Carmen Johnson

Fac/Perm/Co ID # 60-04 Date 4/17/12 Doc ID# DIN

Form 01077 (R7-89)

FORM 101.1 | REVISION 13

CERTIFICATION OF ENGINEERING CALCULATION

STATION AND UNIT NUMBER McGUIRE NUCLEAR STATION

TITLE OF CALCULATION LANDFILL

SOLID WASTE SECTION APR 12 1991

CALCULATION NUMBER MCC-1114.02-00-0001

ORIGINALLY CONSISTING OF:

PAGES 1 THROUGH 53

TOTAL ATTACHMENTS 4 TOTAL MICROFICHE ATTACHMENTS 0

TOTAL VOLUMES 1 TYPE I CALCULATION/ANALYSIS YES ☐ NO ☒

TYPE I REVIEW FREQUENCY N/A

THESE ENGINEERING CALCULATIONS COVER QA CONDITION Non-QA ITEMS. IN ACCORDANCE WITH ESTABLISHED PROCEDURES, THE QUALITY HAS BEEN ASSURED AND I CERTIFY THAT THE ABOVE CALCULATION HAS BEEN ORIGINATED, CHECKED OR APPROVED AS NOTED BELOW:

ORIGINATED BY C.B. Thom DATE 7/6/90

CHECKED BY P. Michael Sanford DATE 8/29/90

APPROVED BY _____ DATE _____

ISSUED TO TECHNICAL SERVICES DIVISION _____ DATE _____

RECEIVED BY TECHNICAL SERVICES DIVISION _____ DATE _____

MICROFICHE ATTACHMENT LIST: ☐ Yes ☐ No SEE FORM 101.4

REV. NO.	CALCULATION PAGES (VOL)			ATTACHMENTS (VOL)			VOLUMES		ORIG	CHKD	APPR	ISSUE DATE
	REVISED	DELETED	ADDED	REVISED	DELETED	ADDED	DELETED	ADDED	DATE	DATE	DATE	REC'D DATE

Form 101.2 Revision 1
26164 (R9-89)

File/Calculation No. MCC-1114.02-00-0001

REVISION DOCUMENTATION SHEET

Revision Number	Review Frequency Changed Yes/No	Revision Description
0	N/A	ORIGINAL RELEASE

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. 0 File No MCC-1114.02-00-0001 Sheet 1 Of

Subject Landfill

By CB Thom Date 7/25/

Prob No. Checked By P.M. Sanford Date 8-29-90

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DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 2 Of

Subject LANDFILL

By J.B. [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

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Station McGuire N.S Unit – Rev. 0 File No. MCC-1114.02-00-0001 Sheet 3 Of

Subject LANDFILL

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-8-90

1.1 STATEMENT OF PROBLEM

THIS CALCULATION DOCUMENTS THE DESIGN OF THE McGUIRE NUCLEAR STATION BRC LANDFILL WHICH IS LOCATED SOUTH OF THE PLANT DIRECTLY OFF CASHION ROAD.

1.2 RELATION TO NUCLEAR SAFETY

THE LANDFILL IS NON-SAFETY RELATED. THE McGUIRE LANDFILL IS A TYPICAL SANITARY LANDFILL LOCATED OFF THE STATION "PROPER" SITE.

1.3 DESIGN METHOD

THE LANDFILL HAS BEEN DESIGNED IN ACCORDANCE WITH THE NORTH CAROLINA SOLID WASTE MANAGEMENT RULES. THE PRIMARY REFERENCE SOURCES UTILIZED WERE THE "GEOSYNTHETIC DESIGN GUIDANCE FOR HAZARDOUS WASTE LANDFILL CELLS AND SURFACE IMPOUNDMENTS" AND DESIGN, CONSTRUCTION & MONITORING OF SANITARY LANDFILL BOOK *

* FOR EXACT REF. SEE P. 4

1.4 REFERENCES

1. SAGHI, AMALENDU, (1990) "DESIGN, CONSTRUCTION, & MONITORING OF SANITARY LANDFILL," WILEY, NEW YORK.

2. RICHARDSON, G.N., AND KOERNER, R.M. (1987) "GEOSYNTHETIC DESIGN GUIDANCE FOR HAZARDOUS WASTE LANDFILL CELLS AND SURFACE IMPOUNDMENT, EPA.

3. KOERNER, R.M., (1986) "DESIGNING WITH GEOSYNTHETICS," PRENTICE-HALL.

4. BAUMEISTER, THEODORE, (1958) "MECHANICAL ENGINEERS' HANDBOOK". McGRAW-HILL.

5. SOWERS, GEORGE F., (1979) "INTRODUCTORY SOIL MECHANICS AND FOUNDATIONS: GEOTECHNICAL ENGINEERING". MACMILLAN.

6. THE STATE OF NORTH CAROLINA EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL. (1988)

7. REPORT OF GEOLOGIC & HYDROGEOLOGIC ASSESSMENT PHASE I PROPOSED LANDFILL DISPOSAL SITE. (JUNE 1, 1990) LAW ENGINEERING.

8. DRAWINGS: CFD-MG-6433C-0010 LANDFILL ACCESS ROAD LAYOUT
- 0020 LANDFILL EARTHWORK EXCAVATION PLA
- 0030 LANDFILL SECTIONS & DETAILS
- 0040 LANDFILL SECTIONS & DETAILS
- 0050 LANDFILL FABRICATION DETAILS
- 0060 LANDFILL OPERATIONS
- 0070 LANDFILL EROSION CONTROL

1.5 ASSUMPTIONS

ALL ASSUMPTIONS WILL BE STATED WITHIN THE BODY OF THE CALCULATION.

1.6 CALCULATIONS

ALL CALCULATIONS NECESSARY TO DOCUMENT THE ADEQUACY OF THE DESIGN ARE SHOWN ON THE FOLLOWING PAGES 7 TO 53.

1.7 CONCLUSION

THE LANDFILL WILL PERFORM IN ACCORDANCE W/ THE STATE REGULATIONS OVER THE FULL 25 TO 30 YEAR LIFE.

1.3 DISCUSSION

THE McGUIRE LANDFILL HAD TO BE DESIGNED TO COLLECT & TREAT THE LEACHATE. LEACHATE IS DEFINED AS ANY FLUID DRAINING OUT OF AN ACTIVE AREA. AN ACTIVE AREA IS AN AREA WHERE WASTE HAS ALREADY BEEN DISPOSED.

DUE TO THE HIGH COST & MAINTENANCE PROBLEMS ASSOCIATED W/ AN ON SITE TREATMENT FACILITY, IT WAS DECIDED TO PUMP THE LEACHATE APPROX. 2 MILES TO THE WC TREATMENT FACILITY AT McGUIRE NUCLEAR STATION.

IN ORDER TO MINIMIZE THE AMOUNT OF LEACHATE COLLECTED DUE TO RAINFALL, (ANY RAIN THAT FALLS ON THE ACTIVE AREA IS CONSIDERED LEACHATE), THE LANDFILL WAS DIVIDED UP INTO 4 CELLS. EACH

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Prob No. Checked By P.M. Sanford Date 8-14-90

1.8 DISCUSSION

OF THE 4 CELLS ARE ISOLATED BY A CLAY BERM & A HDPE WATER STOP. THE WC TREATMENT FACILITY COULD NOT TREAT THE VOLUME GENERATED BY A SINGLE CELL LANDFILL. ALSO, NOTE THAT THE PIPING SYSTEM INSTALLED WILL DELIVER THE LEACHATE AT A RATE OF 300 GPM. (NOTE: THE STATION HAS AGREED TO RECEIVE FLOW RATES UP TO 500 gpm).

THE LEACHATE COLLECTION SYSTEM CONSISTS OF TWO HDPE 8" Ø PIPES WHICH RUN PARALLEL TO EACH OTHER. ONE OF THE PIPES IS SOLID THE OTHER IS PERFORATED. THE PERFORATED PIPE COLLECTS LEACHATE ON THE ACTIVE SIDE OF THE BERM AND IS SWITCHED OVER TO THE SOLID PIPE ON THE INACTIVE SIDE OF THE BERM AND ROUTED TO THE LEACHATE BASIN BY GRAVITY FROM WHICH IT WILL BE PUMPED TO THE WC TREATMENT FACILITY. THE PERFORATED PIPE ON THE INACTIVE SIDE OF THE BERM COLLECTS THE STORMWATER AND ROUTES IT TO A EROSION CONTROL SEDIMENT BASIN. THE LEACHATE COLLECTION SYSTEM IS DESCRIBED SCHEMATICALLY IN THE OPERATIONAL DRAWING.

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Subject LANDFILL

By CB Crom Date 6/5/90

Prob No. Checked By P.M. Sanford Date 8-14-90

STABILITY OF INTERIOR & EXTERIOR SLOPES

THE McGUIRE LANDFILL HAS A INTERIOR SLOPE OF 2½H : 1V AND AN EXTERIOR SLOPE OF 3H : 1V. BASED ON DISCUSSIONS W/ *GARY WEEKLY & HIS EXPERIENCE W/ SOIL IN THIS REGION HE FELT THAT WE SHOULD NOT HAVE ANY TROUBLE W/ SLOPE STABILITY.

*SOILS ENGR. @ LAW ENG.

EVENTHOUGH GARY WEEKLY FELT THAT OUR SLOPES WOULD BE ADEQUATE, A SLOPE STABILITY ANALYSIS HAS BEEN RUN TO VERIFY THE STABILITY OF THE SLOPE.

THE SLOPE ANALZED IS SHOWN ON THE NEXT PAGE. THE SLOPE ANALZED IS THE WORST CASE SLOPE ON THE LANDFILL ∴ IF THE COMPUTOR ANALYSIS SHOWS THIS SLOPE TO BE ADEQUATE THEN ALL OTHER PORTIONS OF THE SLOPE ARE OK BY COMPARISON.

THE PROGRAM USED IS CALLED "STABR" THE PROGRAM CALCULATES THE FACTOR OF SAFETY FOR SPECIFIED CIRCLES, OR SEARCHES FOR THE CIRCULAR SLIP SURFACE HAVING THE MIN. FACTOR OF SAFETY. THE FACTOR OF SAFETY IS CALCULATED BY THE ORDINARY METHOD OF SLICES AND BISHOP'S MODIFIED METHOD.

