11.01
8	178.53	214.02	-8.90
9	190.39	212.16	-6.79
10	202.30	210.74	-4.67
11	214.26	209.77	-2.56
12	226.25	209.23	-.45
13	238.25	209.14	1.67
14	250.25	209.48	3.78
15	262.22	210.28	5.89
16	274.16	211.51	8.00
17	286.04	213.18	10.12
18	297.85	215.29	12.23
19	309.58	217.83	14.34
20	321.21	220.80	16.46
21	332.71	224.20	18.57
22	344.09	228.02	20.68
23	355.32	232.26	22.79

24	366.38	236.91	24.91
25	377.26	241.96	27.02
26	387.95	247.41	29.13
27	398.44	253.26	31.25
28	408.69	259.48	33.36
29	418.72	266.08	35.47
30	428.49	273.04	37.59
31	438.00	280.36	39.70
32	447.23	288.03	41.81
33	456.18	296.03	43.92
34	464.82	304.35	46.04
35	465.49	305.04	

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          Y            A     X     I     S

          93.00    168.00    243.00    318.00    393.00    468.00

X        .00 **-*--***-******-***+---------+---------+---------+
             -                 ...
             -                ....
             -               .....
             -             .......
             -            ........
      75.00 +             ........
             -           ........
             -          .........8
             -         ..........8
             -        .........886
             -       .........8061
A    150.00 +       .........8621
             -      .........80614
             -      .........86147
             -      ........8.61..
             -     .........8.14..
             -     .........8.1...
X    225.00 +     .........861..*
             -    .........8.12....
             -    .........8.12....
             -    .........8.12.....
             -    ..........831......
             -    ..........8.1......
I    300.00 +    ..........8.1......*
             -    ..........812.....*.
             -    ..........8.16....*.
             -    ..........8.316...*..
             -    ...........8.14.......
             -     ...........8.16......*
S    375.00 +     ...........8.311.....*
             -      ...........8.2316....
             -      ............**2216...
             -       .............85211477
             -       ..............8.2.114
             -        ..............882231
     450.00 +         ...............8552
             -         ...............8.5
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     525.00 +               .............
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     600.00 ** *  *** ****** ****       ..*
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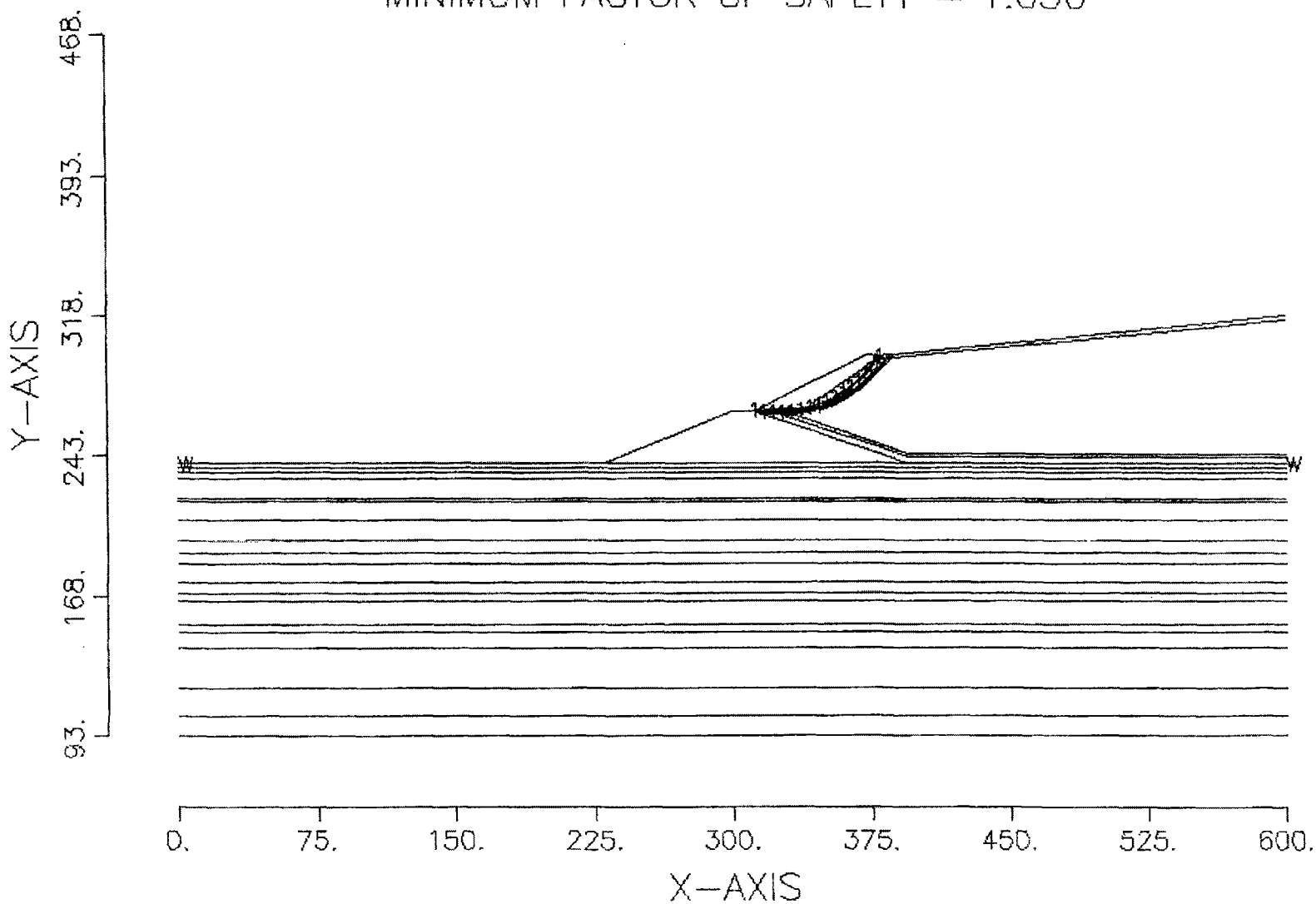
AGEC
Midvale UT s/n5206

CELL 7/LT/STATIC/WASTE +20

2500 SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.636



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 7/LT/STATIC/WASTE +20

BOUNDARY COORDINATES

9 TOP BOUNDARIES
39 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	239.00	230.00	239.00	5
2	230.00	239.00	300.00	267.00	3
3	300.00	267.00	310.50	267.00	3
4	310.50	267.00	312.50	267.00	2
5	312.50	267.00	365.90	293.70	2
6	365.90	293.70	373.10	297.30	1
7	373.10	297.30	375.10	297.30	1
8	375.10	297.30	378.10	296.30	1
9	378.10	296.30	600.00	318.50	1
10	312.50	267.00	319.70	267.00	2
11	319.70	267.00	327.20	264.50	2
12	327.20	264.50	333.60	264.50	1
13	333.60	264.50	378.50	295.00	4
14	378.50	295.00	600.00	316.50	4
15	333.60	264.50	395.30	244.00	1
16	395.30	244.00	600.00	244.00	1
17	327.20	264.50	395.00	242.00	2
18	395.00	242.00	600.00	242.00	2
19	310.50	267.00	394.50	239.00	3
20	230.00	239.00	394.50	239.00	5
21	394.50	239.00	600.00	239.00	5
22	.00	236.00	600.00	236.00	6
23	.00	234.00	600.00	234.00	7
24	.00	230.00	600.00	230.00	8
25	.00	220.00	600.00	220.00	7
26	.00	218.00	600.00	218.00	8
27	.00	208.00	600.00	208.00	7
28	.00	197.00	600.00	197.00	8
29	.00	191.00	600.00	191.00	7
30	.00	185.00	600.00	185.00	8
31	.00	175.00	600.00	175.00	7
32	.00	169.00	600.00	169.00	8
33	.00	165.00	600.00	165.00	7
34	.00	153.00	600.00	153.00	8
35	.00	149.00	600.00	149.00	7
36	.00	140.00	600.00	140.00	8
37	.00	119.00	600.00	119.00	7
38	.00	104.00	600.00	104.00	8
39	.00	93.00	600.00	93.00	7

ISOTROPIC SOIL PARAMETERS

8 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.

1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	34.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	600.00	234.00

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 280.00
AND X = 320.00

EACH SURFACE TERMINATES BETWEEN X = 350.00
AND X = 400.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00

5.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.636

X-CENTER = 323.73
Y-CENTER = 333.03
RADIUS = 67.10

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.84	267.00	-8.07
2	316.79	266.30	-3.80
3	321.78	265.97	.47
4	326.78	266.01	4.74
5	331.76	266.42	9.01
6	336.70	267.20	13.28
7	341.56	268.35	17.55
8	346.33	269.86	21.82
9	350.97	271.72	26.09
10	355.46	273.92	30.36
11	359.78	276.45	34.63
12	363.99	279.29	38.91
13	367.78	282.43	43.18
14	371.43	285.85	47.45
15	374.81	289.53	51.72
16	377.91	293.46	55.99
17	379.95	296.49	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	312.17	.56	3.43	.00	.00	20.07	117.08
2	314.64	4.29	693.17	.00	.00	840.19	987.76
3	318.24	2.91	1176.09	.00	.00	1237.41	884.00
4	320.74	2.08	1161.03	.00	.00	1212.59	737.56
5	322.28	1.00	650.72	.00	.00	647.66	375.51
6	324.78	4.00	3144.74	.00	.00	3131.09	1677.93
7	329.37	4.98	5026.08	.00	.00	4844.33	2399.79
8	334.23	4.94	6003.50	.00	.00	5656.12	2663.64
9	337.37	1.35	1797.42	.00	.00	1664.90	770.65
10	339.81	3.51	4940.91	.00	.00	4707.84	1562.60
11	343.95	4.77	7256.22	.00	.00	6892.44	2270.33
12	348.65	4.64	7476.92	.00	.00	7119.11	2334.94
13	353.22	4.49	7406.85	.00	.00	7105.77	2331.14
14	357.62	4.31	7066.24	.00	.00	6864.24	2262.29
15	361.83	4.11	6484.29	.00	.00	6407.99	2132.23
16	364.90	2.01	3008.70	.00	.00	3039.67	1024.27
17	366.84	1.88	2823.30	.00	.00	2852.54	960.94
18	369.60	3.65	4994.36	.00	.00	5177.15	1781.38
19	372.26	1.67	2030.86	.00	.00	2165.89	768.50
20	373.95	1.71	1784.52	.00	.00	1885.11	691.87
21	374.95	.29	264.37	.00	.00	286.82	110.42
22	376.50	2.81	1736.09	.00	.00	1800.88	790.32
23	378.00	.19	63.21	.00	.00	57.50	37.46
24	378.30	.40	109.49	.00	.00	92.07	69.96
25	378.74	.48	96.37	.00	.00	66.47	71.40
26	379.47	.97	78.13	.00	.00	-11.83	102.24

FAILURE SURFACE # 2 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.643

X-CENTER = 327.96
Y-CENTER = 326.07
RADIUS = 61.45

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.02	267.00	-13.67
2	315.88	265.82	-9.01
3	320.82	265.04	-4.34
4	325.80	264.66	.32

5	330.80	264.68	4.98
6	335.78	265.12	9.64
7	340.71	265.96	14.31
8	345.56	267.19	18.97
9	350.29	268.82	23.63
10	354.87	270.82	28.30
11	359.27	273.19	32.96
12	363.46	275.91	37.62
13	367.43	278.96	42.28
14	371.12	282.33	46.95
15	374.54	285.98	51.61
16	377.64	289.90	56.27
17	380.42	294.06	60.94
18	381.87	296.68	

FAILURE SURFACE # 3 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.643

X-CENTER = 328.45
Y-CENTER = 328.85
RADIUS = 64.04

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.84	267.00	-12.80
2	316.71	265.89	-8.32
3	321.66	265.17	-3.85
4	326.65	264.83	.63
5	331.65	264.89	5.10
6	336.63	265.33	9.58
7	341.56	266.17	14.05
8	346.41	267.38	18.53
9	351.15	268.97	23.00
10	355.75	270.92	27.47
11	360.19	273.23	31.95
12	364.43	275.87	36.42
13	368.45	278.84	40.90
14	372.23	282.12	45.37
15	375.75	285.67	49.85
16	378.97	289.50	54.32
17	381.89	293.56	58.79
18	383.90	296.88	

FAILURE SURFACE # 4 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.645

X-CENTER = 323.39
Y-CENTER = 331.13
RADIUS = 55.31

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.02	267.00	-8.73
2	315.96	266.24	-4.34
3	320.95	265.86	.05
4	325.95	265.87	4.44
5	330.93	266.25	8.82
6	335.87	267.02	13.21
7	340.74	268.16	17.60
8	345.51	269.68	21.99
9	350.14	271.55	26.37
10	354.62	273.77	30.76
11	358.92	276.33	35.15
12	363.01	279.20	39.53

13	366.87	282.39	43.92
14	370.47	285.85	48.31
15	373.79	289.59	52.70
16	376.82	293.57	57.08
17	378.63	296.35	

FAILURE SURFACE # 5 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.645

X-CENTER = 325.98
Y-CENTER = 341.41
RADIUS = 75.52

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	312.65	267.08	-8.27
2	317.60	266.36	-4.48
3	322.59	265.97	-.68
4	327.59	265.91	3.11
5	332.58	266.18	6.91
6	337.54	266.78	10.70
7	342.45	267.71	14.49
8	347.30	268.96	18.29
9	352.04	270.53	22.08
10	356.68	272.41	25.88
11	361.18	274.59	29.67
12	365.52	277.07	33.47
13	369.69	279.82	37.26
14	373.67	282.85	41.05
15	377.44	286.13	44.85
16	380.99	289.66	48.64
17	384.29	293.41	52.44
18	387.21	297.21	

FAILURE SURFACE # 6 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.648

X-CENTER = 324.68
Y-CENTER = 338.50
RADIUS = 72.95

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	310.20	267.00	-9.48
2	315.14	266.18	-5.56
3	320.11	265.69	-1.63
4	325.11	265.55	2.30
5	330.11	265.75	6.23
6	335.08	266.29	10.16
7	340.00	267.17	14.08
8	344.85	268.39	18.01
9	349.60	269.94	21.94
10	354.24	271.80	25.87
11	358.74	273.99	29.79
12	363.08	276.47	33.72
13	367.24	279.25	37.65
14	371.20	282.30	41.58
15	374.94	285.62	45.51
16	378.44	289.19	49.43
17	381.69	292.98	53.36
18	384.65	296.95	

