WASTE MANAGEMENT

Magnolia Sanitary Landfill
Monroe, Louisiana

Permit Renewal Application

Agency Interest No. 12241
Facility No. D-073-1848
Permit No. P-0046R1

Volume II of III

NOVEMBER 2007

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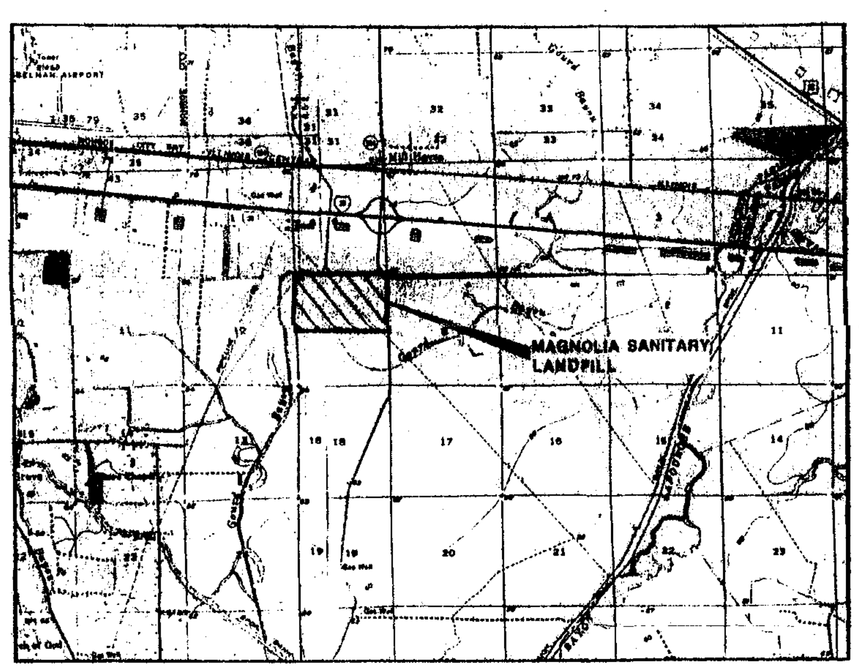
Waste Management Of Louisiana, Inc.

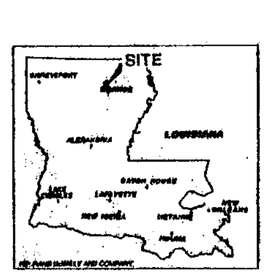
MAGNOLIA SANITARY LANDFILL

Monroe, Louisiana



LOCATION MAP

Scale in Miles



DRAWING NO.	TITLE
1	EXISTING SITE PLAN
2	EXCAVATION PLAN
3	LINER SYSTEM PLAN
4	LEACHATE COLLECTION SYSTEM PLAN
5	CLOSURE COVER AND SURFACE WATER MANAGEMENT PLAN
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STATE OF LOUISIANA
TERRI L. RICHARDSON
REG. No. 24659
REGISTERED PROFESSIONAL ENGINEER
CIVIL ENGINEERING

PREPARED BY
RUST ENVIRONMENT & INFRASTRUCTURE
SOUTHWEST REGION
BATON ROUGE, LOUISIANA

PREPARED FOR
WASTE MANAGEMENT OF LOUISIANA, INC.
MONROE, LOUISIANA

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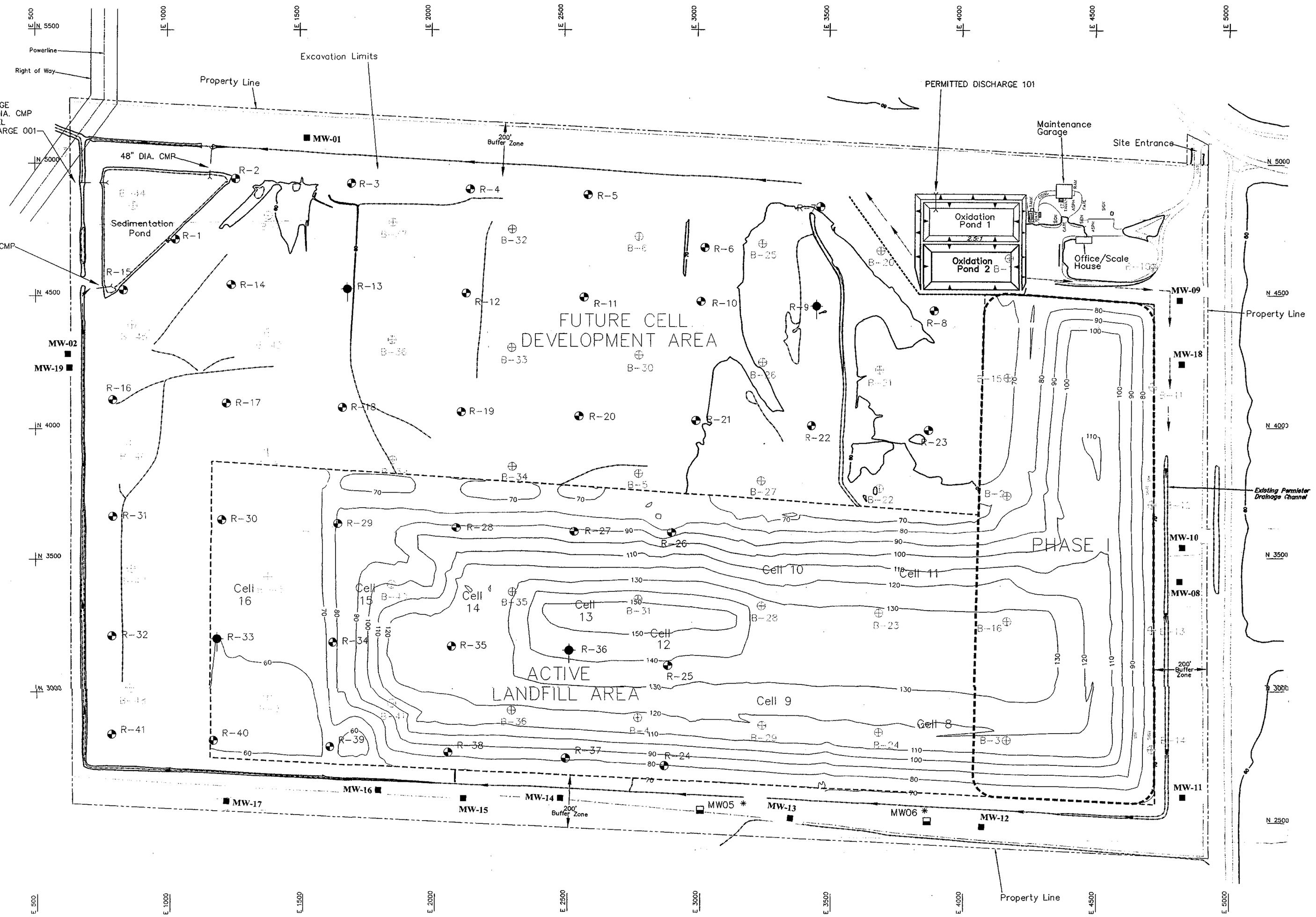

LEGEND

- EXISTING CONTOUR
- GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- MW06 * GROUNDWATER MONITORING WELL PLUGGED AND ABANDONED
- EXISTING MONITORING WELL
- DRAINAGE FLOW DIRECTION
- LIMIT OF PHASE I
- RUST E & I 50' BORING LOCATION
- RUST E & I 100' BORING LOCATION

0' 100' 200' 400'
SCALE

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 28228
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
1/12/05

This map compiled by photogrammetric methods from aerial photography dated 10-6-01.
Vertical datum based on NGS Mean Sea Level. Contour Interval 2 ft.
Grid based on arbitrary coordinate system. Re: Air Survey Corp. Project #930433
Dashed contours indicate that ground is partially obscured by vegetation or shadows.
These areas may not meet standard accuracy and require field testing/completion.

NO	REVISIONS	DRN	CHK	DATE
1	VERTICAL EXPANSION	DCA	DLS	04/01

BATON ROUGE, LOUISIANA

DRN		MCNAMARA
DES	TR	RICHARDSON
		REED
CHK	JR	RICHARDSON
APP	TR	RICHARDSON

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WASTE MANAGEMENT

EARTH TECH
Baton Rouge, Louisiana

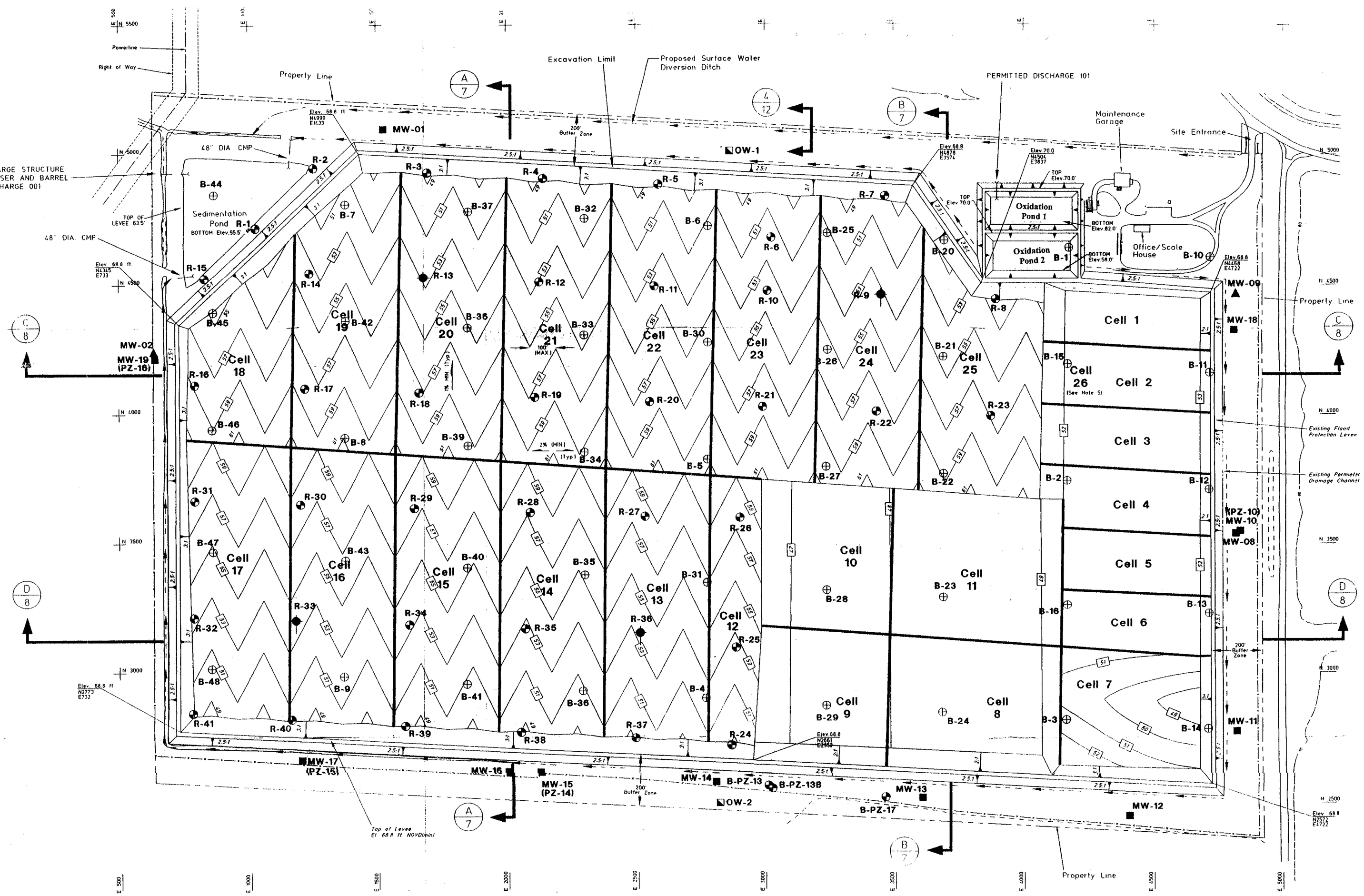
PREPARED FOR

PREPARED BY

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

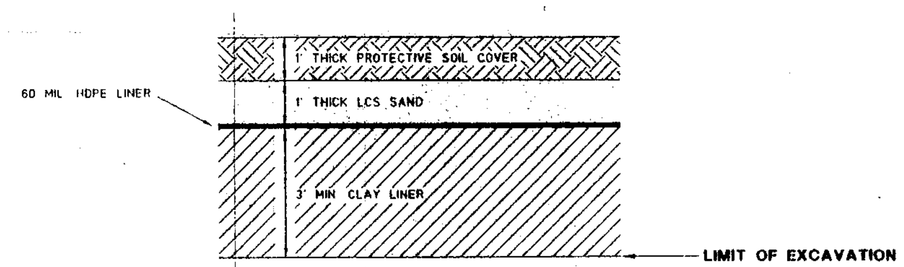
EXISTING SITE PLAN

DATE	01/11/05 3:56 P.M.
PROJECT NO	42891.010
FILENAME	42891A04.DWG
SHEET NO	1 of 15
DRAWING NO	1



LEGEND

- EXISTING CONTOUR
- GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- DRAINAGE FLOW DIRECTION
- CURRENT GROUNDWATER MONITOR WELL SYSTEM
- (PZ-14) FORMER PIEZOMETER CONVERTED TO A MONITORING WELL
- CELL DIVIDER BERM
- 5% min. SLOPE FOR TOP OF INTERIM OR FINAL COVER
- PROPOSED EXCAVATION GRADE CONTOUR
- CROSS-SECTION LOCATION
- RUST E & I BORING LOCATION
- RUST E & I 100' BORING LOCATION
- SOUTHWEST LABORATORIES, INC. 1984 BORING LOCATION
- RUST PIEZOMETER LOCATION
- SOUTHWEST LABORATORIES, INC. 1984 OBSERVATION WELL LOCATION



Section thru Floor of Landfill

NOTES

1. THE TOP OF PERIMETER LEVEE MUST BE AT A MINIMUM ELEVATION OF 68.8 FT NGVD
2. THE LINES SHOWN MAY VARY IN LOCATION DEPENDING ON THE SLOPE OF THE INTERIM COVER ON FEBRUARY 1, 1998. THE SLOPE ON THE INTERIM COVER MAY VARY DEPENDING ON THE AMOUNT OF REFUSE PLACED IN THESE AREAS PRIOR TO FEBRUARY 1, 1998.
3. ALL INTERIM COVER SHALL BE STRIPPED OF THE UPPER VEGETATION AND GRADED TO FORM A SMOOTH, UNIFORM GRADE JUST PRIOR TO CLAY LINER INSTALLATION
4. AN EXCAVATION PLANS AND SECTIONS FOR LEACHATE COLLECTION SYSTEM TRENCHES AND SUMPS ARE SHOWN ON SHEETS 9 & 10. TRENCH AND SUMP LOCATIONS ARE SHOWN ON SHEET 4.
5. CELL 26 WILL BE CONSTRUCTED WITH AN INTERIM LINER OVER THE PREVIOUSLY CONSTRUCTED DISPOSAL AREA WITH A LINER EXTENSION FROM CELL 25
6. CELL 1 THROUGH CELL 11 CONSTRUCTED PRIOR TO OCTOBER 9, 1993

0 100 200 300 400 500
SCALE IN FEET

This map compiled by photogrammetric methods from aerial photography dated 4-22-93
Vertical datum based on NGS Mean Sea Level. Contour Interval 2 ft
Grid based on arbitrary coordinate system. Re: Air Survey Corp. Project #7930033
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RE: DRAWING COPIED FROM CADD FILE 86415.DWG ON 8/21/96

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TERRI L. RICHARDSON
REG. No. 24659
REGISTERED
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

Description		Date	Ini.
Drawn By:	PARTIN	9/96	
Designer:	RICHARDSON	1/94	
Checked:	MARTIN	9/96	
P.E.	RICHARDSON	9/96	
Approved:	RICHARDSON	9/96	
Revision:			
Revision:			
Revision:			
Project No.		32711.100	
Drawing No.		32711A22.DWG	
Date Issued		09-06-96	
Plot Time		8:59 a.m.	

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MONROE, LOUISIANA
PROJECT TITLE

WASTE MANAGEMENT OF LOUISIANA, INC.
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EXCAVATION PLAN

2
DWG. NO.

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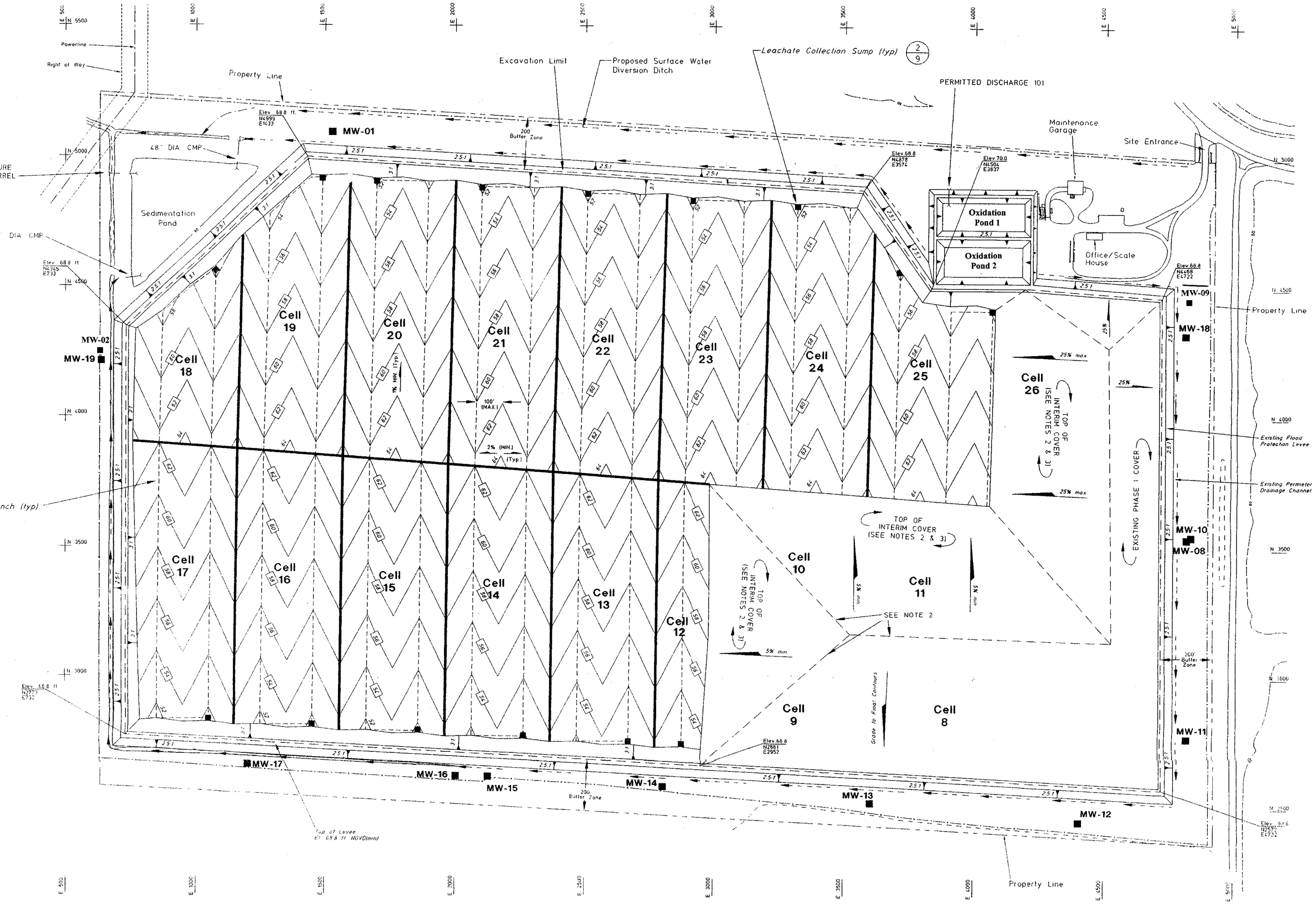
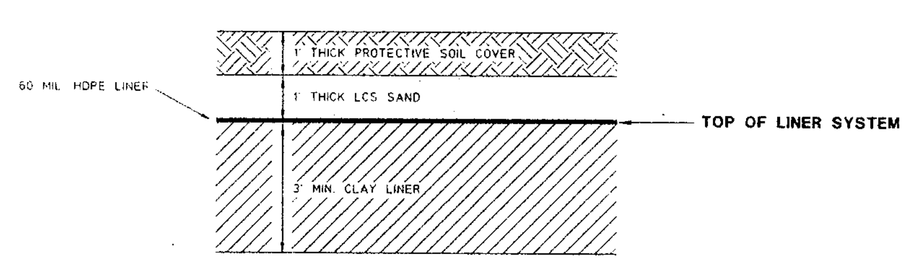


LEGEND

- EXISTING CONTOUR
- GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- DRAINAGE FLOW DIRECTION
- EXISTING GROUNDWATER MONITOR WELL SYSTEM
- PROPOSED TOP OF CLAY LINER GRADE CONTOUR
- CELL DIVIDER BERM (1/11)
- SLOPE FOR TOP OF INTERIM OR FINAL COVER
- LEACHATE COLLECTION LINE (3/9)
- LEACHATE COLLECTION SUMP (1/9) (2/9)



Section thru Floor of Landfill

NOTES:

1. THE TOP OF PERIMETER LEVEE MUST BE AT A MINIMUM ELEVATION OF 68.8 FT. NGVD.
2. THE LINES SHOWN MAY VARY IN LOCATION DEPENDING ON THE SLOPE OF THE INTERIM COVER ON FEBRUARY 1, 1996. THE SLOPE ON THE INTERIM COVER WILL VARY DEPENDING ON THE AMOUNT OF REFUSE PLACED IN THESE AREAS PRIOR TO FEBRUARY 1, 1996.
3. THE RECOMPACTED CLAY LINER SHALL BE INSTALLED DIRECTLY OVER THE INTERIM COVER IN THESE AREAS. PRIOR TO CLAY LINER INSTALLATION, THE EXISTING VEGETATION ON THE INTERIM COVER SHALL BE STRIPPED TO A MINIMUM DEPTH OF 6".

0 100 200 300 400 500
SCALE IN FEET

This map compiled by photogrammetric methods from aerial photography dated 6-22-93. Vertical datum based on Nat. Mean Sea Level, Contour Interval 2 ft. Grid based on arbitrary coordinate system. Ref. Air Survey Corp. Project #7930.33. Contour contours indicate that ground is partially obscured by vegetation or shadows. These areas may not meet standard accuracy and require field testing/completion.

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Drawn By:	PARTIN	9/96	
Designer:	RICHARDSON	1/94	
Checked:	MARTIN	9/96	
P.E.	RICHARDSON	9/96	
Approved:	RICHARDSON	9/96	
Revision:			
Revision:			
Revision:			
Project No.		32711.100	
Drawing No.		32711A22.DWG	
Date Issued:		09-06-96	
Plot Time		1:27 p.m.	

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MONROE, LOUISIANA
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WASTE MANAGEMENT OF LOUISIANA, INC.
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RUST ENVIRONMENT & INFRASTRUCTURE

LINER SYSTEM PLAN

DWG. NO. **3**

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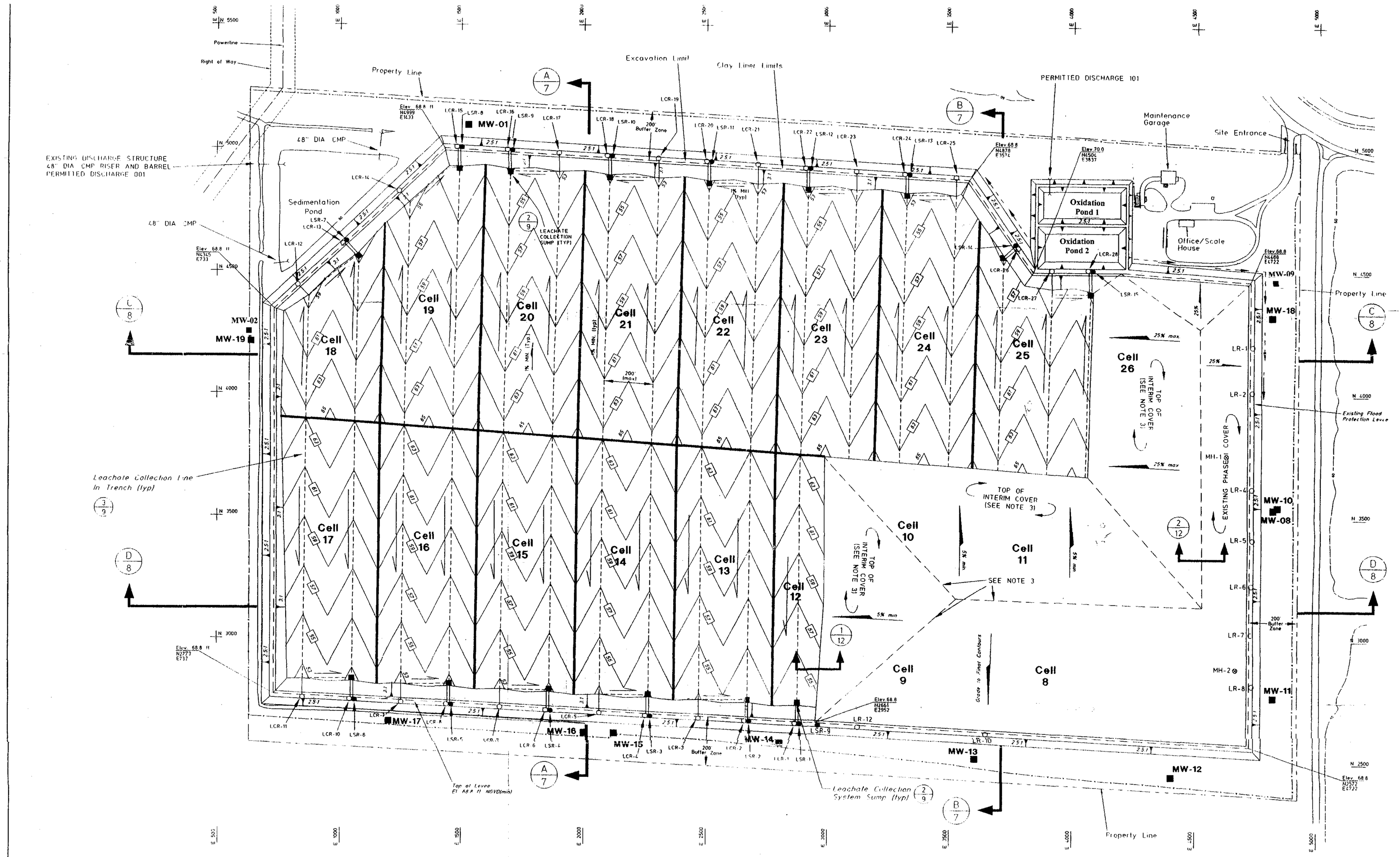
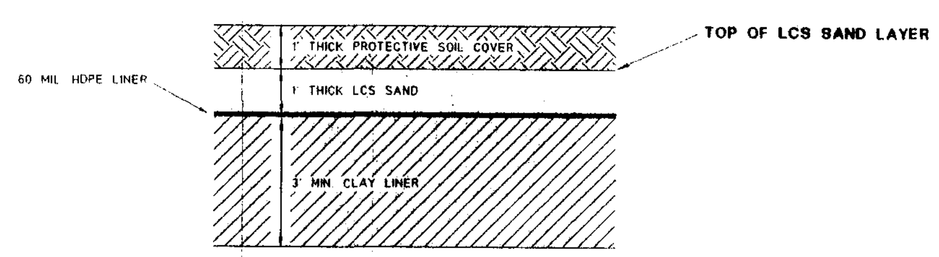


LEGEND

- EXISTING CONTOUR
- GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- DRAINAGE FLOW DIRECTION
- EXISTING GROUNDWATER MONITOR WELL SYSTEM
- PROPOSED GRADE FOR TOP OF LEACHATE COLLECTION SYSTEM SAND LAYER
- CELL DIVIDER BERM
- SLOPE FOR TOP OF INTERIM OR FINAL COVER
- LEACHATE COLLECTION LINE AND FLOW DIRECTION
- LEACHATE COLLECTION SUMP
- LEACHATE CLEANOUT RISER
- LEACHATE SUMP RISER
- MH-2 EXISTING MANHOLE
- LR-10 EXISTING LEACHATE RISER
- CROSS-SECTION LOCATION



Section thru Floor of Landfill

NOTES

1. SPECIFICATIONS FOR LEACHATE COLLECTION SYSTEM MATERIALS AND INSTALLATION ARE PROVIDED ON DRAWINGS 9 AND 10.
2. CONTOURS SHOWN REPRESENT TOP OF LEACHATE COLLECTION SYSTEM SAND LAYER. A MINIMUM 1' THICK PROTECTIVE SOIL COVER (NOT SHOWN) SHALL BE INSTALLED OVER THE ENTIRE FLOOR AND SLOPE AREA FOLLOWING INSTALLATION OF THE LCS SAND.
3. THE LINES SHOWN MAY VARY IN LOCATION DEPENDING ON THE SLOPE OF THE INTERIM COVER ON FEBRUARY 1, 1996. THE SLOPE ON THE INTERIM COVER WILL VARY DEPENDING ON THE AMOUNT OF REFUSE PLACED IN THESE AREAS PRIOR TO FEBRUARY 1, 1996.

0 100 200 300 400 500
SCALE IN FEET

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TERRI L. RICHARDSON
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10/20/96

Description		Date	Ini.
Drawn By:	PARTIN	9/96	
Designer:	RICHARDSON	1/96	
Checked:	MARTIN	9/96	
P.E.:	RICHARDSON	9/96	
Approved:	RICHARDSON	9/96	
Revision:			
Revision:			
Revision:			
Project No.		32711.100	
Drawing No.		32711A22.DWG	
Date Issued:		09-06-96	
Plot Time:		2:59 p.m.	

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MONROE, LOUISIANA
PROJECT TITLE

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RUST ENVIRONMENT & INFRASTRUCTURE

LEACHATE COLLECTION SYSTEM PLAN

4
DWG NO

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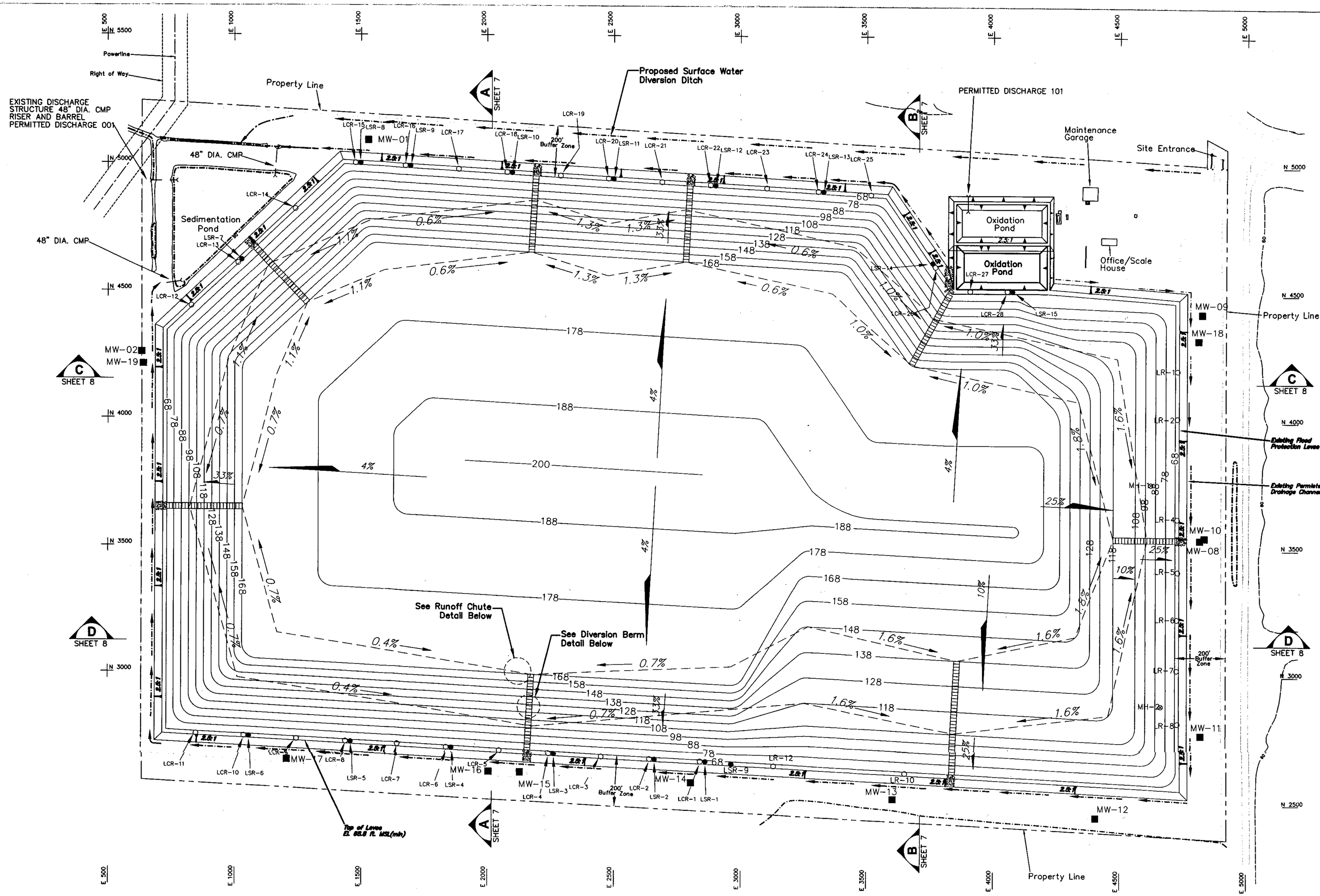


LEGEND

- EXISTING CONTOUR
- GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- DRAINAGE FLOW DIRECTION
- PROPOSED GROUNDWATER MONITOR WELL SYSTEM
- CROSS-SECTION LOCATION (SHEET 8)
- FINAL COVER ELEVATION CONTOUR (FT MSL)
- SLOPE ON TOP OF FINAL COVER
- LEACHATE CLEANOUT RISER (SHEET 10)
- LEACHATE SUMP RISER (SHEET 10)
- DIVERSION BERM SIZE (SEE SCHEDULE)
- LOCATION OF RUNOFF DIVERSION BERMS
- RUNOFF CHUTE
- EXISTING MANHOLE
- EXISTING LEACHATE RISER
- SLOPE PROTECTION

NOTE:

1.) SEE DETAIL 3 ON DRAWING 12 FOR FINAL COVER DETAIL

2.) PERMANENT ACCESS ROAD (NOT SHOWN) WILL BE CONSTRUCTED TO PROVIDE ACCESS FOR FINAL COVER MAINTENANCE.

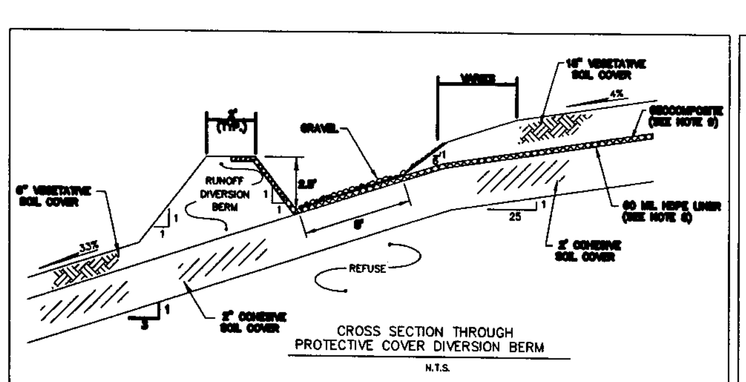
3.) RUNOFF CHUTES AND DIVERSION CHANNELS SHALL BE LINED WITH EROSION CONTROL MATS (ENKAMAT 7020 OR EQUIVALENT).

4.) ELEVATIONS SHOWN ARE MAXIMUM AND REPRESENT TOP OF FINAL COVER. FINAL CONTOUR LOCATIONS ARE APPROXIMATE.

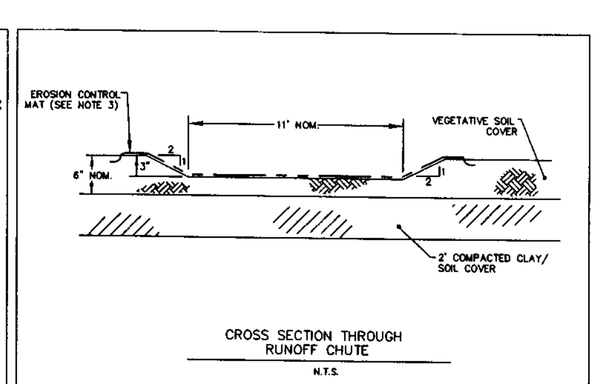
5.) PERIMETER DRAINAGE SYSTEM CALCULATIONS ARE PRESENTED IN APPENDIX E OF THE PERMIT. IMPROVEMENTS TO THE DRAINAGE SYSTEM SHALL BE IMPLEMENTED AS NEEDED DURING SITE DEVELOPMENT.

6.) THE RUNOFF DIVERSION BERMS AND CHUTES MAY BE CONSTRUCTED WITH FLATTER SLOPES PROVIDED THE BERM HEIGHT OR DEPTH REQUIREMENT IS MET.

7.) OWNER/OPERATOR MAY REPLACE THE SIXTY (60) MIL. HDPE LINER WITH A FORTY (40) MIL. FML DURING CONSTRUCTION OF THE FINAL COVER SYSTEM.



CROSS SECTION THROUGH PROTECTIVE COVER DIVERSION BERM
N.T.S.



CROSS SECTION THROUGH RUNOFF CHUTE
N.T.S.

STATE OF LOUISIANA
DALE L. STEIB
REG. No 28229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
6/20/06

0' 100' 200' 400'
SCALE

This map compiled by photogrammetric methods from aerial photography dated 6-10-2001. Vertical datum based on NGS Mean Sea Level, Contour Interval 2 ft. Grid based on arbitrary coordinate system. Re: Air Survey Corp. Project #7930433 Dashed contours indicate that ground is partially obscured by vegetation or shadows. These areas may not meet standard accuracy and require field testing/completion.

NO	REVISIONS	DRN	CHK	DATE
2	VERTICAL EXPANSION	DCA	DLS	04/01
1	ADDED BLOWER/FLARE LOCATION AND REVISED SOUTH-EAST GAS COLLECTION HEADERS AND GAS EXTRACTION WELLS	JEP	TLR	03/97

BATON ROUGE, LOUISIANA

DRN		PARTIN
DES	INI	RICHARDSON
CHK	INI	MARTIN
APP	INI	RICHARDSON

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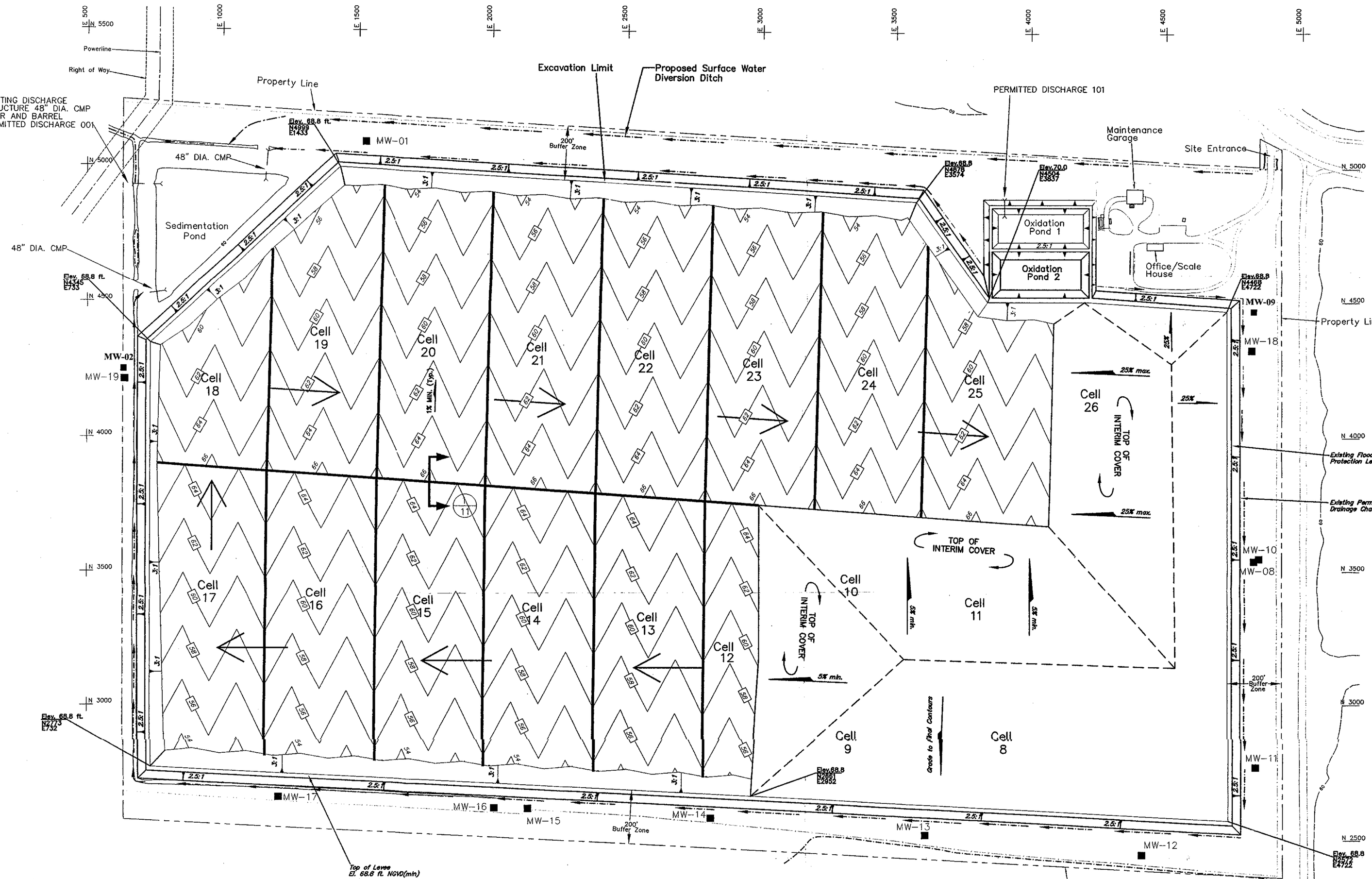
PREPARED FOR: WM WASTE MANAGEMENT

PREPARED BY: EARTH TECH, Baton Rouge, Louisiana

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

CLOSURE COVER AND SURFACE WATER MANAGEMENT PLAN

DATE	06-20-06 10:30 A.M.
PROJECT NO	50504
FILENAME	42891ASP.DWG
SHEET NO	5 of 15
DRAWING NO	5



LEGEND

- EXISTING CONTOUR
- GRID COORDINATE
- PROPERTY BOUNDARY
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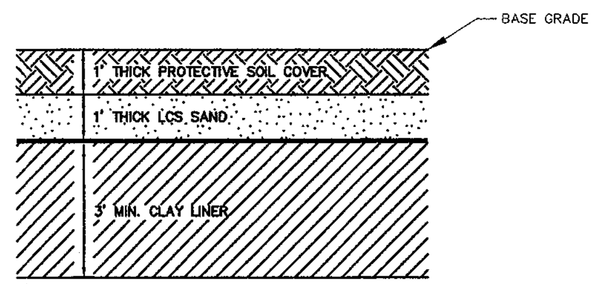
- EXISTING GROUNDWATER MONITOR WELL SYSTEM
- PROPOSED EXCAVATION GRADE CONTOUR
- CELL DIVIDER BERM
- SLOPE FOR TOP OF INTERIM OR FINAL COVER
- FILL DIRECTION
- CROSS-SECTION LOCATION



Section thru Floor of Landfill

NOTES:

1. IF THE LANDFILL DEVELOPMENT SEQUENCE VARIES SIGNIFICANTLY FROM THAT SHOWN DUE TO OPERATIONAL CONSIDERATIONS LDEQ SOLID WASTE DIVISION WILL BE NOTIFIED.

0' 100' 200' 400'
SCALE

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 29229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
1/12/05

This map compiled by photogrammetric methods from aerial photography dated 6-10-2001. Vertical datum based on NGS Mean Sea Level, Contour Interval 2 ft. Grid based on arbitrary coordinate system. Re: Air Survey Corp. Project #7930433 Dashed contours indicate that ground is partially obscured by vegetation or shadows. These areas may not meet standard accuracy and require field testing/completion.

NO	REVISIONS	DATE	DRN	CHK
1	VERTICAL EXPANSION	01/02	JPA	DLS

BATON ROUGE, LOUISIANA

DRN		MCNAMARA
DES	INI	RICHARDSON
CHK	INI	MARTIN
APP	INI	RICHARDSON

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WASTE MANAGEMENT

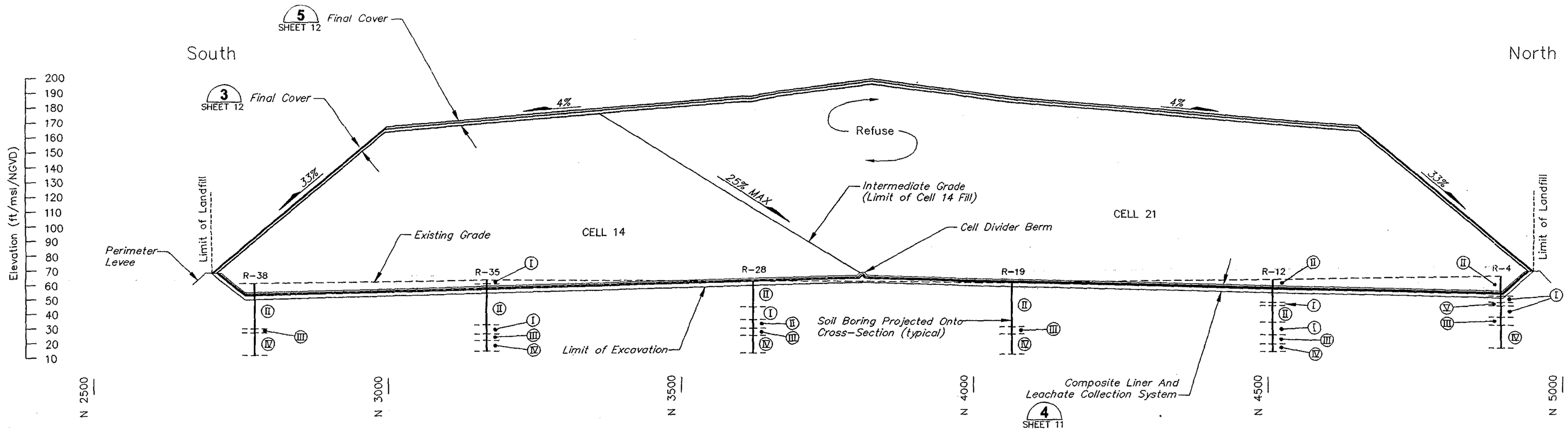
PREPARED FOR

PREPARED BY EARTH TECH
Baton Rouge, Louisiana

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

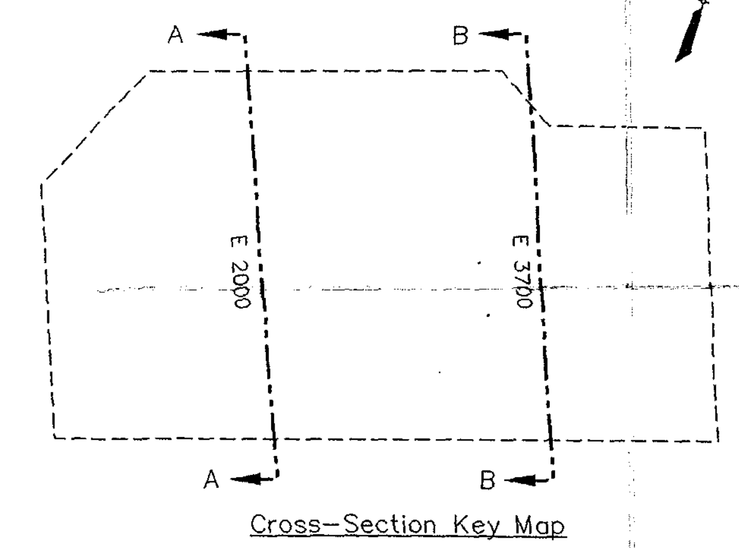
LANDFILL DEVELOPMENT PLAN

DATE	01/11/05 4:25 P.M.
PROJECT NO	42891.010
FILENAME	42891LDP.DWG
SHEET NO	6 of 15
DRAWING NO	6

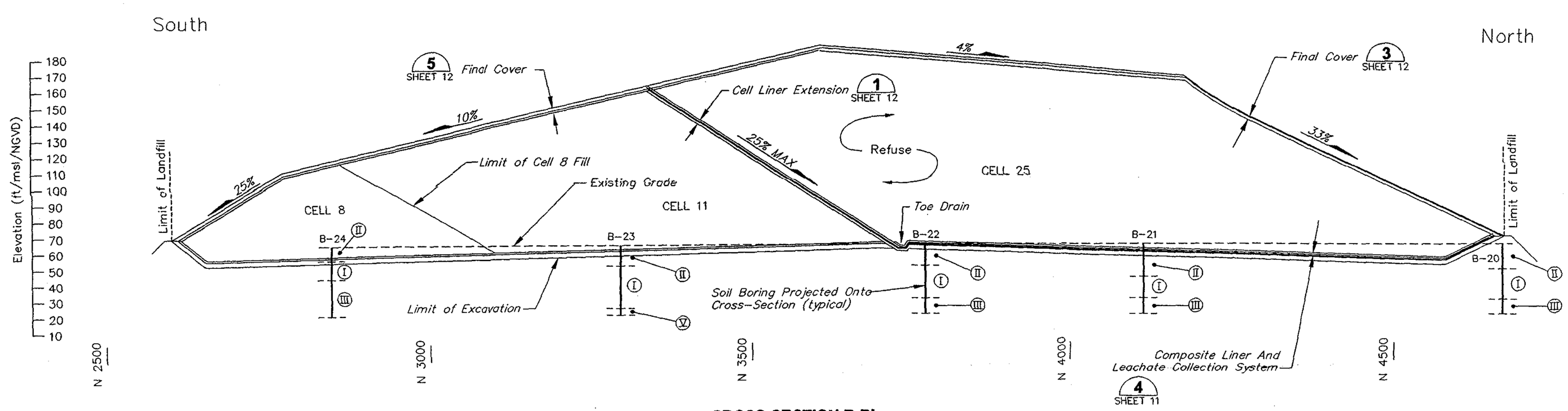


CROSS-SECTION A-A'

HORIZ. 0' 50' 100' 200'
VERT. 0' 40' 80'
SCALE



Cross-Section Key Map



CROSS-SECTION B-B'

HORIZ. 0' 50' 100' 200'
VERT. 0' 40' 80'
SCALE

NOTES

1. CROSS-SECTION LOCATIONS ARE SHOWN ON DRAWING NO. 5.

SOIL DEFINITIONS

(I) SOFT TO VERY STIFF REDDISH-BROWN CLAY (CH)
(II) SOFT TO MEDIUM STIFF REDDISH-BROWN & LIGHT GRAY SILTY CLAY (CL)
(III) VERY LOOSE TO LOOSE BROWN CLAYEY SILT (ML)
(IV) LOOSE TO MEDIUM DENSE BROWN SILTY SAND (SM)
(V) MEDIUM TO DENSE BROWN SAND (SP)

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 28223
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
5/14/03

NO	REVISIONS	DATE	DRN	CHK
1	VERTICAL EXPANSION	04/01	DCA	DLS

BATON ROUGE, LOUISIANA
DRN MCNAMARA
DES RICHARDSON
CHK MARTIN
APP RICHARDSON

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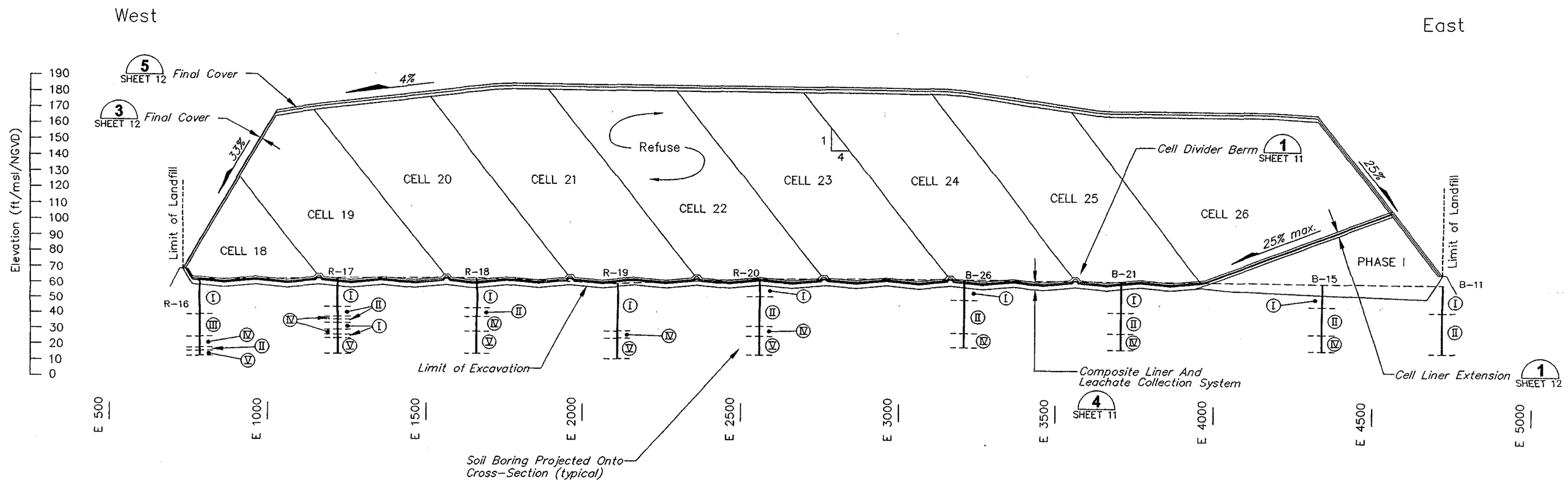
WASTE MANAGEMENT
EARTH TECH
Baton Rouge, Louisiana

PREPARED FOR
PREPARED BY

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

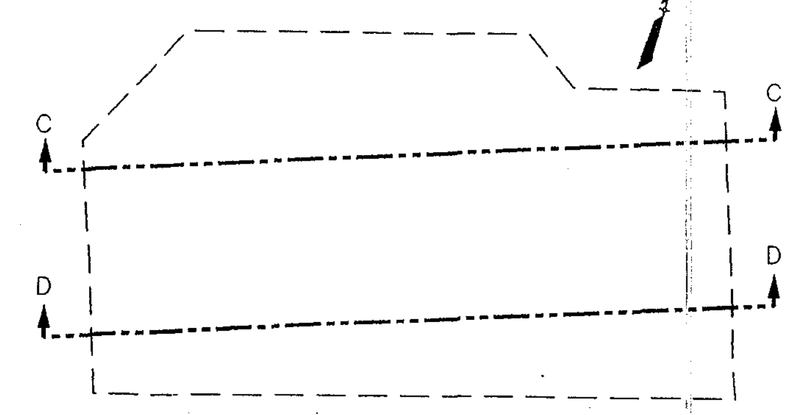
LANDFILL CROSS-SECTIONS

DATE 01-28-03 10:30 A.M.
PROJECT NO 42891.010
FILENAME 42891AS1.DWG
SHEET NO 7 of 15

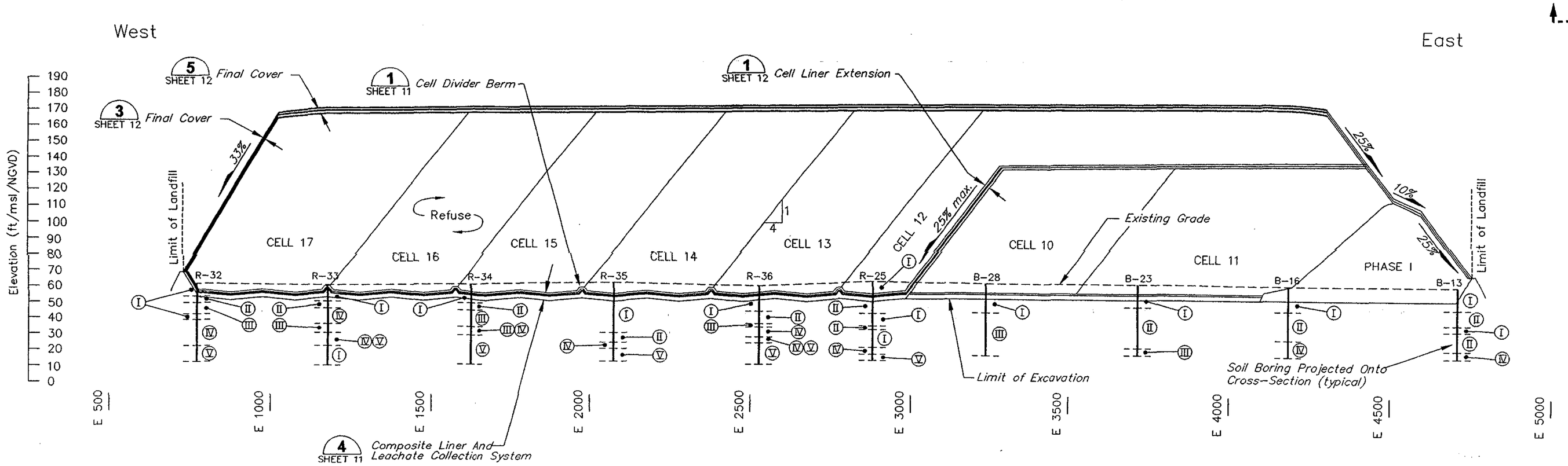


CROSS-SECTION C-C

HORIZ. 0' 100' 200' 400'
VERT. 0' 40' 80'
SCALE



Cross-Section Key Map



CROSS-SECTION D-D

HORIZ. 0' 100' 200' 400'
VERT. 0' 40' 80'
SCALE

NOTES

1. CROSS-SECTION LOCATIONS ARE SHOWN ON DRAWING NO. 5.

SOIL DEFINITIONS

- (I) SOFT TO VERY STIFF REDDISH-BROWN CLAY (CH)
- (II) SOFT TO MEDIUM STIFF REDDISH-BROWN & LIGHT GRAY SILTY CLAY (CL)
- (III) VERY LOOSE TO LOOSE BROWN CLAYEY SILT (ML)
- (IV) LOOSE TO MEDIUM DENSE BROWN SILTY SAND (SM)
- (V) MEDIUM TO DENSE BROWN SAND (SP)

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 28229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
3/10/03

NO	REVISIONS	DRN	CHK	DATE
1	VERTICAL EXPANSION	DCA	DLS	04/01

BATON ROUGE, LOUISIANA

DRN		MCNAMARA
DES	INI	RICHARDSON
CHK	INI	MARTIN
APP	INI	RICHARDSON

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WASTE MANAGEMENT

EARTH TECH
Baton Rouge, Louisiana

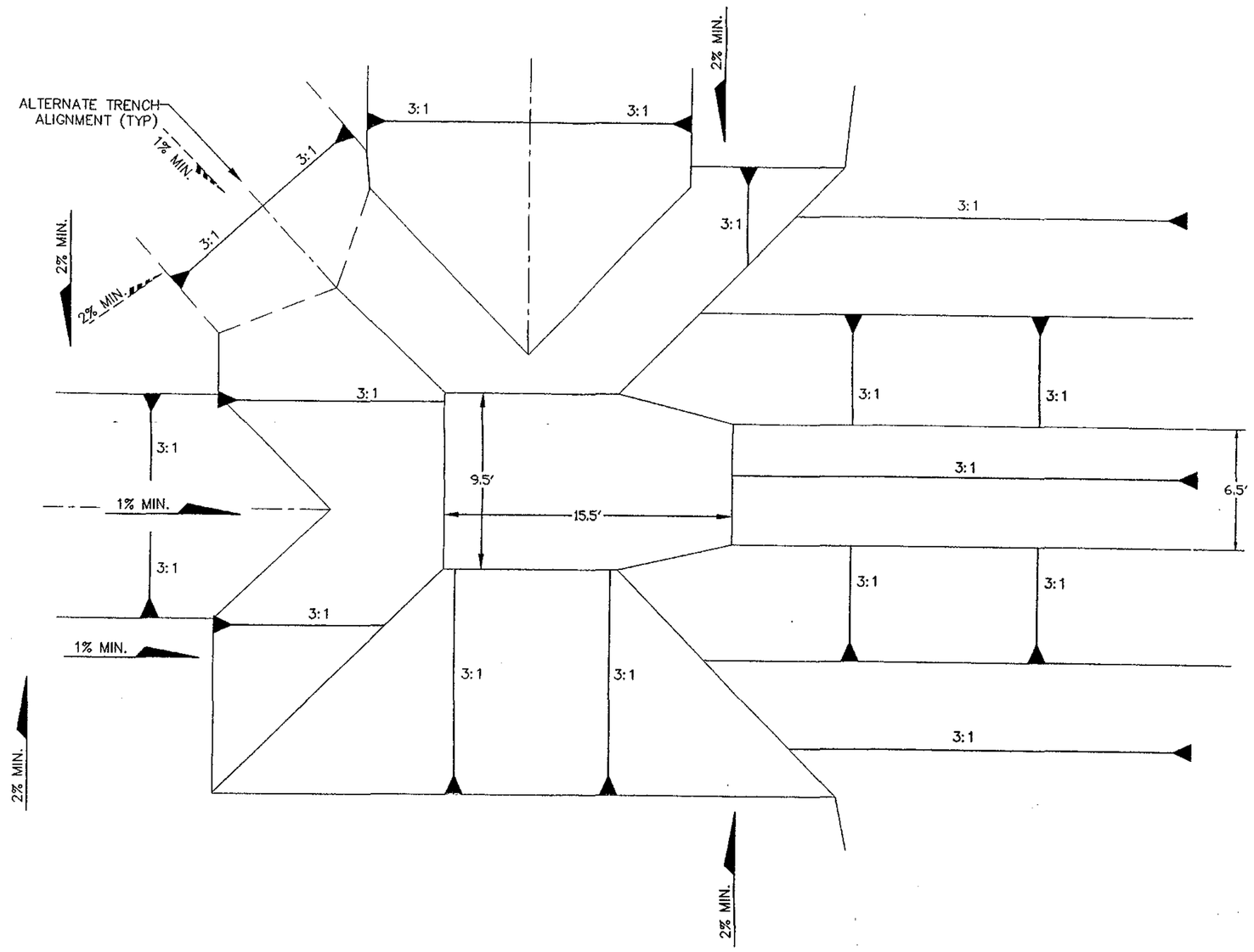
PREPARED FOR

PREPARED BY

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

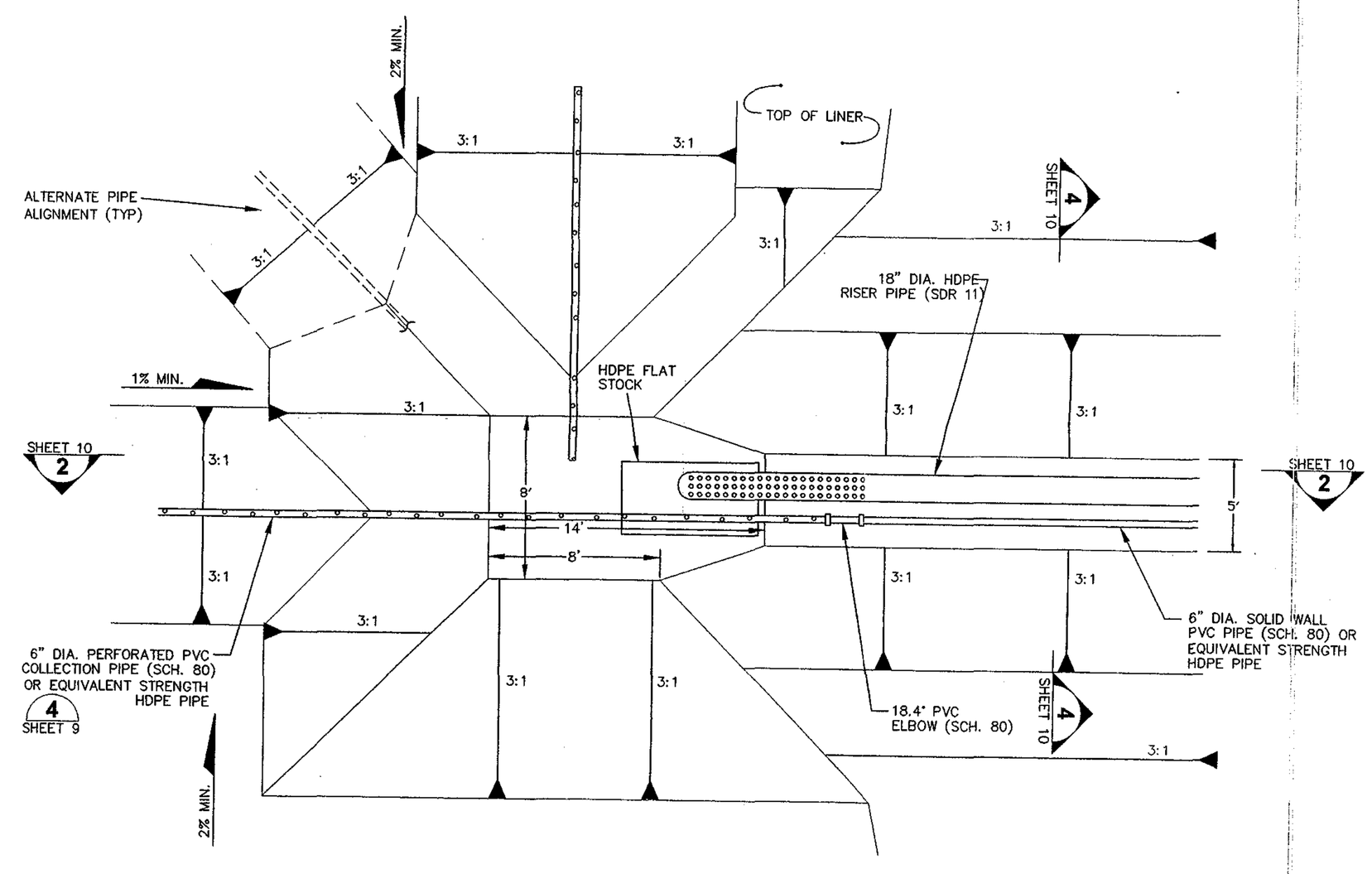
LANDFILL CROSS-SECTIONS

DATE	01-28-03 10:30 A.M.
PROJECT NO	42891.010
FILENAME	42891AS2.DWG
SHEET NO	8 of 15
DRAWING NO	8



LEACHATE COLLECTION SUMP EXCAVATION PLAN 1

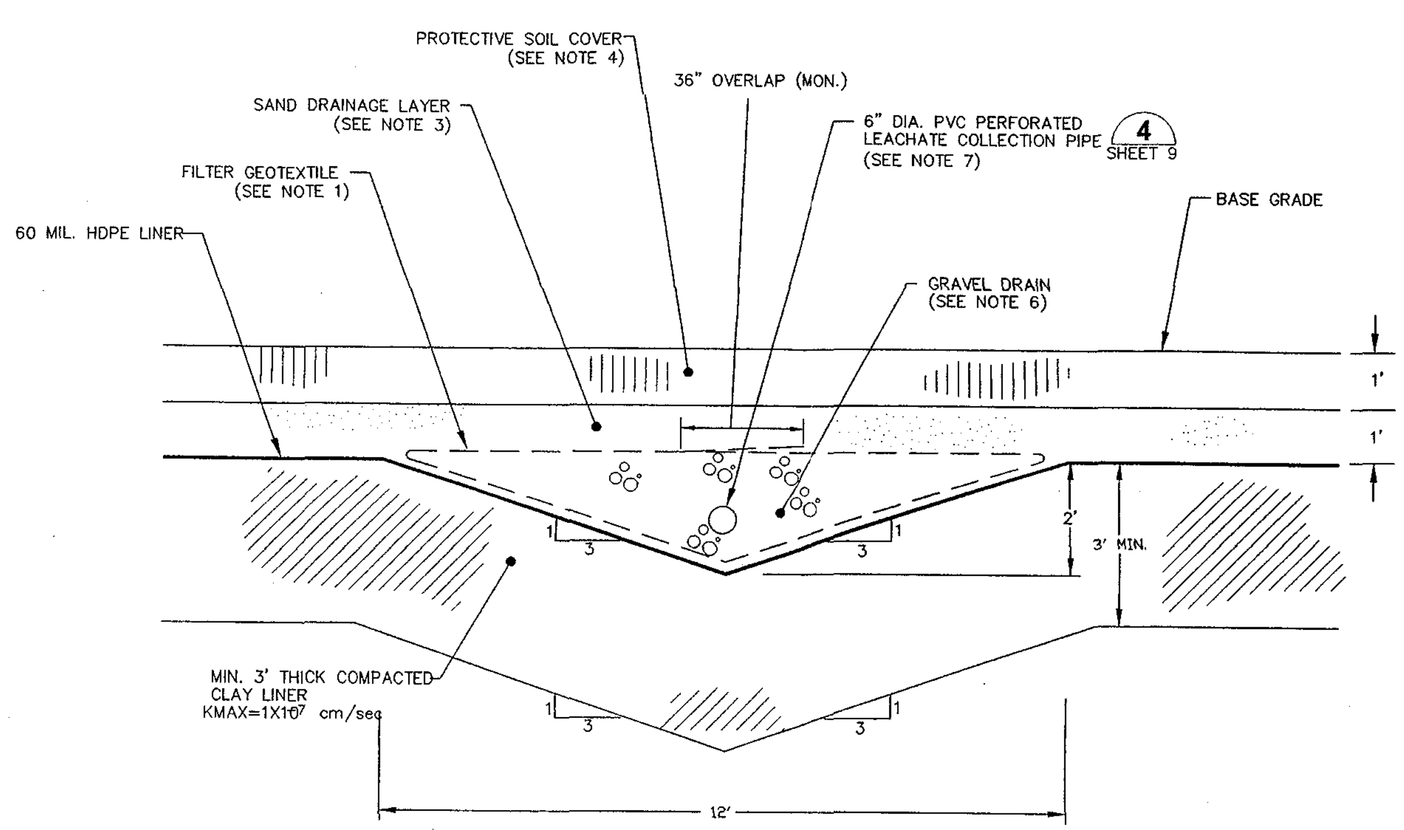
0' 2.5' 5'
SCALE



LEACHATE COLLECTION SUMP PLAN (TOP OF LINER) 2

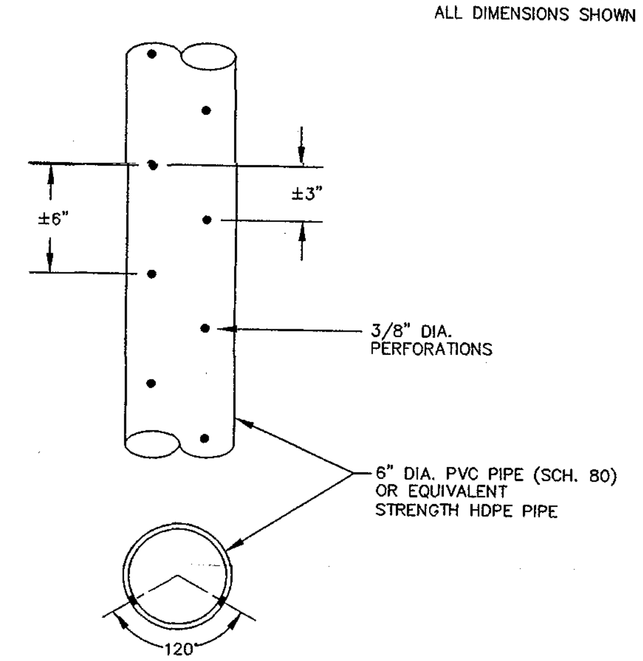
0' 2.5' 5'
SCALE

NOTE:
THE ORIENTATION AND NUMBER OF LEACHATE COLLECTION LINES MAY VARY FROM SUMP TO SUMP. THIS PLAN VIEW SHOWS A TYPICAL LAYOUT.
ALL DIMENSIONS SHOWN ARE TYPICAL.



LEACHATE COLLECTION TRENCH DETAIL 3

0' 1' 2'
SCALE



PVC LEACHATE COLLECTION PIPE PERFORATION 4

0' 1' 2'
SCALE

NOTES:

1. GEOTEXTILE TO BE TREVIRA 1135 OR AMOCO 4512 OR OWNER-APPROVED EQUAL.
2. IF FILTER CHARACTERISTICS OF ADJACENT DRAINAGE AND PROTECTIVE LAYERS ARE NOT COMPATIBLE, A GEOTEXTILE FILTER SHALL BE PLACED BETWEEN THE LAYERS.
3. GRANULAR DRAINAGE BLANKET TO BE A CLEAN SAND WITH <5% PASSING NUMBER 200 SIEVE AND WITH A MINIMUM 95% PASSING THE 1/4" SIEVE AND WITH A MINIMUM HYDRAULIC CONDUCTIVITY OF 1x10 cm/sec OR GREATER. OWNER MAY REPLACE GRANULAR DRAINAGE BLANKET WITH FILTER GEOTEXTILE AND GEONET OR GEOCOMPOSITE LAYER WHICH MEETS LEACHATE COLLECTION SYSTEM DESIGN STANDARDS. IF TIRE CHIPS ARE UTILIZED AS PROTECTIVE COVER THEN A MINIMUM OF 12 INCHES OF GRANULAR MATERIAL SHALL BE PLACED BETWEEN THE TIRE CHIPS AND THE DRAINAGE COMPOSITE.
4. MATERIAL USED AS PROTECTIVE SOIL COVER ON THE SLOPES AND FLOOR SHALL BE RELATIVELY FREE OF LARGE ROOTS, GRAVEL, CABLES, AND EXCESSIVE MOISTURE. AS AN ALTERNATIVE, TIRE CHIPS MAY ALSO BE UTILIZED AS PROTECTIVE COVER ON TOP THE 1 FOOT GRANULAR DRAINAGE BLANKET.
5. WASHED GRAVEL, PROTECTIVE LAYER, AND GRANULAR DRAINAGE BLANKET SHALL NOT CONTAIN GREATER THAN 15% CALCIUM CARBONATE.
6. WASHED GRAVEL SHALL HAVE A MAXIMUM PARTICLE SIZE OF 3" AND <5% LESS THAN 1/2". (SEE NOTE 5)
7. THE PVC PERFORATED LCS PIPE SHALL BE INSTALLED OVER 6" OF GRAVEL DRAIN MATERIAL.
8. ALL DIMENSIONS INDICATE MINIMUM VALUES UNLESS OTHERWISE NOTED.
9. IF DIMENSIONS CHANGE SIGNIFICANTLY FROM THAT SHOWN, LDEQ SOLID WASTE DIVISION MUST BE NOTIFIED.

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 28229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING

DATE	DESCRIPTION	BY
2	VERTICAL EXPANSION	DLS
1	TIRE CHIP MOD	DLS

REVISIONS

LINER AND LEACHATE COLLECTION SYSTEM DETAILS

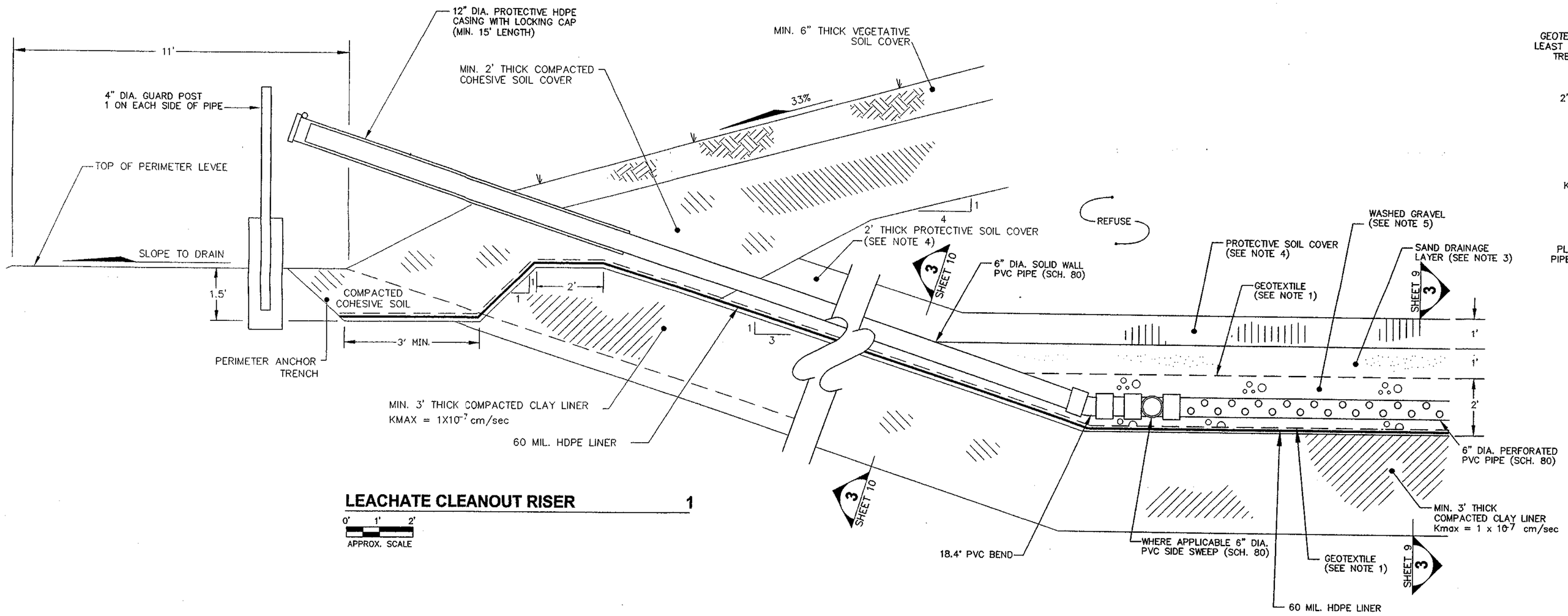
PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

WASTE MANAGEMENT

SIGMA ENGINEERS & CONSTRUCTORS
JOB NO. 31107

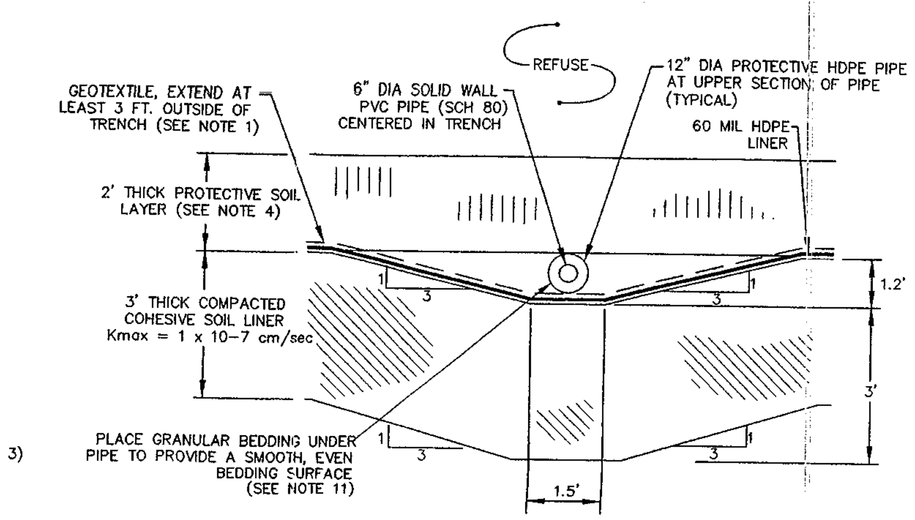
DESIGNED	DRAWN	CHECKED	APPROVED
DLS	JAB	DLS	DLS

DRAWING 10



LEACHATE CLEANOUT RISER 1

0' 1' 2'
APPROX. SCALE

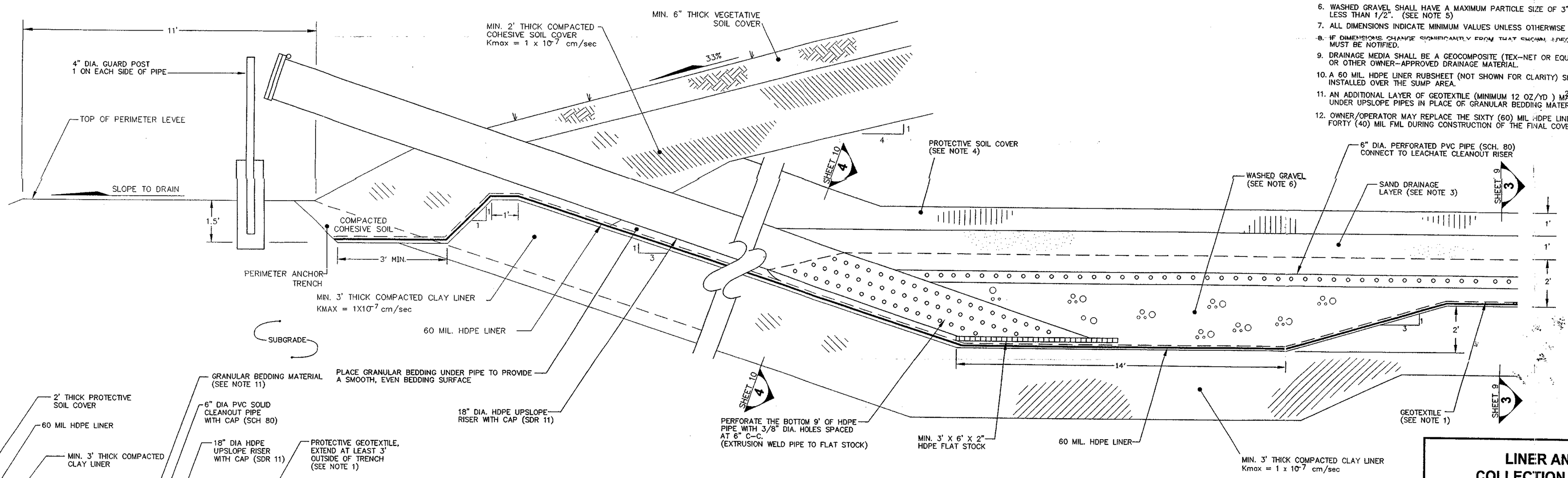


CLEANOUT RISER TRENCH 3

0' 1' 2'
SCALE

NOTES:

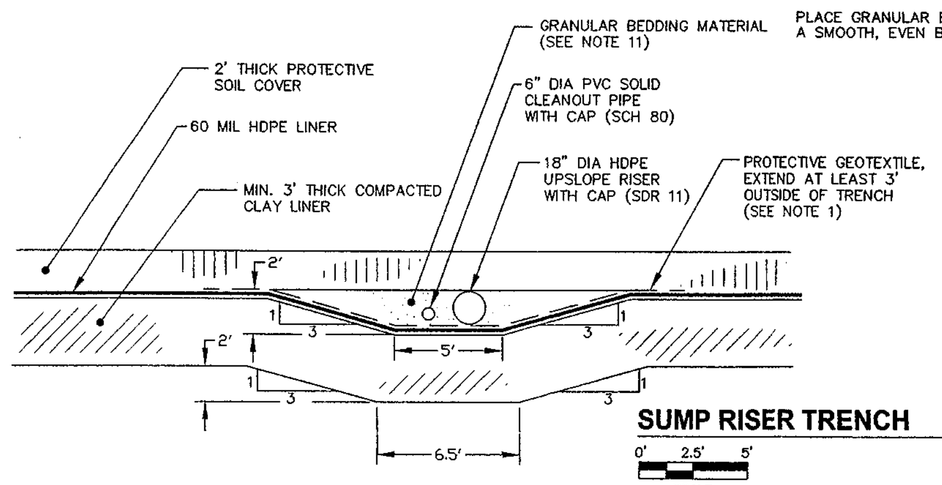
1. GEOTEXTILE TO BE TREVIRA 1135 OR AMOCO 4512 OR OWNER-APPROVED EQUAL.
2. IF FILTER CHARACTERISTICS OF ADJACENT DRAINAGE AND PROTECTIVE LAYERS ARE NOT COMPATIBLE, A GEOTEXTILE FILTER SHALL BE PLACED BETWEEN THE LAYERS.
3. GRANULAR DRAINAGE BLANKET TO BE A CLEAN SAND WITH <5% PASSING NUMBER 200 SIEVE AND WITH A MINIMUM 95% PASSING THE 1/4" SIEVE AND WITH A MINIMUM HYDRAULIC CONDUCTIVITY OF 1x10 cm/sec OR GREATER. OWNER MAY REPLACE GRANULAR DRAINAGE BLANKET WITH FILTER GEOTEXTILE AND GEONET OR GEOCOMPOSITE LAYER WHICH MEETS LEACHATE COLLECTION SYSTEM DESIGN STANDARDS. IF TIRE CHIPS ARE UTILIZED AS PROTECTIVE COVER THEN A MINIMUM OF 12 INCHES OF GRANULAR MATERIAL SHALL BE PLACED BETWEEN THE TIRE CHIPS AND THE DRAINAGE COMPOSITE.
4. MATERIAL USED AS PROTECTIVE SOIL COVER ON THE SLOPES AND FLOOR SHALL BE RELATIVELY FREE OF LARGE ROOTS, GRAVEL, CABLES, AND EXCESSIVE MOISTURE. AS AN ALTERNATIVE, TIRE CHIPS MAY ALSO BE UTILIZED AS PROTECTIVE COVER ON TOP THE 1 FOOT GRANULAR DRAINAGE BLANKET.
5. WASHED GRAVEL, PROTECTIVE LAYER, AND GRANULAR DRAINAGE BLANKET SHALL NOT CONTAIN GREATER THAN 15% CALCIUM CARBONATE.
6. WASHED GRAVEL SHALL HAVE A MAXIMUM PARTICLE SIZE OF 3" AND <5% LESS THAN 1/2". (SEE NOTE 5)
7. ALL DIMENSIONS INDICATE MINIMUM VALUES UNLESS OTHERWISE NOTED.
8. IF DIMENSIONS CHANGE SIGNIFICANTLY FROM THAT SHOWN, THEN SOLID WASTE DIVISION MUST BE NOTIFIED.
9. DRAINAGE MEDIA SHALL BE A GEOCOMPOSITE (TEX-NET OR EQUIVALENT) OR OTHER OWNER-APPROVED DRAINAGE MATERIAL.
10. A 60 MIL. HDPE LINER RUBSHEET (NOT SHOWN FOR CLARITY) SHALL ALSO BE INSTALLED OVER THE SUMP AREA.
11. AN ADDITIONAL LAYER OF GEOTEXTILE (MINIMUM 12 OZ/YD^2) MAY BE PLACED UNDER UPSLOPE PIPES IN PLACE OF GRANULAR BEDDING MATERIAL.
12. OWNER/OPERATOR MAY REPLACE THE SIXTY (60) MIL HDPE LINER WITH A FORTY (40) MIL FML DURING CONSTRUCTION OF THE FINAL COVER SYSTEM.



LEACHATE CLEANOUT RISER 2

0' 1' 2'
APPROX. SCALE

NOTE: UPSLOPE CLEANOUT RISER PIPE NOT SHOWN FOR CLARITY.



SUMP RISER TRENCH 4

0' 2.5' 5'
SCALE

STATE OF LOUISIANA
DALE L. STEB
REG. No. 25229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
11/03/07

DATE	DESCRIPTION	BY
2	VERTICAL EXPANSION	DLS
1	TIRE CHIP MOD	DLS

REVISIONS

LINER AND LEACHATE COLLECTION SYSTEM DETAILS

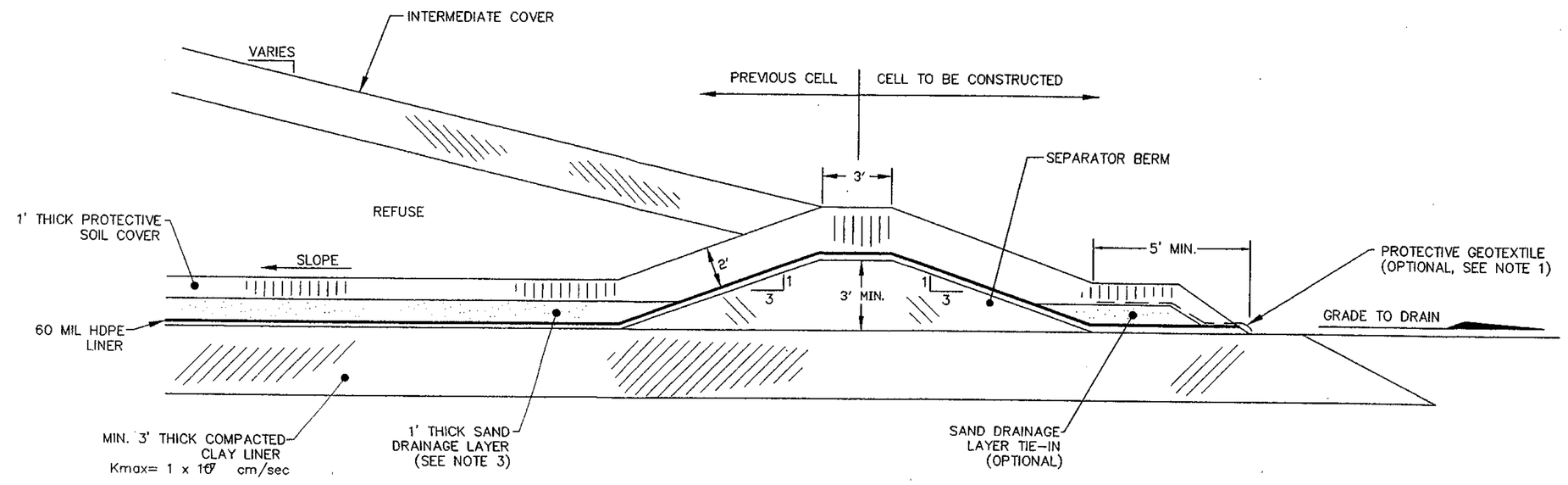
PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

WASTE MANAGEMENT

SIGMA ENGINEERS & CONSTRUCTORS
JOB NO. 31102

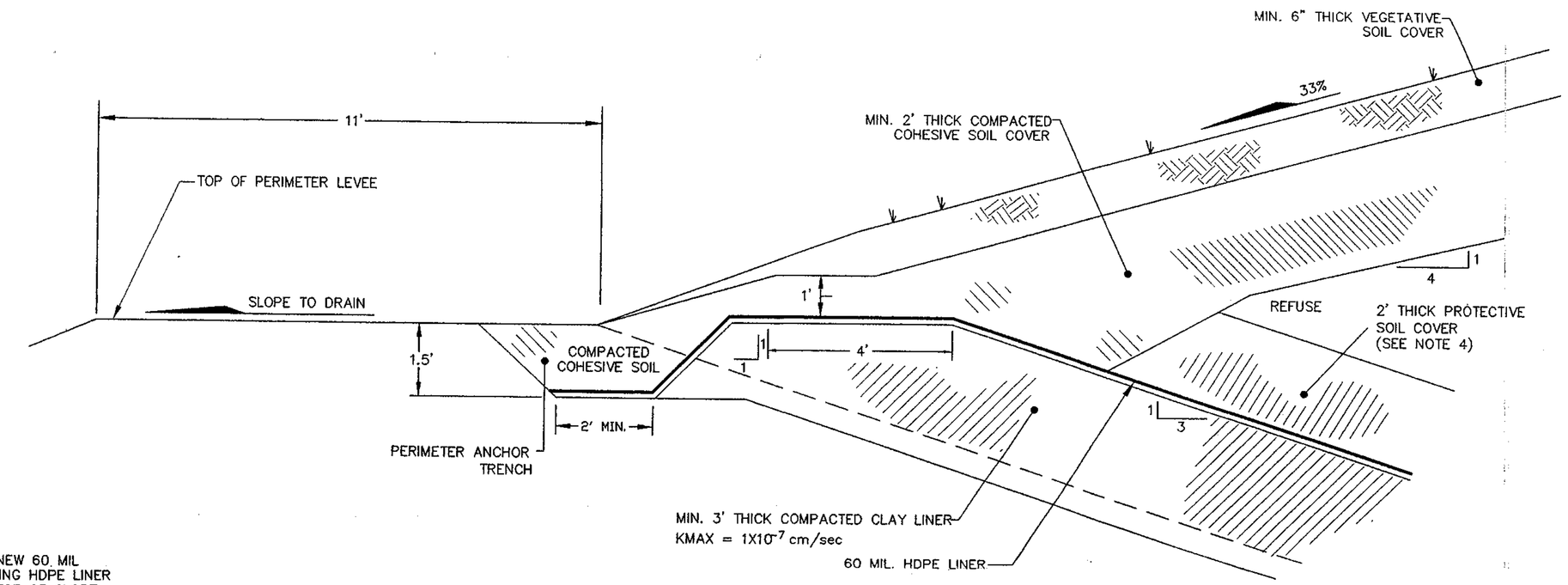
DESIGNED	DRAWN	CHECKED	APPROVED
DLS	JAB	DLS	DLS

DRAWING 11



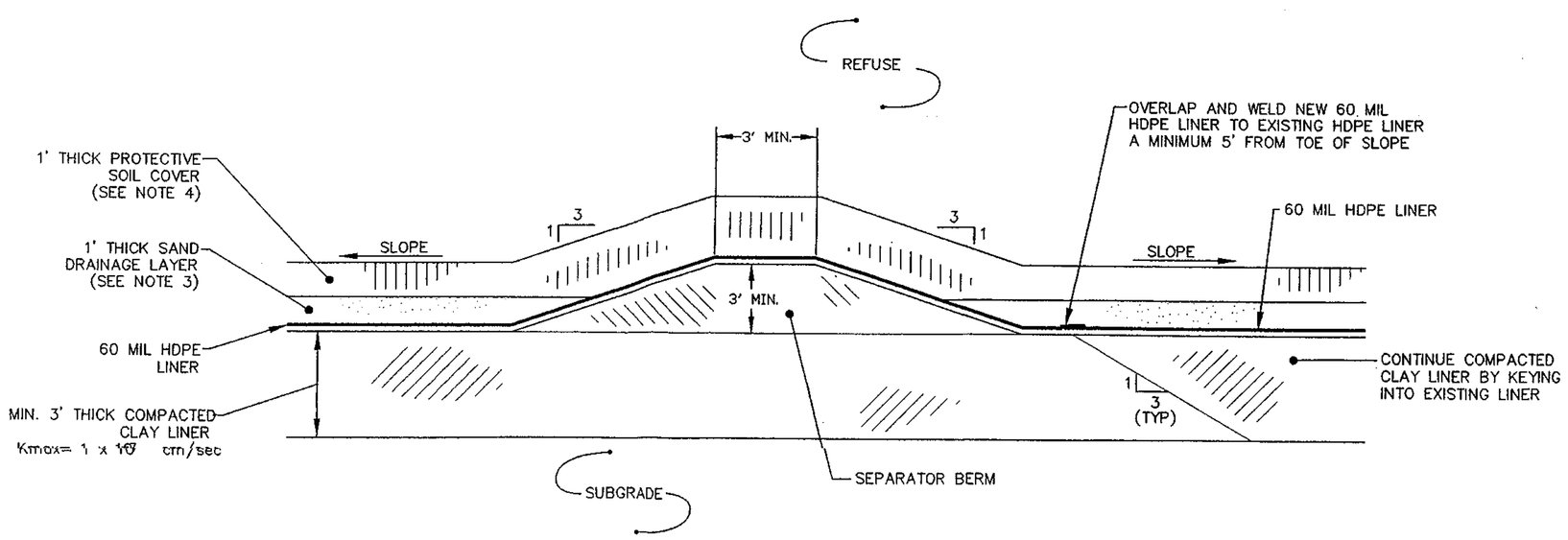
SEPARATOR BERM BETWEEN CELLS 1

0' 2' 4'
SCALE



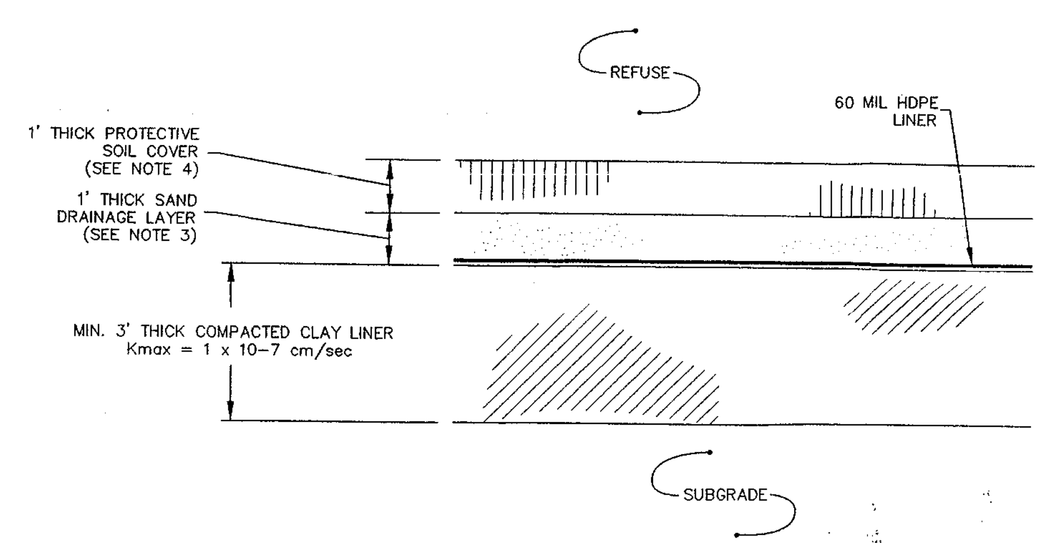
ANCHOR TRENCH DETAIL 2

NOT TO SCALE



LINER CONNECTION BETWEEN CELLS 3

0' 1.5' 3'
SCALE



LINER SECTION 4

0' 1' 2'
SCALE

NOTES:

1. GEOTEXTILE TO BE TREVIRA 1135 OR AMOCO 4512 OR OWNER-APPROVED EQUAL.
2. IF FILTER CHARACTERISTICS OF ADJACENT DRAINAGE AND PROTECTIVE LAYERS ARE NOT COMPATIBLE, A GEOTEXTILE FILTER SHALL BE PLACED BETWEEN THE LAYERS.
3. GRANULAR DRAINAGE BLANKET TO BE A CLEAN SAND WITH <5% PASSING NUMBER 200 SIEVE AND WITH A MINIMUM 95% PASSING THE 1/4" SIEVE AND WITH A MINIMUM HYDRAULIC CONDUCTIVITY OF $1x10^{-2}$cm/sec OR GREATER. OWNER MAY REPLACE GRANULAR DRAINAGE BLANKET WITH FILTER GEOTEXTILE AND GEONET OR GEOCOMPOSITE LAYER WHICH MEETS LEACHATE COLLECTION SYSTEM DESIGN STANDARDS. IF TIRE CHIPS ARE UTILIZED AS PROTECTIVE COVER THEN A MINIMUM OF 12 INCHES OF GRANULAR MATERIAL SHALL BE PLACED BETWEEN THE TIRE CHIPS AND THE DRAINAGE COMPOSITE.
4. MATERIAL USED AS PROTECTIVE SOIL COVER ON THE SLOPES AND FLOOR SHALL BE RELATIVELY FREE OF LARGE ROOTS, GRAVEL, CABLES, AND EXCESSIVE MOISTURE. AS AN ALTERNATIVE, TIRE CHIPS MAY ALSO BE UTILIZED AS PROTECTIVE COVER ON TOP THE 1 FOOT GRANULAR DRAINAGE BLANKET.
5. WASHED GRAVEL, PROTECTIVE LAYER, AND GRANULAR DRAINAGE BLANKET SHALL NOT CONTAIN GREATER THAN 15% CALCIUM CARBONATE.
6. DRAINAGE MEDIA SHALL CONSIST OF GEOCOMPOSITE (TEX-NET OR EQUIVALENT) OR OTHER OWNER-APPROVED MATERIAL.
7. IF DIMENSIONS CHANGE SIGNIFICANTLY FROM THAT SHOWN, LDEQ SOLID WASTE DIVISION MUST BE NOTIFIED.
8. OWNER/OPERATOR MAY REPLACE THE SIXTY (60) MIL HDPE LINER WITH A FORTY (40) MIL FML DURING CONSTRUCTION OF THE FINAL COVER SYSTEM.

STATE OF LOUISIANA
DALE L. STEB
REG. No. 28220
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
11/8/04

DATE	DESCRIPTION	BY
2	VERTICAL EXPANSION	DLS
1	TIRE CHIP MOD	DLS

REVISIONS

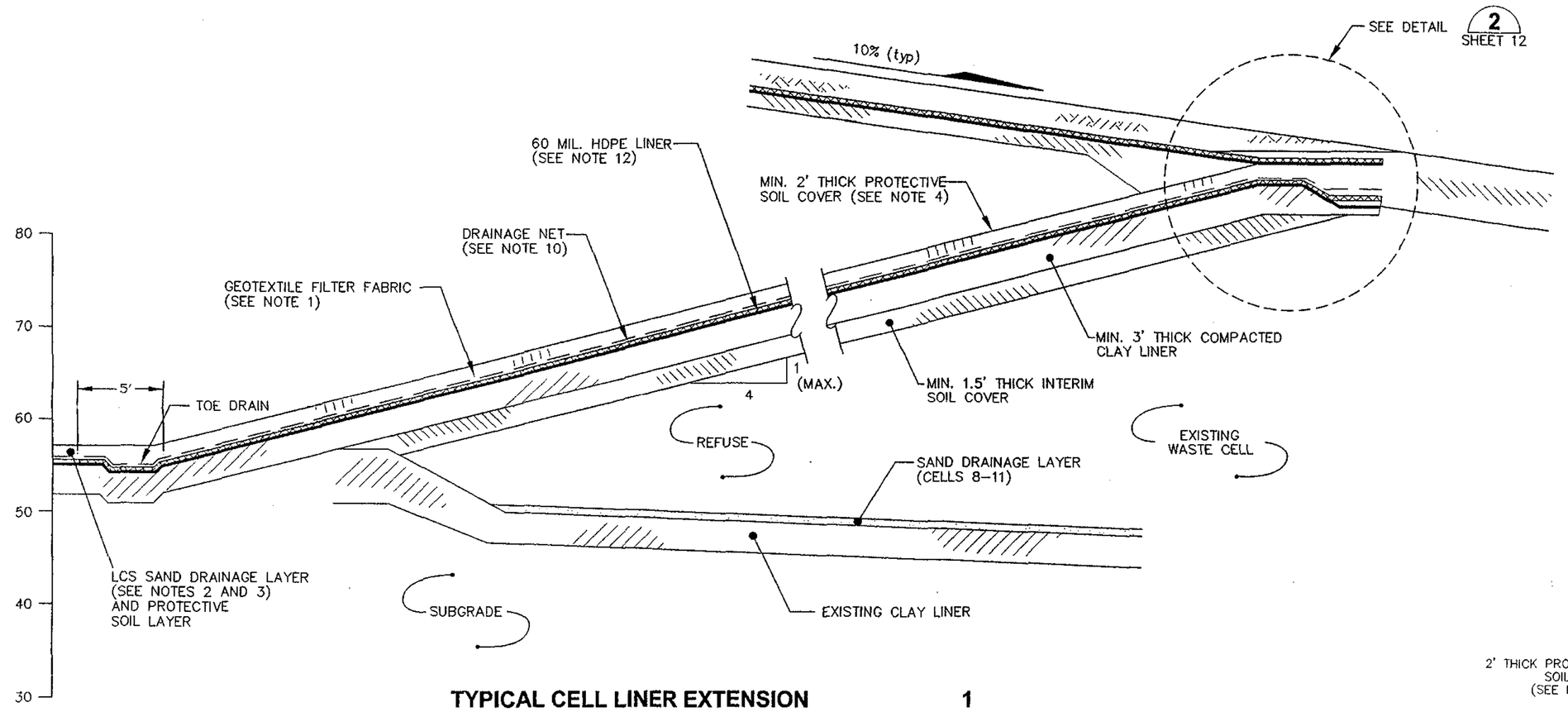
LINER AND LEACHATE COLLECTION SYSTEM DETAILS

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

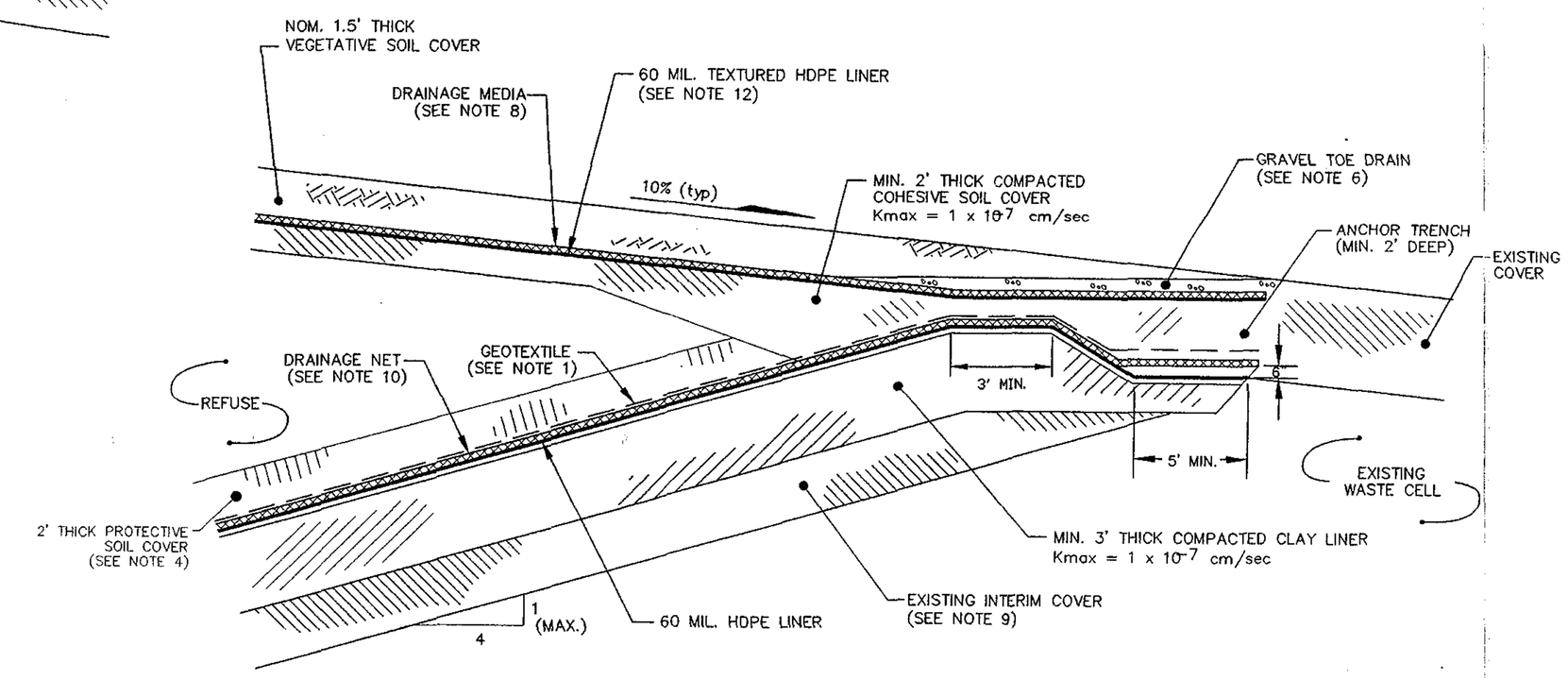
WASTE MANAGEMENT

SIGMA ENGINEERS & CONSTRUCTORS
JOB No. 31107

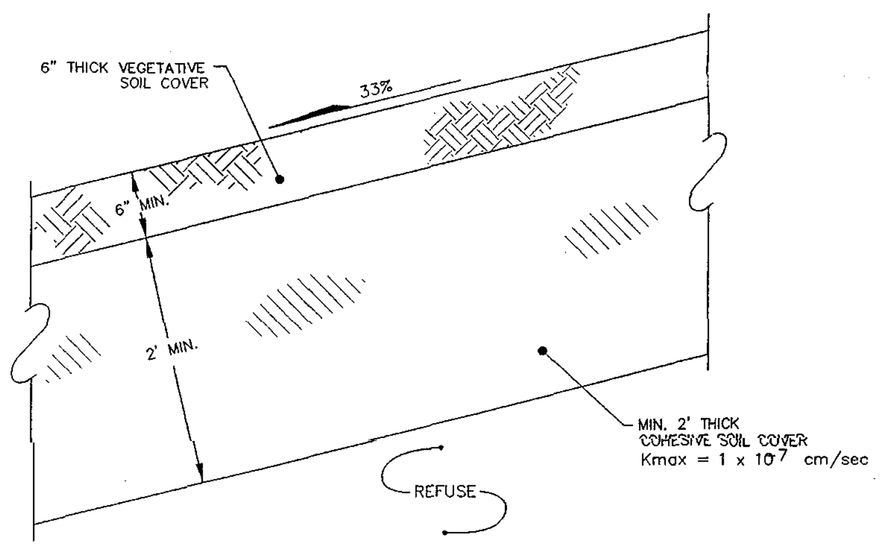
DESIGNED	DRAWN	CHECKED	APPROVED
DLS	JAB	DLS	DLS



TYPICAL CELL LINER EXTENSION 1

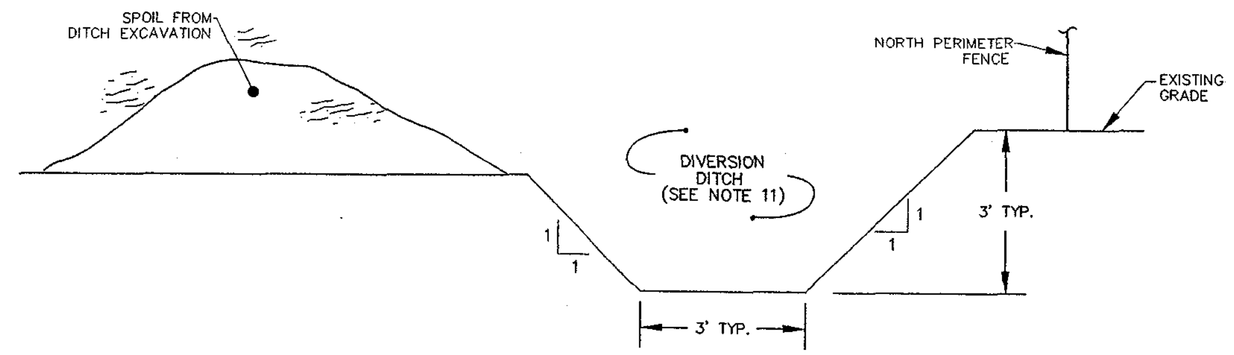


LINER EXTENSION DETAIL 2



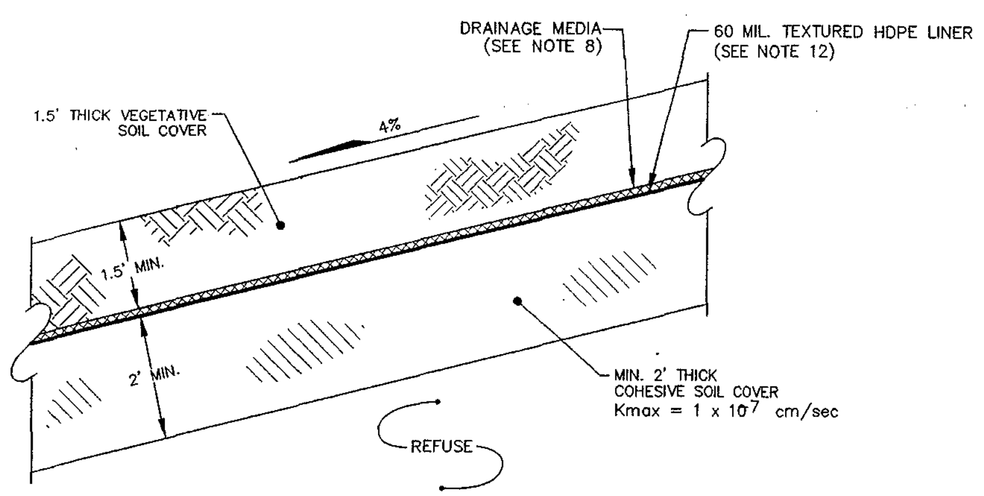
FINAL COVER DETAIL (33% SLOPE) 3

NOT TO SCALE



SURFACE WATER DIVERSION DITCH 4

NOT TO SCALE



FINAL COVER DETAIL (4% SLOPE) 5

NOT TO SCALE

NOTES:

1. GEOTEXTILE SHALL BE TREVIRA 1135 OR AMOCO 4512 OR OWNER-APPROVED EQUAL.
2. IF FILTER CHARACTERISTICS OF ADJACENT DRAINAGE AND PROTECTIVE LAYERS ARE NOT COMPATIBLE, A GEOTEXTILE FILTER SHALL BE PLACED BETWEEN THE LAYERS.
3. GRANULAR DRAINAGE BLANKET TO BE A CLEAN SAND WITH <5% PASSING NUMBER 200 SIEVE AND WITH A MINIMUM 95% PASSING THE 1/4" SIEVE AND WITH A MINIMUM HYDRAULIC CONDUCTIVITY OF 1x10 cm/sec OR GREATER. OWNER MAY REPLACE GRANULAR DRAINAGE BLANKET WITH FILTER GEOTEXTILE AND GEONET OR GEOCOMPOSITE LAYER WHICH MEETS LEACHATE COLLECTION SYSTEM DESIGN STANDARDS. IF TIRE CHIPS ARE UTILIZED AS PROTECTIVE COVER THEN A MINIMUM OF 12 INCHES OF GRANULAR MATERIAL SHALL BE PLACED BETWEEN THE TIRE CHIPS AND THE DRAINAGE COMPOSITE.
4. MATERIAL USED AS PROTECTIVE SOIL COVER ON THE SLOPES AND FLOOR SHALL BE RELATIVELY FREE OF LARGE ROOTS, GRAVEL, CABLES, AND EXCESSIVE MOISTURE. AS AN ALTERNATIVE, TIRE CHIPS MAY ALSO BE UTILIZED AS PROTECTIVE COVER ON TOP THE 1 FOOT GRANULAR DRAINAGE BLANKET.
5. PROTECTIVE SOIL COVER, AND GRANULAR DRAINAGE BLANKET SHALL NOT CONTAIN GREATER THAN 15% CALCIUM CARBONATE.
6. GRAVEL SHALL HAVE A MAXIMUM PARTICLE SIZE OF 3" AND <5% LESS THAN 1/2".
7. ALL DIMENSIONS INDICATE MINIMUM VALUES UNLESS OTHERWISE NOTED. IF DIMENSIONS CHANGE SIGNIFICANTLY FROM THAT SHOWN, LDEQ SOLID WASTE DIVISION MUST BE NOTIFIED.
8. DRAINAGE MEDIA SHALL BE A GEOCOMPOSITE (TEX-NET OR EQUIVALENT) OR OTHER OWNER-APPROVED DRAINAGE MATERIAL.
9. A MINIMUM OF 6 INCHES OF SOIL SHALL BE STRIPPED FROM THE EXISTING INTERIM COVER PRIOR TO CLAY LINER INSTALLATION.
10. THE DRAINAGE NET SHALL BE A HIGH DENSITY POLYETHYLENE DRAINAGE NET (POLY-NET PN-3000 OR EQUIVALENT).
11. THE SURFACE WATER DIVERSION DITCH WILL BE CONSTRUCTED, IF NEEDED, AT THE LOCATION SHOWN ON DRAWING NOS. 2 AND 3. DIMENSIONS AND SIDESLOPES OF THE DITCH MAY VARY FROM THOSE SHOWN.
12. OWNER/OPERATOR MAY REPLACE THE SIXTY (60) MIL HDPE LINER WITH A FORTY (40) MIL FML DURING CONSTRUCTION OF THE FINAL COVER SYSTEM.

STATE OF LOUISIANA
DALE L. STEB
REG. No. 29229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
11/8/04

DATE	DESCRIPTION	BY
2	VERTICAL EXPANSION	DLS
1	TIRE CHIP MOD	DLS

REVISIONS

LINER AND LEACHATE COLLECTION SYSTEM DETAILS

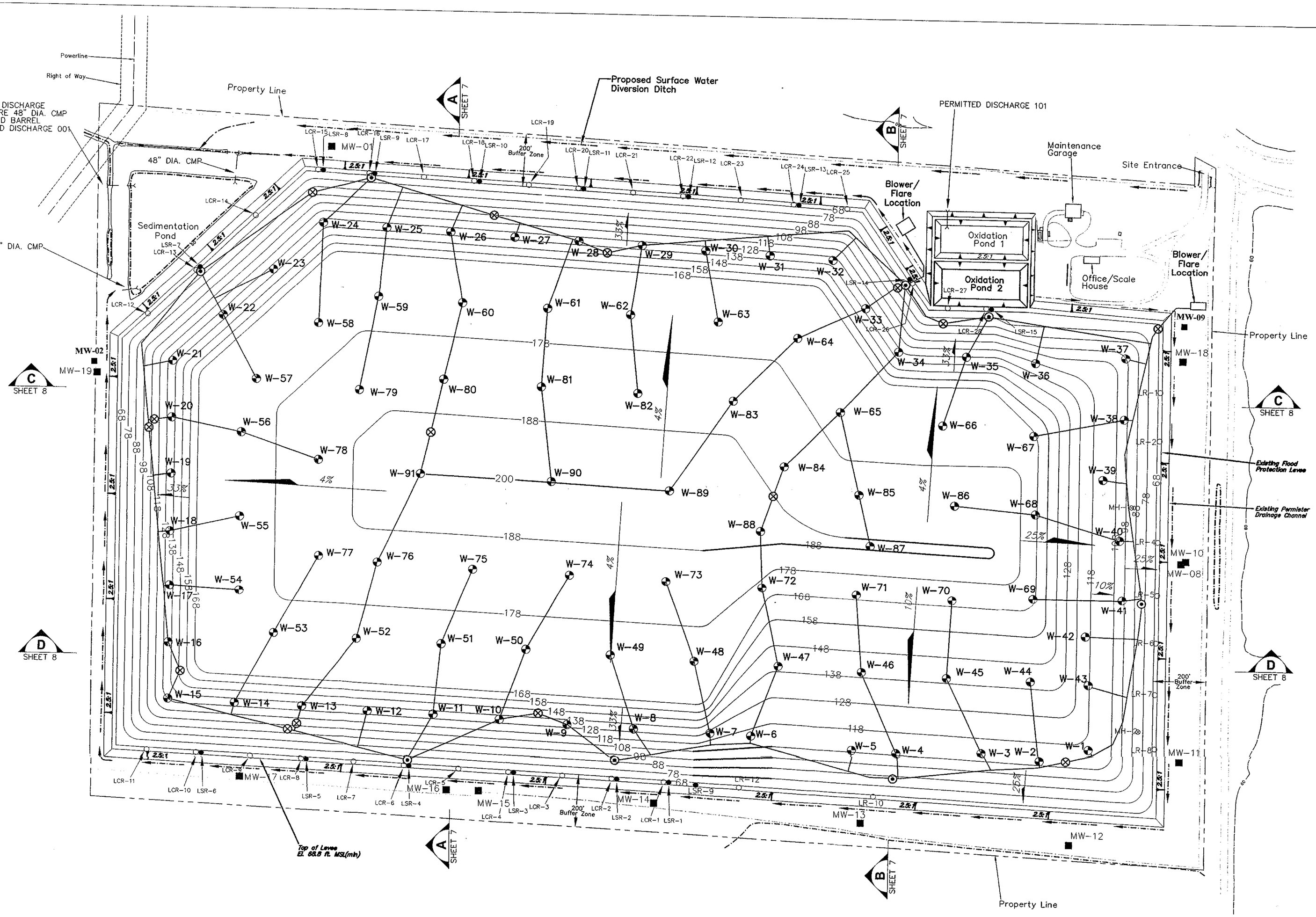
PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

WASTE MANAGEMENT

SIGMA ENGINEERS & CONSTRUCTORS
JOB NO. 31107

DESIGNED	DRAWN	CHECKED	APPROVED
DLS	JAB	DLS	DLS

NAME\DISK\PLOT



LEGEND

- EXISTING CONTOUR
- N 4500 GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- DRAINAGE FLOW DIRECTION
- EXISTING GROUNDWATER MONITOR WELL SYSTEM
- C SHEET 8 CROSS-SECTION LOCATION
- 70 FINAL COVER ELEVATION CONTOUR (FT MSL)
- 33% SLOPE ON TOP OF FINAL COVER
- LCR-4 LEACHATE CLEANOUT RISER 1 SHEET 10
- LSR-3 LEACHATE SUMP RISER 2 SHEET 10
- W-86 PROPOSED GAS EXTRACTION WELL
- GAS CONDENSATE DRAIN
- UNDERGROUND CONTROL VALVE
- GAS COLLECTION HEADER

0' 100' 200' 400'
SCALE

NOTES:

1. THE LOCATIONS OF THE BLOWER/FLARE STATIONS, GAS EXTRACTION WELLS, AND GAS COLLECTION HEADER ARE CONCEPTUAL AND ARE SUBJECT TO CHANGE. A DETAILED GAS MANAGEMENT SYSTEM DESIGN WILL BE PREPARED PRIOR TO THE CONSTRUCTION OF THE SYSTEM.
2. THE LANDFILL GAS MANAGEMENT SYSTEM APPROVED BY THE LDEQ ON JUNE 17, 1996 WILL BE EVALUATED FOR INCLUSION, IF APPROPRIATE, INTO THE GAS COLLECTION SYSTEM UPON FINAL DESIGN.

This map compiled by photogrammetric methods from aerial photography dated 6-10-2001. Vertical datum based on NGS Mean Sea Level, Contour Interval 2 ft. Grid based on arbitrary coordinate system. Re: Air Survey Corp. Project #7930433 Dashed contours indicate that ground is partially obscured by vegetation or shadows. These areas may not meet standard accuracy and require field testing/completion.

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 28229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
1/12/05

NO	REVISIONS	DRN	CHK	DATE
1	ADDED BLOWER/FLARE LOCATION AND REVISED SOUTH-EAST GAS COLLECTION HEADERS AND GAS EXTRACTION WELLS	DCA	DLS	04/01
2	VERTICAL EXPANSION	JEP	TLR	03/97

BATON ROUGE, LOUISIANA

DRN	PARTIN	
DES	INI	RICHARDSON
CHK	INI	MARTIN
APP	INI	RICHARDSON

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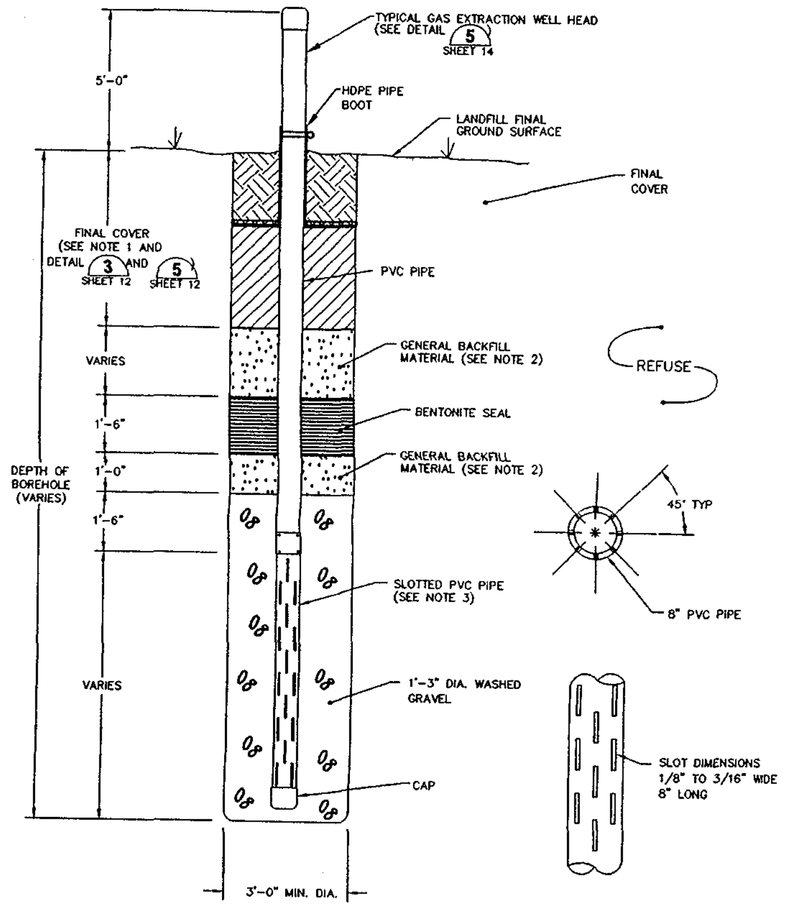
PREPARED FOR: WASTE MANAGEMENT

PREPARED BY: EARTH TECH, Baton Rouge, Louisiana

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

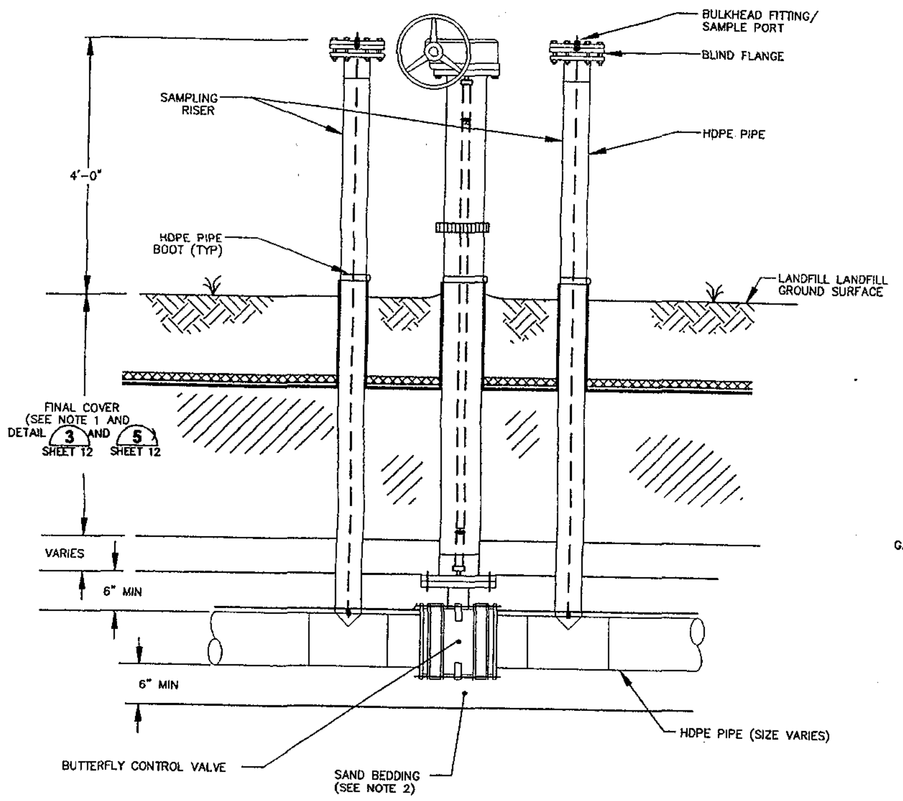
CONCEPTUAL GAS MANAGEMENT PLAN

DATE	07-06-01 4:30 P.M.
PROJECT NO	42891.010
FILENAME	42891ASP.DWG
SHEET NO	13 of 15
DRAWING NO	12



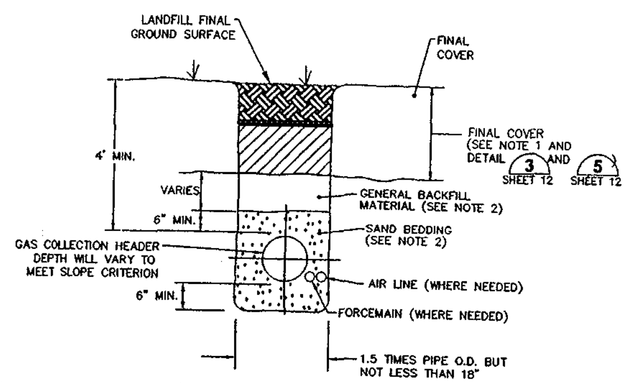
GAS EXTRACTION WELL 1

NOT TO SCALE



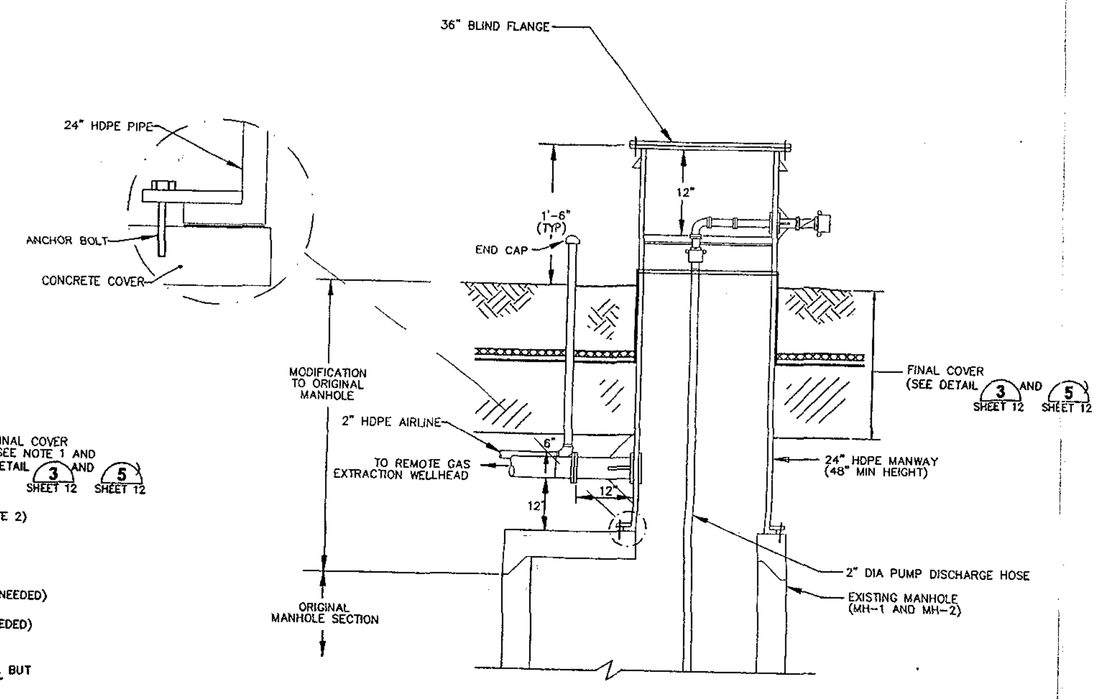
UNDERGROUND CONTROL VALVE 2

NOT TO SCALE



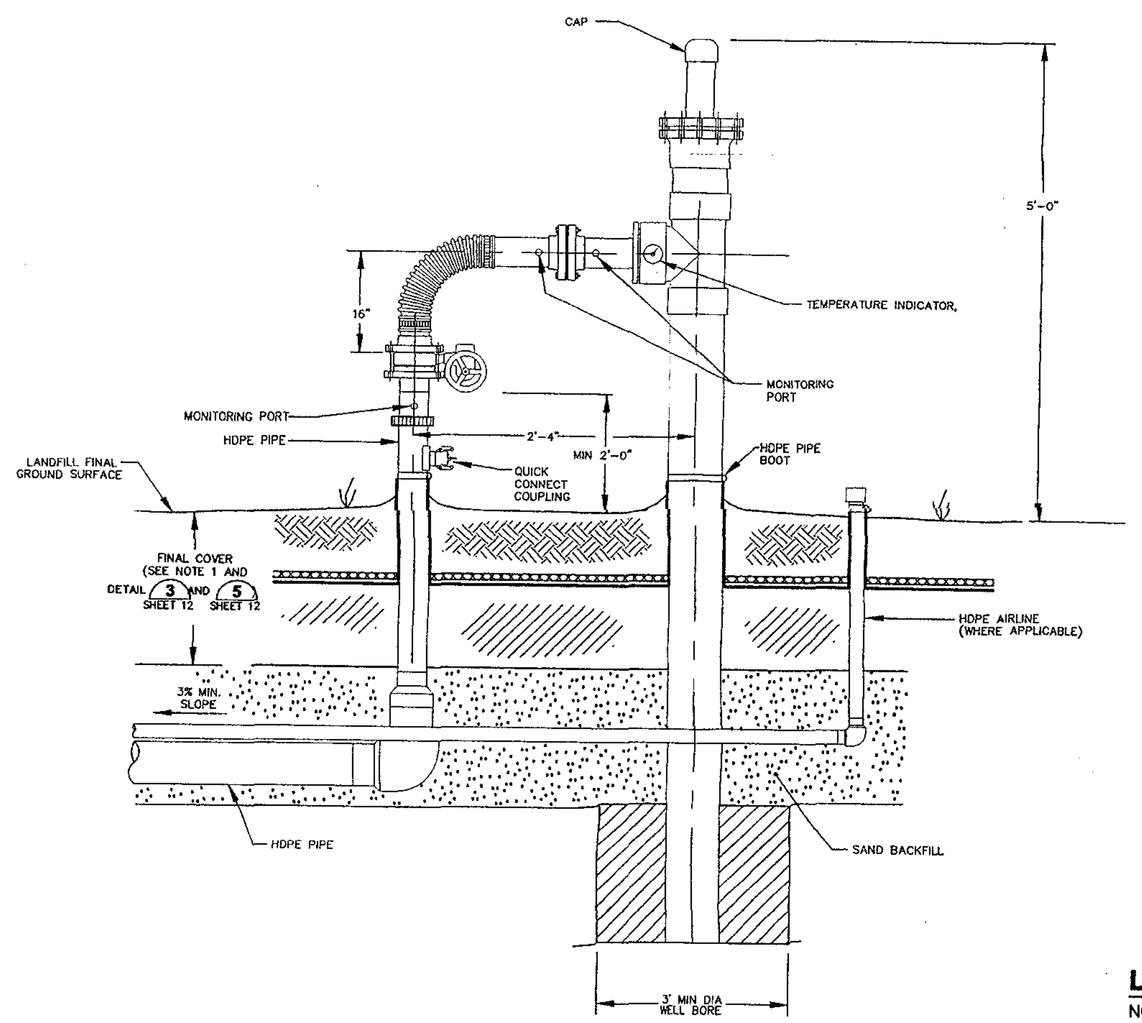
HEADER COLLECTION PIPE TRENCH 3

NOT TO SCALE



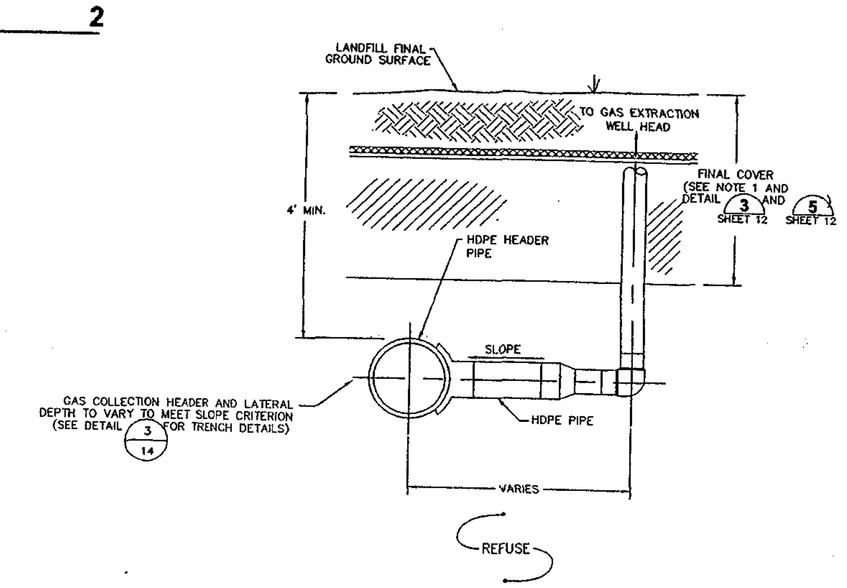
EXISTING MANHOLE CONNECTION 4

NOT TO SCALE



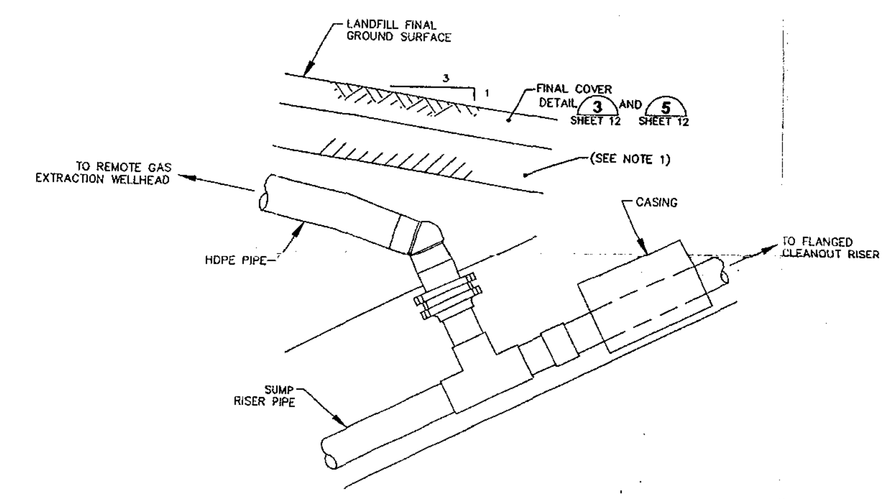
TYPICAL GAS EXTRACTION WELL HEAD 5

NOT TO SCALE



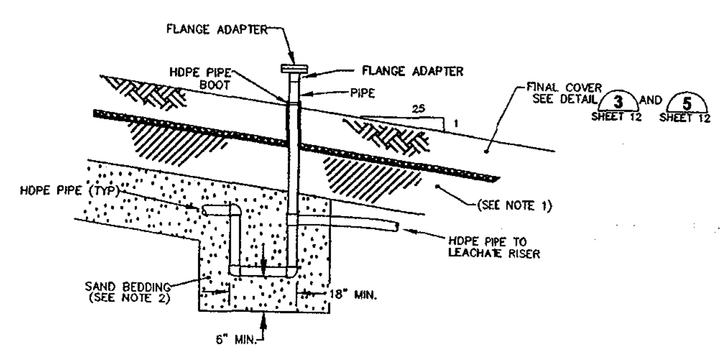
LATERAL COLLECTION PIPE 6

NOT TO SCALE



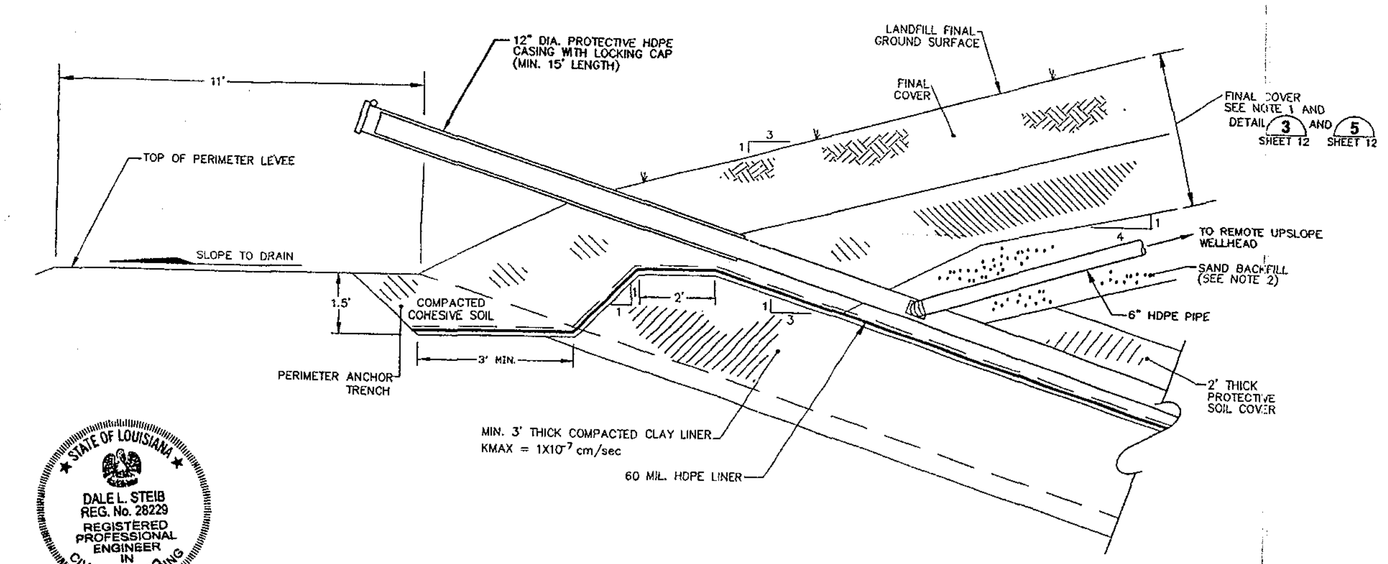
LEACHATE CLEANOUT RISER CONNECTION 7

NOT TO SCALE



LANDFILL GAS CONDENSATE DRAIN 8

NOT TO SCALE



LEACHATE RISER CONNECTION 9

NOT TO SCALE

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 28229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
3/10/03

NOTES:

1.) IF THE COMPONENTS OF THE GAS SYSTEM ARE INSTALLED BEFORE THE FINAL COVER HAS BEEN INSTALLED, THE FINAL COVER SYSTEM SHOWN WILL BE REPLACED WITH MATERIAL EQUIVALENT TO THE EXISTING COVER SYSTEM. REPLACEMENT SOIL SHALL BE COMPACTED IN LIFTS OF 8 TO 9 INCHES TO EQUAL ORIGINAL COVER DENSITY.

2.) CLEAN SAND BEDDING/BACKFILL AND GENERAL BACKFILL MATERIAL SHALL BE COMPACTED IN MAXIMUM LIFTS OF 9 INCHES.

3.) SLOTS ON PVC PIPE MAY BE MODIFIED TO ACCOMMODATE LEACHATE WITHDRAWAL.

NO	REVISIONS	DRN	CHK	DATE
1	REVISED DETAILS AS PER PERMIT MODIFICATION NO. 28	JEP	TLR	03/97
2	VERTICAL EXPANSION	DCA	DLS	04/01

BATON ROUGE, LOUISIANA

DRN	MCNAMARA	
DES	INI	RICHARDSON
CHK	INI	MARTIN
APP	INI	RICHARDSON

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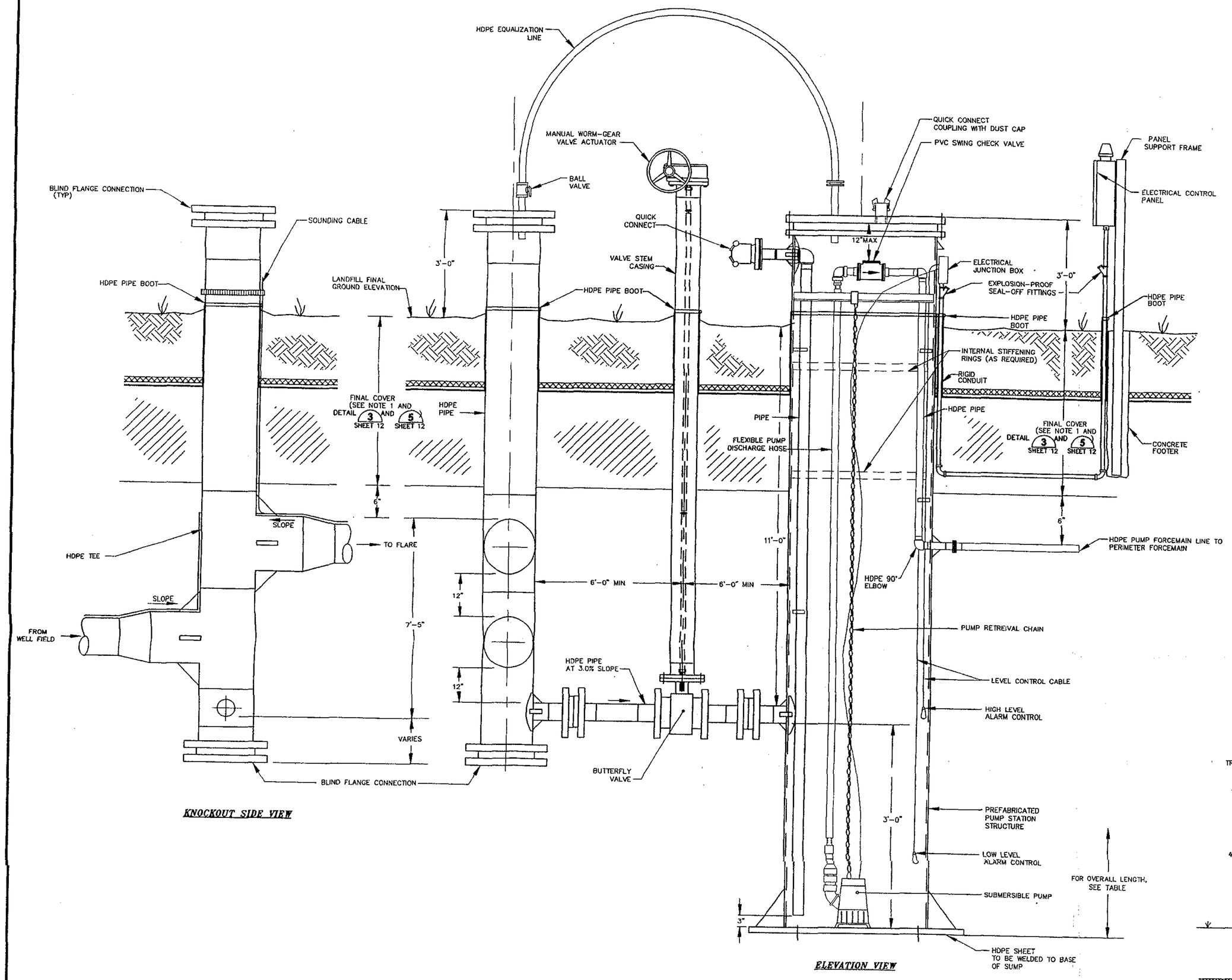
PREPARED FOR: WASTE MANAGEMENT

PREPARED BY: EARTH TECH, Baton Rouge, Louisiana

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

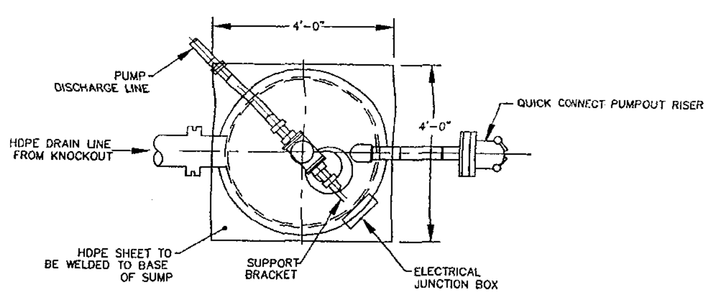
GAS COLLECTION SYSTEM DETAILS

DATE	01-28-03 10:30 A.M.
PROJECT NO	42891.010
FILENAME	42891AG1.DWG
SHEET NO	14 of 15
DRAWING NO	14



KNOCKOUT SIDE VIEW

ELEVATION VIEW

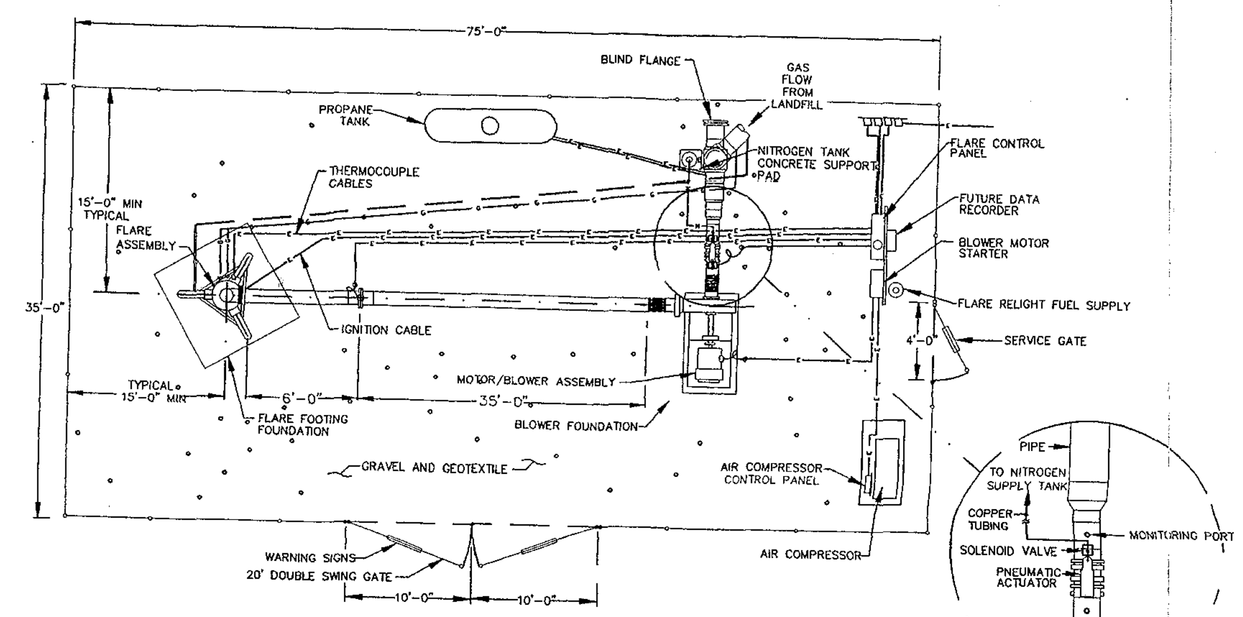


PLAN VIEW

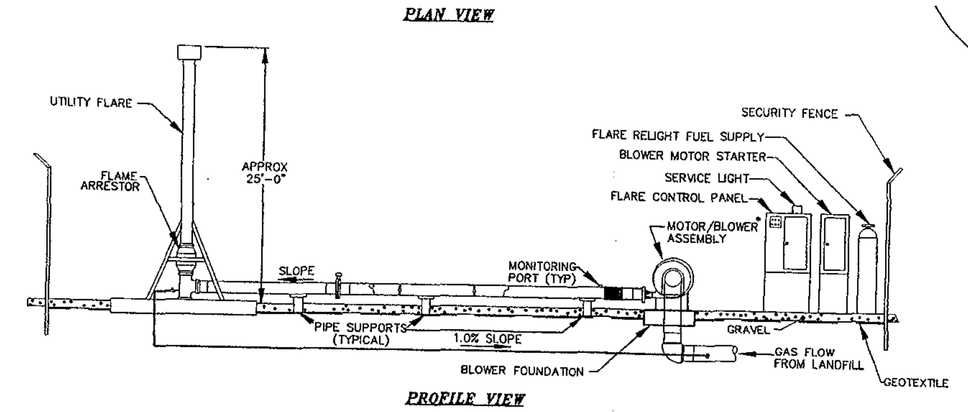
FINAL COVER (SEE DETAIL 3 SHEET 12 AND 5 SHEET 12)

LIQUID KNOCKOUT AND PUMP STATION 1

NOT TO SCALE



PLAN VIEW

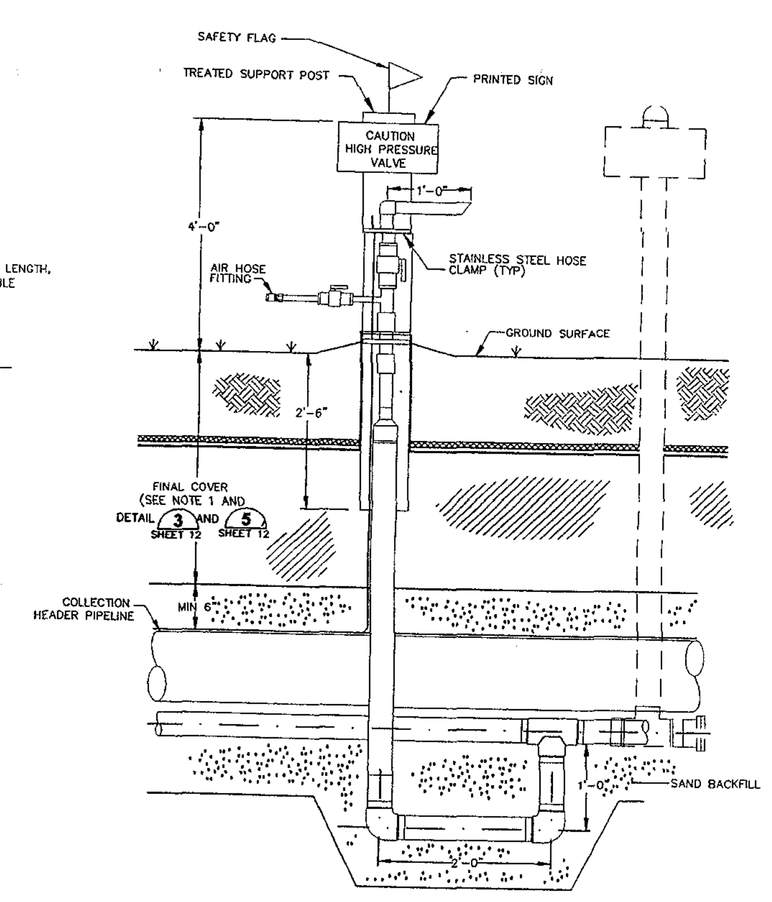


PROFILE VIEW

BLOWER / FLARE STATION LAYOUT 2

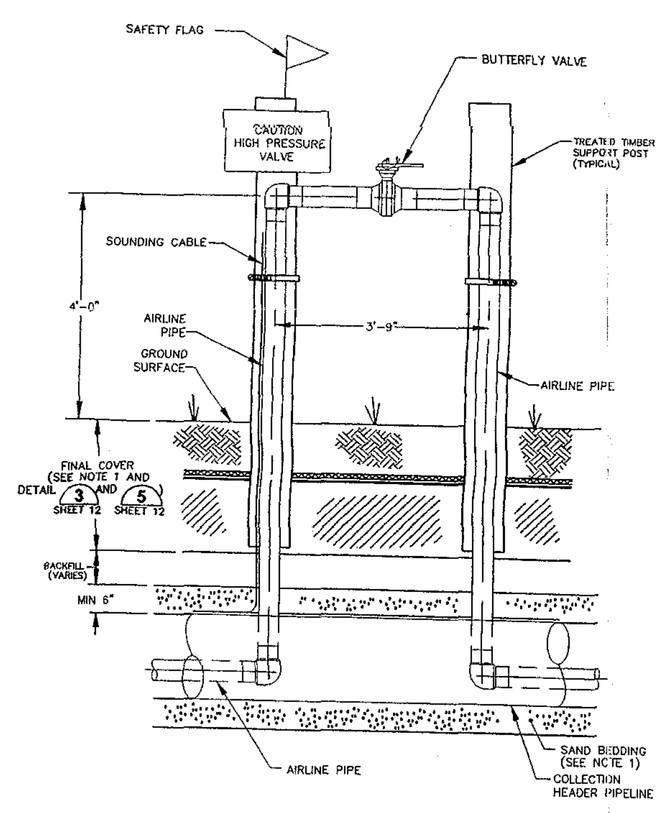
NOT TO SCALE

STATE OF LOUISIANA
DALE L. STEIB
REG. No. 28229
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
3/17/03



AIRLINE BLOWOFF RISER 3

NOT TO SCALE



AIRLINE ISOLATION VALVE 4

NOT TO SCALE

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2.) CLEAN SAND BEDDING/BACKFILL AND GENERAL BACKFILL MATERIAL SHALL BE COMPACTED IN MAXIMUM LIFTS OF 9 INCHES.

NO	REVISIONS	DRN	CHK	DATE
1	REVISED DETAILS AS PER PERMIT MODIFICATION NO. 28	JEP	TLR	03/97
2	VERTICAL EXPANSION	DCA	DLS	04/01

BATON ROUGE, LOUISIANA

DRN MCNAMARA
DES INI RICHARDSON
CHK INI MARTIN
APP INI RICHARDSON

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PREPARED FOR: WASTE MANAGEMENT

PREPARED BY: EARTH TECH, Baton Rouge, Louisiana

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

GAS COLLECTION SYSTEM DETAILS

DATE 01-28-03 10:30 A.M.
PROJECT NO 42891.010
FILENAME 42891AG2.DWG
SHEET NO 15 of 15
DRAWING NO 15

HISTORICAL DATA

OUACHITA ENTERPRISE CORP.

(An Economic Development Organization)

141 DeSiard St. • Ste. 511 • Monroe, LA 71201 • (318) 387-0787 • FAX (318) 387-8529

OUACHITA, LOUISIANA
1991 PARISH (COUNTY) PROFILE

LOCATION

PARISH SEAT: Monroe

Major Cities	Distance in Miles/Time*
Atlanta, GA	503/7.54
Dallas, TX	288/4.35
Houston, TX	347/6.04
New Orleans, LA	287/4.34

*Note: Distance computed between major cities and parish seat.

POPULATION

	1991***	1990	1980
Parish	142,813	142,191	139,241
Monroe	55,038	54,909	57,597
West Monroe	14,130	14,096	14,993
Claiborne CDP*	---	8,300	6,278
Brownsville/ Bawcomville CDP*	---	7,397	7,252
Swartz CDP*	---	3,698	---
Richwood	2,395	1,253	1,223
Area Population**	284,053	282,708	285,243

*Census Designated Place
**Area includes parish and all contiguous parishes.
***Estimated July 1, 1991

LABOR FORCE

	Parish	Area
Estimated labor force*	68,700	124,950
Manufacturing employment*	7,584	15,087
Unemployment rate**	5.9%	

*1990 **1992

Louisiana is a right to work state.

EDUCATION

Number of Schools:

Elem. K-6	Jr. High. 7-8	High 9-12	Private K-12
34	10	7	6

Number of Faculty:

Elem.	Jr. High.	High	Private
1,076	361	501	207

Number of Students:

Elem.	Jr. High.	High	Private
15,324	4,934	6,597	2,290

Vocational-Technical Schools (within 1 hour commuting distance)	Enrollment 1990-91
Delta Ouachita Regional Technical Institute	1,027

Colleges/Universities (within 1 hour commuting distance)	Enrollment Fall 1991
Northeast Louisiana University-Monroe	10,560
Louisiana Tech University-Ruston	10,110
Grambling State University-Grambling	6,000

Public Libraries:	5
Total Number of Volumes	265,181

CLIMATE

Annual Average Temperature	65 F
Monthly Average Temperature:	
January	44 F
July	83 F
Annual Average Rainfall	67.2 inches
Average Elevation:	77 feet
Area in Square Miles:	627 sq. miles

TRANSPORTATION

Highways:

Interstate 20; U.S. 80 and 165; State 15, 34, and 139

Railroads:

Arkansas Louisiana Missouri
Midsouth
Union Pacific
Industry Switching Service Available. Frequency of service may vary--once or twice daily.

WATER FREIGHT CARRIERS:.....26

Terminal Facilities are available within the parish.

AIR SERVICE:

Nearest commercial airport:
Monroe Regional Airport

Distance.....2 miles*
Number of Runways.....2
Length of Runways.....7,500 feet
5,000 feet

Commercial airlines:
American Eagle
Delta
Northwest Airlink

Average number flights per day.....24
Local airport: None
*Note: Distance computed between parish seat and airport.

Waterways:

Nearest Deepwater Port Facilities	Channel depth	Distance to port*	Foreign Trade Zone
Port of Baton Rouge	40 feet	194 miles	Yes

Nearest Shallow Draft Port Facilities	Channel depth	Distance to port*	Foreign Trade Zone
Madison Parish Port	9 feet	55 miles	No

*Note: Distance computed between parish seat and port.

FINANCING RESOURCES

	Number	Total Deposits ($000)
Banks	8	$1,827,078

	Number*	Total Assets*
Credit Unions	14	$99,120,567

*estimated

TAXES

Sales Taxes:	Rate
State	4%
Parish	2%
Municipal Range	2% - 4%
Parish Millage Rate (1991)	30.97-109.36
1991 State Sales Tax Collections	$38,191,010

GOVERNMENT

City	Type Government	Zoning Regulations	Fire Insurance Rating
Monroe	Mayor/Council	Yes	Class 2
West Monroe	Mayor/Alderman	Yes	Class 3
Claiborne	Police Jury	No	Class 4
Pioneersville/ Wilcomville	Police Jury	No	Class 4
Swartz	Police Jury	No	Class 4
Richwood	Mayor/Alderman	Yes	Class 4

QUALITY OF LIFE

Recreational:

Auditorium	Country Clubs	Parks
Ball Fields	Fishing	Recreational Centers
Bowling Alleys	Golf Courses	Skating Rink
Cinemas	Hunting	Swimming Pools
Coliseum	Museum	Tennis Courts

Medical:

General Hospitals:	5	Beds	1,144
Nursing Homes:	15	Beds	1,704

Communications:

Newspapers:	Daily	Weekly	Semi-weekly
	1	1	2

Television Stations: 4 Cable: Yes

There are 5 channels available without cable.

Community Facilities:

Hotels/motels/bed & breakfast: 26

Total Rooms 1,791

Shopping Malls

Monroe Civic Center

Convention Centers

UTILITIES AND SERVICES

Electricity:

Louisiana Power & Light

Telephone:

ATC Long Distance

AT&T Company

Century Telephone Enterprises, Inc.

Long Distance Savers

LDDS Communications, Inc.

MCI Telecommunications, Inc.

South Central Bell

U.S. Sprint

Water:

City	Supplier
Monroe	City of Monroe
W. Monroe	City of West Monroe
Claiborne	Greater Ouachita Water Company
Brownsville/ Bawcomville	Greater Ouachita Water Company
Swartz	Greater Ouachita Water Company
Richwood	Greater Ouachita Water Company

Natural Gas:
Arkansas Louisiana Gas Company (ARKLA)
Louisiana Gas Service Company
Primos Production
Southern Industrial Gas (SIGCO)
Tennessee Gas Pipeline Company
Trans Louisiana Gas Company
Wintershall Pipeline Corporation

Sewer System:

City	Supplier
Monroe	City of Monroe
W. Monroe	City of West Monroe
Claiborne	West Ouachita Sewer District
Brownsville/ Bawcomville	West Ouachita Sewer District
Swartz	Lakeshore Sewer District/Greater Ouachita Sewer District
Richwood	Town of Richwood

MAJOR PRIVATE EMPLOYERS

Name	Product or Service	Number of Employees	Union
Riverwood Forest Products	Paper products	2,156	Yes
St. Francis Medical Center	Medical	1,732	No
GM Corp., Inland Guide	Auto headlights	857	Yes
State Farm Insurance Company	Insurance	854	No
Glenwood Medical Center	Medical	786	No
HCA North Monroe Hospital	Medical	785	No
Century Telephone	Telephone Service	555	No
Bancroft Bag, Inc.	Multi-Wall Bags	537	Yes

MAJOR GOVERNMENTAL OR OTHER EMPLOYERS

Name	Product or Service	Number of Employees
Ouachita Parish School System	Education	2,044
Monroe City School System	Education	1,376
Northeast Louisiana Univ.	Education	1,200
City of Monroe	Government	1,122
E.A. Conway Hospital	Medical	732

OUACHITA ENTERPRISE CORP.