THE FOLLOWING SOIL VALUES REPRESENT THE MOST CONSERVATIVE VALUES OF ALL THE SOIL BORING DATA:

*REF. LAW SOIL REPORT (SEE ATTACH. III) Appendix E

*C = .01

ϕ = 26.4°

γ = 95 lb/ft³

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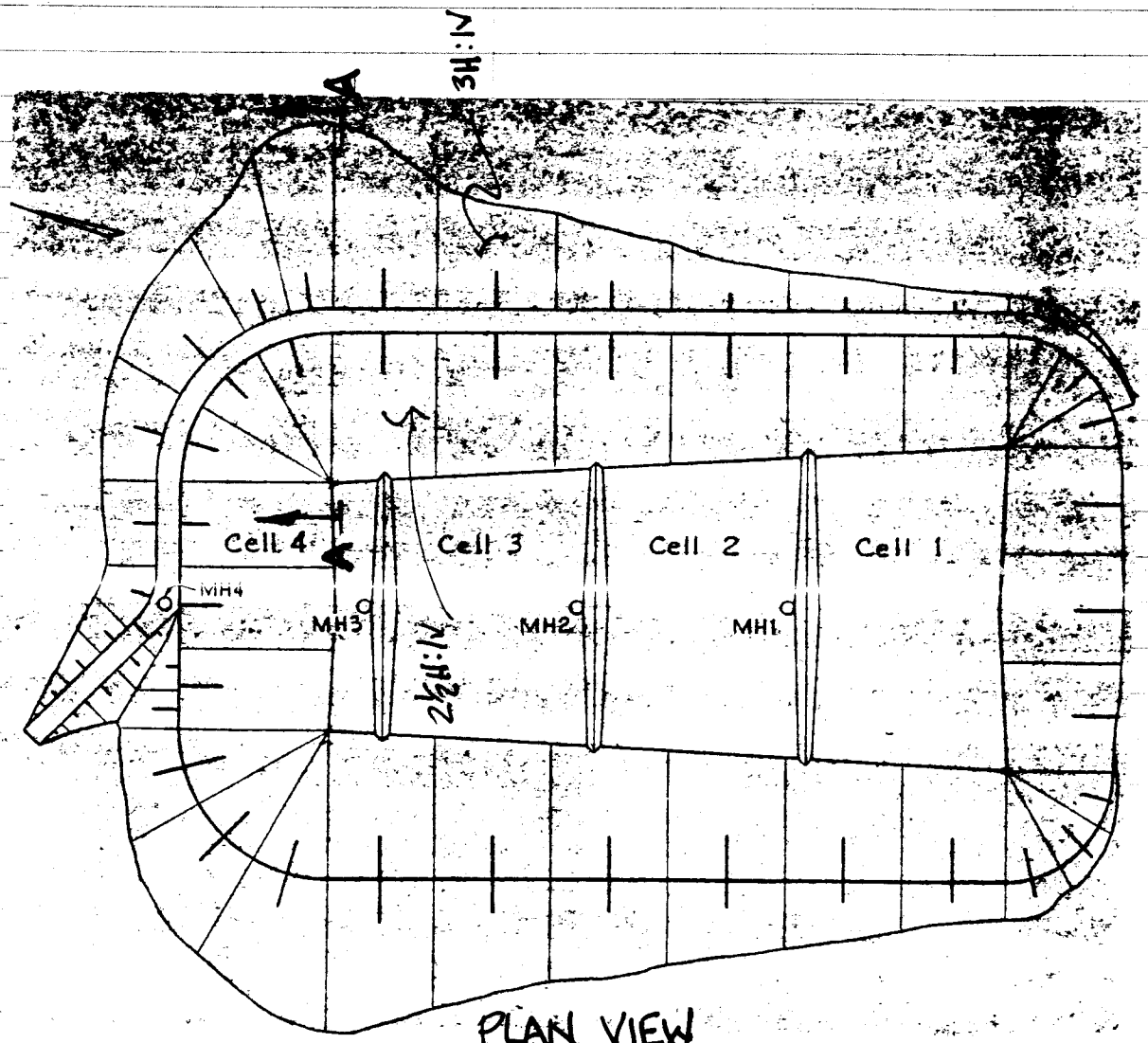
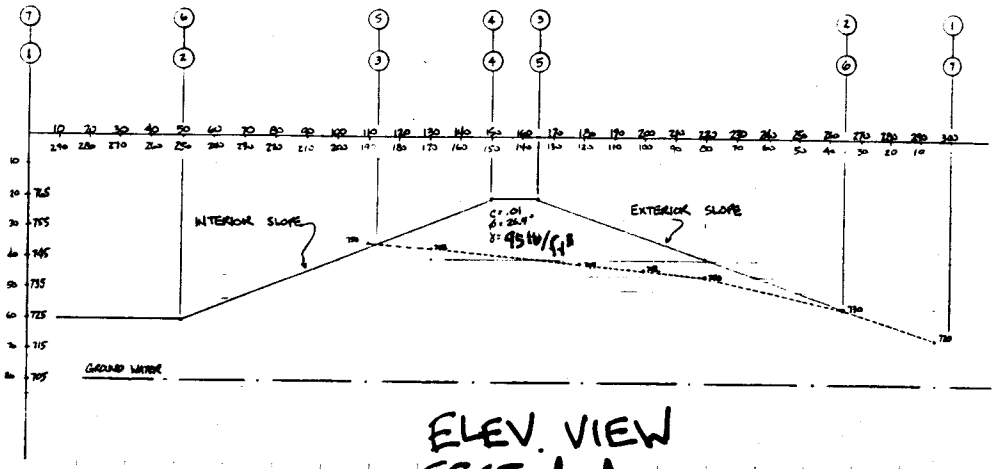
By CB [illegible] Date 6/5/90

Prob No. Checked By P.M. Sanford Date 8-14-90

STABILITY OF INTERIOR & EXTERIOR SLOPES



PLAN VIEW



ELEV. VIEW
SECT A-A

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DUKE POWER COMPANY

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Subject LANDFILL

By SB Date 6/5/90

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STABILITY OF INTERIOR & EXTERIOR SLOPES

NOTE, THE STABR PROGRAM ONLY ANALYZES ONE SLOPE AT A TIME. IN OTHER WORDS, THERE IS AN ANALYSIS FOR THE INTERIOR SLOPE & ONE FOR THE EXTERIOR SLOPE.

*REF. APPENDIX A

* THE MINIMUM F.S. (INTERIOR) = 1.243
* THE MINIMUM F.S. (EXTERIOR) = 1.431

BASED ON REVIEW OF THE COMPUTOR RESULTS THE SLOPES AT THE McGUIRE LANDFILL ARE STABLE.

STABILITY OF THE SOIL BERMS

SINCE THE MATERIAL PLACED IN THE LANDFILL IS HETEROGENEOUS THE CONVENTIONAL THEORIES OF SLOPE STABILITY DO NOT APPLY.

THE BERMS IN THE LANDFILL WILL BE INSTALLED USING A 3H:1V SLOPE.

BASED ON OBSERVATION OF OTHER LANDFILLS A 3H:1V WASTE SLOPE IS STABLE.* THE PREVIOUS STATEMENT REFERS TO THE SLOPE OF THE WASTE ONLY. IN THE McGUIRE LANDFILL A SOIL BERM WILL ALSO BE PLACED IN FRONT OF THE WASTE TO SEPARATE EACH OF THE 4 CELLS. (SEE SKETCH ON P. 17) THIS SOIL BERM WILL INCREASE THE STABILITY OF THE SLOPE.

*REF. 1 P. 165

EROSION CONTROL OF THE EXPOSED SLOPE WILL BE PROVIDED BY SEEDING THE SLOPES IN GRASS OR BY THE USE OF GEOTEXTILES.

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HDPE LINER

REF. 2
EPA III-10

THE MINIMUM TECHNOLOGY GUIDANCE PROVIDED BY EPA (1985) REQUIRES A LINER THICKNESS OF 30 MILS. THE INDUSTRY STANDARD FOR SANITARY LANDFILLS SEEMS TO BE 60 MIL HDPE.

SIZE LINER THICKNESS USING CONSERVATIVE ASSUMPTIONS W/ FOLLOWING FORMULA:

* REF. 3
DESIGNING W/ GEO. SYNTHETICS P. 250 249

$$(*)\quad t = \frac{p}{\cos\beta}\,\frac{x}{\sigma_u}\,(\tan\delta_u + \tan\delta_L)$$

Δ WT. OF GARBAGE

$\square$ HEIGHT OF LANDFILL.

$p = \Delta\, 80\ lb/ft^3\ (\square\, 45') = 3600\ lb/ft^2$ (*)

$\beta = 0°$ to $45°$

$x = .5$ to 3.0 in

(*) NOTE: THAT THE WEIGHT OF THE SOIL ON THE LINER CONTROLS OVER THE WEIGHT OF EQUIPMENT

$$\sigma_u = \frac{140\ \#/in\ of\ width\ (12\ in)}{\left(\frac{60\ MIL}{1000\ MIL/in}\right)\left(\frac{1}{12\ in}\right)(1')} = 336{,}000\ lb/ft^2$$

$\delta_u = 20°$ to $40°$ FOR LANDFILL CONTAINMENT

$\delta_L = 20°$ to $40°$

$$t = \frac{3600\ lb/ft^2}{(\cos 20°)}\,\frac{(3)}{336{,}000\ lb/ft^2}\,(\tan 40° + \tan 40°) = .0574\ in =$$

57.4 MIL

$\therefore$ USE 60 MIL.

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Subject LANDFILL

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LINER ANCHORAGE

THE PURPOSE OF THE ANCHOR IS TO PREVENT MOVEMENT OF THE LINER INTO THE LANDFILL. THE ANCHOR MUST PROVIDE SUFFICIENT RESTRAINT TO PREVENT THIS MOVEMENT BUT SHOULD NOT BE SO STRONG THAT THE LINER TEARS BEFORE ANCHOR YIELDS. THE ANCHOR SHOULD THEREFORE BE DESIGNED TO PROVIDE A REACTION FORCE THAT IS GREATER THAN THAT REQ'D TO STABILIZE THE LINER AND LESS THAN THE ULTIMATE STRENGTH OF THE LINER.

MOST ANCHOR TRENCHES ARE CURRENTLY CONSTRUCTED TO MEET GENERAL RECOMMENDATIONS PROVIDED BY THE LINER INSTALLER. THIS RECOMMENDATIONS ARE BASED ON PAST EXPERIENCE AND ARE PURELY EMPIRICAL. AS LONG AS THE McGUIRE DESIGN GEOMETRIES ARE SIMILAR TO THE DETAILS RECOMMENDED BY GUNDLE THEN THE TYPICAL ANCHORAGES PROVIDED BY GUNDLE ARE ACCEPTABLE.

DETERMINE STRENGTH OF ANCHOR PER FT.