FAILURE SURFACE # 7 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.652

X-CENTER = 325.37
Y-CENTER = 324.88
RADIUS = 59.83

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	310.20	267.00	-12.28
2	315.09	265.94	-7.49
3	320.05	265.28	-2.70
4	325.04	265.05	2.09
5	330.04	265.23	6.88
6	335.00	265.83	11.67
7	339.90	266.84	16.46
8	344.69	268.26	21.25
9	349.35	270.07	26.04
10	353.85	272.26	30.83
11	358.14	274.82	35.62
12	362.21	277.74	40.41
13	366.01	280.98	45.20
14	369.54	284.52	49.99
15	372.75	288.35	54.78
16	375.63	292.44	59.57
17	377.94	296.35	

FAILURE SURFACE # 8 SPECIFIED BY 16 COORDINATE POINTS

SAFETY FACTOR = 1.656

X-CENTER = 326.59
Y-CENTER = 328.55
RADIUS = 61.34

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	315.10	268.30	-8.46
2	320.05	267.57	-3.78
3	325.04	267.24	.89
4	330.04	267.31	5.56
5	335.01	267.80	10.23
6	339.93	268.69	14.90
7	344.76	269.97	19.58
8	349.48	271.65	24.25
9	354.03	273.70	28.92
10	358.41	276.12	33.59
11	362.58	278.89	38.26
12	366.50	281.98	42.94
13	370.16	285.39	47.61
14	373.53	289.08	52.28
15	376.59	293.04	56.95
16	378.76	296.37	

FAILURE SURFACE # 9 SPECIFIED BY 17 COORDINATE POINTS

SAFETY FACTOR = 1.657

X-CENTER = 329.55
Y-CENTER = 321.84
RADIUS = 55.46

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	315.10	268.30	-12.52
2	319.98	267.22	-7.35

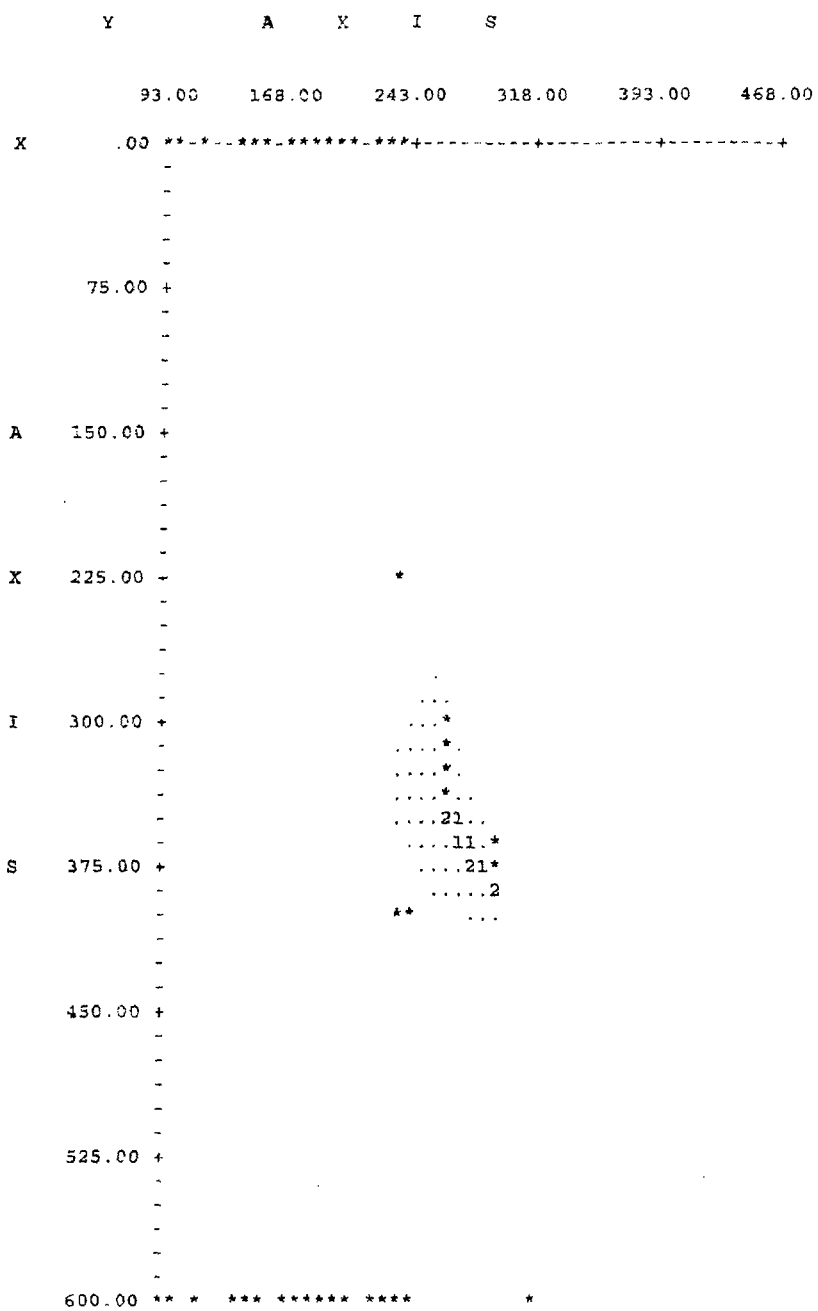
3	324.94	266.58	-2.18
4	329.94	266.39	2.98
5	334.93	266.65	8.15
6	339.88	267.36	13.32
7	344.75	268.51	18.49
8	349.49	270.09	23.65
9	354.07	272.10	28.82
10	358.45	274.51	33.99
11	362.59	277.30	39.16
12	366.47	280.46	44.32
13	370.05	283.96	49.49
14	373.30	287.76	54.66
15	376.19	291.84	59.83
16	378.70	296.16	65.00
17	378.80	296.37	

FAILURE SURFACE #10 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.658

X-CENTER = 330.48
Y-CENTER = 327.33
RADIUS = 62.22

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	313.47	267.48	-13.56
2	318.33	266.31	-8.95
3	323.27	265.53	-4.35
4	328.25	265.15	.26
5	333.25	265.18	4.86
6	338.24	265.60	9.47
7	343.17	266.42	14.07
8	348.02	267.64	18.68
9	352.76	269.24	23.28
10	357.35	271.22	27.89
11	361.77	273.56	32.50
12	365.98	276.24	37.10
13	369.97	279.25	41.71
14	373.70	282.58	46.31
15	377.16	286.20	50.92
16	380.31	290.08	55.52
17	383.14	294.20	60.13
18	384.73	296.96	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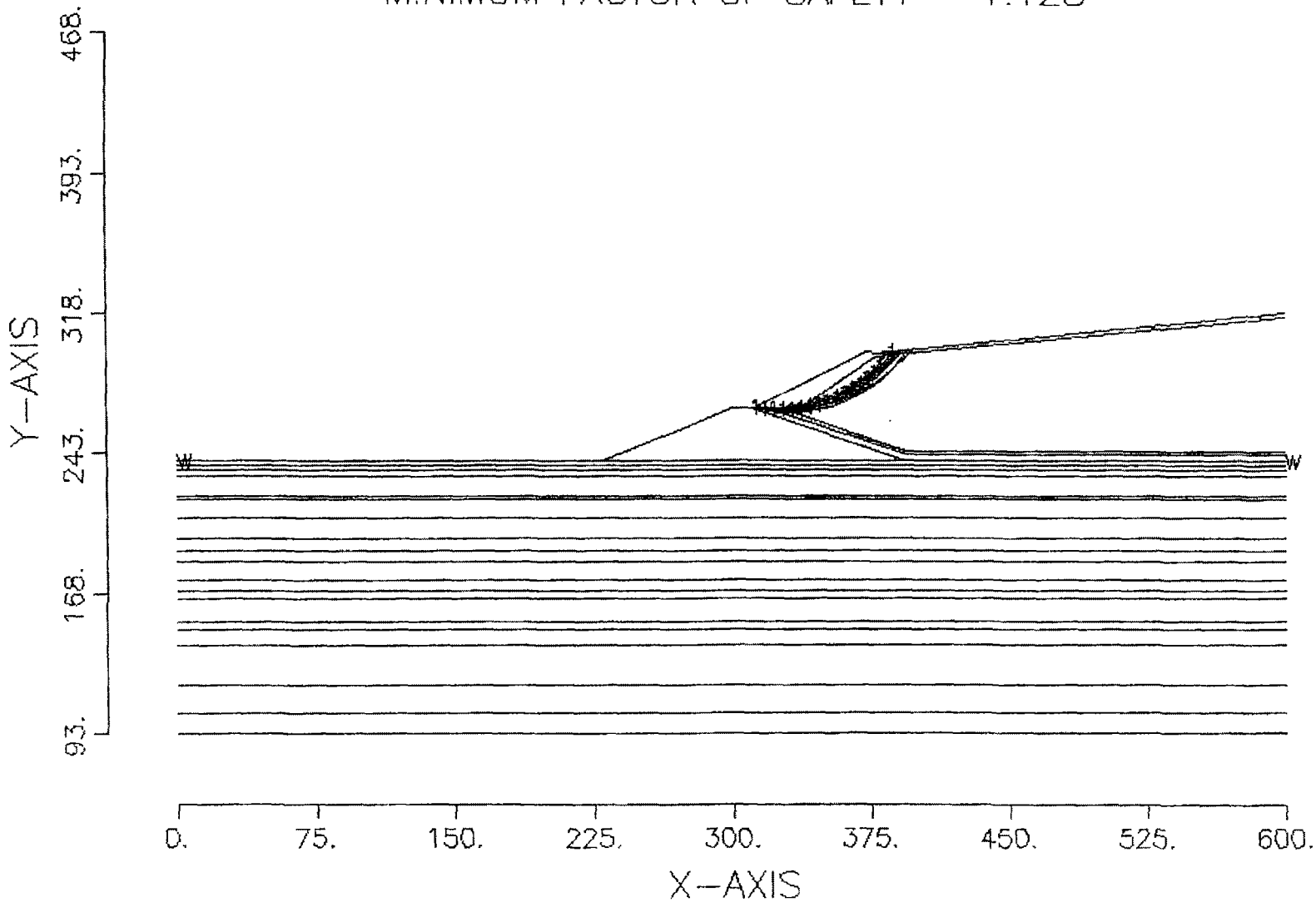
A 150.00
X 225.00
I 300.00
S 375.00
450.00
525.00
600.00

AGEC
Midvale UT s/n5206

CELL 7/LT/SEISMIC/WASTE +20

2500 SURFACES HAVE BEEN GENERATED
10 MOST CRITICAL OF SURFACES GENERATED
MINIMUM FACTOR OF SAFETY = 1.128



--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION CELL 7/LT/SEISMIC/WASTE +20

BOUNDARY COORDINATES

9 TOP BOUNDARIES
39 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	239.00	230.00	239.00	5
2	230.00	239.00	300.00	267.00	3
3	300.00	267.00	310.50	267.00	3
4	310.50	267.00	312.50	267.00	2
5	312.50	267.00	365.90	293.70	2
6	365.90	293.70	373.10	297.30	1
7	373.10	297.30	375.10	297.30	1
8	375.10	297.30	378.10	296.30	1
9	378.10	296.30	600.00	318.50	1
10	312.50	267.00	319.70	267.00	2
11	319.70	267.00	327.20	264.50	2
12	327.20	264.50	333.60	264.50	1
13	333.60	264.50	378.50	295.00	4
14	378.50	295.00	600.00	316.50	4
15	333.60	264.50	395.30	244.00	1
16	395.30	244.00	600.00	244.00	1
17	327.20	264.50	395.00	242.00	2
18	395.00	242.00	600.00	242.00	2
19	310.50	267.00	394.50	239.00	3
20	230.00	239.00	394.50	239.00	5
21	394.50	239.00	600.00	239.00	5
22	.00	236.00	600.00	236.00	6
23	.00	234.00	600.00	234.00	7
24	.00	230.00	600.00	230.00	8
25	.00	220.00	600.00	220.00	7
26	.00	218.00	600.00	218.00	8
27	.00	208.00	600.00	208.00	7
28	.00	197.00	600.00	197.00	8
29	.00	191.00	600.00	191.00	7
30	.00	185.00	600.00	185.00	8
31	.00	175.00	600.00	175.00	7
32	.00	169.00	600.00	169.00	8
33	.00	165.00	600.00	165.00	7
34	.00	153.00	600.00	153.00	8
35	.00	149.00	600.00	149.00	7
36	.00	140.00	600.00	140.00	8
37	.00	119.00	600.00	119.00	7
38	.00	104.00	600.00	104.00	8
39	.00	93.00	600.00	93.00	7

ISOTROPIC SOIL PARAMETERS

8 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.

1	120.0	120.0	100.0	28.0	.00	.0	1
2	110.0	110.0	270.0	28.0	.00	.0	1
3	130.0	130.0	400.0	34.0	.00	.0	1
4	120.0	120.0	100.0	25.0	.00	.0	1
5	130.0	130.0	200.0	30.0	.00	.0	1
6	120.0	120.0	200.0	30.0	.00	.0	1
7	110.0	110.0	200.0	30.0	.00	.0	1
8	110.0	110.0	200.0	27.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	234.00
2	600.00	234.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .180 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

2500 TRIAL SURFACES HAVE BEEN GENERATED.

50 SURFACES INITIATE FROM EACH OF 50 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 280.00
AND X = 320.00

EACH SURFACE TERMINATES BETWEEN X = 350.00
AND X = 400.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00

5.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

SAFETY FACTORS ARE CALCULATED BY THE MODIFIED BISHOP METHOD.