(An Economic Development Organization)

141 DeSiard St. • Ste. 511 • Monroe, LA 71201 • (318) 387-0787 • FAX (318) 387-8529

1990 Census of Population and Housing
040 Louisiana
050 Ouachita Parish

Total population	142,191
SEX	
Male	67,060
Female	75,131
AGE	
Under 5 years	11,410
5 to 17 years	30,336
18 to 20 years	8,289
21 to 24 years	9,685
25 to 44 years	41,616
45 to 54 years	13,355
55 to 59 years	5,767
60 to 64 years	5,707
65 to 74 years	9,138
75 to 84 years	5,256
85 years and over	1,632
Median age	30.2
Under 18 years	41,746
Percent of total population	29.4
65 years and over	16,026
Percent of total population	11.3
HOUSEHOLDS BY TYPE	
Total households	50,518
Family households (families)	36,482
Married-couple families	26,414
Percent of total households	52.3
Other family, male householder	1,492
Other family, female householder	8,576
Nonfamily households	14,036
Percent of total households	27.8
Householder living alone	12,166
Householder 65 years and over	5,008
Persons living in households	137,302
Persons per household	2.72
GROUP QUARTERS	
Persons living in group quarters	4,889
Institutionalized persons	2,283
Other persons in group quarters	2,606
RACE AND HISPANIC ORIGIN	
White	96,870
Black	44,096
Percent of total population	31.0
American Indian, Eskimo, or Aleut	239

Percent of total population	0.2
Asian or Pacific Islander	740
Percent of total population	0.5
Other race	246
Hispanic origin (of any race)	1,194
Percent of total population	0.8
1990 Census of Population and Housing	
040 Louisiana	
050 Ouachita Parish	
Total housing units	56,300
OCCUPANCY AND TENURE	
Occupied housing units	50,518
Owner occupied	32,724
Percent owner occupied	64.8
Renter occupied	17,794
Vacant housing units	5,782
For seasonal, recreational, or occasional use	274
Homeowner vacancy rate (percent)	2.7
Rental vacancy rate (percent)	11.2
Persons per owner-occupied unit	2.77
Persons per renter-occupied unit	2.63
Units with over 1 person per room	3,030
UNITS IN STRUCTURE	
1-unit, detached	38,165
1-unit, attached	914
2 to 4 units	4,740
5 to 9 units	2,489
10 or more units	3,505
Mobile home, trailer, other	6,487
VALUE	
Specified owner-occupied units	25,507
Less than $50,000	11,932
$50,000 to $99,000	10,759
$100,000 to $149,000	1,797
$150,000 to $199,999	556
$200,000 to $299,999	277
$300,000 or more	186
Median (dollars)	52,800
CONTRACT RENT	
Specified renter-occupied units paying cash rent	15,971
Less than $250	8,780
$250 to $499	6,689
$500 to $749	452
$750 to $999	30
$1,000 or more	20
Median (dollars)	235
RACE AND HISPANIC ORIGIN OF HOUSEHOLDER	
Occupied housing units	50,518
White	36,943
Black	13,199
Percent of occupied units	26.1
American Indian, Eskimo, or Aleut	96
Percent of occupied units	0.2
Asian or Pacific Islander	208
Percent of occupied units	0.4
Other race	72

Hispanic origin (of any race).....	358
Percent of occupied units.....	0.7

CLIMATOGRAPHY OF THE UNITED STATES NO. 81

Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1961-90

LOUISIANA

James R. Owenby and D.S. Ezell

January 1992

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Climatic Data Center
Asheville, North Carolina

LOUISIANA

PRECIPITATION NORMALS (INCHES)

STATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
JENNINGS	NORMAL	5.31	4.19	4.34	4.07	5.57	4.65	5.82	5.11	5.50	4.22	4.65	5.62	59.05
	MEDIAN	5.21	3.71	3.99	2.38	5.20	3.79	5.43	4.50	5.20	3.14	4.13	5.03	57.75
KEITHVILLE	NORMAL	4.36	4.36	4.27	4.03	5.47	4.23	3.58	2.47	3.51	3.64	4.68	4.63	49.20
	MEDIAN	3.66	3.79	4.62	3.79	5.97	3.13	2.43	2.03	2.85	2.69	4.40	4.00	48.45
KENTWOOD	NORMAL	6.08	5.75	6.20	6.17	5.96	4.78	6.08	5.66	4.70	3.41	4.86	6.23	65.88
	MEDIAN	5.77	5.13	5.57	5.13	5.43	4.40	5.83	5.29	3.89	3.19	4.92	5.28	66.61
KORAN	NORMAL	4.65	4.76	4.12	3.98	5.31	4.31	3.81	2.41	3.20	3.57	4.74	4.71	48.87
	MEDIAN	3.52	4.13	4.70	4.07	4.81	3.22	2.91	2.23	2.84	2.70	4.13	4.28	46.63
LAFAYETTE FAA AP	NORMAL	4.95	4.28	4.13	4.07	5.15	5.13	6.96	5.38	5.36	3.78	3.81	5.36	58.36
	MEDIAN	4.48	3.69	3.46	3.24	4.62	4.49	6.23	4.49	5.11	2.53	3.26	4.51	59.40
LAKE CHARLES WSO AP	NORMAL	4.52	3.59	3.29	3.33	5.67	4.96	5.20	5.33	5.69	3.95	4.26	5.05	54.84
	MEDIAN	4.47	3.09	2.70	2.32	5.69	4.75	4.97	5.05	4.79	3.06	4.08	4.09	55.16
LAKE PROVIDENCE	NORMAL	5.24	5.26	6.15	5.06	5.45	4.00	4.28	2.88	3.02	3.94	5.06	6.02	56.36
	MEDIAN	4.81	4.98	5.68	4.73	4.81	4.18	4.28	2.63	2.98	2.77	4.56	5.60	56.45
LEESVILLE	NORMAL	4.78	5.02	4.62	3.75	5.22	4.59	4.68	3.53	3.85	3.61	4.85	6.41	54.91
	MEDIAN	4.07	4.25	4.51	2.80	4.68	3.39	4.67	3.81	3.53	2.94	4.49	5.29	52.04
LELAND BOWMAN LOCK	NORMAL	4.77	3.91	3.79	3.97	4.63	5.93	8.20	7.08	5.73	3.99	4.15	5.02	61.22
	MEDIAN	4.19	3.70	3.25	3.61	3.64	4.48	7.91	7.31	5.08	3.13	3.77	4.38	61.01
LOGANSPORT 4 ENE	NORMAL	4.22	4.14	4.04	3.96	5.71	4.23	3.74	2.78	3.78	3.85	4.10	4.80	49.35
	MEDIAN	3.52	3.84	3.96	3.54	5.30	3.43	2.90	2.45	3.20	2.75	4.03	4.65	48.43
LONGVILLE	NORMAL	5.37	4.39	4.52	3.45	5.42	5.04	5.31	3.85	5.18	4.38	4.96	6.11	57.98
	MEDIAN	4.86	3.85	4.15	3.19	5.46	4.28	5.01	3.56	4.74	3.10	4.28	5.49	56.38
L S U BEN HUR FARM	NORMAL	4.79	5.42	4.74	4.68	4.71	5.14	5.79	5.84	4.62	3.16	4.41	5.59	58.89
	MEDIAN	4.15	5.01	4.67	3.41	4.17	4.04	5.53	5.07	3.97	2.83	4.27	5.52	58.25
LSU CITRUS RES CTR	NORMAL	5.05	5.83	4.99	4.06	5.08	5.59	6.82	6.67	5.89	3.40	4.26	5.21	62.85
	MEDIAN	4.78	5.03	5.00	3.33	4.43	4.93	7.09	6.53	5.58	3.20	3.42	5.47	65.30
MANSFIELD 3 WSW	NORMAL	4.28	4.30	4.10	3.98	5.85	4.21	3.57	2.69	3.69	3.57	4.43	4.94	49.61
	MEDIAN	3.99	3.70	4.17	3.33	5.52	3.55	3.03	2.72	3.36	3.04	4.08	4.82	47.78
MANY	NORMAL	4.81	4.38	4.97	3.93	5.66	4.38	4.33	3.66	3.49	4.08	4.12	5.81	53.62
	MEDIAN	3.72	3.61	5.16	3.11	5.04	3.64	3.87	3.74	3.19	3.33	3.64	5.57	50.38
MARION 7 SE	NORMAL	4.84	5.00	5.44	4.40	5.33	3.93	4.65	2.67	3.98	3.58	5.16	5.35	54.33
	MEDIAN	4.25	3.82	4.97	3.95	4.90	3.78	4.74	1.96	3.37	2.94	4.63	4.95	49.98
[illegible]SVILLE	NORMAL	5.66	5.01	5.97	4.60	5.62	4.39	4.79	3.76	4.38	4.11	4.98	6.75	60.02
	MEDIAN	5.78	4.78	5.08	3.96	5.56	3.71	4.16	3.96	3.67	3.54	4.12	5.83	60.75
[illegible]MENTAU	NORMAL	5.44	4.68	4.16	4.36	5.63	4.70	6.02	5.39	5.80	4.18	4.43	5.68	63.47
	MEDIAN	5.44	4.19	3.83	2.72	5.83	4.09	5.77	4.98	4.87	3.27	4.00	4.89	59.94
MINDEN	NORMAL	4.33	4.58	4.41	3.78	5.04	4.35	4.40	2.85	3.37	3.52	5.18	4.78	50.59
	MEDIAN	3.74	4.11	4.51	3.47	4.19	3.93	3.49	2.48	2.81	2.83	4.73	4.13	45.38
MONROE FAA AP	NORMAL	4.56	4.67	5.29	4.31	5.51	3.82	3.66	2.69	3.46	3.24	4.56	5.51	51.48
	MEDIAN	3.72	4.00	4.88	3.77	4.74	3.53	3.37	2.38	2.63	2.41	3.49	5.79	49.48
MORGAN CITY	NORMAL	5.00	5.00	4.23	4.00	4.88	6.03	8.10	7.59	6.57	3.74	4.29	5.17	64.60
	MEDIAN	4.69	4.69	3.85	2.45	4.22	4.18	7.13	6.99	5.37	3.46	3.98	4.93	64.05
NATCHITOCHES	NORMAL	4.87	4.61	4.70	4.25	5.98	4.31	3.51	3.33	3.37	3.79	4.23	6.11	52.96
	MEDIAN	3.76	3.35	4.73	3.35	4.78	3.00	3.18	3.28	3.04	3.26	3.33	5.69	52.29
NEW IBERIA	NORMAL	4.42	4.19	4.16	3.90	4.70	5.82	7.45	6.48	5.61	3.99	3.84	5.20	59.56
	MEDIAN	3.57	3.93	4.12	2.45	4.36	5.44	7.09	5.73	4.51	3.03	3.53	4.80	61.12
NEW ORLEANS WSCMO AP	NORMAL	5.05	6.01	4.90	4.50	4.56	5.84	6.12	6.17	5.51	3.05	4.42	5.75	61.88
	MEDIAN	4.20	5.38	4.63	3.32	3.92	5.20	5.78	6.02	4.67	2.87	3.94	5.25	60.43
N O AUDUBON WSFO CI	NORMAL	4.85	5.25	4.75	4.72	4.49	5.75	6.72	6.64	5.70	2.92	4.29	5.20	61.33
	MEDIAN	3.82	5.12	4.61	3.27	3.63	4.40	6.31	6.19	5.22	2.63	3.61	5.09	62.12
NEW ORLEANS ALGIERS	NORMAL	4.82	5.23	4.72	4.63	5.12	5.43	6.50	6.25	5.01	3.11	4.16	5.06	60.04
	MEDIAN	4.24	5.05	4.51	3.08	4.39	4.73	6.35	6.49	4.50	2.19	3.63	5.18	59.45
NEW ORLEANS OPS 14	NORMAL	4.81	5.37	4.44	4.47	4.65	4.13	5.24	5.36	5.26	2.64	3.79	5.09	55.25
	MEDIAN	4.42	4.99	3.95	3.41	4.40	3.91	5.10	5.30	4.77	2.09	3.79	5.19	54.83
NEW ORLEANS WATER PLT	NORMAL	4.80	5.12	4.41	4.36	4.37	5.46	5.67	6.27	5.35	2.91	3.91	4.92	57.55
	MEDIAN	4.23	4.93	3.93	2.81	3.76	4.07	5.62	6.08	4.60	2.39	3.18	4.52	56.57
NEW ORLEANS OPS 5	NORMAL	5.04	5.75	5.10	4.60	4.93	5.19	6.32	6.10	5.64	3.20	4.32	5.46	61.93
	MEDIAN	4.91	5.19	5.01	3.05	4.79	4.42	6.31	6.13	4.78	2.03	3.77	5.72	61.17
NEW ORLEANS OPS 3	NORMAL	4.98	5.41	5.05	4.58	4.52	5.40	6.08	6.09	5.66	3.04	4.21	5.33	60.35
	MEDIAN	4.28	5.03	4.67	2.84	4.30	5.45	6.07	6.04	4.95	2.73	3.52	5.14	59.23
NEW ORLEANS OPS 6	NORMAL	4.92	5.28	4.71	4.43	4.78	5.63	6.25	6.40	5.37	2.85	4.26	5.29	60.17
	MEDIAN	4.18	5.09	4.24	3.05	4.58	5.24	6.63	5.58	4.68	2.67	3.51	4.88	59.13
NEW ROADS 5 ESE	NORMAL	5.49	5.78	5.14	4.87	5.35	4.17	5.73	5.39	4.91	3.82	4.54	5.95	61.04
	MEDIAN	5.74	4.73	4.53	4.10	4.43	3.19	5.36	4.91	3.99	2.80	4.94	5.17	60.64
OAKDALE	NORMAL	5.74	4.94	5.23	4.35	5.63	4.72	5.92	4.92	5.23	4.83	5.07	6.89	63.47
	MEDIAN	5.74	4.29	4.52	3.17	5.38	4.38	6.61	4.21	4.38	2.97	4.34	6.42	62.08
OAKHOLIA	NORMAL	5.73	5.78	5.43	5.68	5.18	4.58	5.62	5.64	4.82	3.93	4.57	5.92	62.88
	MEDIAN	5.76	5.26	4.88	4.28	4.70	4.30	5.54	5.17	3.68	3.09	5.09	5.31	61.42
[illegible]IN FIRE TOWER	NORMAL	5.78	4.87	5.27	4.21	6.44	5.50	5.74	4.71	5.79	4.44	4.88	6.61	64.24
	MEDIAN	5.37	3.95	4.66	3.07	5.43	4.41	5.24	4.83	5.26	3.00	4.67	6.49	63.43

LOUISIANA

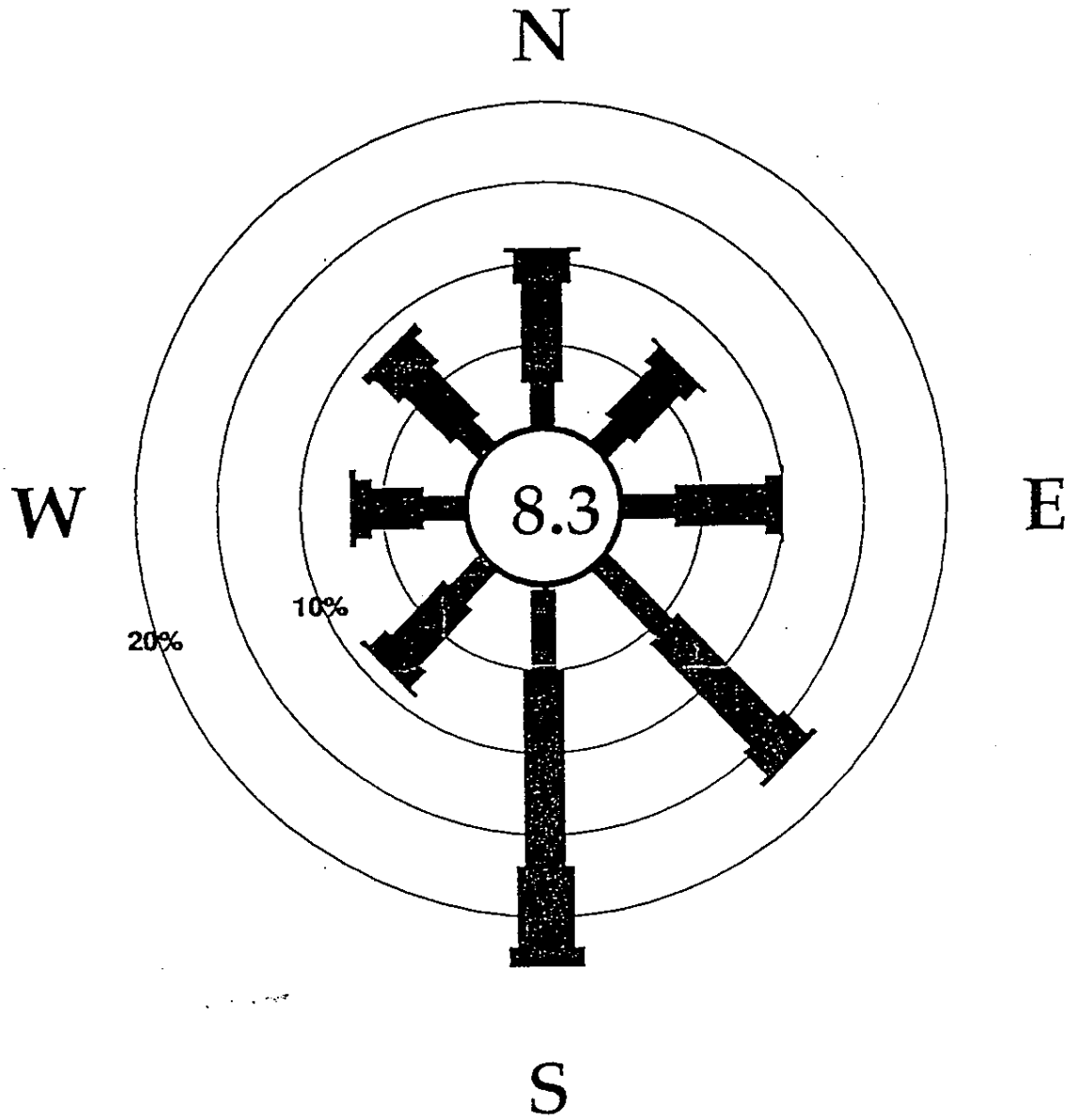
TEMPERATURE NORMALS (DEG F)

STATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
ETTE FAA AP	NORMAL MAX	60.0	63.4	71.2	78.6	84.6	89.5	90.6	90.4	86.9	79.9	71.1	63.8	77.5
.0 LT	NORMAL MIN	41.2	43.9	51.1	50.6	65.3	71.1	73.5	73.1	69.0	57.9	50.1	44.2	58.2
	NORMAL	50.6	53.7	61.2	68.6	75.0	80.4	82.1	81.5	78.0	68.9	60.6	53.9	67.9
	MEDIAN	49.9	52.8	61.3	68.5	74.8	80.1	81.8	81.9	77.8	68.8	60.8	54.4	67.8
	MID OBS TIME ADJ MAX	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
	MID OBS TIME ADJ MIN	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
LAKE CHARLES WSO AP	NORMAL MAX	59.7	63.4	70.7	77.9	84.0	89.0	90.8	90.8	86.8	80.2	70.8	63.3	77.3
2400 LT	NORMAL MIN	41.1	44.0	50.7	58.7	65.7	71.6	73.6	73.0	68.6	57.9	50.0	43.8	58.2
	NORMAL	50.4	53.7	60.7	68.3	74.9	80.3	82.2	81.9	77.7	69.1	60.4	53.5	67.8
	MEDIAN	49.6	53.3	60.7	68.3	75.3	80.1	82.1	81.9	77.8	68.8	61.1	53.2	67.9
	MID OBS TIME ADJ MAX	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
	MID OBS TIME ADJ MIN	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
LAKE PROVIDENCE	NORMAL MAX	52.2	57.4	66.5	75.5	82.5	89.3	91.7	91.2	86.4	77.2	66.3	56.2	74.4
0800 LT	NORMAL MIN	33.6	37.3	45.5	54.2	62.2	69.4	72.2	71.0	65.6	55.3	45.0	36.9	53.9
	NORMAL	43.0	47.4	56.0	64.9	72.6	79.4	82.0	81.1	76.0	65.3	55.7	46.6	64.2
	MEDIAN	43.0	46.8	56.1	64.6	72.4	79.5	81.8	81.2	75.6	65.1	56.3	46.6	64.1
	MID OBS TIME ADJ MAX	.7	.9	-.1	.0	-.3	-.2	-.2	-.4	-.3	-.4	.4	.3	
	MID OBS TIME ADJ MIN	.2	.3	.2	.2	-.1	.1	.0	.0	-.1	-.1	.0	.0	
LEESVILLE	NORMAL MAX	57.7	62.2	70.5	78.0	84.1	89.8	92.5	92.4	87.8	79.6	69.5	60.9	77.1
0800 LT	NORMAL MIN	35.4	38.1	46.2	54.4	61.1	67.3	70.4	69.5	64.7	52.6	45.1	38.0	53.6
	NORMAL	46.6	50.2	58.4	66.1	72.6	78.5	81.5	81.0	76.3	66.1	57.3	49.5	65.3
	MEDIAN	46.1	49.7	58.3	66.0	73.1	78.4	81.4	80.9	75.8	66.3	57.5	49.4	65.3
	MID OBS TIME ADJ MAX	.6	.9	-.1	.0	-.2	-.2	-.2	-.1	-.3	-.3	.4	.4	
	MID OBS TIME ADJ MIN	.2	.3	.2	.1	.1	.1	.0	.0	-.1	-.1	.0	.0	
LELAND BOWMAN LOCK	NORMAL MAX	58.9	62.3	69.6	76.5	82.7	88.0	89.8	89.9	86.8	79.7	71.0	63.3	76.5
0800 LT	NORMAL MIN	40.3	42.6	51.4	59.5	66.3	71.4	72.9	72.4	68.1	57.2	49.8	42.9	57.4
	NORMAL	49.6	52.5	60.5	68.0	74.5	79.7	81.4	81.2	77.5	68.5	60.4	53.1	67.2
	MEDIAN	48.5	52.2	60.8	67.8	74.8	79.3	81.6	81.3	77.6	68.4	60.6	53.0	67.3
	MID OBS TIME ADJ MAX	.6	.9	-.1	.0	-.2	-.1	-.1	-.1	-.2	-.3	.4	.4	
	MID OBS TIME ADJ MIN	.1	.2	.2	.1	.1	.0	.0	.0	-.1	-.1	.0	.0	
LOGANSPORT 4 ENE	NORMAL MAX	56.4	61.2	70.0	77.8	83.9	90.2	93.9	93.8	87.7	78.8	67.9	59.3	76.7
2400 LT	NORMAL MIN	33.6	36.7	44.1	52.7	60.1	66.6	69.5	68.6	63.3	51.1	43.0	35.9	52.1
	NORMAL	45.0	49.0	57.1	65.3	72.0	78.4	81.8	81.2	75.6	65.0	55.5	47.6	64.5
	MEDIAN	45.5	48.8	57.3	65.0	71.9	78.6	81.5	81.4	75.8	65.0	55.8	47.8	64.3
	MID OBS TIME ADJ MAX	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
	MID OBS TIME ADJ MIN	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
L S U BEN HUR FARM	NORMAL MAX	59.4	63.0	70.7	78.5	84.5	89.6	90.9	90.8	87.6	80.4	71.3	63.6	77.5
0800 LT	NORMAL MIN	38.3	40.9	48.5	56.2	63.2	68.6	71.4	70.6	65.8	54.9	47.6	41.3	55.7
	NORMAL	48.9	52.0	59.6	67.4	73.8	79.1	81.2	80.8	77.2	67.7	59.5	52.3	66.6
	MEDIAN	47.3	51.5	59.5	67.4	74.3	79.3	80.9	80.8	77.3	67.8	59.4	52.3	66.6
	MID OBS TIME ADJ MAX	.6	.9	-.1	.0	-.2	-.1	-.2	-.1	-.2	-.3	.5	.4	
	MID OBS TIME ADJ MIN	.1	.2	.2	.1	.1	.0	.0	.0	-.1	-.1	.0	.0	
LSU CITRUS RES CTR	NORMAL MAX	60.7	63.4	69.5	77.0	83.3	88.7	90.4	89.2	85.8	78.6	70.5	63.9	76.8
2400 LT	NORMAL MIN	42.9	45.1	51.9	60.2	67.0	72.5	73.7	73.6	71.6	62.4	54.1	46.4	60.1
	NORMAL	51.8	54.3	60.7	68.6	75.2	80.6	82.1	81.4	78.7	70.6	62.3	55.2	68.5
	MEDIAN	50.9	54.1	60.6	68.3	75.3	80.9	81.8	81.5	78.8	70.2	62.3	54.3	68.4
	MID OBS TIME ADJ MAX	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
	MID OBS TIME ADJ MIN	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
NY	NORMAL MAX	56.8	61.5	70.0	78.1	83.9	89.8	92.9	92.9	87.5	79.1	68.9	60.7	76.8
0800 LT	NORMAL MIN	32.7	35.9	43.9	52.2	59.7	66.5	69.7	68.4	63.1	50.0	42.7	35.2	51.7
	NORMAL	44.8	48.7	57.0	65.2	71.9	78.2	81.4	80.7	75.4	64.5	55.8	48.0	64.3
	MEDIAN	44.5	48.3	57.0	64.8	72.3	78.1	81.3	80.8	75.1	64.3	55.6	47.6	64.4
	MID OBS TIME ADJ MAX	.7	.9	-.1	.0	-.2	-.2	-.2	-.1	-.3	-.4	.4	.4	
	MID OBS TIME ADJ MIN	.2	.3	.2	.1	.1	.1	.0	.0	-.1	-.1	.0	.0	
MINDEN	NORMAL MAX	54.5	59.6	68.1	76.5	83.0	89.4	92.7	93.0	87.2	78.1	67.6	57.8	75.6
0800 LT	NORMAL MIN	32.2	35.7	43.6	52.6	60.4	67.8	71.3	70.4	64.6	52.0	43.2	35.1	52.4
	NORMAL	43.4	47.7	55.8	64.6	71.7	78.6	82.0	81.7	75.9	65.1	55.4	46.4	64.0
	MEDIAN	43.3	47.4	55.6	64.6	71.7	78.4	81.5	81.6	76.2	64.8	55.3	46.6	64.2
	MID OBS TIME ADJ MAX	.7	.9	-.1	.0	-.3	-.2	-.2	-.1	-.3	-.4	.4	.3	
	MID OBS TIME ADJ MIN	.2	.3	.2	.2	.1	.1	.0	.0	-.1	-.1	.0	.0	
MONROE FAA AP	NORMAL MAX	53.8	59.3	67.9	76.7	83.8	90.5	92.4	91.6	86.7	78.3	67.2	57.5	75.5
2400 LT	NORMAL MIN	34.6	38.5	46.1	54.5	62.7	69.6	72.1	70.4	64.7	51.9	44.2	37.2	53.9
	NORMAL	44.2	48.9	57.0	65.6	73.3	80.1	82.3	81.0	75.7	65.1	55.7	47.4	64.7
	MEDIAN	44.3	48.2	56.9	65.4	73.4	80.0	82.3	81.0	75.5	64.8	55.3	46.9	64.9
	MID OBS TIME ADJ MAX	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
	MID OBS TIME ADJ MIN	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
MORGAN CITY	NORMAL MAX	61.5	64.6	71.3	78.4	84.1	89.0	90.7	90.6	87.8	80.7	72.5	65.2	78.0
0800 LT	NORMAL MIN	41.8	44.3	52.0	59.3	65.8	71.3	73.4	73.0	69.8	59.6	51.8	45.8	58.9
	NORMAL	51.7	54.5	61.7	68.9	75.0	80.2	82.1	81.8	78.8	70.2	62.1	55.0	68.5
	MEDIAN	51.1	54.4	61.1	68.3	75.1	80.6	81.8	81.8	78.7	70.4	62.0	54.7	68.7
	MID OBS TIME ADJ MAX	.6	.9	-.1	.0	-.2	-.1	-.2	-.1	-.2	-.3	-.4	.4	
	MID OBS TIME ADJ MIN	.1	.2	.2	.1	.1	.0	.0	.0	-.1	-.1	.0	.0	
NATCHITOCHES	NORMAL MAX	56.7	61.6	70.0	78.2	84.6	90.7	93.7	93.4	88.1	79.3	69.0	60.0	77.1
0800 LT	NORMAL MIN	34.8	38.0	46.2	54.6	62.1	69.0	72.1	71.1	65.8	53.7	45.5	37.8	54.2
	NORMAL	45.8	49.9	58.1	66.4	73.3	79.9	82.9	82.3	77.0	66.5	57.2	48.9	65.7
	MEDIAN	45.4	49.2	57.7	66.6	73.4	79.9	82.8	82.3	76.8	66.2	57.0	49.0	65.9
	MID OBS TIME ADJ MAX	.7	.9	-.1	.0	-.3	-.2	-.2	-.1	-.3	-.4	.4	.4	
	MID OBS TIME ADJ MIN	.2	.3	.3	.2	.1	.1	.0	.0	-.1	-.1	.0	.0	
NEW IBERIA	NORMAL MAX	60.3	63.3	71.0	78.3	84.3	89.3	90.7	90.4	86.9	79.8	71.4	64.1	77.5
2400 LT	NORMAL MIN	40.5	43.5	50.6	58.7	65.3	70.6	72.7	72.2	68.3	57.4	49.9	43.4	57.8
	NORMAL	50.4	53.5	60.8	68.5	74.8	79.9	81.7	81.3	77.6	68.6	60.7	53.8	67.6
	MEDIAN	49.6	52.9	61.2	68.1	75.1	80.0	81.7	81.5	77.3	68.8	60.4	53.2	67.8
	MID OBS TIME ADJ MAX	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
	MID OBS TIME ADJ MIN	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
NEW ORLEANS WSCMO AP	NORMAL MAX	60.8	64.1	71.6	78.5	84.4	89.2	90.6	90.2	86.6	79.4	71.1	64.1	77.6
2400 LT	NORMAL MIN	41.8	44.4	51.6	58.4	65.2	70.8	73.1	72.8	69.5	58.7	51.0	44.8	58.5
	NORMAL	51.3	54.3	61.6	68.5	74.8	80.0	81.9	81.5	78.1	69.1	61.1	54.5	68.1
	MEDIAN	50.4	53.9	61.7	68.6	74.8	79.8	81.6	81.6	77.8	69.0	61.1	54.4	68.1
	MID OBS TIME ADJ MAX	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
	MID OBS TIME ADJ MIN	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	

NOTE: 1. ADJUSTMENT FACTORS WILL ADJUST TEMPERATURE TO MIDNIGHT OBSERVATION TIME.
2. TIME APPEARING UNDER STATION NAME IS CURRENT OBSERVATION TIME.

SHREVEPORT WSO AP
Annual Summary Wind Rose
1961-1980

Anemometer Ht.: 20.0 ft



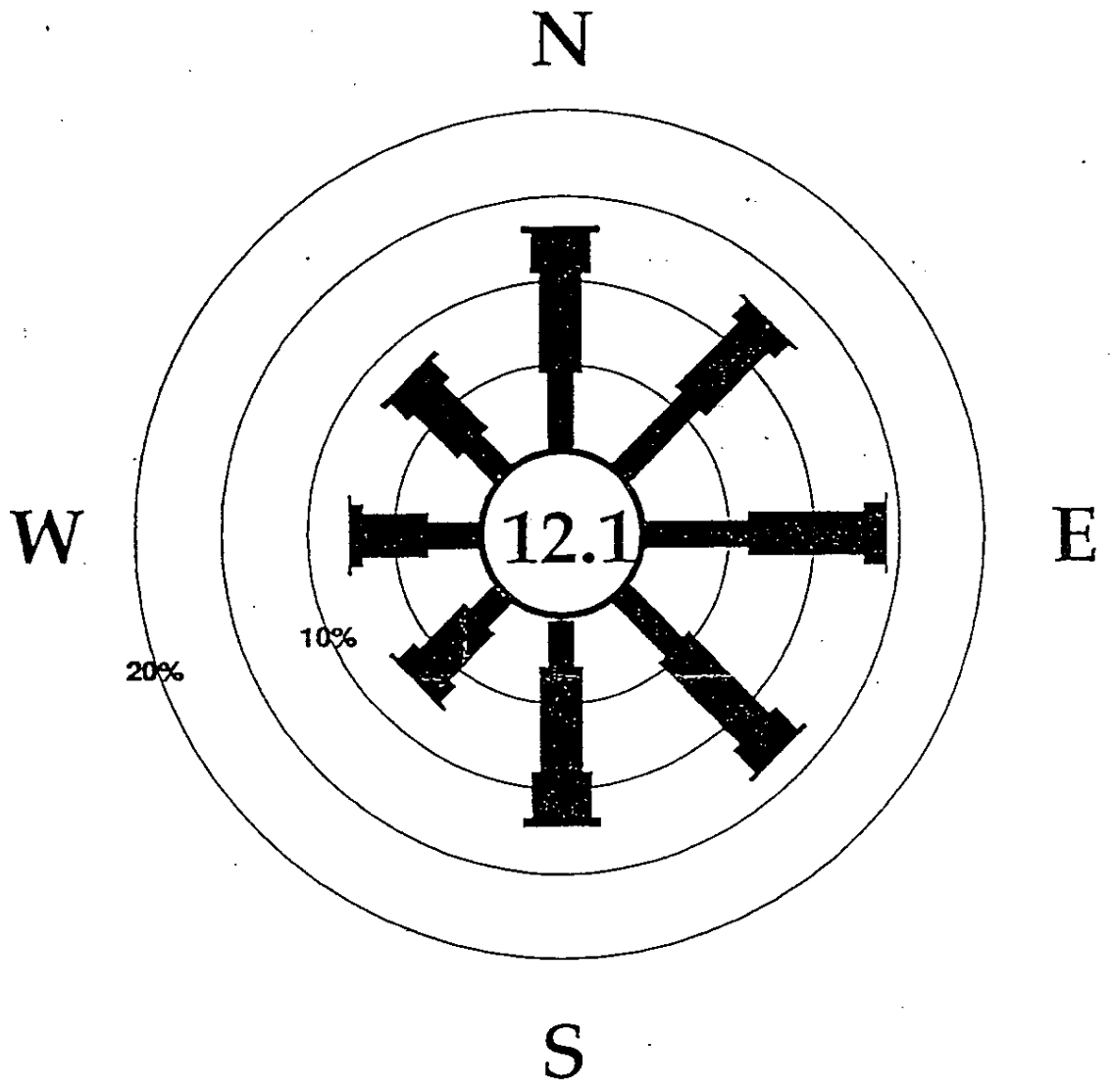
Windspeed Class Designations

1-5 knots 6-10 knots 11-15 knots > 15 knots

SOUTHERN REGIONAL CLIMATE CENTER / LOUISIANA OFFICE OF STATE CLIMATOLOGY

BATON ROUGE WSO AP
Annual Summary Wind Rose
1961-1980

Anemometer Ht.: 20.0 ft



Windspeed Class Designations

1-5 knots 6-10 knots 11-15 knots > 15 knots

SOUTHERN REGIONAL CLIMATE CENTER / LOUISIANA OFFICE OF STATE CLIMATOLOGY

FIELD EXPLORATION

ATTACHMENT B

GEOTECHNICAL BORING LOGS

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-20' WET ROTARY 20'-50' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-1 SHEET 1 of 2

WATER LEVEL	20'	14.6'		DRILLING START TIME	DRILLING FINISH TIME
TIME	0	15 min.		11:00	10:00
DATE	7/12/93	7/12/93		DATE 07/12/93	DATE 07/13/93

DATUM: Ground Surface ELEVATION: 65.1 Ft. NGVD

BORING COORDINATES: N4964 E800 SURFACE CONDITIONS: Dry, level, grass

DRILL RIG: Failing 1500 DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS. LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.50		Stiff to very stiff reddish-brown CLAY (CH) *moist, blocky, slickensided, with ferrous stains*	ST						
	2.50			ST						
5	1.00		-- becoming medium stiff to stiff	ST	5					
	2.00			ST						
	1.50			ST						
10	2.00			ST	10					
	2.50			ST						
15	2.50			ST	15					
	2.50			ST						
	0.50		Very soft to soft reddish-brown and light gray SILTY CLAY (CL) wet, mottled, with rootlets	ST						
20	<0.25			ST	20					
	<0.25			ST						
			Loose reddish-brown CLAYEY SILT (ML) saturated, with ferrous stains	ST	25					
25	--		Loose reddish-brown SILTY SAND (SM) saturated, fine to medium grained, with some clay	SS						
	3-3-5 8 BPF			SS						
	3-2-7 9 BPF			SS	30					
30	5-13-15 28 BPF		-- becoming medium dense	SS						
	5-9-13 22 BPF			SS						
35	1-1-1 2 BPF		-- becoming very loose	SS	35					

(continued . . .)

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO. R-1	
	DRY AUGER 0-20'				SHEET 2 of 2	
	WET ROTARY 20'-50'					
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:					
PHASE II REDESIGN	ST - Shelby Tube				DRILLING	
MONROE, LOUISIANA	SS - Split Spoon				START	FINISH
(See Boring Location Plan)	WATER LEVEL	20'	14.6'		TIME 11:00	TIME 10:00
	TIME	0 .	15 min.			
	DATE	7/12/93	7/12/93		DATE 07/12/93	DATE 07/13/93

DATUM: Ground Surface ELEVATION: 65.1 Ft NGVD

BORING COORDINATES: N4964 E800 SURFACE CONDITIONS: Dry, level, grass

DRILL RIG: Failing 1500 DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS. LOGGER: T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	8-13-15 28 BPF		Medium dense reddish-brown SILTY SAND (SM) saturated, very fine grained, with some clay	SS						
	1-9-9 18 BPF			SS						
40	9-13-15 28 BPF			SS	40					
	24-36-42 78 BPF		Dense to very dense brown SAND (SP) saturated, fine grained, poorly graded	SS						
45	11-13-27 40 BPF			SS	45					
	11-13-27 40 BPF			SS						
	19-29-46 75 BPF			SS						
50			Boring R-1 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/13/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-16' WET ROTARY 16'-50'	R-2
	SAMPLING METHOD:	SHEET 1 of 2
	ST - Shelby Tube	DRILLING
	SS - Split Spoon	START / FINISH
	WATER LEVEL: 16' / 10.0'	TIME 12:50 / TIME 16:45
	TIME: 0 / 15 min.	
	DATE: 7/10/93 / 7/10/93	DATE 07/10/93 / DATE 07/10/93

DATUM: Ground Surface ELEVATION: 62.0 Ft. NGVD

BORING COORDINATES: N4946 E1256 SURFACE CONDITIONS: Dry, level, grass

DRILL RIG: Failing 1500 DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS. LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	0.25		Soft to medium stiff reddish-brown CLAY (CH) moist, slickensided, mottled, with ferrous stains and calcareous nodules	ST						
	NR			ST						
5	1.00		-- slickensided	ST	5	74	40	37	84	0.91s
	1.50		-- becoming medium stiff to stiff	ST						
	1.50			ST						
10	2.00			ST	10					
	1.50			ST						
15	1.50		Medium stiff to stiff reddish-brown SILTY CLAY (CL) moist, with ferrous stains and nodules	ST	15	33	13	24	100	0.91
	--									
	--		-- becoming very soft							
20	<0.25			ST	20	29	10	26	(1)	
	<0.25			ST						
25	<0.25			ST	25					
	<0.25			ST						
	<0.25			ST						
30	--		Very loose dark gray SILTY SAND (SP-SM) saturated, fine to medium grained, poorly graded	ST	30					
	1-1-1 2 BPF		-- 10 inch peat layer beginning at 32'	SS		(2)		22		
35	5-9-13 22 BPF		Medium dense dark gray SAND (SP-SM) saturated, fine to medium grained, poorly graded	SS	35					

(continued . . .)

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-16'				R-2
	WET ROTARY 16'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PROPOSED HORIZONTAL EXPANSION	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	16'	10.0'		TIME / TIME
	TIME	0	15 min.		12:50 / 16:45
	DATE	7/10/93	7/10/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 62.0 Ft. NGVD					07/10/93 / 07/10/93

BORING COORDINATES:	N4946 E1256	SURFACE CONDITIONS:	Dry, level, grassy
DRILL RIG:	Failing 1500	DRILLER:	Joby Barr
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2-6-13 19 BPF		Medium dense dark gray SILTY SAND (SP-SM) saturated, fine grained, poorly graded, with some peat	SS						
	9-10-12 22 BPF			SS						
40	2-3-4 9 BPF		-- becoming loose to medium dense	SS	40					
	5-10-15 25 BPF			SS						
45	15-23-31 54 BPF		-- becoming very dense, trace fine gravel	SS	45					
	5-4-9 13 BPF		-- becoming medium dense	SS		(3)		19		
	9-10-12 22 BPF			SS						
50			Boring R-2 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/10/93.		50					
55			Notes: (1) Percent pasing 200 sieve = 70.8%. (2) Percent pasing 200 sieve = 9.0%. See gradation curve. (3) Percent pasing 200 sieve = 6.6%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-18'				R-3
	WET ROTARY 18'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	17'	11.0'		TIME / TIME
	TIME	0	38 min.		7:35 / 11:50
	DATE	7/6/93	7/6/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 64.9 Ft. NGVD					07/06/93 / 07/06/93

BORING COORDINATES: N4928 E1696	SURFACE CONDITIONS: Dry, level, bare
DRILL RIG: Mobile B-61	DRILLER: Ken Gibson
SPT HAMMER WEIGHT: 140 LBS.	LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.25		Medium stiff to stiff reddish-brown and light gray CLAY (CH) moist, slickensided with calcareous nodules and ferrous stains	ST						
	0.75			ST						
5	1.75			ST	5					
	2.50			ST						
	2.75		– becoming stiff to very stiff	ST						
10 ▼	3.00			ST	10					
	1.50			ST						
15	0.75		Soft to medium stiff reddish-brown SILTY CLAY (CL) wet, with sand	ST	15					
▽	0.50			ST						
	0.50			ST						
20	0.75			ST	20					
	0.75			ST						
25	0.25		– becoming very soft to soft and brown and light gray	ST	25					
	0.50			ST						
	0.25			ST						
30	0.25			ST	30					
	0.75			ST						
35	1-2-2 4 BPF		Medium stiff gray CLAY (CH) wet, with trace sand and silt	SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 7/6/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-18' WET ROTARY 18'-50'	R-3
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	SHEET 2 of 2
	WATER LEVEL 17' 11.0' TIME 0 38 min. DATE 7/10/93 7/10/93	DRILLING START TIME 7:35 DATE 07/06/93 FINISH TIME 11:50 DATE 07/06/93

DATUM: Ground Surface ELEVATION: 64.9 FL NGVD

BORING COORDINATES: N4928 E1696	SURFACE CONDITIONS: Dry, level, bare
DRILL RIG: Mobile B-61	DRILLER: Ken Gibson
SPT HAMMER WEIGHT: 140 LBS.	LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	0.75		Medium stiff gray Clay (CH) wet	ST						
	0.75		Medium stiff gray SANDY CLAY (CL) wet	ST						
40	1-1-1 2 BPF		Very loose gray SILTY SAND (SM), saturated	SS	40					
	7-12-14 26 BPF		Medium dense to very dense gray SAND (SP) saturated, fine to medium grained, poorly graded, with silt lenses	SS						
45	5-15-20 35 BPF			SS	45					
	15-17-29 46 BPF			SS						
	17-23-42 65 BPF			SS						
50			Boring R-3 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/6/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 7/10/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-18'				R-4
	WET ROTARY 18'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	17'	11.4'		TIME / TIME
	TIME	0	17 min.		16:32 / 19:10
	DATE	7/5/93	7/5/93		DATE / DATE
					07/05/93 / 07/05/93

DATUM: Ground Surface ELEVATION: 65.1 Ft. NGVD

BORING COORDINATES: N4906 E2143

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobil B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.75		Stiff to very stiff brown CLAY (CH) moist, slickensided with ferrous nodules	ST						
	1.75			ST						
5	2.25			ST	5					
	2.25			ST						
	3.25			ST		76	49	32	89	1.98s
10	2.50		– with calcareous nodules	ST	10					
	2.50			ST						
15	0.75		Medium stiff reddish-brown and light gray SILTY CLAY (CL) moist, with ferrous stains	ST	15					
	0.75			ST						
	0.75		Medium stiff brown SILT (ML) wet, trace fine sand	ST		27	3	27		
20	0.25		Soft to medium stiff reddish-brown and light gray SILTY CLAY (CL) wet	ST	20					
	5-3-5 8 BPF			SS						
25	0.75			ST	25					
	0.50			ST						
	3-5-7 12 BPF		Medium dense brown SILTY SAND (SM) wet, fine grained, poorly graded	SS		(1)		19		
30	8-11-11 22 BPF			SS	30					
	6-10-12 32 BPF			SS						
35	4-7-11 18 BPF		Medium dense brown SAND (SP) wet, fine to medium grained, poorly graded	SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-18'				R-4
	WET ROTARY 18'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	17'	11.4'		TIME / TIME
	TIME	0	17 min.		16:32 / 19:10
	DATE	7/5/93	7/5/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 65.1 Ft. NGVD					07/05/93 / 07/05/93

BORING COORDINATES:	N4906 E2143	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobil B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	12-14-14 28 BPF		Medium dense to dense gray SAND (SP) wet, fine to medium grained, poorly graded, with clay lenses	SS						
	14-18-18 36 BPF			SS		(2)		20		
40	14-21-20 41 BPF			SS	40					
	15-8-21 29 BPF			SS						
45	14-19-25 44 BPF		-- with some fine gravel	SS	45					
	18-23-25 48 BPF			SS						
	7-12-27 39 BPF			SS						
50			Boring R-4 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/5/93.		50					
55			Notes: (1) Percent passing 200 sieve = 7.2%. See gradation curve. (2) Percent passing 200 sieve = 4.6%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-16'				R-5
	WET ROTARY 16'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	15'	7.0'		TIME / TIME
	TIME	0	15 min.		15:45 / 16:00
	DATE	6/21/93	6/21/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 61.8 Ft. NGVD					06/21/93 / 06/29/93

BORING COORDINATES:	N4884 E2587	SURFACE CONDITIONS:	Wet, level, bare
DRILL RIG:	Mobil B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.25		Medium stiff to stiff brown and light gray CLAY (CH) wet, slickensided, with some ferrous nodules	ST						
	0.50			ST						
5	1.75			ST	5					
▼	1.00		– borehole became blocked at 7.0 feet prior to obtaining water level reading	ST		79	49	40	81	0.78s
	2.25		– becoming stiff	ST						
10	2.25			ST	10					
	2.25			ST						
▽ 15	0.75		– becoming medium stiff to stiff	ST	15					
	1.00		Stiff brown and light gray SILTY CLAY (CL), wet, with ferrous stains	ST						
	1.50		Medium stiff to stiff brown and light gray CLAY (CH) wet, with ferrous stains	ST						
20	1.50			ST	20					
	1.50		Medium stiff to stiff brown SANDY CLAY (CL) wet, with sand layers	ST		38	22	27	98	0.56
25	NR		Loose to medium dense brown SILTY SAND (SM) wet, fine grained, poorly graded, with silt and clay lenses	ST	25					
	4-10-11 21 BPF			SS						
	3-5-6 11 BPF			SS						
30	11-7-11 18 BPF			SS	30					
	8-9-19 28 BPF			SS						
35	3-4-3 7 BPF			SS	35					
			(continued . . .)							

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-16'				R-5
	WET ROTARY 16'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	15'	7.0'		TIME / TIME
	TIME	0	15 min.		15:45 / 16:00
	DATE	6/21/93	6/21/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 61.8 Ft. NGVD					06/21/93 / 06/29/93

BORING COORDINATES:	N4884 E2587	SURFACE CONDITIONS:	Wet, level, bare
DRILL RIG:	Mobil B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	8-12-7 19 BPF		Loose to medium dense brown SILTY SAND (SM) wet, fine grained, poorly graded, with silt and clay layers	SS						
	7-4-5 9 BPF			SS						
40	9-17-25 42 BPF		Medium dense to dense brown SAND (SP) wet, fine grained, poorly graded, with silt lenses	SS	40					
	7-13-19 32 BPF			SS						
45	4-18-21 39 BPF			SS	45					
	8-15-12 27 BPF			SS						
	7-10-11 21 BPF			SS						
50			Boring R-5 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/29/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 6/21/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.	
	DRY AUGER 0-10'				R-6	
	WET ROTARY 10'-50'				SHEET	
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2	
PHASE II REDESIGN	ST - Shelby Tube				DRILLING	
MONROE, LOUISIANA	SS - Split Spoon				START	FINISH
(See Boring Location Plan)	WATER LEVEL	10'	8.7'		TIME	TIME
	TIME	0	15 min.		13:15	18:00
	DATE	6/12/93	6/12/93		DATE	DATE
DATUM: Ground Surface ELEVATION: 61.6 Ft. NGVD					06/12/93	06/12/93

BORING COORDINATES:	N4862 E3027	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.00		Medium stiff to stiff brown and light gray CLAY (CH) moist to wet, slickensided	ST						
	1.00			ST						
5	1.50			ST	5					
	1.75			ST						
	0.50		Soft brown SILT (ML) wet	ST		26	2	24		
10	2.00		Stiff brown and light gray CLAY (CH) wet, slickensided	ST	10					
	2.00			ST						
15	2.50			ST	15					
	0.50		Soft to medium stiff brown SILTY CLAY (CL) wet, with sand lenses	ST						
	1.00		Medium stiff to stiff light gray and brown CLAY (CH) moist to wet, slickensided	ST						
20	1.50			ST	20	53	30	26	98	1.26s
	2.25			ST						
25	3.00			ST	25					
	2.50			ST						
	2-2-2 4 BPF		Soft light gray and brown SILTY CLAY (CL) wet	SS						
30	0.25			ST	30					
	3-3-12 15 BPF		Medium dense brown SILTY SAND (SM) wet, fine grained, poorly graded with silt lenses	SS						
35	15-14-16 30 BPF		Medium dense to dense brown SAND (SP) wet, fine grained, porly graded	SS	35	(1)		21		

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-10'				R-6
	WET ROTARY 10'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	10'	8.7'		TIME / TIME
	TIME	0	15 min.		13:15 / 18:00
	DATE	6/12/93	6/12/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 61.6 Ft. NGVD					06/12/93 / 06/12/93

BORING COORDINATES:	N4862 E3027	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobil B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	14-16-21 37 BPF		Dense to very dense brown SAND (SP) wet, fine grained, poorly graded	SS						
	15-17-21 38 BPF			SS						
40	16-21-30 51 BPF			SS	40					
	6-12-25 37 BPF			SS						
45	15-20-33 53 BPF		-- fine to medium grained, with some fine gravel	SS	45					
	13-17-33 50 BPF			SS						
50	15-26-35 61 BPF			SS	50	(2)		16		
			Boring R-6 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/12/93.							
55			Notes: (1) Percent passing 200 sieve = 2.7%. See gradation curve. (2) Percent passing 200 sieve = 3.1%. See gradation curve.		55					
60					60					
65					65					
70					70					

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-16'				R-7
	WET ROTARY 16'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	16'	10.4'		TIME / TIME
	TIME	0	15 min.		15:05 / 11:20
	DATE	7/6/93	7/6/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 62.7 Ft. NGVD					07/06/93 / 07/07/93

BORING COORDINATES:	N4840 E3467	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.00		Medium stiff to stiff brown and light gray CLAY (CH) moist to wet, slickensided, with ferrous nodules	ST						
	1.00			ST						
5	1.75			ST	5					
	2.00			ST		77	49	40	83	1.46s
	2.25			ST						
▽ 10	1.50			ST	10					
	2.00			ST						
▽ 15	2.50			ST	15					
	1.00		Soft to medium stiff brown and reddish-brown SILTY CLAY (CL) moist to wet, with ferrous stains	ST		27	8	30	100	0.69
	0.50			ST						
20	2.00		Medium stiff to stiff reddish-brown and light gray CLAY (CH) moist to wet, slickensided	ST	20					
	1.25			ST						
25	1.25			ST	25					
	1.25		Medium stiff brown SANDY CLAY (CL), wet	ST						
	6-9-16 25 BPF		Medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS						
30	5-11-22 33 BPF		Dense brown SAND (SP) saturated, fine grained, poorly graded	SS	30					
	9-23-23 46 BPF			SS						
35	9-21-20 41 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-16' WET ROTARY 16'-50' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-7 SHEET 2 of 2 DRILLING

WATER LEVEL	16'	10.4'		START TIME	FINISH TIME
TIME	0	15 min.		15:05	11:20
DATE	7/6/93	7/6/93		DATE 07/06/93	DATE 07/07/93

DATUM: Ground Surface ELEVATION: 62.7 Ft. NGVD

BORING COORDINATES:	N4840 E3467	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Failing 36	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	9-19-19 38 BPF		Dense to very dense brown SAND (SP) wet, fine to medium grained, poorly graded	SS						
	10-20-25 45 BPF			SS						
40	5-14-23 37 BPF			SS	40					
	12-28-37 65 BPF			SS						
45	12-26-41 67 BPF			SS	45					
	11-20-24 44 BPF		-- trace silt	SS						
	10-16-23 39 BPF		-- with some fine gravel	SS						
50			Boring R-7 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/7/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/12/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-22'				R-8
	WET ROTARY 22'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	21'	10.7'		TIME / TIME
	TIME	0	45 min.		14:45 / 11:25
	DATE	7/11/93	7/12/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 64.1 Ft. NGVD					07/11/93 / 07/12/93

BORING COORDINATES:	N4442 E3894	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.25		Medium stiff to stiff brown CLAY (CH) moist, slickensided, with ferrous stains and nodules	ST						
	2.00			ST						
5	1.25			ST	5	86	56	42	79	1.16s
	2.00		-- becoming light gray and reddish-brown	ST						
	2.00			ST						
10	2.00			ST	10					
	2.25			ST						
15	2.50		-- with calcareous nodules	ST	15					
	2.50			ST						
	0.75		Soft to medium stiff reddish-brown and brown SILTY CLAY (CL) moist, with ferrous stains	ST		33	14			
20	0.50			ST	20					
	2.00		Medium stiff to stiff brown, light gray, and reddish-brown CLAY (CH) moist to wet, slickensided	ST						
25	1.00			ST	25					
	1.75		-- becoming sandy	ST						
	1.25		Medium stiff brown SANDY CLAY (CL), wet	ST						
30	5-11-16 27 BPF		Loose to medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS	30					
	5-3-7 10 BPF		-- with silt layers	SS						
35	5-6-20 26 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-22' WET ROTARY 22'-50' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-8 SHEET 2 of 2

WATER LEVEL	21'	10.7'		DRILLING START	DRILLING FINISH
TIME	0	15 min.		TIME 14:15	TIME 11:25
DATE	7/11/93	7/12/93		DATE 07/11/93	DATE 07/12/93

DATUM: Ground Surface ELEVATION: 64.1 Ft. NGVD

BORING COORDINATES: N4442 E3894 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	8-12-12 24 BPF		Medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS						
	12-16-16 32 BPF		Medium dense to dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
40	10-20-21 41 BPF			SS	40					
	11-12-12 24 BPF			SS						
45	2-8-12 20 BPF		-- with some fine gravel	SS	45					
	18-31-65 96 BPF		-- becoming very dense	SS						
	17-29-29 58 BPF			SS						
50			Boring R-8 was terminated at 50 feet. Borehole was grouted full depth with a 5% bentonite/cement grout on 7/12/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 7/12/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-6'				R-9
	WET ROTARY 6'-100'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 3
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	5'	2.0'		TIME / TIME
	TIME	0	15 min.		9:00 / 8:30
	DATE	6/10/93	6/10/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 54.3 Ft. NGVD					06/10/93 / 06/12/93

BORING COORDINATES: N4459 E3451	SURFACE CONDITIONS: Dry, level, grass
DRILL RIG: Mobile B-61	DRILLER: Ken Gibson
SPT HAMMER WEIGHT: 140 LBS.	LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.50		Stiff brown and light gray CLAY (CH) moist, slickensided	ST						
	1.50			ST						
5	2.25			ST	5					
	2.25			ST						
	0.25		Loose to medium dense brown and gray CLAYEY SILT (ML) wet, with sand lenses	ST		26	3	24	(1)	
10	1.00		Medium stiff to stiff brown and light gray CLAY (CH) moist, slickensided	ST	10					
	1.00			ST						
15	1.25			ST	15					
	0.50		Medium stiff brown SILTY CLAY (CL) moist, with sand lenses	ST		39	20	26	98	0.63
	1.00			ST						
20	1.00		Medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded, with some clay	ST	20					
	3-12-14 26 BPF			SS						
25	2-6-10 16 BPF			SS	25	(2)				
	7-12-12 24 BPF		Medium dense to dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	9-12-13 25 BPF			SS						
30	6-12-21 33 BPF		– with some gravel	SS	30					
	9-25-25 50 BPF			SS						
35	6-12-18 30 BPF			SS	35	(3)				
			(continued . . .)							

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-6'				R-9
	WET ROTARY 6'-100'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 3
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	5'	2.0'		TIME / TIME
	TIME	0	15 min.		9:00 / 8:30
	DATE	6/10/93	6/10/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 54.3 Ft. NGVD					06/10/93 / 06/12/93

BORING COORDINATES: N4459 E3451	SURFACE CONDITIONS: Dry, level, grass
DRILL RIG: Mobile B-61	DRILLER: Ken Gibson
SPT HAMMER WEIGHT: 140 LBS.	LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	8-11-25 36 BPF		Medium to dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	10-15-20 35 BPF			SS						
40			-- with silt lenses and fine gravel		40					
	5-10-20 30 BPF		-- becoming loose	SS						
	2-6-2 8 BPF			SS						
45	6-7-11 18 BPF		-- becoming medium dense to dense	SS	45	(4)				
	6-13-13 26 BPF			SS						
	8-16-25 41 BPF			SS						
50					50					
55	11-14-15 29 BPF			SS	55					
	17-29-27 56 BPF		-- becoming very dense	SS						
60					60					
				ST						
65	12-24-32 56 BPF		Soft gray weathered to unweathered CLAYEY SHALE dry to moist, blocky	SS	65					
	>4.50			ST						
70					70					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-6' WET ROTARY 6'-100'	R-9
	SAMPLING METHOD:	SHEET 3 of 3
	ST - Shelby Tube SS - Split Spoon	DRILLING START / FINISH
	WATER LEVEL: 5' / 2.0'	TIME: 9:00 / 8:30
	TIME: 0 / 15 min.	
	DATE: 6/10/93 / 6/10/93	DATE: 06/10/93 / 06/12/93

DATUM: Ground Surface ELEVATION: 54.3 Ft. NGVD

BORING COORDINATES: N4459 E3451	SURFACE CONDITIONS: Dry, level, grass
DRILL RIG: Mobile B-61	DRILLER: Ken Gibson
SPT HAMMER WEIGHT: 140 LBS.	LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Soft gray weathered to unweathered CLAYEY SHALE dry to moist, blocky							
75	>4.50		-- alternating light gray and gray in color	ST	75	77	48	29	91	(5)
80	>4.50			ST	80					
	11-31-26 57 BPF			SS						
85	>4.50			ST	85					
90	>4.50			ST	90					
95	>4.50			ST	95					
100	>4.50			ST	100					

Boring R-9 was terminated at 100 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/12/93.

Notes:
(1) % passing 200 sieve = 70.5%.
(2) % passing 200 sieve = 7.7%. See gradation curve.
(3) % passing 200 sieve = 2.2%.
(4) % passing 200 sieve = 1.9%.
(5) Vertical Permeability = 4.70 E-09 cm/sec. See permeability test result.

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-8'				R-10
	WET ROTARY 8'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	7'	6.1'		TIME / TIME
	TIME	0	15 min.		10:55 / 16:50
	DATE	6/13/93	6/13/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 54.2 Ft. NGVD					06/13/93 / 06/13/93

BORING COORDINATES:	N4475 E3011	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.50		Medium stiff to stiff reddish-brown and light gray CLAY (CH) moist to wet, slickensided, with ferrous nodules and trace silt	ST						
	1.50			ST						
5	1.25			ST	5					
▼	1.50			ST		53	31	29	97	1.33
	0.75		Medium stiff reddish-brown and light gray SILTY CLAY (CL) wet, with sand	ST						
10	0.75			ST	10	30	12			
	2.00		Medium stiff to stiff brown and light gray CLAY (CH) moist to wet, slickensided, with trace silt	ST						
15	1.75			ST	15					
	1.25			ST						
	1.75		-- becoming reddish-brown, with ferrous nodules	ST						
20	1.50			ST	20					
	1.50			ST						
25	1.25			ST	25					
	1.75		-- with sand layers	ST						
	–		Loose brown SILTY SAND (SM) wet, fine grained, poorly graded	ST						
30	5-3-2 5 BPF		-- with silt lenses	SS	30					
	8-15-27 43 BPF		Dense brown SAND (SP) saturated, fine grained, poorly graded	SS						
35	16-18-21 39 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-8'				R-10
	WET ROTARY 8'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	7'	6.1'		TIME / TIME
	TIME	0	15 min.		10:55 / 16:50
	DATE	6/13/93	6/13/93		DATE / DATE
					06/13/93 / 06/13/93

DATUM: Ground Surface ELEVATION: 54.2 Ft. NGVD

BORING COORDINATES: N4475 E3011

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	16-26-25 51 BPF		Dense to very dense brown SAND (SP) saturated, fine to medium grained, poorly graded, with some fine gravel	SS						
	7-18-25 43 BPF			SS						
40	7-18-24 42 BPF			SS	40					
	9-16-21 37 BPF			SS						
45	12-18-26 44 BPF			SS	45					
	11-24-33 57 BPF			SS						
	13-15-13 28 BPF		-- becoming gray	SS						
50			Boring R-10 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/13/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 6/13/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-16'				R-11
	WET ROTARY 16'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	17'	16.2'		TIME / TIME
	TIME	0	15 min.		8:00 / 12:35
	DATE	6/15/93	6/15/93		DATE / DATE
					06/15/93 / 06/15/93

DATUM: Ground Surface ELEVATION: 61.2 Ft. NGVD

BORING COORDINATES: N4492 E2570

SURFACE CONDITIONS: Dry, level, grass

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.00		Stiff to very stiff light gray and brown CLAY (CH) moist, with ferrous nodules and organics	ST						
	1.25		Stiff light gray and brown CLAY (CH) moist, slickensided, with ferrous nodules	ST						
5	1.75			ST	5					
	1.75			ST						
	1.50			ST						
10	2.00			ST	10					
	2.00		-- becoming moist to wet	ST		97	64	44	78	1.24
15	2.00			ST	15					
	1.75			ST						
	1.75			ST						
20	2.00		Medium stiff to stiff gray CLAY (CH) moist to wet, slickensided	ST	20					
	1.50			ST				38	84	0.89
25	1.25			ST	25					
	1.25			ST						
	1.25		-- becoming light gray and brown	ST						
30	2.75		-- with ferrous nodules	ST	30					
	1.50			ST		93	59	47	75	0.87
35	1.25		Loose light gray SILTY SAND (SM), saturated, fine grained, poorly graded	ST	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 6/15/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-16' WET ROTARY 16'-50' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-11 SHEET 2 of 2

WATER LEVEL	17'	16.2'		DRILLING START	DRILLING FINISH
TIME	0	15 min.		TIME 8:00	TIME 12:35
DATE	6/15/93	6/15/93		DATE 06/15/93	DATE 06/15/93

DATUM: Ground Surface ELEVATION: 61.2 Ft. NGVD

BORING COORDINATES: N4492 E2570 SURFACE CONDITIONS: Dry, level, grass

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1-2-7 9 BPF		Loose to medium dense light gray SILTY SAND (SM) saturated, fine grained, poorly graded	SS						
	2-2-9 11 BPF			SS		(1)				
40	9-11-22 33 BPF		Dense to very dense light gray SAND (SP) saturated, fine to medium grained, poorly graded with silt and clay lenses	SS	40					
	11-23-29 52 BPF			SS						
45	4-12-29 41 BPF			SS	45					
	10-20-32 52 BPF			SS		(2)				
	17-20-30 50 BPF		-- trace fine gravel	SS						
50			Boring R-11 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/15/93.		50					
55			Notes: (1) % passing 200 sieve = 8.6% (2) % passing 200 sieve = 3.2%		55					
60					60					
65					65					
70					70					

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-14'				R-12
	WET ROTARY 14'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	14'	11.0'		TIME / TIME
	TIME	0	18 min.		16:10 / 9:40
	DATE	6/16/93	6/16/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 63.5 Ft. NGVD					06/16/93 / 06/17/93

BORING COORDINATES:	N4509 E2126	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.00		Medium stiff to stiff brown SILTY CLAY (CH) moist, slickensided, with ferrous and calcareous nodules	ST						
	1.50			ST						
5	1.50		-- becoming light gray	ST	5					
	1.75			ST						
	1.75		-- becoming reddish-brown	ST						
10	2.50			ST	10					
	1.25			ST						
15	1.25			ST	15					
	1.00		Soft to medium stiff reddish-brown SILTY CLAY (CL) moist, with ferrous nodules	ST		33	15	25	101	0.42
	1.50		Soft to medium stiff reddish-brown CLAY (CH) moist to wet, with ferrous and calcareous nodules	ST						
20	0.75			ST	20					
	1.00			ST						
25	1.25			ST	25					
	0.50		-- becoming soft and wet	ST						
	1.00		-- with sand	ST						
30	0.25		Soft to medium stiff brown and gray SILTY CLAY (CL) wet, with sand lenses	ST	30	30	14			
	1-1-2 3 BPF			SS						
35	1-4-7 11 BPF			SS	35					
			(continued . . .)							

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-14' WET ROTARY 14'-50'	R-12
	SAMPLING METHOD:	SHEET 2 of 2
	ST - Shelby Tube	DRILLING
	SS - Split Spoon	START / FINISH
	WATER LEVEL: 14' / 11.0'	TIME: 16:10 / 9:40
	TIME: 0 / 18 min.	
	DATE: 6/16/93 / 6/16/93	DATE: 06/16/93 / 06/17/93

DATUM: Ground Surface ELEVATION: 63.5 Ft. NGVD

BORING COORDINATES: N4509 E2126

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	0.75		Medium stiff gray SILTY CLAY (CL) wet, with sand lenses	ST						
	1.50		– with sand layers	ST						
40	2-4-11 15 BPF		Very loose to medium dense gray SILTY SAND (SM) wet, fine grained, poorly graded, with wood	SS	40					
	1-1-3 4 BPF			SS						
45	4-15-17 32 BPF			SS	45					
	7-14-18 32 BPF		Dense to very dense gray SAND (SP) wet, fine to medium grained, poorly graded	SS						
	26-22-32 34 BPF		– becoming brown, with fine gravel	SS						
50			Boring R-12 was terminated at 50 feet. Borehole grouted full depth with a 5% *bentonite/cement grout on 6/17/93.*		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 6/15/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-26'				R-13
	WET ROTARY 26'-100'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 3
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	26'	10.0'		TIME / TIME
	TIME	0	2.4 hrs		10:40 / 19:25
	DATE	7/1/93	7/1/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 63.4 Ft. NGVD					07/01/93 / 7/02/93

BORING COORDINATES:	N4526 E1679	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.50		Stiff brown and reddish-brown CLAY (CH) dry to moist, slickensided, with ferrous nodules and vegetative matter	ST						
	1.75			ST						
5	1.75		-- becoming light gray	ST	5					
	1.50			ST				39	82	1.25s
	2.00			ST						
10					10					
	2.25			ST						
	2.50			ST						
15	2.25		-- with ferrous stains and calcareous nodules	ST	15					
	2.00			ST						
	2.00			ST						
20					20					
	1.50			ST						
	0.75		Medium stiff brown and light gray SILTY CLAY (CL) moist to wet	ST						
25	0.75			ST	25	32	15	28	96	0.46
	0.75		-- with sand lenses	ST		32	15	23	100	0.69
	1.25			ST				26	124	(1,2)
30					30					
	1.25			ST				26	119	(3)
	3-4-7 11 BPF			SS						
35	1.25			ST	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-26' WET ROTARY 26'-100'	R-13
	SAMPLING METHOD:	SHEET 2 of 3
	ST - Shelby Tube	DRILLING
	SS - Split Spoon	START / FINISH

WATER LEVEL	26'	10.0'		START TIME	FINISH TIME
TIME	0	2.4 hrs		10:40	19:25
DATE	7/1/93	7/1/93		DATE 07/01/93	DATE 07/02/93

DATUM: Ground Surface ELEVATION: 63.4 Ft. NGVD

BORING COORDINATES: N4526 E1679 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	NR		Medium stiff brown and light gray SILTY CLAY (CL) wet, with sand layers, organic matter and calcareous nodules	ST						
	0.50			ST						
40	--		Gray SILTY SAND (SM) saturated, fine grained, poorly graded with clay lenses	ST	40					
	7-13-16 29 BPF		Medium dense to dense gray and brown SAND (SP) saturated, fine to medium grained, poorly graded, with clay lenses	SS						
45	8-11-17 28 BPF			SS	45					
	6-16-29 45 BPF			SS						
	9-19-29 48 BPF		– with some fine gravel	SS						
50					50					
	24-25-26 51 BPF		– becoming dense to very dense	SS						
55					55					
	21-15-16 31 BPF			SS						
60					60					
	10-15-19 34 BPF			SS						
65					65					
	30-17-21 38 BPF			SS						
70					70					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-26'				R-13
	WET ROTARY 26'-100'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				3 of 3
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	26'	10.0'		TIME / TIME
	TIME	0	2.4 hrs		
	DATE	7/1/93	7/1/93		DATE / DATE
					07/01/93 / 07/02/93

DATUM: Ground Surface ELEVATION: 63.4 Ft. NGVD

BORING COORDINATES: N45269 E1679

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Dense to very dense gray and brown SAND (SP) saturated, fine to medium grained, poorly graded, with some fine gravel							
75	13-21-20 41 BPF		Dense light gray and gray CLAYEY SILT (ML) dry	SS	75					
80	>4.50		Soft light to dark gray weathered to unweathered CLAYEY SHALE dry, with reddish-brown and gray clay layers	ST	80					
85	>4.50			ST	85					
90	>4.50			ST	90					
95	>4.50			ST	95					
100	1.50		Stiff reddish-brown and gray CLAY (CH) moist to wet	ST	100					

Boring R-13 was terminated at 100 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/2/93.

Notes:
(1) See Consolidation Test results.
(2) Vertical Permeability = 3.4 E-07 cm/sec. See Permeability Test results.
(3) Horizontal Permeability = 4.9 E-07 cm/sec. See Permeabiliy Test results.

LOGGED BY PJR DATE 8/3/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-22' WET ROTARY 22'-50' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-14 SHEET 1 of 2

WATER LEVEL	22'	11.7'	
TIME	0	15 min.	
DATE	7/14/93	7/14/93	

DRILLING	START	FINISH
TIME	12:40	16:00
DATE	07/14/93	07/14/93

DATUM: Ground Surface ELEVATION: 63.5 Ft. NGVD

BORING COORDINATES: N4543 E1239

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Failing 1500

DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.50		Stiff dark brown CLAY (CH) moist, mottled, with rootlets, calcareous nodules and ferrous stains	ST						
	1.50			ST						
5	2.00		-- *becoming blocky*	ST	5					
	1.50			ST						
	1.50		-- becoming dark reddish-brown	ST						
10	2.00			ST	10					
	2.00		-- slickensided	ST						
15	0.50		Medium stiff to stiff light gray and reddish-brown SILTY CLAY (CL) moist, mottled, with rootlets and ferrous nodules	ST	15					
	2.00			ST						
	1.00			ST						
20	--		Loose reddish-brown CLAYEY SAND (SC) saturated, fine grained, poorly graded, *with silt*	ST	20	24	5	22	(1)	
	--			ST		(2)		24		
25	--		Loose to medium dense dark reddish-brown SILTY SAND (SM) *saturated, very fine grained, poorly graded*	ST	25					
	3-5-8 13 BPF			SS						
	4-4-3 7 BPF NR			SS						
30	1-0-1 1 BPF		*Very loose to loose dark brown* CLAYEY SILT (ML) saturated, with ferrous stains and very fine grained sand	SS	30					
	3-3-4 7 BPF			SS		24	7	30	(3)	
35	1-0-5 5 BPF		Soft dark gray SILTY CLAY (CL) wet, with sand	SS	35					

(continued . . .)

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO. R-14	
	DRY AUGER 0-22'			SHEET 2 of 2	
	WET ROTARY 22'-50'				
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	SAMPLING METHOD:			DRILLING	
	ST - Shelby Tube			START	FINISH
	SS - Split Spoon				
	WATER LEVEL	22'	11.7'	TIME 12:40	TIME 16:00
	TIME	0	15 min.		
	DATE	7/14/93	7/14/93	DATE 07/14/93	DATE 07/14/93

DATUM: Ground Surface ELEVATION: 63.5 Ft. NGVD

BORING COORDINATES: N4543 E1239

DRILL RIG: Failing 1500

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Joby Barr

LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Soft dark gray SILTY CLAY (CL), wet, with sand							
	1-4-3 7 BPF		Loose dark brown SILTY SAND (SM) saturated, very fine grained, poorly graded, with some silt and trace clay	SS						
	1-17-18 35 BPF		Dense dark brown SAND (SP) saturated, very fine to fine grained, poorly graded, with some silt and trace	SS						
40	10-13-13 26 BPF			SS	40					
	10-10-15 25 BPF			SS						
45	10-56-6" 66 BPF		– becoming very dense, with trace fine gravel	SS	45					
	10-41-16-3" 57 B/9"			SS						
	24-34-18-3" 52 B/9"			SS						
50			Boring R-14 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/14/93.		50					
55			*Note:* (1) Percent passing 200 sieve = 47.1% (2) Percent passing 200 sieve = 41.7% (3) Percent passing 200 sieve = 57.3%		55					
60					60					
65					65					
70					70					

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-22' WET ROTARY 22'-50'	R-15
	SAMPLING METHOD:	SHEET 1 of 2
	ST - Shelby Tube	DRILLING
	SS - Split Spoon	START / FINISH
	WATER LEVEL: 22' / 11.3'	TIME 7:00 / TIME 11:45
	TIME: 0 / 15 min.	
	DATE: 7/10/93 / 7/10/93	DATE 07/10/93 / DATE 07/10/93

DATUM: Ground Surface ELEVATION: 63.0 Ft. NGVD

BORING COORDINATES: N4557 E798

DRILL RIG: Failing 1500

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Joby Barr

LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 7/10/93 CHK'D BY DBK

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.50		*Stiff reddish-brown* CLAY (CH) moist, slickensided, with rootlets	ST						
	1.50			ST						
5	2.00		– becoming light gray and mottled	ST	5					
	2.00			ST						
	1.50			ST						
10	NR			ST	10					
	2.50			ST						
15	2.00			ST	15					
	1.50			ST						
	1.00		*Soft to medium stiff brown and light gray* SILTY CLAY (CL) moist, with ferrous stains and nodules	ST						
20	0.50			ST	20					
	<0.25		– becoming wet, very soft and very SILTY CLAY	ST						
25	<0.25			ST	25					
	–		Very loose to loose dark brown CLAYEY SILT (ML) saturated, with some fine grained sand	ST						
	1-0-4 4 BPF			SS						
30	3-3-3 6 BPF			SS	30					
	1-0-2 2 BPF			SS						
35	5-10-7 17 BPF		Loose to medium dense dark gray SILTY SAND (SM) saturated, fine grained, poorly graded	SS	35					

(continued . . .)

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA *(See Boring Location Plan)*	DRY AUGER 0-22' WET ROTARY 22'-50'	R-15
	SAMPLING METHOD:	SHEET 2 of 2
	ST - Shelby Tube	DRILLING
	SS - Split Spoon	START / FINISH
	WATER LEVEL: 22' / 11.3'	TIME: 7:00 / 11:45
	TIME: 0 / 15 min.	
	DATE: 7/10/93 / 7/10/93	DATE: 07/10/93 / 07/10/93

DATUM: Ground Surface ELEVATION: 63.0 Ft NGVD

BORING COORDINATES: N4557 E798

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Failing 1500

DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	6-10-14 24 BPF		Loose to medium dense dark gray SILTY SAND (SM) saturated, fine grained, poorly graded	SS						
	1-5-4 9 BPF			SS						
40	5-9-10 19 BPF			SS	40					
	2-5-9 14 BPF			SS						
45	19-24-30 54 BPF		Very dense gray SAND (SP) saturated, fine grained, poorly graded with trace fine gravel	SS	45					
	9-24-36 60 BPF			SS						
	19-23-36 59 BPF			SS						
50			*Boring R-15 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/10/93.*		50					
55					55					
60					60					
65					65					
70					70					

LOGGED BY PJR DATE 7/10/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.	
	DRY AUGER 0-24'				R-16	
	WET ROTARY 24'-50'				SHEET	
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2	
PHASE II REDESIGN	ST - Shelby Tube				DRILLING	
MONROE, LOUISIANA	SS - Split Spoon				START	FINISH
(See Boring Location Plan)	WATER LEVEL	24'	12.0'		TIME	TIME
	TIME	0	15 min.		13:15	17:00
	DATE	7/9/93	7/9/93		DATE	DATE
DATUM: Ground Surface ELEVATION: 62.5 Ft. NGVD					07/09/93	07/09/93

BORING COORDINATES:	N4112 E792	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Failing 1500	DRILLER:	Joby Barr
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.50		Medium stiff to stiff reddish brown and light gray CLAY (CH) moist, mottled, with rootlets, calcareous, and ferrous nodules	ST						
	2.00			ST						
5	2.50			ST	5					
	2.00			ST						
	1.50		– becoming blocky	ST						
10	1.50			ST	10					
	2.50		– slickensided	ST						
15	2.00			ST	15					
	1.50		– becoming gray and reddish-brown	ST						
	1.00			ST						
20	1.00			ST	20					
	2.50			ST						
25	0.25		Loose dark brown CLAYEY SILT (ML) saturated, with very fine grained sand and rootlets	ST	25					
	0.25			ST						
	0.25			ST						
30	2-3-2 5 BPF			SS	30					
	1-2-4 6 BPF			SS						
35	1-2-6 8 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-24'				R-16
	WET ROTARY 24'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	24'	12.0'		TIME / TIME
	TIME	0	15 min.		
	DATE	7/9/93	7/9/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 62.5 Ft. NGVD					07/09/93 / 07/09/93

BORING COORDINATES: N4112 E792	SURFACE CONDITIONS: Dry, level, bare
DRILL RIG: Failing 1500	DRILLER: Joby Barr
SPT HAMMER WEIGHT: 140 LBS.	LOGGER: T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Loose dark brown CLAYEY SILT (ML) saturated, with very fine grained sand							
	2-4-6 10 BPF		Medium dense dark brown SILTY SAND (SM) saturated, very fine grained, poorly graded	SS						
	2-10-18 28 BPF			SS						
40	1-2-10 12 BPF			SS	40					
	10-12-14 26 BPF			SS						
45	2-6-6 12 BPF		Medium stiff dark brown SILTY CLAY (CL) saturated, with sand	SS	45					
	--		Medium dense dark brown SAND (SP) saturated, fine to coarse grained, poorly graded, with some fine gravel	ST						
	2-8-16 24 BPF			SS						
50			Boring R-16 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/9/93.		50					
55					55					
60					60					
65					65					
70					70					

SOILS AND FOUNDATION ENGINEERS, INC.

DRILLING CONTRACTOR

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

AME AND LOCATION	DRILLING METHOD:		BORING NO. R-16
	DRY AUGER 0-24'		
	WET ROTARY 24'-50'		SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:		
PHASE II REDESIGN	ST - Shelby Tube		DRILLING
MONROE, LOUISIANA	SS - Split Spoon		START / FINISH
(See Boring Location Plan)	WATER LEVEL 24' 12.0'		TIME / TIME
	TIME 0 15 min.		
	DATE 7/9/93 7/9/93		DATE 07/09/93 / DATE 07/09/93

ATUM: Ground Surface ELEVATION: 62.5 Ft. NGVD

ORING COORDINATES: N4112 E792 | SURFACE CONDITIONS: Dry, level, bare

ILL RIG: Failing 1500 | DRILLER: Joby Barr

T HAMMER WEIGHT: 140 LBS. | LOGGER: T. F. Keowen

SOILS AND FOUNDATION ENGINEERS, INC.

DRILLING CONTRACTOR

(ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Loose dark brown CLAYEY SILT (ML) saturated, with very fine grained sand							
	2-4-6 10 BPF		Medium dense dark brown SILTY SAND (SM) saturated, very fine grained, poorly graded	SS						
	2-10-18 28 BPF			SS						
	1-2-10 12 BPF			SS	40					
				SS						
	2-6-6 12 BPF		Medium stiff dark brown SILTY CLAY (CL) saturated, with sand	SS	45					
			Medium dense dark brown SAND (SP) saturated, fine to coarse grained, poorly graded, with some fine gravel	ST						
	2-8-16 24 BPF			SS	50					
			Boring R-16 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/9/93.		55					
					60					
					65					
					70					

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

LOGGED BY PJM DATE

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-22' WET ROTARY 22'-50' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-17 SHEET 2 of 2

				DRILLING	
				START	FINISH
WATER LEVEL	21'	11.5'		TIME	TIME
TIME	0	18 min.		12:45	19:00
DATE	7/14/93	7/14/93		DATE	DATE
				07/14/93	07/14/93

DATUM: Ground Surface ELEVATION: 62.8 Ft. NGVD

BORING COORDINATES: N40948 E1220

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2-3-5 8 BPF		Loose brown SILTY SAND (SM) saturated, very fine grained, poorly graded with clay layer	SS						
	0.50		Soft to medium stiff gray CLAY (CH) wet, with sand layers	ST						
40	3-3-7 10 BPF		Medium dense to very dense gray SAND (SP-SM) saturated, fine grained, poorly graded	SS	40					
	10-12-23 35 BPF			SS		(2)		21		
45	12-31-32 63 BPF		-- becoming brown, fine to medium grained	SS	45					
	15-23-31 54 BPF			SS						
	6-16-22 38 BPF			SS						
50			Boring R-17 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/14/93.		50					
55			Notes: (1) Percent passing 200 sieve = 11.6%. (2) Percent passing 200 sieve = 11.0%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-22'				R-17
	WET ROTARY 22'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	21'	11.5'		TIME / TIME
	TIME	0	18 min.		12:45 / 19:00
	DATE	7/14/93	7/14/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 62.8 Ft. NGVD					07/14/93 / 07/14/93

BORING COORDINATES:	N40948 E1220	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2-3-5 8 BPF		Loose brown SILTY SAND (SM) saturated, very fine grained, poorly graded with clay layer	SS						
	0.50		Soft to medium stiff gray CLAY (CH) wet, with sand layers	ST						
40	3-3-7 10 BPF		Medium dense to very dense gray SAND (SP-SM) saturated, fine grained, poorly graded	SS	40					
	10-12-23 35 BPF			SS		(2)		21		
45	12-31-32 63 BPF		– becoming brown, fine to medium grained	SS	45					
	15-23-31 54 BPF			SS						
	6-16-22 38 BPF			SS						
50			Boring R-17 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/14/93.		50					
55			Notes: (1) Percent passing 200 sieve = 11.6%. (2) Percent passing 200 sieve = 11.0%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-24'				R-18
	WET ROTARY 24'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	23'	14.2'		TIME / TIME
	TIME	0	12 hrs.		18:30 / 11:10
	DATE	7/13/93	7/14/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 63.0 Ft. NGVD					07/13/93 / 07/14/93

BORING COORDINATES:	N4081 E1660	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.00		Stiff to very stiff brown CLAY (CH) moist, slickensided, with calcareous and ferrous nodules	ST						
	1.75			ST						
5	2.25		– becoming reddish-brown and light gray	ST	5					
	2.00			ST						
	2.25			ST						
10	2.25			ST	10					
	2.25			ST						
15	2.25			ST	15					
	2.75			ST						
	2.50			ST						
20	1.25		Soft to medium stiff brown SANDY CLAY (CL) wet, with silty sand layers	ST	20					
	0.75			ST						
25	0.25		– with clayey sand layers	ST	25					
	5-6-6 12 BPF		Loose to medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS						
	1-2-3 5 BPF			SS						
30	6-9-13 22 BPF		– with silt lenses	SS	30					
	4-6-13 19 BPF			SS						
35	9-16-17 33 BPF		Dense brown SAND (SP) saturated, fine grained, poorly graded	SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-24'				R-18
	WET ROTARY 24'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	23'	14.2'		TIME / TIME
	TIME	0	12 hrs		18:30 / 11:10
	DATE	7/13/93	7/14/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 63.0 Ft. NGVD					07/13/93 / 07/14/93

BORING COORDINATES:	N4081 E1660	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	9-15-22 37 BPF		Medium dense to very dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	6-10-16 26 BPF			SS						
40	9-25-26 51 BPF			SS	40					
	9-17-17 34 BPF			SS						
45	12-22-35 57 BPF			SS	45					
	31-36-53 89 BPF			SS						
	31-36-45 81 BPF			SS						
50			Boring R-18 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/14/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-14'				R-19
	WET ROTARY 14'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	15'	13.1'		TIME / TIME
	TIME	0	22 min.		9:50 / 15:00
	DATE	6/17/93	6/17/93		DATE / DATE
					06/17/93 / 06/17/93

DATUM: Ground Surface ELEVATION: 60.1 Ft. NGVD

BORING COORDINATES:	N4063 E2107	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.25		Medium stiff to stiff light gray and brown CLAY (CH) dry to moist, slickensided, with ferrous nodules	ST						
	1.25			ST						
5	1.50		-- with calcareous nodules	ST	5					
	1.75			ST						
	1.75			ST						
10	2.00			ST	10					
	1.50			ST						
15	0.75		-- becoming wet	ST	15	103	69	56	68	0.79s (1)
	0.75			ST						
	1.25			ST						
20	1.75			ST	20					
	1.50			ST						
25	1.25			ST	25					
	1.25			ST		79	40	45	74	0.65
	0.75			ST						
30	0.75			ST	30					
	8-11-11 22 BPF		Medium dense brown SILTY SAND (SM) wet, fine grained, poorly graded	SS						
35	5-4-5 9 BPF		-- with silt layers	SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO. R-19
	DRY AUGER 0-14'			SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL PROPOSED HORIZONTAL EXPANSION MONROE, LOUISIANA (See Boring Location Plan)	WET ROTARY 14'-50'			
	SAMPLING METHOD:			DRILLING
	ST - Shelby Tube			START / FINISH
	SS - Split Spoon			
	WATER LEVEL	15'	13.1'	TIME 9:50 / TIME 15:00
	TIME	0	28 min.	
	DATE	6/17/93	6/17/93	DATE 06/17/93 / DATE 06/17/93

DATUM: Ground Surface ELEVATION: 60.1 Ft. NGVD

BORING COORDINATES: N4063 E1660

DRILL RIG: Mobile B-61

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS:

DRILLER: Ken Gibson

LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	15-17-13 30 BPF		Dense light gray SAND (SP) wet, fine grained, poorly graded	SS		(2)		23		
	9-17-26 43 BPF			SS						
40	10-14-23 37 BPF			SS	40					
	9-19-29 48 BPF			SS						
45	7-17-26 37 PF		-- with some silt	SS	45					
	12-20-20 40 BPF			SS						
50	12-19-29 48 BPF			SS	50	(3)		21		
			Boring R-19 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/17/93.							
55			Notes: (1) See Consolidation Test results. (2) Percent passing 200 sieve = 2.6%. See gradation curve. (3) Percent passing 200 sieve = 3.8%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-12' WET ROTARY 12'-50'	R-20
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	SHEET 1 of 2
	WATER LEVEL: 13' / 10.9' TIME: 0 / 17 min. DATE: 6/15/93 / 6/15/93	DRILLING START TIME 12:50 / FINISH TIME 18:00 START DATE 06/15/93 / FINISH DATE 06/15/93

DATUM: Ground Surface ELEVATION: 63.2 Ft. NGVD

BORING COORDINATES: N4045 E2551

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.25		Medium stiff to very stiff brown SILTY CLAY (CH) dry to moist, slickensided, with vegetative matter	ST						
	2.50			ST						
5	3.25		– with ferrous nodules	ST	5					
	2.25			ST						
	2.00			ST		92	60	37	84	1.21s
10	0.75			ST	10					
	0.50		Soft to medium stiff brown and light gray SILTY CLAY (CL) wet, with ferrous nodules	ST						
15	0.50			ST	15					
	0.25			ST						
	1.50			ST		26	3	32	87	0.53 (1)
20	0.75			ST	20					
	1.25			ST						
25	0.50			ST	25					
	1-2-2 4 BPF			SS						
	2-4-5 9 BPF			SS						
30	1-1-5 6 BPF		– with sand lenses	SS	30					
	5-5-9 14 BPF		Medium dense gray SILTY SAND (SM) saturated, fine grained, poorly graded, with silt lenses	SS						
35	1-3-9 12 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-12'				R-20
	WET ROTARY 12'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	13'	10.9'		TIME / TIME
	TIME	0	17 min.		12:50 / 18:00
	DATE	6/15/93	6/15/93		DATE / DATE
					06/15/93 / 06/15/93

DATUM: Ground Surface ELEVATION: 63.2 Ft. NGVD

BORING COORDINATES: N4045 E2551 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Medium dense gray SILTY SAND (SM) saturated, fine grained, poorly graded, with silt lenses							
	3-8-12 20 BPF		Medium dense to very dense gray SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	10-19-21 40 BPF			SS						
40	10-13-20 33 BPF			SS	40					
	10-15-19 34 BPF			SS						
45	9-15-15 30 BPF			SS	45					
	22-29-23 52 BPF			SS						
	13-11-10 21 BPF			SS						
50			Boring R-20 was terminated at 50 feet. Borehole was grouted full depth with a 5% bentonite/cement grout on 6/15/93.		50					
55			Note: (1) Triaxial Unconsolidated Undrained Compression Test. Confining Pressure = 10 PSI		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-6'				R-21
	WET ROTARY 6'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	7'	5.7'		TIME / TIME
	TIME	0	16 min.		7:36 / 11:55
	DATE	6/14/93	6/14/93		DATE / DATE
					06/14/93 / 06/14/93

DATUM: Ground Surface ELEVATION: 58.0 Ft. NGVD

BORING COORDINATES: N4027 E2992

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.25		Medium stiff to stiff brown and light gray CLAY (CH) moist, with some shells	ST						
	2.25			ST						
5	0.75			ST	5					
	0.75		Medium stiff brown and light gray SILTY CLAY (CL) wet, with ferrous nodules	ST						
	1.00			ST		42	23	27	97	0.66
10					10					
	<0.25		Very loose to loose brown SANDY SILT (ML) wet, with clay lenses	ST						
	<0.25			ST		(1)		24		
15	0.25			ST	15					
	3-3-4 7 BPF			SS						
			Medium stiff to stiff brown and light gray CLAY (CH) moist to wet, with ferrous nodules							
	1.25			ST						
20	1.25			ST	20					
	2.00			ST						
25	1.25		Loose to medium dense brown CLAYEY SILT (ML) wet, with sand	ST	25	25	4	24		
	0.75			ST						
	3-7-12 19 BPF		Medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded, with silt lenses	SS						
30	2-6-12 18 BPF			SS	30					
	6-14-18 32 BPF		Dense to very dense brown SAND (SP) saturated, fine grained, poorly graded, with silt lenses	SS		(2)		22		
35	15-25-26 51 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

NAME AND LOCATION	DRILLING METHOD:				BORING NO.	
	DRY AUGER 0-6'				R-21	
	WET ROTARY 6'-50'				SHEET	
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2	
PHASE II REDESIGN	ST - Shelby Tube				DRILLING	
MONROE, LOUISIANA	SS - Split Spoon				START	FINISH
(See Boring Location Plan)	WATER LEVEL	7'	5.7'		TIME	TIME
	TIME	0	16 min.		7:36	11:55
	DATE	6/14/93	6/14/93		DATE	DATE
DATUM: Ground Surface ELEVATION: 58.0 Ft. NGVD					06/14/93	06/14/93

BORING COORDINATES: N4027 E2992 | SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 | DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. | LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

(ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.25		Medium stiff to stiff brown and light gray CLAY (CH) moist, with some shells	ST						
	2.25			ST						
5	0.75			ST	5					
	[illegible]		Medium stiff brown and light gray SILTY CLAY (CL) wet, with ferrous nodules	ST						
	[illegible]			ST		42	23	27	97	0.66
0					10					
	<0.25		Very loose to loose brown SANDY SILT (ML) wet, with clay lenses	ST						
	<0.25			ST		(1)		24		
	0.25			ST	15					
	3-3-4 7 BPF			SS						
	1.25		Medium stiff to stiff brown and light gray CLAY (CH) moist to wet, with ferrous nodules	ST						
	1.25			ST	20					
	2.00			ST						
	1.25		Loose to medium dense brown CLAYEY SILT (ML) wet, with sand	ST	25	25	4	24		
	0.75			ST						
	3-7-12 19 BPF		Medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded, with silt lenses	SS						
	2-6-12 18 BPF			SS	30					
	8-14-18 32 BPF		Dense to very dense brown SAND (SP) saturated, fine grained, poorly graded, with silt lenses	SS		(2)		22		
	[illegible]			SS	35					

(continued . . .)

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

LOGGED BY

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-6'				R-22
	WET ROTARY 6'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	6'	4.4'		TIME / TIME
	TIME	0	15 min.		9:05 / 8:20
	DATE	6/9/93	6/9/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 55.0 Ft. NGVD					06/09/93 / 06/10/93

BORING COORDINATES: N4009 E3432	SURFACE CONDITIONS: Dry, level, bare
DRILL RIG: Mobile B-61	DRILLER: Ken Gibson
SPT HAMMER WEIGHT: 140 LBS.	LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.75		Soft to stiff reddish-brown and light gray SILTY CLAY (CL) dry to moist	ST						
	0.25			ST						
5	1.50			ST	5	36	19	25	100	1.40
	1.50		-- becoming wet, with sand lenses	ST						
	0.75			ST						
10	0.50		Medium stiff reddish-brown SANDY CLAY (CL) wet, with sand lenses	ST	10	28	8			
	1.00		Medium stiff to stiff reddish-brown CLAY (CH) wet	ST						
15	1.00			ST	15					
	1.50		-- trace fine gravel	ST						
	1.75			ST						
20	--		Medium dense brown SILTY SAND (SM) wet, fine grained, poorly graded	ST	20					
	4-6-14 20 BPF			SS						
25	8-16-20 36 BPF		Dense to very dense brown SAND (SP) saturated, fine grained, poorly graded, with silt lenses	SS	25					
	8-13-25 38 BPF			SS						
	12-41-28 69 BPF		-- fine to medium grained, with some fine gravel	SS						
30	9-19-24 43 BPF			SS	30					
	12-16-22 38 BPF			SS						
35	9-20-25 45 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-6'				R-22
	WET ROTARY 6'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	6'	4.4'		TIME / TIME
	TIME	0	15 min.		9:05 / 8:20
	DATE	6/9/93	6/9/93		DATE / DATE
					06/09/93 / 06/10/93

DATUM: Ground Surface ELEVATION: 55.0 Ft. NGVD

BORING COORDINATES:	N4009 E3432	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	19-29-34 63 BPF		Dense to very dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	20-45-53 98 BPF			SS						
40	9-22-27 49 BPF			SS	40					
	9-17-25 42 BPF			SS						
45	19-27-27 54 BPF			SS	45					
	19-33-45 78 BPF			SS						
	7-15-25 40 BPF		-- with some clay	SS						
50			Boring R-21 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/10/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/3/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-14' WET ROTARY 14'-50'	R-23
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	SHEET 1 of 2
	WATER LEVEL 15' 12.0' TIME 0 15 min. DATE 6/8/93 6/8/93	DRILLING START TIME 7:45 — DATE 06/08/93 FINISH TIME 8:50 — DATE 06/09/93

DATUM: Ground Surface ELEVATION: 62.2 Ft. NGVD

BORING COORDINATES: N3992 E3874 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	--		Medium stiff reddish-brown CLAY (CH) moist, slickensided, with ferrous nodules							
	1.50			ST						
5	1.50			ST	5	92	56	40	80	1.16s
	1.50			ST						
	1.50		-- becoming brown and light gray	ST						
10	1.50			ST	10					
	1.00			ST						
+5	0.50			ST	15	67	48	24	101	(1,2)
	0.25			ST						
	4-3-3 6 BPF		-- with silt layers	SS	20					
20	1.75		Stiff to very stiff reddish-brown SILTY CLAY (CL) wet, with sand	ST						
	2.00			ST						
25	1.00			ST	25					
	2.00			ST						
	1.00			ST		44	23	23	105	2.36
30	1.75			ST	30					
	--		Medium dense brown SILTY SAND (SM) wet, fine grained, poorly graded	ST						
35	3-7-19 26 BPF		Medium dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS	35	(3)		20		

(continued . . .)

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-14'				R-23
	WET ROTARY 14'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	15'	12.0'		TIME / TIME
	TIME	0	15 min.		7:45 / 8:50
	DATE	6/8/93	6/8/93		DATE / DATE
					06/08/93 / 06/08/93

DATUM: Ground Surface ELEVATION: 62.2 Ft. NGVD

BORING COORDINATES: N3992 E3874 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	25-33-35 68 BPF		Medium dense to very dense brown SAND (SP) wet, fine to medium grained, poorly graded, with lenses of organic matter	SS						
	19-22-33 55 BPF			SS						
40			-- with some gravel		40					
	8-9-15 24 BPF			SS						
	14-30-50 80 BPF			SS						
45	20-30-35 15 BPF			SS	45	(4)		17		
			Very dense brown SAND (SP-SM) wet, fine grained, poorly graded, with some silt	SS						
	24-35-40 75 BPF			SS						
	24-35-34 69 BPF			SS						
50			Boring R-23 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/8/93.		50					
55			Notes: (1) Percent passing 200 sieve = 97.4%. (2) Vertical Permeability = 2.94 E-08 cm/sec. See permeability test. (3) Percent passing 200 sieve = 3.1%. See gradation curve. (4) Percent passing 200 sieve = 6.5%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.	
	DRY AUGER 0-20'				R-24	
	WET ROTARY 20'-50'				SHEET	
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2	
PHASE II REDESIGN	ST - Shelby Tube				DRILLING	
MONROE, LOUISIANA	SS - Split Spoon				START	FINISH
(See Boring Location Plan)	WATER LEVEL	21'	11.7'		TIME	TIME
	TIME	0	1.7 hrs		10:55	17:50
	DATE	7/13/93	7/13/93		DATE	DATE
					07/13/93	07/13/93

DATUM: Ground Surface ELEVATION: 63.8 Ft. NGVD

BORING COORDINATES: N2719 E2867 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.00		Medium stiff to stiff reddish-brown CLAY (CH) moist, slickensided, with vegetation matter from 0 to 4'	ST						
	0.75			ST						
5	1.00			ST	5					
	1.00		-- with ferrous stains and calcareous nodules	ST						
	1.50			ST						
10	1.50			ST	10					
	2.25			ST						
15	2.25			ST	15					
	2.00			ST						
	0.75			ST						
20	1.75		Very soft to soft reddish-brown and gray SILTY CLAY (CL) wet	ST	20					
	0.50			ST						
25	0.25			ST	25					
	NR			ST						
	1-1-2 3 BPF		Very soft brown CLAY (CH) wet	SS						
30	0.75		Medium stiff light gray and reddish-brown SILTY CLAY (CL) wet, with sandy clay layers	ST	30					
	1.25			ST						
35	1.25		Medium stiff gray CLAY (CH) wet, with clayey sand layers	ST	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-20'			R-24
	WET ROTARY 20'-50'			SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	21'	11.7'	TIME / TIME
	TIME	0	20 min.	10:55 / 17:50
	DATE	7/13/93	7/13/93	DATE / DATE
				07/13/93 / 07/13/93

DATUM: Ground Surface ELEVATION: 63.8 Ft. NGVD

BORING COORDINATES: N2719 E2867

DRILL RIG: Mobile B-61

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Ken Gibson

LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	0.50		Very soft to soft gray CLAY (CH) wet, with clayey sand layers	ST						
	NR			ST						
40	7-8-6 14 BPF		Medium dense to very dense gray SILTY SAND (SM) saturated, fine to medium grained, poorly graded	SS	40					
	3-8-14 27 BPF			SS						
45	6-12-12 24 BPF		-- with silt lenses	SS	45					
	6-9-13 22 BPF			SS						
	26-46-54 100 BPF		-- with some clay lenses	SS	50					
50			Boring R-24 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/13/93.							
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-24'			R-25
	WET ROTARY 24'-50'			SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			1 of 2
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	23'	12.0'	TIME / TIME
	TIME	0	11.1 hrs	19:35 / 10:30
	DATE	7/12/93	7/12/93	DATE / DATE
				07/12/93 / 07/12/93

DATUM: Ground Surface ELEVATION: 64.7 Ft. NGVD

BORING COORDINATES:	N3096 E2885	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.00		Medium stiff to stiff brown CLAY (CH) dry to moist, slickensided, with ferrous and calcareous nodules	ST						
	1.00			ST						
5	1.50			ST	5					
	1.75		-- becoming light gray and reddish-brown	ST		74	45	41	82	1.07s
	1.75			ST						
10	1.75			ST	10					
	2.50			ST						
15	2.50			ST	15					
	2.25			ST						
	1.50			ST						
20	0.50		Soft to medium stiff reddish-brown and light gray SILTY CLAY (CL) wet	ST	20					
	<0.25		-- becoming sandy	ST						
25	0.50		-- with sand layers	ST	25	28	13	28	97	
	1.00			ST						
	0.75		Medium stiff brown and reddish-brown CLAY (CH) wet, with sand layers	ST						
30	1.25		Medium stiff reddish-brown and gray SANDY CLAY (CL) wet	ST	30					
	0.75			ST						
35	0.75		Medium stiff gray CLAY (CH) wet, with sandy clay layers	ST	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO. R-25	
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-24'				SHEET 2 of 2	
	WET ROTARY 24'-50'					
	SAMPLING METHOD:				DRILLING	
	ST - Shelby Tube				START	FINISH
	SS - Split Spoon					
	WATER LEVEL	23'	12.0'		TIME 19:35	TIME 10:30
	TIME	0	11.1 hrs			
	DATE	7/12/93	7/12/93		DATE 07/12/93	DATE 07/12/93

DATUM: Ground Surface ELEVATION: 64.7 Ft. NGVD

BORING COORDINATES: N3096 E2885 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	0.75		Medium stiff gray CLAY (CH) wet, with sandy clay layers	ST						
	1.25			ST						
40	0.75			ST	40					
	5-8-10 18 BPF		Medium dense gray SILTY SAND (SM) saturated, fine-grained, poorly graded	SS						
45	3-7-13 20 BPF			SS	45					
	7-7-14 21 BPF		Medium dense to dense gray SAND (SP) saturated, fine grained, poorly graded	SS						
	10-15-20 35 BPF			SS						
50			Boring R-25 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/13/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 7/12/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-24'				R-26
	WET ROTARY 24'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	23'	15.5'		TIME / TIME
	TIME	0	18 min.		15:00 / 19:20
	DATE	7/12/93	7/12/93		DATE / DATE
					07/12/93 / 07/12/93

DATUM: Ground Surface ELEVATION: 62.2 Ft. NGVD

BORING COORDINATES:	N3898 E4319	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.00		Medium stiff to stiff brown and reddish-brown CLAY (CH) moist, slickensided, with calcareous nodules and ferrous stains	ST						
	1.50			ST						
5	2.25		-- becoming light gray	ST	5					
	1.75			ST						
	2.00			ST						
10	2.25			ST	10					
	2.25			ST						
▼15	2.25			ST	15					
	1.75			ST						
	0.75			ST						
20	0.50		Soft light gray SILTY CLAY (CL) wet	ST	20					
▽	0.25		-- with silt layers	ST						
25	0.25			ST	25					
	NR		Very loose brown SILT (ML) wet	ST						
	1-0-1 2 BPF			SS						
30	1-0-0 1 BPF		Very soft to medium stiff brown CLAY (CH) wet, with sand layers	SS	30					
	1.00			ST						
35	0.50		Medium dense to dense brown SILTY SAND (SM), saturated	ST	35					
			Soft brown SANDY CLAY (CL), wet							

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 7/12/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-24'			R-26
	WET ROTARY 24'-50'			SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	SAMPLING METHOD:			
	ST - Shelby Tube			DRILLING
	SS - Split Spoon			START / FINISH
	WATER LEVEL	23'	15.5'	TIME / TIME
	TIME	0	18 min.	15:00 / 19:20
	DATE	7/12/93	7/12/93	DATE / DATE
				07/12/93 / 07/12/93

DATUM: Ground Surface ELEVATION: 62.2 Ft. NGVD

BORING COORDINATES:	N3898 E4319	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Soft brown SANDY CLAY (CL), wet							
	8-20-26 46 BPF		Medium dense to dense brown SILTY SAND (SM) saturated, fine grained, poorly graded, with silt layers	SS						
	12-16-17 33 BPF			SS						
40	10-12-17 29 BPF			SS	40					
	6-7-10 17 BPF		Medium dense to dense brown SAND (SP) saturated, fine to medium grained, poorly graded, with silt lenses	SS						
45	2-7-11 16 BPF			SS	45					
	7/13/19 32 BPF			SS						
	13-17-23 40 BPF			SS						
50			Boring R-26 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/12/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 7/12/93 CHK'D BY DBK

SOIL BORING LOG

E NAME AND LOCATION	DRILLING METHOD:		BORING NO. R-26
	DRY AUGER 0-24'		
	WET ROTARY 24'-50'		SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	SAMPLING METHOD:		
	ST - Shelby Tube		DRILLING
	SS - Split Spoon		START / FINISH
	WATER LEVEL	23' / 15.5'	TIME / TIME
	TIME	0 / 18 min.	15:00 / 19:20
	DATE	7/12/93 / 7/12/93	DATE / DATE
UM: Ground Surface ELEVATION: 62.2 Ft. NGVD			07/12/93 / 07/12/93

ING COORDINATES: N3898 E4319 — SURFACE CONDITIONS: Dry, level, bare

L RIG: Mobile B-61 — DRILLER: Ken Gibson

AMMER WEIGHT: 140 LBS. — LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
		Soft brown SANDY CLAY (CL), wet							
1-20-26 16 BPF		Medium dense to dense brown SILTY SAND (SM) saturated, fine grained, poorly graded, with silt layers	SS						
1-16-17 1 BPF			SS						
12-17 BPF			SS	40					
7-10 BP		Medium dense to dense brown SAND (SP) saturated, fine to medium grained, poorly graded, with silt lenses	SS						
11 PF			SS	45					
19 F			SS						
23 F			SS	50					
		Boring R-26 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/12/93.		55					
				60					
				65					
				70					

LOGGED BY PJR DATE 7/12/93 CHK'D BY DBK

LOGGED BY PJR DATE 8/14/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER	0-24'			R-27
	WET ROTARY	24'-50'			SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	24'	12.0'		TIME / TIME
	TIME	0	20 min.		13:15 / 18:05
	DATE	6/14/93	6/14/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 62.9 Ft. NGVD					06/14/93 / 06/14/93

BORING COORDINATES:	N3604 E2532	SURFACE CONDITIONS:	Dry, level, grass
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	10-15-19 34 BPF		Dense brown SAND (SP) saturated, fine to medium grained, poorly graded, with trace fine gravel	SS						
	13-14-18 32 BPF			SS		(2)				
40	2-9-18 27 BPF		– becoming medium dense to dense	SS	40					
	11-13-14 27 BPF			SS						
45	11-18-25 43 BPF			SS	45					
	20-23-30 53 BPF			SS						
	10-18-22 40 BPF			SS		(3)				
50			Boring R-27 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/14/93.		50					
55			Notes: (1) % passing 200 sieve = 4.3%.. See gradation curve. (2) % passing 200 sieve = 2.0%. See gradation curve. (3) % passing 200 sieve = 3.7%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-18' WET ROTARY 18'-50'	R-28
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	SHEET 1 of 2
	WATER LEVEL: 19' / 11.5' TIME: 0 / 71 min. DATE: 6/30/93 / 6/30/93	DRILLING START: TIME 17:30, DATE 06/29/93 FINISH: TIME 16:10, DATE 06/30/93

DATUM: Ground Surface ELEVATION: 61.7 Ft. NGVD

BORING COORDINATES: N3620 E2088

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile Buggy Rig

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.25		Medium stiff to stiff brown CLAY (CH) dry to moist, slickensided, with ferrous nodules	ST						
	1.25			ST						
5	1.75		-- becoming light gray and brown	ST	5					
	2.00			ST						
	1.75			ST						
10	2.00			ST	10					
	1.50			ST						
15	1.75		-- becoming reddish-brown and light gray	ST	15					
	1.50			ST						
	1.50		Medium stiff brown and light gray SILTY CLAY (CL) wet, with sand layers and rootlets	ST						
20	1.50			ST	20					
	1.00			ST						
25	0.75			ST	25					
	1.50		Medium stiff gray and brown CLAY (CH) wet, with sand lenses	ST						
	1.50			ST						
30	1.00		-- with rootlets	ST	30					
	NR			ST						
35	8-12-17 29 BPF		Medium dense gray SILTY SAND (SM) saturated, fine grained, poorly graded, with clay lenses	SS	35					

(continued . . .)

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-18'				R-28
	WET ROTARY 18'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				2 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	19'	11.5'		TIME / TIME
	TIME	0	71 min.		17:30 / 16:10
	DATE	6/30/93	6/30/92		DATE / DATE
DATUM: Ground Surface ELEVATION: 61.7 Ft NGVD					06/29/93 / 06/30/93

BORING COORDINATES:	N3620 · E2088	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile Buggy Rig	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	12-17-18 35 BPF		Dense gray SILTY SAND (SM) saturated, fine grained, poorly graded, with trace rootlets	SS						
	4-11-14 25 BPF		Medium dense to very dense gray SAND (SP) saturated, poorly graded, fine to medium grained, with clay lenses	SS						
40	9-10-11 21 BPF			SS	40					
	16-38-40 78 BPF			SS						
45	12-21-52 73 BPF			SS	45					
	9-14-27 41 BPF			SS						
	13-26-44 70 BPF			SS						
50			Boring R-28 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/30/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO. R-29	
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-18'				SHEET 1 of 2	
	WET ROTARY 18'-50'					
	SAMPLING METHOD:				DRILLING	
	ST - Shelby Tube				START	FINISH
	SS - Split Spoon					
	WATER LEVEL	19'	15.1'		TIME 8:00	TIME 15:33
	TIME	0	20 min.			
	DATE	7/8/93	7/8/93		DATE 07/08/93	DATE 07/08/93

DATUM: Ground Surface ELEVATION: 64.9 Ft. NGVD

BORING COORDINATES: N3636 E1641 | SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 | DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. | LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	0.75		Medium stiff brown CLAY (CL) moist, with ferrous stains	ST						
	0.50			ST						
5	1.75		Medium stiff to stiff brown CLAY (CH) moist, slickensided, with ferrous stains	ST	5					
	1.50			ST		90	60	37	83	1.28s
	1.50		-- becoming reddish-brown and light gray with calcareous nodules	ST						
10	1.75			ST	10					
	1.75			ST						
15	0.75		Soft to medium stiff reddish-brown SILTY CLAY (CL) moist to wet	ST	15					
	0.25			ST						
▽	0.25		Very soft to soft brown very SILTY CLAY (CL) wet, with ferrous stains	ST		(1)		23		
20	0.25			ST	20					
	NR		Very loose brown SILT (ML) wet	ST						
25	0-0-1 1 BPF			SS	25	25	3	22	(2)	
	NR			ST						
	2-1-7 8 BPF			SS						
30	12-16-15 31 BPF		Medium dense to dense brown SILTY SAND (SP-SM) saturated, fine grained, poorly graded	SS	30					
	6-11-16 27 BPF			SS		(3)		22		
35	13-26-23 49 BPF		Dense brown SAND (SP) saturated, fine grained, poorly graded	SS	35					

(continued . . .)

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO. R-29	
	DRY AUGER 0-18'				SHEET 2 of 2	
	WET ROTARY 18'-50'					
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:					
PHASE II REDESIGN	ST - Shelby Tube				DRILLING	
MONROE, LOUISIANA	SS - Split Spoon				START	FINISH
(See Boring Location Plan)	WATER LEVEL	19'	15.1'		TIME 8:00	TIME 15:33
	TIME	0	20 min.			
	DATE	7/8/93	7/8/93		DATE 07/08/93	DATE 07/08/93

DATUM: Ground Surface ELEVATION: 64.9 Ft. NGVD

BORING COORDINATES: N3636 E1641 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Dense to very dense brown SAND (SP) saturated, fine to medium grained, poorly graded							
	10-21-19 40 BPF			SS						
	17-31-30 61 BPF			SS						
40	8-18-30 48 BPF			SS	40					
	13-17-22 39 BPF			SS						
45	6-12-24 36 BPF			SS	45					
	16-25-43 68 BPF		-- *with silt lenses*	SS		(4)		18		
	10-30-30 60 BPF		-- *with some fine gravel*	SS						
50					50					
			Boring R-29 was terminated at 50 feet. Borehole grouted full depth with a 5% *bentonite/cement grout on 7/8/93.*							
55			Notes: (1) Percent passing 200 sieve = 88.3% (2) Percent passing 200 sieve = 80.9%. (3) Percent passing 200 sieve = 5.7%. See gradation curve. (4) Percent passing 200 sieve = 4.4%.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-16'				R-30
	WET ROTARY 16'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	15'	11.2'		TIME / TIME
	TIME	0	17 min.		14:10 / 19:20
	DATE	7/7/93	7/7/93		DATE / DATE
DATUM: Ground Surface ELEVATION: 61.6 Ft. NGVD					07/07/93 / 07/07/93

BORING COORDINATES:	N3651 E1201	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Mobile B-61	DRILLER:	Ken Gibson
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.50		Very stiff brown CLAY (CH) dry to moist, slickensided, with ferrous nodules	ST						
	3.50		-- with vegetative matter, calcareous nodules, and ferrous stains	ST						
5	3.75			ST	5					
	3.25		-- becoming reddish-brown	ST		89	56	33	87	2.21s
	3.25			ST						
10					10					
	0.75		Soft to medium stiff brown SILTY CLAY (CL) wet	ST						
	0.50			ST						
15	<0.25		Loose to medium dense brown CLAYEY SILT (ML) wet, with ferrous stains and some very fine grained sand	ST	15					
	0.50			ST		24	4			
	0.75			ST						
20					20					
	NR		Medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded, with silt layers	ST						
	2-6-7 13 BPF			SS						
25	3-4-2 6 BPF			SS	25					
	9-7-13 20 BPF			SS						
	8-9-7 18 BPF		Loose brown SILT (ML) wet, with some sand	SS						
30					30					
	6-6-10 16 BPF		Medium dense to dense brown SAND (SP) saturated, fine grained, poorly graded, with silt lenses	SS						
	10-10-12 22 BPF			SS						
35	12-16-23 39 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-16'			R-30
	WET ROTARY 16'-50'			SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			2 of 2
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	15'	11.2'	TIME / TIME
	TIME	0	17 min.	14:10 / 19:20
	DATE	7/7/93	7/7/93	DATE / DATE
				07/07/93 / 07/07/93

DATUM: Ground Surface ELEVATION: 61.6 Ft. NGVD

BORING COORDINATES: N3651 E1201

DRILL RIG: Mobile B-61

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Ken Gibson

LOGGER: P. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	12-12-15 27 BPF		Medium dense to dense brown SAND (SP) saturated, fine grained, poorly graded, with silt lenses	SS						
	12-18-34 52 BPF		-- becoming dense to very dense	SS						
40	10-21-30 51 BPF			SS	40					
	12-16-34 50 BPF			SS						
45	19-17-23 40 BPF			SS	45					
	13-21-31 52 BPF			SS						
	13-26-26 52 BPF			SS						
50			*Boring R-30 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/7/93.*		50					
55					55					
60					60					
65					65					
70					70					

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.	
	DRY AUGER 0-16'				R-31	
	WET ROTARY 16'-50'				SHEET	
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2	
PHASE II REDESIGN	ST - Shelby Tube				DRILLING	
MONROE, LOUISIANA	SS - Split Spoon				START	FINISH
(See Boring Location Plan)	WATER LEVEL	17'	12.0'		TIME	TIME
	TIME	0	15 min.		16:15	12:00
	DATE	7/8/93	7/8/93		DATE	DATE
					07/08/93	07/09/93

DATUM: Ground Surface ELEVATION: 60.5 Ft. NGVD

BORING COORDINATES: N3665 E0791 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Failing 1500 DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS. LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.00		Stiff to very stiff dark brown and reddish-brown CLAY (CH) dry to moist, blocky, slickensided, with rootlets and calcareous nodules	ST						
	3.00			ST						
5	3.50			ST	5					
	3.50			ST						
	2.00		– trace fine grained sand	ST		88	58	45	77	1.22s
10	2.50			ST	10					
▼	2.50			ST						
15	2.50			ST	15					
▽	2.50			ST						
	2.00			ST						
20	2.50			ST	20	59	36	26	96	1.62
	0.50		Soft dark reddish-brown SILTY CLAY (CL) wet, with some very fine grained sand	ST						
25	0.50			ST	25					
	0.50		Loose to medium dense dark reddish-brown SILTY SAND (SM) saturated, very fine to fine grained, poorly graded	ST						
	7-11-10 21 BPF			SS		(1)		25		
30	6-15-15 30 BPF			SS	30					
	8-13-22 35 BPF		Dense dark brown SAND (SP) saturated, very fine to fine grained, poorly graded, with trace clay	SS						
35	NR			SS	35					

(continued . . .)

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-16'				R-31
	WET ROTARY 16'-50'				SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				1 of 2
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	17'	12.0'		TIME / TIME
	TIME	0	15 min.		16:15 / 12:00
	DATE	7/8/93	7/8/93		DATE / DATE
					07/08/93 / 07/09/93

DATUM: Ground Surface ELEVATION: 60.5 Ft. NGVD

BORING COORDINATES: N3665 E0791

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Failing 1500

DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.00		Stiff to very stiff dark brown and reddish-brown CLAY (CH) dry to moist, blocky, slickensided, with rootlets and calcareous nodules	ST						
	3.00			ST						
5	3.50			ST	5					
	3.50			ST						
	2.00		-- trace fine grained sand	ST		88	58	45	77	1.22s
10	2.50			ST	10					
	2.50			ST						
15	2.50			ST	15					
	2.50			ST						
	2.00			ST						
20	2.50			ST	20	59	36	26	96	1.62
	0.50		Soft dark reddish-brown SILTY CLAY (CL) wet, with some very fine grained sand	ST						
25	0.50			ST	25					
	0.50		Loose to medium dense dark reddish-brown SILTY SAND (SM) saturated, very fine to fine grained, poorly graded	ST						
	7-11-10 21 BPF			SS		(1)		25		
30	6-15-15 30 BPF			SS	30					
	8-13-22 35 BPF		Dense dark brown SAND (SP) saturated, very fine to fine grained, poorly graded, with trace clay	SS						
35	NR			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-16' WET ROTARY 16'-50' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-31 SHEET 2 of 2

WATER LEVEL	13'	11.2'	
TIME	0	15 min.	
DATE	7/8/93	7/8/93	

DRILLING	START	FINISH
TIME		
DATE	07/08/93	07/09/93

DATUM: Ground Surface ELEVATION: 60.5 Ft. NGVD

BORING COORDINATES: N3665 E0791

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Failing 1500

DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	12-15-15 30 BPF		Dense to very dense dark brown SAND (SP) saturated, fine to medium grained, poorly graded	SS		(2)		26		
	12-25-21 46 BPF			SS						
40	7-12-23 35 BPF			SS	40					
	14-22-36 58 BPF			SS						
45	17-25-40 65 BPF			SS	45					
	17-61 78 BPF			SS						
	32-47-43 90 BPF			SS		(3)		19		
50			Boring R-31 was terminated at 50 feet. Borehole was grouted full depth with a 5% bentonite/cement grout on 7/9/93.		50					
55			Notes: (1) Percent passing 200 sieve = 33.2%. See gradation curve. (2) Percent passing 200 sieve = 4.4%. See gradation curve. (3) Percent passing 200 sieve = 3.1%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-12'				R-32
	WET ROTARY 12'-50'				SHEET 1 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:				
PHASE II REDESIGN	ST - Shelby Tube				DRILLING
MONROE, LOUISIANA	SS - Split Spoon				START / FINISH
(See Boring Location Plan)	WATER LEVEL	12'	11.5'		TIME / TIME
	TIME	0	15 min.		10:30 / 15:45
	DATE	7/8/93	7/8/93		DATE / DATE
					07/08/93 / 07/08/93

DATUM: Ground Surface ELEVATION: 61.5 Ft. NGVD

BORING COORDINATES: N3211 E0787

DRILL RIG: Failing 1500

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Joby Barr

LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.50		Very stiff dark reddish-brown CLAY (CH) dry to moist, slickensided, mottled, with rootlets and calcareous nodules,	ST						
	3.50			ST						
5	2.50			ST	5					
	4.00			ST						
	0.50		Soft dark reddish-brown and gray SILTY CLAY (CL) moist to wet, mottled	ST						
10	0.50			ST	10					
	0.50		Loose dark reddish-brown CLAYEY SILT (ML) wet, with ferrous stains	ST						
15	<0.25			ST	15					
	<0.25		-- with trace very fine grained sand	ST						
	0.50			ST						
20	<0.25		Soft dark reddish-brown CLAY (CH) wet, with very fine grained sand	ST	20					
	7-17-19 36 BPF		Medium dense dark reddish-brown SILTY SAND (SM) saturated, very fine to fine grained, poorly graded	SS		(1)		22		
25	4-8-17 25 BPF			SS	25					
	6-11-16 27 BPF			SS						
	9-12-21 33 BPF			SS						
30	3-4-7 11 BPF			SS	30					
	4-7-21 28 BPF			SS						
35	17-23-39 62 BPF		-- becoming very dense	SS	35					

(continued . . .)

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO. R-32
	DRY AUGER 0-12'			SHEET 2 of 2
	WET ROTARY 12'-50'			
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	12'	11.5'	TIME / TIME
	TIME	0	15 min.	10:30 / 15:45
	DATE	7/8/93	7/8/93	DATE / DATE
				07/08/93 / 07/08/93

DATUM: Ground Surface ELEVATION: 61.5 Ft. NGVD

BORING COORDINATES: N3211 E0787

DRILL RIG: Failing 1500

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Joby Barr

LOGGER: T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Very dense dark reddish-brown SILTY SAND (SM) saturated, very fine to fine grained, poorly graded							
	13-24-51 75 BPF			SS						
			Very dense dark reddish-brown SAND (SP) saturated, fine to medium grained, poorly graded							
	13-29-30 59 BPF			SS		(2)		21		
40					40					
	9-27-30 57 BPF			SS						
				SS						
	17-30-38 68 BPF									
45	17-39-50 89 BPF			SS	45					
	17-36-23 59 BPF			SS						
	22-38-13 51 BPF			SS						
50			Boring R-32 was terminated at 50 feet. Borehole was grouted full depth with a 5% bentonte/cement grout on 7/8/93.		50					
55			Note: (1) Percent passing 200 sieve = 40.3%. See gradation curve. (2) Percent passing 200 sieve = 4.0%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-14'			R-33
	WET ROTARY 14'-100'			SHEET 1 of 3
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	14'	11.7'	TIME / TIME
	TIME	0	15 min.	17:30 / 12:30
	DATE	7/13/93	7/13/93	DATE / DATE
				07/13/93 / 07/15/93

DATUM: Ground Surface ELEVATION: 61.6 Ft. NGVD

BORING COORDINATES: N3199 E1182

DRILL RIG: Failing 1500

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Joby Barr

LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.50		Very stiff dark reddish-brown CLAY (CH) moist, slickensided, blocky, with calcareous nodules, ferrous stains and rootlets	ST						
	3.50			ST						
5	3.00			ST	5					
	3.00		– becoming light gray and mottled	ST						
	2.50			ST						
10					10					
	1.50		Medium stiff to stiff reddish-brown and gray SILTY CLAY (CL) wet, mottled, with calcareous nodules	ST		43	22	25	102	1.49
	1.00		– with trace very fine grained sand	ST						
15	1.00		*Loose to medium dense dark reddish-brown* CLAYEY SILT (ML) saturated, with trace very fine grained sand	ST	15					
	<0.25			ST						
	9-9-10 19 BPF			SS		(1)		21		
20	4-3-6 9 BPF			SS	20					
	4-6-5 11 BPF			SS						
25	5-10-15 25 BPF		Medium dense to dense dark brown SILTY SAND (SP-SM) saturated, fine grained, poorly graded	SS	25	(2)		21		
	4-5-9 14 BPF			SS						
	1-15-17 32 BPF			SS	30					
30	4-14-14 28 BPF			SS						
	6-15-25 40 BPF			SS						
35	7-18-25 43 BPF			SS	35					

(continued . . .)

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-14' WET ROTARY 14'-100'	R-33
	SAMPLING METHOD:	SHEET 2 of 3
	ST - Shelby Tube SS - Split Spoon	DRILLING

WATER LEVEL	14'	11.7'		START TIME	FINISH TIME
TIME	0	15 min.		17:30	12:30
DATE	7/13/93	7/13/93		DATE 07/13/93	DATE 07/15/93

DATUM: Ground Surface ELEVATION: 61.6 Ft. NGVD

BORING COORDINATES: N3199 E1182 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Failing 1500 DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS. LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3-9-16 25 BPF		Medium dense dark brown SILTY SAND (SP-SM) saturated, fine grained, poorly graded	SS						
	8-16-28 44 BPF		Medium dense to very dense dark brown SAND (SP) saturated, fine grained, poorly graded	SS						
40	10-15-18 33 BPF			SS	40					
	5-17-25 42 BPF			SS						
45	4-8-13 21 BPF			SS	45	(3)		21		
	10-27-27 54 BPF			SS						
	2-21-31 52 BPF			SS						
50					50					
55	6-12-12 24 BPF		-- becoming dark gray with some silt	SS	55	(4)		22		
60	18-30-30 60 BPF		-- with some fine gravel	SS	60					
65	19-25-24 49 BPF		Dense dark gray GRAVELY SAND (SW) saturated, fine to coarse grained, well graded, with numerous fine gravel	SS	65	(5)		12		
	25-40-42 82 BPF		Very dense dark gray SAND (SP) saturated, fine grained, poorly graded, with trace fine gravel	SS	70					

(continued . . .)

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-14'			R-33
	WET ROTARY 14'-100'			SHEET 3 of 3
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	14'	11.7'	TIME / TIME
	TIME	0	15 min.	17:30 / 12:30
	DATE	7/13/93	7/13/93	DATE / DATE
				07/13/93 / 07/15/93

DATUM: Ground Surface ELEVATION: 61.6 Ft. NGVD

BORING COORDINATES: N3199 E1182 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Failing 1500 DRILLER: Joby Barr

SPT HAMMER WEIGHT: 140 LBS. LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Soft dark gray weathered to unweathered CLAYEY SHALE moist, laminated, blocky, with silt lenses							
75	14-25-30 55 BPF			SS	75	60	26			
	>4.50			ST	80					
80										
	>4.50			ST	85					
85										
	>4.50			ST	90					
90										
	>4.50		Hard dark gray CLAY (CH) moist, slickensided, with trace silt	ST	95					
95			Hard dark gray SILTY CLAY (CL) moist, with some very fine grained sand							
	22-36-17-3 53 BPF			SS	100					
100			Boring R-33 was terminated at 100 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/15/93.							

Notes:
(1) Percent passing 200 sieve = 67.8%.
(2) Percent passing 200 sieve = 6.7%. See gradation curve.
(3) Percent passing 200 sieve = 4.9%. See gradation curve.
(4) Percent passing 200 sieve = 10.8%. See gradation curve.
(5) Percent passing 200 sieve = 5.2%. See gradation curve.

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-14'			R-34
	WET ROTARY 14'-50'			SHEET 1 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	15'	10.4'	TIME / TIME
	TIME	0	2 hrs.	8:30 / 17:00
	DATE	7/9/93	7/9/93	DATE / DATE
				07/09/93 / 07/09/93

DATUM: Ground Surface ELEVATION: 61.5 Ft. NGVD

BORING COORDINATES: N3184 E1621 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.25		Stiff reddish-brown and light gray CLAY (CH) dry to moist, slickensided, with calcareous nodules and ferrous stains	ST						
	2.00			ST						
5	2.00			ST	5					
	2.00			ST						
	1.75			ST						
10	1.75			ST	10					
	0.75		Medium stiff reddish-brown and light gray SILTY CLAY (CL) wet, with ferrous stains	ST						
15	0.50			ST	15					
	0.25		Loose brown CLAYEY SILT (ML) wet, with fine grained sand	ST						
	0.25			ST						
20	0.50			ST	20					
	0.50			ST		(1)		22		
25	0.05			ST	25	23	2			
			Medium stiff brown SILTY CLAY (CL), wet	ST						
	1.00		Medium dense brown SILTY SAND (SM), wet, fine grained, poorly graded							
	2-6-3 9 BPF		Loose brown CLAYEY SILT (ML) wet, with sand layers	SS		22	3	26	(2)	
30	6-10-17 27 BPF		Medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS	30	(3)		19		
	8-16-17 33 BPF		Medium dense to dense brown SAND (SP) saturated, fine grained, poorly graded	SS						
35	3-11-15 26 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO. R-34
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-14'			SHEET 2 of 2
	WET ROTARY 14'-50'			
	SAMPLING METHOD:			DRILLING
	ST - Shelby Tube			START / FINISH
	SS - Split Spoon			
	WATER LEVEL	15'	10.4'	TIME / TIME
	TIME	0	2 hrs.	8:30 / 17:00
	DATE	7/9/93	7/9/93	DATE / DATE
				07/09/93 / 07/09/93

DATUM: Ground Surface ELEVATION: 61.5 Ft. NGVD

BORING COORDINATES: N3184 E1621 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	13-23-31 54 BPF		Medium dense to very dense brown SAND (SP) saturated, fine grained, poorly graded	SS						
	13-18-18 36 BPF			SS						
40	10-20-27 47 BPF		-- with silt lenses	SS	40					
	8-16-17 33 BPF			SS						
45	4-7-14 21 BPF			SS	45					
	20-22-20 42 BPF			SS						
	19-30-33 63 BPF			SS						
50			Boring R-34 was terminated at 50 feet. Borehole was grouted full depth with a 5% bentonite/cement grout on 7/9/93.		50					
55			Note: (1) Percent passing 200 sieve = 76.1%. See gradation curve. (2) Percent passing 200 sieve = 69.9%. See gradation curve. (3) Percent passing 200 sieve = 16.2%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.
	DRY AUGER 0-24'				R-35
	WET ROTARY 24'-50'				SHEET 1 of 2
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	SAMPLING METHOD:				DRILLING
	ST - Shelby Tube				START / FINISH
	SS - Split Spoon				
	WATER LEVEL	24'	23.5'		TIME / TIME
	TIME	0	15 min.		16:35 / 10:00
	DATE	6/30/93	6/30/93		DATE / DATE
					06/30/93 / 07/01/93

DATUM: Ground Surface ELEVATION: 63.4 Ft. NGVD

BORING COORDINATES: N3169 E2069 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile Buggy DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.25		Medium stiff brown SILTY CLAY (CL) dry to moist, with vegetative matter	ST						
	1.00			ST						
			Medium stiff to very stiff brown CLAY (CH) moist to wet, slickensided, with ferrous stains	ST	5					
5	4.25									
	3.00			ST						
	2.75			ST						
			-- with calcareous nodules		10					
10	1.75			ST		92	60	46	75	(1)
	2.00			ST				42	76	(2)
15	1.25			ST	15					
	1.75		-- becoming light gray	ST						
	1.75			ST						
20	1.75			ST	20					
	1.75			ST						
25	1.50			ST	25					
	1.25			ST						
	0.50			ST						
30	0.75			ST	30					
	0.50		Medium stiff gray SILTY CLAY (CL) wet	ST						
35	0.50		-- with sand layers	ST	35	24	7	31	90	

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-24'			R-35
	WET ROTARY 24'-50'			SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	24'	23.5'	TIME 16:35 / TIME 10:00
	TIME	0	16 min.	
	DATE	6/30/93	6/30/93	DATE 06/30/93 / DATE 07/01/93

DATUM: Ground Surface ELEVATION: 63.4 Ft. NGVD

BORING COORDINATES: N3169 E2069 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile Buggy DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.25		Medium stiff gray and reddish-brown SANDY CLAY (CL) wet, with sand layers	ST						
40	4-17-17 34 BPF; 8-9-13 22 BPF		Medium dense to dense gray SILTY SAND (SM) wet, fine grained, poorly graded, with clay and vegetative lenses	SS; SS	40					
45	10-20-30 50 BPF; 20-27-30 57 BPF; 8-23-27 50 BPF; 11-27-41 68 BPF		Very dense gray SAND (SP) wet, fine grained, poorly graded; -- with silt lenses	SS; SS; SS; SS	45					
50			Boring R-35 was terminated at 50 feet. Borehold was grouted full depth with a 5% bentonite/cement grout on 7/1/93.		50					
55			Notes: (1) Vertical Permeability = 2.35 E-09 cm/sec. See permeability test result. (2) Horizontal Permeability = 8.6 E-09 cm/sec. See permeability test result.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 9/8/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PROPOSED II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-20' WET ROTARY 20'-100' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-36 SHEET 1 of 3

WATER LEVEL	19'	10.9'	
TIME	0	55 min.	
DATE	7/3/93	7/3/93	

DRILLING	START	FINISH
TIME	8:05	12:00
DATE	07/03/93	07/05/93

DATUM: Ground Surface ELEVATION: 61.8 Ft. NGVD

BORING COORDINATES: N3153 E2512

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.25		Medium stiff to very stiff brown and light gray CLAY (CH) moist, stickensided with ferrous and calcareous nodules	ST						
	2.25			ST						
5	3.50			ST	5					
	3.25			ST						
	2.25		-- becoming reddish-brown	ST						
10	2.25			ST	10	77	47	33	102	1.84s
	2.25			ST						
15	0.75			ST	15	54	35	38	91	1.06s
	0.25		Soft to medium stiff reddish-brown and light gray SILTY CLAY (CL) moist to wet	ST						
	0.25		-- with sand layers	ST						
20	0.50			ST	20	30	9	29		
	2-4-3 7 BPF			SS						
25	1-0-1 1 BPF		Very loose brown CLAYEY SILT (ML) wet, with some sand	SS	25	(1)		28		
	3-3-3 6 BPF		Very loose to medium dense brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS						
	4-7-8 15 BPF			SS						
30	PUSH			SS	30					
	10-9-10 19 BPF		Medium dense brown SAND (SP-SM) saturated, fine grained, poorly graded, with silt	SS		(2)		22		
35	5-7-17 24 BPF			SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO. R-36	
	DRY AUGER 0-20'				SHEET 2 of 3	
	WET ROTARY 20'-100'					
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	SAMPLING METHOD:				DRILLING	
	ST - Shelby Tube				START	FINISH
	SS - Split Spoon					
	WATER LEVEL	19'	10.9'		TIME 8:05	TIME 12:00
	TIME	0	55 min.			
	DATE	7/3/93	7/3/93		DATE 07/03/93	DATE 07/05/93

DATUM: *Ground Surface* ELEVATION: 61.8 Ft. NGVD

BORING COORDINATES: N3153 E2512

DRILL RIG: Mobile B-61

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Ken Gibson

LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	11-22-17 39 BPF		Medium dense to dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	8-16-15 31 BPF			SS						
40	6-8-15 23 BPF			SS	40					
	5-14-16 30 BPF			SS						
45	10-17-25 42 BPF		-- with some fine gravel and silt lenses	SS	45					
	12-17-24 41 BPF			SS						
50	10-16-21 37 BPF			SS	50					
55	14-23-31 54 BPF		Very dense gray SAND (SP-SM) saturated, fine to medium grained, poorly graded	SS	55	(3)		22		
60	15-24-45 69 BPF			SS	60					
65	26-34-54 88 BPF			SS	65					
70	20-37-25 62 BPF		-- with silt	SS	70	(4)		22		

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY TFK DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-20' WET ROTARY 20'-100' SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	R-36 SHEET 3 of 3

WATER LEVEL	19'	10.9'	
TIME	0	15 min.	
DATE	7/3/93	7/3/93	

DRILLING	START	FINISH
TIME	8:05	12:00
DATE	07/03/93	07/05/93

DATUM: Ground Surface ELEVATION: 61.8 Ft. NGVD

BORING COORDINATES: N3153 E2512

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
			Soft light gray to gray weathered to unweathered CLAYEY SHALE dry to moist, laminated, blocky, with sand lenses							
	20-29-29 58 BPF			SS						
75					75					
	>4.50		-- with clay lenses	ST						
80					80					
	>4.50			ST						
85					85					
	>4.50			ST						
90					90					
	>4.50			ST						
95					95					
	>4.50			ST						
100					100					

Boring R-36 was terminated at 100 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/5/93.

Notes:
(1) Percent passing 200 sieve = 73.3%.
(2) Percent passing 200 sieve = 9.4%. See gradation curve.
(3) Percent passing 200 sieve = 4.6%. See gradation curve.
(4) Percent passing 200 sieve = 6.9%. See gradation curve.

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-12' WET ROTARY 12'-50'	R-37
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	SHEET 1 of 2
	WATER LEVEL 13' 11.2' TIME 0 15 min. DATE 6/16/93 6/16/93	DRILLING START TIME 8:00 DATE 06/16/93 FINISH TIME 12:20 DATE 06/16/93

DATUM: Ground Surface ELEVATION: 62.6 FL NGVD

BORING COORDINATES: N2748 E2495

SURFACE CONDITIONS: Wet, level, grass

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	0.25		Soft brown CLAY (CH) wet, with vegetative matter	ST						
	3.25		Stiff to very stiff light gray and brown CLAY (CH) moist, slickensided, with calcareous nodules	ST						
5	2.50			ST	5					
	2.50			ST						
	2.00		– becoming reddish-brown and light gray	ST		95	63	35	86	1.05s
10	1.75			ST	10					
	0.75		– *becoming medium stiff*	ST						
15	0.75			ST	15					
	0.75		Loose brown and gray SANDY SILT (ML) wet, with ferrous nodules and sand lenses	ST			NP			
	0.25		Soft to medium stiff brown and gray SILTY CLAY (CL) wet	ST						
20	0.50			ST	20					
	PUSH		Loose brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS						
25	2-4-5 9 BPF			SS	25	(1)				
	5-5-2 7 BPF		Medium stiff brown SILTY CLAY (CL) *moist to wet, with sand layers*	SS						
	0.5			ST		29	8			
30	10-8-9 17 BPF		Medium dense brown SILTY SAND (SP-SM) saturated, fine grained, poorly graded, with silt lenses	SS	30	(2)				
	4-12-12 24 BPF			SS						
35	3-10-11 21 BPF		Medium dense brown SAND (SP) saturated, fine grained, poorly graded	SS	35					

(continued . . .)

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 6/16/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-12'			R-37
	WET ROTARY 12'-50'			SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	13'	11.2'	TIME / TIME
	TIME	0	15 min.	8:00 / 12:20
	DATE	6/10/93	6/10/93	DATE / DATE
				06/10/93 / 06/10/93

DATUM: Ground Surface ELEVATION: 62.6 Ft. NGVD

BORING COORDINATES: N2748 E2495

SURFACE CONDITIONS: Wet, level, grass

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	11-24-26 58 BPF		Dense to very dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	30-24-30 54 BPF			SS		(3)				
40	13-24-28 52 BPF			SS	40					
	8-17-27 44 BPF			SS						
45	4-5-15 20 BPF		-- becoming medium dense to dense, with silt lenses	SS	45					
	8-16-20 36 BPF			SS						
	8-16-23 39 BPF			SS		(4)				
50			Boring R-37 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/16/93.		50					
55			Notes: (1) Percent passing 200 sieve = 20.6% (2) Percent passing 200 sieve = 9.8% (3) Percent passing 200 sieve = 3.2%. See gradation curve. (4) Percent passing 200 sieve = 1.7%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 6/10/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-24' WET ROTARY 24'-50'	R-38
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	SHEET 1 of 2

				DRILLING	
				START	FINISH
WATER LEVEL	25'	23.8'		TIME	TIME
TIME	0	20 min.		15:08	9:50
DATE	6/17/93	6/17/93		DATE 06/17/93	DATE 06/18/93

DATUM: Ground Surface ELEVATION: 61.7 Ft. NGVD

BORING COORDINATES: N2771 E2052

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. J. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	2.75		Medium stiff to very stiff gray and brown CLAY (CH) *dry to moist, slickensided, with ferrous and calcareous nodules*	ST						
	1.75			ST						
5	4.25			ST	5					
	2.25			ST						
	2.25		-- becoming reddish-brown	ST						
10	1.50			ST	10					
	2.00			ST						
15	1.75			ST	15					
	2.50			ST						
	2.50			ST						
20	2.50			ST	20					
	1.25			ST						
25	1.00			ST	25					
	0.50		-- becoming soft to medium stiff	ST						
	1.25			ST						
30	0.75			ST	30					
	3-14-26 40 BPF		Dense brown SILTY SAND (SM) wet, fine grained, poorly graded	SS						
35	5-6-14 22 BPF		Medium dense brown SAND (SP) wet, fine grained, poorly graded	SS	35					

(continued . . .)

LOGGED BY PJR DATE 8/3/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-24'			R-38
	WET ROTARY 24'-50'			SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			2 of 2
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	25'	23.8'	TIME / TIME
	TIME	0	20 min.	15:08 / 9:50
	DATE	6/17/93	6/17/93	DATE / DATE
				06/17/93 / 06/18/93

DATUM: Ground Surface ELEVATION: 61.7 Ft. NGVD

BORING COORDINATES: N2771 E2052

SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61

DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS.

LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	14-30-47 77 BPF		Very dense brown SAND (SP) wet, fine to medium grained, poorly graded	SS						
	14-23-29 52 BPF			SS						
40	19-33-35 68 BPF			SS	40					
	9-20-37 57 BPF			SS						
45	5-19-37 56 BPF			SS	45					
	10-26-29 55 BPF		-- becoming light gray	SS						
	32-37-45 82 BPF			SS						
50			Boring R-38 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 6/18/93.		50					
55					55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/3/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:		BORING NO. R-39
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-18' WET ROTARY 18'-50'		SHEET 1 of 2
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon		DRILLING START / FINISH
	WATER LEVEL 19' 11.6'		TIME 17:25 / TIME 10:30
	TIME 0 15 min.		
	DATE 7/9/93 7/9/93		DATE 07/09/93 / DATE 07/10/93

DATUM: Ground Surface ELEVATION: 64.1 FL NGVD

BORING COORDINATES: N2794 E1605 SURFACE CONDITIONS: Dry, level, bare

DRILL RIG: Mobile B-61 DRILLER: Ken Gibson

SPT HAMMER WEIGHT: 140 LBS. LOGGER: P. J. Robicheaux

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.50		Stiff, reddish-brown and gray CLAY (CH) dry to moist, slickensided, with calcareous nodules	ST						
	1.50			ST						
						90	62	36	85	1.32s
5	2.00			ST	5					
	2.00			ST						
	1.75			ST						
10					10					
▼	2.25			ST						
	2.50			ST						
15	1.75		-- with ferrous stains	ST	15	72	46	32	91	1.38s
	0.75		Soft to medium stiff brown SILTY CLAY (CL) wet, with silty sand layers	ST						
▽	0			ST						
20					20					
	0		Loose to medium dense brown SILTY SAND (SP-SM) saturated, fine grained, poorly graded	ST						
	6-10-14 24 BPF			SS						
25	2-3-6 9 BPF			SS	25	(1)		23		
	6-5-9 14 BPF		-- with silt layers	SS						
	10-12-9 21 BPF		-- with silty clay lenses	SS						
30					30					
	5-9-17 26 BPF		Medium dense to dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS						
	12-15-18 33 BPF			SS						
35	3-11-18 29 BPF			SS	35					
			(continued . . .)							

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	DRY AUGER 0-18' WET ROTARY 18'-50'	R-39
	SAMPLING METHOD: ST - Shelby Tube SS - Split Spoon	SHEET 2 of 2
	WATER LEVEL: 19' / 11.6' TIME: 0 / 15 min. DATE: 7/9/93 / 7/9/93	DRILLING START TIME 17:25 DATE 07/09/93 DRILLING FINISH TIME 10:30 DATE 07/10/93

DATUM: Ground Surface ELEVATION: 64.1 Ft. NGVD

BORING COORDINATES: N2794 E1605

DRILL RIG: Mobile B-61

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Ken Gibson

LOGGER: P. J. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	20-22-28 50 BPF		Dense to very dense brown SAND (SP) wet, fine to medium grained, poorly graded	SS						
	13-23-24 47 BPF			SS		(2)		22		
40	7-18-21 39 BPF			SS	40					
	10-12-28 40 BPF			SS						
45	6-13-30 43 BPF			SS	45					
	20-28-63 91 BPF			SS						
	22-49-51 100 BPF			SS						
50			*Boring R-39 was terminated at 50 feet.* Borehole grouted full depth with a 5% bentonite/cement grout on 7/10/93.		50					
55			Notes: (1) Percent passing 200 sieve = 9.0 %. See gradation curve. (2) Percent passing 200 sieve = 3.1 %. See gradation curve.		55					
60					60					
65					65					
70					70					

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-18'			R-40
	WET ROTARY 18'-50'			SHEET 1 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	19'	10.3'	TIME / TIME
	TIME	0	7.8 hrs	10:45 / 12:20
	DATE	7/10/93	7/11/93	DATE / DATE
				07/10/93 / 07/11/93

DATUM: Ground Surface ELEVATION: 62.6 Ft. NGVD

BORING COORDINATES: N2817 E1165

DRILL RIG: Mobile B-61

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Ken Gibson

LOGGER: P. J. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	3.00		Stiff to very stiff reddish-brown and light gray CLAY (CH) dry to moist, slickensided, with calcareous nodules and ferrous nodules	ST						
	2.25			ST						
5	1.75			ST	5					
	2.25			ST						
	1.75			ST						
10	1.50			ST	10					
	0.50		Medium stiff brown SILTY CLAY (CL) moist, with ferrous stains	ST						
15	0.75		Very loose to loose brown CLAYEY SILT (ML) wet, with ferrous stains	ST	15					
	0.25			ST						
	<0.25			ST						
20	0.50			ST	20					
	–		Very loose to loose brown SILTY SAND (SM) wet, with clay lenses	ST						
25	NR			ST	25					
	13-6-9 15 BPF		Medium dense brown SANDY SILT (ML) wet, with silty sand layers	SS						
	4-5-12 17 BPF			SS						
30	12-18-17 35 BPF		Medium dense to dense brown SAND (SP) saturated, fine to medium grained, poorly graded	SS	30					
	15-17-23 40 BPF			SS						
35	4-10-14 24 BPF		-- with silt lenses -- with clay lenses	SS	35					

(continued . . .)

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-18'			R-40
	WET ROTARY 18'-50'			SHEET 2 of 2
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	19'	10.3'	TIME / TIME
	TIME	0	7.8 hrs	10:45 / 12:20
	DATE	7/10/93	7/11/93	DATE / DATE
				07/10/93 / 07/11/93

DATUM: Ground Surface ELEVATION: 62.6 Ft. NGVD

BORING COORDINATES: N2817 E1165

DRILL RIG: Mobile B-61

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Ken Gibson

LOGGER: P. J. Robicheaux

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	5-11-19 30 BPF		Medium dense to very dense brown SAND (SP) saturated, fine to medium grained, *poorly graded*	SS						
	11-12-17 29 BPF			SS						
40	19-18-24 42 BPF			SS	40					
	9-16-21 37 BPF			SS						
45	6-10-21 31 BPF			SS	45					
	15-25-27 52 BPF			SS						
	12-22-27 49 BPF			SS						
50			Boring R-40 was terminated at 50 feet. Borehole was grouted full depth with a 5% bentonite/cement grout on 7/11/93.		50					
55					55					
60					60					
65					65					
70					70					

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-16'			R-41
	WET ROTARY 16'-50'			SHEET 1 of 2
MAGNOLIA SANITARY LANDFILL PHASE II REDESIGN MONROE, LOUISIANA (See Boring Location Plan)	SAMPLING METHOD:			
	ST - Shelby Tube			DRILLING
	SS - Split Spoon			START / FINISH
	WATER LEVEL	16'	12.5'	TIME / TIME
	TIME	0	15 min.	11:15 / 10:00
	DATE	7/7/93	7/7/93	DATE / DATE
				07/07/93 / 07/08/93

DATUM: Ground Surface ELEVATION: 62.5 Ft NGVD

BORING COORDINATES: N2842 E782

DRILL RIG: Failing 1500

SPT HAMMER WEIGHT: 140 LBS.

SURFACE CONDITIONS: Dry, level, bare

DRILLER: Joby Barr

LOGGER: T. F. Keowen

DRILLING CONTRACTOR CUSTOM CORING, INC.

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	1.50		Stiff to very stiff dark reddish-brown CLAY (CH) moist, blocky, slickensided, with rootlets and calcareous nodules	ST						
	1.50			ST						
5	3.00			ST	5					
	1.50		-- becoming reddish-brown and gray, mottled	ST						
	1.50			ST						
10	1.00			ST	10	55	35	26	100	1.17
	0.50			ST						
15	--		Loose reddish-brown CLAYEY SILT (ML) wet, with clay layers	ST	15					
	<0.25		Very soft dark reddish-brown SILTY SAND (SM) saturated, very fine grained, poorly graded	ST						
	NR			ST						
20	6-8-11 19 BPF			ST	20	(1)		25		
	--		-- becoming medium dense							
25	--				25					
	PUSH		Dense to very dense reddish brown SAND (SP-SM) saturated, fine grained, poorly graded, with some silt	SS						
	6-13-26 39 BPF			SS						
30	19-34-16 50 BPF			SS	30					
	13-26-27 53 BPF			SS						
35	24-27-29 56 BPF			SS	35	(2)		21		

(continued . . .)

LOGGED BY TFK DATE 8/11/93 CHK'D BY DBK

SOIL BORING LOG

SITE NAME AND LOCATION	DRILLING METHOD:			BORING NO.
	DRY AUGER 0-16'			R-41
	WET ROTARY 16'-50'			SHEET
MAGNOLIA SANITARY LANDFILL	SAMPLING METHOD:			2 of 2
PHASE II REDESIGN	ST - Shelby Tube			DRILLING
MONROE, LOUISIANA	SS - Split Spoon			START / FINISH
(See Boring Location Plan)	WATER LEVEL	16'	12.5'	TIME / TIME
	TIME	0	15 min.	11:15 / 10:00
	DATE	7/7/93	7/7/93	DATE / DATE
				07/07/93 / 07/08/93

DATUM: Ground Surface ELEVATION: 62.5 Ft. NGVD

BORING COORDINATES:	N2842 E782	SURFACE CONDITIONS:	Dry, level, bare
DRILL RIG:	Failing 1500	DRILLER:	Joby Barr
SPT HAMMER WEIGHT:	140 LBS.	LOGGER:	T. F. Keowen

DEPTH IN FEET (ELEVATION)	POCKET PENETROMETER (TSF) OR BLOW COUNT	USCS SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	DEPTH IN FEET (ELEVATION)	LIQUID LIMIT (%)	PLASTICITY INDEX	WATER CONTENT (%)	DRY DENSITY (PCF)	COMPRESSIVE STRENGTH (TSF)
	9-17-35 52 BPF		Dense to very dense reddish-brown SAND (SP-SM) saturated, fine grained, poorly graded, with some silt	SS						
	5-15-27 42 BPF			SS						
40	4-7-24 31 BPF			SS	40					
	11-14-18 32 BPF			SS						
45	7-36-50 86 BPF		Very dense reddish-brown SAND (SP-SM) saturated, fine to medium grained, poorly graded	SS	45					
	24-36-50 86 BPF			SS						
	27-30-33 63 BPF			SS						
50			Boring R-41 was terminated at 50 feet. Borehole grouted full depth with a 5% bentonite/cement grout on 7/8/93.		50					
55			Notes: (1) Percent passing 200 sieve = 28.2%. See gradation curve. (2) Percent passing 200 sieve = 5.3%. See gradation curve.		55					
60					60					
65					65					
70					70					

DRILLING CONTRACTOR CUSTOM CORING, INC.

LOGGED BY PJR DATE 8/11/93 CHK'D BY DBK

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Hollow Stem Auger: 0 - 24'

SAMPLING METHOD: ■ Shelby Tube ☒ Split Spoon

BORING NO. B-PZ-10

SHEET 1 OF 1

					DRILLING START	DRILLING FINISH
WATER LEVEL	14.50'				TIME	TIME
TIME					08:40	13:00
DATE	1/30/96				DATE	DATE
SYMBOL	▽	▼			1-30-96	1-30-96

DATUM Top of Casing ELEVATION 65.98

DRILL RIG Mobile B-57 N 3547 E 4835

SURFACE CONDITIONS: Level, wet

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT LBS

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	0.75			Soft dark brown CLAY (CH) saturated, abundant rootlets and plant fragments, trace silt and very fine grained sand	ST							
	1.50			-- stiff, plant material less abundant	ST							
	1.25			-- blocky, with fine to medium grained, angular to subangular, clear to white sand irregularly distributed along fractures	ST		5					
	1.25			-- dark gray, sand absent, slickensided (very well developed)	ST							
	1.50			-- ferrous stain common, occasional calcareous nodules	ST							
10	2.00			-- medium reddish brown, trace very fine grained sand	ST		10					
	2.00				ST							
▽ 15	2.00			Stiff medium reddish brown very SILTY CLAY/CLAYEY SILT (CL/ML) wet, abundant rootlets, trace of very fine mica flakes and very fine grained sand	ST		15					
	<0.25				ST							
	<0.25			Medium reddish brown CLAYEY SILT (ML) wet, some very fine grained sand, occasional rootlet, trace of very fine mica	ST		20					
20	<0.25				ST							
	1.25			Stiff dark reddish brown CLAY (CH) damp, slickensided (well developed), occasional rootlet	ST							
25				Boring B-PZ-10 was terminated at 24 ft. bgs and completed as piezometer PZ-10.			25					
							30					
35 36.0							35					

LOGGED BY Tom Keowen

CHECKED BY SCL

SOIL BOREHOLE LOG

SITE NAME AND LOCATION Waste Management of Louisiana, Inc. Magnolia Sanitary Landfill Shallow Piezometer Study Monroe, Louisiana	DRILLING METHOD: Hollow Stem Auger: 0 - 18'	BORING NO. B-PZ-11	
	SAMPLING METHOD: ■ Shelby Tube ☒ Split Spoon	SHEET 1 OF 1	
		DRILLING START / FINISH	
	WATER LEVEL 12.0'	TIME 14:30	TIME 15:30
	TIME		
	DATE 1/30/96	DATE 1-30-96	DATE 1-30-96
DATUM Ground Surface ELEVATION 66.24	SYMBOL ▽ ▼		
DRILL RIG Mobile B-57 N 2506 E 3873	SURFACE CONDITIONS: Wet, level, muddy		
ANGLE Vertical BEARING ------			
SAMPLE HAMMER WEIGHT LBS			

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	1.25			Medium stiff medium gray and reddish brown CLAY (CH) damp, rootlets common	ST							
	1.00			– dark brown, fewer rootlets, blocky, occasional calcareous nodule (~1/16")	ST							
	1.25			– calcareous nodules larger and more common (~1/4" - 1/2")	ST		5					
	1.00			– medium reddish brown, abundant large (~1/2") calcareous nodules, well developed slickensides	ST							
	2.25			Medium reddish brown stiff CLAY (CH) damp, black ferrous stain common, trace of very fine grained sand	ST							
10	1.00			Medium stiff reddish brown SILTY CLAY (CL) trace very fine to fine grained sand, black staining more abundant	ST		10					
▽	<0.25			Medium reddish brown CLAYEY SILT (ML) wet, some very fine grained sand, trace fine mica, occasional black ferrous stain	ST							
15	<0.25			– black staining absent, more very fine grained sand and mica	ST		15					
	NR			No Recovery	NR							
				Boring B-PZ-11 was terminated at 18 ft. bgs and completed as piezometer PZ-11.								
20							20					
25							25					
							30					
35							35					
36.0												

LOGGED BY Tom Keowen

CHECKED BY SGL

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	Waste Management of Louisiana, Inc. Magnolia Sanitary Landfill Shallow Piezometer Study Monroe, Louisiana
DRILLING METHOD:	Rotary Wash: 0 - 86'
SAMPLING METHOD:	■ Shelby Tube ☒ Split Spoon
BORING NO.	B-PZ-12
SHEET	1 OF 3
DRILLING START TIME	16:00
DRILLING FINISH TIME	17:30
DRILLING START DATE	2-6-96
DRILLING FINISH DATE	2-8-96
WATER LEVEL / TIME / DATE / SYMBOL	
DATUM	Ground Surface
ELEVATION	65.88
DRILL RIG	Failing 36
N 2512 E 3895	
SURFACE CONDITIONS:	Wet, level, muddy
ANGLE	Vertical
BEARING	------
SAMPLE HAMMER WEIGHT	300 LBS
DRILLING CONTR	Singley Construction
DRILLER	Timothy Beach
PN	32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				First 18 ft. not logged. See log of B-PZ-11.								
	PUSH		X	Medium reddish brown CLAYEY SILT (ML) wet, some very fine grained sand, trace of fine mica flakes	SS							
	PUSH		X	– becoming more clayey with depth	SS							
	PUSH		X		SS							
	PUSH		X	Dark reddish brown SILTY SAND (SM) wet, very fine grained, trace of clay	SS							
	6/4/6 10 BPF		X	– medium dense, very fine to fine grained, less silty	SS							
	2/4/4 8 BPF		X		SS							
	2/2/4 6 BPF		X		SS							
	2/3/5 8 BPF		X	– medium brown, fine mica common	SS							
36.0	4/3/4 7 BPF		X	– medium greenish gray, loose, very fine grained, with some fine	SS							

Continued Next Page

LOGGED BY Tom Keaven

CHECKED BY SCL

WMSOIL, 3/19/96

Tracking Code:

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 86'

SAMPLING METHOD: ■ Shelby Tube ☒ Split Spoon

BORING NO. B-PZ-12

SHEET 2 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					TIME 16:00	TIME 17:30
DATE					DATE 2-6-96	DATE 2-8-96
SYMBOL	▽	▼				

DATUM Ground Surface ELEVATION 65.88

DRILL RIG Failing 36 N 2512 E 3895

SURFACE CONDITIONS: Wet, level, muddy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 300 LBS

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
36.0	3/2/2 4 BPF			grained sand – medium dense, fine grained, with some very fine grained sand, mica more common	SS							
	2/5/10 15 BPF				SS							
	2/6/7 13 BPF			Dense medium gray SAND (SP) fine grained, with some very fine grained sand and silt	SS		40					
	8/20/15 35 BPF			– very dense, medium gray, fine grained with some medium grained sand	SS							
45	6/11/15 26 BPF				SS		45					
	8/15/22 37 BPF			– medium brown, medium grained with some fine grained and trace very fine grained sand, mica absent, subrounded to rounded	SS							
	5/10/12 22 BPF				SS							
50	2/3/7 10 BPF			– medium dense, trace fine grained sand, very fine grained sand absent, trace coarse grained sand (moderately well rounded)	SS		50					
	6/7/5 12 BPF			Medium dense medium brown SILTY SAND (SM) wet, very fine to fine grained with trace medium grained and coarse grained sand (moderately well rounded)	SS							
55	6/8/8 16 BPF			Dense medium gray SAND (SP) wet, fine to medium grained with some very fine grained sand, subrounded to rounded, trace of silt	SS		55					
	8/10/12 22 BPF				SS							
	4/7/11 18 BPF			– medium grained with some fine grained sand, trace well rounded coarse grained sand	SS							
60	4/8/11 19 BPF			– less fine grained sand, coarse grained sand more common	SS		60					
	3/2/3 5 BPF			– medium to coarse grained with very fine to fine grained sand common and some well rounded gravel, angular to moderately rounded, occasional 1/2" - 3/4" thick clayey layer	SS							
65	2/8/8 16 BPF			– becoming more clayey, gravel common	SS		65					
	1/8/14 22 BPF			– dense, less clay, more gravel (80-90% of sample)	SS							
	15/26 >25 BPF			– medium grained with some fine grained sand, subangular to medium rounded, trace fine gravel	SS							
70	5/8/7 15 BPF			– dense, coarse to very coarse grained, with abundant fine gravel (60-70% of sample)	SS		70					
72.0												

LOGGED BY Tom Keowen

CHECKED BY [illegible]

WMSOIL, 3/19/96

Tracking Codes: 32"

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 86'

SAMPLING METHOD: ■ Shelby Tube ☒ Split Spoon

BORING NO. B-PZ-12

SHEET 3 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					16:00	17:30
DATE					DATE	DATE
SYMBOL	▽	▼			2-6-96	2-8-96

DATUM Ground Surface ELEVATION 65.88

DRILL RIG Failing 36 N 2512 E 3895

SURFACE CONDITIONS: Wet, level, muddy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 300 LBS

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
72.0	2/2/4 6 BPF			Medium dense poorly graded GRAVEL (GP) wet, fine, angular to well rounded	SS							
75	2/3/6 9 BPF			-- abundant angular to well rounded, coarse to very coarse sand, with some subangular to rounded medium grained sand, trace very fine to fine grained sand (~25% of sample is sand)	SS		75					
	4/9/9 18 BPF			-- some coarse gravel	SS							
	15/27 >25 BPF			Very dense medium gray SAND (SP) wet, fine to medium grained, subrounded to moderately well rounded, coarse grained sand and fine gravel common, subangular to rounded, some very fine grained sand and silt	SS							
80	10/14/15 29 BPF			-- very fine to fine grained, some subangular to subrounded medium grained sand, trace of coarse grained sand (moderately rounded), gravel absent	SS		80					
	1/3/3 6 BPF			-- gravel (angular to rounded), fine to medium (small amount recovered)	SS							
85	3/6/12 18 BPF			Hard dark greenish gray SILTY CLAY (CL) moist, very thinly laminated with light greenish gray silt and trace of fine dark mica flakes between layers	SS		85					
				Boring B-PZ-12 was terminated at 86 ft. bgs and completed as piezometer PZ-12.								
90							90					
95							95					
100							100					
105							105					
108.0												

LOGGED BY Tom Keowen

CHECKED BY SR

Tracking Codes: 327 YMSOIL 3/19/96

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Hollow Stem Auger: 0 - 32'

SAMPLING METHOD: ■ Shelby Tube

BORING NO. B-PZ-13

SHEET 1 OF 1

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					16:30	11:00
DATE					DATE	DATE
SYMBOL	▽	▼			1-30-96	1-31-96

DATUM Ground Surface ELEVATION 63.04

DRILL RIG Mobile B-57 N E

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT LBS

SURFACE CONDITIONS: Level, soft, muddy

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	1.50			Medium stiff dark reddish brown CLAY (CH) damp, rootlets common	ST							
	1.00			– dark gray, rootlets less common	ST							
	3.00			– very stiff, dark reddish brown, moist, slickensided, calcareous nodules common	ST		5					
	2.50			–clear to white, very fine to fine with trace of medium and coarse grained sand present along slickensides, (angular to subangular), occasional large (~1/2") calcareous nodule	ST							
	1.50			–medium stiff, dark reddish brown to dark gray, slickensides absent	ST							
10	1.50			– calcareous nodules smaller (~1/8" - 1/4")	ST		10					
	1.75				ST							
15	2.25			– occasional rootlet	ST		15					
	1.75			–slickensided (well developed), black ferrous stains common, calcareous nodules common	ST							
	1.75			– dark gray, calcareous nodules absent, lignitized wood fragments common, rootlets common	ST							
20	0.50			– light gray to light greenish gray, wood fragments absent, blocky, slickensides absent	ST		20					
	0.50			– abundant ferrous stains, wet, some silt, very blocky	ST							
25	–				ST		25					
	1.00			Dark reddish brown SILTY CLAY (CL) damp, trace ferrous stain	ST							
	0.75			– 2" layer of very fine grained dark brown SILTY/CLAYEY SAND (SM/SC), at ~29.5', wet, becoming more silty with depth	ST		30					
	<0.25			Dark brown SILTY/CLAYEY SAND (SM/SC) wet, fine grained with some fine sand, definite upper contact – becoming more clayey with depth	ST							
35 36.0				Boring B-PZ-13 was terminated at 32 ft. bgs and grouted full depth with a cement/bentonite slurry.			35					

LOGGED BY Tom Keowen

CHECKED BY SM

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Hollow Stem Auger: 0 - 20'

SAMPLING METHOD: ■ Shelby Tube

BORING NO. B-PZ-13B

SHEET 1 OF 1

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					TIME 13:00	TIME 14:00
DATE					DATE 1-31-96	DATE 1-31-96
SYMBOL	▽	▼				

DATUM Ground Surface ELEVATION 62.09

DRILL RIG Mobile B-57 N E

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT LBS

SURFACE CONDITIONS: Level, soft, muddy

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	1.50			Medium stiff dark reddish brown CLAY (CH) damp, rootlets common	ST							
	3.50			– very stiff, calcareous nodules common (~1/16" - 1/4"), rootlets less common	ST							
	2.50			– dark reddish brown and gray, block, slickensided	ST		5					
	1.75			– trace very fine to fine grained subangular to angular sand along slickensides, slickensides more poorly developed	ST							
	1.75			– slickensides absent, calcareous nodules rare and smaller (<1/16")	ST							
10	1.75			– dark reddish brown	ST		10					
	2.50			– slickensided, occasional calcareous nodules (~1/8")	ST							
15	3.25			– large calcareous nodules (1/2") common, blocky	ST		15					
	2.25			– black ferrous stain common	ST							
	1.50			–dark gray, well developed slickensides, occasional lignitized wood fragment, occasional rootlet	ST							
20				Boring B-PZ-13B was terminated at 20 ft. bgs.			20					
25							25					
							30					
35 36.0							35					

LOGGED BY Tom Keowen

CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Hollow Stem Auger: 0 - 26'

SAMPLING METHOD: ■ Shelby Tube

BORING NO. B-PZ-14

SHEET 1 OF 1

					DRILLING START	DRILLING FINISH
WATER LEVEL	22.0'					
TIME					TIME 14:30	TIME 17:15
DATE	1/31/96				DATE 1-31-96	DATE 1-31-96
SYMBOL	▽	▼				

DATUM Ground Surface ELEVATION 63.22

DRILL RIG Mobile B-57 N 2614 E 2127

SURFACE CONDITIONS: Wet, level, muddy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT LBS

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	<0.25			Very soft dark brown CLAY (CH) wet, blocky slickensided, abundant rootlets and wood fragments, some ferrous stains	ST							
	0.75			– dark reddish brown, calcareous nodules common, <1/16", occasional rootlet	ST							
	1.50			–medium stiff, blocky, slickensided, with some very fine to fine grained sand along slickensides (white to clear, subangular to angular), calcareous nodules absent	ST		5					
	2.00			– slickensides absent	ST							
	1.50			– dark reddish brown and medium gray, occasional rootlet	ST							
10	1.50			– slickensided (well developed), rootlets common	ST		10					
	2.25			– slickensides poorly developed, occasional lignitized wood fragment	ST							
15	1.75			– wood absent	ST		15					
	2.25			– calcareous nodules common (~1/4"), slickensides absent	ST							
	1.50			– reddish brown and dark gray very well developed slickensides, rootlets common	ST							
20	0.75			Medium stiff dark reddish brown SILTY CLAY (CL) damp, abundant rootlets and wood fragments	ST		20					
▽	1.25			Stiff dark brown CLAY (CH) damp, blocky, slickensided, wood fragments and rootlets common, in 2" - 6" layers separated by 1" - 2" layers of dark brown CLAYEY SILT (ML), wet	ST							
25	1.00			Medium stiff medium gray SILTY CLAY (CL) damp, wood fragment and rootlets common	ST		25					
				Boring B-PZ-14 was terminated at 26 ft. bgs and completed as piezometer PZ-14.								
35 36.0							30 35					

LOGGED BY Tom Keowen

CHECKED BY SK

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Hollow Stem Auger: 0 - 20'

SAMPLING METHOD: ■ Shelby Tube

BORING NO. B-PZ-15

SHEET 1 OF 1

					DRILLING START	DRILLING FINISH
WATER LEVEL	14.0'				TIME	TIME
TIME					13:30	15:00
DATE	2/5/96				DATE	DATE
SYMBOL	▽	▼			2-5-96	2-5-96

DATUM Ground Surface ELEVATION 66.05

DRILL RIG Mobile B-57 N 2651 E 1204

SURFACE CONDITIONS: Wet, level, muddy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT LBS

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	0.75			Medium stiff dark brown CLAY (CH) damp, wood fragment and rootlets common, occasional ferrous nodules	ST							
	>4.50			–hard, slickensided, calcareous nodules common (~1/16"), rootlets more common, some light brown dry silt present along slickensides	ST							
	2.75			–very stiff to medium gray and dark reddish brown, slickensides more numerous and better developed, rootlets abundant, trace of very fine to fine grained clear to white sand along slickensides	ST		5					
	2.00			–wood absent, rootlets less common, calcareous nodules common, less silt, sand absent	ST							
	2.25			–medium reddish brown and medium gray, fewer rootlets, trace of silt	ST		10					
10	2.25			– blocky, calcareous nodules rare, rootlets absent	ST							
	0.75			Medium stiff brown SILTY CLAY (CL) damp, some ferrous staining, occasional rootlet	ST							
▽ 15	<0.25			Medium brown CLAYEY SILT (ML) wet, trace ferrous stain, trace very fine grained sand – becoming less clayey with depth, occasional carbonized rootlet	ST		15					
	<0.25				ST							
	<0.25			– trace very fine grained sand, trace mica	ST							
20				Boring B-PZ-15 was terminated at 20 ft. bgs and completed as piezometer PZ-15.			20					
25							25					
							30					
35 36.0							35					

LOGGED BY Tom Keowen

CHECKED BY SH

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD: Hollow Stem Auger: 0 - 28'

SAMPLING METHOD: ■ Shelby Tube ☒ Split Spoon

BORING NO. B-PZ-16

SHEET 1 OF 1

					DRILLING START	DRILLING FINISH
WATER LEVEL	21.3'					
TIME					TIME 07:30	TIME 09:30
DATE	2/6/96				DATE 2-6-96	DATE 2-6-96
SYMBOL	▽	▼				

DATUM Ground Surface ELEVATION 66.45

DRILL RIG Mobile B-57 N 4216 E 641

SURFACE CONDITIONS: Wet, level, muddy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT LBS

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	0.75			Medium stiff dark brown CLAY (CH) damp, abundant rootlets	ST							
	2.25			– very stiff, blocky, slickensided, calcareous nodules common (~1/8" - 1/16")	ST							
	1.50			– stiff, dark reddish brown, rootlets rare	ST		5					
	1.75			– medium stiff, medium reddish brown and medium gray, very blocky, calcareous nodules rare	ST							
	1.50				ST							
10	1.75			– massively bedded, calcareous nodules and rootlets absent	ST		10					
	2.25			– blocky, occasional rootlet and calcareous nodule (~1/16")	ST							
15	2.00			– dark reddish brown, rootlets more common	ST		15					
	--			No Recovery	NR							
	2.00			– medium gray, blocky	SS							
20 ▽	1.00			Medium stiff gray and reddish brown SILTY CLAY (CL) wet, blocky, rootlets common, ferrous stains common, becoming more silty with depth	ST		20					
	<0.25			Soft medium gray and reddish brown CLAYEY SILT (ML) wet, ferrous stains and rootlets common, trace very fine grained sand	ST							
25	<0.25			– trace fine mica flake	ST		25					
				No Recovery	NR							
				Boring B-PZ-16 was terminated at 28 ft. bgs.			30					
35 36.0							35					

LOGGED BY Tom Keowen

CHECKED BY Sen

SOIL BOREHOLE LOG

.E NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Shallow Piezometer Study
Monroe, Louisiana

DRILLING METHOD:
Dry Auger: 0 - 12'
Rotary Wash: 12' - 26'

SAMPLING METHOD: ■ Shelby Tube
☒ Split Spoon

BORING NO. B-PZ-17

SHEET 1 OF 1

					DRILLING START	DRILLING FINISH
WATER LEVEL	12.0'				TIME	TIME
TIME					08:00	10:00
DATE	2/9/96				DATE	DATE
SYMBOL	▽	▼			2-9-96	2-9-96

DATUM Ground Surface ELEVATION 62.30

DRILL RIG Failing 36 N E

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 300 LBS

SURFACE CONDITIONS:

DRILLING CONTR Singley Construction

DRILLER Timothy Beach

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0	1.00			Medium stiff medium reddish brown CLAY (CH) damp, trace silt and very fine grained sand, rootlets common	ST							
	0.50			– slickensided (well developed)	ST							
	1.25			– some ferrous staining, fewer rootlets	ST		5					
	2.00			– medium reddish brown and gray, some silt along slickensides, more ferrous stain	ST							
	2.50			– very stiff, massive, some silt, rootlets rare, occasional carbonized wood fragments	ST							
10	0.25			Soft medium reddish brown SILTY CLAY/CLAYEY SILT (CL/ML) damp, some very fine grained sand and fine mica flakes, occasional rootlet, becoming more silty with depth	ST		10					
▽	<0.25			Medium reddish brown CLAYEY SILT (ML) wet, some very fine grained sand and fine mica flakes, occasional black ferrous stain, occasional rootlet	ST							
15	–			No Recovery	NR		15					
	PUSH			– ferrous stain and rootlets rare	SS							
	PUSH			– trace very fine grained sand and mica, rootlets absent, becoming more clayey	SS		20					
20	PUSH				SS							
	PUSH			– dark reddish brown, less clayey, very fine grained sand common, some fine mica flakes	SS							
25	PUSH			Dark greenish brown SILTY SAND (SM) wet, some fine mica, trace clay	SS		25					
				Boring B-PZ-17 was terminated at 26 ft. bgs and grouted full depth.								
35 36.0							30 35					

LOGGED BY Tom Keowen

CHECKED BY SN

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
Waste Management of Louisiana, Inc. Magnolia Sanitary Landfill Nested Piezometer Installation Monroe, Louisiana	Rotary Wash: 0 - 37'	BPZ-17A
	SAMPLING METHOD: ☒ Split Spoon	SHEET 1 OF 1

					DRILLING	
					START	FINISH
WATER LEVEL					TIME	TIME
TIME					08:30	08:45
DATE					DATE	DATE
SYMBOL	▽	▼			5-21-96	5-21-96

DATUM N.G.V.D. ELEVATION 63.30

DRILL RIG Hilyard Top Drive N 2501 E 3883

SURFACE CONDITIONS: Level, grassy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				*0 - 35' Not Sampled*								
5							5					
10							10					
15							15					
20							20					
25							25					
30							30					
35							35					
	PUSH			*Loose greenish gray SILTY SAND (SM)* saturated, fine to very fine grained, poorly graded	SS							
39.0				Boring BPZ-17A was terminated at 37 ft. bgs.								