SEE NOTE on pg. 13

△ REF. 1. DESIGN, CONSTRUCTION & MONT. OF SANIT. LANDFILL, p. 160

△ $F_{RG} = \gamma_s (h + h') b \tan\delta + \gamma_s L_a (h) \tan\delta$

γ_s = 85 lb/ft³

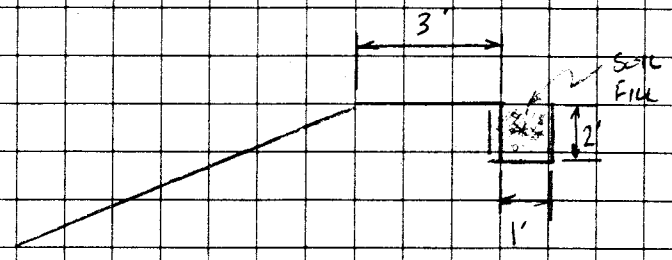
h = 2'

h' = 1'

b = 1'

δ = 38

L_a = 3'



TRENCH ANCHOR

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DUKE POWER COMPANY

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LINER ANCHORAGE CONT.

$F_{RL} = 85\#/ft^3 (2+1)(1)(\tan 38) + 85\#/ft^3 (3ft)(1ft)(\tan 38) =$

$F_{RL} = 398\#/FT$

NOTE: THE FORMULA SHOWN ON PREVIOUS PAGE SIMPLY TAKES THE WEIGHT OF SOIL THAT IS ACTUALLY ON TOP OF LINER & REDUCES IT BY THE TANGET OF THE ANGLE OF INTERNAL FRICTION. THE FORMULA SHOWN ON P. 160 OF AMALENDU BAGCHI'S, DESIGN, CONSTRUCTION & MONITORING OF SANITARY LANDFILL PUBLISHED 1990, IS INCORRECT. THIS CAN BE CONFIRMED BY REVIEWING UNITS & BY REVIEWING THE EXAMPLE PROBLEM ON THE SAME PAGE.

REF. 2 GEOSYNTHETIC DESIGN GUIDANCE FOR HAZARDOUS WASTE LANDFILL CELLS & SURFACE IMPOUNDMENTS. P. EPA III-21

* ALSO, NOTE THAT BAGHI RECOMMENDS SIZING THE TRENCH ANCHOR BASED ON THE TENSILE CAPACITY OF THE LINER. EPA'S APPROACH DIFFERS. EPA RECOMMENDS THAT THE ANCHOR NOT BE STRONGER THAN THE LINER. THE RATIONAL BEHIND THIS RECOMMENDATION IS THAT IT IS BETTER FOR THE ANCHOR TO SHIFT THAN FOR THE LINER TO TEAR.

TENSILE STRENGTH FOR 60 MIL:

$126 \frac{lb}{in^2} \times 12'' = 1512\#/FT$

$398\#/FT < 1512\#/FT$

∴ ANCHOR WILL YIELD FIRST ∴ OK

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DUKE POWER COMPANY

Station M. GUIRE N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 14 Of

Subject LANDFILL

By [illegible] Date 5/25/91

Prob No. Checked By P.M. Sanford Date 8-22-90

CHECK LINER FOR WEIGHT OF EQUIPMENT

*REF # 2 EXAMPLE 4.3

*ASSUME 55 TON PAN W/4 WHEELS → 27.5 K/WHEEL
GROUND CONTACT PRESSURE = 55 psi = σ_c

THICKNESS OF COVER ABOVE HDPE LINER: D: 2'

DEFINE FIELD CONTACT STRESS, σ_c'

R = EFFECTIVE RADIUS OF TIRE CONTACT = $\left[\frac{P}{\pi \sigma_c}\right]^{1/2}$

$$R = \left[\frac{27{,}500}{\pi \times 55}\right]^{1/2} = 12.6 \text{ in.}$$

$$\sigma_c' = \sigma_c \left[\frac{R^2}{(R+D)^2}\right] = 55 \left[\frac{12.6^2}{(12.6+24)^2}\right] = 6.5 \text{ psi}$$

∴ EQUIPMENT PLACES 6.5 psi OF PRESSURE ON THE HDPE LINER.

*REF. P 11

*3600 lb/ft² ÷ 144 in²/ft² = 25 psi > 6.5 psi

∴ LOAD DUE TO EQUIPMENT DOES NOT CONTROL THICKNESS.

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DUKE POWER COMPANY

Station McGuire, N.S. Unit — Rev. — File No. MCC-1114.02-00-0001 Sheet 15 Of

Subject LANDFILL

By B. Fom Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-22-90

DETERMINE LEACHATE VOLUME

ALL LEACHATE COLLECTED WILL BE PUMPED TO THE WC TREATMENT FACILITY WHICH IS LOCATED ON THE OTHER SIDE OF HIGHWAY 73 AJACENT TO McGUIRE NUCLEAR STATION.

DETERMING THE ANTICIPATED VOLUME OF LEACHATE IS IMPORTANT FOR THE FOLLOWING REASONS:

(1) THE LEACHATE HOLDING BASIN SIZE IS DEPENDANT ON THIS VOLUME.

(2) THE PUMPING RATE WILL BE DETERMINED BY THIS VOLUME.

(3) THE STORAGE CAPACITY WITHIN A CELL WILL BE DETERMINED BY THIS VOLUME.

(4) THE WC TREATMENT OPERATIONAL PROCEDURES WILL BE DETERMINED BY THIS VOLUME.

THE LANDFILL HAS BEEN DIVIDED INTO 4 ACTIVE CELLS TO MINIMIZE LEACHATE VOLUME, EACH CELL WILL BE COMPLETELY FULL & CAPPED OFF BEFORE USING THE NEXT CELL.

THE VOLUME OF WATER FALLING INTO AN ACTIVE CELL IS BASED WORST CASE PROJECTED AREA.

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DUKE POWER COMPANY

Station [illegible] Unit — Rev. 0 File No MCC-1114.02-00-0001 Sheet [illegible] Of

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Prob No. Checked By P.M. Sanford Date 8-23-90

POST CLOSURE LEACHATE VOLUME

*BASED ON SOME LONG TERM PERCOLATION STUDIES AT SEVERAL EXISTING LANDFILLS IT CAN BE CONSERVATIVELY ASSUMED THAT LONGTERM LEACHATE GENERATION WILL BE NO MORE THAN ⊛ 20% OF THE AVERAGE ANNUAL RAINFALL.

*REF 1. DESIGN CONST. & MAINT. OF SANIT. LANDFILL p 33

AREA USED TO CALCULATE POST CLOSURE LEACHATE VOL.:

□ 300' x □ 350' = 210,000 ft²

⊛ NOTE: THIS VALUE BASED ON LANDFILL W/ SILTY LOAM COVER, NOT RED CLAY.

AV. ANNUAL RAINFALL = 45" ⊛

20% OF AV. RAINFALL: .2(45") = 9"/YEAR

CONSERVATIVELY ASSUME THAT THE 9"/YEAR GETS INTO THE LEACHATE COLLECTION SYSTEM IN 1 WEEK.

⊛ BASED ON DATA THAT J.R. HENDRICKS PEOPLE HAVE.

$\therefore \frac{9''}{12''}(210{,}000) = 157{,}500\ ft^3 = 1{,}178{,}100$ gallons/WEEK

□ REF. CFD-MG-6433C-L-00360, SECT. AA & BB

CONVERT TO GALLONS PER MINUTE:

$1{,}178{,}100 \frac{gallons}{wk}\left(\frac{1wk}{7days}\right)\left(\frac{1day}{24hrs}\right)\left(\frac{1hr}{60min}\right) = 116.9$ gpm

∴ VOLUME GENERATED DURING A 1 HOUR STORM =

116.9 gpm (60 min) = 7014 gallons

DUKE POWER COMPANY

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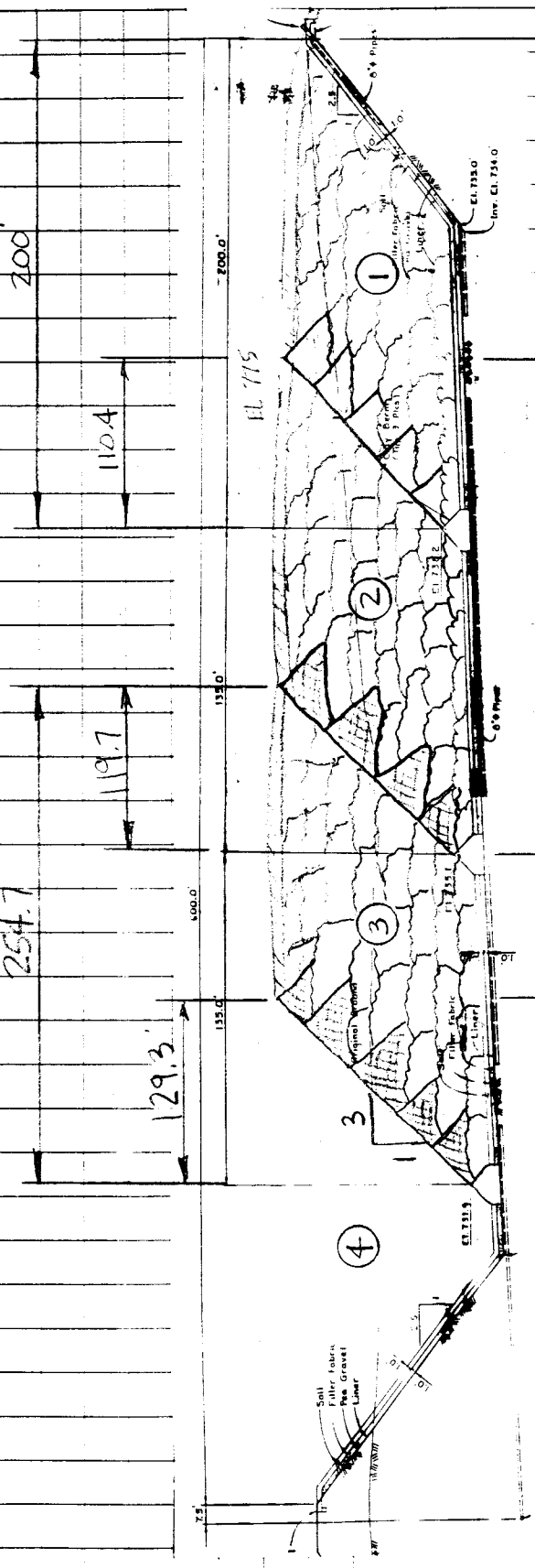
Station McGUIRE N.S. Unit — Rev. — File No MC-1114.02-00-0001 Sheet 7 Of

Subject LANDFILL

By [illegible] Date 5/25/91

Prob No. Checked By P.M. Sanford Date 8-23-90

775 - 733.2 = 36.3 36.3(3) = 110.4
775 - 735.1 = 39.9 (3) = 119.7
775 - 731.9 = 43.1 (3) = 129.3



(NOTE: LANDFILL IS 85.0' WIDE)

SUMMARY OF SURFACE AREA FOR EACH CELL

1 : 200' x 350' : 70,000 ft²
2 : 245.4 x 350' : 85,890 ft²
3 : 254.7 x 350' : 89,145 ft²
4 : 259.3 x 350' : 90,755 ft²

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DUKE POWER COMPANY

Station McGUIRE N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 18 Of

Subject LANDFILL

By [illegible] Date 5/25/90

Prop. No. Checked By P.M. Sanford Date 8-23-90

LEACHATE VOLUME DUE TO DIRECT RAINFALL FALLING ON ACTIVE CELL

MAX. SURFACE AREA = 90,755 ft^2

RAINFALL

REF. 6
EROSION & SEDIMENT CONTROL MANUAL P. 8.03.7

* 100 YEAR 1 HR STORM = 3"
100 YEAR 24 HR STORM = 7.0"

STORM	VOLUME (GALLONS)
100 YEAR 1 HR	$\frac{3''}{12''/ft}(90{,}755\ ft^2)(7.48\ \frac{gal}{ft^3}) = 169{,}712$ gallons
100 YEAR 24 HR	$\frac{7}{12}(90{,}755\ ft^2)(7.48\ \frac{gal}{ft^3}) = 395{,}994$ gallons

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DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 19 Of

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DETERMINE MAX. FLOWRATE OF LEACHATE DISCHARGE PIPE

THE MANNING EQUATION WILL BE USED.