FAILURE SURFACE # 1 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.128

X-CENTER = 325.98
Y-CENTER = 341.41
RADIUS = 75.52

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	312.65	267.08	-8.27
2	317.60	266.36	-4.48
3	322.59	265.97	-.68
4	327.59	265.91	3.11
5	332.58	266.18	6.91
6	337.54	266.78	10.70
7	342.45	267.71	14.49
8	347.30	268.96	18.29
9	352.04	270.53	22.08
10	356.68	272.41	25.88
11	361.18	274.59	29.67
12	365.52	277.07	33.47
13	369.69	279.82	37.26
14	373.67	282.85	41.05
15	377.44	286.13	44.85
16	380.99	289.66	48.64
17	384.29	293.41	52.44
18	387.21	297.21	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	312.92	.53	9.84	.00	.00	30.56	141.81
2	315.39	4.42	859.15	.00	.00	1098.92	1587.71
3	318.65	2.10	877.35	.00	.00	954.71	954.13
4	321.14	2.89	1663.80	.00	.00	1789.14	1536.50
5	322.70	.22	148.50	.00	.00	149.98	123.42
6	325.20	4.78	3896.61	.00	.00	3932.53	2998.33
7	330.08	4.99	5353.10	.00	.00	5163.53	3631.40
8	334.70	4.25	5456.72	.00	.00	5082.14	3421.52
9	337.19	.71	987.58	.00	.00	940.03	452.19
10	340.00	4.91	7376.91	.00	.00	6885.70	3290.35
11	344.88	4.84	8094.19	.00	.00	7449.42	3523.43
12	349.67	4.75	8540.99	.00	.00	7785.01	3662.19
13	354.36	4.63	8719.59	.00	.00	7904.13	3711.44
14	358.93	4.50	8639.24	.00	.00	7818.79	3676.15
15	363.35	4.34	8316.04	.00	.00	7541.83	3561.64
16	365.71	.38	721.75	.00	.00	658.47	312.71
17	367.80	3.79	7312.77	.00	.00	6675.27	3162.90
18	371.40	3.41	6270.89	.00	.00	5774.02	2767.20
19	373.39	.57	1003.28	.00	.00	922.20	444.81
20	374.39	1.43	2372.52	.00	.00	2205.52	1080.04
21	376.27	2.34	3312.71	.00	.00	3053.64	1537.79
22	377.77	.66	787.14	.00	.00	728.56	383.71
23	378.30	.40	447.86	.00	.00	412.35	220.52
24	379.74	2.49	2397.99	.00	.00	2177.52	1211.18
25	382.64	3.30	2068.28	.00	.00	1787.14	1182.26
26	385.18	1.79	521.58	.00	.00	336.80	398.96
27	386.64	1.14	92.82	.00	.00	-38.71	146.88

FAILURE SURFACE # 2 SPECIFIED BY 19 COORDINATE POINTS

SAFETY FACTOR = 1.132

X-CENTER = 325.41
Y-CENTER = 349.26
RADIUS = 82.64

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	313.47	267.48	-6.57
2	318.44	266.91	-3.11
3	323.43	266.64	.36
4	328.43	266.67	3.83
5	333.42	267.01	7.29
6	338.38	267.64	10.76
7	343.29	268.57	14.23
8	348.14	269.80	17.69
9	352.90	271.32	21.16
10	357.56	273.13	24.63
11	362.11	275.21	28.10
12	366.52	277.57	31.56
13	370.78	280.18	35.03
14	374.87	283.05	38.50
15	378.79	286.17	41.96
16	382.50	289.51	45.43
17	386.01	293.07	48.90
18	389.30	296.84	52.37
19	389.79	297.47	

FAILURE SURFACE # 3 SPECIFIED BY 19 COORDINATE POINTS

SAFETY FACTOR = 1.134

X-CENTER = 328.44
Y-CENTER = 343.51
RADIUS = 78.05

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	312.65	267.08	-9.83
2	317.58	266.22	-6.16
3	322.55	265.69	-2.49
4	327.55	265.47	1.18
5	332.54	265.57	4.85
6	337.53	265.99	8.52
7	342.47	266.73	12.19
8	347.36	267.79	15.86
9	352.17	269.16	19.53
10	356.88	270.83	23.21
11	361.48	272.80	26.88
12	365.94	275.06	30.55
13	370.24	277.60	34.22
14	374.38	280.41	37.89
15	378.32	283.48	41.56
16	382.06	286.80	45.23
17	385.59	290.35	48.90
18	388.87	294.12	52.57
19	391.57	297.65	

FAILURE SURFACE # 4 SPECIFIED BY 19 COORDINATE POINTS

SAFETY FACTOR = 1.134

X-CENTER = 328.72
Y-CENTER = 341.27
RADIUS = 75.91

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	312.65	267.08	-10.33
2	317.57	266.18	-6.56
3	322.54	265.61	-2.79
4	327.53	265.37	.99
5	332.53	265.45	4.76
6	337.52	265.87	8.54
7	342.46	266.61	12.31
8	347.34	267.68	16.09
9	352.15	269.06	19.86
10	356.85	270.76	23.64
11	361.43	272.76	27.41
12	365.87	275.07	31.18
13	370.15	277.65	34.96
14	374.25	280.52	38.73
15	378.15	283.65	42.51
16	381.83	287.03	46.28
17	385.29	290.64	50.06
18	388.50	294.47	53.83
19	390.76	297.57	

FAILURE SURFACE # 5 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.136

X-CENTER = 319.99
Y-CENTER = 359.16
RADIUS = 92.38

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	312.65	267.08	-3.00
2	317.65	266.81	.10
3	322.65	266.82	3.20
4	327.64	267.10	6.30
5	332.61	267.65	9.40
6	337.54	268.47	12.50
7	342.42	269.55	15.61
8	347.24	270.90	18.71
9	351.97	272.50	21.81
10	356.62	274.36	24.91
11	361.15	276.46	28.01
12	365.57	278.81	31.11
13	369.85	281.39	34.21
14	373.98	284.21	37.32
15	377.96	287.24	40.42
16	381.76	290.48	43.52
17	385.39	293.92	46.62
18	388.63	297.35	

FAILURE SURFACE # 6 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.140

X-CENTER = 324.68
Y-CENTER = 338.50
RADIUS = 72.95

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	310.20	267.00	-9.48
2	315.14	266.18	-5.56
3	320.11	265.69	-1.63
4	325.11	265.55	2.30

5	330.11	265.75	6.23
6	335.08	266.29	10.16
7	340.00	267.17	14.08
8	344.85	268.39	18.01
9	349.60	269.94	21.94
10	354.24	271.80	25.87
11	358.74	273.99	29.79
12	363.08	276.47	33.72
13	367.24	279.25	37.65
14	371.20	282.30	41.58
15	374.94	285.62	45.51
16	378.44	289.19	49.43
17	381.69	292.98	53.36
18	384.65	296.95	

FAILURE SURFACE # 7 SPECIFIED BY 19 COORDINATE POINTS

SAFETY FACTOR = 1.140

X-CENTER = 329.75
Y-CENTER = 337.06
RADIUS = 71.46

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	313.47	267.48	-11.17
2	318.37	266.52	-7.16
3	323.34	265.89	-3.15
4	328.33	265.62	.86
5	333.33	265.69	4.87
6	338.31	266.12	8.88
7	343.25	266.89	12.89
8	348.12	268.01	16.90
9	352.91	269.46	20.91
10	357.58	271.25	24.92
11	362.11	273.35	28.93
12	366.49	275.77	32.94
13	370.68	278.49	36.95
14	374.68	281.50	40.96
15	378.46	284.77	44.97
16	381.99	288.31	48.98
17	385.27	292.08	52.99
18	388.28	296.07	57.00
19	389.15	297.41	

FAILURE SURFACE # 8 SPECIFIED BY 21 COORDINATE POINTS

SAFETY FACTOR = 1.141

X-CENTER = 331.63
Y-CENTER = 341.67
RADIUS = 77.46

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.02	267.00	-13.58
2	315.88	265.83	-9.89
3	320.81	264.97	-6.19
4	325.78	264.43	-2.49
5	330.77	264.21	1.21
6	335.77	264.32	4.91
7	340.75	264.75	8.61
8	345.70	265.49	12.31
9	350.58	266.56	16.01
10	355.39	267.94	19.71
11	360.09	269.63	23.41

12	364.68	271.61	37.11
13	369.13	273.89	30.81
14	373.43	276.45	34.51
15	377.55	279.28	38.21
16	381.48	282.38	41.91
17	385.20	285.72	45.60
18	388.70	289.29	49.30
19	391.96	293.08	53.00
20	394.97	297.07	56.70
21	395.61	298.05	

FAILURE SURFACE # 9 SPECIFIED BY 18 COORDINATE POINTS

SAFETY FACTOR = 1.141

X-CENTER = 328.45
Y-CENTER = 328.85
RADIUS = 64.04

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.84	267.00	-12.80
2	316.71	265.89	-8.32
3	321.66	265.17	-3.85
4	326.65	264.83	.63
5	331.65	264.89	5.10
6	336.63	265.33	9.58
7	341.56	266.17	14.05
8	346.41	267.38	18.53
9	351.15	268.97	23.00
10	355.75	270.92	27.47
11	360.19	273.23	31.95
12	364.43	275.87	36.42
13	368.45	278.84	40.90
14	372.23	282.12	45.37
15	375.75	285.67	49.85
16	378.97	289.50	54.32
17	381.89	293.56	58.79
18	383.90	296.88	

FAILURE SURFACE #10 SPECIFIED BY 21 COORDINATE POINTS

SAFETY FACTOR = 1.142

X-CENTER = 328.40
Y-CENTER = 354.55
RADIUS = 89.10

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.84	267.00	-9.11
2	316.77	266.21	-5.89
3	321.75	265.70	-2.68
4	326.74	265.46	.54
5	331.74	265.51	3.75
6	336.73	265.84	6.97
7	341.69	266.44	10.18
8	346.62	267.33	13.40
9	351.48	268.49	16.62
10	356.27	269.92	19.83
11	360.97	271.61	23.05
12	365.57	273.57	26.26
13	370.06	275.78	29.48
14	374.41	278.24	32.69
15	378.62	280.94	35.91
16	382.67	283.87	39.12

17	386.55	287.03	42.34
18	390.24	290.40	45.55
19	393.75	293.97	48.77
20	397.04	297.73	51.98
21	397.44	298.23	

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          Y            A     X     I     S

          93.00    168.00    243.00    318.00    393.00    468.00

X        .00 **-*--***-******-***+---------+---------+---------+
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      75.00 +
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I    300.00 +                   ...*
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Appendix C

Interface Stability Calculations

AGEC
Applied GeoTech

PROJECT NO. 1090175 TITLE Cell 6 & 7 DATE 3/10/10 BY [illegible]

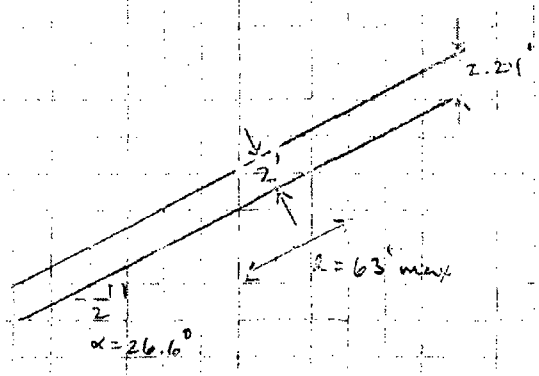
SUBJECT Interface Stability – Closure Cap SHEET 1 OF 3

① 2H:1V Slope – Edge of closure cap/[illegible] mound

- 60 mil Textured HDPE with compacted clay on both sides
- 2 feet of compacted clay above membrane
- membrane is placed on 2H:1V slope

- Silty Clay vs. textured HDPE $\phi = 41.5°$ (Bhatia & Kasturi, Syracuse Univ)
- For clay placed in contact with textured HDPE, the strength of the clay is expected to control. (Jones and Dixon, 1998)

For compacted clay: $c = 270$ psf
$\phi = 28°$
$\gamma = 120$ pcf



$W = (63)(2)(120) = 15{,}120$ lb/ft

$W \cos\alpha = 13{,}520$ lb/ft

$W \cos\alpha \tan\phi = 7{,}189$ lb/ft

$(cL\phi) = (270)(63) = 17{,}010$ lb/ft

$W \sin\alpha = 6770$ lb/ft

Seismic $K_h W = (0.49)(15{,}120) = 7408$ lb/ft

AGEC

Applied GeoTech

PROJECT NO. 1090175 TITLE Cell 6 & 7 DATE 3/10/10 BY [illegible]

SUBJECT Interface Stability – Closure Cap SHEET 2 OF 3

Static condition

Driving Forces = 6770 lb/ft

Resisting Forces = 7189 + 17,010 24,199 lb/ft

$FS = \frac{24,199}{6770} = 3.6$ OK

If only friction considered

$FS = \frac{\tan 41.6^\circ}{\tan 26.6^\circ} = 1.8$ OK

Seismic Condition

Driving Forces = 6770 + 2722 = 9492

Resisting Forces = 7189 + 17,010 = 24,199 lb/ft

$FS = \frac{24,199}{9492} = 2.5$ OK

If only friction considered

$FS = \frac{\cos 26.6^\circ}{\sin 26.6^\circ + 0.29 \times \cos 26.6^\circ} \tan 41.6^\circ = 1.3$ OK

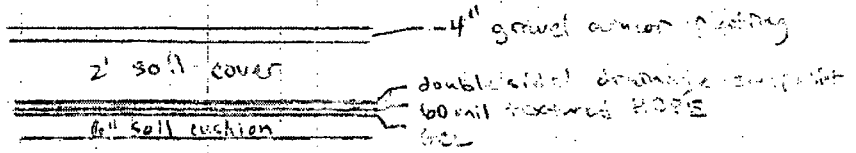
AGEC

Applied GeoTech

PROJECT NO. 109075 TITLE Cell 6 & 7 DATE 3/10/10 BY JFH

SUBJECT Interface Stability -- Closure Cap SHEET 3 OF 3

(2) 10% slope (top of closure cap) = 5.7°



critical surface is textured HDPE vs. geotextile fabric based on previous testing by AGEC, $\phi = 26.9°$ (wet condition)

Static Condition

$$FS = \frac{\tan 26.9}{\tan 5.7°} = 5.1 \quad \text{OK}$$

Seismic Conditions

$$FS = \left[\frac{\cos 5.7°}{\sin 5.7° + 0.18 \cos 5.7°}\right] \tan 26.9° = 1.8 \quad \text{OK}$$

Appendix D

Settlement Calculations

Cell 6 Orig. Design 7/24/

JOB NUMBER: 1090175

Constant Maximum Past Pressure: 0 psf
Length(X): .000 ft X-Coord = .000 ft Load: 0 psf
Width (Y): .000 ft Y-Coord = .000 ft Water Depth: 7 ft
Load Depth 0 ft Replacement Fill Depth 0 ft

Load No.	Adjacent Load (psf)	Length(X) (ft)	Width(Y) (ft)	Depth (ft)	Coordinate X(ft)	Coordinate Y(ft)
1	1080	710.0	1500.0	.0	.0	.0
2	960	665.0	1500.0	.0	.0	.0
3	960	625.0	1500.0	.0	.0	.0
4	600	590.0	1500.0	.0	.0	.0
5	600	550.0	1500.0	.0	.0	.0
6	300	525.0	1500.0	.0	.0	.0
7	420	460.0	1500.0	.0	.0	.0
8	480	320.0	1500.0	.0	.0	.0
9	480	160.0	1500.0	.0	.0	.0