LOGGED BY Bobby Bailey

CHECKED BY

Tracking Codes: 32 MSOIL, 6/5/98

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
Waste Management of Louisiana, Inc. Magnolia Sanitary Landfill Nested Piezometer Installation Monroe, Louisiana	Rotary Wash: 0 - 43'	BPZ-17B
	SAMPLING METHOD: ☒ Split Spoon	SHEET 1 OF 2

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					09:05	09:15
DATE					DATE	DATE
SYMBOL	▽	▼			5-21-96	5-21-96

DATUM N.G.V.D. ELEVATION 63.10

DRILL RIG Hilyard Top Drive N 2498 E 3894 SURFACE CONDITIONS: Level, grassy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				0 - 41.5' Not Sampled								
5							5					
10							10					
15							15					
20							20					
25							25					
30							30					
35							35					
36.0												

LOGGED BY Bobby Bailey

CHECKED BY LAO

Continued Next Page

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
Waste Management of Louisiana, Inc. Magnolia Sanitary Landfill Nested Piezometer Installation Monroe, Louisiana	Rotary Wash: 0 - 43'	BPZ-17B
	SAMPLING METHOD: ☒ Split Spoon	SHEET 2 OF 2

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					09:05	09:15
DATE					DATE	DATE
SYMBOL	▽	▼			5-21-96	5-21-96

DATUM N.G.V.D. ELEVATION 63.10

DRILL RIG Hilyard Top Drive N 2498 E 3894 SURFACE CONDITIONS: Level, grassy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc. DRILLER J. Johnson

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
36.0												
40							40					
	PUSH		X	Dense gray SAND (SP) saturated with silt trace, fine to very fine grained, poorly graded	SS							
				Boring BPZ-17B was terminated at 43 ft. bgs.								
45							45					
50							50					
55							55					
60							60					
65							65					
70							70					
72.0												

PN 32711.100

LOGGED BY Bobby Bailey

CHECKED BY

Tracking Codes: 37 /MSOIL, 8/4/96

SOIL BOREHOLE LOG

SITE NAME AND LOCATION Waste Management of Louisiana, Inc. Magnolia Sanitary Landfill Nested Piezometer Installation Monroe, Louisiana	DRILLING METHOD: Rotary Wash: 0 - 54' SAMPLING METHOD: ☒ Split Spoon	BORING NO. BPZ-17C SHEET 1 OF 2

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					09:40	09:55
DATE					DATE	DATE
SYMBOL	▽	▼			5-21-96	5-21-96

DATUM N.G.V.D. ELEVATION 62.90

DRILL RIG Hilyard Top Drive N 2498 E 3905

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

SURFACE CONDITIONS: Level, grassy

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				0 - 52.5' Not Sampled								
5							5					
10							10					
15							15					
20							20					
25							25					
							30					
35							35					
36.0												

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

LOGGED BY Bobby Bailey

CHECKED BY LAO

Tracking Codes: 32 MSOIL, 6/4/96

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 54'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-17C

SHEET 2 OF 2

DRILLING	START	FINISH
TIME	09:40	09:55
DATE	5-21-96	5-21-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 62.90

DRILL RIG Hilyard Top Drive N 2498 E 3905

SURFACE CONDITIONS: Level, grassy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
36.0												
40							40					
45							45					
50							50					
	12/15/13 30 BPF			Medium dense brown SILTY SAND (SM) wet, very fine to fine grained, poorly graded	SS							
				Boring BPZ-17C was terminated at 54 ft. bgs.								
55							55					
60							60					
65							65					
70							70					
72.0												

LOGGED BY Bobby Bailey

CHECKED BY

Tracking Codes: WMSOIL, 6/4/96

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 60'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-17D

SHEET 1 OF 2

DRILLING	START	FINISH
TIME	10:15	10:40
DATE	5-21-96	5-21-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 62.90

DRILL RIG Hilyard Top Drive N 2498 E 3917

SURFACE CONDITIONS: Flat, grassy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				0 - 58.5' Not Sampled								
5							5					
10							10					
15							15					
20							20					
25							25					
30							30					
35							35					
36.0												

LOGGED BY Bobby Bailey

CHECKED BY CAD

MSOIL, 8/4/96

Tracking Codes: 32

Continued Next Page

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 60'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-17D

SHEET 2 OF 2

DRILLING	
START	FINISH
TIME 10:15	TIME 10:40
DATE 5-21-96	DATE 5-21-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 62.90

DRILL RIG Hilyard Top Drive N 2498 E 3917

SURFACE CONDITIONS: Flat, grassy

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
36.0												
40							40					
45							45					
50							50					
55							55					
	PUSH			Medium dense gray SAND (SP) wet, very fine to fine grained, poorly graded	SS							
60				Boring BPZ-17D was terminated at 60 ft. bgs.			60					
65							65					
70							70					
72.0												

LOGGED BY Bobby Bailey

CHECKED BY [illegible]

WMSOIL, 6/4/96

Tracking Codes: 3

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 20'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-18A

SHEET 1 OF 1

DRILLING	START	FINISH
TIME	07:05	07:20
DATE	5-22-96	5-22-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 56.80

DRILL RIG Hilyard Top Drive N 3079 E 1221

SURFACE CONDITIONS: Level

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				*0 - 18.5' Not Sampled*								
	PUSH			Loose to medium dense dark reddish-brown CLAYEY SILT (ML) saturated with very fine grained sand	SS							
				Boring BPZ-18A was terminated at 20 ft. bgs.								
36.0												

Tracking Codes: ? WMSOIL, 6/4/96

LOGGED BY Bobby Bailey

CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 36'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-18B

SHEET 1 OF 1

DRILLING	
START	FINISH
TIME 07:30	TIME 07:40
DATE 5-22-96	DATE 5-22-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 56.80

DRILL RIG Hilyard Top Drive N 3077 E 1233

SURFACE CONDITIONS: Level

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				0 - 34.5' Not Sampled								
35	PUSH		X	Medium dense dark brown SILTY SAND (SM) saturated, fine grained, poorly graded	SS							
38.0				Boring BPZ-18B was terminated at 36 ft. bgs.								

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

LOGGED BY Bobby Bailey

CHECKED BY CAO

Tracking Codes: WMSOIL, 6/5/96

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 54'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-18C

SHEET 1 OF 2

DRILLING	START	FINISH
TIME	07:50	08:05
DATE	5-22-96	5-22-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 56.80

DRILL RIG Hilyard Top Drive N 3076 E 1246

SURFACE CONDITIONS: Level

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				0 - 52.5' Not Sampled								
5												
10												
15												
20												
25												
30												
35												
36.0												

LOGGED BY Bobby Bailey

CHECKED BY [illegible]

Tracking Codes: 3 WMSOIL 6/4/96

Continued Next Page

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 54'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-18C

SHEET 2 OF 2

DRILLING	START	FINISH
TIME	07:50	08:05
DATE	5-22-96	5-22-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 56.80

DRILL RIG Hilyard Top Drive N 3076 E 1246

SURFACE CONDITIONS: Level

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
36.0												
40							40					
45							45					
50							50					
	PUSH			Very dense dark brown and dark gray SAND (SP) saturated, fine grained, poorly graded	SS							
				Boring BPZ-18C was terminated at 54 ft. bgs.								
55							55					
60							60					
65							65					
70							70					
72.0												

LOGGED BY Bobby Bailey

CHECKED BY

WMSOIL, 8/4/95

Tracking Codes: 3

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 66'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-18D

SHEET 1 OF 2

DRILLING	START	FINISH
TIME	08:25	08:55
DATE	5-22-96	5-22-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 56.60

DRILL RIG Hilyard Top Drive N 3074 E 1259

SURFACE CONDITIONS: Level

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
0.0				0 - 64.5' Not Sampled								
5							5					
10							10					
15							15					
20							20					
25							25					
30							30					
35							35					
36.0												

LOGGED BY Bobby Bailey

CHECKED BY

Tracking Codes: WMSOIL, 6/4/96

Continued Next Page

SOIL BOREHOLE LOG

.E NAME AND LOCATION

Waste Management of Louisiana, Inc.
Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

DRILLING METHOD: Rotary Wash: 0 - 66'

SAMPLING METHOD: ☒ Split Spoon

BORING NO. BPZ-18D

SHEET 2 OF 2

DRILLING	
START	FINISH
TIME 08:25	TIME 08:55
DATE 5-22-96	DATE 5-22-96

WATER LEVEL				
TIME				
DATE				
SYMBOL	▽	▼		

DATUM N.G.V.D. ELEVATION 56.60

DRILL RIG Hilyard Top Drive N 3074 E 1259

SURFACE CONDITIONS: Level

ANGLE Vertical BEARING ------

SAMPLE HAMMER WEIGHT 140 LBS

DRILLING CONTR Anderson Engineering, Inc.

DRILLER J. Johnson

PN 32711.100

DEPTH IN FEET (BGS)	BLOWS/FT OR POCKET PEN. (TSF)	SOIL GRAPH	SAMPLER	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	DEPTH IN FEET (BGS)	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	COMPRESSIVE STRENGTH (TSF)
36.0												
40							40					
45							45					
50							50					
55							55					
60							60					
65	PUSH			Dense dark gray GRAVELLY SAND (SW) *saturated, fine to coarse grained, well graded*	SS		65					
				Boring BPZ-18D was terminated at 66 ft. bgs.								
70							70					
72.0												

LOGGED BY Bobby Bailey

CHECKED BY

WMSOIL, 6/4/96

Tracking Codes:

PIEZOMETER CONSTRUCTION DETAILS

ATTACHMENT B.2

Piezometer No.: P-1

Boring No. X-Ref: R-3

PIEZOMETER CONSTRUCTION SUMMARY

Grid Coords: N4921 E1690

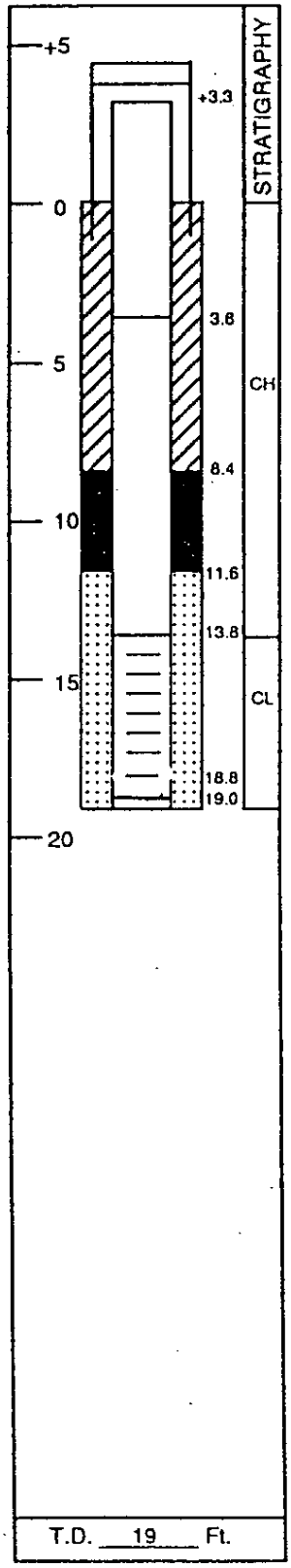
Lat.: 31°28'51" Long.: 92°00'03"

Site Name: Magnolia Landfill

Elevation Ground Level: 64.78 Ft. NGVD

Elevation Top of Casing: 68.11 Ft. NGVD

Location: Monroe, Louisiana



Drilling Summary:

Total Depth: 19'

Borehole Diameter: 6"

Casing Stick-up Height: 3.33'

Driller: Custom Coring, Inc. (CCI)
Joby Barr

Geologist: RUST E&I, Philip Robicheaux

Rig: Failing 1500

Bit(s): 0-19': 6" Wet Rotary

Drilling Fluid: 0-19': Potable Water

Protective Casing: 4" x 4" x 5' Aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling	7/15/93		7/15/93	
Geophys. Logging:	N/A		N/A	
Casing:	N/A		N/A	
Filter Placement:	7/15/93		7/15/93	
Bentonite Seal:	7/15/93		7/16/93	
Development:	8/5/93		8/5/93	

Well Design & Specifications

Basis: Geologic Log: X Geophysical Log: ____
Casing String (s): C = Casing S = Screen

Depth	String(s)	Elevation
+3.33 - 13.8'	C1	68.11 - 50.98
13.8' - 18.8'	S1	50.98 - 45.98
-		-
-		-
-		-

Casing: C1 1-1/4" dia., Sch. 40 PVC, Flush-Threaded, TRI-LOCK
C2 N/A

Screen: S1 1-1/4" dia., Sch. 40 PVC, Flush-Threaded, 0.010" Slot, TRI-LOCK
S2 N/A

Filter Pack: 11.6' to 19.0': 20/40 CSSI

Grout Seal: 0.0' to 8.4': Portland Type I Cement with 5% Pure Gold Bentonite Jel

Bentonite Seal: 8.4' to 11.6': 1/4" dia. VOLCLAY Bentonite Pellets

Well Development:

Airlift method with oilless air compressor.

Stabilization Test Data: N/A

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

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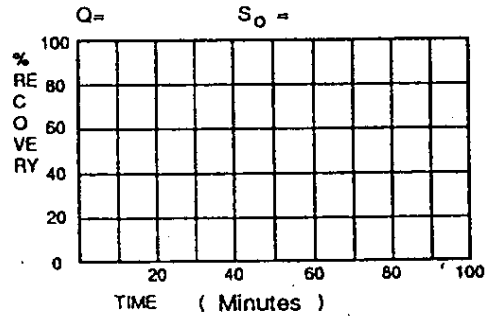


Comments:

Piezometer No.: P-2

Boring No. X-Ref: R-21

PIEZOMETER CONSTRUCTION SUMMARY

Grid Coords: N3983 E2983

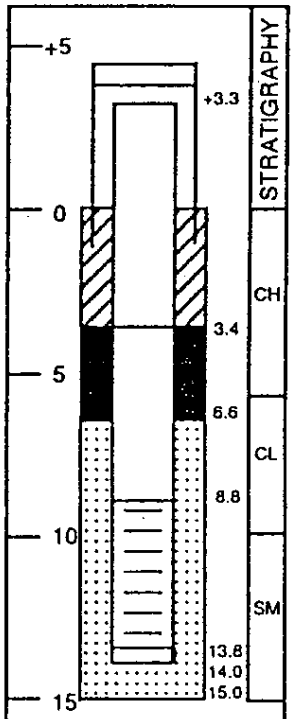
Lat.: 31°28'41" Long.: 91°59'49"

Site Name: Magnolia Landfill

Elevation Ground Level: 58.20 Ft. NGVD

Elevation Top of Casing: 61.77 Ft. NGVD

Location: Monroe, Louisiana



T.D. 15 Ft.

Drilling Summary:

Total Depth: 15'

Borehole Diameter: 6"

Casing Stick-up Height: 3.57'

Driller: Custom Coring, Inc. (CCI)
Joby Barr

Geologist: RUST E&I, Philip Roblcheaux

Rig: Failing 1500

Bit(s): 0-15': 6" Wet Rotary

Drilling Fluid: 0-19': Potable Water

Protective Casing: 4" x 4" x 5' Aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling	7/15/93		7/15/93	
Geophys. Logging:	N/A		N/A	
Casing:	N/A		N/A	
Filter Placement:	7/15/93		7/15/93	
Bentonite Seal:	7/15/93		7/16/93	
Development:	8/5/93		8/6/93	

Well Design & Specifications

Basis: Geologic Log: X Geophysical Log: ____
Casing String (s): C = Casing S = Screen

Depth	String(s)	Elevation
+3.57 - 8.8'	C1	61.77 - 49.40
8.8' - 13.8'	S1	49.40 - 44.40

Casing: C1 1-1/4" dia., Sch. 40 PVC, Flush-Threaded, TRI-LOCK
C2 N/A

Screen: S1 1-1/4" dia., Sch. 40 PVC, Flush-Threaded, 0.010" Slot, TRI-LOCK
S2 N/A

Filter Pack: 6.6' to 15.0': 20/40 CSSI

Grout Seal: 0.0' to 3.4': Portland Type I Cement with 5% Pure Gold Bentonite Jel

Bentonite Seal: 3.4' to 6.6': 1/4" dia. VOLCLAY Bentonite Pellets

Well Development:

Airlift method with oilless compressor.

Stabilization Test Data: N/A

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

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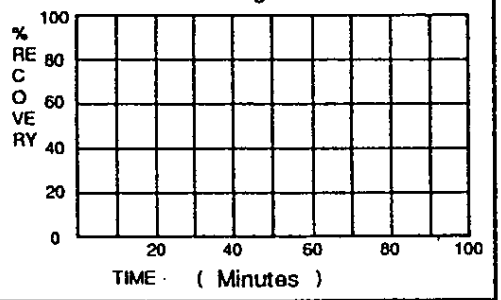


Comments:

Piezometer No.: P-3

Boring No. X-Ref: R-7

PIEZOMETER CONSTRUCTION SUMMARY

Grid Coords: N4840 E3499

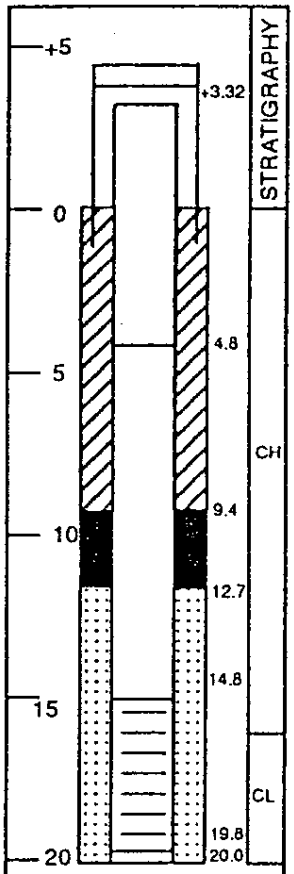
Lat.: 31°28'49" Long.: 91°59'48"

Site Name: Magnolia Landfill

Elevation Ground Level: 62.75 Ft. NGVD

Elevation Top of Casing: 66.07 Ft. NGVD

Location: Monroe, Louisiana



T.D. 20 Ft.

Drilling Summary:

Total Depth: 20'

Borehole Diameter: 6"

Casing Stick-up Height:

Driller: Custom Coring, Inc. (CCI)
Joby Barr

Geologist: RUST E&I, Philip Robicheaux

Rig: Failing 1500

Bit(s): 0-20': 6" Wet Rotary

Drilling Fluid: 0-20': Potable Water

Protective Casing: 4" x 4" x 5' Aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling	7/15/93		7/15/93	
Geophys. Logging:	N/A		N/A	
Casing:	N/A		N/A	
Filter Placement:	7/15/93		7/15/93	
Bentonite Seal:	7/16/93		7/16/93	
Development:	8/4/93		8/5/93	

Well Design & Specifications

Basis: Geologic Log: X Geophysical Log: ___
Casing String (s): C = Casing S = Screen

Depth	String(s)	Elevation
+3.32 - 14.8'	C1	66.07 - 47.95
14.8' - 19.8'	S1	47.95 - 42.95
-		-
-		-
-		-

Casing: C1 1-1/4" dia., Sch. 40 PVC, Flush-Threaded, TRI-LOCK
C2 N/A

Screen: S1 1-1/4" dia., Sch. 40 PVC, Flush-Threaded, 0.010" Slot, TRI-LOCK
S2 N/A

Filter Pack: 12.7' to 20.0': 20/40 CSSI

Grout Seal: 0.0' to 9.4': Portland Type I Cement with 5% Pure Gold Bentonite Jel

Bentonite Seal:

Well Development:

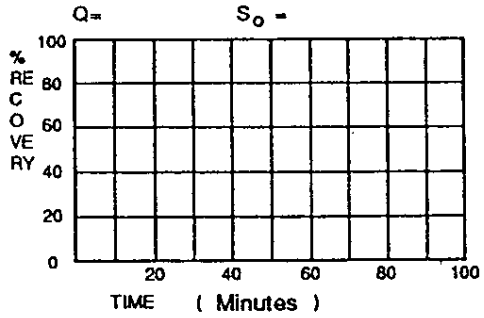
Airlift method with oilless air compressor.

Stabilization Test Data: N/A

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o =



Comments:

RUST ENVIRONMENT & INFRASTRUCTURE

PIEZOMETER DEVELOPMENT RECORD

CLIENT: Waste Management of Louisiana, Inc.
LOCATION: Magnolia Sanitary Landfill
1000 Russel Sage Road
Monroe, Louisiana

PAGE : 1 of 2
PROJECT NO.: 32711.100
DEVELOPMENT DATE: 02/10/96

GENERAL WELL DATA

Monitor Well ID	PZ-10	PZ-11	PZ-12	PZ-14
Date Installed	01/30/96	01/30/96	02/06/96	01/31/96
Well Construction	PVC	PVC	PVC	PVC
Well Diameter (inches)	2"	2"	2"	2"
Original Well Depth (ft bls)	25.00	18.00	86.00	26.00
Screened Interval (ft bls)	20.0 - 24.0	13.0 - 18.0	76.0 - 86.0	21.0 - 26.0

WATER LEVEL DATA

Description of Measuring Point (MP)	Top of Casing	Top of Casing	Top of Casing	Top of Casing
MP Elevation (feet) (1)	66.34	66.30	65.94	63.38
Sounded Depth of Well (feet)(A)	26.32	21.74	86.09	29.59
Depth to Water/Hydrocarbon (ft bmp)(B)	18.14	19.09	16.90	15.45
Water Column in Well (feet) (A - B = C)	8.18	2.65	69.19	14.14
Gallons per Foot (see Note)(D)	0.16	0.16	0.16	0.16
Gallons in Well (C x D = E)	1.31	0.42	11.07	2.26

WELL DEVELOPMENT DATA

Time	15:40	08:30	09:15	10:40
Method	Bailer	Bailer	Bailer	Bailer
Four Well Volumes (gallons) (E x 4)	5.24	1.70	44.28	9.05
Actual Volume Removed	7.0	2.5	45.0	6.0 (Dry)

DEVELOPMENT PARAMETER

Temperature °C before/after	20.2/20.2/19.2/19.2	19.7/19.8/19.4	17.8/17.3/19.3	19.8/19.3/19.8
Specific Conductance (µmhos)	5060/5490/6580/631	517/1527/153	729/745/769	3950/2930/3090
pH (su)	8.21/7.67/7.62/7.62	7.19/7.17/7.12	7.19/7.80/7.82	7.12/7.02/6.98

REMARKS:

DEVELOPMENT PERSONNEL: T. F. Keowen

REMARKS:
ft bls - feet below land surface
bmp - feet below measuring point
(1) - Feet referenced to NGVD
µmhos/cm - micromhos per centimeter
su - standard units

General Well Casing Volumes

Casing Diam. Gal/ft.	Casing Diam. Gal/ft.	Casing Diam. Gal/ft.	Casing Diam. Gal/ft.
1 1/4" = 0.077	2" = 0.16	3" = 0.37	4" = 0.65
1 1/2" = 0.10	2 1/2" = 0.24	3 1/2" = 0.50	6" = 1.46

RUST ENVIRONMENT & INFRASTRUCTURE

PIEZOMETER DEVELOPMENT RECORD

CLIENT: Waste Management of Louisiana, Inc.
LOCATION: Magnolia Sanitary Landfill
1000 Russel Sage Road
Monroe, Louisiana

PROJECT NO.: 32711.100
DEVELOPMENT DATE: 02/10/96

GENERAL WELL DATA

Monitor Well ID	PZ-15	PZ-16		
Date Installed	02/05/96	02/06/96		
Well Construction	PVC	PVC		
Well Diameter (inches)	2"	2"		
Original Well Depth (ft bls)	20.00	28.00		
Screened Interval (ft bls)	15.0 - 20.0	23.0 - 28.0		

WATER LEVEL DATA

Description of Measuring Point (MP)	Top of Casing	Top of Casing		
MP Elevation (feet) (1)	66.13	66.39		
Sounded Depth of Well (feet)(A)	22.62	31.64		
Depth to Water/Hydrocarbon (ft bmp)(B)	17.88	16.69		
Water Column in Well (feet) (A - B = C)	4.74	14.95		
Gallons per Foot (see Note)(D)	0.16	0.16		
Gallons in Well (C x D = E)	0.76	2.39		

WELL DEVELOPMENT DATA

Time	11:50	13:00		
Method	Bailer	Bailer		
Four Well Volumes (gallons) (E x 4)	3.03	9.57		
Actual Volume Removed	4.5	10.5		

DEVELOPMENT PARAMETER

Temperature °C before/after	19.3/19.8/19.8/20.1	20.2/19.8/19.7/19.7		
Specific Conductance (µmhos)	1565/1640/1541/163	2088/3270/3330/3280		
pH (su)	7.66/7.18/7.05/7.02	.46/7.02/6.98/6.96		

REMARKS:

DEVELOPMENT PERSONNEL: T. F. Keowen

REMARKS:
ft bls - feet below land surface
ft bmp - feet below measuring point
(1) - Feet referenced to NGVD
µmhos/cm - micromhos per centimeter
su - standard units

General Well Casing Volumes

Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.
1 1/4"	= 0.077	2"	= 0.16	3"	= 0.37	4"	= 0.65
1 1/2"	= 0.10	2 1/2"	= 0.24	3 1/2"	= 0.50	6"	= 1.46

RUST ENVIRONMENT & INFRASTRUCTURE

MONITOR WELL DEVELOPMENT RECORD

CLIENT: Waste Management of Louisiana, Inc.
LOCATION: Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

PROJECT NO.: 32711.100
DEVELOPMENT DATE: 05/22/96

GENERAL WELL DATA

Monitor Well ID	PZ-17A	PZ-17B	PZ-17C	PZ-17D
Date Installed	05/21/96	05/21/96	05/21/96	05/21/96
Well Construction	PVC	PVC	PVC	PVC
Well Diameter (inches)	0.75	0.75	0.75	0.75
Original Well Depth (ft bls)	37.24	42.84	53.62	59.17
Screened Interval (ft bls)	37.24 - 36.24	42.84 - 41.84	53.62 - 52.62	59.17 - 58.17

WATER LEVEL DATA

Description of Measuring Point (MP)	Top of Casing	Top of Casing	Top of Casing	Top of Casing
Height of MP Below Land Surface (feet)	1.76	1.47	1.58	1.53
MP Elevation (feet)(1)	65.07	64.58	64.50	64.44
Sounded Depth of Well (feet)(A)	39.00	44.31	55.20	60.70
Depth to Water/Hydrocarbon (ft bmp)(B)	11.76	11.48	17.41	17.29
Water Column in Well (feet) (A - B = C)	27.24	32.83	37.79	43.41
Gallons per Foot (see Note)(D)	0.02	0.02	0.02	0.02
Gallons in Well (C x D = E)	0.54	0.66	0.76	0.87

WELL DEVELOPMENT DATA

Time	13:00	13:45	14:30	15:15
Method	Stainless Steel Bailer	Stainless Steel Bailer	Stainless Steel Bailer	Stainless Steel Bailer
Four Well Volumes (gallons) (E x 4)	2.16	2.64	3.04	3.48
Actual Volume Removed	2.2	2.7	3.0	3.0

REMARKS:

DEVELOPMENT PERSONNEL: B. Bailey

REMARKS:

ft bls - feet below land surface
bmp - feet below measuring point
(1) - Feet referenced to NGVD
µmhos/cm - micromhos per centimeter
su - standard units

General Well Casing Volumes

Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.
1 1/4"	= 0.077	2"	= 0.16	3"	= 0.37	4"	= 0.65
1 1/2"	= 0.10	2 1/2"	= 0.24	3 1/2"	= 0.50	6"	= 1.46

RUST ENVIRONMENT & INFRASTRUCTURE

MONITOR WELL DEVELOPMENT RECORD

CLIENT: Waste Management of Louisiana, Inc.
LOCATION: Magnolia Sanitary Landfill
Nested Piezometer Installation
Monroe, Louisiana

PROJECT NO.: 32711.100
DEVELOPMENT DATE: 05/22/96

GENERAL WELL DATA

Monitor Well ID	PZ-18A	PZ-18B	PZ-18C	PZ-18D
Date Installed	05/22/96	05/22/96	05/22/96	05/22/96
Well Construction	PVC	PVC	PVC	PVC
Well Diameter (inches)	0.75	0.75	0.75	0.75
Original Well Depth (ft bls)	19.53	35.74	53.23	65.29
Screened Interval (ft bls)	19.53 - 18.53	35.74 - 34.74	53.23 - 52.23	65.29 - 64.29

WATER LEVEL DATA

Description of Measuring Point (MP)	Top of Casing	Top of Casing	Top of Casing	Top of Casing
Height of MP Below Land Surface (feet)	1.57	1.76	0.97	1.46
MP Elevation (feet)(1)	58.38	58.56	57.78	58.07
Sounded Depth of Well (feet)(A)	21.10	37.50	54.20	66.75
Depth to Water/Hydrocarbon (ft bmp)(B)	5.28	9.55	9.38	9.84
Water Column in Well (feet) (A - B = C)	15.82	27.95	44.82	56.91
Gallons per Foot (see Note)(D)	0.02	0.02	0.02	0.02
Gallons in Well (C x D = E)	0.32	0.56	0.90	1.14

WELL DEVELOPMENT DATA

Time	16:05	17:10	18:00	19:10
Method	Stainless Steel Bailer	Stainless Steel Bailer	Stainless Steel Bailer	Stainless Steel Bailer
Four Well Volumes (gallons) (E x 4)	1.28	2.24	3.60	4.56
Actual Volume Removed	1.5	2.5	3.0	3.0

REMARKS:

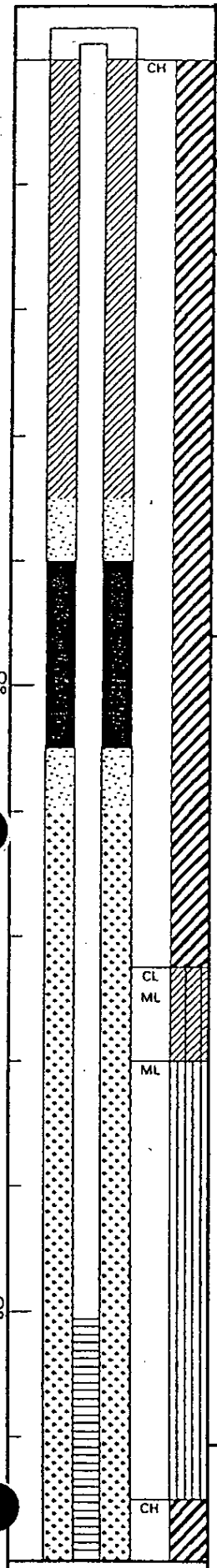
DEVELOPMENT PERSONNEL: B. Bailey

REMARKS:

ft bls - feet below land surface
bmp - feet below measuring point
(1) - Feet referenced to NGVD
µmhos/cm - micromhos per centimeter
su - standard units

General Well Casing Volumes

Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.	Casing Diam.	Gal/ft.
1 1/4"	= 0.077	2"	= 0.16	3"	= 0.37	4"	= 0.65
1 1/2"	= 0.10	2 1/2"	= 0.24	3 1/2"	= 0.50	6"	= 1.46



T.D. = 24.0 FT.

WELL NUMBER: PZ-10
BORING NO. X-REF: B-PZ-10

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 3546.76
E 4834.93

SURFACE ELEVATION: 63.02 N.G.V.D.
TOP OF CASING ELEV: 66.34 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 24.0'
BOREHOLE DIAMETER: 8.0"
CASING STICK-UP: 3.32'
DRILLER: Singley Construction Company

RIG: Mobile B-57
BIT(S): Hollow Stem Auger

DRILLING FLUID: Not Used

PROTECTIVE CASING: Anodized Aluminum

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	1/30/96	08:30	1/30/96	13:00
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:				
BENTONITE SEAL:				
DEVELOPMENT:	2/10/96	15:40	2/10/96	16:30
COMPLETION:	1/30/96	13:00	1/30/96	13:45

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-3.32 / 19.0	C1	66.34 / 44.0
20.0 / 24.0	S1	43.0 / 39.0
/		/
/		/
/		/

C1: 2" dia., Sch. 40 PVC, Flush Threaded, Tri-Lock
S1: 2" dia., Sch. 40 PVC, Flush Threaded, 0.010" Slot, Tri-Lock

FILTER PACK: 24.0 - 12.0: 20/40 Silica Sand

FINE SAND: 12.0 - 11.0 Sugar Sand; 8.0 - 7.0 Sugar Sand

GROUT SEAL: 5% Cement/bentonite - 7' to Ground Surface

BENTONITE SEAL: 8 - 11 Bentonite Pellets

PIEZOMETER DEVELOPMENT:

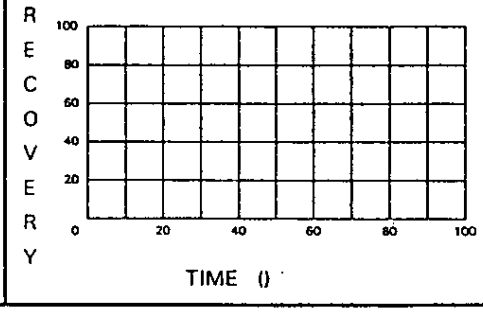
Piezometer PZ-10 was developed by bailing. 7 gallons (approximately 5 well volumes) were removed.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)
15:40	8.21	5060	20.2
15:50	7.67	5490	20.2
16:00	7.62	6580	19.2
16:30	7.62	6310	19.2

RECOVERY DATA:

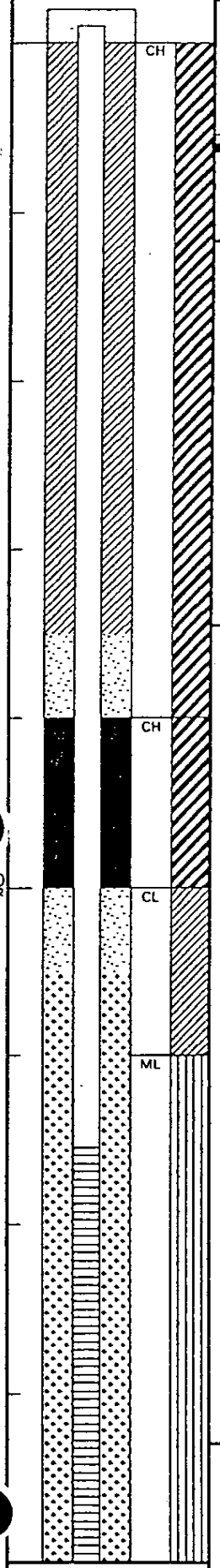
Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

SUPERVISED BY: Tom Keowen
CHK'D BY: LMO



T.D. = 18.0 FT.

WELL NUMBER: PZ-11

BORING NO. X-REF: B-PZ-11

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2506.19
E 3873.09

SURFACE ELEVATION: 63.17 N.G.V.D.
TOP OF CASING ELEV: 66.30 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 18.0'
BOREHOLE DIAMETER: 8.0"
CASING STICK-UP: 3.13'
DRILLER: Singley Construction Company

RIG: Mobile B-57
BIT(S): Hollow Stem Auger

DRILLING FLUID: Not Used

PROTECTIVE CASING: Anodized Aluminum

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	1/30/96	14:30	1/30/96	15:30
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:				
BENTONITE SEAL:				
DEVELOPMENT:	2/10/96	08:30	2/10/96	09:00
COMPLETION:	1/30/96	15:30	1/30/96	16:00

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-3.13 / 13.0	C1	66.30 / 50.2
13.0 / 18.0	S1	50.2 / 45.2
/		/
/		/
/		/

C1: 2" dia., Sch. 40 PVC, Flush Threaded, Tri-Lock
S1: 2" dia., Sch. 40 PVC, Flush Threaded, 0.010" Slot, Tri-Lock

FILTER PACK: 18.0 - 11.0: 20/40 Silica Sand

FINE SAND: 11.0 - 10.0 Sugar Sand; 8.0 - 7.0 Sugar Sand

GROUT SEAL: 5% Cement/bentonite - 6' to Ground Surface

BENTONITE SEAL: 8 - 11 Bentonite Pellets

PIEZOMETER DEVELOPMENT:

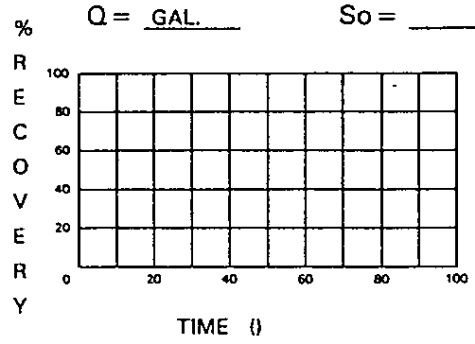
Piezometer PZ-11 was developed by bailing. 2.5 gallons (approximately 6 well volumes) were removed.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)
08:30	7.19	1517	19.7
08:45	7.17	1527	19.8
09:00	7.12	1530	19.4

RECOVERY DATA:

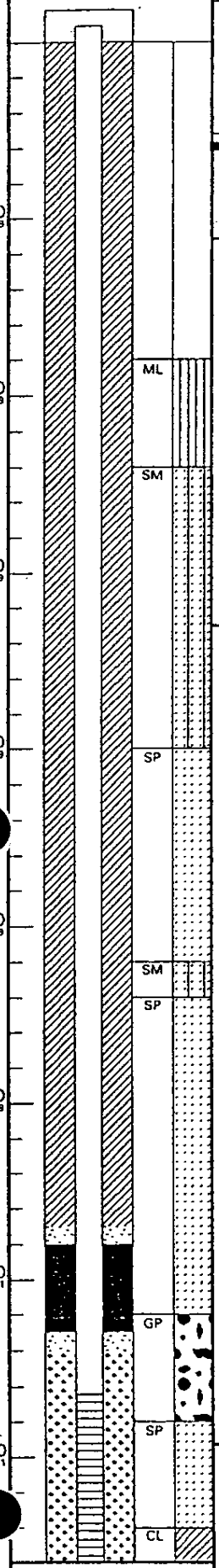
Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

SUPERVISED BY: Tom Keowen
CHK'D BY:



T.D. = 86.0 FT.

WELL NUMBER: PZ-12

BORING NO. X-REF: B-PZ-12

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2512.50 E 3894.51

SURFACE ELEVATION: 62.92 N.G.V.D.

TOP OF CASING ELEV: 65.94 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 86.0'

BOREHOLE DIAMETER: 8.0"

CASING STICK-UP: 3.02'

DRILLER: Singley Construction Company

RIG: Failing 36

BIT(S): Hollow Stem Auger

DRILLING FLUID: Water

PROTECTIVE CASING: Anodized Aluminum

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	2/6/96	16:00	2/6/96	15:30
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:				
BENTONITE SEAL:				
DEVELOPMENT:	2/10/96	09:15	2/12/96	16:30
COMPLETION:	2/8/96	15:30	2/8/96	17:30

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C = CASING S = SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-3.02 / 76.0	C1	65.94 / -13.1
76.0 / 86.0	S1	-13.1 / -23.1
/		/
/		/
/		/

C1: 2" dia., Sch. 40 PVC, Flush Threaded, Tri-Lock

S1: 2" dia., Sch. 40 PVC, Flush Threaded, 0.010" Slot, Tri-Lock

FILTER PACK: 86.0 - 74.0: 20/40 Silica Sand

FINE SAND: 74.0 - 73.0 Sugar Sand; 68.0 - 67.0 Sugar Sand

GROUT SEAL: 5% Cement/bentonite - 67' to Ground Surface

BENTONITE SEAL: 68 - 73 Bentonite Pellets

PIEZOMETER DEVELOPMENT:

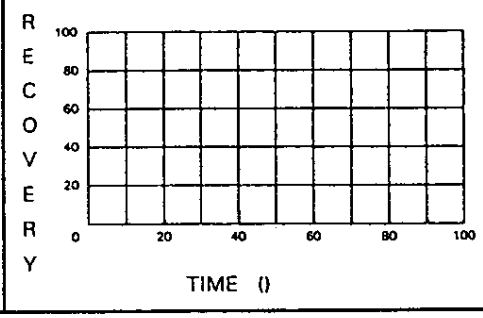
Piezometer PZ-12 was developed by bailing. 45 gallons (approximately 4.2 well volumes) were removed.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)
09:15	7.19	729	17.8
09:40	7.80	745	17.3
10:30	7.82	769	19.3

RECOVERY DATA:

Q = GAL. So = _____



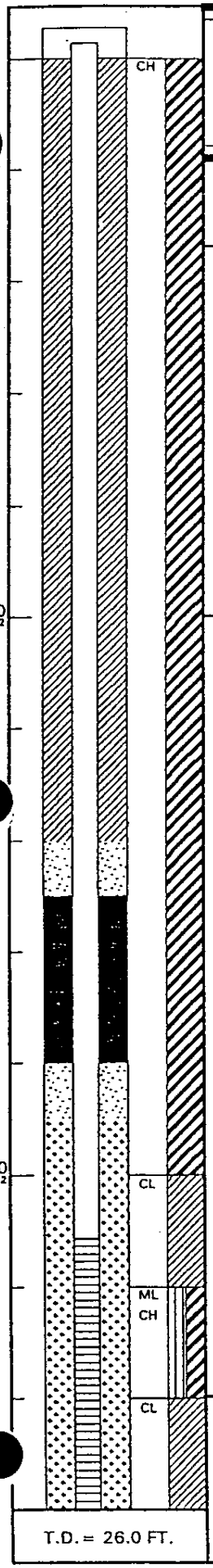
COMMENTS:

SITE NAME: Magnolia Sanitary Landfill

LOCATION: Monroe, Louisiana

SUPERVISED BY: Tom Keowen

CHK'D BY: LAD



WELL NUMBER: PZ-14

BORING NO. X-REF: B-PZ-14

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2614.41 E 2127.17

SURFACE ELEVATION: 60.15 N.G.V.D.

TOP OF CASING ELEV: 63.38 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 26.0'

BOREHOLE DIAMETER: 8.0"

CASING STICK-UP: 3.23'

DRILLER: Singley Construction Company

RIG: Mobile B-57

BIT(S): Hollow Stem Auger

DRILLING FLUID: Not Used

PROTECTIVE CASING: Anodized Aluminum

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	1/30/96	14:30	1/30/96	17:15
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:				
BENTONITE SEAL:				
DEVELOPMENT:	2/10/96	10:40	2/10/96	11:30
COMPLETION:	2/1/96	07:00	2/1/96	08:30

SITE NAME: Magnolia Sanitary Landfill

LOCATION: Monroe, Louisiana

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-3.23 / 21.0	C1	63.38 / 39.2
21.0 / 26.0	S1	39.2 / 34.2

C1: 2" dia., Sch. 40 PVC, Flush Threaded, Tri-Lock

S1: 2" dia., Sch. 40 PVC, Flush Threaded, 0.010" Slot, Tri-Lock

FILTER PACK: 26.0 - 19.0: 20/40 Silica Sand

FINE SAND: 19.0 - 18.0 Sugar Sand; 15.0 - 14.0 Sugar Sand

GROUT SEAL: 5% Cement/bentonite - 14' to Ground Surface

BENTONITE SEAL: 15 - 18 Bentonite Pellets

PIEZOMETER DEVELOPMENT:

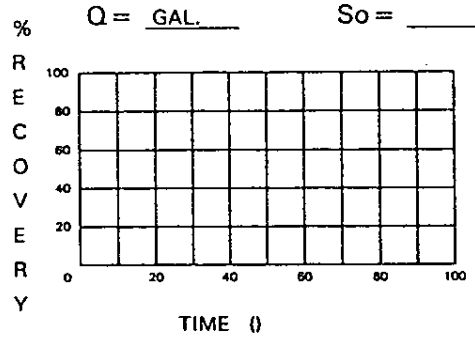
Piezometer PZ-14 was developed by bailing. Recovery of this piezometer was slow. 7 gallons (approximately 3.1 well volumes) were removed.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)
10:40	7.12	3950	19.8
11:00	7.02	2930	19.5
11:30	6.98	3090	19.8

RECOVERY DATA:

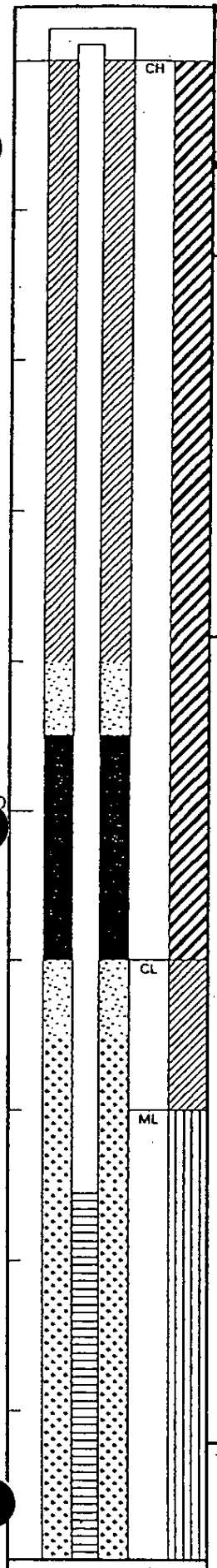
Q = GAL. So = _____



COMMENTS:

SUPERVISED BY: Tom Keowen

CHK'D BY: [illegible]



T.D. = 20.0 FT.

WELL NUMBER: PZ-15

BORING NO. X-REF: B-PZ-15

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2651.28
E 1204.15

SURFACE ELEVATION: 63.05 N.G.V.D.
TOP OF CASING ELEV: 66.13 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 20.0'
BOREHOLE DIAMETER: 8.0"
CASING STICK-UP: 3.08'
DRILLER: Singley Construction Company

RIG: Mobile B-57
BIT(S): Hollow Stem Auger

DRILLING FLUID: Not Used

PROTECTIVE CASING: Anodized Aluminum

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	2/5/96	13:00	2/5/96	15:00
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:				
BENTONITE SEAL:				
DEVELOPMENT:	2/5/96	11:50	2/5/96	12:30
COMPLETION:	2/5/96	15:00	2/5/96	16:00

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-3.08 / 15.0	C1	66.13 / 48.1
15.0 / 20.0	S1	48.1 / 43.1
/		/
/		/
/		/

C1: 2" dia., Sch. 40 PVC, Flush Threaded, Tri-Lock
S1: 2" dia., Sch. 40 PVC, Flush Threaded, 0.010" Slot, Tri-Lock

FILTER PACK: 20.0 - 13.0: 20/40 Silica Sand

FINE SAND: 13.0 - 12.0 Sugar Sand; 9.0 - 8.0 sugar Sand

GROUT SEAL: 5% Cement/bentonite - 8' to Ground Surface

BENTONITE SEAL: 9 - 12 Bentonite Pellets

PIEZOMETER DEVELOPMENT:

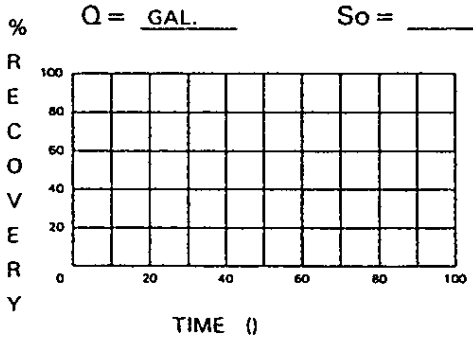
Piezometer PZ-15 was developed by bailing. 4.5 gallons (approximately 5.9 well volumes) were removed.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)
11:50	7.66	1565	19.3
12:00	7.18	1640	19.8
12:15	7.05	1541	19.8
12:30	7.02	1637	20.1

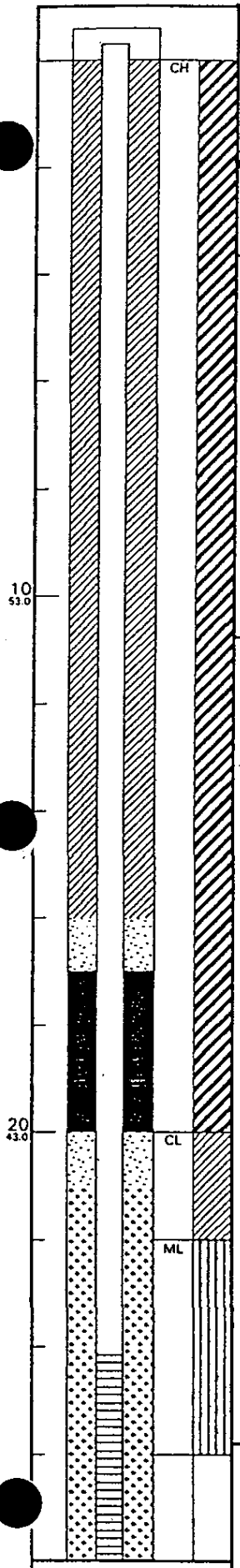
RECOVERY DATA:

Q = GAL. So = _____



COMMENTS:

SUPERVISED BY: Tom Keowen
CHK'D BY: [illegible]



T.D. = 28.0 FT.

WELL NUMBER: PZ-16

BORING NO. X-REF: B-PZ-16

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 4216.38, E 640.85

SURFACE ELEVATION: 63.00 N.G.V.D.

TOP OF CASING ELEV: 66.39 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 28.0'

BOREHOLE DIAMETER: 8.0"

CASING STICK-UP: 3.39'

DRILLER: Singley Construction Company

RIG: Mobile B-57

BIT(S): Hollow Stem Auger

DRILLING FLUID: Not Used

PROTECTIVE CASING: Anodized Aluminum

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	2/6/96	07:30	2/6/96	09:30
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:				
BENTONITE SEAL:				
DEVELOPMENT:	2/10/96	13:00	2/10/96	13:45
COMPLETION:	2/6/96	09:30	2/6/96	10:15

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-3.39 / 23.0	C1	66.39 / 40.0
23.0 / 28.0	S1	40.0 / 35.0
/		/
/		/
/		/

C1: 2" dia., Sch. 40 PVC, Flush Threaded, Tri-Lock

S1: 2" dia., Sch. 40 PVC, Flush Threaded, Tri-Lock

FILTER PACK: 28.0 - 21.0: 20/40 Silica Sand

FINE SAND: 21.0 - 20.0 Sugar Sand; 17.0 - 16.0 Sugar Sand

GROUT SEAL: 5% Cement/bentonite - 16' to Ground Surface

BENTONITE SEAL: 17 - 20 Bentonite Pellets

PIEZOMETER DEVELOPMENT:

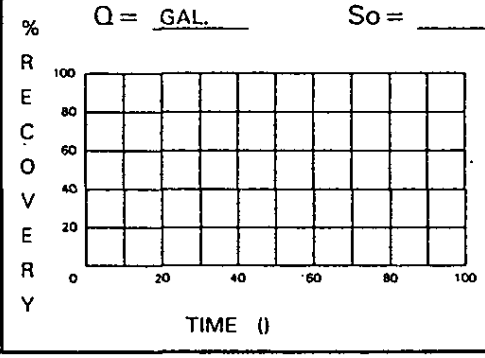
Piezometer PZ-16 was developed by bailing. 10.5 gallons (approximately 4.4 well volumes) were removed.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)
13:00	7.46	2088	20.2
13:15	7.02	3270	19.8
13:33	6.98	3330	19.7
13:45	6.96	3280	19.7

RECOVERY DATA:

Q = GAL. So = _____



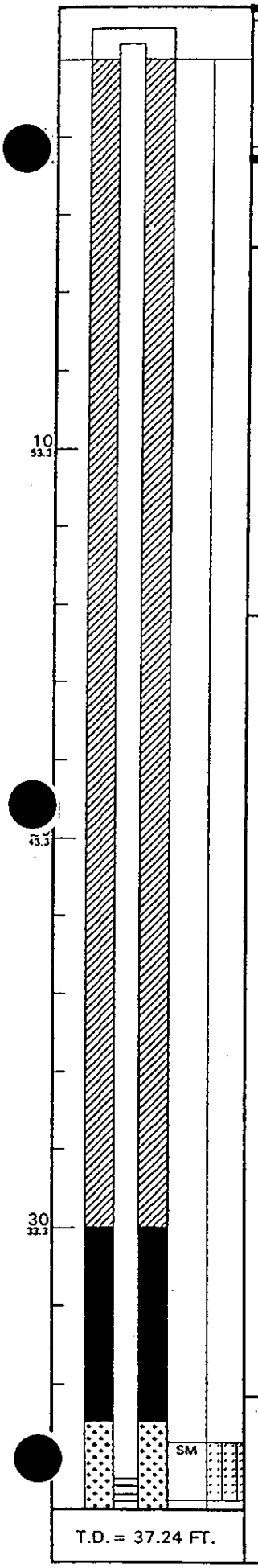
COMMENTS:

SITE NAME: Magnolia Sanitary Landfill

LOCATION: Monroe, Louisiana

SUPERVISED BY: Tom Keowen

CHK'D BY: LAO



WELL NUMBER: PZ-17A
BORING NO. X-REF: BPZ-17A

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2500.51
E 3883.46

SURFACE ELEVATION: 63.30 N.G.V.D.
TOP OF CASING ELEV: 65.07 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 37.24'
BOREHOLE DIAMETER: 4.0"
CASING STICK-UP: 1.77'
DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive
BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/21/96	08:30	05/21/96	08:45
GEOPHYS,LOGGING:				
CASING:				
FILTER PLACEMENT:	05/21/96	08:45	05/21/96	09:00
BENTONITE SEAL:	05/21/96	16:45	05/21/96	16:55
DEVELOPMENT:	05/22/96	13:00	05/22/96	13:40

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-1.77 / 36.24	C1	65.07 / 27.1
36.24 / 37.24	S1	27.1 / 26.1
/		/
/		/
/		/

C1: 4 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock
S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 37.0 - 35.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 30.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 35.0 - 30.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

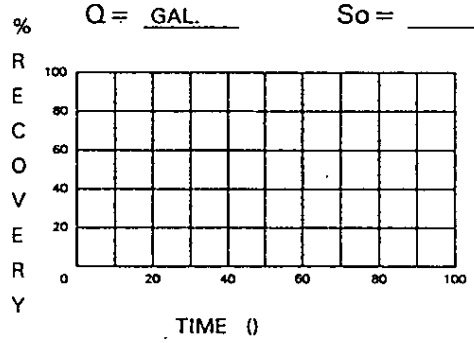
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 2.2 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

RECOVERY DATA:

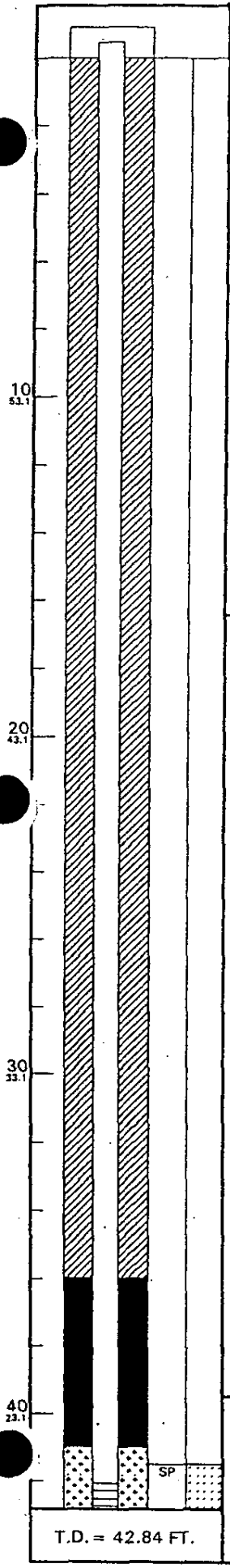
Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

SUPERVISED BY: Bobby Bailey
CHK'D BY:



WELL NUMBER: PZ-17B

BORING NO. X-REF: BPZ-17B

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2498.40
E 3894.24

SURFACE ELEVATION: 63.10 N.G.V.D.
TOP OF CASING ELEV: 64.58 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 42.84'
BOREHOLE DIAMETER: 4.0"
CASING STICK-UP: 1.48'
DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive
BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/21/96	09:05	05/21/96	09:15
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:	05/21/96	09:20	05/21/96	09:30
BENTONITE SEAL:	05/21/96	16:55	05/21/96	17:05
DEVELOPMENT:	05/22/96	13:45	05/22/96	14:25

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-1.48 / 41.84	C1	64.58 / 21.3
41.84 / 42.84	S1	21.3 / 20.3
/		/
/		/
/		/

C1: 5 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock
S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 43.0 - 41.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 36.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 41.0 - 36.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

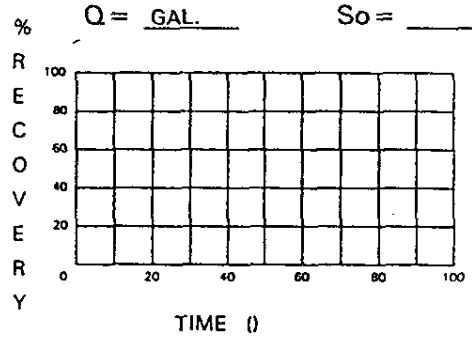
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 2.7 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

RECOVERY DATA:

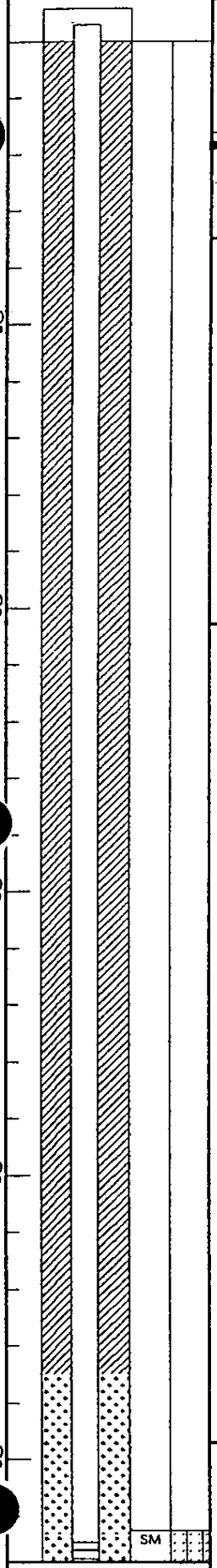
Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

SUPERVISED BY: Bobby Bailey
CHK'D BY: _____



T.D. = 53.62 FT.

WELL NUMBER: PZ-17C

BORING NO. X-REF: BPZ-17C

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2497.50
E 3905.17

SURFACE ELEVATION: 62.90 N.G.V.D.
TOP OF CASING ELEV: 64.50 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 53.62'
BOREHOLE DIAMETER: 4.0"
CASING STICK-UP: 1.60'
DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive
BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/21/96	09:40	05/21/96	09:55
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:	05/21/96	09:55	05/21/96	10:10
BENTONITE SEAL:	05/21/96	17:05	05/21/96	17:15
DEVELOPMENT:	05/22/96	14:30	05/22/96	15:10

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-1.60 / 52.62	C1	64.50 / 10.3
52.62 / 53.62	S1	10.3 / 9.3
/		/
/		/
/		/

C1: 6 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock
S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 54.0 - 52.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 47.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 52.0 - 47.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

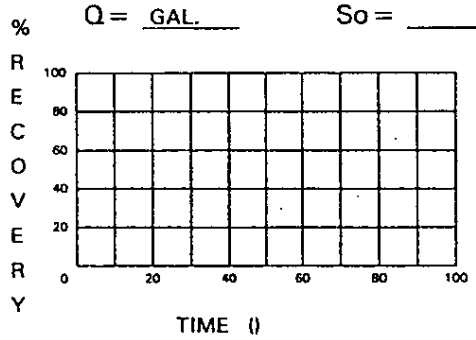
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 3.0 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

RECOVERY DATA:

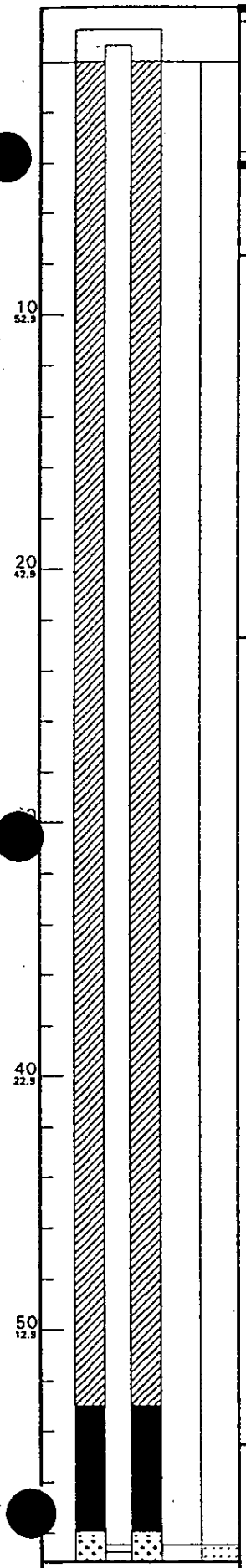
Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

SUPERVISED BY: Bobby Bailey
CHK'D BY:



WELL NUMBER: PZ-17D

BORING NO. X-REF: BPZ-17D

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 2497.66
E 3917.26

SURFACE ELEVATION: 62.90 N.G.V.D.
TOP OF CASING ELEV: 64.44 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 59.17'
BOREHOLE DIAMETER: 4.0"
CASING STICK-UP: 1.54'
DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive
BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/21/96	10:15	05/21/96	10:40
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:	05/21/96	10:45	05/21/96	11:20
BENTONITE SEAL:	05/21/96	17:15	05/21/96	17:30
DEVELOPMENT:	05/22/96	15:15	05/22/96	15:55

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-1.54 / 58.17	C1	64.44 / 4.7
58.17 / 59.17	S1	4.7 / 3.7
/		/
/		/
/		/

C1: 7 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock
S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 60.0 - 58.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 53.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 58.0 - 53.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

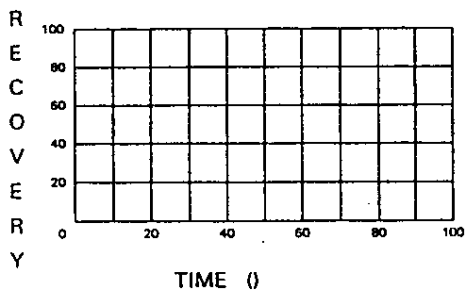
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 3.0 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

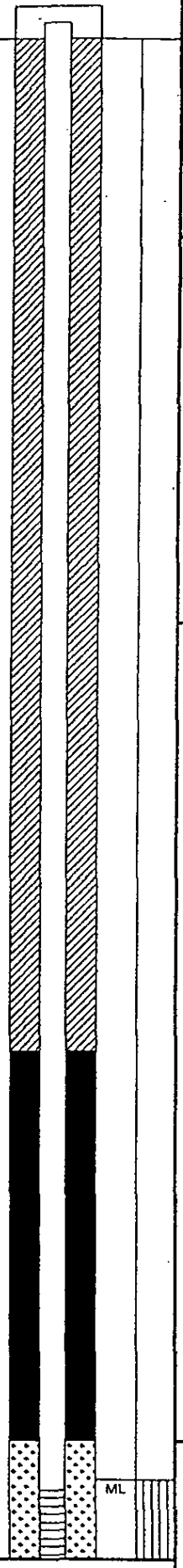
RECOVERY DATA:

Q = GAL. So = _____



COMMENTS:

SUPERVISED BY: Bobby Bailey
CHK'D BY: LAO



T.D. = 19.53 FT.

WELL NUMBER: PZ-18A
BORING NO. X-REF: BPA-18A

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 3079.15
E 1220.62

SURFACE ELEVATION: 56.80 N.G.V.D.
TOP OF CASING ELEV: 58.38 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 19.53'
BOREHOLE DIAMETER: 4.0"
CASING STICK-UP: 1.58'
DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive
BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/22/96	07:05	05/22/96	07:20
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:	05/22/96	07:20	05/22/96	07:30
BENTONITE SEAL:	05/22/96	11:00	05/22/96	11:10
DEVELOPMENT:	05/22/96	16:05	05/22/96	17:00

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-1.58 / 18.53	C1	58.38 / 38.3
18.53 / 19.53	S1	38.3 / 37.3
/		/
/		/
/		/

C1: 2 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock
S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 20.0 - 18.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 13.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 18.0 - 13.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

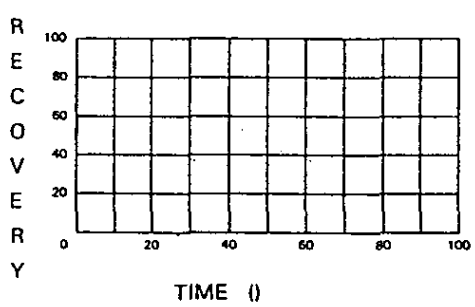
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 1.5 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

RECOVERY DATA:

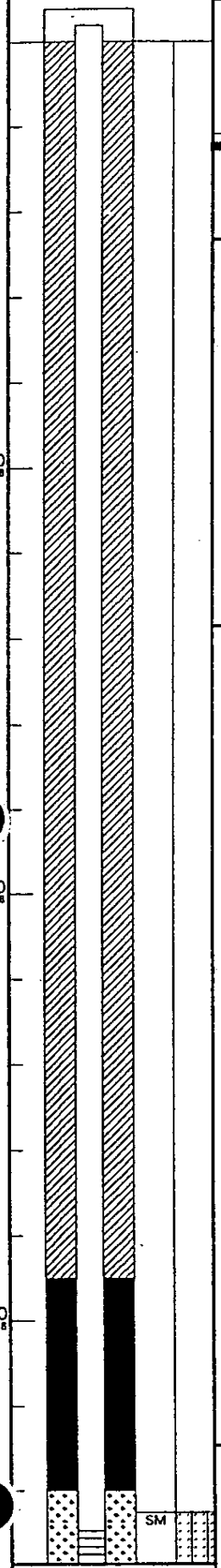
Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

SUPERVISED BY: Bobby Bailey
CHK'D BY: [illegible]



T.D. = 35.74 FT.

WELL NUMBER: PZ-18B

BORING NO. X-REF: BPZ-18B

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 3076.96
E 1233.38

SURFACE ELEVATION: 56.80 N.G.V.D.
TOP OF CASING ELEV: 58.56 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 35.74'
BOREHOLE DIAMETER: 4.0"
CASING STICK-UP: 1.76'
DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive
BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/22/96	07:30	05/22/96	07:40
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:	05/22/96	07:40	05/22/96	07:50
BENTONITE SEAL:	05/22/96	11:10	05/22/96	11:25
DEVELOPMENT:	05/22/96	17:10	05/22/96	17:55

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-1.76 / 34.74	C1	58.56 / 22.1
34.74 / 35.74	S1	22.1 / 21.1
/		/
/		/
/		/

C1: 4 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock
S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 36.0 - 34.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 29.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 34.0 - 29.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

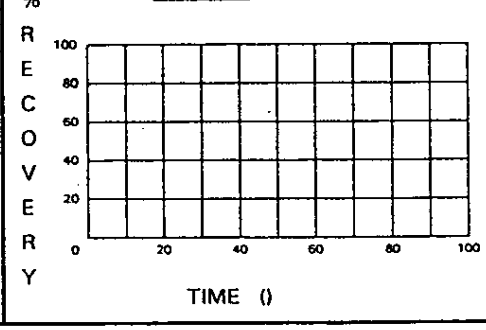
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 2.5 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

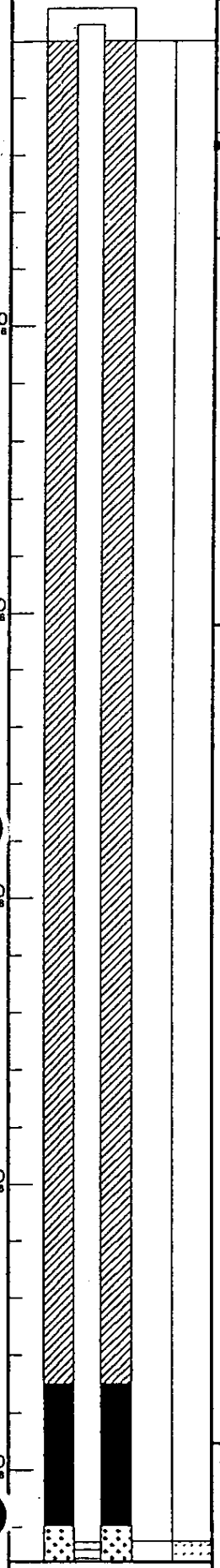
RECOVERY DATA:

Q = GAL. So = _____



COMMENTS:

SUPERVISED BY: Bobby Bailey
CHK'D BY: [illegible]



WELL NUMBER: PZ-18C
BORING NO. X-REF: BPZ-18C

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 3075.51
E 1246.00

SURFACE ELEVATION: 56.80 N.G.V.D.
TOP OF CASING ELEV: 57.78 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 53.23'
BOREHOLE DIAMETER: 4.0"
CASING STICK-UP: 0.98'
DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive
BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/22/96	07:50	05/22/96	08:05
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:	05/22/96	08:05	05/22/96	08:15
BENTONITE SEAL:	05/22/96	11:25	05/22/96	11:35
DEVELOPMENT:	05/22/96	18:00	05/22/96	19:00

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-0.98 / 52.23	C1	57.78 / 4.6
52.23 / 53.23	S1	4.6 / 3.6
/		/
/		/
/		/

C1: 6 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock
S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 54.0 - 52.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 47.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 52.0 - 47.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

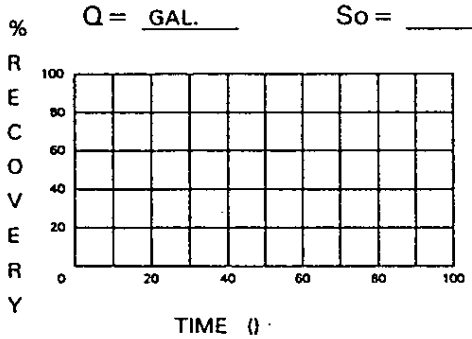
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 3.0 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

RECOVERY DATA:

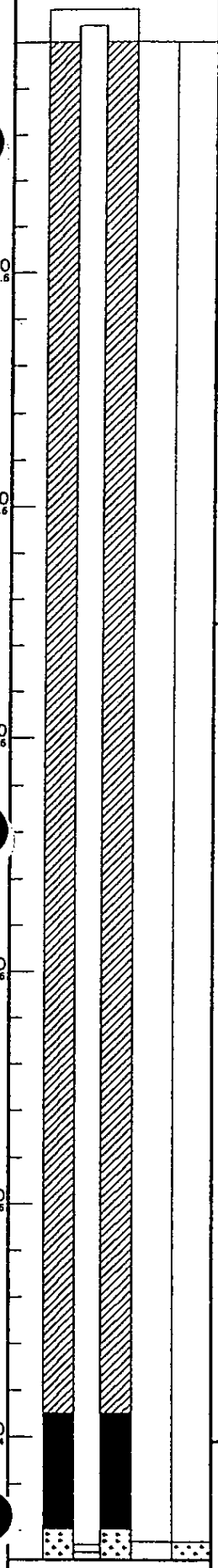
Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill
LOCATION: Monroe, Louisiana

SUPERVISED BY: Bobby Bailey
CHK'D BY:



WELL NUMBER: PZ-18D

BORING NO. X-REF: BPZ-18D

PIEZOMETER CONSTRUCTION SUMMARY

SURVEY COORDS: N 3073.90 E 1258.90

SURFACE ELEVATION: 56.60 N.G.V.D.

TOP OF CASING ELEV: 58.07 N.G.V.D.

DRILLING SUMMARY:

TOTAL DEPTH: 65.29'

BOREHOLE DIAMETER: 4.0"

CASING STICK-UP: 1.47'

DRILLER: Anderson Engineering, Inc. - J. Johnson

RIG: Hilyard Top Drive

BIT(S): 4" Drag Bit

DRILLING FLUID: Water

PROTECTIVE CASING: 4.25" I.D. Steel

CONSTRUCTION TIME LOG:

TASK:	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:	05/22/96	08:25	05/22/96	08:55
GEOPHYS.LOGGING:				
CASING:				
FILTER PLACEMENT:	05/22/96	08:55	05/22/96	09:05
BENTONITE SEAL:	05/22/96	11:35	05/22/96	11:45
DEVELOPMENT:	05/22/96	19:10	05/22/96	20:00

WELL DESIGN & SPECIFICATIONS

BASIS: GEOLOGIC LOG ☒ GEOPHYSICAL LOG ☐

CASING STRING(S): C=CASING S=SCREEN

DEPTH (ft)	STRINGS(S)	ELEVATION (ft N.G.V.D.)
-1.47 / 64.29	C1	58.07 / -7.7
64.29 / 65.29	S1	-7.7 / -8.7
/		/
/		/
/		/

C1: 7 10-ft. x 0.75" I.D. Sch. 80 PVC, Flush Threaded, Tri-Lock

S1: 1 1-ft. x 0.75" I.D. Sch. 80 PVC, (0.02-inch slot)

FILTER PACK: 66.0 - 64.0: 10/20 Silica Sand

FINE SAND:

GROUT SEAL: 59.0 - 2.0 Bentonite Slurry

BENTONITE SEAL: 64.0 - 59.0 1/8" Bentonite Pellets

PIEZOMETER DEVELOPMENT:

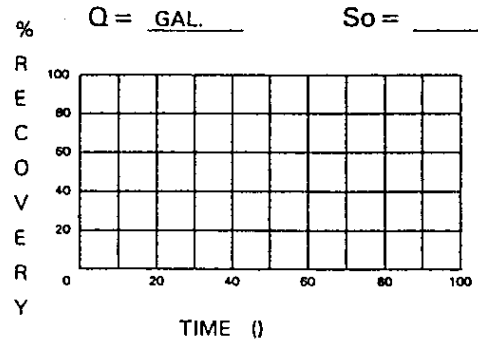
Well development accomplished by 0.5" O.D. Stainless Steel bailer. Approximately 3.0 gallons were removed from the well.

STABILIZATION TEST DATA:

TIME	pH	SPEC. COND.	TEMP. (°F)

RECOVERY DATA:

Q = GAL. So = _____



COMMENTS:

SITE NAME: Magnolia Sanitary Landfill

LOCATION: Monroe, Louisiana

SUPERVISED BY: Bobby Bailey

CHK'D BY: KB

PIEZOMETER REGISTRATION FORMS

DENMON ENGINEERING COMPANY, INC.

Engineers and Surveyors

Terry D. Denmon, P.E. & P.L.S.
Terry W. Lewis, P.E.
Thomas M. Bonnette, P.E.
Chris W. Patrick, P.E.

PIEZOMETER/MONITORING WELL OBSERVATION
MAGNOLIA SANITARY LANDFILL MONROE, LA

PIEZOMETER MONITOR WELL NO.	TOC ELEV. (NGVD)	PIEZOMETER MONITOR WELL NO.	TOC ELEV. (NGVD)
MW01	66.19	MW02	66.02
MW03	65.89	MW04	63.51
MW05	65.13	MW06	65.97
MW07	66.15	MW08	65.39
MW09	65.50	PZ10	66.34
PZ11	66.30	PZ12	65.94
PZ14	63.38	PZ15	66.13
PZ16	66.39	PZ17A	65.07
PZ17B	64.58	PZ17C	64.50
PZ17D	64.44	PZ18A	58.38
PZ18B	58.56	PZ18C	57.78
PZ18D	58.07		

The above elevations represent findings surveyed between May 30, 1996 and June 4, 1996 under my direct supervision and are true and accurate to the best of my knowledge and belief.

STATE OF LOUISIANA
TERRY D. DENMON
REG. No. 4323
REGISTERED
LAND SURVEYOR

TERRY D. DENMON, P.L.S. #4323

Mail To: P.O. Box 8460, Monroe, Louisiana 71211 • Telephone (318) 388-1422
Ship To: 3016 Cameron Street, Monroe, Louisiana 71201 • FAX (318) 361-5036

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

RECEIVED
SEP 15 1993

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
   ☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ HEAT PUMP SUPPLY
   ☐ HEAT PUMP HOLE ☐ ABANDONED PILOT HOLE ☒ OTHER Piezometer (please specify)
2. WELL OWNER Waste Management PHONE (318) 343-5636
3. ADDRESS PO. Box 13467 Monroe, LA 71213-3467
4. OWNER'S WELL NUMBER OR NAME (If any) P-1
5. DATE COMPLETED 7.15.93 DEPTH OF HOLE 19' FT., DEPTH OF WELL 18.8 FT.
6. STATIC WATER LEVEL _____ FT. BELOW GROUND SURFACE MEASURED ON _____ (Date)
7. CASING 1¼ IN. ☐ STEEL OR ☒ PVC SCH. 40 LENGTH 14 FT.
8. SCREEN 1¼ IN. ☐ STEEL OR ☒ PVC SCH. 40 SLOT SIZE .010 LENGTH 5 FT.
9. CEMENTED FROM 8.4 FT. TO GROUND SURFACE, USING ☐ PUMP-DOWN METHOD OR ☒ GRAVITY METHOD
10. LOCATION OF WELL: PARISH _____ WELL IS NEAR, _____ (Town or City)
    APPROXIMATELY 5 MILES FROM East from Monroe (Crossroads, Railroad, Any Landmark, etc.)
    (Please draw sketch on back of Original)
11. REMARKS: Magnolia Landfill
12. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	11	Tan Lt. Tan Clay	0	13.8	CH
11	19	Tan Sandy Clay	13.8	19	CL

13. FOR HEAT PUMP HOLES ONLY: AVG. DEPTH _____ FT., NUMBER OF HOLES _____
    TUBING MATERIAL ☐ PVC, ☐ PE, ☐ PB, ☐ OTHER _____
14. ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☐

(REV. 11/85)

OWNER'S COPY

CCI Environmental Drilling
Name of Water Well Contractor

LICENSE NUMBER WWC-320

Authorized Signature [signature] Date 8/17/93

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN: CHIEF — WATER RESOURCES SECTION
P. O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

STATE 22 (1–2) PARISH (3–5) LOCAL WELL NO. – (6–11)
IDENTIFICATION NUMBER 3128510920003 (12–26)
OWNER'S NAME (27–41)
WELL DEPTH (42–45) Ft. Use of Well (46) (47–48)
Date Completed MO. YR. (49–52)
OWNER'S NO. (53–56) Geologic Unit (57–64)
CONTRACTOR'S NAME
SECTION 7 TOWNSHIP 17N RANGE 5E
HOLE DEPTH 19 ELEV. QUAD. NO.

Inspected By _____
Date _____
Remarks _____

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
   [ ] DOMESTIC [ ] RIG SUPPLY [X] MONITORING [ ] HEAT PUMP SUPPLY
   [ ] HEAT PUMP HOLE [ ] ABANDONED PILOT HOLE [ ] OTHER Piezometer (please specify)
2. WELL OWNER Waste Management PHONE (318) 343-5636
3. ADDRESS P.O. Box 13467 Monroe, LA 71213-3467
4. OWNER'S WELL NUMBER OR NAME (If any) P-2
5. DATE COMPLETED 7-16-93 DEPTH OF HOLE 15' FT., DEPTH OF WELL 13.8 FT.
6. STATIC WATER LEVEL N/A FT. BELOW GROUND SURFACE MEASURED ON N/A (Date)
7. CASING 1 1/4 IN. [ ] STEEL OR [X] PVC SCH. 40 LENGTH 8.8 FT.
8. SCREEN 1 1/4 IN. [ ] STEEL OR [X] PVC SCH. 40 SLOT SIZE .010 LENGTH 5 FT.
9. CEMENTED FROM 3.4 FT. TO GROUND SURFACE, USING [ ] PUMP-DOWN METHOD OR [X] GRAVITY METHOD
10. LOCATION OF WELL: PARISH _____ WELL IS NEAR, Monroe (Town or City)
    APPROXIMATELY 5 MILES FROM Monroe (Crossroads, Railroad, Any Landmark, etc.)
    (Please draw sketch on back of Original)
11. REMARKS: Magnolia Landfill
12. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	6	CH			
6	10	CL			
10	15	SM			

13. FOR HEAT PUMP HOLES ONLY: AVG. DEPTH _____ FT., NUMBER OF HOLES _____
    TUBING MATERIAL [ ] PVC, [ ] PE, [ ] PB, [ ] OTHER _____
14. ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES [ ] NO [ ]

(REV. 11/85)

OWNER'S COPY

CCI Environmental Drilling
Name of Water Well Contractor

LICENSE NUMBER WWC-320

Authorized Signature _____ Date 8/17/93

MAIL ORIGINAL TO:

LOUISIANA DEPARTMENT OF
TRANSPORTATION AND DEVELOPMENT
ATTN: CHIEF — WATER RESOURCES SECTION
P. O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

STATE 22 (1–2) PARISH (3–5) LOCAL WELL NO. – (6–11)
IDENTIFICATION NUMBER 3128410915947 (12–26)
OWNER'S NAME (27–41)
WELL DEPTH (42–45) Ft. Use of Well (46, 47–48)
Date Completed MO. YR. (49–52)
OWNER'S NO. (53–56) Geologic Unit (57–64)
CONTRACTOR'S NAME
SECTION 7 TOWNSHIP 17N RANGE 5E
HOLE DEPTH 15 ELEV. QUAD. NO.

Inspected By _____
Date _____
Remarks _____

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-15)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
   ☐ DOMESTIC ☐ RIG SUPPLY ☐ MONITORING ☐ HEAT PUMP SUPPLY
   ☐ HEAT PUMP HOLE ☐ ABANDONED PILOT HOLE ☒ OTHER Piezometer (please specify)
2. WELL OWNER Waste Management PHONE (318) 343-5636
3. ADDRESS PO Box 13467 Monroe, LA. 71213-3467
4. OWNER'S WELL NUMBER OR NAME (If any) P-3
5. DATE COMPLETED July 15, 1993 DEPTH OF HOLE 20' FT., DEPTH OF WELL 198' FT.
6. STATIC WATER LEVEL _____ FT. BELOW GROUND SURFACE MEASURED ON _____ (Date)
7. CASING 1¼ IN. ☐ STEEL OR ☒ PVC SCH. 40 LENGTH 148 FT.
8. SCREEN 1¼ IN. ☐ STEEL OR ☒ PVC SCH. 40 SLOT SIZE .010 LENGTH 5 FT.
9. CEMENTED FROM 148 FT. TO GROUND SURFACE, USING ☐ PUMP-DOWN METHOD OR ☒ GRAVITY METHOD
10. LOCATION OF WELL: PARISH _____ WELL IS NEAR Monroe (Town or City)
    APPROXIMATELY 5 MILES FROM Monroe (Crossroads, Railroad, Any Landmark, etc.)
    (Please draw sketch on back of Original)
11. REMARKS: Magnolia Landfill
12. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	16	CH			
16	20	CL			

13. FOR HEAT PUMP HOLES ONLY: AVG. DEPTH _____ FT., NUMBER OF HOLES _____
    TUBING MATERIAL ☐ PVC, ☐ PE, ☐ PB, ☐ OTHER _____
14. ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒

(REV. 11/85)

OWNER'S COPY

CCI Environmental Drilling
Name of Water Well Contractor

LICENSE NUMBER WWC- 320

Authorized Signature _____ Date 8/17/93

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN: CHIEF — WATER RESOURCES SECTION
P. O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

STATE 22 (1–2) PARISH (3–5) LOCAL WELL NO. – (6–11)
IDENTIFICATION NUMBER 3128410915949 (12–26)
OWNER'S NAME (27–41)
WELL DEPTH (42–45) Ft. Use of Well (46, 47–48)
Date Completed MO. YR. (49–52)
OWNER'S NO. (53–56) Geologic Unit (57–64)
CONTRACTOR'S NAME
SECTION 7 TOWNSHIP 17N RANGE 5E
HOLE DEPTH 20 ELEV. QUAD. NO.

Inspected By _____
Date _____
Remarks _____

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☐ MONITORING ☒ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)
2. WELL OWNER Waste Management of LA. PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O. Box 13467 / 1000 Russell Sage Rd. Monroe, LA 71213
4. OWNER'S WELL NUMBER OR NAME (If any) B-PZ-10
5. DATE COMPLETED 1-30-96 DEPTH OF HOLE 24 FT. DEPTH OF WELL 24 FT.
6. STATIC WATER LEVEL 15 FT. BELOW GROUND SURFACE MEASURED ON 2-27-96 (Date)
7. CASING 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 14 FT.
8. SCREEN 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 10 FT.
9. CEMENTED FROM 8 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH OUACHITA WELL IS NEAR, Monroe (Town or City)
APPROXIMATELY 1 MILES FROM I-20 (Crossroads, Railroad, Any Landmark, etc.)
(Please draw sketch on back of Original)
11. REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	5	Soft Dark Brown Clay	15	20	Reddish Brown very
		trace silt			Clayey silt - very fine micaceous
5	10	Dark Gray, Sand absent	20	24	Stiff dark reddish
		Ferrous Stain Common			Brown Clay wet
10	15	medium reddish			Some very fine gravel
		Brown -			Sand

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____
ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒
NAME OF PERSON WHO DRILLED THE WELL: Timmy Beam

(REV. 7/93) CONTRACTOR'S COPY

Singley Construction Co. Inc
Name of Water Well Contractor
LICENSE NUMBER WWC-469
Gary Phillips 3-6-96
Authorized Signature Date

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH 073 WELL NO. -57682
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of We
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: _____ DATE: _____
INSPECTED BY: _____ DATE: _____
REMARKS: _____

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 322836 LONGITUDE 915926
SECTION 07 TOWNSHIP 17N RANGE 5E
ELEV. 6598 QUAD. NO. 46B
SITE ADDRESS: 1000 Russell Sage Rd.
Monroe, LA 71213

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☐ MONITORING ☒ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Waste Management of LA PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS POB 13467 1000 Russell Sage Rd Monroe, LA 71213
4. OWNER'S WELL NUMBER OR NAME (If any) B-PZ-11
5. DATE COMPLETED 1-30-96 DEPTH OF HOLE 18 FT. DEPTH OF WELL 18 FT.
6. STATIC WATER LEVEL 16 FT. BELOW GROUND SURFACE MEASURED ON 2-27-96 (Date)
7. CASING 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 13 FT.
8. SCREEN 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 5 FT.
9. CEMENTED FROM 7 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, Monroe (Town or City)
APPROXIMATELY 1 MILES FROM I-20 (Crossroads, Railroad, Any Landmark, etc.)
(Please draw sketch on back of Original)

REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	5	Medium Stiff Clay			
5	10	Medium gray Clay			
10	15	Medium stiff Brown			
15	18	Brown Clayey Silt			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒

NAME OF PERSON WHO DRILLED THE WELL: Tommy Beach

(REV. 7/93) CONTRACTOR'S COPY

Singley Construction Co Inc
Name of Water Well Contractor
LICENSE NUMBER WWC-469
Gary P Hill 3-6-96
Authorized Signature Date

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF
TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH 073 WELL NO. -5769Z
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 322826 LONGITUDE 915938
SECTION 07 TOWNSHIP 17N RANGE R5E
ELEV. 56.28 QUAD. NO. 46B
SITE ADDRESS: 1000 Russell Sage Rd.
Monroe, LA 71213

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☐ MONITORING ☒ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Waste Management of LA. PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O.B. 13467 - 1000 Russell Sage Rd Monroe LA 71213
4. OWNER'S WELL NUMBER OR NAME (If any) B-PZ-12
5. DATE COMPLETED 2-8-96 DEPTH OF HOLE 84 FT. DEPTH OF WELL 84 FT.
6. STATIC WATER LEVEL 15 FT. BELOW GROUND SURFACE MEASURED ON 2-27-96 (Date)
7. CASING 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 74 FT.
8. SCREEN 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 10 FT.
9. CEMENTED FROM 68 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH OUACHITA WELL IS NEAR, MONROE (Town or City)
APPROXIMATELY 1 MILES FROM I-20 (Crossroads, Railroad, Any Landmark, etc.)
(Please draw sketch on back of Original)

11. REMARKS:

12. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	5	medium stiff dark Brown Clay - Calcareous nodules	30	35	medium Brown sand Fine mica common
5	10	Medium gray clay	35	40	medium greenish gray loose very Fine
10	15	Calcareous nodules rare medium stiff Brown	40	50	medium gray sand trace Coarse gravel sand
15	20	medium reddish Brown Clayey Silt very Fine sand	50	60	Dense medium gray sand trace well rounded
20	25	Dark Brown silty sand wet very Fine	60	70	medium dark gray sand gravel common
25	30	Dark Brown sand very Fine - Fine mica	70	84	medium poorly graded Gravel - Medium grained sand

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION; DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒

NAME OF PERSON WHO DRILLED THE WELL: Timmy Beach

(REV. 7/93) CONTRACTOR'S COPY

Sivley Construction Co Inc
Name of Water Well Contractor
LICENSE NUMBER WWC-469
Authorized Signature: Gary P Hill Date: 3-6-96

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH 073 WELL NO. -5770Z
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 322826 LONGITUDE 915937
SECTION 07 TOWNSHIP 17N RANGE R5E
ELEV. 6588 QUAD. NO. 46B
SITE ADDRESS: 1000 Russell Sage Rd, Monroe, LA 71213

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHEET FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☐ MONITORING ☒ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Waste Management of LA PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O.B. 13467 - 1000 Russell Sage Rd Monroe LA 71213
4. OWNER'S WELL NUMBER OR NAME (if any) B-PZ-14
5. DATE COMPLETED 2-1-96 DEPTH OF HOLE 26 FT. DEPTH OF WELL 26 FT.
6. STATIC WATER LEVEL 11 FT. BELOW GROUND SURFACE MEASURED ON 2-27-96 (Date)
7. CASING 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 21 FT.
8. SCREEN 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 5 FT.
9. CEMENTED FROM 15 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, Monroe (Town or City)
APPROXIMATELY 1 MILES FROM I-20 (Crossroads, Railroad, Any Landmark, etc.)

(Please draw sketch on back of Original)

REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	5	medium Stiff Clay	20	25	gray and medium
5	10	medium Brown and			reddish Brown Silty
		medium gray			Clay - Becoming more
10	15	medium gray - Dark			silty wet
		reddish Brown	25	26	Medium gray - reddish
15	20	medium gray, Blocky			Brown clayey silt

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒

NAME OF PERSON WHO DRILLED THE WELL: Timmy Beach

(REV. 7/93) CONTRACTOR'S COPY

Singley Construction Co Inc
Name of Water Well Contractor

LICENSE NUMBER WWC-469

Gary P Hill 3-6-96
Authorized Signature Date

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH 073 WELL NO. -57712
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 322827 LONGITUDE 715958
SECTION 07 TOWNSHIP 17N RANGE R5E
ELEV. 532 QUAD. NO. 46B
SITE ADDRESS: 1000 Russell Sage Rd, Monroe, LA 71213

WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☐ MONITORING ☒ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Waste Management of LA. PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O.B. 13467 - 1000 Russell Sage Rd Monroe LA 71213
4. OWNER'S WELL NUMBER OR NAME (if any) B-PZ-15
5. DATE COMPLETED 2-5-96 DEPTH OF HOLE 20 FT. DEPTH OF WELL 20 FT.
6. STATIC WATER LEVEL 14 FT. BELOW GROUND SURFACE MEASURED ON 2-27-96 (Date)
7. CASING 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 15 FT.
8. SCREEN 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 5 FT.
9. CEMENTED FROM 9 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH OUACHITA WELL IS NEAR, MONROE (Town or City)
APPROXIMATELY 1 MILES FROM I-20 (Crossroads, Railroad, Any Landmark, etc.)
(Please draw sketch on back of Original)
11. REMARKS:
12. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	5	medium siff dark	10	15	medium siff Brown
		Brown Clay - Nodules			Silty clay damp Medium
		Common			Brown clayey silt
5	10	Very Stiff - Trace Very	15	20	medium Brown Clayey
		Fine to Fine grained			Silt - Trace very
		Clear - Medium Red			Fine grained sand

13. FOR HEAT PUMP ONLY: AVG DEPTH _____ FT. NUMBER OF HOLES _____
14. ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒
15. NAME OF PERSON WHO DRILLED THE WELL: Timmy Beach

(REV. 7/93)

CONTRACTOR'S COPY

Singley Construction Co Inc
Name of Water Well Contractor
LICENSE NUMBER WWC-469
Gary P Hill 3-6-96
Authorized Signature Date

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH 073 WELL NO. -5772Z
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 322828 LONGITUDE 920009
SECTION 07 TOWNSHIP 17N RANGE R5E
ELEV. 6605 QUAD. NO. 46B
SITE ADDRESS: 1000 Russell Sage Rd.
Monroe, LA 71213

TOTAL P.07

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHEET FORM (DOTD-GW-1S)

EASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
   - ☐ DOMESTIC ☐ RIG SUPPLY ☐ MONITORING ☒ PIEZOMETER ☐ RECOVERY
   - ☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)
2. WELL OWNER Waste Management of Lay PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O. Box 13467 - 1000 Russell Sage Rd. Monroe LA 71213
4. OWNER'S WELL NUMBER OR NAME (if any) B-PZ-16
5. DATE COMPLETED 2-6-96 DEPTH OF HOLE 28.0 FT. DEPTH OF WELL 28.0 FT.
6. STATIC WATER LEVEL 13 FT. BELOW GROUND SURFACE MEASURED ON 2-27-96 (Date)
7. CASING 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 23 FT.
8. SCREEN 2 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 5 FT.
9. CEMENTED FROM 17 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH OUACHITA WELL IS NEAR, MONROE (Town or City)
    APPROXIMATELY 1 MILES FROM I-20 (Crossroads, Railroad, Any Landmark, etc.)

(Please draw sketch on back of Original)

REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	5	Dark Brown Clay Stiff, dark Brown	25	28	trace Fine mica Flake
5	10	medium stiff reddish Brown and medium gray			very Fine grained sand
10	15	Calcareous nodules are rootlets, absent-Dark reddish			
15	20	medium gray, Blocky			
20	25	medium gray medium Reddish Brown			
		Silty Clay wet Becoming more silty with depth			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒

NAME OF PERSON WHO DRILLED THE WELL: Timmy Beach

(REV. 7/93)

CONTRACTOR'S COPY

Singley Construction Co Inc
Name of Water Well Contractor

LICENSE NUMBER WWC- 469

Gary D Hill 3-6-96
Authorized Signature Date

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

PARISH 073 WELL NO. -5773Z

IDENTIFICATION NUMBER 0

REVISED COORDINATES

Geologic Unit

SECTION TOWNSHIP RANGE

ELEV. QUAD. NO.

Use of Well

INPUT BY: _____ DATE: _____

INSPECTED BY: _____ DATE: _____

REMARKS: _____

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY

LATITUDE 322843 LONGITUDE 920015

SECTION 07 TOWNSHIP 17N RANGE R5E

ELEV. 6645 QUAD. NO. 46B

SITE ADDRESS: 1000 Russell Sage Rd. Monroe, LA 71213

BEST COPY OF THE NEXT 9 PAGES

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

COPY

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Magnolia Sanitary RDF PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O. Box 13467 / Monroe, LA 71213-2467
4. OWNER'S WELL NUMBER OR NAME (if any) PZ-17A
5. DATE COMPLETED 05/21/96 DEPTH OF HOLE 37 FT. DEPTH OF WELL 37 FT.
6. STATIC WATER LEVEL 18 FT. BELOW GROUND SURFACE MEASURED ON 05/23/96 (Date)
7. CASING .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 36 FT.
8. SCREEN .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 1 FT.
9. CEMENTED FROM 35 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, [illegible] (Town or City)
APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)
(Please draw sketch on back of Original)
11. REMARKS:
12. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	Medium Stiff Clay			
10	12	Silty Clay			
12	24	Clayey Silt			
24	37	Silty Sand			

13. FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____
14. ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? ☐ YES ☒ NO
15. NAME OF PERSON WHO DRILLED THE WELL J. Johnson

(REV. 7/93) OWNER'S COPY

Name of Water Well Contractor: [illegible] Consultants, Inc
LICENSE NUMBER WWC-399
Authorized Signature [signature] Date 06/27/96

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH WELL NO.
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 32 28 27 LONGITUDE 91 59 38
SECTION 07 TOWNSHIP 17N RANGE 05E
ELEV. 00265 QUAD. NO. 0350
SITE ADDRESS: P.O. Box 13467 Monroe, LA 71213-2467

LOUISIANA DEPARTMENT OF TRANSPO TION AND DEVELOPMENT
WATER RESOURCE CTION
WATER WELL REGISTRATION SH ORM (DOTD-GW-1S)

COPY

ASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Magnolia Sanitary RDF PHONE (318) 343-5636

3. WELL OWNER'S ADDRESS P.O. Box 13467/Monroe, LA 71213-3467

4. OWNER'S WELL NUMBER OR NAME (if any) PZ-17B

5. DATE COMPLETED 05/21/96 DEPTH OF HOLE 43 FT. DEPTH OF WELL 43 FT.

6. STATIC WATER LEVEL 17 FT. BELOW GROUND SURFACE MEASURED ON 05/23/96 (Date)

7. CASING .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 46 FT.

8. SCREEN .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 1 FT.

9. CEMENTED FROM 46 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD

10. LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, Magnolia Landfill (Town or City)

APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)

(Please draw sketch on back of Original)

REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	Medium Stiff Clay			
10	12	Silty Clay			
12	24	Clayey Silt			
24	43	Silty Sand			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☒

NAME OF PERSON WHO DRILLED THE WELL J. Johnson

(REV. 7/93) OWNER'S COPY

Anderson Engineering Consultants, Inc.
Name of Water Well Contractor

LICENSE NUMBER WWC-399

[signature] 06/27/96
Authorized Signature Date

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

PARISH WELL NO.

IDENTIFICATION NUMBER

REVISED COORDINATES

Geologic Unit

Use of Well

SECTION TOWNSHIP RANGE

ELEV. QUAD. NO.

INPUT BY: DATE:

INSPECTED BY: DATE:

REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY

LATITUDE 32 28 27 LONGITUDE 91 59 38

SECTION 09 TOWNSHIP 17N RANGE 05E

ELEV. 0065 QUAD. NO. 0350

SITE ADDRESS: P.O. Box 13467
Monroe, LA 71213-3467

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

COPY

USE OF WELL (Check Appropriate Box)

☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

WELL OWNER: Magnolia Sanitary RDF PHONE (318) 343-5636

WELL OWNER'S ADDRESS: P.O. Box 13467 / Monroe, LA 71213-3467

OWNER'S WELL NUMBER OR NAME (if any): MP2-IFC

DATE COMPLETED: 05/21/96 DEPTH OF HOLE: 54 FT. DEPTH OF WELL: 54 FT.

STATIC WATER LEVEL: 17 FT. BELOW GROUND SURFACE MEASURED ON: 05/28/96 (Date)

CASING: .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH: 56 FT.

SCREEN: .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE: .010 LENGTH: 1 FT.

CEMENTED FROM: 51 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD

LOCATION OF WELL: PARISH: Ouachita WELL IS NEAR: Magnolia Landfill (Town or City)

APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)

(Please draw sketch on back of Original)

REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	Medium Stiff Clay			
10	12	Silty Clay			
12	24	Clayey Silt			
24	54	Silty Sand			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☑

NAME OF PERSON WHO DRILLED THE WELL: J. Johnson

(REV. 7/93) OWNER'S COPY

Anderson Engineering Consultants, Inc.
Name of Water Well Contractor

LICENSE NUMBER: WWC-399

Authorized Signature: [signature] Date: 06/27/96

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

PARISH WELL NO.

IDENTIFICATION NUMBER

REVISED COORDINATES

Geologic Unit

Use of Well

SECTION TOWNSHIP RANGE

ELEV. QUAD. NO.

INPUT BY: DATE:

INSPECTED BY: DATE:

REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY

LATITUDE: 322864 LONGITUDE: 915938

SECTION: 007 TOWNSHIP: 17N RANGE: 05E

ELEV.: 0065 QUAD. NO.: 035D

SITE ADDRESS: P.O. Box 13467
Monroe, LA 71213-3467

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

COPY

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

USE OF WELL (Check Appropriate Box)

☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

WELL OWNER: Magnolia Sanitary RDF PHONE (318) 343-5636
WELL OWNER'S ADDRESS: P.O. Box 13467 / Monroe LA 71213-3467
OWNER'S WELL NUMBER OR NAME (if any): PZ-17D
DATE COMPLETED: 05/21/96 DEPTH OF HOLE: 59 FT. DEPTH OF WELL: 59 FT.
STATIC WATER LEVEL: 17 FT. BELOW GROUND SURFACE MEASURED ON: 05/23/96 (Date)
CASING: .025 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH: 46 FT.
SCREEN: .025 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE: .010 LENGTH: 1 FT.
CEMENTED FROM: 58 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
LOCATION OF WELL: PARISH: Ouachita WELL IS NEAR: Magnolia Landfill (Town or City)
APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)
(Please draw sketch on back of Original)
REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	Medium Stiff Clay			
10	12	Silty Clay			
12	24	Clayey Silt			
24	59	Silty Sand			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____
ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☑
NAME OF PERSON WHO DRILLED THE WELL: J. Johnson

(REV. 7/93) OWNER'S COPY

Anderson Engineering Consultants, Inc.
Name of Water Well Contractor
LICENSE NUMBER: WWC-399
Authorized Signature: [signature] Date: 06/27/96

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH WELL NO.
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE: 322827 LONGITUDE: 915938
SECTION: 007 TOWNSHIP: 17N RANGE: 05E
ELEV.: 0064 QUAD. NO.: 035D
SITE ADDRESS: P.O. Box 13467
Monroe, LA 71213-3467

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

COPY

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Magnolia Sanitary RDF PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O. Box 13467 Monroe, LA 71213-3467
4. OWNER'S WELL NUMBER OR NAME (if any) PZ-18 A
5. DATE COMPLETED 05/22/96 DEPTH OF HOLE 20 FT. DEPTH OF WELL 20 FT.
6. STATIC WATER LEVEL 10 FT. BELOW GROUND SURFACE MEASURED ON 05/23/96 (Date)
7. CASING 025 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 16 FT.
8. SCREEN 025 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE 010 LENGTH 1 FT.
9. CEMENTED FROM 18 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
10. LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, Magnolia Landfill (Town or City)

APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)

(Please draw sketch on back of Original)

11. REMARKS:

12. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	Fat Clay			
10	12	Silty Clay			
12	20	Clayey Silt			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____
ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☑
NAME OF PERSON WHO DRILLED THE WELL: J.T. Johnson

(REV. 7/93)

OWNER'S COPY

Anderson Engineering Const, Inc
Name of Water Well Contractor
LICENSE NUMBER WWC-399
Authorized Signature Date 06/27/96

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH WELL NO.
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 322833 LONGITUDE 920009
SECTION 007 TOWNSHIP 17N RANGE 05E
ELEV. 0058 QUAD. NO. 035D
SITE ADDRESS: PO Box 13467
Monroe, LA 71213-3467

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

COPY

USE OF WELL (Check Appropriate Box)

☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY

☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

WELL OWNER Magnolia Sanitary RDF PHONE (318) 343-5636

WELL OWNER'S ADDRESS P.O. Box 13467 / Monroe, LA 71213-3467

OWNER'S WELL NUMBER OR NAME (if any) PZ-18B

DATE COMPLETED 05/22/96 DEPTH OF HOLE 36 FT. DEPTH OF WELL 36 FT.

STATIC WATER LEVEL 10 FT. BELOW GROUND SURFACE MEASURED ON 05/23/96 (Date)

CASING .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 36 FT.

SCREEN .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 1 FT.

CEMENTED FROM 34 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD

LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, Magnolia, Hardhill (Town or City)

APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)

(Please draw sketch on back of Original)

REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	FAT Clay			
10	12	Silty Clay			
12	24	Clayey Silt			
24	36	Silty Sand			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☑

NAME OF PERSON WHO DRILLED THE WELL: J. Johnson

(REV. 7/93)

OWNER'S COPY

Anderson Engineering Consultants, Inc.
Name of Water Well Contractor

LICENSE NUMBER WWC- 399

Authorized Signature _____ Date 06/27/96

MAIL ORIGINAL TO:

LOUISIANA DEPARTMENT OF
TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

PARISH WELL NO.

IDENTIFICATION NUMBER

REVISED COORDINATES

Geologic Unit Use of Well

SECTION TOWNSHIP RANGE

ELEV. QUAD. NO.

INPUT BY: DATE:

INSPECTED BY: DATE:

REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY

LATITUDE 32 28 33 LONGITUDE 92 00 09

SECTION 007 TOWNSHIP 17N RANGE 05E

ELEV. 0059 QUAD. NO. 0350

SITE ADDRESS: P.O. Box 13467
Monroe, LA 71213-3467

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
WATER RESOURCES SECTION
WATER WELL REGISTRATION SHORT FORM (DOTD-GW-1S)

COPY

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

USE OF WELL (Check Appropriate Box)

☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY

☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

WELL OWNER Magnolia Sanitary RDF PHONE (318) 343-5636

WELL OWNER'S ADDRESS P.O. Box 13469 / Monroe, LA 71213-3467

OWNER'S WELL NUMBER OR NAME (if any) PZ-18C

DATE COMPLETED 05/22/96 DEPTH OF HOLE 53 FT. DEPTH OF WELL 53 FT.

STATIC WATER LEVEL 9 FT. BELOW GROUND SURFACE MEASURED ON 05/23/96 (Date)

CASING .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 56 FT.

SCREEN .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 1 FT.

CEMENTED FROM 55 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD

LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, Magnolia Landfill (Town or City)

APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)

(Please draw sketch on back of Original)

REMARKS:

DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	Fat Clay			
10	12	Silty Clay			
12	24	Clayey Silt			
24	53	Silty Sand			

FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____

ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☑

NAME OF PERSON WHO DRILLED THE WELL: J. Johnson

(REV. 7/93)

OWNER'S COPY

Anderson Engineering Consultants, Inc.
Name of Water Well Contractor

LICENSE NUMBER WWC-399

Authorized Signature _____ Date 06/27/96

MAIL ORIGINAL TO:

LOUISIANA DEPARTMENT OF
TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY

PARISH _____ WELL NO. _____

IDENTIFICATION NUMBER _____ 0 _____

REVISED COORDINATES _____

Geologic Unit _____ Use of Well _____

SECTION _____ TOWNSHIP _____ RANGE _____

ELEV. _____ QUAD. NO. _____

INPUT BY: _____ DATE: _____

INSPECTED BY: _____ DATE: _____

REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY

LATITUDE 322833 LONGITUDE 920009

SECTION 007 TOWNSHIP 17N RANGE 05E

ELEV. 0058 QUAD. NO. 035D

SITE ADDRESS: P.O. Box 13467
Monroe, LA 71213-3467

LOUISIANA DEPARTMENT OF TRANSP[illegible]ATION AND DEVELOPMENT
[illegible] WATER RESOURC[illegible]CTION
WATER WELL REGISTRATION SHO[illegible] FORM (DOTD-GW-1S)

COPY

PLEASE PRINT IN INK OR TYPE WHEN COMPLETING THIS FORM

1. USE OF WELL (Check Appropriate Box)
☐ DOMESTIC ☐ RIG SUPPLY ☒ MONITORING ☐ PIEZOMETER ☐ RECOVERY
☐ HEAT PUMP HOLE ☐ HEAT PUMP SUPPLY ☐ ABANDONED PILOT HOLE ☐ OTHER _____ (Please Specify)

2. WELL OWNER Magnolia Sanitary LDF PHONE (318) 343-5636
3. WELL OWNER'S ADDRESS P.O. Box 13469 / Monroe, LA 71213-3467
4. OWNER'S WELL NUMBER OR NAME (if any) P2-18D
5. DATE COMPLETED 05/22/96 DEPTH OF HOLE 65 FT. DEPTH OF WELL 65 FT.
6. STATIC WATER LEVEL 10 FT. BELOW GROUND SURFACE MEASURED ON 05/23/96 (Date)
7. CASING .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER LENGTH 66 FT.
8. SCREEN .075 IN. ☐ METAL ☒ PLASTIC ☐ OTHER SLOT SIZE .010 LENGTH 1 FT.
9. CEMENTED FROM 65 FT. TO GROUND SURFACE, USING ☒ PUMP DOWN METHOD OR ☐ GRAVITY METHOD
0. LOCATION OF WELL: PARISH Ouachita WELL IS NEAR, Magnolia Landfill (Town or City)
APPROXIMATELY _____ MILES FROM _____ (Crossroads, Railroad, Any Landmark, etc.)
(Please draw sketch on back of Original)
1. REMARKS:
2. DRILLER'S LOG (Description and color of cuttings, such as shale, sand, etc. in feet)

FROM	TO	DESCRIPTION	FROM	TO	DESCRIPTION
0	10	Fat Clay			
10	12	Silty Clay			
12	24	Clayey Silt			
24	65	Silty Sand			

3. FOR HEAT PUMP ONLY: AVG. DEPTH _____ FT. NUMBER OF HOLES _____
4. ABANDONMENT INFORMATION: DOES THE NEW WELL REPLACE AN EXISTING WELL? YES ☐ NO ☑
5. NAME OF PERSON WHO DRILLED THE WELL: J. Johnson

(REV. 7/93)

OWNER'S COPY

Anderson Engineering Consultants, Inc.
Name of Water Well Contractor
LICENSE NUMBER WWC-399
[signature] 06/27/96
Authorized Signature Date

MAIL ORIGINAL TO:
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
ATTN.: CHIEF - WATER RESOURCES SECTION
P.O. BOX 94245
BATON ROUGE, LA 70804-9245
(504) 379-1434

FOR OFFICE USE ONLY
PARISH WELL NO.
IDENTIFICATION NUMBER
REVISED COORDINATES
Geologic Unit
Use of Well
SECTION TOWNSHIP RANGE
ELEV. QUAD. NO.
INPUT BY: DATE:
INSPECTED BY: DATE:
REMARKS:

FOR MONITOR/PIEZO/RECOVERY WELLS ONLY
LATITUDE 322833 LONGITUDE 912007
SECTION 007 TOWNSHIP 17N RANGE 05E
ELEV. 0058 QUAD. NO. 035D
SITE ADDRESS: P.O. Box 13467
Monroe, LA 71213-3467

IN-SITU PERMEABILITY TEST DATA

9/8/93
KW

Magnolia - Rust E&I
ProTech Field Notes

		WL from TOC	Top of Pump	Well Information
1138 ~~MW07~~	MW07	17.59'	33.30'	Well #7
				Elev. —
1149	MW08	15.80'	39.85'	Well #8
				Elev. —
1157	MW09	15.20'	35.35'	Well #9
				Elev. —
1215	MW02	15.55'		
1218	Stop purging MW02			
1226	MW05	15.76'	44.25'	Well # 5
				Elev. 65.89
1236	Purging MW05		16 sec/qt purge rate	
1241	MW05	17.60		
1304	MW05	17.40		
1335	Test #1	6 min → 5gal	WL	17.37'
	#2	6 min → 5gal	WL	~~17.38'~~ 17.37'
	#3	6 min → 5gal	WL	17.38'
	#4	6 min → 5gal	WL	17.38'
	#5	6 min → 5gal	WL	17.39'

9/8/93
KW

Magnolia - Rust

Pro-Tech
293-0136

		WL from TOC	Top of Pump	Well Information
0729	MW01	14.50'	35.20'	Well #1
				Elev. 67.28
0742	Start purging MW01		15sec/qt purge rate	
0933	P-3	14.06'	-	No Info
0939	P-1	16.01'	-	No Info
0947	MW02	14.72'	43.15'	Well #2
				Elev. 66.82
[illegible]9	P-2	10.43'	-	No Info
1015	Stop purging MW01		WL 15.77	
1050	Start purging MW02		16sec/qt purge rate	
1109	MW03	15.61'	31.50'	Well #3
				Elev. 66.93
1120	MW04	13.65'	35.27'	Well #4
				Elev. 64.59
[illegible]9	MW06	16.96'	25.17'	Well #6
				Elev — 66.82

1415	MWO 2	WL 14.57				
	Test #1	6:18 Min	→	5gal	WL	15.20
	#2	6:15 Min	→	5gal	WL	15.35
	#3	6:16 Min	→	5gal	WL	15.35
	#4	6:23 Min	→	5gal	WL	15.33
	#5	6:19 Min	→	5gal	WL	15.33
1509	MWO1	WL 14.46				
	Test #1	4:57 min	→	5gal	WL	15.59
	#2	5:00 min	→	5gal	WL	15.60
	#3	5:03 min	→	5gal	WL	15.64
	#4	5:04 min	→	5gal	WL	15.65
	#5	5:04 min	→	5gal	WL	15.65

FLOWNET REFRACTION CALCULATIONS

RUST **Rust Environment & Infrastructure**

CALCULATION SHEET

PAGE 1 OF 1

PROJECT NO. 32711.100

CLIENT Wst. Mgmt. of LA SUBJECT

Prepared By MDC Date 6/11/96

PROJECT Magnolia Landfill NOD Response

Reviewed By Date

Refraction Angle Calculations

Approved By Date

Assumptions	hydraulic conductivity (K)			Ref.
① Stratum I	2×10^{-8} cm/sec	→	5.67×10^{-5} ft/day	(2/94 Permit Mod)
② Stratum II	7.38×10^{-4} cm/sec.	→	2.09 ft/day	(2/96 field tests)
③ Stratum III	4.1×10^{-3} cm/sec.	→	11.61 ft/day	(2/96 field tests)
④ Stratum III (base)	1.32×10^{-2} cm/sec.	→	37.3 ft/day	(2/96 field tests)
⑤ Stratum IV	5×10^{-9} cm/sec	→	1.42×10^{-5} ft/day	(2/94 Permit Mod)

Calculation of Refraction Angles between Units

Using - $\frac{\tan \theta_1}{\tan \theta_2} = \frac{K_1}{K_2}$

I. Stratum II / Stratum III $= \frac{\tan \theta_1}{\tan \theta_2} = \frac{2.09}{11.61}$

$= \frac{\tan(0.1)}{\tan \theta_2} = 0.18$

$= \tan \theta_2 = 0.0097$

$\theta_2 = 0.56$

II. Stratum III / Stratum IV (base) $= \frac{\tan(0.56)}{\tan \theta_2} = \frac{11.61}{37.3} = 0.31$

$\tan \theta_2 = 0.031$

$\theta_2 = 1.8$

Note III. Stratum I / Stratum II $= \frac{\tan(1)}{\tan \theta_2} = \frac{0.0000567}{2.09}$

$= \tan \theta_2 = 644.09$

$\theta_2 = 89.9$

GEOTECHNICAL TESTING

ATTACHMENT C

SUBCONTRACT LABORATORY TEST SUMMARY SHEETS

ATTACHMENT C.1

LABORATORY TEST RESULTS

PROJECT MAGNOLIA LANDFILL BORINGS

TABLE NO. 1
JOB NO. 93-134-01
DATE 7-5-93

SAMPLES RECEIVED 6/28/93

FOR RUST ENVIRONMENT & INFRASTRUCTURE
RUST JOB 86415.200

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-9	8-10	SILT WITH SAND (ML)	DISTURBED					24		26	23	3	70.5% PASSES 200
	16-18	SILTY CLAY (CL)	0.63			U	YIELD	26	98	39	19	20	
	24-26	FINE SAND WITH SILT (SP)											CURVE ATTACHED
	34-36	SAND AND GRAVEL & TRACE OF SILT (SP)											CURVE ATTACHED
	44-46	SAND AND GRAVEL & TRACE OF SILT (SP)											CURVE ATTACHED
	54-56		SAMPLE NOT RECEIVED										
	73-75	LAMINATED CLAY SHALE (CH)	SAMPLE BROKEN - TOO SHORT FOR STRENGTH & PERM							77	29	48	$K=4.7\times10^{-9}$ DATA ATTACHED
R-11	12-14	CLAY (CH)	1.24			U	MULTI - SHEAR @ 1.7%	44	78	97	33	64	
	22-24	CLAY (CH)	0.89			U	MULTI - SHEAR @ 1.7%	38	84				
	32-34	CLAY (CH)	0.87			U	MULTI - SHEAR @ 2.7%	47	75	93	34	59	
	36.5-38	FINE SAND WITH SILT (SP)											8.6% PASSES 200 SIEVE
	46.5-48	FINE SAND WITH TRACE OF SILT (SP)											CURVE ATTACHED

LABORATORY TEST RESULTS

PROJECT MAGNOLIA LANDFILL BORINGS

FOR RUST ENVIRONMENT & INFRASTRUCTURE
RUST JOB 86415.200

TABLE NO. 2
JOB NO. 93-134-01
DATE 7-5-93

SAMPLES RECEIVED
6/28/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-27	6-8		SAMPLE NOT RECEIVED										
	12-14	CLAY (CH)	1.54			U	MULTI - SHEAR @ 1.3%	46	80	105	31	74	
	22-24	SILTY CLAY (CL)	DISTURBED					32		39	18	21	
	28-30	FINE SAND WITH TRACE OF SILT (SP)											CURVE ATTACHED
	38-40	FINE SAND WITH TRACE OF SILT (SP)											CURVE ATTACHED
	48-50	FINE SAND WITH TRACE OF SILT & SMALL GRAVEL (SP)											CURVE ATTACHED
R-37	8-10	CLAY (CH)	1.05			U	SLICKENSIDE @2.3%	35	86	95	32	63	
	16-18	SILTY FINE SAND TO SANDY SILT (SP-SM)								NON PLASTIC			
	24-26	SILTY FINE SAND (SM)											20.6% PASSES 200
	28-30	SANDY CLAY (CL)								29	21	8	
	30-32	FINE SAND WITH SILT (SP)											9.8% PASSES 200
	38-40	FINE SAND WITH TRACE OF SILT (SP)											CURVE ATTACHED
	48-50	SAND (SP)											CURVE ATTACHED

LABORATORY TEST RESULTS

PROJECT MAGNOLIA SANITARY LANDFILL
MONORE, LOUISIANA

FOR RUST E & I
JOB NO. 86415.200

TABLE NO. 3
JOB NO. 93-134
DATE 8/2/93
SAMPLES RECEIVED
7/22/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-2	4-6	CLAY (CH)	0.91			U	SLS	37	84	74	32	40	
	14-16	SILTY CLAY (CL)	0.91			U	YIELD	24	100	33	20	13	
	20-22	SILTY CLAY (CL)						26		29	19	10	70.8% PASSES #200
	32-34	FINE SAND WITH SILT (SM)						22					CURVE 4
	46-48	FINE SAND WITH SILT (SM)						19		--	NP	--	CURVE 4
R-4	8-10	CLAY (CH)	1.98			U	SLS	32	89	76	27	49	
	18-20	SILT (ML)						27		27	24	3	
	28-30	FINE SAND WITH SILT (SM)						19					CURVE 4
	38-40	FINE SAND WITH SILT (SP)						20					CURVE 4
R-6	8-10	SILT (ML)						24		26	24	2	
	20-22	CLAY (CH)	1.26			U	SLS	26	98	53	23	30	
	34-36	FINE SAND (SP)						21					CURVE 5
	48-50	SAND W/TRACE GRAVEL (SP)						16					CURVE 5

SLS - SLICKENSIDED

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA SANITARY LANDFILL
MONORE, LOUISIANA

FOR RUST E & I
JOB NO. 86415.200

TABLE NO. 4
JOB NO. 93-134
DATE 8/2/93
SAMPLES RECEIVED
7/27/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-17	2-4	CLAY (CH)	2.34			U	SLS	38	84	75	28	47	
	22-24	SILTY CLAY (CL)	DISTURBED					21		27	16	11	
	32-34	ALT 4" LAYERS SAND AND CLAY (SM&CH)						21		--	NP	--	11.6% PASSES #200 (SAND)
	42-44	FINE SAND WITH SILT (SM)						21					CURVE 5
R-19	14-16	CLAY (CH)	0.79			U	SLS	56	68	103	34	69	
	26-28	CLAY (CH)	0.65			U	YIELD	45	74	79	39	40	
	36-38	FINE SAND (SP)						23					CURVE 6
	48-50	FINE SAND (SP)						21					CURVE 6
R-21	8-10	SILTY CLAY (CL)	0.66					27	97	42	19	23	
	12-14	SILTY SAND (SM)						24					66.9% PASSES #200
	24-26	SILT (ML)	DISTURBED					24		25	21	4	
	32-34	FINE SAND (SP)						22					CURVE 6
	46-48	SAND WITH GRAVEL (SP)						12					CURVE 6
R-23	4-6	CLAY (CH)	1.16			U	SLS	40	80	92	36	56	
	14-16	CLAY (CH)								67	19	48	97.4% PASSES #200 PERM 2.48 X 10-8

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

FOR RUST E & I
JOB NO. 86415.200

TABLE NO. 5
JOB NO. 93-134
DATE 8/2/93
SAMPLES RECEIVED
7/27/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-23	28-30	SILTY CLAY (CL)	2.36			U	YIELD	23	105	44	21	23	
	34-36	FINE SAND (SP)						20					CURVE 7
	44-46	FINE SAND WITH SILT (SM)						17					CURVE 7
R-27	6-8	CLAY (CH)	2.10			U	SLS	32	88	87	33	54	
R-29	6-8	CLAY (CH)	1.28			U	SLS	37	83	90	30	60	
	18-20	SILTY SAND (SM)	NON-COHESIVE					23		--	NP	--	
	24-26	SILT (ML)						22		25	22	3	80.9% PASSES #200
	32-34	FINE SAND WITH SILT (SM)						22					CURVE 7
	40-48	FINE SAND (SP)						18					CURVE 7
R-31	8-10	CLAY (CH)	1.22			U	SLS	45	77	88	30	58	
	20-22	CLAY (CH)	1.62			U	YIELD	26	96	59	33	36	
	28-30	SILTY SAND (SM)						25					CURVE 8
	34-36	FINE SAND (SP)						26					CURVE 8
	48-50	FINE SAND (SP)						19					CURVE 8

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

FOR RUST E & I
JOB NO. 86415.200

TABLE NO. 6
JOB NO. 93-134
DATE 8/2/93
SAMPLES RECEIVED
7/27/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-33	10-12	SILTY CLAY (CL)	1.49			U	VERT. SHEAR	25	102	43	21	22	
	18-20	SILT (ML)						21		--	NP	--	67.8% PASSES #200
	26-28	FINE SAND WITH SILT (SM)						21					CURVE 9
	44-46	FINE SAND (SP)						21					CURVE 9
	53-55	SAND WITH SILT (SM)						22					CURVE 9
	63-65	SANDY GRAVEL (GP-GW)						12					CURVE 9
	73-75	SILT (MH)								60	34	26	
R-36	8-10	CLAY (CH)	1.84			U	SLS	33	102	77	30	47	
	14-16	CLAY (CH)	1.06			U	SLS	38	91	54	19	35	
	18-20	SILTY CLAY (CL)						29		30	21	9	
	24-26	SILT (ML)						28					73.3% PASSES #200
	32-34	FINE SAND WITH SILT (SM)						22					CURVE 10
	53-55	FINE SAND (SP)						22					CURVE 10
	68-70	FINE SAND WITH SILT (SM)						22					CURVE 10

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA SANITARY LANDFILL
MONORE, LOUISIANA

FOR RUST E & I
JOB NO. 86415.200

TABLE NO. 7
JOB NO. 93-134
DATE 8/2/93
SAMPLES RECEIVED
7/27/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-39	4-6	CLAY (CH)	1.32			U	SLS	36	85	90	28	62	
	14-16	CLAY (CH)	1.38			U	SLS	32	91	72	26	46	
	24-26	FINE SAND WITH SILT (SM)						23					CURVE 11
	38-40	FINE SAND (SP)						22					CURVE 11
R-41	10-12	CLAY (CH)	1.17			U		26	100	55	20	35	
	18-20	SILTY SAND (SM)						25					CURVE 11
	34-36	FINE SAND WITH SILT (SM)						21					CURVE 11

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

FOR RUST E & I
JOB NO. 86415.200

TABLE NO. 8
JOB NO. 93-134
DATE SAMPLES RECEIVED 8/9/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (KSF) TOTAL	CONFINING PRESSURE (KSF) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-14	20-22	CLAYEY SILT W/SAND (ML)						22		24	19	5	47.1% PASSES #200
	22-24	CLAYEY SAND (SC)						24					41.7% PASSES #200
	32-34	CLAYEY SILT W/SAND (ML)						30		24	17	7	57.3% PASSES #200
R-32	22-24	SILTY FINE SAND (SM)						22					CURVE NO. 12
	38-40	FINE SAND W/SILT (SP)						21					CURVE NO. 12
R-34	18-20	(WAS NOT SENT)											
	22-24	CLAYEY SILT (ML)						22					CURVE NO. 12
	24-26	SILT (ML)								23	21	2	
	28-30	CLAYEY SILT W/SAND (ML)						26		22	19	3	69.9% PASSES #200
	30-32	SILTY SAND W/CLAY (SM)						19					CURVE NO. 12

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA LANDFILL
MONROE, LOUISIANA

FOR RUST E & I
PROJECT 86415.200

TABLE NO. 9
JOB NO. 93-134
DATE
SAMPLES RECEIVED 8/13/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (PSI) TOTAL	CONFINING PRESSURE (PSI) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-5	6-8	CLAY (CH)	0.78			U	SLS*	40	81	79	30	49	
	22-24	SILTY CLAY (CL)	0.56			U	YIELD	27	98	38	16	22	
R-7	6-8	CLAY (CH)	1.46			U	SLS	40	83	77	28	49	
	16-18	SILTY CLAY (CL)	0.69			U	VERTICAL SHEARS	30	100	27	19	8	
R-8	4-6	CLAY (CH)	1.16			U	SLS	42	79	86	30	56	
	18-20	SILTY CLAY (CL)								33	19	14	
R-10	6-8	CLAY (CH)	1.33			U	VERTICAL SHEARS	29	97	53	22	31	
	10-12	SILTY CLAY (CL)								30	18	12	
R-12	16-18	SILTY CLAY (CL)	0.42			U	MULTI SHEAR	25	101	33	18	15	
	30-32	SILTY CLAY W/SAND (CL)								30	16	14	
R-13	6-8	CLAY (CH)	1.25			U	SLS	39	82				
	24-26	SILTY CLAY W/SAND (CL)	0.46			U	YIELD	28	96	32	17	15	
	26-28	SILTY CLAY W/SAND (CL)	0.69			U	YIELD	23	100	32	17	15	
R-20	8-10	CLAY (CH)	1.21			U	SLS	37	84	92	32	60	
	18-20	SILT (ML)	0.53	10		UU		32	87	26	23	3	

*SLICKENSIDED

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA LANDFILL
MONROE, LOUISIANA

FOR RUST E & I
PROJECT 86415.200

TABLE NO. 10
JOB NO. 93-134
DATE SAMPLES RECEIVED 8/13/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS					CLASSIFICATION TESTS					OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	CONFINING PRESSURE (PSI) TOTAL	CONFINING PRESSURE (PSI) EFFECTIVE	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	TYPE AND LOCATION OF RESULTS
R-22	4-6	SILTY CLAY (CL)	1.40			U	YIELD	25	100	36	17	19	
	10-12	SILTY CLAY (CL)								28	20	8	
R-25	6-8	CLAY (CH)	1.07			U	SLS	41	82	74	29	45	
	24-26	SILTY CLAY (CL)	---					28	97	28	15	13	DISTURBED
R-29	18-20	SILTY CLAY (CL)						21					88.3% PASSES #200
R-30	6-8	CLAY (CH)	2.21			U	SLS	33	87	89	33	56	
	16-18	SILT (ML)								24	20	4	
R-35	10-12	CLAY (CH)								92	32	60	2.35×10^{-9}
	34-36	SILTY CLAY (CL)						31	90	24	17	7	DISTURBED

SOILS AND FOUNDATION
ENGINEERS, INC.

LABORATORY TEST RESULTS

PROJECT MAGNOLIA LANDFILL
MONROE, LOUISIANA

FOR RUST E & I PROJECT 86415.200

TABLE NO. 11
JOB NO. 93-134
DATE 10/13/93

SAMPLE DESCRIPTION			STRENGTH TEST CONDITIONS AND RESULTS			CLASSIFICATION TESTS						PERMEABILITY (cm/sec)	OTHER TESTS
BORING NO.	DEPTH (FEET)	CLASSIFICATION OF MATERIAL	COMPRESSIVE STRENGTH (TSF)	TEST TYPE	TYPE OF FAILURE	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LL	PL	PI	% PASSING #200 SIEVE		TYPE AND LOCATION OF RESULTS
R-19	16-18	CLAY (CH)						116	36	80	98.4	HORIZ: 1.46×10^{-8}	
												VERT: 2.59×10^{-8}	

SOILS AND FOUNDATION ENGINEERS, INC
GEOTECHNICAL CONSULTANTS

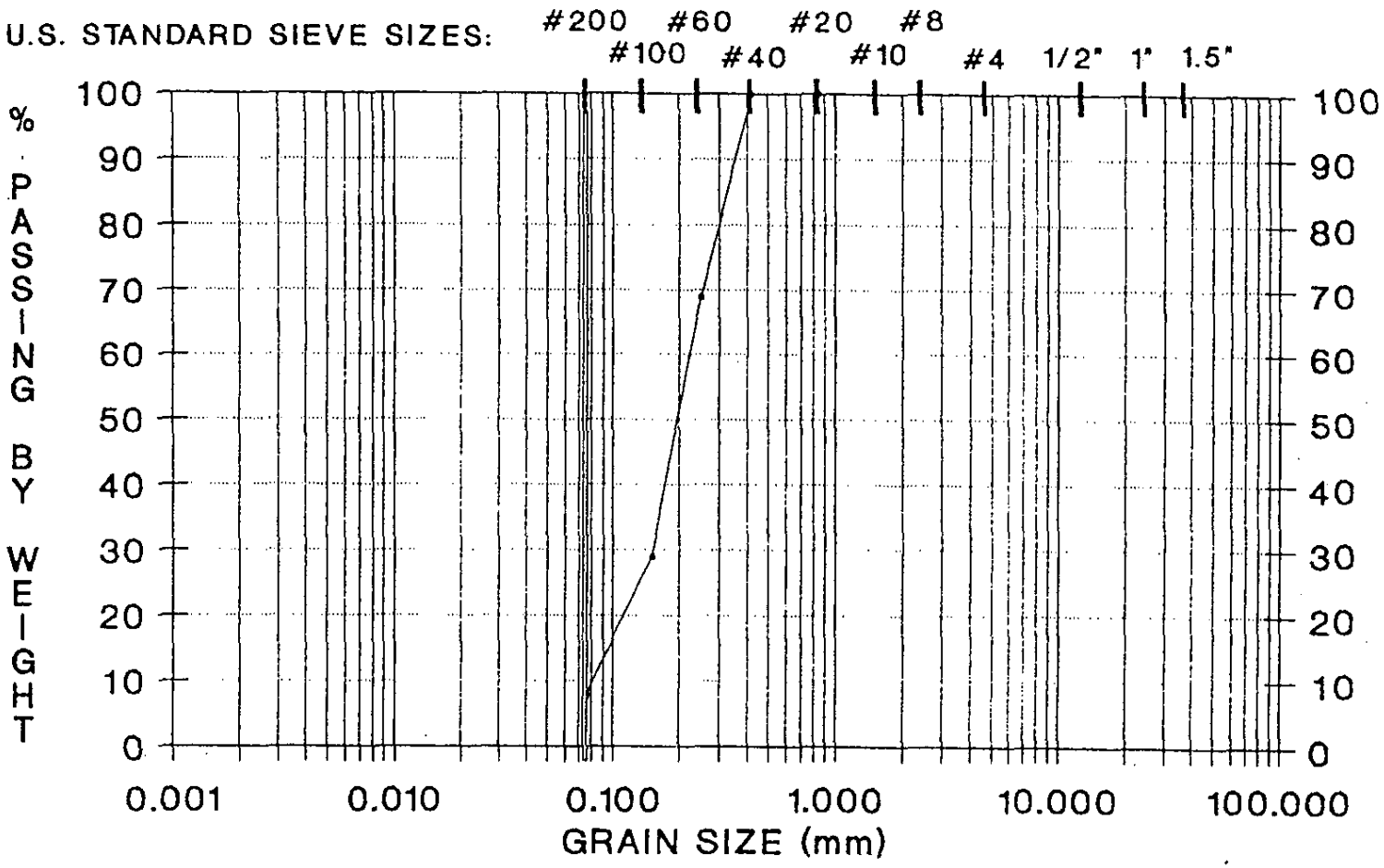
GRADATION TEST RESULTS

ATTACHMENT C.2

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-9 DEPTH: 24' - 26'

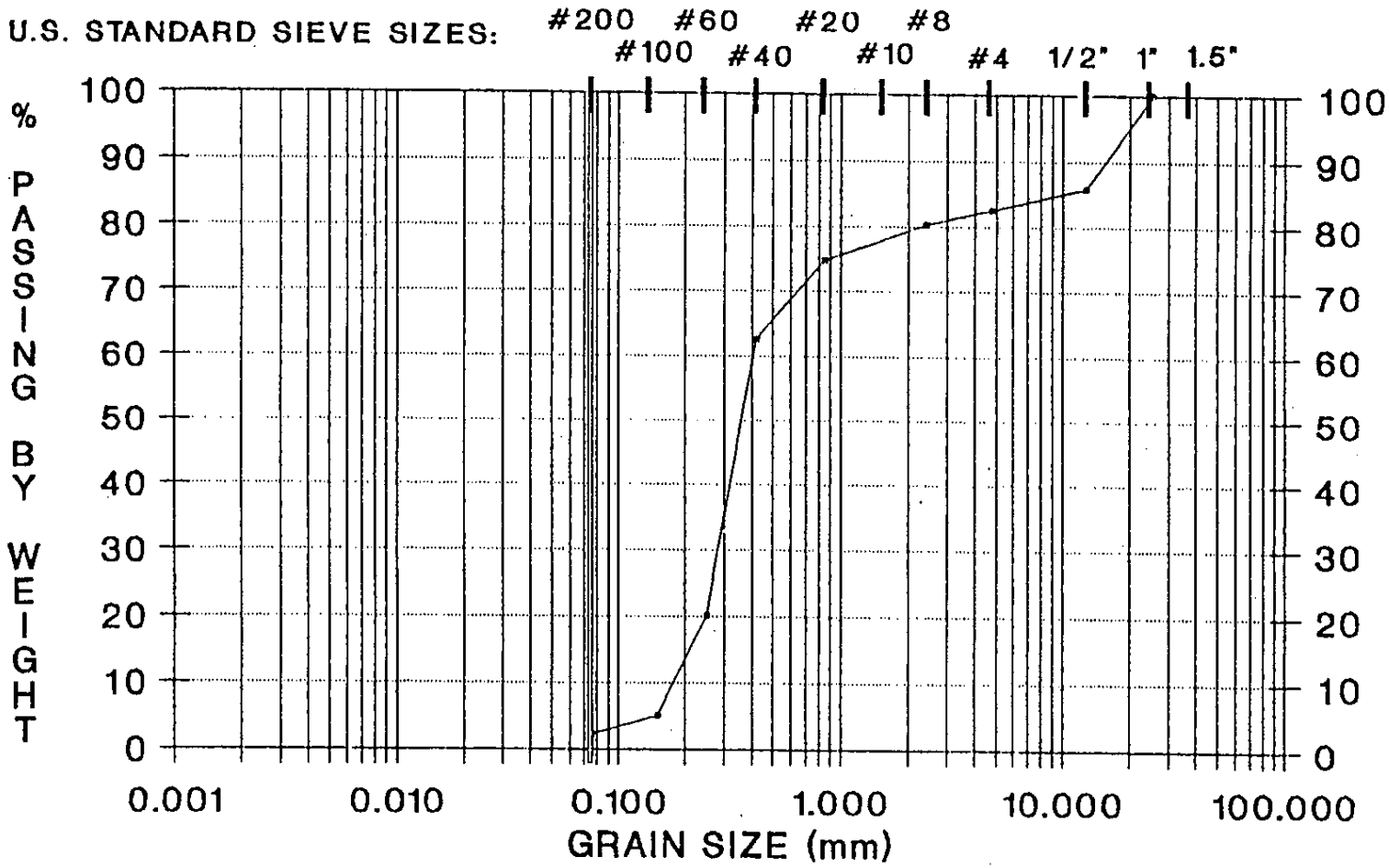


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-9 DEPTH: 34' - 36'

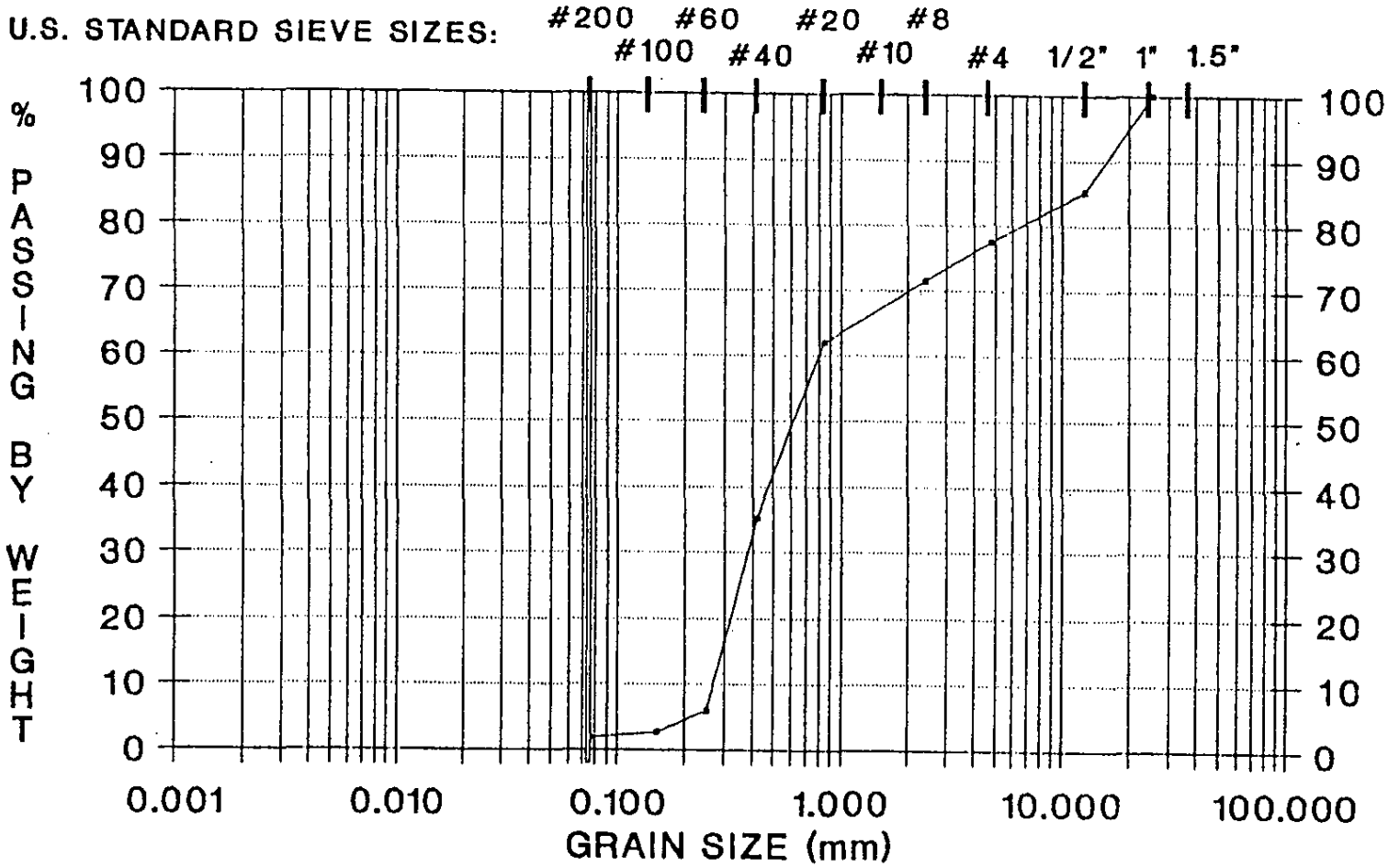


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-9 DEPTH: 44' - 46'

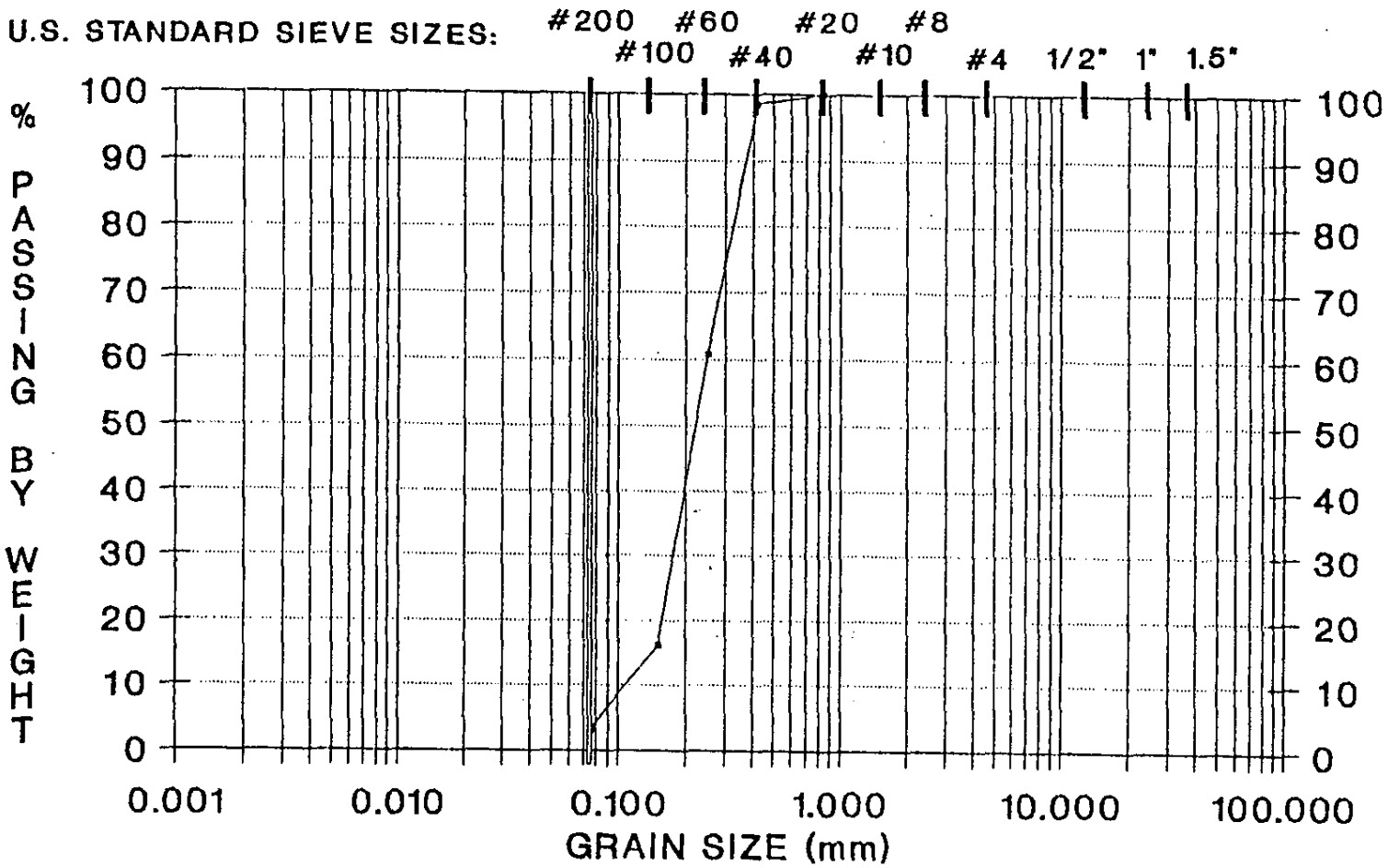


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-11 DEPTH: 46' - 48'

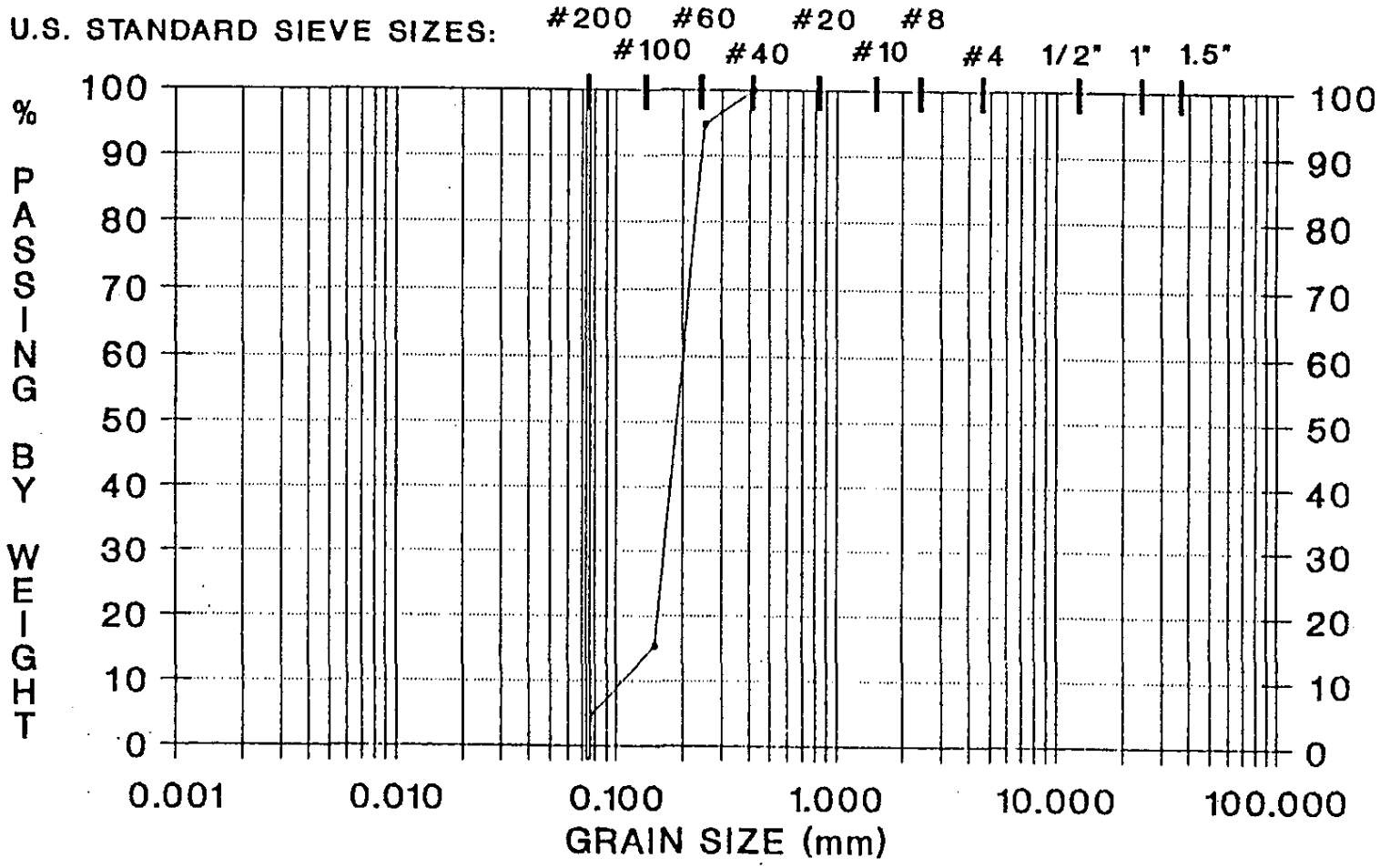


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-27 DEPTH: 28' - 30'

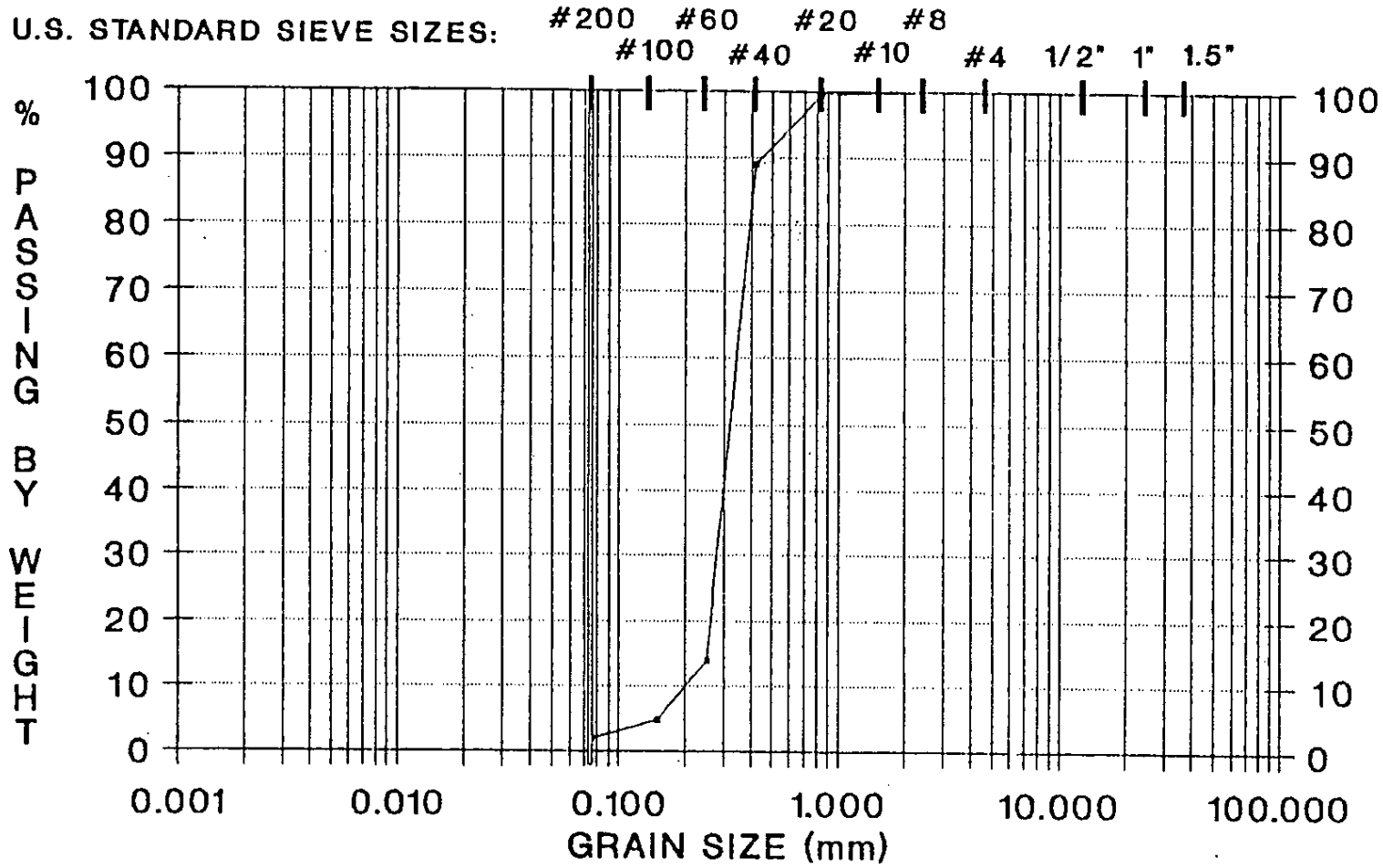


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-27 DEPTH: 38' - 40'

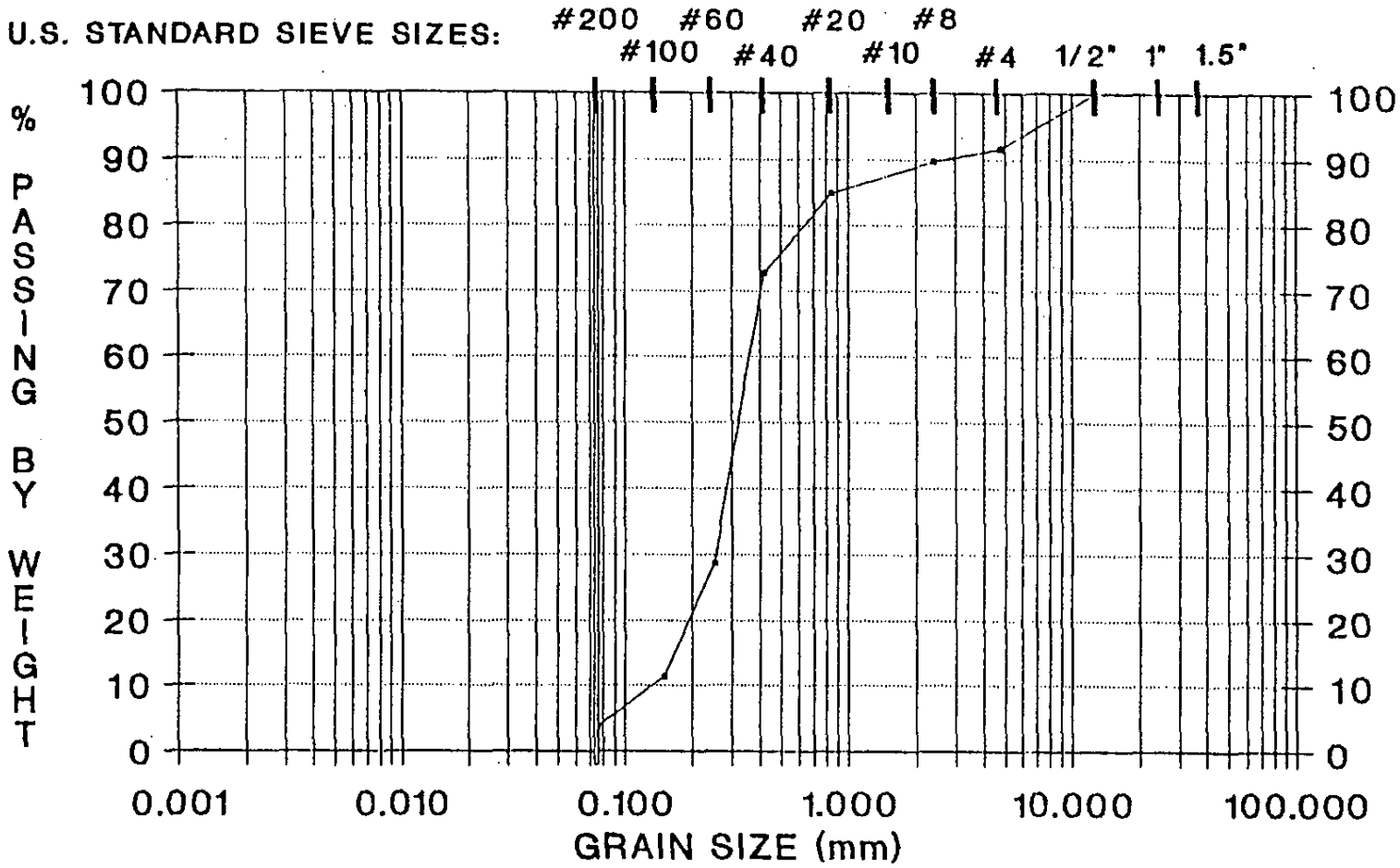


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-27 DEPTH: 48' - 50'