ASSUMPTIONS;

(1) CLOSED CHANNEL FLOW WILL BE USED TO CALCULATE FLOW RATE BECAUSE CLOSED CHANNEL WILL PROVIDE HIGHEST FLOW RATES.
(2) STORMWATER IMMEDIATELY GETS INTO THE LEACHATE COLLECTION SYSTEM.
(3) MINOR LOSSES WILL BE NEGLECTED.

NOTE: AFTER A CELL BECOMES ACTIVE OVER THE ENTIRE BOTTOM PORTION OF THE CELL THE LEACHATE COLLECTION SYSTEM WILL SLOW DOWN AND THE FLOW WILL BECOME OPEN, SINCE THE LEACHATE COLLECTION POND MUST BE DESIGNED FOR THE WORST CASE FLOW THE OPEN CHANNEL FLOW FORMULA'S WILL BE USED.

TWO CASES WILL BE ANALYZED:
(1) HIGH ELEV. 738.2 W/ STORMWATER VOLUME FROM CELL 1.
(2) HIGH ELEV. 731.9 W/ STORMWATER VOLUME FROM CELL 4.

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DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 20 Of

Subject LANDFILL

By GB Thom Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

DETERMINE MAX. FLOWRATE OF LEACHATE DISCHARGE PIPE

CASE I

$g = 32.2\ ft/sec^2$

$n = .009$ (PLASTIC PIPE)

$L = 520 + 410 + 7.5 = 937.5$

$d = 8'' = .667'$

(SCALED FROM DRAWING)

$$\Delta ELEV. = \frac{V^2}{2g} + h_{LOSS}$$

FLOW IS CLOSED CHANNEL

*MANNING FORMULA

$$*h_L = \frac{2.87 n^2 L V^2}{d^{4/3}}$$

$$738.2 - 717.72 = \frac{V^2}{2(32.2)} + 2.87(.009)^2(937.5)\frac{V^2}{(.6667)^{1.333}} =$$

$$20.48 = .0155V^2 + .374V^2$$

$$V = 7.25\ fps$$

$$Q = VA = 7.25\left(\frac{\pi(.6667)^2}{4}\right) = 2.53\ cfs = \underline{1135\ gpm}$$

CASE II

$g = 32.2\ ft/sec^2$

$n = .009$

$L = 520 + 110 = 630'$

$d = .667'$

$$731.9 - 717.72 = \frac{V^2}{2(32.2)} + 2.87(.009)^2(630)\frac{V^2}{(.6667)^{1.333}} =$$

$$14.18 = .0155V^2 + .251V^2$$

$$V = 7.29\ fps =$$

$$Q = VA = 7.29\left(\frac{\pi(.6667)^2}{4}\right) = 2.5\ cfs = 1123\ gpm$$

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGUIRE N.S. Unit — Rev. — File No. MCC-1114.02-00-0001 Sheet 21 Of

Subject LANDFILL

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-27-90

DETERMINE TIME REQD FOR LANDFILL TO EMPTY:

SINCE CASE 2 HAS THE LARGEST STORMWATER VOL. & HIGHEST FLOW POND WILL BE SIZED BASED ON CASE 2 (CELL #4).

$$TIME_{(EMPTY)} = \frac{\text{TOT. VOL. OF STORMWATER FOR 100 YR STORM}}{\text{DISCHARGE FLOWRATE}}$$

$$TIME_{(EMPTY)} = \frac{169,712 \text{ gallons} + 7014 \text{ gallons}}{1135 \text{ gpm}} = 156 \text{ min.}$$

*PUMP RATE OF LEACHATE SYSTEM. REF. MECHANICAL SECT. OF PROJECT MANUAL

DEFICIT FLOW RATE: 1135 gpm − 300* gpm = 835 gpm

∴ VOL. OF STORAGE REQ'D = DEFICIT FLOWRATE (TIME REQ'D TO EMPTY)

VOL = 835 gpm (156 min) = 130,260 gallons.

∴ STORAGE MUST BE PROVIDED FOR 130,260 gallons.

NOTE: ALSO MUST ACCOUNT FOR VOLUME OF RAIN THAT FALLS DIRECTLY INTO POND.

Form 00184 (R4-88)

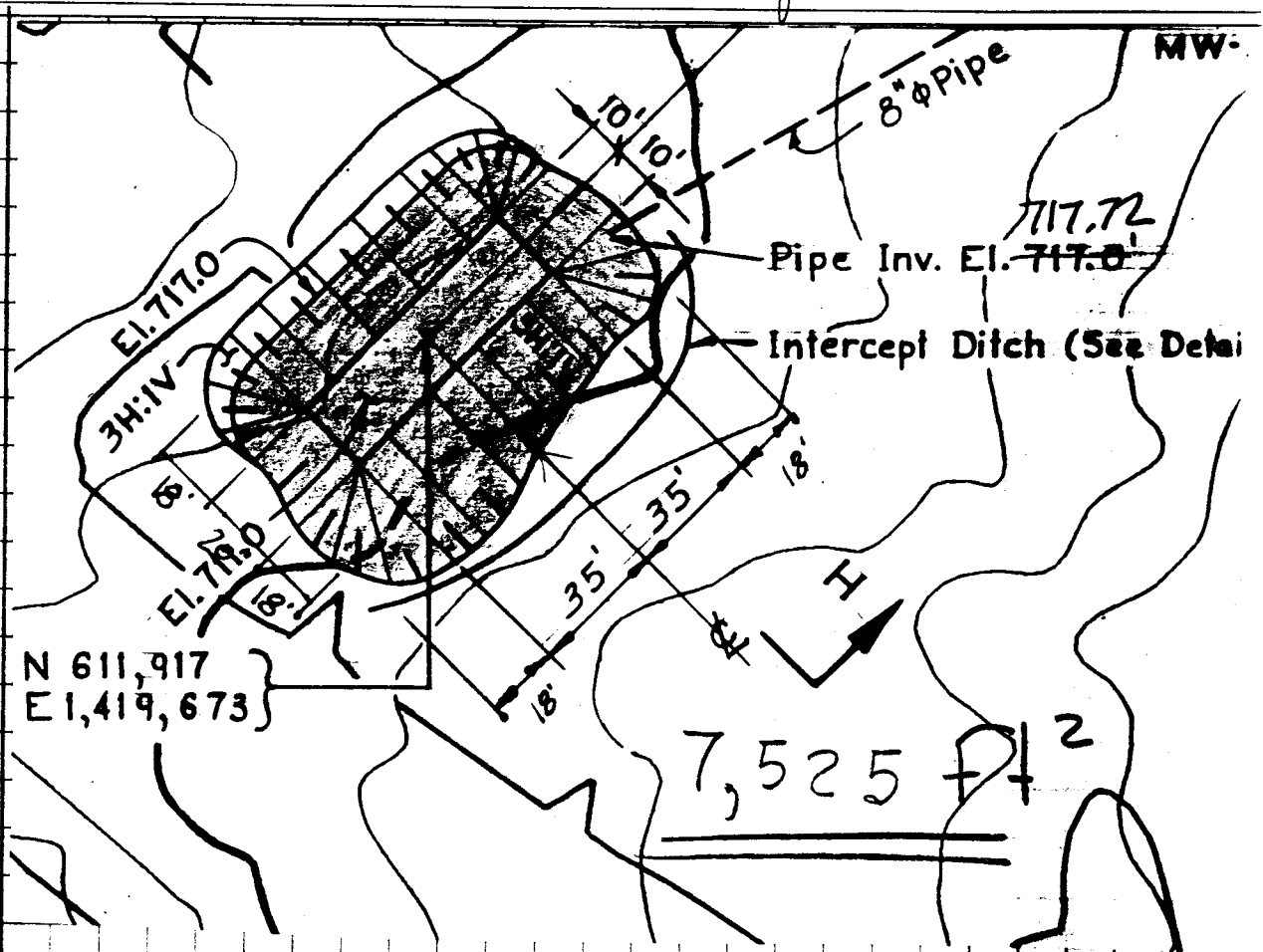
DUKE POWER COMPANY

Station McGUIRE N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet ____ Of ____

Subject LANDFILL

By CB Thor Date 5/25/90

Prob No. ____ Checked By P.M. Sanford Date 8-27-90



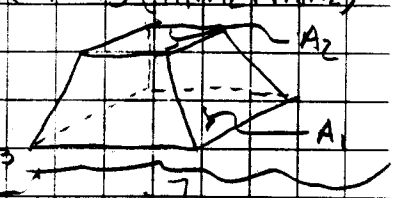
*REF 4
P. 2-20

*$Vol = \frac{1}{6} h\left[ab + (a+a_1)(b+b_1) + a_1 b_1\right]$: OR $V = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$

$a = 56$ $b = 106$ $h = 6'$

$a_1 = 20$ $b_1 = 70$

Using THIS eq. Vol = 20,438 ft³



$Vol = \frac{1}{6}(6)\left[56(106) + (56+20)(106+70) + 20(70)\right] = 20{,}712\ ft^3$

$20{,}712\ ft^3 \left(7.48\ gal/ft^3\right) = 154{,}925$ gallons

DETERMINE VOLUME OF WATER COLLECTED DUE TO DIRECT RAINFALL

SURFACE AREA: $7525\ ft^2 \times \frac{3''}{12''/'} = 1882\ ft^3 = 14{,}072$ gallons

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire Unit ____ Rev. ____ File No. MCC-1114.02-00-0001 Sheet 23 Of ____

Subject [illegible]

By [illegible] Date [illegible]

Prop No. ____ Checked By P.M. Sanford Date 8-27-90

TOTAL VOLUME REQUIRED FOR LEACHATE POND

VOLUME REQD. DUE TO DIRECT RAINFALL = 14,072 gallons
VOLUME REQD. DUE TO LEACHATE = 130,260 gallons

∴ TOTAL = 144,332 gallons

VOLUME OF LEACHATE POND PROVIDED = 154,925 gallons
VOLUME OF TOTAL LEACHATE + Rainfall = 144,332 gallons

EXCESS CAPACITY = 154,925 - 144,332 = 10,593 gallons

Form 00184 (R4-88)

DUKE POWER COMPANY

Station [illegible] Unit ___ Rev. ___ File No. MCC-1114.02-00-0001 Sheet 24 Of ___

Subject LANDFILL

By [illegible] Date [illegible]

Prop No. ___ Checked By P.M. Sanford Date 8-23-90

*REF = 2

P. EPA III-2

LEACHATE COLLECTION SYSTEM

*MINIMUM TECHNOLOGY GUIDANCE PROVIDED BY EPA.