SOIL LAYER	SOIL TYPE	LAYER THICK (FT)	LAYER DEPTH (FT)	SOIL DENSITY (PSF)	COMP RATIO	RECOMP RATIO	SETTLEMENT VIRGIN (IN)	SETTLEMENT RECOMP (IN)
1	4	4	120.0	.1500	.1500	10.823	.000
2	2	6	110.0	.2000	.2000	5.001	.000
3	2	8	110.0	.2500	.2500	5.549	.000
4	2	10	110.0	.3000	.3000	6.300	.000
5	2	12	110.0	.3500	.3500	7.035	.000
6	1	13	110.0	.3000	.3000	2.923	.000
7	8	21	110.0	.1000	.1000	7.175	.000
8	7	28	110.0	.0300	.0300	1.666	.000
9	6	34	110.0	.0500	.0500	2.170	.000
10	4	38	110.0	.0050	.0050	.136	.000
11	4	42	110.0	.0200	.0200	.517	.000
12	3	45	110.0	.0800	.0800	1.491	.000
13	2	47	110.0	.0100	.0100	.121	.000
14	8	55	110.0	.0400	.0400	1.837	.000
15	10	65	110.0	.0900	.0900	4.734	.000
16	10	75	110.0	.0400	.0400	1.924	.000
17	6	81	110.0	.0010	.0010	.027	.000
18	4	85	110.0	.0300	.0300	.519	.000
19	465	550	110.0	.0150	.0150	11.073	.000

TOTAL SETTLEMENT= 71.022 inches

Cell 6 20' mound 3 to 2 slope

JOB NUMBER: 1090175

Constant Maximum Past Pressure: 0 psf
Length(X): .000 ft X-Coord = .000 ft Load: 0 psf
Width (Y): .000 ft Y-Coord = .000 ft Water Depth: 7 ft
Load Depth 0 ft Replacement Fill Depth 0 ft

Load No.	Adjacent Load (psf)	Length(X) (ft)	Width(Y) (ft)	Depth (ft)	Coordinate X(ft)	Y(ft)
1	1080	710.0	1500.0	.0	.0	.0
2	960	665.0	1500.0	.0	.0	.0
3	960	625.0	1500.0	.0	.0	.0
4	600	590.0	1500.0	.0	.0	.0
5	600	550.0	1500.0	.0	.0	.0
6	300	525.0	1500.0	.0	.0	.0
7	900	515.0	1500.0	.0	.0	.0
8	960	485.0	1500.0	.0	.0	.0
9	540	460.0	1500.0	.0	.0	.0
10	420	365.0	1500.0	.0	.0	.0
11	480	215.0	1500.0	.0	.0	.0
12	420	80.0	1500.0	.0	.0	.0

SOIL LAYER	SOIL TYPE	LAYER THICK (FT)	LAYER DEPTH (FT)	SOIL DENSITY (PSF)	COMP RATIO	RECOMP RATIO	SETTLEMENT VIRGIN (IN)	SETTLEMENT RECOMP (IN)
1	4	4		120.0	.1500	.1500	11.836	.000
2	2	6		110.0	.2000	.2000	5.645	.000
3	2	8		110.0	.2500	.2500	6.332	.000
4	2	10		110.0	.3000	.3000	7.226	.000
5	2	12		110.0	.3500	.3500	8.102	.000
6	1	13		110.0	.3000	.3000	3.376	.000
7	8	21		110.0	.1000	.1000	8.349	.000
8	7	28		110.0	.0300	.0300	1.960	.000
9	6	34		110.0	.0500	.0500	2.573	.000
10	4	38		110.0	.0050	.0050	.162	.000
11	4	42		110.0	.0200	.0200	.619	.000
12	3	45		110.0	.0800	.0800	1.790	.000
13	2	47		110.0	.0100	.0100	.145	.000
14	8	55		110.0	.0400	.0400	2.218	.000
15	10	65		110.0	.0900	.0900	5.753	.000
16	10	75		110.0	.0400	.0400	2.354	.000
17	6	81		110.0	.0010	.0010	.033	.000
18	4	85		110.0	.0300	.0300	.640	.000
19	465	550		110.0	.0150	.0150	14.202	.000

TOTAL SETTLEMENT= 83.315 inches

Cell 6 20' mound 10% Slope

JOB NUMBER: 1090175

Constant Maximum Past Pressure: 0 psf
Length(X): .000 ft X-Coord = .000 ft Load: 0 psf
Width (Y): .000 ft Y-Coord = .000 ft Water Depth: 7 ft
Load Depth 0 ft Replacement Fill Depth 0 ft

Load No.	Adjacent Load (psf)	Length(X) (ft)	Width(Y) (ft)	Depth (ft)	Coordinate X(ft)	Coordinate Y(ft)
1	1080	710.0	1500.0	.0	.0	.0
2	960	665.0	1500.0	.0	.0	.0
3	960	625.0	1500.0	.0	.0	.0
4	600	590.0	1500.0	.0	.0	.0
5	600	550.0	1500.0	.0	.0	.0
6	300	525.0	1500.0	.0	.0	.0
7	900	515.0	1500.0	.0	.0	.0
8	960	485.0	1500.0	.0	.0	.0
9	540	460.0	1500.0	.0	.0	.0
10	420	410.0	1500.0	.0	.0	.0
11	480	330.0	1500.0	.0	.0	.0
12	480	250.0	1500.0	.0	.0	.0
13	480	180.0	1500.0	.0	.0	.0
14	480	100.0	1500.0	.0	.0	.0
15	360	30.0	1500.0	.0	.0	.0

SOIL LAYER	SOIL TYPE	LAYER THICK (FT)	LAYER DEPTH (FT)	SOIL DENSITY (PSF)	COMP RATIO	RECOMP RATIO	SETTLEMENT VIRGIN (IN)	SETTLEMENT RECOMP (IN)
1	4	4	120.0	.1500	.1500	12.308	.000
2	2	6	110.0	.2000	.2000	5.947	.000
3	2	8	110.0	.2500	.2500	6.700	.000
4	2	10	110.0	.3000	.3000	7.659	.000
5	2	12	110.0	.3500	.3500	8.599	.000
6	1	13	110.0	.3000	.3000	3.586	.000
7	8	21	110.0	.1000	.1000	8.885	.000
8	7	28	110.0	.0300	.0300	2.091	.000
9	6	34	110.0	.0500	.0500	2.751	.000
10	4	38	110.0	.0050	.0050	.173	.000
11	4	42	110.0	.0200	.0200	.663	.000
12	3	45	110.0	.0800	.0800	1.920	.000
13	2	47	110.0	.0100	.0100	.156	.000
14	8	55	110.0	.0400	.0400	2.383	.000
15	10	65	110.0	.0900	.0900	6.192	.000
16	10	75	110.0	.0400	.0400	2.537	.000
17	6	81	110.0	.0010	.0010	.036	.000
18	4	85	110.0	.0300	.0300	.691	.000
19	465	550	110.0	.0150	.0150	15.311	.000

TOTAL SETTLEMENT= 88.592 inches

M 7 orig. design

JOB NUMBER: 1090175

Constant Maximum Past Pressure: 0 psf
Length(X): .000 ft X-Coord = .000 ft Load: 0 psf
Width (Y): .000 ft Y-Coord = .000 ft Water Depth: 7 ft
Load Depth 0 ft Replacement Fill Depth 0 ft

Load No.	Adjacent Load (psf)	Length(X) (ft)	Width(Y) (ft)	Depth (ft)	Coordinate X(ft)	Y(ft)
1	960	985.0	600.0	.0	.0	.0
2	960	945.0	600.0	.0	.0	.0
3	960	905.0	600.0	.0	.0	.0
4	360	880.0	600.0	.0	.0	.0
5	1080	825.0	600.0	.0	.0	.0
6	480	720.0	600.0	.0	.0	.0
7	480	560.0	600.0	.0	.0	.0
8	480	400.0	600.0	.0	.0	.0
9	480	240.0	600.0	.0	.0	.0
10	480	80.0	600.0	.0	.0	.0

SOIL LAYER	SOIL TYPE	LAYER THICK (FT)	DEPTH (FT)	SOIL DENSITY (PSF)	COMP RATIO	RECOMP RATIO	SETTLEMENT VIRGIN (IN)	RECOMP (IN)
1	4	4	120.0	.1500	.1500	11.225	.000
2	2	6	110.0	.2000	.2000	5.256	.000
3	2	8	110.0	.2500	.2500	5.858	.000
4	2	10	110.0	.3000	.3000	6.664	.000
5	2	12	110.0	.3500	.3500	7.454	.000
6	1	13	110.0	.3000	.3000	3.100	.000
7	8	21	110.0	.1000	.1000	7.631	.000
8	7	28	110.0	.0300	.0300	1.778	.000
9	6	34	110.0	.0500	.0500	2.322	.000
10	4	38	110.0	.0050	.0050	.145	.000
11	4	42	110.0	.0200	.0200	.554	.000
12	3	45	110.0	.0800	.0800	1.599	.000
13	2	47	110.0	.0100	.0100	.130	.000
14	8	55	110.0	.0400	.0400	1.971	.000
15	10	65	110.0	.0900	.0900	5.084	.000
16	10	75	110.0	.0400	.0400	2.068	.000
17	6	81	110.0	.0010	.0010	.029	.000
18	4	85	110.0	.0300	.0300	.558	.000
19	465	550	110.0	.0150	.0150	11.502	.000

TOTAL SETTLEMENT= 74.929 inches

ell 7 20' mound 5% slope

JOB NUMBER: 1090175

Constant Maximum Past Pressure: 0 psf
Length(X): .000 ft X-Coord = .000 ft Load: 0 psf
Width (Y): .000 ft Y-Coord = .000 ft Water Depth: 7 ft
Load Depth 0 ft Replacement Fill Depth 0 ft

Load No.	Adjacent Load (psf)	Length(X) (ft)	Width(Y) (ft)	Depth (ft)	Coordinate X(ft)	Coordinate Y(ft)
1	960	985.0	600.0	.0	.0	.0
2	960	945.0	600.0	.0	.0	.0
3	960	905.0	600.0	.0	.0	.0
4	360	880.0	600.0	.0	.0	.0
5	1080	825.0	600.0	.0	.0	.0
6	960	790.0	600.0	.0	.0	.0
7	960	760.0	600.0	.0	.0	.0
8	480	740.0	600.0	.0	.0	.0
9	480	640.0	600.0	.0	.0	.0
10	480	480.0	600.0	.0	.0	.0
11	480	320.0	600.0	.0	.0	.0
12	480	160.0	600.0	.0	.0	.0
13	240	40.0	600.0	.0	.0	.0

SOIL LAYER	SOIL TYPE	LAYER THICK (FT)	LAYER DEPTH (FT)	SOIL DENSITY (PSF)	COMP RATIO	RECOMP RATIO	SETTLEMENT VIRGIN (IN)	SETTLEMENT RECOMP (IN)
1	4	4	120.0	.1500	.1500	12.071	.000
2	2	6	110.0	.2000	.2000	5.795	.000
3	2	8	110.0	.2500	.2500	6.516	.000
4	2	10	110.0	.3000	.3000	7.442	.000
5	2	12	110.0	.3500	.3500	8.351	.000
6	1	13	110.0	.3000	.3000	3.481	.000
7	8	21	110.0	.1000	.1000	8.620	.000
8	7	28	110.0	.0300	.0300	2.027	.000
9	6	34	110.0	.0500	.0500	2.666	.000
10	4	38	110.0	.0050	.0050	.168	.000
11	4	42	110.0	.0200	.0200	.643	.000
12	3	45	110.0	.0800	.0800	1.860	.000
13	2	47	110.0	.0100	.0100	.151	.000
14	8	55	110.0	.0400	.0400	2.309	.000
15	10	65	110.0	.0900	.0900	6.002	.000
16	10	75	110.0	.0400	.0400	2.461	.000
17	6	81	110.0	.0010	.0010	.035	.000
18	4	85	110.0	.0300	.0300	.671	.000
19	465	550	110.0	.0150	.0150	14.594	.000

TOTAL SETTLEMENT= 85.863 inches

cell 7 20' mound 10% slope

JOB NUMBER: 1090175

Constant Maximum Past Pressure: 0 psf
Length(X): .000 ft X-Coord = .000 ft Load: 0 psf
Width (Y): .000 ft Y-Coord = .000 ft Water Depth: 7 ft
Load Depth 0 ft Replacement Fill Depth 0 ft

Load No.	Adjacent Load (psf)	Length(X) (ft)	Width(Y) (ft)	Depth (ft)	Coordinate X(ft)	Coordinate Y(ft)
1	960	985.0	600.0	.0	.0	.0
2	960	945.0	600.0	.0	.0	.0
3	960	905.0	600.0	.0	.0	.0
4	360	880.0	600.0	.0	.0	.0
5	1080	825.0	600.0	.0	.0	.0
6	960	790.0	600.0	.0	.0	.0
7	960	760.0	600.0	.0	.0	.0
8	480	740.0	600.0	.0	.0	.0
9	480	640.0	600.0	.0	.0	.0
10	480	610.0	600.0	.0	.0	.0
11	480	520.0	600.0	.0	.0	.0
12	480	455.0	600.0	.0	.0	.0
13	480	360.0	600.0	.0	.0	.0
14	480	290.0	600.0	.0	.0	.0
15	480	220.0	600.0	.0	.0	.0
16	480	145.0	600.0	.0	.0	.0
17	480	50.0	600.0	.0	.0	.0

SOIL LAYER	SOIL TYPE	LAYER THICK (FT)	LAYER DEPTH (FT)	SOIL DENSITY (PSF)	COMP RATIO	RECOMP RATIO	SETTLEMENT VIRGIN (IN)	SETTLEMENT RECOMP (IN)
1	4	4	120.0	.1500	.1500	12.736	.000
2	2	6	110.0	.2000	.2000	6.223	.000
3	2	8	110.0	.2500	.2500	7.041	.000
4	2	10	110.0	.3000	.3000	8.066	.000
5	2	12	110.0	.3500	.3500	9.072	.000
6	1	13	110.0	.3000	.3000	3.788	.000
7	8	21	110.0	.1000	.1000	9.423	.000
8	7	28	110.0	.0300	.0300	2.230	.000
9	6	34	110.0	.0500	.0500	2.946	.000
10	4	38	110.0	.0050	.0050	.186	.000
11	4	42	110.0	.0200	.0200	.714	.000
12	3	45	110.0	.0800	.0800	2.070	.000
13	2	47	110.0	.0100	.0100	.169	.000
14	8	55	110.0	.0400	.0400	2.579	.000
15	10	65	110.0	.0900	.0900	6.727	.000
16	10	75	110.0	.0400	.0400	2.768	.000
17	6	81	110.0	.0010	.0010	.039	.000
18	4	85	110.0	.0300	.0300	.757	.000
19	465	550	110.0	.0150	.0150	16.648	.000