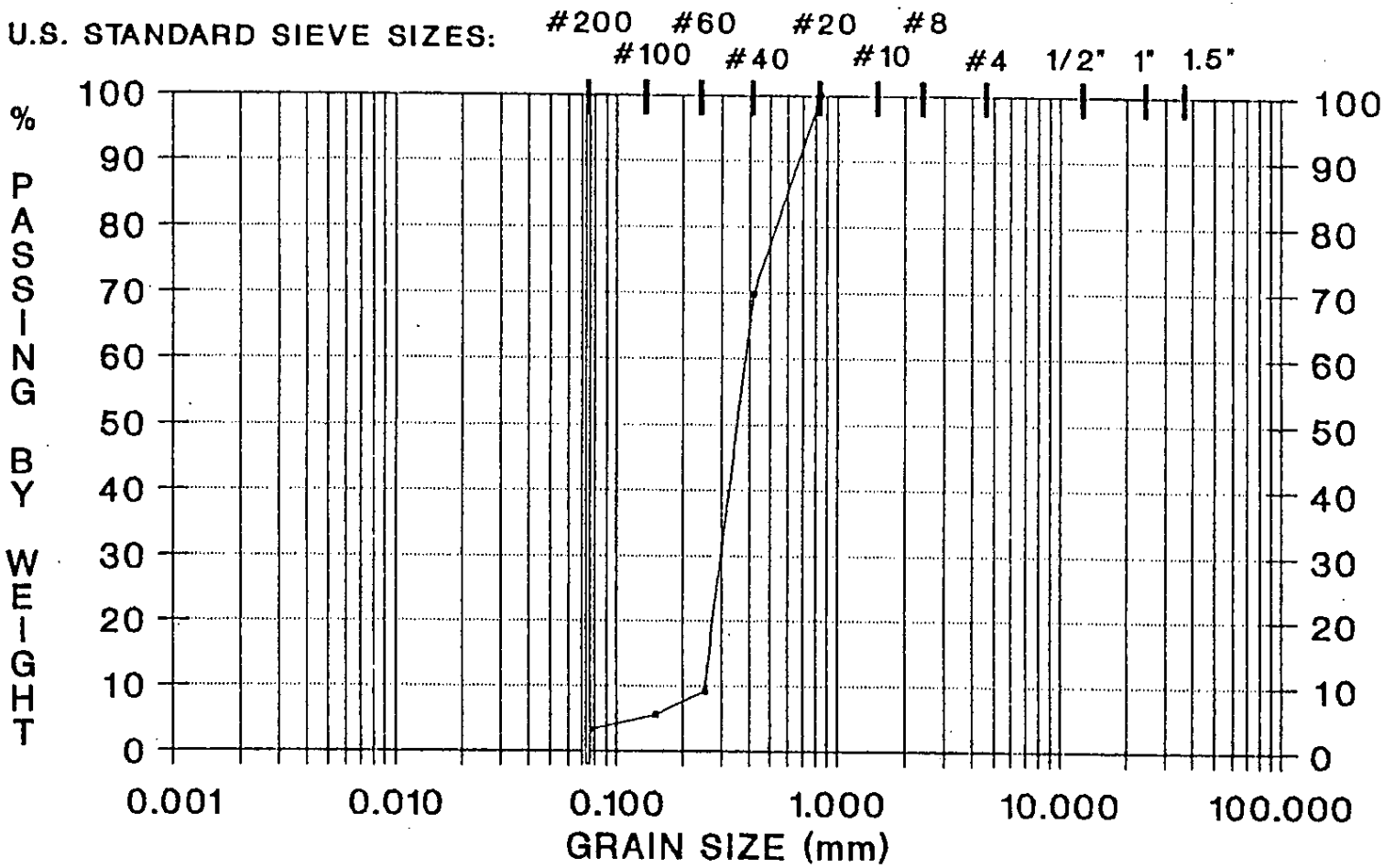


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

SOIL DESCRIPTION:

BORING NO. R-37 DEPTH: 38' - 40'

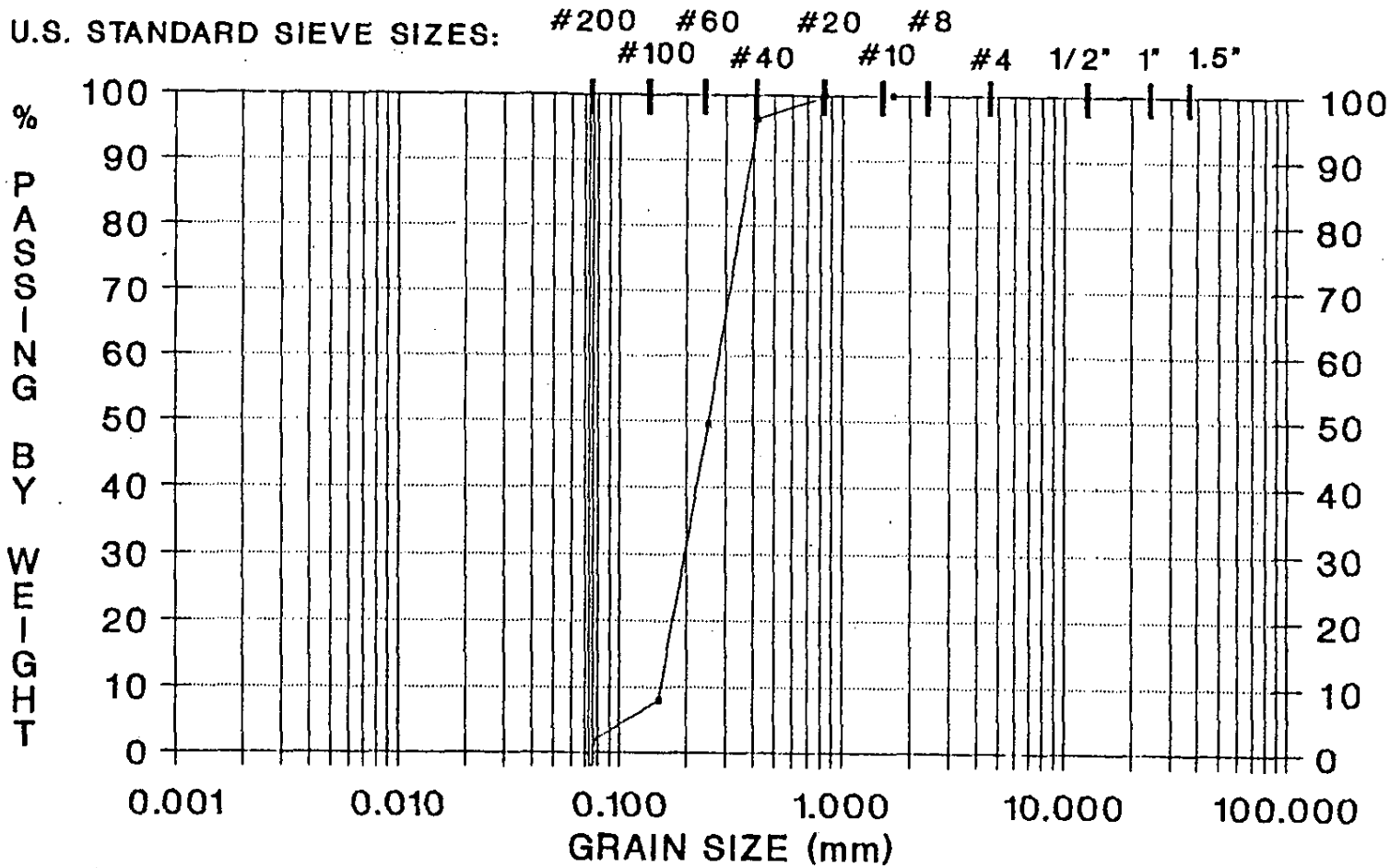


JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

SIEVE ANALYSIS (U.S. STANDARD SIEVE)

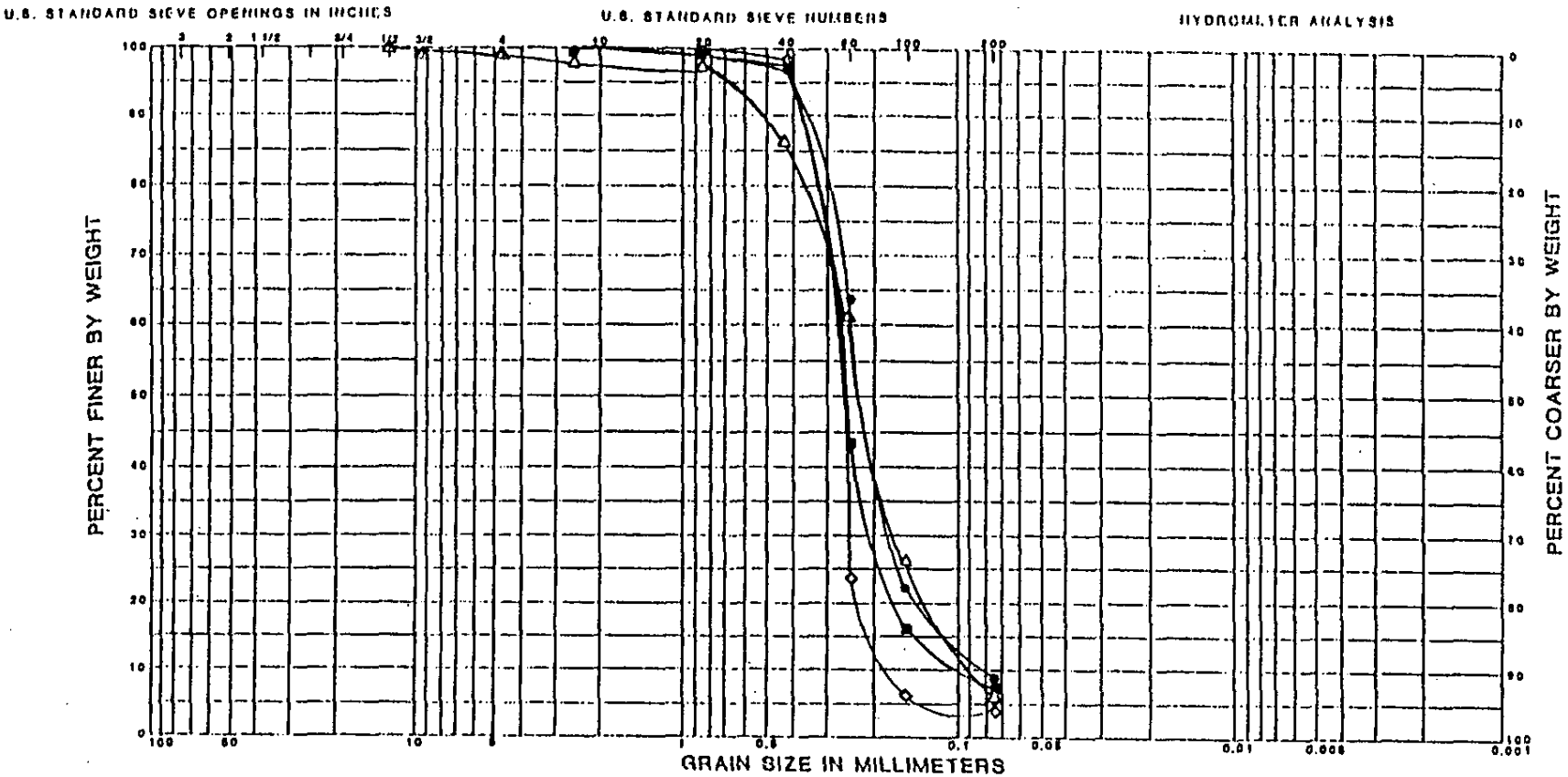
SOIL DESCRIPTION:

BORING NO. R-37 DEPTH: 48' - 50'



JOB NO. 93-134 MAGNOLIA LANDFILL
SOILS AND FOUNDATION ENGINEERS, INC.
JULY 6, 1993

PARTICLE - SIZE DISTRIBUTION



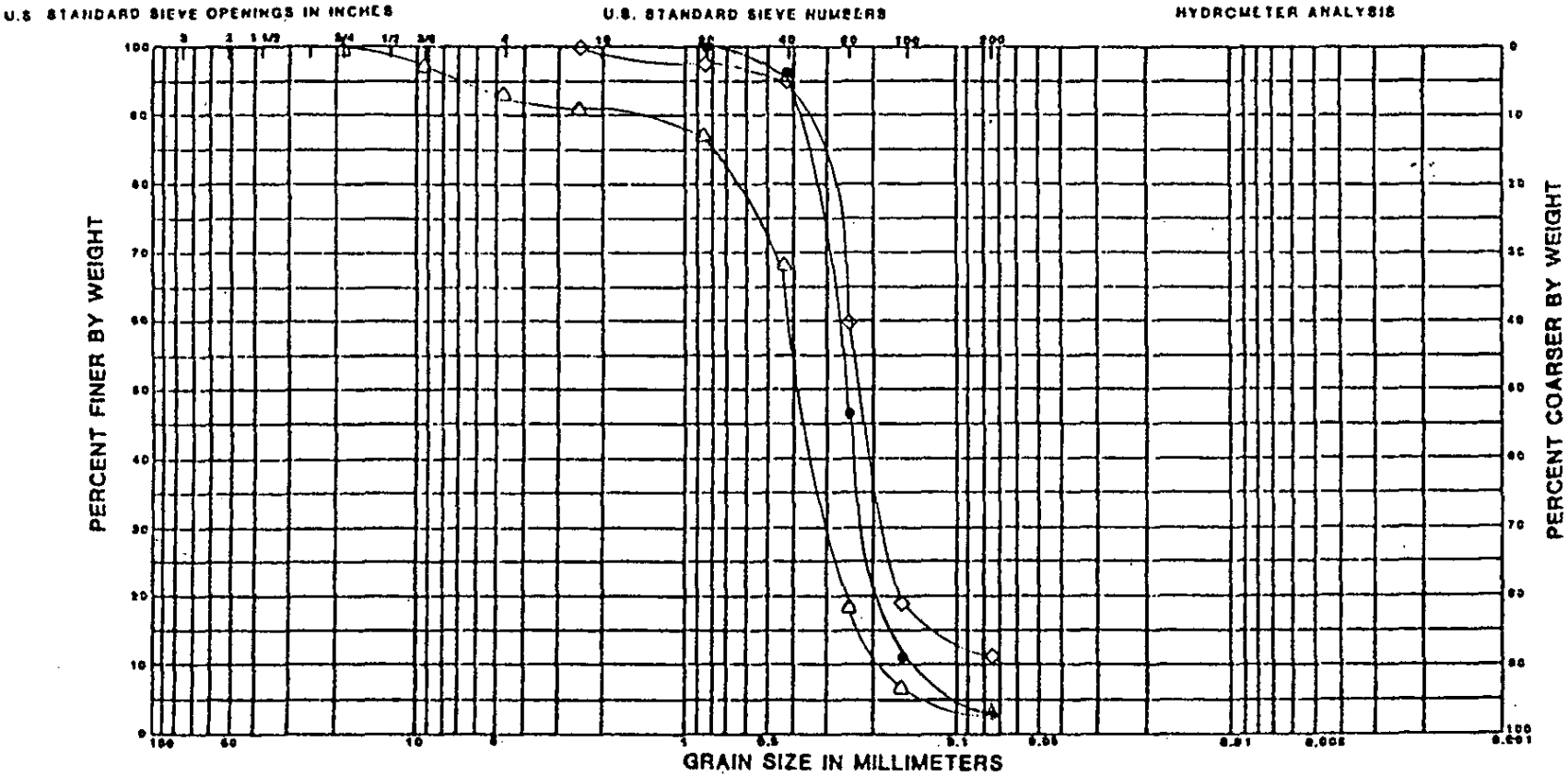
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-2	32-34	FINE SAND W/SILT (SM)	22			9.0
△	R-2	46-48	FINE SAND W/SILT (SM)	19			6.6
■	R-4	28-30	FINE SAND W/SILT (SM)	19			7.2
◇	R-4	38-40	FINE SAND W/SILT (SP)	20			4.6

PROJECT: MAGNOLIA LANDFILL
RUST E & I PROJECT
LOCATION 86415.200
MONROE, LOUISIANA
JOB NO. 93-134
DATE: 8/3/93

CURVE 4

PARTICLE - SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-6	34-36	FINE SAND (SP)	21			2.7
△	R-6	48-50	SAND W/TRACE GRAVEL (SP)	16			3.1
◇	R-17	42-44	FINE SAND W/SILT (SP-SM)	21			11.0

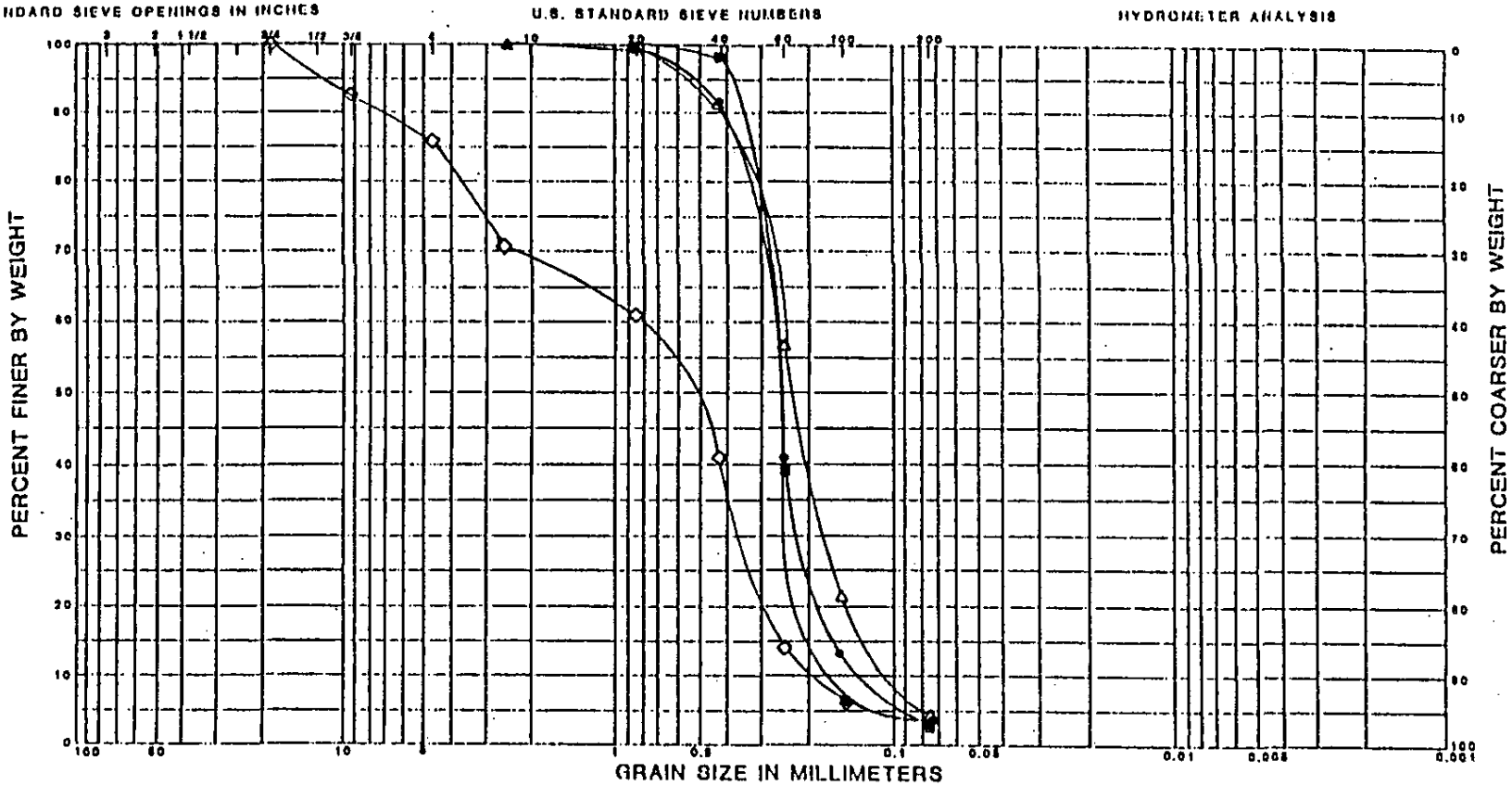
PROJECT: MAGNOLIA LANDFILL
RUST E & I PROJECT
LOCATION 86415.200
MONROE, LOUISIANA

JOB NO. 93-134

DATE: 8/3/93

CURVE 5

PARTICLE - SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-19	36-38	FINE SAND (SP)	23			2.6
△	R-19	48-50	FINE SAND (SP)	21			3.8
■	R-21	32-34	FINE SAND (SP)	22			2.8
◇	R-21	46-48	SAND W/GRAVEL (SP)	12			3.2

PROJECT: MAGNOLIA LANDFILL
RUST E & I PROJECT

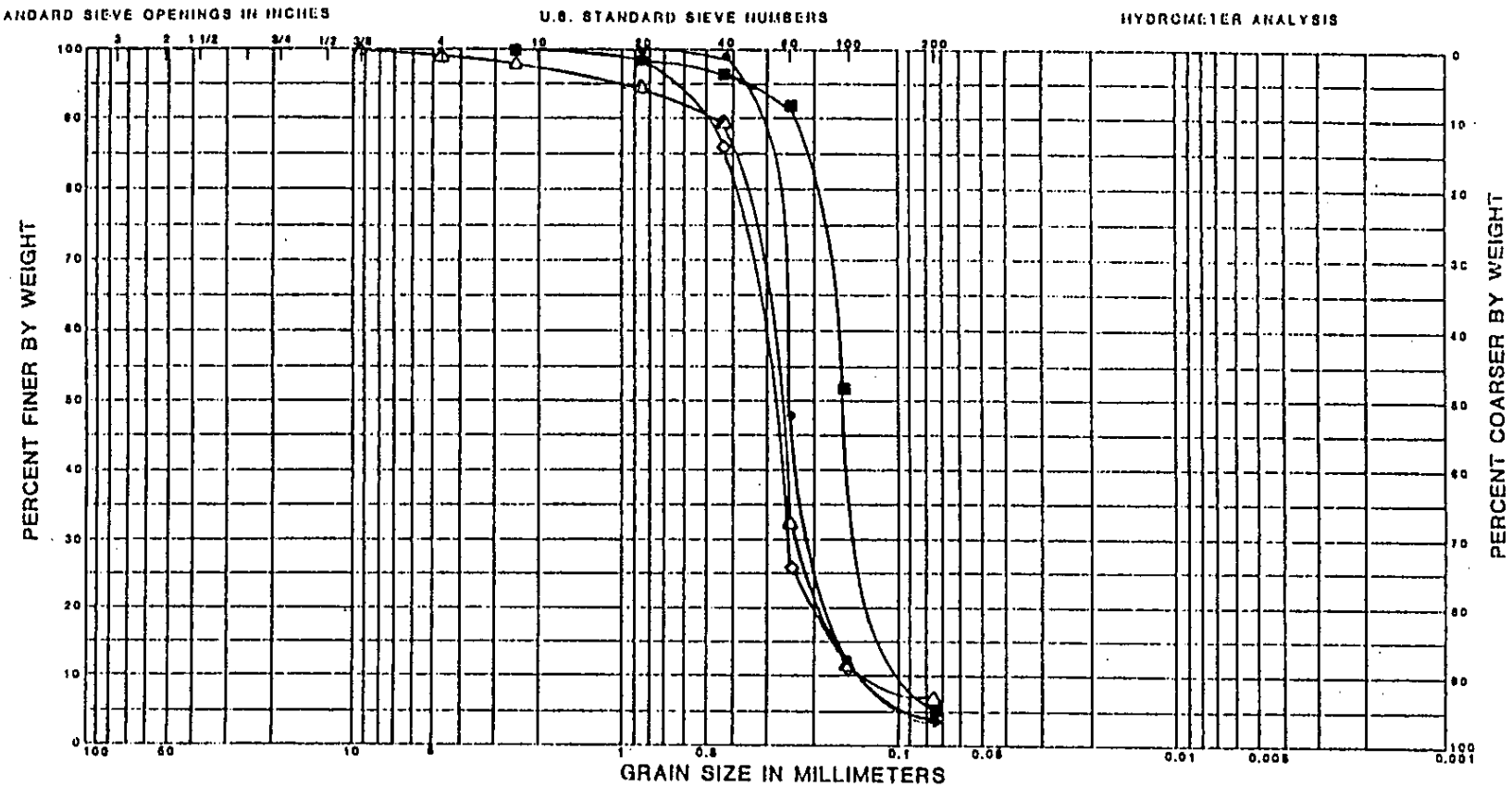
LOCATION: 86415.200
MONROE, LOUISIANA

JOB NO. 93-134

DATE: 8/3/93

CURVE 6

PARTICLE - SIZE DISTRIBUTION



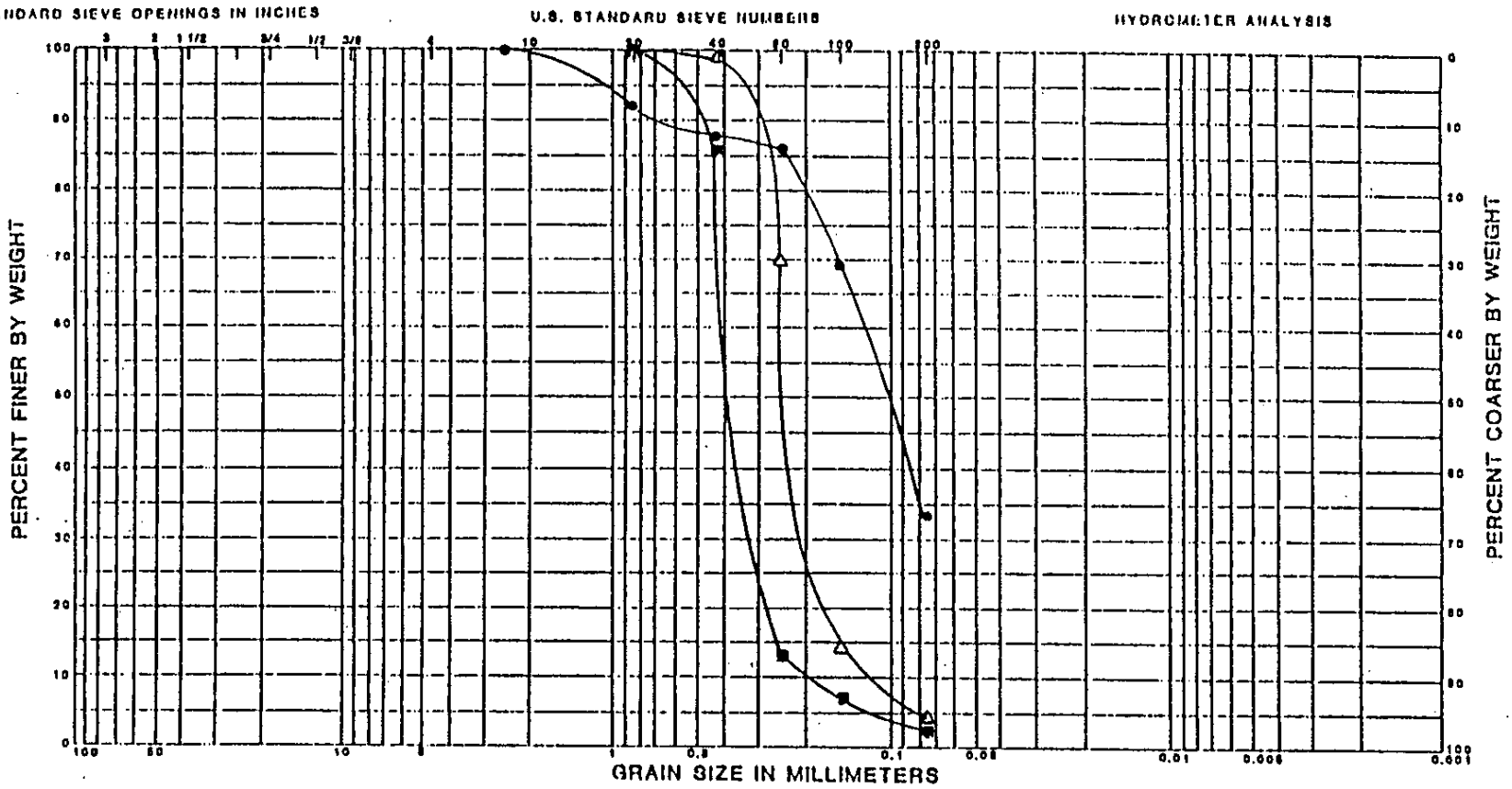
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-23	34-36	FINE SAND (SP)	20			3.1
△	R-23	44-46	FINE SAND W/SILT (SM)	17			6.5
■	R-29	32-34	FINE SAND W/SILT (SM)	22			5.7
◇	R-29	46-48	FINE SAND (SP)	18			4.4

PROJECT: MAGNOLIA LANDFILL
RUST E & I PROJECT
LOCATION 86415.200
MONROE, LOUISIANA
JOB NO. 93-134
DATE: 8/3/93

CURVE 7

PARTICLE - SIZE DISTRIBUTION



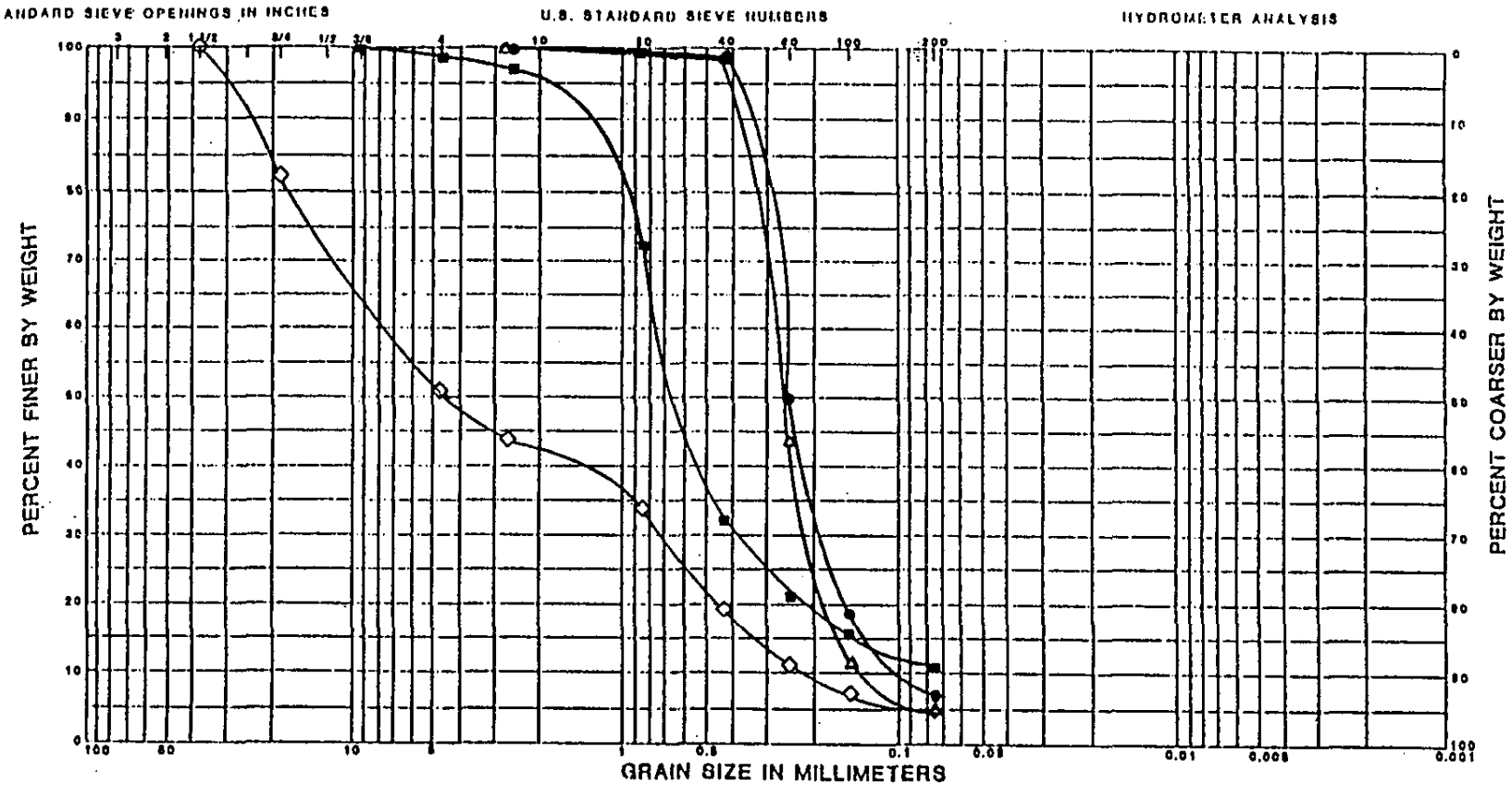
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-31	28-30	SILTY SAND (SM)	25			33.2
△	R-31	34-36	FINE SAND (SP)	25			4.4
■	R-31	48-50	FINE SAND (SP)	19			3.1
◇							

PROJECT: MAGNOLIA LANDFILL
RUST E & I PROJECT
LOCATION 86415.200
MONROE, LOUISIANA
JOB NO. 93-134
DATE: 8/3/93

CURVE 8

PARTICLE - SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-33	26-28	FINE SAND W/SILT (SM)	21			6.7
△	R-33	44-46	FINE SAND (SP)	21			4.9
■	R-33	53-55	SAND W/SILT (SM)	22			10.8
◇	R-33	63-65	SANDY GRAVEL (GP-GW)	12			5.2

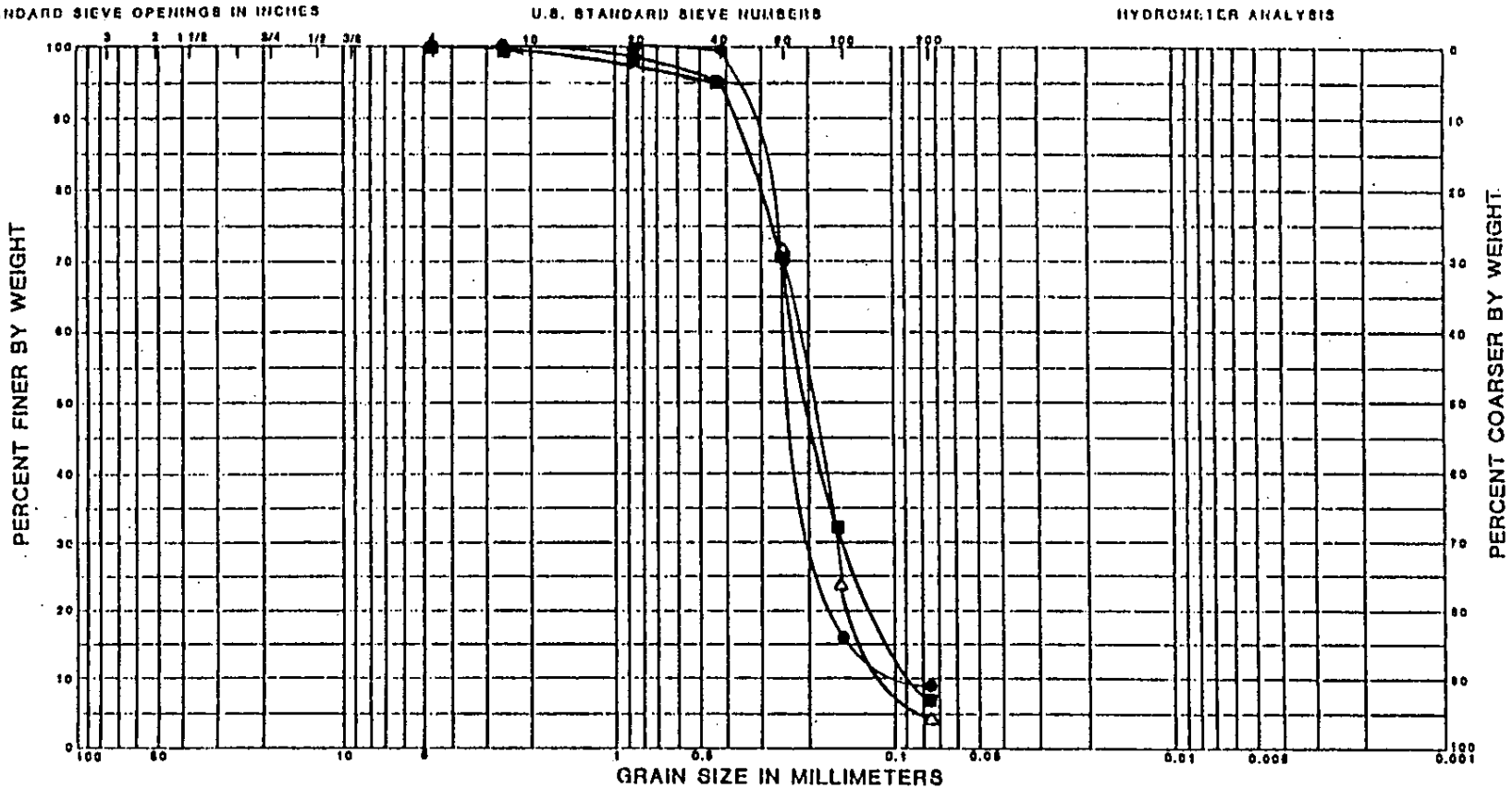
PROJECT: MAGNOLIA LANDFILL
RUST E & I PROJECT
LOCATION 86415.200
MONROE, LOUISIANA

JOB NO. 93-134

DATE: 8/3/93

CURVE 9

PARTICLE - SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-36	32-34	FINE SAND W/SILT (SM)	22			9.4
△	R-36	53-55	FINE SAND (SP)	22			4.6
■	R-36	68-70	FINE SAND W/SILT (SM)	22			6.9
◇							

PROJECT: MAGNOLIA LANDFILL
RUST E' & I PROJECT

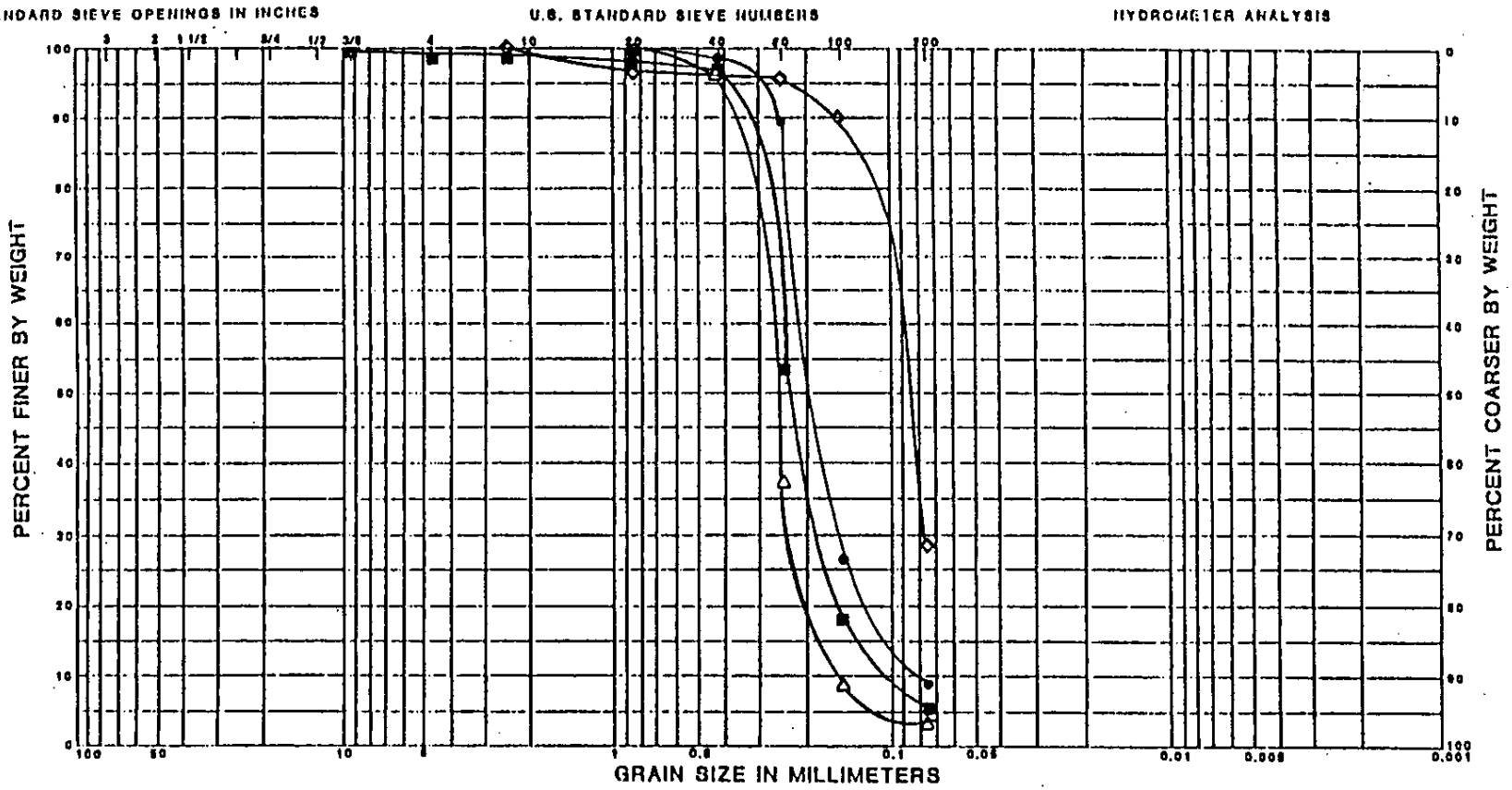
LOCATION 86415.200
MONROE, LOUISIANA

JOB NO. 93-134

DATE: 8/3/93

CURVE 10

PARTICLE - SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-39	24-26	FINE SAND W/SILT (SM)	23			9.0
△	R-39	38-40	FINE SAND (SP)	22			3.1
■	R-41	34-36	FINE SAND W/SILT (SM)	21			5.3
◇	R-41	18-20	SILTY SAND (SM)	25			28.2

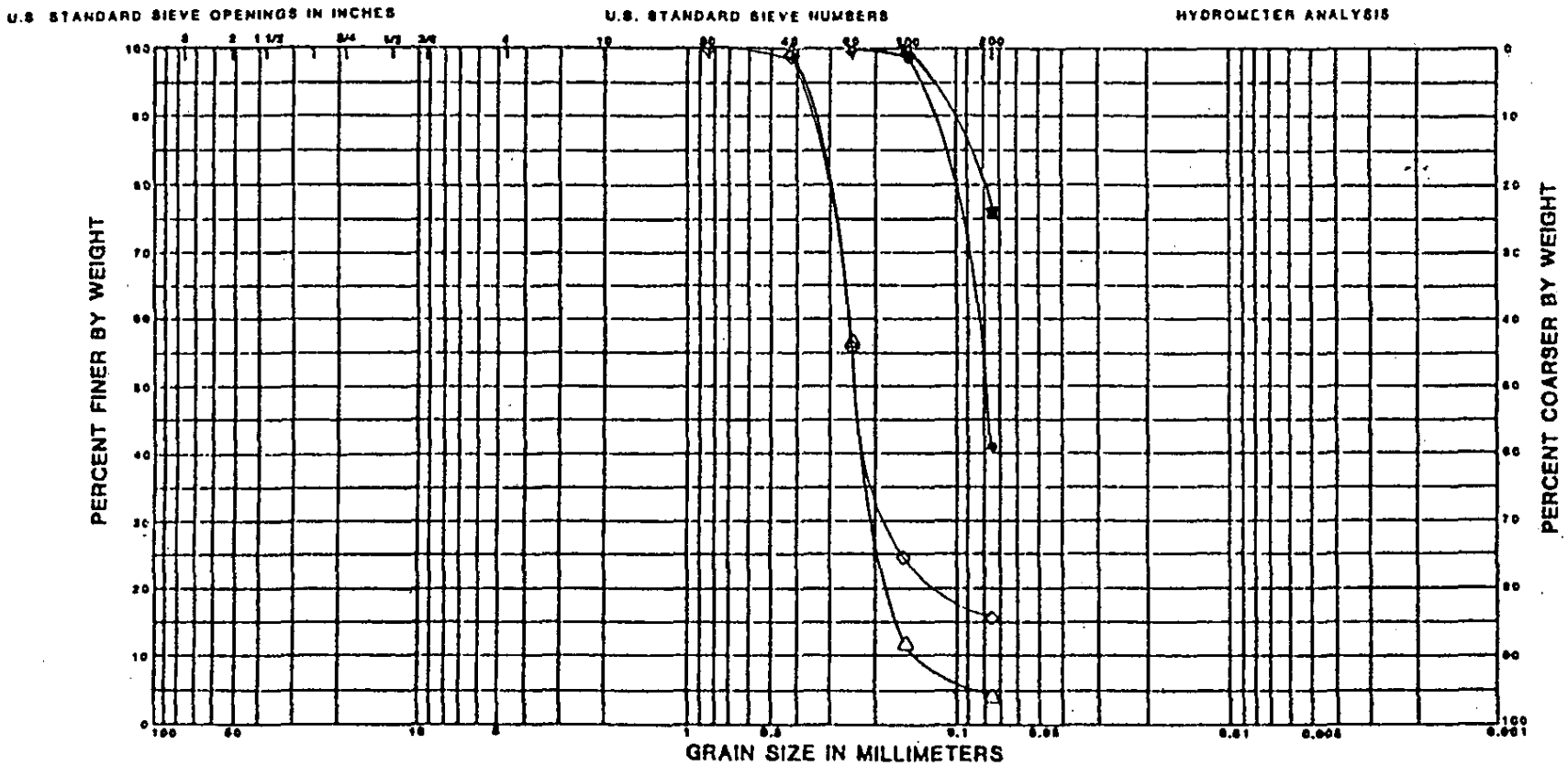
PROJECT: MAGNOLIA LANDFILL
RUST E&I PROJECT
LOCATION 86415.200
MONROE, LOUISIANA

JOB NO. 93-134

DATE: 8/3/93

CURVE 11

PARTICLE - SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	BORING NO.	DEPTH (FEET)	SOIL CLASSIFICATION	MC	LL	PI	% PASS. 200 SIEVE
●	R-32	22-24	SILTY FINE SAND W/CLAY (SM)				40.3
△	R-32	38-40	FINE SAND W/SILT (SP)				4.0
■	R-34	22-24	CLAYEY SILT (ML)				76.1
◇	R-34	30-32	SILTY SAND W/CLAY (SM)				16.2

PROJECT: MAGNOLIA LANDFILL
RUST E & I
PROJECT 86415.200

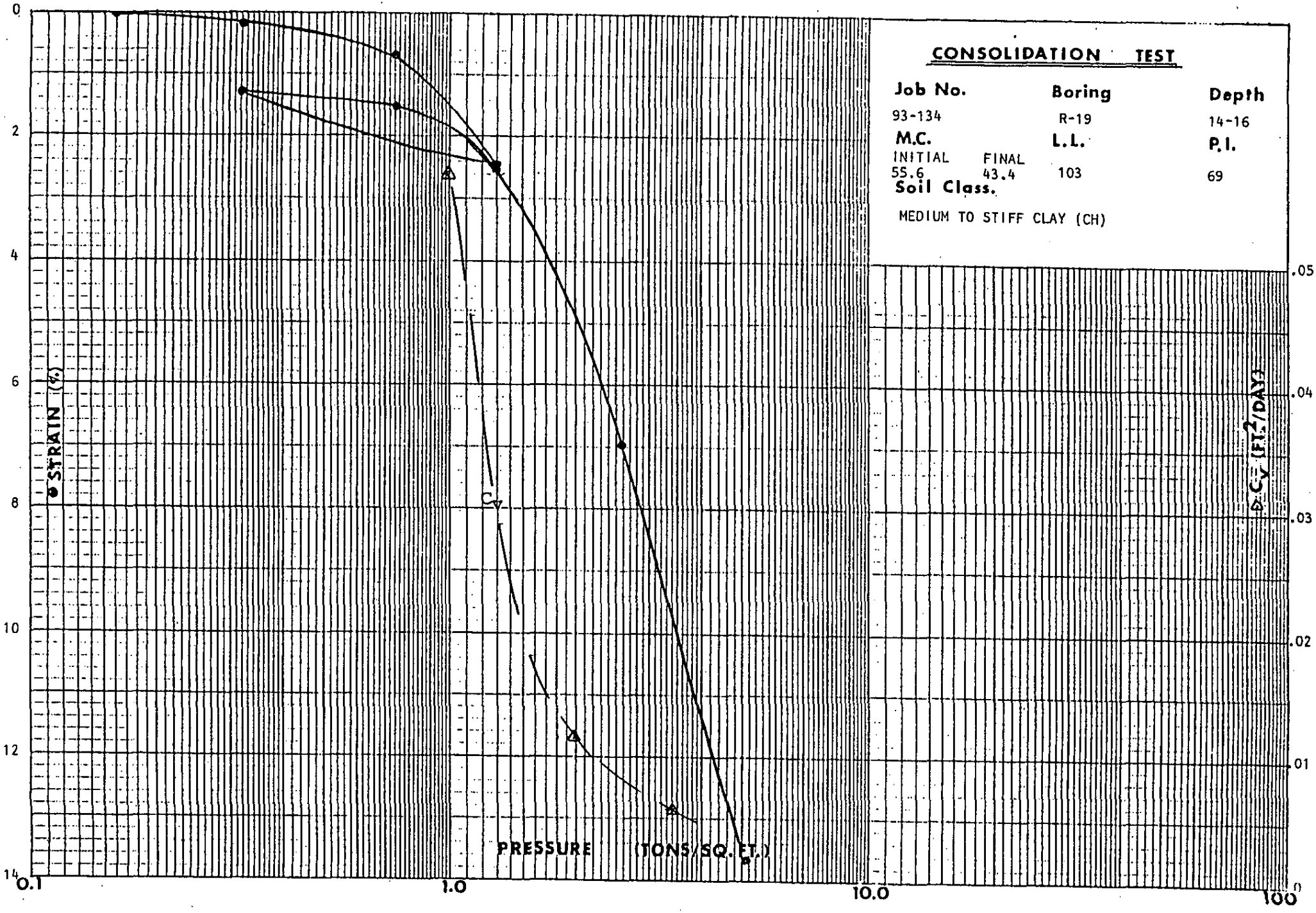
LOCATION MONROE, LOUISIANA

JOB NO. 93-134

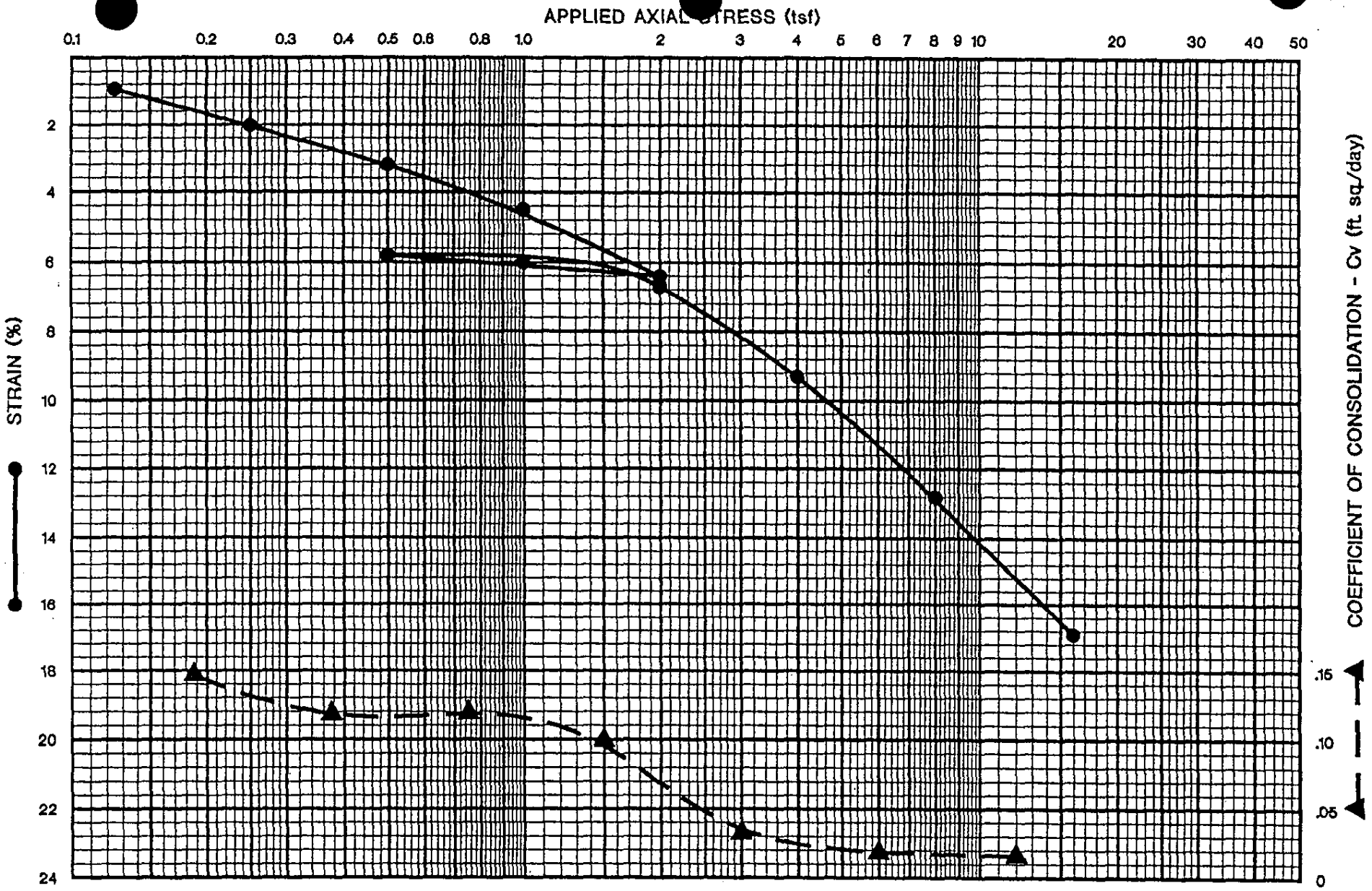
DATE: 8/12/93

CURVE 12

CONSOLIDATION TEST RESULTS


CONSOLIDATION TEST
Job No.
93-134
Boring
R-19
Depth
14-16
M.C.
INITIAL
55.6
FINAL
43.4
L.L.
103
P.I.
69
Soil Class.
MEDIUM TO STIFF CLAY (CH)
STRAIN (%)
PRESSURE (TONS/SQ. FT.)
C_v (FT.^{2}/DAY)
0
2
4
6
8
10
12
14
0.1
1.0
10.0
100
.05
.04
.03
.02
.01
0

C:\93-1676\93 1.DWG\9-16-93.PLT



CONSOLIDATION TEST

SAMPLE IDENTIFICATION

BORING NO.: R-13
DEPTH (feet): 28-30
MATERIAL: Brown SILTY CLAY

FILE NO.: 93-1676

STE
Soil Testing Engineers, Inc.

CLASSIFICATION DATA

INITIAL MOISTURE CONTENT (%) = 27.1
INITIAL DRY DENSITY (lbs./cu.ft.) = 93.0
FINAL MOISTURE CONTENT (%) = 22.3

FIGURE NO.:

CONSOLIDATION TEST-FINAL

PROJECT MAGNOLIA LANDFILL DATE (start) _____ (calc.) _____
FILE NO. 93-1676 DONE BY _____
BORING R-13 DEPTH 28-30 CALC. BY _____
MATERIAL BR SiCL

INITIAL SAMPLE HEIGHT (Ho) .8 inches

	M/C Before	M/C After	$H_s = .0124 \times w_s/G_s$
Ring# 4	Can# 550	Can# 506	
Wt./Ring 763.8	Wet Wt. 140.9	Wet Wt. 135.49	H_o=.800
Ring Wt. 641.9	Dry Wt. 115.31	Dry Wt. 114.59	H_s= -
Sample Wt. 121.9	Tar Wt. 21.0	Tar Wt. 21.0	H_v=
W γ 118.15	Water Wt. 25.59	Water Wt. 20.9	e=
D γ 92.96	Sample Wt. 94.31	Sample Wt. 93.59	
	% Moisture 27.1	% Moisture 22.3	

	(1) Load (tsf)	(2) Dial Rdg 100% Df	(3) Amount Consol. d=Df-Dfo	(4) Strain d/Ho x100	(5) Ht. after this load (H)	(6) Ht. after last load (Hp)	(7) Sum Cols (5)+(6) (Sum)	(8) Avg. Ht. this load Ho=Sum/2	(9) t_{90} (min)	(10) Cv	(11) ΔH_v = H_v-3	(12) e H_v/H_s
		.0649										
.25	1/8	.0724	.0075	.0094	.7925	.8	1.5925	.79625	2.3²/5.29	.2541		
.500	1/4	.0812	.0163	.020	.7837	.7925	1.5762	.7881	3²/9	.1463		
1.0	1/2	.0907	.0258	.032	.7742	.7837	1.5579	.77895	3.3²/10.89	.1181		
2.0	1	.1009	.036	.045	.7640	.7742	1.5382	.7691	3.25²/10.56	.1188		
4.0	2	.1163	.051	.064	.7490	.7640	1.513	.7565	3.5²/12.25	.0990		
1.0	1/2 RB	.1112	.046	.058	.7540	.7490	1.503	.7515	5²/25	.0479		
2.0	1 RL	.1131	.048	.060	.7520	.7540	1.506	.7530	2.2²/4	.3005		
4	2 RL	.1181	.053	.067	.7470	.7520	1.499	.7495	3.75²/14.06	.0847		
8	4	.1392	.074	.093	.7260	.7470	1.473	.7365	6²/36	.0319		
16	8	.1675	.1026	.128	.6974	.7260	1.4234	.7117	7.75²/60.06	.0179		
32	16	.2001	.1352	.169	.6648	.6974	1.3622	.6811	7.9²/62.41	.0158		

$Cv = 2.12 (Ho^2/t_{90})$ or see Book: $Cv = C(100/t_{90})$

STEI 10

PERMEABILITY TEST RESULTS

SOILS AND FOUNDATION ENGINEERS, INC.
FLEXWALL PERMEABILITY TEST RESULTS

JOB No. 93-134
PROJECT NAME: MAGNOLIA LANDFILL
PROJECT LOCATION: MONROE, LOUISIANA
TEST DATE: 6-30/7-5-93
SOIL DESCRIPTION: CLAY SHALE (R-9,73-75' LL=77 PI=48)

INITIAL SOIL SPECIMEN SIZE:

Average Diameter = 7.31 (cm) = 2.88 (in)
Average Height = 8.54 (cm) = 3.36 (in)
Average Area = 42.00 (sq cm)
Average Volume = 358.76 (cu cm)

TEST SPECIMEN SOIL PROPERTIES:

Specific Gravity = 2.80
Initial Wet Unit Weight = 117.4 PCF
Dry Unit Weight = 91.4 PCF

	MOISTURE CONTENT	SATURATION
INITIAL:	28.5 %	87.5 %
FINAL:	31.6 %	99.8 %

TEST CONDITIONS:

a-in = 0.2 sq cm a-out = 0.1 sq cm

			***** TEST PRESSURES *****							
Test No.	H1 (cm)	H2 (cm)	CELL (psig)	TOP (psig)	BOTTOM (psig)	k (psig)	Time (secs)	Temp (xC)	RT	k (cm/sec)
1	10.1	9.5	110.0	95.0	96.7	1.8	6720	22.7	0.936	1.10E-08
2	24.7	23.0	110.0	95.0	99.3	4.3	16800	22.2	0.947	4.62E-09
3	33.8	30.8	110.0	95.0	100.7	5.8	52140	21.3	0.970	2.02E-09
4	31.1	23.2	110.0	95.0	99.8	4.8	270420	21.0	0.976	1.25E-09

AVERAGE PERMEABILITY = 4.72E-09 cm/sec

SOILS AND FOUNDATION ENGINEERS, INC.
FLEXWALL PERMEABILITY TEST RESULTS

JOB No. 93-134 (RUST E&I 86415.200)
PROJECT NAME: MAGNOLIA LANDFILL
PROJECT LOCATION: MONROE, LOUISIANA
TEST DATE: 9/08/93-9/11/93
SOIL DESCRIPTION: GRAY CLAY (VERT. R-19 16'-18')

INITIAL SOIL SPECIMEN SIZE:

Average Diameter = 7.15 (cm) = 2.81 (in)
Average Height = 7.12 (cm) = 2.80 (in)
Average Area = 40.10 (sq cm)
Average Volume = 285.57 (cu cm)

TEST SPECIMEN SOIL PROPERTIES:

Specific Gravity = 2.70
Initial Wet Unit Weight = 99.6 PCF
Dry Unit Weight = 62.7 PCF

	MOISTURE CONTENT	SATURATION
INITIAL:	58.8 %	94.2 %
FINAL:	64.0 %	98.3 %

TEST CONDITIONS:

a-in = 1.0 sq cm a-out = 1.0 sq cm

			***** TEST PRESSURES *****							
Test No.	H1 (cm)	H2 (cm)	CELL (psig)	TOP (psig)	BOTTOM (psig)	k (psig)	Time (secs)	Temp (°C)	RT	k (cm/sec)
1	17.2	15.3	78.0	70.0	73.0	3.0	25200	20.0	1.000	2.92E-08
2	15.3	14.2	78.0	70.0	73.0	3.0	16380	20.0	1.000	2.62E-08
3	14.2	12.1	78.0	70.0	73.0	3.0	30360	20.5	0.987	2.68E-08
4	12.1	9.5	78.0	70.0	73.0	3.0	47160	20.5	0.987	2.16E-08

AVERAGE PERMEABILITY = 2.59E-08 cm/sec

SOILS AND FOUNDATION ENGINEERS, INC.
FALLING HEAD PERMEABILITY TEST RESULTS

JOB No. 93-134 (RUST E&I 86415.200)
PROJECT NAME: MAGNOLIA LANDFILL
PROJECT LOCATION: MONROE, LOUISIANA
TEST DATE: 9-16/20-93
SOIL DESCRIPTION: GRAY CLAY (HORZ. PERM R-19 16-18')

INITIAL SOIL SPECIMEN SIZE:

Diameter: 4.87 (cm) = 1.92 (in)
Height: 5.46 (cm) = 2.15 (in)
Area: 18.60 (sq cm)
Volume: 101.49 (cu cm)

TEST SPECIMEN SOIL PROPERTIES:

Specific Gravity = 2.70
Initial Wet Unit Weight = 99.2 PCF
Dry Unit Weight = 60.5 PCF

	MOISTURE CONTENT	SATURATION
INITIAL:	64.0 %	96.8 %
FINAL:	64.0 %	97.5 %

TEST No.	H1 (cm)	H2 (cm)	DPRESS (psig)	Time (secs)	Q out (cu cm)	Temp (°C)	RT	k (cm/sec)
1	77.1	75.6	5.0	64424.0	1.2	19.2	1.018	1.30E-08
2	75.6	75.2	5.0	14204.0	0.3	19.2	1.018	1.48E-08
3	75.2	73.8	5.0	58740.0	1.3	19.2	1.018	1.55E-08
4	73.8	73.1	5.0	32340.0	0.7	19.2	1.018	1.52E-08

AVERAGE PERMEABILITY = 1.46E-08 cm/sec

SOILS AND FOUNDATION ENGINEERS, INC.
FLEXWALL PERMEABILITY TEST RESULTS

JOB No. 93-134 (RUST E&I 86415.200)
PROJECT NAME: MAGNOLIA LANDFILL
PROJECT LOCATION: MONROE, LOUISIANA
TEST DATE: 9/08/93-9/11/93
SOIL DESCRIPTION: GRAY CLAY (VERT. R-19 16'-18')

INITIAL SOIL SPECIMEN SIZE:

Average Diameter = 7.15 (cm) = 2.81 (in)
Average Height = 7.12 (cm) = 2.80 (in)
Average Area = 40.10 (sq cm)
Average Volume = 285.57 (cu cm)

TEST SPECIMEN SOIL PROPERTIES:

Specific Gravity = 2.70
Initial Wet Unit Weight = 99.6 PCF
Dry Unit Weight = 62.7 PCF

	MOISTURE CONTENT	SATURATION
INITIAL:	58.8 %	94.2 %
FINAL:	64.0 %	98.3 %

TEST CONDITIONS:

a-in = 1.0 sq cm a-out = 1.0 sq cm

			***** TEST PRESSURES *****							
Test No.	H1 (cm)	H2 (cm)	CELL (psig)	TOP (psig)	BOTTOM (psig)	k (psig)	Time (secs)	Temp (°C)	RT	k (cm/sec)
1	17.2	15.3	78.0	70.0	73.0	3.0	25200	20.0	1.000	2.92E-08
2	15.3	14.2	78.0	70.0	73.0	3.0	16380	20.0	1.000	2.62E-08
3	14.2	12.1	78.0	70.0	73.0	3.0	30360	20.5	0.987	2.68E-08
4	12.1	9.5	78.0	70.0	73.0	3.0	47160	20.5	0.987	2.16E-08

AVERAGE PERMEABILITY = 2.59E-08 cm/sec

SOILS AND FOUNDATION ENGINEERS, INC.
FALLING HEAD PERMEABILITY TEST RESULTS

JOB No. 93-134 (RUST E&I 86415.200)
PROJECT NAME: MAGNOLIA LANDFILL
PROJECT LOCATION: MONROE, LOUISIANA
TEST DATE: 9-16/20-93
SOIL DESCRIPTION: GRAY CLAY (HORZ. PERM R-19 16-18')

INITIAL SOIL SPECIMEN SIZE:

Diameter: 4.87 (cm) = 1.92 (in)
Height: 5.46 (cm) = 2.15 (in)
Area: 18.60 (sq cm)
Volume: 101.49 (cu cm)

TEST SPECIMEN SOIL PROPERTIES:

Specific Gravity = 2.70
Initial Wet Unit Weight = 99.2 PCF
Dry Unit Weight = 60.5 PCF

	MOISTURE CONTENT	SATURATION
INITIAL:	64.0 %	96.8 %
FINAL:	64.0 %	97.5 %

TEST No.	H1 (cm)	H2 (cm)	DPRESS (psig)	Time (secs)	Q out (cu cm)	Temp (°C)	RT	k (cm/sec)
1	77.1	75.6	5.0	64424.0	1.2	19.2	1.018	1.30E-08
2	75.6	75.2	5.0	14204.0	0.3	19.2	1.018	1.48E-08
3	75.2	73.8	5.0	58740.0	1.3	19.2	1.018	1.55E-08
4	73.8	73.1	5.0	32340.0	0.7	19.2	1.018	1.52E-08

AVERAGE PERMEABILITY = 1.46E-08 cm/sec

SOILS AND FOUNDATION ENGINEERS, INC.
FLEXWALL PERMEABILITY TEST RESULTS

JOB No. 93-134
PROJECT NAME: MAGNOLIA LANDFILL
PROJECT LOCATION: MONROE, LOUISIANA
TEST DATE: 7-29/8-2-93
SOIL DESCRIPTION: REDDISH BROWN CLAY (LL=67 PI=48) R-23 14-16'

INITIAL SOIL SPECIMEN SIZE:

Average Diameter = 7.12 (cm) = 2.80 (in)
Average Height = 7.14 (cm) = 2.81 (in)
Average Area = 39.79 (sq cm)
Average Volume = 283.94 (cu cm)

TEST SPECIMEN SOIL PROPERTIES:

Specific Gravity = 2.80
Initial Wet Unit Weight = 126.7 PCF
Dry Unit Weight = 101.3 PCF

	MOISTURE CONTENT	SATURATION
INITIAL:	25.1 %	96.8 %
FINAL:	23.5 %	95.0 %

TEST CONDITIONS:

a-in = 1.0 sq cm a-out = 1.0 sq cm

			***** TEST PRESSURES *****							
Test No.	H1 (cm)	H2 (cm)	CELL (psig)	TOP (psig)	BOTTOM (psig)	k (psig)	Time (secs)	Temp (xC)	RT	k (cm/sec)
1	17.8	14.2	70.0	60.0	63.0	3.0	51480	19.7	1.005	2.75E-08
2	11.4	10.9	70.0	60.0	63.0	3.0	7620	20.0	1.000	2.62E-08
3	10.9	10.0	70.0	60.0	63.0	3.0	10800	20.0	1.000	3.34E-08
4	10.0	7.3	70.0	60.0	63.0	3.0	36000	19.5	1.011	3.07E-08

AVERAGE PERMEABILITY = 2.94E-08 cm/sec

SOILS AND FOUNDATION ENGINEERS, INC.
FLEXWALL PERMEABILITY TEST RESULTS

JOB No. 93-134 (RUST E&I 86415.200)
PROJECT NAME: MAGNOLIA LANDFILL EXPANSION
PROJECT LOCATION: MONROE, LOUISIANA
TEST DATE: 8-15/23-93
SOIL DESCRIPTION: REDDISH BROWN & GRAY CLAY (R-35 10-12')

INITIAL SOIL SPECIMEN SIZE:

Average Diameter = 7.18 (cm) = 2.83 (in)
Average Height = 7.18 (cm) = 2.83 (in)
Average Area = 40.47 (sq cm)
Average Volume = 290.71 (cu cm)

TEST SPECIMEN SOIL PROPERTIES:

Specific Gravity = 2.78
Initial Wet Unit Weight = 109.5 PCF
Dry Unit Weight = 75.2 PCF

	MOISTURE CONTENT	SATURATION
INITIAL:	45.7 %	97.0 %
FINAL:	46.8 %	100.5 %

TEST CONDITIONS:

a-in = 0.9 sq cm a-out = 0.9 sq cm

			***** TEST PRESSURES *****							
Test No.	H1 (cm)	H2 (cm)	CELL (psig)	TOP (psig)	BOTTOM (psig)	k (psig)	Time (secs)	Temp (xC)	RT	k (cm/sec)
1	20.1	19.7	85.0	72.0	75.0	3.0	50940	20.2	0.993	2.33E-09
2	19.7	19.5	85.0	72.0	75.0	3.0	40500	20.2	0.993	2.09E-09
3	18.4	18.2	85.0	72.0	75.0	3.0	29640	20.0	1.000	2.32E-09
4	17.9	17.6	85.0	72.0	75.0	3.0	32100	20.0	1.000	2.68E-09

AVERAGE PERMEABILITY = 2.35E-09 cm/sec

STE
Soil Testing Engineers, Inc.

LABORATORY TEST RESULTS

Sample ID	Depth (feet)	Moisture Content (%)	Dry Density (pcf)	Permeability (cm/sec)	Consolidation
R-13	28-30 Vert.	26.1	98.4	3.4×10^{-7}	*
R-13	30-32 Horiz.	25.6	94.9	4.9×10^{-7}	
R-35	12-14 Horz.	42.2	76.0	8.6×10^{-9}	

* See Consolidation Curve

FALLING HEAD PERMEABILITY DETERMINATION

Job No.: 93-1676
Project: MAGNOLIA LANDFILL

SAMPLE R-13 28-30 KV

Height: 3.05 in.
Diameter: 2.75 in.
Dry Density: 98.40 pcf
Sp. Gr.: 2.70

Area: 5.94 in.^2
Volume: 18.12 in.^3
Solid Volume: 10.58 in.^3

PRESSURE

Inlet: 54.00 psi
Outlet: 50.00 psi

H3: 6.80 in.
Hc: 6.80 in.

PIPET

Diameter: 0.312 in.
Area: 0.08 in. ^2

Pore Volume: 123.48 cm^3

Initial		Final		H1	H2	Ha	Hb	Time	Flow	Permeability	PVR
date	time	date	time	(in.)	(in.)	(in.)	(in.)	(min.)	(cm^3)	(cm/sec)	(%)
9/15	8:20	9/15	9:50	37.5	35.2	17.3	20.7	90	2.88	4.11E-07	2.3
9/15	9:50	9/15	18:20	35.2	22.8	20.7	33.5	510	18.42	3.66E-07	14.9
9/16	7:48	9/16	13:08	37.8	29.1	16.7	25.7	320	29.32	3.74E-07	23.7
9/16	13:08	9/16	15:47	29.1	25.5	25.7	29.4	159	33.83	3.43E-07	27.4
9/16	15:47	9/16	17:05	25.5	23.9	29.4	31.0	78	35.83	3.29E-07	29.0
9/16	17:06	9/16	18:10	38.3	36.3	16.8	18.8	64	38.34	3.99E-07	31.0
9/16	18:10	9/17	7:14	36.3	18.4	18.8	36.7	784	60.76	3.47E-07	49.2

TWA
4.4×10^{-7}

FALLING HEAD PERMEABILITY DETERMINATION

Job No.: 93-1676
Project: MAGNOLIA LANDFILL

SAMPLE R-13 30-32 KH

Height: 2.00 in.
Diameter: 2.05 in.
Dry Density: 94.98 pcf
Sp. Gr.: 2.70

Area: 3.30 in.^2
Volume: 6.60 in.^3
Solid Volume: 3.72 in.^3

PRESSURE

Inlet: 55.00 psi
Outlet: 50.00 psi

H3: 7.80 in.
Hc: 7.80 in.

PIPET

Diameter: 0.312 in.
Area: 0.08 in. ^2

Pore Volume: 47.19 cm^3

Initial		Final		H1	H2	Ha	Hb	Time	Flow	Permeability	PVR
date	time	date	time	(in.)	(in.)	(in.)	(in.)	(min.)	(cm^3)	(cm/sec)	(%)
9/14	14:31	9/15	7:36	37.9	16.5	17.2	38.8	1025	26.81	3.01E-07	56.8
9/15	7:43	9/15	9:49	35.3	29.9	17.2	24.5	126	33.58	6.58E-07	71.1
9/15	9:49	9/15	18:20	29.9	15.5	24.5	38.7	511	51.62	4.25E-07	109.4
9/16	7:43	9/16	13:07	37.3	22.6	16.2	31.7	324	70.10	6.35E-07	148.5
9/16	13:07	9/16	15:46	22.6	17.2	31.7	37.3	159	76.80	5.48E-07	162.7
9/16	15:46	9/16	17:02	17.2	15.5	37.3	38.8	76	78.93	3.54E-07	167.3
9/16	17:04	9/16	18:10	37.4	33.9	17.1	20.8	66	83.31	6.90E-07	176.5
9/16	18:10	9/17	7:15	33.9	15.5	20.8	38.8	785	106.37	3.43E-07	225.4
9/17	7:25	9/17	9:27	35.9	29.6	17.2	24.0	122	114.26	7.02E-07	242.1

TWA
4.2×10^{-7}

FALLING HEAD PERMEABILITY DETERMINATION

Job No.: 93-1676
Project: MAGNOLIA LANDFILL

SAMPLE R-35 12-14 KH

Height: 2.10 in.
Diameter: 2.05 in.
Dry Density: 76.00 pcf
Sp. Gr.: 2.70

Area: 3.30 in.^2
Volume: 6.93 in.^3
Solid Volume: 3.13 in.^3

PRESSURE

Inlet: 56.00 psi
Outlet: 50.00 psi

H3: 7.20 in.
Hc: 7.20 in.

PIPET

Diameter: 0.312 in.
Area: 0.08 in. ^2

Pore Volume: 62.35 cm^3

Initial		Final		H1	H2	Ha	Hb	Time	Flow	Permeability	PVR
date	time	date	time	(in.)	(in.)	(in.)	(in.)	(min.)	(cm^3)	(cm/sec)	(%)
9/14	14:26	9/15	7:34	37.6	37.5	16.4	17.9	1028	0.13	8.59E-09	0.2
9/15	7:34	9/15	18:20	37.5	37.1	17.9	18.7	646	0.63	9.90E-09	1.0
9/15	18:20	9/16	7:42	37.1	36.7	18.7	19.4	802	1.13	8.02E-09	1.8
9/16	7:42	9/16	13:07	36.7	36.5	19.4	19.7	325	1.38	8.65E-09	2.2
9/16	13:07	9/16	15:45	36.5	36.4	19.7	19.8	158	1.50	7.13E-09	2.4
9/16	15:45	9/16	18:10	36.4	36.3	19.8	20.0	145	1.69	1.17E-08	2.7
9/16	18:10	9/17	7:16	36.3	35.8	20.0	20.6	786	2.26	7.56E-09	3.6

TWA

8.6×10^{-9}

ENGINEERING CALCULATIONS

EARTHWORK MASS BALANCE CALCULATIONS

ATTACHMENT D.1

CLIENT WML - Magnolia Landfill
PROJECT Phase II Redesign
SUBJECT Earth Mass Balance Calculations.
Prepared By ZHA Date 10-22-93
Reviewed By DSK Date 10-22-93
Approved By ____ Date ____

OBJECTIVE: To calculate the earth mass balance at the site and to determine the available quantities of material available for use as clay liner, clay cover, and vegetative soil.

APPROACH: 1) Determine the soil made available by the excavation of cells 12 thru 15.
2) Determine the volume of soil required for clay liner construction, final clay cover, and vegetative soils.
3) Use steps (1) and (2) to determine the earth mass balance.

REFERENCE: "Surveying", by Hoffit and Bouchard, Horvell, Harper, and Low Sixth Edition, 1975, pp-307

ASSUMPTIONS: Cross sections were developped using the elevations from the appropriate soil borings installed July 1993. Any material removed from the area, particularly in the areas of cell 12, is not considered in these calculations. Daily cover volume was excluded from these calculations due to the use of synthetic cover system.

EQUATIONS: * Area of a polygon:

EQ. 1 $$2A = X_1(Y_2 - Y_n) + X_2(Y_3 - Y_1) + \dots + X_{n-1}(Y_n - Y_{n-2}) + X_n(Y_1 - Y_{n-1})$$

where, A = Area of polygon (ft^2)
X_i, Y_i = coordinates at the ends of lines defining the polygon.

* To determine the volume of excavation:

EQ. 2 $$\text{volume} = \text{Avg.}(A_i + A_{i+1}) \cdot L_{A_i, A_{i+1}}$$

where, A_i, A_{i+1} = cross-sectional areas calculated using Eq. 1 (ft^2)

$L_{A_i, A_{i+1}}$ = Distance between A_i and A_{i+1}

* To determine volume of clay liner:

EQ. 3 $V = A \times h$

where, A = Area of base excavation (from Eq. 1) (ft^2)
h = Thickness of clay liner (ft).

* To determine volume of final clay cover & Topsoil

EQ. 4 $V = A \times h$

where, A = Surface Area of final cover (ft^2) (obtained from MRJ's Surface Water Management calculations)...

h = Thickness of final cover or top soil, (ft)

DATA:

1) The section lines used by Rao to calculate the cross-sectional areas used the excavated volume calculations are shown on the attached drawing and are numbered inside a hexagon.

2) The points used to define the base excavation surface area are encircled on the attached drawing.

3) The slope sections used to calculate the surface area of the slopes are surrounded by a square on the attached drawing

4) The areas that have already been covered are numbered inside a triangle on the attached drawing.

5) The coordinate system used in the calculations is shown on the attached drawing.

6) The surface area of the final cover was measured by Robin James in the Surface Water Management Calculation sheets, pp. 14 (attached).

CALCULATIONS:

1) The volume of the excavated material was calculated by Rao Paladugu and reviewed by ZHA and TLR. The calculation sheets are presented in sheets 4 through 6.

Cross sections were defined as shown in the attached calculation sheets and drawing. The area of each cross section was then calculated using EQ.1. The volume of soil excavated between two sections was then calculated using EQ.2.

Cross Section	Area (ft^2)	Avg(A_i, A_{i+1}) (ft^2)	$L_{A_i, A_{i+1}}$ (ft)	Volume (ft^3)	Volume (CY)
1	9,098				
		11,742	383	4,498,000	166,600
2	14,385				
		17,353	440	7,633,320	282,716
3	20,320				
		19,240	447	8,600,280	318,579
4	18,160				
		16,870	443	7,473,410	276,793
5	15,580				
		14,200	441	6,262,200	231,933
6	12,820				
		—	—	—	
6a	4,550				
		5082	1080	5,488,560	203,280
7	5,615				

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT: WASTE MANAGEMENT

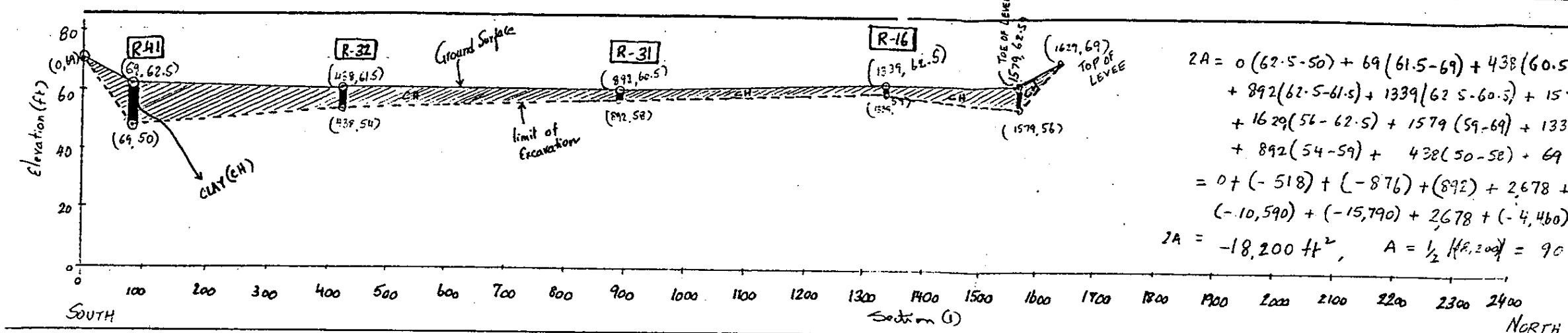
SUBJECT: EARTHWORK BALANCE CALCULATIONS

PROJECT: MAGNOLIA SANITARY LANDFILL

Prepared By: Ran Date: 9.21.93

Reviewed By: ZHA Date:

Approved By: OAK Date: 10-22-93



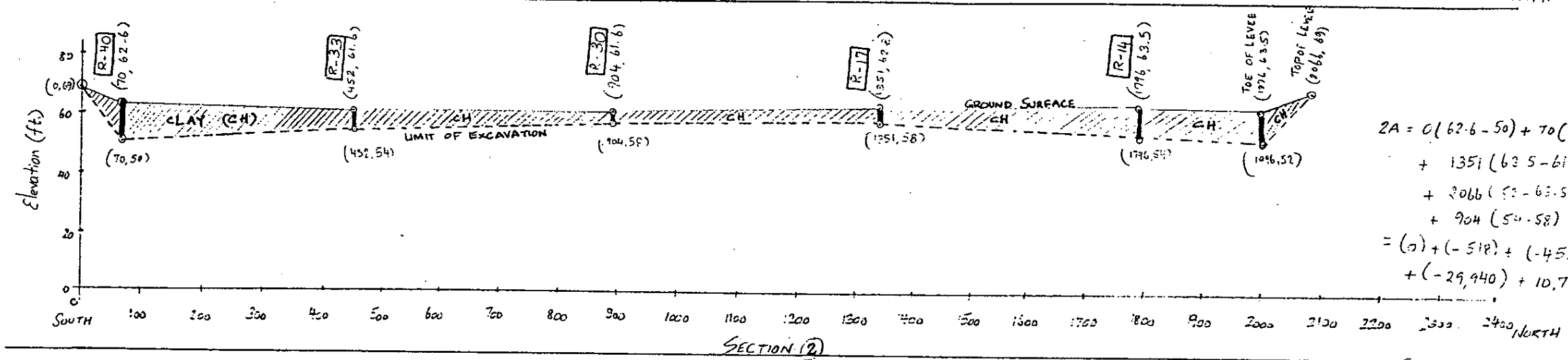
$$2A = 0(62.5-50) + 69(61.5-69) + 438(60.5-62.5) + 892(62.5-61.5) + 1339(62.5-60.5) + 1579(69-62.5) + 1629(56-62.5) + 1579(59-69) + 1339(58-56) + 892(54-59) + 438(50-58) + 69(69-54)$$

$$= 0 + (-518) + (-876) + (892) + 2678 + 10,260 (-10,590) + (-15,790) + 2678 + (-4,460) + (-3,504) + 1035$$

$$2A = -18,200\ ft^2, \quad A = \tfrac{1}{2}|-18,200| = 9098\ ft^2$$

NOTES:

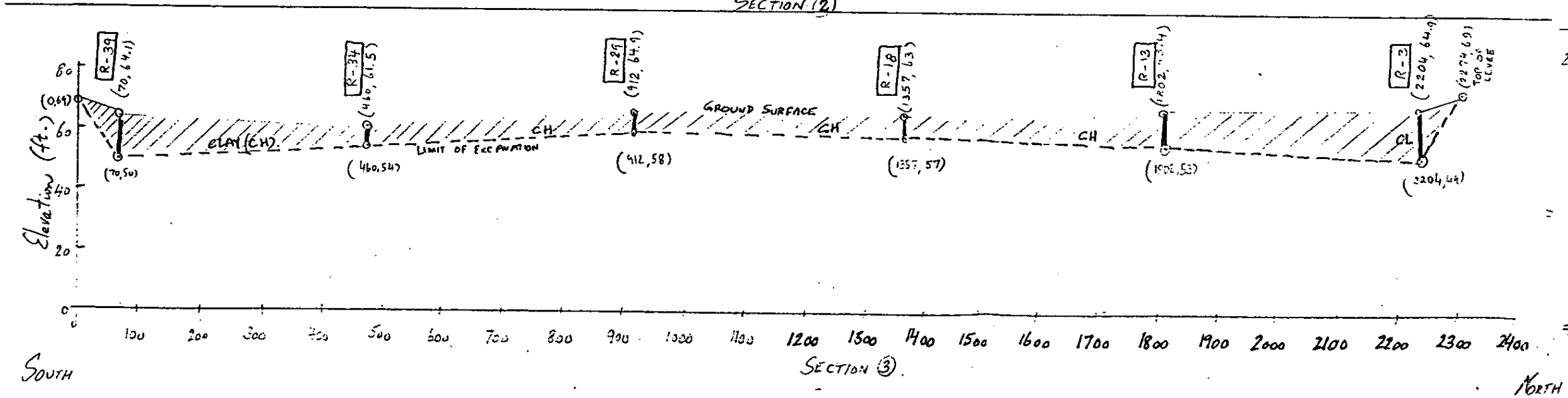
1. Refer to EXCAVATION PLAN (Magnolia) drawing for locations of Sections.
2. Sections are North-South.
3. Boring logs of RUST E&I (June, July 93) were used for ground surface elevations and strata descriptions.



$$2A = 0(62.6-50) + 70(61.6-69) + 452(61.6-62.6) + 904(62.8-61.6) + 1351(63.5-61.6) + 1796(63.5-62.8) + 1996(69-63.5) + 2066(52-63.5) + 1996(54-69) + 1796(58-52) + 1351(56-54) + 904(54-58) + 452(50-58) + 70(69-54)$$

$$= (0) + (-518) + (-452) + 1,035 + 2,567 + 1,257 + 10,780 + (-23,710) + (-29,940) + 10,780 + 5,404 + (-3,616) + (-3,616) + 1050$$

$$= -28,780, \quad A = \tfrac{1}{2}|-28,780| = 14,390\ ft^2$$



$$2A = 0(64.1-50) + 70(61.5-69) + 460(64.9-64.1) + 912(63-61.5) + 1357(63.4-64.9) + 1802(53-63.4) + 2204(49-63.4) + 2274(49-64.9) + 2204(53-69) + 1802(57-49) + 1357(58-53) + 912(54-57) + 460(50-58) + 70(69-54)$$

$$= 0 + (-525) + 368 + 1,368 + (-2,036) + 3,424 + 12,340 + (-36,160) + (-35,260) + 14,420 + 6,785 + (-2,736) + (-3,680) + 1,050$$

$$\Rightarrow 2A = -40,640 \qquad A = \tfrac{1}{2}|-40,640| = 20,320\ ft^2$$

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT: WASTE MANAGEMENT

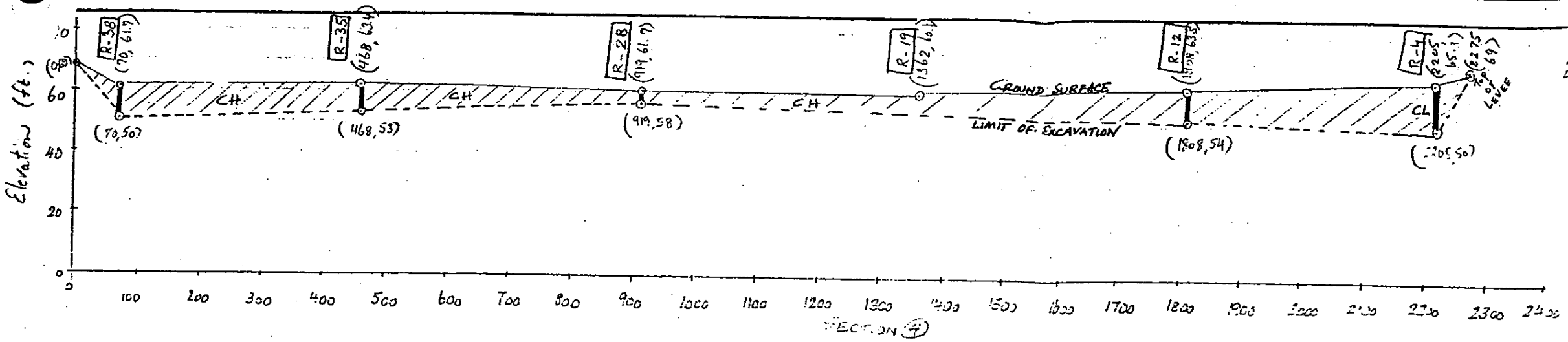
SUBJECT: EARTHWORK BALANCE CALCULATIONS

PROJECT: MAGNOLIA SANITARY LANDFILL

Prepared By: Ran Date: 9.21.93

Reviewed By: ZHA Date:

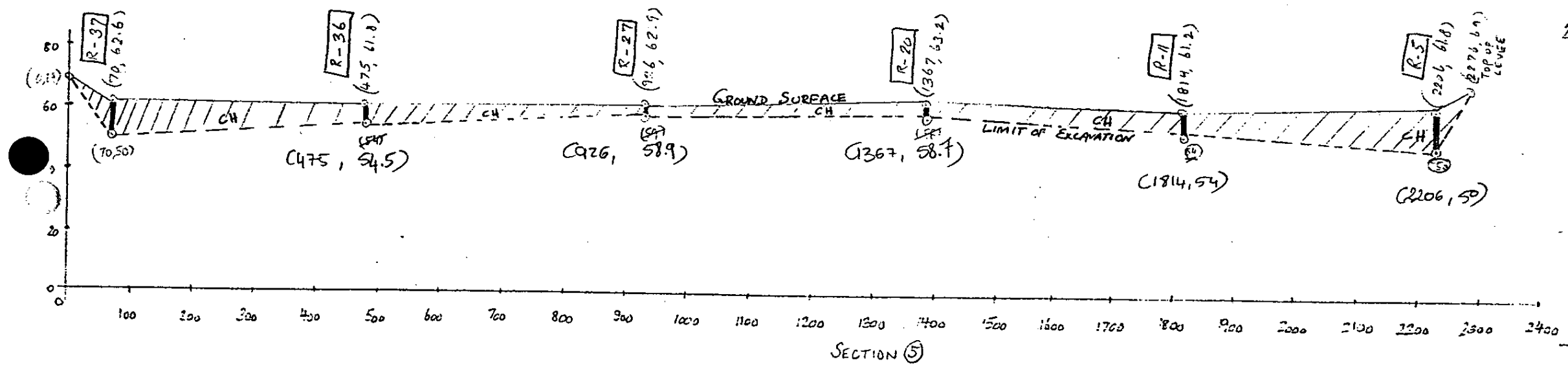
Approved By: DGK Date: 10-22-93



$$2A = 0(61.7-50) + 70(63.4-69) + 468(61.7-61.7) + 919(60.1-63.4) + 1362(63.5-61.7) + 1808(65.1-60.1) + 2205(69-63.5) + 2275(50-65.1) + 2205(54-69) + 1808(58-50) + 919(53-54) + 468(50-58) + 70(69-53)$$

$$= 0 + (-392) + 0 + (-3{,}033) + 2{,}452 + 9{,}040 + 12{,}130 + (-34{,}350) + (-33{,}080) + 14{,}460 + (-919) + (-3{,}744) + 1{,}120$$

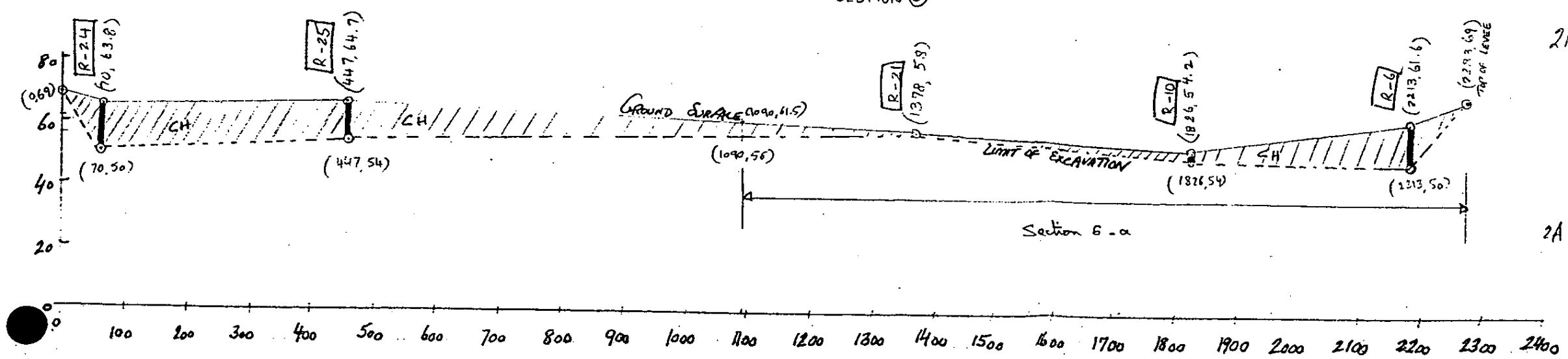
$$2A = -36{,}310 \text{ ft}^2 \qquad A = \tfrac{1}{2}\left|-36{,}310\right| = 18{,}160 \text{ ft}^2 \checkmark$$



$$2A = 0(62.6-50) + 70(61.8-69) + 475(62.9-62.6) + 926(63.2-61.8) + 1367(61.2-62.9) + 1814(61.8-63.2) + 2206(69-61.2) + 2276(50-61.8) + 2206(54-69) + 1814(58-50) + 1367(59-54) + 926(54-58.9) + 475(50-54.5) + 70(69-54)$$

$$= 0 + (-504) + 142 + 1{,}296 + (-2{,}324) + (-2{,}540) + 17{,}210 + (-26{,}860) + (-33{,}090) + 14{,}510 + 6{,}835 + (-3{,}704) + (-4{,}275) + (1{,}050)$$

$$2A = \cancel{-32{,}250}\ -31753, \quad A = \tfrac{1}{2}\left|\cancel{-32{,}250}\ -31753\right| = \cancel{16{,}130}\ 15{,}880 \text{ ft}^2$$



$$2A = 0(63.8-50) + 70(64.7-69) + 447(58-63.8) + 1378(54.2-64.7) + 1826(61.6-58) + 2213(69-54.2) + 2283(50-61.6) + 2213(54-69) + 1826(58-50) + 1378(54-54) + 447(50-58) + 70(69-54)$$

$$2A = 0 + (-301) + (-2{,}593) + (-14{,}470) + 6{,}574 + 32{,}750 + (-26{,}480) + (-33{,}200) + 14{,}610 + 0 + (-3{,}576) + 1{,}050$$

$$2A = -25{,}640 \checkmark$$

$$A = \tfrac{1}{2}\left|-25{,}640\right| = 12{,}820 \text{ ft}^2$$

Area of Section 6-a

$$2A = 1090(58-56) + 1378*(54.2-61.5) + 1826*(61.6-58) + 2213(69-54.2)$$
$$+ 2283(50-61.6) + 2213(54-69) + 1826*(56-50) + 1090*(61.5-54)$$

$$2A = 1090*(2) + 1378*(-7.3) + 1826*(3.6) + 2213*(14.8)$$
$$+ 2283*(-11.6) + 2213*(-15) + 1826*(6) + 1090*(7.5)$$

$$2A = -9100 \text{ ft}^2$$

$$A_{6a} = \left|\frac{2A}{2}\right| = 4550 \text{ ft}^2$$

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415-300

CLIENT: WASTE MANAGEMENT

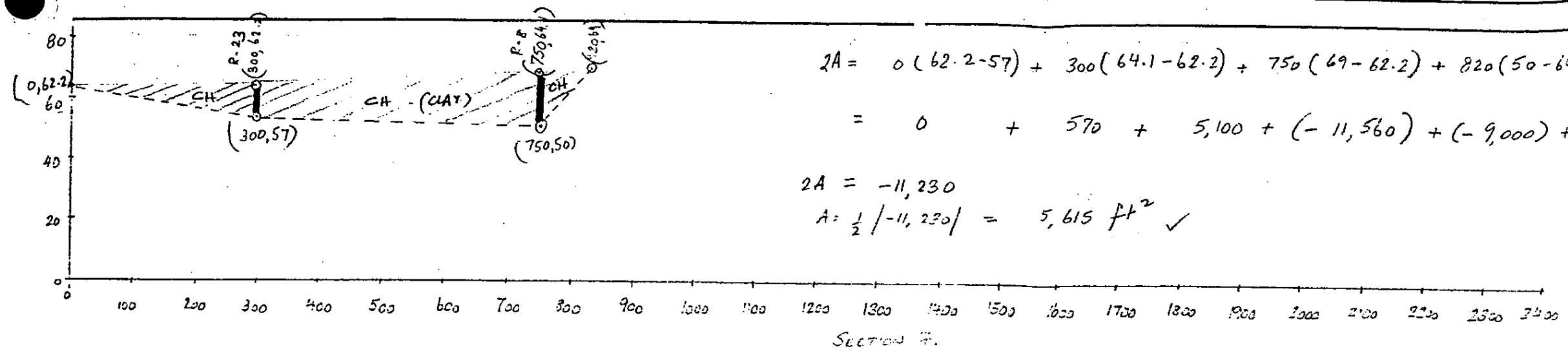
SUBJECT: EARTHWORK BALANCE CALCULATIONS

PROJECT: MAGNOLIA SANITARY LANDFILL

Prepared By: RAO Date: 9.21.93

Reviewed By: ZHA Date: 10-

Approved By: DOK Date: 10-22-93

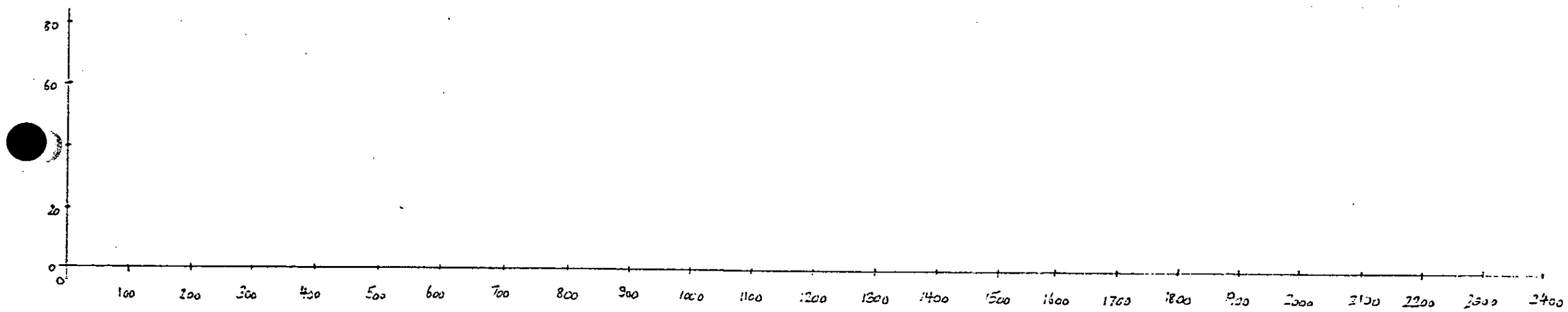


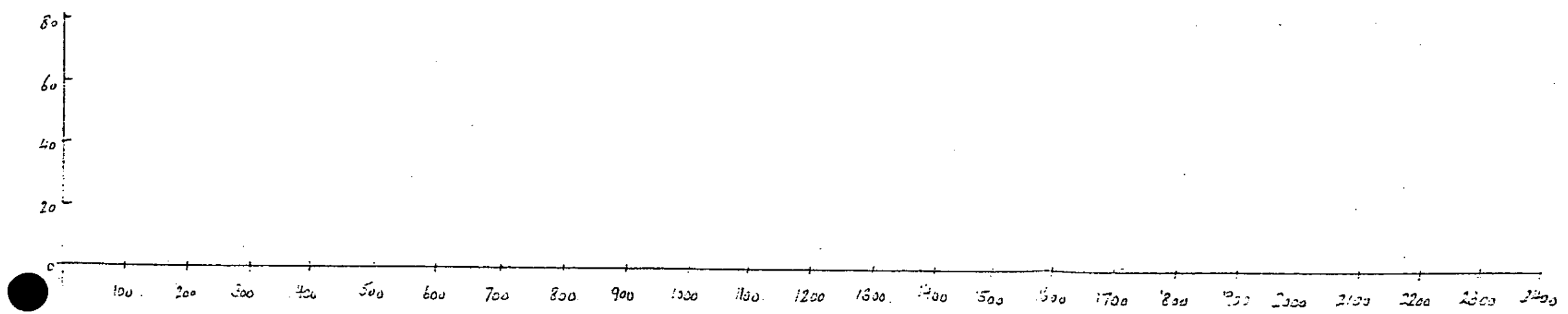
$$2A = 0(62.2-57) + 300(64.1-62.2) + 750(69-62.2) + 820(50-64.1) + 750(57-69) + 300(62.2-50)$$

$$= 0 + 570 + 5{,}100 + (-11{,}560) + (-9{,}000) + 3{,}660$$

$$2A = -11{,}230$$

$$A = \tfrac{1}{2}\,|-11{,}230| = 5{,}615\ ft^2 \checkmark$$





⇒ total volume available thru excavation = 1,479,851 c.y.

2) The coordinates of the points used to define the base excavation area are:

Point	X(ft)	Y(ft)
1	290	345
2	2465	230
3	2500	1760
4	3585	1185
5	3609	1965
6	3270	1990
7	3065	2350
8	965	2455
9	290	340

The surface area of the base excavation then is: From EQ.1

$$A = 0.5 \times \{290 \times (230 - 340) + 2465 \times (1260 - 345) + 2500 \times (1185 - 230) + 3585 \times (1965 - 1260) + 3609 \times (1990 - 1185) + 3270 \times (2350 - 1965) + 3065 \times (2455 - 1990) + 965 \times (340 - 2350) + 290 \times (345 - 2455)\}$$

$$= 0.5 \times \{290 \times (-110) + 2465 \times (915) + 2500 \times (955) + 3585 \times (705) + 3609 \times (805) + 3270 \times (385) + 3065 \times (465) + 965 \times (-2010) + 290 \times (-2110)\}$$

$$= 0.5 \times \{-31,900 + 2,255,475 + 2,387,500 + 2,527,425 + 2,905,245 + 1,258,950 - 1,939,650 - 611,900\}$$

$$= 0.5 \times (10,176,370) \Rightarrow A = 5,088,185 \text{ ft}^2$$

∴ The volume of the Clay liner is

$$V = A \times 3' = 5,088,185 \times 3 = 15,264,555 \text{ ft}^3$$

or $V_{\text{liner, base}} = 565,354$ c.y.

3) The slope sections were determined as stated previously. The sections side lengths, averaged lengths, areas, and corresponding liner volumes are listed below (based on 3' clay liner).

Section	Width 1 (ft)	Width 2 (ft)	Avg. Width (ft)	Length 1 (ft)	Length 2 (ft)	Avg Length (ft)	Area (ft^2)	Volume (ft^3)
1	65	70	65.7	2160	2100	2130	143,775	431,325
2	70	40	55	965	870	917.5	50,462	151,386
3	40	80	60	1585	1570	1552.5	93,150	279,450
4	80	65	72.5	2240	2200	2220	160,950	482,850
5	120	78	99	410	340	375	37,125	111,375
6	65	65	65	410	410	410	26,650	79,950

Total = 1,536,336 ft^3

$\Rightarrow V_{Liner,slopes} = 56,901$ C.Y.

$\Rightarrow$ Total volume of Liner $= V_{Liner,base} + V_{Liner,slopes} = 565,354$ C.Y. + 56,901 C.Y.

$\Rightarrow V_{Liner} = 622,255$ C.Y.

4) The surface area of the final cover was calculated by HRJ in the Surface Water Management Calculation sheets, pp 14, which is attached.

The final cover area was calculated at 8,788,350 ft^2

$\therefore$ the volume of the 1.5-ft clay cover is $= 8,788,350 \times 1.5'$.

or $V_{Total\ cover} = 13,182,525\ ft^3$

or $V_{Total\ cover} = 488,200$ C.Y.

5) The topsoil available at the site can be calculated by multiplying the surface area from part 2 above by the top 6 inches of soil.

$V_{Topsoil\ available} = V_{TSA} = 5{,}088{,}185 \times 0.5' = 2{,}544{,}092\ ft^3$

or $\underline{\underline{V_{TSA} = 94{,}225\ C.Y.}}$

6) A minimum of 1 foot of topsoil will be placed

$\Rightarrow V_{TSR} = \{ \text{Area from Section 4} \times 1 \}$

$= 8{,}788{,}350\ ft^2 \times 1'$
$= 8{,}788{,}350\ ft^3$

or $\underline{\underline{V_{TSR} = 325{,}500\ C.Y.}}$

7) Summation of Earth Mass Balance Calculations:

* Available Soil Volumes

** Volume of Clay liner Available (cells 12-25)	1,479,851 C.Y.
** Volume of topsoil Available	94,225 C.Y.

* Required Soil Volumes

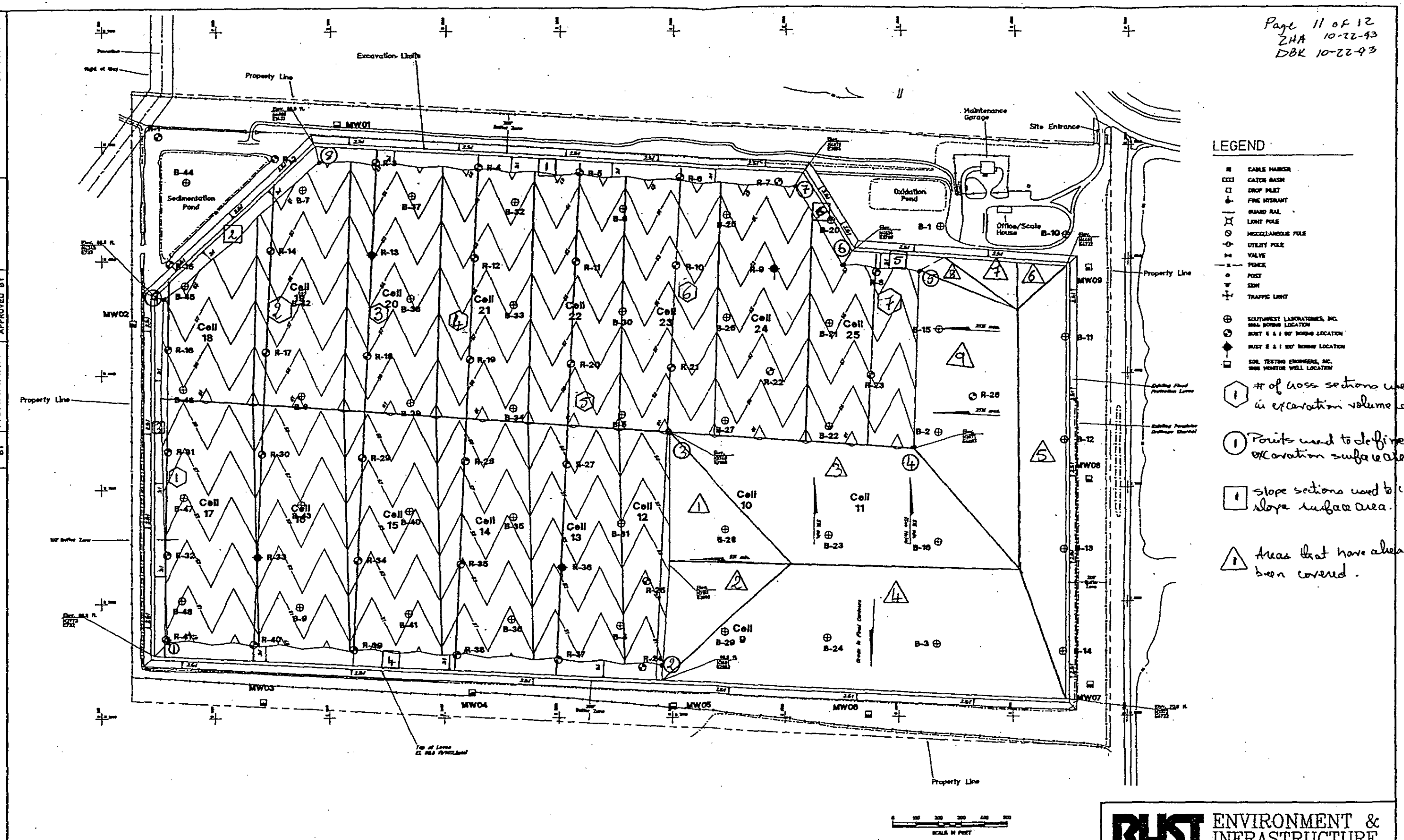
Volume of 3' clay bottom liner (cells 12-25)	565,354 C.Y.
Volume of 3' clay side wall liner	56,901 C.Y.
Volume of 1.5' clay cover (cells 1-25)	488,200 C.Y.
Volume of 1.0' topsoil (cells 1-25)	325,500 C.Y.
** Total Volume of Clay Required	1,110,800 C.Y.
** Total Volume of Topsoil Required	325,500 C.Y.

* Mass Balance

** Clay Liner Material	+ 369,051 C.Y.
** Topsoil Material	- 231,275 C.Y.

CONCLUSION: The volume of soil excavated from cells 12 thru 25 will be sufficient to construct all of the cells bottom liner and top cover system. A volume in excess of 300,000 C.Y. will require removal or may be used as daily cover material.
However, over 200,000 C.Y. of topsoil will have to be imported to the site to compensate for the difference between required and available on-site topsoil.

Page 11 of 12
ZHA 10-22-93
DBK 10-22-93



DRAWING NO. 86415-PS
CHECKED BY / APPROVED BY
DRAWN BY MCNAMARA

RUST ENVIRONMENT & INFRASTRUCTURE

DATE	NO.	REVISION	BY

WASTE MANAGEMENT OF LOUISIANA, INC.
CLIENT

MAGNOLIA SANITARY LANDFILL
OUACHITA PARISH
MONROE, LOUISIANA
PROJECT TITLE

EXCAVATION PLAN

FIG. NO. 2

ATTACHMENT P. 14

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT Waste Management

PROJECT Magnolia Landfill

SUBJECT Surface Water Management – Peak Discharge

Prepared By RMJ Date

Reviewed By ZHA Date 10-22-93

Approved By DBK Date 10-22-93

Drainage Area	Area (FT²)	Area (mi²)	Tc through subarea (HR)	q_u (CSM/IN)	q_p/area (CFS)	q_p total (CFS)
A upper	2,049,450	0.0735	0.76	340	147	
A lower	1,042,000	0.0374	1.21	270	60	207
B upper	620,600	0.0223	0.44	425	56	
B lower	402,400	0.0144	0.53	400	34	90
C upper	371,200	0.0133	0.39	450	35	
C lower	285,450	0.0102	0.39	450	27	62
D upper	1,348,650	0.0484	0.58	380	109	
D lower	600,700	0.0215	0.73	350	44	153
E upper	370,550	0.0133	0.24	540	42	
E lower	107,400	0.0039	0.21	550	13	55
F upper	514,400	0.0185	0.46	430	47	
F lower	97,500	0.0035	0.36	460	9	56
G upper	513,250	0.0184	0.68	350	38	
G lower	464,800	0.0167	0.61	360	35	73

$q_p \quad q_u \quad A_m \quad Q \quad F_p$

$q_{A_U} = (340)(0.0735)(5.9)(1.0) = 147$ cfs

$q_{A_L} = (270)(0.0374)(5.9)(1.0) = 60$ cfs

$q_{B_U} = (425)(0.0223)(5.9)(1.0) = 56$ cfs

$q_{B_L} = (400)(0.0144)(5.9)(1.0) = 34$ cfs

$q_{C_U} = (450)(0.0133)(5.9)(1.0) = 35$ cfs

$q_{C_L} = (450)(0.0102)(5.9)(1.0) = 27$ cfs

$q_{D_U} = (380)(0.0484)(5.9)(1.0) = 109$ cfs

$q_{D_L} = (350)(0.0215)(5.9)(1.0) = 44$ cfs

$q_{E_U} = (540)(0.0133)(5.9)(1.0) = 42$ cfs

$q_{E_L} = (550)(0.0039)(5.9)(1.0) = 13$ cfs

$q_{F_U} = (430)(0.0185)(5.9)(1.0) = 47$ cfs

$q_{F_L} = (460)(0.0035)(5.9)(1.0) = 9$ cfs

$q_{G_U} = (350)(0.0184)(5.9)(1.0) = 38$ cfs

$q_{G_L} = (360)(0.0167)(5.9)(1.0) = 35$ cfs

WASTE VOLUME CALCULATIONS

EARTH TECH

CALCULATION SHEET

CLIENT:	Waste Management of Mississippi, Inc.	PAGE: 1 of 4	
PROJECT:	Magnolia Landfill	PROJECT NO.: 42891	
SUBJECT:	Volume Calculations for Vertical Modification	Prepared By: DLS	Date: 3/01
		Checked By: TE	Date: 3/01

OBJECTIVE:

Determine the Volumes for the Magnolia Landfill with a Vertical Expansion.

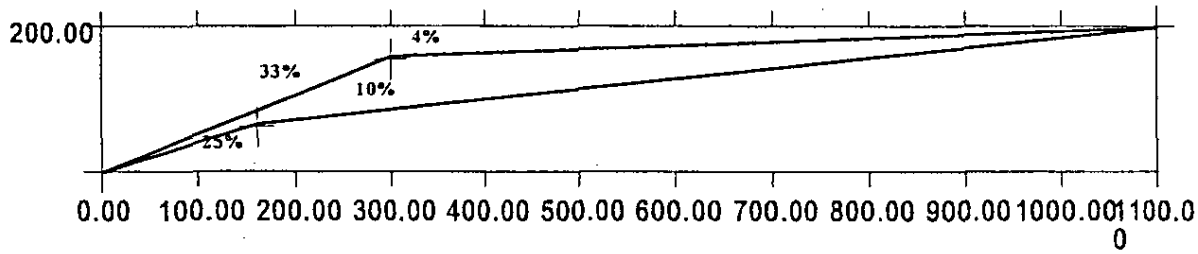
METHOD OF ANALYSIS:

Volumes were calculated using ACAD Eagle Point. These calculations were derived by making surfaces on a newly deigned cap reflecting 33% side slopes and a 4% top. The following methods were used in determining the volumes for the different cases.

- **Volume of vertical expansion over entire landfill including presubtitle D**

  Notes: A slope stability analysis of the proposed vertical expansion has determined that the slopes will be feasible.

SECTION OF LANDFILL COVER TO BE USED IN VOLUME CALCULATIONS.



CALCULATIONS:

Volume of protective and drainage layers over Presubtitle D Area (if lined)

- 2,411,916 ft^2 x 2 ft = 4,823,832 ft^3 / 27 = 178,660 CY

Volume of final cover over Presubtitle D Area

- 2,411,916 ft^2 x 3 ft = 7,235,748 ft^3 / 27 = 267,990 CY

1. **Volume over Presubtitle D Area (Existing topo. vs. Bottom of Permitted Cover) =**
   Existing Topo. vs. top of Permitted Cover = 2,039,611 CY (see AutoCAD Output)
   Less protective, drainage layers, and final cover over Presubtitle D:
   2,039,611 CY - 267,990 CY - 178,660 CY = **1,592,961 CY**

2. **Volume over Presubtitle D Area (Existing Topo. vs. Bottom of Vertical Expansion Cover) =**
   Existing Topo. vs. top of Vertical Expansion Cover = 3,931,094 CY (see AutoCAD Output)
   Less protective, drainage layers, and final cover over Presubtitle D Area:
   3,931,094 CY - 267,990 CY - 178,660 CY = **3,484,444 CY**

3. **Volume over Cells 12-25 (Bottom of Permitted Cover vs. Bottom of Vertical Expansion Cover) =**
   Top of Permitted Cover vs. top of Vertical Expansion Cover = 4,408,932 CY
   Bottom of Permitted Cover vs. Bottom of Vertical Expansion Cover = **4,408,932 CY**

4. **Volume over entire landfill (Bottom of Permitted Cover vs. Bottom of Vertical Cover)=**
   Top of Permitted Cover vs. Top of Vertical Expansion Cover = 6,349,924 CY
   Bottom of Permitted Cover vs. Bottom of Vertical Expansion Cover = **6,349,924 CY**

5. **Volume over entire landfill (Bottom of Permitted Cover vs. Bottom of Vertical Cover + Existing Topo. vs. Bottom of Permitted Cover for Cells 1-11 =**
   Top of Permitted Cover vs. Top of Vertical Expansion Cover = 6,349,924 CY
   Bottom of Permitted Cover vs. Bottom of Vertical Expansion Cover = 6,349,924 CY
   Existing Topo. vs. top of Permitted Cover for Presubtitle D Area = 2,039,611 CY
   Less protective, drainage layers, and final cover over Presubtitle D:
   6,349,924 CY + 2,039,611 CY - 267,990 CY - 178,660 CY = **7,942,885 CY**

CONCLUSIONS:

- Additional volume through lining and vertically expanding the Presubtitled Area yields
  ~ 3,500,000 CY

- Additional volume vertically expanding over Cells 12-25 yields
  ~ 4,400,000 CY

- Additional volume vertically expanding over Cells 12-25 including half of the presubtitled Area yields:
  ~ 4,800,000CY

- Total additional through site-wide vertical expansion
  ~ 7,900,000CY

Prismoidal Volume Results

Original Surface Model:	Newcover3-19
Final Surface Model:	cover1121
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	6349924.16 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	6349924.16 cu yd
	3536.21 cu yd
Raw Fill Volume:	
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	3536.21 cu yd

Prismoidal Volume Results 3-19-2001

Original Surface Model:	cover1121
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	1807.08 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	1807.08 cu yd
	4408932.02 cu yd
Raw Fill Volume:	
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	4408932.02 cu yd

Edge of road Area = 8539008.35, Perimeter = 11997.52

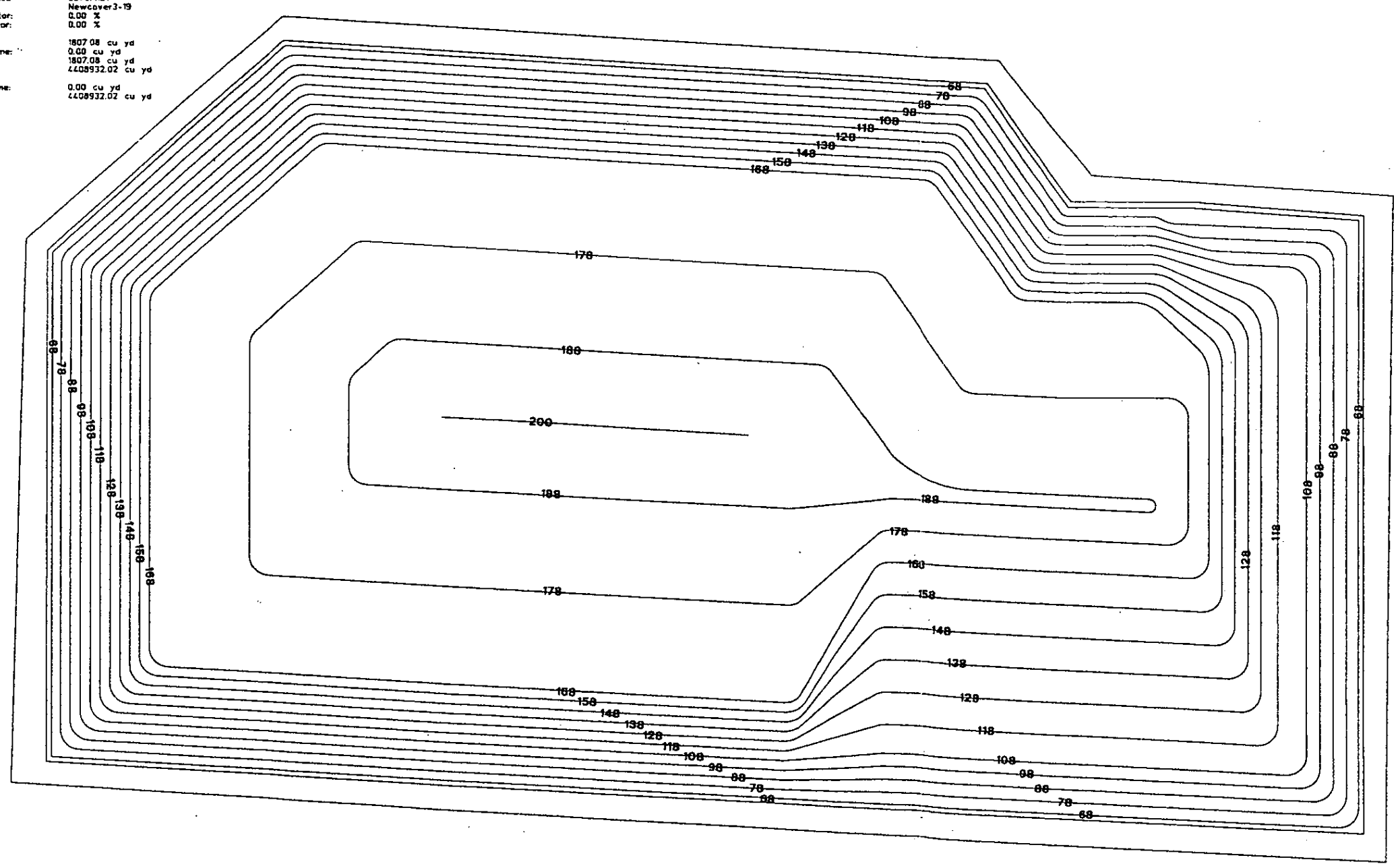
Prismoidal Volume Results 3-19-2001

Original Surface Model:	cover1121
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	3536.20 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	3536.20 cu yd
	6349924.18 cu yd
Raw Fill Volume:	
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	6349924.18 cu yd

Cells 1-10 Area = 2411916.13, Perimeter = 7306.33

Prismoidal Volume Results 3-19-2001

Original Surface Model:	existtopo
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	2766.43 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	2766.43 cu yd
	3913094.28 cu yd
Raw Fill Volume:	
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	3913094.28 cu yd



Prismoidal Volume Results

Original Surface Model:	existtopo
Final Surface Model:	cover1121
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	29964.44 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	29964.44 cu yd
Raw Fill Volume:	2039611.48 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	2039611.48 cu yd

Edge of road Area = 8539008.35, Perimeter = 11997.52

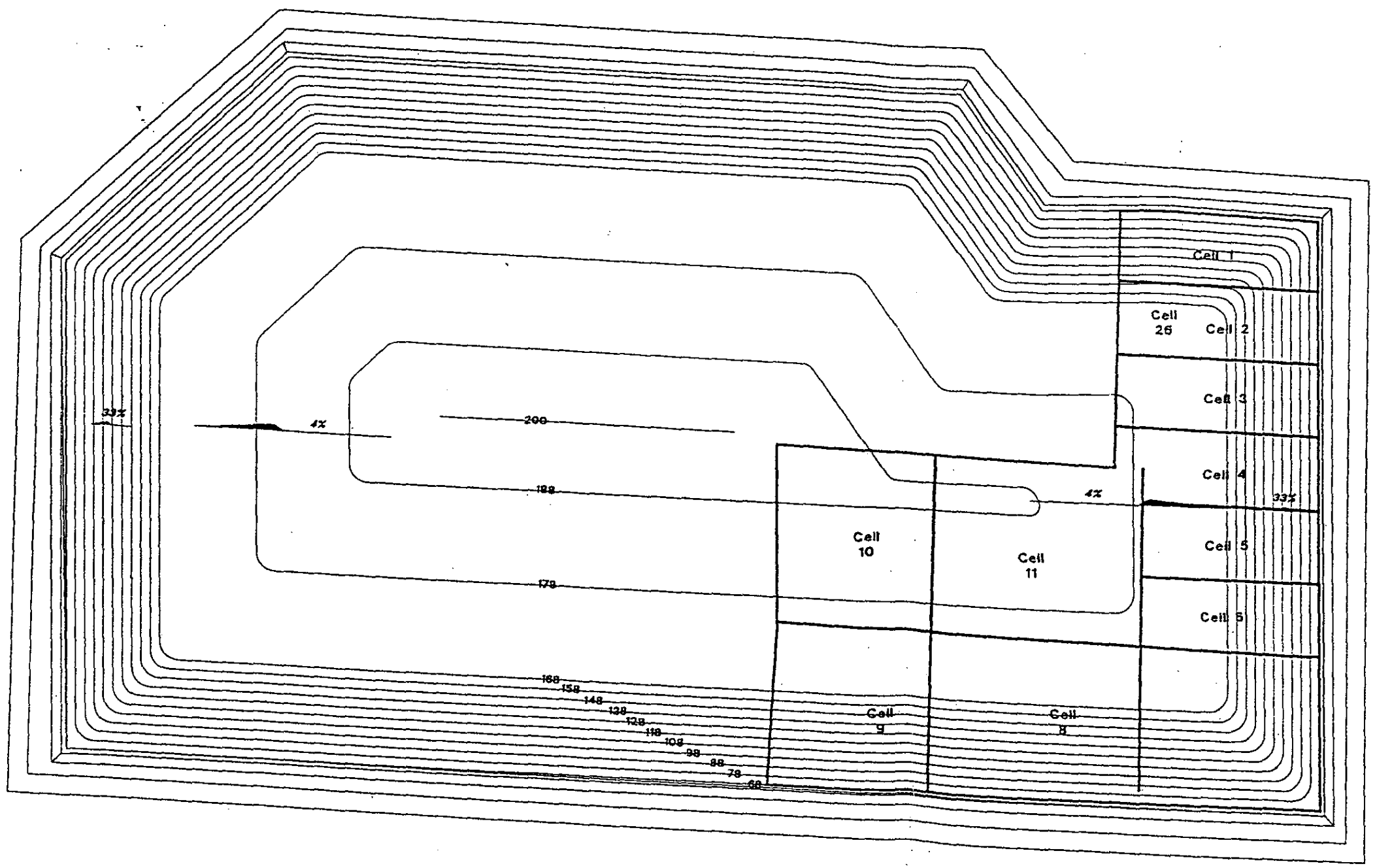
Prismoidal Volume Results 3-19-2001

Original Surface Model:	cover1121
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	2538.20 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	2538.20 cu yd
	6369924.18 cu yd
Raw Fill Volume:	
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	6369924.18 cu yd

Cells 1-10 Area = 2419916.13, Perimeter = 7306.33

Prismoidal Volume Results 3-19-2001

Original Surface Model:	existtopo
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	2766.43 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	2766.43 cu yd
	3912094.28 cu yd
Raw Fill Volume:	
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	3912094.28 cu yd



Prismoidal Volume Results

Original Surface Model:	existtopo
Final Surface Model:	cover1121
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	29964.44 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	29964.44 cu yd
Raw Fill Volume:	2039611.48 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume	2039611.48 cu yd

Prismoidal Volume Results

Original Surface Model:	Newcover3-19
Final Surface Model:	cover1121
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	6349924.16 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	6349924.16 cu yd
Raw Fill Volume:	3536.21 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	3536.21 cu yd

Prismoidal Volume Results 3-19-2001

Original Surface Model:	cover1121
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	1807.08 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	1807.08 cu yd
Raw Fill Volume:	4408932.02 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	4408932.02 cu yd

Edge of road Area = 8539008.35, Perimeter = 11997.52

Prismoidal Volume Results 3-19-2001

Original Surface Model:	cover1121
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	3536.20 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	3536.20 cu yd
Raw Fill Volume:	6349924.18 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	6349924.18 cu yd

Cells 1-10 Area = 2471916.13, Perimeter = 7306.33

Prismoidal Volume Results 3-19-2001

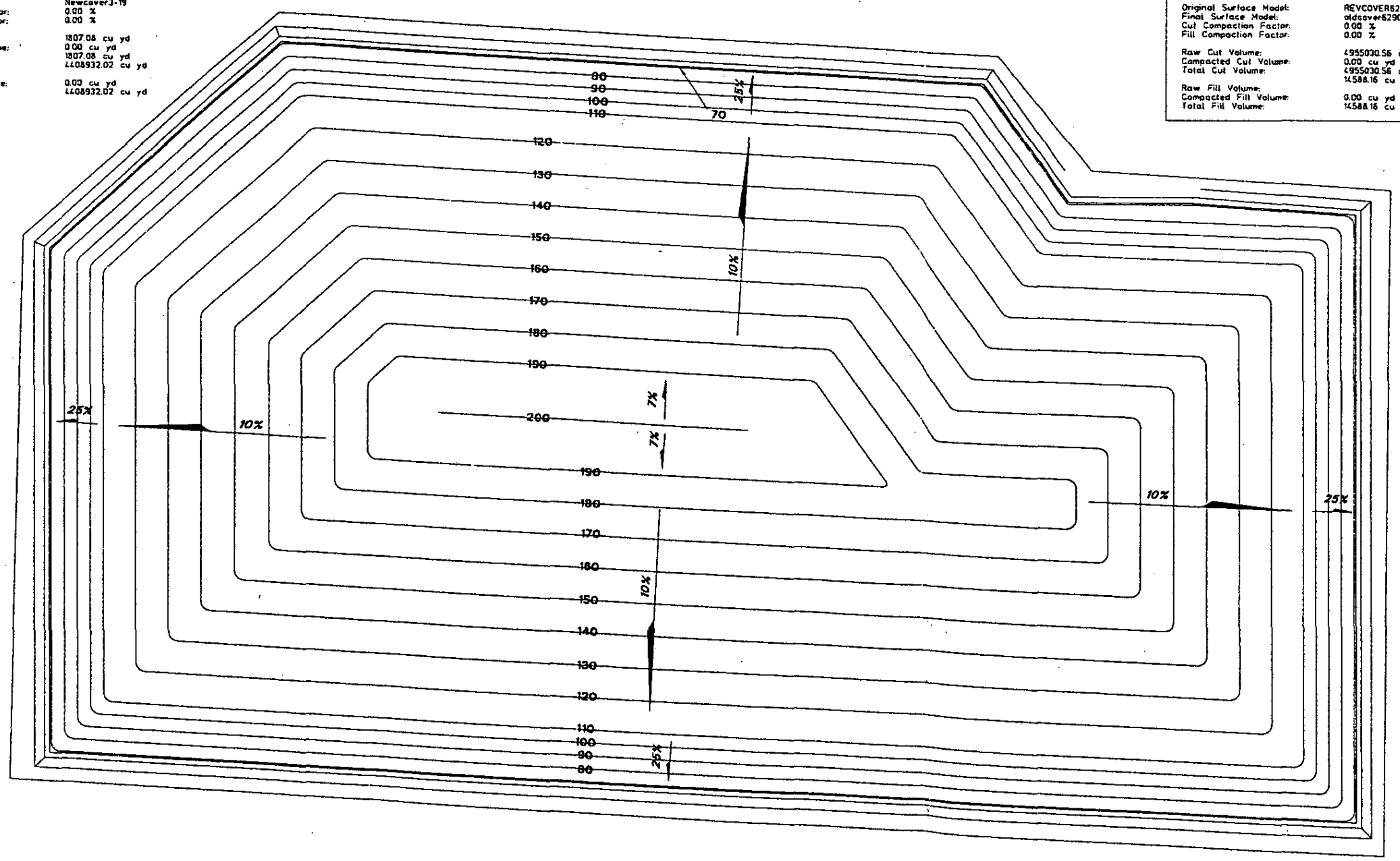
Original Surface Model:	existtopo
Final Surface Model:	Newcover3-19
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	2766.43 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	2766.43 cu yd
Raw Fill Volume:	3913094.28 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	3913094.28 cu yd

Prismoidal Volume Results

Original Surface Model:	REVCOVER62801
Final Surface Model:	oldcover62901
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	4955030.56 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	4955030.56 cu yd
Raw Fill Volume:	14588.16 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	14588.16 cu yd

Prismoidal Volume Results

Original Surface Model:	oldcover62901
Final Surface Model:	REVCOVER62801
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	14588.16 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	14588.16 cu yd
Raw Fill Volume:	4955031.27 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	4955031.27 cu yd



Prismoidal Volume Results

Original Surface Model:	existtopo
Final Surface Model:	cover1121
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	29964.44 cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	29964.44 cu yd
Raw Fill Volume:	2039611.48 cu yd
Compacted Fill Volume:	0.00 cu yd
Total Fill Volume:	2039611.48 cu yd

BASAL HEAVE CALCULATIONS

CLIENT WML - Magnolia Landfill SUBJECT Basal Heave Calculation

PROJECT Phase II Redesign

Prepared By TR Date 8/4/93

Reviewed By DBK Date 10/11/93

Approved By ____ Date ____

OBJECTIVE: Determine the maximum depth of excavation at borehole locations for Magnolia Landfill.

APPROACH: Perform basal heave calculations for all RUST E & I borehole locations within the Phase II re-design area using the following equation (from Ref. 1):

$$FS = \frac{h_s \gamma_s}{h_w \gamma_w}$$; where: FS = Factor of Safety
h_s = thickness of overburden (ft)
h_w = piezometric head (ft)
γ_w = unit weight of water
γ_s = unit weight of soil

Soil strata information will be obtained from borehole logs (RUST E & I).

DATA/ASSUMPTIONS:

- h_w, piezometric head data will be determined based on typical groundwater level measurements in the nine site monitoring wells. See Potentiometric map on page 5
- γ_w = 62.4 pcf
- γ_s = 110 pcf
- F.S. = 1.1 (minimum)

CLIENT WMI - Magnolia Landfill SUBJECT Basal Heave Calculation

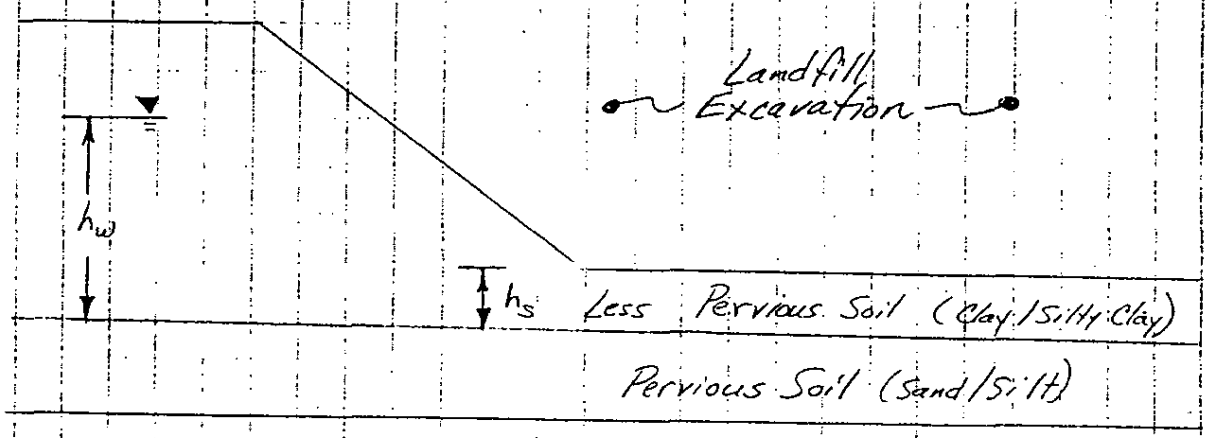
PROJECT

Prepared By TLR Date 8/4/93

Reviewed By DBK Date 10/11/93

Approved By ____ Date ____

GEOMETRY:



CALCULATIONS:

$$F.S. = \frac{h_s \gamma_s}{h_w \gamma_w} \longrightarrow h_s = \frac{(F.S.)(h_w)(\gamma_w)}{\gamma_s}$$

$$= \frac{(1.1)(h_w)(62.4\,pcf)}{110\,pcf}$$

$$= 0.624\, h_w$$

h_s is tabulated on the following page for each of the RUST borings located within the proposed excavation. Also listed is the excavation elevation (top of sand elevation + h_s) with a F.S. = 1.1.

h_w on the table was determined from the potentiometric map (attached) for water levels measured on April 9, 1987 (historical high level).

3/6
DBK
10/23/93

BASAL HEAVE CALCULATIONS
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

Coordinates North	Coordinates East	Boring No.	Ground Elev. (ft)	Ground-water Elev. (ft)	Soil Elev. (ft)	hw (ft)	hs (ft)	Min. Excav. Elev. (ft)	Max. Depth (ft)	Design Excav. Elev. (ft)
4820	970	R-1	65.1	54.2	42.1	12.1	7.6	49.7	15.4	NA
4946	1256	R-2	62.0	54.0	32.0	22.0	13.7	45.7	16.3	NA
4928	1696	R-3	64.9	53.7	23.9	29.8	18.6	42.5	22.4	49.0
4906	2143	R-4	65.1	53.6	37.1	16.5	10.3	47.4	17.7	50.0
4884	2587	R-5	61.8	53.6	36.8	16.8	10.5	47.3	14.5	51.5
4682	3027	R-6	61.6	53.6	29.6	24.0	15.0	44.6	17.0	49.5
4840	3467	R-7	62.7	53.5	35.7	17.8	11.1	46.8	15.9	52.5
4442	3894	R-8	64.1	53.1	35.1	18.0	11.2	46.3	17.8	53.3
4459	3451	R-9	54.3	53.3	34.3	19.0	11.9	46.2	8.1	53.5
4475	3011	R-10	54.2	53.4	27.2	26.2	16.3	43.5	10.7	53.8
4492	2570	R-11	61.2	53.4	26.2	27.2	17.0	43.2	18.0	54.0
4509	2126	R-12	63.5	53.5	24.5	29.0	18.1	42.6	20.9	53.5
4526	1679	R-13	63.4	53.5	23.4	30.1	18.8	42.2	21.2	53.0
4543	1239	R-14	63.5	53.6	43.5	10.1	6.3	49.8	13.7	53.7
4557	798	R-15	63.0	53.4	37.0	16.4	10.2	47.2	15.8	NA
4112	792	R-16	62.5	53.3	38.5	14.8	9.2	47.7	14.8	59.0
4098	1220	R-17	62.8	53.2	36.8	16.4	10.2	47.0	15.8	58.0
4081	1660	R-18	63.0	53.2	37.0	16.2	10.1	47.1	15.9	57.5
4063	2107	R-19	60.1	53.1	29.1	24.0	15.0	44.1	16.0	58.0
4045	2551	R-20	63.2	53.1	31.2	21.9	13.7	44.9	18.3	58.5
4027	2992	R-21	58.0	53.0	34.0	19.0	11.9	45.9	12.1	58.5
4009	3432	R-22	55.0	52.8	35.0	17.8	11.1	46.1	8.9	57.8
3992	3874	R-23	62.2	52.7	30.2	22.5	14.0	44.2	18.0	57.0
2719	2867	R-24	63.8	52.1	23.8	28.3	17.7	41.5	22.3	49.5
3096	2885	R-25	64.7	52.4	22.7	29.7	18.5	41.2	23.5	53.0
3898	4319	R-26	62.2	52.6	36.2	16.4	10.2	46.4	15.8	58.0

Note:
NA

4/6
DBK 10/23/93

BASAL HEAVE CALCULATIONS
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA
(Continued)

Coordinates North	Coordinates East	Boring No.	Ground Elev. (ft)	Ground-water Elev. (ft)	Soil Elev. (ft)	hw (ft)	hs (ft)	Excav. Elev. (ft)	Max. Depth (ft)	Design Excav. Elev. (ft)
3604	2532	R-27	62.9	52.7	35.9	16.8	10.5	46.4	16.5	59.0
3620	2088	R-28	61.7	52.7	28.7	24.0	15.0	43.7	18.0	58.0
3636	1641	R-29	64.9	52.7	41.9	10.8	6.7	48.6	16.3	57.5
3651	1201	R-30	61.6	52.7	47.6	5.1	3.2	50.8	10.8	58.0
3665	791	R-31	60.5	52.8	34.5	18.3	11.4	45.9	14.6	58.0
3211	787	R-32	61.5	52.6	49.5	3.1	1.9	51.4	10.1	54.0
3199	1182	R-33	61.6	52.5	47.6	4.9	3.1	50.7	10.9	53.8
3184	1621	R-34	61.5	52.4	45.5	6.9	4.3	49.8	11.7	53.0
3169	2069	R-35	63.4	52.3	25.4	26.9	16.8	42.2	21.2	53.0
3153	2512	R-36	61.8	52.3	37.8	14.5	9.0	46.8	15.0	54.0
2748	2495	R-37	62.6	52.1	40.6	11.5	7.2	47.8	14.8	49.5
2771	2052	R-38	61.7	52.0	29.7	22.3	13.9	43.6	18.1	49.0
2794	1605	R-39	64.1	52.2	44.1	8.1	5.1	49.2	14.9	50.0
2817	1165	R-40	62.6	52.3	47.6	4.7	2.9	50.5	12.1	50.5
2842	782	R-41	62.5	52.4	48.5	3.9	2.4	50.9	11.6	50.5

NOTES:
1. Groundwater elevations based on typical levels
2. NA = Not Applicable. No excavation planned at this boring location

CLIENT WNL - Magnolia landfill
SUBJECT Basal Heave Calculations
PROJECT Phase II Redesign

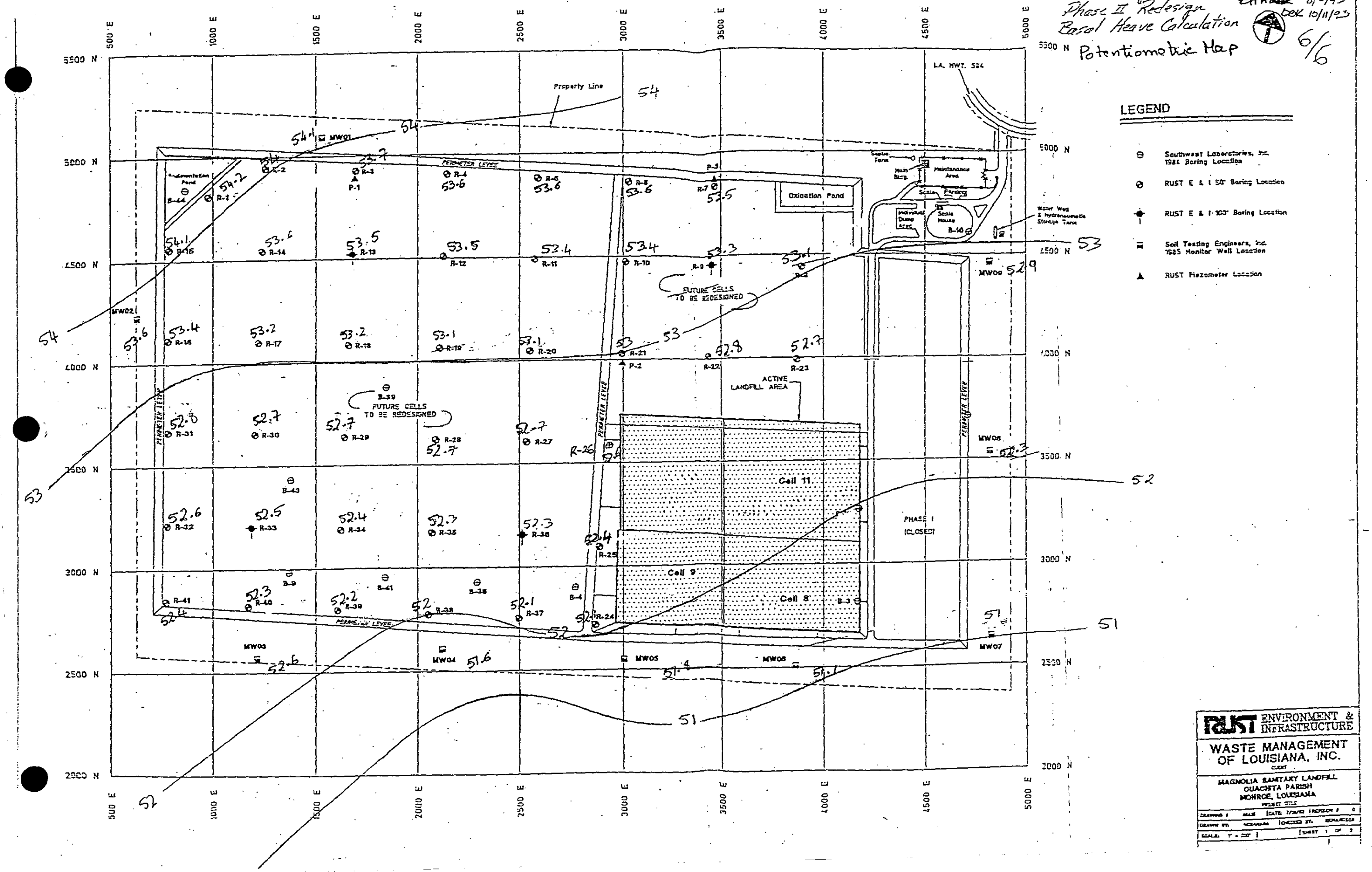
Prepared By ZHA Date 10-22-93
Reviewed By DBK Date 10-23-93
Approved By ____ Date ____

CONCLUSION: The minimum excavation elevations at all the RUST E&I borings at the site were calculated. The minimum excavation elevation is at boring R-32 at 51.4' NGVD.

It is important that the design excavation be always at higher elevations than the minimum elevations allowed if a F.S. of 1.1 is to be maintained and a bottom uplift prevented under long term conditions.

WML - Magnolia Landfill
Phase II Redesign
Basal Heave Calculation
Potentiometric Map

Page 6 of 6
8/1/93
DCK 10/11/93
6/6



RUST ENVIRONMENT & INFRASTRUCTURE

WASTE MANAGEMENT OF LOUISIANA, INC.
CLIENT

MAGNOLIA SANITARY LANDFILL
OUACHITA PARISH
MONROE, LOUISIANA
PROJECT TITLE

DRAWING #		DATE 7/26/93	REVISION # C
DRAWN BY		CHECKED BY	
SCALE 1" = 200'		SHEET 1 OF 3	

SLOPE STABILITY CALCULATIONS

EARTH TECH

CALCULATION SHEET

CLIENT:	Waste Management of Louisiana, Inc.	PAGE: 1 of 3	
PROJECT:	Magnolia Landfill	PROJECT NO.: 42891	
SUBJECT:	Slope Stability Calculations for Vertical Modification	Prepared By: TB	- Date: 10/00
		Checked By:	- Date:

OBJECTIVE:

Analyze the long-term slope stability of the final landfill configuration.

METHOD OF ANALYSIS:

Use program GEOSLOPE to find the most critical failure surface and the corresponding factor of safety using the simplified bishop procedure.

ASSUMPTIONS:

All the layers and their properties are listed on the attached drawing and output file.

CALCULATIONS:

The program analyzed failure surfaces until a most critical factor of safety was determined. The minimum factor of safety for the long-term condition is 1.657. The output file containing the information pertinent to the most critical surface is attached.

Layer No.	Total Unit Weight	Saturated Unit Weight	Cohesion Intercept	Friction Angle (DEG)
1	110	115	1000	0
2	65	70	200	28
3	95	100	0	35
4	100	100	0	8
5	110	115	0	10
6	110	115	200	17
7	115	120	100	17
8	110	115	0	25
9	115	120	0	30
10	140	140	1000	20

CONCLUSION:

The GEOSLOPE program using the stated soil parameters and slope geometry generated a minimum factor of safety of 1.657. This factor of safety is in excess of the minimum standard 1.5 for long-term conditions. Therefore, no stability problems are anticipated for the design slopes.

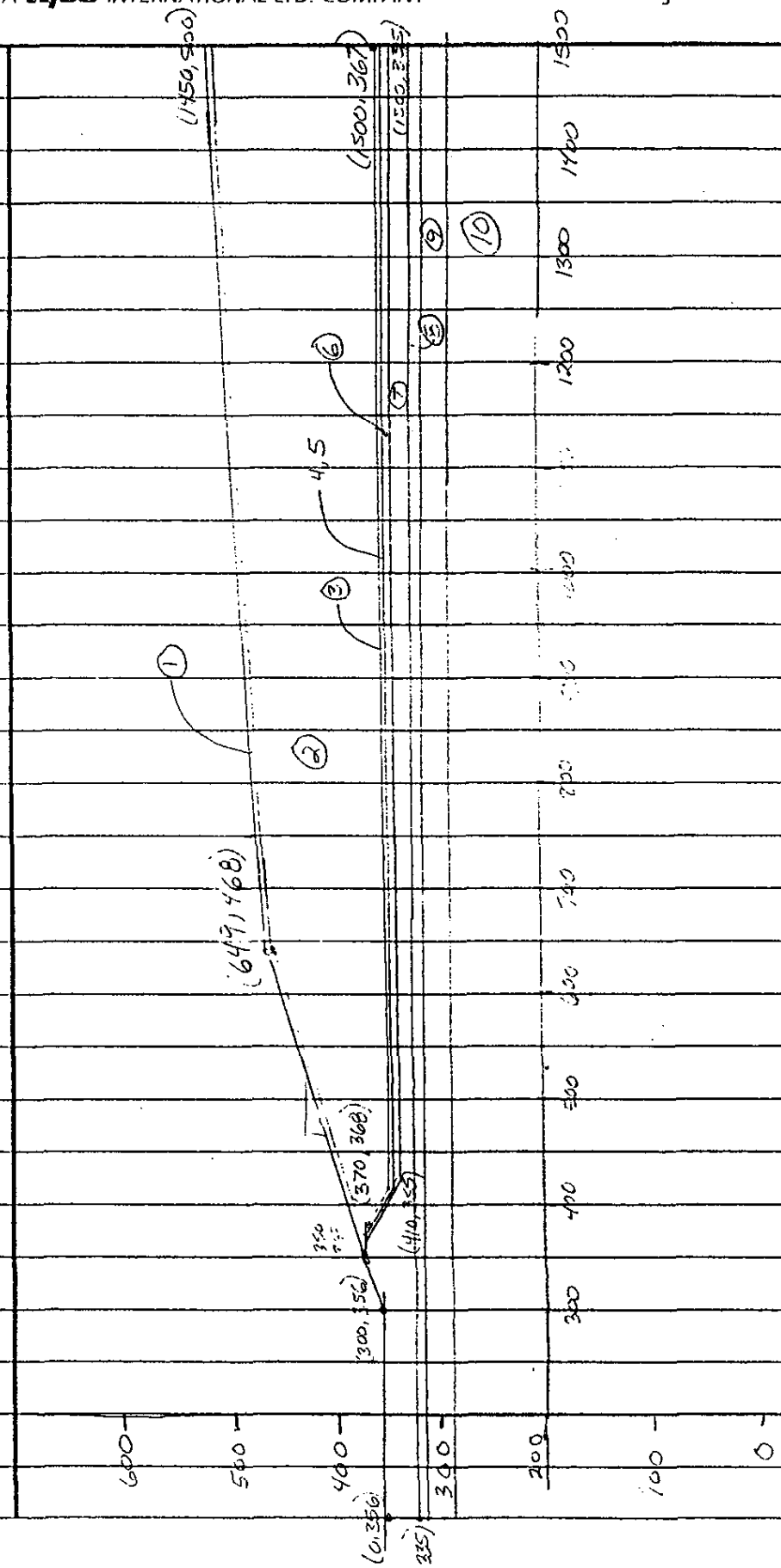
EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

Date: 10/00

Client: WMLA

Project No.: 42891



GEOSLOPE
Version 4.20

Supplied by GEOCOMP Corp.
342 Sudbury Rd., Concord, MA. 01742
(617) 369-8304

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GEOSLOPE is based on the program, STABL3, developed at Purdue University under sponsorship of the Federal Highway Administration.

GEOCOMP Corp. has modified the program to run on various microcomputers and plotting devices.

GEOCOMP Corp. makes no warranties as to the fitness of this software. The user bears all responsibility for accuracy and correctness of results produced by this software. See the users manual for further warranty information.

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

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

PROBLEM DESCRIPTION MAGNOLIA LANDFILL

BOUNDARY COORDINATES

5 TOP BOUNDARIES
22 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	356.00	300.00	356.00	7
2	300.00	356.00	348.00	368.00	7
3	348.00	368.00	350.00	368.00	7
4	350.00	368.00	649.00	468.00	1
5	649.00	468.00	1450.00	500.00	1
6	350.00	368.00	362.00	368.00	7
7	362.00	368.00	369.60	368.00	6
8	370.00	368.00	649.00	465.50	2
9	649.00	465.50	1450.00	497.50	2
10	369.60	368.00	370.00	368.00	4
11	370.00	368.00	410.00	355.00	4

12	410.00	355.00	1450.00	367.00	3
13	410.00	355.00	416.00	353.00	4
14	416.00	353.00	1450.00	365.00	4
15	369.80	368.00	416.00	352.80	5
16	416.00	352.80	1450.00	364.80	5
17	369.60	368.00	416.00	352.60	6
18	362.00	368.00	416.00	350.00	7
19	416.00	350.00	1450.00	361.00	7
20	.00	335.00	1450.00	335.00	8
21	.00	325.00	1450.00	330.00	9
22	.00	287.00	1450.00	287.00	10

ISOTROPIC SOIL PARAMETERS

10 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	110.0	115.0	1000.0	.0	.00	.0	1
2	65.0	70.0	200.0	28.0	.00	.0	1
3	95.0	100.0	.0	35.0	.00	.0	1
4	100.0	100.0	.0	8.0	.00	.0	1
5	110.0	115.0	.0	10.0	.00	.0	1
6	110.0	115.0	200.0	17.0	.00	.0	1
7	115.0	120.0	100.0	17.0	.00	.0	1
8	110.0	115.0	.0	25.0	.00	.0	1
9	115.0	120.0	.0	30.0	.00	.0	1
10	140.0	140.0	1000.0	20.0	.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	356.00
2	1450.00	367.00

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

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 200.00
AND X = 400.00

EACH SURFACE TERMINATES BETWEEN X = 600.00
AND X = 800.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y =200.00

10.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

RESTRICTIONS HAVE BEEN IMPOSED UPON THE ANGLE OF INITIATION.
THE ANGLE HAS BEEN RESTRICTED BETWEEN THE ANGLES OF -45.0 AND .0 DEG.

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.