A. A GRANULAR DRAINAGE LAYER SHOULD BE AT LEAST 12" THICK W/ MIN. HYDRAULIC CONDUCTIVITY OF 1×10^{-2} cm/sec AND MINIMUM BOTTOM SLOPE OF 2%.

B. THE DRAINAGE LAYER SHOULD INCLUDE A PIPE NETWORK WHICH IS DESIGNED TO EFFICIENTLY COLLECT LEACHATE. THE PIPE AND DRAINAGE LAYER MATERIALS SHOULD BE CHEMICALLY RESISTANT TO THE WASTE AND LEACHATE. THE PIPE SHOULD ALSO BE STRONG ENOUGH TO WITHSTAND EXPECTED LOADING.

C. A FILTER LAYER (GRANULAR OR SYNTHETIC) SHOULD BE USED ABOVE THE DRAINAGE LAYER TO PREVENT CLOGGING.

D. THE DRAINAGE SYSTEM MUST COVER THE BOTTOM AND SIDEWALLS OF THE UNIT.

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire, N.C. Unit ___ Rev. ___ File No. MCC-1114.02-00-0001 Sheet 25 Of ___

Subject [illegible]

By [illegible] Date [illegible]

Prop No. ___ Checked By P.M. Sanford Date 8-27-90

DRAINAGE BLANKET

IN ORDER TO REMOVE THE LEACHATE FROM THE LANDFILL AS QUICKLY AS POSSIBLE #67 STONE WILL BE UTILIZED. STONE WILL BE LESS LIKELY TO BECOME CLOGGED, WILL MOVE LEACHATE QUICKER AND PROVIDES A HIGHER VOID RATIO BETWEEN PARTICLES WHICH PROVIDE ADDITIONAL LEACHATE STORAGE.

DESIRED HYDRAULIC CONDUCTIVITY: 1×10^{-2} cm/sec (Permeability)

*REF. 5 INTROD. SOIL MECHANICS: FOUNDATIONS: SOWERS. p.97

*HYDRAULIC CONDUCTIVITY OF GRAVEL: 1×10^{-1} cm/sec

1.0×10^{-1} cm/sec > 1×10^{-2} cm/sec ∴ OK

MINIMUM BOTTOM SLOPE: 2%

ACTUAL BOTTOM SLOPE: 3.4%

3.4% > 2.0% OK

Form 00184 (R4-88)

DUKE POWER COMPANY

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Subject [illegible]

By [illegible] Date [illegible]

Prop. No. Checked By P.M. Sanford Date 8-27-90

DRAINAGE BLANKET ON SLOPE

THE INTERIOR SLOPE OF THE McGUIRE LANDFILL IS 2½ HORIZ. TO 1 VERT. THE DRAINAGE BLANKET ON THE SLOPES IS PEA GRAVEL (#78M WASHED STONE) IT IS SAFE TO ASSUME THAT THE PEA GRAVEL HAS AN ANGLE OF REPOSE > TO THE CONCRETE SAND SHOWN IN CHART BELOW.

Gundle

SIDE SLOPES AND FRICTION ANGLES

Friction Surfaces

Sliding Surface	Angle of Friction (degrees) Gundline HD	Textured Gundline HD
Gundline HD/H.R. Clay	17.0	25.8
Gundline HD/Ottawa Sand	18.0	34.0
Gundline HD/Concrete Sand	25.0	38.0
Gundline HD/Geotextile (Mirafi 140N)	9.0	32.0

Slopes Corresponding to Friction Angle

Slope	Angle of Friction
8:1	7.1°
6:1	9.5°
5:1	11.3°
4:1	14.0°
3.5:1	15.9°
3:1	18.4°
2.5:1	21.8°
2:1	26.6°
1.5:1	33.7°
1:1	45.0°

1/88

[illegible]

∴ 21.8° > 38°

∴ THE CONCRETE SAND IS STABLE

GEOTEXTILE FILTER

TO ENSURE THAT THE LEACHATE CAN FREELY FLOW INTO THE LEACHATE COLLECTION SYSTEM AND THAT THE SYSTEM DOES NOT BECOME CLOGGED DUE TO THE INFLOW OF FINES FROM THE SURROUNDING WASTE AND SOIL LAYERS, THE GEOTEXTILE FILTER WILL BE SIZED BASED ON THE FOLLOWING FORMULAS:

*REF. #2
P. EPA III-7

*TASK FORCE 25 1983

1. SOIL < 50% PASSING THE No. 200 SIEVE
   AOS OF FABRIC > No. 30 SIEVE (.59mm)
2. SOIL > 50% PASSING THE No. 200 SIEVE
   AOS OF THE FABRIC > No. 50 SIEVE (.297mm)

*CARROLL / CHEN

$$\frac{O_{95} \text{ OF THE GEOTEXTILE}}{d_{85} \text{ OF THE SOIL}} < 2$$

$$\frac{O_{95} \text{ OF THE GEOTEXTILE}}{d_{15} \text{ OF THE SOIL}} > 2$$

*GIROUD

RELATIVE DENSITY	$1 < CU < 3$	$CU > 3$
LOOSE (DR < 50%)	$O_{95} < CU(d_{50})$	$O_{95} < (9 d_{50})/$
INTERMEDIATE (50% < DR > 80%)	$O_{95} < 1.5(CU)(d_{50})$	$O_{95} < (13.5 d_{50})/$
DENSE (DR > 80%)	$O_{95} < 2(CU)(d_{50})$	$O_{95} < (18 d_{50})/$

CHECK ACCEPTABILITY OF POLYFELT 650

AOS : .15 - .21

* REF. # 7 GRAIN SIZE REPORT App. C

CHECK OWI* BETWEEN 3'-10'

TASK FORCE 25

70% PASSES THROUGH # 200 [illegible] AOS > .297 mm

.297 mm > .21 mm → CHECK

CARROLL / CHEN

O_{95} : .21

$\frac{O_{95}}{d_{85}} = \frac{.21}{.25} = .84 < 2$

$\frac{O_{95}}{d_{15}} = \frac{.21}{.0015} = 140 > 2$ OK

GIROUD

ASSUME: DENSE COMPACTION

$CU = \frac{d_{60}}{d_{10}} = \frac{.03}{.0015} = 20$

$\frac{18(.018)}{20} = .0162 < .21$ mm → CHECK

CHECK OWI BETWEEN 28.5 - 30'

TASK FORCE 25

38% PASSES THROUGH #200 ∴ USE AOS > .59

∴ .59 > .15 → CHECK

CARROLL / CHEN

$O_{95} = .15$ to $.21$

$\frac{O_{95}}{d_{85}} = \frac{.21}{.40} = .53 < 2$

$\frac{O_{95}}{d_{15}} = \frac{.15}{.015} = 10 > 2$ ∴ OK

GIROUD

$CU = \frac{d_{60}}{d_{10}} = \frac{.18}{.01} = 18$ $d_{50} = .15$

$\frac{18(.15)}{18}$ $.15 < .21$ mm → CHECK

CHECK OW2 BETWEEN 3-10'

TASK FORCE 25

70% PASSES THROUGH # 200 ∴ USE AOS > .297 mm

.297 mm > .15 mm → CHECK

CARROLL | CHEN

O_{95} = .15 to .21

$\frac{O_{95}}{d_{85}} = \frac{.21}{.25} = .84 < 2$

$\frac{O_{95}}{d_{15}} = \frac{.15}{.0015} = 100 > 2$ ∴ ok

GIROUD

ASSUME: DENSE COMPACTION

$CU = \frac{d_{60}}{d_{10}} = \frac{.03}{.0015} = 20$

$\frac{18(.015)}{20} = .0135 < .21$ mm → CHECK

CHECK OW2 BETWEEN 18.5 - 20'

TASK FORCE 25'

60% PASSES THROUGH # 200 ∴ AOS = .297mm

.297mm > .15 → CHECK

CARROLL / CHEN

$O_{95} = .15$ to $.21$

$\frac{O_{95}}{d_{85}} = \frac{.21}{.25} = .84 < 2$

$\frac{O_{95}}{d_{15}} = \frac{.15}{.0015} = 100 > 2$ ∴ OK

GIROUD

ASSUME: DENSE COMPACTION

$CU = \frac{d_{60}}{d_{10}} = \frac{.075}{.0015} = 50$

$\frac{18(.07)}{50} = .025 < .15$ mm → CHECK

CHECK OW-4 3'-10'

TASK FORCE 25

78 % PASSES THROUGH # 200 ∴ AOS > .297mm

.297m > .15 → CHECK

CARROLL / CHEN

$O_{95} = .15$ to $.21$

$\frac{O_{95}}{d_{85}} = \frac{.21}{.15} = 1.4 < 2$ OK

$\frac{O_{95}}{d_{15}} = \frac{.15}{.0015}$ 100 > 2 OK

GIROUD

ASSUME: DENSE COMPACTION

$CU = \frac{d_{60}}{d_{10}} = \frac{.025}{.0015} = 16.7$

$\frac{18(.015)}{16.7} = .016 < .15$ mm → CHECK

CHECK OW4 3.5 to 15.0

TASK FORCE 25

78% PASSES THROUGH # 200 ∴ AOS > .297mm

.297 > .15 → CHECK

CARROLL / CHEN

O_{95} : .15 to .21

$\frac{O_{95}}{d_{85}} = \frac{.21}{.1} = 2.1 > 2$ → CHECK

$\frac{O_{95}}{d_{15}} = \frac{.15}{.0015} = 100 > 2$

GIROUD

ASSUME : DENSE COMPACTION

$CU = \frac{d_{60}}{d_{10}} = \frac{.04}{.0015} = 26$

$\frac{18(.028)}{26} = .019 < .15$ mm → CHECK

CHECK OWS [illegible]