TOTAL SETTLEMENT= 94.183 inches

EXHIBIT C

ENGINEERING CALCULATIONS

HYDROLOGY, HYDRAULICS AND EROSION CONTROL

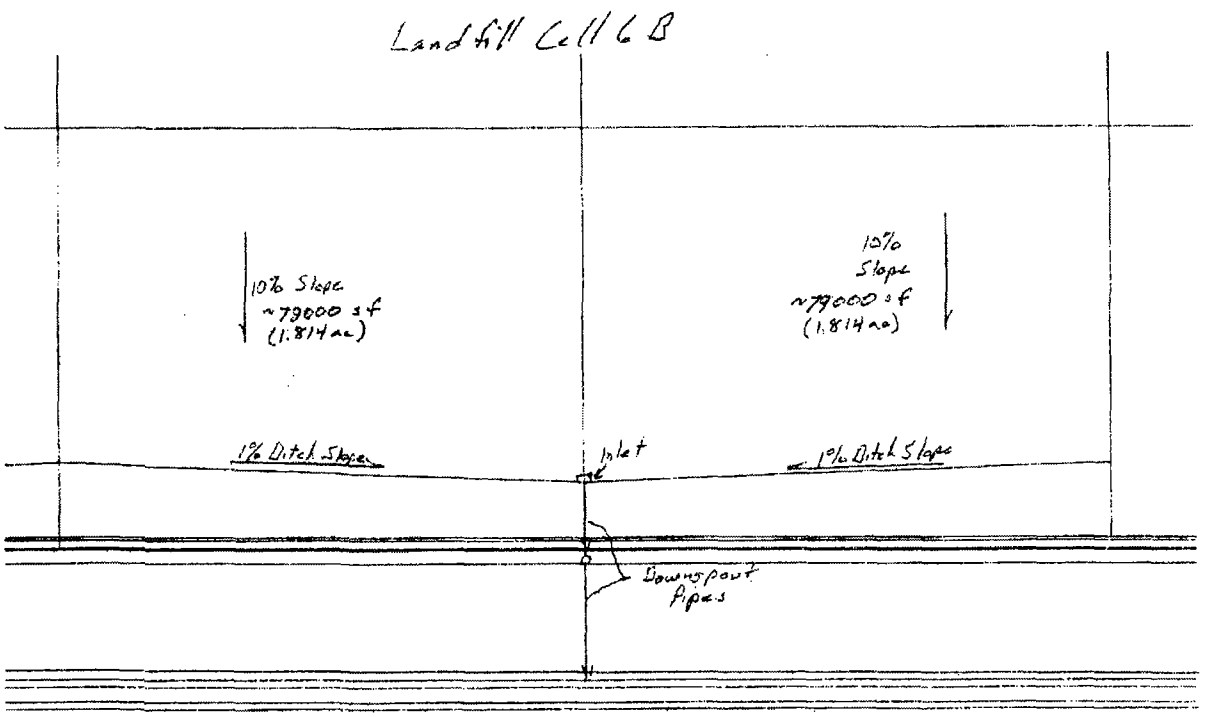
LEACHATE WITHDRAWAL PIPES

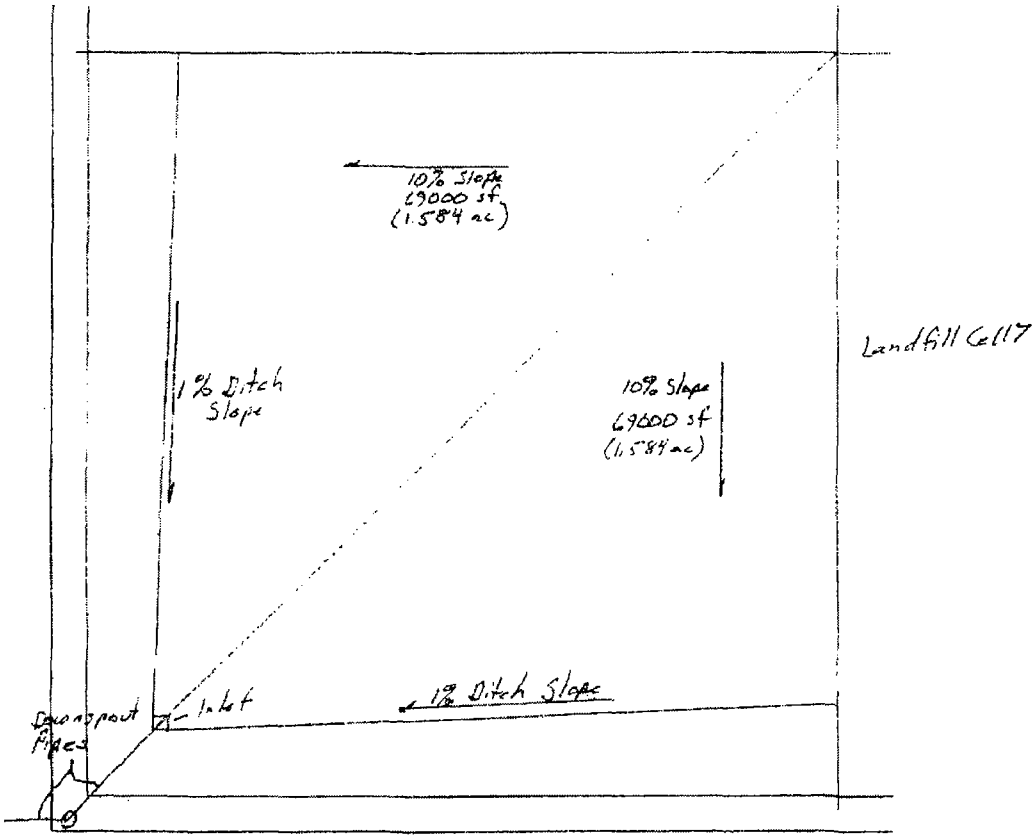
1. Determine hydrology in estimating runoff discharge, perimeter ditch capacity and depth, down spout design, and erosion control design for Cells 6B and 7 Closures assuming a maximum perimeter berm height above the cell embankments of 28 feet on Cell 6B and 29 feet on Cell 7, respectively.

2. Hydrology using the SCS Curve Number Methodology

   a. Landfill Cell 6B closure cap consists of individual drainage areas contributing runoff to the perimeter ditches of approximately 79,000 square feet (1.814 acres) and a total drainage area contributing runoff to a downspout of approximately 158,000 square feet (3.627 acres). The following is a sketch of the Cell 6B closure drainage areas.

   b. Landfill Cell 7 closure cap consists of individual drainage areas contributing runoff to the perimeter ditches of approximately 69,000 square feet (1.584 acres) and a total drainage area contributing runoff to a downspout of approximately 138,000 square feet (3.168 acres). The following is a sketch of the Cell 7 closure drainage areas.

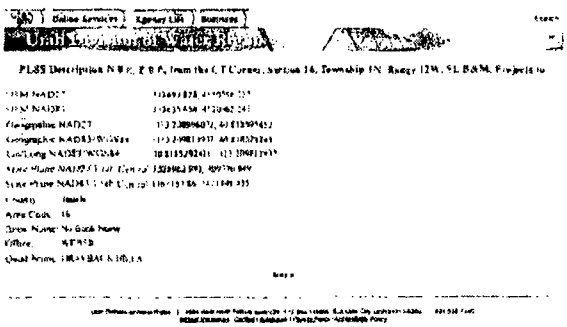




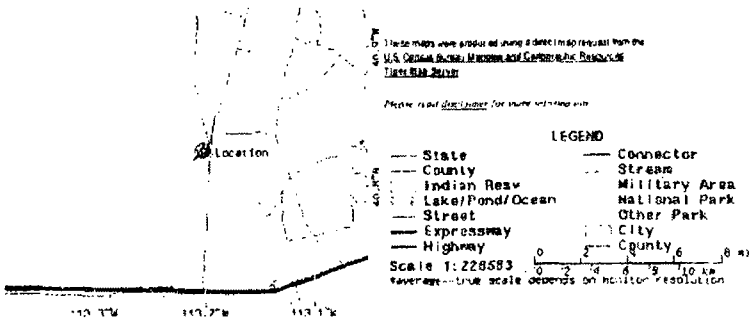
c. Use 79,000 square feet (1.814 acres) of drainage area for design of the perimeter drainage ditches and 158,000 square feet (3.627 acres) of drainage area for design of the downspout piping. Results will be applied to both landfill cell closure caps.

d. Design for the 100-year 24-hour precipitation event. The precipitation from the 100-year 24-hour precipitation event was obtained from Point Precipitation Frequency Estimates from NOAA Atlas 14. The following pages show facility latitude/longitude conversions, facility location, and precipitation depths.

Calculate Locations



Precipitation Frequency Data Server http://hdsc.nws.noaa.gov/cgi-bin/hdsc/buildout.perl?type=pf&units=



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; USGS Aerial Photograph may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera
tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to NOAA Atlas 14 Document

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within
+/-30 minutes ...OR... +/-1 degree of this location (40.8185/-113.2098). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the
Western Regional Climate Center's state-specific SNOTEL station maps

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Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions? HDSC.Questions@noaa.gov

Disclaimer

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 40.8185 N 113.2098 W 4268 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Dec 16 2009

Confidence Limits Seasonality Location Maps Other Info. GIS data Maps Docs Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.09	0.14	0.18	0.24	0.29	0.36	0.41	0.49	0.58	0.74	0.80	0.92	1.02	1.11	1.33	1.49	1.76	2.01
2	0.12	0.18	0.22	0.30	0.37	0.45	0.50	0.61	0.72	0.92	0.99	1.14	1.26	1.37	1.63	1.83	2.16	2.46
5	0.17	0.25	0.31	0.42	0.52	0.60	0.65	0.76	0.89	1.13	1.20	1.37	1.51	1.64	1.96	2.19	2.54	2.89
10	0.21	0.32	0.40	0.53	0.66	0.73	0.78	0.90	1.02	1.29	1.37	1.56	1.70	1.85	2.21	2.44	2.82	3.21
25	0.28	0.43	0.53	0.72	0.89	0.96	0.99	1.09	1.22	1.51	1.59	1.81	1.96	2.12	2.51	2.77	3.14	3.60
50	0.35	0.53	0.66	0.89	1.10	1.17	1.18	1.26	1.38	1.68	1.75	2.01	2.14	2.32	2.72	2.99	3.34	3.85
100	0.43	0.66	0.81	1.10	1.36	1.41	1.43	1.46	1.55	1.85	1.92	2.21	2.33	2.50	2.92	3.20	3.50	4.06
200	0.53	0.80	0.99	1.34	1.66	1.70	1.72	1.74	1.75	2.02	2.08	2.41	2.50	2.68	3.10	3.39	3.61	4.22
500	0.68	1.03	1.28	1.72	2.13	2.16	2.19	2.21	2.23	2.25	2.29	2.67	2.72	2.89	3.30	3.60	3.67	4.35
1000	0.81	1.24	1.53	2.06	2.56	2.58	2.60	2.63	2.66	2.68	2.71	2.87	2.90	3.04	3.42	3.74	3.77	4.38

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.11	0.17	0.21	0.28	0.35	0.41	0.46	0.55	0.64	0.82	0.89	1.01	1.12	1.23	1.46	1.64	1.93	2.20
2	0.14	0.21	0.26	0.35	0.44	0.52	0.57	0.68	0.79	1.02	1.09	1.24	1.38	1.51	1.80	2.01	2.35	2.68
5	0.20	0.30	0.37	0.50	0.61	0.69	0.73	0.85	0.97	1.25	1.32	1.49	1.64	1.80	2.15	2.39	2.76	3.14
10	0.25	0.38	0.47	0.63	0.78	0.85	0.88	0.99	1.12	1.43	1.50	1.70	1.85	2.03	2.41	2.67	3.05	3.47
25	0.33	0.51	0.63	0.85	1.05	1.11	1.12	1.22	1.34	1.67	1.74	1.97	2.13	2.32	2.74	3.01	3.38	3.87
50	0.42	0.64	0.79	1.06	1.31	1.36	1.38	1.42	1.53	1.85	1.93	2.18	2.33	2.54	2.98	3.26	3.58	4.13
100	0.52	0.79	0.98	1.31	1.63	1.67	1.68	1.70	1.74	2.04	2.11	2.40	2.53	2.75	3.20	3.49	3.75	4.35
200	0.64	0.97	1.21	1.63	2.02	2.04	2.06	2.08	2.11	2.24	2.30	2.63	2.73	2.95	3.39	3.71	3.85	4.52
500	0.84	1.28	1.59	2.14	2.64	2.65	2.68	2.71	2.74	2.76	2.79	2.93	2.98	3.20	3.62	3.96	4.00	4.66
1000	1.02	1.56	1.93	2.60	3.22	3.23	3.26	3.29	3.33	3.36	3.40	3.43	3.46	3.50	3.77	4.11	4.15	4.67

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day

e. Drainage basin slope is 10% which is the top slope for both landfill cell closure caps.

f. Basin flow length is approximately 230 feet.

g. Ditch flow length is approximately 345 feet.

h. Ditch slope is 1.0% (or 0.01) for both landfill closures.

i. Curve Number (CN) for the gravel armor to be placed on the cap surface for erosion protection is CN=83. This is based on a conservative assumption that the gravel cover to be a Hydrologic Soil Group B instead of A. According to Technical Release 55 (TR-55) from the U.S. Soil Conservation Service, a gravel road with Hydrologic Soil Group B has a curve number of 85, however, the gravel road is highly compacted and contains a significant amount of fine soil particles to bind the gravel materials and provide strength to the road surface. The gravel armor is placed with few fines and is not compacted. A gravel road with Hydrologic Soil Group A has a curve number of 76. The assumption of CN=83 should, therefore, be conservative.

j. Using HYDRO, a computer based hydrologic program used for estimating peak discharge rates using the SCS curve number methodology, the estimated peak discharge for the perimeter ditches is 1.16 cfs. The peak discharge for the downspout piping is twice that for the ditch since two drainage areas since the downspouts receive runoff from, two symmetrical drainage areas, each contributing runoff to the downspouts from opposite directions. Peak downspout discharge rate is 2.32 cfs.