1
Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 1 SPECIFIED BY 42 COORDINATE POINTS

SAFETY FACTOR = 1.657

X-CENTER = 396.75
Y-CENTER = 652.45
RADIUS = 315.46

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	288.89	356.00	-19.09
2	298.34	352.73	-17.27
3	307.89	349.76	-15.45
4	317.53	347.10	-13.64
5	327.25	344.74	-11.82
6	337.03	342.69	-10.00
7	346.88	340.95	-8.19
8	356.78	339.53	-6.37
9	366.72	338.42	-4.56
10	376.69	337.62	-2.74
11	386.67	337.15	-.92
12	396.67	336.99	.89
13	406.67	337.14	2.71
14	416.66	337.61	4.53
15	426.63	338.40	6.34
16	436.57	339.51	8.16
17	446.47	340.93	9.97
18	456.32	342.66	11.79
19	466.11	344.70	13.61
20	475.82	347.06	15.42
21	485.46	349.71	17.24
22	495.02	352.68	19.06

23	504.47	355.94	20.87
24	513.81	359.51	22.69
25	523.04	363.36	24.50
26	532.14	367.51	26.32
27	541.10	371.95	28.14
28	549.92	376.66	29.95
29	558.58	381.65	31.77
30	567.08	386.92	33.59
31	575.41	392.45	35.40
32	583.57	398.24	37.22
33	591.53	404.29	39.04
34	599.30	410.59	40.85
35	606.86	417.13	42.67
36	614.21	423.91	44.48
37	621.35	430.92	46.30
38	628.26	438.15	48.12
39	634.93	445.59	49.93
40	641.37	453.24	51.75
41	647.56	461.10	53.57
42	652.77	468.15	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	293.61	9.45	1854.09	.00	2410.12	1228.98	830.18
2	299.17	1.66	702.91	.00	629.00	409.42	180.45
3	303.94	7.89	5678.50	.00	3772.52	3192.45	1087.50
4	312.71	9.64	12392.39	.00	6204.52	7186.04	1929.20
5	322.39	9.72	18130.89	.00	7817.33	11500.73	2725.22
6	332.14	9.79	23597.10	.00	9238.29	15598.70	3481.25
7	341.96	9.85	28762.08	.00	10465.92	19480.78	4197.46
8	347.44	1.12	3571.45	.00	1252.80	2429.75	516.47
9	349.00	2.00	6470.88	.00	2269.45	4402.50	934.15
10	353.39	6.78	23294.40	.00	7976.81	16042.89	3373.06
11	359.39	5.22	19580.70	.00	6388.45	13630.20	2831.64
12	364.36	4.72	18852.41	.00	5948.27	13327.93	2745.32
13	368.16	2.88	12035.04	.00	3696.92	8515.35	1745.49
14	369.70	.20	848.69	.00	258.17	603.04	123.36
15	369.90	.20	850.61	.00	258.43	604.73	123.68
16	373.34	6.69	28781.92	.00	8764.39	20441.51	4176.00
17	381.68	9.99	44002.23	.00	13422.12	30932.41	6310.18
18	387.91	2.47	11026.87	.00	3361.59	7691.98	1568.11
19	392.91	7.53	33879.90	.00	10307.19	23654.76	4818.51
20	396.68	.02	70.15	.00	21.31	48.69	9.92
21	396.90	.43	1937.76	.00	588.48	1345.25	274.03
22	397.38	.52	2373.42	.00	720.51	1647.97	335.68
23	402.16	9.03	40996.87	.00	12387.49	28523.84	5807.39
24	408.34	3.33	15146.27	.00	4548.33	10513.59	2140.71
25	413.00	6.00	27462.68	.00	8130.65	19178.18	3900.66
26	416.33	.66	3046.35	.00	890.03	2139.17	434.58
27	421.65	9.97	46612.94	.00	13222.55	33006.43	6692.81
28	431.60	9.94	47487.69	.00	12678.86	34330.23	6937.04
29	441.52	9.90	47925.81	.00	11938.44	35453.16	7144.21
30	451.39	9.85	47929.55	.00	11001.98	36376.74	7314.60
31	461.21	9.79	47504.15	.00	9870.50	37102.75	7448.55
32	470.96	9.72	46657.31	.00	8545.12	37632.94	7546.36
33	480.64	9.64	45399.34	.00	7027.16	37969.20	7608.40
34	487.17	3.42	15819.79	.00	2110.77	13607.17	2726.38
35	491.95	6.13	27951.87	.00	3207.35	25226.47	2684.17
36	496.57	3.11	13961.38	.00	1345.81	12949.09	1377.82
37	498.43	.60	2669.20	.00	234.36	2515.90	213.37
38	501.60	5.74	25337.18	.00	1839.60	21786.73	9205.64
39	504.67	.40	1735.83	.00	101.00	1512.97	639.28

40	509.34	8.95	38864.94	.00	1232.99	35569.15	12568.16
41	514.29	.95	4118.63	.00	12.65	3878.92	1369.43
42	518.90	8.27	35451.87	.00	.00	33481.76	11824.83
43	527.59	9.10	38414.22	.00	.00	36350.31	12870.07
44	536.62	8.96	37045.03	.00	.00	35153.31	12486.01
45	545.51	8.82	35474.76	.00	.00	33786.25	12047.38
46	554.25	8.66	33717.13	.00	.00	32255.49	11556.23
47	562.83	8.50	31786.76	.00	.00	30567.43	11014.60
48	571.25	8.33	29700.42	.00	.00	28729.75	10424.97
49	579.49	8.15	27475.19	.00	.00	26749.84	9789.71
50	587.55	7.96	25129.29	.00	.00	24635.70	9111.38
51	595.41	7.77	22681.64	.00	.00	22395.60	8392.63
52	603.08	7.56	20152.55	.00	.00	20038.85	7636.46
53	610.54	7.35	17562.52	.00	.00	17574.89	6845.88
54	617.78	7.13	14932.96	.00	.00	15014.07	6024.23
55	624.80	6.91	12285.65	.00	.00	12367.30	5175.00
56	631.59	6.68	9643.15	.00	.00	9646.64	4302.06
57	638.15	6.44	7027.93	.00	.00	6864.71	3409.46
58	644.46	6.19	4463.00	.00	.00	4035.50	2501.69
59	648.28	1.44	694.90	.00	.00	539.29	465.62
60	649.93	1.87	661.64	.00	.00	418.61	513.38
61	651.82	1.90	261.45	.00	.00	-2177.10	1932.09

1
Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 2 SPECIFIED BY 42 COORDINATE POINTS

SAFETY FACTOR = 1.700

X-CENTER = 421.00
Y-CENTER = 647.17
RADIUS = 308.62

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.11	358.78	-19.93
2	320.51	355.37	-18.07
3	330.02	352.27	-16.22
4	339.62	349.47	-14.36
5	349.31	346.99	-12.50
6	359.07	344.83	-10.65
7	368.90	342.98	-8.79
8	378.78	341.45	-6.93
9	388.71	340.25	-5.08
10	398.67	339.36	-3.22
11	408.65	338.80	-1.36
12	418.65	338.56	.49
13	428.65	338.65	2.35
14	438.64	339.06	4.21
15	448.62	339.79	6.06
16	458.56	340.85	7.92
17	468.46	342.22	9.77
18	478.32	343.92	11.63
19	488.11	345.94	13.49
20	497.84	348.27	15.34
21	507.48	350.92	17.20
22	517.03	353.87	19.06
23	526.49	357.14	20.91
24	535.83	360.71	22.77
25	545.05	364.58	24.63
26	554.14	368.75	26.48
27	563.09	373.20	28.34
28	571.89	377.95	30.20

29	580.53	382.98	32.05
30	589.01	388.29	33.91
31	597.31	393.87	35.77
32	605.42	399.71	37.62
33	613.34	405.82	39.48
34	621.06	412.18	41.34
35	628.57	418.78	43.19
36	635.86	425.62	45.05
37	642.92	432.70	46.91
38	649.76	440.00	48.76
39	656.35	447.52	50.62
40	662.69	455.25	52.48
41	668.78	463.18	54.33
42	672.93	468.96	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	311.68	1.13	44.86	.00	.00	78.43	84.71
2	316.38	8.27	3131.62	.00	840.76	2864.83	1032.73
3	325.27	9.51	9512.10	.00	2901.33	7751.28	1982.02
4	334.82	9.60	15645.08	.00	4785.84	12323.11	2804.13
5	343.81	8.38	18302.37	.00	5508.44	14166.69	3056.18
6	348.65	1.31	3212.08	.00	968.25	2482.05	525.80
7	349.65	.69	1715.92	.00	518.31	1300.38	275.47
8	354.54	9.07	25221.13	.00	7453.73	19269.80	4011.67
9	360.54	2.93	9238.06	.00	2636.65	7033.98	1440.11
10	365.45	6.90	23741.24	.00	6633.71	18216.91	3688.72
11	369.25	.70	2562.60	.00	702.01	1951.77	392.66
12	369.70	.20	736.48	.00	201.37	561.31	112.84
13	369.90	.20	738.74	.00	201.81	563.21	113.18
14	374.39	8.78	33380.58	.00	9265.13	25296.50	5071.54
15	383.75	9.93	39702.34	.00	11270.67	29439.59	5882.05
16	388.93	.43	1781.28	.00	509.75	1301.63	259.72
17	392.92	7.55	31391.73	.00	9032.30	22888.42	4561.37
18	396.90	.43	1807.85	.00	522.90	1315.33	261.81
19	397.38	.52	2217.47	.00	641.84	1612.89	320.99
20	398.16	1.03	4361.36	.00	1263.78	3170.82	630.92
21	403.66	9.98	42990.38	.00	12469.23	30935.34	6151.02
22	409.33	1.35	5880.02	.00	1707.45	4194.10	833.38
23	413.00	6.00	26559.71	.00	7654.19	19002.86	3770.13
24	417.33	2.65	11962.54	.00	3404.51	8601.98	1702.80
25	423.65	10.00	46478.21	.00	12860.98	33562.06	6623.36
26	433.65	9.99	48308.48	.00	12753.66	35310.89	6937.84
27	443.63	9.97	49692.77	.00	12444.26	36852.16	7214.99
28	453.59	9.94	50627.20	.00	11933.17	38187.02	7455.03
29	463.51	9.90	51110.76	.00	11220.85	39316.76	7658.18
30	473.39	9.85	51145.58	.00	10308.13	40242.86	7824.71
31	483.22	9.79	50736.39	.00	9195.87	40966.80	7954.89
32	492.98	9.72	49891.22	.00	7885.32	41490.36	8049.04
33	502.66	9.64	48620.89	.00	6377.87	41815.57	8107.52
34	507.58	.19	962.88	.00	112.34	844.92	163.82
35	512.35	9.36	46041.29	.00	4562.67	42277.01	4384.56
36	517.18	.30	1450.21	.00	118.40	1366.93	141.77
37	517.63	.60	2902.08	.00	231.26	2760.28	228.17
38	521.02	6.18	29647.05	.00	1917.60	25780.75	10617.58
39	525.30	2.38	11306.88	.00	511.32	10242.46	3499.07
40	530.30	7.63	36072.50	.00	727.40	33516.75	11442.13
41	534.97	1.72	8075.39	.00	.00	7648.31	2608.00
42	540.44	9.22	43097.05	.00	.00	40879.70	13960.88
43	549.59	9.09	41867.00	.00	.00	39809.91	13626.33
44	558.61	8.95	40414.48	.00	.00	38558.72	13235.04
45	567.49	8.80	38752.95	.00	.00	37132.49	12789.00

46	576.21	8.64	36896.92	.00	.00	35537.66	12290.24
47	584.77	8.48	34862.65	.00	.00	33781.46	11741.01
48	593.16	8.30	32667.05	.00	.00	31870.98	11143.54
49	601.36	8.11	30328.46	.00	.00	29814.02	10500.25
50	609.38	7.92	27866.35	.00	.00	27618.96	9813.78
51	617.20	7.72	25300.99	.00	.00	25294.48	9086.83
52	624.82	7.51	22653.20	.00	.00	22849.67	8322.25
53	632.21	7.29	19945.35	.00	.00	20294.83	7523.26
54	639.39	7.06	17199.77	.00	.00	17640.48	6693.15
55	645.96	6.08	12951.60	.00	.00	13370.09	5227.35
56	649.38	.76	1482.78	.00	.00	1522.26	606.36
57	653.05	6.59	11195.28	.00	.00	11528.65	4781.76
58	659.52	6.34	7737.76	.00	.00	7793.32	3613.59
59	665.74	6.09	4426.54	.00	.00	4075.93	2451.03
60	669.93	2.30	862.84	.00	.00	581.35	644.83
61	672.00	1.85	254.01	.00	.00	-2160.57	1863.34

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 3 SPECIFIED BY 46 COORDINATE POINTS

SAFETY FACTOR = 1.707

X-CENTER = 360.53
Y-CENTER = 721.20
RADIUS = 383.21

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	244.44	356.00	-16.89
2	254.01	353.10	-15.39
3	263.66	350.44	-13.90
4	273.36	348.04	-12.40
5	283.13	345.89	-10.91
6	292.95	344.00	-9.41
7	302.81	342.37	-7.91
8	312.72	340.99	-6.42
9	322.66	339.87	-4.92
10	332.62	339.01	-3.43
11	342.60	338.41	-1.93
12	352.60	338.08	-.44
13	362.60	338.00	1.06
14	372.59	338.18	2.55
15	382.58	338.63	4.05
16	392.56	339.33	5.54
17	402.51	340.30	7.04
18	412.44	341.53	8.53
19	422.33	343.01	10.03
20	432.17	344.75	11.52
21	441.97	346.75	13.02
22	451.71	349.00	14.51
23	461.40	351.51	16.01
24	471.01	354.26	17.50
25	480.55	357.27	19.00
26	490.00	360.53	20.49
27	499.37	364.03	21.99
28	508.64	367.77	23.48
29	517.81	371.76	24.98
30	526.88	375.98	26.47
31	535.83	380.44	27.97
32	544.66	385.13	29.46
33	553.37	390.05	30.96
34	561.94	395.19	32.45

35	570.38	400.56	33.95
36	578.68	406.14	35.44
37	586.82	411.94	36.94
38	594.82	417.95	38.43
39	602.65	424.17	39.93
40	610.32	430.58	41.42
41	617.82	437.20	42.92
42	625.14	444.01	44.42
43	632.28	451.01	45.91
44	639.24	458.19	47.41
45	646.01	465.55	48.90
46	647.79	467.59	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	249.23	9.57	1667.62	.00	2086.04	1072.72	778.09
2	258.83	9.64	4895.83	.00	3865.78	2733.48	1075.60
3	268.51	9.71	7873.88	.00	5488.92	4225.62	1342.90
4	278.25	9.77	10587.69	.00	6954.27	5550.94	1580.31
5	288.04	9.82	13024.61	.00	8260.87	6711.30	1788.18
6	296.47	7.05	10647.71	.00	6615.44	5410.65	1388.04
7	301.41	2.81	4644.38	.00	2792.41	2357.40	589.44
8	307.77	9.90	19331.44	.00	10394.34	9691.15	2321.98
9	317.69	9.94	23740.32	.00	11219.78	12998.25	2914.40
10	327.64	9.96	27837.36	.00	11883.58	16359.92	3516.60
11	337.61	9.98	31628.66	.00	12385.25	19545.08	4087.18
12	345.30	5.40	18553.89	.00	6841.40	11805.18	2431.25
13	349.00	2.00	7059.00	.00	2553.59	4540.87	930.69
14	351.30	2.60	9309.65	.00	3329.50	6027.06	1231.84
15	357.30	9.40	35898.24	.00	12130.29	23805.91	4815.57
16	362.30	.60	2384.58	.00	770.73	1616.40	324.44
17	366.10	7.00	28940.22	.00	9055.00	19817.13	3960.48
18	369.70	.20	849.91	.00	258.03	589.86	117.38
19	369.90	.20	851.35	.00	258.04	591.29	117.64
20	371.30	2.59	11056.12	.00	3343.68	7686.13	1528.87
21	377.59	9.99	42590.04	.00	12765.69	29604.21	5889.14
22	385.86	6.56	27867.36	.00	8234.29	19429.24	3865.82
23	390.85	3.42	14444.91	.00	4219.63	10118.95	2013.29
24	394.62	4.13	17383.20	.00	5038.18	12191.17	2427.01
25	396.90	.43	1795.58	.00	516.89	1262.73	251.41
26	397.38	.52	2196.88	.00	631.57	1545.76	307.77
27	400.08	4.87	20314.39	.00	5793.04	14339.69	2855.51
28	406.26	7.49	30821.85	.00	8624.64	21892.47	4363.83
29	411.22	2.44	9938.39	.00	2718.57	7120.05	1419.32
30	414.22	3.56	14513.11	.00	3900.80	10461.88	2085.23
31	419.16	6.33	25803.92	.00	6644.23	18884.71	3757.76
32	427.25	9.85	40303.31	.00	9585.64	30280.13	6010.23
33	437.07	9.80	39992.01	.00	8465.73	31093.86	6156.00
34	446.84	9.74	39344.63	.00	7186.01	31746.16	6272.85
35	454.49	5.56	22141.46	.00	3486.16	18442.77	3640.27
36	459.34	4.12	16236.96	.00	2261.24	14132.90	1460.15
37	464.70	6.61	25700.58	.00	3036.21	23018.81	2378.20
38	468.37	.73	2793.69	.00	285.14	2560.75	210.87
39	469.87	2.27	8707.15	.00	829.50	7362.33	3020.57
40	473.38	4.74	18026.50	.00	1420.80	15478.22	6350.30
41	478.15	4.80	18108.33	.00	976.66	16230.34	5645.77
42	484.07	7.05	26537.84	.00	552.58	24576.96	8530.89
43	488.80	2.40	9012.74	.00	.00	8515.97	2950.92
44	494.68	9.37	34977.69	.00	.00	33054.05	11469.69
45	504.00	9.27	34261.60	.00	.00	32400.19	11265.98
46	513.23	9.17	33366.80	.00	.00	31594.31	11014.92
47	522.34	9.06	32300.25	.00	.00	30640.29	10717.70

48	531.35	8.95	31069.69	.00	.00	29542.19	10375.59
49	540.24	8.83	29683.70	.00	.00	28304.36	9989.95
50	549.01	8.71	28151.67	.00	.00	26931.40	9562.21
51	557.65	8.58	26483.45	.00	.00	25427.93	9093.81
52	566.16	8.44	24689.49	.00	.00	23798.74	8586.24
53	574.53	8.30	22781.04	.00	.00	22049.03	8041.13
54	582.75	8.15	20769.72	.00	.00	20184.04	7460.10
55	590.82	7.99	18668.05	.00	.00	18209.60	6844.98
56	598.73	7.83	16488.53	.00	.00	16131.40	6197.52
57	606.48	7.67	14244.60	.00	.00	13955.81	5519.73
58	614.07	7.50	11949.87	.00	.00	11689.40	4813.64
59	621.48	7.32	9618.35	.00	.00	9339.03	4081.39
60	628.71	7.14	7264.42	.00	.00	6912.07	3325.28
61	635.76	6.96	4902.76	.00	.00	4416.36	2547.76
62	641.88	5.28	2183.02	.00	.00	1666.39	1433.38
63	645.26	1.49	328.48	.00	.00	-915.82	1288.18
64	646.90	1.78	141.73	.00	.00	-1604.73	1587.95

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 4 SPECIFIED BY 44 COORDINATE POINTS

SAFETY FACTOR = 1.727

X-CENTER = 422.79
Y-CENTER = 680.44
RADIUS = 340.50

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.11	358.78	-18.31
2	320.61	355.64	-16.62
3	330.19	352.78	-14.94
4	339.85	350.20	-13.26
5	349.58	347.91	-11.57
6	359.38	345.90	-9.89
7	369.23	344.18	-8.21
8	379.13	342.75	-6.53
9	389.06	341.62	-4.84
10	399.03	340.77	-3.16
11	409.01	340.22	-1.48
12	419.01	339.96	.21
13	429.01	340.00	1.89
14	439.00	340.33	3.57
15	448.98	340.95	5.25
16	458.94	341.87	6.94
17	468.87	343.07	8.62
18	478.76	344.57	10.30
19	488.60	346.36	11.98
20	498.38	348.44	13.67
21	508.09	350.80	15.35
22	517.74	353.45	17.03
23	527.30	356.38	18.72
24	536.77	359.59	20.40
25	546.14	363.07	22.08
26	555.41	366.83	23.76
27	564.56	370.86	25.45
28	573.59	375.16	27.13
29	582.49	379.72	28.81
30	591.25	384.54	30.50
31	599.87	389.61	32.18
32	608.33	394.94	33.86
33	616.64	400.51	35.54

34	624.77	406.32	37.23
35	632.74	412.37	38.91
36	640.52	418.65	40.59
37	648.11	425.16	42.27
38	655.51	431.89	43.96
39	662.71	438.83	45.64
40	669.70	445.98	47.32
41	676.48	453.33	49.01
42	683.04	460.88	50.69
43	689.38	468.61	52.37
44	690.17	469.64	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	311.73	1.23	50.90	.00	.00	83.40	90.06
2	316.48	8.26	3017.10	.00	758.68	2746.77	990.03
3	325.40	9.58	9176.69	.00	2659.39	7486.06	1904.35
4	335.02	9.66	15082.45	.00	4401.82	11926.18	2690.40
5	343.92	8.15	17012.25	.00	4896.35	13248.52	2830.32
6	348.79	1.58	3708.08	.00	1071.19	2880.76	604.18
7	349.79	.42	987.89	.00	286.54	754.26	158.17
8	354.69	9.38	24977.36	.00	7068.77	19238.13	3960.23
9	360.69	2.62	7930.15	.00	2168.55	6096.32	1233.27
10	365.62	7.23	23898.76	.00	6395.22	18509.71	3701.90
11	369.42	.37	1297.46	.00	340.65	998.86	198.41
12	369.70	.20	706.34	.00	185.23	544.00	108.01
13	369.90	.20	708.55	.00	185.64	545.87	108.34
14	374.56	9.13	33303.57	.00	8880.45	25496.07	5047.76
15	384.10	9.94	38160.15	.00	10439.00	28615.81	5645.05
16	389.10	.08	313.42	.00	86.52	231.89	45.68
17	392.92	7.55	30107.60	.00	8358.95	22227.11	4373.44
18	396.90	.43	1734.13	.00	484.25	1277.37	251.02
19	397.38	.52	2127.07	.00	594.44	1566.33	307.77
20	398.33	1.39	5645.34	.00	1579.97	4154.75	816.13
21	404.02	9.98	41312.26	.00	11586.79	30114.76	5910.41
22	409.51	.99	4143.60	.00	1164.33	2995.81	587.53
23	413.00	6.00	25535.24	.00	7121.66	18515.60	3625.45
24	417.50	3.01	13082.98	.00	3600.56	9534.81	1862.33
25	424.01	10.00	44904.46	.00	12003.15	32878.69	6399.72
26	434.01	9.99	46827.07	.00	11936.55	34694.42	6721.17
27	443.99	9.98	48351.93	.00	11686.71	36321.88	7009.29
28	453.96	9.96	49475.13	.00	11253.95	37761.94	7264.23
29	463.91	9.93	50194.72	.00	10638.53	39015.53	7486.16
30	473.81	9.89	50511.28	.00	9841.05	40083.80	7675.28
31	483.68	9.84	50427.74	.00	8862.25	40968.20	7831.85
32	493.49	9.78	49948.53	.00	7702.85	41669.77	7956.05
33	503.24	9.72	49080.70	.00	6363.93	42189.98	8048.14
34	508.43	.68	3403.95	.00	394.01	2979.85	568.33
35	513.26	8.96	44482.78	.00	4452.64	40539.47	4139.20
36	518.64	1.81	8871.17	.00	732.89	8286.06	846.03
37	519.89	.68	3318.06	.00	258.54	3133.62	255.02
38	523.72	6.99	33958.96	.00	2141.93	29687.29	12036.95
39	527.26	.08	383.54	.00	18.87	346.62	116.35
40	532.03	9.47	45559.21	.00	1282.24	42042.76	14102.59
41	537.44	1.34	6402.10	.00	21.62	6054.27	2029.03
42	542.12	8.04	38410.70	.00	.00	36439.18	12212.34
43	550.78	9.27	43939.82	.00	.00	41735.16	14007.89
44	559.99	9.15	42855.70	.00	.00	40786.80	13715.90
45	569.08	9.03	41568.78	.00	.00	39671.72	13372.58
46	578.04	8.90	40088.78	.00	.00	38394.41	12979.31
47	586.87	8.76	38427.13	.00	.00	36960.25	12537.75
48	595.56	8.62	36596.13	.00	.00	35374.71	12049.58

49	604.10	8.46	34609.26	.00	.00	33643.82	11516.66
50	612.49	8.30	32480.35	.00	.00	31773.36	10940.77
51	620.71	8.14	30224.37	.00	.00	29769.78	10323.89
52	628.76	7.96	27857.52	.00	.00	27640.22	9668.22
53	636.63	7.78	25395.84	.00	.00	25391.50	8975.86
54	644.32	7.59	22856.66	.00	.00	23031.38	8249.21
55	648.56	.89	2540.23	.00	.00	2583.60	934.40
56	652.26	6.51	17325.94	.00	.00	17570.91	6429.05
57	659.11	7.20	16273.05	.00	.00	16569.96	6259.81
58	666.21	6.99	12732.16	.00	.00	12949.31	5145.05
59	673.09	6.78	9270.76	.00	.00	9311.17	4024.91
60	679.76	6.56	5908.61	.00	.00	5667.12	2902.95
61	685.57	5.07	2377.99	.00	.00	1906.03	1512.78
62	688.74	1.27	244.46	.00	.00	-1031.86	1160.86
63	689.77	.80	43.72	.00	.00	-906.65	754.12

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 5 SPECIFIED BY 41 COORDINATE POINTS

SAFETY FACTOR = 1.755

X-CENTER = 380.05
Y-CENTER = 629.30
RADIUS = 295.89

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	266.67	356.00	-21.56
2	275.97	352.32	-19.63
3	285.39	348.97	-17.69
4	294.91	345.93	-15.75
5	304.54	343.21	-13.82
6	314.25	340.82	-11.88
7	324.03	338.77	-9.94
8	333.88	337.04	-8.01
9	343.79	335.65	-6.07
10	353.73	334.59	-4.14
11	363.70	333.87	-2.20
12	373.70	333.48	-.26
13	383.70	333.44	1.67
14	393.69	333.73	3.61
15	403.67	334.36	5.55
16	413.63	335.33	7.48
17	423.54	336.63	9.42
18	433.41	338.26	11.36
19	443.21	340.23	13.29
20	452.94	342.53	15.23
21	462.59	345.16	17.17
22	472.15	348.11	19.10
23	481.60	351.38	21.04
24	490.93	354.97	22.97
25	500.14	358.88	24.91
26	509.21	363.09	26.85
27	518.13	367.60	28.78
28	526.89	372.42	30.72
29	535.49	377.53	32.66
30	543.91	382.92	34.59
31	552.14	388.60	36.53
32	560.18	394.55	38.47
33	568.01	400.77	40.40
34	575.62	407.26	42.34
35	583.01	413.99	44.27

36	590.17	420.97	46.21
37	597.09	428.19	48.15
38	603.76	435.64	50.08
39	610.18	443.31	52.02
40	616.33	451.19	53.96
41	621.99	458.97	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	271.32	9.30	2050.82	.00	2431.03	1378.55	809.97
2	280.68	9.42	6052.24	.00	4669.94	3505.21	1180.45
3	290.15	9.53	9778.69	.00	6710.80	5409.01	1512.11
4	297.46	5.09	6586.00	.00	4302.55	3543.76	918.50
5	302.27	4.54	6923.91	.00	4248.71	3711.36	915.22
6	309.39	9.71	19029.02	.00	10189.23	9974.34	2307.44
7	319.14	9.79	24533.56	.00	11622.87	14083.79	3023.34
8	328.96	9.85	29715.05	.00	12850.44	17966.50	3699.74
9	338.84	9.90	34543.32	.00	13870.64	21622.93	4336.73
10	345.89	4.21	16019.26	.00	6134.75	10189.35	2016.52
11	348.93	1.85	7233.69	.00	2739.86	4631.76	913.14
12	349.93	.15	570.97	.00	216.60	367.99	97.78
13	351.87	3.73	14946.63	.00	5591.02	9714.47	2581.21
14	357.87	8.27	35432.40	.00	12637.12	23336.03	6200.57
15	362.85	1.70	7684.60	.00	2647.24	5156.47	1370.11
16	366.65	5.90	27485.65	.00	9214.10	18480.31	4910.37
17	369.70	.20	956.40	.00	314.30	649.42	172.56
18	369.90	.20	958.13	.00	314.46	651.01	172.98
19	371.85	3.70	17786.76	.00	5833.44	12089.76	3212.35
20	378.70	10.00	48543.58	.00	15857.60	32726.30	8695.64
21	386.42	5.45	26604.78	.00	8641.21	17836.41	4739.28
22	391.42	4.55	22253.55	.00	7186.82	14960.05	3975.01
23	395.19	3.00	14653.86	.00	4715.58	9803.07	2604.75
24	396.90	.43	2092.57	.00	671.43	1401.80	372.47
25	397.38	.52	2561.65	.00	821.34	1716.62	456.12
26	400.66	6.03	29414.70	.00	9379.37	19762.50	5251.06
27	406.84	6.33	30678.85	.00	9686.58	20604.90	5474.89
28	410.14	.27	1315.57	.00	412.04	886.84	235.64
29	411.95	3.35	16214.74	.00	5038.20	11047.28	2116.54
30	414.81	2.37	11487.52	.00	3535.64	7852.94	1504.48
31	419.77	7.54	36651.69	.00	10940.28	25388.36	4856.27
32	428.47	9.87	48254.11	.00	13605.78	34224.21	6531.99
33	438.31	9.80	47924.84	.00	12527.35	35014.95	6669.74
34	448.08	9.73	47140.35	.00	11241.86	35596.52	6771.06
35	457.77	9.65	45911.92	.00	9750.83	35970.93	6836.28
36	467.37	9.55	44254.06	.00	8055.93	36140.45	6865.81
37	475.85	7.41	33215.68	.00	4996.89	28292.63	5375.47
38	480.57	2.04	8972.32	.00	1162.23	8052.70	809.08
39	484.51	5.84	25149.01	.00	2798.31	23248.37	2335.84
40	487.70	.54	2271.95	.00	213.93	2153.93	172.49
41	489.45	2.96	12450.39	.00	1050.28	10654.28	4250.92
42	492.09	2.33	9682.58	.00	673.33	8419.33	3359.20
43	496.70	6.88	28227.46	.00	1095.21	25879.17	8692.11
44	501.14	2.01	8160.69	.00	63.40	7729.60	2594.25
45	505.67	7.06	28381.34	.00	.00	27071.50	9089.23
46	513.67	8.92	35102.94	.00	.00	33612.13	11323.26
47	522.51	8.76	33457.20	.00	.00	32189.73	10892.31
48	531.19	8.60	31616.24	.00	.00	30592.12	10408.27
49	539.70	8.42	29597.75	.00	.00	28826.96	9873.47
50	548.02	8.23	27420.93	.00	.00	26902.57	9290.43
51	556.16	8.04	25105.79	.00	.00	24827.33	8661.68
52	564.09	7.83	22673.83	.00	.00	22610.56	7990.06
53	571.81	7.62	20147.28	.00	.00	20261.91	7278.48

54	579.32	7.39	17549.48	.00	.00	17791.88	6530.12
55	586.59	7.16	14904.70	.00	.00	15211.90	5748.45
56	593.63	6.92	12237.72	.00	.00	12534.12	4937.15
57	600.43	6.67	9573.86	.00	.00	9771.65	4100.19
58	606.97	6.42	6938.94	.00	.00	6938.88	3241.93
59	613.26	6.15	4359.01	.00	.00	4051.45	2367.11
60	617.75	2.82	1187.43	.00	.00	894.36	817.73
61	620.58	2.84	459.72	.00	.00	-2992.00	2745.80

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 6 SPECIFIED BY 51 COORDINATE POINTS

SAFETY FACTOR = 1.760

X-CENTER = 333.99
Y-CENTER = 785.59
RADIUS = 450.00

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	200.00	356.00	-16.69
2	209.58	353.13	-15.41
3	219.22	350.47	-14.14
4	228.92	348.03	-12.87
5	238.67	345.80	-11.59
6	248.46	343.79	-10.32
7	258.30	342.00	-9.05
8	268.18	340.43	-7.77
9	278.08	339.08	-6.50
10	288.02	337.94	-5.23
11	297.98	337.03	-3.95
12	307.95	336.34	-2.68
13	317.94	335.88	-1.41
14	327.94	335.63	-.13
15	337.94	335.61	1.14
16	347.94	335.81	2.41
17	357.93	336.23	3.69
18	367.91	336.87	4.96
19	377.87	337.74	6.23
20	387.81	338.82	7.51
21	397.73	340.13	8.78
22	407.61	341.65	10.05
23	417.46	343.40	11.33
24	427.26	345.36	12.60
25	437.02	347.54	13.87
26	446.73	349.94	15.15
27	456.38	352.55	16.42
28	465.97	355.38	17.69
29	475.50	358.42	18.97
30	484.96	361.67	20.24
31	494.34	365.13	21.51
32	503.64	368.80	22.79
33	512.86	372.67	24.06
34	521.99	376.75	25.33
35	531.03	381.02	26.61
36	539.97	385.50	27.88
37	548.81	390.18	29.15
38	557.55	395.05	30.42
39	566.17	400.11	31.70
40	574.68	405.37	32.97
41	583.07	410.81	34.24
42	591.33	416.44	35.52

43	599.47	422.25	36.79
44	607.48	428.24	38.06
45	615.35	434.40	39.34
46	623.09	440.74	40.61
47	630.68	447.25	41.88
48	638.13	453.93	43.16
49	645.42	460.77	44.43
50	652.56	467.77	45.70
51	652.94	468.16	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	204.79	9.58	1650.19	.00	1865.26	1051.97	750.84
2	214.40	9.64	4858.80	.00	3635.74	2705.39	1038.03
3	224.07	9.70	7854.90	.00	5272.85	4215.71	1300.36
4	233.79	9.75	10628.29	.00	6775.76	5584.25	1538.06
5	243.56	9.80	13169.47	.00	8143.70	6812.25	1751.35
6	253.38	9.84	15469.87	.00	9376.05	7900.94	1940.45
7	263.24	9.88	17521.75	.00	10472.17	8851.59	2105.57
8	273.13	9.91	19318.13	.00	11431.52	9665.39	2246.92
9	283.05	9.94	20853.03	.00	12253.62	10343.61	2364.72
10	293.00	9.96	22121.29	.00	12938.09	10887.49	2459.19
11	298.99	2.02	4619.14	.00	2694.55	2257.53	507.26
12	303.98	7.95	19448.54	.00	10789.99	9502.92	2103.55
13	312.95	9.99	27679.13	.00	13892.77	13956.71	2992.29
14	322.94	10.00	31004.60	.00	14162.51	16937.62	3510.05
15	332.94	10.00	34053.45	.00	14293.69	19769.16	4001.87
16	342.94	10.00	36819.36	.00	14286.20	22451.54	4467.78
17	347.97	.06	235.78	.00	88.12	146.65	28.99
18	349.00	2.00	7622.17	.00	2847.51	4741.93	937.36
19	353.96	7.93	31178.30	.00	11204.43	19837.34	3896.47
20	359.96	4.07	16759.81	.00	5694.52	10962.43	2135.83
21	364.95	5.91	25155.73	.00	8160.86	16836.93	3260.82
22	368.75	1.69	7373.41	.00	2315.13	5002.22	965.30
23	369.70	.20	876.42	.00	272.79	596.93	115.09
24	369.90	.20	877.54	.00	272.64	598.20	115.31
25	373.94	7.87	34376.41	.00	10571.67	23540.17	4537.60
26	382.84	9.94	42782.82	.00	12870.84	29543.89	5699.66
27	388.48	1.33	5665.50	.00	1679.32	3935.04	759.78
28	392.92	7.55	31734.30	.00	9254.29	22189.50	4286.50
29	396.90	.43	1782.10	.00	511.85	1253.73	242.30
30	397.38	.52	2179.32	.00	624.84	1534.24	296.53
31	397.68	.09	353.43	.00	101.22	248.92	48.11
32	402.67	9.88	40359.79	.00	11334.60	28647.47	5543.96
33	408.80	2.39	9553.45	.00	2611.42	6855.45	1328.68
34	413.00	6.00	23741.54	.00	6283.03	17236.58	3340.04
35	416.73	1.46	5732.41	.00	1466.00	4211.23	815.45
36	422.36	9.81	38501.91	.00	9249.62	28897.86	5587.45
37	432.14	9.76	37962.95	.00	8002.59	29620.17	5712.91
38	441.87	9.71	37146.07	.00	6620.04	30206.05	5814.67
39	447.47	1.48	5595.42	.00	885.48	4668.23	897.97
40	452.29	8.17	30504.60	.00	4217.15	26662.23	2670.89
41	457.64	2.52	9277.53	.00	1073.94	8351.48	836.61
42	459.26	.71	2586.14	.00	279.56	2360.98	188.51
43	462.79	6.36	23110.57	.00	2097.60	19687.63	7831.79
44	466.40	.86	3099.10	.00	226.54	2685.62	1068.35
45	471.17	8.67	31129.64	.00	1439.72	28189.34	9548.93
46	477.27	3.53	12648.40	.00	138.29	11859.23	4006.70
47	481.99	5.93	21168.04	.00	.00	20056.42	6770.47
48	489.65	9.38	33355.20	.00	.00	31610.56	10685.01
49	498.99	9.30	32749.82	.00	.00	31056.42	10517.62
50	508.25	9.22	31994.28	.00	.00	30371.28	10310.66

51	517.43	9.13	31093.33	.00	.00	29557.87	10064.95
52	526.51	9.04	30052.43	.00	.00	28619.24	9781.41
53	535.50	8.94	28877.35	.00	.00	27558.40	9460.96
54	544.39	8.84	27574.15	.00	.00	26378.34	9104.49
55	553.18	8.73	26149.71	.00	.00	25082.49	8713.05
56	561.86	8.62	24610.98	.00	.00	23674.14	8287.62
57	570.42	8.51	22965.63	.00	.00	22156.95	7829.32
58	578.87	8.39	21221.21	.00	.00	20534.30	7339.15
59	587.20	8.27	19386.27	.00	.00	18810.30	6818.37
60	595.40	8.14	17469.20	.00	.00	16988.71	6268.11
61	603.48	8.01	15478.90	.00	.00	15073.71	5689.64
62	611.42	7.87	13424.62	.00	.00	13069.62	5084.25
63	619.22	7.73	11315.93	.00	.00	10981.04	4453.35
64	626.88	7.59	9162.44	.00	.00	8812.58	3798.31
65	634.40	7.44	6974.20	.00	.00	6569.24	3120.65
66	641.77	7.29	4761.45	.00	.00	4256.24	2421.94
67	647.21	3.58	1542.61	.00	.00	1235.83	942.95
68	649.65	1.30	409.58	.00	.00	285.92	293.41
69	651.43	2.26	357.33	.00	.00	-1262.05	1797.82
70	652.75	.38	7.85	.00	.00	-306.14	309.71

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 7 SPECIFIED BY 35 COORDINATE POINTS

SAFETY FACTOR = 1.776

X-CENTER = 399.84
Y-CENTER = 590.24
RADIUS = 247.88

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	311.11	358.78	-19.82
2	320.52	355.39	-17.51
3	330.06	352.38	-15.20
4	339.71	349.76	-12.88
5	349.45	347.53	-10.57
6	359.29	345.69	-8.26
7	369.18	344.26	-5.95
8	379.13	343.22	-3.64
9	389.11	342.59	-1.33
10	399.10	342.35	.99
11	409.10	342.53	3.30
12	419.09	343.10	5.61
13	429.04	344.08	7.92
14	438.94	345.46	10.23
15	448.78	347.23	12.54
16	458.55	349.41	14.86
17	468.21	351.97	17.17
18	477.77	354.92	19.48
19	487.19	358.26	21.79
20	496.48	361.97	24.10
21	505.61	366.05	26.41
22	514.56	370.50	28.72
23	523.33	375.31	31.04
24	531.90	380.46	33.35
25	540.25	385.96	35.66
26	548.38	391.79	37.97
27	556.26	397.94	40.28
28	563.89	404.41	42.59
29	571.25	411.17	44.91
30	578.34	418.23	47.22

31	585.13	425.57	49.53
32	591.62	433.18	51.84
33	597.80	441.04	54.15
34	603.65	449.15	56.46
35	606.79	453.88	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	311.68	1.14	45.23	.00	.00	77.37	81.28
2	316.38	8.27	3123.98	.00	835.12	2840.25	984.28
3	325.29	9.54	9473.38	.00	2860.59	7666.95	1883.33
4	334.88	9.65	15510.94	.00	4662.33	12130.81	2651.94
5	343.85	8.29	17720.22	.00	5201.93	13621.98	2824.65
6	348.73	1.45	3476.74	.00	1019.76	2671.19	543.99
7	349.73	.55	1317.16	.00	386.76	990.82	201.84
8	354.64	9.29	25041.88	.00	7149.38	19035.96	3809.67
9	360.64	2.71	8268.60	.00	2266.38	6268.02	1233.77
10	365.59	7.18	23756.06	.00	6337.11	18181.85	3539.33
11	369.39	.42	1468.31	.00	382.65	1116.11	215.89
12	369.70	.20	704.18	.00	183.20	535.59	103.54
13	369.90	.20	706.20	.00	183.51	537.34	103.85
14	374.56	9.13	32987.03	.00	8672.74	24995.21	4820.64
15	384.12	9.98	37471.82	.00	9990.55	27898.08	5366.83
16	389.13	.04	138.49	.00	37.07	101.92	19.59
17	392.92	7.55	29013.74	.00	7762.37	21354.07	4101.91
18	396.90	.43	1659.44	.00	443.80	1221.51	234.45
19	397.38	.52	2033.76	.00	543.94	1497.01	287.30
20	398.37	1.46	5686.05	.00	1520.79	4185.36	803.09
21	404.10	10.00	39040.00	.00	10373.83	28577.60	5483.84
22	409.55	.90	3512.99	.00	927.97	2562.51	491.82
23	413.00	6.00	23639.11	.00	6143.47	17343.29	3324.74
24	417.54	3.09	12304.55	.00	3116.57	9108.01	1742.39
25	424.06	9.95	40389.97	.00	9750.79	30266.38	5774.62
26	433.99	9.90	40928.81	.00	9062.93	31428.85	5974.78
27	443.86	9.84	40909.32	.00	8125.54	32338.15	6131.35
28	453.66	9.76	40339.52	.00	6940.10	32996.42	6244.69
29	460.60	4.11	16808.88	.00	2533.73	14146.73	2675.49
30	465.43	5.55	22444.06	.00	2974.87	19725.70	1958.88
31	470.63	4.83	19248.28	.00	2163.21	17447.32	1732.63
32	473.38	.67	2655.14	.00	264.73	2454.19	194.25
33	475.74	4.05	15892.05	.00	1405.37	13574.07	5352.96
34	479.02	2.52	9784.24	.00	710.97	8483.91	3345.65
35	483.74	6.91	26659.25	.00	1206.05	24214.83	8076.95
36	489.03	3.67	14077.90	.00	177.83	13222.30	4405.10
37	493.67	5.61	21358.22	.00	.00	20299.42	6759.53
38	501.04	9.13	34280.52	.00	.00	32673.46	10910.61
39	510.09	8.96	32856.43	.00	.00	31449.00	10543.94
40	518.95	8.77	31171.01	.00	.00	30003.83	10111.18
41	527.62	8.57	29247.11	.00	.00	28347.87	9615.29
42	536.08	8.35	27110.11	.00	.00	26491.80	9059.49
43	544.32	8.13	24787.59	.00	.00	24447.05	8447.17
44	552.32	7.88	22309.22	.00	.00	22225.90	7782.04
45	560.08	7.63	19706.82	.00	.00	19842.00	7068.17
46	567.57	7.36	17013.05	.00	.00	17309.34	6309.75
47	574.79	7.08	14263.01	.00	.00	14644.19	5511.66
48	581.73	6.79	11492.01	.00	.00	11863.49	4678.97
49	588.37	6.49	8736.92	.00	.00	8986.51	3817.44
50	594.71	6.18	6034.73	.00	.00	6034.17	2933.35
51	600.73	5.86	3423.01	.00	.00	3030.04	2033.75
52	603.87	.44	159.48	.00	.00	106.50	120.74
53	605.44	2.70	471.93	.00	.00	-3303.29	2755.60

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 8 SPECIFIED BY 39 COORDINATE POINTS

SAFETY FACTOR = 1.791

X-CENTER = 433.73
Y-CENTER = 609.90
RADIUS = 265.30

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	333.33	364.33	-21.16
2	342.66	360.72	-19.00
3	352.12	357.47	-16.84
4	361.69	354.57	-14.68
5	371.36	352.04	-12.52
6	381.12	349.87	-10.36
7	390.96	348.07	-8.20
8	400.86	346.65	-6.04
9	410.80	345.60	-3.88
10	420.78	344.92	-1.72
11	430.77	344.62	.44
12	440.77	344.70	2.60
13	450.76	345.15	4.76
14	460.73	345.98	6.92
15	470.66	347.19	9.08
16	480.53	348.76	11.24
17	490.34	350.71	13.40
18	500.07	353.03	15.56
19	509.70	355.71	17.72
20	519.23	358.76	19.88
21	528.63	362.16	22.04
22	537.90	365.91	24.20
23	547.02	370.01	26.36
24	555.98	374.45	28.52
25	564.77	379.23	30.68
26	573.37	384.33	32.84
27	581.77	389.75	35.00
28	589.96	395.49	37.16
29	597.93	401.53	39.32
30	605.67	407.86	41.48
31	613.16	414.49	43.64
32	620.39	421.39	45.80
33	627.37	428.56	47.96
34	634.06	435.98	50.12
35	640.47	443.66	52.28
36	646.59	451.57	54.44
37	652.41	459.70	56.60
38	657.91	468.05	58.75
39	658.10	468.36	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	338.00	9.33	3185.68	.00	.00	3889.06	1222.52
2	345.33	5.34	4622.77	.00	.00	5309.77	1222.04
3	348.35	.70	741.70	.00	.00	848.51	186.13
4	349.35	1.30	1435.25	.00	19.67	1619.94	353.48
5	351.06	2.12	2564.12	.00	115.87	2803.77	603.66
6	356.90	9.57	15744.11	.00	1676.56	15755.86	3248.72

7	361.84	.31	628.79	.00	85.21	596.19	119.90
8	365.80	7.60	17247.52	.00	2588.46	16074.68	3183.44
9	369.70	.20	505.71	.00	81.67	464.92	90.93
10	369.90	.20	508.45	.00	82.38	467.14	91.31
11	370.68	1.36	3499.79	.00	578.65	3203.01	625.42
12	376.24	9.76	26856.04	.00	4929.12	23599.42	4587.97
13	385.13	8.02	24154.87	.00	4977.86	20293.68	3920.44
14	390.05	1.82	5706.97	.00	1234.80	4733.26	911.28
15	393.82	5.73	18506.38	.00	4091.21	15022.30	2888.26
16	396.90	.43	1412.21	.00	318.37	1139.94	218.80
17	397.38	.52	1734.64	.00	392.26	1398.96	268.45
18	399.25	3.22	10770.36	.00	2463.38	8657.25	1659.65
19	405.43	9.14	31671.05	.00	7407.20	24945.34	4772.75
20	410.40	.80	2850.47	.00	678.00	2233.47	426.39
21	413.40	5.20	18846.58	.00	4459.39	14619.37	2787.16
22	418.39	4.78	17952.61	.00	4212.16	13961.36	2651.34
23	425.78	10.00	39523.57	.00	9023.39	30691.89	5798.98
24	435.77	10.00	41840.60	.00	9140.16	32654.36	6134.06
25	445.77	9.99	43644.52	.00	9021.77	34375.68	6427.97
26	455.75	9.97	44926.13	.00	8668.38	35856.82	6680.86
27	465.69	9.93	45681.04	.00	8080.45	37099.18	6892.99
28	475.59	9.87	45909.43	.00	7258.85	38104.15	7064.59
29	485.44	9.81	45616.38	.00	6204.76	38873.66	7195.98
30	490.51	.34	1570.46	.00	194.72	1359.75	251.61
31	495.37	9.39	43290.89	.00	4724.94	38865.86	3827.34
32	501.46	2.79	12740.45	.00	1153.14	11749.87	1157.08
33	503.23	.75	3411.65	.00	286.67	3185.17	250.00
34	506.65	6.10	27614.95	.00	1965.57	24078.06	9415.82
35	510.41	1.42	6377.64	.00	364.75	5627.39	2200.61
36	515.17	8.11	36417.09	.00	1299.28	33453.65	10884.98
37	520.89	3.34	14939.01	.00	130.69	14097.95	4582.58
38	525.60	6.07	27090.23	.00	.00	25778.31	8375.65
39	533.26	9.27	41084.88	.00	.00	39163.70	12746.65
40	542.46	9.12	39867.82	.00	.00	38119.77	12436.65
41	551.50	8.96	38383.54	.00	.00	36860.35	12062.66
42	560.37	8.79	36650.21	.00	.00	35393.73	11627.15
43	569.07	8.60	34687.73	.00	.00	33728.40	11132.63
44	577.57	8.40	32517.80	.00	.00	31873.14	10581.71
45	585.86	8.19	30164.32	.00	.00	29837.73	9977.29
46	593.95	7.97	27653.13	.00	.00	27632.76	9322.52
47	601.80	7.74	25011.21	.00	.00	25269.22	8620.67
48	609.41	7.49	22267.42	.00	.00	22759.45	7875.40
49	616.78	7.24	19451.06	.00	.00	20116.05	7090.43
50	623.88	6.97	16593.47	.00	.00	17353.61	6270.13
51	630.71	6.70	13725.96	.00	.00	14487.26	5418.97
52	637.27	6.41	10880.90	.00	.00	11534.00	4541.99
53	643.53	6.12	8091.04	.00	.00	8512.49	3644.76
54	647.80	2.41	2517.18	.00	.00	2601.16	1234.72
55	650.70	3.41	2764.85	.00	.00	2711.94	1459.97
56	654.42	4.02	1879.50	.00	.00	1501.68	1261.13
57	657.17	1.49	229.35	.00	.00	-1871.51	1508.78
58	658.01	.19	3.16	.00	.00	-329.34	203.52

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE # 9 SPECIFIED BY 41 COORDINATE POINTS

SAFETY FACTOR = 1.797

X-CENTER = 400.84
Y-CENTER = 600.88
RADIUS = 269.26

POINT X-SURF Y-SURF ALPHA

NO.			(DEG)
1	288.89	356.00	-23.50
2	298.06	352.01	-21.38
3	307.37	348.37	-19.25
4	316.81	345.07	-17.12
5	326.37	342.13	-14.99
6	336.03	339.54	-12.86
7	345.78	337.31	-10.74
8	355.60	335.45	-8.61
9	365.49	333.96	-6.48
10	375.43	332.83	-4.35
11	385.40	332.07	-2.22
12	395.39	331.68	-.09
13	405.39	331.66	2.03
14	415.38	332.02	4.16
15	425.36	332.74	6.29
16	435.30	333.84	8.42
17	445.19	335.30	10.55
18	455.02	337.13	12.67
19	464.78	339.33	14.80
20	474.45	341.88	16.93
21	484.01	344.79	19.06
22	493.46	348.06	21.19
23	502.79	351.67	23.31
24	511.97	355.63	25.44
25	521.00	359.93	27.57
26	529.87	364.56	29.70
27	538.55	369.51	31.83
28	547.05	374.78	33.95
29	555.34	380.37	36.08
30	563.43	386.26	38.21
31	571.28	392.44	40.34
32	578.91	398.92	42.47
33	586.28	405.67	44.60
34	593.40	412.69	46.72
35	600.26	419.97	48.85
36	606.84	427.50	50.98
37	613.13	435.27	53.11
38	619.14	443.27	55.24
39	624.84	451.48	57.36
40	630.23	459.90	59.49
41	631.57	462.17	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	293.47	9.17	2194.30	.00	2633.51	1501.58	811.76
2	299.03	1.94	1016.94	.00	862.81	610.18	219.71
3	303.69	7.37	6291.11	.00	4195.90	3658.77	1062.77
4	312.09	9.44	13908.72	.00	7268.73	8141.21	1941.12
5	321.59	9.56	20271.04	.00	9260.62	12791.70	2732.15
6	331.20	9.66	26366.08	.00	11031.57	17195.70	3481.24
7	340.90	9.75	32148.89	.00	12579.12	21353.75	4188.50
8	346.89	2.22	8061.00	.00	3037.26	5364.16	1038.20
9	349.00	2.00	7417.63	.00	2787.40	4943.23	954.07
10	352.80	5.60	21845.69	.00	8076.48	14692.28	2816.38
11	357.10	2.98	12373.34	.00	4421.43	8332.77	1585.23
12	360.29	3.41	14751.56	.00	5167.84	10150.32	2633.32
13	363.75	3.49	15731.58	.00	5406.65	10933.45	2836.48
14	367.55	4.11	19300.94	.00	6468.49	13349.81	3463.36
15	369.70	.20	960.06	.00	318.09	667.82	173.25
16	369.90	.20	962.14	.00	318.44	669.61	173.72

17	372.71	5.43	26393.41	.00	8756.77	18346.81	4759.74
18	380.41	9.97	49647.05	.00	16497.66	33963.21	8811.13
19	387.27	3.75	18965.22	.00	6301.39	12807.05	3322.56
20	392.27	6.25	31922.17	.00	10601.16	21562.14	5593.90
21	396.04	1.30	6674.09	.00	2213.17	4462.83	1157.80
22	396.90	.43	2203.56	.00	730.32	1473.88	382.37
23	397.38	.52	2699.44	.00	894.48	1805.74	468.46
24	401.52	7.75	40050.30	.00	13238.10	26823.74	6958.93
25	407.70	4.61	23916.49	.00	7870.51	15914.46	4128.72
26	412.69	5.38	28103.20	.00	9147.32	18800.42	4877.42
27	415.69	.62	3231.76	.00	1044.14	2155.47	559.20
28	420.68	9.36	49734.03	.00	15683.82	33548.39	8703.52
29	430.33	9.94	53889.05	.00	16206.86	36951.92	9586.50
30	439.22	7.84	42998.63	.00	12320.12	29995.21	7781.71
31	444.16	2.05	11301.46	.00	3135.14	8069.21	1487.95
32	450.11	9.83	54145.07	.00	14474.14	39254.61	7233.33
33	459.90	9.76	53448.80	.00	13264.96	39868.55	7337.76
34	469.61	9.67	52246.16	.00	11829.30	40253.86	7403.30
35	479.23	9.57	50553.75	.00	10169.19	40413.00	7430.37
36	488.74	9.45	48392.30	.00	8286.87	40348.60	7419.41
37	497.13	7.33	36187.58	.00	5049.49	31514.05	5797.87
38	501.79	1.99	9602.94	.00	1135.47	8827.91	866.02
39	505.33	5.09	24047.34	.00	2441.33	22780.98	2234.82
40	508.11	.48	2218.32	.00	190.73	2152.30	168.29
41	510.16	3.62	16676.35	.00	1234.33	14491.76	5645.45
42	512.56	1.17	5342.78	.00	322.56	4719.37	1838.49
43	517.07	7.86	35269.36	.00	1011.78	32948.00	10714.71
44	521.03	.05	212.23	.00	.04	204.64	66.53
45	525.46	8.82	38649.85	.00	.00	37267.11	12131.00
46	534.21	8.69	36982.13	.00	.00	35885.28	11728.22
47	542.80	8.50	34886.50	.00	.00	34107.09	11202.20
48	551.20	8.29	32598.01	.00	.00	32146.73	10622.29
49	559.39	8.08	30140.36	.00	.00	30013.56	9991.26
50	567.35	7.86	27539.46	.00	.00	27718.19	9312.25
51	575.09	7.62	24822.21	.00	.00	25271.65	8588.52
52	582.59	7.38	22016.95	.00	.00	22686.01	7823.64
53	589.84	7.12	19153.37	.00	.00	19974.55	7021.54
54	596.83	6.86	16261.64	.00	.00	17151.33	6186.38
55	603.55	6.58	13372.87	.00	.00	14231.90	5322.76
56	609.99	6.30	10518.73	.00	.00	11233.34	4435.73
57	616.14	6.00	7730.90	.00	.00	8174.20	3530.78
58	621.99	5.70	5041.57	.00	.00	5075.48	2614.12
59	627.14	4.60	2264.11	.00	.00	1858.15	1498.61
60	629.84	.79	201.41	.00	.00	-905.15	818.85
61	630.90	1.34	133.66	.00	.00	-2220.36	1463.50

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

FAILURE SURFACE #10 SPECIFIED BY 45 COORDINATE POINTS

SAFETY FACTOR = 1.800

X-CENTER = 414.29
Y-CENTER = 641.95
RADIUS = 312.24

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	288.89	356.00	-22.76
2	298.11	352.13	-20.93
3	307.45	348.56	-19.09
4	316.90	345.29	-17.26
5	326.45	342.32	-15.42

6	336.09	339.66	-13.59
7	345.81	337.31	-11.75
8	355.60	335.28	-9.92
9	365.45	333.56	-8.08
10	375.35	332.15	-6.25
11	385.29	331.06	-4.41
12	395.26	330.29	-2.58
13	405.25	329.84	-.74
14	415.25	329.71	1.09
15	425.25	329.91	2.93
16	435.24	330.42	4.76
17	445.20	331.25	6.60
18	455.14	332.40	8.44
19	465.03	333.86	10.27
20	474.87	335.65	12.11
21	484.65	337.74	13.94
22	494.35	340.15	15.78
23	503.98	342.87	17.61
24	513.51	345.90	19.45
25	522.94	349.23	21.28
26	532.25	352.86	23.12
27	541.45	356.78	24.95
28	550.52	361.00	26.79
29	559.45	365.51	28.62
30	568.22	370.30	30.46
31	576.84	375.37	32.29
32	585.30	380.71	34.13
33	593.57	386.32	35.96
34	601.67	392.19	37.80
35	609.57	398.32	39.63
36	617.27	404.70	41.47
37	624.77	411.32	43.30
38	632.04	418.18	45.14
39	639.10	425.27	46.97
40	645.92	432.58	48.81
41	652.51	440.10	50.64
42	658.85	447.83	52.48
43	664.94	455.76	54.31
44	670.77	463.89	56.15
45	674.21	469.01	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	293.50	9.22	2140.56	.00	2596.47	1450.78	802.12
2	299.06	1.89	959.06	.00	820.29	573.06	209.75
3	303.73	7.45	6211.81	.00	4141.56	3595.26	1054.03
4	312.18	9.45	13712.02	.00	7141.12	8033.61	1920.41
5	321.68	9.55	20042.54	.00	9132.08	12697.76	2712.76
6	331.27	9.64	26148.14	.00	10932.64	17148.87	3468.92
7	340.95	9.72	31995.11	.00	12540.94	21387.50	4188.98
8	346.91	2.19	7948.33	.00	3005.69	5326.85	1029.16
9	349.00	2.00	7430.24	.00	2803.94	4985.12	960.39
10	352.80	5.60	21919.99	.00	8145.80	14833.71	2837.88
11	356.40	1.59	6566.72	.00	2372.22	4441.64	844.19
12	359.60	4.81	20751.79	.00	7356.71	14360.18	3720.82
13	363.73	3.45	15698.14	.00	5445.62	10988.25	2847.13
14	367.53	4.15	19699.71	.00	6673.14	13729.17	3557.32
15	369.70	.20	972.12	.00	325.84	681.08	176.47
16	369.90	.20	974.33	.00	326.26	682.96	176.96
17	372.68	5.35	26404.00	.00	8871.89	18476.57	4787.40
18	380.32	9.94	50452.18	.00	17022.04	34715.74	8995.08
19	387.22	3.85	19973.30	.00	6752.41	13551.01	3511.16

20	392.20	6.12	32167.90	.00	10896.13	21803.02	5649.30
21	395.98	1.42	7557.80	.00	2557.92	5066.57	1312.78
22	396.90	.43	2275.36	.00	770.06	1525.38	395.24
23	397.38	.52	2788.60	.00	943.81	1869.40	484.37
24	401.45	7.61	40789.21	.00	13804.07	27345.04	7085.28
25	407.63	4.75	25679.74	.00	8671.93	17067.09	4422.19
26	412.63	5.25	28725.61	.00	9631.77	19160.38	4964.58
27	415.63	.75	4120.16	.00	1372.02	2735.35	708.75
28	420.63	9.25	51906.79	.00	16959.67	34784.36	9012.85
29	430.24	9.99	57721.90	.00	18159.93	39118.76	10135.93
30	440.22	9.97	58983.54	.00	17788.45	40524.39	10500.13
31	450.17	9.93	59807.15	.00	17217.80	41737.08	10814.35
32	460.08	9.89	60192.06	.00	16448.43	42758.91	11079.11
33	468.16	6.27	38307.29	.00	9986.53	27646.55	7163.40
34	473.08	3.57	21827.82	.00	5494.67	16154.77	2946.03
35	479.76	9.78	59575.57	.00	14317.06	44859.70	8176.47
36	489.50	9.71	58560.96	.00	12957.22	45331.41	8256.60
37	499.16	9.62	57120.50	.00	11403.11	45607.27	8303.46
38	508.74	9.53	55267.97	.00	9656.24	45689.11	8317.37
39	518.22	9.43	53020.24	.00	7718.49	45579.25	8298.70
40	525.46	5.04	27552.65	.00	3302.85	24526.00	4467.31
41	530.12	4.27	22861.05	.00	2288.97	21427.26	2099.38
42	533.81	3.11	16372.54	.00	1379.62	15762.92	1544.41
43	535.61	.48	2509.16	.00	188.74	2457.54	191.92
44	538.33	4.96	25565.19	.00	1560.26	22499.85	8754.11
45	541.13	.64	3251.72	.00	149.78	2977.39	956.77
46	545.08	7.27	36706.11	.00	831.64	34496.56	11082.60
47	549.62	1.80	9002.73	.00	.00	8639.23	2773.07
48	554.98	8.93	44105.08	.00	.00	42505.82	13669.54
49	563.83	8.78	42354.17	.00	.00	41028.72	13233.14
50	572.53	8.62	40409.79	.00	.00	39382.82	12746.86
51	581.07	8.45	38287.87	.00	.00	37574.75	12212.67
52	589.44	8.28	36005.43	.00	.00	35611.48	11632.63
53	597.62	8.09	33580.64	.00	.00	33500.49	11008.94
54	605.62	7.90	31032.44	.00	.00	31249.46	10343.88
55	613.42	7.70	28381.08	.00	.00	28866.90	9639.96
56	621.02	7.49	25646.81	.00	.00	26361.26	8899.68
57	628.40	7.28	22851.72	.00	.00	23742.41	8125.94
58	635.57	7.05	20017.87	.00	.00	21020.51	7321.77
59	642.51	6.82	17167.83	.00	.00	18206.36	6490.33
60	647.46	3.08	6983.43	.00	.00	7483.66	2730.52
61	650.75	3.51	7227.70	.00	.00	7699.16	2866.52
62	655.68	6.34	10730.16	.00	.00	11443.11	4492.15
63	661.89	6.09	7303.51	.00	.00	7614.54	3361.01
64	667.86	5.83	4041.93	.00	.00	3812.92	2237.83
65	671.63	1.71	609.04	.00	.00	405.50	461.36
66	673.35	1.72	236.93	.00	.00	-2137.10	1718.80

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Waste Management of North America, Inc. (s/n 5211)
Lombard, IL

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          Y            A     X     I     S

        287.00     468.25     649.50     830.75    1012.00    1193.25

X        .00 *-***------+---------+---------+---------+---------+
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X     543.75    ....113.
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I     725.00    +  ........
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S     906.25    +
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     1087.50    +
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     1268.75    +
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     1450.00    * ***       *
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RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86445-300

CLIENT WHL - Magnolia Landfill
PROJECT Phase II Redesign

SUBJECT Short-Term Slope Stability Analysis Using PC STABL5M

Prepared By ZAA Date 10-8-93
Reviewed By DOK Date 10-22-93
Approved By ____ Date ____

OBJECTIVE: Analyze the Short-Term slope stability of the final Landfill Configuration.

APPROACH: Use Program PC STABL5M to find the most critical failure surface and the corresponding Factor of Safety Using the Simplified Bishop procedure.

References:

1) For the theory behind the methods of analysis used in the program:

"Landslides - Analysis and Control", Transportation Research Board - National Academy of Science, Special Report 1976.

2) For running the program:

"User guide for PC STABL5M", Efthychios Achilleos, Purdue University, West Lafayette, Indiana. December 1988.

ASSUMPTIONS: All the layers and their properties are listed on the attached drawing.

CALCULATIONS: 2000 failure surfaces were analysed by the program until a most critical factor of safety was determined.

The minimum F.S. for the Short-Term condition is 1.75. The location of the circle is shown on the accompanying drawing.

The output file containing the information pertinent to the most critical surface is Attached.

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WML - Magnolia Landfill SUBJECT Short-Term Slope Stability Analysis using PCSTABL5M Prepared By ZHA Date 10-8-93

PROJECT Phase II Redesign Reviewed By DOK Date 10-22-93

Approved By _____ Date _____

Output File	α	Xmin	XTerm.	Ymin	FS
Magst.01	-40	200-300	600-700	275	1.81
Magst.02	-35	200-300	600-700	275	1.82
Magst.03	-45	200-300	600-700	275	1.79
Magst.04	-45	275-325	600-625	275	1.77
Magst.05	-45	300-350	600-650	275	1.85
Magst.06	-40	300-350	600-650	275	1.75
Magst.07	-40	325-375	600-625	275	1.81
Magst.08	-40	350-375	600-625	275	1.81
Magst.09	-40	300-400	600-700	275	1.80
Magst.10	-35	300-350	600-650	275	1.80
Block *					
Mag1.BLK		417-426	600-620		1.78
Mag2.BLK		417-426	620-650		1.86
Mag3.BLK		417-426	575-600		1.98
Mag4.BLK		426-450	600-620		1.87
Mag5.BLK		426-450	650-700		1.82
Mag6.BLK		426-450	690-725		2.34
Mag7.BLK		400-425	600-620		2.16
Bearing *					
Mag13.OUT	-45	250-350	400-500		1.77
Mag14.OUT	-30	300-400	400-500		1.74
Mag15.OUT	-20	300-400	400-500		2.02

*: Analyses performed assuming a maximum Landfill height of 220.5 ft rather than 200' used for the circular failure surfaces.

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WML - Magnolia Landfill

PROJECT Phase II Redesign

SUBJECT Short-Term Slope Stability analysis using PCSTABL5M

Prepared By EHA Date 10-22-93

Reviewed By DEK Date 10-22-93

Approved By ____ Date ____

CONCLUSION : A minimum factor of safety of 1.75 was generated by the PCSTABL5M program using the stated soil parameters and slope geometry. This F.S. is well in excess of the WML minimum standard of 1.5 for short-term conditions. Therefore, no stability problems are anticipated for the design slopes.

It is important, however, that the slope angles specified not be exceeded during construction of the landfill. Construction of slopes steeper than those specified will reduce the F.S., potentially causing unstable slopes and failures.

$$F.S. = \frac{\Sigma \left\{ \frac{C\Delta x + \{W - u\Delta x\} \tan\phi}{m_\alpha} \right\}}{\Sigma W \sin\alpha}$$ Bishop's Formula.

** PCSTABL5M **

by
Purdue University

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--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:

Time of Run:
Run By:

Input Data Filename: magst.in
Output Filename: magst.06

PROBLEM DESCRIPTION: Magnolia Landfill Slope Stability - Short Term Case

BOUNDARY COORDINATES

6 Top Boundaries
28 Total Boundaries

Boundary No.	Soil Tupe Below Bnd.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	8	.00	356.00	300.00	356.00
2	8	300.00	356.00	348.00	368.00
3	8	348.00	368.00	350.00	368.00
4	1	350.00	368.00	530.00	410.00
5	1	530.00	410.00	1450.00	500.00
6	1	1450.00	500.00	1500.00	495.00
7	8	350.00	368.00	362.00	368.00
8	2	362.00	368.00	530.00	408.50

9	2	530.00	408.50	1450.00	498.50
10	2	1450.00	498.50	1500.00	493.50
11	7	362.00	368.00	369.60	368.00
12	3	370.00	368.00	530.00	407.00
13	3	530.00	407.00	1450.00	497.00
14	3	1450.00	497.00	1500.00	492.00
15	6	369.60	368.00	369.80	368.00
16	5	369.80	368.00	370.00	368.00
17	5	370.00	368.00	410.00	355.00
18	4	410.00	355.00	1500.00	367.00
19	5	410.00	355.00	416.00	353.00
20	5	416.00	353.00	1500.00	365.00
21	6	369.80	368.00	416.00	352.80
22	6	416.00	352.80	1500.00	364.80
23	7	369.60	368.00	416.00	352.60
24	8	362.00	368.00	416.00	350.00
25	8	416.00	350.00	1500.00	361.00
26	9	.00	335.00	1500.00	335.00
27	10	.00	325.00	1500.00	330.00
28	11	.00	287.00	1500.00	287.00

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ISOTROPIC SOIL PARAMETERS

11 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	100.0	105.0	250.0	.0	.00	.0	1
2	110.0	115.0	1000.0	.0	.00	.0	1
3	65.0	70.0	300.0	23.0	.00	.0	1
4	95.0	100.0	.0	35.0	.00	.0	1
5	100.0	100.0	.0	8.0	.00	.0	1
6	110.0	115.0	.0	10.0	.00	.0	1
7	110.0	115.0	1000.0	.0	.00	.0	1
8	115.0	120.0	500.0	.0	.00	.0	1
9	110.0	115.0	.0	25.0	.00	.0	1
10	115.0	120.0	.0	30.0	.00	.0	1
11	140.0	140.0	2500.0	18.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	356.00
2	1500.00	367.00

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A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 300.00 ft. and X = 350.00 ft.

Each Surface Terminates Between X = 600.00 ft.
and X = 650.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =275.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -40.0 And .0 deg.

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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 Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	311.11	358.78
2	320.31	354.85
3	329.64	351.27
4	339.11	348.03
5	348.68	345.14
6	358.35	342.61
7	368.12	340.44
8	377.95	338.63
9	387.85	337.19
10	397.79	336.11
11	407.76	335.40
12	417.76	335.06
13	427.76	335.09
14	437.75	335.48
15	447.72	336.25
16	457.66	337.38
17	467.54	338.88
18	477.37	340.75
19	487.12	342.97

20	496.78	345.56
21	506.33	348.49
22	515.78	351.78
23	525.09	355.42
24	534.27	359.40
25	543.29	363.71
26	552.15	368.36
27	560.83	373.32
28	569.31	378.61
29	577.60	384.20
30	585.68	390.10
31	593.53	396.29
32	601.15	402.77
33	608.52	409.52
34	615.64	416.55
35	617.54	418.56

Circle Center At X = 422.0 ; Y = 605.8 and Radius, 270.7

*** 1.752 ***

Individual data on the 55 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	1.1	50.9	.0	.0	.0	.0	.0	.0	.0
2	8.1	3311.9	.0	955.6	.0	.0	.0	.0	.0
3	9.3	10109.4	.0	3322.2	.0	.0	.0	.0	.0
4	9.5	16678.3	.0	5493.5	.0	.0	.0	.0	.0
5	8.9	21187.3	.0	6857.6	.0	.0	.0	.0	.0
6	.7	1824.6	.0	589.8	.0	.0	.0	.0	.0
7	1.3	3585.5	.0	1157.0	.0	.0	.0	.0	.0
8	8.4	24777.4	.0	8024.0	.0	.0	.0	.0	.0
9	3.6	11977.4	.0	3829.2	.0	.0	.0	.0	.0
10	6.1	21603.7	.0	6863.0	.0	.0	.0	.0	.0
11	1.5	5522.9	.0	1732.1	.0	.0	.0	.0	.0
12	.2	752.1	.0	235.5	.0	.0	.0	.0	.0
13	.2	754.0	.0	236.0	.0	.0	.0	.0	.0
14	8.0	30657.0	.0	9775.2	.0	.0	.0	.0	.0
15	9.9	39744.2	.0	13039.1	.0	.0	.0	.0	.0
16	1.6	6511.1	.0	2165.1	.0	.0	.0	.0	.0
17	7.6	31396.3	.0	10558.7	.0	.0	.0	.0	.0
18	.4	1811.8	.0	615.2	.0	.0	.0	.0	.0
19	.4	1567.0	.0	532.6	.0	.0	.0	.0	.0
20	.2	656.4	.0	222.5	.0	.0	.0	.0	.0
21	9.8	41676.9	.0	14252.7	.0	.0	.0	.0	.0
22	2.2	9580.0	.0	3301.7	.0	.0	.0	.0	.0

23	6.0	25935.9	.0	8918.4	.0	.0	.0	.0	.0
24	1.8	7690.8	.0	2629.0	.0	.0	.0	.0	.0
25	10.0	44698.7	.0	14992.7	.0	.0	.0	.0	.0
26	10.0	45943.0	.0	14905.9	.0	.0	.0	.0	.0
27	10.0	46677.1	.0	14588.7	.0	.0	.0	.0	.0
28	9.9	46899.4	.0	14041.7	.0	.0	.0	.0	.0
29	9.9	46612.9	.0	13265.5	.0	.0	.0	.0	.0
30	9.8	45824.6	.0	12261.3	.0	.0	.0	.0	.0
31	9.7	44546.0	.0	11030.4	.0	.0	.0	.0	.0
32	9.7	42792.6	.0	9574.4	.0	.0	.0	.0	.0
33	9.6	40584.3	.0	7895.4	.0	.0	.0	.0	.0
34	7.2	28994.0	.0	4731.2	.0	.0	.0	.0	.0
35	2.3	8954.9	.0	1264.3	.0	.0	.0	.0	.0
36	5.6	21325.5	.0	2594.3	.0	.0	.0	.0	.0
37	.5	1964.6	.0	203.3	.0	.0	.0	.0	.0
38	3.2	11769.2	.0	1080.0	.0	.0	.0	.0	.0
39	2.0	7243.1	.0	545.6	.0	.0	.0	.0	.0
40	2.9	10343.0	.0	583.8	.0	.0	.0	.0	.0
41	4.3	14897.2	.0	415.0	.0	.0	.0	.0	.0
42	1.1	3780.2	.0	19.9	.0	.0	.0	.0	.0
43	7.9	26215.9	.0	.0	.0	.0	.0	.0	.0
44	8.9	27369.6	.0	.0	.0	.0	.0	.0	.0
45	8.7	24593.6	.0	.0	.0	.0	.0	.0	.0
46	8.5	21691.4	.0	.0	.0	.0	.0	.0	.0
47	8.3	18689.2	.0	.0	.0	.0	.0	.0	.0
[illegible]	8.1	15614.3	.0	.0	.0	.0	.0	.0	.0
49	7.9	12495.1	.0	.0	.0	.0	.0	.0	.0
50	7.6	9360.6	.0	.0	.0	.0	.0	.0	.0
51	7.4	6240.8	.0	.0	.0	.0	.0	.0	.0
52	5.8	2801.4	.0	.0	.0	.0	.0	.0	.0
53	1.3	329.7	.0	.0	.0	.0	.0	.0	.0
54	.3	57.9	.0	.0	.0	.0	.0	.0	.0
55	1.6	116.7	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	311.11	358.78
2	320.32	354.88
3	329.67	351.33
4	339.14	348.12
5	348.72	345.27
6	358.41	342.77
7	368.18	340.64
8	378.02	338.87
9	387.92	337.46
10	397.87	336.43
11	407.84	335.76
12	417.84	335.46
13	427.84	335.54
14	437.83	335.98

15	447.80	336.79
16	457.73	337.98
17	467.61	339.53
18	477.42	341.44
19	487.16	343.72
20	496.80	346.36
21	506.35	349.35
22	515.77	352.69
23	525.06	356.38
24	534.21	360.42
25	543.21	364.79
26	552.04	369.49
27	560.68	374.51
28	569.14	379.85
29	577.39	385.50
30	585.42	391.45
31	593.23	397.70
32	600.81	404.23
33	608.13	411.04
34	615.20	418.11
35	615.42	418.36

Circle Center At X = 420.9 ; Y = 605.2 and Radius, 269.8

*** 1.766 ***

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Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	316.67	360.17
2	325.89	356.29
3	335.24	352.76
4	344.72	349.57
5	354.30	346.72
6	363.99	344.22
7	373.76	342.08
8	383.59	340.30
9	393.49	338.87
10	403.44	337.81
11	413.41	337.11
12	423.41	336.77
13	433.41	336.79
14	443.40	337.18
15	453.37	337.94
16	463.31	339.05
17	473.20	340.53

18	483.03	342.36
19	492.79	344.55
20	502.46	347.10
21	512.03	349.99
22	521.49	353.23
23	530.82	356.82
24	540.02	360.74
25	549.07	364.99
26	557.96	369.57
27	566.68	374.47
28	575.22	379.68
29	583.55	385.20
30	591.69	391.02
31	599.60	397.13
32	607.29	403.53
33	614.74	410.20
34	621.94	417.14
35	623.91	419.19

Circle Center At X = 427.7 ; Y = 611.5 and Radius, 274.8

*** 1.826 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	344.44	367.11
2	353.08	362.07
3	361.95	357.45
4	371.03	353.26
5	380.30	349.52
6	389.74	346.22
7	399.33	343.38
8	409.05	341.00
9	418.86	339.09
10	428.76	337.66
11	438.71	336.70
12	448.70	336.22
13	458.70	336.23
14	468.69	336.71
15	478.64	337.67
16	488.54	339.11
17	498.35	341.02
18	508.07	343.40
19	517.65	346.25
20	527.09	349.55
21	536.36	353.30

22	545.44	357.49
23	554.31	362.12
24	562.94	367.16
25	571.33	372.61
26	579.44	378.46
27	587.26	384.69
28	594.77	391.29
29	601.96	398.25
30	608.80	405.54
31	615.29	413.15
32	619.63	418.77

Circle Center At X = 453.6 ; Y = 544.3 and Radius, 208.1

*** 1.838 ***

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Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.33	364.33
2	342.35	360.00
3	351.52	356.02
4	360.84	352.39
5	370.29	349.12
6	379.86	346.21
7	389.53	343.68
8	399.29	341.52
9	409.13	339.73
10	419.03	338.32
11	428.98	337.30
12	438.96	336.66
13	448.96	336.40
14	458.96	336.52
15	468.94	337.03
16	478.90	337.92
17	488.82	339.19
18	498.68	340.85
19	508.48	342.88
20	518.18	345.28
21	527.79	348.05
22	537.28	351.20
23	546.65	354.70
24	555.87	358.56
25	564.94	362.77
26	573.85	367.33
27	582.57	372.22

28	591.09	377.45
29	599.41	383.00
30	607.51	388.86
31	615.38	395.03
32	623.01	401.50
33	630.38	408.26
34	637.49	415.29
35	642.87	421.04

Circle Center At X = 450.7 ; Y = 596.9 and Radius, 260.5

*** 1.838 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	338.89	365.72
2	347.84	361.27
3	356.97	357.19
4	366.26	353.48
5	375.69	350.15
6	385.25	347.21
7	394.92	344.67
8	404.69	342.52
9	414.53	340.77
10	424.44	339.43
11	434.40	338.49
12	444.38	337.96
13	454.38	337.83
14	464.38	338.12
15	474.35	338.81
16	484.29	339.91
17	494.18	341.41
18	504.00	343.31
19	513.73	345.62
20	523.36	348.32
21	532.87	351.41
22	542.24	354.88
23	551.47	358.74
24	560.53	362.97
25	569.41	367.56
26	578.10	372.52
27	586.58	377.82
28	594.83	383.46
29	602.85	389.44
30	610.61	395.74
31	618.12	402.35

32	625.34	409.27
33	632.28	416.47
34	635.72	420.34

Circle Center At X = 452.4 ; Y = 582.7 and Radius, 244.9

*** 1.891 ***

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Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	327.78	362.94
2	336.95	358.96
3	346.26	355.31
4	355.70	352.02
5	365.26	349.08
6	374.92	346.51
7	384.68	344.29
8	394.50	342.44
9	404.39	340.95
10	414.33	339.84
11	424.30	339.10
12	434.30	338.73
13	444.30	338.73
14	454.29	339.11
15	464.26	339.86
16	474.20	340.98
17	484.09	342.47
18	493.91	344.33
19	503.66	346.55
20	513.32	349.14
21	522.88	352.09
22	532.32	355.39
23	541.63	359.04
24	550.79	363.03
25	559.81	367.36
26	568.65	372.03
27	577.31	377.02
28	585.79	382.34
29	594.05	387.96
30	602.11	393.89
31	609.93	400.12
32	617.52	406.64
33	624.86	413.43
34	631.36	419.92

Circle Center At X = 439.2 ; Y = 606.6 and Radius, 267.9

*** 1.919 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.33	364.33
2	342.58	360.53
3	351.96	357.05
4	361.45	353.90
5	371.04	351.08
6	380.73	348.59
7	390.49	346.44
8	400.33	344.63
9	410.22	343.16
10	420.16	342.03
11	430.12	341.25
12	440.12	340.82
13	450.11	340.73
14	460.11	340.99
15	470.09	341.59
16	480.05	342.55
17	489.96	343.84
18	499.83	345.48
19	509.63	347.46
20	519.36	349.78
21	529.00	352.43
22	538.54	355.42
23	547.98	358.73
24	557.29	362.37
25	566.47	366.33
26	575.51	370.61
27	584.40	375.20
28	593.12	380.09
29	601.67	385.28
30	610.03	390.77
31	618.19	396.54
32	626.16	402.59
33	633.90	408.91
34	641.43	415.50
35	647.85	421.53

Circle Center At X = 447.6 ; Y = 629.2 and Radius, 288.5

*** 2.018 ***

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	322.22	361.56
2	331.35	357.47
3	340.62	353.71
4	350.01	350.27
5	359.51	347.17
6	369.12	344.39
7	378.82	341.96
8	388.60	339.86
9	398.44	338.10
10	408.34	336.69
11	418.28	335.63
12	428.26	334.91
13	438.25	334.54
14	448.25	334.52
15	458.25	334.84
16	468.22	335.52
17	478.17	336.54
18	488.08	337.91
19	497.93	339.62
20	507.71	341.68
21	517.42	344.07
22	527.04	346.81
23	536.56	349.87
24	545.97	353.27
25	555.25	356.99
26	564.39	361.03
27	573.39	365.39
28	582.24	370.06
29	590.91	375.04
30	599.41	380.32
31	607.71	385.88
32	615.82	391.74
33	623.72	397.87
34	631.40	404.28
35	638.85	410.95
36	646.06	417.87
37	649.80	421.72

Circle Center At X = 443.9 ; Y = 621.3 and Radius, 286.8

*** 2.023 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	327.78	362.94
2	337.08	359.27
3	346.51	355.95
4	356.06	352.98
5	365.71	350.36
6	375.45	348.10
7	385.27	346.20
8	395.15	344.67
9	405.08	343.51
10	415.05	342.71
11	425.04	342.29
12	435.04	342.23
13	445.04	342.54
14	455.02	343.23
15	464.96	344.28
16	474.86	345.70
17	484.70	347.48
18	494.46	349.63
19	504.14	352.14
20	513.73	355.01
21	523.19	358.22
22	532.54	361.79
23	541.74	365.70
24	550.79	369.95
25	559.68	374.52
26	568.40	379.43
27	576.92	384.65
28	585.25	390.19
29	593.37	396.03
30	601.26	402.17
31	608.93	408.60
32	616.35	415.30
33	619.94	418.80

Circle Center At X = 431.6 ; Y = 612.3 and Radius, 270.1

*** 2.071 ***

Y A X I S F T

```
                .00     187.50     375.00     562.50     750.00     937.50
X          .00 +---------+----*-***+---------+---------+---------+
                -
                -
                -
                -
                -
       187.50 +
                -
                -
                -
                -                    .*
                -                   .11*
A      375.00 +                    .14*
                -                  ..1*.
                -                  ..1..
                -                  ..1..
                -                  ..11..
                -                   .410.*
X      562.50 +                    ..312.
                -                   ..411
                -                     .51
                -                       5
                -
                -
I      750.00 +
                -
                -
                -
                -
                -
S      937.50 +
                -
                -
                -
                -
                -
      1125.00 +
                -
                -
                -
                -
                -
F     1312.50 +
                -
                -
                -
                -                            *
                -
T     1500.00 +                 *  ***      *
```

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WML - Magnolia landfill SUBJECT Short-Term Slope Stability Analysis - Hand-Check

PROJECT Phase II Redesign

Prepared By ZHA Date 10-21-93

Reviewed By PBK Date 10-22-93

Approved By _____ Date _____

OBJECTIVE : to hand-check the Factor of Safety generated by PCSTABL5M for short-term slope stability

APPROACH : Use Bishop's Simplified Method of Slices to analyse the most critical failure surface generated by PCSTABL5M

The most critical failure surface will be drawn and the slices and soil layers defined. A spreadsheet will then be used to calculate the F.S.

Reference : Stephen G. Wright, class notes, CE 387M1, "Stability of Earth Slopes", Spring '89.

ASSUMPTIONS : * The waste, clay cover, and vegetative soil will be lumped into one layer.

* The KS sand, geotextile, and HDPE liner will be neglected.

* The clay liner and in-situ clay will be lumped.

Waste : $c = 300$ psf, $\phi = 23°$, $\gamma = 65$ pcf, $\gamma_s = 70$ pcf.

Clay Liner : $c = 1000$ psf, $\phi = 0°$, $\gamma = 110$ pcf, $\gamma_s = 115$ pcf.

In-situ Clay : $c = 500$ psf, $\phi = 0°$, $\gamma = 115$ pcf, $\gamma_s = 120$ pcf.

CLIENT WNL - Magnolia Landfill
PROJECT Phase II Redesign

SUBJECT Short-Term Slope Stability Analysis Hand-check

Prepared By ZHA Date 10-21-93
Reviewed By DBK Date 10-22-93
Approved By ____ Date ____

EQUATIONS

EQ. 1

$$F = \frac{\sum \left\{ \frac{c\Delta x + (W - u\Delta x)\tan\phi}{m_\alpha} \right\}}{\sum W \sin\alpha}.$$

where: F = Factor of Safety
c = cohesion intercept, psf
ϕ = Angle of shearing resistance, deg.
u = pore pressure, psf. (unit weight of water × depth along the center of the slice below the water table to the bottom of the slice)
W = weight of an individual slice, lb.
Δx = width of a slice, ft
h = height of a slice, ft
α = inclination of the base of an individual slice, deg.

and

$$m_\alpha = \frac{1 + \frac{\tan\alpha \tan\phi}{F}}{\sec\alpha}.$$

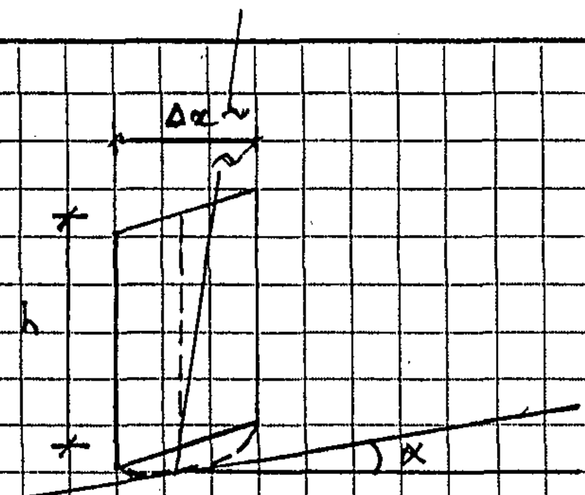
CALCULATIONS: The calculations are presented on page 4 (spread sheet)

CONCLUSION: The hand-check calculation shows that the minimum factor of safety generated by PC STABL5M is OK.

$FS_{hand} = 1.78$

$FS_{PC\,STABL} = 1.75$

3/4

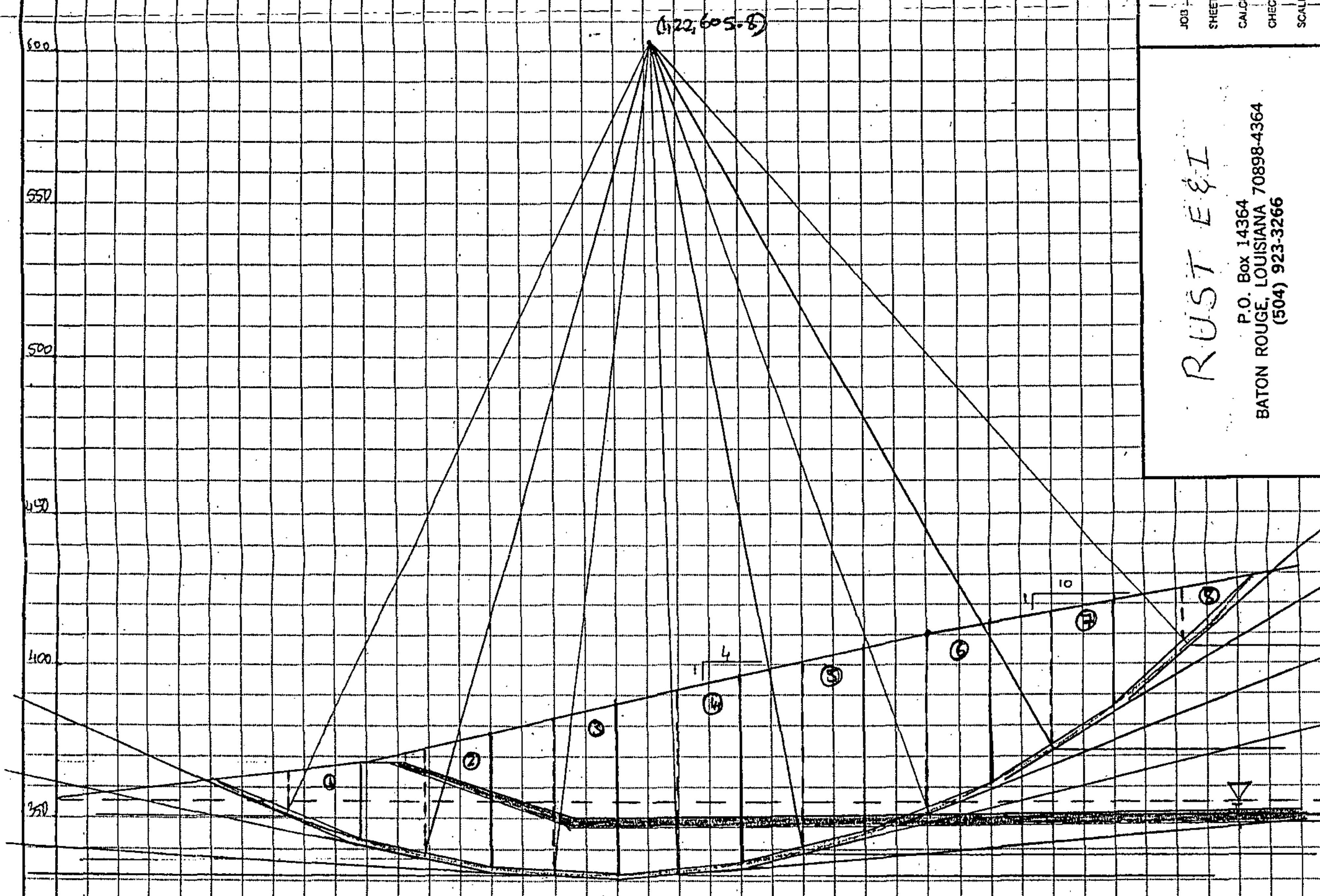


α is (-) when counterclockwise

$$F.S. = \frac{\sum \left\{ \frac{c\Delta x + [W - u\Delta x]\tan\phi}{m\alpha} \right\}}{\sum W \sin\alpha}$$

JOB 96645.300 - Magnolia Phase II Redesign
SHEET NO. 3 OF 4
CALCULATED BY ZHA DATE 10-20-93
CHECKED BY DBK DATE 10-22-93
SCALE 1.25" = 50'

RUST E&I
P.O. Box 14364
BATON ROUGE, LOUISIANA 70898-4364
(504) 923-3266



Slice #	α (°)	Δx (ft)	h (ft)	c (psf)	φ (°)	γ (pcf)	γs (pcf)	γused (pcf)	u (psf)
1	-24	46	12	500	0	115	120	114.5	124.8
2	-12	42	34	500	0	105	110	108	1060.8
3	-3.0	40	48	500	0	91	96	93	1377.8
4	5.5	40	57	500	0	86	91	90	1310.4
5	14	40	59	500	0	77	82	78	873.6
6	22	40	56	650	11.5	65	70	66	0
7	33	40	43	300	23	65	70	65	0
9	43	45	17	300	23	65	70	65	0

300
250
200
150

250 300 350 400 450 500 550 600 650

86415
DBK 10-22-93

** Magnolia Landfill - Short-Term Slope Stability Analysis - Simplified Bishop Procedure **

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Slice #	α (deg)	Dx (ft)	h (ft)	Unit Weight (pcf)	W (lb)	W*Sin(alpha)	c (psf)	Phi	u (psf)	c * Dx	u * Dx	W-u*Dx	(W-u*Dx)* Tan(Phi)	10+13	F(assmd)	m(alpha)	14/16
1	-24	47	12	114.5	32289	-13,133	500	0.0	125	23,500	5,866	26,423	0	23,500	1.76	0.9135	25,724
2	-12	42	34	108	154224	-32,065	500	0.0	1061	21,000	44,554	109,670	0	21,000	1.76	0.9781	21,469
3	-3	40	48	93	178560	-9,345	500	0.0	1373	20,000	54,912	123,648	0	20,000	1.76	0.9986	20,027
4	5.5	40	57	90	205200	19,668	500	0.0	1310	20,000	52,416	152,784	0	20,000	1.76	0.9954	20,093
5	14	40	59	78	184080	44,533	500	0.0	874	20,000	34,944	149,136	0	20,000	1.76	0.9703	20,612
6	22	40	56	66	147840	55,382	650	11.5	0	26,000	0	147,840	30,078	56,078	1.76	0.9705	57,784
7	33	40	43	65	111800	60,891	300	23.0	0	12,000	0	111,800	47,456	59,456	1.76	0.97	61,293
8	43	45	17	65	24863	16,956	300	23.0	0	13,500	0	24,863	10,554	24,054	1.76	0.8958	26,850

Sum[W*Sin(alpha)] = 142886

Sum{[c*Dx-(W-u*Dx)*Tan(Phi)]/m(alpha)} = 253853

The Calculated Factor of Safety Is Sum{[c*Dx-(W-u*Dx)*Tan(Phi)]/m(alpha)}/Sum[W*Sin(alpha)] = 1.78

Factor of Safety from Program PCSTABL = 1.75

A/A

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WMI - Magnolia Landfill
PROJECT Phase II Redesign

SUBJECT Long-Term Slope Stability Analysis using PC STABL5M

Prepared By ZHA Date 10-8-93
Reviewed By OBK Date 10-23-93
Approved By _____ Date _____

OBJECTIVE: To Analyse the Long-Term stability of the Landfill slopes.

APPROACH: Use program PCSTABL5M to find the most critical failure surface and the corresponding Factor of Safety.

Of the several methods available in the PCSTABL5M program, the Simplified Bishop procedure was used.

REFERENCES:

1) For the Theory behind the methods of analyses used in the program:

"Landslides, Analysis and Control", Special Report 176, Transportation Research Board, National Academy of Sciences.

2) For running the program:

"User Guide For PC STABL5M", Eftychios Achilleos, Purdue University, West Lafayette, Indiana, December 1988.

ASSUMPTIONS: ** The Long-Term soil parameters (Clay liner and in-situ CH, CL, and shale) were determined using correllations established by James Mitchell of Woodward Clyde. (Woodward-Clyde's Symposium on the Recent development in the Understanding and Characterization of Soil Properties, July 30-31, 1977).

It is important to note that geotechnical engineers are encouraged to use correllations only when real data (other than index properties) are not available. This may be the case of a preliminary study when extensive testing has not been achieved yet.

In this particular case, the underlying soils were not tested for long-Term strength parameters. The short-Term was expected to be the most critical of the two

The long-Term strength parameters assumed for this analysis are:

* Clay liner: $c = 200$ psf, $\phi = 17°$
* In-situ Clay & CL: $c = 100$ psf, $\phi = 17°$
* In-situ shale: $c = 1000$ psf, $\phi = 20°$

* The Elevation of the Landfill was set to 200' (NGVD).

** All Synthetic liners and geotextiles were included in the analysis

CALCULATIONS: 1400 failure surfaces were investigated until a most critical surface was determined.

The minimum factor of safety for the long-term condition is 1.90. The location of the surface is shown on the accompanying drawing.

The output file containing the information pertinent to the most critical surface is included.

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WHL - Magnolia Landfill
PROJECT Phase II Redesign

SUBJECT Long-Term Slope Stability Analysis using PCSTABL5M

Prepared By ZHA Date 10-8-93
Reviewed By DBK Date 10-22-93
Approved By ____ Date ____

SUMMARY OF PCSTABL5M RESULTS

Output File	α	X init.	X Term	Y min	$FS_{min} - FS_{max}$
MagLT.01	-25	200-400	600-800	275	2.52 - 2.64
MagLT.02	-30	200-400	600-800	↓	2.52 - 2.84
MagLT.03	-25	200-300	550-650		2.29 - 2.44
MagLT.04	-25	200-300	450-550		2.23 - 2.30
MagLT.05	-30	200-300	450-550		2.25 - 2.31
MagLT.06	-30	300-325	500-525		2.35 - 2.48
MagLT.07	-30	200-300	500-525		2.25 - 2.37
MagLT.08	-25	200-300	500-525		2.25 - 2.29
MagLT.09	-20	200-300	525-550		2.28 - 2.33
MagLT.10	-25	200-275	400-475		2.07 - 2.24
MagLT.11	-25	250-300	375-425		1.94 - 2.01
MagLT.12	-25	275-300	375-400		1.94 - 1.98
MagLT.13	-30	275-300	375-400		1.90 - 1.91
MagLT.14	-35	275-300	375-400		1.90 - 1.93
MagLT.15	-40	"	"		1.91 - 1.94

CIRCL2 method (Simplified Bishop) was used.

CONCLUSION: The long-Term slopes stability of Magnolia Landfill was investigated. The minimum long-Term F.S. is 1.90 which is greater than the 1.5 minimum standard set by WHL. No long-Term stability problems are, therefore, anticipated for the landfill.

$$F.S. = \sum \left\{ \frac{c\Delta x + (W - u\,\Delta x)\tan\phi}{m_\alpha} \right\} \Big/ \sum W \sin\alpha$$

Bishop's Formula.

The computer generated output file is attached.

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:

Time of Run:
Run By:

Input Data Filename: maglt.in
Output Filename: maglt.14

PROBLEM DESCRIPTION: Magnolia Landfill Slope Stability - Long Term Case

BOUNDARY COORDINATES

6 Top Boundaries
28 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	356.00	300.00	356.00	8
2	300.00	356.00	348.00	368.00	8
3	348.00	368.00	350.00	368.00	8
4	350.00	368.00	530.00	410.00	1
5	530.00	410.00	1450.00	500.00	1
6	1450.00	500.00	1500.00	495.00	1
7	350.00	368.00	362.00	368.00	8
8	362.00	368.00	530.00	408.50	2
9	530.00	408.50	1450.00	498.50	2
10	1450.00	498.50	1500.00	493.50	2
11	362.00	368.00	369.60	368.00	7
12	370.00	368.00	530.00	407.00	3
13	530.00	407.00	1450.00	497.00	3
14	1450.00	497.00	1500.00	492.00	3
15	369.60	368.00	369.80	368.00	6
16	369.80	368.00	370.00	368.00	5

17	370.00	368.00	410.00	355.00	5
18	410.00	355.00	1500.00	367.00	4
19	410.00	355.00	416.00	353.00	5
20	416.00	353.00	1500.00	365.00	5
21	369.80	368.00	416.00	352.80	6
22	416.00	352.80	1500.00	364.80	6
23	369.60	368.00	416.00	352.60	7
24	362.00	368.00	416.00	350.00	8
25	416.00	350.00	1500.00	361.00	8
26	.00	335.00	1500.00	335.00	9
27	.00	325.00	1500.00	330.00	10
28	.00	287.00	1500.00	287.00	11

ISOTROPIC SOIL PARAMETERS

11 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	100.0	105.0	250.0	.0	.00	.0	1
2	110.0	115.0	1000.0	.0	.00	.0	1
3	65.0	70.0	200.0	28.0	.00	.0	1
4	95.0	100.0	.0	35.0	.00	.0	1
5	100.0	100.0	.0	8.0	.00	.0	1
6	110.0	115.0	.0	10.0	.00	.0	1
7	110.0	115.0	200.0	17.0	.00	.0	1
8	115.0	120.0	100.0	17.0	.00	.0	1
9	110.0	115.0	.0	25.0	.00	.0	1
10	115.0	120.0	.0	30.0	.00	.0	1
11	140.0	140.0	1000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	356.00
2	1500.00	367.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 275.00 ft. and X = 300.00 ft.

Each Surface Terminates Between X = 375.00 ft. and X = 400.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =275.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -35.0 And .0 deg.

1

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 Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	286.11	356.00
2	294.69	350.86
3	303.95	347.09
4	313.68	344.79
5	323.65	344.00
6	333.63	344.75
7	343.37	347.02
8	352.64	350.75
9	361.24	355.85

10	368.96	362.21
11	375.61	369.68
12	378.87	374.74

Circle Center At X = 323.7 ; Y = 408.8 and Radius, 64.9

*** 1.898 ***

Individual data on the 25 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load lbs(kg)
1	8.6	2645.4	1139.8	2932.5	.0	.0	.0	.0	.0
2	5.3	3963.4	722.5	3004.7	.0	.0	.0	.0	.0
3	4.0	4078.1	437.4	2747.2	.0	.0	.0	.0	.0
4	9.7	14319.5	37.4	7689.2	.0	.0	.0	.0	.0
5	10.0	19348.3	.0	8698.7	.0	.0	.0	.0	.0
6	10.0	22239.7	.0	8756.6	.0	.0	.0	.0	.0
7	9.7	22724.4	.0	7861.4	.0	.0	.0	.0	.0
8	4.6	10624.6	.0	3300.0	.0	.0	.0	.0	.0
9	2.0	4398.0	.0	1247.9	.0	.0	.0	.0	.0
10	2.6	5598.5	.0	1486.4	.0	.0	.0	.0	.0
11	8.6	16156.9	.0	3318.4	.0	.0	.0	.0	.0
12	.8	1247.5	.0	152.5	.0	.0	.0	.0	.0
13	2.7	4037.8	.0	234.4	.0	.0	.0	.0	.0
14	4.3	5429.9	.0	.0	.0	.0	.0	.0	.0
15	.6	694.3	.0	.0	.0	.0	.0	.0	.0
16	.2	206.9	.0	.0	.0	.0	.0	.0	.0
17	.2	202.7	.0	.0	.0	.0	.0	.0	.0
18	1.3	1223.3	.0	.0	.0	.0	.0	.0	.0
19	1.7	1255.4	.0	.0	.0	.0	.0	.0	.0
20	.1	31.8	.0	.0	.0	.0	.0	.0	.0
21	.1	32.6	.0	.0	.0	.0	.0	.0	.0
22	2.1	1113.6	.0	.0	.0	.0	.0	.0	.0
23	.4	166.5	.0	.0	.0	.0	.0	.0	.0
24	1.2	436.5	.0	.0	.0	.0	.0	.0	.0
25	2.0	274.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	288.89	356.00
2	297.24	350.50
3	306.38	346.44

4	316.06	343.92
5	326.02	343.01
6	335.99	343.72
7	345.71	346.06
8	354.93	349.94
9	363.39	355.27
10	370.87	361.91
11	377.17	369.68
12	380.24	375.06

Circle Center At X = 326.5 ; Y = 404.0 and Radius, 61.0

*** 1.905 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	286.11	356.00
2	294.32	350.29
3	303.34	345.96
4	312.92	343.11
5	322.84	341.81
6	332.83	342.10
7	342.66	343.96
8	352.06	347.36
9	360.81	352.20
10	368.69	358.36
11	375.48	365.70
12	381.04	374.01
13	381.67	375.39

Circle Center At X = 326.0 ; Y = 404.7 and Radius, 63.0

*** 1.912 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	288.89	356.00

2	297.61	351.11
3	306.97	347.60
4	316.76	345.54
5	326.75	345.00
6	336.70	345.97
7	346.39	348.45
8	355.59	352.36
9	364.09	357.63
10	371.70	364.12
11	378.23	371.69
12	380.36	375.08

Circle Center At X = 325.3 ; Y = 410.4 and Radius, 65.5

*** 1.912 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.33	356.00
2	291.60	350.38
3	300.64	346.10
4	310.24	343.27
5	320.15	341.96
6	330.15	342.18
7	339.99	343.95
8	349.44	347.22
9	358.27	351.90
10	366.28	357.90
11	373.27	365.05
12	379.06	373.20
13	379.96	374.99

Circle Center At X = 323.7 ; Y = 406.5 and Radius, 64.6

*** 1.918 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	283.33	356.00
2	291.57	350.32
3	300.56	345.95
4	310.11	342.98
5	319.99	341.47
6	329.99	341.48
7	339.88	342.98
8	349.43	345.96
9	358.42	350.34
10	366.65	356.02
11	373.93	362.87
12	380.09	370.75
13	382.87	375.67

Circle Center At X = 325.0 ; Y = 407.6 and Radius, 66.3

*** 1.918 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.33	356.00
2	291.95	350.93
3	301.20	347.12
4	310.88	344.63
5	320.82	343.51
6	330.82	343.80
7	340.68	345.47
8	350.20	348.51
9	359.22	352.84
10	367.54	358.39
11	375.00	365.04
12	381.46	372.68
13	383.43	375.80

Circle Center At X = 323.8 ; Y = 415.0 and Radius, 71.5

*** 1.919 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.33	356.00
2	292.07	351.14
3	301.39	347.50
4	311.11	345.16
5	321.06	344.16
6	331.05	344.53
7	340.91	346.24
8	350.43	349.27
9	359.47	353.57
10	367.83	359.05
11	375.37	365.61
12	381.96	373.14
13	383.76	375.88

Circle Center At X = 323.4 ; Y = 417.7 and Radius, 73.6

*** 1.922 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	288.89	356.00
2	297.10	350.29
3	306.12	345.97
4	315.71	343.15
5	325.63	341.91
6	335.63	342.27
7	345.43	344.23
8	354.80	347.73
9	363.48	352.69
10	371.26	358.98
11	377.92	366.43
12	383.31	374.86
13	383.75	375.87

Circle Center At X = 328.4 ; Y = 404.0 and Radius, 62.2

*** 1.923 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.33	356.00
2	291.83	350.73
3	301.05	346.85
4	310.76	344.45
5	320.72	343.60
6	330.69	344.32
7	340.43	346.59
8	349.70	350.34
9	358.27	355.50
10	365.92	361.94
11	372.48	369.49
12	375.23	373.89

Circle Center At X = 321.1 ; Y = 407.1 and Radius, 63.6

*** 1.924 ***

1

```
            Y            A     X     I     S            F     T

             .00    187.50    375.00    562.50    750.00    937.50

X        .00 +---------+----*-***+---------+---------+---------+
             -
             -
             -
             -
             -
     187.50 +
             -
             -
             -                  .1
             -                  1*
             -                  11*
A    375.00 +                  .1*
             -                   *.
             -
             -
             -
             -                      *
X    562.50 +
             -
```

```
                -
                -
                -
                -
I     750.00 +
                -
                -
                -
                -
                -
S     937.50 +
                -
                -
                -
                -
                -
     1125.00 +
                -
                -
                -
                -
                -
F    1312.50 +
                -
                -
                -
                -                          *
                -
T    1500.00 +                *   ***      *
```

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WNL-Magnolia landfill SUBJECT Long-Term Slope Stability Analysis - Hand Check

PROJECT Phase II Redesign

Prepared By ZHA Date 10-8-93

Reviewed By DBK Date 10-22-93

Approved By ____ Date ____

OBJECTIVE: To double-check the Factor of Safety generated by PCSTABL5M.

APPROACH: Use Bishop's Simplified Method of Slices to check the most critical failure surface generated by PCSTABL5M

The most critical failure surface will be drawn and the slices and soil layers defined. A spreadsheet will then be used to calculate the FS.

REFERENCE: Stephen G. Wright, class notes, CE 387M1, "Stability of Earth Slopes", Spring '89.

ASSUMPTIONS:

* The waste, clay cover, and vegetative soil will lumped into one layer.
* The LCS sand, geotextile, and HDPE liner will be neglected.
* The clay and in-situ clay will be lumped.

Waste: $c = 200$ psf, $\phi = 28°$, $\gamma = 65$ pcf, $\gamma_s = 70$ pcf

In-situ Clay*: $c = 150$ psf, $\phi = 17°$, $\gamma = 112$ pcf, $\gamma_s = 117$ pcf.

* the Clay liner and insitu Clay were lumped into one layer and assigned soil parameters that are the average values of both soils.

→

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE 2 OF 4
PROJECT NO. 86415.300

CLIENT WML - Magnolia Landfill
PROJECT Phase II Redesign
SUBJECT Long-Term Slope Stability Analysis. Hand check
Prepared By ZHA Date 10-8-93
Reviewed By DBK Date 10-22-93
Approved By ____ Date ____

EQUATIONS

EQ1:

$$F = \sum \frac{\left\{ \frac{\bar{c}\Delta x + [W - u\Delta x]\tan\bar{\phi}}{m_\alpha} \right\}}{\sum W \sin\alpha}$$

where:
F = Factor of Safety
$\bar{c}$ = Cohesion intercept, psf.
$\bar{\phi}$ = Angle of Shearing resistance, deg
u = pore pressure, psf (unit weight of water × depth below water table) from center of slice
W = weight of an individual slice, lb
Δx = width of a slice, ft
h = height of a slice, ft.
α = inclination of the base of an individual slice, deg

and,

$$m_\alpha = \frac{1 + \frac{\tan\alpha \tan\bar{\phi}}{F}}{\sec\alpha}.$$

CALCULATIONS: The calculations are presented on page 4 (spreadsheet).

CONCLUSIONS: The hand calculations confirm the minimum F.S. calculated by the Program PCSTABL5M

$F.S._{hand} = 1.92$

$F.S._{PCSTABL5} = 1.90$

Geometry and calculation summary follow.

RUST ENVIRONMENT & INFRASTRUCTURE

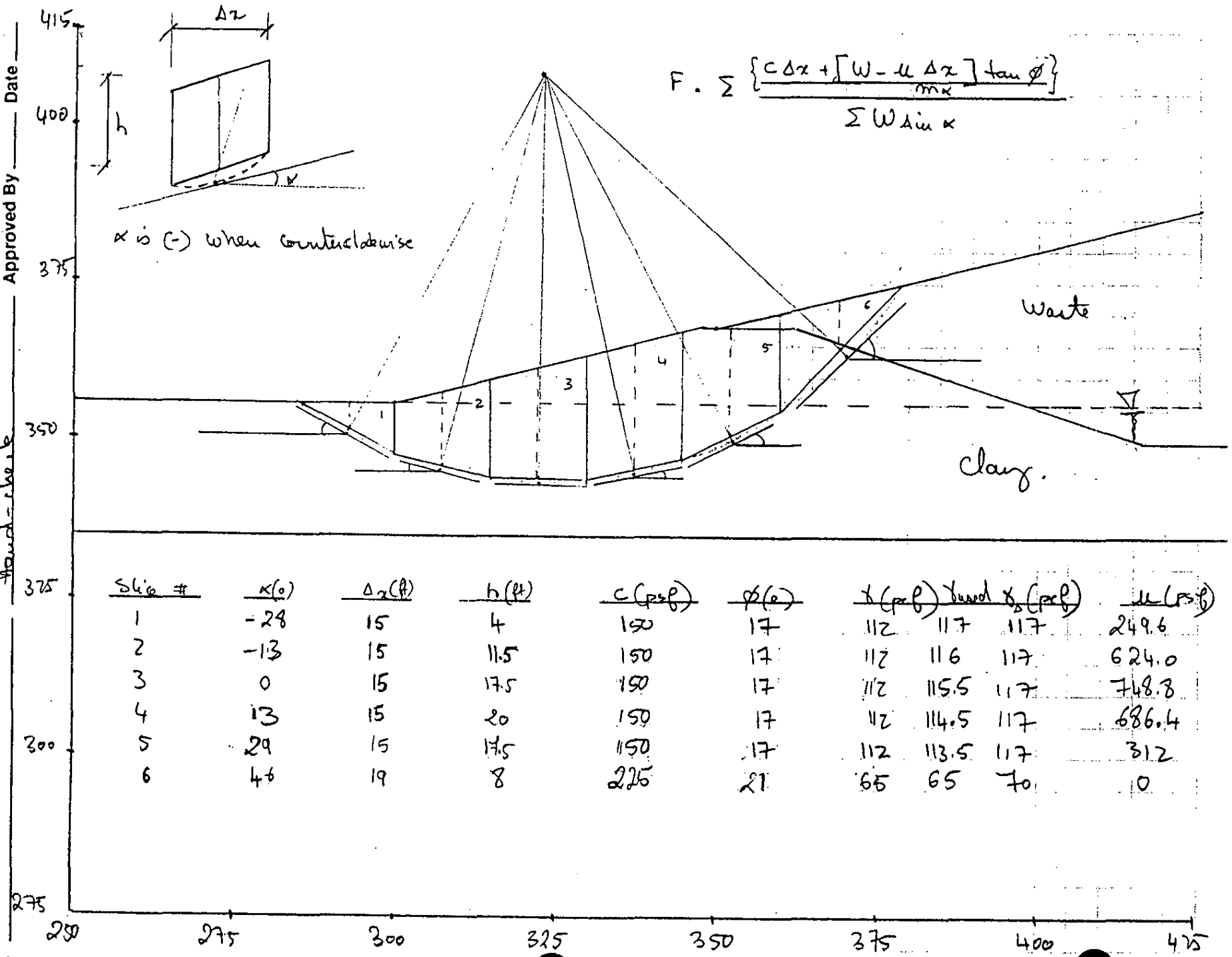
CALCULATION SHEET

PAGE 3 OF 4
PROJECT NO. 86415.300

CLIENT LWL-Magnolia Landfill
PROJECT Phase II Redesign

SUBJECT Long-Term Slope Stability & Analysis Hand-check

Prepared By ZHA Date 10-8-93
Reviewed By DBK Date 10-22-93
Approved By ____ Date ____



Slice #	α(°)	Δx(ft)	h(ft)	c(psf)	φ(°)	γ(pcf)	γ_saturated	γ_s(pcf)	u(psf)
1	-28	15	4	150	17	112	117	117	249.6
2	-13	15	11.5	150	17	112	116	117	624.0
3	0	15	17.5	150	17	112	115.5	117	748.8
4	13	15	20	150	17	112	114.5	117	686.4
5	29	15	17.5	150	17	112	113.5	117	312
6	46	19	8	225	21	65	65	70	0

** Magnolia Landfill - Long-Term Slope Stability Analysis - Simplified Bishop Procedure **

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Slice #	α (deg)	Dx (ft)	h (ft)	Unit Weight (pcf)	W (lb)	W*Sin(alpha)	c (psf)	Phi	u (psf)	c * Dx	u * Dx	W-u*Dx	(W-u*Dx)* Tan(Phi)	10+13	F(assmd)	m(alpha)	14/16
1	-28	15	4.0	117	3510	-1,648	150	17	250	2,250	3,744	-234	-72	2178.5	1.9	0.8074	2,698
2	-13	15	11.5	116	20010	-4,501	150	17	624	2,250	9,360	10,650	3,256	5506	1.9	0.9382	5,869
3	0	15	17.5	115.5	30319	0	150	17	748	2,250	11,220	19,099	5,839	8089.1	1.9	1	8,089
4	13	15	20.0	114.5	34350	7,727	150	17	686	2,250	10,296	24,054	7,354	9604	1.9	1.0106	9,504
5	29	15	17.5	113.5	29794	14,444	150	17	312	2,250	4,680	25,114	7,678	9928	1.9	0.9526	10,422
6	46	19	19.0	65	11733	8,440	225	21	0	4,275	0	11,733	4,504	8778.7	1.9	0.84	10,451

Sum[W*Sin(alpha)] = 24,462

Sum{[c*Dx-(W-u*Dx)*Tan(Phi)]/m(alpha)} = 47032

The Calculated Factor of Safety is Sum{[c*Dx-(W-u*Dx)*Tan(Phi)]/m(alpha)}/Sum[W*Sin(alpha)] = 1.92

Factor of Safety from Program PCSTABL = 1.90

A/A

BEARING CAPACITY CALCULATIONS

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WML-Magnolia Landfill SUBJECT Bearing Capacity Calculation Prepared By DBK Date 8/12/93

PROJECT Phase II Redesign Reviewed By ZHA Date 10-22-93

Approved By ____ Date ____

OBJECTIVE: TO determine safety factor of the landfill's underlying SOILS against a bearing type failure.

APPROACH: Perform bearing capacity calculations using the laboratory test data and Karl Tazaghi's bearing capacity equation; for shallow footings:

Ref 1)
"Foundation Analysis and Design"
Joseph E. Bowles
4th Edition 1988
Mc Graw-Hill, Inc.
Pages 186 - 189.

Bearing-capacity equation:

Terzaghi (see Table 4-2 for typical values and for $K_{p\gamma}$ values)

$$q_{ult} = cN_c s_c + \bar{q}N_q + 0.5\gamma B N_\gamma s_\gamma \qquad N_q = \frac{a^2}{2\cos^2(45 + \phi/2)}$$

$$a = e^{(0.75\pi - \phi/2)\tan\phi}$$

$$N_c = (N_q - 1)\cot\phi$$

$$N_\gamma = \frac{\tan\phi}{2}\left(\frac{K_{p\gamma}}{\cos^2\phi} - 1\right)$$

For:	strip	round	square
$s_c =$	1.0	1.3	1.3
$s_\gamma =$	1.0	0.6	0.8

TABLE 4-2

Bearing-capacity factors for the Terzaghi equations

Values of N_γ for ϕ of 34 and 48° are original Terzaghi values and used to back-compute $K_{p\gamma}$

ϕ, deg	N_c	N_q	N_γ	$K_{p\gamma}$
0	5.7†	1.0	0.0	10.8
5	7.3	1.6	0.5	12.2
10	9.6	2.7	1.2	14.7
15	12.9	4.4	2.5	18.6
20	17.7	7.4	5.0	25.0
25	25.1	12.7	9.7	35.0
30	37.2	22.5	19.7	52.0
34	52.6	36.5	36.0	
35	57.8	41.4	42.4	82.0
40	95.7	81.3	100.4	141.0
45	172.3	173.3	297.5	298.0
48	258.3	287.9	780.1	
50	347.5	415.1	1153.2	800.0

† = 1.5π + 1.

Soil strata information will be obtained from RUST E&I boring logs. Laboratory test results will be provided by SOILS AND FOUNDATION ENGINEERS, INC. and Southwestern

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WML-Magnolia Landfill SUBJECT Bearing Capacity Calculation

PROJECT Phase II Redesign

Prepared By DBK Date 8/12/93

Reviewed By ZAA Date 10-22-93

Approved By ____ Date ____

DATA: RUST E&I Boring Logs AND SFE LABORATORY TEST RESULTS

Cohesion = Unconfined Compressive Strength / 2

BORING NUMBER	DEPTH	ELEVATION	BLOW COUNT	COHESION (PSF)
R-2	5	57	--	910
62.0	15	47	--	910
	21	41	--	
	33	29	2	
	47	15	13	
R-4	9	56	--	1980
65.1	19	46	--	
	29	36	12	
	39	26	36	
R-6	9	53	--	
62.2	21	41	--	1260
	35	27	30	
	49	13	50	
R-9	9	45	--	
54.3	17	37	--	630
	25	29	16	
	35	19	30	
	45	9	18	
	74	-20	--	
R-11	13	48	--	1240
61.2	23	38	--	890
	33	28	--	870
	37	24	9	
	47	14	50	
R-14	21	43	--	
63.5	23	41	--	
	33	31	7	
R-17	3	60	--	2340
62.8	23	40	--	
	33	30	--	
	43	20	35	
R-19	15	45	--	790
60.1	27	33	--	650
	37	23	30	
	49	11	48	
R-21	9	49	--	660
58.0	13	45	--	
	25	33	--	
	33	25	32	
	47	11	43	
R-23	5	57	--	1160
62.2	15	47	--	
	29	33	--	2360
	35	27	26	
	45	17	15	

BORING NUMBER	DEPTH	ELEVATION	BLOW COUNT	COHESION (PSF)
R-27	7	56	--	2100
62.9	13	50	--	1540
	23	40	--	
	29	34	12	
	39	24	32	
	49	14	40	
R-29	7	58	--	1280
64.9	19	46	--	
	25	40	1	
	33	32	27	
	47	18	50	
R-31	9	52	--	1220
60.5	21	40	--	1620
	29	32	21	
	35	26	--	
	49	12	50	
R-32	23	39	36	
61.5	39	23	50	
R-33	11	51	--	1490
61.6	19	43	19	
	27	35	14	
	45	17	21	
	54	8	24	
	64	-2	49	
	74	-12	50	
R-34	19	43	--	
61.5	25	37	--	
	29	33	9	
	31	31	27	
R-36	9	53	--	1840
61.8	15	47	--	1060
	19	43	--	
	25	37	1	
	33	29	19	
	54	8	50	
	69	-7	50	
R-37	9	54	--	
62.6	17	46	--	
	25	38	9	
	29	34	--	
	31	32	17	
	39	24	50	
	49	14	39	
R-39	5	59	--	1320
64.1	15	49	--	1380
	25	39	9	
	39	25	47	
R-41	11	52	--	1170
62.5	19	44	--	
	35	28	50	

CLIENT WML - Magnolia Landfill SUBJECT Bearing Capacity Calculation Prepared By DBK Date 8/12/93

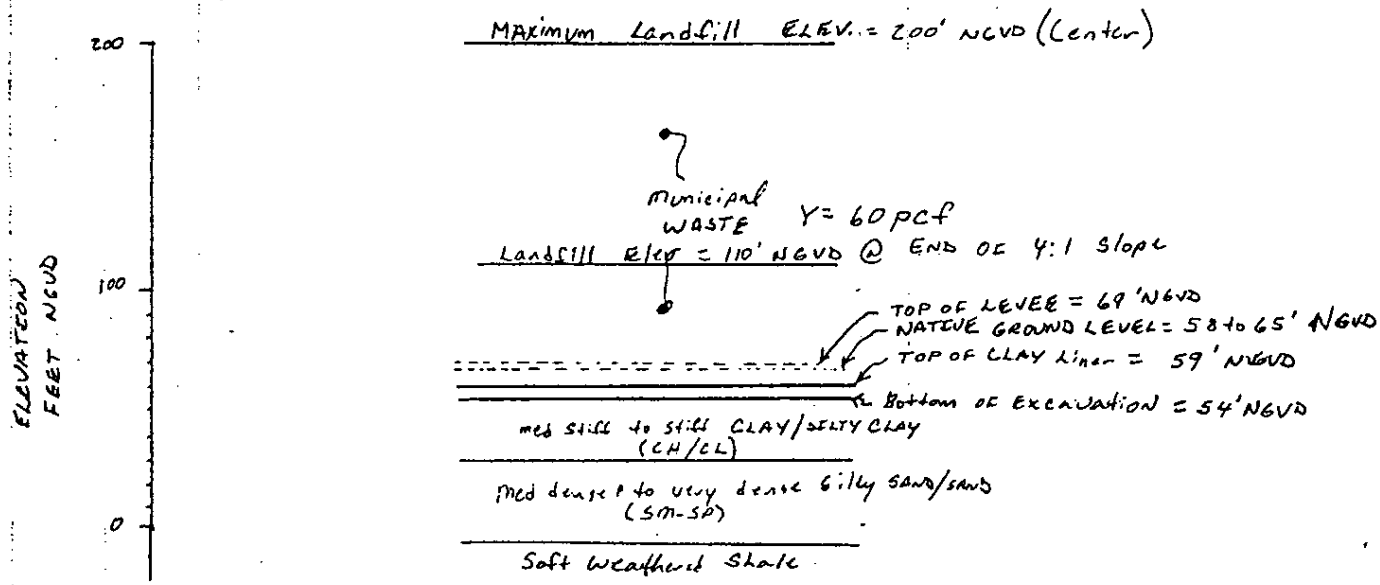
PROJECT Phase II Redesign Reviewed By EHH Date 10-22-93

Approved By ____ Date ____

ASSUMPTIONS:

- Shear strength above liner bottom is neglected.
- Liner strength assumed equivalent to native soils, including the same unit weights.
- Neglect any strength gains or loss of weight due to the excavation of CLAY (γ = 115pcf) and replacing with Refuse (γ = 60PCF).
- Neglect shear strength from refuse
- Assume immediate application of load with no pore pressure loss/dissipation.

GEOMETRY:



RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WMI - MAGNOLIA LANDFILL

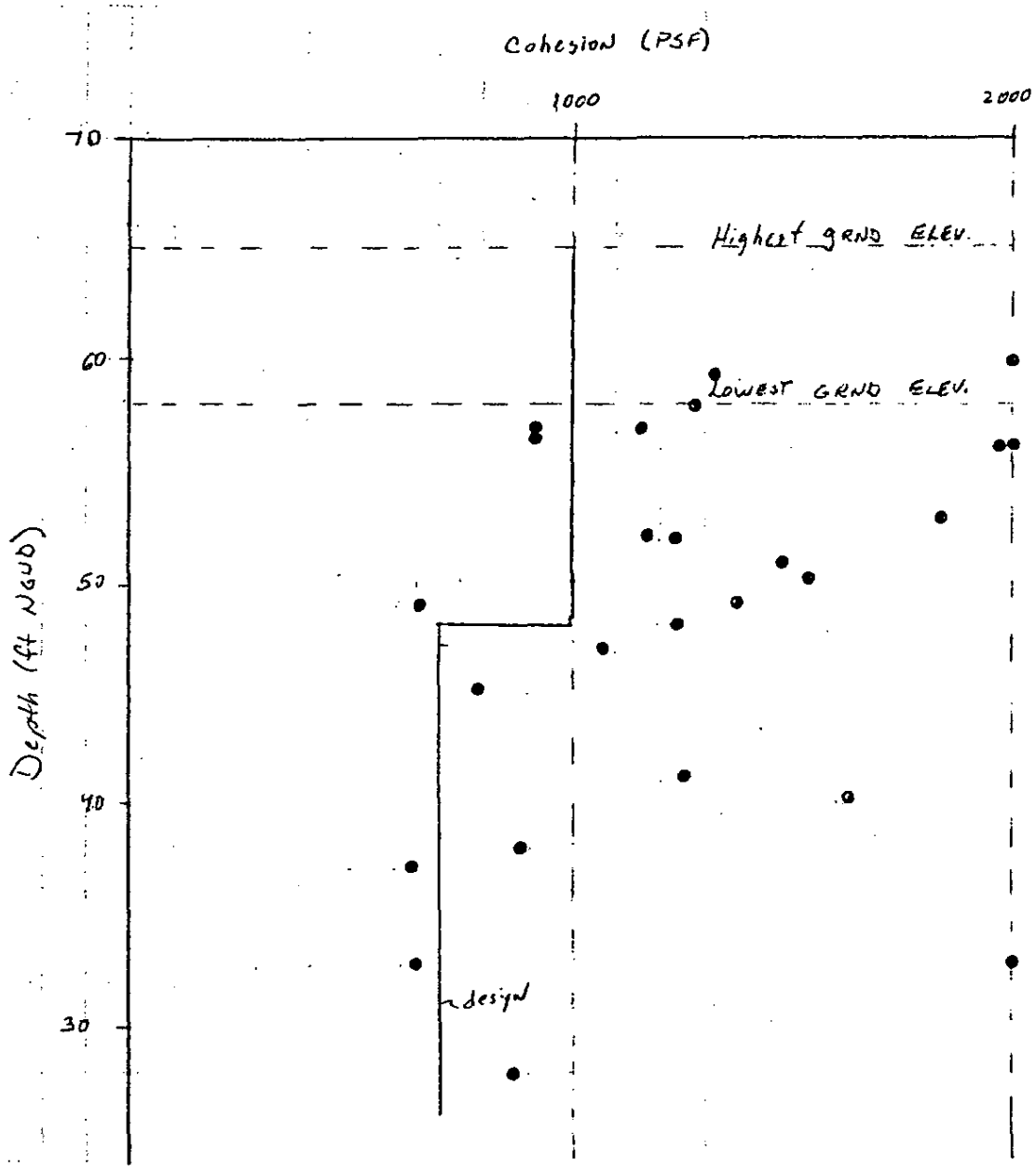
SUBJECT Bearing Capacity Calculation

Prepared By DBK Date 8/12/93

PROJECT Phase II Redesign

Reviewed By EHA Date 10-22-93

Approved By ____ Date ____



CLIENT WML - Magnolia Landfill SUBJECT Bearing Capacity Calculation Prepared By DBK Date 8/12/93
PROJECT Phase II Redesign Reviewed By ZHA Date 10-22-93
Approved By ____ Date ____

CALCULATIONS:

1) Ultimate Bearing Capacity

$$q_{ult} = C N_c S_c + \bar{q} N_q + 0.5 \gamma B N_\gamma S_\gamma$$

For strip footings: $S_c = S_\gamma = 1.0$

$$q_{ult} = 5.7C + q + 0$$

$\phi = 0 \therefore N_\gamma = 0$

$N_c = 5.70$

$N_q = 1.0$

$$q_{ULT} = (5.7)(1000 psf) + (9.5)(115 pcf)$$

$$q_{ULT} = \underline{\underline{6,792.5 \text{ PSF}}}$$

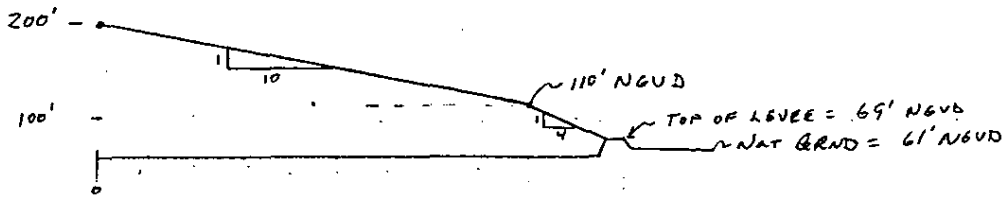
$C = 1000 psf$

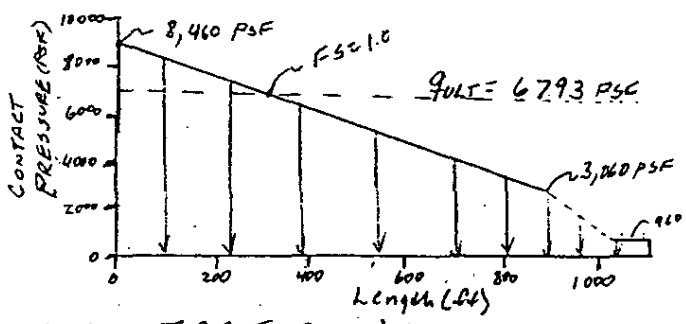
2) CONTACT PRESSURE ON LINER

$q_{CENTER} = (200 - 59')(60 PCF) = 8,460$ PSF

$q_{4:1} = (110 - 59')(60 PCF) = 3,060$ PSF

$q_{LEVEE} = (69' - 61')(120 pcf) = 960$ PSF





3) SAFETY FACTOR NEAR LEVEE

$$F = \frac{q_{ULT}}{q_{4:1}} = \frac{6792.3 \text{ PSF}}{3060 \text{ PSF}} = \underline{\underline{2.2 \text{ @ TOP OF } 4:1 \therefore \text{ SAFE}}}$$

Normal allowable FS range from 2.5 to 3.0.

CLIENT WMI-Magnolia Landfill SUBJECT Bearing Capacity Calculation
PROJECT Phase II Redesign

Prepared By DBK Date 8/12/93
Reviewed By ZHA Date 10-22-93
Approved By ____ Date ____

CONCLUSIONS:

Given the Geometry and site Characteristics, the proposed landfill is safe with respects to an edge bearing capacity failure.

PROVISIONS:

The refuse should never be stacked vertically above elevation 125' NGVD. Instead, the refuse should be placed in 10 to 20' uniform lifts abac 125 ft-NGVD. A tier type construction sequence may also be used provided the tier height do not exceed 20 feet for every 40 feet of Width.

REFERENCES:

1) Bowles, J.E., Foundation Analysis and Design, Mc Graw-Hill, Inc., Fourth Edition, 1988 pages 186 - 195.

SETTLEMENT CALCULATIONS

CLIENT WMI- Magnolia Landfill

PROJECT Phase II Redesign Monroe, Louisiana

SUBJECT Settlement Calculations within the Refuse

Prepared By DBK Date 9/22/93

Reviewed By ZHA Date 10/5/93

Approved By ____ Date ____

OBJECTIVE: Determine the minimum and maximum amount of settlements within the refuse.

APPROACH: Perform settlement calculations for the maximum refuse height within the Phase II Redesign area using the following methods

Method 1: The 5 and 10% Method (Ref 1)

EQ 1) $DH_{max} = 10\% \times H$ ✓

EQ. 2) $DH_{min} = 5\% \times H$

Where:

DH_{max} = Maximum Total Settlement (ft)

DH_{min} = Minimum Total Settlement (ft)

H = Refuse Thickness (ft)

Method 2: The Sowers Method (Refs 1, 2, & 3)

EQ 3) $e_o = \frac{WG}{S_r}$ ✓

Where:

S_r = Degree of Saturation (%)

G = Specific Gravity

W = Water Content (%)

e_o = Initial Void Ratio

EQ 4) $DH_i = \left(a_i\right)\left(\frac{H}{1+e_o}\right)\left(Log_{10}\left(\frac{t_2}{t_1}\right)\right)$ ✓

EQ 5) $DS = DH_{max} - DH_{min}$

EQ 6) $\frac{\left(L^2 + DS^2\right)^{1/2} - L}{L} = \varepsilon$

EQ 7) $a_{max} = .09 \times e_o$

$a_{min} = .03 \times e_o$

Where:

DH_{max} = maximum Total Settlement (ft)

DH_{min} = minimum Total Settlement (ft)

a_{max} = "Favorable" Alpha Factor

a_{min} = "Unfavorable" Alpha Factor

H = Refuse Thickness (ft)

t_2 = Time @ Completion of Set. (months)

t_1 = Time @ Completion of filling (months)

e_o = Initial Void Ratio

DS = Differential Settlement (ft)

L =

ε = elongation of geomembrane @ yield

a = Secondary compression Factor

max, min = conditions favorable or unfavorable to decomposition (respectively)

CLIENT WML- Magnolia Landfill SUBJECT Settlement Calculations within the Refuse

PROJECT Phase II Redesign Monroe, Louisiana

Prepared By DBK Date 9/22/93

Reviewed By ZAA Date 10/5/93

Approved By ____ Date ____

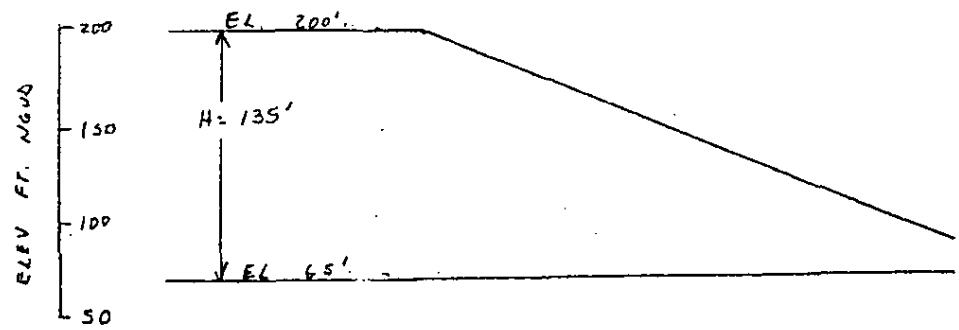
DATA / ASSUMPTIONS:

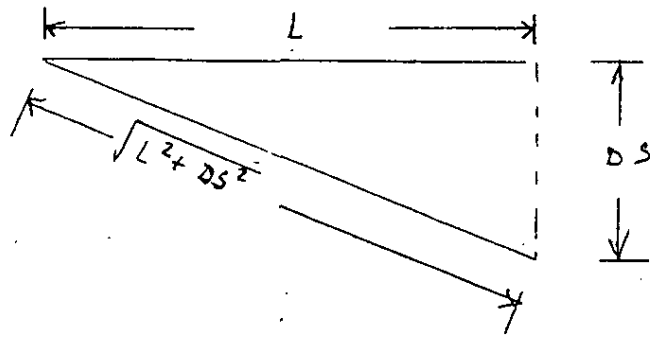
- S_r - Degree of Saturation = 100%
- G - Specific Gravity (1.5 to 2.0) = say 1.75
- W - Water Content = 80%
- ✓ ε - Geomembrane elongation @ Yield = 10% (Synthetic Cap)

- Does not include Consolidation of the subgrade beneath the landfill.

- Strength and elongation of welds are equivalent or greater than geomembrane.

GEOMETRY:





CLIENT WML- Magnolia Landfill SUBJECT Settlement Calculations within the Refuse

PROJECT Phase II Redesign Monroe, Louisiana

Prepared By DBK Date 9/23/93

Reviewed By ZHA Date 10/5/93

Approved By _____ Date _____

CALCULATIONS:

Method 1 -

EQ 1) $DH_{max} = 0.10 \times 135' = \underline{\underline{13.50 \text{ feet}}}$

EQ 2) $DH_{min} = 0.05 \times 135' = \underline{\underline{6.75 \text{ feet}}}$

Method 2 -

EQ 3) $e_o = \frac{WG}{S_r} = \frac{(0.80)(1.75)}{1.00} = \underline{\underline{1.40}}$

$a_{max} = 0.09 \times e_o = 0.09 \times 1.40 = \underline{\underline{0.13}}$

$a_{min} = 0.03 \times e_o = 0.03 \times 1.40 = \underline{\underline{0.04}}$

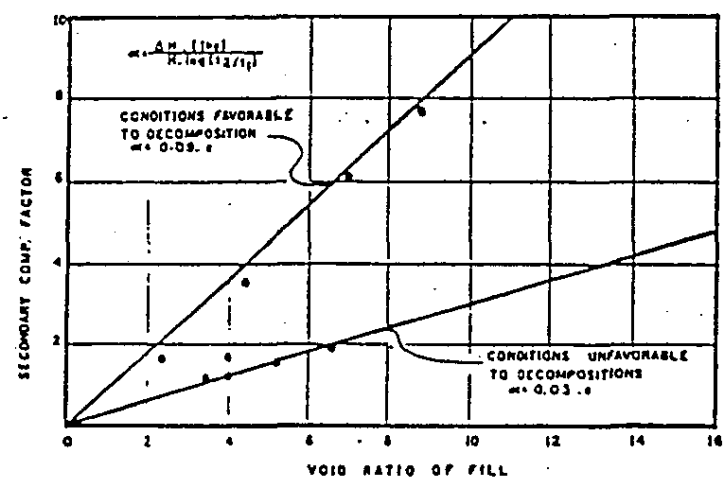


FIG. 6.—Secondary Compression of Waste Fills (8)

CLIENT WML- Magnolia Landfill SUBJECT Settlement Calculations within the Refuse

PROJECT Phase II Redesign Monroe, Louisiana

Prepared By DBK Date 9/23/93

Reviewed By ZHH Date 10/5/93

Approved By ____ Date ____

EQ 4)

$$DH_{max} = (a_{max})\left(\frac{H}{1+e_0}\right)\left(\log_{10}(t_2/t_1)\right)$$

$$DH_{max} = (0.13)\left(\frac{135}{1+1.40}\right)\left(\log_{10}\left(\frac{t_2}{t_1}\right)\right) = 7.31 \log_{10}(t_2/t_1)$$

$$DH_{min} = (a_{min})\left(\frac{H}{1+e_0}\right)\left(\log_{10}(t_2/t_1)\right)$$

$$DH_{min} = (0.04)\left(\frac{135}{1+1.40}\right)\left(\log_{10}(t_2/t_1)\right) = 2.25 \log_{10}(t_2/t_1)$$

t_2/t_1	t_1 (months)	t_2 (months)	DH_{max} (ft)	DH_{min} (ft)	DS (ft)
20	15	300	9.51	2.92	6.59
15	20	300	8.59	2.65	5.94
10	30	300	7.31	2.25	5.06
5	60	300	5.11	1.57	3.54
2.5	120	300	2.91	0.90	1.91

Assume 25 yr design life (t_2 = 300 months). USE $t_2/t_1 = 20$

EQ 5) $DS = DH_{max} - DH_{min}$

Method 1 $DS = 13.5' - 6.75' = \underline{\underline{6.75'}}$

Method 2 $DS = 9.50' - 2.92' = \underline{\underline{6.58'}}$

USE: DS = 6.75 feet to Calculate Elongation of Geomembrane and $\varepsilon = 10\%$ (most specs require 12%)

EQ 6) $$\frac{(L^2 + DS^2)^{1/2} - L}{L} = \varepsilon = 0.10$$

$$(L^2 + DS^2)^{1/2} = 1.10L$$

$$L^2 + DS^2 = 1.21L^2$$

$$L^2 = 4.76\,DS^2$$

[illegible] = 140 ft

CLIENT WML- Magnolia Landfill
PROJECT Phase II Redesign Monroe, Louisiana

SUBJECT Settlement Calculations within the Refuse

Prepared By DBK Date 9/23/93
Reviewed By ZHA Date 10/5/93
Approved By _____ Date _____

CONCLUSIONS:

Based on the assumptions and conditions stated previously, A differential settlement of approximately 6.75 feet would have to occur over a length of 14.85 feet in order to fail a geomembrane due to elongation. This is very unlikely. Therefore, in this particular case it is our judgement that the geomembrane will not be stretched to its yield point due to differential settlement.

REFERENCES:

1.) RUST E&I Standard Number T.14.311, "Settlement Analysis for Landfill Geomembrane Covers", Dec 1989.

2. Sowers, George F., "Settlement of Waste Disposal Fills." Proceedings, 8th International Conference on Soil Mechanics, Moscow, USSR, 1973, PP. 207-210.

3. Yen, Bing C. and Scanlon, Brian, "Sanitary Landfill Settlement Rates." Journal of the Geotechnical Engineering Division, ASCE. May 1975, pp 475-487.

model studies of sanitary fill settlement rates by observing 20-ft (6.1-m) high refuse cells at the site of an operating landfill. Their observations covered a

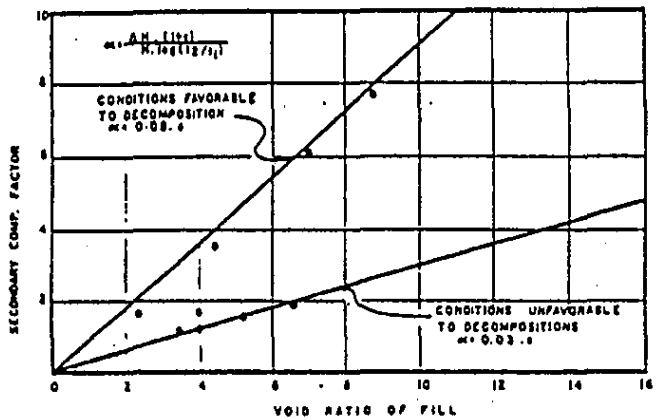


FIG. 6.—Secondary Compression of Waste Fills (8)

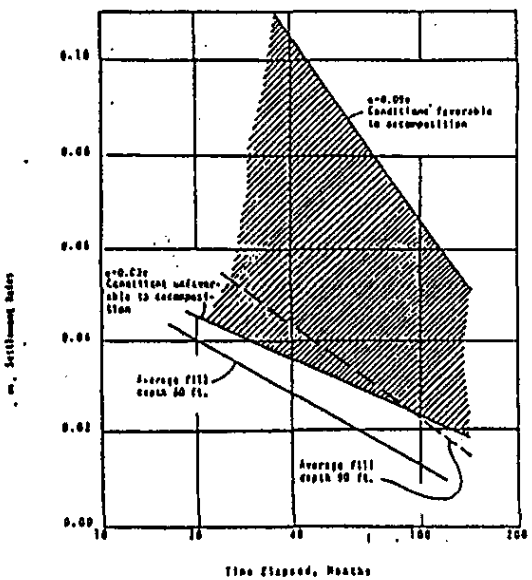


FIG. 7.—Range of Settlement Rates and Comparison with Observed Results

time period of 14 months. For comparison, Fig. 5 shows data computed from Merz and Stone's study, along with data collected in this study fc most compar subgroup. [This is the subgroup with fill heights less 40 ft

(12 m) and having construction periods of less than 12 months.] The straight line function shown in Fig. 5 is computed with a least-squares fitting to the observed field data only. Although the degree of correlation is not strong ($r = -0.32$), the settlement rate tends to decrease as median fill age increased. When this function is extrapolated to the time range involved in Merz and Stone's study, it falls within their data group also.

When the data for the Merz and Stone and the field data are considered together, Fig. 5 supports the conclusion that the rate of settlement decreases linearly with respect to the logarithmic time as pointed out previously.

Comparison with Other Field Observations.—Sowers (8) suggested that continuing settlement of sanitary landfill is analogous to secondary compression of soil. The settlement with respect to time was described by Sowers as follows:

$$\Delta H = \alpha \frac{H}{1+e} \log\left(\frac{t_2}{t_1}\right) \quad \ldots\ldots (3)$$

in which ΔH = total settlement; H = fill depth; t = time; and e = void ratio. The α is a coefficient that depends on field conditions favorable or unfavorable to decomposition. The relationship of α with respect to void ratio is shown in Fig. 6 according to Sowers (8).

An attempt was made for a comparative study between observed field data of this study to that of Sowers'. The purpose of comparison is not to check the "correctness" of either investigation, for the sites are different and the environments vary. The purpose is to explore the trend of settlement rate based on the long-term field data of different sites to shed some light on the settlement analysis.

Eq. 3 is divided with time elapsed t on both sides, i.e.

$$\frac{\Delta H}{t_2 - t_1} = \frac{\alpha}{1+e} \frac{H}{t_2 - t_1} \log\left(\frac{t_2}{t_1}\right) \quad \ldots\ldots (4)$$

Note that $\Delta H/(t_2 - t_1)$ is now the average settlement rate, m, during the time elapsed.

Sowers (8) pointed out that because of the high permeability and partial saturation of sanitary landfills, the initial settlement is virtually completed in a month or two. For the purpose of this comparison, let t_1 = 1 month, i.e.

$$m = \frac{\alpha}{1+e} \frac{H}{t-1} \log(t) \quad \ldots\ldots (5)$$

in which t = time elapsed.

Eq. 5 may be used to calculate the settlement rates, m, for a given fill using the α values suggested by Sowers (8). The settlement rates can then be compared with the results observed in this study.

Shown in Fig. 7 are the results taken from Fig. 2. These are for fills averaging 60 ft (18 m) in depth. They are compared with calculated m values using $0.03\ e < \alpha < 0.09\ e$ of Fig. 6 and for a depth of 60 ft (18 m), from Eq. 5. An average void ratio of 4 was used for the fill. An adjustment for the effect of construction time was incorporated into these calculatio g. 1).

The calculated values of settlement rate compare well se observed

H_f ai restricted, and the relationship between time elapsed t_1 and settlement rate m can be more clearly seen.

Plots of m versus log (t_1) for fills between 40 ft-80 ft deep (12 m-24 m), between 80 ft-100 ft (24 m-31 m), and greater than 100 ft (31 m) are shown in Figs. 2, 3, and 4. The linear relationship between m and t_1 are obtained by least-squares fitting with regression coefficient shown.

These three plots are for *only the fill column subgroups* with t_c between 70 months and 82 months. Table 1 summarizes results of other subgroups in which the construction period, t_c, ranges from less than 1 yr to nearly 7 yr. The mean values of settlement rate, m, for the fill columns of different depth ranges are shown in Table 1. Values of mean m were computed only in those intervals that contained at least three field survey measurements.

Effect of Median Fill Age on Settlement Rates as Function of Fill Depth.—The decreasing trend of m with respect to t_1 can be seen in each of the figures and in Table 1. However, even after a period of 6 yr from the completion of a fill (70 months-120 months in terms of median fill age), settlement rates on the order of 0.02 ft/months (0.006 m/month) may still be expected.

It is also interesting to note the range of post-construction settlement for the sites investigated. An estimate of the average total post-construction settlement was computed by integrating the m and log (t_1) functions of Figs. 2-4 between the fill completion date and that extrapolated value of t_1 for which $m = 0$. The results showed that post-construction settlement ranges between 4.5%-6%, of total fill depth, i.e., about 4.5 ft-6 ft (1.4 m-1.8 m) of past construction settlement would be expected for a 100 ft (31 m) of fill without subjecting the fill to any external load other than its own weight and biodegradation.

Effect of Depth on Rate of Settlement.—As can be seen from Figs. 2-4 and Table 1, deeper fill depth generally shows a faster rate of settlement regardless of construction period, t_c, and median fill age, t_1. However, the differences are not linearly proportional to the depth of fill, H_f. Results from the three sites studied indicates that although the rate of settlement increases with depth, this effect levels off for depths greater than 90 ft (27 m). The settlement rates for fill depth of more than 100 ft (31 m) are substantially the same after 5 yr as those with H_f between 80 ft-100 ft (24 m-31 m). This is not surprising when considering that refuse at greater depth probably simulates an anaerobic environment and thus has a slower biochemical decay than those of shallower depth. At shallower depth the environment is probably closer to aerobic and will have a greater rate of decay and thus settlement rates. A greater settlement rate for an aerobic process than an anerobic process has been reported by other investigators. For example, Sowers (8) compared the rate of settlement between aerobic and anaerobic environment at comparable void rates and overburden stresses and showed that an aerobic environment generally has the greater settlement.

Effect of Construction Period on Settlement Rate.—The length of the construction period, t_c, also affects settlement rate. In Table 2, the time required for the completion of settlement (i.e., when $m = 0$) were computed using the least-squares fitted m log (t_1) functions (Figs. 2-4).

It can be seen from Table 2 that the faster rate of the construction (smaller t_c values) will result in a much shorter time for the fill to complete its settlement. This effect is more pronounced for the shallower fills. Thus may be

advantageous to construct the sanitary landfill as fast as is feasible in order to accelerate the settlement.

Length of Post-Construction Settlement Period.—The fill column subgroups with $70 = t_c = 82$ months had the largest data populations with the widest coverage in terms of t_1. For some of the fill columns in this group the settlement observations extended over a 9-yr period. Figs. 2, 3, and 4 show the scatter diagrams for these subgroups along with the regression coefficient, r. Extrapolation of these functions suggest that, even without additional surface loads

TABLE 2.—Comparison of Settlement and Construction Period

Range of fill depth, H_f, in feet (meters) (1)	Average construction period, t_c, in months (2)	Total time required for construction and settlement, in months (3)	Approximate time required for settlement to complete, in months (4)
40-80	12	113	101
(12-24)	72	324	252
80-100	12	245	233
(24-31)	72	310	238

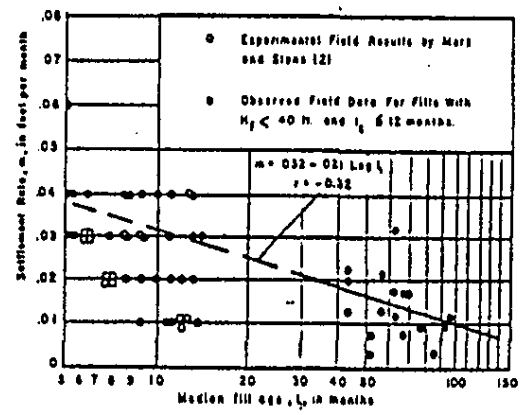


FIG. 5.—Comparison of Field Settlement Rates

being added, the settlement process may last over 250 months before $m = 0$. There is a long time required for completion of settlement from a geotechnical engineering viewpoint. This appears to be one of the major difficulties for using deep landfill sites as load-bearing fills.

Comparisons with Results of Other Investigators

Comparison with Field Model Studies.—Merz and Sto onducted field

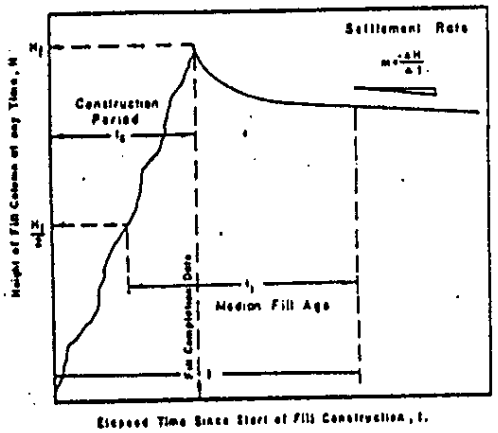


FIG. 1.—Diagram Showing Notations Used in Analysis

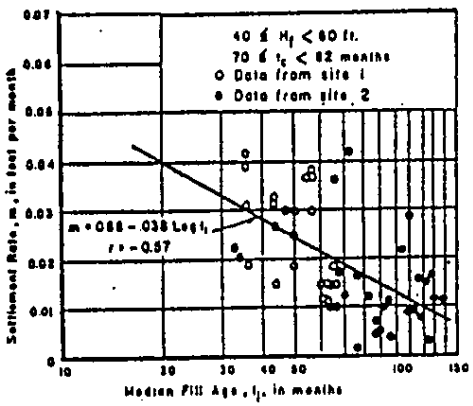


FIG. 2.—Settlement Rates Versus Time Elapsed for Fill Depths between 40 ft and 80 ft (12 m and 24 m)

in which t = the total elapsed time since the beginning of construction. This estimation of t_1 enabled the inclusion of data from the other two fills.

The data were then analyzed to identify the relationships between median fill age (t_1, rate of settlement m), depth of fill H_f, and construction time t_c.

Data Presentation

Since the fill column, H_f, is a measure of average stress acting upon and within the refuse, the fill columns were divided into subgroups bas ranges of H construction time t_c. Thus, within each subgroup the ion

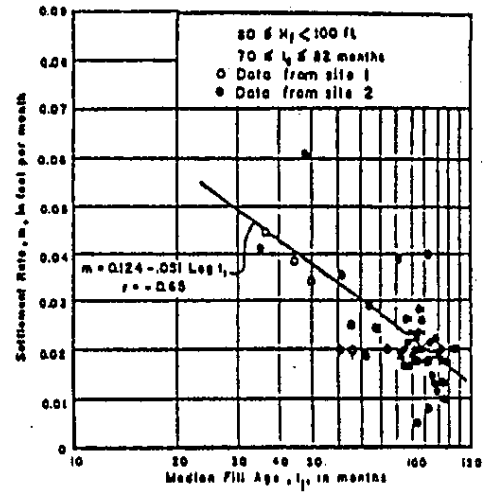


FIG. 3.—Settlement Rates Versus Time Elapsed for Fill Depths between 80 ft and 100 ft (24 m and 31 m)

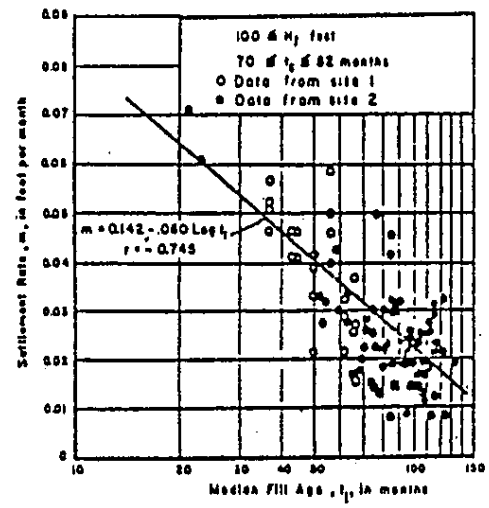


FIG. 4.—Settlement Rates Versus Time Elapsed for Fill Depths Greater Than 100 ft (31 m)

TABLE 1.—*Continued*

(1)	(2)	(3)	(4)
81-100 (25-31)	x	x	0.020
100+ (31+)	x	x	0.020

[a]x *indicates that less than three field settlement survey data were available in that particular* H_f, t_1, t_c interval, and therefore, no mean value of settlement rate m was computed.

Notes: Data in Col. 2 from Site 2 only; data in Col. 3 from Sites 2 and 3 only; data in Col. 4 from Sites 1 and 2 only.

layers approximately 5-ft (1.5 m) thick, including a 1-ft (0.3-m) earth cover. In all cases, the compaction was done by passing over the completed layers with D-8 bulldozers. The density varies greatly depending on the type of debris contained. However, grossly it is estimated after compaction the average of density is approx 40 pcf (640 kg/m^3).

Site Conditions.—Site 1 is underlain by middle Miocene Topanga formation with recent alluvial gravelly sand sand along the southeast margin of the site. The Topanga formation is predominantly medium to coarse grained sandstone and conglomerate with lesser amounts of interbedded shales. The sandstone is generally cemented with low porosity and relatively incompressible under the loading condition of the sanitary landfill. The settlement of gravely sand of recent alluvium along the southeast margin of the site is estimated to be essentially completed during the long construction period (70 months-82 months) as shown in the footnote in Table 1. Thus, the post-construction settlements analyzed herein are primarily due to the settlement of the landfill material itself.

Site 2 was an open pit mine for diatomaceous earth before being converted into a sanitary landfill. The site is generally underlain by a bedrock formation of Valmonte diatomaceous shales, mudstones, and Monterey series of shales.

Exploratory borings along one boundary of this site have revealed that these diatomaceous shales vary widely in density. Blow-count ranged from 12 blows/ft (39 blows/m) to over 100 blows/ft (330 blows/m), but most commonly between 20 blows/ft (66 blows/m) and 60 blows/ft (200 blows/m). Confined compression tests on two shale samples have shown a range of 1.5%-3% of axial strain under a normal load of 4,800 psf (230,000 N/m^2). This is the approximate overburden pressure for sanitary landfill thickness of 120 ft (36 m) which is the maximum estimated thickness of the site. It is the writers' experience that driven samples from diatomaceous shale usually subject to considerable sample disturbances in the form of cracking. Thus, the oedometer testing results tend to overestimate field settlement. Note also that almost all of site 2 landfill was constructed over a 6-yr or more period. The settlement due to compression of the underlying diatomaceous shale is not considered a significant factor in the post-construction settlement period studied herein.

Site 3 is an area of approx 22 acres (89,000 m^2). A large portion of the original site occupied a topographically low or slough area. The subsurface material underlying the landfill which has a maximum depth o[illegible] (12 m) is recent alluvial deposits consisting primarily of medium to [illegible]se silty sand and clayey sand. The thickness of these sediments is approx 3 ft-6 ft (0.9 m-1.8 m) from boring logs but cannot be clearly distinguished from the underlying more extensive upper Pleistocene sediments. The upper Pleistocene deposits are divided lithologically into an upper portion of predominantly fine grained sediments containing a semiperched zone of impermeable silts and clay, and a lower portion of coarser material which form an aquifer designated locally as "200-ft (61-m) sand." From a settlement viewpoint, the subsurface material is compressible under a maximum of 40 ft (12 m) of landfill. It is difficult to differentiate the exact amount of settlement due to consolidation of subsurface material from the total measured post-construction ground surface survey, because of the lack of detailed soil data and the relatively long construction period (24 months-50 months). Thus, results of settlement survey for site No. 2 is only included in Table 1 for providing a trend of settlement rate along with data from other two sites. The survey data of site No. 3 are not used for detailed analysis because it is impossible to differentiate the settlement of subsurface material from the consolidation of landfill itself even though the consolidation of landfill is believed to be the primary contributor of the total surveyed settlement.

Analysis of Settlement Data

Definition of Variables.—A sketch illustrating the notation used in this study is shown in Fig. 1. The settlement rate, m, is defined as

$$m = \frac{\text{(Change in elevation of survey monument, in feet)}}{\text{(Elapsed time between surveys, in months)}} \quad \ldots\ldots\ldots\ldots (1)$$

The time variable used here is the estimated "median age of a fill column." This is measured as the elapsed time between the date of settlement survey and that time when the fill column is half completed. The term "fill column" is defined as the column of earth and refuse fill lying directly below a survey monument, and extending to the natural soil. Other variables used were the completed fill column depth, H_f, and the total fill construction time period, t_c, in months. These parameters are chosen because the construction or filling period of sanitary landfill is usually long and should be taken into consideration for settlement rate analysis.

For one of the landfills studied, successive annual topographic maps, obtained by aerial surveys, were available for every year of the construction period. These were considered sufficiently accurate to plot the rate of construction. For each fill column corresponding to a survey monument on the completed fill surface, H_f, t_c, and t_1 could be computed. Values of m were then computed by forward differences for those values of t_1 corresponding to survey dates. These post-construction surveys were all conventional level net surveys. For the other two sites studied, estimates of t_c and H_f were available from the operating agencies' survey records. From Fig. 1 and the data available, the median age of fill column, t_1, is estimated as

$$t_1 = t - \frac{t_c}{2} \quad \ldots\ldots\ldots\ldots (2)$$

cited in 1971 by Moorehouse (3). However, being primarily written by sanitary, mining, and municipal engineers, the majority of the literature focuses upon safe disposal practices. Relatively few are concerned with the geotechnical characteristics of sanitary fills.

More recently, excellent articles by geotechnical engineers (3,4,7,8) have provided insight to the settlement problem. The mechanisms of sanitary landfill settlement generally may include gross volume loss due to the movement of fine material into larger void spaces, strength losses due to chemical and biological reactions, material losses caused by biochemical degradation and methane production, creep processes, and consolidation processes similar to those occurring in soils. Field observations of up to 15 months (2,7), e.g., were analyzed for evaluation of the gross behavior of settlement rate. However, before sanitary landfill can be used as load-bearing fills with any reasonable degree of quality assurance, many research tasks await the attention of geotechnical engineers. One of the fundamental research tasks is the collection and analysis of field observation data.

The writers have conducted a study of field observations of up to 9 yr of settlement records for three completed sanitary landfills located in Los Angeles County, California. The areas of the three filled sites are 19 acres, 80 acres, and 22 acres (77,000 m^2, 324,000 m^2, and 89,000 m^2), respectively, and the maximum depth of fill is approx 125 ft (38 m). The purposes of this study are to: (1) Examine the data systematically for common trends in the settlement-time relationship in the years following construction; (2) deduce from field data the lessons learned on factors that influence the settlement process; and (3) provide a real data base against which future theoretical models might be tested. The writers recognize the limitations of field observation data and thus do not intend herein to provide numerical rates of settlement readily extendable to other sites. However, attempts have been made to compare the results of this study qualitatively with those published by other investigators to establish the general trend of settlement rates.

Sources of Data and Site Conditions

The settlement measurements used in this study were taken from three sanitary landfills which were periodically surveyed by the Los Angeles County Engineer Department and the Los Angeles County Sanitation Districts. The survey periods ranged up to 9 yr after completion of the fills. Some of the basic survey data used in this study have been compiled in reports of the Los Angeles County Engineer Department (1). The remainder was furnished directly to the writers by the operating agencies.

The fills varied in thickness from approx 20 ft-125 ft (6.1 m-38 m) and were constructed over periods ranging from less than 1 yr to 7 yr. The fills are all above the ground-water surface, and constructed with relatively impermeable lining soil layers to prevent leachate from reaching the ground water.

Aside from the soil covers, the fills were constructed mainly of residential refuse (paper waste, garbage, grass cuttings, etc.). Minor amounts of brush and construction wastes were also included.

Two of the fills were constructed in compacted layers, of up to 2 6.1 m) inclu 1 2-ft (0.61-m) cover. The third was constructed in co ted

TABLE 1.—Mean Values of Settlement Rate m,* in feet per month

Completed fill height, H_f, feet (meters) (1)	Construction period, t_c, in months: $t_c \leq 12$ (2)	$24 \leq t_c \leq 50$ (3)	$70 \leq t_c \leq 82$ (4)
(a) For Median Fill Age, t_1, $\leq$ 40 months			
40 (12)	x	x	x
40-80 (12-24)	0.030	x	0.030
81-100 (25-31)	0.050	x	x
100+ (31+)	x	x	0.057
(b) For 40 $\leq t_1 \leq$ 60 months			
40 (12)	0.016	0.016	0.015
40-80 (12-24)	0.010	0.026	0.029
81-100 (25-31)	0.030	x	0.040
100+ (31+)	x	x	0.041
(c) For 60 $\leq t_1 \leq$ 80 months			
40 (12)	0.016	0.010	0.009
40-80 (12-24)	0.009	0.012	0.016
81-100 (25-31)	0.036	x	0.025
100+ (31+)	x	x	0.025
(d) For 80 $\leq t_1 \leq$ 100 months			
40 (12)	0.008	0.012	x
40-80 (12-24)	x	0.012	0.008
81-100 (25-31)	x	x	0.022
100+ (31+)	x	x	0.025
(e) For 100 $\leq t_1 \leq$ 120 months			
40 (12)	x	x	x
40-80 (12-24)	x	x	0.015

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Sanitary Landfill Settlement Rates

By Bing C. Yen[1] and Brian Scanlon,[2] Members, ASCE

Introduction

An all-embracing definition of a sanitary landfill is difficult to formulate, due to the varying techniques used. The Committee on Sanitary Landfill Practice (6) provided a general description as follows:

> Sanitary landfill is a method of disposing of refuse on land without creating nuisance or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area and to reduce it to the smallest practical volume and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary.

Formal sanitary landfill practice goes back to about 1930 in this country and 1916 in England; informal practice probably goes back to man's beginning. Estimates from the Bureau of Solid Waste Management (BSWM) give a breakdown of solid waste production by source as follows: Municipal (including commercial and institutional)—6.5 lb (2.95 kg) per capita per day; and industrial (excluding mining)—3.9 lb (1.78 kg) per capita per day. Using the BSWM data, a city with a population of 1,000,000 will generate approx 5,000,000 cu yd (3.8×10^6 m^3) of compacted waste per year. The magnitude of this problem has caused great interest in the subject of solid waste disposal and, more recently, in solid waste utilization. The escalation of land values in most parts of the country will increase the demand of converting the sanitary landfill sites to usable land. Well-engineered sanitary landfill sites have become assets to the region in which they are developed and accepted by the citizens (4).

Abundant literature is available for solid waste disposal, including 450 articles

Note.—Discussion open until October 1, 1975. To extend the closing date one month, a written request must be filed with the Editor of Technical Publications, ASCE. This paper is part of the copyrighted Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 101, No. GT5, May, 1975. Manuscript was submitted for review for possible publication on June 11, 1974.

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APPENDIX B

SANITARY LANDFILL SETTLEMENT RATES

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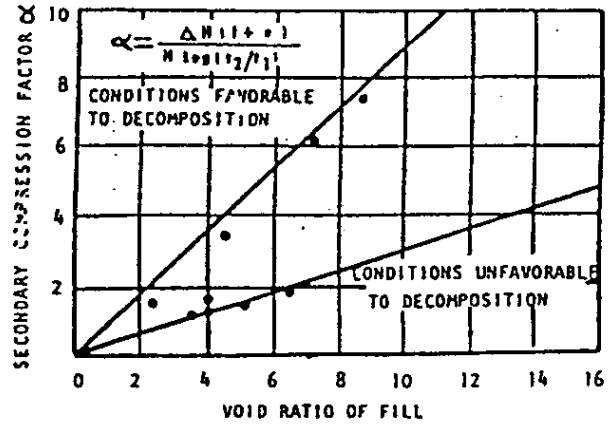


FIG. 4 SECONDARY COMPRESSION OF WASTE FILLS

in the same way as it is effective with organic clays and peats. Because of high permeability and partial saturation, the initial-primary settlement is virtually complete in a month or two. The secondary is so great, however, that it determines the preload periods.

Environmental control offers intriguing possibilities for minimizing continuing settlement from ravelling and bio-chemical action. Flooding the fill, with no opportunity for water circulation, may bring decomposition to a halt when the products of decomposition inhibit further bio-chemical action. Keeping the fill dry can have a similar effect. Both have been achieved in test fills encapsulated in plastic. Chemical control of decomposition is a possible future development.

CONCLUSIONS

Waste fills are being used increasingly for structural support. Settlements can be so great that they generally control structural design. Techniques for predicting settlement and methods for minimizing settlement have been compiled from scattered large-scale pilot tests and full size instrumented fills.

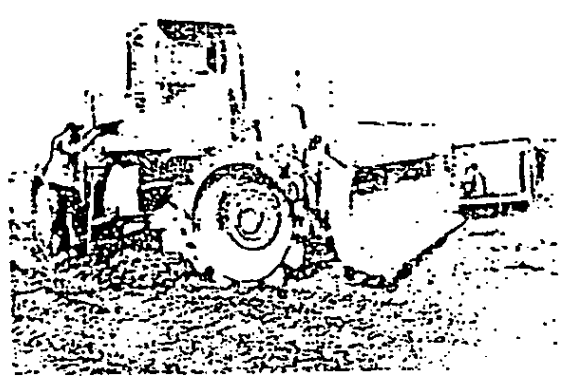


FIG. 5 COMPACTOR FOR SOLID WASTES

1. The total settlement for the first month can be found from a compression index that is related to the void ratio: $C_c = 0.15\ e_0$ for fills low in organic matter to $C_c = 0.55\ e_0$ for fills high in organic matter.

2. Continuing settlement is analogous to secondary compression and is also related to the environment for bio-chemical decay. The rate can be expressed by $\alpha = 0.03\ e_0$ for conditions unfavorable to decay to $\alpha = 0.09\ e_0$ for conditions favorable to decay.

3. Settlement can be minimized by fill compaction, preloading and possibly by environment control.

4. Compaction is most effective during the first 8 to 12 passes.

ACKNOWLEDGEMENTS

The data in this paper have been accumulated from many sources. Mr. Donald York, Engineer of Soils, The Port of New York Authority and Mr. C. M. Kennedy,

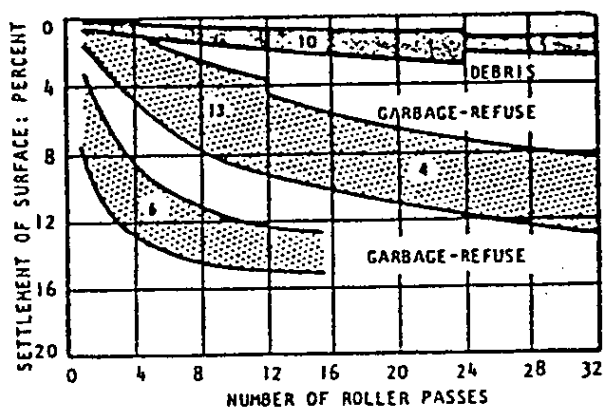


FIG. 6 COMPACTION OF WASTE FILLS BY 12 TON ROLLERS IN 5 FT OR 1.5 M LIFTS AND 30-50 TON ROLLERS IN 8-10 FT OR 2.5-3 M LIFTS (NUMBER OF TEST AREAS SHOWN IN SHADED ZONES)

Vice President of Engineering, Law Engineering Testing Company deserve special thanks for making data available.

REFERENCES

MERZ, R.C. and STONE, R., (1962), "Landfill Settlement Rates", PUBLIC WORKS, Vol. 93, No. 9, p. 103-106.

SOWERS, G.F., (1968), "Foundation Problems In Sanitary Landfills", JOURNAL OF THE SANITARY ENGINEERING DIVISION, PROCEEDINGS ASCE, Vol. 94, No. SA1, p. 103-116.

STOLL, U.W., (1971), "Mechanical Properties of Milled Trash", MEETING PREPRINT 1319, ASCE, New York.

2. The relation of stress to settlement during the first month can be expressed by the well-known equation:

$$\Delta e = -C_c \log \frac{\sigma_o' + \Delta\sigma}{\sigma_o'} \qquad (1)$$

3. The compression index, C_c is related to the initial void ratio, as shown in Fig. 2. There is a considerable variation in C_c for any value of e. The higher values are for fills containing large amounts of garbage, wood, brush, and tin cans; the lower values are for the less resilient materials. The upper limit for peat soils is also shown; the maximum C_c for peat is about one-third greater than the maximum observed for waste fills.

4. The amount of ravelling or combustion settlement cannot be predicted.

RATE OF SETTLEMENT

Settlement of the waste fills continues at substantial rates as can be seen from Fig. 3. This is the combination of mechanical secondary compression, physico-chemical action, and bio-chemical decay. When there has been no drastic change in the environment the settlement-log time relationship is more or less linear, similar to secondary compression of soils. The settlement can be expressed by:

$$\Delta e = -\alpha \log (t_2/t_1) \qquad (2)$$

where α is a coefficient analogous to C_c. The limited data available indicate that α is a function of the void ratio, Fig. 4. For any given void ratio there is a large range in α, related to the potential for physico-chemical and bio-chemical decay. The value is high if the organic content subject to decay is large and the environment is favorable: (warm, moist, with fluctuating water table that pumps fresh air into the fill). The value is low for more inert materials and in unfavorable environments. More research and data are necessary before the relationship can be defined more closely.