TASK FORCE 25

85% PASSES THROUGH # 200 ∴ AOS > .297mm

.297mm > .15 mm → CHECK

CARROLL / CHEN

O_{95} = .15 to .21

$\frac{O_{95}}{d_{85}} = \frac{.21}{.075} = 2.8 > 2$ CHECK

$\frac{O_{95}}{d_{15}} = \frac{.15}{.0015} = 100 > 2$

GIROUD

ASSUME: DENSE COMPACTION

$CU = \frac{d_{60}}{d_{10}} = \frac{.015}{.0015} = 10$

$\frac{18(.009)}{10} = .0162 < .15$ mm → CHECK

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By [illegible] Date [illegible]

Prep. No. Checked By P.M. Sanford Date 8-27-90

CHECK OWS 13.5 to 15.0

TASK FORCE 25

60% PASSES THROUGH # 200 ∴ AOS > .297 mm

.297 > .15 mm → CHECK

CARROLL CHEN

O_{95}: .15 to .21

$\frac{O_{95}}{d_{85}} = \frac{.21}{.25} = .84 < 2$ OK

$\frac{O_{95}}{d_{15}} = \frac{.15}{.007} = 21 > 2$ OK

GIROUD

ASSUME: DENSE COMPACTION

$CU = \frac{d_{60}}{d_{10}} = \frac{.08}{.0035} = 22.9$

$\frac{18(.035)}{22.9} = .028 < .15 mm$ → CHECK

GEOTEXTILE FILTER

FOR CALCULATION PURPOSES THE GEOTEXTILE FILTER FABRIC USED IS POLYFELT TS 650 W/ AOS OF .15mm to .21 mm. THREE FORMULAS HAVE BEEN UTILIZED TO DETERMINE THE ACCEPTABILITY OF A GEOTEXTILE W/ AN AOS OF .15mm to .21mm

TASK FORCE 25

THIS IS THE SIMPLEST OF THE THREE FORMULAS. BASICALLY THIS APPROACH JUST PROVIDES A MINIMUM AOS FOR SOILS THAT ARE PREDOMINANTLY LARGE GRAIN AND A MINIMUM AOS THAT ARE PREDOMINANTLY SMALL GRAIN.

CARROLL / CHEN

THESE FORMULAS ARE SLIGHTLY MORE RESTRICTIVE THAN THE TASK FORCE 25. THERE ARE TWO FORMULAS, THE FIRST IS TO CHECK FLOWING THROUGH THE SECOND IS TO CHECK CLOGGING

GIROUND

THIS FORMULA IS THE MOST CONSERVATIVE WHICH TAKES INTO ACCOUNT THE GRADING. THE FORMULA CHECKS THE FLOWING THROUGH FACTOR ONLY.

Form 00184 (R4-88)

DUKE POWER COMPANY

Station [illegible] Unit [illegible] Rev. [illegible] File No MCC-114.02-00-0001 Sheet 37 Of [illegible]

Subject LANDFILL

By [illegible] Date [illegible]/25/90

Prob No. [illegible] Checked By P. M. Sanford Date 8-27-90

GEOTEXTILE FILTER

AFTER CHECKING ALL THE SOIL BORINGS AGAINST EACH OF THE THREE APPROACHES AND KNOWING THAT THE PRIMARY OBJECTIVE IS TO PREVENT CLOGGING OF THE GEOTEXTILE, A GEOTEXTILE W/ AN AOS BETWEEN .15 & .21 IS ACCEPTABLE.

THE TASK FORCE 25 CRITERIA WAS NOT MET FOR ANY OF THE SOIL BORINGS THIS IS OK BY ENGINEERING JUDGEMENT SINCE THIS CRITERIA DOES NOT ACCOUNT FOR MATERIAL W/ A LOT OF FINES.

PRIMARILY THE CARROLL/CHEN FORMULAS WERE MET EXCEPT IN THE FLOW THROUGH CRITERIA WAS SLIGHLY EXCEEDED. AS PREVIOUSLY MENTIONED FLOW THROUGH OF FINES INTO LEACHATE PIPE CAN EASILY BE CORRECTED BY USING THE CLEANOUTS; HOWEVER, A CLOGGED FILTER FABRIC CAN NOT BE CORRECTED.

THE GIROUND CRITERIA WAS NOT MET FOR ANY OF THE SOIL BORINGS. THIS CRITERIA IS VERY CONSERVATIVE, AS WELL AS IT IS ONLY CHECKING FLOW THROUGH AS OPPOSED TO CLOGGING.

CONCLUSION: A POLYESTER GEOTEXTILE W/ AOS OF BETWEEN .15 & .21 IS ACCEPTABLE AS A FILTER BLANKET BETWEEN 12" OF SOIL & 12" OF LEACHATE COLLECTION SYSTEM.

GEOTEXTILE FABRIC FOR STRENGTH

*REF 3 DESIGNING W/ GEOSYNTHETICS, R.M KOERNER P. 67

* BURST RESISTANCE

ASSUME PRESSURE AT GEOTEXTILE / STONE BASE INTERFACE IS 200psi. THIS IS CONSERVATIVE, MOST TRUCKS HAVE TIRE PRESSURE OF 100psi.

$p' = .75 p_a$ $p_a = 200psi$

$p' = .75(200psi) = 150 psi$

STONE SIZE #67 RANGES FROM 3/4 ON DOWN

∴ USE 1" ON CHART

∴ BURST PRESSURE PLACED ON FABRIC = 45 psi

▽ REF 3 P. 69

▽ TENSILE STRENGTH

$T = p'(\varepsilon)^2$ $p' = .75 p_a$ p_a = SAME AS ABOVE

ε = STRAIN OF FABRIC BETWEEN CONTACT POINTS, USE 75%

$T = .75(200psi)(.75)^2 = 84$ lb.

∴ TENSILE STRENGTH REQUIRED = 84#

Form 00184 (R4-88)

DUKE POWER COMPANY

Station [illegible] Unit — Rev. [illegible] File No. MKC-1114.02-00-0001 Sheet 39 Of

Subject [illegible]

By [illegible] Date [illegible]

Prob No. Checked By P.M. Sanford Date 8-28-90

REF. 3 P. [illegible]

* PUNCTURE (TEAR) RESISTANCE

$p' = .75 P_a$

S' = SHAPE FACTOR
$S' = 1 - S$ WHERE
S FOR CRUSHED STONE = .4

AOS OF GEOTEXTILE = .21mm = d_i

STONE SIZE = 1" = d_a

TIRE PRESSURE = 200 psi = P_a

$T_{REQD} = \pi d_i d_a p' S'$

$\therefore T_{REQD} = 3.14(.21mm)(3.937 \times 10^{-2} \frac{in}{mm})(1")(.75)(200psi)(1-.4) =$

$T_{REQD} = 2.33\#$

SUMMARY

CHECK F.S. FOR PUNCTURE 650 & 1000 (using min avg ROLL Properties

	650	1000
BURST RESISTANCE	$\frac{260}{45} = 5.7$	$\frac{450}{45} = 10$
TENSILE	$\frac{170}{84} = 2.0$	$\frac{320}{84} = 3.8$
PUNCTURE	$\frac{85}{2.33} = 36$	$\frac{140}{2.33} = 60$ *

* Puncture for 1000 would be a little different since AOS of 1000 is different

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Subject [illegible]
By [illegible] Date [illegible]
Prob No. ____ Checked By P.M. Sanford Date 8-28-90

LEACHATE PIPE

CHECK PIPE FOR CRUSHING

(*) REF PLEXCO DESIGN MANUAL SEE ATTACH II

USE IOWA FORMULA (*)

$$\% \text{ DEFLECTION} = \frac{\text{CALCULATED DEFLECTION} \times 100}{\text{OUTSIDE DIAMETER OF PIPE}}$$

X = CALCULATED DEFLECTION

$$X = \frac{K \times D \times W}{(.149 \times PS) + (.061 \times E')} \qquad t = \frac{OD \times 1.06}{SDR}$$

$$W = \frac{DC \times OD \times SD}{144} \qquad R = \frac{(OD - t)}{2}$$

$$P.S. = \frac{E \times I}{.149 \times R^3}$$

OD = OUTSIDE DIAMETER OF PIPE (INCH) = 8.625 inches
K = BEDDING FACTOR = .1
D = DEFLECTION LAG FACTOR = 1.5
W = WEIGHT PER LINEAL INCH (#/INCH)
PS = PIPE STIFFNESS (PSI)
E' = SOIL MODULUS
E = FLEXURAL MODULUS
DC = DEPTH OF COVER = 50'
SD = SOIL DENSITY = 90#/ft³
SDR = STANDARD DIMENTIONAL RATIO
t = AVERAGE WALL THICKNESS (INCH)
I = MOMENT OF INERTIA = $\frac{t^3}{12}$
R = $\frac{(OD - t)}{2}$

CHECK PIPE FOR CRUSHING

$$W = \frac{50' \times 3.625 \text{ inches} \times 90 \text{ lb/ft}^3}{144 \frac{\text{in}^2}{\text{ft}^2}} = 269.5 \text{ \#/inch}$$

$$t = \frac{8.625(1.06)}{17} = .538$$

$$I = \frac{(.538)^3}{12} = .0129$$

$$R = \frac{(8.625 - .538)}{2} = 4.04$$

$$PS = \frac{133{,}000 \times .0129}{.149 \times 4.04^3} = 174.6$$

$$X = \frac{.1(1.5)(269.5 \text{ \#/inch})}{.149(174.6) + .061(3000)^*} = .193 \text{ inch deflection}$$

* ASSUMING GRAVEL BACKFILL PACKED.

$$\% \text{ DEFLECTION} = \frac{.193 \text{ inch} \times 100}{8.625} = 2.24\%$$

2.24% IS DUE TO WEIGHT OF SOIL ONLY

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 42 Of

Subject LANDFILL

By [signature] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-28-90

CHECK LIVE LOAD DUE TO EQUIP

(A) REF. 2 P. EPA 11-15

(A) $\sigma_c' = \sigma_c \left(\frac{R^2}{(R+D)^2} \right)$

D: THICKNESS ABOVE PIPE
R: EFFECTIVE RADIUS OF TIRE CONTACT
P: AXLE LOAD
σ_c: TIRE CONTACT PRESS

$R = \left(\frac{P}{\pi \sigma_c} \right)^{1/2}$

* ASSUME 55 TON PAN W/4 WHEELS

*P: 27.5^k
σ_c: 55 psi
D: 2'

$R = \left[\frac{27{,}500}{\pi (55)} \right]^{1/2} = 12.6 \text{ inch}$

$\sigma_c' = 55 \text{ psi} \left[\frac{(12.6 \text{ inch})^2}{(12.6 + 24)^2} \right]$

$\sigma_c' = 6.5 \text{ psi}$

∴ W IN FORMULA ON P. 41 WOULD BE

$W = 6.5 \frac{\text{lb}}{\text{in}^2} (8.625 \text{ in}) = 56.1 \text{ \#/in}$

SINCE 56.1 #/in << 269.5 #/in IT IS APPARENT THAT WEIGHT OF SOIL CONTROLS SINCE L.L. DISIPATES AS SOIL COVER INCREASES.