PROJECT Landfill Cells 6B and 7 Closure Perimeter Ditch Hydrology

AREA= 1.8 ACRES
AVERAGE BASIN SLOPE= 10.0 PERCENT
CURVE NUMBER= 83.0
DESIGN STORM= 1.86 INCHES
STORM DURATION= 24.0 HOURS
HYDRAULIC LENGTH= 580 FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0656 HOURS QPCFS= 20.93 CFS QPIN= 11.4412 INCHES
CS= 56.3934 ITERATIONS= 8 SCS 24-hour

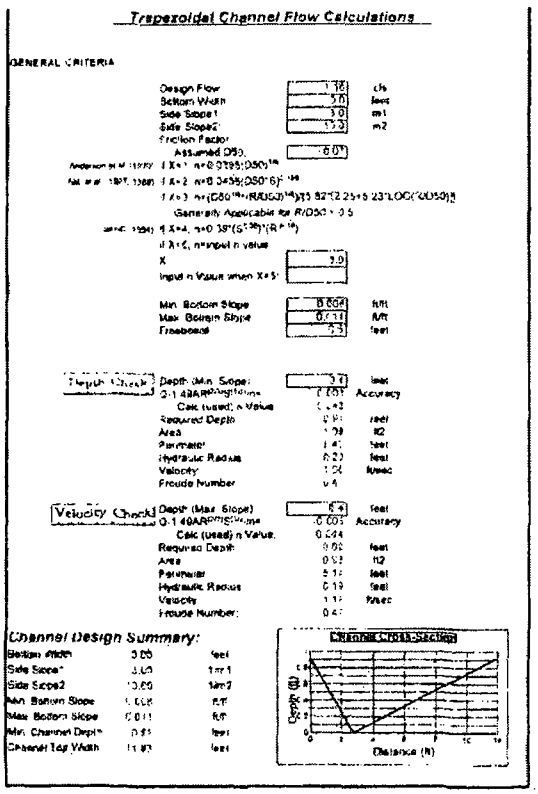
TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
10.77	.4091	.0000	.0000	0	.00
10.78	.4108	.0000	.0000	1.4	.00
10.80	.4126	.0000	.0000	7.8	.00
10.81	.4142	.0000	.0000	15.7	.00
10.83	.4159	.0000	.0000	20.3	.00
10.84	.4176	.0000	.0000	20.6	.00
10.86	.4193	.0000	.0000	18.1	.00
10.87	.4210	.0000	.0000	14.3	.00
10.88	.4227	.0000	.0000	10.4	.00
10.90	.4244	.0001	.0000	7.2	.00
10.91	.4261	.0001	.0000	4.7	.00
10.93	.4277	.0002	.0000	3.0	.00
10.94	.4294	.0002	.0000	1.9	.00
10.96	.4311	.0002	.0000	1.1	.00
10.97	.4328	.0003	.0000	.7	.00
10.98	.4346	.0003	.0000	.4	.00
11.00	.4362	.0003	.0000	.2	.00
11.01	.4386	.0004	.0000	.1	.00
11.03	.4410	.0005	.0000	.0	.00
11.93	1.1229	.1842	.0090	.0	1.04
11.94	1.1430	.1933	.0091	.0	1.06
11.95	1.1631	.2026	.0093	.0	1.08
11.97	1.1832	.2121	.0094	.0	1.11
11.98	1.2033	.2217	.0096	.0	1.13
12.00	1.2234	.2314	.0097	.0	1.16
12.01	1.2298	.2345	.0031	.0	1.16
12.03	1.2336	.2364	.0019	.0	1.12
12.04	1.2374	.2382	.0019	.0	1.03
12.05	1.2412	.2401	.0019	.0	.89
12.07	1.2450	.2420	.0019	.0	.73
12.08	1.2488	.2439	.0019	.0	.60
12.10	1.2526	.2458	.0019	.0	.48

HYDROGRAPH PEAK= 1.16 cfs
TIME TO PEAK= 12.01 Hours
RUNOFF VOLUME= .09 Acre-Feet

3. Perimeter drainage ditch design.

   a. Design the ditches for a flow of 1.16 cfs.
   b. The ditches consist of the v-type ditch design with a 10% sideslope on one side and a 3H:1V slope on the other side.
   c. Bottom slope of the ditch is 1% (0.01 ft/ft) and the ditches have a gravel armor lining.
   d. Assume the channel roughness to be 0.035 for gravel.
   e. The attached printout shows that the channel will have a flow depth of approximately 0.4 foot and a flow velocity of 1.16 feet per second. There is a safety factor of about 1.5 against erosion of the gravel armor material in the ditch.

4. Downspout Design


Trapezoidal Channel Flow Calculations

GENERAL CRITERIA

Design Flow	1.16	cfs
Bottom Width	5.0	feet
Side Slope1	3.0	m1
Side Slope2	10.0	m2
Friction Factor		
Assumed D50	0.07	
Min. Bottom Slope	0.004	ft/ft
Max. Bottom Slope	0.011	ft/ft
Freeboard	0.5	feet

Depth Check

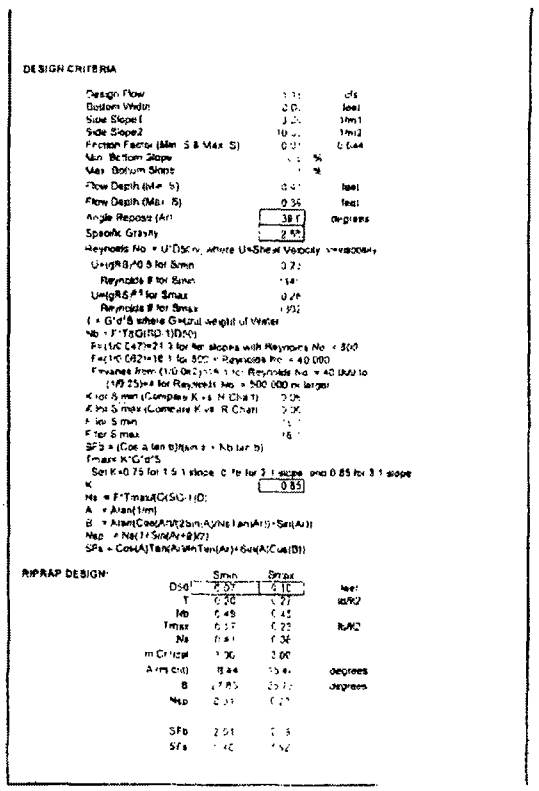
Depth (Min. Slope)	0.4	feet
Calc (used) n Value		
Required Depth		feet
Area		ft2
Perimeter		feet
Hydraulic Radius		feet
Velocity		ft/sec
Froude Number		

Velocity Check

Depth (Max. Slope)	0.4	feet
Calc (used) n Value		
Required Depth		feet
Area		ft2
Perimeter		feet
Hydraulic Radius		feet
Velocity		ft/sec
Froude Number		

Channel Design Summary:

Bottom Width	5.00	feet
Side Slope1	3.00	1m1
Side Slope2	10.00	1m2
Min. Bottom Slope	0.004	ft/ft
Max. Bottom Slope	0.011	ft/ft
Min. Channel Depth	0.85	feet
Channel Top Width	11.83	feet


DESIGN CRITERIA

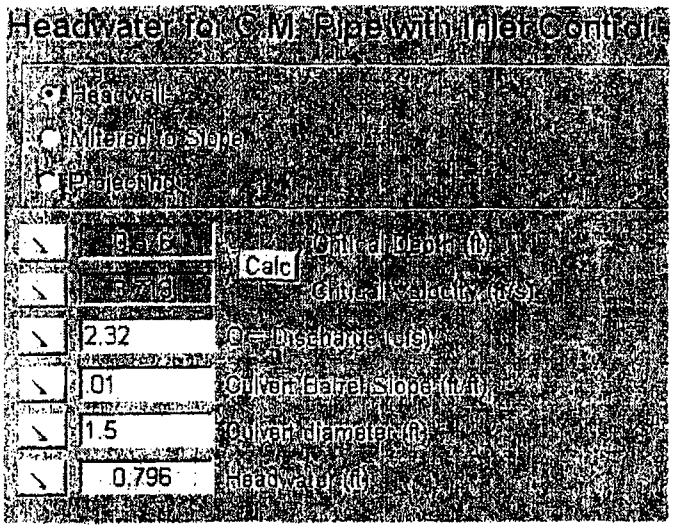
Design Flow		cfs
Bottom Width		feet
Side Slope1		1m1
Side Slope2		1m2
Friction Factor (Min. S & Max. S)		
Min. Bottom Slope		%
Max. Bottom Slope		%
Flow Depth (Min. S)		feet
Flow Depth (Max. S)	0.35	feet
Angle Repose (Ar)	38.1	degrees
Specific Gravity	2.65	

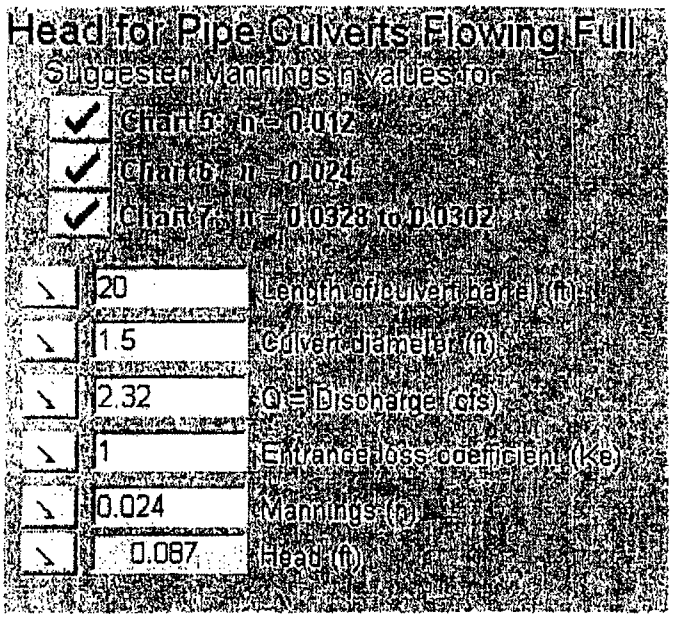
RIPRAP DESIGN:

	Smin	Smax	
D50	0.07	0.10	feet
T			lb/ft2
Nb			
Tmax			lb/ft2
Ns			
m Critical			
A (rad)			degrees
B			degrees
Nsp			
SFb			
SFs			

a. Design the downspouts for a flow of 2.32 cfs (i.e. 2 x 1.16 cfs).
b. Using Hydraulic Design Nomographs from the Federal Highway Administration and the computer program by the Federal Highway Administration "Hydro Charts and Equations" an 18-inch diameter corrugated polyethylene pipe was selected for the downspouts. Headwater depth requirement is 0.8 foot. Smaller diameter pipe is adequate to convey the design flowrate, however, the 18-inch diameter pipe is recommended for clean-out purposes and

as a safety factor against plugging. Computer printout sheets are attached for the downspout design and headwater requirements.



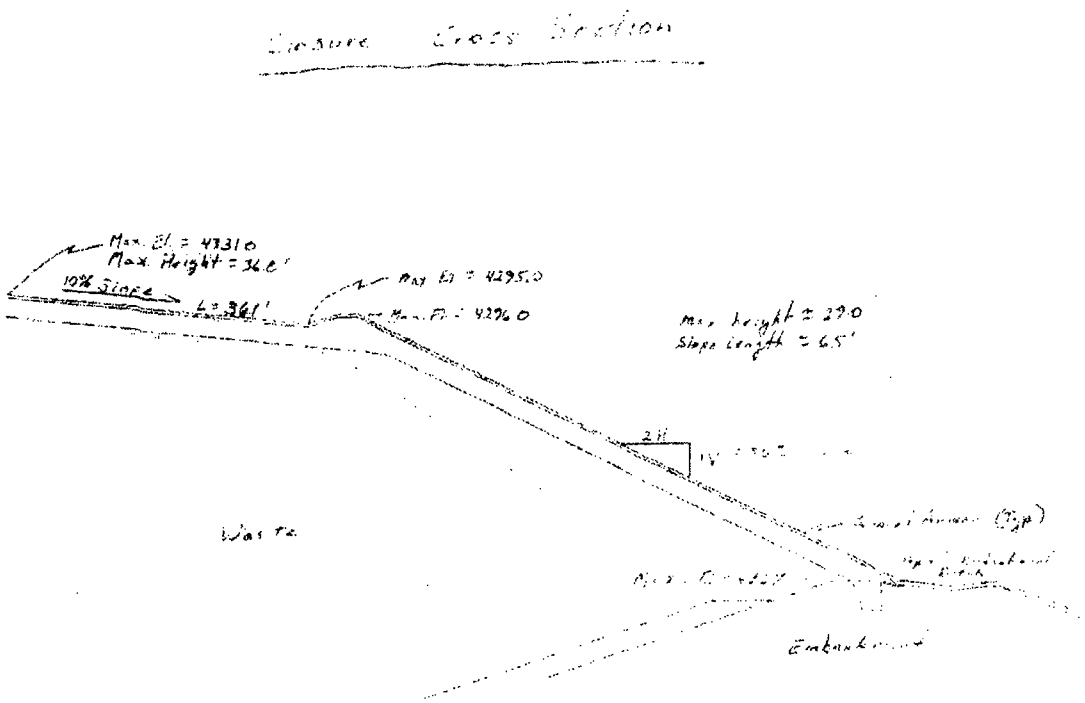


5. Erosion Protection

a. Purpose and Procedure.

The purpose of these calculations is to determine which erosion protection measure to use and how to apply it. The closure cap will consist of 10% slope on the upper cap surface and a 2H:1V slope around the perimeter of the closure cap. Drainage ditches will be provided on top of the cell embankments to collect runoff from the closure cap perimeter slopes. Therefore, there will be no impact on the gravel armor placed on the cell embankments resulting from closure cap runoff. The figure below shows a cross-section of the closure cap slopes, the slope heights, and the slope lengths.

The procedure used to determine the erosion protection requirements for the top 10% slope and for the 2H:1V perimeter slopes of the closure cap is taken from the publication "Erosion and Sedimentation in Utah - A Guide for Control", Utah Water Research Laboratory, February 1984. This publication is specific to Utah. The degree of erosion protection required is based on the steepness and length of the slopes. Erosion protection measures will be determined for the longest slope length and the erosion control measures determined for the longest slope will be conservatively applied to all slopes.



b. The procedure from the above publication uses the Universal Soil Loss Equation (in modified form to represent Utah's climatic and topographic conditions) to estimate the soil erosion potential of the surface soils assuming no application of erosion control measures. Erosion control measures to be implemented are based on the soil erosion potential calculated.

The universal soil loss equation used to calculate soil erosion potential is:

$$A = R \cdot K \cdot LS$$

where; A = Computed amount of soil loss per unit area for the time interval represented by factor R, generally in tons per acre per year.

R = Rainfall (precipitation) factor.

K = Soil erodibility factor in tons per acre per year per unit of R.

LS = Topographic factor (length and steepness of slope).