The rate of settlement produced by ravelling and combustion is erratic. Movement generally occurs in sudden episodes of varying magnitude following progressive deterioration. Deterioration is related to environmental changes. These include rapid changes in ground water, flooding due to torrential rainfall or

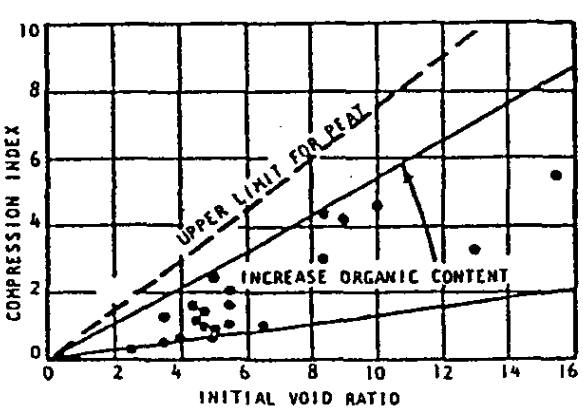


FIG. 2 COMPRESSIBILITY OF WASTE DISPOSAL FILLS

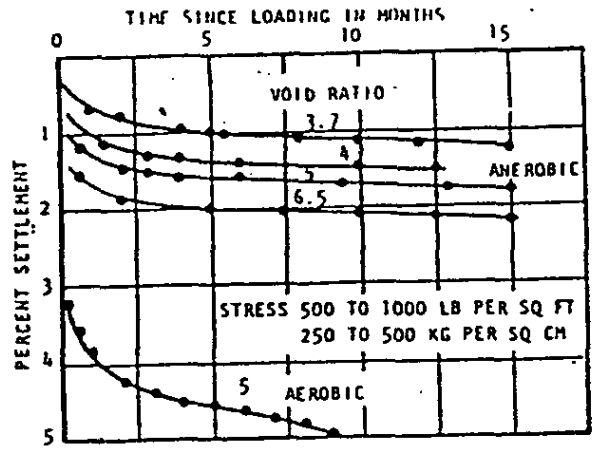


FIG. 3 TIME-SETTLEMENT FOR WASTE OF GARBAGE, REFUSE AND BUILDING DEBRIS

broken water pipes, and drying and exposure to air from making excavations in the soil cover or the fill.

MINIMIZING SETTLEMENT

The ultimate settlement is related to the initial void ratio and the environmental conditions favorable to deterioration, decay, ravelling and combustion. Because void ratio or initial density is related to the initial-primary settlement as well as secondary compression, densification offers an element of control over potential settlement.

Some form of compaction is employed with the controlled, encapsulated fills. The tracked tractor with a bulldozer blade both spreads and crushes the looser materials. Special trash compactors weighing about 30 tons with lugs similar to the sheepsfoot roller but larger are very effective in compacting fill in lifts 6 to 8 ft. (2 to 2.5 m) thick, Fig. 5. The 40 to 50 ton rubber tired roller is effective in layers that are 10 ft. (3 m) thick initially.

Examples of the surface settlement or densification produced are shown in Fig. 6. The data include rollers of from 12 to 50 tons; these have been normalized considering the effective depth of compaction based on the author's experience. They show considerable variations in effectiveness of compaction: a maximum compaction of 15 per cent and a minimum of 2 per cent. The higher degrees of compaction may include some lateral displacement of the fill. The greatest effect is in the first 12 to 15 roller passes: there are some benefits with as many as 25 passes. Resilient materials such as old tires do not densify under any amounts of rolling.

If the roller is too heavy a bearing capacity failure will result. If a very wet fill is compacted, a temporary pore pressure build-up reduces the strength and bearing capacity sufficiently that shear failure, lateral displacement and loosening will occur. Only field tests can show the optimum roller weight and rate of rolling, for any given situation.

Preloading with fill can reduce potential settlement

Table 1

MUNICIPAL WASTE MATERIALS INCORPORATED IN FILLS

Material	Typical Percentage	Characteristics As Fill
Garbage: Food Waste	10-20	Wet. Ferments and decays readily; Compressible, weak.
Paper, Cloth	10-40	Dry to damp, decays and burns, compressible.
Lawn and Garden Refuse: Grass, Brush, Stumps	10-20	Damp. Ferments, decays, and burns.
Plastic	1-2	Dry: Compressible, decay resistant but may burn.
Hollow Metal: Cans, Drums, Refrigerators, Auto Bodies, Bed Springs	5-15	Dry. Corrodable and crushable.
Massive Metal: Castings, Kettle Bottoms, Auto Batteries	1	Dry. Slightly corrodable, rigid.
Rubber: Tires, Trimmings	5-10	Dry. Resilient, burnable, compressible but uncrushable, decay resistant.
Glass	5-15	Dry. Crushable and compressible, decay resistant.
Lumber from Demolition	0-5	Dry. Crushable, compressible, decays and burns, some interlocking strength.
Rubble: Brick, Concrete, Stone, Soil from Demolitions	0-10	Damp. Crushable, erodable, decay resistant.
Ashes, Cinders, Chemical Wastes*	0-5	Damp. Soil-like: Compressible, active chemically and partially soluble.

* Does not include separate industrial waste-disposal fills.

MECHANISMS OF SETTLEMENT

A number of mechanisms are responsible for the settlement:

1. Mechanical: Distortion, bending, crushing and reorientation of the materials, similar to the consolidation of organic soils.

2. Ravelling: The erosion or sifting of fine materials into the voids between larger particles.

3. Physico-Chemical Change: Corrosion, oxidation and combustion.

4. Bio-Chemical Decay: Fermentation and decay, both aerobic and anerobic.

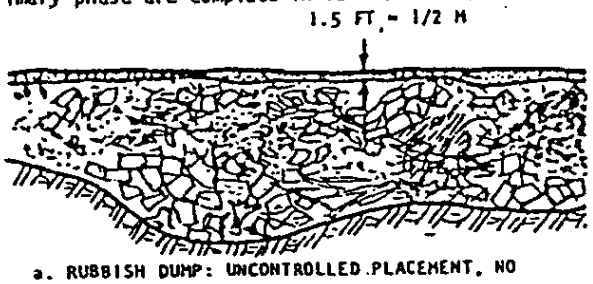
5. Interaction: Methane from bio-chemical decay may support combustion, ignited spontaneously from the heat of decay. Organic acids from decay may produce corrosion; volume changes from consolidation may trigger ravelling.

Of these mechanisms, only the first is load related and can be analyzed in terms of the stresses involved. The other mechanisms are related to the environment: air, moisture, and temperature. A waste fill is dynamic, changing with the environment and partially creating its own environment. For example, temperatures 60° F (33C) above ambient are common during biochemical decay. Decay utilizes moisture and the oxygen in the air voids to form carbon dioxide; when the oxygen is depleted, methane is produced which is poisonous and inflammable. Saturation of the fill inhibits decay, because the bacteria are eventually destroyed by the products of their own growth.

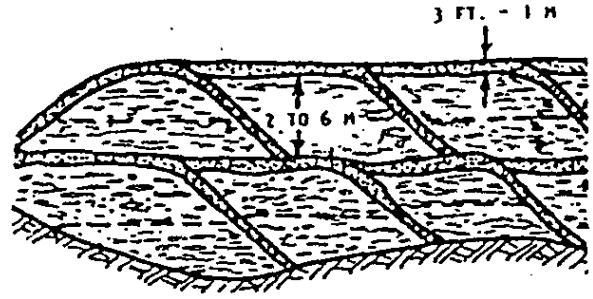
AMOUNT OF SETTLEMENT

The usual laboratory tests for consolidation are meaningless with such heterogeneous materials of such varied particle sizes. Instead, large scale pilot cells, 3 to 6 ft. (1 to 2 m) in diameter and the behavior of actual fills must be analyzed for meaningful data. These are limited (Stoll, 1971) (Merz and Stone, 1962) (Law, Various Dates). However, tentative conclusions can be drawn which are useful in predicting settlements.

1. The mechanical settlement occurs rapidly with little or no pore pressure build-up. The initial and primary phase are complete in less than 1 month.



a. RUBBISH DUMP: UNCONTROLLED PLACEMENT, NO COMPACTION



b. SANITARY LANDFILL: SPREAD AND COMPACTED IN LAYERS 6 TO 10 FT OR 2 TO 3 M THICK, ENCAPSULATED WITH SOIL IN CELLS 6 TO 20 FT OR 2 TO 6 M THICK DAILY

FIG. 1 CONSTRUCTION OF WASTE DISPOSAL FILLS

SETTLEMENT OF WASTE DISPOSAL FILLS

TASSEMENT DES REMBLAIS DES TERRES

ОСАДКИ НАСЫПЕЙ ИЗ ОТХОДОВ

GEORGE F. SOWERS, Consultant, Law Engineering Testing Company, Atlanta (U.S.A.)

SYNOPSIS. Waste disposal fills are becoming the major mechanism for disposing of materials unsuitable for other purposes, including garbage, household refuse, construction debris and industrial wastes. Settlement of such organic-mineral complexes occurs through four mechanisms: (1) consolidation or void ratio reduction, (2) biochemical decomposition, (3) physico-chemical, and (4) ravelling of soil into large voids. The author's studies show that settlement is similar to that of peats: large initial consolidation, little or no hydrodynamic and substantial secondary compression. The compression index C_c is approximately proportional to the initial void ratio and increases with the organic content of the fill.

Decomposition and disintegration are reflected in the rate of secondary compression. For aerobic moist conditions above the water table the secondary is three times as great as for anerobic below a stagnant water table. The rate of ravelling cannot be expressed analytically at present. Settlement can be reduced by compaction, preloading, and controlling the environmental factors favorable to decomposition.

INTRODUCTION

Land filling has become the major method for disposing of solid wastes in the USA. Two purposes are served: (1) rid the community of waste that cannot be economically recycled or consumed, and (2) fill in low areas of land to provide usable space. In the past such waste disposal fills have been considered suitable only for green areas or parks. The increasing scarcity of land in urban areas is making it necessary to build structures above such fills. Data on the engineering properties of such fills is lacking. The engineering problems involved have been summarized by Sowers (1968). These include bearing capacity, settlement, gas production, leachate production, corrosion of buried materials, and difficult construction. The present paper presents quantitative data on settlement that the author has accumulated.

IMPORTANCE OF SETTLEMENT

Settlement is the key to the use of waste disposal fills. Because potential settlements are large, they control the design of roads, parking lots, and lighter structures supported on shallow foundations. Moreover, when deep foundations are employed, the continuing fill settlement is critical because explosive gas can collect in the enlarging gap between the fill surface and the supported floor. If the ground floor is fill-supported, the differential settlement between the pile and ground-supported components can be damaging. For example, both problems are developing simultaneously at a large restaurant whose site is underlain by an old sanitary land fill. The ground floor and the partitions resting on it sag downward from the pile-supported exterior wall and methane is accumulating below the floor adjacent to the wall. Disaster could occur from either structural collapse or explosion.

THE NATURE OF WASTE DISPOSAL FILLS

Waste is as heterogeneous as the modern industrial-urban complex that produces it. It consists of anything that cannot be further used or recycled economically; thus, its composition varies from community to community, and from nation to nation. The principal ingredients are given in Table I.

The density varies greatly from 200 lb. per cu. yd. (120 kg per cu. m) to 500 lb. per cu. yd. (300 kg per cu. m) as delivered to the fill, depending on the amount of metal and debris. After compaction the densities may be more than 1000 lb. per cu. yd. (600 kg per cu. m). Moisture contents range from 10 to 50 per cent and average specific gravity of solids from 1.7 to 2.5. Typical void ratios are between 15 uncompacted and 2 well-compacted.

Two extreme forms of decomposition are utilized: the open dump and the encapsulated "sanitary land fill", Fig. 1. The former is heterogeneous, accumulating at random as dumped, possibly allowed to burn, and finally covered with soil to control odors, rats, and flies. The true sanitary land fill is spread in layers, compacted, and then covered with soil after each days filling. Each cell may be 10 to 25 ft. (3 to 8 m) thick, 50 ft. (16 m) wide, and 100 to 200 ft. (30 m to 60 m) long, covered with 1 m of soil.

APPENDIX A

SETTLEMENT OF WASTE DISPOSAL FILLS

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5 REFERENCE DOCUMENTS

5.1 Donohue Reference Documents:

- T.00.006 - Policy for Deviations or Waivers from Technical Standards

Approved by:

Thomas C. Leonhardt, P.E.
Executive Vice President

Lee J. Glueckstein, P.E.
Manager of Disciplines

PS/si

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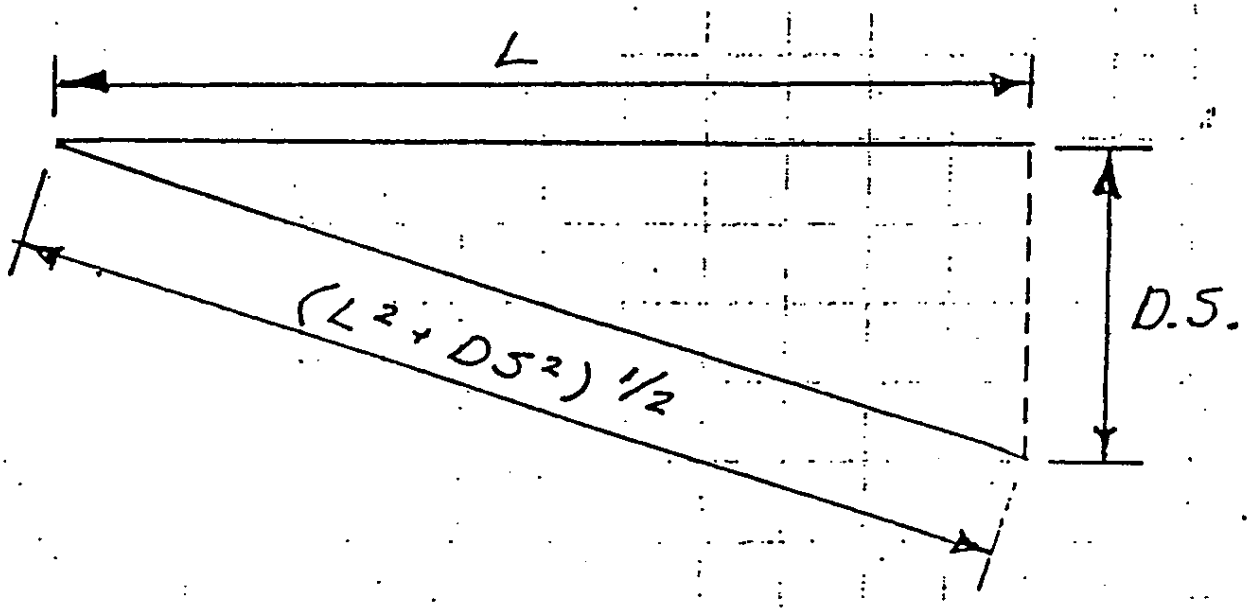

ELONGATION OF COVER GEOMEMBRANE

FIGURE 1

4.5.8 Summary

4.5.8.1 It is very unlikely that more than 4.5 (D.S.) feet of differential settlement would occur within 9.9 (L) feet of distance. Therefore, in this particular case it is our judgment that the geomembrane will not be stretched to its yield point due to differential settlement.

4.5.8.2 It should be recognized that waste settlement calculations are difficult to evaluate due to the inherent complexities and unknowns involved. Therefore, the approach taken is conservative and will normally lead to high settlement magnitudes. Using this method it is desirable to select a geomembrane with the highest value of elongation at yield for cap designs. Other properties to be evaluated before selection of the geomembrane include: friction, tensile strength and puncture strength.

4.5.8.3 Consolidation of the subgrade beneath the landfill should also be calculated to validate the integrity of the leachate collection system grades. This will be covered in a separate Standard.

TABLE 2

Method	Max. Settlement	Min. Settlement	D.S.
Sowers	DH max = 5.5'	DH min = 1.8'	3.7'
5 & 10%	10% x 90 = 9.0'	5% x 90 = 4.5'	4.5'

Calculate D.S. by subtracting the minimum settlement from the maximum settlement for each method. To be conservative, use whichever value is greater.

4.5.7 Calculate Elongation of Geomembrane

4.5.7.1 Calculate the length of geomembrane over which the maximum differential settlement could occur without stretching the geomembrane to its yield point by the following method.

4.5.7.2 Typical maximum allowable elongation at yield for geomembranes is 10%. Refer to National Sanitation Foundation, Standard 54, Nov. 1989 for specification values for geomembranes, or consult manufacturer's data or ASTM test results.

4.5.7.3 Use Figure 1 to visualize the relationship between D.S. and distance.

From Figure 1:

$$\frac{(L^2 + DS^2)^{0.5} - L}{L} \leq 10\% \quad \text{(elongation at yield)} \qquad \text{(Eq. 5)}$$

Therefore:

$$\frac{(L^2 + DS^2)^{0.5} - L}{L} = 0.10$$

$$(L^2 + DS^2)^{0.5} = 1.1\ L$$

$$L^2 + DS^2 = 1.21\ L^2$$

$$0.21\ L^2 = DS^2$$

$$L^2 = 4.76\ DS^2$$

And Finally

$$\boxed{L = 2.2\ DS} \qquad \text{(Eq. 6)}$$

Using the previously assumed values,

$$L = 2.2 \times 4.5' = 9.9'$$

TABLE 1

COMPARISON OF SETTLEMENT AND OPERATIONAL FILLING PERIODS

Thickness of Waste H (ft)	Filling Time t_1 (months)	Approximate Settlement Time t_2 (months)
40-80	12	101
40-80	72	252
80-100	12	233
80-100	72	238

4.5.5 Calculate DH

Calculate maximum and minimum values of DH using "a" max and "a" min.

4.5.5.1 Example Calculation (Continued)

Assuming:

e_o = 1.4
a max = 0.09 e_o = 0.126
a min = 0.03 e_o = 0.042
H = 90 ft
t_1 = 16 months
t_2 = 235 months

Using Eq. 2:

$$DH\ max = 0.126 \frac{90}{1+1.4} \log_{10} \frac{235}{16}$$

$$= 5.5\ ft.$$

$$DH\ min = 0.042 \frac{90}{1+1.4} \log_{10} \frac{235}{16}$$

$$= 1.8\ ft.$$

4.5.5.2 Alternatively, calculate differential settlement between areas of different waste thicknesses using a single "a" value.

4.5.6 Estimate Differential Settlement = D.S.

Differential Settlement should be estimated conservatively by comparing DH max and DH min with the values achieved by the 5 and 10% method.

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4.5.3 Estimate Initial Void Ratio, e_o

$$e_o = \frac{w\,G}{Sr} \qquad \text{(Eq. 1)}$$

Assume the following values for this example calculation:

Sr (Degree of Saturation), = 100% (saturation)
G (Specific Gravity), = 1.5 to 2.0, say 1.75
w (Water Content), = 80%

$$e_o = \frac{(0.80)\ (1.75)}{(1.00)} = 1.4 \quad \text{(This value should be } \geq 1\text{)}$$

4.5.4 Estimate Settlement with Respect to Time

$$DH = a\ \frac{H}{1+e_o}\ \log_{10}\ \frac{t_2}{t_1} \qquad \text{(Eq. 2)}$$

Where:

DH = Total Settlement (ft)
a = Secondary Compression Factor (a = alpha)
H = Thickness (Height) of Waste (ft)
e_o = Initial Void Ratio
t_2 = Time at completion of settlement (months)
t_1 = Time at completion of filling (months)

4.5.4.1 Estimate Secondary Compression Factor, "a". "a" is a function of the initial void ratio, e_o. See Figure 6 in Appendix B for graph of "a" vs. e_o.

For conditions "favorable" to decomposition

"a" max. = 0.09 e_o (approximation only) (Eq. 3)

For conditions "unfavorable" to decomposition

"a" min. = 0.03 e_o (approximation only) (Eq. 4)

4.5.4.2 Estimate t_2 and t_1. Actual values based on construction schedules should be used if available. Otherwise, the values listed in Table 1 can be used as approximate values. (From: "Sanitary Landfill Settlement Rates")

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4.3 As of the effective date of this Standard there are two acceptable procedures to predict the magnitude of waste settlement within a landfill. Values from both methods should be calculated and compared.

4.4 Method 1 - The 5 and 10% Method

4.4.1 Based on past experience within Donohue's Waste Management Engineering Discipline, a quick method to estimate settlement is to use the 5 and 10% method. This method assumes that the minimum settlement is 5% of the total height of waste. The maximum settlement is assumed to be 10% of the total height of waste. These settlements should be estimated to occur after the time the landfill achieves final grade and is capped. In this way the on-going settlements that occur during the filling process do not need to be taken into account.

4.4.2 The differential settlement is calculated as the difference in feet between these maximum and minimum values.

4.5 Method 2 - The Sowers Method

4.5.1 This method predicts potential maximum settlement and is discussed in two professional papers. These papers are attached to this Standard as Appendices A and B. It is the design engineer's responsibility to choose appropriate values for the formulas which will provide a maximum or minimum settlement with the assistance of a geotechnical engineer.

4.5.1.1 Sowers, George F., "Settlement of Waste Disposal Fills." Proceedings, 8th International Conference on Soil Mechanics, Moscow, U.S.S.R., 1973, pp.207-210, Appendix A.

4.5.1.2 Yen, Bing C. and Scanlon, Brian, "Sanitary Landfill Settlement Rates." Journal of the Geotechnical Engineering Division, ASCE. May 1975, pp. 475-487. Appendix B.

4.5.2 The authors measured actual settlement rates at several sanitary landfills. They conclude that settlement is a function of the height of fill, the length of the filling period, the suitability of waste for decomposition, and environmental factors such as temperature and moisture content.

2 REQUIREMENTS

2.1 All Waste Management Engineering Discipline staff shall read and implement this Standard.

2.2 These design calculations shall be performed by an Engineer for landfill caps that include a geomembrane liner.

2.3 These calculations shall be QC reviewed by a member of the Geotechnical Engineering staff prior to inclusion in the Engineering Report.

2.4 The designer should read the professional papers which are included as Appendixes A and B, for conditions of application of these equations. If conditions exist which do not apply to these methods, the Discipline Manager shall be consulted.

2.5 Suggested modifications to this Standard shall be submitted to the Waste Management Engineering Discipline Manager for review and approval. The Discipline Manager will then route the proposed modifications to various Geotechnical Engineers for review and comment.

3 RESPONSIBILITIES

3.1 The Senior Geotechnical Engineer and the Waste Management Engineering Discipline Manager are responsible for the updating and quality control of this Standard.

3.2 The Waste Management Engineering Discipline staff is responsible for following this Standard.

4 PROCEDURES

4.1 Settlement of landfill waste material will most likely occur over time due to the following mechanisms:

4.1.1 Overburden stresses from the waste and the cover soils causing compression of waste materials and re-orientation of waste material.

4.1.2 Ongoing biological and chemical decomposition of the waste, physical, mechanical, or other internal changes.

4.2 The predominant type of waste within the landfill (i.e., ash, hazardous, municipal, construction, etc.) and the amount of compactive effort applied during placement will also affect the magnitude of settlement. For example, loosely compacted, highy organic, readily biodegradable fills will display much higher settlements than heavily compacted construction debris.

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SETTLEMENT ANALYSIS FOR LANDFILL GEOMEMBRANE COVERS

1 INTRODUCTION

1.1 Purpose - This Standard presents a uniform approach to estimating the magnitude of waste settlement in a landfill to assess the magnitude of geomembrane elongation resulting from differential settlement as well as grade changes.

1.2 Application - This Standard applies to all landfill designs which include a geomembrane cover. Underlined text in this Standard is policy. Deviation from policy shall be in accordance with Technical Standard T.00.006. Deviation from guidelines requires approval from a Senior Geotechnical Engineer in the Waste Management Engineering Discipline acting on behalf of the Waste Management Engineering Discipline Manager.

1.3 Effective Date - This Standard shall be effective on the date listed as the Origin Date.

1.4 Authority - The interpreting authority of this Standard is a Senior Geotechnical Engineer acting on behalf of the Waste Management Engineering Discipline Manager.

1.5 Glossary

1.5.1 Differential Settlement, DS - The vertical difference in feet between the maximum and minimum settlement magnitudes, usually measured across a specified horizontal distance.

1.5.2 Initial Void Ratio, e_o - The ratio within the waste of the volume of voids to the volume of solids.

1.5.3 Degree of Saturation, Sr - The percentage of void space that is filled with water.

1.5.4 Specific Gravity, G - The ratio of the unit weight of solid constituents to the unit weight of water.

1.5.5 Water Content, w - The ratio of the weight of water to the weight of oven dried solid material within a sample of the waste.

1.5.6 Total Settlement, DH - The estimated settlement occurring at a specific location within the landfill, usually referenced to the time period after landfill capping.

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in this study. This is true both in terms of the general trend of m decreasing with logarithmically scaled time, and in the order of magnitude of settlement rate.

The data observed in Fig. 7 appear to be under conditions unfavorable to decomposition according to Sowers' criteria. For comparison, the average settlement rate of Fig. 3 which represents field observed data of fill columns with an average depth of 90 ft (27 m) is also shown in Fig. 7. It can be said qualitatively that the settlement rate is indeed decreasing with time logarithmically even though it is premature to determine quantitatively the exact rate of settlement at this time and more research is needed.

Summary and Conclusions

Up to 9 yr of settlement records of three sanitary landfill sites have been studied and, within the limitations of the type of fills and environments investigated, a common trend of settlement rate with respect to median fill age has been identified. Although additional research is needed prior to the reliable prediction of the magnitude of ultimate settlement, the following conclusions are reached:

1. The rate of settlement appears to decrease linearly proportional to the logarithm of median fill age. This observation appears to be substantiated by model and the field observed data of other investigators.
2. Settlement rate increases with fill depth in general. However, there seems to exist a limit of fill depth. Greater than this depth the rate of settlement will not increase significantly. This is probably due to the anaerobic environment of deeper fills that decompose slower than shallow fills which simulate an aerobic environment. This depth is approx 100 ft (30.5 m) for the cases studied.

Acknowledgment

The writers wish to thank Harvey T. Brandt and John D. Parkhurst for the use of the landfill data. They also wish to thank Ken Harvey, Carl Sjoberg, and Herman Kneeling for their interest and suggestions in this project, and their assistance in locating data.

Appendix I.—References

1. "Development of Construction and Use Criteria for Sanitary Landfills," Final Report, The County of Los Angeles, Department of the County Engineer, and Engineering-Sciences, Inc., Los Angeles, Calif.
2. Merz, R. C., and Stone, R., "Landfill Settlement Rates," *Public Works*, Vol. 93, Sept., 1962.
3. Moorehouse, D. C., "Solid Waste Utilization," presented in the Professional and Technical Development Program of the Woodward-Clyde Consultants, 1971.
4. Neely, G. A., and Artz, N. S., "Model Sanitary Landfill in Kansas City," *Civil Engineering*, ASCE, Vol. 42, No. 10, Oct., 1972, pp. 72-76.
5. "Refuse Volume Reduction in a Sanitary Landfill," by the Sanitary Engineering Research Committee of the Sanitary Engineering Division, N. L. Nemerow, Chmn., *Journal of the Sanitary Engineering Division*, ASCE, Vol. 85, No. SA6, Proc. Paper 2250, Nov., 1959, pp. 37-50.

6. *Sanitary Landfill, Manual No. 39*, by the Committee on Sanitary Landfill Practice of the Sanitary Engineering Division, ASCE, 1959.
7. Sowers, G. F., "Foundation Problems in Sanitary Landfills," *Journal of the Sanitary Engineering Division*, ASCE, Vol. 94, No. SA1, Proc. Paper 5811, Feb., 1968, pp. 103-116.
8. Sowers, G. F., "Settlement of Waste Disposal Fills," *Proceedings*, 8th International Conference on Soil Mechanics and Foundation Engineering, Moscow, Union of Soviet Socialist Republic, 1973, pp. 207-210.

Appendix II.—Notation

The following symbols are used in this paper:

H = height of sanitary landfill column at any time;
H_f = height at completion of sanitary landfill column;
m = settlement rate of surface of landfill column after completion;
r = regression coefficient;
t = elapsed time since beginning of construction of sanitary landfill;
t_i = median age of fill column; and
t_c = length of construction period of fill column.

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WHL - Magnolia Landfill SUBJECT Settlement Prepared By SHH Date 10-11-93

PROJECT Phase II Redesign Analysis Using Program Setoff Reviewed By DBK Date 10-11-93

Approved By ____ Date ____

OBJECTIVE: To calculate the settlement of the foundation at Magnolia Landfill and draw corresponding settlement contours.

APPROACH: Use Program SETOFF to calculate the settlements at 174 points under the Landfill. The results will then be used to plot settlement contours.

Reference:

1) For the theory behind the program:

Ray E. Olson, Class Notes, CE 387R.1, "Consolidation & Settlement", Spring '89, The University of Texas at Austin, Austin, Texas.

2) For the use of the program:

"Documentation of Computer Program Setoff", by Karl W. Fenske and Shin-Tower Wang, Ensoft Inc., 1990.

ASSUMPTIONS: The assumptions behind the Consolidation Theory are:

1) Deformation occurs only in the vertical direction.
2) Water flow occurs only in the vertical direction.
3) Water flows in accordance to Darcy's law.
4) Strains are small.
5) All soil properties are constant.
6) The soil is primarily elastic.
7) The soil is homogeneous.
8) No secondary effects (only resistance to volume change is hydrodynamic)
9) Sr = 100% = Saturation
10) pore water and soil grains are incompressible.
11) Soil is loaded instantaneously at time 0 and load does not change w/ time
12) The two horizontal boundaries are either impervious or free draining

** Consolidation Curves (Stress-Strain) are attached.

** Landfill height of 200', NGVD

** Water table at 5' below bottom of the excavation.

** Unit weights used are:

* Clay Liner & in-situ clay: $\gamma_A = 109$ pcf
* Silty Clay: $\gamma_A = 129$ pcf.
* Sand: $\gamma_A = 170$ pcf
* Shale: $\gamma_A = 130$ pcf

** The load areas representing the landfill for use in SETOFF are shown on the attached drawing.

** Sand and shale are incompressible.

<u>EQUATIONS</u>: The program uses Terzaghi's one-dimensional consolidation theory to compute the settlements.

<u>EQ1</u>: $$S = R_R L \log \frac{\bar{\sigma}_i}{\bar{\sigma}_o} + R_c L \log \frac{\bar{\sigma}_f}{\bar{\sigma}_i}$$

where:
S = Settlement, ft
R_R = Recompression ratio (strain)
R_c = Compression ratio (strain)
L = Thickness of compressible layer, ft
$\bar{\sigma}_o$ = initial effective stress, psf.
$\bar{\sigma}_i$ = previous consolidation pressure, psf.
$\bar{\sigma}_f$ = final effective stress, psf.

** Settlements Calculated Using the Program Settoff **

Settlement Point	Site Coordinates		Settlement (Inch)
	X (ft)	Y (ft)	
1	200	310	0.90
2	390	460	14.86
3	700	750	26.95
4	1000	1030	34.05
5	1300	1310	38.56
6	1930	1320	38.56
7	2560	1340	38.56
8	2800	1620	38.56
9	2940	1910	25.18
10	3050	2200	20.66
11	3160	2360	11.00
12	4200	90	0.00
13	4060	270	0.06
14	3770	580	24.83
15	3480	900	32.42
16	2560	1230	38.56
17	1300	1410	38.56
18	1030	1680	38.45
19	930	2020	28.36
20	750	2320	14.41
21	750	2500	8.82
22	730	1690	28.86
23	450	1970	19.94
24	260	2170	10.96
25	4290	1960	0.03
26	4130	1820	13.95
27	3800	1530	25.35
28	3490	1240	35.64
29	2010	270	0.09
30	2010	540	24.80
31	2010	850	32.42
32	2010	1120	38.55
33	2000	1540	38.56
34	2000	1820	32.44
35	2000	2110	24.98
36	2000	2380	13.98
37	290	1400	13.92
38	550	1390	24.83
39	870	1380	32.43
40	3130	1060	38.38
41	3640	1090	32.42
42	3950	1090	24.83
43	4160	1910	13.68
44	4180	1090	13.68
45	4170	170	0.00
46	2900	2320	19.96

DBK 10/11/93

Settlement Point	Site Coordinates X (ft)	Site Coordinates Y (ft)	Settlement (inch)
47	2840	2150	24.83
48	990	2420	14.68
49	1000	2270	24.77
50	3100	1420	38.56
51	3160	1570	38.55
52	3220	1720	25.20
53	3270	1810	24.84
54	3300	1940	24.59
55	3320	2010	14.11
56	3120	2210	14.12
57	3030	1760	24.89
58	2750	1920	32.54
59	2690	1780	32.48
60	2580	1540	38.56
61	2530	1440	38.56
62	2490	1290	38.56
63	2490	2410	13.91
64	2480	2190	25.42
65	2460	2100	24.93
66	2450	2000	32.16
67	1480	2470	13.67
68	1490	2320	19.97
69	1500	2150	29.87
70	1490	1840	32.43
71	1490	1750	32.84
72	1090	2010	31.49
73	1150	1860	32.43
74	2000	1180	38.56
75	300	390	13.85
76	230	1870	13.67
77	280	1840	13.90
78	460	1790	24.80
79	1240	1610	38.75
80	1110	1500	38.55
81	1010	1350	37.67
82	1120	1120	38.54
83	1210	1460	38.56
84	1270	1510	38.56
85	1210	1220	38.56
86	1370	1360	38.56
87	240	1180	13.78
88	450	830	24.79
89	490	450	14.67
90	580	620	24.83
91	890	880	32.42
92	790	360	13.68
93	1080	260	0.06
94	1300	570	24.82
95	1380	760	31.43

DBK 10/11/93

Settlement Point	Site Coordinates X (ft)	Site Coordinates Y (ft)	Settlement (inch)
96	1420	860	32.42
97	1510	1040	37.67
98	2020	210	0.01
99	2020	680	24.86
100	2020	760	31.43
101	2190	400	13.93
102	2690	260	0.06
103	2740	500	24.59
104	2750	770	32.03
105	2780	970	32.55
106	2870	1150	38.56
107	3010	1160	38.56
108	3370	1140	38.55
109	3370	1000	32.60
110	3220	860	32.42
111	3260	750	28.91
112	3350	460	15.78
113	3230	150	0.00
114	3770	200	0.01
115	4270	90	0.00
116	4010	320	5.26
117	3990	470	19.95
118	4260	550	0.09
119	4180	640	13.15
120	3260	880	24.85
121	3610	740	26.09
122	4050	1080	24.30
123	4280	1640	0.04
124	4180	1520	13.16
125	3850	1380	24.86
126	3610	1400	32.43
127	3920	1660	24.83
128	4020	1760	24.76
129	3730	2000	14.28
130	3710	1720	25.07
131	3460	1600	38.36
132	1990	2230	24.89
133	740	1910	24.84
134	720	2110	14.30
135	660	1720	24.86
136	650	1220	24.91
137	640	720	24.84
138	1000	690	24.88
139	2400	600	24.83
140	3860	550	24.81
141	3840	1060	24.88
142	3820	1590	24.60
143	320	1790	13.96
144	340	1170	14.03

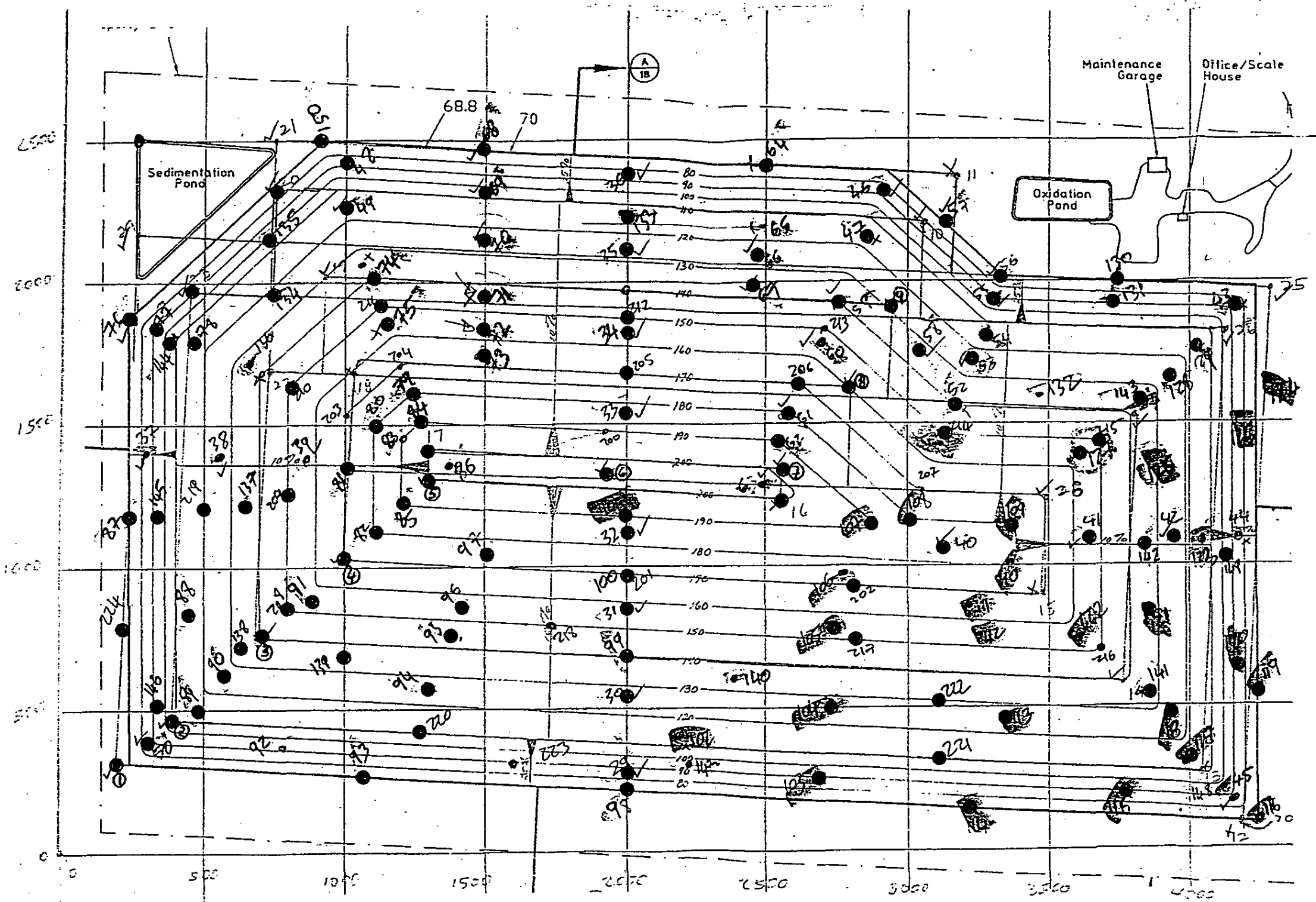
DBK 10/11/93

Settlement Point	Site Coordinates		Settlement (Inch)
	X (ft)	Y (ft)	
145	340	510	14.00
146	1130	300	0.59
147	4130	210	0.01
148	4140	1020	13.91
149	900	2500	11.00
150	1920	1480	38.56
151	2020	975	32.47
152	2810	930	32.43
153	1000	1540	35.64
154	1190	1710	38.46
155	2000	1680	42.04
156	2600	1640	38.67
157	3050	1260	38.56
158	800	850	32.41
159	800	1260	32.42
160	800	1630	32.38
161	1130	1920	32.54
162	2000	1870	32.43
163	2680	1830	32.43
164	3180	1460	38.56
165	3660	1440	32.42
166	3680	700	24.91
167	2810	740	26.09
168	1740	790	32.33
169	510	1210	24.83
170	1270	420	14.01
171	3120	320	0.52
172	3120	520	24.76
173	1610	420	14.01
174	220	790	13.15

DBK 10/11/93

Page 7 of 8 1" = 500'

DSK 10/25/95



PC	CC	X	Y
26	1	4130	1820
27	2	3800	1530
28	3	3490	1240
29	4	2010	270
30	5	2010	540
31	6	2010	850
32	7	2010	1120
33	8	2000	1540
34	9	2000	1820
35	10	2000	2110
36	11	2000	2380
37	12	290	1400
38	13	[illegible]	1390
39	14	270	1380
40	15	3130	1060
41	16	3800	1090
42	17	3950	1000
43	18	4170	1910
44	19	4170	1090
45	20	4170	170
46	21	2900	2320
47	22	2840	2250
48	23	990	2430
49	24	1000	[illegible]
50	25	300	[illegible]
51	26	2100	1470

PROPOSED FINAL CONTOUR PLAN
MAGNOLIA LANDFILL
MONROE, LOUISIANA

0 100 200
scale

LEGEND

● Settlement NODULE POINT

Use 40 scale

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WML - Magnolia Landfill SUBJECT Settlement Analysis Using Program SETOFF

PROJECT Phase II Redesign

Prepared By DBK Date 10/12/93

Reviewed By DBK Date 10-22-93

Approved By _____ Date _____

CONCLUSIONS: Settlements calculated by the Computer program SETOFF ranged between 0 (near the Landfill edge) and 39 inches (at the center). Settlements were calculated at 174 points, then settlement contour lines were drawn, as shown on the previous page.

Computer generated settlement output fill MagNL9.OUT is attached

Magnl9.out

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*****************************************
*                                       *
*     FOUNDATION SETTLEMENT ANALYSIS    *
*                                       *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 1 - PROBLEM CONTROL PARAMETERS

COMPUTATION UNITS	=	1
1 = U.S. GRAVITATIONAL SYSTEM		
2 = S.I. ABSOLUTE SYSTEM		
NUMBER OF SOIL LAYERS	=	5
NUMBER OF SOIL COMPRESSIBILITIES	=	5
NUMBER OF SETTLEMENT POINTS	=	25
NUMBER OF LOADED AREAS	=	9

TABLE 2 - SOIL AND LAYER INFORMATION

SOIL LAYER NO.	DEPTH TO CENTER FT	LAYER THICKNESS FT	LAYER THICK. FACTOR	UNIT WEIGHT LB/FT**3	SOIL COMP NO.	OVERBURDEN PRESSURE KSF	INIT VERTICAL STRAIN (F0) %
1	2.50	5.00	1.00	109.00	1	.273	.020
2	15.00	20.00	1.00	46.60	2	1.011	.473
3	29.00	8.00	1.00	66.60	3	1.743	4.265
4	50.50	35.00	1.00	67.60	4	3.193	00.000
5	84.00	32.00	1.00	77.60	5	5.617	00.000

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*****************************************
*                                       *
*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 3 - SOIL COMPRESSIBILITY SOURCE AND DATA

SOIL COMPRESSIBILITY NO. 1
Consolidation Curve from Borehole R-19 - CH - 14'-16'

F, %	.020	.200	.700	2.450	.700	1.300	2.550	13.650
P,KSF	.320	.640	1.480	2.600	1.480	.640	2.600	12.200

SOIL COMPRESSIBILITY NO. 2
Consolidation Curve from Borehole R-19 - CH - 14'-16'

F, %	.020	.200	.700	2.450	.700	1.300	2.550	13.650
P,KSF	.320	.640	1.480	2.600	1.480	.640	2.600	12.200

SOIL COMPRESSIBILITY NO. 3
Consolidation Curve from borehole R-13 - CH - 28'-30'

F, %	.940	4.500	6.400	6.000	5.800	6.700	9.300	16.900
P,KSF	.250	2.000	4.000	2.000	1.000	4.000	8.000	32.000

SOIL COMPRESSIBILITY NO. 4
Incompressible Layer - Sand

THE SLOPE OF THE F(%)-LOG P CURVE IS .000

SOIL COMPRESSIBILITY NO. 5
Incompressible Layer - Clay Shale

THE SLOPE OF THE F(%)-LOG P CURVE IS .000

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 4 - SETTLEMENT POINT DATA

POINT NO,	POINT COORDINATES X FT	Y FT	LAYER NO.*
1	1920.00	1480.00	1
2	2020.00	975.00	1
3	2810.00	930.00	1
4	1000.00	1540.00	1
5	1190.00	1710.00	1
6	2000.00	1680.00	1
7	2600.00	1640.00	1
8	3050.00	1260.00	1
9	800.00	850.00	1
10	800.00	1260.00	1
11	800.00	1630.00	1
12	1130.00	1920.00	1
13	2000.00	1870.00	1
14	2680.00	1830.00	1
15	3180.00	1460.00	1
16	3660.00	1440.00	1
17	3680.00	700.00	1
18	2810.00	740.00	1
19	1740.00	790.00	1
20	510.00	1210.00	1
21	1270.00	420.00	1
22	3120.00	320.00	1
23	3120.00	520.00	1
24	1610.00	420.00	1
25	220.00	790.00	1

* NUMBER OF SOIL LAYER AT WHICH SETTLEMENT COMPUTATION BEGINS

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 5 - LOADED AREA INFORMATION

AREA ID	AREA SHAPE	LOADED AREA CENTER X-COORD FT	Y-COORD FT	AREA DIMEN. XLEN FT	YLEN FT	AREA SLOPE	SUSTAINED LOADING KSF	AREA ELEV FT
1	1	2200.00	1250.00	4020.00	1860.00	.000	2.400	.00
2	1	1950.00	2330.00	2420.00	360.00	.000	2.400	.00
3	1	2230.00	1220.00	3680.00	1500.00	.000	1.800	.00
4	1	1900.00	2135.00	2300.00	370.00	.000	1.800	.00
5	1	2240.00	1220.00	3080.00	940.00	.000	1.800	.00
6	1	1921.00	1850.00	2001.00	340.00	.000	1.800	.00
7	1	2245.00	1355.00	2490.00	650.00	.000	1.800	.00
8	1	1920.00	1700.00	1760.00	60.00	.000	1.800	.00
9	1	1795.00	1365.00	1270.00	110.00	.000	.000	.00

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 6 = AVERAGE STRESS INCREASE

SETTLEMENT POINT NO.	1	2	3	4	5	6	7
DEPTH, FT			STRESS, KSF				
2.50	7.800	6.000	6.000	6.900	7.800	9.580	7.800
15.00	7.800	6.009	6.001	6.900	7.778	9.016	7.829
29.00	7.799	6.041	6.007	6.899	7.711	8.484	7.889
50.50	7.797	6.136	6.030	6.892	7.556	8.091	7.914
84.00	7.787	6.282	6.082	6.868	7.346	7.729	7.824

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 6 = AVERAGE STRESS INCREASE (CONT)

SETTLEMENT POINT NO.	8	9	10	11	12	13	14
DEPTH, FT			STRESS, KSF				
2.50	7.800	6.000	6.000	6.000	6.000	6.000	6.000
15.00	7.800	5.997	5.998	5.991	6.030	6.002	6.002
29.00	7.799	5.984	5.992	5.961	6.093	6.008	6.009
50.50	7.793	5.925	5.964	5.859	6.131	6.032	6.040
84.00	7.773	5.775	5.894	5.674	6.070	6.074	6.112

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 6 = AVERAGE STRESS INCREASE (CONT)

SETTLEMENT POINT NO.	15	16	17	18	19	20	21
DEPTH, FT			STRESS, KSF				
2.50	7.800	6.000	4.200	4.210	6.000	4.200	2.400
15.00	7.800	5.999	4.212	4.486	5.978	4.199	2.410
29.00	7.798	5.996	4.249	4.731	5.913	4.196	2.442
50.50	7.788	5.980	4.349	4.868	5.766	4.180	2.515
84.00	7.755	5.934	4.478	4.956	5.584	4.136	2.586

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 6 = AVERAGE STRESS INCREASE (CONT)

SETTLEMENT POINT NO.	22	23	24	25
DEPTH, FT			STRESS, KSF	
2.50	1.200	4.200	2.400	2.399
15.00	1.201	4.187	2.410	2.342
29.00	1.203	4.146	2.442	2.196
50.50	1.215	4.029	2.515	1.963
84.00	1.252	3.847	2.587	1.742

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 7 - COMPUTED SETTLEMENT IN INCHES

SETTLEMENT POINT NO.	1	2	3	4	5	6	7
LAYER							
1	6.400	5.313	5.313	5.891	6.400	7.259	6.400
2	26.141	22.207	22.188	24.275	26.097	28.379	26.198
3	6.018	4.946	4.930	5.473	5.967	6.399	6.070
4	.000	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000	.000
TOTAL(In.)	38.559	32.467	32.430	35.639	38.464	42.037	38.668

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*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 7 - COMPUTED SETTLEMENT IN INCHES (CONT)

SETTLEMENT POINT NO.	8	9	10	11	12	13	14
LAYER							
1	6.400	5.313	5.313	5.313	5.313	5.313	5.313
2	26.140	22.176	22.180	22.163	22.258	22.189	22.189
3	6.018	4.918	4.923	4.908	4.971	4.930	4.931
4	.000	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000	.000
TOTAL(In.)	38.559	32.407	32.416	32.384	32.543	32.432	32.433

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*                                       *
*     FOUNDATION SETTLEMENT ANALYSIS    *
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 7 - COMPUTED SETTLEMENT IN INCHES (CONT)

SETTLEMENT POINT NO.	15	16	17	18	19	20	21
LAYER							
1	6.400	5.313	3.856	3.865	5.313	3.856	1.637
2	26.140	22.182	17.086	17.972	22.130	17.044	9.761
3	6.018	4.924	3.962	4.253	4.884	3.929	2.612
4	.000	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000	.000
TOTAL(In.)	38.558	32.420	24.904	26.090	32.327	24.828	14.009

RUST ENVIRONMENT & INFRASTRUCTURE.

CALCULATION SHEET

PROJECT NO. 96615.300

CLIENT WML - Magnolia landfill | SUBJECT Foundation Settlement Analysis | Prepared By ZHA Date 10/5/93

PROJECT PHAS E Redesign | Reviewed By DBK Date 10/12/93

Approved By ____ Date ____

* OBJECTIVE : To verify the settlement analysis performed using program SETOFF.

* APPROACH : Use Terzaghi's theory of consolidation to calculate the settlement under the heaviest section of the cap (where largest settlement is most likely to occur).

* REFERENCES

1) "Foundation Engineering", Peck, Hanson, & Thornburn, 2nd Edition, John Wiley & Sons, 1974.

2) Olson, Roy E., Class notes, CE 387R.1, "Consolidation & Settlement", Spring 1989, The University of Texas at Austin, Graduate program in Geotechnical Engineering

* EQUATIONS

EQ1 : $$S = R_R L \log \frac{\bar{\sigma}_i}{\bar{\sigma}_o} + R_c L \log \frac{\bar{\sigma}_f}{\bar{\sigma}_i}$$

where, S = Settlement, inch.
L = Thickness of compressible layer.
$\bar{\sigma}_i$ = Previous consolidation pressure, psf
$\bar{\sigma}_o$ = Effective stress at center of compressible layer, psf
$\bar{\sigma}_f$ = Final effective stress at center of compressible layer, psf.
R_R = Recompression Ratio
R_c = Compression Ratio.

EQ2 : $$R_R = \frac{\bar{\sigma}_i - \bar{\sigma}_o}{\log(\bar{\sigma}_i/\bar{\sigma}_o)}, \quad R_c = \frac{\bar{\sigma}_f - \bar{\sigma}_i}{\log(\bar{\sigma}_f/\bar{\sigma}_i)}$$

Both R_R & R_c are obtained [illegible]

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86715.300

CLIENT WML Magnetic landfill

PROJECT Phase II Redesign

SUBJECT Foundation Settlement Analysis

Prepared By ZHA Date 10/5/93

Reviewed By DBK Date 10/12/93

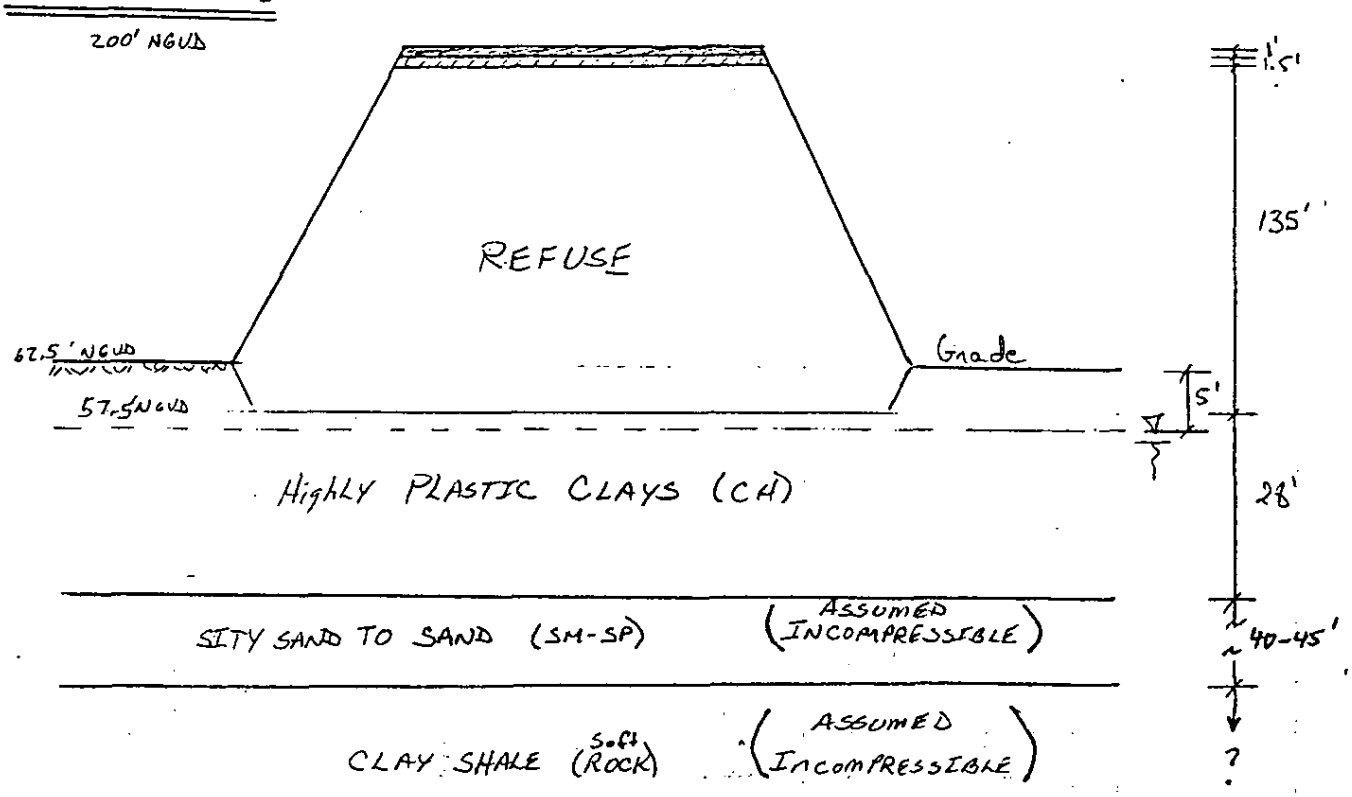
Approved By ____ Date ____

* ASSUMPTIONS

Layer 1: Vegetative Soil, $\gamma = 100$ pcf, $L = 1'$
Layer 2: Clay cover, $\gamma = 110$ pcf, $L = 1.5'$
Layer 3: Waste, $\gamma = 65$ pcf, $\gamma_A = 70$ pcf, $\gamma' = 7.6$ pcf, $L = 135.0'$
Layer 4: Clay CH, $\gamma = 105$ pcf, $\gamma_A = 109$ pcf, $\gamma' = 46.6$ pcf, $L = 28'$
Layer 5: CL clay, $\gamma = 120$ pcf, $\gamma_A = 129$ pcf, $\gamma' = 66.6$ pcf, $L = 8'$

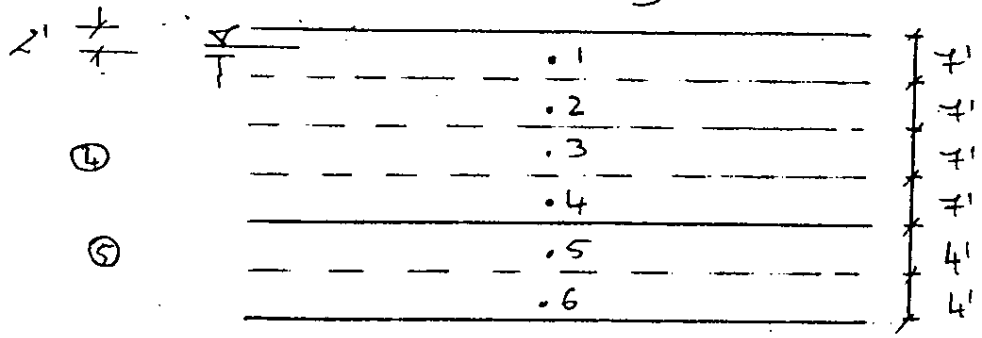
- The clay liner was lumped with the in-situ clay with an assumed compaction rate of 95% proctor. (95% of $\gamma_A = 115$ pcf is 109 pcf)
- The water table is 5' below grade.
- Layer 5 is underlain by sand then shale both of which are assumed incompressible.

* CALCULATIONS



- Initial & Final Effective Stresses

The initial stresses will be calculated after preconstruction excavation and the placement of the 3' Clay liner.



The surcharge will include layers 1, 2, 3, & 4.

$$\Delta p = 1' \times 100 + 1.5' \times 110 + 135' \times 60 pcf$$

$$\Rightarrow \Delta p = 8365.0 \text{ psf}.$$

Point	$\bar{\sigma}_o$ (psf)	$\bar{\sigma}_f$ (psf)
1	280	8645
2	606	8971
3	932	9297
4	1258	9623
5	1555	9920
6	1821	10186

- Compression & Recompression Ratios

Compression & Recompression ratios (R_c & R_R, resp.) are determined from the slopes of the linear portions of the consolidation curves.

For CH Layer (Layer 5):

$$R_R = \frac{.002 - 0}{\log(1.3/.16)} = .002 \quad , \quad R_c = \frac{.136 - .016}{\log(6/1.5)} = .199$$

For CL Layer (Layer 6)

$$R_R = \frac{.043 - .004}{\log(1/.1)} = .039 \quad , \quad R_c = \frac{.14 - .024}{\log(10/1)} = .116$$

Both consolidation curves are attached.

- Previous Consolidation Pressures, $\bar{\sigma}_c'$

The Previous consolidation pressure is also determined from the consolidation curves.

For CH (Layer 5) $\bar{\sigma}_c' = 1.5$ tsf $= 3000$ psf

For CL (Layer 6) $\bar{\sigma}_c' = 1.8$ tsf $= 3600$ psf.

- Settlements

Layer 5 :

$$\Delta S_5 = R_R \, \Delta L \, \Sigma \log\left(\frac{\bar{\sigma}_i}{\bar{\sigma}_o}\right) + R_c \, \Delta L \, \Sigma \log\left(\frac{\bar{\sigma}_f}{\bar{\sigma}_i}\right)$$

$$= 7 \cdot \left\{ .002 \times \left[\log\frac{3000}{280} + \log\frac{3000}{606} + \log\frac{3000}{932} + \log\frac{3000}{1258}\right] + .199 \times \left[\log\frac{8645}{3000} + \log\frac{8971}{3000} + \log\frac{9297}{3000} + \log\frac{9623}{3000}\right]\right\}$$

$$= 7' \{ 0.002(1.030 + 0.695 + 0.508 + 0.377) + 0.199(0.460 + 0.476 + 0.491 + 0.506) \}$$

$$= 7 \times (0.005 + 0.385) = 7 \times 0.390 = 2.73'$$

$\Rightarrow$ $\underline{\Delta S_5 = 32.8''}$

Layer 6 :

$$\Delta S_6 = R_R \, \Delta L \, \Sigma \log\left(\frac{\bar{\sigma}_i}{\bar{\sigma}_o}\right) + R_c \, \Delta L \, \Sigma \log\left(\frac{\bar{\sigma}_f}{\bar{\sigma}_i}\right)$$

$$= 4 \cdot \left\{ .039 \cdot \left[\log\frac{3600}{1555} + \log\frac{3600}{1821}\right] + 0.116\left[\log\frac{9920}{3600} + \log\frac{10186}{3600}\right]\right\}$$

$$4 \times \{ 0.039(0.365 + 0.296) + 0.116(0.440 + 0.452)$$

$$= 4 \times (0.017 + 0.103) = 4' \times 0.120 = 0.48'$$

$\Rightarrow$ $\underline{\Delta S_6 = 5.8''}$

$\therefore$ Total Settlement $= S = \Delta S_5 + \Delta S_6 = 32.8'' + 5.8''$

$\Rightarrow$ $\underline{\underline{S = 38.6''}}$

- Submergence Correction

$S = 38.6'' = 3.2'$

$\therefore \Delta p = 1' \times 100 + 1.5' \times 110 + 133.2' \times 60 + 1.78' \times 7.6$

$\Rightarrow \Delta p = 8271$ psf.

$\Rightarrow$ new values for final effective stress:

$\bar{\sigma}_{f_1} = 8551$ psf $\qquad \bar{\sigma}_{f_4} = 9529$ psf

$\bar{\sigma}_{f_2} = 8877$ psf $\qquad \bar{\sigma}_{f_5} = 9826$ psf

$\bar{\sigma}_{f_3} = 9203$ psf $\qquad \bar{\sigma}_{f_6} = 10092$ psf

$\therefore$

$$\Delta S_5 = 7.0' \times \left\{0.005 + 0.199\left[\log\frac{8551}{3000} + \log\frac{8877}{3000} + \log\frac{9203}{3000} + \log\frac{9529}{3000}\right]\right\}$$

$$= 7.0 \times \{0.005 + 0.119[(0.455 + 0.471 + 0.487 + 0.502)]\}$$

$$= 7.0 \times (.005 + 0.381) = 7.0 \times 0.386$$

$\Rightarrow \Delta S_5 = 2.70' = 32.4''$

$$\Delta S_6 = 4 \times \left\{.026 + .116 \times \left[\log\frac{9826}{3600} + \log\frac{10092}{3600}\right]\right\}$$

$\Delta S_6 = 4 \times (0.026 + 0.103) = 4 \times 0.129 = 0.5' = 6.1''$

$\therefore \quad S = \Delta S_5 + \Delta S_6 = 32.4'' + 6.1'' = 38.5''$

CONCLUSIONS

A hand check settlement of 38.5" was calculated at the center of the landfill. Similar settlements (38-40") were also obtained from the computer program SETOFF.

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*****************************************
*                                       *
*     FOUNDATION SETTLEMENT ANALYSIS    *
*                                       *
*****************************************
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Magnolia Sanitary Landfill
Without Water Levels

TABLE 7 - COMPUTED SETTLEMENT IN INCHES (CONT)

SETTLEMENT POINT NO.	22	23	24	25
LAYER				
1	.406	3.856	1.637	1.636
2	3.556	17.005	9.761	9.411
3	1.300	3.897	2.612	2.099
4	.000	.000	.000	.000
5	.000	.000	.000	.000
TOTAL(In.)	5.263	24.758	14.009	13.146

IN-SITU PERMEABILITY CALCULATIONS

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WML-Magnolia Landfill SUBJECT In-Situ Permeability Calculations Piezometers

PROJECT Phase II Redesign

Prepared By DBK Date 8/9/93

Reviewed By ZHA Date 9-20-93

Approved By ____ Date ____

OBJECTIVE: To determine the in-situ coefficients of permeability at the piezometer locations at Magnolia Landfill.

APPROACH: Perform varible head field permeability calculations for Piezometers P-1, P-2 and P-3 installed July 1993 using Cedergren (1967) and NAVFAC (1982) equations.

Ref 1: Cedergren, Harry R.
"Seepage, drainage, and Flow Nets", 3rd Edition
1967, 1977, 1989 by John Wiley & Sons, Inc.
Pages 56 - 61

Ref 2: Department of the Navy
Naval Facilities Engineering Command
NAVFAC DM-7.1, MAY 1982, "SOIL MECHANICS-Design Manual 7.1"
Pages 7.1-103 through 7.1-108

EQ 1: SHAPE FACTOR (F)

$$F = \frac{2\pi L}{Ln(L/R)}$$

F = Shape factor of intake point (dim)
L = Length of Intake point (cm)
R = Radius within Screen Zone (cm)
π = 3.1415
Ln = Natural Log

EQ 2: AREA OF STANDPIPE (A)

$$A = \pi r^2$$

A = Area of standpipe (cm^2)
π = 3.1415
r^2 = Radius of (inside) Piezometer (cm)

→

EQ3: Coefficient of Permeability (k)

$$k = \frac{A}{F(t_2 - t_1)} \ln \frac{h_1}{h_2}$$

$$k = \frac{r^2}{2L} \ln\left(\frac{L}{R}\right)\left[\frac{\ln(h_1/h_2)}{t_2 - t_1}\right]$$

k = mean Coefficient of Permeability (cm/sec)
h_0 = initial static water level head (cm)
h_i = head level @ time t_i (cm)
t_i = time (sec)

DATA / ASSUMPTIONS

- EQ3 assumes isotropic soil conditions where the vertical mean coeff. of permeability (k_v) is equal to the horizontal mean coeff of permeability (k_h) (i.e. $k_v = k_h$ or $m = \sqrt{k_h/k_v} = 1$).
- Screen Length of Piezometer L = 5ft = 152.4 cm
- 1¼ O.D. SCH 40 PVC Piezometer riser pipe
- r = 0.69 in = 1.753 cm
- Six (6)-inch diameter hole

  R = 3 in = 7.62 cm
- Eight (8)-inch diameter hole

  R = 4 in = 10.16 cm

CLIENT WML-MAGNOLIA LANDFILL

PROJECT

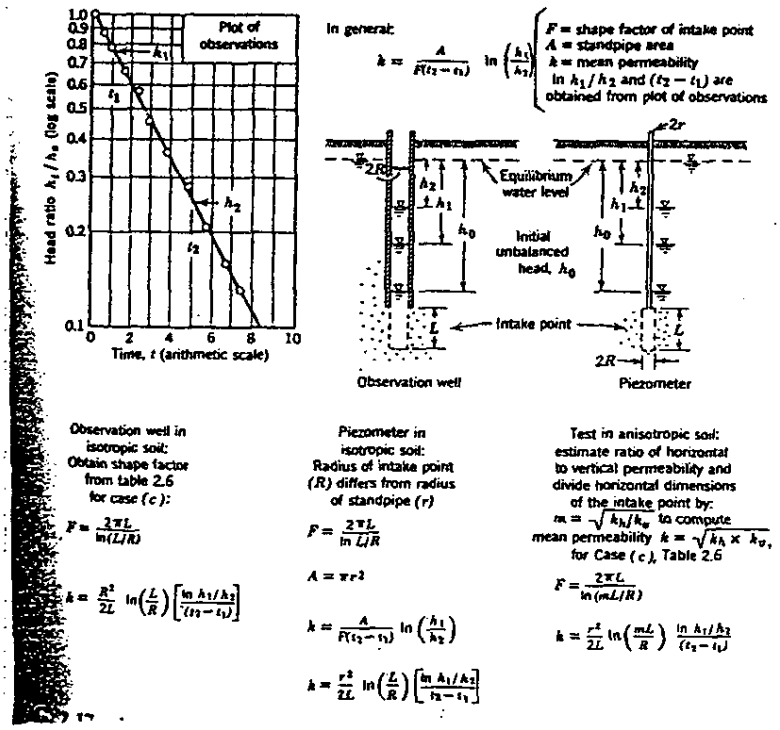
SUBJECT In-Situ Permeability Calculations Piezometers

Prepared By DGK Date 8/9/93

Reviewed By [illegible] Date 9-20-93

Approved By Date

GEOMETRY



CALCULATIONS

$$F_{6''} = \frac{2\pi L}{\ln(L/R)} = \frac{(2)(3.1415)(152.4\text{ cm})}{\ln(152.4\text{ cm}/7.62\text{ cm})} = 319.6$$

$$F_{8''} = \frac{2\pi L}{\ln(L/R)} = \frac{2(3.1415)(152.4\text{ cm})}{\ln(152.4\text{ cm}/10.16\text{ cm})} = 353.6$$

$$A = \pi r^2 = (3.1415)(1.753\text{ cm})^2 = 9.654\text{ cm}^2$$

$$K_{6''} = \frac{A}{F(t_2-t_1)} \ln\left(\frac{h_1}{h_2}\right) = \frac{9.654}{319.6(t_2-t_1)} \cdot \ln\left(\frac{h_1}{h_2}\right)$$

$$K_{8''} = \frac{A}{F(t_2-t_1)} \ln\left(\frac{h_1}{h_2}\right) = \frac{9.654}{353.6(t_2-t_1)} \cdot \ln\left(\frac{h_1}{h_2}\right)$$

RUST ENVIRONMENT & INFRASTRUCTURE — CALCULATION SHEET — PAGE 4 OF 5
PROJECT NO. 86415.300
CLIENT WHL - Magnolia Landfill — SUBJECT In-situ permeability Testing Piezometers — Prepared By ZHA Date 9-20-93
PROJECT Phase II Redesign — Reviewed By DBK Date 10/11/93
Approved By ____ Date ____

CALCULATIONS: Tabulated results for P-1, P-2, and P-3 are included in the attached tables. Graphs of h/h_0 vs Time for the three piezometers are included.
A sample calculation of the hydraulic conductivity is included herein.

The permeability corresponding to h/h_0 ranging from 0.31 to 0.1 is accepted as a practical number.

From Eq. 1 the Shape Factor, F, is defined as:

$$F = \frac{2\pi L}{\ln(L/R)}$$

where, L = screen length = 5 ft = 152.4 cm
R = Borehole Radius = 3" = 7.62 cm

$$\therefore F = \frac{2 \cdot \pi \cdot 152.4}{\ln(152.4/7.62)} = 319.64, \quad \therefore \underline{\underline{F = 319.64}}$$

From Eq. 2 the cross-sectional area of the piezometers, A, is

$$A = \pi r^2$$

where, r = inside radius of piezometer = 0.625 in = 1.588 cm

$$\therefore A = \pi \times (1.588)^2 = 7.92 \text{ cm}^2, \quad \therefore \underline{\underline{A = 7.92 \text{ cm}^2}}$$

From Eq. 3 The hydraulic conductivity, K, is defined as

$$K = \frac{A}{F(t_2 - t_1)} \cdot \ln\left(\frac{h_1}{h_2}\right)$$

where h_i = head at time t_i

From readings for piezometer P-3, we'll calculate K between 5 min & 6 min, where $h_{i,t=5min} = 5.53$ ft and $h_{i,t=6min} = 5.44$ ft

or $t_1 = 5\,min = 300\,sec$, $t_2 = 6\,min = 360\,sec$

& $h_1 = 5.53\,ft$ & $h_2 = 5.44\,ft$

$$\therefore K = \frac{7.92}{319.64(360-300)} \times \ln\left(\frac{5.53}{5.44}\right) \cong 6.80 \times 10^{-6}\ cm/sec.$$

$$\therefore \underline{\underline{K = 6.8 \times 10^{-6}\ cm/sec}}$$

CONCLUSIONS:

The coefficients of permeability were determined in three piezometers from rising head test data using the Cedergreen method. The results indicate that those materials screened and classified as very silty clays to SANDY SILTS (CL-ML) have coefficients of permeability RANGING, from 6×10^{-6} to 8×10^{-7} cm/sec.

It should be noted that the rising head test performed on P-2 was not allowed to fully recover back near the original static water level. This can be attributed to the low permeability of the soils and the time restaints of the field test. Instead of eliminating the permeability test completely, the data was reviewed and found to be consistant. A coefficient of permeability was obtained near the termination of the test (head Ratio = 81%) which was near the required head ratio of 10 to 31%.

Piezometer No.	Coff of Permeability (cm/sec)
P-1	8×10^{-7}
P-2	1×10^{-6}
P-3	6×10^{-6}

Magnolia Sanitary La - Monroe, Louisiana
Piezometer P1 - Permeability Calculations

Well Diameter, 2r (inches/cm) =	6.00	15.24	Area of borehole, A (si/scm) =	1.23	7.92	
Well Diameter, 2r (inches/cm) =	1.25	3.18	Screen Length, L (ft/cm) =	5.00	152.40	
Shape Factor, F = (2*PI*L)/Ln(L/R) =		319.64	Water Elevation Before Development (NGVD) =			53.04
TOC Elevation (ft NGVD) =		68.11	Initial head ho (ft NGVD/ft) =	48.40	4.64	

Time	Reading (ft)	Head Elevation (ft, NGVD)	Head Ratio h/ho	Equalization Ratio 1-h/ho	t1 (min)	t2 (min)	h1 (ft)	h2 (ft)	Permeabililty, k (cm/sec)
0.00	0	48.40	1.00	0.00	0	0	0	0	0.00E+00
0.10	0	48.40	1.00	0.00	0	0.1	4.64	4.64	0.00E+00
0.20	0	48.40	1.00	0.00	0.1	0.2	4.64	4.64	0.00E+00
0.30	0	48.40	1.00	0.00	0.2	0.3	4.64	4.64	0.00E+00
0.50	0	48.40	1.00	0.00	0.3	0.5	4.64	4.64	0.00E+00
0.75	0	48.40	1.00	0.00	0.5	0.75	4.64	4.64	0.00E+00
1.00	0	48.40	1.00	0.00	0.75	1	4.64	4.64	0.00E+00
1.25	0	48.40	1.00	0.00	1	1.25	4.64	4.64	0.00E+00
1.50	0	48.40	1.00	0.00	1.25	1.5	4.64	4.64	0.00E+00
1.75	0.01	48.41	1.00	0.00	1.5	1.75	4.64	4.63	3.56E-06
2.00	0.01	48.41	1.00	0.00	1.75	2	4.63	4.63	0.00E+00
3.00	0.01	48.41	1.00	0.00	2	3	4.63	4.63	0.00E+00
4.00	0.02	48.42	1.00	0.00	3	4	4.63	4.62	8.93E-07
5.00	0.03	48.43	0.99	0.01	4	5	4.62	4.61	8.95E-07
6.00	0.04	48.44	0.99	0.01	5	6	4.61	4.6	8.96E-07
7.00	0.05	48.45	0.99	0.01	6	7	4.60	4.59	8.98E-07
8.00	0.06	48.46	0.99	0.01	7	8	4.59	4.58	9.00E-07
9.00	0.07	48.47	0.98	0.02	8	9	4.58	4.57	9.02E-07
10.00	0.07	48.47	0.98	0.02	9	10	4.57	4.57	0.00E+00
20.00	0.17	48.57	0.96	0.04	10	20	4.57	4.47	9.13E-07
30.00	0.27	48.67	0.94	0.06	20	30	4.47	4.37	9.34E-07
40.00	0.36	48.76	0.92	0.08	30	40	4.37	4.28	8.59E-07
50.00	0.44	48.84	0.91	0.09	40	50	4.28	4.2	7.79E-07
60.00	0.53	48.93	0.89	0.11	50	60	4.20	4.11	8.94E-07
70.00	0.61	49.01	0.87	0.13	60	70	4.11	4.03	8.11E-07
80.00	0.68	49.08	0.85	0.15	70	80	4.03	3.96	7.23E-07
90.00	0.76	49.16	0.84	0.16	80	90	3.96	3.88	8.43E-07
100.00	0.84	49.24	0.82	0.18	90	100	3.88	3.8	8.60E-07
110.00	0.91	49.31	0.80	0.20	100	110	3.80	3.73	7.68E-07
1029.00	4.08	52.48	0.12	0.88	110	1029	3.73	0.56	8.52E-07

Magnolia Sanitary Landfill - Monroe, Louisiana
Piezometer P2 - Permeability Calculations

Well Diameter, 2r (inches/cm) =	6.00	15.24	Area of borehole, A (si/scm) =	1.23	7.92		
Well Diameter, 2r (inches/cm) =	1.25	3.18	Screen Length, L (ft/cm) =	5.00	152.40		
Shape Factor, F = (2*PI*L)/Ln(L/R) =		319.64	Water Elevation Before Development (NGVD) =				52.30
TOC Elevation (ft NGVD) =		61.77	Initial head ho (ft NGVD/ft) =	43.98	8.32		

Time	Reading (ft)	Head Elevation (ft, NGVD)	Head Ratio h/ho	Equalization Ratio 1-h/ho	t1 (min)	t2 (min)	h1 (ft)	h2 (ft)	Permeability, k (cm/sec)
0.00	0	43.98	1.00	0.00	0	0	0	0	0.00E+00
0.10	0.01	43.99	1.00	0.00	0.00	0.10	8.32	8.31	4.96E-06
0.20	0.02	44.00	1.00	0.00	0.10	0.20	8.31	8.3	4.97E-06
0.30	0.02	44.00	1.00	0.00	0.20	0.30	8.30	8.3	0.00E+00
0.50	0.02	44.00	1.00	0.00	0.30	0.50	8.30	8.3	0.00E+00
0.75	0.03	44.01	1.00	0.00	0.50	0.75	8.30	8.29	1.99E-06
1.00	0.03	44.01	1.00	0.00	0.75	1.00	8.29	8.29	0.00E+00
1.25	0.03	44.01	1.00	0.00	1.00	1.25	8.29	8.29	0.00E+00
1.50	0.04	44.02	1.00	0.00	1.25	1.50	8.29	8.28	1.99E-06
1.75	0.04	44.02	1.00	0.00	1.50	1.75	8.28	8.28	0.00E+00
2.00	0.05	44.03	0.99	0.01	1.75	2.00	8.28	8.27	2.00E-06
3.00	0.06	44.04	0.99	0.01	2.00	3.00	8.27	8.26	4.99E-07
4.00	0.08	44.06	0.99	0.01	3.00	4.00	8.26	8.24	1.00E-06
5.00	0.1	44.08	0.99	0.01	4.00	5.00	8.24	8.22	1.00E-06
6.00	0.11	44.09	0.99	0.01	5.00	6.00	8.22	8.21	5.03E-07
7.00	0.13	44.11	0.98	0.02	6.00	7.00	8.21	8.19	1.01E-06
8.00	0.14	44.12	0.98	0.02	7.00	8.00	8.19	8.18	5.04E-07
9.00	0.16	44.14	0.98	0.02	8.00	9.00	8.18	8.16	1.01E-06
10.00	0.17	44.15	0.98	0.02	9.00	10.00	8.16	8.15	5.06E-07
20.00	0.35	44.33	0.96	0.04	10.00	20.00	8.15	7.97	9.22E-07
30.00	0.54	44.52	0.94	0.06	20.00	30.00	7.97	7.78	9.96E-07
40.00	0.73	44.71	0.91	0.09	30.00	40.00	7.78	7.59	1.02E-06
50.00	0.91	44.89	0.89	0.11	40.00	50.00	7.59	7.41	9.91E-07
60.00	1.09	45.07	0.87	0.13	50.00	60.00	7.41	7.23	1.02E-06
70.00	1.26	45.24	0.85	0.15	60.00	70.00	7.23	7.06	9.82E-07
80.00	1.43	45.41	0.83	0.17	70.00	80.00	7.06	6.89	1.01E-06
90.00	1.59	45.57	0.81	0.19	80.00	90.00	6.89	6.73	9.70E-07

Magnolia Sanitary La[illegible] - Monroe, Louisiana
Piezometer P3 - Permeability Calculations

Well Diameter, 2r (inches/cm) =	6.00	15.24	Area of borehole, A (sl/scm) =	1.23	7.92	
Well Diameter, 2r (inches/cm) =	1.25	3.18	Screen Length, L (ft/cm) =	5.00	152.40	
Shape Factor, F = (2*PI*L)/Ln(L/R) =		319.64	Water Elevation Before Development (NGVD) =			52.92
TOC Elevation (ft NGVD) =		66.67	Initial head ho (ft NGVD/ft) =	46.97	5.95	

Time	Reading (ft)	Head Elevation (ft, NGVD)	Head Ratio h/ho	Equalization Ratio 1-h/ho	t1 (min)	t2 (min)	h1 (ft)	h2 (ft)	Permeabilility, k (cm/sec)
0.00	0	46.97	0.64	0.36	0	0	0	0	0.00E+00
0.10	0.01	46.98	0.64	0.36	0.00	0.10	5.95	5.94	6.94E-06
0.20	0.01	46.98	0.64	0.36	0.10	0.20	5.94	5.94	0.00E+00
0.30	0.02	46.99	0.64	0.36	0.20	0.30	5.94	5.93	6.96E-06
0.50	0.04	47.01	0.64	0.36	0.30	0.50	5.93	5.91	6.97E-06
0.75	0.06	47.03	0.63	0.37	0.50	0.75	5.91	5.89	5.60E-06
1.00	0.08	47.05	0.63	0.37	0.75	1.00	5.89	5.87	5.62E-06
1.25	0.11	47.08	0.63	0.37	1.00	1.25	5.87	5.84	8.46E-06
1.50	0.13	47.10	0.62	0.38	1.25	1.50	5.84	5.82	5.66E-06
1.75	0.15	47.12	0.62	0.38	1.50	1.75	5.82	5.8	5.68E-06
2.00	0.17	47.14	0.62	0.38	1.75	2.00	5.80	5.78	5.70E-06
3.00	0.26	47.23	0.61	0.39	2.00	3.00	5.78	5.69	6.48E-06
4.00	0.34	47.31	0.60	0.40	3.00	4.00	5.69	5.61	5.85E-06
5.00	0.42	47.39	0.59	0.41	4.00	5.00	5.61	5.53	5.93E-06
6.00	0.51	47.48	0.58	0.42	5.00	6.00	5.53	5.44	6.77E-06
7.00	0.59	47.56	0.57	0.43	6.00	7.00	5.44	5.36	6.12E-06
8.00	0.66	47.63	0.56	0.44	7.00	8.00	5.36	5.29	5.43E-06
9.00	0.75	47.72	0.55	0.45	8.00	9.00	5.29	5.2	7.08E-06
10.00	0.83	47.80	0.54	0.46	9.00	10.00	5.20	5.12	6.40E-06
20.00	1.56	48.53	0.45	0.55	10.00	20.00	5.12	4.39	6.35E-06
30.00	2.16	49.13	0.38	0.62	20.00	30.00	4.39	3.79	6.07E-06
40.00	2.68	49.65	0.32	0.68	30.00	40.00	3.79	3.27	6.09E-06
50.00	3.13	50.10	0.26	0.74	40.00	50.00	3.27	2.82	6.11E-06
60.00	3.51	50.48	0.22	0.78	50.00	60.00	2.82	2.44	5.98E-06
70.00	3.84	50.81	0.18	0.82	60.00	70.00	2.44	2.11	6.00E-06
80.00	4.11	51.08	0.15	0.85	70.00	80.00	2.11	1.84	5.65E-06
90.00	4.35	51.32	0.12	0.88	80.00	90.00	1.84	1.6	5.77E-06

Figure 1 - Piezometer P1

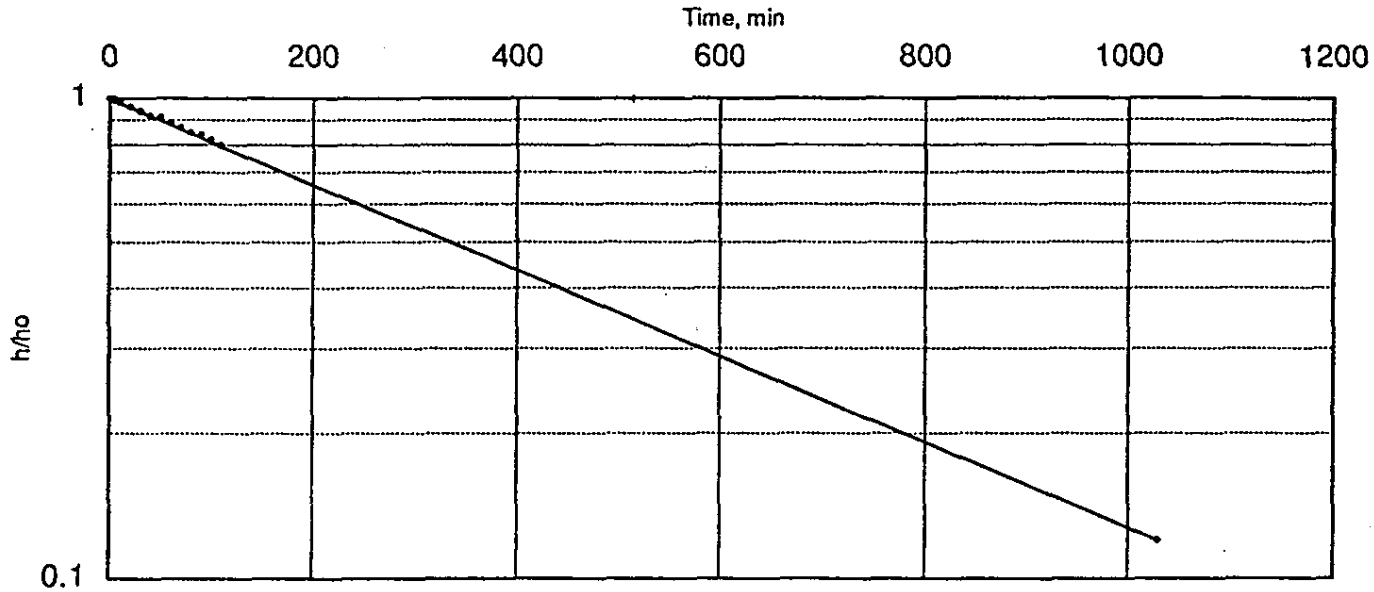


Figure 2 - Piezometer P2

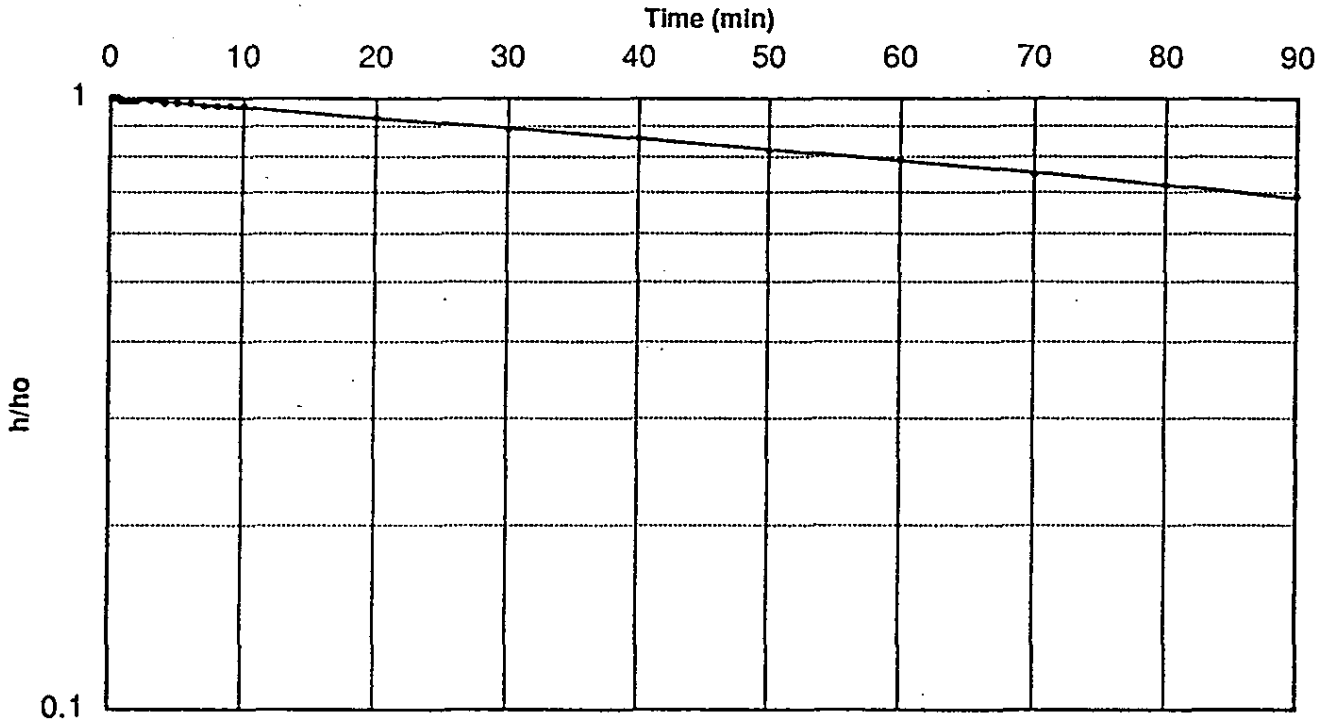
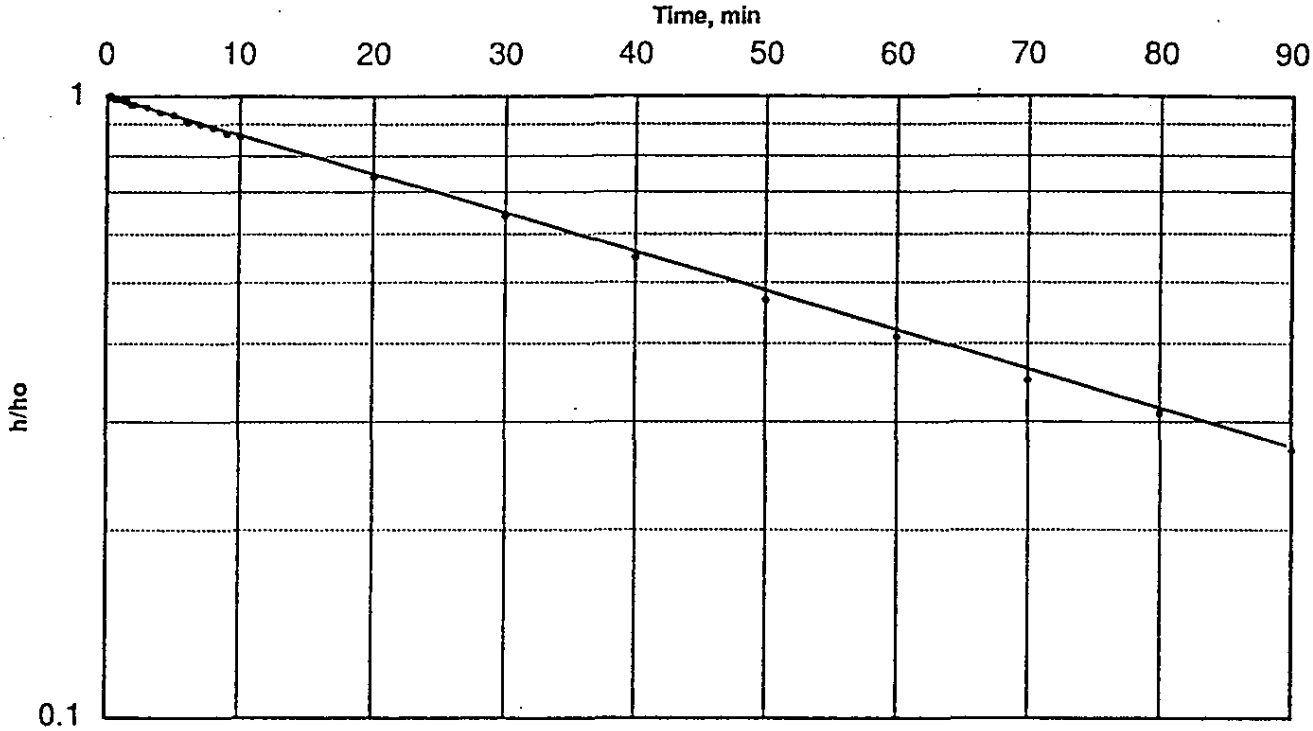


Figure 3 - Piezometer P3



RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WHI - Magnolia Landfill

SUBJECT In-situ Permeability Calculations Existing Monitoring Wells

PROJECT Phase II - Redesign

Prepared By ZHA Date 9/16/93

Reviewed By DGK Date 10/11/93

Approved By _____ Date _____

Objective: Determine the in-situ hydraulic conductivity (permeability) at monitor wells MW1, MW2 and MW5 at Magnolia landfill.

Approach: Use the modified non-equilibrium well equation (graphical solution) to calculate the transmissivity of the water bearing layer. Permeability can then be determined by dividing the transmissivity with the thickness of the water bearing layer.
This method was used because a variable head test could not be established at the wells due to fast recharge and limited capacity of the pump used.

Reference: Fletcher Driscoll
"Groundwater & Wells", Second Edition
1986, Johson Division
P. 219 - 221.

Equation 1: Transmissivity:

$$T = \frac{264\,Q}{\Delta s}$$

where: T = Transmissivity, gpd/ft
Q = Flow rate, gpm
Δs = Change in drawdown between any two times on the log scale whose ratio is 10 (one log cycle)

Equation 2: Permeability:

$$K = \frac{T}{b}$$

where: K = Permeability in cm/sec
T = Transmissivity in cm^2/sec
b = Thickness of water bearing layer in cm.

The time vs drawdown curves for MW1, MW2 and MW5 are attached.

Assumptions: Equation 1 is a modified version of Theis nonequilibrium equation which is based on the following assumptions:

1) The water bearing layer is isotropic & homogeneous.
2) Formation is uniform in thickness and infinite in areal extent
3) Formation receives no recharge from any source
4) Full well penetration.
5) Water removed is discharged instantaneously when the head is lowered
6) Well is 100 percent efficient
7) All water removed from well comes from aquifer storage.
8) Laminar flow in well & aquifer.
9) Water table or potentiometric surface has no slope.
10) The well function (U) is small. The value (U) becomes smaller as t increases and r decreases. $U < 0.05$.

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE 3 OF 7

PROJECT NO. 80415.300

CLIENT WML-Magnolia

SUBJECT In-situ Permeability Calculations Existing Monitoring Wells

Prepared By EHA Date 9/16/93

PROJECT Phase II - Redesign

Reviewed By DBK Date 10/11/93

Approved By ____ Date ____

Data

* MW1: Static water level = 14.46' TOC
TOC Elevation = 67.28' NGVD
⇒ Static water Elevation = 52.82 NGVD

Time	Water Level Reading (ft)	Water Level Elevation (ft)	Time Elapsed (min)	Drawdown (ft)
15:09	14.46	52.82	0	0
20:06	15.59	51.69	4.95	1.13
25:06	15.60	51.68	9.95	1.14
30:09	15.64	51.64	15.00	1.18
35:13	15.65	51.63	20.10	1.19
40:17	15.65	51.63	25.13	1.19

* MW2: Static water level = 14.57' TOC
TOC Elevation = 66.82' NGVD
⇒ Static Water Elevation = 52.25' NGVD

Time	Water Level Reading (ft)	Water Level Elevation (ft)	Time Elapsed (min)	Drawdown (ft)
14:15	14.57	52.25	0	0
14:21:18	15.20	51.62	6.30	0.63
14:27:33	15.35	51.47	12.55	0.78
14:33:49	15.35	51.47	18.82	0.78
14:40:12	15.33	51.49	25.20	0.76
14:46:31	15.33	51.49	31.52	0.76

* MW5: Static Water Level = 15.76' TOC = 50.13 ft NGVD
TOC Elevation = 65.89 ft-NGVD

TIME	Reading (ft)	Elevation (ft)	TIME ELAPSED (min)	Drawdown (ft
12:26:00	15.76	50.13	0	0
12:41:00	17.60	48.29	15.0	1.84

RUST ENVIRONMENT & INFRASTRUCTURE — CALCULATION SHEET

PAGE 4 OF 7
PROJECT NO. 864751800

CLIENT WML - Magnolia
SUBJECT In-situ Permeability Calculations Existing Monitoring Wells
PROJECT Phase II - Redesign

Prepared By EAA Date 9/16/93
Reviewed By DBK Date 10/12/93
Approved By ____ Date ____

Calculations:

* Conversion Factor to convert gpd/ft to $cm^3/sec/cm$

1 $$\text{Factor} = 1\,\frac{\cancel{gal}}{\cancel{day}} \times \frac{1}{\cancel{ft}} \times \frac{1\,\cancel{ft^3}}{7.48\,\cancel{gal}} \times \frac{1\,\cancel{day}}{86{,}400\,sec} \times \frac{1\,\cancel{ft}}{30.48\,cm} \times \frac{28{,}316.8\,cm^3}{\cancel{ft^3}}$$

$$\Rightarrow \text{Factor} = 0.00144\ \frac{gpd/ft}{cm^3/sec/cm}$$

* MW1

- 25 gallons pumped over 25.13 minutes

$$\Rightarrow Q = \frac{25}{25.13} = 0.995\ gpm$$

- ΔS From Graph $\Delta S = 1.60$ ft

$$- T = \frac{264\,Q}{\Delta S} = \frac{264 \times .995}{1.60} \times 0.00144 = 0.236\ cm^3/sec/cm$$

- b = Elev at top of shale - Elev top of sand

$$= 70 - 30.9 = 39.1' = 1191.8\ cm$$

$$\Rightarrow K = \frac{T}{b} = \frac{0.236}{1191.8} \cong 2.0 \times 10^{-4}\ cm/sec$$

$$\Rightarrow K = 2.0 \times 10^{-4}\ cm/sec$$

RUST ENVIRONMENT & INFRASTRUCTURE CALCULATION SHEET PAGE 5 OF 7
PROJECT NO. 86415300
CLIENT HWL - Magnolia SUBJECT In-Situ Prepared By ZHA Date 9/16/93
PROJECT Phase II - Redesign Permeability Calculations Reviewed By DBK Date 10/12/93
Existing Monitoring Wells Approved By ____ Date ____

*HW2:

- 25 gallons pumped over 31.52 minutes

$\Rightarrow Q = \frac{25}{31.52} = .793$ gpm

- From graph, $\Delta S = 0.78$ ft

- $T = \frac{264Q}{\Delta S} = \frac{264 \times .793}{.78} \times 0.00144 = 0.386$ cm³/sec/cm

- b = Elevation at top of shale - Elevation at top of sand

$= 70 - 30 = 40' = 1219.2$ cm

$\Rightarrow K = \frac{T}{b} = \frac{0.386}{1219.2} = 3.2 \times 10^{-4}$ cm/sec

$\Rightarrow K = 3.2 \times 10^{-4}$ cm/sec.

*HW5

- 5 gallons pumped over 6 minutes $\Rightarrow Q = \frac{5}{6} = .83$ gpm

- From graph, $\Delta S = 2.05$

- $T = \frac{264Q}{\Delta S} = \frac{264 \times .83}{2.05} \times .00144 = .154$ cm²/sec/cm

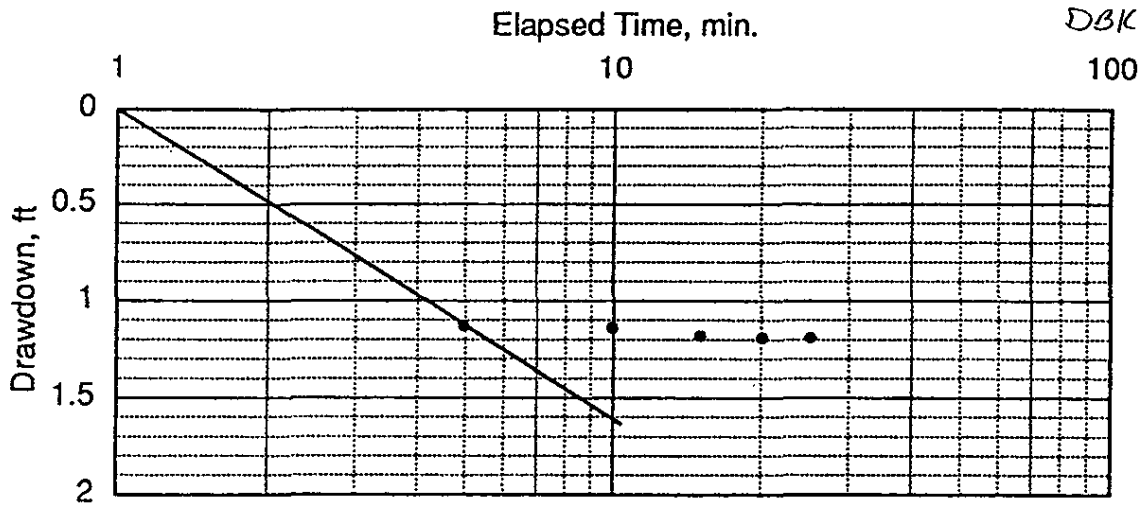
- b = Elevation at top of shales - Elevation top of sand

$= 70 - 32.5 = 37.5' = 1143$

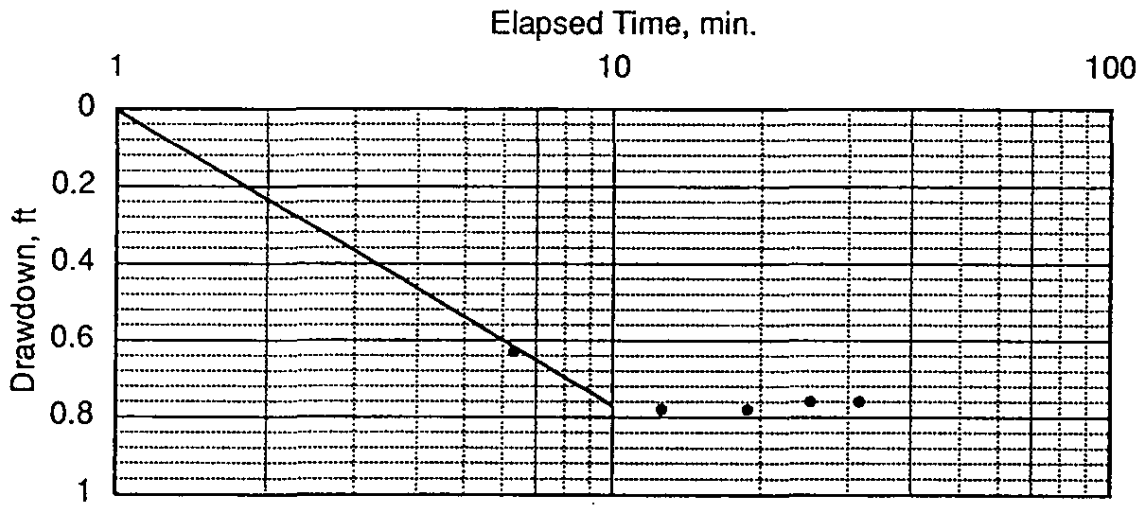
$\Rightarrow K = \frac{T}{b} = \frac{.154}{1143} = 1.3 \times 10^{-4}$ cm/sec

6 OF 7
Magnolia Landfill
Phase II - Redesign
DBK 10/12/93

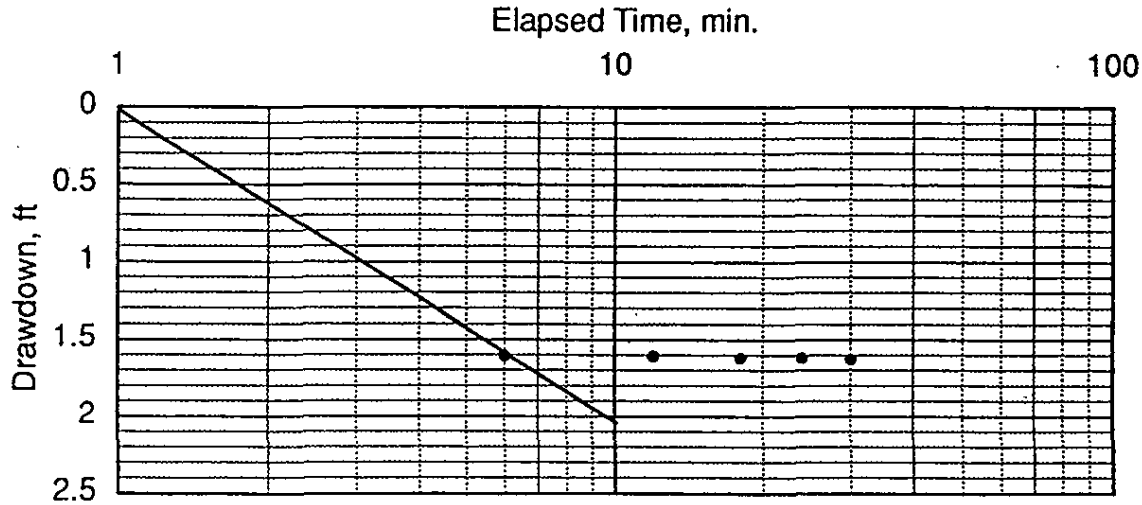
MW1



MW2



MW5



RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT WMI-Magnolia Landfill
PROJECT Phase II - Redesign

SUBJECT In-Situ Permeability Calculations Existing Monitoring Wells

Prepared By DBK Date 10/12/93
Reviewed By DBK Date 10/12/93
Approved By ____ Date ____

CONCLUSIONS: The in-situ coefficients of permeability calculated from the field pump test data ranged between 1.3 to 3.2 $\times 10^{-4}$ cm/sec. This range is considered to be slightly lower than expected and could be attributed to the limited capacity of the pump. Clean to silty sands typically have coefficients of permeability ranging between 1×10^{-2} to 1×10^{-4} cm/sec.

LINER AND GEOSYNTHETICS CALCULATIONS

ATTACHMENT D.8

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMLA

PROJECT Magnolia Landfill

SUBJECT HDPE Liner Stresses Calc

Prepared By DLS Date 2/10/03

Reviewed By _____ Date _____

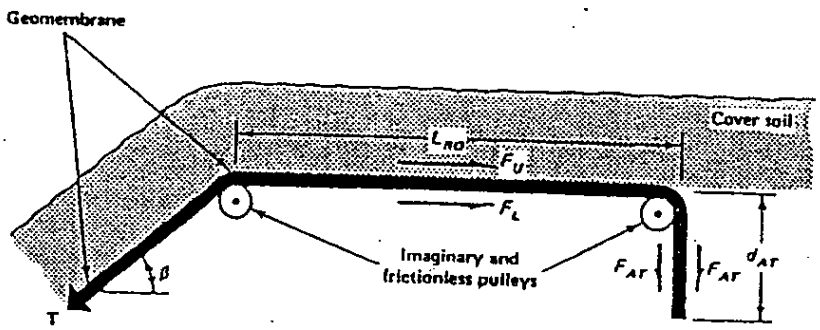
Approved By _____ Date _____

OBJECTIVE: Develope a table to determine the Liner anchor trench Depth vs Liner Runout. Trench will be a depth which will ensure liner Pullout instead of liner Failure.

REFERENCES: 1) Designing with Geosynthethics, Koerner, 2nd Edition, 1990
2). NSC Geosynthetic Technical Manual

DATA/ASSUMPTIONS
- Liner is 60 mil smooth HDPE
- Soil/Line friction angle ($\delta = 15°$)
- Soil friction ($\phi = 0°$)
- Liner placed or 3:1 slope with 2' clay cover
- F.S. = 2
- $\gamma_{clay} = 110$ pcf

$$T_{allow} = F_U + F_L + 2F_{AT} \quad \text{(Reference 1)}$$



Where:

1) T_{allow} = the $\sigma_{allow}\ t$, in which
σ_{allow} = the allowable geomembrane stress = σ_{ult}/FS,
σ_{ult} = the ultimate geomembrane stress, e.g., yield or break,
FS = the factor of safety, and
t = the geomembrane thickness;

2) F_U = the friction force above geomembrane (assumed to be negligible, since the cover soil probably moves along with the liner as it deforms);

3) $F_L = q \tan \delta\ (L_{RO})$, in which
q = the surcharge pressure = $d_{cs}\ \gamma_{cs}$,
d_{cs} = the depth of cover soil,
γ_{cs} = the unit weight of cover soil,
δ = the friction angle between geomembrane and soil, and
L_{RO} = the (unknown) length of runout; and

4) $F_{AT} = (\sigma_h)_{ave} \tan \delta\ (d_{AT})$, in which

σ_h = the average horizontal stress in anchor trench = $K_O \sigma_V$,
$\sigma_v = \gamma\ H_{ave}$,
γ = the unit weight of backfill soil,
H_{ave} = the average depth of anchor trench (requires an estimate),
$K_O = 1 - \sin \phi$,
ϕ = the angle of shearing resistance of backfill soil, and
d_{AT} = the (unknown) depth of anchor trench.

CALCULATIONS:

1) $T_{allow} = (\sigma_{allow})(t)$

$T_{allow} = \left(\frac{\sigma_{ULT}}{FS}\right)(t)$ $\sigma_{UH} = 2200$ psi (Ref 2)

CALC: (Continued)

$$t = 60 \text{ mil} \times \frac{1 \text{ in}}{0.001 \text{ mil}} = 0.06 \text{ in}$$

$$T_{allow} = \frac{2200 \text{ psi}}{2} (0.06 \text{ in})$$

$$T_{allow} = 66 \text{ lb/in} \times \frac{12 \text{ in}}{\text{ft}} = 792 \text{ lb/ft}$$

2) $F_u = 0$

3) $F_L = (q)(\tan \delta)(L_{RO})$

$F_L = (d_{cs})(\gamma_{cs})(\tan \delta)(L_{RO})$

$F_L = (2 \text{ ft})(110 \text{ pcf})(\tan 15°)(L_{RO})$

$\underline{F_L = 59 \, L_{RO}}$

4) $2 F_{AT} = [(k)(\sigma_v)(\tan \delta)(\delta_{AT})]^2$

$2 F_{AT} = [(1 - \sin \phi)(\gamma_{H\,Ave})(\tan \delta)(\delta_{AT})]^2$

$2 F_{AT} = (110)(\tfrac{1}{2} \delta_{AT})(\tan 15°)(\delta_{AT})$

$2 F_{AT} = \underline{29.5 \, \delta_{AT}^2}$

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMLA

SUBJECT

PROJECT Magnolia Landfill

HDPE Liner Stresses Calc

Prepared By DLS Date 2/10/03

Reviewed By Date

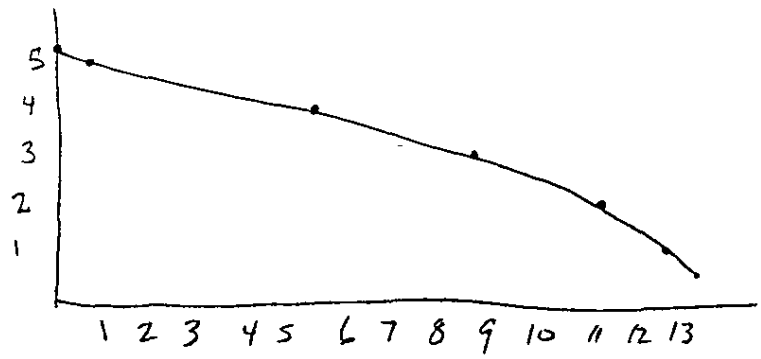
Approved By Date

$$T_{allow} = \cancel{F_u}^{\,0} + F_L + 2F_{AT}$$

$$792 \text{ lb/ft} = 59\, L_{Ro} + 29.5\, \delta_{AT}^2$$

$$L_{Ro} = \frac{792 - 29.5\, \delta_{AT}^2}{59 \ \frac{lb}{ft^2}}$$

δ_{AT}	L_{Ro}
0.5'	13.3'
1.0'	12.9'
2.0'	11.4'
3.0'	8.9'
4.0'	5.4'
5.0'	0.9'
5.2'	0'



CONCLUSION: Design of the Anchor trench and Corresponding length of runout should follow the guidlines described in the above table.

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMLA SUBJECT

PROJECT Magnolia Landfill HDPE Liner Stresses Calc.

Prepared By DLS Date 2/10/03

Reviewed By Date

Approved By Date

OBJECTIVE: Determine if the liner will pullout when subjected to maximum operational pressure (Landfill Closure)

REFERENCES: 1) Designing with Geosynthetics, Koerner, 2nd Edition, 1990
2) NSC GeoSynthetics Technical Manual

DATA/ASSUMPTIONS: To be Conservative use maximum and minimum height of Landfill
max cover height — 200'
Lowest Base Grade — 59'
difference — 141'
assume Avg γ_{AVG} = 100 pcf

max Stress at Landfill closure (141 ft)(100 pcf) = 14,100 lb/ft²

$$0.06\text{ in} \times \frac{1\text{ ft}}{12\text{ in}} = 0.005\text{ ft} \times 14{,}100 \ \frac{\text{lb}}{\text{ft}^2}$$

70.5 lb/ft (conservative)

$$\text{lb/ft} = 59\, L_{RD} + 29.5\, d_{AT}^2 \qquad \text{use } L_{RD} = 0$$

$$d_{AT} = \sqrt{\frac{70.5 - (59)(0)}{29.5}} \qquad d_{AT} = 1.55$$

$$\boxed{1.55 < 5.5}$$

CONCLUSION: operation stresses are not sufficient for Liner pullout.

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT Waste Management of LA

PROJECT Magnolia Landfill

SUBJECT Liner Leakage Calculations

Prepared By HRJ Date

Reviewed By TLR Date

Approved By Date

OBJECTIVE: Determine the anticipated leachate volume which could reasonably be expected to pass through the composite liner system designed for Magnolia Landfill, in accordance with LAC 33: VII. 521. F. 4. b.

DATA/ASSUMPTIONS:

- For expected flows, assume a hole size of $a = 3\,mm^2$ (Giroud & Bonaparte, 1989).
- Liner system consists of a 60-mil HDPE liner overlying a minimum 3 ft thick recompacted clay liner.
- The "good contact" condition is assumed, which corresponds to a geomembrane installed, with as few wrinkles as possible, on top of a low-permeability soil layer that has been adequately compacted and has a smooth surface.
- The contained liquid (leachate) is on the geomembrane side of the composite liner, at a maximum depth of 1.0 ft (305 mm).

CALCULATIONS:

The method used is that proposed by Giroud & Bonaparte, 1989, "Geotextiles and Geomembranes," as follows:

$$Q = \beta h_w^{0.9} a^{0.1} K_{soil}^{0.74}$$

; where: Q = flow rate per hole

h_w = depth of leachate (m)

a = geomembrane hole area (m)

K_{soil} = hydraulic conductivity of soil (m/sec)

β = contact factor = 0.21 for "good contact"

CLIENT Waste Management of LA SUBJECT Liner Leakage Calculations
PROJECT Magnolia Landfill

Prepared By HRJ Date
Reviewed By TRL Date
Approved By DBK Date 10-23-93

$$Q = \beta h_w^{0.9} a^{0.1} K_{soil}^{0.74}$$

$$= (0.21)(305\ mm)^{0.9}(3\ mm^2)^{0.1}(1\times10^{-6}\ mm/sec)^{0.74}$$

$$= (0.21)(172.14\ mm^{0.9})(1.12\ mm^{0.2})(0.0000363\ mm/sec^{0.74})$$

$$= 0.00147\ mm^3/sec$$

FOR A DESIGN VALUE, AN ASSUMED 5 holes/acre IS RECOMMENDED BY GIROUD & BONAPARTE. USING THIS VALUE, THE ESTIMATED LEAKAGE RATE FOR THE COMPOSITE LINER IS AS FOLLOWS:

$$Q/hole \times 5\ holes/acre \times 86{,}400\ sec/day = x\ mm^3/acre/day$$

$$0.00147\ mm^3/sec/hole \times 5\ holes/acre \times 86{,}400\ sec/day = 635\ mm^3/acre/day$$

$$0.000000635\ m^3/acre/day \times (3.28)^3\ ft^3/m^3 = 0.0000224\ ft^3/acre/day$$

$$\approx 0.000167\ gal/acre/day$$

CONCLUSION : The Leakage rate was calculated at 1.67×10^{-4} gal/acre/day, indicating that Liner Leakage is negligible and should not constitute a source of concern.

ZDA.

Sanitary Landfill Design

Section Divider

long cracks, as well as to a wide range of liquid heads on top of the composite liner.

1.2 Composite liners

A composite liner is a liner composed of a geomembrane and a layer of low-permeability soil placed in close contact with each other (Fig. 1). Composite liners are increasingly used in liquid storage and waste-containment facilities.

Leakage through a composite liner can result from flow through geomembrane defects or permeation through the geomembrane. In the case of a geomembrane defect, the rate of leakage through a composite liner is significantly less than the rate of leakage through a similar defect in a geomembrane placed on a high-permeability soil, as shown in several papers (Brown *et al.*, 1987; Jayawickrama *et al.*, 1988; Bonaparte *et al.*, 1989; Giroud & Bonaparte, 1989*b*; Giroud *et al.*, 1989). On the other hand, as discussed by Giroud and Bonaparte (1989*a*), the rate of leakage due to permeation through an intact geomembrane is not significantly different whether the geomembrane is placed on a low-permeability soil (to form a composite liner) or a high-permeability soil. In this paper, only leakage due to geomembrane defects is considered.

1.3 Flow through a composite liner with a defect in the geomembrane

In this paper, the contained liquid is assumed to be on the geomembrane side of the composite liner. If there is a defect in the geomembrane, the liquid flows first through the geomembrane defect, then laterally some distance between the geomembrane and the low-permeability soil, and

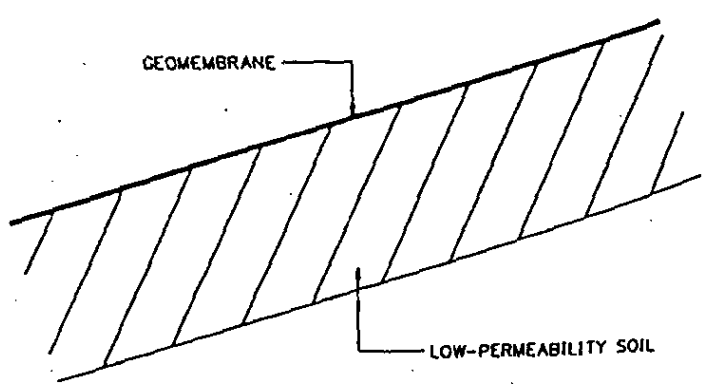


Fig. 1. Composite liner.

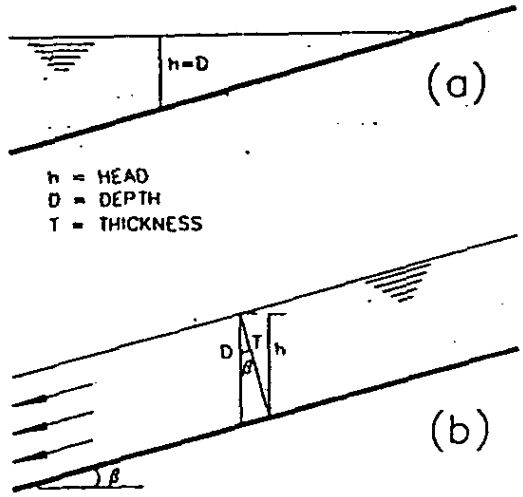


Fig. 3. Head of liquid: (a) if hydrostatic conditions prevail, the head is equal to the depth of liquid; (b) if the liquid is unconfined and flowing, the head is less than the depth of liquid and is given by eqn (1).

1.4 Organization of the paper

Section 2 presents leakage-rate equations for the case of small geomembrane defects that can be modeled by circular or square holes. These equations are derived from work previously published by the authors (Bonaparte *et al.*, 1989; Giroud & Bonaparte, 1989*b*; Giroud *et al.*, 1989). The equations given in Section 2 are only valid for rather small liquid heads.

Section 3 presents an extension of the equations given in Section 2 for cases where the liquid head on top of the geomembrane is large.

Section 4 presents the development of the method to evaluate leakage rates for the case of long geomembrane defects.

Section 5 presents the application of the method.

Finally, Section 6 presents conclusions.

1.5 Limitations of the method

Geomembranes are not absolutely impermeable and, even if the geomembrane has no defects, there is always leakage due to permeation. Rates of leakage due to permeation are usually very small. The method presented in this paper does not consider the rate of leakage due to permeation, which must therefore be added for a complete evaluation of the rate of leakage through a geomembrane liner.

h_w = head of liquid on top of the geomembrane; and k_s = hydraulic conductivity of the low-permeability soil component of the composite liner. These empirical equations are not dimensionally homogeneous and can only be used with the following units: Q(m^3/s), a(m^2), h_w(m), and k_s(m/s). The *good* and *poor* contact conditions were defined in Section 1.3. Fundamental studies leading to the above equations were conducted by Giroud and Bonaparte and first published by USEPA (1987); they were then refined and published by Giroud and Bonaparte (1989*a,b*). These studies were derived from analyses and/or laboratory tests by Faure (1979, 1984), Fukuoka (1985, 1986), Sherard (1985), Brown *et al.* (1987), and Jayawickrama *et al.* (1988).

2.2 Radius of the wetted area

Equations (2) and (3) were developed for circular holes using the assumption that the flow in the low-permeability soil layer is perpendicular to the plane of the geomembrane (i.e. the flow is vertical if the composite liner is horizontal, as in Fig. 2). It was also assumed that the hydraulic gradient in the low-permeability soil layer is equal to one, which restricts the use of eqns (2) and (3) to cases where the liquid head on top of the geomembrane (h_w) is small (theoretically zero, and, as a reasonable approximation, less than the thickness of the low-permeability soil layer). The assumption of a hydraulic gradient equal to one explains why the leakage rates given by eqns (2) and (3) do not depend on the thickness of the low-permeability soil layer.

As a result of the above assumptions, the rate of leakage through a composite liner due to a circular hole can be expressed as follows:

$$Q = \pi R^2 k_s \tag{4}$$

where R = radius of the wetted area (i.e. the area of the low-permeability soil layer where flow takes place) (Fig. 2); and k_s = hydraulic conductivity of the low-permeability soil.

Equation (4) can be equated with eqn (2) for *good* contact conditions, and with eqn (3) for *poor* contact conditions, to yield the following radii of the wetted area:

- for *good* contact conditions,

$$R = 0{\cdot}26\, a^{0{\cdot}05}\, h_w^{0{\cdot}45}\, k_s^{-0{\cdot}13} \tag{5}$$

- for *poor* contact conditions,

$$R = 0{\cdot}61\, a^{0{\cdot}05}\, h_w^{0{\cdot}45}\, k_s^{-0{\cdot}13} \tag{6}$$

where eqns (7) and (9) are related to *good* contact conditions, and eqns (8) and (10) to *poor* contact conditions. These empirical equations are not dimensionally homogeneous and can only be used with the following units: Q(m^3/s), R(m), b(m), h_w(m), and k_s(m/s).

3 EXTENSION TO LARGE LIQUID HEADS

3.1 Head of liquid on top of the low-permeability soil

Equations (2) to (10) were established assuming that the hydraulic gradient in the low-permeability soil layer is one. However, the average hydraulic gradient in the soil is always greater than one. Assuming that the flow is vertical, the average hydraulic gradient is given by

$$i = 1 + h/H_s \tag{11}$$

where h = liquid head on top of the low-permeability soil layer (i.e. in the space between the geomembrane and the low-permeability soil layer); and H_s = thickness of the low-permeability soil layer.

The head of liquid on top of the low-permeability soil layer decreases progressively from a maximum value (h_w) in the geomembrane hole area to zero at the edge of the wetted area (Fig. 4). As a result, the hydraulic gradient in the low-permeability soil varies from a maximum value under the geomembrane hole area to one at the edge of the wetted area. According to eqn (11), the maximum value is given by

$$i_{max} = 1 + h_w/H_s \tag{12}$$

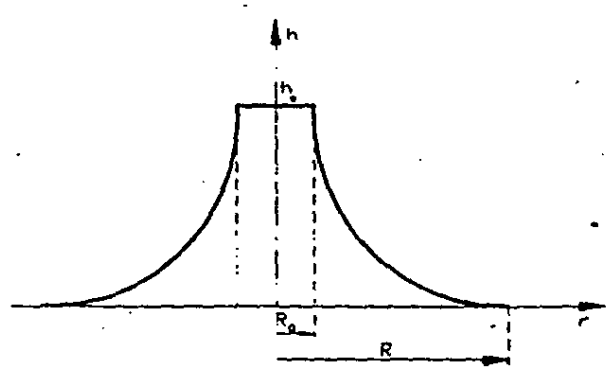


Fig. 4. Distribution of liquid head on top of the low-permeability soil. The geomembrane hole is assumed to be circular with a radius R_0, and R is the radius of the wetted area. The liquid head on top of the geomembrane (h_w) is directly applied to the soil through the geomembrane hole.

LEACHATE COLLECTION SYSTEM CALCULATIONS

ATTACHMENT D.9

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CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMLA

SUBJECT Leachate and Riser Pipe Deflection Analysis

PROJECT Magnolia Landfill

Prepared By DLS Date 5/01

Reviewed By _____ Date _____

Approved By _____ Date _____

Objective: Perform a structural analysis for the Leachate collection System for Magnolia Vertical Expansion Analysis will Check deflections for

1.) 6" ϕ PVC Sch 80 Collection Pipe;
2.) 6" ϕ PVC Sch 80 riser pipe;
3.) 18" ϕ HDPE SDR 11 riser pipe

(The Greatest Loading occurs at maximum cover for each pipe)

Assumptions:

1. Unit weights used are in accordance with Waste Management Design Requirements.

Vegetative cover	– 100 pcf
Geocomposite	– 1 pcf
Cohesive Soil	– 110 pcf
Waste	– 60 pcf
LCS Sand	– 95 pcf
Clay liner	– 110 pcf
protective Soil	– 60 pcf

2. all Loads applied perpendicular to pipes

3. Bedding material is a Coarse grained w/ little or no fines w/ a relative density between 40% and 70% (Class D)

4. No live Loads will be considered since leachate system is Complete

CLIENT WMLA
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SUBJECT Leachate and Riser Pipe Deflection Analysis

Prepared By DCS Date 5/01
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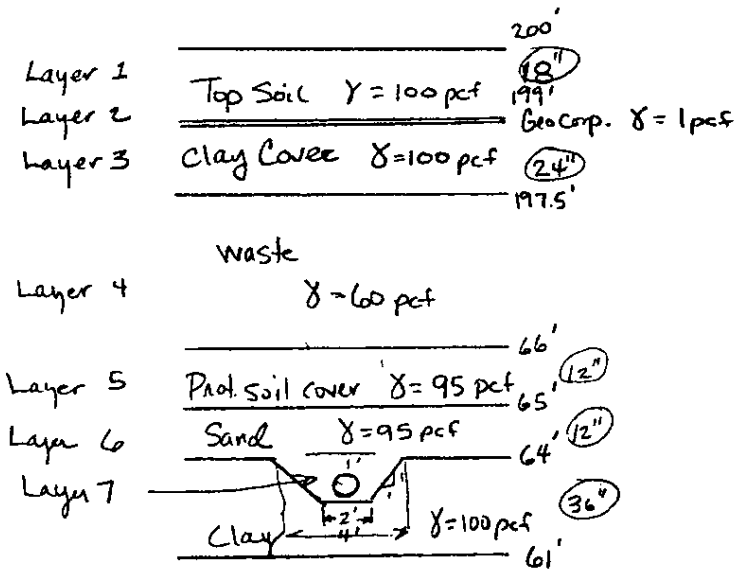
5. 5% maximum allowable cross-section deflection due to external loads, as stated in Reference 1.

Dead Load Calculation for 6" Ø Collection Pipe:



Leachate Collection Pipe Cross Section
OD = 6.625"
t = 0.432"

For Layers 1,2,3,4,5 and 6 prism loading occurs and is described as:

$W_c = H_w B_c$ (Equation 1); where W_c = earth load, lb/ft
H = fill height above pipe, ft
w = unit weight of soil, lb/ft³
B_c = outside diameter of pipe, ft

therefore

$$W_{c_1} = (1\,ft)(100\,lb/ft^3)(6.625\,in)\left(\frac{1\,ft}{12\,in}\right) = 55.2\ lb/ft$$

$$W_{c_2} = (0.22\,in)\left(\frac{1\,ft}{12\,in}\right)(1\,lb/ft^3)(6.625\,in)\left(\frac{1\,ft}{12\,in}\right) = 0.01\ lb/ft$$

$$W_{c_3} = (1.5\,ft)(110\,lb/ft^3)(6.625\,in)\left(\frac{1\,ft}{12\,in}\right) = 91.1\ lb/ft$$

$$W_{c4} = (131.5\ ft)(60\ lb/ft^3)(6.625\ in)\left(\frac{1\ ft}{12\ in}\right) = 435.60\ lb/ft$$

$$W_{c5} = (1\ ft)(60\ lb/ft^3)(6.625\ in)\left(\frac{1\ ft}{12\ in}\right) = 33.1\ lb/ft$$

$$W_{c6} = (1\ ft)(95\ lb/ft^3)(6.625\ in)\left(1\ \frac{ft}{12\ in}\right) = 52.4\ lb/ft$$

for Layer 7, the upping trench, the Marston equation is used:

$$W_c = C_d\, W\, B_d\, B_c \quad \text{(Equation 2)};$$

where W_c = earth load, lb/ft
C_d = coeff based on H (fill height above pipe ft) and B_d
B_d = ditch width at top of pipe, ft
B_c = outside diameter of pipe, ft

Further, C_d is described as:

$$C_d = \frac{1 - e^{-2K\mu' \frac{H}{B_d}}}{2K\mu'} \quad \text{(Equation 3)}$$

where $K\mu'$ = 0.1924 for the gravel till material of trench (Ref. 1, Fig. A.1 for granular materials without cohesion
H = 1 ft
B_d = 4 ft

therefore,

$$C_d = \frac{1 - e^{-2(0.1924)\left(\frac{1}{4}\right)}}{2(0.1924)} = 0.2384 \checkmark$$

It follows that,

$$W_{c_7} = (0.2384)(110\ lb/ft^3)(4\ ft)(6.625\ in.)\left(\frac{1\ ft}{12\ in}\right)$$

$$= 57.9\ lb/ft \checkmark$$

for the 6" ϕ Collection Pipe;

$$W_{c_{Total}} = W_{c_1} + W_{c_2} + W_{c_3} + W_{c_4} + W_{c_5} + W_{c_6} + W_{c_7}$$

$$= (55.2 + 0.0 + 91.1 + 4356.0 + 33.1 + 52.4 + 57.9)\ lb/ft$$

$$W_{c_{Total}} = 4{,}6457\ lb/ft \checkmark$$

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CALCULATION SHEET

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PROJECT NO. 42891

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SUBJECT Leachate and Riser Pipe deflection analysis

Prepared By DLS Date 5/01

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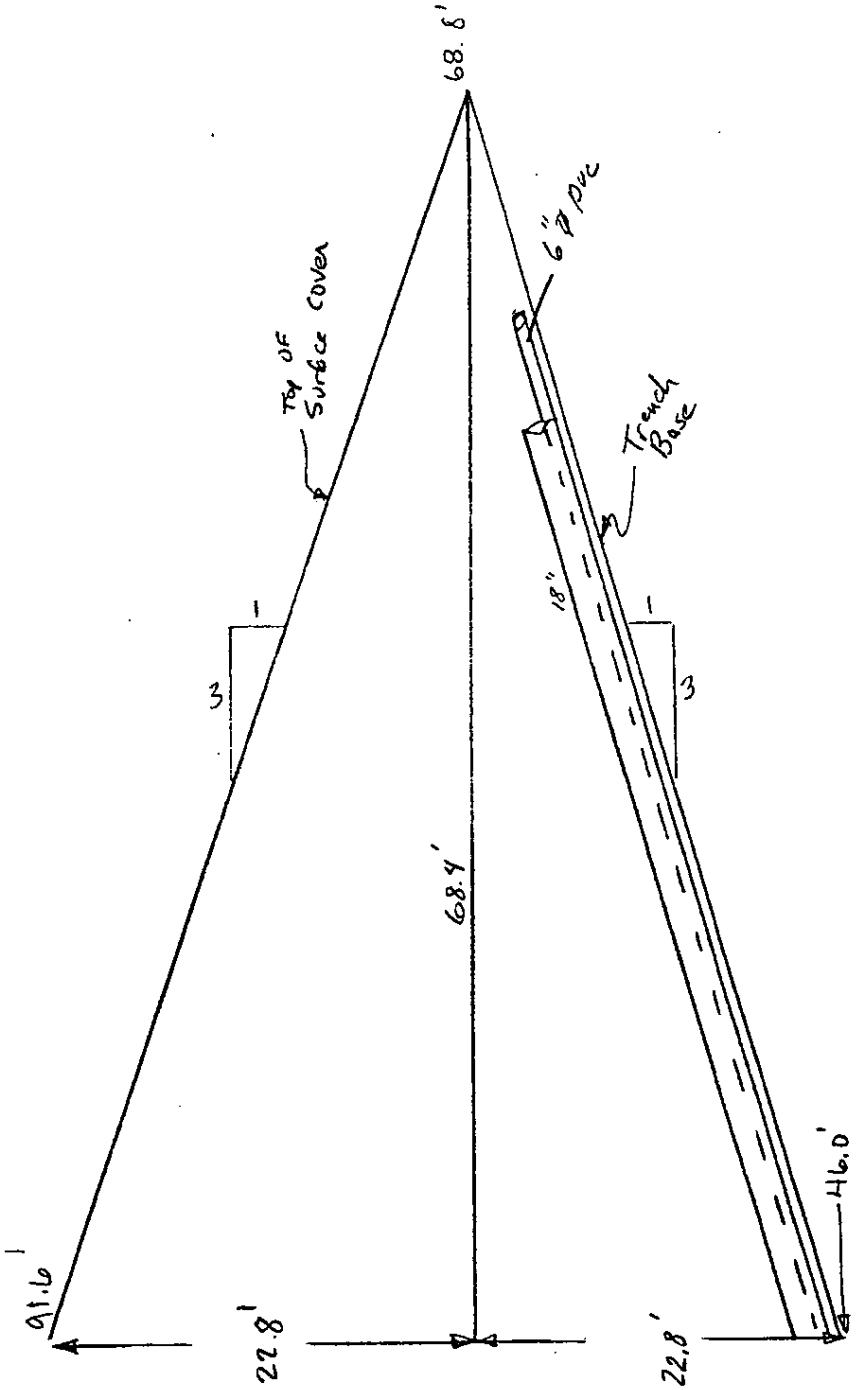

Total Height of Cover to Top of 6" ø Riser =

91.6' − 46.0' = 45.6'

PROJECT NO. 42891

CLIENT WMCA
PROJECT Magnolia Landfill

SUBJECT Leachate and Riser Pipe deflection analysis

Prepared By DLS Date 5/01
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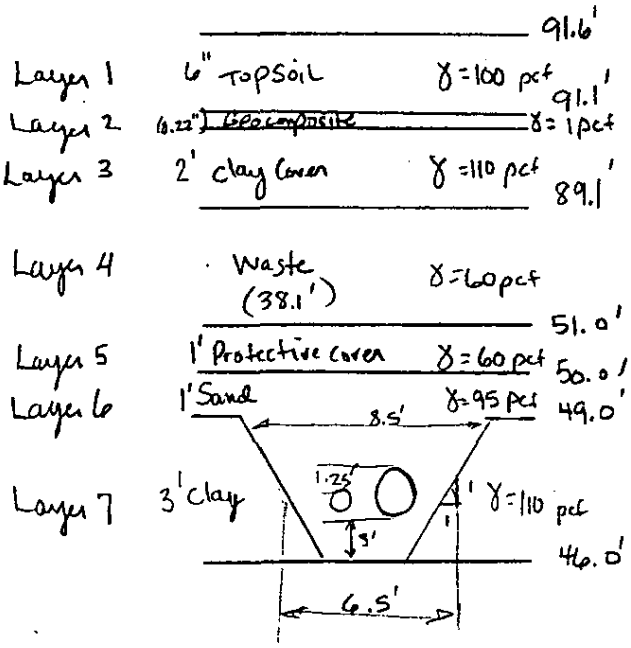
Dead Load Calculation for 6" ϕ Riser Pipe:



6" ϕ PVC and 18" ϕ HDPE Pipe Cross-Sections

6" O.D = 6.625"
t = 0.432"

18" O.D. = 18.00"
t = 1.636"

For Layers 1, 2, 3, 4, 5 and 6, Prism loading occurs and is described by Equation 1 as follows:

$$W_c = H_w B_c$$

$$W_{c1} = (0.5\,ft)(100\,lb/ft^3)(6.625\,in.)\left(\frac{1\,ft}{12\,in}\right) = 27.6\ pF$$

$$W_{c2} = (0.22\,in)\left(\frac{1\,ft}{12\,in}\right)\left(\frac{1\,lb}{ft^3}\right)(6.625\,in.)\left(\frac{1\,ft}{12\,in}\right) = 0.01\ pF$$

$$W_{c3} = (2.0\,ft)(110\,lb/ft^3)(6.625\,in)(1\,ft/12\,in) = 121.5\ pF$$

$$W_{c4} = (38.1\,ft)(60\,lb/ft^3)(6.625\,in)(1\,ft/12\,in) = 1{,}262.1\ pF$$

$$W_{c5} = (1\,ft)(60\,lb/ft^3)(6.625\,in)(1\,ft/12\,in) = 33.1\ pF$$

$$W_{c6} = (1\,ft)(95\,lb/ft^3)(6.625\,in)(1\,ft/12\,in) = 52.4\ pF$$

For Layer 7; using Equation 3, with $K_a' = 0.1924$, $H = 1.25$, and $B_d = 6.5'$

$$C_d = 1 - e^{-2K_a' \frac{H}{B_d}}$$

$$= \frac{1 - e^{-2(0.1924)\frac{1.25}{6.5}}}{2(0.1924)}$$

$$C_d = 0.1854$$

Using Equation 2,

$$W_{c_7} = C_d W B_d B_c$$

$$= (0.1854)(110\ lb/ft^3)(6.5\ ft)(6.625\ in)\left(\frac{1\ ft}{12\ in}\right)$$

$$W_{c_7} = 73.2\ lb/ft$$

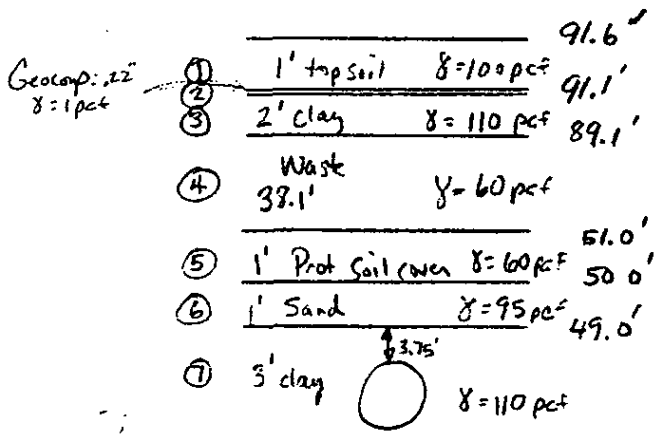
For the 6" ϕ PVC Riser Pipe

$$W_{c_{Total}} = W_{c_1} + W_{c_2} + W_{c_3} + W_{c_4} + W_{c_5} + W_{c_6} + W_{c_7}$$

$$= (27.6 + 0.0 + 121.5 + 1{,}262.1 + 33.1 + 52.4 + 73.2)\ lb/ft$$

$$W_{c_{Total}} = 1{,}569.9\ lb/ft$$

Dead Load Calculation for 18" ϕ HDPE Riser Pipe:



Note: H = 3.75 differs from the Cross-section information shown on the previous page because the location being analyzed for the 18" HDPE Pipe lines in the sump. See Cross-Section through typical sump on drawing # 9. Bd = 8.5' from the Cross-Section on the previous page because the top of the 18" pipe lies completely in the riser trench as it enters the sump.

Loading is the same for Layers 1, 2, 3, 4, 5 and 6 as calculated for the 6" ϕ riser pipe:

$W_{C_1} = 27.6$ pf
$W_{C_2} = 0.01$ pf
$W_{C_3} = 121.5$ pf
$W_{C_4} = 1{,}262.1$ pf
$W_{C_5} = 33.1$ pf
$W_{C_6} = 52.4$ pf

For Layer 7, use Equation 3, with $K\mu' = 0.1924$, $H = 3.75$ and $B_d = 8.5'$

$$C_d = \frac{1 - e^{-2(0.1924)\left(\frac{3.75}{8.5}\right)}}{2(0.1924)} = 569.1 \text{ lb/ft}$$

$$W_{C\,total} = 27.6 + 0.00 + 121.5 + 1{,}262.1 + 33.1 + 54.4 + 569.1 = 2{,}067.8 \text{ lb/ft}$$

Deflection Calculation for 6" ϕ PVC Collection Pipe:

Using Spangler's Modified formula for the deflection of a buried unpressurized tube:

$$y_v = \frac{D_L\, k\, W_c}{2E/[3(DR-1)^3] + 0.061E'} \quad \text{(Equation 4)}$$

Where y_v = Vertical deflection, in
D_L = deflection Lag factor
(1.0 for prism load Method, and 1.5 for Marston's Flexible Load Formula)
K = bedding Constant
(class D, $k = 0.110$, see Ref 1, Table A 3)
W_c = earth load on pipe = $W_c/12$, ft
DR = dimension ratio, outside diameter/wall thickness
dimensionless $(6.625/0.432) = 15.34$
E = Modulus of elasticity of pipe material
(For PVC, class 12454-A or B materials $E = 400\,000$ psi)
E' = Modulus of soil reaction (Coarse-grained soils with little or no fines, 40-70% relative density,
(see Ref 1, Table A.4, $E' = 2000$ psi)

For prism Loads in Layers 1, 2, 3, 4, 5, and 6: $D_L = 1.0$
$W_{c1-6} = 4,587.8$ lb/ft

$$y_v = \frac{(1.0)(0.110)(4,587.8\ \text{lb/ft})\left(\frac{1\ \text{ft}}{12\ \text{in}}\right)}{2(400,000\ \text{psi})/[3(15.34-1)^3] + 0.061(2000\ \text{psi})}$$

$y_v = 0.1980$ inches ✓

For Marston's formula, Layer 7:

$D_L = 1.5$

$W_{C7} = 57.9$ lb/ft

$$y_{v_m} = \frac{(1.5)(6.110)(57.9\ \text{lb/ft})\left(\frac{1\ \text{ft}}{12\ \text{in}}\right)}{2(400{,}000\ \text{psi})/[3(15.34-1)^3] + 6.061(2000\ \text{psi})}$$

$$= \frac{0.7961}{212.43}$$

$y_{v_m} = 0.0037$ inches ✓

$y_{v\ Total} = y_{v_p} + y_{v_m} = 0.1980 + 0.0037$

$y_{v\ Total} = 0.2017$ inches ✓

Deflection Calculation for 6" ϕ PVC Riser Pipe:

For Prism-loads in layers 1,2,3,4,5 and 6: $D_L = 1.0$, $W_{c_{1-6}} = 1{,}496.7$ lb/ft

Using Equation 4,

$$y_{v_p} = \frac{(1.0)(0.110)(1{,}496.7\ \text{lb/ft})\left(\frac{1\ \text{ft}}{12\ \text{in}}\right)}{2(400{,}000\ \text{psi})/\left[3[15.34-1)^3\right] + (0.061)(2000\ \text{psi})} = 0.065\ \text{inches}$$

For Marston's formula, Layer 7: $D_L = 1.5$, $W_{c_7} = 73.2$ lb/ft

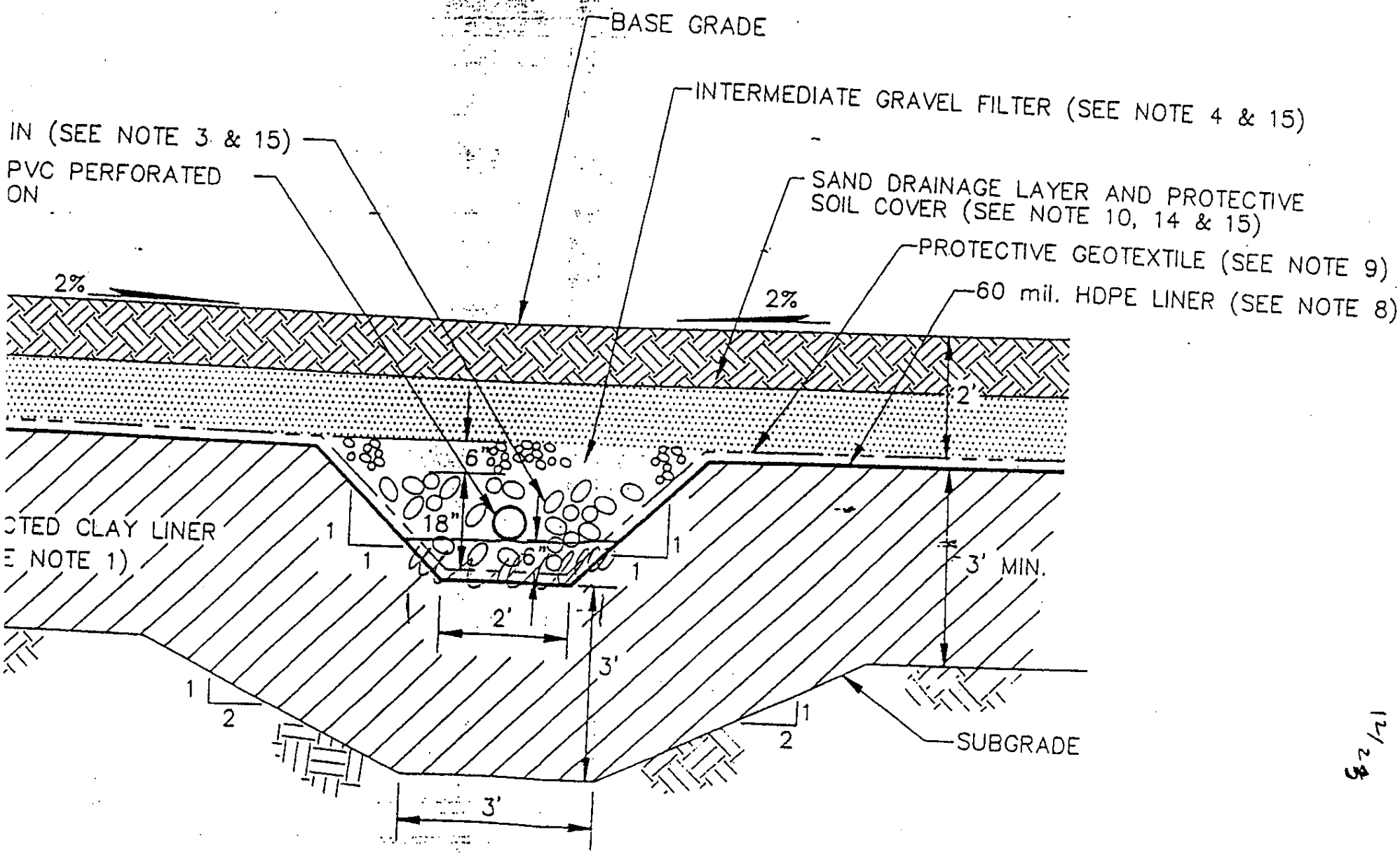
$$y_{v_m} = \frac{(1.5)(0.110)(73.2\ \text{lb/ft})\left(\frac{1\ \text{ft}}{12\ \text{in}}\right)}{2(400{,}000\ \text{psi})/\left[3(15.34-1)^3\right] + (0.061)(2000\ \text{psi})}$$

$y_{v_m} = 0.0047$ inches

$$y_{v_{Total}} = y_{v_p} + y_{v_m}$$

$$= 0.065 + 0.0047$$

$y_{v_{Total}} = 0.0697$ inches ✓


BASE GRADE
INTERMEDIATE GRAVEL FILTER (SEE NOTE 4 & 15)
IN (SEE NOTE 3 & 15)
PVC PERFORATED
ON
SAND DRAINAGE LAYER AND PROTECTIVE
SOIL COVER (SEE NOTE 10, 14 & 15)
PROTECTIVE GEOTEXTILE (SEE NOTE 9)
60 mil. HDPE LINER (SEE NOTE 8)
2%
2%
2'
6"
18"
6"
CTED CLAY LINER
E NOTE 1)
1
1
1
1
2'
3'
3' MIN.
1
2
1
2
3'
SUBGRADE

Deflection Calculation for 18" ϕ HDPE Riser Pipe:

Using Equation 4 with $SDR = \frac{18.00}{1.636} = 11.00$ $E = 30{,}000$ psi

For prism loads in Layers 1-6, DL = 1.0

$W_{c_{1-6}} = 1{,}498.7$

$$y_{v_p} = \frac{(1.0)(0.110)(1{,}498.7)\left(\frac{1}{12}\right)}{\left[2(30{,}000)/(3(11)^3\right] + 0.061(2000)} = 0.10 \text{ inches}$$

For Marston's formula, Layer 7: DL = 1.5 using equation 6

$W_c = 569.1$ lb/ft

$$y_{v_m} = \frac{(1.5)(0.110)(569.1)\left(\frac{1}{12}\right)}{\left[2(30{,}000)/3(11)^3\right] + 0.061(2000)} = 0.05712 \text{ inches}$$

$y_{v_{Total}} = y_{v_A} + y_{v_m} = 0.10 + 0.05712 = 0.1571$ inches

Structural Stability Analysis Conclusions:

As stated in the Assumptions, a 5% maximum allowable Cross Sectional deflection for external loads:

For the 6" ϕ PVC Collection and Riser Pipe;
$(6.625")(0.05) = 0.3313"$ max deflection
For the 18" ϕ HDPE Riser Pipe;
$(18.00")(0.05) = 0.900"$ max deflection

Comparisons:

For the 6" ϕ PVC Collection Pipe, the effective load bearing area is slightly reduced because of the presence of 4 3/8" drain holes per linear foot of pipe. This gives the following Safety factor:

Surface area of 1 linear foot

$$2\pi rL = 2\pi(6.625/2)(1) = 20.81 \text{ in}^2$$

Area of 4 3/8" holes:

$$4(\pi r^2) = 4\left(\pi\left(\tfrac{3}{16}\right)^2\right) = 0.44 \text{ in}^2$$

Therefore, the effective area is:

$$20.81 - 0.44 = 20.37 \text{ inches}$$

$$\frac{20.37}{20.81} = 97.9\%$$

Deflection Calculations yields 0.2017 inches $\left(\frac{97.9}{100} \times 0.3313 \text{ in}\right) = 0.324$

$0.2017 < 0.3243$ ok F.S. = 1.6

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CALCULATION SHEET

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CLIENT WMLA

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Prepared By DLS Date 5/01

Reviewed By _____ Date _____

Approved By _____ Date _____

For the 6" ϕ PVC Riser Pipe, deflection Calculations yielded 0.0697 inches

✓ 0.0697 < 0.3313 ok

For the 18" ϕ HDPE Riser Pipe, deflection Calculations yielded 0.1571 inches

✓ 0.1571 < 0.900 ok

References:

1) American Water Works Association (AWWA), c 900-89

Design Requirements

Geotechnical and hydrogeological work must be performed in accordance with Waste Management's Site Assessment Manual. Copies of this manual were distributed last week to several project managers, and a copy is in the library. Formats for forms such as boring logs and well construction diagrams are provided in the manual, and must be followed. If you have any questions concerning these requirements, see Brian Kendrick.

The design of the landfill is governed by the requirements of the Louisiana Solid Waste Rules and Regulations (LSWRR), promulgated February 20, 1993. Sections of the pertinent LSWRR are attached for your convenience. The design must also meet the requirements of WMI Environmental Directives ED-107 for landfill design and ED-108 for leachate management. Copies of these directives are also attached.

Design Values

All calculations performed by the design staff should use the following assigned values for soil, waste, and liner properties, to ensure consistency.

Strata Description	Unit Weight (pcf)	Saturated Unit Wt. (pcf)	Cohesion (psf)	Friction Angle (deg.)
Vegetative soil	100	105	0	20
Soil/geocomposite	N/A	N/A	0	18
Geocomposite	1	1	2	12
Cohesive soil	110	115	200	12
Waste	65	70	300	20
LCS sand	95	100	0	35
Geotextile/liner	N/A	N/A	0	10
Liner/clay	N/A	N/A	0	10
Clay liner	110	115	200	12

(subgrade soils to be added as soon as data is available)

Note that interface layers such as soil/geocomposite are only applicable to slope stability calculations.

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and

$$P_t = \frac{2}{\mathrm{DR} - 1} \times \frac{\mathrm{HDB}}{F}$$

Solving for DR

$$\mathrm{DR} = \left(\frac{2}{P_t} \times \frac{\mathrm{HDB}}{F}\right) + 1$$

$$= \left(\frac{2}{120} \times \frac{4000}{2.5}\right) + 1$$

$$= 27.7$$

Select available dimension ratio that is equal to or lower than

$$\mathrm{DR} = 25, \text{ PC } 100.$$

Recalculating P_s with actual t gives

$$a = 1100$$

$$P_s = 30 \text{ psi}$$

then

$$P_t = 115$$

$$\mathrm{DR} = 28.8$$

Proper design requires selection of DR 25, PC 100 C900-89 pipe.

SECTION A.4: EXTERNAL LOADS

Sec. A.4.1 Dead Loads

The earth load shall be determined using the modified Marston formula[1] for loads imparted to a flexible pipe, as follows:

$$W_c = C_d w B_d B_c \qquad \text{(Eq A.7)}$$

Where:

W_c	=	earth load, in pounds per linear foot
C_d	=	a coefficient based on type of backfill soil and on the ratio of H (depth of fill to top of pipe, in feet) to B_d (Figure A.1)
w	=	unit weight of soil, in pounds per cubic feet
B_d	=	ditch width at top of pipe, in feet
B_c	=	outside diameter of pipe, in feet

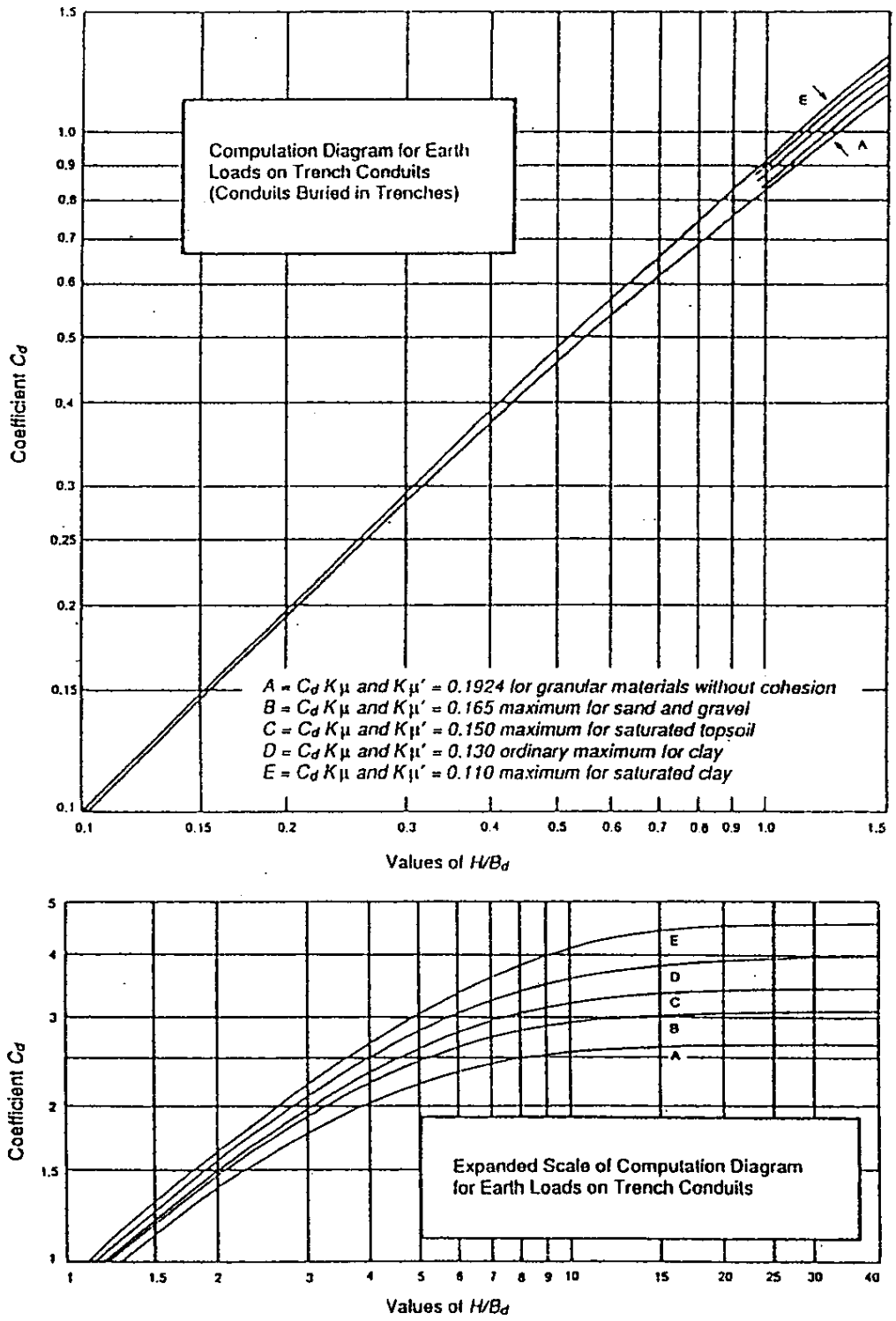

Figure A.1 Computation diagram for earth loads on trench conduits.

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Table A.2 Highway Live Loads*

Pipe Size in.	Depth of Cover—ft 2.5	3.5	5	8	12	16	20	24
	W_l—lb/lin ft							
4	297	162	81	54	40	27	18	14
6	567	324	189	94	68	40	26	20
8	783	486	297	148	94	54	36	28
10	972	621	378	189	108	68	45	35
12	1161	756	459	243	122	81	53	41

*Extracted from Table 1-8, ANSI/AWWA C101/A21.1-67 (R77), American National Standard for Thickness Design of Cast-Iron Pipe.

Sec. A.4.2 Live Loads

The live load W_l shall be determined using the modified AASHO H-20 loading as described in ANSI/AWWA C101/A21.1,[2] and listed in Table A.2. Table A.2 is based on two passing trucks with adjacent wheels 3 ft (0.9 m) apart, having a 9000-lb wheel load on unpaved road or flexible pavement, and having a 50 percent impact factor.

Sec. A.4.3 Total Load

The total load W on buried flexible pipe is as follows:

$$W = W_e + W_l \text{ (pounds per linear foot)} \qquad \text{(Eq A.8)}$$

Where:

W_e = earth load and superimposed dead load
W_l = superimposed live load

SECTION A.5: DEFLECTION

Sec. A.5.1 General

The stresses that result from internal pressure and external load are not additive in the design of a flexible conduit such as PVC pipe. Although a maximum deflection of 5 percent is specified in Sec. A.1.1.3 for a design limit, PVC pressure pipe can be deflected up to 7 1/2 percent without reducing its ability to resist internal pressure. Failure modes are discussed in Sec. A.7.

Sec. A.5.2 Design Theory—Earth Loads

Currently, the best-documented and best-known design theory for the deflection of a cylindrical horizontal tube under earth load is Spangler's modified formula[3,4] for the deflection of a buried unpressurized tube. The formula for PVC pipe is as follows:

$$y_v = \frac{D_L K W_c}{2E/[3(DR-1)^3] + 0.061E'} \qquad \text{(Eq A.9)}$$

Where:

y_v = vertical deflection of pipe, in inches
D_L = deflection lag factor (approximately 1.5)
K = bedding constant (see Table A.3, Sec. A.5.4)
W_c = earth load on pipe = $W_c / 12$, in pounds per linear inch
DR = dimension ratio
E = modulus of elasticity of pipe material (for PVC class 12454-A or class 12454-B materials, E = 400,000 psi)
E' = modulus of soil reaction (Table A.4).

Sec. A.5.3 Earth Load Plus Live Load

For inclusion of live loads, Spangler's formula must be further modified because the deflection lag factor is not applicable to live loads. The formula is as follows:

$$y_v = \frac{D_L K W_c + K W_d}{2E / [3(\mathrm{DR} - 1)^3] + 0.061 E'} \qquad \text{(Eq A.10)}$$

Where:

W_d = live load on pipe = $W_l / 12$, in pounds per linear inch

Other factors are the same as in Eq A.9.

Sec. A.5.4 Deflection Formula Factors D_L, K, and E'

The values for D_L, K, and E' corresponding to different pipe embedment conditions for use in Eq A.9 and Eq A.10 are listed in Tables A.3 and A.4.

SECTION A.6: INSTALLATION

Sec. A.6.1 Pipe Embedment

The embedment of pipe shall conform with the recommended practices given in ASTM D2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping and *PVC Pipe*.[6] Flexible pipe, unlike a rigid pipe, tends to bed itself. For flexible pipe, the most important parameters are stability of the bedding and density of the sidefills. Installation precautions are also given in ASTM 2774

Table A.3 Values for Deflection-Formula Factors

Comparable Bedding				
Class*	Laying Condition*	Field Condition	Bedding Angle	K
D	Types 1 & 2	A & B	0°	0.110
—	Type 3	—	60°±	0.102±
—	—	E & F	90°	0.096
C	—	—	96°	0.095
B	Types 4 & 5	S	180°	0.083

*As described in *Design and Construction of Sanitary and Storm Sewers*, ASCE Manual No. 37 (WPCF Manual of Practice No. 9), WPCF, ASCE, Washington, D.C. (1967).[5]

TABLE 10
VALUES FOR DEFLECTION-FORMULA FACTORS

COMPARABLE BEDDING				
Class*	Laying Conditions*	Field Condition	Bedding Angle	K
D	Types 1 and 2	A and B	0°	0.110
-	Type 3	-	60°±	0.102±
-	-	E and F	90°	0.096
C	-	-	96°	0.095
B	Types 4 and 5	S	180°	0.083

* As described in *Design and Construction of Sanitary and Storm Sewers*, ASCE Manual No. 37 (WPCF Manual of Practice No. 9), WPCF, ASCE, Washington, D.C. (1967).[5]

☼ Source of Table: ANSI/AWWA C900-89.

TABLE 2a

TYPICAL VALUES OF MODULUS OF SOIL REACTION E' FOR AVERAGE INITIAL FLEXIBLE PIPE DEFLECTION*

	E' for Degree of Compaction of Pipe Zone Backfil (psi)			
Soil Type - Pipe Zone Material (Unified Classification System†) (1)	Loose (2)	Slight, <85% Proctor, <40% Relative Density (3)	Moderate, 85-95% Proctor, 40-70% Relative Density (4)	High, >95% Proctor, >70% Relative Density (5)
Fine-grained soils (LL>50)‡ Soils with medium to high plasticity; CH, MH, CH-MH	No data available: Consult a competent soils engineer; otherwise use E' = 0			
Fine-grained soils (LL<50) Soils with medium to no plasticity; CL, ML, ML-CL, with less than 25% coarse-grained particles	50	200	400	1000
Fine-grained soils (LL<50) Soils with medium to no plasticity; CL, ML, ML-CL, with more than 25% coarse-grained particles	100	400	1000	2000
Coarse-grained soils with fines; GM, GC, SM, SC;§ contains more than 12% fines	100	400	1000	2000
Coarse-grained soils with little or no fines; GW, GP, SW, SP;§ contains less than 12% fines	200	1000	2000	3000
Crushed rock	1000	3000	3000	3000
Accuracy in terms of percentage deflection**	±2	±2	±1	±0.5

Note: Values applicable only for fills less than 50 ft (15 m). Table does not include any safety factor. For use in predicting initial deflections only, appropriate Deflection Lag Factor must be applied for long-term deflections. If bedding falls on the borderline between two compaction categories, select lower E' value or average the two values. Percentage Proctor based on laboratory maximum dry density from test standards using about 12,500 ft-lb/ft^3 (598,000 J/m^3) (ASTM D698, AASHTO T-99, USBR Designation E-11). 1 psi = 6.9 kN/m^2.

* The pipe-zone embedment conditions included in this table are not intended as installation recommendations and are provided for information only. For installation recommendations, see Sec. A.6, ANSI/AWWA C900-89.

† ASTM Designation D2487. USBR Designation E-3.

‡ LL=Liquid Limit.

§ Or any borderline soil beginning with one of these symbols (for example, GM-GC, GC-SC).

** For ±1% accuracy and predicted deflection of 3%, actual deflection would be between 2% and 4%.

¤ Source of Table: ANSI/AWWA C900-89.

. Figure

4.8 feet
oot box
of 16.9

PAGE 28/29

From Concrete Pipe Design
American Concrete Pipe Association

CHAPTER 4

LOADS AND SUPPORTING STRENGTHS

The design procedure for the selection of pipe strength requires:

1. Determination of Earth Load
2. Determination of Live Load
3. Selection of Bedding
4. Determination of Bedding Factor
5. Application of Factor of Safety
6. Selection of Pipe Strength

DETERMINATION OF EARTH LOAD

The earth load transmitted to a pipe is largely dependent on the type of installation, and the four common types are Trench, Positive Projecting Embankment, Negative Projecting Embankment and Induced Trench. Pipe are also installed by jacking or tunneling methods where deep installations are necessary or where conventional open excavation and backfill methods may not be feasible. The essential features of each of these installations are shown in Figure 146.