Form 00184 (R4-88)

DUKE POWER COMPANY

Station [illegible] Unit — Rev. ____ File No. MCC-1114.02-00-0001 Sheet 43 Of ____

Subject [illegible]

By [illegible] Date [illegible]

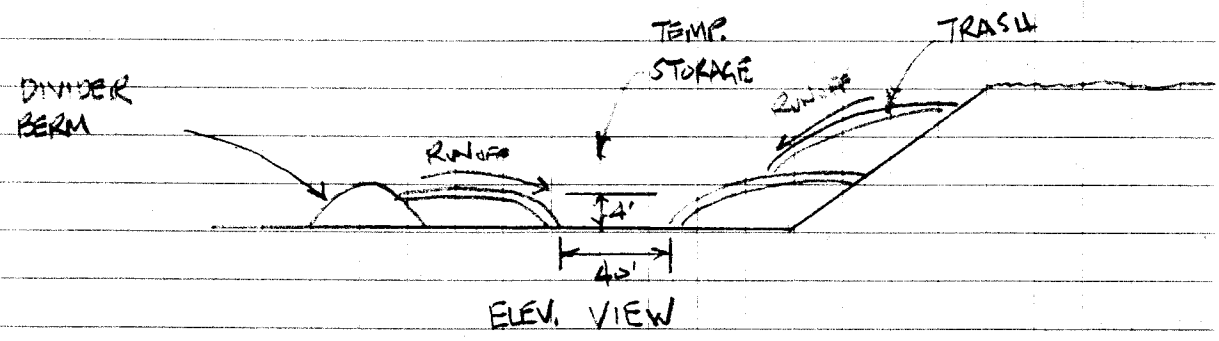
Prop No. ____ Checked By P.M. Sanford Date 8-23-90

SIZE LEACHATE TRENCH WITHIN ACTIVE CELL

DURING A 100 YEAR 1 HR STORM THERE WILL BE A NEED TO PROVIDE TEMPORARY STORAGE OF THE RAINFALL UNTIL IT HAS HAD A CHANCE TO BE ABSORBED INTO THE LEACHATE COLLECTION SYSTEM. NOTE, CELL 4 DOES NOT REQUIRE ANY STORAGE FOR LEACHATE ABSORBTION BECAUSE IT IS THE LAST CELL.

AS CELLS 1 to 3 RISE IN ELEVATION THE LEACHATE DUE TO RAINFALL DECREASES BECAUSE THE PROJECTED SURFACE AREA IS DECREASING. THEREFORE, THE PROJECTED SURFACE AREA FOR VARIOUS ELEVATIONS WILL BE CALCULATED AND THEN REQUIRED STORAGE VOLUMES WILL BE GENERATED.

CELL 3 HAS THE LARGEST PROJECTED AREAS SINCE IT IS THE DEEPEST OF THE CELLS 1 to 3.



ELEV. VIEW

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire U.S. Unit — Rev. — File No. MCL-11M.02-[illegible]-0001 Sheet 44 Of

Subject [illegible]

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-28-90

PROJECTED AREAS FROM CELL 3

INTIAL ELEVATION

*REF. P. 17 PROJECTED AREA = 91,145 ft² *

WIDTH OF BOTTOM OF LANDFILL AT THIS LOCATION:

765 - 731.9 = 33.1 (Δ in ELEV)

* SIDE SLOPE 2.5H : 1V

350 - 33.1 (2.5*)(2) = 184.5 = WIDTH OF CELL

∴ WIDTH @ ELEV. 765.1 = 184.5'

ELEVATION 750

AT INTIAL ELEV. THE LENGTH OF CELL 3 IS 254.7'
that catches rainfall.

750 - 731.9 = 18.1'

* BERM SLOPE 3H : 1V

254.7 - 18.1 (3*) = 200.4' = LENGTH OF CELL

WIDTH OF LANDFILL AT EL. 750:

765 - 750 = 15'

350 - 15 (2.5*)(2) = 275'

ELEVATION 760

AT INITIAL ELEV. THE LENGTH OF CELL 3 IS 254.7 (That catches RAINFALL)

760 - 731.9 = 28.1'

* BERM SLOPE 3H : 1V

254.7 - 28.1 (3*) = 170.4' = LENGTH OF CELL

WIDTH OF LANDFILL AT EL. 760:

765 - 760 = 5'

Δ SIDE SLOPE 2.5H : 1V

350 - 5(1.5 Δ)(2) = 325'

SUMMARY

ELEV.	PROJECTED AREA	VOL. OF LEACHATE DUE TO 1 HR 100 YR STORM
INITIAL	39,145 ft²	$\frac{3''}{12}(39{,}145\ ft^2) = 22{,}287\ ft^3$
750	200.4 (350) = 70,140 ft²	$\frac{3}{12}(70{,}140\ ft^2) = 17{,}535\ ft^3$
760	170.4 (350) = 59,640 ft²	$\frac{3}{12}(59{,}640\ ft^2) = 14{,}910\ ft^3$

EXAMPLES OF TRENCH SIZES

INITIAL ELEV. TO ELEV. 750.

LENGTH (SAME AS WIDTH OF CELL @ INITIAL ELEV.) = 184.5'
WIDTH = 41
HEIGHT = 3'

∴ VOLUME PROVIDED = 184.5 x 41' x 3' = 22,694

22,694 > 22,287 ∴ OK

ELEV. 750 to ELEV. 760

LENGTH (SAME AS WIDTH OF CELL @ EL. 750') = 275'
WIDTH = 32'
HEIGHT = 2'

∴ VOLUME PROVIDED = 275 x 32 x 2 = 17,600

17,600 > 17,535 ∴ OK

ELEV 760 to TOP

LENGTH (SAME AS WIDTH OF CELL @ EL 760) = 325'
WIDTH = 31'
HEIGHT = 1.5

∴ VOLUME PROVIDED = 325(31)(1.5) = 15,113

15,113 > 14910 ∴ OK

Form 00184 (R4-88)

DUKE POWER COMPANY

Station [illegible] Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 47 Of

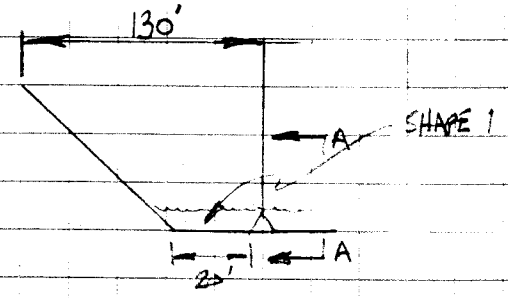
Subject LANDFILL

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

CHECK VOLUME OF CELL 4

DURING A 100 YEAR 1 HR STORM CELL 4 COULD POTENTIALLY OVERFLOW BERM INTO CELL 3 IF NOT SIZED CORRECTLY. CELL 4 IS VERY SENSITIVE TO THIS ISSUE SINCE IT DOES NOT HAVE MUCH OF A BOTTOM. (ONLY [illegible] WIDE)



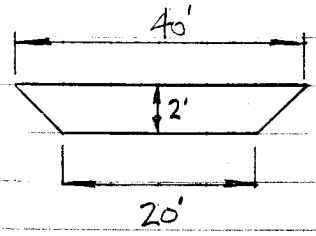
DETERMINE THE VOLUME OF RAIN THAT MAY BE GENERATED BY CELL 4 BEFORE IT BECOMES ACTIVE.

$$\frac{3''}{12''/'}(350')(130') = 11{,}375\ ft^3 = 85{,}085\ gallons$$

DETERMINE VOLUME PROVIDED:

DIVIDE VOLUME INTO TWO SHAPES:

SHAPE 1:

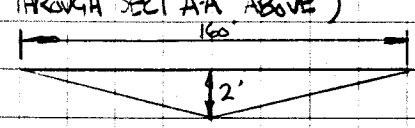


AREA: $\frac{1}{2}(40+20)(2') = 60\ ft^2$

VOL: AREA x LENGTH

VOL: $60 \times 160' = 9600\ ft^3$

SHAPE 2 (CUT LKG. THROUGH SECT A-A ABOVE)



AREA: $\frac{1}{2}(160)(2) = 80\ ft^2$

VOL: AREA x WIDTH

VOL: $80\ ft^2(20\ ft) = 1600\ ft^3$

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire N.S. Unit – Rev. 0 File No. MCC-1114.02-00-0001 Sheet 48 Of

Subject LANDFILL

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

CHECK VOL. OF CELL # CONT.

TOTAL STORAGE PROVIDED 9600 ft³ + 1600 ft³ = 11,200 ft³

11,200 ft³ = 83,776 gallons

Pg 20

TOTAL STORAGE REQD = 85,985 gallons − (1123 gpm)(60 min) =

17,705 gallons

83,776 > 17,705

∴ CELL 4 WILL NOT OVERFLOW INTO CELL 3. NOTE, THIS IS ONLY A CONCERN WHEN CELL 3 BECOMES ACTIVE.

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 49 Of

Subject LANDFILL

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

CALCULATE VOLUME OF LANDFILL

*REF 4 p. 2-20

★ **Obelisk** (frustum of a rectangular pyramid in Fig. 75).
Volume = $\frac{1}{6}h[(2a + a_1)b + (2a_1 + a)b_1] = \frac{1}{6}h[ab + (a + a_1)(b + b_1) + a_1b_1]$.

HEIGHT = 765-735 = 30'

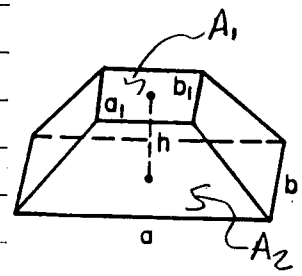


FIG. 75

CHECKED USING EQ. C9 FROM ENGINEERING FORMULAS 2ND ED. KURT GIECK

$V = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2})$

$A_1 = a_1 b_1 = 200(450) = 90{,}000$

$A_2 = a\,b = 350(600) = 210{,}000$

DETERMINE VOLUME OF THE TWO PARTS:

$V_{check} = \frac{30}{3}(90000 + 210000 + \sqrt{90000 \cdot 210000}) = 4{,}374{,}773$ FT

(1) VOLUME OF OBELISK AS SHOWN ABOVE

(2.) VOLUME OF WEDGE

(★) 220 IS THE WIDTH WHEN THE ENTIRE BOTTOM OF LANDFILL IS AT ELEV. 737

(△) b = 425 + 25 = 450, 25 IS THE INCREASED LENGTH BASED ON INTERIOR SLOPE 2½H : 1V

VOL. (1) : (OBELISK)

a = 350 (★) a_1 200 (△) b = 600 b_1 450

h = 30'

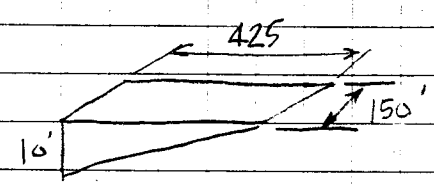
$V = \frac{1}{6}(30')[(350(600)) + (350 + 200)(600 + 450) + 200(450)] =$

4,387,500 ft^3

less than ½% difference of 4,387,500 ∴ OK ALT. CHECK.