Calculated erosion after applying erosion control measures is determined by applying and erosion control factor (VM) to the universal soil loss equation. The erosion control factor is dependant upon the type and extent to which the erosion control measure is used (ie. vegetative - type and density, mulches - type and thickness, chemical - type and application amount, mechanical - compactive effort, smoothness of surface, etc.).

i The rainfall (precipitation) factor (R) is obtained from mean annual iso-erodent (R) value maps. The R-value for the facility as obtained from the Tooele area map is:

$$R = 6.0$$

Since R = 6.0 is based on an annual recurrence interval, a correction factor is obtained from the figure below for the 100-yr recurrence interval
For the 100-yr recurrence interval:

$$R = 6.0*(2.51) = 15.06$$

ii. Soil erodibility factor (K) is determined using figure 2 from the above referenced report. The gradation of the materials is based on information from the AGEC soils report.

The worst case condition is represented by the soils whose gradation is on the fine side of the soil gradation envelope. Parameters obtained from the gradation envelope and parameters assumed for use with the nomographs to determine K are:

84 % silt and very fine sand, and
16% sand were obtained from the gradation envelope.

0 % organic material and a very slow permeability were assumed parameters.

Applying the above parameters to the nomographs from Figure 2 gives a soil erodibility factor (K) equal to 0.72.

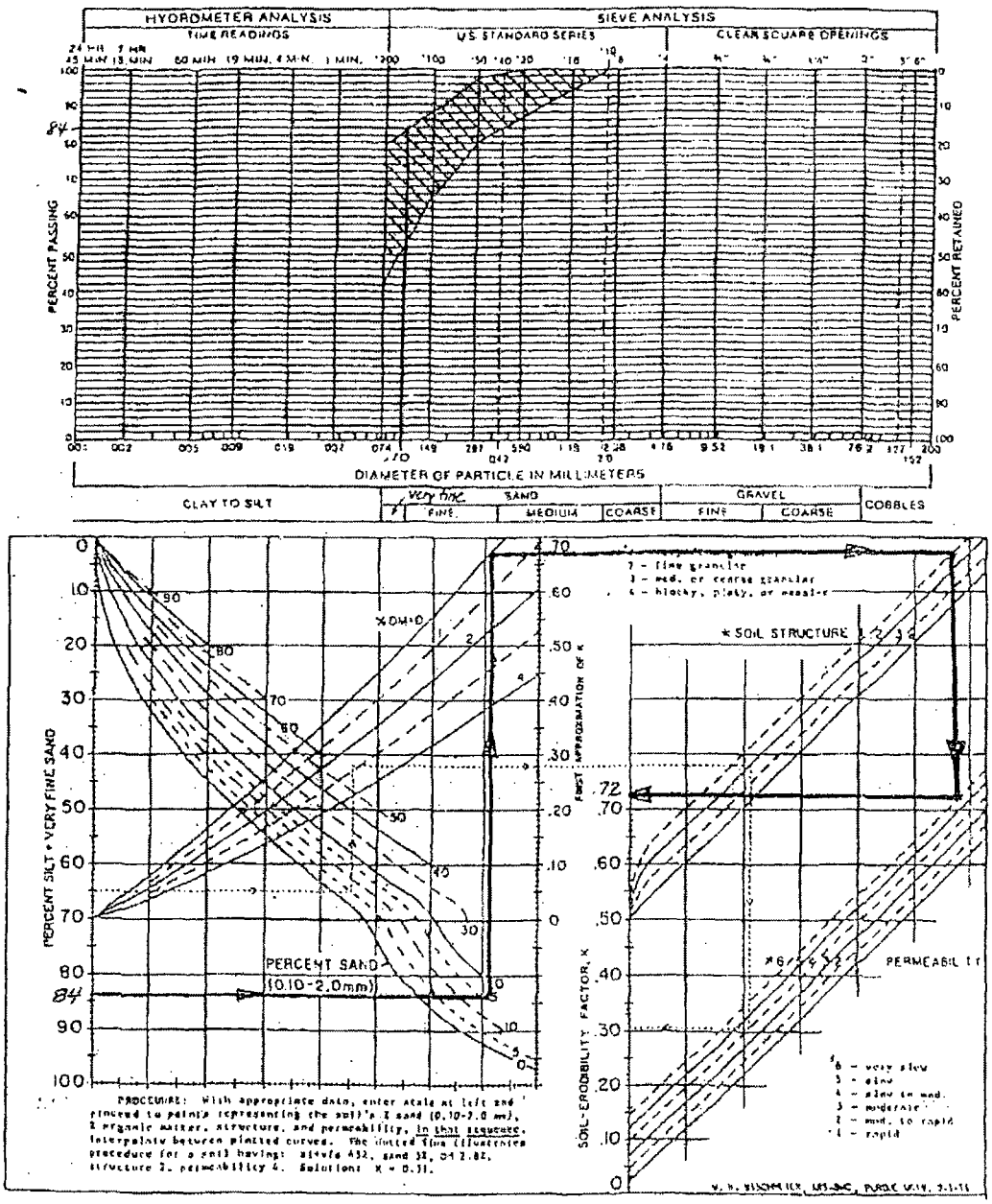


Figure 2-2. Nomograph for determining soil erodibility factor K.

iii. The topographic factor (LS) is determined assuming single slopes. The closure section shows the configuration of typical slope segments that need to be accounted for in the calculations which includes a 10% top slope and a 2H:1V perimeter slop for the closure caps. The LS factor is determined by the following equation:

$$LS = \left(\frac{65.41\ s^2}{s^2 + 10{,}000} + \frac{4.56\ s}{\sqrt{s^2 + 10{,}000}} + 0.065 \right) \left(\frac{l}{72.6} \right)^m$$

where; LS = topographic factor for slope segment n.
l = length of slope segment n.
s = slope gradient of segment n in percent.
l = slope length
m = slope gradient factor, which is
0.2 for gradients of 0 to 2 percent
0.3 for gradients of 1 to 3 percent
0.4 for gradients of 3.5 to 4.5 percent
0.5 for gradients greater than 5 percent

The following table provides LS factor values for the 2H:1V and 10% slopes.

SLOPE LENGTHS (ft) AND LS FACTOR VALUES	
Slope Length	LS Factor
2H:1V (50%) Slope	
65.00	14.3695
10H:1V (10%)	
361.00	2.6009

iv. Potential Erosion Rates without erosion protection where R = 15.06, K = 0.72 and LS as tabulated above are presented in the table below:

Slope Length (ft)	LS	A (tons/ac/yr)
2H:1V (50%) Slope		
65.00	14.3695	155.81
10H:1V (10%)		
361.00	2.6009	28.20

v. Required Stone Mulch Thickness

The amount of stone mulch required to limit soil loss to one ton per acre per year is determined from figure 6 of the above referenced report as shown on the following page. This figure shows the amount of stone mulch required to reduce the erosion potential from as much as 130 tons per acre per year to one ton per acre per year in the original report. The curve was extrapolated to show the required amount of stone mulch required for the potential erosion rates calculated above. Dr. Joel E. Fletcher, one of the researchers and authors of the publication from which this procedure was taken, was contacted regarding the extrapolation of the curve. According to Dr. Fletcher, test results were obtained beyond the limits of the curve presented in the publications to verify the accuracy of the curves and extrapolation would still be accurate. The curve in figure 6, and extrapolation of the curve, is represented by the following equation:

Stone Mulch (tons/ac) = 3.75(Erosion Potential) + 13.1

The stone mulch requirement for the 2H:1V (50%) Slope is:

Stone Mulch (tons/ac) = 3.75 (155.81) + 13.1 = Approximately 600 tons per acre of stone mulch. The required thickness of stone mulch is:

t = (Required tons/acre of stone mulch x 2000 lbs/ton x 12 in/ft)/
(43560 ft^2/acre x stone mulch density lbs/ft^3)

Assuming a stone mulch density of 110 lbs/ft^3

t = 600(2000)(12)/(43560)(110) = 3.0 in.

The stone mulch requirement for the 10H:1V (10%) Slope is:

Stone Mulch (tons/ac) = 3.75 (28.2) + 13.1 = Approximately 120 tons per acre of stone mulch. The required thickness of stone mulch is:

t = (Required tons/acre of stone mulch x 2000 lbs/ton x 12 in/ft)/
(43560 ft^2/acre x stone mulch density lbs/ft^3)

Assuming a stone mulch density of 110 lbs/ft^3

t = 120(2000)(12)/(43560)(110) = 0.6 in.

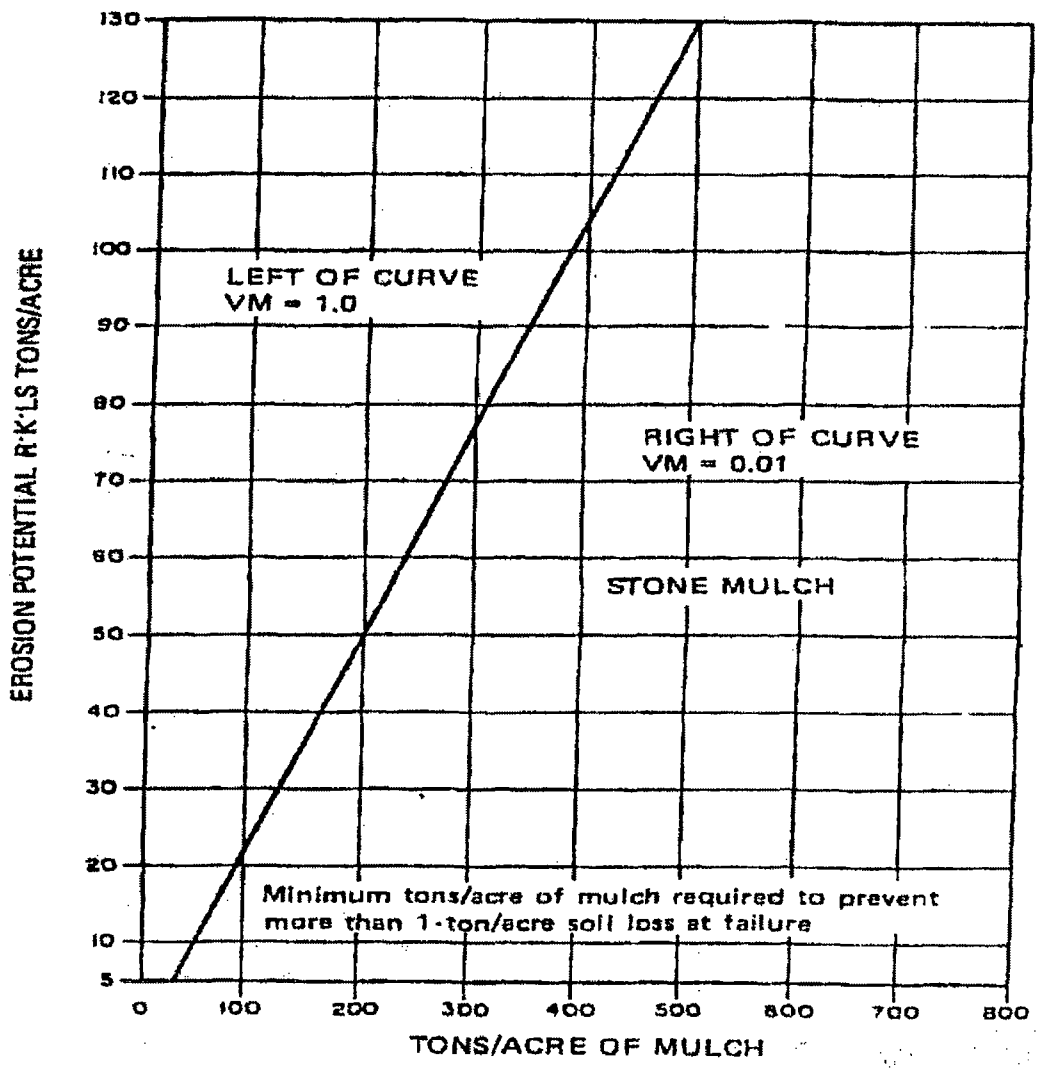


Figure 6. Stone mulch vs. R·K·LS.

vi. Required D_{50} Size for Stone Mulch

Stephens method from NUREG/CR-4651 was used to determine the D_{50} size fo the gravel armor.

$$D_{50} = \left[\frac{q(\tan\theta)^{7/6} n_p^{1/6}}{cg^{1/2}[(1-n_p)(G_s-1)\cos\theta(\tan\phi - \tan\theta)]^{5/3}} \right]^{2/3}$$

Where: q = flow per unit width in cfs/ft
θ = angle of slope in degrees
n_p = porosity of the rock
g = Gravitational acceleration in ft/s^2
G_s = Specific gravity of the rock
ϕ = angle of repose of rock in degrees
C = factor that varies from 0.22 for gravel and pebbles to 0.27 for crushed granite.

Use: q = flow per unit width in cfs/ft
θ = 26.565° for 2H:1V slopes
5.711° for 10 percent slopes
n_p = 32 percent or 0.32 for gravel
g = 32.2 ft/s^2
G_s = 2.65
ϕ = 37° degrees for 1-inch rounded rock
C = 0.22 to be conservative

The above equation solves for a D50 for which rock movement is expected to begin at a given value for q. NUREG/CR-4651 recommends multiplying the q value by Oliver's constant of 1.2 for gravel and 1.8 for crushed rock to provide a safety factor against rock movement. A value of 1.35 is used for the gravel to be conservative.

As presented in the hydrology section, the flow for a 1.814 acre area is 1.16 cfs giving a flow rate for 1 acre of 0.64 cfs. A one acre area using the maximum 10% slope length is about 361 feet x 120 feet. Therefore, the flow per unit with on the 10% slopes is 0.01 cfs/ft. A one acre area using the maximum 2H:1V slope length is about 65 feet x 670 feet. Therefore, the flow per unit with on the 2H:1V slopes is 0.002 cfs/ft. Assuming concentration factors (F_C) and multiplying by Oliver's constant (F_{OC}) of 1.35 by the flow rates calculated for each of the slope areas provides a modified flow (q_{MOD}) for which the gravel D_{50} requirements are calculated in the following table.