Trench. This type of installation is normally used in the construction of sewers, drains and water mains. The pipe is installed in a relatively narrow trench excavated in undisturbed soil and then covered with backfill extending to the ground surface.

The backfill load on pipe installed in a trench condition is computed by the equation:

$$W_d = C_d w B_d^2 \tag{5}$$

C_d is further defined as:

$$C_d = \frac{1 - e^{-2K\mu' \frac{H}{B_d}}}{2K\mu'} \tag{6}$$

POST-CLOSURE STORM WATER MANAGEMENT PLAN

ATTACHMENT D.10

CLIENT Waste Management
PROJECT Magnolia Landfill

SUBJECT Surface Water Management

Prepared By [illegible] Date 10/6/93
Reviewed By [illegible] Date 10/22/93
Approved By ____ Date ____

OBJECTIVE: Develop a surface water drainage plan to drain runoff from the closed landfill. The drainage system must be sized to accommodate the 25-year, 24-hour storm event.

ASSUMPTIONS/
DATA:

- The 25-year, 24-hour storm event for Monroe, Louisiana is 9.0 inches (See Figure B-6, attached, from Reference 1). However, LAC 33:VII requires that the drainage system be sized for a 9-inch rainfall.
- For hydrologic soil group D (silty or sandy clay loam, silty clay, or clay) and open space with over 75% grass cover, the curve number, CN = 80 (Table 2-2a, attached, from Reference 1).
- Assume ditch grade will be close to existing, minimum 0.1%. ✓
- Ditch dimensions will be calculated at the points shown on the attached Figure 1 on page 33. Routing of flow in the ditches is also shown on this figure.
- The required cross-sectional area of the ditch at designated locations will be determined based on Manning's Equation (Reference 2).
- Assume the ditches flow full and are grass-lined.
- Velocity of water in the ditches is less than 4 ft/sec (max. recommended).

DETERMINE THE TIME OF CONCENTRATION, T_c, AND TRAVEL TIME, T_t, FOR EACH DRAINAGE AREA. ASSUME SHEET FLOW FOR A MAX. OF 300 FT, FOLLOWED BY SHALLOW CONCENTRATED FLOW.

FOR SHEET FLOW: $$T_{t1} = \frac{0.007(nL)^{0.8}}{(P)^{0.5}(S)^{0.4}}$$

WHERE: T_{t1} = TRAVEL TIME (HR)

n = MANNING'S ROUGHNESS COEFFICIENT ($n = 0.20$ MEDIUM GRASS, SEE TABLE 3.1, ATTACHED)

L = FLOW LENGTH ($L = 300$ FT. (MAX))

P = 25-YEAR, 24-HOUR RAINFALL ($P = 8.0$ INCHES); (Figure B-6)

S = SLOPE OF HYDRAULIC GRADE LINE (FT/FT) 0.07, 0.10, 0.25

FOR SHALLOW CONCENTRATED FLOW AND OPEN CHANNEL FLOW: (CHUTE & DITCH)

$$T_{t2} = \frac{L}{3600V} \quad ; \quad T_{t3,4} = \frac{L}{3600V}$$

WHERE: T_{t2} = TRAVEL TIME (HR.)

L = FLOW LENGTH (FT.)

V = AVERAGE VELOCITY (FT/SEC) (SEE NOTE 1).

$$V_{(\text{OPEN CHANNEL FLOW})} = \frac{1.49\, r^{2/3} S^{1/2}}{n}$$

3600 = CONVERSION FACTOR

FOR EACH DRAINAGE AREA: $T_c = T_{t1} + T_{t2} + T_{t3}$

WHERE: T_c = TIME OF CONCENTRATION (HR.)

CLIENT Waste Management
PROJECT Magnolia Landfill

SUBJECT Surface Water Management - Time of Concentration

Prepared By [illegible] Date 10/6/93
Reviewed By [illegible] Date 10/22/93
Approved By ____ Date ____

NOTE:

1. Average velocity from Figure 3.1 attached,
   for a slope of 0.10 ft/ft, V = 5.0 ft/sec;
   for a slope of 0.25 ft/ft, V = 8.0 ft/sec; and
   for a slope of 0.07 ft/ft, V = 4.2 ft/sec.
   Slope along runoff diversion berms vary, so velocity at these locations will be determined for each case.

2. For ditch flow, initially assume a velocity of 1 ft/sec (based on little grade).

Sheet Flow:

A upper:

$$T_{t_{1_U}} = \frac{(0.007)(0.20 \times 300)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.16$$

A lower:

$$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 100)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.06$$

$$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 200)^{0.8}}{(9.0)^{0.5}\ (0.25)^{0.4}} = 0.08$$

0.14

B upper:

$$T_{t_{1_U}} = \frac{(0.007)(0.20 \times 210)^{0.8}}{(9.0)^{0.5}\ (0.07)^{0.4}} = 0.13$$

$$T_{t_{1_U}} = \frac{(0.007)(0.20 \times 90)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.06$$

0.19

B lower:

$$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 100)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.06$$

$$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 200)^{0.8}}{(9.0)^{0.5}\ (0.25)^{0.4}} = 0.08$$

0.14

C upper:

$$T_{t_{1_U}} = \frac{(0.007)(0.20 \times 210)^{0.8}}{(9.0)^{0.5}\ (0.07)^{0.4}} = 0.13$$

$$T_{t_{1_U}} = \frac{(0.007)(0.20 \times 90)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.06$$

0.19

C lower:

$$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 100)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.06$$

$$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 200)^{0.8}}{(9.0)^{0.5}\ (0.25)^{0.4}} = 0.08$$

0.14

Sheet Flow (Cont'd.):

D upper: $T_{t_{1_U}} = \frac{(0.007)(0.20 \times 170)^{0.8}}{(9.0)^{0.5}\ (0.07)^{0.4}} = 0.11$ ✓

$T_{t_{1_U}} = \frac{(0.007)(0.20 \times 130)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.08$ ✓

0.19 ✓

D lower: $T_{t_{1_L}} = \frac{(0.007)(0.20 \times 100)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.06$ ✓

$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 200)^{0.8}}{(9.0)^{0.5}\ (0.25)^{0.4}} = 0.08$ ✓

0.14 ✓

E upper: $T_{t_{1_U}} = \frac{(0.007)(0.20 \times 230)^{0.8}}{(9.0)^{0.5}\ (0.07)^{0.4}} = 0.14$ ✓

$T_{t_{1_U}} = \frac{(0.007)(0.20 \times 70)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.05$ ✓

0.19 ✓

E lower: $T_{t_{1_L}} = \frac{(0.007)(0.20 \times 90)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.06$ ✓

$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 210)^{0.8}}{(9.0)^{0.5}\ (0.25)^{0.4}} = 0.08$ ✓

0.14 ✓

F upper: $T_{t_{1_U}} = \frac{(0.007)(0.20 \times 300)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.16$ ✓

F lower: $T_{t_{1_L}} = \frac{(0.007)(0.20 \times 20)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.02$ ✓

$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 210)^{0.8}}{(9.0)^{0.5}\ (0.25)^{0.4}} = 0.08$ ✓

0.10 ✓

Sheet Flow (cont'd.)

G_{upper}: $T_{t_{1_U}} = \frac{(0.007)(0.20 \times 300)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.16$ ✓

G_{lower}: $T_{t_{1_L}} = \frac{(0.007)(0.20 \times 50)^{0.8}}{(9.0)^{0.5}\ (0.10)^{0.4}} = 0.04$ ✓

$T_{t_{1_L}} = \frac{(0.007)(0.20 \times 210)^{0.8}}{(9.0)^{0.5}\ (0.25)^{0.4}} = 0.08$ ✓

0.12 ✓

CLIENT WML

PROJECT MAGNOLIA

SUBJECT SURFACE WATER MANAGEMENT - TIME OF CONCENTRATION

Prepared By [illegible] Date 10/6/93

Reviewed By [illegible] Date 10/25/93

Approved By ____ Date ____

$T_{t_2} = \frac{L}{3600V}$

SHALLOW CONCENTRATED FLOW:

$A_{UPPER\ 10\%} = \frac{420}{3600(5)} = 0.02$ ✓ $A_{UPPER\ 5\%} = \frac{1210}{3600(3.6)} = 0.09$ ✓ $= 0.11$ ✓

$A_{LOWER\ 25\%} = \frac{30}{3600(8)} = 0.001$ ✓

$B_{UPPER\ 10\%} = \frac{700}{3600(5)} = 0.04$ ✓ $B_{UPPER\ 18\%} = \frac{120}{3600(7)} = 0.005$ ✓ $= 0.04$ ✓

$B_{LOWER\ 25\%} = \frac{30}{3600(8)} = 0.001$ ✓

$C_{UPPER\ 10\%} = \frac{700}{3600(5)} = 0.04$ ✓ $C_{UPPER\ 25\%} = \frac{60}{3600(8)} = 0.002$ ✓ $= 0.04$ ✓

$D_{UPPER\ 10\%} = \frac{620}{3600(5)} = 0.03$ ✓ $D_{UPPER\ 10\%} = \frac{490}{3600(5)} = 0.03$ ✓ $= 0.06$ ✓

$E_{UPPER\ 10\%} = \frac{730}{3600(5)} = 0.04$ ✓ $E_{UPPER\ 30\%} = 0.00$ $= 0.04$ ✓

$F_{UPPER\ 10\%} = \frac{470}{3600(5)} = 0.03$ ✓ $F_{UPPER\ 13\%} = \frac{150}{3600(5.8)} = 0.01$ ✓ $= 0.04$ ✓

$G_{UPPER\ 10\%} = \frac{450}{3600(5)} = 0.03$ ✓ $G_{UPPER\ 8\%} = \frac{600}{3600(4.6)} = 0.04$ ✓ $= 0.07$ ✓

If $S_B = 10\%$, $V = 5$ ft/sec ✓ $S_A = 5\%$, $V = 3.6$ ft/sec ✓ $S_E = 30\%$, $V = 9$ ft/sec ✓

$S = 7\%$, $V = 4.2$ ft/sec ✓ $S_B = 18\%$, $V = 7$ ft/sec ✓ $S_F = 13\%$, $V = 5.8$ ft/sec ✓

$S = 25\%$, $V = 8.0$ ft/sec $S_C = 25\%$, $V = 8$ ft/sec ✓ $S_G = 8\%$, $V = 4.6$ ft/sec ✓

Chute Flow:

A upper: $T_{t_3} = \frac{210}{3600\,(29)} = 0.00$ ✓

B upper: $T_{t_3} = \frac{230}{3600\,(29)} = 0.00$ ✓

C upper: $T_{t_3} = \frac{210}{3600\,(29)} = 0.00$ ✓

D upper: $T_{t_3} = \frac{210}{3600\,(29)} = 0.00$ ✓

E upper: $T_{t_3} = \frac{230}{3600\,(29)} = 0.00$ ✓

F upper: $T_{t_3} = \frac{240}{3600\,(29)} = 0.00$ ✓

G upper: $T_{t_3} = \frac{210}{3600\,(29)} = 0.00$ ✓

Ditch Flow:

A upper: $T_{t4} = \frac{1850}{3600\,(1)} = 0.51$ ✓

A lower: $T_{t4} = \frac{3820}{3600\,(1)} = 1.06$ ✓

B upper: $T_{t4} = \frac{700}{3600\,(1)} = 0.19$ ✓

B lower: $T_{t4} = \frac{1360}{3600\,(1)} = 0.38$ ✓

C upper: $T_{t4} = \frac{540}{3600\,(1)} = 0.15$ ✓

C lower: $T_{t4} = \frac{870}{3600\,(1)} = 0.24$ ✓

D upper: $T_{t4} = \frac{1150}{3600\,(1)} = 0.32$ ✓

D lower: $T_{t4} = \frac{2100}{3600\,(1)} = 0.58$ ✓

E lower: $T_{t4} = \frac{250}{3600\,(1)} = 0.07$ ✓

F upper: $T_{t4} = \frac{950}{3600\,(1)} = 0.26$ ✓

G upper: $\frac{1650}{3600\,(1)} = 0.46$ ✓

F lower: $T_{t4} = \frac{950}{3600\,(1)} = 0.26$ ✓

G lower: $\frac{1760}{3600\,(1)} = 0.49$ ✓

CLIENT WASTE MANAGEMENT SUBJECT SURFACE WATER MANAGEMENT - TIME OF CONCENTRATION Prepared By [illegible] Date 10/6/93

PROJECT MAGNOLIA LANDFILL Reviewed By [illegible] Date 10/25/93

Approved By ____ Date ____

THE UNIT PEAK DISCHARGE METHOD, AS DESCRIBED IN THE USDA SOIL CONSERVATION SERVICE HANDBOOK, "URBAN HYDROLOGY FOR SMALL WATERSHEDS" WILL BE USED (REF. 1).

DRAINAGE AREA	MAX. SLOPE LENGTH (FT.)	SHEET FLOW (FT.)	SHALLOW CONC. FLOW (FT.)	(CHUTES) OPEN CHANNEL FLOW (FT.)	(DITCH) OPEN CHANNEL FLOW (FT.)	SHEET FLOW T_{t1} (HR.)	SHALLOW CONC. FLOW T_{t2} (HR.)	CHUTE FLOW T_{t3} (HR.)	DITCH FLOW T_{t4}	T_c
A upper	750	300	1630	210	1850	0.16	0.11	0.00	0.51	0.78
A lower	330	300	30	—	3820	0.14	0.00	—	1.06	1.20 ←
B upper	1000	300	820	230	700	0.19	0.04	0.00	0.19	0.42
B lower	330	300	30	—	1360	0.14	0.00	—	0.38	0.52 ←
C upper	1000	300	760	210	540	0.19	0.04	0.00	0.15	0.38 ←
C lower	310	300	10	—	870	0.14	0.00	—	0.24	0.38
D upper	920	300	1110	210	1150	0.19	0.06	0.00	0.32	0.57
D lower	310	300	10	—	2100	0.14	0.00	—	0.58	0.72 ←
E upper	1040	300	730	230	—	0.19	0.04	0.00	0.00	0.23 ←
E lower	320	300	20	—	250	0.14	0.00	—	0.07	0.21
F upper	780	300	620	240	950	0.16	0.04	0.00	0.26	0.46 ←
F lower	230	230	—	—	950	0.10	0.00	—	0.26	0.36
G upper	750	300	1050	210	1650	0.16	0.07	0.00	0.46	0.69 ←
G lower	260	260	—	—	1760	0.12	0.00	—	0.49	0.61

NOTE: 1. T_c ABOVE REPRESENTS THE TIME OF CONCENTRATION WITHIN A SINGLE WATERSHED AND DOES NOT INCLUDE DOWNSTREAM TRAVEL TIME.

2. FOR CHUTE FLOW, FROM CALCULATIONS FOR CHUTE SIZING, VELOCITY FOR CHUTE CHANNELS WILL BE ≈ 29 FT/SEC.

$q_p = q_u A_m Q F_p$; where:

q_p = peak discharge (cfs)
q_u = unit peak discharge (csm/in) (see Exhibit 4-III)
A_m = drainage area (mi^2)
Q = direct runoff (in.); and
F_p = pond and swamp factor ($F_p = 1.0$)

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$; where:

$S = \frac{1000}{CN} - 10 = 2.5$ (CN = 80)
P = 25-year, 24-hour rainfall ($P = 8.0$ inches)
I_a = initial abstraction, $I_a = 0.500$ for CN=80 (Table 4-1, attached)

$$= \frac{(9.0 - 0.5)^2}{(9.0 - 0.5) + 2.5}$$

$$\boxed{Q = 6.6 \text{ inches}}$$

$I_a / P = 0.500 / 9.0 = 0.06 \sim 0.1$

CLIENT Waste Management
PROJECT Magnolia Landfill

SUBJECT Surface Water Management - Peak Discharge

Prepared By [illegible] Date 10/6/93
Reviewed By [illegible] Date 10/19/93
Approved By ____ Date ____

Areas:

A_U: 387,000 ✓
22,500 ✓
808,400 ✓
47,000 ✓
13,000 ✓
5,800 ✓
28,500 ✓
292,600 ✓
2,850 ✓
385,000 ✓
16,500 ✓
8,250 ✓
251,850 ✓
10,950 ✓ 2,280,200

A_L: 51,200 ✓
76,500 ✓
336,600 ✓
97,500 ✓
429,000 ✓
51,200 ✓ 1,042,000 ✓

B_U: 197,800 ✓
17,200 ✓
358,800 ✓
32,500 ✓
11,700 ✓
618,000

B_L: 22,400 ✓
27,500 ✓
121,000 ✓
143,000
32,500 ✓
48,000 ✓ 394,400

C_U: 2,200 ✓
136,500 ✓
14,000 ✓
174,800 ✓
7,200 ✓
15,000 ✓ 349,700

C_L: 23,250 ✓
20,000 ✓
84,000
16,000
67,200
21,700 232,150

D_U: 13,500
248,500
13,660 ✓
883,500
198,300
10,500 ✓
11,900
11,250 ✓
17,500 ✓ 1,404,050

D_L: 28,300 ✓
49,000 ✓
215,600 ✓
46,500
204,600
20,800 565,300

E_U: 153,900
3,450
149,850 ✓
17,500
42,550 367,250

E_L: 24,000 ✓
17,500
67,100 108,600

Areas:

Fu: 220,800 ✓
102,700
164,000 ✓
25,600 ✓ - 513,100

FL: 48,000 ✓
38,500 ✓
12,100 98,600

Gu: 255,500 ✓
227,500 ✓
1,400
18,250 ✓
1,250
12,000 ✓ 515,900

GL: 52,800 ✓
66,000 ✓
290,400 ✓
3,000
22,000
32,500 ✓ 466,700

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PROJECT NO. 86415.300

CLIENT Waste Management

PROJECT Magnolia Landfill

SUBJECT Surface Water Management – Peak Discharge

Prepared By [illegible] Date 10/6/93

Reviewed By [illegible] Date 10/25/93

Approved By _____ Date _____

Drainage Area	Area (FT²)	Area (mi²)	Tc through subarea (HR)	q_u (CSM/IN)	q_P/area (CFS)	q_P total (CFS)
A upper	2,280,200	0.0818 ✓	0.78	340 ✓	184	
A lower	1,042,000	0.0374 ✓	1.20	270 ✓	67	251
B upper	618,000	0.0222 ✓	0.42	425 ✓	62	
B lower	394,400	0.0141 ✓	0.52	400 ✓	37	99
C upper	349,700	0.0125 ✓	0.38	450 ✓	37	
C lower	232,150	0.0083 ✓	0.39	450 ✓	25	62
D upper	1,404,050	0.0504 ✓	0.57	380 ✓	126	
D lower	565,300	0.0203 ✓	0.72	350 ✓	47	173
E upper	367,250	0.0132 ✓	0.23	540 ✓	47	
E lower	108,600	0.0039 ✓	0.21	550 ✓	14	61
F upper	513,100	0.0184 ✓	0.46	430 ✓	52	
F lower	98,600	0.0035 ✓	0.36	460 ✓	11	63
G upper	515,900	0.0185 ✓	0.69	350 ✓	43	
G lower	466,700	0.0167 ✓	0.61	360 ✓	40	83

$\Sigma_{q_p} = 673$

$q_p \quad q_u \quad A_m \quad Q \quad F_p$

$q_{A_1} = (340)(0.0818)(6.6)(1.0) = 184$ ✓ cfs

$q_{A_L} = (270)(0.0374)(6.6)(1.0) = 67$ ✓ cfs

$q_{B_U} = (425)(0.0222)(6.6)(1.0) = 62$ ✓ cfs

$q_{B_L} = (400)(0.0141)(6.6)(1.0) = 37$ ✓ cfs

$q_{C_U} = (450)(0.0125)(6.6)(1.0) = 37$ ✓ cfs

$q_{C_L} = (450)(0.0083)(6.6)(1.0) = 25$ ✓ cfs

$q_{D_U} = (330)(0.0504)(6.6)(1.0) = 126$ ✓ cfs

$q_{D_L} = (350)(0.0203)(6.6)(1.0) = 47$ ✓ cfs

$q_{E_U} = (540)(0.0132)(6.6)(1.0) = 47$ ✓ cfs

$q_{E_L} = (550)(0.0039)(6.6)(1.0) = 14$ ✓ cfs

$q_{F_U} = (430)(0.0184)(6.6)(1.0) = 52$ ✓ cfs

$q_{F_L} = (460)(0.0035)(6.6)(1.0) = 11$ ✓ cfs

$q_{G_U} = (350)(0.0185)(6.6)(1.0) = 43$ ✓ cfs

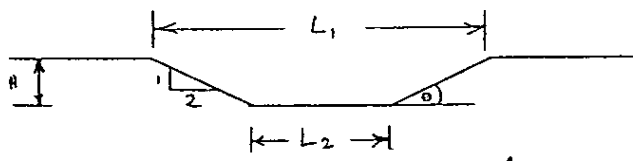
$q_{G_L} = (360)(0.0167)(6.6)(1.0) = 40$ ✓ cfs

Ditch Sizing:

Ditch dimensions will be determined for points 1 through 12, as shown on page 33, using Manning's Equation for open channel flow.

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where:
- Q = flow rate (cfs) = q_p
- n = Manning's coefficient ($n = 0.027$ for grass-lined channel, Table 3.1, page 29)
- A = cross-sectional flow area (FT^2)
- R = hydraulic radius
- S = hydraulic gradient



$d = \frac{H}{\sin\theta}$

$L_1 = L_2 + 4H$

Assuming full flow:

$$A = HL_2 + H\left(\frac{L_1 - L_2}{2}\right)$$

$$= H\left(L_2 + \frac{L_1 - L_2}{2}\right)$$

$$= H\left(\frac{L_1 + L_2}{2}\right)$$

$R = A/P_w$; where $P_w = L_2 + 2\frac{H}{\sin\theta}$

$$R = \frac{\left(\frac{L_1 + L_2}{2}\right)H}{L_2 + \frac{2H}{\sin\theta}}$$

Then, Manning's Equation is: $Q = \frac{1.49}{n}\left[\frac{L_1 + L_2}{2}(H)\right]\left[\frac{\left(\frac{L_1+L_2}{2}\right)H}{L_2 + \frac{2H}{\sin\theta}}\right]^{2/3} S^{1/2}$

- The peak flow rate, Q, will be adjusted (for additional travel time) as flow proceeds through downstream areas
- [illegible] (Table 3.1, Page 29)

Point 1: Top Elevation = 63.0' (surrounding land)
Flow, $Q_{PT1} = q_{FU} + q_{EU} = 52 + 47 = 99$ cfs ✓
Slope = 0.08% = 0.0008 ft/ft
Assume ditch height = 3.5 ft

H	L_1	L_2	$\frac{1.49}{n}$	$(\frac{L_1+L_2}{2})H$	$R^{2/3}$	$S^{1/2}$	Q	V
3.5	18.5	4.5	55.39	40.25	1.5870	0.0283	100	2.5

Therefore, use $H = 3.5'$, $L_1 = 18.5'$, $L_2 = 4.5'$ ✓
Bottom Elevation = 59.5' ✓
V = 2.5 ft/sec ✓

Point 2: Top Elevation = 63.0' (surrounding land, assumed)
Bottom Ditch Elevation = 59.1'
$S = \frac{59.5' - 59.1'}{400} = 0.001$

Top Water Elevation = 62.5'
$S = \frac{62.9' - 62.5'}{400} = 0.001$

Flow from following upstream areas:
E_{UPPER}: $0.46 + \frac{400}{(3600)(2.6)} = 0.50$ hr
$q_u = 400$ csm/in, $Q = (400 \text{ csm/in})(0.0185 \text{ mi}^2)(6.6 \text{ in}) = 49$ cfs
E_{UPPER}: $Q = (400 \text{ csm/in})(0.0133 \text{ mi}^2)(6.6 \text{ in}) = 35$ cfs ✓
E_{LOWER}: $Q = 14$ cfs
Total Flow, $Q_{PT2} = Q_{FU} + Q_{EU} + Q_{EL} = 49 + 35 + 14 = 98$ cfs ✓

H	L_1	L_2	$\frac{1.49}{n}$	$(\frac{L_1+L_2}{2})H$	$R^{2/3}$	$S^{1/2}$	Q	V
3.4	17.6	4.0	55.39	36.72	1.5415	0.0316	99	2.7

Therefore, use $H = 3.4'$, $L_1 = 17.6'$, $L_2 = 4.0'$
Bottom Elevation = 59.1' ✓
V = 2.7 ft/sec ✓

Point 3:

Top Elevation = 63.0' (surrounding land, assumed)

Bottom Ditch Elevation = 57.9' Top Water Elevation = 62.3'

$S = \frac{59.1' - 57.9'}{1160} = 0.001$ $S = \frac{62.5' - 62.3'}{1160} = 0.001$

Flow from following upstream areas:

F_{UPPER}: $0.50 + \frac{1160}{(3600)(2.8)} = 0.62$ hr

$q_v = 385$ csm/in, $Q = (385 \text{ csm/in})(0.0185 \text{ mi}^2)(6.6 \text{ in}) = 47$ cfs

E_{UPPER}: $Q = (385 \text{ csm/in})(0.0133 \text{ mi}^2)(6.6 \text{ in}) = 34$ cfs

E_{LOWER}: $0.21 + \frac{1160}{(3600)(2.8)} = 0.33$ hr

$q_v = 480$ csm/in, $Q = (480 \text{ csm/in})(0.0039 \text{ mi}^2)(6.6 \text{ in}) = 12$ cfs ✓

D_{UPPER}: $Q = 126$ cfs

$\frac{1}{2}D_{LOWER}$: $Q = 23.5$ cfs

Total Flow, $Q_{PT3} = Q_{FU} + Q_{EU} + Q_{EL} + Q_{DU} + Q_{\frac{1}{2}DL}$

$= 47 + 34 + 12 + 126 + 23.5 = 243$ cfs ✓

H	L_1	L_2	$\frac{1.49}{n}$	$\left(\frac{L_1+L_2}{2}\right)H$	$R^{2/3}$	$S^{1/2}$	Q	V
4.4	25.6'	8.0	55.39	73.92	1.9262	0.0316	249	3.4

Therefore, use $H = 4.4'$, $L_1 = 25.6'$, $L_2 = 8.0'$

Bottom Elevation = 57.9' ✓

$V = 3.4$ ft/sec ✓

Point 4:

Top Elevation = 63.0' (surrounding land, assumed)

Bottom Ditch Elevation = 56.9' Top Water Elevation = 61.3'

$S = \frac{57.9' - 56.9'}{1050} = 0.001$ $S = \frac{62.3 - 61.3}{1050} = 0.001$

Flow from following upstream areas:

F_{UPPER}: $0.62 + \frac{1050}{(3600)(3.5)} = 0.70$ hr

$q_v = 350$ csm/in, $Q = (350 \text{ csm/in})(0.0185 \text{ mi}^2)(6.6 \text{ in}) = 43$ cfs ✓

E_{UPPER}: $(350 \text{ csm/in})(0.0132 \text{ mi}^2)(6.6 \text{ in}) = 31$ cfs ✓

E_{LOWER}: $0.33 + \frac{1050}{(3600)(3.5)} = 0.41$ hr ✓

$q_v = 450$ csm/in, $Q = (450 \text{ csm/in})(0.0039 \text{ mi}^2)(6.6 \text{ in}) = 12$ cfs ✓

D_{UPPER}: $0.58 + \frac{1050}{(3600)(3.5)} = 0.66$ hr

$\frac{1}{2}$ D LOWER: $0.73 + \frac{1050}{(3600)(3.5)} = 0.81$ hr

$q_v = 335$ csm/in, $Q = (335 \text{ csm/in})(0.0102 \text{ mi}^2)(6.6 \text{ in}) = 22$ cfs

$\frac{1}{2}$ D LOWER: $Q = 23.5$ cfs

Total Flow, $Q_{PT4} = Q_{FU} + Q_{EU} + Q_{EL} + Q_{DU} + Q_{\frac{1}{2}DL} + Q_{\frac{1}{2}DL}$

$= 43 + 31 + 12 + 120 + 22 + 23.5$

$= 251$ cfs

H	L_1	L_2	$\frac{1.49}{n}$	$\left(\frac{L_1+L_2}{2}\right)H$	$R^{2/3}$	$S^{1/2}$	Q	V
4.4	26.6	9	55.39	78.32	1.9550	0.0316	268	3.4

Therefore, use $H = 4.4'$, $L_1 = 26.6'$, $L_2 = 9'$

Bottom Elevation = 56.9'

V = 3.4 ft/sec

Point 5: Top Elevation = 63.0' (surrounding land assumed)

Bottom Ditch Elevation = 56.4' Top Water Elevation = 61.0'

$S = \frac{56.9' - 56.4'}{550} = 0.001$ $S = \frac{61.3 - 61.0'}{550} = 0.0001$

Flow from following upstream areas:

F upper: $0.70 + \frac{550}{(3600)(3.5)} = 0.74$ hr

$q_v = 340$ csm/in, $Q = (340 \text{ csm/in})(0.0185 \text{ mi}^2)(6.6 \text{ in}) = 42$ cfs

E upper: $Q = (340 \text{ csm/in})(0.0133 \text{ mi}^2)(6.6 \text{ in}) = 30$ cfs

E lower: 0.41 hr $+ \frac{550}{(3600)(3.5)} = 0.45$ hr

$q_v = 425$ csm/in, $Q = (425 \text{ csm/in})(0.0039 \text{ mi}^2)(6.6 \text{ in}) = 11$ cfs

D upper: $0.66 + \frac{550}{(3600)(3.5)} = 0.70$ hr

$q_v = 350$ csm/in, $Q = (350 \text{ csm/in})(0.0484 \text{ mi}^2)(6.6 \text{ in}) = 112$ cfs

$\frac{1}{2}$ D lower: $0.81 + \frac{550}{(3600)(3.5)} = 0.85$ hr

$q_v = 325$ csm/in, $Q = (325 \text{ csm/in})(0.0108 \text{ mi}^2)(6.6 \text{ in}) = 23$ cfs

$\frac{1}{2}$ D lower: $0.73 + \frac{550}{(3600)(3.5)} = 0.77$ hr

$q_v = 345$ csm/in, $Q = (345 \text{ csm/in})(0.0108 \text{ mi}^2)(6.6 \text{ in}) = 25$ cfs

C upper: $Q = 37$ cfs

$\frac{1}{2}$ C lower: $Q = 12.5$ cfs

CLIENT WML
PROJECT MAGNOLIA

SUBJECT SURFACE WATER - DITCH SIZING

Prepared By [illegible] Date 10/6/93
Reviewed By [illegible] Date 10/29/93
Approved By ____ Date ____

Total Flow, $Q_{PTS} = Q_{FU} + Q_{EU} + Q_{EL} + Q_{DU} + Q_{DL} + Q_{CU} + Q_{\frac{1}{2}CL}$

$= 42 + 30 + 11 + 112 + 23 + 25 + 37 + 12.5$

$= 293$ cfs ✓

H	L_1	L_2	$\frac{1.49}{n}$	$\left(\frac{L_1+L_2}{2}\right)H$	$R^{2/3}$	$S^{1/2}$	Q	V
4.6	28.4	10.0	55.39	88.32	2.0296	0.0316	314	3.6

Therefore, use $H = 4.6'$, $L_1 = 28.4'$, $L_2 = 10.0'$
Bottom Elevation = 56.4' ✓
$V = 3.6$ ft/sec ✓

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

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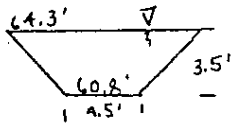
CLIENT Waste Management SUBJECT Surface Water Management - Ditch Sizing
PROJECT Magnolia Landfill

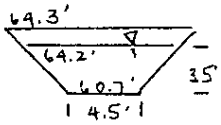
Prepared By [illegible] Date 10/6/93
Reviewed By [illegible] Date 10/29/93
Approved By ____ Date ____

Point 12: Top Elevation = 64.3 ft (surrounding land)



Flow, Q = 0 cfs Bottom Elevation = 60.7 ft
Assume slope, S = 0.1 = 0.0004 ft/ft
Assume ditch height, H = 3.5 ft, L_1 = 18.5 ft L_2 = 4.5 ft

Point 11: Top Elevation = 64.3 ft (surrounding land, assumed)



Ditch Bottom Elevation = 60.8 ft ; Water Top Elevation = 64.2'

$S_B = \frac{60.8 - 60.7}{350} = 0.0003$; $S_T = \frac{64.3 - 64.2'}{350} = 0.0004$

Flow from upstream areas:

$G_{1/5\,LOWER}$: Q = 8 cfs H = 1.6'

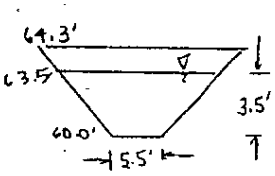
G_{UPPER} : Q = 43 cfs

Total Flow, $Q_{PT.11} = Q_{GL} + Q_{GU} = 8 + 43 = 51$ cfs ✓

H	L_1	L_2	$\frac{1.49}{n}$	$\left(\frac{L_1+L_2}{2}\right)H$	$\left[\frac{\left(\frac{L_1+L_2}{2}\right)H}{L_2 + 2H/\sqrt{2}}\right]^{2/3}$	$S^{1/2}$	Q (cfs)
3.5	18.5	4.5	55.39	40.25	1.5870	0.0173	61

Therefore, use H = 3.5 ft, L_1 = 18.5 ft L_2 = 4.5 ft
Bottom Elevation = 60.7' ✓
$V = \left(\frac{1.49}{n}\right)(R^{2/3})(S^{1/2}) = 1.5$ ft/sec ✓

Point 10: Top Elevation = 64.3 ft (surrounding land, assumed)



Ditch Bottom Elevation = 60.0' Top Water Elevation = 63.5 ft

$S = \frac{60.7' - 60.0'}{1650} = 0.0004$ $S = \frac{64.2' - 63.5'}{1650} = 0.0004$

Flow from upstream areas:

$G_{1/5\,LOWER}$: $Q = 0.61 + \frac{1650}{(3600)(2.5)} = 0.79$ hr ✓

q_u = 335 csm/in; Q = (335)(0.0033)(6.6) = 7 cfs ✓

G_{UPPER} : $Q = 0.68 + \frac{1650}{(3600)(2.5)} = 0.86$ hr ✓

q_u = 330 csm/in; Q = (330)(0.0184)(6.6) = 40 cfs ✓

$G_{4/5\,LOWER}$: Q = 32 cfs

Total Flow, $Q_{PT10} = Q_{GL} + Q_{GU} = (32 + 7) + 40 = 79$ cfs ✓

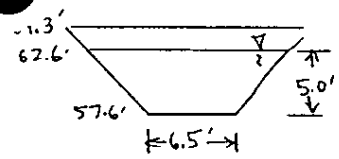
H	L_1	L_2	$\frac{1.49}{n}$	$(\frac{L_1+L_2}{2})H$	$R^{2/3}$	$S^{1/2}$	Q (cfs)
3.5	19.5	5.5	55.39	43.75	1.6244	0.02	79

Therefore, use $H = 3.5'$, $L_1 = 19.5'$, $L_2 = 5.5'$
Bottom Elevation = 60.0'
$V = (\frac{1.49}{n})(R^{2/3})(S^{1/2}) = 1.8$ ft/sec ✓

Point 9: Top Elevation = 64.3 ft (surrounding land, assume)
Ditch Bottom Elevation = 57.6' Water Top Elevation = 62.6'

$S = \frac{60.0' - 57.6'}{2300} = 0.001$; $S = \frac{63.5 - 62.6'}{2300} = 0.0004$

Flow from upstream areas:



G 1/3 LOWER : $0.79\ hr + \frac{2300}{(3600)(2.5)} = 1.04\ hr$ ✓
$q_u = 300$ csm/in ; $Q = (300)(0.0033)(6.6) = 7$ cfs ✓

G UPPER : $0.86\ hr + \frac{2300}{(3600)(2.5)} = 1.11\ hr$ ✓
$q_u = 280$ csm/in ; $Q = (280)(0.0184)(6.6) = 34$ cfs ✓

G 4/5 LOWER : $0.61\ hr + \frac{2300}{(3600)(2.5)} = 0.87\ hr$ ✓
$q_u = 340$ csm/in ; $Q = (340)(0.0132)(6.6) = 30$ cfs ✓

A UPPER : Q = 184 cfs
A 1/2 LOWER : Q = 33.5 cfs

Total Flow, $Q_{PT9} = Q_{G1/3L} + Q_{G_U} + Q_{G4/5L} + Q_{A_{2L}} + Q_{A_L}$
$= 7 + 34 + 30 + 184 + 33.5 = 289$ cfs ✓

H	L_1	L_2	$\frac{1.49}{n}$	$(\frac{L_1+L_2}{2})H$	$R^{2/3}$	$S^{1/2}$	Q
5	26.5	6.5	55.39	82.50	2.0155	0.036	291

Therefore, use $H = 5$ ft, $L_1 = 26.5$ ft, $L_2 = 6.5$ ft
Bottom Elevation = 57.6 ft
$V = (\frac{1.49}{n})(R^{2/3})(S^{1/2}) = 3.5$ ft/sec ✓

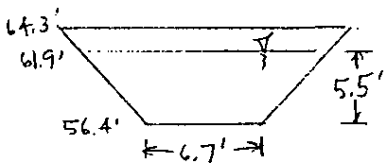
CLIENT Waste Management SUBJECT Surface Water Management - Ditch Sizing
PROJECT Magnolia Landfill

Prepared By [illegible] Date 10/6/93
Reviewed By [illegible] Date 11/01/93
Approved By ____ Date ____

Point 8: Top Elevation = 64.3 ft (surrounding land, assume)
Ditch Bottom Elevation = 56.4' Top Water Elevation = 61.9'

$S = \frac{57.6' - 56.4'}{1850} = 0.0006$ $S = \frac{62.6 - 61.9'}{1850} = 0.0004$

Flow from upstream area:



G 1/5 LOWER: $1.04\ hr + \frac{1850}{(3600)(3.4)} = 1.19\ hr$

$q_u = 275$ csm/in ; $Q = (275)(0.0033)(6.6) = 6$ cfs

G UPPER: $1.11\ hr + \frac{1850}{(3600)(3.4)} = 1.26\ hr$

$q_u = 260$ csm/in ; $Q = (260)(0.0184)(6.6) = 32$ cfs

G 4/5 LOWER: $0.87\ hr + \frac{1850}{(3600)(3.4)} = 1.02\ hr$

$q_u = 300$ csm/in ; $Q = (300)(0.0132)(6.6) = 26$ cfs

A UPPER: $0.76\ hr + \frac{1850}{(3600)(3.4)} = 0.91\ hr$

$q_u = 315$ csm/in ; $Q = (315)(0.0735)(6.6) = 153$ cfs

A 1/2 LOWER: $1.21\ hr + \frac{1850}{(3600)(3.4)} = 1.36\ hr$

$q_u = 250$ csm/in ; $Q = (250)(0.0187)(6.6) = 31$ cfs

A 1/2 LOWER: $Q = 33.5$ cfs

Total Flow, $Q_{PT.8} = Q_{G1/5L} + Q_{GU} + Q_{G4/5L} + Q_{AU} + Q_{A1/2L} + Q_{A1/2L}$
$= 6 + 32 + 26 + 153 + 31 + 33.5 = 282$ cfs

H	L_1	L_2	$\frac{1.49}{n}$	$(\frac{L_1+L_2}{2})H$	$R^{2/3}$	$S^{1/2}$	Q
5.5	28.7	6.7	55.39	97.35	2.1323	0.0245	282

Therefore, use H = 5.5 ft, L_1 = 28.7 ft, L_2 = 6.7 ft
Bottom Elevation = 56.4' ft
V = 2.9 ft/sec

Point 7: Top Elevation = 64.3 ft (surrounding land, assume)
Ditch Bottom Elevation = 56.0 ft Water Top Elevation = 61.5'

$S = \frac{56.4' - 56.0'}{960} = 0.0004$ $S = \frac{61.9' - 61.5'}{960} = 0.0004$

Flow from upstream area:

G 1/5 LOWER: $1.19\ hr + \frac{960}{(3600)(3.9)} = 1.3\ hr$

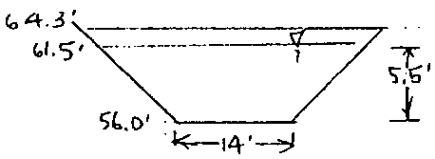
$q_u = 260$ csm/in ; $Q = (260)(0.0033)(6.6) = 6$ cfs

G UPPER: $1.26\ hr + \frac{960}{(3600)(3.9)} = 1.3\ hr$

$q_u = 260$ csm/in ; $Q = (260)(0.0184)(6.6) = 32$ cfs

G 4/5 LOWER: $1.02\ hr + \frac{960}{(3600)(3.9)} = 1.1\ hr$

$q_u = 280$ csm/in ; $Q = (280)(0.0132)(6.6) = 24$ cfs



A UPPER: $0.91\ hr + \frac{960}{(3600)(3.9)} = 0.98\ hr$

$q_u = 300$ csm/in ; $Q = (300)(0.0735)(6.6) = 146$ cfs

A ½ LOWER: $1.36\ hr + \frac{960}{(3600)(3.9)} = 1.42\ hr$

$q_u = 240$ csm/in ; $Q = (240)(0.0187)(6.6) = 30$ cfs

A ½ LOWER: $1.21\ hr + \frac{960}{(3600)(3.9)} = 1.28\ hr$

$q_u = 270$ csm/in ; $Q = (270)(0.0187)(6.6) = 33$ cfs

B UPPER: $Q = 62$ cfs

B ½ LOWER: $Q = 135$ cfs

Total Flow, $Q_{PT7} = Q_{G\,1/5L} + Q_{G\,U} + Q_{G\,4/5L} + Q_{A\,U} + Q_{A\,1/2L} + Q_{A\,1/2L} + Q_{B\,U} + Q_{B\,1/2L}$

$= 6 + 32 + 24 + 146 + 30 + 33 + 62 + 18.5$

$= 352$ cfs

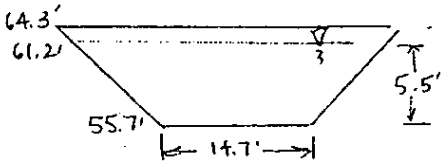
H	L_1	L_2	$\frac{1.49}{n}$	$\left(\frac{L_1+L_2}{2}\right)H$	$R^{2/3}$	$S^{1/2}$	Q
5.5	36	14	55.39	137.50	2.3339	0.02	356

Therefore, use H = 5.5 ft, L_1 = 36 ft, L_2 = 14 ft
Bottom Elevation = 56.0 ft
V = 2.6 ft/sec

Point 6: Top Elevation = 64.3 ft (surrounding land, assume)
Ditch Bottom Elevation = 55.7' ft ; Water Top Elevation = 61.2'

$S = \frac{56.0 - 55.7'}{700} = 0.0004$ $S = \frac{61.5 - 61.2'}{700} = 0.0004$

Flow from upstream areas:



G 1/2 LOWER: $1.3\,hr + \frac{700}{(3600)(4.3)} = 1.3\,hr$ ✓
$q = 260$ csm/in ; $Q = (260)(0.0033)(6.6) = 6$ cfs ✓

G UPPER: $1.3\,hr + \frac{700}{(3600)(4.3)} = 1.3\,hr$ ✓
$q = 260$ csm/in ; $Q = (260)(0.0184)(6.6) = 32$ cfs ✓

G 1/4 LOWER: $1.1\,hr + \frac{700}{(3600)(4.3)} = 1.1\,hr$ ✓
$q = 280$ csm/in ; $Q = (280)(0.0132)(6.6) = 24$ cfs ✓

A UPPER: $0.98\,hr + \frac{700}{(3600)(4.3)} = 1.0\,hr$ ✓
$q = 300$ csm/in ; $Q = (300)(0.0735)(6.6) = 146$ cfs ✓

A 1/2 LOWER: $1.42\,hr + \frac{700}{(3600)(4.3)} = 1.5\,hr$ ✓
$q = 240$ csm/in ; $Q = (240)(0.0187)(6.6) = 30$ cfs ✓

A 1/2 LOWER: $1.28\,hr + \frac{700}{(3600)(4.3)} = 1.3\,hr$ ✓
$q = 260$ csm/in ; $Q = (260)(0.0187)(6.6) = 32$ cfs ✓

B UPPER: $0.44 + \frac{700}{(3600)(4.3)} = 0.49\,hr$ ✓
$q = 410$ csm/in. ; $Q = (410)(0.0223)(6.6) = 60$ cfs ✓

B 1/2 LOWER: $0.53\,hr + \frac{700}{(3600)(4.3)} = 0.58\,hr$ ✓
$q = 380$ csm/in ; $Q = (380)(0.0072)(6.6) = 18$ cfs ✓

B 1/2 LOWER: $Q = 18.5$ cfs

Total Flow $= Q_{PT6} = Q_{G1/2L} + Q_{GU} + Q_{G1/4L} + Q_{AU} + Q_{A1/2L} + Q_{A1/2L}$
$Q_{BU} + Q_{B1/2L} + Q_{B1/2L}$
$= 6 + 32 + 24 + 146 + 30 + 32 + 60 + 18 + 18.5$
$= 367$ cfs ✓

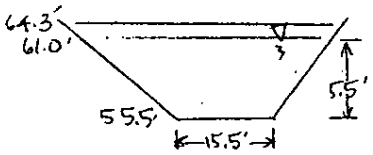
H	L_1	L_2	$\frac{1.49}{n}$	$(\frac{L_1+L_2}{2})H$	$R^{2/3}$	$S^{1/2}$	Q
5.5	36.7	14.7	55.39	141.35	2.3489	0.02	368

Therefore, use $H = 5.5$ ft, $L_1 = 36.7$ ft, $L_2 = 14.7$ ft
Bottom Elevation = 55.7 ft
$V = 2.6$ ft/sec ✓

Point 5: Top Elevation = 64.3 ft (surrounding land, assume)
Ditch Bottom Elevation = 55.5'; Top Water Elevation = 61.0'

$S = \frac{55.7' - 55.5'}{450} = 0.0004$; $S = \frac{61.2' - 61.0'}{450} = 0.0004$

Flow from upstream areas:



G 1/5 LOWER : $1.3\,hr + \frac{450}{(3600)(4.5)} = 1.3\,hr$ ✓
$q = 260$ csm/in ; $Q = (260)(0.0033)(6.6) = 6$ cfs ✓

G UPPER : $1.3\,hr + \frac{450}{(3600)(4.5)} = 1.3\,hr$ ✓
$q = 260$ csm/in ; $Q = (260)(0.0184)(6.6) = 32$ cfs ✓

G 4/5 LOWER : $1.1\,hr + \frac{450}{(3600)(4.5)} = 1.1\,hr$ ✓
$q = 280$ csm/in ; $Q = (280)(0.0132)(6.6) = 24$ cfs ✓

A UPPER : $1.0\,hr + \frac{450}{(3600)(4.5)} = 1.0\,hr$ ✓
$q = 300$ csm/in ; $Q = (300)(0.0735)(6.6) = 146$ cfs ✓

A 1/2 LOWER : $1.5\,hr + \frac{450}{(3600)(4.5)} = 1.5\,hr$ ✓
$q = 240$ csm/in ; $Q = (240)(0.0187)(6.6) = 30$ cfs ✓

A 1/2 LOWER : $1.3\,hr + \frac{450}{(3600)(4.5)} = 1.3\,hr$ ✓
$q = 260$ csm/in ; $Q = (260)(0.0187)(6.6) = 32$ cfs ✓

B UPPER : $0.49\,hr + \frac{450}{(3600)(4.5)} = 0.52\,hr$ ✓
$q = 400$ csm/in ; $Q = (400)(0.0223)(6.6) = 59$ cfs ✓

B 1/2 LOWER : $0.58\,hr + \frac{450}{(3600)(4.5)} = 0.61\,hr$ ✓
$q = 375$ csm/in ; $Q = (375)(0.0072)(6.6) = 18$ cfs ✓

B 1/2 LOWER : $0.53\,hr + \frac{450}{(3600)(4.5)} = 0.56\,hr$ ✓
$q = 390$ csm/in ; $Q = (390)(0.0072)(6.6) = 19$ cfs ✓

C 1/2 LOWER : $Q = 12.5$ cfs ✓

Total Flow, $Q_{TS} = Q_{G1/5L} + Q_{GU} + Q_{G4/5L} + Q_{AU} + Q_{1/2AL} + Q_{1/2AL}$
$+ Q_{BU} + Q_{B1/2L} + Q_{B1/2L} + Q_{C1/2L}$
$= 6 + 32 + 24 + 146 + 30 + 32 + 59 + 18 + 19 + 12.5$
$= 379$ cfs ✓

H	L_1	L_2	$\frac{1.49}{n}$	$\left(\frac{L_1+L_2}{2}\right)H$	$R^{2/3}$	$S^{1/2}$	Q
5.5	37.5	15.5	55.39	145.75	2.3654	0.02	382

Therefore, use $H = 5.5'$, $L_1 = 37.5'$, $L_2 = 15.5'$
Bottom Elevation = 55.5 ft
V = [illegible] ft/sec ✓

References:

1. USDA, Soil Conservation Service, TR-55, "Urban Hydrology for Small Watrsheds," June 1986.

2. Chow, Ven Te, "Open Channel Hydraulics," McGraw-Hill Book Company, Inc., 1959.

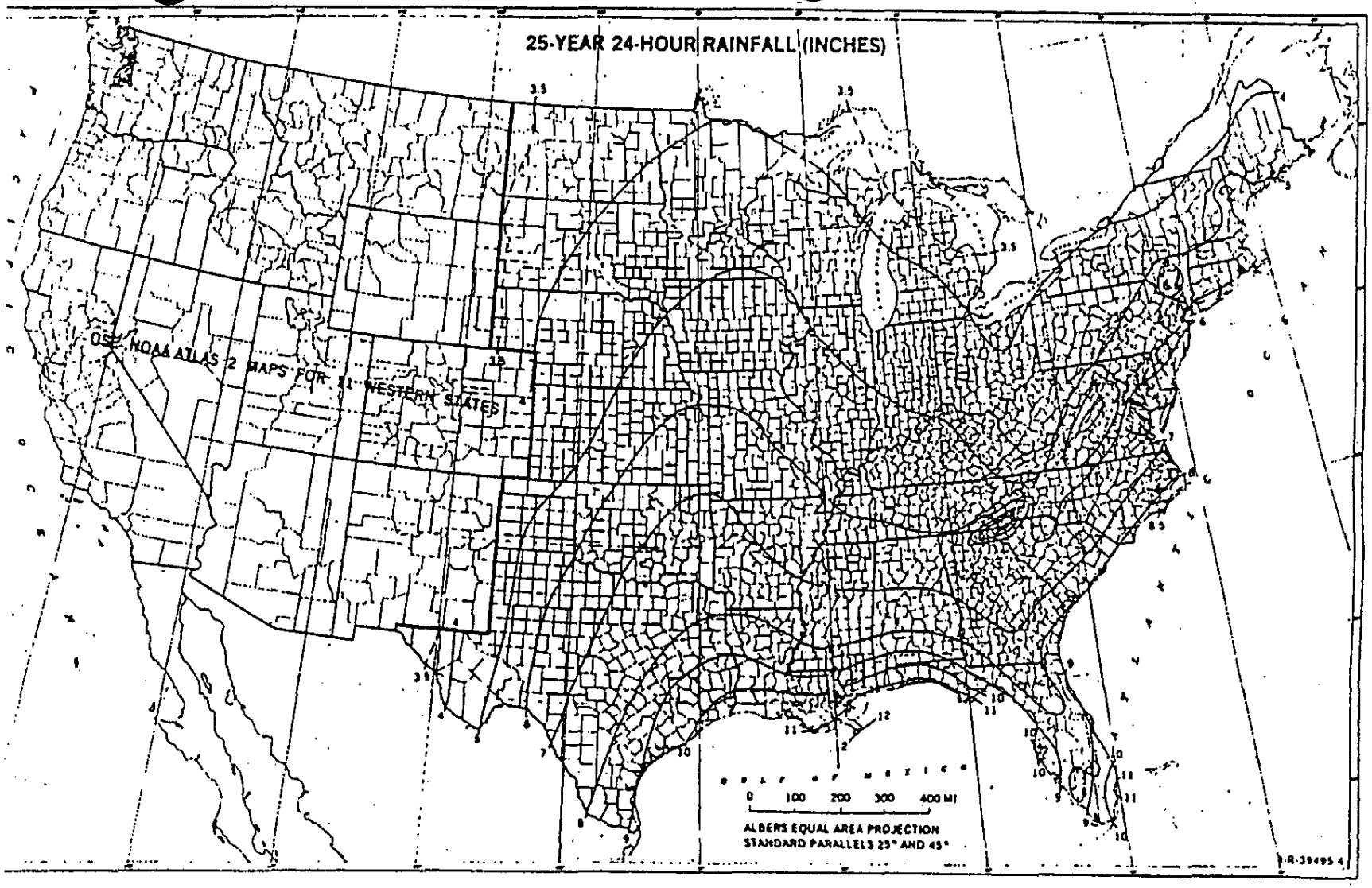


Figure II-6.—Twenty-five-year, 24-hour rainfall.

Table 2-2a.—Runoff curve numbers for urban areas[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}} \qquad \text{[Eq. 3-3]}$$

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1]The n values are a composite of information compiled by Engman (1986).
[2]Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3]When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1),
L = flow length (ft),
P_2 = 2-year, 24-hour rainfall (in), and
s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

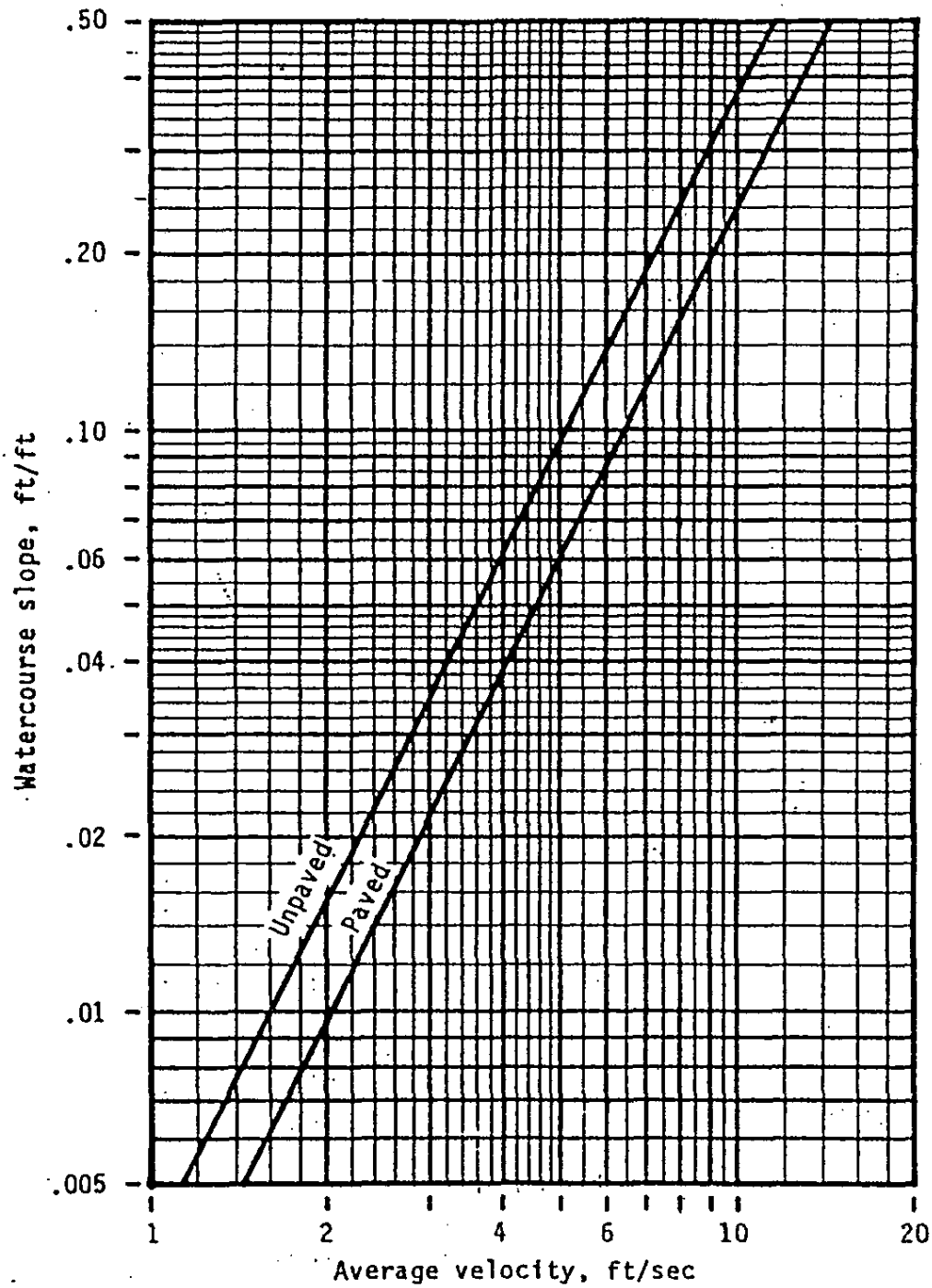


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

Chapter 4: Graphical Peak Discharge method

This chapter presents the Graphical Peak Discharge method for computing peak discharge from rural and urban areas. The Graphical method was developed from hydrograph analyses using TR-20, "Computer Program for Project Formulation—Hydrology" (SCS 1983). The peak discharge equation used is

$$q_p = q_u A_m Q F_p \qquad \text{[Eq. 4-1]}$$

where

q_p = peak discharge (cfs);
q_u = unit peak discharge (csm/in);
A_m = drainage area (mi²);
Q = runoff (in); and
F_p = pond and swamp adjustment factor.

The input requirements for the Graphical method are as follows: (1) T_c (hr), (2) drainage area (mi²), (3) appropriate rainfall distribution (I, IA, II, or III), (4) 24-hour rainfall (in), and (5) CN. If pond and swamp areas are spread throughout the watershed and are not considered in the T_c computation, an adjustment for pond and swamp areas is also needed.

Peak discharge computation

For a selected rainfall frequency, the 24-hour rainfall (P) is obtained from appendix B or more detailed local precipitation maps. CN and total runoff (Q) for the watershed are computed according to the methods outlined in chapter 2. The CN is used to determine the initial abstraction (I_a) from table 4-1. I_a/P is then computed.

If the computed I_a/P ratio is outside the range shown in exhibit 4 (4-I, 4-IA, 4-II, and 4-III) for the rainfall distribution of interest, then the limiting value should be used. If the ratio falls between the limiting values, use linear interpolation. Figure 4-1 illustrates the sensitivity of I_a/P to CN and P.

Peak discharge per square mile per inch of runoff (q_u) is obtained from exhibit 4-I, 4-IA, 4-II, or 4-III by using T_c (chapter 3), rainfall distribution type, and I_a/P ratio. The pond and swamp adjustment factor is obtained from table 4-2 (rounded to the nearest table value). Use worksheet 4 in appendix D to aid in computing the peak discharge using the Graphical method.

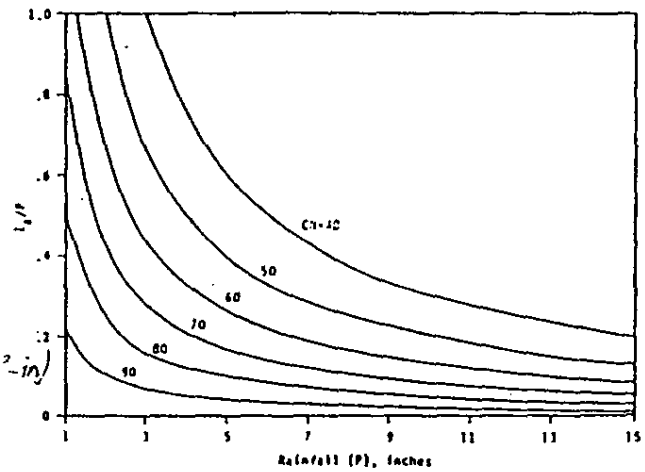
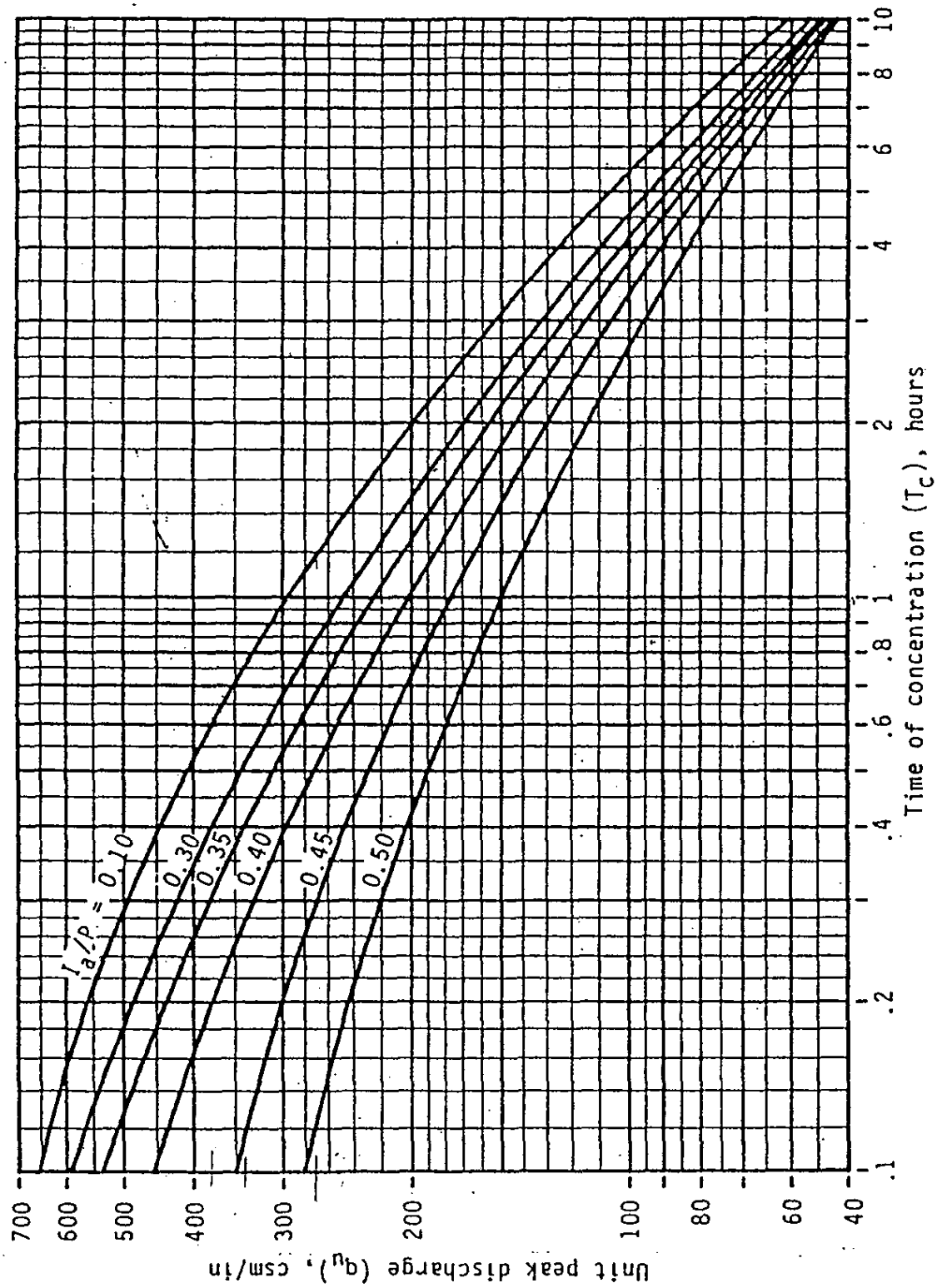


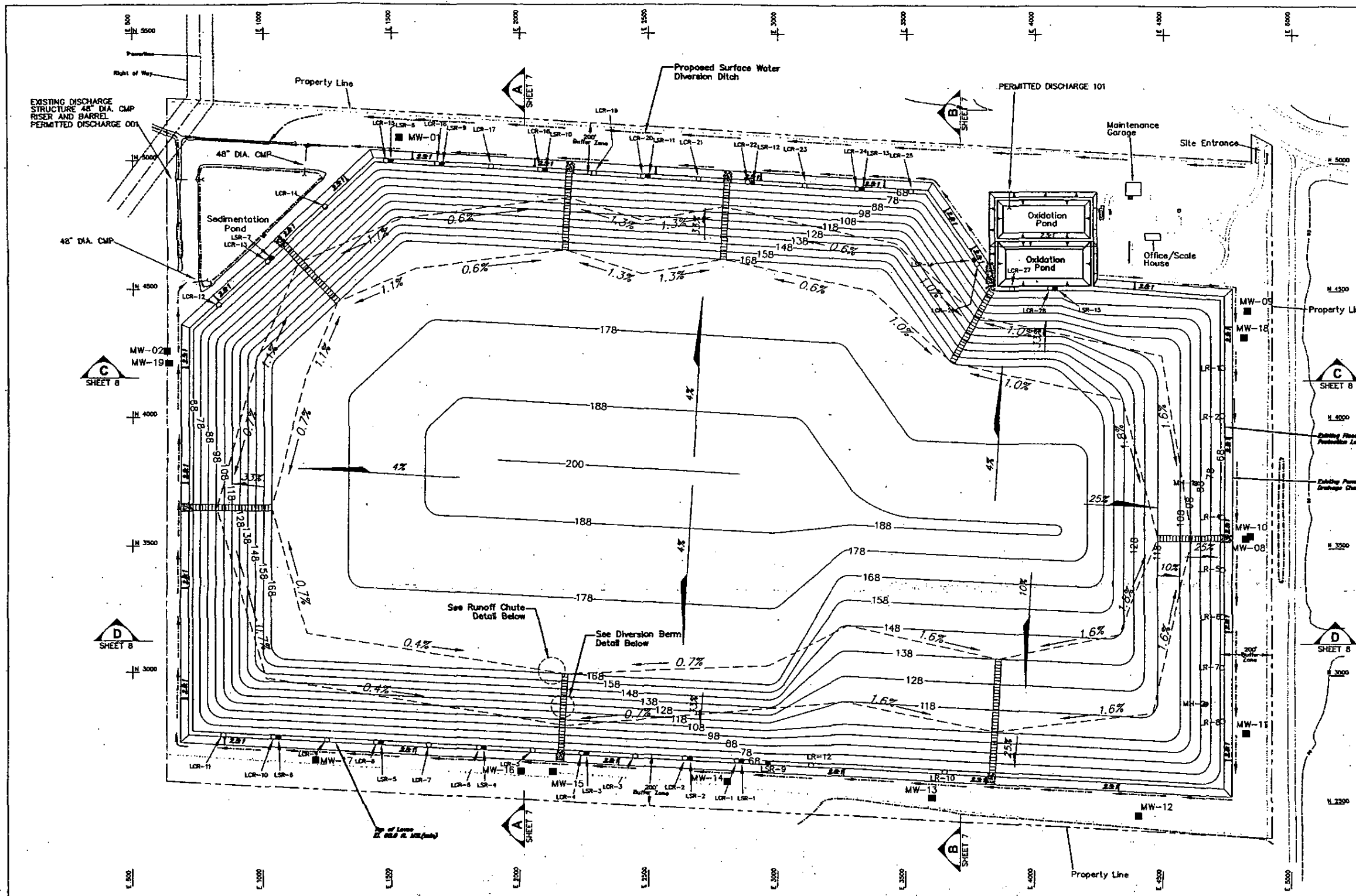
Figure 4-1.—Variation of I_a/P for P and CN.

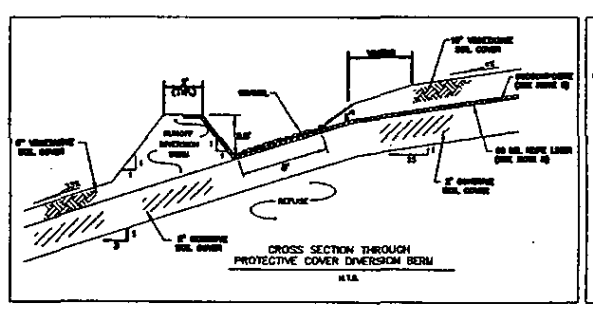
Table 4-1.—I_a values for runoff curve numbers

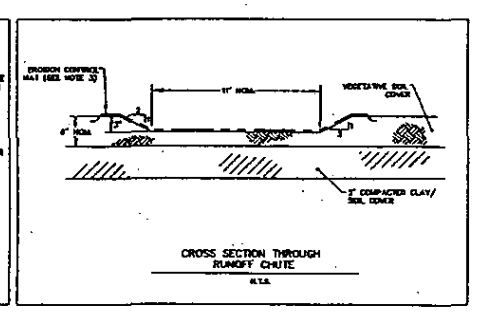
Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	70	0.857
41	2.878	71	0.817
42	2.762	72	0.778
43	2.651	73	0.740
44	2.545	74	0.703
45	2.444	75	0.667
46	2.348	76	0.632
47	2.255	77	0.597
48	2.167	78	0.564
49	2.082	79	0.532
50	2.000	80	0.500
51	1.922	81	0.469
52	1.846	82	0.439
53	1.774	83	0.410
54	1.704	84	0.381
55	1.636	85	0.353
56	1.571	86	0.326
57	1.509	87	0.299
58	1.448	88	0.273
59	1.390	89	0.247
60	1.333	90	0.222
61	1.279	91	0.198
62	1.226	92	0.174
63	1.175	93	0.151
64	1.125	94	0.128
65	1.077	95	0.105
66	1.030	96	0.083
67	0.985	97	0.062
68	0.941	98	0.041
69	0.899		

Exhibit 4-III: Unit peak discharge (q_u) for SCS type III rainfall distribution









This map compiled by photogrammetric methods from aerial photography dated 6-10-2001.
Vertical datum based on MLS Mean Sea Level, Contour Interval 2 ft.
Grid based on arbitrary coordinate system. Per Air Survey Corp. Project #7930433
Dashed contours indicate that ground is partially obscured by vegetation or shadows.
These areas may not meet standard accuracy and require field testing/completion.

LEGEND

- EXISTING CONTOUR
- N 4500 — GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- DRAINAGE FLOW DIRECTION
- PROPOSED GROUNDWATER MONITOR WELL SYSTEM
- C SHEET 8 — CROSS-SECTION LOCATION
- 70 — FINAL COVER ELEVATION CONTOUR (FT MSL)
- 33% — SLOPE ON TOP OF FINAL COVER
- LCR-4 — LEACHATE CLEANOUT RISER (1 SHEET 10)
- LSR-3 — LEACHATE SUMP RISER (2 SHEET 10)
- 1 — DIVERSION BERM SIZE (SEE SCHEDULE)
- LOCATION OF RUNOFF DIVERSION BERMS
- RUNOFF CHUTE
- MH-2 — EXISTING MANHOLE
- LR-10 — EXISTING LEACHATE RISER
- SLOPE PROTECTION

NOTE:

1.) SEE DETAIL 3 ON DRAWING 12 FOR FINAL COVER DETAIL

2.) PERMANENT ACCESS ROAD (NOT SHOWN) WILL BE CONSTRUCTED TO PROVIDE ACCESS FOR FINAL COVER MAINTENANCE.

3.) RUNOFF CHUTES AND DIVERSION CHANNELS SHALL BE LINED WITH EROSION CONTROL MATS (ENKAMAT 7020 OR EQUIVALENT).

4.) ELEVATIONS SHOWN ARE MAXIMUM AND REPRESENT TOP OF FINAL COVER. FINAL CONTOUR LOCATIONS ARE APPROXIMATE.

5.) PERIMETER DRAINAGE SYSTEM CALCULATIONS ARE PRESENTED IN APPENDIX E OF THE PERMIT. IMPROVEMENTS TO THE DRAINAGE SYSTEM SHALL BE IMPLEMENTED AS NEEDED DURING SITE DEVELOPMENT.

6.) THE RUNOFF DIVERSION BERMS AND CHUTES MAY BE CONSTRUCTED WITH FLATTER SLOPES PROVIDED THE BERM HEIGHT OR DEPTH REQUIREMENT IS MET.

7.) OWNER/OPERATOR MAY REPLACE THE SIXTY (60) MIL. HDPE LINER WITH A FORTY (40) MIL. FML DURING CONSTRUCTION OF THE FINAL COVER SYSTEM.

STATE OF LOUISIANA
DALE L. STEB
REG. No. 28129
REGISTERED PROFESSIONAL ENGINEER
6/20/06

0' 100' 200' 400'
SCALE

2	VERTICAL EXPANSION	DCA	DLS	04/01	
1	ADDED BLOWER/FLARE LOCATION AND REVISED SOUTH-EAST GAS COLLECTION HEADERS AND GAS EXTRACTION WELLS	JEP	TLR	03/97	
NO	REVISIONS	DRN	CHK	DATE	

BATON ROUGE, LOUISIANA

DRN	PARTIN	
DES	RICHARDSON	
CHK	MARTIN	
APP	RICHARDSON	

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WASTE MANAGEMENT

PREPARED FOR

PREPARED BY

S A E T E C H
Baton Rouge, Louisiana

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

CLOSURE COVER AND SURFACE WATER MANAGEMENT PLAN

DATE	06-20-06 10:30 A.M.
PROJECT NO	50504
FILENAME	42891ASP.DWG
SHEET NO	5 of 15
DRAWING NO	5

EROSION CONTROL CALCULATIONS

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891.01

CLIENT WMLA SUBJECT Erosion Loss Calculations

PROJECT Magnolia Landfill

Prepared By DLS Date 6/01

Reviewed By _____ Date _____

Approved By _____ Date _____

Objective: Determine the average soil loss in tons per acre per year, for the final cover design of Magnolia Landfill.

Approach: Use the USDA Universal Soil Loss equation

$A = RKL_sCP$; where: A = average annual soil loss (tons/acre/year)
R = rainfall and Runoff erosivity
K = soil erodibility factor (tons/acre)
L_s = slope length factor
C = cover management factor
P = practice factor

Geometry: shown on attached Figure 1

Data: R = 380 (obtained from "Erosion and Sediment Control Handbook," Goldman, et al., attached Figure 5.2)

K = 0.26 tons/acre (silty clay loam with 4% organic matter content, obtained from Ref 1 Table 1)

C = 0.007 (for grass, mod. to high productivity level, obtained from Reference 1, Table 2)

P = 1.0 (conservative, no support practice, obtained from Reference 1, table 3)

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMLA

SUBJECT Erosion Loss Calculations

PROJECT Magnolia Landfill

Prepared By DES Date 6/01

Reviewed By _____ Date _____

Approved By _____ Date _____

For areas A, B, C, D & E on attached, Fig. 1 there is 850 feet of 4% Slope and 300 feet of % slope. (Ref 1, Table 4)

850 feet @ 4% slope, LS = 0.97
300 feet @ 33% slope, LS = 16.4

For area F on attached Fig 1 there is 700 feet of 4% slope and 300 feet of 25% slope (Ref 1, Table 4)

700 feet @ 4% slope, LS = 0.87
300 feet @ 33% slope, LS = 16.4

For Area G on attached Fig 1 there is 650 feet of 4% slope and 300 feet of 25% slope (Ref 1, Table 4)

650 feet @ 4% slope, LS = 0.85
300 feet @ 33% slope, LS = 16.4

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMLA

SUBJECT Erosion Loss Calculations

PROJECT Magnolia Landfill

Prepared By DLS Date 6/01

Reviewed By _____ Date _____

Approved By _____ Date _____

Calculations:

For Areas A, B, C, D & E, the estimated Soil Loss is

Upper 4% Slopes: $A = RKLsCP$

$= (380)(0.26 \text{ tons/acre})(0.97)(0.007)(1.0)$
$= 0.67$ tons/acre/year

Lower 33% slopes: $A = RKLsCP$

$= (380)(0.26 \text{ tons/acre})(16.4)(0.007)(1.0)$
$= 11.34$ tons/acre/year

$A_{TOTAL} = 12.01$ tons/acre/year

For Area F, the estimated Soil Loss is

Upper 4% slopes $A = (380)(0.26 \text{ tons/acre})(0.87)(0.007)(1.0)$
$= 0.60$ tons/acre/year

Lower 33% slopes $A = (380)(0.26 \text{ tons/acre})(16.4)(0.007)(1.0)$
$= 11.34$ tons/acre/year

$A_{TOTAL} = 11.94$ tons/acres/year

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMCA SUBJECT Erosion Loss Calculations

PROJECT Magnolia Landfill

Prepared By DLS Date 6/01

Reviewed By _____ Date _____

Approved By _____ Date _____

For Area G, the estimated Soil Loss is

Upper 4% slopes $A = (380)(0.26 \text{ tons/acre})(0.85)(0.007)(1.0)$
$= 0.59$ tons/acre/year

Lower 33% slopes $A = (380)(0.26 \text{ tons/acre})(16.4)(0.007)(1.0)$
$= 11.34$ tons/acre/year

$A_{TOTAL} = 11.93$ tons/acre/year

References: EPA - 600/2-79-165, August 1979, "Design and Construction of Covers for Solid Waste Landfills,

Attachments:

Figure 1	Find Contour Map
Figure 2	Average Annual Values of Rainfall-Erosivity factor (R)
Table 1	'k Values for USDA Textural Classes
Table 2	C Values for States east of Rocky Mountains
Table 3	Values of Factor P
Table 4	LS Value for Specific combinations of Slope Length and steepness.

Publication: "Getting to the Roots of Erosion Control at Landfills". by Greg Northcutt

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 42891

CLIENT WMLA

SUBJECT Erosion Loss Calculations

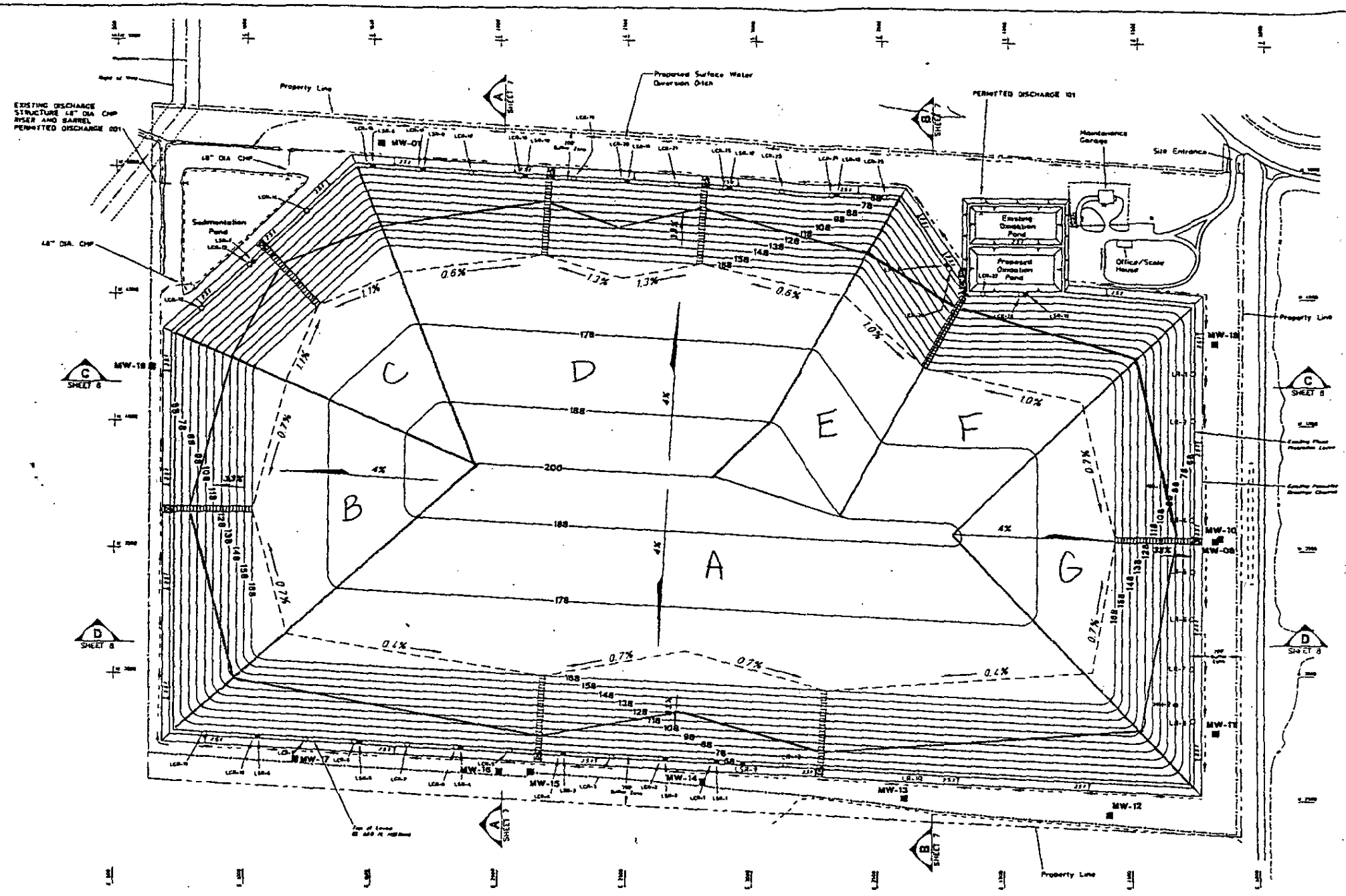
PROJECT Magnolia Landfill

Prepared By DLS Date 6/01

Reviewed By _____ Date _____

Approved By _____ Date _____

Conclusion: The average annual Loss for the areas of the Landfill range from 11.93 to 12.01 tons/acre/year which is greater than the recommended limit of 5 tons/acre/year. Therefore it is recommended that erosion control berms be designed for the upper and Lower Slopes to achute with erosion Control fabric. These berms are shown on Drawing 5 of the design drawings.



LEGEND

- EXISTING CONTOUR
- GRID COORDINATE
- PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING CULVERT
- DRAINAGE FLOW DIRECTION
- PROPOSED GROUNDWATER MONITOR WELL SYSTEM
- CROSS-SECTION LOCATION (SHEET 8)
- 70 — FINAL COVER ELEVATION CONTOUR (FT MSL)
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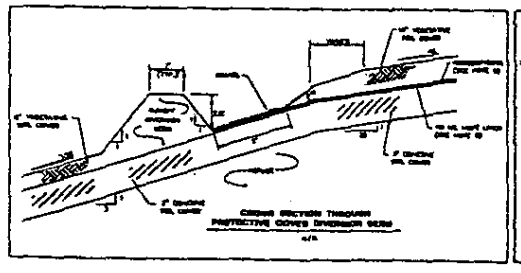
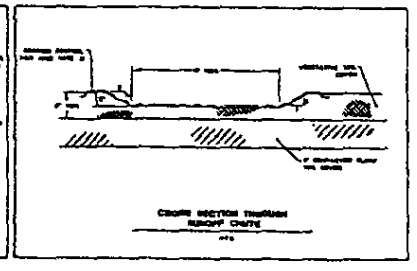
- LEACHATE SUMP RISER (2 / SHEET 10)
- DIVERSION BERM SIZE (SEE SCHEDULE)
- LOCATION OF RUNOFF DIVERSION BERMS
- RUNOFF CHUTE
- EXISTING MANHOLE
- EXISTING LEACHATE RISER
- SLOPE PROTECTION

NOTE:

1) SEE DETAIL 3 ON DRAWING 12 FOR FINAL COVER DETAIL.
2) PERMANENT ACCESS ROAD (NOT SHOWN) WILL BE CONSTRUCTED TO PROVIDE ACCESS FOR FINAL COVER MAINTENANCE.
3) RUNOFF CHUTES AND DIVERSION CHANNELS SHALL BE LINED WITH EROSION CONTROL MATS (ENKAMAT 7020 OR EQUIVALENT).
4) ELEVATIONS SHOWN ARE MAXIMUM AND REPRESENT TOP OF FINAL COVER. FINAL CONTOUR LOCATIONS ARE APPROXIMATE.
5) PERIMETER DRAINAGE SYSTEM CALCULATIONS ARE PRESENTED IN APPENDIX E OF THE PERMIT IMPROVEMENTS TO THE DRAINAGE SYSTEM SHALL BE IMPLEMENTED AS NEEDED DURING SITE DEVELOPMENT.
6) THE RUNOFF DIVERSION BERMS AND CHUTES MAY BE CONSTRUCTED WITH FLATTER SLOPES PROVIDED THE BERM HEIGHT OR DEPTH REQUIREMENT IS MET.
7) OWNER/OPERATOR MAY REPLACE THE SIXTY (60) MIL HDPE LINER WITH A FORTY (40) MIL. FINL DURING CONSTRUCTION OF THE FINAL COVER SYSTEM.





DIVERSION BERM SCHEDULE

LOCATION	MIN. BERM HEIGHT (FT) H	CHANNEL BOTTOM WIDTH (FT) BJ
1	3.3	5.0
2	1.6	4.5

0' 250' 500'
SCALE

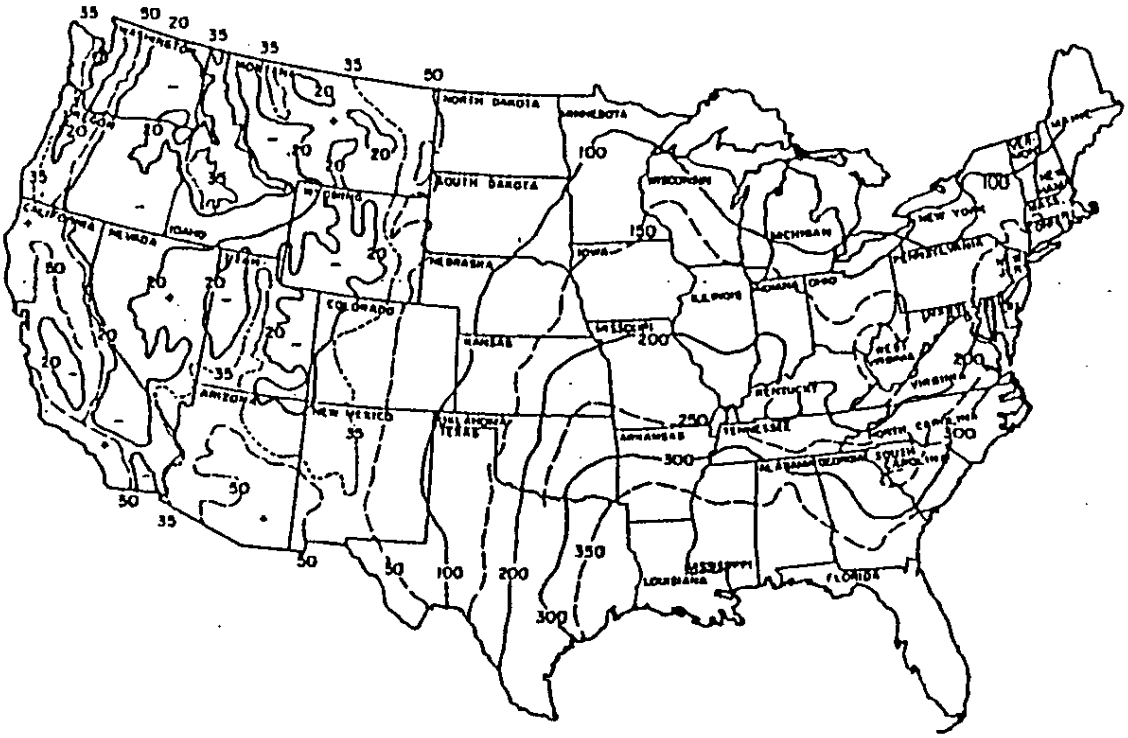
RE: Drawing created from Existing Site Plan Project No.86415, file 86415.DWG.

Drawn By:	ARDIS	5/99		Project No.	42891.010	4/2001	1	VERTICAL EXPANSION	DLS
Designer:	BLACKMAR	5/99		Drawing No	42891A02.DWG				
P.E.	BLACKMAR	5/99		Date Issued.	04-24-01				
Approved:	BLACKMAR	5/99		Plot Time:	4:08 P.M	DATE	NO	REVISION	BY

WASTE MANAGEMENT
PREPARED FOR

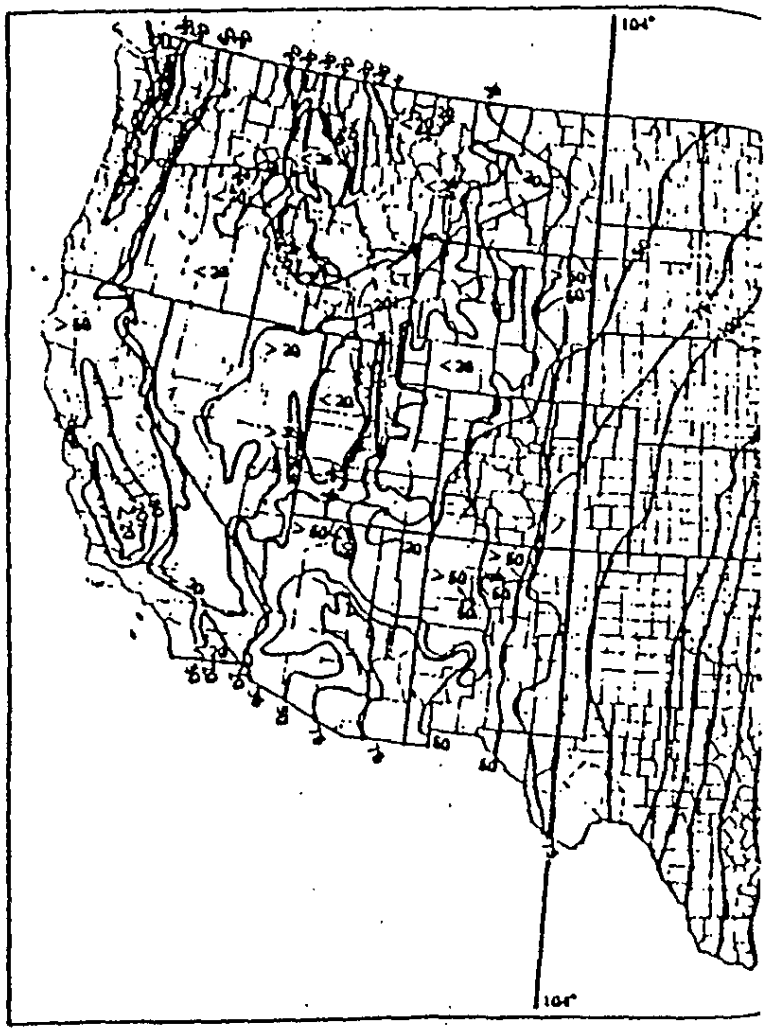
EARTH TECH
Baton Rouge, Louisiana
PREPARED BY

FIGURE 8
FINAL CONTOUR PLAN
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA
APRIL 2001
42891.01



Average annual values of rainfall-erosivity factor R .79

FIGURE 2A



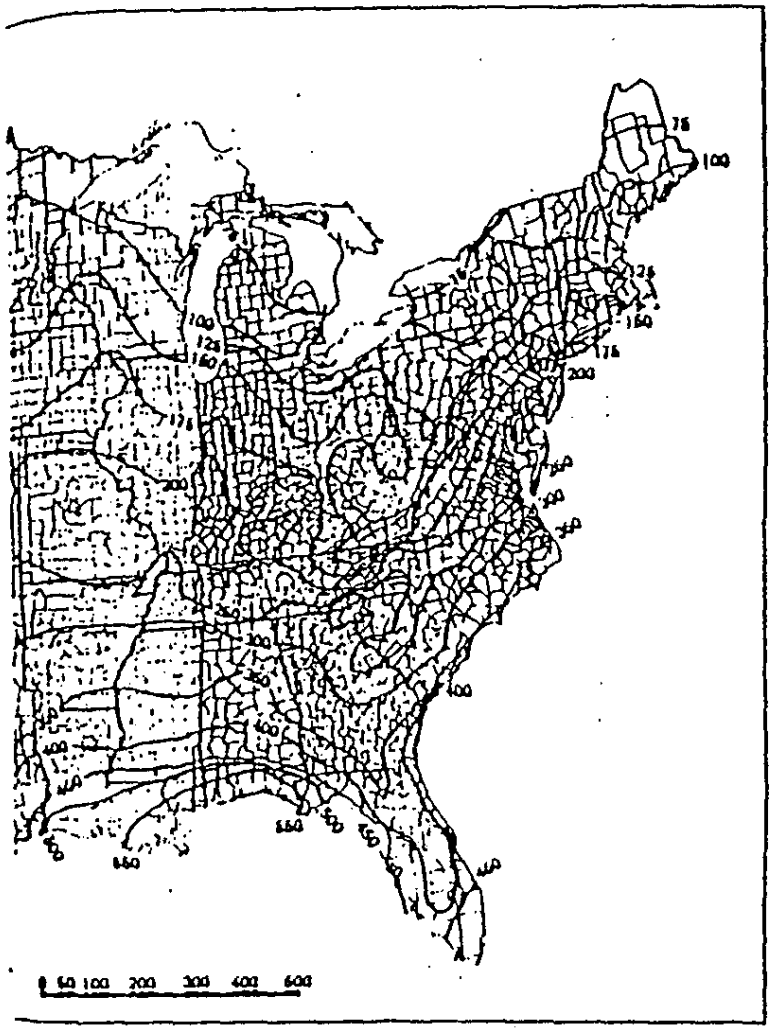


Fig. 5.2 *R values for areas east of 104°.* Because of irregular topography in the west United States, calculate *R* values in this region by using local rainfall data. *R* is in units of 100 *ft · tons/acre per in/hr.* To convert *R* to units of 10^1 J/ha per mm/hr, multiply 1.70. (20) Scale in in miles.

Figure 28

TABLE 1

APPROXIMATE VALUES OF FACTOR K FOR USDA TEXTURAL CLASSES[79]

Texture class	Organic matter content		
	<0.5%	2%	4%
	K	K	K
Sand	0.05	0.03	0.02
Fine sand	.16	.14	.10
Very fine sand	.42	.36	.28
Loamy sand	.12	.10	.08
Loamy fine sand	.24	.20	.16
Loamy very fine sand	.44	.38	.30
Sandy loam	.27	.24	.19
Fine sandy loam	.35	.30	.24
Very fine sandy loam	.47	.41	.33
Loam	.38	.34	.29
Silt loam	.48	.42	.33
Silt	.60	.52	.42
Sandy clay loam	.27	.25	.21
Clay loam	.28	.25	.21
Silty clay loam	.37	.32	.26
Sandy clay	.14	.13	.12
Silty clay	.25	.23	.19
Clay		0.13-0.29	

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

TABLE 2

GENERALIZED VALUES OF FACTOR C FOR STATES EAST OF THE ROCKY MOUNTAINS[79]

Crop, rotation, and management	Productivity level	
	High	Mod.
	C value	
Base value: continuous fallow, tilled up and down slope	1.00	1.00
CORN		
C, RdR, fall TP, conv	0.54	0.62
C, RdR, spring TP, conv	.50	.59
C, RdL, fall TP, conv	.42	.52
C, RdR, wc seeding, spring TP, conv	.40	.49
C, RdL, standing, spring TP, conv	.38	.48
C-W-M-M, RdL, TP for C, disk for W	.039	.074
C-W-M-M, RdL, TP for C, disk for W	.032	.061
C, no-till pl in c-k sod, 95-80% rc	.017	.053
COTTON		
Cot, conv (Western Plains)	0.42	0.49
Cot, conv (South)	.34	.40
MEADOW		
Grass & Legume mix	0.004	0.01
Alfalfa, lespedeza or Serich	.020	
Sweet clover	.025	
SORGHUM, GRAIN (Western Plains)		
RdL, spring TP, conv	0.43	0.53
No-till pl in shredded 70-50% rc	.11	.18
SOYBEANS		
B, RdL, spring TP, conv	0.48	0.54
C-B, TP annually, conv	.43	.51
B, no-till pl	.22	.28
C-B, no-till pl, fall shred C stalks	.18	.22
WHEAT		
W-F, fall TP after W	0.38	
W-F, stubble mulch, 500 lbs rc	.32	
W-F, stubble mulch, 1000 lbs rc	.21	

Abbreviations defined:

B - soybeans
C - corn
c-k - chemically killed
conv - conventional
cot - cotton
F - fallow
M - grass & legume hay
pl - plant
W - wheat
wc - winter cover

lbs rc - pounds of crop residue per acre remaining on surface after new crop seeding
% rc - percentage of soil surface covered by residue mulch after new crop seeding
70-50% rc - 70% cover for C values in first column; 50% for second column
RdR - residues (corn stover, straw, etc.) removed or burned
RdL - all residues left on field (on surface or incorporated)
TP - turn plowed (upper 5 or more inches of soil inverted, covering residues)

TABLE 3

VALUES OF FACTOR P[79]

Practice	Land slope (percent)				
	1.1-2	2.1-7	7.1-12	12.1-18	18.1-24
	(Factor P)				
Contouring (P_c)	0.60	0.50	0.60	0.80	0.90
Contour strip cropping (P_{sc})					
R-R-M-M[1]	0.30	0.25	0.30	0.40	0.45
R-W-M-M	0.30	0.25	0.30	0.40	0.45
R-R-W-M	0.45	0.38	0.45	0.60	0.68
R-W	0.52	0.44	0.52	0.70	0.90
R-O	0.60	0.50	0.60	0.80	0.90
Contour listing or ridge planting (P_{cl})	0.30	0.25	0.30	0.40	0.45
Contour terracing (P_t)[2]	[3] $0.6/\sqrt{n}$	$0.5/\sqrt{n}$	$0.6/\sqrt{n}$	$0.8/\sqrt{n}$	$0.9/\sqrt{n}$
No support practice	1.0	1.0	1.0	1.0	1.0

[1] R = rowcrop, W = fall-seeded grain, O = spring-seeded grain, M = meadow. The crops are grown in rotation and so arranged on the field that rowcrop strips are always separated by a meadow or winter-grain strip.

[2] These P_t values estimate the amount of soil eroded to the terrace channels and are used for conservation planning. For prediction of off-field sediment, the P_t values are multiplied by 0.2.

[3] n = number of approximately equal-length intervals into which the field slope is divided by the terraces. Tillage operations must be parallel to the terraces.

TABLE 4

VALUES OF THE FACTOR LS FOR SPECIFIC COMBINATIONS OF SLOPE LENGTH AND STEEPNESS[79]

% Slope	Slope length (feet)											
	25	50	75	100	150	200	300	400	500	600	800	1000
0.5	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.17	0.19	0.20
1	0.09	0.10	0.12	0.13	0.15	0.16	0.18	0.20	0.21	0.22	0.24	0.26
2	0.13	0.16	0.19	0.20	0.23	0.25	0.28	0.31	0.33	0.34	0.38	0.40
3	0.19	0.23	0.26	0.29	0.33	0.35	0.40	0.44	0.47	0.49	0.54	0.57
4	0.23	0.30	0.36	0.40	0.47	0.53	0.62	0.70	0.76	0.82	0.92	1.0
5	0.27	0.38	0.46	0.54	0.66	0.76	0.93	1.1	1.2	1.3	1.5	1.7
6	0.34	0.48	0.58	0.67	0.82	0.95	1.2	1.4	1.5	1.7	1.9	2.1
8	0.50	0.70	0.86	0.99	1.2	1.4	1.7	2.0	2.2	2.4	2.8	3.1
10	0.69	0.97	1.2	1.4	1.7	1.9	2.4	2.7	3.1	3.4	3.9	4.3
12	0.90	1.3	1.6	1.8	2.2	2.6	3.1	3.6	4.0	4.4	5.1	5.7
14	1.2	1.6	2.0	2.1	2.8	3.3	4.0	4.6	5.1	5.6	6.5	7.3
16	1.4	2.0	2.5	2.8	3.5	4.0	4.9	5.7	6.4	7.0	8.0	9.0
18	1.7	2.4	3.0	3.4	4.2	4.9	6.0	6.9	7.7	8.4	9.7	11.0
20	2.0	2.9	3.5	4.1	5.0	5.8	7.1	8.2	9.1	10.0	12.0	13.0
25	3.0	4.2	5.1	5.9	7.2	8.3	10.0	12.0	13.0	14.0	17.0	19.0
30	4.0	5.6	6.9	8.0	9.7	11.0	14.0	16.0	18.0	20.0	23.0	25.0
40	6.3	9.0	11.0	13.0	16.0	18.0	22.0	25.0	28.0	31.0	--	--
50	8.9	13.0	15.0	18.0	22.0	25.0	31.0	--	--	--	--	--
60	12.0	16.0	20.0	23.0	28.0	--	--	--	--	--	--	--

Values given for slopes longer than 300 feet or steeper than 18% are extrapolations beyond the range of the research data and, therefore, less certain than the others.

GROUND WATER SAMPLING AND ANALYSIS PLAN

APPENDIX F

GROUNDWATER SAMPLING AND ANALYSIS PLAN

FOR

MAGNOLIA SANITARY LANDFILL

OUACHITA PARISH, LOUISIANA

MSW Permit: P-0046/R1

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1.0 INTRODUCTION

On February 20, 1993, the state of Louisiana promulgated regulations governing all aspects of municipal solid waste management. The Louisiana Administrative Code (LAC) addresses Groundwater Sampling and Analysis Requirements (LAC 33:VH.521.F.5.c. and 709.E.2) and Detection Monitoring Program (LAC 33:V11.709.E.3). The purpose of this Groundwater Sampling and Analysis Plan (GWSAP) is to satisfy the requirements of the above promulgated regulations as they pertain to the Magnolia Sanitary Landfill located in Ouachita Parish.

The goal of the groundwater sampling and analysis plan is to establish consistent sampling and analysis procedures that ensure monitoring results are representative of groundwater quality at the background and downgradient well locations. The procedures outlined in the GWSAP are considered applicable for all groundwater monitoring wells included in the administratively approved monitoring network. The plan includes procedures and techniques for:

- sample collection which ensures that collected samples are representative of the zone(s) being monitored and prevents cross-contamination of or tampering with samples;
- sample preservation and shipment which ensure the integrity and reliability of the sample collected for analysis;
- chain of custody control;
- quality-assurance/quality control, including detection limits, precision and accuracy of analyses, field blanks, and laboratory spikes and blanks;
- selection of parameters or constituents to be sampled and analyzed during detection monitoring and justification for parameters or constituents where applicable;
- identification of analytical procedures to be followed (reference source of analytical method);
- sampling frequency during the detection monitoring program;
- statistical method to be used in evaluating the groundwater monitoring data for each groundwater parameter or constituent sampled at each monitoring well; and
- Reporting limit for each parameter or constituent.

Sections 2.0 through 4.0 of this plan provide information regarding groundwater sample collection, preservation and analysis methodologies, chain of custody procedures and the establishment of background groundwater quality in accordance with LAC 33:VII.709.E.2.d. Sections 5.0 and 6.0 of this plan address the Detection Monitoring Program (LAC 33:VH.709.E.3) and a brief description of the action(s) that will be taken if assessment monitoring (LAC 33:VII.709.E.4) is needed.

2.0 GROUNDWATER SAMPLING PROCEDURES

The following subsections summarize specific tasks involved in sampling of the groundwater monitoring system. Samples will be obtained from the facility groundwater monitoring system by a sampling technician fully trained in the required sampling procedures. The sampling technician in association with the site personnel will be responsible for developing and maintaining up-to-date field information collected during the sampling event.

Basic sample collection information will be recorded/documented for each sample on a Field Information Form (Figure 2-1). Information such as; the well identification number, total well depth, elevation of top of casing, water level, water color, well evacuation procedures and equipment, date, time, sample identification numbers, field measurements (pH, specific conductance, etc.) and methods, name of collector, field observations, and the total volume evacuated will be recorded.

2.1 Well Inspection

Prior to performing any purging or sampling, each monitoring well will be inspected to assess its integrity. The condition of each well will be evaluated for any physical damage that may have been caused by the operation of site equipment of other vehicular traffic. The security of each well will be assessed in order to confirm that no outside source constituents have been introduced to the well. All inspection information, as well as the date and time, general weather conditions, and sampling personnel identification, will be documented on the Field Information Form (Figure 2-1). The actual form utilized may vary in format but the information indicated it should be recorded.

2.2 Sample Collection Procedures

For sample collection, each monitoring well in the groundwater monitoring system will have a dedicated sampling device (e.g. a Well Wizard bladder pump, hand bailer, or an approved equivalent). Groundwater sample collection equipment and methodologies will minimize the

potential for alteration or contamination of the sample to assure obtaining a sample representative of the formation groundwater. At present, each of the facility groundwater monitoring wells currently contain dedicated pneumatically-driven bladder pumps (Well Wizard) manufactured by QED Environmental Systems which are capable of providing consistent pump flow rates during purging and sampling. The Well Wizard ™ sampling pumps were previously approved by the administrative authority prior to use in the facility's current monitoring program. Continued use of the bladder pumps or an equivalent system dedicated to each individual well will be used to provide consistent purging and sampling methods throughout the active life and closer-post closure period of the facility. Samples will be collected in an order that minimizes potential alteration of the sample due to agitation or oxidation. MW-09 will be sampled for chlorides only until no longer required by the administrative authority, as it is not considered a part of the site groundwater monitoring system for the purposes of statistical evaluations.

No equipment or method will intentionally be used that will chemically alter or influence the sample. Care will be taken to avoid placing clean sampling equipment on the ground or on any contaminated surface. If groundwater impact is known to exist at a certain location, non-impacted wells will be sampled before those wells that are known to be affected. The sampling methods and equipment used are considered to be compatible throughout the life of the facility. However, if necessary, a non-dedicated sampling device may be used, but will be decontaminated prior to use. If the non-dedicated sampling device is disposable, and in its original container, decontamination will not be necessary.

2.2.1 Equipment Decontamination

All equipment which may contact the interior of the well or groundwater will be decontaminated in the field immediately prior to use, or in the office/lab and protected using aluminum foil and/or plastic bags. Decontamination procedure will consist of the following steps:

- Wash with laboratory grade soap (such as Liquinox);

- Triple rinse with distilled or deionized water; and
- Air dry prior to use.

Personnel who contact sampling equipment subsequent to decontamination shall wear powderless latex (or nitrile) gloves. Gloves should be replaced immediately if they become contaminated or torn.

2.2.2 Water Level Measurements

Prior to groundwater purging and sampling, water level measurements will be taken at each well location utilizing a portable water level indicator, fiberglass tape, or other suitable measuring device capable of achieving an accuracy of 0.01 foot. The measuring device will be used in accordance with the manufacturer's recommendations and/or directions. All wells will be measured for depth to water on the same day and immediately prior to purging. Measurements will be collected to the nearest 0.01 foot, and the values will be recorded Field Information Form. Since the wells utilize dedicated sampling devices, total depth measurement will be measured annually. If 10 percent of the screened interval is blocked by sediments, the well will be redeveloped prior to the next required sampling event. Water level measurements will be collected over a period of time short enough to avoid temporal variations in water levels.

2.2.3 Purging/Bailing

Immediately prior to sampling at each well location, water will be evacuated until a minimum of three well volumes (based on well construction records) has been purged.

Three well volumes can be calculated by the formula:

$$V_{casing} = 0.122 \times D^2 (E_2 - E_1) \quad (1)$$

Where;

V_{casing} = three (3) well volumes, in gallons
0.122 = conversion factor, inches to ft and ft^3 to gallons

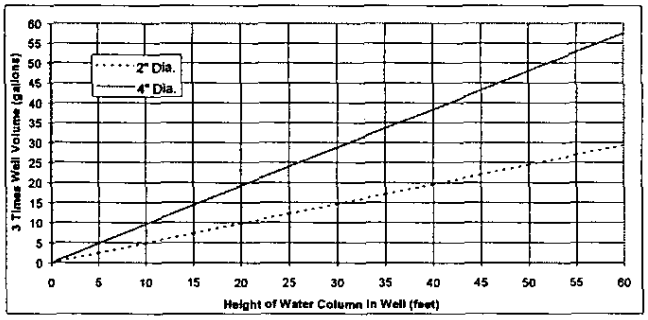
D	=	well diameter in inches
E_1	=	depth to top of water surface in feet from top of well casing
E_2	=	depth to bottom of the well from top of well casing, determined from well construction records, in feet.

Example: A 2-inch diameter well with a total well depth of 32.41 ft. (measured from top of well casing) and depth to water from top of well casing determined to be 20.35 ft.

$$V_{casing} = 0.122 \times 2^2 \text{ (32.41 feet - 20.35 feet)} = 5.88 \text{ gallons}$$

If a 4-inch monitor well is used the chart below should be consulted to calculate purged volumes.

If a well is pumped or bailed dry, it will be allowed to recover and then sampled. This will allow the samples to be representative of the water bearing unit. If sufficient water is not available for sampling within 24 hours of purging for slowly recovering wells, the well will be considered dry. As discussed previously, a dedicated sampling device or decontaminated bailer will be utilized for this task. The well will be sampled after purging and when sufficient water for sampling has recharged the well.



During the purging process, representative samples of discharged water should be periodically collected in clean containers and analyzed for field water quality parameters to evaluate the quality of the groundwater to aid in determining when formation water is entering the well. At a minimum, the following parameters will be measured in the field: pH, specific conductance, turbidity, and temperature. Other field parameters such as dissolved oxygen (DO) and oxidation-reduction (redox) may be used to assist in evaluating purge effectiveness. Water quality parameters can be considered stable if three successive readings are within ±0.1 for pH and ±3% for conductivity. Guidance for other monitored parameters include ±10 mv for redox potential, and/or ±10% for turbidity and DO, however, due to variability of site conditions these standards are more flexible for use in evaluating purge effectiveness.

If low-flow purging and sampling methods are allowed by LAC 33:V11.709, a revision to this GWSAP will be submitted that describes all procedures to be used. The revision will be in general accordance with EPA/540/S-95/504, *"Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures"* or equivalent document approved by the administrative authority.

2.2.3 Sample Withdrawal and Collection

The Well Wizard sampling pumps are capable of providing variable withdrawal rates for groundwater sample collection from a monitoring well based on consideration of the parameter to be analyzed in the sample. Samples will be collected at pumping rates that minimize potential alteration of the sample due to agitation or oxidation. Pumping rates for collection of samples for volatiles analysis (VOA's, etc.) will be approximately 100 ml/min or less, to the extent practical based on the sampling equipment used. Pumping rates for collection of other analyses may be increased, but will be adjusted to a rate that also prevents chemical alteration. Samples will be collected and containerized in the order of the volatilization sensitivity of the parameter (i.e. volatile organics, organic compounds, inorganic species, and major cations and anions). The samples will be collected in containers with the appropriate sample preservative as described below.

2.3 Sample Preservation

Sample preservation, handling, and analysis will meet the specifications described by "Test Methods for Evaluating Solid Waste Physical/Chemical Methods, third edition" (EPA Publication Number SW-846, 1986, as revised December, 1987) or an equivalent substitute as approved by the EPA and/or the administrative authority. Additionally, specifications for the parameters, containers, preservation methods and analytical limits listed in Tables 1 and 2 of LAC 33:VII Appendix C will be followed. As required by LAC 33:VII. Appendix C, samples collected as part of the monitoring program will not be field filtered prior to analysis. The appropriate sample container and preservative requirement for each analyte is listed on Table 2-1 of this plan. Pre-labeled sample containers will be supplied by the laboratory for each

sampling event and will indicate the test parameters required. The appropriate preservatives will be added to each sample container based on the required analytical method. A summary of container type(s), holding times, and preservative requirements are listed in Table 2-1 of this plan.

2.4 Sample Shipment

After collection and sample preservation, the pre-labeled sample containers will be placed into an insulated, plastic-shelled suitable shipping container using frozen ice packs or other suitable frozen material for temperature control. All samples included in the sample container will be packed in a manner that will minimize the potential for container breakage. The Field Information Forms (Figure 2-1) and laboratory Chain of Custody form (COC, Figure 2-2) will be sealed in a water resistant bag and placed with the appropriate sample bottle set. Actual forms utilized may vary in format, but the information indicated is considered typical. The sample container will then be sealed with a custody seal and sent to the designated analytical laboratory via overnight courier. All shipments will be scheduled for next day delivery. The temperature of the samples will be measured and recorded when the sample container arrives at the analytical laboratory to assure that the appropriate sample temperature was maintained during shipment.

2.5 Chain of Custody

The following chain of custody procedures will allow for the possession and handling of samples to be traced from the time of collection through laboratory analysis. All sample containers will be labeled to avoid misidentification, have proper seals, and indicate test parameters required. Chain of Custody procedures will ensure that collected samples are representative of the zone being monitored and will prevent cross-contamination or potential tampering with samples collected.

At the time each sample is collected, Chain-of-Custody (Figure 2-2) and Field Information Forms (Figure 2-1) will be completed and placed in the sample shipping container. The Field

Information Form will include general sampling event information including location, time, weather conditions, sampler identification, well integrity, any numerical field data values and well purging procedures. The shipping container will then be sealed with a shipping seal for detection of unauthorized opening or potential tampering with sample containers and with the custody seal provided within the sample container. Upon arrival of the sample shipping container at the laboratory, it will be opened, and the Chain of Custody Forms will be signed and time/dated by the person taking custody of the sample shipping container. If the sample container is shipped to another facility, this person will affix the bill of lading or receipt to the Chain of Custody Form.

3.0 GROUNDWATER ANALYSIS PROCEDURES

The following sections provide procedures for analytical analysis of the groundwater samples collected from the monitoring well network. Analytical methodologies as well as field and laboratory QA/QC procedures are discussed.

3.1 Analytical Methods/Procedures

Sample preservation, handling, and analysis will meet the specifications described by *Test Methods for Evaluating Solid Waste*, Physical/Chemical Methods, (EPA Publication Number SW-846), third edition, Final Update 3, May 1997 or an equivalent substitute as approved by the administrative authority. Analytical methods for parameters not listed in SW-846 will also be approved by the administrative authority. Additionally, specifications for the parameters, containers, preservation methods and analytical limits listed in Table 1 and 2 of LAC 33:VII Appendix C will be followed. Severn Trent Laboratories (STL) in Arvada Colorado is anticipated to be the designated analytical laboratory for facility groundwater monitoring samples. However, if operational needs dictate, another analytical laboratory may be utilized.

Table 2-2 presents the methodologies used by STL or their designated alternative laboratories for each parameter or group of parameters. Reference sources for the analytical methods are listed at the end of the table. In accordance with LAC 33:VII.709.E.2.c.v., the practical quantitation limit (PQL) for each parameter or constituent listed in LAC 33:VII. Appendix C, Table 1 is presented in Table 3-1 of this plan. All methods are USEPA approved.

3.2 Quality Assurance/Quality Control

In addition to strict chain of custody procedures, field blanks and trip blanks are used to assure the integrity of the sampling and shipping process. A record of laboratory sample receipt, storage and analysis procedures will be kept for each sample received. A summary of this record will be part of the laboratory analysis report. Any internal quality control problem associated with the submitted sample/analyte will be identified on the data qualifier report included with each sample's analytical client report.

Field Sampling QA/QC

Field Procedures. As quality assurance procedures are an integral part of each segment of field sampling methodology, the quality assurance procedures associated with each step of the field sampling routine (e.g., proper well purging, field sampling and preservation methodologies) have been directly incorporated into each respective field sampling subsection of this GWSAP.

Field and Trip Blanks. Trip and field blanks will be utilized during each round of sampling at the site. The trip blank, containing laboratory-grade distilled water, will remain unopened and sent from and to the laboratory in the same manner as the site environmental samples. The trip blank will be provided by the analytical laboratory supplying the sample container(s). A trip blank will be analyzed for volatile organic compounds. The field blank will be prepared in the field by pouring the supplied laboratory-grade distilled water into one of the clean sample containers opened in the field. The field blank will then be sealed and shipped in the same manner as the environmental samples. A field blank will be analyzed for the detection monitoring constituents.

Laboratory QA/QC

Analytical Blanks and Spikes. The selected laboratory will use method quality control procedures that are equivalent to those described in *Test Methods for Evaluating Solid Waste* Physical/Chemical Methods, (EPA Publication Number SW-846), third edition, Final Update 3, May 1997 or an equivalent substitute as approved by the administrative authority. Duplicate samples, method blanks, instrument/reagent blanks, matrix spikes, blank/water reagent spikes and surrogate spikes are typical quality control checks performed throughout the analytical laboratory. With the exception of instrument/reagent blanks and surrogate spikes, these checks are typically performed at frequency of 5% or 10% (i.e., 1 in 20 samples, 1 in 10 samples). Instrument/reagent blanks and surrogate spikes are performed on a daily or per sample (where required by method) frequency. Each of the above applied Quality Control checks will be compared against the Acceptance Criterion for each QC check to ensure that analytical quality is maintained.

The method blank is a blank solution which is treated as a sample for the parameter being measured, including all pretreatment/preparation procedures, is analyzed in the same manner as the environmental samples to assess analytical accuracy and the potential for sample contamination. Instrument/reagent blanks are used on a daily basis (where used) to detect contamination or interferences in the sample treatment solvents and chemicals to ensure that none of these applied chemicals could systematically bias sample results.

Matrix spikes are environmental samples fortified with known concentrations of analytes expected to be in the sample. The percent recovery of any spiked analyte is taken as a measure of the bias of the analytical method caused by the sample matrix. Blank/reagent water spikes are blank solutions fortified with known concentrations of analytes expected to be in environmental samples. These spikes may (reagent water spikes) or may not (blank spike) be taken through the full analytical procedure prior to analysis. The percent recovery of any spiked analyte is taken as a measure of control on the analytical procedure. Surrogate spikes, where a compound of known amount, which is not expected to be in the environmental sample, is added to the sample. Volatile Organic Compound analysis uses this type of spike to measure method extraction efficiency. This spike is performed on every sample and QC sample where the analytical method requires it.

Instrument Calibration. Applicable instruments are calibrated using calibration standards and method-specified calibration criteria. A solution containing various compounds of known concentrations is diluted and analyzed to establish calibration curves is performed daily or per the method to monitor the accuracy and precision of the instrument. Instrument calibration is verified by analyzing a solution containing a known concentration of the pure compound(s) of interest and comparing it against the calibration curve. This standard compound is taken from the same stock as that used to develop the calibration curve. Calibration verification is done at a 5% frequency, or as the method requires, to check the stability of the calibration curve as well as the accuracy and precision of the system or analyst.

All standards and reagents used in laboratory procedures will be inventoried, labeled, logged and documented in accordance with Inorganics, Inorganics/chemical Methods and Robotics, Semi-volatiles and Volatiles documentation procedures. All stock standards are purchased as certified primary solutions from reputable, commercial lab suppliers, are prepared from neat chemicals with certified purity. Stock standards are combined and/or diluted into secondary dilution standards, which are then diluted into working standards.

Instrument Maintenance. Routine maintenance is performed and documented for all major instruments. In addition, any service agreements for laboratory equipment are renewed annually. The EPA's "Good Automated Laboratory Practices" (GALPs) are followed in the laboratory.

Method Detection Limits (MDLs). The analytical laboratory uses the procedures described in Appendix B to 40 CFR 136 to determine MDLs. Each year method specific upper and lower precision and accuracy limits are developed from historical matrix spike and duplicate data.

MDLs will be checked on an annual basis to determine if a statistical difference exists between the former year's MDL and the yearly update. The Dixon Outlier Test or the statistical test developed by John Keenan Taylor in Quality Assurance of Chemical Measurements is used to determine if a statistical difference exists between the two years' mean values.

The laboratory-specific PQLs are provided by Severn Trent Laboratories (STL), in Arvada, Colorado. These PQLs are considered the lowest achievable quantitation limits demonstrated by the laboratory and are identified for each constituent on Table 3-1 of this plan. Sample analyses conducted by STL, or an alternate laboratory, if selected, will be required to achieve PQLs that are equivalent or lower than the PQLs calculated by STL.

4.0 ESTABLISHMENT OF BACKGROUND GROUNDWATER QUALITY

The purpose of obtaining adequate background groundwater data is to approximate the true range of ambient concentrations of targeted analytes in the hydrogeologic system being monitored. In other words, background groundwater data should eliminate, to the extent possible, all potential causes of statistically significant changes in groundwater chemistry not attributable to the monitored facility. True background data is obtained by monitoring a sufficient number of wells upgradient of the facility (for inter-well comparisons), or wells downgradient of the facility not previously impacted by the MSWLF unit (for intra-well comparisons).

Magnolia Sanitary Landfill is an existing facility with an established groundwater monitoring system. Background groundwater quality has been established for the facilities hydraulically upgradient well(s) and downgradient wells in the approved groundwater monitoring system for each groundwater parameter or constituent (LAC 33:VII.709.E.2.d). In the event that a new monitor well is installed or an existing monitor well must be replaced, the constituents to be monitored for the establishment of background groundwater quality are listed in Table 4-1. This background constituent list consists of all constituents listed in LAC 33:VII. Appendix C, Table 1. Establishment of background groundwater quality is not required for MW-09, and will be monitored for chlorides only until no longer required by the administrative authority.

4.1 Number of Background Samples Required

Baseline data have been utilized to develop background for the selected statistical methodology using intra-well comparisons, and background conditions will be developed from the data available for each well. The groundwater flow regime at the site suggests that background samples should not be collected on a more frequent basis than quarterly to maintain the concept of independent samples. For intra-well statistical comparisons, a minimum of eight (8) independent samples will be utilized. If eight independent samples are not available, background samples will be collected semi-annually until eight samples are available for statistical analysis.

Background groundwater quality has also been established in the hydraulically upgradient wells for the parameters in accordance with LAC 33:VII.709.E.2.d. The background groundwater quality information must take into account multiple sampling events, seasonal variations and spatial variations of the monitoring wells across the site and within a particular permeable zone. Thus, the number of samples collected to establish groundwater quality data must not only be consistent with the appropriate statistical procedures, but address the additional site-specific variables.

The statistical method used to evaluate the groundwater data for each parameter or constituent at this facility meet the performance standards in accordance with LAC 33:VII.709.E.2.e. The most appropriate method has been selected for each individual parameter based the analysis of the data. The background groundwater quality information must also take into account multiple sampling events, seasonal variations and spatial variation of the monitoring wells across the site and within a particular permeable zone. Additionally, the background groundwater quality may require the statistical method to include procedures to control or correct for seasonal and spatial variability, as well as temporal conditions in the data.

The statistical procedures used to evaluate the groundwater monitoring data are dependent on the character of the background data collected. Background constituent concentrations for each parameter listed in Table 4-1 have been derived from the analytical results using the statistical methods described in Section 5, Detection Monitoring Program. The proposed statistical method(s) were previously submitted to the Louisiana Department of Environmental Quality (LDEQ) within ninety (90) days after the collection of background groundwater quality data and approved. The statistical evaluation plan established for this facility is technically sound and is the most appropriate method(s) to be protective of human health and the environment. Furthermore, the statistical plan describes the general process for the statistical method based on the number of samples collected

5.0 DETECTION MONITORING PROGRAM

This section presents a summary of the groundwater monitoring and reporting activities to be implemented at the facility. Included is a discussion of the methodology used to select appropriate groundwater monitoring indicator parameters, detection monitoring, verification re-sampling, statistical approach, reporting, and, if necessary, assessment monitoring activities.

5.1 Groundwater Detection Monitoring Parameters

The parameters that are monitored during Detection Monitoring were selected from the listing of inorganic and organic constituents found in Appendix C, Table I of LAC 33:VII. Changes to this list will be made if any constituents are exempted by the administrative authority in the future. The Appendix C detection monitoring constituent list has been included as Table 5-1. Additionally, MW-09, not considered a part of the site groundwater monitoring system for the purposes of statistical evaluations, will be monitored for chloride levels only until no longer required by the administrative authority.

5.2 Groundwater Detection Monitoring Frequency

Analytical results of monitoring events have been submitted to the Solid Waste Division as semi-annual groundwater monitoring reports since 1986. After the establishment of background groundwater quality (refer to Section 4.0) and in accordance with LAC 33:VII.709.E.3.c and d, sampling and analysis of all wells will be conducted every six months for the life of the facility and the duration of the specified post-closure care period, unless a reduced frequency is approved by the administrative authority.

5.3 Reporting Requirements

A report containing the analytical results from each site sampling event will be submitted to the LDEQ Solid Waste Division unless otherwise directed by the administrative authority. A time-versus-chlorides graph for MW-09 will be included in the report until no longer required by the administrative authority. Additional documentation will include appropriate QA/QC data and

the Chain of Custody forms. If a statistically significant increase (SSI) in concentration, as defined by the selected statistical method, of any monitored constituent is identified from the analytical results, resampling for those constituents may be conducted up to 2 times to verify any suspected increase in concentration as a part of normal site sampling procedures (pass "1 of 2" verification re-sampling). Verification sampling will consist of resampling events scheduled at an interval sufficient to ensure sample independence. If the verification sampling results indicate that a source other than the MSWLF unit being sampled caused the SSI or that the SSI resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality, a report with the appropriate conclusions will be submitted to the administrative authority within 90 days after the determination in accordance with LAC 33:VII.709.E.3.f.iii.b.

In accordance with LAC 33:VII.709.E.3.f, if the facility determines a verified SSI for one or more parameters or constituents has occurred, the site will:

- notify the administrative authority in accordance with the Notification Regulations and Procedures for Unauthorized Discharge (LAC 33:1 Subpart 2), and

- submit to the Office of Environmental Assessment, Environmental Technology Division, within 14 days after the determination is made, a report that identifies which parameters or constituents were determined to have shown statistically significant changes from background levels;

- within 90 days after the determination is made,

    - initiate an assessment monitoring program for the facility meeting the requirements of Subsection E.4,
    - <u>or</u> submit, for approval, a report to the Office of Environmental Assessment, Environmental Technology Division demonstrating that a source other than the facility being sampled caused the contamination or that the statistically significant increase resulted from an error in Subclauses E.3.g.i.(a)-(d).

5.4 Data Evaluation

This section outlines the proposed evaluation methodology that may be used for detection of a release from the facility, by using PQLs listed on Table 3-1 as the concentration limits for VOCs, and the Shewart-CUSUM control chart for intra-well comparisons; Prediction Limits for up- to downgradient statistical comparisons; non-statistical visual evaluation methodologies, or other statistical methods approved by the LDEQ.

At each statistical event, background is examined for outliers, anomalies, and trends that might be an indication of a release. Outliers and anomalies are inconsistently large or small values that can occur due to sampling, laboratory, transportation or transcription errors, or even by chance alone. Significant trends in the background indicate a potential source of systematic error, or may indicate a release from the MSWLF unit that must be evaluated and corrected before the detection monitoring program can be continued. If systematic errors are included in the historical database used for statistical evaluation, a misinterpretation of the data set under analysis could result. The likely outcome would be an artificial increase in the magnitude of statistical limits, which could result in an increase in the false negative rate (i.e., a decrease in the sensitivity of the statistical procedure).

To remove the possibility of historical outliers and trends creating false statistical limits, the data for each well and each constituent will be tested for the existence of outliers. The DUMPStat® program uses the method described by Dixon (*Biometrics*, 1953, 9, 74-89) to define outliers in the background data set. Outliers should be removed from consideration during the establishment of all statistical limits. The outlier procedure described above may be applied, and appropriate statistical limits set, in accordance with Section 5.4.1, Statistical Methodology.

5.4.1 Statistical Methodology

The statistical method used to evaluate the groundwater data for each parameter or constituent will be in accordance with LAC 33:VII.709.E.2.e. The statistical method selected is dependent

upon the analytical data to be representative of background groundwater quality. Additionally, the background groundwater quality may require the statistical method to include procedures to control or correct for seasonal and spatial variability, as well as temporal conditions in the data. A site-specific statistical methodology was selected in accordance with ASTM D 6312-98, *"Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs"* and LAC 33:VII.709.E.2.e. The statistical evaluation methodology will be established such that the statistical method(s) chosen are technically sound and are the most appropriate method(s) to be protective of human health and the environment.

The statistical approach presented in this Plan is not generic, but was developed through the interaction of a qualified statistician (Dr. Robert Gibbons, professor at the University of Illinois, Chicago) and the Waste Management Corporate Director of Hydrogeology. The use of intra-well statistical comparisons for evaluation of groundwater chemistry data is supported by the USEPA and is in widespread use.

5.4.1.1 Volatile Organic Compounds

VOCs represent very effective indicators of a release from a MSWLF unit. Because these compounds are rarely detected in background groundwater samples, establishing monitor well-specific limits for VOCs is generally not an option.

The use of a PQL in the absence of a measurable background value is supported by 40 CFR 258.53(h)(5) which states that any PQL used in a statistical analysis:

> ... be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

The use of laboratory-specific PQLs already incorporates a measure of the statistical uncertainty that is associated with the analytical measurement process. Any VOC detected and verified at a concentration above the PQL would be statistically significant, and therefore trigger further action. The proposed laboratory PQLs are provided in Table 3-1.

5.4.1.2 Inorganic Parameters

The statistical analysis methodology for inorganic parameters with a detection frequency greater than 25% is based on a combined Shewhart-cumulative sum (CUSUM) control chart that is capable of detecting both sudden and gradual changes in groundwater chemistry (Gibbons, 1992; Gibbons, 1994). Combined Shewart-CUSUM control charts will be constructed for each well and parameter monitored to provide a statistical/visual tool for detecting trends and abrupt changes in inorganic groundwater chemistry. For inorganic parameters with a detection frequency less or equal to 25%, calculation of non-parametric or Poisson prediction limits are conducted. If, in the future, the number of statistical comparisons required for the site and the alternatives allowed to manage the site-wide false positive and false negative rates are inappropriate for the combined Shewhart-CUSUM control chart method, the statistical program may require alternate methods (such as normal prediction limits)

The combined Shewhart-CUSUM procedure requires a minimum of eight (8) historical independent samples (i.e., background data) to provide a reliable estimate of the mean and standard deviation of each constituent in each well. The combined Shewart-CUSUM control chart procedure assumes that the data are independent and normally distributed with a fixed mean and constant variance. The Shewhart-CUSUM control chart method statistically compares subsequent sample results to the estimated control limit both in terms of their absolute magnitude and cumulative sum. Shewhart-CUSUM control charts are not recommended for data sets less than 8 independent samples except as time-series plots and evaluation of trends.

If all inorganic parameter data collected during the background period (minimum of 8 independent events) are not detected in concentrations greater than the respective PQL's, the PQL will be used as the non-parametric prediction limit. The collection of thirteen (13) samples in background for this detection frequency provides a 99% confidence non-parametric prediction limit with one re-sample. Note, that 99% confidence is equivalent to a 1% false

positive rate and pertains to a single comparison (that is, well and constituent) and not the site-wide error rate (all wells and constituents) this is set to 5%. If the detection frequency is greater than zero but less than 25%, the non-parametric prediction limit is the largest of the 13 background samples (for 1 verification re-sample) or 8 background samples if a pass "1 of 2" verification re-sampling program is implemented.

5.4.2 Statistical Analysis

The statistical analysis program for inorganic parameters DUMPStat® is based on combined Shewhart-CUSUM control charts or prediction limits at all compliance point wells.

DUMPStat® uses a screening procedure based on the data set and total number of statistical comparisons per conducted for each monitoring event to allow for management of the site-wide false positive rate. A statistical power curve is also computed to illustrate the site-wide false positive rate. The EPA guidance document entitled "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance" dated July 1992 recommends that the selected statistical method for multiple constituent comparisons provide a site-wide false positive rate of 5% or less while maintaining a statistical power (1 minus the false negative rate) from the EPA reference power curve (correlating to a statistical power of >50% for a 3-sigma release and >80% for a 4-sigma release). If this cannot be achieved through a parameter or monitoring point reduction, then options available within DUMPStat® can be used. Adjustments to the control chart factor (for intra-well control charts) and verification re-sampling options, or the use of normal prediction limits may be implemented to achieve the statistical standards recommended by USEPA (1992) and Robert Gibbons (1994, 1999). This concept is consistent with the proposed EPA guidance in the Unified Statistical Guidance Document.

5.4.3 Detection Verification Procedure

Once groundwater analysis results have been collected, checked for QA/QC consistency and determined to be above the appropriate statistical level, the results must be verified in accordance with the objectives of 40 CFR Part 258.53. Verification re-sampling is an integral part of the statistical methodology described by EPA's Addendum to Interim Final Guidance Document. Without verification re-sampling, much larger statistical limits would be required to achieve site-wide false positive rates of 5% or less. Furthermore, the resulting false negative rate would be greatly increased. The use of a "pass 1 of 2" verification options will be used on a per event basis to help control the calculated site-wide false positive rate.

5.4.3.1 Volatile Organic Compounds

If one or more VOCs are detected above their statistical limit (i.e., PQL), up to two verification resamples will be scheduled no sooner than 30 days apart to provide sample independence. A statistically significant increase (SSI) will be recorded if any single VOC is verified in each of the scheduled re-sampling events in a concentration greater than the PQL.

5.4.3.2 Inorganic Constituents

If one or more of the inorganic parameters are detected above their statistical limit (i.e., Shewhart-CUSUM control chart computation value/prediction limit), up to two verification re-samples will be collected at the next sampling event with the re-sampling event scheduled no sooner than 30 days apart to provide sample independence. A SSI will be recorded if verification of one elevated parameter is confirmed in a concentration greater than the control/prediction limit for each of the discrete verification re-samples. If the re-sampling program confirms that the initial sample represented a laboratory or sampling-induced outlier, the verification sample will replace the original reported value to eliminate bias from the CUSUM calculation which considers all data points collected at the site.

5.4.4 False Positive Statistical Failures

To address seasonal variations and spatial variations of the monitoring wells across the site, incorporating a *minimum* number of effective monitoring parameters into the detection monitoring program is recommended to balance the false positive and false negative error rates in the statistical approach. The larger the number of parameters, the greater the statistical limit must be to avoid excessive false positive statistical decisions based on the inherent error rate (e.g., 0.05, or 0.01). For example, if a given detection monitoring program consists of only five compliance point wells and 20 monitoring parameters (i.e., 100 statistical decisions per sampling event), even using a very low error rate (e.g. 0.01 or 1.0%) would yield one false positive result every sample event. This failure rate assumes that adequate background data have been collected, and the most appropriate statistical methodology is being used. The

number of false positive results increases significantly if either of these factors is not correctly applied. The overall false positive rate can be controlled by limiting the number of statistical comparisons (i.e. the number of parameters and monitor points). The objective of the analyte selection process, therefore, is to select only those monitoring parameters that are demonstrated to be effective indicators of a release from the facility and eliminate those that are not.

5.4.5 Background Update Procedure

Quite often, the most appropriate method to improve the false-positive and false-negative rate(s) as well as the statistical power is to incorporate additional representative data into the background data set. Procedures to control or correct for seasonal and spatial variability as well as temporal change are critical to the effectiveness of the statistical approach. As monitoring continues and the process is shown to be in control, the background mean ($\bar{x}$) and variance (s) should be updated periodically to incorporate these new data. Not more often than once every two years, all new data that are in control will be pooled with the previous samples and $\bar{x}$ and s recomputed. These new values of $\bar{x}$ and s will then be used in constructing future control charts. This updating process will continue for the life of the facility and/or monitoring program. By updating the background, the statistics become more suited to the current conditions and are more likely to be protective of human health than the environment (i.e. few were false-positive/false-negative statistical results).

Prior to utilizing the periodically updated background data set for statistical evaluation, a demonstration shall be submitted to the Louisiana Department of Environmental Quality Environmental Technology Division (LDEQ-ETD) for approval. The demonstration will include documentation that all newly incorporated data are in control and present the updated values for the background mean and variance.

6.0 ASSESSMENT MONITORING PROCEDURE

The Assessment Monitoring Program will be triggered when a statistically significant increase compared to the established background concentration in one or more of sampled parameters or constituents concentration has been verified. Once Assessment Monitoring is deemed necessary, appropriate assessment actions will be determined. An assessment monitoring program that meets the requirements of LAC 33:VII.709.E.4 will be submitted to the administrative authority within 90 days after the determination has been made.

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Table 2-1
Magnolia Sanitary Landfill
Sample Collection, Preservation, and Holding Times[8]

PARAMETER[1]	SAMPLE COLLECTION[2] AND CONTAINER	SAMPLE[3,4] PRESERVATION	RECOMMENDED[5] HOLDING TIME
Acid Extractables	1000 ml Glass only (Amber) w/Teflon liner	Cool, 4°C	Extract within 7 days; analyze within 40 days
Alkalinity	100 ml P,G	Cool, 4°C	14 days
Ammonia	125 ml P,G	Cool, 4°C H_2SO_4 to pH <2	28 days
Base/Neutral Extractables (priority pollutants)	1000 ml Glass only (Amber) w/Teflon liner	Cool, 4°C	Extract within 7 days; analyze within 40 days
Biochemical Oxygen demand, 5 day (BOD5)	1000 ml P,G	Cool, 4°C	48 hours
Calcium	500 ml P	HNO3 to pH <2	6 months
Chemical Oxygen demand (COD)	125 ml P,G	Cool, 4°C H_2SO_4 to pH <2	28 days
Chloride	250 ml P,G	None required	28 days
Coliform, fecal and total	100 ml P,G sterilized	Cool, 4°C	24 hours
Cyanide	1000 ml P,G	Cool, 4°C NaOH to pH >12 0.6g ascorbic acid[6]	14 days[7]
Fluoride	250 ml P	None required	28 days
Hardness	100 ml P,G	HNO_3 to pH <2	6 months
Metals			
Chromium (hexavalent)	200 ml P,G	Cool, 4°C	24 hours
Mercury (dissolved)	1000 ml P,G	Filter on site	28 days
Mercury (total)	1000 ml P,G	HNO3 to pH <2 HNO_3 to pH <2	28 (lays

Table 2-1 (Cont'd)
Magnolia Sanitary Landfill
Sample Collection, Preservation, and Holding Times[8]

PARAMETER[1]	SAMPLE COLLECTION[2] AND CONTAINER	SAMPLE[3],[4] PRESERVATION	RECOMMENDED[5] HOLDING TIME
Other metals, (dissolved) (Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Zinc)	1000 ml P,G	Filter on site HNO3 to pH <2	6 months
Other metals, (totals) (Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Zinc)	1000 ml P,G	HNO3 to pH <2	6 months
Nitrate	125 ml P,G	Cool, 4°C	28 days
Nitrite	125 ml P,G	Cool, 4°C	28 days
Oil and Grease	1000 ml, G only	Cool, 4°C	28 days
PCB (priority pollutant)	1000 ml, Glass only (Amber w/Teflon liner	H2SO4 to pH <2 Cool, 4°C	Extract within 7 days; analyze within 40 days
Pesticides Endrin Lindane Toxaphene Methoxychlor	1000 ml, Glass only (Amber) w/Teflon liner	Cool, 4°C	Extract within 7 days analyze within 40 days
pH (field)	25 ml P,G	None required	Analyze immediately
Phenols	500 ml G only	Cool, 4°C H2S04 to pH <2	28 days
Phosphorous (total)	125 ml P,G	Cool 4°C H2SO4 to pH <2	28 days

Table 2-1 (Cont'd)
Magnolia Sanitary Landfill
Sample Collection, Preservation, and Holding Times[8]

PARAMETER[1]	SAMPLE COLLECTION[2] AND CONTAINER	SAMPLE[3,4] PRESERVATION	RECOMMENDED[5] HOLDING TIME
Specific Conductance(field)	100 ml P,G	None required	Analyze immediately
Sulfate	50 ml P,G	Cool, 4°C	28 days
Temperature (field)	1000 ml P,G	None required	Analyze immediately
Total Dissolved Solids residue on evaporation (TDS/ROE) 180° C	1000 ml P	Cool, 4°C	7 days
Total Organic Carbon (TOC)	2-40 ml P	Cool, 4°C	28 days
Total Suspended Solids (TSS)	1000 ml P	H2SO4 to pH <2 Cool, 4°C	7 days
Volatile Organic Acids, priority pollutants	4-40 ml glass vial w/septum caps	Cool, 4°C, 0.008% Na2S2O3	14 days

1. Table may include more parameters than required for groundwater sampling. A general discussion on sampling water and industrial waste water may be found in ASTM, Part 31, pages 72-81 (1976) Method D-3370.

2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

3. Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

4. When any sample is to be shipped by common carrier or sent through the United States mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table 5-4, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H2SO) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

6. Should only be used in the presence of residual chlorine.

7. Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot testis obtained. The sample is filtered and then NaOH is added to pH 12.

8. In accordance with LAC 33:VII. Appendix C, sample preservation, handling, and analysis will meet the specifications described by "Test Methods for Evaluating Solid Waste Physical/Chemical Methods, third edition" (EPA Publication Number SW-846, 1986, as revised December, 1987) or an equivalent substitute as approved by the administrative authority.

Table 2-2
Magnolia Sanitary Landfill
Methodologies for Testing and Analysis

PARAMETER	METHOD DESCRIPTION	METHOD*
Acid Extractables (priority pollutants)	GC/MS	EPA 625/8270(D)
Alkalinity	Colorimetric, Automated Methyl Orange	(A)310.2/310.1
Ammonia	Colorimetric; Automated Phenate	(A)350.1
Base/Neutral Extractables (priority pollutants)	GC/MS	8270C(D)
Biochemical Oxygen Demand, 5 day (BOD5)	BOD (5 day, 20 C)	(A)405.1
Calcium	Atomic Emission Spectrometric	(A)200.7/6010B(D)
Chemical Oxygen demand (COD)	Colorimetric	(A)410.4
Chloride	Colorimetric, Automated Ferricyanide	(A)325.2/300.0A
Coliform (fecal)	Delayed Incubation Procedure	(B)909C
Coliform (total)	Standard Membrane Filter Procedure	(B)909A
Cyanide (total)	Colorimetric, Automated UV	(A)335.3/9012(D)
Fluoride	Potentiometric, Ion Selective Electrode	(A)340.2
Hardness	Calculation	(C)2340B
Metals, dissolved		
Arsenic	Atomic Absorption, furnace technique, ICPMS, ICP	(A)206.2/6020/6010B (D)
Barium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Boron	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Cadmium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Chromium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Chromium (hexavalent)	Atomic Absorption, Chelation extraction, ICPMS	(A)218.4/6020
Iron	Atomic Emission Spectrometric, ICP	(A)200.7/6010B
Lead	Atomic Absorption, furnace technique, ICPMS	(A)239.21/7421/6020(D)
Magnesium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Manganese	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Mercury	Atomic Absorption, cold vapor technique	(A)245.2/7470(D)

Table 2-2
Magnolia Sanitary Landfill
Methodologies for Testing and Analysis

PARAMETER	METHOD DESCRIPTION	METHOD*
Metals, dissolved		
Nickel	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Potassium	Atomic Absorption, direct aspiration, ICP	(A)258.1/6010B(D)
Selenium	Atomic Absorption, furnace technique, ICP,ICPMS	(A)270.2/6010B/6020(D)
Silver	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Sodium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Zinc	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Metals, total		
Antimony	Atomic Emission Spectrometric, ICP	(A)200.7/6020(D)
Arsenic	Atomic Absorption, furnace technique, ICPMS	(A)206.2/6020(D)
Barium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Beryllium	Atomic Emission Spectrometric, ICP, ICPMS	(A)200.7/6010B/6020(D)
Boron	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Cadmium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Chromium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Copper	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Iron	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Lead	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Magnesium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Manganese	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Mercury	Atomic Emission Spectrometric, ICP	(A)245.2/7470(D)
Nickel	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Potassium	Atomic Absorption, direct aspiration, ICP	(A)258.1/6010B(D)
Selenium	Atomic Absorption, furnace technique, ICPMS, ICP	(A)270.2/6020/6010B(D)
Silver	Atomic Emission Spectrometric, ICP	(A)200.7/6010(BD)
Sodium	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Thallium	Atomic Absorption, furnace technique, ICPMS	(A)279.2/6020(D)
Zinc	Atomic Emission Spectrometric, ICP	(A)200.7/6010B(D)
Nitrate	Colorimetric, Automated, Hydrazine Reduction	(A)353.1/300.0A
Nitrite	Colorimetric, Automated, Hydrazine Reduction	(A)353.1
Oil and Grease	Gravimetric, Separatory Funnel Extraction or Spectrometric, Infrared	(A)413.1/9070(D) OR (A)413.2
PCB (priority pollutants)	Gas Chromatograph	EPA 8270(B)/8080(D)
Pesticides (Endrin, Lindane, Toxaphene, Methoxychlor)	Gas Chromatograph	EPA 8270(B)/8080(D)
pH (field)	Electrometric	(A)150.1

Table 2-2
Magnolia Sanitary Landfill
Methodologies for Testing and Analysis

PARAMETER	METHOD DESCRIPTION	METHOD*
Phenols	Colorimetric, Automated 4-AAP with Distillation	(A)420.2/9066(D)
Phosphorous	Colorimetric, Automated Ascorbic Acid	(A)365.4
Specific Conductance (field)	Wheatstone bridge	(A)120.1
Sulfate	Turbidimetric	(A)375.2 or 300.0
Temperature (field)	Reversing Thermometer	(B)212
Total dissolved solids Residue on evaporation (TDS/ROE)	Gravimetric, Dried at 180 C	(A)160.1
Total Organic Carbon (TOC)	Combustion or Oxidation	(A)415.1
Total Suspended Solids (TSS)	Gravimetric, Dried at 103-105 C	(A)160.2
Volatile Organic Acids (PP/VOA), priority pollutants	Purge and Trap/GC/MS	EPA 323/8260(D)

*NOTE: Analytical methods listed above may be substituted for as deemed necessary if the alternate methods provide adequate analytical data to fulfill monitoring requirements and meet regulatory performance standards.

References:

A: Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-0920, EMSL, Cincinnati, Revision (March 1983)

B: Standard Methods for the Examination of Water and Wastewaters, 15th Edition, APHA-AQWQA-WPCF, 1980

C*: Standard Methods for the Examination of Water and Wastewaters, 18th Edition, APHA-AWWA-WEF, 1992

D: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, as revised.

Table 3-1
Magnolia Sanitary Landfill
Laboratory Reporting Limits[1]

COMMON NAME		PQL (ug/L)
Inorganic Constituents:		
(1)	Antimony	6.0
(2)	Arsenic	10.0
(3)	Barium	200
(4)	Beryllium	1.0
(5)	Cadmium	5.0
(6)	Chromium	10.0
(7)	Cobalt	50.0
(8)	Copper	25.0
(9)	Lead	5.0
(10)	Nickel	40.0
(11)	Selenium	5.0
(12)	Silver	25.0
(13)	Thallium	2.0
(14)	Vanadium	50.0
(15)	Zinc	20.0
Organic Constituents:		
(16)	Acetone	100.0
(17)	Acrylonitrile	100.0
(18)	Benzene	5.0
(19)	Bromochloromethane	10.0
(20)	Bromodichloromethane	5.0
(21)	Bromoform; Tribromomethane	5.0
(22)	Carbon disulfide	5.0
(23)	Carbon tetrachloride	5.0
(24)	Chlorobenzene	5.0
(25)	Chloroethane; Ethyl chloride	10.0
(26)	Chloroform; Trichloromethane	5.0
	Dibromochloromethane;	5.0
(28)	1,2-Dibromo-3-chloropropane; DBCP	1.0
(29)	1,2-Dibromoethane; Ethylene dibromide; EDB	1.0
(30)	o-Dichlorobenzene; 1,2-Dichlorobenzene	10.0
(31)	p-Dichlorobenzene; 1,4-Dichlorobenzene	10.0
(32)	trans-1,4-Dichloro-2-butene	10.0
(33)	1, 1 -Dichloroethane; Ethylidene chloride	5.0
(34)	1,2-Dichloroethane; Ethylene dichloride	5.0
(35)	1,1-Dichloroethylene; 1,1- Dichloroethene; Vinylidene chloride	5.0
(36)	cis- 1,2-Dichloroethylene; cis- 1,2- Dichloroethene	10.0
(37)	trans- 1,2-Dichloroethylene; trans- 1,2- Dichloroethene	10.0
(38)	1,2-Dichloropropane; Propylene dichloride	5.0

Table 3-1 (Cont'd)
Magnolia Sanitary Landfill
Laboratory Reporting Limits[1]

COMMON NAME		PQL (ug/L)
Organic Constituents (cont'd):		
(39)	cis-1,3-Dichloropropene	5.0
(40)	trans-1,3-Dichloropropene	5.0
(41)	Ethylbenzene	5.0
(42)	2-Hexanone; Methyl butyl ketone	10.0
(43)	Methyl bromide; Bromomethane	10.0
(44)	Methyl chloride; Chloromethane	5.0
(45)	Methylene bromide; Dibromomethane	10.0
(46)	Methylene chloride; Dichloromethane	5.0
(47)	Methyl ethyl ketone; MEK; 2-Butanone	50.0
(48)	Methyl iodide; Iodomethane	10.0
(49)	4-Methyl-2-pentanone;Methyl isobutyl ketone	10.0
(50)	Styrene	5.0
(51)	1,1,1,2-Tetrachloroethane	5.0
(52)	1,1,2,2-Tetrachloroethane	5.0
(53)	Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	5.0
(54)	Toluene	5.0
(55)	1,1,1-Trichloroethane; Methylchloroform	5.0
(56)	1,1,2-Trichlolroethane	3.0
(57)	Trichloroethylene; Trichloroethene	5.0
(58)	Trichlorofluoromethane; CFC-11	10.0
(59)	1,2,3-Trichloropropane	10.0
(60)	Vinyl acetate	10.0
(61)	Vinyl chloride	2.0
(62)	Xylenes	10.0

Note 1: In accordance with LAC 33:VII. Appendix C, sample preservation, handling, and analysis will meet the specifications described by "Test Methods for Evaluating Solid Waste Physical/Chemical Methods, third edition" (EPA Publication Number SW-846, 1986, as revised December, 1987) or an equivalent substitute approved by the administrative authority.

Table 4-1
Magnolia Sanitary Landfill
Background Groundwater Quality Parameter List[1]

COMMON NAME		CAS RN
Inorganic Constituents (Total):		
(1)	Antimony	(Total)
(2)	Arsenic	(Total)
(3)	Barium	(Total)
(4)	Beryllium	(Total)
(5)	Cadmium	(Total)
(6)	Chromium	(Total)
(7)	Cobalt	(Total)
(8)	Copper	(Total)
(9)	Lead	(Total)
(10)	Nickel	(Total)
(11)	Selenium	(Total)
(12)	Silver	(Total)
(13)	Thallium	(Total)
(14)	Vanadium	(Total)
(15)	Zinc	(Total)
Organic Constituents:		
(16)	Acetone	67-64-1
(17)	Acrylonitrile	107-13-1
(18)	Benzene	71-43-2
(19)	Bromochloromethane	74-97-5
(20)	Bromodichloromethane	75-27-4
(21)	Bromoform (tribromomethane)	75-25-2
(22)	Carbon disulfide	75-15-0
(23)	Carbon tetrachloride	56-23-5
(24)	Chlorobenzene	108-90-7
(25)	Chloroethane (ethyl chloride)	75-00-3
(26)	Chloroform (trichloromethane)	67-66-3
(27)	Dibromochloromethane (chlorodibromomethane)	124-48-1
(28)	1,2-Dibromo-3-chloropropane (DBCP)	96-12-8
(29)	1,2-Dibromoethane (ethylene dibromide, EDB)	106-93-4
(30)	o-Dichlorobenzene (1,2-dichlorobenzene)	95-50-1
(31)	p-Dichlorobenzene (1,4-dichlorobenzene)	106-46-7
(32)	trans- 1,4-Dichloro-2-butene	110-57-6
(33)	1,1-Dichloroethane (ethyldidene chloride)	75-34-4
(34)	1,2-Dichloroethane (ethylene dichloride)	107-06-2
(35)	1, 1 -Dichloroethylene (1, 1 -dichloroethene, vinylidene chloride)	75-35-4
(36)	cis-1,2-Dichloroethylene (cis-1,2-dichloroethene)	156-59-2
(37)	trans- 1.2-Dichloroethylene (trans- 1,2-dichloroethene)	156-60-5
(38)	1,2-Dichloropropane (Propylene dichloride)	78-87-5

Table 4-1 (Cont'd.)
Magnolia Sanitary Landfill
Background Groundwater Quality Parameter List[1]

COMMON NAME		CAS RN
(39)	cis-1,3-Dichloropropene	10061-01-5
(40)	trans- 1,3-Dichloropropene	10061-02-6
(41)	Ethylbenzene	100-41-4
(42)	2-Hexanone (methyl butyl ketone)	591-78-6
(43)	Methyl bromide (bromomethane)	74-83-9
(44)	Methyl chloride (chloromethane)	74-87-3
(45)	Methylene bromide (dibromomethane)	74-95-3
(46)	Methylene chloride (dichloromethane)	75-09-2
(47)	Methyl ethyl ketone (MEK, 2-butanone)	78-93-3
(48)	Methyl iodide (iodomethane)	74-88-4
(49)	4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1
(50)	Styrene	100-42-5
(51)	1, 1, 1,2-Tetrachloroethane	630-20-6
(52)	1,1,2,2-Tetrachloroethane	79-34-5
(53)	Tetrachloroethylene (tetrachloroethane, perchloroethylene)	127-18-4
(54)	Toluene	108-88-3
(55)	1, 1, 1 -Trichloroethane (methylchloroform)	71-55-6
(56)	1,1,2-Trichloroethane	79-00-5
(57)	Trichloroethylene (trichloroethene)	79-01-6
(58)	Trichlorofluoromethane (CFC-11)	75-69-4
(59)	1,2,3-Trichloropropane	96-18-4
(60)	Vinyl acetate	108-05-4
(61)	Vinyl chloride	75-01-4
(62)	Xylenes (total)	1330-20-7

Note 1: This list defines all those constituents identified in Appendix I of 40 CFR Part 258 and LAC 33:VII. Appendix C, Table 1.

Table 5-1
Magnolia Sanitary Landfill
Detection Monitoring Groundwater Quality Parameter List[1]

COMMON NAME		CAS RN
Inorganic Constituents (Total):		
(1)	Antimony	(Total)
(2)	Arsenic	(Total)
(3)	Barium	(Total)
(4)	Beryllium	(Total)
(5)	Cadmium	(Total)
(6)	Chromium	(Total)
(7)	Cobalt	(Total)
(8)	Copper	(Total)
(9)	Lead	(Total)
(10)	Nickel	(Total)
(11)	Selenium	(Total)
(12)	Silver	(Total)
(13)	Thallium	(Total)
(14)	Vanadium	(Total)
(15)	Zinc	(Total)
Organic Constituents:		
(16)	Acetone	67-64-1
(17)	Acrylonitrile	107-13-1
(18)	Benzene	71-43-2
(19)	Bromochloromethane	74-97-5
(20)	Bromodichloromethane	75-27-4
(21)	Bromoform (tribromomethane)	75-25-2
(22)	Carbon disulfide	75-15-0
(23)	Carbon tetrachloride	56-23-5
(24)	Chlorobenzene	108-90-7
(25)	Chloroethane (ethyl chloride)	75-00-3
(26)	Chloroform (trichloromethane)	67-66-3
(27)	Dibromochloromethane (chlorodibromomethane)	124-48-1
(28)	1,2-Dibromo-3-chloropropane (DBCP)	96-12-8
(29)	1,2-Dibromoethane (ethylene dibromide, EDB)	106-93-4
(30)	o-Dichlorobenzene (1,2-dichlorobenzene)	95-50-1
(31)	p-Dichlorobenzene (1,4-dichlorobenzene)	106-46-7
(32)	trans- 1,4-Dichloro-2-butene	110-57-6
(33)	1,1-Dichloroethane (ethyldidene chloride)	75-34-4
(34)	1,2-Dichloroethane (ethylene dichloride)	107-06-2
(35)	1, 1 -Dichloroethylene (1, 1 -dichloroethene, vinylidene chloride)	75-35-4
(36)	cis-1,2-Dichloroethylene (cis-1,2-dichloroethene)	156-59-2
(37)	trans- 1.2-Dichloroethylene (trans- 1,2-dichloroethene)	156-60-5

Table 5-1 (Cont'd.)
Magnolia Sanitary Landfill
Detection Monitoring Groundwater Quality Parameter List[1]

COMMON NAME		CAS RN
(38)	1,2-Dichloropropane (Propylene dichloride)	78-87-5
(39)	cis-1,3-Dichloropropene	10061-01-5
(40)	trans- 1,3-Dichloropropene	10061-02-6
(41)	Ethylbenzene	100-41-4
(42)	2-Hexanone (methyl butyl ketone)	591-78-6
(43)	Methyl bromide (bromomethane)	74-83-9
(44)	Methyl chloride (chloromethane)	74-87-3
(45)	Methylene bromide (dibromomethane)	74-95-3
(46)	Methylene chloride (dichloromethane)	75-09-2
(47)	Methyl ethyl ketone (MEK, 2-butanone)	78-93-3
(48)	Methyl iodide (iodomethane)	74-88-4
(49)	4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1
(50)	Styrene	100-42-5
(51)	1, 1, 1,2-Tetrachloroethane	630-20-6
(52)	1,1,2,2-Tetrachloroethane	79-34-5
(53)	Tetrachloroethylene (tetrachloroethane, perchloroethylene)	127-18-4
(54)	Toluene	108-88-3
(55)	1, 1, 1 -Trichloroethane (methylchloroform)	71-55-6
(56)	1,1,2-Trichloroethane	79-00-5
(57)	Trichloroethylene (trichloroethene)	79-01-6
(58)	Trichlorofluoromethane (CFC-11)	75-69-4
(59)	1,2,3-Trichloropropane	96-18-4
(60)	Vinyl acetate	108-05-4
(61)	Vinyl chloride	75-01-4
(62)	Xylenes (total)	1330-20-7

Note 1: This list defines all those constituents identified in Appendix I of 40 CFR Part 258 and LAC 33:VII. Appendix C, Table 1.

FIGURES

Field Information Form	2-1
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Detection Monitoring Program Procedural Flowchart	5-1

Field Information Form

(For Informational Purposes Only. Actual Form May Vary)

FIELD INFORMATION FORM

WM WASTE MANAGEMENT

Site Name: _____

Site No.: _____ Sample Point: _____ Sample ID

This Waste Management Field Information Form is Required
This form is to be completed, in addition to any State Forms. The Field Form is submitted along with the Chain of Custody Forms that accompany the sample containers (i.e. with the cooler that is returned to the laboratory).

Laboratory Use Only/Lab ID: _____

PURGE INFO

PURGE DATE (MM DD YY)	PURGE TIME (2400 Hr Clock)	ELAPSED HRS (hrs:min)	WATER VOL IN CASING (Gallons)	ACTUAL VOL PURGED (Gallons)	WELL VOLs PURGED

Note: For Passive Sampling, replace "Water Vol in Casing" and "Well Vols Purged" w/ Water Vol in Tubing/Flow Cell and Tubing/Flow Cell Vols Purged. Mark changes, record field data, below.

PURGE/SAMPLE EQUIPMENT

Purging and Sampling Equipment ... Dedicated: Y or N

Filter Device: Y or N 0.45 µ or _____ µ (circle or fill in)

Purging Device _____ A- Submersible Pump B-Peristaltic Pump C-QED Bladder Pump D-Bailer E-Piston Pump F-Dipper/Bottle

Sampling Device _____

X-Other: _____

Filter Type: _____ A-In-line Disposable B-Pressure C-Vacuum X-Other _____

Sample Tube Type: _____ A-Teflon B-Stainless Steel C-PVC D-Polypropylene X-Other: _____

WELL DATA

Well Elevation (at TOC) _____ (ft/msl) Depth to Water (DTW) (from TOC) _____ (ft) Groundwater Elevation (site datum, from TOC) _____ (ft/msl)

Total Well Depth (from TOC) _____ (ft) Stick Up (from ground elevation) _____ (ft) Casing ID _____ (in) Casing Material _____

Note: Total Well Depth, Stick Up, Casing Id, etc. are optional and can be from historical data, unless required by Site/Permit. Well Elevation, DTW, and Groundwater Elevation must be current.

STABILIZATION DATA (Optional)

Sample Time (2400 Hr Clock)	Rate/Unit	pH (std)	Conductance (SC/EC) (µmhos/cm @ 25 °C)	Temp. (°C)	Turbidity (ntu)	D.O. (mg/L - ppm)	eH/ORP (mV)	DTW (ft)
	1st	1st						
	2nd	2nd						
	3rd	3rd						
	4th	4th						
Suggested range for 3 consec. readings or note Permit/State requirements:		+/- 0.2	+/- 3%	–	–	+/- 10%	+/- 25 mV	Stabilize

Stabilization Data Fields are Optional *(i.e. complete stabilization readings for parameters required by WM, Site, or State). These fields can be used where four (4) field measurements are required by State/Permit/Site. If a Data Logger or other Electronic format is used, fill in final readings below and submit electronic data separately to Site. If more fields above are needed, use separate sheet or form.*

FIELD DATA

SAMPLE DATE (MM DD YY)	pH (std)	CONDUCTANCE (umhos/cm @ 25°C)	TEMP. (°C)	TURBIDITY (ntu)	DO (mg/L-ppm)	eH/ORP (mV)	Other: _____ Units _____

Final Field Readings are required *(i.e. record field measurements, final stabilized readings, passive sample readings before sampling for all field parameters required by State/Permit/Site.*

FIELD COMMENTS

Sample Appearance: _____ Odor: _____ Color: _____ Other: _____

Weather Conditions (required daily, or as conditions change): Direction/Speed: _____ Outlook: _____ Precipitation: Y or N

Specific Comments (including purge/well volume calculations if required): _____

I certify that sampling procedures were in accordance with applicable EPA, State, and WM protocols (if more than one sampler, all should sign):

___/___/___ _____ _____ _____

___/___/___ _____ _____ _____

Date Name Signature Company

DISTRIBUTION: WHITE/ORIGINAL - Stays with Sample, YELLOW - Returned to Client, PINK - Field Copy

STL-8029WM R: 12/00

Chain of Custody Form

(For Informational Purposes Only. Actual Form May Vary)

Chain of Custody Record

SEVERN TRENT SERVICES

Severn Trent Laboratories, Inc.

STL-4124 (0700)

Client	Project Manager	Date	Chain of Custody Number 036068
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page _____ of _____
City / State / Zip Code	Site Contact	Lab Contact	
Project Name and Location (State)	Carrier/Waybill Number		
Contract/Purchase Order/Quote No.			