TABLE
Gravel D_{50} Calculation

q cfs/ft	F_C	F_{OC}	q_{MOD} cfs/ft	θ deg	n_p %	g ft/sec^2	G_s	ϕ deg	C	D_{50} ft	D_{50} in
0.01	20	1.35	0.27	5.711	0.32	32.2	2.65	37	0.22	0.0752	0.90
0.002	3	1.35	0.008	26.565	0.32	32.2	2.65	37	0.22	0.0818	0.98

Concentration factors are not a component of the NUREG/CR-4651 procedure, but are provided to show the types of flow concentration that may occur, beyond the safety factors already provided in the procedure, and still maintain erosion stability. The local gravel source that has historically been used for gravel armor (stone mulch) has a D_{50} size of approximately 1 inch. Using this D_{50} size provides allowable concentration factors of 20 and 3 on the 10% slopes and the 2H:1V slopes, respectively. The D_{50} sizes of 0.90 inch for the 10% slopes and 0.98 inch for the 2H:1V slopes should be adequate in providing stability against erosion of the stone mulch based on the above evaluations and based on visual observations of the existing slopes where the stone mulch has been effectively used for erosion protective cover.

vii. Gravel Thickness and Minimum D_{50} Recommendations

Historically the cell embankments and closure caps have received a 4-inch thickness of gravel armor with a D_{50} of about 0.9 inch and there are no observed areas of erosion occurring. This thickness mainly results from the difficulty in placing less than 4 inches of gravel armor and achieving consistent cover over all surfaces.

Recommended design is to provide a target gravel thickness of 4 inches over the entire closure cap surface with a minimum gravel thickness of 2 inch on the 10% slopes (typically 2 x D_{50}) and a minimum gravel thickness of 3 inches, as calculated, on the 2H:1V slopes. Minimum D50 diameter of the gravel is 0.9 inch on the 10% slopes and 1 inch on the 2H:1V slopes.

c. Top of Embankment Ditches

The maximum area contributing runoff to the embankment drainage ditches is 27,685 square feet (0.64 acre). Hydrologic calculations show storm water discharge for the small drainage areas of the closure caps at the facility to be approximately 0.65 cfs per acre. Therefore, the discharge for the embankment drainage ditches is 0 cfs at the beginning of the ditches and increases to 0.42 cfs at the storm water inlets at the low point of the drainage ditches. Maximum inflow to the inlets is two ditch flows, or 0.84 cfs, since two ditches converge on one inlet.

The embankment ditches will have a minimum slope of 0.5% and will have a V-ditch shape with side slopes of about 6% or 16.7H:1V and maximum flow. Based on hydraulic calculations, the flow depth in the top of embankment ditches is about 0.24 foot. The gravel armor has a safety factor of over 6 against erosion within the ditches.

HANSEN ALLEN & LUCE inc

Client	Clean Harbors Environmental Services	Sheet	1 of 2
Project	Landfill Cells 6B and 7 Closures	Comp.	KCS
Feature	Embankment Ditch Hydraulics	Chck'd	MEA
Project #	064.82.100	Date	10-Mar-10

Trapezoidal Channel Flow Calculations

GENERAL CRITERIA:

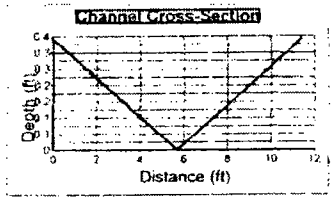
Design Flow	0.42	cfs	
Bottom Width	0.0	feet	
Side Slope1	16.7	m1	
Side Slope2	16.7	m2	
Friction Factor.			
Assumed D50 =	0.083	ft	
Anderson et al. (1970) If X=1, n=0.0395(D50)$^{1/6}$			n= 0.026
Abt et al (1987, 1988) If X=2, n=0.0456(D50*S)$^{0.1/6}$			n= 0.013
If X=3, n=(D50$^{1/6}$*(R/D50)$^{1/6}$)/[3.82*[2.25+5.23*LOG(R/D50)]]			
Generally Applicable for R/D50 > 0.5			n= 0.059
Jarrett (1984) If X=4, n=0.39*(S$^{0.38}$)*(R$^{-0.16}$)			n= 0.073
If X=5, n=input n value			
X	3.0		
Input n Value when X=5			
Min. Bottom Slope	0.005	ft/ft	
Max. Bottom Slope	0.005	ft/ft	
Freeboard	0.1	feet	

Depth Check	Depth (Min. Slope)	0.24	feet
	Q/1.49AR$^{(2/3)}$S$^{(1/2)}$/n=	[illegible]	Accuracy
	Calc (used) n Value	[illegible]	
	Required Depth	[illegible]	feet
	Area.	[illegible]	ft2
	Perimeter	[illegible]	feet
	Hydraulic Radius	[illegible]	feet
	Velocity	[illegible]	ft/sec
	Froude Number	[illegible]	
Velocity Check	Depth (Max. Slope)	0.24	feet
	Q/1.49AR$^{(2/3)}$S$^{(1/2)}$/n=	[illegible]	Accuracy
	Calc (used) n Value	[illegible]	
	Required Depth	[illegible]	feet
	Area	[illegible]	ft2
	Perimeter	[illegible]	feet
	Hydraulic Radius	[illegible]	feet
	Velocity	[illegible]	ft/sec
	Froude Number	[illegible]	

Channel Design Summary:

Bottom Width	[illegible]	feet
Side Slope1	[illegible]	1/m1
Side Slope2.	[illegible]	1/m2
Min. Bottom Slope	[illegible]	ft/ft
Max. Bottom Slope	[illegible]	ft/ft
Min. Channel Depth	[illegible]	feet
Channel Top Width	[illegible]	feet

Channel Cross-Section



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Client	Clean Harbors Environmental Services	Sheet	2 of 2
Project	Landfill Cells 6B and 7 Closures	Comp.	KCS
Feature	Embankment Ditch Hydraulics	Chck'd	MEA
Project #	064.82.100	Date	10-Mar-10

DESIGN CRITERIA:

Design Flow	[illegible]	cfs	
Bottom Width	[illegible]	feet	
Side Slope1.	[illegible]	1/m1	
Side Slope2	[illegible]	1/m2	
Friction Factor (Min. S & Max. S).	[illegible]		
Min. Bottom Slope	[illegible]	%	
Max. Bottom Slope	[illegible]	%	
Flow Depth (Min. S)	[illegible]	feet	
Flow Depth (Max. S)	[illegible]	feet	
Angle Repose (Ar)	39.0	degrees	
Specific Gravity	2.55		

Reynolds No. = U*D50/v, where U=Shear Velocity, v=viscosity

U=(gRS)^0.5 for Smin [illegible]

Reynolds # for Smin [illegible]

U=(gRS)$^{0.5}$ for Smax [illegible]

Reynolds # for Smax [illegible]

T = G*d*S where G=Unit weight of Water

Nb = F*T/(G(SG-1)D50)

F=(1/0.047)=21.3 for flat slopes with Reynolds No. < 500

F=(1/0.062)=16.1 for 500 < Reynolds No. < 40,000

F=varies from (1/0.062)=16.1 for Reynolds No. = 40,000 to (1/0.25)=4 for Reynolds No. = 500,000 or larger

K for S min (Compare K vs. R Chart) [illegible]

K for S max (Compare K vs. R Chart) [illegible]

F for S min [illegible]

F for S max [illegible]

SFb = (Cos a tan b)/(sin a + Nb tan b)

Tmax= K*G*d*S

Set K=0.75 for 1.5:1 slope, 0.76 for 2:1 slope, and 0.85 for 3:1 slope

K 0.85

Ns = F*Tmax/(G(SG-1)D)

A = Atan(1/m)

B = Atan(Cos(Ar)/(2Sin(A)/NsTan(Ar))+Sin(Ar))

Nsp = Ns(1+Sin(Ar+B)/2)

SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

RIPRAP DESIGN:

	Smin	Smax	
D50	0.08	0.08	feet
T	[illegible]	[illegible]	lb/ft2
Nb	[illegible]	[illegible]	
Tmax	[illegible]	[illegible]	lb/ft2
Ns	[illegible]	[illegible]	
m Critical	[illegible]	[illegible]	
A (m crit)	[illegible]	[illegible]	degrees
B	[illegible]	[illegible]	degrees
Nsp	[illegible]	[illegible]	
SFb	[illegible]	[illegible]	
SFs	6.00	5.30	

HANSEN ALLEN & LUCE inc
ENGINEERS

CLIENT: Clean Harbors - Grassy Mountain Facility
PROJECT: RCRA Cell 6B and 7 Closures
FEATURE: Closure Hydrology, Hydraulics, & Erosion Control
PROJECT NO.: 64.82.100

SHEET 16 OF 16
COMPUTED KCS
CHECKED MEA
DATE: March 2010

I. Evaluate the long-term strength of the HDPE pipe against failure or significant loss of cross-sectional area.

Reference Manuals: "Design & Engineering Guide for Polyethylene Piping", by Rinker Materials, August 2003.

"Plexco/Spirolite Engineering Manual 2. System Design", by Chevron Chemical Co., April 1996.

Design Criteria:

Pipe Diameters = 10 inches - top and bottom pipes.
Maximum Design Height of Overburden = about 58 feet for Cell 7 and about 50 feet for Cell 6B. Use 58 feet to represent a calculation for both cells. The overburden includes 2 feet of soil and gravel cover material, 0.5 foot of soil cushion, 50.5 feet of waste, 2 feet of primary soil protective cover, 2 feet of secondary soil protective cover, and 1 foot of sump gravel.

Unit weight of overburden:

Soil cover and gravel	= 125	pcf
Waste	= 90	pcf

A. Soil Pressure by components

$$P_T = P_S + P_L$$

where: P_T = Total load pressure
P_S = Static or dead load pressure
P_L = Live load pressure

Using the Boussinesq's Equation from the manual reference above, the live load pressure can be estimated as follows

$$P_L = \frac{3W_L H^3}{2\pi * R^5}$$

W_L = wheel load (lb)
H = vertical depth of crown
R = distance from the point load application to the crown

Assuming a tire load of 4,000 pound, then the live load on the pipe would be as follows

$$P_L = \frac{3(4000)(58)^3}{2\pi *(58)^5}$$

P_L = 0.57 psf (load is insignificant to the dead load and will be excluded)

Therefore, only the dead load will be used to pipe strength design.

P_T = P_S = height of overburden x unit weight of overburden
$P_{T24"}$ = (2.5' + 2' + 2' + 1')(125 pcf) + (50.5')(90 pcf)
= 5,482 psf = 38.1 psi for the 10" pipe

B. Evaluate Wall Crushing

The compression stress on the pipe walls is given below:

$$S = \frac{P_L D_O}{288t}$$

S = Compressive stress (psi)
P_L = vertical load applied to pipe (psf)
t = wall thickness (in)
D_O = outside diameter of pipe (in)

The maximum long-term design stress value for Plexco polyethylene pipe is 800 psi. The ratio of pipe diameter to wall thickness is given below.

$$\frac{D_O}{t} = \frac{288(800)}{5{,}482\,psf}$$

$$\frac{D_O}{t} = 42.0$$

Therefore a SDR of 41 or lower should be strong enough to avoid crushing failure.

C. Evaluate Wall Buckling

Wall buckling resistance of pipe is increased when it is buried. The soil and pipe work together to resist buckling. AWWA C-950 gives a design equation for buckling of buried plastic pipe which is applicable to PLEXCO pipe.

$$P_{cb} = \frac{1}{SF}\sqrt{\left(\frac{2.67 \cdot R_w \cdot B \cdot E_s \cdot E}{DR^3}\right)}$$

P_{cb} = Critical buckling stress (psi)
SF = Safety factor,
R_w = Water buoyancy factor, (dimensionless)
B = Empirical Coefficient of Elastic Support (dimensionless)
E_s = Soil modulus, (See Table C-4)
E = Pipe modulus of elasticity, psi
DR = Dimension ratio

Where,

$$R_w = 1 - \left(0.33 \cdot \frac{H_w}{H}\right)$$

H_w = Height of water table above the pipe (ft)
The water should not pond above 1 ft high, so the maximum water height will be 1 ft
H = Height of soil cover above pipe (ft)
The cover over the sump area is about 58 ft

$$B = \frac{1}{1 + 4e^{(-0.065H)}}$$

e = Natural log base number
H = Height of soil cover above pipe (ft)

For the 10" pipe:

$$P_{cb} = \frac{1}{2}\sqrt{\frac{2.67 \cdot (0.968) \cdot (0.995) \cdot (30{,}000psi)(1600psi)}{(21)^3}}$$

$$P_{cb} = 57.7psi$$

$$R = 1 - 0.33\frac{1'}{58'}$$

$$R = 0.994$$

$$B = \frac{1}{1 + 4e^{(-0.065(58))}}$$

$$B = 0.916$$

The pipe should not buckle since the calculated buckling resistance of 57.7 psi exceeds the 38.1 psi loading on pipe.

D. Evaluate Ring Deflection

Ring deflections are calculated using the following modified Spangler's equation:

$$\Delta X = \frac{D_1 \cdot K \cdot W}{\left(\frac{2E}{3(DR-1)^3}\right) + 0.061E'}$$

□X = Horizontal deflection (in.)
D_1 = Deflection lag factor, PolyPipe recommends 1.0 (dimensionless)
K = Bedding constant, Polypipe recommends 0.1 (dimensionless)
W = Earthload (lbs/inch)
E = Modulus of elasticity of pipe, 30,000 psi
E' = Soil modulus
DR = Dimension ratio

For the 10" pipe:

$$\Delta X = \frac{1 \cdot 0.1 \cdot (38.1 \cdot 10)}{\left(\frac{2 \cdot 30{,}000}{3(21-1)^3}\right) + 0.061 \cdot 1200}$$

$$\Delta X = 0.50in$$

This assumes a soil modulus of 1200 psi which is for fine grained soil compacted to 90% SPD. The percent deflection is calculated using the following formula:

$$d = \frac{\Delta X}{D} \cdot 100$$

d = Percent deflection (%)

□X = Horizontal deflection (in.)
D = Outside diameter (in.)

$$d = \frac{0.50}{10} \cdot 100$$

$$d = 5.0\%$$

Allowable deflection for SDR 21 pipe is 6.0 percent.

To see if this deflection could cause failure in the pipe the ring bending strain was computed below. This equation is provided in the Plexco/Spirolite Engineering Manual.

$$\varepsilon = f_D \frac{\Delta Y}{D_M} \frac{2C}{D_M}$$

C = 0.53t = 0.53 *0.512 = 0.27

$$\varepsilon = 6 \frac{0.50}{9.457} \frac{2(0.27)}{9.457}$$

$$\varepsilon = 0.0181 = 1.81\%$$

□ = wall strain, (%)
f_d = deformation shape factor, 4.28 for elliptical deformation, 6.0 for non uniform deformation
D_M = mean diameter (in), D_O-1.06t, 10-1.06(0.512) = 9.457 inches
C = outer fiber to wall centroid (in)
t = pipe minimum wall thickness

The PLEXCO design manual references a study by Jansen that states strains of 8% should perform well for at least 50 years. ISCO industries also lists its high density polyethylene pipe as having an elongation at yield of 8%.