Analysis (Attach list if more space is needed)

Special Instructions/ Conditions of Receipt

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H_2SO_4	HNO3	HCl	NaOH	ZnAc/ NaOH														

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 3 months)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other_____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By			1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Stays with the Sample; CANARY - Returned to Client with Report; PINK - Field Copy

Detection Monitoring Program Procedural Flowchart

MAGNOLIA SANITARY LANDFILL
DETECTION MONITORING PROGRAM
PROCEDURAL FLOWCHART

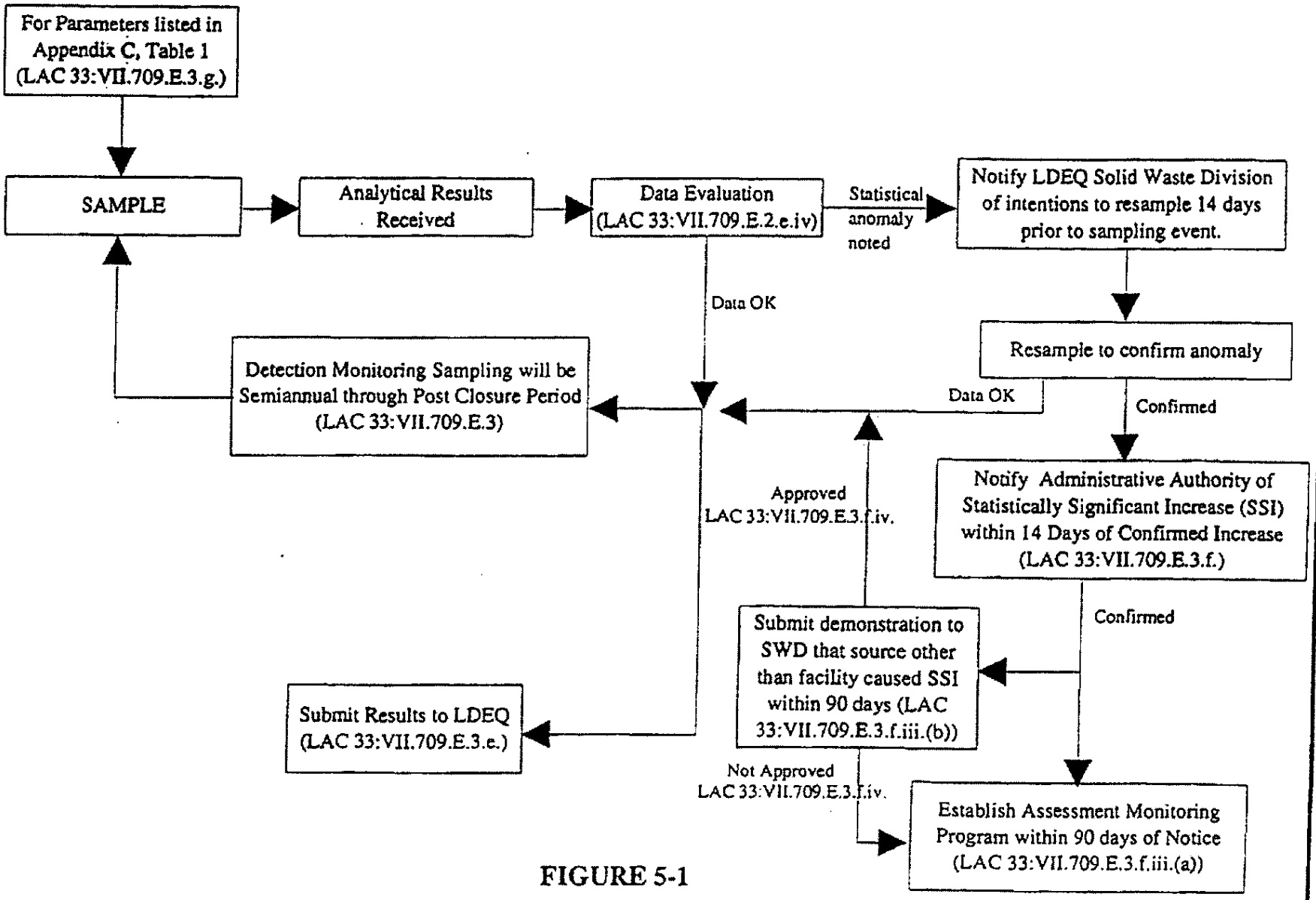

FIGURE 5-1

COMPREHENSIVE AIR MONITORING PLAN

APPENDIX G

COMPREHENSIVE AIR MONITORING PLAN

FOR

MAGNOLIA SANITARY LANDFILL

OUACHITA PARISH, LOUISIANA

Prepared by:

RUST Environment & Infrastructure
8919 World Ministry Avenue, Suite 201
Baton Rouge, Louisiana 70810

October 1996

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1.0 INTRODUCTION

The purpose of this plan is to outline the plan and procedures for monitoring for the presence of landfill gas along the site property line and adjacent to any on-site structures, and to monitor the potential for a gas accumulation within on-site structures at the Magnolia Sanitary Landfill. If on-site monitoring indicates the possibility of off-site migration, additional monitoring will be performed to determine the extent of migration beyond the property line and also the potential for accumulation within off-site structures (i.e. buildings, sub-grade utilities). A final objective is to ensure that the site remains within applicable regulatory and safety guidelines regarding control of landfill gas migration.

2.0 GENERAL SITE INFORMATION

2.1 Location

Magnolia Sanitary Landfill is a fully permitted 261-acre non-hazardous solid and industrial waste landfill. The site is located in the north 1/2 of section 7, Township 17 North, Range 5 West, Ouachita Parish, Louisiana which is located one-half mile south of I-20 at the La. Hwy. 594 exit, east of Monroe. The landfill is bordered on the north and south by wooded areas which are essentially used as private hunting grounds. To the east lies the Russell Sage Wildlife Management Area, and the west is farmland owned by Waste Management of Louisiana, Inc., (WML). The permitted acreage is also owned by WML. Though proximate to populated areas of the City and two major thoroughfares, the site is isolated from residential developments with the nearest structure being well over a mile away.

2.2 History of Use

Prior to its use as a landfill, this acreage was farmed in conjunction with the land immediately to the west. The land was put under a lease option, permitted, and began operation as a landfill in February 1986 by American Waste and Pollution Control Company (AWPCC), a subsidiary of Waste Management of North America, Inc. The site is operated as an area fill within a continuous excavation depth of about 10 feet. In 1992, AWPCC purchased the permitted acreage and the farmland to the west from the lessor. In 1993, AWPCC changed its name to WML. As of October 1993, approximately 57 acres have been landfilled to as much as 30 feet above grade.

3.0 MONITORING FACTORS

3.1 Soil and Hydrogeologic Conditions

With respect to this gas migration plan, the most significant aspect of the site geology to recognize is the presence of a relatively thick, low-permeability clay (CH) layer over the site area extending from the ground surface to about 15 feet deep. Immediately below the CH layer is a layer of low permeability, low to medium plasticity clay (CL). Imbedded within a portion of the CL layer is a silty sand (ML) area or lens which also exhibits low permeability (1×10^{-5} cm/sec). Some slickensides in the clay are noted down to the design base grades about 10 feet below natural grades. The clay soils can be very wet to nearly saturated in the winter or very dry and desiccated in the summer.

3.2 Hydraulic Conditions

Groundwater is found at 8 to 15 feet below ground surface. Groundwater surfaces are determined based upon the monitoring of the groundwater monitoring wells at the site which have been periodically monitored since 1985 and the RUST E&I hydrogeological investigation of 1993. The bottom liner of existing cells (as of 10/93) is excavated and recompacted clay. Future cells are being redesigned to include a geomembrane. We anticipate that migration of gas below the groundwater surface is extremely unlikely.

3.3 Location of Structures and Facility Boundary

The 11" x 17" reduction of the Probe Location Map (Attachment 1) shows the entire landfill property and on-site buildings. Gas monitoring is expected to be conducted in the management area for the maintenance building due to the potential gas accumulation within the structure. The landfill is bordered on the north and south by wooded areas which are essentially used as private hunting grounds. To the east lies the Russell Sage Wildlife Management area, and the west is farmland owned by Waste Management of Louisiana, Inc., (WML). The permitted acreage is also owned by WML. Though proximate to populated areas of the City and two major thoroughfares, the site is isolated from residential developments with the nearest structure being well over a mile away.

3.4 Summary of Monitoring Factors and Monitoring Plan

Migration of gas below the groundwater surface is extremely unlikely. Migration of gas into and through the clayey layer will be very restricted. Therefore, the most likely pathways for gas movement would be the slickensides and seasonal shrinkage cracks. However, even these routes are not expected to provide continuous conduits comparable to sandy or silty deposits. Due to the very low potential for lateral gas migration, a monitoring program which consists of quarterly barhole probing is sufficient.

3.5 Gas Control/Collection System

On June 17, 1996 the administrative authority approved a permit modification for the installation of an active gas collection system which eliminated the eight previously approved passive flares and utilization of a single utility flare. The installation of the active gas collection system will result in enhancements to operational efficiency for the effective management and control of landfill gas produced through facility operations. A conceptual design for the final active gas collection and treatment system is presented on Drawings No. 13, 14, and 15 of the design report prepared by RUST E&I, which is in Appendix E. It is anticipated the active gas collection system will be installed in phases since the interim or final design (i.e., location and number of gas extraction wells) and ultimately the effectiveness of a gas system is dependent upon the waste mass configuration. Therefore, during the active life of the facility additional gas extraction wells and flares will be installed in phases to control potential odors and gas migration as required. The gas extraction wells and flares installed in the separate phases, similar to those approved by the administrative authority, will be incorporated into or replaced during the installation of the final gas collection system in order to assure that methane gas is limited to less than the explosive limit at the site boundary and less than 25 % of the Lower Explosive Limit in facility structures.

3.6 Historic Gas Monitoring Program

The gas monitoring program to date has consisted of semi-annual barhole probings and gas detection testing using a Gastech NP-204 gas meter. Every 500 feet around the site perimeter and along areas that have been filled, a barhole is punched approximately 2 to 3 feet into the ground and a check for gas is made with the meter. A sample probing grid and report form have been included for illustrative purposes in Attachment. 1. As of October 22, 1993, lateral gas migration has never been detected during a monitoring event. Beginning with the fourth quarter of 1993, quarterly monitoring is being performed at the facility. Records of monitoring events are kept on file at the facility.

4.0 REGULATORY REQUIREMENTS

The permit for Magnolia Sanitary Landfill is being modified to specify quarterly monitoring will be conducted and a report sent to the State. Semi-annual monitoring was conducted as per the site's permit prior to October 1993.

The Louisiana Solid Waste Rule (effective 2/20/93) requires (D.3.a.i.) facilities receiving waste with a potential to produce methane gas shall be subject to the air monitoring requirements. (D.3.a.ii.) The permit holder or applicant subject to air monitoring requirements shall submit to the Solid Waste Division a comprehensive air-monitoring plan that will limit methane gas to less than the explosive limits at the facility boundary and to 25 percent of the lower-explosive limits in facility buildings. (D.3.a.ii.(a).) The type and frequency of monitoring must be determined based upon the following factors: (D.3.a.ii.(a).(i).) soil condition, (D.3.a.ii.(a).(ii).) hydrogeologic conditions surrounding the facility, (D.3.a.ii.(a).(iii).) hydraulic conditions surrounding the facility, and (D.3.a.ii.(a).(iv).) the location of facility structures and property boundaries. (D.3.a.ii.(b).) The minimum frequency of monitoring shall be quarterly. (D.3.a.iii.) If methane gas levels exceed the limits specified in Subsection D.3.a.ii. of this Section are detected, the permit holder must: (D.3.a.iii.(a).)immediately take all necessary steps to ensure protection of human health and notify the administrative authority; (D.3.a.iii.(b).) within seven days of detection submit a report to the administrative authority that provides the methane gas levels detected and a description of the steps taken to protect human health; (D.3.a.iii.(c).) within 30 days of detection submit a remediation plan for the methane gas releases to the administrative authority. The plan shall describe the nature and extent of the problems and the proposed remedy and shall include an implementation schedule. The plan must be implemented within 60 days of detection. (D.3.iv.) The permit holder shall notify the administrative authority when strong odors occur at facility boundary. (D.3.a.v.) Records of inspection, surveys, and all gas monitoring must be maintained at the facility. (D.3.a.vi.) Odors shall be controlled by the best means practicable. (D.3.a.vii.) Facilities must ensure that the units do not violate any applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated pursuant to Section 110 of the Clean Air Act, as amended.

To satisfy these requirements, all applicable sections of the site's permit will be amended to comply with these rules. The changes will be sent to the administrative authority as part of the facility's mandatory modification by February 1994. A comprehensive air monitoring plan is developed and submitted to the State by Nov. 9, 1993 which addresses these rules. This document serves as that plan.

5.0 MONITORING FREQUENCY AND LOCATIONS

Monitoring for combustible gas concentrations will be performed on a quarterly basis at barhole probe locations, the main building, and the scale house. The locations of the barhole probes BH-1 through BH-12 and the monitoring locations for the scale house (GM-1) and the maintenance building (GM-2) are shown on Attachment 1. Monitoring of the additional barhole probes (BH-13 through BH-26), as shown, will be implemented as the landfill operation of the site expands laterally. Barhole probes are located as shown to monitor gas conditions at the site boundary. The Gas Monitoring and Testing Procedures are presented in Attachment 2. The Gas-Tech Model NP-204 Natural Gas Indicator or an equivalent will be used for gas monitoring and this equipment is detailed in Attachment 3. For barhole probing, a plunger bar is required (see Attachment 5).

6.0 DATA REPORTING AND EVALUATION

All monitoring results and observations will be recorded on monitoring report forms (see Attachment 2). Data is evaluated for anomalies and trends. A copy of the monitoring data is filed at the site, and a copy forwarded to the Louisiana Department of Environmental Quality.

Where combustible gas concentrations exceed 5% at a probe location or 1.25 % within a structure, further investigations should be identified in a separate report and attached to the Gas Monitoring Report. Appropriate remedial action will be the responsibility of the facility's General Manager with the assistance of the Site Engineer.

If methane gas levels exceeding the limits specified in the above paragraph are detected, facility personnel will immediately take all necessary steps to ensure protection of human health and safety, and notify the LDEQ. Actions necessary to protect human health and safety will most likely involve evacuation and ventilation of affected structures.

6.1 Monitoring Personnel

Personnel designated to perform the monitoring and reporting of data must be trained in the operation, maintenance and calibration of all monitoring equipment.

7.0 SAFETY

7.1 Potential Safety Hazards

When monitoring on landfill sites, the monitoring technicians should be alert to the hazards caused by the presence of potentially combustible landfill gas. Hazards that might occur could be one or more of the following:

a. Fires may start from exposed and/or decomposing solid waste.

b. Fires and explosions may occur from the presence of landfill gas. Methane gas (CH4), which is about 50% of the total of landfill gas, and which is also known as marsh gas and/or methyl hydride, is a flammable, colorless, odorless, and tasteless gas.

c. Landfill gas may cause an oxygen deficiency in underground trenches, vaults, conduits and structures, and confined-space entry procedures should be followed.

d. Hydrogen sulfide (H_2S) may also be present. H_2S is a colorless, very flammable gas which, in low concentrations, has an offensive odor similar to that of rotten eggs. H_2S can be highly toxic. Although the odor of H_2S is recognizable (unless masked) at 1/400 of the lowest possible amount that can cause injurious effects, sense of smell is lost within two to 15 minutes of exposure. At higher concentrations, it will instantly deaden the sense of smell and cause death within seconds by terminating the function of the nerve and motor center in the brain.

7.2 Safety Precautions

The following safety precautions should be adhered to by personnel when monitoring for combustible gas:

1. At least two people should be present at all times when monitoring for combustible gas concentrations (buddy system).

2. Hard hats and glasses must be worn at all times.

3. Absolutely no smoking at any time.

4. A fire extinguisher must be readily available, especially when monitoring gas concentrations within structures and/or confined spaces.

5. The site specific landfill safety program should be followed.

6. Barhole probing will not be conducted near building unless:

    a. Sub-grade utility lines are located and clearly marked prior to the monitoring event.

    b. A person with knowledge of all sub-grade utility lines is present at the time of the monitoring event.

    c. Monitoring personnel are in receipt of an accurate site utility plan/map.

Methane is an odorless, tasteless gas, and it is undetectable by the human senses. Therefore, sampling personnel must continually be aware of and avoid all potential sources of ignition. When monitoring in confined areas, it is recommended that a Gas Tech GX82 Tritector or an equivalent be used to continually monitor the gas conditions within the working area. This instrument monitors for methane, oxygen and hydrogen sulfide and will provide both a visual and audible alarm if gas concentrations exceed or drop below a set level.

7.3 Combustible Property of Methane

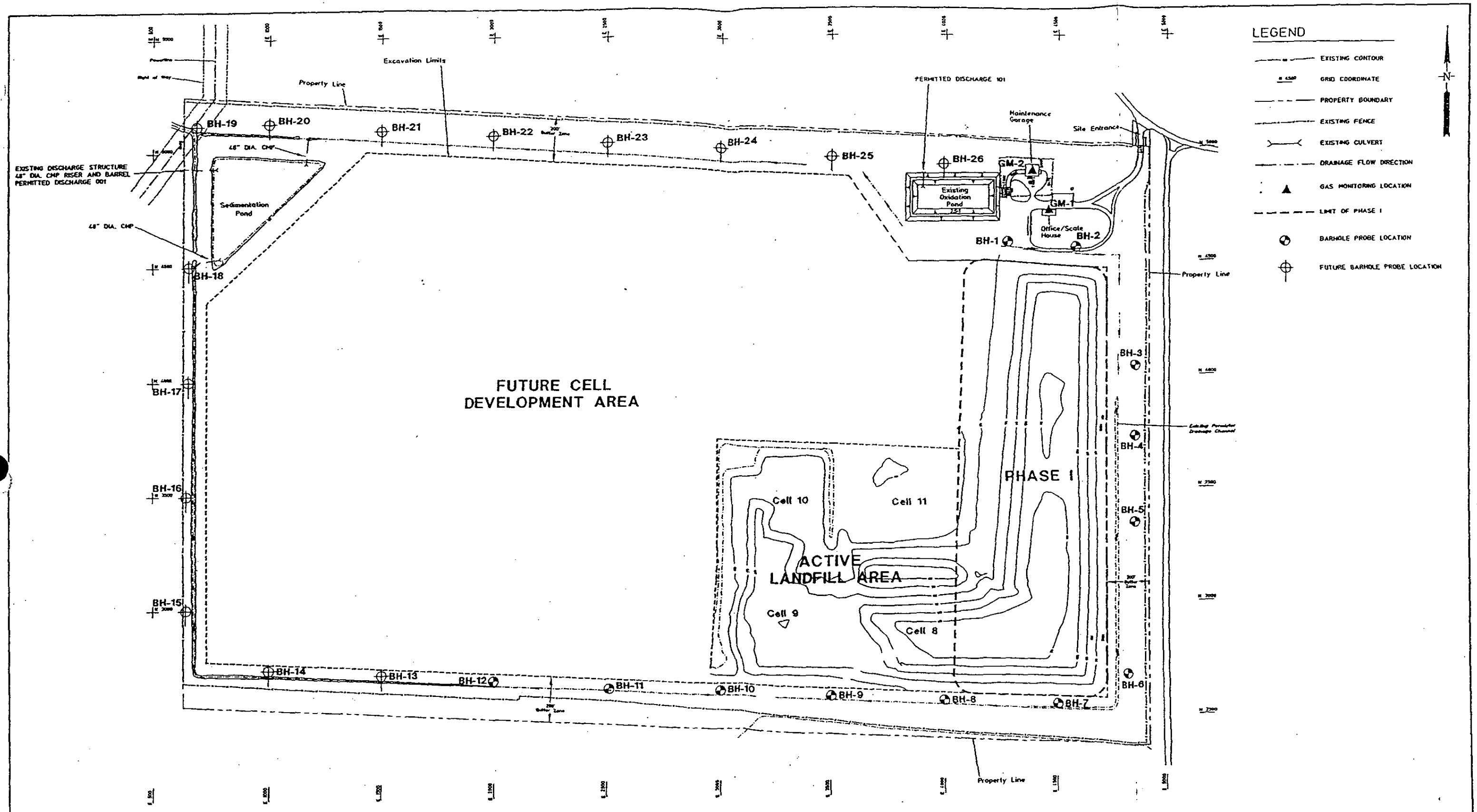
When methane is introduced into an area, fresh air is gradually displaced until the area may be completely filled with the gas. During this process, the air/mixture passes through three specific ranges: lean, explosive and rich.

Mixtures in the lean range, which extends from fresh air to the lower explosive limit (LEL), contain too little gas in relation to the amount of air to burn, (that is, propagation of flame does not occur on contact with a source of ignition). A mixture of the LEL, which is 5% by volume, is the lowest concentration of methane in air that will explode or burn when ignited. Mixtures in the explosive or flammable range, which extends from the LEL to the upper explosive limit (UEL), will propagate flame. Large volumes of combustible gases or vapors in these concentrations, if

ignited, can cause damage and personal injury. A mixture at the UEL (15%) has the highest concentration of combustible gas in air that will burn. Mixtures in the rich range, which extends from the UEL to 100% methane, contain too much gas in relation to air to be combustible. However, since the addition of air to these high concentrations of methane creates mixtures in the flammable region, they must be considered equally dangerous.

ATTACHMENT 1

PROBE LOCATION MAP



This map compiled by photogrammetric methods from aerial photography dated 4-22-93. Vertical datum based on NGS Mean Sea Level, Contour Interval 2 ft. Grid based on arbitrary coordinate system. Re: Air Survey Corp. Project #7830433. Dashed contours indicate that ground is partially obscured by vegetation or shadows. These areas may not meet standard accuracy and require field testing/completion.

RUST ENVIRONMENT & INFRASTRUCTURE

Drawn By:	ARDIS	10/96		Project No.	32711.100				
Checked:	MCNAMARA	10/96		Drawing No.	32711A31.DWG				
P.E.	RICHARDSON	10/96		Date Issued:	10-25-96				
	RICHARDSON			Plot Time:	3:55 p.m.	DATE	NO.	REVISION	BY

WASTE MANAGEMENT OF LOUISIANA, INC.

CLIENT

PERMIT MODIFICATION
MAGNOLIA SANITARY LANDFILL
MONROE, LOUISIANA

PROBE LOCATION MAP

1

ATTACHMENT 2

MONITORING AND TESTING PROCEDURES

ATTACHMENT NO. 2

MONITORING AND TESTING PROCEDURES

Barhole probing and structure testing will monitor for combustible gas concentrations. Landfill gas monitoring will be performed with a dual range, natural gas indicator that measures concentration as percent by volume of methane equivalents. Two ranges of detection will be available; 0 to 5%, and 0 to 100% methane by volume. A device such as the GAS-TECH Model NP-204 (Attachment 3) will be used. The combustible gas indicator will be equipped with a flexible extension hose and rigid metal or fiberglass 30-inch long probe. At a minimum, the combustible gas indicator will be calibrated on a annual basis in accordance with the manufacturer's specifications. The amount of monitoring and handling of the meter will dictate if the calibration frequency should be increased.

The instrument is not to be used at locations where compounds such as tetraethyl lead or hydraulic fluids or lubricants, which contain salines, silicates or silicones may be present in the atmosphere. These chemicals contaminate the sensor and thus reduce measurement accuracy. If it is suspected that such compounds may be present in the test area, check the calibration of the instrument after making a maximum of five measurements.

Combustible gas monitoring procedures will be done initially in the high range. If the reading is less than five percent, the procedure will be repeated at the low range. The reading will be recorded on a data sheet in the field.

Barhole Probing

Barhole probing is most useful when conducted along the perimeter of a landfill to determine whether combustible gas is migrating off-site. Areas with gas-stressed vegetation (burned-out areas) are usually indicators of near surface landfill gas migration.

With the aid of the plunger bar (Attachment 4), a hole is made to a depth of 2.5 to 3 ft. below ground surface. Upon removal of the plunger bar, the sampling probe is immediately inserted into the hole and sealed to minimize air infiltration of the barhole sample. With the instrument in the HIGH range, the aspirator bulb is slowly squeezed and released several times, recording the reading obtained following continuous sampling (stabilized value). If the concentration of gas is less than 5% on the HIGH scale, another barhole is punched, and the sampling procedure is repeated in the LOW range. When barhole monitoring yields a high concentration of combustible gas, additional barhole probing is required. Barholes are punched and sampled at "as directed" intervals, radiating out in various directions from the original barhole of concern, until readings of zero are obtained.

Barhole probing will be done at varying depths from the ground surface to a depth of about three feet. Shallower barhole probing on the order of 6 inches to 12 inches will be done when investigating for cover soil gas concentrations in vegetation stressed areas.

The monitoring technician should note that there are a number of seasonal variables which may affect the overall effectiveness of the barhole probe method. The moisture content of the ground may greatly affect the concentration of gas detected because combustible gas migrates readily through dry soil and bedrock materials, as opposed to wet or saturated materials. Additionally, water saturated conditions may prohibit the use of the barhole probe method. Under these conditions, water infiltrates the barhole and can be sucked into the instrument during sampling. This would

damage the filament and render the instrument useless. The use of a moisture trap and an aluminum probe with small diameter cross-drilled holes about six inches from the tip, helps reduce the possibility of liquid drawing into the gas detector, but does not prevent it.

During testing, the technician should note the retraction of the aspirator bulb. If the bulb is very slow in returning to its normal inflated form this is an indication that liquids are being drawn through the probe.

Frozen ground conditions will inhibit plunger bar penetration. The preferred months for employing the barhole probe technique are the summer months, when conditions are dry. Though seasonal weather conditions may inhibit the use of the barhole probe technique, they do not prohibit its use as a year-round monitoring technique.

Combustible gas is dynamic and extremely migratory and may vary in concentrations at the same location due to seasonal conditions. Thus, at times it may be difficult to correlate data from one sampling area to the next.

Building/Structure Monitoring

The monitoring of structures can present a sensitive situation due to the possibility/proximity of human inhabitants. Combustible gas accumulation should be monitored within confined areas of the structure such as corners, along baseboards, crawl spaces, attics, underground facilities, drainage structures (drains, toilets, sumps, etc.) or any area where air movement is restricted. Data will be recorded on the Gas Monitoring Report.

When monitoring for combustible gas in buildings or structures, a rigid fiberglass probe will be used. The narrow tip allows for easy access to cracks and other narrow spaces. An aluminum probe can also be used for sampling; however, the two cross-drilled holes should first be covered to prevent the dilution of the sample.

The instrument will not be used at locations where compounds such as tetraethyl lead or hydraulic fluids or lubricants, which contain salines, silicates or silicones, may be present in the atmospheres. These chemicals contaminate the sensor and thus reduce measurement accuracy.

In addition to routine sampling, buildings may be monitored by permanently installed gas detectors. As continuous monitoring devices, these detectors have a built-in alarm system which sounds if gas concentrations exceed a predetermined value.

The Sierra Model 2001 Combustible Gas Monitor (see Attachment 5), which is factory and dealer calibrated to sound an internal alarm when combustible gas concentrations reach or exceed by volume 1% methane (10,000 ppm), will be used for structure monitoring. The monitors will be installed following gas detection at barhole probe locations nearby structures. The monitors will be installed where combustible gas is most likely to accumulate and in areas of potential leaks, as discussed above.

It is recommended that a simple check of the alarm be performed each month to verify sensor activity. This can be achieved using an ordinary butane lighter. More frequent checks are necessary during periods of extreme humidity and temperature changes. Review of the instruction manual is

recommended prior to installation and/or testing.

If the alarm is activated, the following procedures should be considered to ensure safety:

1. DO NOT turn on or off, unplug or operate any electrical items (i.e., lights, fans, overhead doors, drills, etc.).

2. Open all available doors and windows to ventilate the structure. The monitor will continue to alarm until methane concentrations drop below one percent methane.

3. If the alarm continues, even after ventilating the area, evacuate all personnel from the structure. NOTE: Personnel should be aware the monitors are calibrated to alarm at one percent methane and that the lower explosive limit is five percent. Therefore, a safety margin is provided.

4. Designated personnel using gas detection equipment will be called in to determine where the infiltration of methane gas is occurring (i.e., floor drains, foundation cracks, underground utility connections, etc.). In the case of this site, the Environmental Engineer should be contacted immediately in the event that gas is detected within on-site structures.

5. After the area of concern has been determined, it should be sealed to prevent another occurrence. Silicone caulks should not be used, as they are poisonous to the gas detecting equipment and may cause inaccurate readings.

6. The Regional Engineering Manager and Corporate gas monitoring staff will be notified of the situation. An assessment will then be performed to prevent any future occurrence.

Care should be taken in the placement of the monitors, because they will be affected by the following:

1. high concentrations of carbon monoxide,
2. paint thinner, gasoline fumes, and other similar vapor emitting components,
3. aerosol spray or cleaners.

Situations such as these should be avoided because several occurrences may affect the calibration of the monitor.

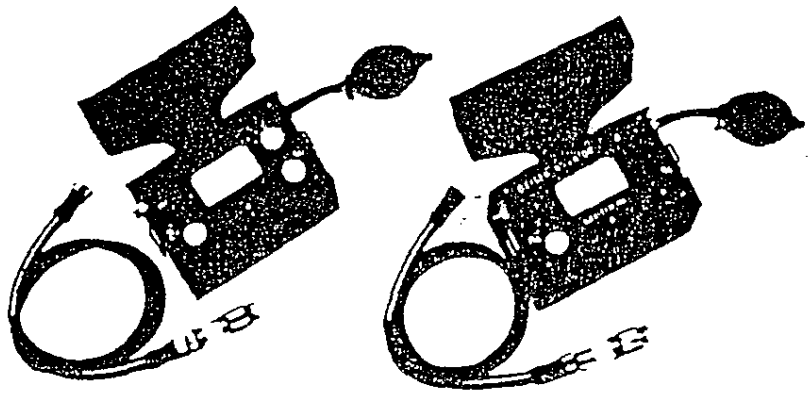
ATTACHMENT 3

GAS-TECH MODEL NP-204 DESCRIPTION

HAND HELD PORTABLE COMBUSTIBLE GAS AND OXYGEN INDICATORS

P-200 SERIES

GAS TECH



FEATURES

- Fast Response
- Light Weight
- Rugged Construction
- Simplicity of Operation
- Low Cost
- Gas Tech's Proven Dependability

DESCRIPTION

Series P200, five lightweight, handheld portables for detecting combustible gases/vapors and monitoring atmospheric oxygen content, represent the broadest line of common design instruments available. Engineered to serve the demanding field requirements of industry, public works and public utilities, these instruments share many common features and offer the user distinct advantages in terms of economy, dependability, maintainability and ease of operation. Built to withstand rough field environments, all Series P200 instruments are constructed with rugged cast aluminum housings, and incorporate highly reliable advanced electrical design characteristics. All active and passive components are mounted on easy-to-get-at, high quality, printed circuit boards. In operation, all P200 instruments are not only easy to use, sharing common functional characteristics, but they are extraordinarily fast in providing accurate readings. For gas indicators, the response time is no more than 4 seconds, and for oxygen indicators an accurate reading is attained within 6 seconds.

By maximizing the use of common components and operating characteristics, GasTech offers not only high quality field instruments, but has greatly simplified and expedited other very important considerations, such as field service, personnel training and accessory interchangeability. And finally, and perhaps most importantly, the commonality of components can save valuable time when field service becomes necessary. Fundamental operating features are easy to understand and all components are very accessible for checkout, replacement or repair.

GP-204 GENERAL COMBUSTIBLE GAS INDICATOR

A general-purpose instrument for measuring or testing any area where combustible gases or vapors may accumulate. Having a range of 0 to 100% LEL, and providing a reading within 4 seconds of sample draw with standard hose length, this instrument utilizes a closely-matched two-filament bridge detection circuit that features inherent electrical compensation characteristics exhibits outstanding zero stability, even as the level of the battery voltage decreases. Another important feature of GP-204 is the span adjust capability, allowing for increased accuracy, especially in situations where different gases are being tested. Compact, easy to hold in one hand, and weighing but 5 pounds, the GP-204 is powered by either two D size rechargeable nickel-cadmium batteries, or two D size flashlight batteries. The instrument has an illuminated meter which together with the basic rugged construction makes it suitable for almost any work situation. Calibration is performed on methane, but other calibrations may be requested when ordering. As with all Series P200 instruments, necessary accessories are provided in the standard package to include 3-foot Teflon-lined hose, end-of-line probe with integral removable dust filter, leather carrying case with strap, and batteries (charger included if required).

NP-204 NATURAL GAS LEAK DETECTOR

A dual-range instrument designed primarily for locating natural gas leaks. Normally calibrated on natural gas, the instrument has two ranges, 0 to 5% natural gas by volume, and 0 to 100% gas, which are displayed on the graduated illuminated scale. In addition to all of the design characteristics of the GP-204, this gas leak detector has a second complete Wheatstone bridge utilizing thermal conductivity filaments. When testing for gas leaks, this second range is selected by an additional position on the selector switch marked "100% GAS". NP-204 operates from two D size dry cell or rechargeable-type batteries and comes complete with carrying case and all necessary accessories. Rechargeable batteries substantially improve the accuracy of this version of the NP-204 in comparison to any dry-cell type instrument on the 100% gas range where the reading at a given gas concentration is directly proportional to the detector circuit voltage. Especially useful to the gas distribution industry for bar-hole readings when searching for leaks in underground mains, NP-204 is a versatile instrument also suitable for testing hazardous work spaces such as manholes, sewers and other confined areas. Calibration on other gases with a thermal conductivity substantially different from air, may be re

GAS-TECH NP-204 OPERATING PRINCIPLE

The Model NP-204 is essentially two instruments combined into one. In the LOW (0-5%) range, it is a combustible gas indicator - utilizing the catalytic detection principle. In the HIGH (0-100%) range, it is a thermal conductance indicator - utilizing the cooling effect of natural gas. Both detection methods employ the Wheatstone bridge measurement principle.

Low Range (0 - 5%)

The LOW range employs a catalytic platinum filament. The filament is initially heated by the battery current (based upon voltage setting), to a point where it will cause catalytic oxidation of combustible gas that comes in contact with the active surface. This oxidation produces a definite heat of combustion - correlating to the concentration of gas. The heat generated increases the temperature (i.e., higher electrical resistance) of the filament. This increase in resistance produces an upward deflection on the meter corresponding to gas concentration.

The catalytic method is only applicable in areas where gas concentrations re less than 5%, as oxygen is necessary to support catalytic oxidation. As gas concentrations exceed 5%, the heat of combustion no longer increases with increase in gas content (Refer to Sampling of Rich Mixtures).

High Range (0 - 100%)

The HIGH range employs a thermal conductance filament. The filament is initially heated by the battery current (based upon voltage setting), to a point where it assumes a definite temperature and resistance. As natural gas is introduced, the filament becomes cooler (i.e., lower electrical resistance) due to the cooling ability of natural gas. This decrease in resistance produces an upward deflection on the meter corresponding to gas concentration.

The thermal conductance method is not dependent on combustion, hence it is applicable regardless of the oxygen content of the sample. It is a relatively insensitive method, hence it is utilized at higher gas concentrations - greater than 5%.

INSTRUMENT SET-UP

To ensure the functionality of the instrument prior to sampling, the following procedure for instrument set-up must be followed:

1. Confirm that the needle is set at zero when the meter is off. If necessary, "zero" the needle by adjusting the small plastic set screw located directly beneath the scale on the face of the instrument.

2. Confirm that the voltage setting is satisfactory. To do this, switch the instrument to the "VOLT ADJ" position. Lift and turn the "VOLT ADJ" control knob to position the needle at the red "V" line on the meter scale. If the needle cannot be set as high as the red "V" line with the "VOLT ADJ" control knob all the way clockwise, the nickel-cadmium batteries require recharging. A 16-hour charge is necessary to restore batteries to full capacity. If necessary, standard size D alkaline-type (Duracell or Energizers) dry cell batteries may be used. However, these batteries will give only three to four hours of operating life. Do not attempt to use the instrument if the voltage check proves unsatisfactory. If the voltage check proves satisfactory, proceed as follows with the remaining steps of instrument set-up.

3. Switch the meter to the LOW range, and with the sample inlet in fresh air, squeeze the aspirator bulb four to five times to purge residual gas from the instrument.

4. With the instrument in the LOW range, confirm that the needle is set at zero. If necessary, adjust the needle using the "ZERO ADJ L" control knob until the needle is "zeroed".

5. Switch the meter to the HIGH range and confirm that the needle settles on, or close to, zero. A slight variation from zero is acceptable, however, if the needle "zeroes" above 3.0% as read on the HIGH scale, internal calibration of the meter is required. Variations from zero, up to 3.0% may be subtracted from the observed result. However, variations from zero of greater than 3.0% cannot be subtracted out (non-linear) and require internal calibration of the meter.

   NOTE: During sampling, the voltage and LOW range zero must be rechecked every two to three samples.

   The instrument is now adjusted and ready for use. When not in use, the instrument should always be in the "off" position. This will help prolong the operating life of the batteries. The instrument should always be purged of residual gas with fresh air immediately following each sample.

Internal Adjustments

"ZERO - H": an adjustment potentiometer used to "zero" the meter needle while in the HIGH range.

INSTRUMENT CALIBRATION

Prior to each sampling event, the instrument should be calibrated for accuracy on both the LOW and HIGH scales, using known gas concentrations of methane. 2.5% and 50% methane are recommended for meter calibration.

To calibrate the instrument, the following procedures should be employed:

A. Perform preliminary adjustments as described in Section 4.0 - Instrument Set-up, steps 1-4.

B. Switch the needle to the HIGH range and confirm that the needle settles on zero. If the needle does not "zero", internal calibration is required. This is accomplished by adjusting the internal "ZERO-H" potentiometer until the needle is centered on zero.

C. Purge a dedicated gas sampling bag of all residual gas. Fill the gas sampling bag 3/4 full with 2.5% methane and clamp the bag closed. With the instrument in the LOW range, remove the clamp from the gas sampling bag and aspirate the 2.5% methane through the meter and confirm a reading of 2.5% on the LOW scale. If necessary, adjust the internal "SPAN-L" potentiometer until a reading of 2.5% is achieved.

D. Purge a second dedicated gas sampling bag of all residual gas. Fill the gas sampling bag 3/4 full with a 50% mixture of methane and clamp the bag closed. With the instrument in the HIGH range, remove the clamp from the gas sampling bag and aspirate the 50% methane through the meter and confirm a reading of 50% on the HIGH scale. If necessary, adjust the internal "SPAN-H" potentiometer until a reading of 50% is achieved.

E. Purge the instrument of residual gas with fresh air.

F. The instrument is now calibrated and ready for use.

NOTE: The use of the mini-pump, in place of the aspirator bulb, is preferred for calibration, as it provides a constant draw of gas through the instrument during calibration.

FILAMENT REPLACEMENT

As previously mentioned, prolonged sampling of high gas concentrations while in the LOW range, or introduction of moisture into the internal workings of the instrument, may damage or destroy the internal filament assembly. Faulty instrument performance in calibration and/or sampling signal the need to replace the internal filament assembly.

Two pairs of filaments are used in the Model NP-204: catalytic filaments for the LOW range, and thermal conductance filaments for the high range. Each pair consists of an active or measuring filament and a reference or compensating filament. The active and reference catalytic elements and the active thermal element are all housed within a sintered bronze, porous metal cup, which acts as a flame arrester to retain explosions when sampling explosive gas/air mixtures. The flame arrester is installed within a cavity in the instrument housing, so that a sample drawing into the instrument will pass through the flame arrester and reach the elements. The reference thermal element is mounted outside the flame arrester so that when installed in the instrument, it is enclosed in an isolated cavity and does not encounter the sample.

All four elements and the flame arrester are permanently assembled onto an anodized aluminum plate with holes in each corner, allowing them to be maintained within the instrument by means of four screws. Short wires with lugs are provided to connect the elements and flame arrester to the terminals on the circuit board. The wires and terminals are color-coded for proper connection.

The entire filament/flame arrester assembly must be replaced as a unit if any portion becomes defective or damaged. To replace:

1. Loosen the two panel hold-down screws; remove and invert top panel.
2. Loosen (do not remove) the six screws holding the terminals (T1-16) to the colored lead wires. Pull wires from terminals.
3. Remove four screws, one in each corner of plate.
4. Remove complete plate and filament/flame arrester assembly. Inspect cavity and gasket and be sure that cavity and incoming passage is clear and dry.
5. Install new filament/flame arrester in same position with gasket in place.
6. Connect lead wires to corresponding color-coded terminals and fasten screws securely. Be sure to observe color coding. Note that there are two red wires, T2 or T6, that is most readily accessible.

CAUTION: While handling the new assembly, be very careful not to touch or otherwise damage the exposed thermal reference filament. Line it up carefully with cavity in panel before pushing the assembly into position.

SAMPLING OF RICH MIXTURES

When using the LOW range, gas concentrations greater than 5% will liberate considerable heat on the filament. This heat can damage and thus shorten the life of the filament. Therefore, sustained testing of samples containing gas concentrations greater than 5% should be avoided when the meter is in the LOW range. Rather, this testing should be conducted with the meter in the HIGH range. When sampling rich mixtures using the LOW range, the following instrument reaction can be expected:

1. Mixtures up to 5% (lower explosive limit) methane will read directly on the LOW scale.

2. Mixtures between 5% and 15% (upper explosive limit) methane will read beyond full scale.

3. Mixtures greater than 15% methane will initially read beyond full scale. - depending upon gas concentration. Extremely rich mixtures will yield a zero or negative reading.

ATTACHMENT 4

BARHOLE PLUNGER BAR DESCRIPTION

BAR HOLE PLUNGER BAR

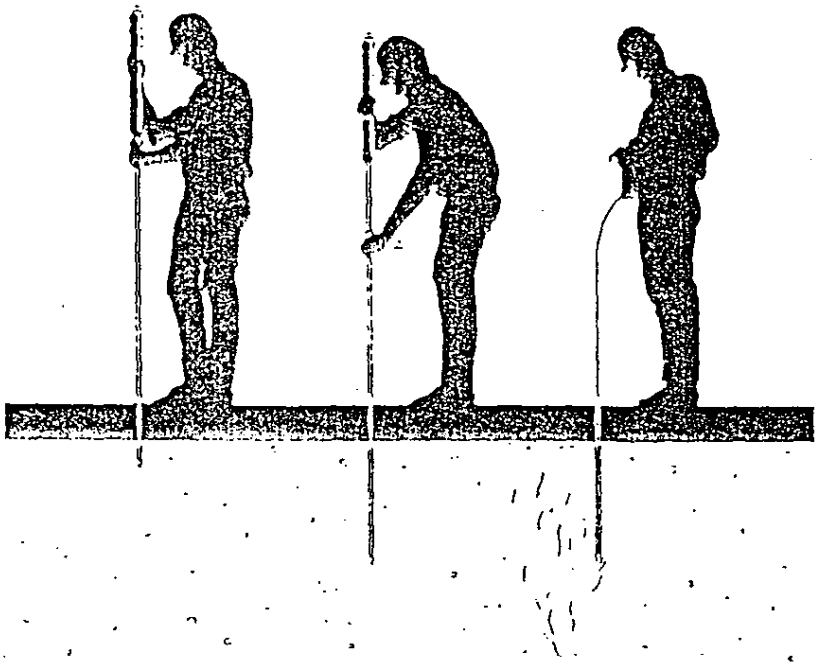
For barhole probing, a plunger bar is required and is available from the following vendors. It is suggested to check delivery time before placing order.

- Heath Consultants
  100 Tosca Drive
  Stoughton, MA 02072
  (617) 344-1400

  ORDER: Heavy Duty Steel Plunger Bar; Insulated 9 lb. Handle and 40" x ½" Rod w/Ball Tip, Model No. 474
  List Price: $67.00

- Engineer Tool Co.
  116 West Main Street
  Lake City, IA 51449
  (712) 464-3591

  ORDER: Deluxe Gas Leak Probe Model No. 50 with 36" Rod, Ball Tip, and Model No. 44 Insulated Handle
  List Price: $59.00



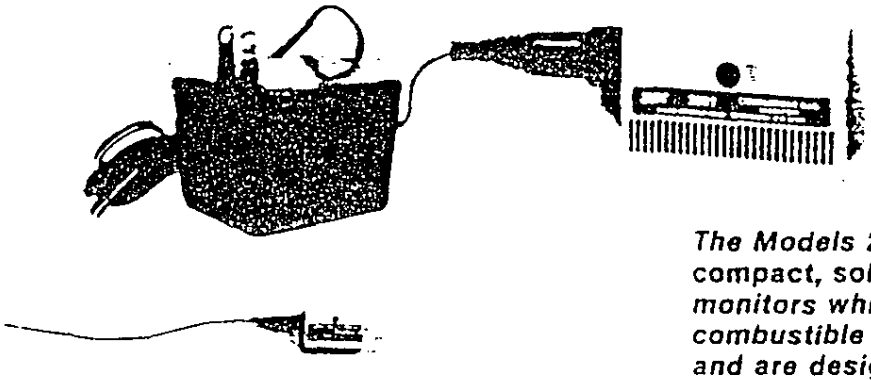
11/02/84

ATTACHMENT 5

SIERRA MODEL 2001 COMBUSTIBLE GAS MONITOR

sierra monitor corporation

Combustible Gas Monitors



The Models 2001 and 2002 are compact, solid-state stationary monitors which detect all combustible gases and vapors, and are designed for continuous, full-time operation anywhere area monitoring is required.

An alarm sounds when the concentration of gas exceeds the factory-set (and user-adjustable) level. Simultaneously, the monitor produces an alarm output signal that may be used to activate a remote alarm, fan or process controller.

A green LED (light-emitting diode) indicator on the monitor shows that power is connected.

The Models 2001 and 2002 are designed for instrinsically safe operation in the presence of flammable gases or vapors. The alarm circuit has no sparking contacts, and the maximum available input power from the AC/DC converter is 9 volts DC and 200 mA.

Acetone, Acetylene, Benzene, Butane, Carbon Monoxide, Dioxane, Ethane, Ethanol, Ethyl Ether, Ethylene Oxide, Gasoline, Hydrogen, Isopropanol, Jet Fuels, Kerosene, Methane, Methanol, Methyl Ethyl Ketone, Natural Gas, Propane, Toluene, Xylene....to name a few.

A solid-state semiconductor-type sensor and associated electronic circuitry ensure trouble-free, long-term operation. There are no pumps, filters, or chemical cells to replace or maintain. Except for periodic calibration to verify the alarm setting, no attention is required after installation. The user may set the alarm level to any point within the specified range by turning an externally accessible potentiometer with a jeweler's screwdriver.

Should the sensor fail (open circuit), a sensor self-check feature ensures that the monitor will sound an inter-

A 5 volt, 25 mA TTL-compatible output signal is produced by the monitor for activating or de-activating remote devices such as horns, fans, solenoid valves, process controllers, etc. Depending upon the pins selected on the cable connector, it is possible to have either a continuous output signal *except* during the alarm, or a signal only *during* the alarm (Normally ON or Normally OFF). This output signal may be transmitted hundreds of meters via a properly shielded cable.

Mines, manholes, tanks, silos, sewers, fuel and solvent storage areas, natural gas fields, pipelines, pump rooms, garages and vehicle maintenance facilities, refineries, LPG-LNG plants, utilities, sewage treatment plants, laboratories, construction tunnels, chemical and metal refining plants, semiconductor wafer-fab and Epi processes.

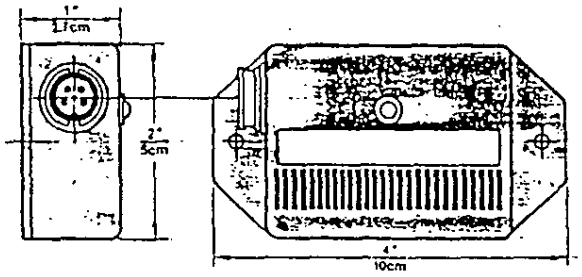
All of the electronic circuitry needed to operate the monitors, except for the DC input power, is contained in a lightweight unit (56 grams) no larger than 10 x 5 x 2.7 cm (4 x 2 x 1 inches). It may be mounted in any orientation on a wall or other surface using either the adhesive strip or screws provided.

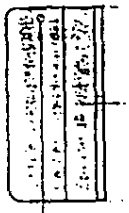
For a single-monitor installation and a local alarm, the accompanying AC-to-DC power supply may be plugged into a standard AC source, and its cable connected to the monitor. No tools are required. CAUTION: The AC/DC power supply is not considered intrinsically safe for use in areas where high concentrations of flammable gases may be present.

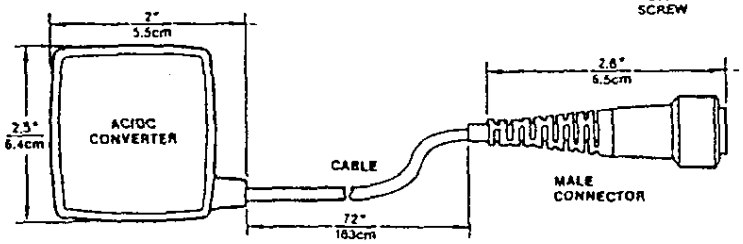
If a remote alarm is desired, SMC's Model 2101 Remote Alarm/Power Supply can be connected up to 100 meters (328 feet) away from the monitors. For multipoint monitoring the SMC Model 2200 Central Alarm Panel will power

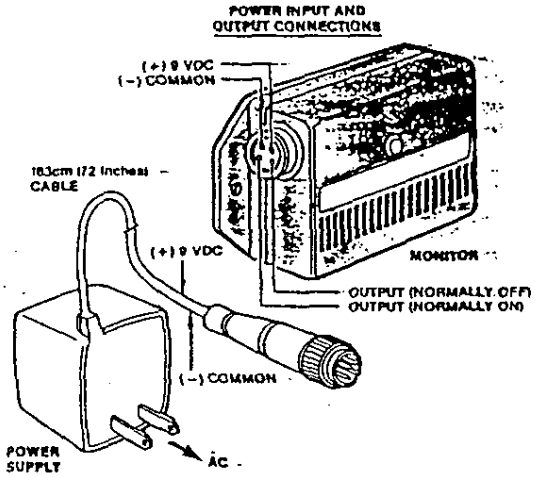
The Models 2001 and 2002 are warranted against defects in workmanship and materials for one year from the date of shipment, when installed in accordance with instructions.

INDICATORS	
Visual:	Green LED for Monitor "ON"
Audio:	Interrupted test tone at warm-up (30–60 seconds). Sustained alarm tone for as long as gas is present. Interrupted (ON/OFF) tone for sensor failure.
SENSOR TYPE	Solid-State Metal Oxide Semiconductor
RANGE	2001 / 2002
Hydrogen, ppm	300–2,000 / 20–500
Methane, ppm	500–10,000 / 25–2000
RESPONSE TIME	Less than 30 seconds
PERIODIC MAINTENANCE, REPLACEMENTS	None, other than routine calibration
OPERATING TEMPERATURE RANGE	+5°C to +35°C (+41°F to +95°F)
INPUT	120 VAC/60 Hz, converted to 9 VDC, 200 mA
OUTPUT	Nominal 5 volts DC, TTL-compatible, will source 5 mA or sink 1.6 mA; Normally ON or Normally OFF signal.
CONNECTIONS	a) Power Supply to AC outlet b) 9 VDC Power Supply to Monitor (Supplied with Model 2003): DIN (Audio), 4-pin connector.
ENCLOSURE MATERIAL	Polystyrene
DIMENSIONS	Refer to diagram below.









Choice of 5-Volt DC output signal is obtained by connecting additional wire to COMMON, and one to desired 5 Volt signal:
Normally ON: 5 VDC, 80 mA available, except during Alarm, for fail-safe applications.
Normally OFF: 5 VDC, 80 mA available only during Alarm.

REPRESENTED BY:

CALL OR WRITE TODAY FOR MORE INFORMATION

smc sierra monitor corporation
1991 Tarob Court
Milpitas, CA 95035 USA (408) [illegible]

CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN

APPENDIX H

CONSTRUCTION QUALITY ASSURANCE & QUALITY CONTROL PLAN

Magnolia Sanitary Landfill

Monroe, Louisiana

October 2005

Prepared For:

WASTE MANAGEMENT

Waste Management of Louisiana, LLC

Prepared by:

aquaterra engineering

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Aquaterra File No. 915177

CONSTRUCTION QUALITY ASSURANCE & QUALITY CONTROL PLAN

Magnolia Sanitary Landfill
Monroe, Louisiana

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CONSTRUCTION QUALITY ASSURANCE & QUALITY CONTROL PLAN

Magnolia Sanitary Landfill
Monroe, Louisiana

1.0 INTRODUCTION

The Magnolia Sanitary Landfill (the "facility") is a solid waste disposal facility owned by and operated by Waste Management of Louisiana, LLC (WM) as a Solid Waste Management Facility under Permit Number D-073-1848/P-0046 issued by the Louisiana Department of Environmental Quality (LDEQ). The facility is regulated in accordance with the State of Louisiana *Environmental Regulatory Code - VII Solid Waste Regulations* (the Regulations), as promulgated by LDEQ.

1.1 EXISTING AND PLANNED CONSTRUCTION

The 261-acre landfill design includes the construction of 25 landfill cells comprising a waste footprint of 202 acres. Landfill construction consists of constructing individual cells, or portions of cells, as the landfill progresses. Currently cells 1 through 19 have been constructed. Cell design includes the following general components of construction:

- excavation into the natural clay soils,
- construction of a recompacted clay liner
- installation of a Flexible Membrane Liner (FML)
- construction of a leachate collection system (LCS).

After the landfill cell construction is completed, and the landfill is filled, a cover will be constructed over the landfill. In areas where the final slope grade is designed to be 10 percent or less, the final cover will consist of a compacted cohesive soil layer, an FML liner, a geocomposite drainage media and a vegetative soil layer. In areas where the final slope grade is designed to be 25 percent or greater, the final cover will consist of a compacted cohesive soil layer and a vegetative soil layer. Vegetation will be established on the final layer.

1.2 PURPOSE

Section 33:VII.509.E.1 of the Regulations requires that:

> "Start-up inspections for new units of a standard permitted facility shall be conducted after completion of all construction measures and after submittal of certification to the Office of Environmental Assessment, Environmental Technology Division, by a registered engineer licensed in the State of Louisiana, that the unit is constructed in accordance with the permit."

Additionally, Section 33:VII.711.B.5.b of the Regulations requires that:

> "The permit holder or applicant must provide and implement a quality-control and quality-assurance plan for liner construction and maintenance that will ensure that liners are designed, constructed, installed, and maintained properly. All facilities must have quality-control plans for the excavations. All excavations and liners shall be inspected and certified by a registered engineer, licensed in the state of Louisiana, with the appropriate expertise."

The Construction Quality Assurance (CQA) report should certify that construction of the landfill facility has been performed in accordance with the project plans and specifications as well as a Construction Quality Assurance/Construction Quality Control Plan (CQA/CQC Plan). This document presents the minimum criteria by which the registered professional engineer should verify construction efforts.

1.3 SCOPE

This CQA/CQC Plan addresses the responsibility and authority of various entities involved in the construction of the landfill, quality objectives, construction testing, and documentation during construction at the facility. The plan as developed in this document addresses the following components of construction:

- Excavation;
- Perimeter Berms;
- Compacted Clay Liner/Compacted Cohesive Soil Layer (cap);
- Flexible Membrane Liner(s); and
- Leachate Collection System.

The CQA/CQC Plan presented in the following paragraphs contains the programs for both CQC testing and observations and CQA analyses for the construction.

2.0 RESPONSIBILITY AND AUTHORITY

The responsibility and authority of the individuals and organizations involved in the design, permitting, construction and inspection of a landfill are discussed below. These responsibilities and authorities are in accordance with the EPA Technical Guidance Document *Quality Assurance and Quality Control for Waste Containment Facilities*. The individuals, their affiliation, responsibilities and authorities are described as follows:

Permitting Agency. The Louisiana Department of Environmental Quality (LDEQ) is the agency responsible for permitting the landfill. LDEQ maintains the responsibility to review the permit documents including the CQA/CQC Plan for compliance with the agency's regulations. LDEQ also has the responsibility to review CQA/CQC documentation during or after construction of a facility, possibly including visits to the construction site to observe the CQC and CQA practices, to confirm that the approved CQA/CQC Plan was followed and that the facility was constructed as specified in the design.

Owner/Operator. The owner/operator is responsible for the design, construction, and operation of the facility. This responsibility includes complying with the requirements of the LDEQ, the submission of CQA/CQC documentation, and assuring the LDEQ that the facility was constructed as specified in the construction plans and specifications and as approved by the permitting agency. The operator has the authority to select and dismiss organizations charged with design, construction, and CQA/CQC.

Owner's Representative. The owner will designate an official representative who is responsible for coordinating schedules, meetings, and field activities. This responsibility includes communications to other members in the owner/operator's organization, owner's representative, permitting agency, material suppliers, general contractor, specialty subcontractors or installers, and CQA Engineer.

Design Engineer. The design engineer is selected by the Owner/Operator. He is responsible for developing plans for construction of landfill segments or cells that are consistent with the permit for the facility and regulatory requirements. The design engineer may be requested to change some aspects of the design if unexpected conditions are encountered during construction (e.g., a change in site conditions, unanticipated logistical problems during construction, or lack of availability of certain materials). Such modifications may be in writing or verbally. In either case, details of the changes must be received by the CQA Engineer and CQC Manager. The plans and specifications referred to in this plan are the product of the Design Engineer. They are a major and essential part of the permit application process and the subsequently constructed facility.

General Contractor. The operator generally contracts with a General Contractor for construction of landfill cells or other civil improvements at the facility. The General Contractor arranges for purchase of materials that meet specifications, contracts with subcontractors for specialized needs, and has overall control over the construction operations, including scheduling. The General Contractor has the primary responsibility for ensuring that a facility is constructed in accord with the plans and specifications that have been developed by the Design Engineer and approved by LDEQ. The General Contractor is also responsible for informing the operator and the CQA Engineer of the scheduling and occurrence of all construction activities. The operator may serve in the capacity of General Contractor and arrange for all, or a portion, of the necessary material, fabrication, and installation contracts. In such cases, the operator's representative will serve the same function as the General Contractor.

Subcontractor. Specialized portions of the construction may be performed by a subcontractor to the General Contractor, or by a specialty contractor hired directly by the manufacturer, or fabricator, or by the operator directly. The duties of the subcontractor will be established by the General Contractor or the operator. The subcontractor is responsible for informing the contractor, the operator and the CQA Engineer of the scheduling and occurrence of all construction activities to be performed by them.

CQC Personnel. Construction quality control personnel are individuals who work for the General Contractor, installation contractor, subcontractor or CQA Engineer and whose job it is to collect the data necessary to document that construction is in accord with the plans and specifications. The CQC Manager should be an individual who is experienced in those aspects of landfill construction including clay and geosynthetic liner construction and leachate system installation. The CQC Manager should maintain overall responsibility for the collection and assimilation of CQC data, and the transfer of these data to the CQA Engineer. Prior to initiation of the project, the CQC Manager shall obtain from the Design Engineer a full set of the plans and specifications for the project. He will check the plans and specifications, including revisions, against the CQA/CQC Plan and specifications. Any discrepancies will be brought to the attention of the CQA Engineer for resolution. The CQC Manager will ensure that a current set of the plans and specifications is maintained at the site.

CQA Engineer. The CQA Engineer is responsible for confirming that the facility was constructed in accordance with the plans and specifications as developed by the Design Engineer and approved by LDEQ. The CQA Engineer has overall responsibility for manufacturing quality assurance, construction quality control and construction quality assurance. The operator will select a CQA Engineer for various phases of construction,

typically for each individual landfill cell construction. The CQA Engineer should be a registered professional engineer in the State of Louisiana. He/she should possess individual experience in those aspects of landfill construction including clay and geosynthetic liner construction and leachate system installation. The CQA Engineer is responsible for reviewing the CQA/CQC Plan as well as general plans and specifications for the project so that the CQA/CQC Plan can be implemented with minimal contradictions or unresolved discrepancies. Other responsibilities of the CQA Engineer include: education of CQC personnel on CQA/CQC requirements, scheduling and coordinating of CQA/CQC inspection activities, ensuring that the procedures established by this CQA/CQC plan are followed, ensuring that test data are maintained for later reporting, and preparation of periodic reports. In the event of nonconformance with the project specifications or CQA/CQC Plan, the CQA Engineer should notify the operator as to the details and, if appropriate, recommend work stoppage and possibly remedial actions. The CQA Engineer is usually required to be at the construction site, or have a representative on-site, during all major construction operations to oversee construction and CQA/CQC personnel.

Testing Laboratory. Many CQA/CQC tests are performed by commercial laboratories. The testing laboratory should have its own internal QC plan to ensure that laboratory procedures conform to the appropriate American Society for Testing and Materials (ASTM) standards or other applicable testing standards. The testing laboratory is responsible for ensuring that tests are performed in accordance with applicable methods and standards, for following internal QC procedures, for maintaining sample chain-of-custody records, and for reporting data. The testing laboratory must be willing to allow the owner/operator, permitting agency, design engineer, installer, or CQA Engineer to observe the sample preparation and testing procedures, or record-keeping procedures, if they so desire.

3.0 DOCUMENTATION

An important aspect of construction quality assurance and quality control is documentation of the construction program. This Plan provides for the collection of quality control data for each component of construction. Documentation of the data and of the construction processes must be adequate. The following provides protocol for documentation.

3.1 ROUTINE REPORTING OF QUALITY CONTROL

Construction Quality Control (CQC) is the act of performing and documenting visual inspections, and field and laboratory testing of the construction materials and methods used and sampling of the components of construction. CQC technicians are responsible for performing the tests required and collecting the necessary samples to document that the materials and construction practices used are in accordance with the project designs.

The Daily Field Report (DFR) is the primary communication tool for the CQC technicians. The CQC Manager will prepare, or have prepared, one DFR for each day the technician is on site. Generally, the DFR will document the following:

- Contractors and subcontractors working on-site;
- Equipment available and operating on site;
- Weather conditions;
- Time CQC personnel were on-site;
- Summary of the contractor's activities throughout the day;

- Types of testing performed, location of the tests, and test results;
- Types of samples obtained, location of the sample points and plans for sample testing;
- Summaries of any meetings held on-site that were attended by CQC personnel; and,
- Notation of on-site visitors significant to the construction (design or CQA Engineer, regulatory representatives, etc.)

DFRs should be submitted to the CQA Engineer, the representative for the operator, and the design engineer, as requested. Additionally, the CQC Manager should maintain a copy of each DFR at the site throughout the duration of the project.

The CQC process will result in the collection of data and samples of completed work product. The location of every test or sampling point must be documented in a manner suitable to allow re-establishment of the sample location. Date and time of the action shall be included. Horizontal location shall be specified by the method in use for this work at the facility (e.g., grid coordinates, station and offset, etc.). Where elevation is also important (e.g., lift number), it shall be included. Each test or sample shall be assigned a unique number. Any sample to be sent off-site shall be under chain-of-custody control. The control sheet shall include the unique sample identification, the sample destination, and the required testing.

The CQC process will oversee the major work elements of excavation, subgrade verification, compacted clay liner (or cohesive soil cover) construction and leachate collection system installation. The CQC aspects of each of these work elements are addressed individually in subsequent sections of this plan.

3.2 SUMMARY REPORTING OF QUALITY ASSURANCE

The purpose of construction quality assurance (CQA) is to ensure the facility is constructed in accordance with the project plans and that the CQA/CQC Plan is followed. Additionally, it is the responsibility of the CQA Engineer to review all CQC actions, perform analytical and statistical analyses of the data collected, and to prepare the certification report.

The CQA Engineer will maintain copies of all DFRs, field and laboratory test reports, project-related memoranda, design change information, etc. He will review all such information and document its compliance with this CQA/CQC Plan.

The CQA Engineer shall prepare various, routine interim reports to the client/owner summarizing the work to date. These reports shall be submitted to the client/owner at the frequency directed.

Upon completion of a cell, phase of a cell, portion of the final cover or other milestone occasion as directed by the owner, the CQA Engineer shall prepare a final Certification Report on the work accomplished. This report shall be signed and sealed by the CQA Engineer. The report shall include the following:

- Results and locations of all tests;
- All Daily Field Reports;
- Results of field and laboratory tests;
- Demonstration that the construction specifications were met;
- Demonstration that the testing frequencies of the CQA/CQC Plan were met;

- Demonstration that the acceptance criteria of the CQA/CQC Plan were met; and
- Certification that the components inspected met the plans and specifications.

4.0 CELL EXCAVATION

Excavations for cell construction at the site will be made into natural clay soils. QC aspects of excavation are related to the classification of soils for subsequent reuse, the documentation of stable subgrade conditions, and the confirmation of base grade elevations.

4.1 SOILS CLASSIFICATION

Materials from cell excavation will be utilized for various purposes. Clays derived from the excavation will be utilized for compacted clay liner, the construction of perimeter berms, the final cover cohesive soil layer and vegetative soil cover layer, and other civil improvements. Additionally, these soils may be used as daily cover for landfill operations.

There are no testing or sampling requirements associated with quality control of excavations, because materials acceptance will be confirmed during liner/cap construction. However, the contractor should visually note material transitions and segregate stockpiles accordingly.

4.2 SUBGRADE VERIFICATION

The subgrade is defined as the soils which form the floor and side slopes of the cell after all soils have been excavated but prior to placement of compacted clay liner. Upon the completion of excavation, the subgrade will be inspected to document conditions. The inspection will consist of a walkover by the CQC Technician, and a written record of visual observations will be made during the walkover. The visual observations shall be accompanied with photographs of typical and anomalous conditions.

Any areas which exhibit anomalous conditions (as observed during the site walkover) will be documented to illustrate the spatial and vertical extent of the anomalous subgrade soils. Anomalous areas which are deemed unsuitable by the design engineer shall be overexcavated to the extent that suitable subgrade conditions are developed. Any backfill of the overexcavated areas shall be placed consistent with the requirements for structural fill as noted in Section 5.

4.3 SURVEY CONTROL

From the field control set by the Design Engineer, the General Contractor shall establish and maintain all necessary controls for the proper layout and performance of the work. The contractor shall use competent personnel and suitable equipment for the layout work required.

Upon completion of excavation to subgrade, the CQA engineer shall oversee the conduct of a verification survey to document subgrade elevation. This survey will serve as the base elevations for the compacted clay liner. The verification survey shall be made utilizing a control grid with control points spaced no greater than 50 feet on center. On side slopes, each section will include at least the crest and toe.

5.0 STRUCTURAL FILL

Earthen fill may be required to achieve subgrade at the facility. This fill must be constructed with the proper materials and to adequate densities to meet the structural requirements necessary to support the landfill. The following paragraphs address these issues.

5.1 MATERIALS VERIFICATION

Fill materials should be adequately classified in accordance with the Unified Soil Classification System. Suitability of the soils should be confirmed by the performance of various geotechnical analyses. Representative samples will be collected and tested to determine Atterberg limits (ASTM D4318) and classified according to ASTM D4388. If the classification notes the presence of significant sand, testing to determine percent passing the No. 200 sieve (ASTM D1140) will also be performed. Standard Effort Compaction tests (ASTM D698) shall be performed to determine the optimum moisture content and maximum dry density. Sufficient testing should be performed to document the classification and moisture/density relationship of all soil types used for structural fill.

5.2 FILL PLACEMENT/COMPACTION

The fill materials should be placed in loose lifts graded to provide a uniform thickness not exceeding nine inches. The surface of each preceding, compacted lift should be lightly scarified to ensure adequate bonding between lifts.

The moisture content during compaction should be maintained greater than the optimum Standard Effort optimum moisture content. The lift should be compacted to a dry density equal to at least 95 percent of its Standard Effort maximum dry density.

5.3 FIELD MOISTURE/DENSITY TESTING

Subsequent to placement and compaction of each lift, the QC technician should determine the in-place density and moisture content. A nuclear moisture/density device should be used to test the compacted lifts using ASTM methods D2922 (density) and D3017 (moisture content). The testing should be conducted at a frequency at least equal to 1 test per 150 cubic yards of constructed fill material. Every test must be specifically marked "Pass" or "Fail". Failing tests should be specifically tracked until the failed area is reworked and re-tested satisfactorily.

6.0 COMPACTED CLAY LINER/COHESIVE SOIL COVER

The compacted clay liner and cohesive soil cover for closure (soil liners) will be constructed using soils obtained from on-site and/or off-site sources. Whenever possible, the clay soils which are excavated for the cells and stockpiled will be reused for the soil liners. The following paragraphs outline quality control parameters for the soil liners, and take into consideration the data from prior cell construction activities where appropriate.

6.1 HISTORICAL DATA

The historical usage of excavated soils for compacted clay liner allows the utility of a large, site-specific database to consider the relationships of various important soil properties. The previous data have been summarized to provide an empirical database to set forth protocol for conducting sample collection and analysis for preconstruction testing and testing during the construction process.

Data for landfill construction over the most recent five years are provided on Tables 1 and 2 and correlations of these data are illustrated on Figures 1 -3. Table 1 depicts the results of moisture density (Standard Proctor - ASTM D 698) relationship testing, and information on Table 2 provides permeability results. Figures 1 and 2 provide the results of linear regression analyses of the moisture density relationship testing. These analyses yield the anticipated

result that the more plastic soils will exhibit lower maximum dry density and higher optimum water contents. The results of a regression trend analyses are provided in the form of a straight line equation for the best-fit line based upon the least squares method of regression. The resulting coefficient of determination (r squared value) is also shown for each analysis. Figure 3 provides the results of linear regression analyses for permeability test results. The logarithms of the permeability data are plotted on the figure to facilitate the statistical evaluations. These data have been compared to the sample density (relative to maximum density - expressed as percent compaction) and moisture content (relative to optimum). These analyses indicate that the permeability values exhibit very little variation with dry density, but increased molding moisture content exhibits a slight effect of decreased permeability. In all cases the tested permeability is significantly below the required maximum allowable.

6.2 MATERIAL ACCEPTANCE

The materials to be used for compacted clay liner/cohesive soil cover are anticipated to be those derived from cell excavation or from nearby (within one mile) borrow sources. Selection of the proper soil types and documentation of material consistency is a requirement for a low permeability, compacted liner or cover. Therefore, material acceptance includes an initial material evaluation program and a continued material verification during construction.

Prior to the construction of the recompacted soil liner/cover, a representative sample will be secured and submitted to the geotechnical laboratory for testing. If the sample is from prior or existing on-site excavations, the sample will be tested to determine Atterberg limits (ASTM D4318) and classified according to ASTM D4388. If the visual classification notes the presence of significant (greater than 10 percent) sand, testing to determine percent passing the No. 200 sieve (ASTM D1140) will also be performed. The sample must be classified as CL (lean clay) or CH (fat clay) in accordance with the Unified Soil Classification System.

If the sample has less than 15% sand (as determined by ASTM D4388 or D1140), the liquid limit and plasticity index will be compared to the regression analyses summarized on Tables 1 and 2, and the appropriate maximum dry density and optimum moisture content will be determined for subsequent compaction control. If the sample is not from on-site, or if the sample contains greater then 15% sand, then a material evaluation program consisting of standard Proctor compaction testing will be conducted.

Material verification/acceptance testing shall be performed during construction to verify that the materials being utilized match the properties of soils approved by preconstruction evaluation testing. Samples will be collected at a frequency of one sample per 2,000 cubic yards. The samples will be tested to determine Atterberg limits (ASTM D4318) and classified according to ASTM D4388. If the visual classification notes the presence of significant (greater than 10%) sand, testing to determine percent passing the No. 200 sieve (ASTM D1140) will also be performed. In addition, samples will be collected at a frequency of at least one sample per 20,000 cubic yards and tested to verify the moisture content/dry density relationship (ASTM D 698). These samples should coincide with Atterberg limits testing. Upon completion of the construction, the CQA Report should include an updated Table 1 and Figures 1 and 2 (with updated regression analyses) to include the additional data for use in the subsequent cell construction.

6.3 CONSTRUCTION CONTROL

During construction of the constructed soil liner, visual control must be exercised to observe material consistency and appropriate construction methods. The following paragraphs outline the requirements for visual control of construction quality of the soil liner systems.

6.3.1 Roots/Clods

The QC representative shall maintain continuous visual inspection of all soil liner material placement, processing, and compaction. He shall specifically observe the materials to determine no substantial change in materials from the accepted materials. In addition, he should watch for the presence of roots, sticks, stones, or other deleterious matter, and for clod size.

No roots or sticks with a diameter in excess of ½ inch or length in excess of 6 inches should be allowed to remain in the loose lifts. Clods should be processed by disking or other means to render clod sizes of less than 3 inches prior to compaction. In addition, the materials should be essentially free of any other foreign materials.

The QC representative shall notify the earthwork contractor of non-conformities. In the event such non-conformities are not resolved, the compaction effort should be suspended, and the CQA Engineer should be notified. Any such notification requirements should be recorded in the DFR.

6.3.2 Lift Thickness

Loose lifts of soil liner should not exceed nine inches. The QC representative shall verify the uncompacted lift thickness continuously. This shall be done by making visual observations of the thickness of newly deposited soils over the prior compacted lift. Notations regarding lift thickness should be made in the DFR and in the photographic record to document the QC effort.

6.3.3 Compaction Techniques

The compactive effort should be accomplished by using a compactor with the ability to penetrate the lift thickness at least 4 inches with "teeth" or "pads" on the compacting device. The CQA Engineer will determine the adequacy of compaction equipment prior to construction. The number of passes over the loose lift should be no less than three, but should be adequate to achieve the required moisture density requirements. The QC technician should maintain continuous visual observations of the compaction effort, and document the compaction techniques in the DFR and in the photographic record.

6.3.4 Lift Bonding

After each lift is placed and compacted, and prior to placement of a subsequent lift, the surface of the existing lift should be sufficiently moistened and roughened to allow bonding of the two lifts. This should be accomplished by watering as necessary and scarifying the existing lift to form a one to two inch thick roughened surface. Scarification can be accomplished with a disc, compactor or similar equipment to achieve the required result.

The construction quality control should include visual documentation of the continuous scarification process. This effort should be documented in the DFRs and in the photographic record.

6.3.5 Field Moisture/Density Testing

Subsequent to placement and compaction of each lift, the QC technician should determine the in-place density and moisture content for comparison to the predetermined requirements as established in Section 6.1. In place testing of the completed liner to determine dry density should be performed using nuclear methods (ASTM D 2922). In place testing of the completed liner to determine moisture content should be performed using nuclear methods (ASTM D 3017). Alternatively, undisturbed samples can be collected from the compacted liner and submitted to the geotechnical laboratory for direct measurement of dry density and moisture content. Testing will be performed at a minimum frequency of twelve tests per acre per lift of in-place compacted liner/cover.

All holes made into compacted liner material must be backfilled with dry bentonite pellets or granulated bentonite which shall be tamped lightly into the hole, wetted, and covered with moist liner soil and retamped.

Separate samples should be collected for laboratory moisture content analysis to verify the nuclear testing method. The number of separate samples should be sufficient to determine the need for moisture correction, as specified by the CQA Engineer. Appropriate moisture corrections should be applied to the nuclear testing methods if the moisture content analyses indicate the need.

The compacted lift must exhibit a minimum dry density of at least 90% of its maximum as determined by the standard Proctor compaction test (ASTM D 698), and the moisture content must be equal to at least optimum moisture content and no greater than 12% in excess of optimum moisture content (as determined by ASTM D698).

Every test must be specifically marked "Pass" or "Fail" in the report of test results. Areas where failing tests are recorded shall be reworked and retested until satisfactory results are obtained. Retests shall be tracked such that a failing tests successive passing test is readily identified.

6.3.6 Permeability Testing

As summarized on Table 2 and in Section 6.1, the prior cell construction has generated a significant amount of permeability test results. Regression analyses and field observations indicate that the on-site clays, when compacted in accordance with the requirements established in Section 6.1, will achieve permeability values which are typically one order of magnitude lower than the maximum allowable value of 1.0E 10-07 cm/sec for clay liner. Therefore, emphasis is placed on the visual and testing observations of material acceptability, placement and compaction methods to ensure a low permeability liner/cover.

Verification samples will be collected and submitted to the geotechnical laboratory to measure permeability (ASTM D 5084) of the in-place liner/cover. Samples will be collected and tested at a frequency of at least one per acre per lift of in-place soils.

All loose surface material shall be removed prior to sampling. The samples shall be taken using the 3-inch drive cylinder method (ASTM D2937), except that field weighing is not required. The permeability sample shall be the full size of the ring for at least two inches in length and have axis perpendicular to the face of the compacted clay for parallel lift construction. The hole(s) shall be backfilled by filling with dry bentonite pellets or granulated bentonite, tamping lightly, covering with moist liner soil and retamping.

The sample shall be trimmed so that none protrudes from the drive cylinder. It shall then be placed into a plastic bag or other container to preserve moisture, which shall be indelibly marked. It shall be returned to the laboratory under Sample Control as soon as possible.

The permeability should not exceed 1.0E10-7 cm/sec for clay liner and for cohesive soil cover where no FML is present and 1.0E10-5 cm/sec for cohesive soil cover beneath the FML. If a sample fails, the CQC Manager shall immediately inform the CQA Engineer and the Client/Owner's Representative. The area to be reworked shall be determined by the CQA Engineer and proposed to the Client/Owner's Representative. Such area shall be reworked, and then retested for moisture/density in accordance with previous sections and for permeability.

Upon completion of the construction, the CQA Report should include an updated Table 2 and Figure 3 (with updated regression analyses) to include the additional data for use in the subsequent cell construction.

6.3.7 Survey Control

From the field control set by the Design Engineer, the General Contractor shall establish and maintain all necessary controls for the proper layout and performance of the work. The contractor shall use competent personnel and suitable equipment for the layout work required.

Upon completion of the compacted clay liner, the CQA engineer shall oversee the conduct of a verification survey to document top of liner elevation and associated liner thickness. This survey will serve as the base elevations for the protective cover/leachate collection system. The verification survey shall be made utilizing a control grid with control points spaced no greater than 50 feet on center. On side slopes, each section will include at least the crest and toe.

Documentation of adequate cohesive soil cover thickness will be accomplished by probing the thickness utilizing a control grid with control points spaced no greater than 200 feet on center. The resulting probe holes should be mended by excavating the general area and replacing the area with the cap in lifts as originally constructed.

The CQA Engineer may grant variances from the thickness requirements provided that:

- The point is not deficient by more than 0.1 feet, and
- No more than 5% of points are deficient, and
- These points are not concentrated in one area, and
- The average thickness (including the deficient points) meets or exceeds the specified value.

6.3.8 Subgrade Acceptance (FML Areas)

Upon satisfactory completion of the compacted soil liner and clay cover where FML will be placed, the surface of the liner must be prepared for deployment of the geomembrane liner or FML, where applicable. This process must be observed by the CQC Technician and documented by a Subgrade Acceptance Form. This form must be signed and dated by the Contractor and geomembrane or FML installer and must specify the area that is being accepted. This acceptance by the geomembrane or FML installer documents the suitability of the subgrade for geomembrane liner or FML deployment and seaming.

7.0 GEOMEMBRANE LINER

Upon acceptance of the subgrade of the completed soil liner and cohesive soil cover, as accepted by the geomembrane liner or FML installer in the form of the subgrade acceptance document (see Section 6.3.8), the FML shall be placed in direct and uniform contact with the soil liner. The following paragraphs detail CQA requirements with relation to the installation of the geomembrane liners.

7.1 MATERIAL ACCEPTANCE

The geomembrane or FML supplier shall provide the CQA Engineer with manufacturer quality control (MQC) information and warranty data for the materials to be delivered on site at least one week prior to delivery. Manufacturer submittal requirements for geomembrane are provided on Table 3. The CQA Engineer will compare the material MQC data to the requirements as provided on Tables 4A and 5A for the smooth and textured HDPE geomembrane respectively. Based upon the information provided, the CQC Engineer will accept the materials for shipment if the requirements of Tables 4A and 5A are met.

The CQC Technician shall inventory all geomembrane or geotextile materials that are received at the site. The inventory will document that the MQC information provided previously to the CQA Engineer is applicable to the inventory shipped.

The CQC Technician shall also observe material handling and storage. Handling of the geomembrane or FML should be with procedures that will not cut, puncture, or otherwise abrade the materials. Any noticeable defects of the delivered material will be documented on the material inventory sheets, and the damaged rolls shall be segregated.

7.2 CONSTRUCTION CONTROL

The construction control of geomembrane or FML deployment and seaming includes visual observations and record keeping as well as destructive sampling and seam testing. The following sections outline procedures for each. An important variation from the CQC procedures associated with the geomembrane or FML is the utility of the geomembrane or FML installer's employees to perform CQC testing of welds (trial welds and continuous seam sampling). The CQA Engineer shall provide an on-site CQA Technician to observe deployment, seaming and CQC of the geomembrane liner or FML. Geomembrane field testing requirements are summarized on Tables 4B and 5B for smooth and textured HDPE geomembrane, respectively.

7.2.1 Proposed Panel Layout Plan

Prior to deployment of the geomembrane liner or FML, the installer will provide the CQA Engineer with a proposed panel layout plan. This plan will illustrate the panel lengths and width, the orientation and direction of the deployment process, and the sequence of deployment. The plan will also include a description of procedures to deploy the geomembrane liner or FML and to temporarily secure the geomembrane liner or FML prior to seaming.

The CQA Engineer will develop a panel and seam numbering system based upon the proposed panel layout. The system will provide a unique number to identify each panel and seam and will be sufficient to be utilized in the field by the CQC and CQA Technicians.

7.2.2 Visual Inspection

The CQA Technician shall maintain continuous, visual observation and documentation of liner deployment and seaming. Specifically, the following observations shall be made.

- Deployment techniques for the synthetic liner will be documented.
- Scratches or crimps in the geomembrane liner or FML will be documented directly on the liner.
- Damage to the underlying soil liner will be identified.
- Compliance with the proposed panel layout plan will be documented and any variations will be noted on the panel layout plan.
- Overlap of panels will be measured and documented every 50 feet prior to seaming to document that minimum overlap has been accomplished.
- Wrinkles developed within the geomembrane liner or FML, including wrinkle height, length, etc. and provisions to minimize wrinkle formation will be noted.
- Repair procedures for all scratches, punctures, tears and crimps will be documented.
- All test weld and seaming operations will be observed (see Section 7. 3).
- All CQC Technician nondestructive seam testing will be observed and documented, noting methods used for seam testing.
- During deployment, seaming and covering, observations of personnel and/or vehicular traffic on the deployed geomembrane liner or FML and related activities that could damage the synthetic liner.

As-built drawings will be made during construction of the liner, and shall include at least the locations of all welded seams, patches, caps, destructive test locations, and panel numbers.

7.3 SEAM TESTING

Approved processes for field seaming are extrusion welding and fusion welding. Seam testing shall include trial welds, continuous (non-destructive) testing of completed seams, and destructive testing of completed seams in accordance with Tables 4B and 5B. The trial welds and continuous testing shall be performed by the geomembrane or FML Installer and documented by the CQA Technician. The destructive samples shall be secured by the CQA Technician and shipped to an independent third party laboratory for testing. The independent third party laboratory shall be certified by the Geosynthetics Accreditation Institute (GAI) to perform the applicable test.

7.3.1 Field Test Welds

Field test welds are a performance test for the welder and his welding equipment. Prior to performing any seams, each technician and welding equipment shall perform a field test weld. Field test welds shall be made at the beginning of each seaming period and if there are significant changes in ambient conditions (temperature variation, moisture). Each seaming technician shall make at least one trial seam each day. After performing a trial seam, two adjoining one inch specimens will be cut from it and tested in shear and peel.

The seaming technician and his equipment shall not be used until satisfactory trial seams have been performed. Each test weld will be documented on a test weld form. The documentation will be performed by the CQC Technician.

7.3.2 Non-Destructive Testing

All non-destructive seam testing will be continuously performed and documented on all welded seams, patches and repairs. Air pressure testing shall be performed for fusion welds where an air channel exists between double welds. Acceptable results for each type of material are listed in Tables 4B and 5B and values are derived from GRI GM-6. Extrusion welds shall be tested by vacuum testing techniques. During the test, no air bubbles appearing after 10 seconds under a vacuum box are acceptable. The CQA Engineer may approve alternative testing procedures if the geomembrane liner or FML installer can prove equal or better capability to detect seam failures. The geomembrane liner or FML Installer should provide the procedures to be used in a separate CQC Plan developed by the Installer. The specific testing program will be reviewed and approved or modified by the CQA Engineer.

7.3.3 Destructive Testing

Destructive samples will be obtained from the welded production seams at a frequency of at least one sample per 500 linear feet of welded seam. The sample should be of sufficient size to yield three 1 foot by 1 foot samples with the seam approximately centered in each sample. One sample shall be provided to the Installer for testing, one seam shall be tested by an independent third party laboratory and the remaining sample shall be archived by the CQA Technician. All samples should be labeled to identify the sample and seam number and date seamed, the welder and the welding equipment. The label should also identify the technician who tested the seam.

Five subsamples should be tested in shear and five in peel in accordance with ASTM D4437. A passing test is one that achieves the minimum acceptable requirement of Tables 4B or 5B.

The results of the testing should be compared to the requirements by the CQC Manager, and the results should be faxed to the CQA Technician who shall notify the Installer of the results. Test results should be provided to the Installer within 24 hours after shipment of the samples.

7.4 DOCUMENTATION

Upon completion of the geomembrane or FML installation, the CQA Technician shall complete a final panel layout plan. Alternately, the final panel layout may be determined by plan survey of panel intersections, destructive test locations, patch locations and other pertinent locations. This plan shall include the final arrangement of panels, including panel and seam numbering, the type of seaming performed, the locations of all destructive seam tests, and the locations of all patches

8.0 LEACHATE COLLECTION SYSTEM/PROTECTIVE COVER

The material for leachate collection system/protective cover may include leachate pipe, sand, gravel and geotextile, as well as alternate materials such as recycled tire chips and geocomposites. This section addresses material acceptance and installation procedures.

8.1 MATERIAL ACCEPTANCE

The man-made materials (pipe and geotextile) supplier shall provide the CQA Engineer with MQC information and warranty data for the materials to be delivered on site at least one week prior to delivery. Manufacturer submittal requirements for the geotextile are provided on Table 6. The CQA Engineer will compare the geotextile MQC data to the requirements as provided on Table 7. Specifications for leachate pipe should be noted on construction drawings and they will govern. Based upon the information provided, the CQC Engineer will accept the materials for shipment if the requirements of Table 7 and the construction drawings are met.

The CQA Engineer shall review all manufacturer's verification tests for the pipe and geotextile to confirm that these materials meet the requirements of the leachate system design. At least one sample of proposed materials for drainage and protective layers will be tested to determine gradation (ASTM D 422) and permeability (ASTM D2434). The minimum permeability of the leachate collection sand drainage layer shall be 1.0×10^{-2} cm/sec 1.0×10^{-4} for the protective layer; however, if other permeability values are provided on the permit drawings, they will govern. Preconstruction testing will be performed in accordance with Table 8. The CQA Engineer will notify the Owner of material acceptance.

If tire chips are used instead of the leachate collection sand, testing and engineering calculations demonstrating a post-compression hydraulic conductivity of greater than or equal to 1×10^{-2} cm/sec shall be provided.

8.2 MATERIAL VERIFICATION

The man-made materials (pipe and geotextile) will be inventoried by the CQC Technician at the site. The manufacturer's verification data sheet will be reviewed upon delivery and compared to the requirements of Table 7. Archive samples will be maintained for selected geotextile rolls for the project duration.

The earthen materials will be sampled and tested to document gradation. Conformance testing will be performed in accordance with Table 8.

8.3 VISUAL INSPECTION

The CQC Technician shall maintain continuous visual inspection during all phases of the leachate system construction. All construction will be performed in accordance with the specifications and construction drawings. Daily documentation will be recorded on the daily field reports. Visual inspection will include at a minimum:

- Leachate pipe installation will be observed to determine type, location, elevations and orientation of the perforations.
- The gravel pack placement around the leachate pipe will be inspected and documented for size. There are no specific dry density or moisture content requirements for the placement. The gravel pack shall be constructed in such a manner that the finished item is firm and compact, and neither damages nor shifts the pipe.
- The installation of the geotextile will be in accordance with plans. For the gravel pack, the material will be placed so the wrap overlap is at least 36 inches. The wrap overlaps will be observed and reported on the daily field report form.
- The sand drainage layer will be observed to note any visual indications of material change. There are no specific dry density or moisture content requirements for the placement. The drainage layer shall be constructed in such a manner that the finished item is firm and compact, based upon visual observations.
- The protective soil layer will be observed to note any visual indications of material change. There are no specific dry density or moisture content requirements for the placement. The protective layer shall be constructed in such a manner that the finished item is firm and compact, based upon visual observations.

9.0 GEOCOMPOSITE

In the event that geotextile-geonet-geotextile geocomposite is to be installed in lieu of drainage sand layer during any portion of construction, this section addresses the CQC and CQA requirements associated with installation of the geocomposite. Additionally, the geocomposite may be utilized as a LCS alternate.

9.1 MATERIAL ACCEPTANCE

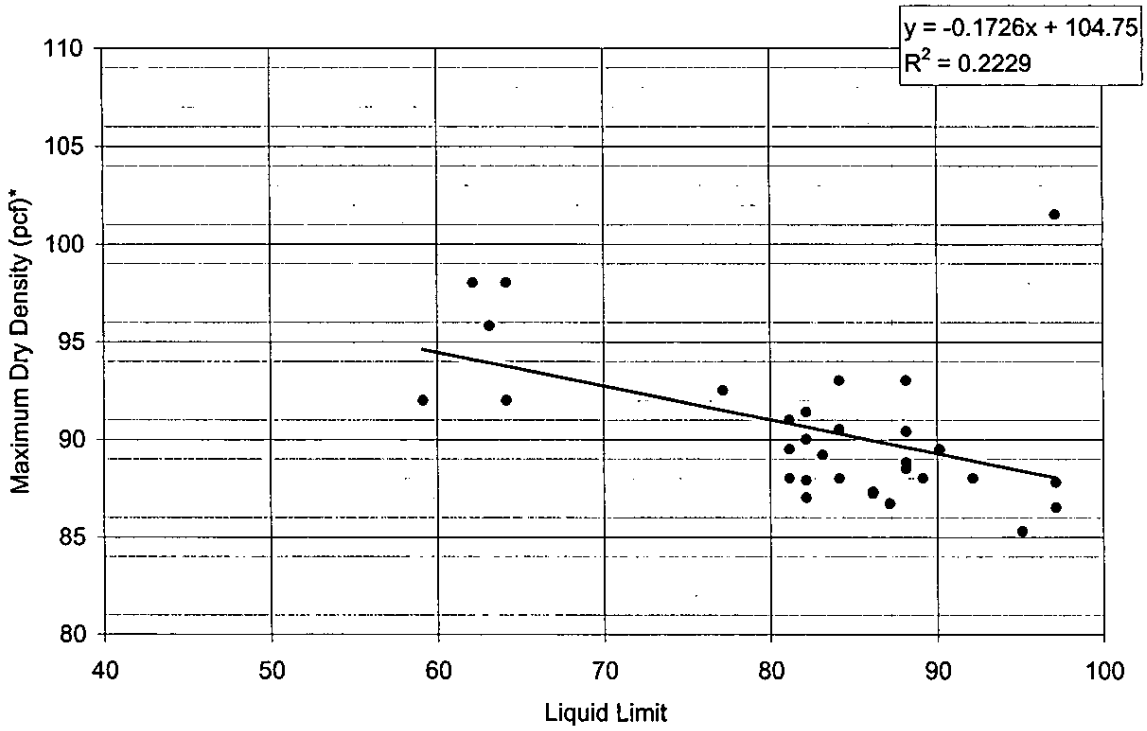
The geocomposite supplier shall provide the CQA Engineer with MQC information and warranty data for the materials to be delivered on site at least one week prior to delivery. Manufacturer submittal requirements for the geocomposite are provided on Table 9. The MQC data will be compared to the requirements for geocomposite as provided in Table 10. Based upon the information provided, the CQC Manager will accept the materials for shipment if the requirements of Table 10 are met.

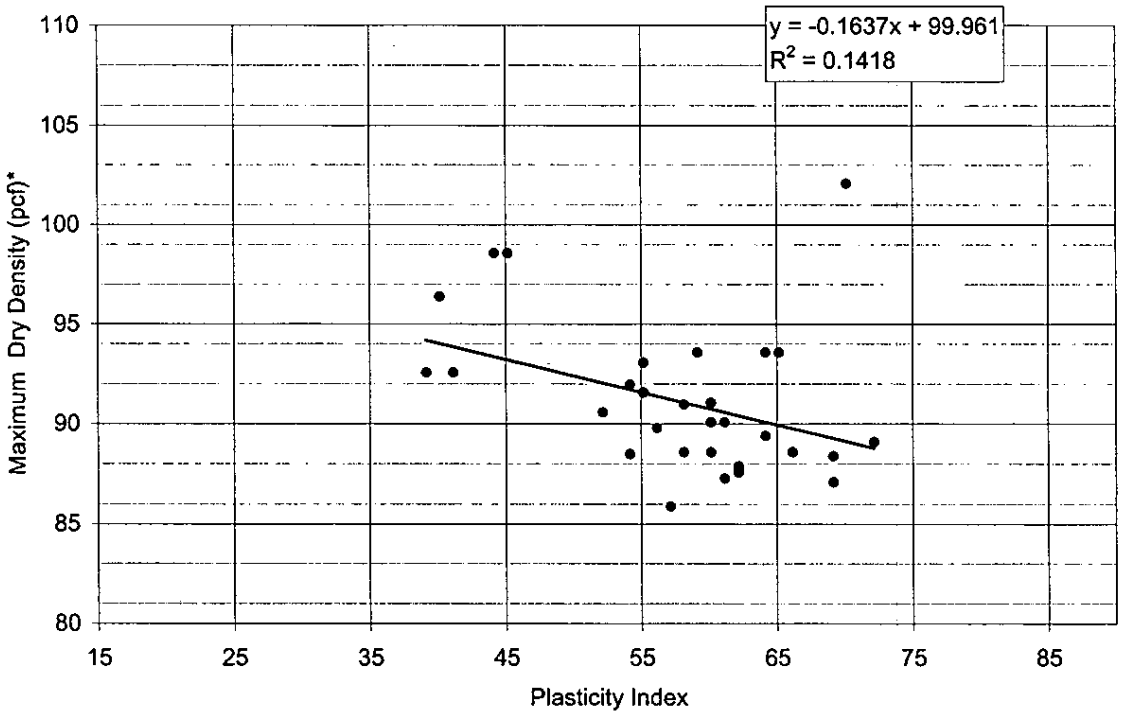
The CQC Technician shall inventory all geocomposite materials that are received on site. The inventory will document that the MQC information provided previously to the CQA Engineer is applicable to the inventory shipped. Selected rolls of geocomposite material will be sampled for confirmation of the materials properties as provided in Table 10.

9.2 INSTALLATION

During shipment and storage, the geocomposites shall be protected from ultraviolet light exposure, moisture, dirt, dust, puncture or other damaging conditions. The General Contractor or the Subcontractor responsible for installation shall be responsible for storage and protection of the geocomposites. The CQC Technician shall observe material handling and storage. Handling of the geocomposite should be with devices that are not capable of cutting, puncturing or otherwise abrading the materials. Any noticeable defects of the delivered material will be documented on the material inventory sheets, and the damaged rolls shall be segregated. Care shall be taken to prevent entrapment of excessive dust or dirt during installation. If the geocomposite is not free of soil and debris before installation, it shall be cleaned by the General Contractor or the Subcontractor just prior to installation.

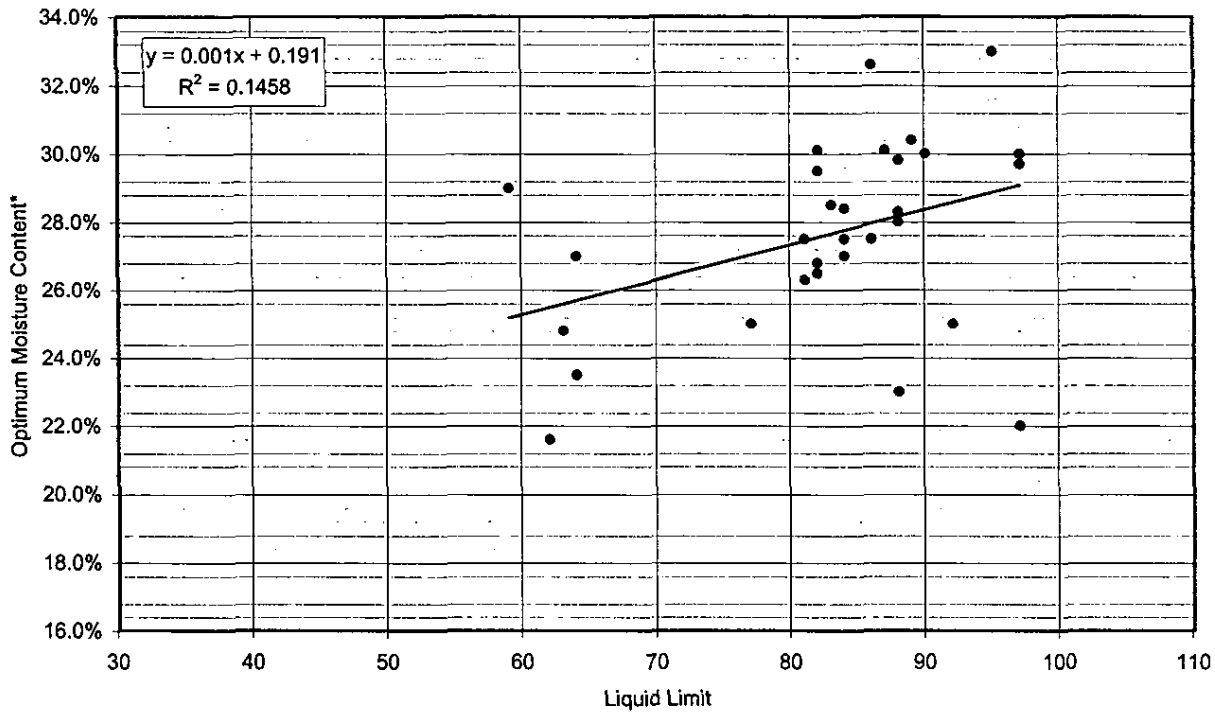
The geocomposite shall be placed with the long dimension of the rolls running vertical with the slope, rather than across (horizontal to) the slope. The geocomposite shall be rolled down the slope in a manner that continually keeps the material in tension. If necessary, the geocomposite shall be straightened by hand after being unrolled to minimize wrinkles. Adjacent rolls shall be overlapped approximately 1 to 2 feet and small holes in the geotextile for each roll should be made so that the geonet may be secured with plastic ties approximately every 5 feet along the roll length. End-to-end overlaps shall be tied at least every 2 feet, and the rolls shall be oriented such that these overlaps are staggered. Plastic ties shall be white or brightly-colored for easy inspection. Metallic ties will not be allowed. The geotextile will then be overlapped and sewn or heat tacked per the manufacturer's recommendation. All soil materials located on top of the geocomposite shall be deployed in such a manner as to ensure that the geocomposite and underlying materials are not damaged, that minimal slippage of the geocomposite on underlying layers occurs, and that no excess tensile stresses occur in the geocomposite.

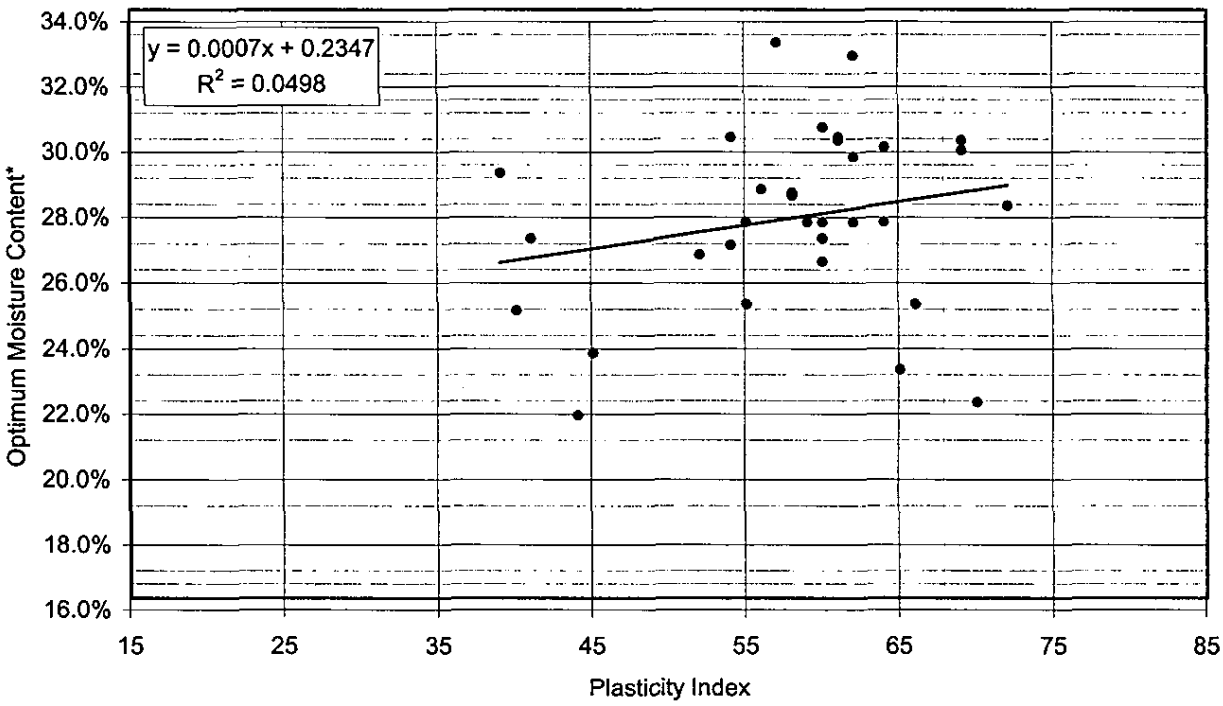




* As determined by Standard proctor compaction test (ASTM D-692)

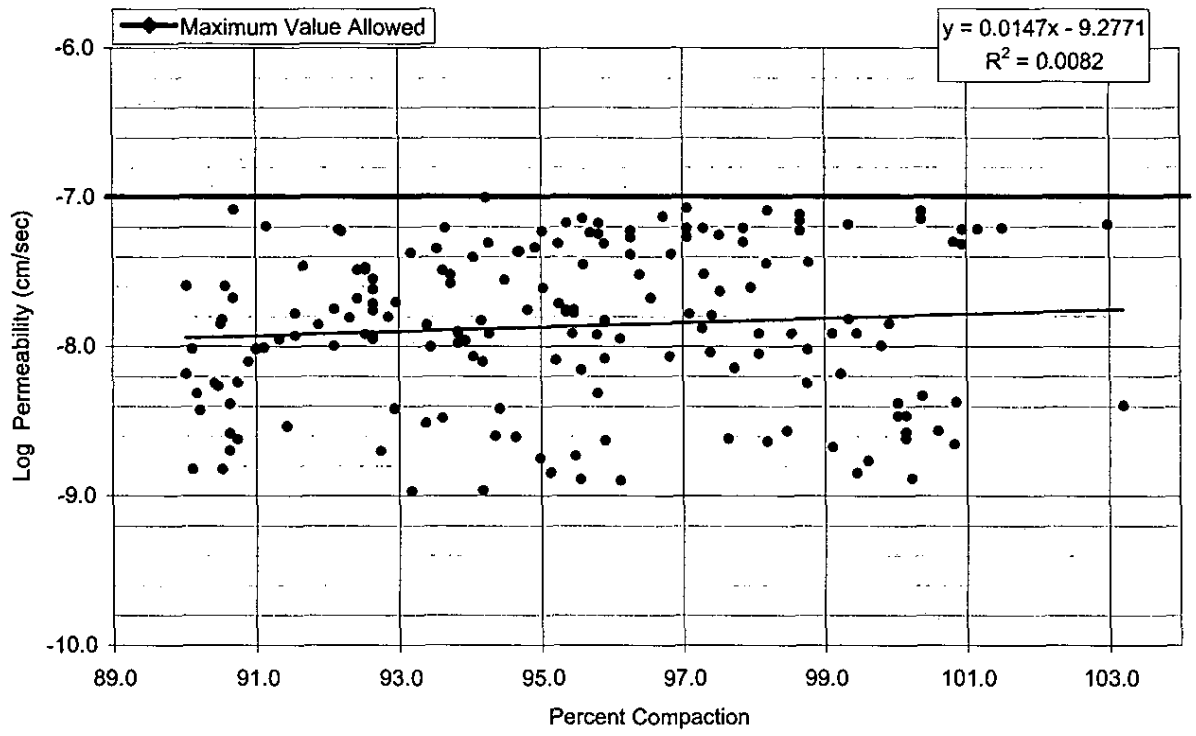
Regression Analysis Dry Density vs Plasticity		
Magnolia Sanitary Landfill CQA Plan Monroe, Louisiana		
Engr: VRD 915177	EQUISTERRA	Fig. No. 1

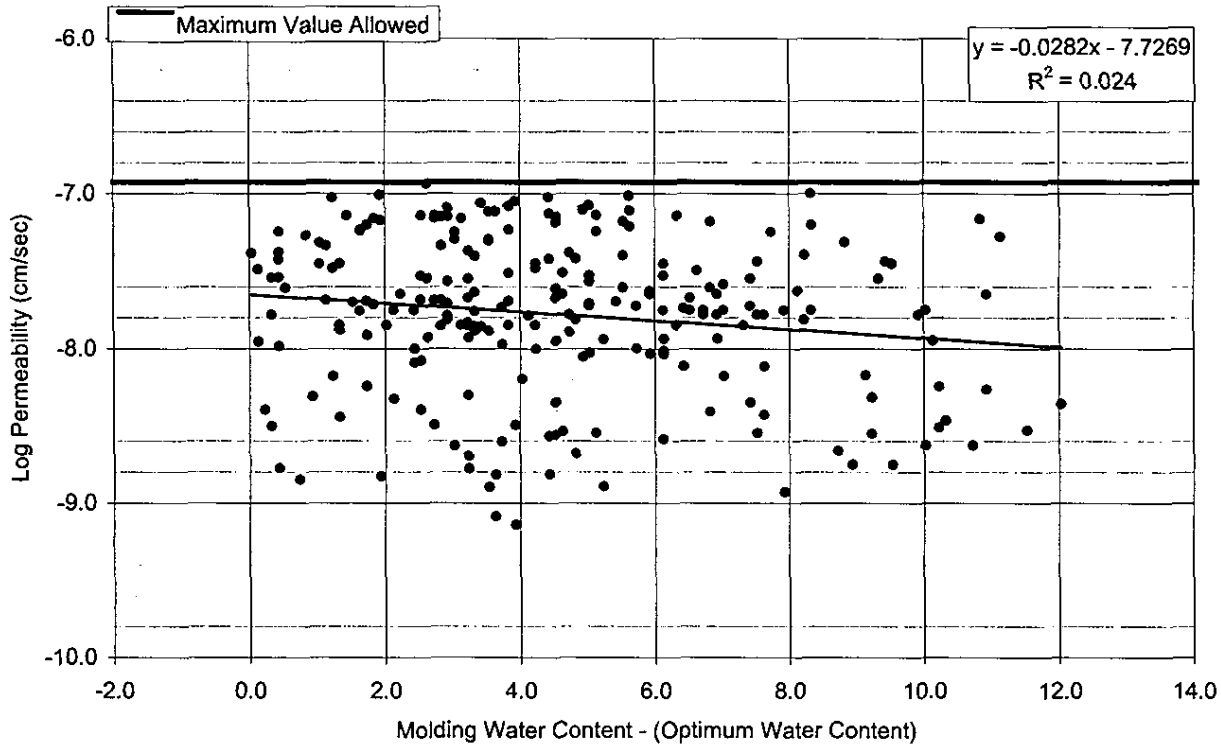




* As determined by Standard proctor compaction test (ASTM D-692)

Regression Analysis Opt. Moisture Content vs Plasticity		
Monroe Sanitary Landfill CQA Plan Monroe Louisiana		
Engr: VRD 915177	Aquaterra	Fig. No. 2





* As determined by Standard proctor compaction test (ASTM D-692)

Regression Analysis Compaction/Water Cont. vs Permeability		
Magnolia Sanitary Landfill CQA Plan Monroe Louisiana		
Engr: VRD 915177	aquaterra	Fig. No. 3

aquaterra engineering

Table 1

Summary of Moisture Content/Maximum Dry Density Tests

Magnolia Sanitary Landfill

Cell No.	Sample No.	Date	Description	Source Area Description	γ_{dmax}	ω_{opt}	Atterberg Limits LL	PL	PI	USCS	-200	Nat. ω	Nat - Opt	Gs
16	0-A	2/28/2000	Brown and Dark Gray Clay	On Site	89.5	26.3%	81	21	60	CH	97.3	31.2%	4.9%	2.7
16	2-C	3/4/2000	Brown and Dark Gray Clay	On Site	98	21.6%	62	18	44	CH	100	20.5%	-1.1%	2.7
16	2-D	3/6/2000	Brown and Dark Gray Clay	On Site	88	27.5%	81	21	60	CH	100	19.7%	-7.8%	2.7
16	6-D	3/22/2000	Dark Gray Clay	On Site	88.5	28.0%	88	16	72	CH	100	34.3%	6.3%	2.7
16	14-A	3/28/2000	Dark Gray Clay	On Site	87	29.5%	82	20	62	CH	94.9	34.3%	4.8%	2.7
16	21-A	4/14/2000	Dark Brown Clay	On Site	88	25.0%	92	26	66	CH	97.1	34.6%	9.6%	2.7
16	26-C	4/27/2000	Dark Brown Clay	On Site	88	28.4%	84	26	58	CH	98.5	40.0%	11.6%	2.7
16	29-E	5/10/2000	Dark Gray Clay	On Site	90	26.5%	82	30	52	CH	97.8	35.8%	9.3%	2.7
16	30-F	5/8/2000	Dark Gray Clay	On Site	88	30.4%	89	29	60	CH	98.9	38.0%	7.6%	2.7
17	1116A	11/16/2001	Gray Clay	Cell Excavation	95.8	24.8%	63	23	40	CH	N/D	37.5%	12.7%	2.75
17	0103B	1/7/2002	Brown Clay	Cell Excavation	101.5	22.0%	97	27	70	CH	96.0%	26.3%	4.3%	2.75
17	0111A	1/15/2002	Stiff Brown Clay w/Shell Fragments	On Site	86.7	30.1%	87	26	61	CH	N/D	N/D	N/D	2.65
17	0116E	1/24/2002	Stiff Brown Clay w/Ferrous Nodules	On Site	88.8	29.8%	88	24	64	CH	N/D	34.7%	4.9%	2.65
17	0117E	1/17/2002	Stiff Brown Clay w/Calcareous Nodules	On Site	87.3	27.5%	86	24	62	CH	N/D	33.6%	6.1%	2.65
17	1205D	2/12/2002	Brown Clay	On Site	87.2	32.6%	86	29	62	CH	N/D	35.1%	2.5%	2.65
17	0218B	2/18/2002	Stiff Brown Clay w/Calcareous Nodules	On Site	85.3	33.0%	95	25	57	CH	98.0%	41.0%	8.0%	2.65
18	0603A	6/3/2003	Gray Clay	New Borrow Source	86.5	30.0%	97	28	69	CH	99.0%	40.0%	10%	2.65
18	1020A	10/20/2003	Dark Brown Clay	On Site Borrow	87.9	30.1%	82	28	54	CH	97.3%	31.3%	1.2%	2.65
18	1113C	11/13/2003	Dark Brown Clay	On Site	89.2	28.5%	83	27	56	CH	98.8%	40.2%	11.7%	2.65
18	1113F	11/13/2003	Dark Brown Clay	On Site	91.4	26.8%	82	28	54	CH	98.2%	33.2%	6.4%	2.7
18	1114C	11/14/2003	Dark Brown Clay	On Site	90.4	28.3%	88	30	58	CH	97.9%	28.8%	0.5%	2.7
18	1121F	11/21/2003	Dark Brown Clay	On Site	87.8	29.7%	97	28	69	CH	96.9%	32.0%	2.3%	2.7
19	0116A	1/16/2004	Dark Brown Clay	On Site	92.0	29.0%	59	20	39	CH	83.7%	33.7%	4.7%	2.7
19	0409C	4/9/2004	Dark Brown Clay	On Site	93.0	27.5%	84	25	59	CH	94.5%	57.2%	29.7%	2.7
19	0417C	4/17/2004	Dark Brown Clay	On Site	93.0	27.5%	84	20	64	CH	95.0%	43.3%	15.8%	2.7
19	0423C	4/23/2004	Dark Brown Clay	On Site	91.0	27.5%	81	26	55	CH	94.4%	27.0%	-0.5%	2.7
19	0430C	4/30/2004	Dark Brown Clay	On Site	92.0	27.0%	64	23	41	CH	93.7%	24.6%	-2.4%	2.7
19	0507C	5/7/2004	Dark Brown Clay	On Site	90.5	27.0%	84	24	60	CH	96.6%	33.0%	6.0%	2.7
19	0720A	7/20/2004	Dark Brown Clay	On Site	98.0	23.5%	64	19	45	CH	97.7%	24.5%	1.0%	2.7
19	0721A	7/21/2004	Dark Brown Clay	On Site	92.5	25.0%	77	22	55	CH	91.1%	32.7%	7.7%	2.7

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Table 1

Summary of Moisture Content/Maximum Dry Density Tests

Magnolia Sanitary Landfill

Cell No.	Sample No.	Date	Description	Source Area Description	γ_{dmax}	ω_{opt}	Atterberg Limits LL	PL	PI	USCS	-200	Nat. ω	Nat - Opt	Gs
19	0721B	7/21/2004	Dark Brown Clay	On Site	93.0	23.0%	88	23	65	CH	90.0%	25.2%	2.2%	2.7
19	0721C	7/21/2004	Dark Brown Clay	On Site	89.5	30.0%	90	29	61	CH	96.7%	40.2%	10.2%	2.7

Description of Symbols

γd_{max}	Maximum Dry Density as determined by Standard Proctor Compaction Test (ASTM D 698)
ω_{opt}	Optimum Water Content asdetermined by Standard Proctor Compaction Test (ASTM D 698)
LL, PL, PI	Atterberg Limits: Liquid Limit, Plastic Limit, Plasticity Index
-200	% of sample passing the # 200 sieve
Nat ω	Natural moisture content of sample at time of sampling
Nat - Opt	Difference between natural moisture content and optimum moisture content
Gs	Specific Gravity (assumed)

Cell Number	Date Sampled	Test Number	Test Results		Ref Proctor			Evaluation		Laboratory Test Results			
			ω	γ_{dry}	Proctor	γ_d max	ω opt		Comp.	Atterberg Limits			K
			(%)	(pcf)	No.	(pcf)	(%)	$\omega - \omega_{opt}$	(%)	LL	PL	PI	(cm/sec)
Cell 16	2000	2-23	27.0%	91.4	0-A	89.5	26.3%	0.7	102.1	91	31	60	1.2E-09
Cell 16	2000	2-30	34.2%	81.6	0-A	89.5	26.3%	7.9	91.2	93	24	69	1.0E-09
Cell 16	2000	2-48	34.5%	84.9	0-A	89.5	26.3%	8.2	94.9	70	15	55	3.4E-08
Cell 16	2000	3-46	28.8%	89.9	0-A	89.5	26.3%	2.5	100.4	77	20	57	2.5E-08
Cell 16	2000	5-2	27.4%	85.6	0-A	89.5	26.3%	1.1	95.6	96	22	74	3.9E-08
Cell 16	2000	5-20	26.3%	90.6	0-A	89.5	26.3%	0.0	101.2	83	21	62	3.5E-08
Cell 16	2000	6-9	35.8%	84.5	0-A	89.5	26.3%	9.5	94.4	95	24	71	3.0E-08
Cell 16	2000	6-31	35.8%	83.2	2-D	88	27.5%	8.3	94.5	89	23	66	8.5E-08
Cell 16	2000	6-36	33.6%	85.8	2-D	88	27.5%	6.1	97.5	90	23	67	3.0E-08
Cell 16	2000	7-7	35.4%	81.7	2-D	88	27.5%	7.9	92.8	99	23	76	1.5E-08
Cell 16	2000	7-11	33.4%	86.2	2-D	88	27.5%	5.9	98.0	102	22	80	2.0E-08
Cell 16	2000	7-23	34.0%	83.9	2-D	88	27.5%	6.5	95.3	93	24	69	1.5E-08
Cell 16	2000	7-27	35.2%	82.5	2-D	88	27.5%	7.7	93.8	95	20	75	4.8E-08
Cell 16	2000	8-9	31.7%	86.8	2-D	88	27.5%	4.2	98.6	85	26	59	2.8E-08
Cell 16	2000	9-2	35.1%	82.8	2-D	88	27.5%	7.6	94.1	88	27	61	3.2E-09
Cell 16	2000	11-13	31.1%	88.1	2-D	88	27.5%	3.6	100.1	67	19	48	6.9E-10
Cell 16	2000	11-24	31.4%	87.4	2-D	88	27.5%	3.9	99.3	88	26	62	6.1E-10
Cell 16	2000	18-7	32.5%	83.4	2-D	88	27.5%	5.0	94.8	82	26	56	7.9E-09
Cell 16	2000	18-3	34.0%	84.8	2-D	88	27.5%	6.5	96.4	90	26	64	1.8E-08
Cell 16	2000	19-14	34.4%	82.2	2-D	88	27.5%	6.9	93.4	81	27	54	9.8E-09
Cell 16	2000	19-41	33.4%	84.1	2-D	88	27.5%	5.9	95.6	-	-	-	1.9E-08
Cell 16	2000	21-05	36.8%	81.4	2-D	88	27.5%	9.3	92.5	93	30	63	2.4E-08
Cell 16	2000	21-07	35.7%	81.5	2-D	88	27.5%	8.2	92.6	84	27	57	1.3E-08
Cell 16	2000	21-11	32.1%	84.0	2-D	88	27.5%	4.6	95.5	88	35	53	1.9E-08
Cell 16	2000	21-15	34.4%	84.9	2-D	88	27.5%	6.9	96.5	82	33	49	1.4E-08
Cell 16	2000	21-31	35.1%	83.1	2-D	88	27.5%	7.6	94.4	87	34	53	1.4E-08
Cell 16	2000	21-40	32.9%	81.5	2-D	88	27.5%	5.4	92.6	85	29	56	1.7E-08
Cell 16	2000	22-6	34.9%	85.2	2-D	88	27.5%	7.4	96.8	87	28	59	1.6E-08
Cell 16	2000	22-4	34.9%	84.9	2-D	88	27.5%	7.4	96.5	84	29	55	2.4E-08
Cell 16	2000	25-7	32.4%	82.3	2-D	88	27.5%	4.9	93.5	65	28	37	7.5E-09
Cell 16	2000	25-8	36.9%	81.3	2-D	88	27.5%	9.4	92.4	76	27	49	3.1E-08
Cell 16	2000	25-10	31.7%	84.6	2-D	88	27.5%	4.2	96.1	75	28	47	8.4E-09
Cell 16	2000	25-18	34.0%	83.5	2-D	88	27.5%	6.5	94.9	-	-	-	1.5E-08
Cell 16	2000	25-21	31.3%	84.4	2-D	88	27.5%	3.8	95.9	78	27	51	2.6E-08
Cell 16	2000	25-20	35.1%	82.2	2-D	88	27.5%	7.6	93.4	-	-	-	1.4E-08
Cell 16	2000	26-17	33.2%	82.0	2-D	88	27.5%	5.7	93.2	74	28	46	1.6E-08
Cell 16	2000	26-18	33.1%	82.5	2-D	88	27.5%	5.6	93.8	82	29	53	5.2E-08
Cell 16	2000	27-8	34.1%	84.8	2-D	88	27.5%	6.6	96.4	-	-	-	2.7E-08
Cell 16	2000	27-42	32.2%	86.3	2-D	88	27.5%	4.7	98.1	83	28	55	1.4E-08
Cell 16	2000	28-1	32.0%	85.5	2-D	88	27.5%	4.5	97.2	83	26	57	1.8E-08
Cell 16	2000	28-2	30.4%	90.5	2-D	88	27.5%	2.9	102.8	73	23	50	1.3E-08
Cell 16	2000	28-12	34.2%	85.3	2-D	88	27.5%	6.7	96.9	80	29	51	1.4E-08
Cell 16	2000	28-17	35.8%	83.0	2-D	88	27.5%	8.3	94.3	73	26	47	1.5E-08
Cell 16	2000	28-23	29.6%	89.7	2-D	88	27.5%	2.1	101.9	78	23	55	1.5E-08
Cell 16	2000	28-34	31.7%	85.3	2-D	88	27.5%	4.2	96.9	79	27	52	1.2E-08
Cell 16	2000	29-13	34.5%	85.2	2-D	88	27.5%	7.0	96.8	83	29	54	1.5E-08
Cell 16	2000	29-17	30.7%	86.9	2-D	88	27.5%	3.2	98.8	76	27	49	1.8E-08
Cell 16	2000	29-26	33.0%	84.4	2-D	88	27.5%	5.5	95.9	81	26	55	5.6E-08
Cell 16	2000	29-27	35.0%	83.6	2-D	88	27.5%	7.5	95.0	84	25	59	3.1E-08
Cell 16	2000	29-36	30.1%	90.2	2-D	88	27.5%	2.6	102.5	82	25	57	2.4E-08
Cell 16	2000	29-43	35.6%	83.4	2-D	88	27.5%	8.1	94.8	96	29	67	2.0E-08
Cell 16	2000	29-47	38.4%	82.5	2-D	88	27.5%	10.9	93.8	69	22	47	1.9E-08
Cell 16	2000	29-52	35.0%	81.2	2-D	88	27.5%	7.5	92.3	-	-	-	1.4E-08
Cell 16	2000	30-1	33.6%	84.2	2-D	88	27.5%	6.1	95.7	79	23	56	1.5E-08
Cell 16	2000	30-14	34.2%	84.3	2-D	88	27.5%	6.7	95.8	88	27	61	1.5E-08
Cell 16	2000	30-27	33.4%	86.1	2-D	88	27.5%	5.9	97.8	82	28	54	1.9E-08
Cell 16	2000	30-35	33.0%	83.7	2-D	88	27.5%	5.5	95.1	82	29	53	2.1E-08
Cell 16	2000	30-38	34.5%	83.9	2-D	88	27.5%	7.0	95.3	90	30	60	2.2E-08
Cell 16	2000	33-16	30.4%	86.2	2-D	88.0	27.5%	2.9	98.0	-	-	-	2.3E-08
Cell 17	2001	7	24.8%	98.8	3	98.0	21.6%	3.2	100.8	58	25	34	4.2E-09
Cell 17	2001	21	26.0%	98.2	3	98.0	21.6%	4.4	100.2	84	21	63	1.3E-09

Cell Number	Date Sampled	Test Number	Test Results		Ref Proctor			Evaluation		Laboratory Test Results			
			ω	γ_{dry}	Proctor	γ_d max	ω opt		Comp.	Atterberg Limits			K
			(%)	(pcf)	No.	(pcf)	(%)	$\omega - \omega_{opt}$	(%)	LL	PL	PI	(cm/sec)
Cell 17	2001	32	24.1%	98.0	3	98.0	21.6%	2.5	100.0	72	22	50	3.4E-09
Cell 17	2001	40	23.7%	101.1	3	98.0	21.6%	2.1	103.2	55	21	34	4.0E-09
Cell 17	2001	4	33.6%	88.7	2	88.0	27.5%	6.1	100.8	96	33	63	2.2E-09
Cell 17	2001	14	35.0%	85.9	2	88.0	27.5%	7.5	97.6	86	27	59	2.4E-09
Cell 17	2001	24	31.3%	88.3	2	88.0	27.5%	3.8	100.3	86	24	62	7.0E-08
Cell 17	2001	54	36.2%	84.0	2	88.0	27.5%	8.7	95.5	90	33	57	1.8E-09
Cell 17	2001	64	24.4%	98.9	3	98.0	21.6%	2.8	100.9	74	23	51	6.00E-08
Cell 17	2001	10	36.3%	85.2	2	88.0	27.5%	8.8	96.8	88	28	60	4.10E-08
Cell 17	2001	21	35.1%	87.3	2	88.0	27.5%	7.6	99.2	93	27	66	6.50E-09
Cell 17	2001	39	38.4%	88.3	2	88.0	27.5%	10.9	100.3	93	21	72	4.60E-09
Cell 17	2001	51	23.2%	100.2	4	101.5	22.0%	1.2	98.7	87	23	44	5.60E-09
Cell 17	2001	9	32.6%	88.1	2	88.0	27.5%	5.1	100.1	87	32	52	2.40E-09
Cell 17	2001	5	35.0%	86.8	1	95.8	24.8%	10.2	90.6	88	29	57	2.60E-09
Cell 17	2001	20	31.4%	88.5	2	88.0	27.5%	3.9	100.6				2.70E-09
Cell 17	2001	38	27.5%	94.3	1	95.8	24.8%	2.7	98.4				2.70E-09
Cell 17	2001	51	31.8%	86.6	1	95.8	24.8%	7.0	90.4	85	29	56	5.60E-09
Cell 17	2001	10	33.7%	86.3	1	95.8	24.8%	8.9	90.1				1.50E-09
Cell 17	2001	16	32.2%	89.0	1	95.8	24.8%	7.4	92.9				3.80E-09
Cell 17	2001	23	34.8%	86.8	1	95.8	24.8%	10.0	90.6	85	29	57	2.00E-09
Cell 17	2001	6	39.0%	83.0	2	88.0	27.5%	11.5	94.3	89	29	60	2.50E-09
Cell 17	2001	19	35.5%	86.8	1	95.8	24.8%	10.7	90.6	88	28	60	2.00E-09
Cell 17	2001	47	36.8%	86.4	1	95.8	24.8%	12.0	90.2				3.70E-09
Cell 17	2001	52	28.0%	95.4	1	95.8	24.8%	3.2	99.6	89	29	60	1.70E-09
Cell 17	2001	15	39.4%	81.6	8	87.2	32.6%	6.8	93.6				3.30E-09
Cell 17	2001	11	33.9%	86.9	1	95.8	24.8%	9.1	90.7				5.70E-09
Cell 17	2002	5	34.0%	86.8	1	95.8	24.8%	9.2	90.6				4.10E-09
Cell 17	2002	23	42.9%	79.7	8	87.2	32.6%	10.3	91.4	91	26	65	2.90E-09
Cell 17	2002	27	37.0%	85.6	8	87.2	32.6%	4.4	98.2				2.30E-09
Cell 17	2002	3	34.3%	86.7	1	95.8	24.8%	9.5	90.5	104	31	73	1.50E-09
Cell 17	2002	7	36.3%	86.4	8	87.2	32.6%	3.7	99.1	97	31	65	2.11E-09
Cell 17	2002	34	41.8%	79.1	8	87.2	32.6%	9.2	90.7				2.38E-09
Cell 17	2002	55	32.9%	87.3	8	87.2	32.6%	0.3	100.1				2.66E-09
Cell 17	2002	64	37.1%	82.3	8	87.2	32.6%	4.5	94.4	85	34	52	3.80E-09
Cell 17	2002	2	37.1%	83.6	8	87.2	32.6%	4.5	95.9	101	27	74	2.33E-09
Cell 17	2002	18	37.8%	82.1	8	87.2	32.6%	5.2	94.2	93	27	66	1.08E-09
Cell 17	2002	38	37.2%	82.5	8	87.2	32.6%	4.6	94.6	94	25	69	2.46E-09
Cell 17	2002	58	36.2%	83.3	8	87.2	32.6%	3.6	95.5	92	26	66	1.29E-09
Cell 17	2002	4	37.4%	82.8	8	87.2	32.6%	4.8	95.0	85	24	62	1.77E-09
Cell 17	2002	13	33.9%	81.4	8	87.2	32.6%	1.3	93.3	82	33	49	3.04E-09
Cell 17	2002	10	42.8%	78.6	8	87.2	32.6%	10.2	90.1	97	26	70	4.80E-09
Cell 17	2002	56	35.8%	86.7	8	87.2	32.6%	3.2	99.4	83	24	59	1.41E-09
Cell 17	2002	16	33.5%	87.2	8	87.2	32.6%	0.9	100.0	86	25	51	4.13E-09
Cell 17	2002	45	32.8%	87.3	8	87.2	32.6%	0.2	100.1	78	24	54	3.41E-09
Cell 17	2002	8	30.9%	89.5	1	95.8	24.8%	6.1	93.4	79	22	57	9.80E-09
Cell 17	2002	25	34.8%	86.7	1	95.8	24.8%	10.0	90.5	89	24	65	1.50E-08
Cell 17	2002	54	38.7%	82.1	8	87.2	32.6%	6.1	94.2	85	25	80	7.80E-09
Cell 17	2002	60	33.0%	85.5	8	87.2	32.6%	0.4	98.1	84	26	59	8.80E-09
Cell 17	2002	3	32.9%	87.1	8	87.2	32.6%	0.3	99.9	87	26	61	1.40E-08
Cell 17	2002	21	33.9%	86.4	8	87.2	32.6%	1.3	99.1	93	26	67	1.20E-08
Cell 17	2002	35	34.9%	86.3	1	95.8	24.8%	10.1	90.1	86	23	63	9.50E-09
Cell 17	2002	52	38.9%	83.2	8	87.2	32.6%	6.3	95.4	89	27	62	1.20E-08
Cell 17	2002	66	36.3%	84.9	8	87.2	32.6%	3.7	97.4	85	25	60	9.00E-09
Cell 17	2002	76	32.7%	86.1	8	87.2	32.6%	0.1	98.7	83	25	58	9.40E-09
Cell 17	2002	27	39.9%	81.8	8	87.2	32.6%	7.3	93.8	94	28	66	1.20E-08
Cell 17	2002	44	37.4%	84.8	8	87.2	32.6%	4.8	97.2	87	32	55	1.30E-08
Cell 17	2002	22	42.5%	78.9	8	87.2	32.6%	9.9	90.5	91	29	62	1.40E-08
Cell 17	2002	8	38.7%	83.0	8	87.2	32.6%	6.1	95.2	90	26	64	8.00E-09
Cell 17	2002	3	38.3%	84.4	8	87.2	32.6%	5.7	96.8	90	28	62	8.50E-09
Cell 17	2002	2	36.4%	85.9	8	87.2	32.6%	3.8	98.5	86	24	62	1.20E-08
Cell 17	2002	7	34.6%	86.7	8	87.2	32.6%	2.0	99.4	93	34	58	1.20E-08
Cell 17	2002	2	38.7%	83.6	8	87.2	32.6%	6.1	95.9	90	25	65	8.20E-09

Table 2
Summary of Previous Permeability Tests
Magnolia Sanitary Landfill

Cell Number	Date Sampled	Test Number	Test Results		Ref Proctor			Evaluation		Laboratory Test Results			
			ω	γ_{dry}	Proctor	γ_d max	ω opt		Comp.	Atterberg Limits			K
			(%)	(pcf)	No.	(pcf)	(%)	$\omega - \omega_{opt}$	(%)	LL	PL	PI	(cm/sec)
Cell 17	2002	6	35.1%	85.2	8	87.2	32.6%	2.5	97.7	88	29	59	7.10E-09
Cell 17	2002	9	36.4%	85.5	8	87.2	32.6%	3.8	98.1	90	24	66	1.2E-08
Oxidation Pond	2003	1020A	33.0%	81.9	1	86.5	30.0%	3.0	94.7	87	31	56	4.3E-08
Oxidation Pond	2003	1020B	34.5%	79.7	1	86.5	30.0%	4.5	92.1	90	30	60	6.0E-08
Cell 18	2003	1101A	31.8%	84.6	2	87.9	30.1%	1.7	96.2	94	24	70	5.31E-08
Cell 18	2003	1103A	31.1%	84.6	2	87.9	30.1%	1.0	96.2	95	26	69	4.07E-08
Cell 18	2003	1104A	31.4%	84.7	2	87.9	30.1%	1.3	96.4	95	25	70	2.99E-08
Cell 18	2003	1104B	32.0%	85.3	2	87.9	30.1%	1.9	97.0	87	25	62	8.31E-08
Cell 18	2003	1105A	33.1%	88.7	2	87.9	30.1%	3.0	100.9	96	26	70	4.78E-08
Cell 18	2003	1105B	31.7%	88.6	2	87.9	30.1%	1.6	100.8	98	28	70	4.93E-08
Cell 18	2003	1105C	33.9%	86	2	87.9	30.1%	3.8	97.8	98	27	71	4.95E-08
Cell 18	2003	1105D	35.0%	83.8	2	87.9	30.1%	4.9	95.3	87	30	57	6.65E-08
Cell 18	2003	1106A	33.5%	85	2	87.9	30.1%	3.4	96.7	91	24	67	7.32E-08
Cell 18	2003	1106B	33.6%	83.2	2	87.9	30.1%	3.5	94.7	89	26	63	4.26E-08
Cell 18	2003	1106C	35.1%	84	2	87.9	30.1%	5.0	95.6	88	27	61	7.10E-08
Cell 18	2003	1106D	34.8%	84	2	87.9	30.1%	4.7	95.6	82	30	52	3.49E-08
Cell 18	2003	1107A	37.0%	83.7	2	87.9	30.1%	6.9	95.2	97	26	71	1.90E-08
Cell 18	2003	1107B	33.3%	86.8	2	87.9	30.1%	3.2	98.7	91	26	65	3.60E-08
Cell 18	2003	1110A	32.5%	87.3	2	87.9	30.1%	2.4	99.3	95	27	68	1.50E-08
Cell 18	2003	1110B	35.1%	85.6	2	87.9	30.1%	5.0	97.4	106	27	79	1.60E-08
Cell 18	2003	1110C	35.1%	85.7	2	87.9	30.1%	5.0	97.5	84	28	56	2.30E-08
Cell 18	2003	1111A	32.7%	82.8	2	87.9	30.1%	2.6	94.2	105	26	79	9.80E-08
Cell 18	2003	1111B	32.7%	87.7	2	87.9	30.1%	2.6	99.8	89	24	65	1.00E-08
Cell 18	2003	1112A	36.9%	84.2	2	87.9	30.1%	6.8	95.8	88	28	60	5.58E-08
Cell 18	2003	1112B	36.4%	85.3	2	87.9	30.1%	6.3	97.0	83	25	58	6.09E-08
Cell 18	2003	1113A	40.9%	83.5	2	87.9	30.1%	10.8	95.0	80	26	54	5.83E-08
Cell 18	2003	1113B	38.4%	85.3	2	87.9	30.1%	8.3	97.0	79	24	55	5.32E-08
Cell 18	2003	1113D	35.7%	84.2	2	87.9	30.1%	5.6	95.8	75	27	48	6.59E-08
Cell 18	2003	1113E	34.3%	85.5	2	87.9	30.1%	4.2	97.3	82	30	52	3.01E-08
Cell 18	2003	1114A	41.2%	82.2	2	87.9	30.1%	11.1	93.5	78	26	52	4.46E-08
Cell 18	2003	1114B	32.8%	86.7	2	87.9	30.1%	2.7	98.6	79	23	56	5.88E-08
Cell 18	2003	1115A	34.6%	85.7	2	87.9	30.1%	4.5	97.5	86	28	58	5.51E-08
Cell 18	2003	1115B	35.2%	83.7	2	87.9	30.1%	5.1	95.2	87	28	59	4.82E-08
Cell 18	2003	1120A	34.5%	80.1	2	87.9	30.1%	4.4	91.1	94	24	70	6.31E-08
Cell 18	2003	1120B	35.7%	79.7	2	87.9	30.1%	5.6	90.7	83	24	59	8.16E-08
Cell 18	2003	1121A	31.9%	84.6	2	87.9	30.1%	1.8	96.2	81	23	58	5.86E-08
Cell 18	2003	1121B	33.0%	86.7	2	87.9	30.1%	2.9	98.6	85	24	61	6.83E-08
Cell 18	2003	1121C	32.0%	84.1	2	87.9	30.1%	1.9	95.7	83	23	60	5.70E-08
Cell 18	2003	1121D	34.0%	86.7	2	87.9	30.1%	3.9	98.6	82	22	60	7.53E-08
Cell 18	2003	1121E	33.0%	88.9	2	87.9	30.1%	2.9	101.1	73	22	51	6.01E-08
Cell 18	2003	1122A	31.3%	88.2	2	87.9	30.1%	1.2	100.3				7.93E-08
Cell 18	2003	1122B	35.2%	86	2	87.9	30.1%	5.1	97.8				6.12E-08
Cell 18	2003	1122C	33.6%	87.3	2	87.9	30.1%	3.5	99.3				6.47E-08
Cell 18	2003	1122D	32.8%	85.5	2	87.9	30.1%	2.7	97.3				6.09E-08
Cell 18	2003	1122E	32.6%	82.3	2	87.9	30.1%	2.5	93.6				6.12E-08
Cell 18	2003	1123A	34.5%	86.3	2	87.9	30.1%	4.4	98.2				8.03E-08
Cell 18	2003	1123B	33.7%	90.5	2	87.9	30.1%	3.6	103.0				6.48E-08
Cell 18	2003	1123C	31.5%	89.2	2	87.9	30.1%	1.4	101.5				6.11E-08
Cell 19	2004	0406A	29.8%	87.3	1	92.0	29.0%	0.8	94.9	94	27	67	4.55E-08
Cell 19	2004	0407A	34.5%	84.3	1	92.0	29.0%	5.5	91.6	87	28	59	3.39E-08
Cell 19	2004	0407B	29.4%	86.1	1	92.0	29.0%	0.4	93.6	85	23	62	3.19E-08
Cell 19	2004	0407C	32.5%	85.7	1	92.0	29.0%	3.5	93.2	92	29	63	4.18E-08
Cell 19	2004	0408A	30.6%	86.7	1	92.0	29.0%	1.6	94.2	89	23	66	4.87E-08
Cell 19	2004	0408B	32.3%	85.1	1	92.0	29.0%	3.3	92.5	91	26	65	3.34E-08
Cell 19	2004	0408C	32.5%	85.2	1	92.0	29.0%	3.5	92.6	87	25	62	1.10E-08
Cell 19	2004	0409A	29.4%	90.1	1	92.0	29.0%	0.4	97.9	81	21	60	2.44E-08
Cell 19	2004	0409B	35.8%	83.4	1	92.0	29.0%	6.8	90.7	103	27	76	2.09E-08
Cell 19	2004	0415A	33.4%	85.0	1	92.0	29.0%	4.4	92.4	66	21	45	3.21E-08
Cell 19	2004	0415B	30.0%	86.2	1	92.0	29.0%	1.0	93.7	64	20	44	2.98E-08

Table 2
Summary of Previous Permeability Tests
Magnolia Sanitary Landfill

Cell Number	Date Sampled	Test Number	Test Results		Ref Proctor			Evaluation		Laboratory Test Results			
			ω	γ_{dry}	Proctor	γ_d max	ω opt		Comp.	Atterberg Limits			K
			(%)	(pcf)	No.	(pcf)	(%)	$\omega - \omega_{opt}$	(%)	LL	PL	PI	(cm/sec)
Cell 19	2004	0416A	29.4%	90.3	1	92.0	29.0%	0.4	98.2	75	22	53	3.54E-08
Cell 19	2004	0416B	31.8%	86.5	1	92.0	29.0%	2.8	94.0	67	20	47	3.90E-08
Cell 19	2004	0417A	35.1%	82.8	1	92.0	29.0%	6.1	90.0	94	27	67	2.51E-08
Cell 19	2004	0417B	30.5%	87.7	1	92.0	29.0%	1.5	95.3	89	24	65	1.68E-08
Cell 19	2004	0419A	30.7%	86.3	1	92.0	29.0%	1.7	93.8	36	16	20	1.03E-08
Cell 19	2004	0419B	32.3%	85.5	1	92.0	29.0%	3.3	92.9	38	16	22	1.96E-08
Cell 19	2004	0419C	31.8%	87.8	1	92.0	29.0%	2.8	95.4	37	15	22	1.74E-08
Cell 19	2004	0420A	34.0%	84.2	1	92.0	29.0%	5.0	91.5	60	21	39	1.65E-08
Cell 19	2004	0420B	30.1%	87.2	1	92.0	29.0%	1.1	94.8	57	23	34	1.74E-08
Cell 19	2004	0421A	35.4%	82.8	1	92.0	29.0%	6.4	90.0	64	22	42	6.48E-09
Cell 19	2004	0422A	32.8%	85.2	1	92.0	29.0%	3.8	92.6	81	25	56	1.72E-08
Cell 19	2004	0422B	32.2%	86.3	1	92.0	29.0%	3.2	93.8	86	27	59	1.24E-08
Cell 19	2004	0423A	30.7%	87.7	1	92.0	29.0%	1.7	95.3	66	22	44	1.72E-08
Cell 19	2004	0423B	31.4%	86.5	1	92.0	29.0%	2.4	94.0	69	21	48	8.45E-09
Cell 19	2004	0427A	33.7%	86.4	1	92.0	29.0%	4.7	93.9	62	20	42	1.08E-08
Cell 19	2004	0427B	35.4%	84.9	1	92.0	29.0%	6.4	92.3	90	29	61	1.54E-08
Cell 19	2004	0428A	31.7%	87.7	1	92.0	29.0%	2.7	95.3	89	28	61	1.73E-08
Cell 19	2004	0428B	31.9%	85.9	1	92.0	29.0%	2.9	93.4	93	26	67	1.38E-08
Cell 19	2004	0428C	29.5%	88.8	1	92.0	29.0%	0.5	96.5	88	28	60	2.09E-08
Cell 19	2004	0428D	29.3%	87.4	1	92.0	29.0%	0.3	95.0	88	26	62	2.43E-08
Cell 19	2004	0429A	30.2%	85.2	1	92.0	29.0%	1.2	92.6	86	23	63	2.79E-08
Cell 19	2004	0429B	31.5%	84.7	1	92.0	29.0%	2.5	92.1	84	26	58	1.76E-08
Cell 19	2004	0430A	33.5%	83.7	1	92.0	29.0%	4.5	91.0	78	24	54	9.48E-09
Cell 19	2004	0430B	32.3%	84.0	1	92.0	29.0%	3.3	91.3	64	19	45	1.10E-08
Cell 19	2004	0503A	32.7%	85.4	1	92.0	29.0%	3.7	92.8	82	28	54	1.56E-08
Cell 19	2004	0504A	29.4%	88.2	1	92.0	29.0%	0.4	95.9	98	27	71	4.83E-08
Cell 19	2004	0504B	29.1%	86.9	1	92.0	29.0%	0.1	94.5	92	28	64	2.75E-08
Cell 19	2004	0504C	34.0%	83.3	1	92.0	29.0%	5.0	90.5	89	25	64	2.50E-08
Cell 19	2004	0504D	34.9%	83.6	1	92.0	29.0%	5.9	90.9	98	33	65	7.84E-09
Cell 19	2004	0505A	30.3%	88.4	1	92.0	29.0%	1.3	96.1	95	32	63	1.11E-08
Cell 19	2004	0505B	30.8%	89.3	1	92.0	29.0%	1.8	97.1	85	29	56	1.63E-08
Cell 19	2004	0505C	31.2%	85.2	1	92.0	29.0%	2.2	92.6	94	29	65	1.91E-08
Cell 19	2004	0505D	30.6%	88.2	1	92.0	29.0%	1.6	95.9	90	29	61	1.48E-08
Cell 19	2004	0507A	29.4%	87.5	1	92.0	29.0%	0.4	95.1				1.42E-09
Cell 19	2004	0507B	32.2%	85.1	1	92.0	29.0%	3.2	92.5				1.19E-08
Cell 19	2004	0510A	33.0%	83.2	1	92.0	29.0%	4.0	90.4	84	23	61	5.38E-09
Cell 19	2004	0510B	30.7%	88.1	1	92.0	29.0%	1.7	95.8	84	24	60	4.82E-09
Cell 19	2004	0522A	33.8%	85.1	1	92.0	29.0%	4.8	92.5	90	23	67	3.22E-08
Cell 19	2004	0524A	34.2%	83.8	1	92.0	29.0%	5.2	91.1				9.70E-09
Cell 19	2004	0524B	32.5%	85.7	1	92.0	29.0%	3.5	93.2				1.07E-09
Cell 19	2004	0524C	33.6%	86.2	1	92.0	29.0%	4.6	93.7				2.60E-08
Cell 19	2004	0524D	32.3%	86.6	1	92.0	29.0%	3.3	94.1				1.47E-08
Cell 19	2004	0524E	33.5%	85.0	1	92.0	29.0%	4.5	92.4				2.07E-08
Cell 19	2004	0525A	32.1%	84.8	1	92.0	29.0%	3.1	92.2				5.85E-08
Cell 19	2004	0525B	32.0%	85.3	1	92.0	29.0%	3.0	92.7				1.99E-09
Cell 19	2004	0525C	33.1%	84.5	1	92.0	29.0%	4.1	91.8				1.38E-08
Cell 19	2004	0525D	31.9%	87.8	1	92.0	29.0%	2.9	95.4	95	24	71	1.65E-08
Cell 19	2004	0525E	32.2%	85.2	1	92.0	29.0%	3.2	92.6				2.39E-08
Cell 19	2004	0525F	31.8%	88.1	1	92.0	29.0%	2.8	95.8				1.18E-08
Cell 19	2004	0526A	32.3%	85.2	1	92.0	29.0%	3.3	92.6	102	27	75	1.17E-08
Cell 19	2004	0526B	31.4%	87.9	1	92.0	29.0%	2.4	95.5				6.88E-09
Cell 19	2004	0526C	32.1%	86.7	1	92.0	29.0%	3.1	94.2				1.20E-08
Cell 19	2004	0526D	32.4%	84.2	1	92.0	29.0%	3.4	91.5				1.17E-08
Cell 19	2004	0526E	32.2%	84.7	1	92.0	29.0%	3.2	92.1	96	24	72	9.91E-09
Cell 19	2004	0526G	30.9%	88.4	1	92.0	29.0%	1.9	96.1				1.26E-09
		Max	42.9%	101.1		101.5	32.6%	12.0	103.2	106.0	34.0	80.0	9.80E-08
		Min	23.2%	78.6		86.5	21.6%	0.1	90.0	36.0	15.0	20.0	1.07E-09
		Average	33.6%	85.9		90.2	29.3%	4.2	95.3	85.2	25.8	59.3	2.47E-08

TABLE 3
Geomembrane Manufacturer Submittals (QC)
Magnolia Sanitary Landfill
Monroe, Louisiana

Origin and Identification	Supplier name, production plant, brand name and number of resin
Resin Certificates	Copies of dated QC certificates from resin supplier
Resin Test Results	Copies of test results from Manufacturer for resin
Reclaimed Polymer	Written statement that the amount of reclaimed polymer was done with the appropriate cleanliness and does not exceed 2% by weght.
Geomembrane Composition	List of materials which comprise geomembrane expressed as percent by weight for the following: polyethlyene, carbon black, and other additives.
Manufacturer's Minimum Specifications	A copy of published minimum Manufacturer specifications and test methods. Written certification stating the Manufacturer's geonet minium specifications are guaranteed by the Manufacturer.
QC Certificates	QC certificates signed by responsible entity employed by Manufacturer. Each certificate should include roll number, test procedures, and QC test results.

TABLE 4A

TESTING REQUIREMENTS - 60 MIL SMOOTH (HDPE) GEOMEMBRANE

Magnolia Sanitary Landfill
Monroe, Louisiana

Properties	Test Method	Manufacturer QC test Frequency	Conformance QA Test Frequency	Required Test Values[11]
Thickness (min. avg.) • Lowest individual for any of the 10 values	ASTM D-5199	1 per Roll	1 per 250,000 sf	60 mil 54 mil
Sheet Density (min avg.)	ASTM D-792 or ASTM D-1505	1 per 50,000 sf	1 per 250,000 sf	0.940 g/cc
Tensile Properties[1] (min. avg.) • Yield Strength • Break Strength • Yield Elongation • Break Elongation	ASTM D-6693 Type IV	1 per 50,000 sf	1 per 250,000 sf	132 lb/in. 228 lb/in. 12% 750%
Tear Resistance (min. avg.)	ASTM D-1004 Die C	1 per 50,000 sf	N/A	42 lbs
Puncture Resistance (min. avg.)	ASTM D-4833	1 per 50,000 sf	1 per 250,000 sf	108 lbs
Stress Crack Resistance[2]	ASTM D-5397 (App.)	(10)	N/A	300 hours
Carbon Black Content[3] (range)	ASTM D-1603	1 per 50,000 sf	1 per 250,000 sf	2-3%
Carbon Black Dispersion[4]	ASTM D-5596	1 per 50,000 sf	1 per 250,000 sf	A1, A2, B1 Category 1,2, or 3
Oxidative Induction time (min. avg.)[5] • Std. OIT or • High Pressure OIT	ASTM D-3895 ASTM D-5885	(10)	N/A	100 min 400 min.

Notes:

1. Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
   - Yield elongation is calculated using a gauge length of 1.3 inches.
   - Break elongation is calculated using a gauge length of 2.0 inches.
2. The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used from the textured sheet materials.
3. Other methods such as ASTM D-4218 (muffle furnace) or microwave method are acceptable if an appropriate correlation to ASTM D-1603 (tube furnace) can be established.
4. Carbon black dispersion (only near spherical agglomerates) for 10 different views:
   - 9 in Categories 1 or 2, and
   - 1 in Category 3.

TABLE 4A (Continued)
TESTING REQUIREMENTS - 60 MIL SMOOTH (HDPE) GEOMEMBRANE

Magnolia Sanitary Landfill
Monroe, Louisiana

Properties	Test Method	Manufacturer QC test Frequency	Conformance QA Test Frequency	Required Test Values[11]
Oven Aging at 85°C (min. avg.) retained after 90 days[6] • Std. OIT or • High Pressure OIT	ASTM D-5721 ASTM D-3895 ASTM D-5885	(10)	N/A	55% 80%
UV Resistance [7] (min. avg.) retained after 1,600 hrs[9] • Std. OIT or • High Pressure OIT	GRI GM-11 ASTM D-3895 ASTM D-5885	(10)	N/A	(8) 50%

Notes:

5. The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
6. It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
7. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
8. Not recommended since the high temperature of the Std-OIT test produces and unrealistic result for some of the antioxidants in the UV exposed samples.
9. UV resistance is based on percent retained value regardless of the original HP-OIT value.
10. Manufacturer may provide certification letter.
11. Based on greater value of previous CQA Plan and Waste Management, Inc.'s Geosynthetic Specification Tables, Revision 4, dated May 2004.

TABLE 4B

FIELD TESTING REQUIREMENTS - 60 Mil Smooth HDPE GEOMEMBRANE

Monroe Sanitary Landfill
Monroe, Louisiana

Properties	Test Method[3]	Sample Size	Minimum Field Test Frequency	Acceptance Criteria
Shear Test[1][2]	ASTM D-6392 (excl. Section 6.3, "Conditioning")	42-in along seam, 12-in wide	Average 1 every 500 lineal ft for each type of welding	Failure is more than 1 out of 5 non-FTB. Minimum yield strength for the seam is 120 lb/in.
Peel Test [1][2]	ASTM D-6392 (excl. Section 6.3, "Conditioning")	42-in along seam, 12-in wide	Average 1 every 500 lineal ft for each type of welding	Failure is more than 1 out of 5 non-FTB. Minimum yield strength for the seam is 90 lb/in for Fusion welds and 78 lb/in for Extrusion Welds.
Air-Pressure	GRI GM-6	N/A	All dual track seams	For 60 mil, 3 psi drop with initial pressure 2-37 psi for 5 minutes, following an initial relaxation period.
Vacuum	N/A	N/A	All extrusion seams	Examine weld for approximately 10 seconds through window for vacuum of minimum 3 psig.

Notes:

1. Maximum of one-non FTB (Film Tear Bond) per five specimens tested is acceptable provided that strength requirements are met on that sample. Film Tearing Bond (FTB) definition: A failure to the ductile mode of one of the bonded sheets by tearing prior to complete separation to the bonded area. Examples of FTB and the associated locus of break codes are provided in ASTM D-6392.
2. For double fusion welded seams, both tracks shall be tested for compliance with the minimum property values listed above.
3. Destructive seams will be evaluated for strength parameters according to ASTM D-6392 (excluding Section 6.3 "Conditioning"). Destructive seams will be evaluated for elongation during cold weather seaming. The Installer is required to submit a cold weather seaming plan for approval along with recommendations in GRI GM-9.
4. Adapted from Waste Management, Inc.'s Geosynthetic Specification Tables, Revision 4, dated May 2004.

TABLE 5A

TESTING REQUIREMENTS - TEXTURED HDPE GEOMEMBRANE

Magnolia Sanitary Landfill

Monroe, Louisiana

Properties	Test Method	Manufacturer QC Test Frequency	Conformance QA Test Frequency	40 MIL Required Test Values [13]	60 MIL Required Test Values [13]
Thickness (min. avg.) • Lowest individual for 8 out of 10 values • Lowest individual for any of the 10 values	ASTM D-5994	1 per Roll	1 per 250,000 sf	38 mil 36 mil 34 mil	57 mil 54 mil 51 mil
Asperity Height (min. avg.)[1][2]	GRI GM-12	1 per 50,000 sf	1 per 250,000 sf	10 mil	10 mil
Sheet Density (min. avg.)	ASTM D-792 or ASTM D-1505	1 per 50,000 sf	1 per 250,000 sf	0.940 g/cc	0.940 g/cc
Tensile Properties[3] (min. avg.) • Yield strength • Break strength • Yield elongation • Break elongation	ASTM D-638 Type IV	1 per 50,000 sf	1 per 250,000 sf	 84 lb/in 60 lb/in 12% 100%	 126 lb/in 90 lb/in 12% 100%
Tear Resistance (min. avg.)	ASTM D-1004 Die C	1 per 50,000 sf	N/A	28 lbs	42 lbs
Puncture Resistance (min. avg.)	ASTM D-4833	1 per 50,000 sf	1 per 250,000 sf	60 lbs	90 lbs
Stress Crack Resistance[4]	ASTM D-5397 (App.)	(12)	N/A	300 hours	300 hours
Carbon Black Content (range) [5]	ASTM D-1603	1 per 50,000 sf	1 per 250,000 sf	2-3%	2-3%
Carbon Black Dispersion [6]	ASTM D-2663 ASTM D-5596	1 per 50,000 sf	1 per 250,000 sf	A1, A2, B1 Category 1,2, or 3 [6]	A1, A2, B1 Category 1,2, or 3 [6]

Notes:

1. Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils.
2. Alternate the measurement side for double sided textured sheet.
3. Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
   - Yield elongation is calculated using a gage length of 1.3 inches.
   - Break elongation is calculated using a gage length of 2.0 inches.
4. The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used from the textured sheet materials
5. Other methods such as ASTM D-4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D-1603 (tube furnace) can be established.
6. Carbon black dispersion (only near spherical agglomerates) for 10 different views:
   - 9 in Categories 1 or 2; and
   - 1 in Category 3.

TABLE 5A (Continued)
TESTING REQUIREMENTS - TEXTURED HDPE GEOMEMBRANE

Magnolia Sanitary Landfill
Monroe, Louisiana

Properties	Test Method	Manufacturer	Conformance	40 MIL Required Test Values [13]	60 MIL Required Test Values [13]
		QC Test Frequency	QA Test Frequency		
Oxidate Induction Time (min. avg.)[7]		(12)	N/A		
• Std. OIT	ASTM D-3895			100 min	
or					
• High Pressure OIT	ASTM D-5885			400 min	
Oven Aging at 85°C[8] retained after 90 days (min. avg.)	ASTM D-5721				
• Std. OIT	ASTM D-3895	(12)	N/A	55%	
or					
• High Pressure OIT	ASTM D-5885			80%	
UV Resistance[9] (min. avg.) retained after 1,600 hrs[11]	GRI GM-11				
• Std. OIT	ASTM D-3895	(12)	N/A	(10)	
or					
• High Pressure OIT	ASTM D-5885			50%	

Notes:
7. The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
8. It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
9. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
10. Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
11. UV resistance is based on percent retained value regardless of the original HP-OIT value.
12. Manufacturer may provide certification letter.
13. Based on GRI GM-13, Rev. 6, dated 23 June 2003.
14. Adapted from Waste Management, Inc.'s Geosynthetic Specification Tables, Revision 4, dated May 2004.

TABLE 5B
FIELD TESTING REQUIREMENTS - TEXTURED HDPE GEOMEMBRANE

Magnolia Sanitary Landfill
Monroe, Louisiana

Properties	Test Method[3]	Sample Size	Minimum Field Test Frequency	40 MIL Acceptance Criteria	60 MIL Acceptance Criteria
Shear Test[1][2]	ASTM D-6392 (excl. Section 6.3, "Conditioning")	42-in along seam, 12-in wide	Average 1 every 1,000 lineal ft for each type of welding	80 psi	120 psi
Peel Test [1][2]	ASTM D-6392 (excl. Section 6.3, "Conditioning")	42-in along seam, 12-in wide	Average 1 every 1,000 lineal ft for each type of welding	52 psi Fusion 52 psi Extrusion	90 psi Fusion 78 psi Extrusion
Air-Pressure	GRI GM-6	N/A	All dual track seams	4 psi drop with initial pressure 24-30 psig for 5 minutes.	3 psi drop with initial pressure 27-30 psig for 5 minutes.
Vacuum	N/A	N/A	All extrusion seams	Examine weld for approximately 10 seconds through window for vacuum of minimum 3 psig.	Examine weld for approximately 10 seconds through window for vacuum of minimum 3 psig.

Notes:

1. Maximum of one-non FTB (Film Tear Bond) per five specimens tested is acceptable provided that strength requirements are met on that sample. Film Tearing Bond (FTB) definition: A failure to the ductile mode of one of the bonded sheets by tearing prior to complete separation to the bonded area. Examples of FTB and the associated locus of break codes are provided in ASTM D-6392.
2. For double fusion welded seams, both tracks shall be tested for compliance with the minimum property values listed above.
3. Destructive seams will be evaluated for strength parameters according to ASTM D-6392 (excluding Section 6.3 "Conditioning"). Destructive seams will be evaluated for elongation during cold weather seaming. The Installer is required to submit a cold weather seaming plan for approval along with recommendations in GRI GM-9.

TABLE 6
Geotextile Manufacturer Submittals (QC)
Magnolia Sanitary Landfill
Monroe, Louisiana

Origin and Identification	Supplier name, production plant, brand name and number of resin
Resin Certificates	Copies of dated QC certificates from resin supplier
Resin Test Results	Copies of test results from Manufacturer for resin
Geotextile Test Results	Copies of QC test results to verify geotextiles meet project specification.
Reclaimed Polymer	Written statement that the amount of reclaimed polymer was done with the appropriate cleanliness.
Geotextile Composition	A copy of published minimum Manufacturer specifications and test methods. Written certification stating the Manufacturer's
Manufacturer's Minimum Specifications	A copy of published minimum Manufacturer specifications and test methods. Written certification stating the Manufacturer's geotextile minium specifications are guaranteed by the Manufacturer.
Needle Certification	Written certification stating the Manufacturer has continuously inspected for needles and that geotextile is needle-free.
QC Certificates	QC certificates signed by responsible entity employed by Manufacturer. Each certificate should include roll number, test procedures, and QC test results.

TABLE 7
TESTING REQUIREMENTS - NONWOVEN GEOTEXTILE

Magnolia Sanitary Landfill
Monroe, Louisiana

Properties	Test Method	Manufacturer QC Test Frequency	Conformance QA Test Frequency	Required Test Values
Mass/Unit Area (MARV)	ASTM D-5261	1 per 100,000 sf	1 per 250,000 sf	10 oz/sy (nominal) 9.1 oz/sy (min. avg.)
Apparent Opening Size (max.)	ASTM D-4751	1 per 540,000 sf	1 per project(1)	0.25 mm No. 60 Sieve
Grab Strength (MARV)	ASTM D-4632	1 per 100,000 sf	1 per 250,000 sf	250 lbs
Grab Tensile Elongation (MARV)	ASTM D-4632	1 per 100,000 sf	1 per 250,000 sf	50%
Trapezoidal Tear Strength (MARV)	ASTM D-4533	1 per 100,000 sf	1 per 250,000 sf	95 lbs
Burst Strength (MARV)	ASTM D-3786	1 per 100,000 sf	1 per 250,000 sf	430 lbs
Puncture Strength (min. avg.)	ASTM D-4833	1 per 100,000 sf	1 per 250,000 sf	120 lbs
Thickness (avg.)	ASTM D-1777	1 per 100,000 sf	1 per 250,000 sf	125 mils
UV Resistance (min.)	ASTM D-4355	1 per resin formulation	N/A	70%(3)
Permittivity (min.)	ASTM D-4491	1 per 540,000 sf	1 per project (1)	0.9 sec^{-1}

Notes:
1. AOS and Permittivity shall only be tested for geotextiles used in filter applications.
2. Manufacturer may elect to provide certification of values for geotextiles.
3. UV evaluation to be on 2.0 inch strip tensile specimens after 500 hours of exposure.
4. Adapted from GRI-GT12(a) dated February 18, 2002 and Waste Management, Inc.'s Geosynthetic Specification Tables, Revision 4, dated January 2004.
5. Test values for geotextiles greater than $10oz/yd^2$ should be adapted from GRI-GT-12(a).

TABLE 8
TESTING REQUIREMENTS - Leachate Collection System

Magnolia Sanitary Landfill
Monroe, Louisiana

PRECONSTRUCTION

Item	Test Method	Minimum Frequency	Minimum Criteria
Gravel for LCS Trench and Sump	Grain Size - mechanical (ASTM D-422)	1 per source	Maximum particle size of 3" and ≤ 5% passing #200 sieve Minimum 95% larger than pipe perforations (typically 3/8" sieve)
	USCS Classification (ASTM D-2487)	1 per source	GW or GP per USCS
(1) Sand Drainage Layer (2) Protective Soil Cover	Grain Size - mechanical (ASTM D-422)	1 per source	min. 95% passing ¼" sieve size and ≤ 5% passing #200 sieve
	Permeability (ASTM D-2434)	1 per source	(1) $\geq 1 \times 10^{-2}$ cm/sec (2) $\geq 1 \times 10^{-4}$ cm/sec
	USCS Classification (ASTM D-2487)	1 per source	SW or SP per USCS

CONFORMANCE

Item	Test Method	Minimum Frequency	Minimum Criteria
Gravel for LCS Trench and Sump	Grain Size - mechanical (ASTM D-422)	1 test 1,500 yd^3	Maximum particle size of 3" and ≤ 5% passing #200 sieve Minimum 95% larger than pipe perforations (typically 3/8" sieve)
	USCS Classification (ASTM D-2487)	1 test 1,500 yd^3	GW or GP per USCS
(1) Sand Drainage Layer (2) Protective Soil Cover	Grain Size - mechanical (ASTM D-422)	1 test 3,000 yd^3	min. 95% passing ¼" sieve size and ≤ 5% passing #200 sieve
	USCS Classification (ASTM D-2487)	1 test 3,000 yd^3	SW or SP per USCS

TABLE 9
Geonet Manufacturer Submittals (QC)
Magnolia Sanitary Landfill
Monroe, Louisiana

Origin and Identification	Supplier name, production plant, brand name and number of resin
Resin Certificates	Copies of dated QC certificates from resin supplier
Resin Test Results	Copies of test results from Manufacturer for resin
Reclaimed Polymer	Written statement that the amount of reclaimed polymer was done with the appropriate cleanliness.
Geonet Composition	List of materials which comprise geonet expressed as percent by weight for the following: polyethlyene, carbon black, and other additives.
Manufacturer's Minimum Specifications	A copy of published minimum Manufacturer specifications and test methods. Written certification stating the Manufacturer's geonet minium specifications are guaranteed by the Manufacturer.
QC Certificates	QC certificates signed by responsible entity employed by Manufacturer. Each certificate should include roll number, test procedures, and QC test results.

TABLE 10
TESTING REQUIREMENTS - GEOCOMPOSITE

Magnolia Sanitary Landfill
Monroe, Louisiana

Geonet Component

Properties	Test Method	Manufacturer QC Test Frequency	Conformance QA Test Frequency	Required Test Values
Thickness (min. avg.)	ASTM D-751 or ASTM D-5199	1 per 100,000 sf	1 per 250,000 sf	200 mil
Density (min. avg.)	ASTM D-792 or ASTM D-1505	1 per 100,000 sf	1 per 250,000 sf	0.940 g/cc
Mass/Unit Area (min. avg.)	ASTM D-5261	1 per 100,000 sf	1 per 250,000 sf	0.16 lbs/ft^2
Carbon Black Content (range)	ASTM D-1603[4]	1 per 100,000 sf	1 per 250,000 sf	2-3%

Finished Geocomposite Product

Properties	Test Method	Manufacturer QC Test Frequency	Conformance QA Test Frequency	Required Test Values
Peel Strength (min. avg.)	ASTM F-904 or ASTM D-914	1 per 100,000 sf	1 per 250,000 sf	0.75 lb/in
Transmissivity [1] (min. avg.)	ASTM D-4716	1 per project	1 per project	1.6×10^{-3} m^2/sec[3] (top deck with no drainage pipe) or 5×10^{-4} m^2/sec (side slope and top deck with drainage pipes at 300 ft centers)

Notes:

1. Transmissivity shall be measured in a 12-inch × 12-inch box using the same boundary conditions, load, duration and gradient as those used by the manufacturer to establish the min. avg. for the required test value.
2. Testing for the geonet component shall be performed in accordance with the upper portion of this table. The geotextile component shall meet the required test values from Table 5 and the manufacturer's QC test frequency requirements. Tracking of the frequency of Manufacturer QC testing and Conformance QA testing shall be based on the geocomposite roll numbers.
3. Transmissivity is measured using water at 20°C with a hydraulic gradient of one under a compressure stress of 1,000 psi between a geomembrane and a neoprene backed steel plate.
4. Other methods such as ASTM D-4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to ASTM D-1603 (tube furnace) can be established.
5. Adapted from Waste Management, Inc.'s Geosynthetic Specification Tables, Revision 4, dated January 2004.