*NOTE: VOL. 2 IS APPROXIMATE.

* VOL. (2)



$\frac{1}{2}(10')(425')(150')^{\Delta} = 318{,}750\ ft^3$

△160 IS THE SMALLEST WIDTH.

∴ TOTAL VOL. = 318,750 ft^3 + 4387,500 ft^3 = 4706250 ft^3 =

174,306 yd^3

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 50 Of

Subject LANDFILL

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

CALCULATE LANDFILL VOLUME CONT

REF. 1 P. 9

A WASTE TO DAILY COVER RATIO OF 4:1 TO 5:1 IS REASONABLE

ASSUMING 4:1 RATIO

∴ CAPACITY OF LANDFILL = .80 (174,306 yd^3) =

$\boxed{139,445 \ yd^3}$

ESTIMATED LIFE ASSUMING 5200 yd^3/YR.

$$\text{LIFE} = \frac{139,445 \ yd^3}{5200 \ yd^3/yr} = 26.8 \text{ YEARS}$$

DUE TO THE FACT THAT MCGUIRE DOES NOT USE A COMPACTOR, BUT JUST USES A BULL DOZER I WOULD ANTICIPATE THAT OUR DAILY COVER RATIO MAY BE MORE LIKE 3:1.

∴ CAPACITY OF LANDFILL = .75 (174,306 yd^3)

130,729 yd^3

ESTIMATED LIFE ASSUMING 5200 yd^3/yr

$$\text{LIFE} = \frac{130,729 \ yd^3}{5200 \ yd^3/yr} = 25.1 \text{ YEARS}$$

CONCLUSION: LANDFILL HAS AN APPROX. LIFE OF 30 YEAR

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. 0 File No. MCC-1114.02-00-0001 Sheet 51 Of

Subject LANDFILL

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

CALCULATE VOLUME OF OPERATIONAL COVER REQD.

USING A 4:1 WASTE TO COVER RATIO

VOL OF OPERATIONAL COVER: .20 (174,306 yd^3) = 34,861 yd^3

USING A 3:1 WASTE TO COVER RATIO

VOL. OF OPERATIONAL COVER = .25 (174,306 yd^3) = 43576 yd^3

∴ OPERATIONAL COVER REQD WILL RANGE BETWEEN:

30,000 yd^3 to 50,000 yd^3

CALCULATE VOLUME OF SOIL REQD FOR FINAL COVER

FINAL COVER WILL BE 2.5' THICK

2' WILL BE SOIL W/ LOW PERMEABILITY
6" WILL BE TOP SOIL

*650 & 370 RATHER THAN 600 TO ENSURE OVERLAP.

VOL. : *650' x *370 x 2 = 481,000 ft^3 = 17,815 yd^3

650 x 370 x $\frac{6}{12}$ = 120,250 ft^3 = 4454 yd^3

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. — File No. MCC-1114.02-00-0001 Sheet 52 Of

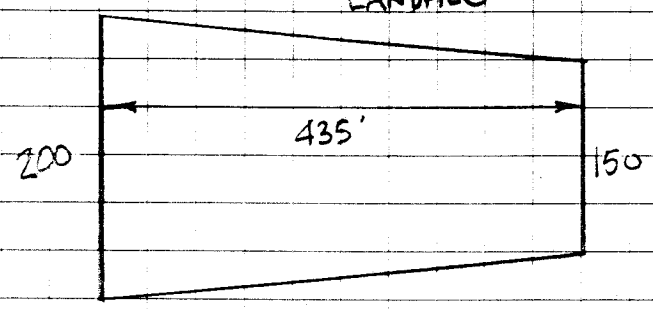
Subject Initial

By [illegible] Date 5/25/90

Prob No. Checked By P.M. Sanford Date 8-29-90

CALCULATE OPERATIONAL SURFACE SOIL VOLUME

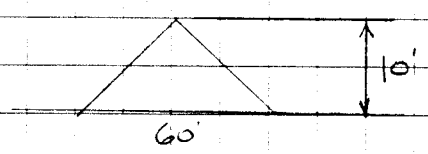
PLAN OF BOTTOM OF LANDFILL



AREA = (200 + 150)(.5)(435) = 76,125 ft^2

SINCE 1' THICK VOL = 76,125 ft^3 = 2819 yd^3

CALCULATE VOLUME OF SOIL REQ'D FOR PRIVACY BERM



VOL: 240' x 60' x 10' x ½ = 72,000 ft^3 = 2667 yd^3

Form 00184 (R4-88)

DUKE POWER COMPANY

Station McGuire N.S. Unit — Rev. — File No. MXC-1114.02-00-0001 Sheet 53 Of

Subject LANDFILL

By [illegible] Date 5/25/[illegible]

Prob No. Checked By P.M. Sanford Date 8-29-90

EARTHWORK SUMMARY

CUT: 124,317 yd^3 *

FILL: 30,216 yd^3 *

*REF. ATTACH. IV

SOIL AVAILABLE FOR OVERATION = *124,317 − 30,216 = 94,101 yd^3

VOL. OF OPERATIONAL COVER REQ'D: 50,000 yd^3

VOL OF SOIL FOR FINAL COVER (TOPSOIL): 4454 yd^3

VOL OF SOIL FOR FINAL COVER (LOW PERMEABILITY): 17,815 yd

VOL OF SOIL FOR OPERATING SURFACE: 2819 yd^3

VOL OF SOIL FOR PRIVACY BERM: 2667 yd^3

TOTAL: 77,755 yd^3

94,101 yd^3 > 77,755 yd^3 ∴

OK PLENTY OF SOIL FOR OPERATION.

Attachment I

STABR

Slope Stability Analysis

MCS-1114.02-00-0001

STATION: _____ UNIT NO. _____

SYSTEM: _____

SPECIFICATION: _____

DEPT. _____

DRW'N BY _____ DATE _____

CHK'D BY _____ DATE _____

ATTACHMENT I (2 of 3)

MCS-1114.02-00-0001

BY: CB Thom 6/5/90

CHECKED: PMS 8/28/90

```
ANALYSIS FOR INTERIOR SLOPE
MCGUIRE LANDFILL STABILITY I
0,4,7,3,1,0,0,0,62.4 I,
1,152,20,6 III
60,45,35,30 IV,
0,65,65,65,65,80 V,
35,55,55,55,55,80 V,
135,20,20,20,41,80 V,
150,20,20,20,37,80 V,
188,35,35,35,35,80 V,
250,60,60,60,60,80 V,
999,60,60,60,60,80 V,
1,.01,26.4,95 VI
2,.01,26.4,95 VI
1,80 VII
35,80 VII
135,80 VII
150,80 VII
188,80 VII
250,80 VII
999,80 VII
```

File: MCGCBT.DAT Line: 1 Col: 1 Rep

Program STABR -- Version 2.84 (MS-DOS)

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

CONTROL DATA

NUMBER OF SPECIFIED CENTERS	0
NUMBER OF DEPTH LIMITING TANGENTS	4
NUMBER OF VERTICAL SECTIONS	7
NUMBER OF SOIL LAYER BOUNDARIES	3
NUMBER OF PORE PRESSURE LINES	1
NUMBER OF POINTS DEFINING COHESION PROFILE	0

SEISMIC COEFFICIENT S1,S2 = .00, .00

UNIT WEIGHT OF WATER = 62.40

SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER (152.0, 20.0) WITH FINAL GRID OF 5.0

ALL CIRCLES TANGENT TO DEPTH, 60.0, 45.0, 35.0, 30.0,

GEOMETRY

SECTIONS	.0	35.0	135.0	150.0	188.0	250.0	999.0
T. CRACKS	65.0	55.0	20.0	20.0	35.0	60.0	60.0
W IN CRACK	65.0	55.0	20.0	20.0	35.0	60.0	60.0
BOUNDARY 1	65.0	55.0	20.0	20.0	35.0	60.0	60.0
BOUNDARY 2	65.0	55.0	41.0	37.0	35.0	60.0	60.0
BOUNDARY 3	80.0	80.0	80.0	80.0	80.0	80.0	80.0

SOIL PROPERTIES

LAYER	COHESION	FRICTION ANGLE	DENSITY
1	0	26.4	95.0

2 .0 26.4 [illegible]

PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

SECTIONS	.0	35.0	135.0	150.0	188.0	250.0	999.0
LINE 1	80.0	80.0	80.0	80.0	80.0	80.0	80.0

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	60.0	40.0	152.0	20.0	8.827	6.731
2	60.0	40.0	142.0	20.0	148.246	113.050
3	60.0	50.0	152.0	10.0	8.538	6.990
4	60.0	40.0	162.0	20.0	4.641	3.524
5	60.0	30.0	152.0	30.0	CENTER BELOW INTERPOLATED CRA	
6	60.0	40.0	157.0	20.0	6.048	4.604
7	60.0	45.0	162.0	15.0	4.511	3.566
8	60.0	40.0	167.0	20.0	3.811	2.886
9	60.0	35.0	162.0	25.0	CENTER BELOW INTERPOLATED CRA	
10	60.0	45.0	167.0	15.0	3.683	2.903
11	60.0	40.0	172.0	20.0	3.234	2.483
12	60.0	35.0	167.0	25.0	CENTER BELOW INTERPOLATED CRA	
13	60.0	45.0	172.0	15.0	3.144	2.471
14	60.0	40.0	177.0	20.0	2.933	2.224
15	60.0	35.0	172.0	25.0	CENTER BELOW INTERPOLATED CRA	
16	60.0	45.0	177.0	15.0	2.780	2.181
17	60.0	40.0	182.0	20.0	2.673	2.036
18	60.0	35.0	177.0	25.0	CENTER BELOW INTERPOLATED CRA	
19	60.0	45.0	182.0	15.0	2.526	1.987
20	60.0	40.0	187.0	20.0	2.480	1.902
21	60.0	35.0	182.0	25.0	CENTER BELOW INTERPOLATED CRA	
22	60.0	45.0	187.0	15.0	2.333	1.844
23	60.0	40.0	192.0	20.0	2.339	1.817
24	60.0	35.0	187.0	25.0	CENTER BELOW INTERPOLATED CRA	
25	60.0	45.0	182.0	15.0	2.526	1.987
26	60.0	50.0	187.0	10.0	2.249	1.825
27	60.0	45.0	192.0	15.0	2.188	1.741
28	60.0	50.0	192.0	10.0	2.099	1.710
29	60.0	45.0	197.0	15.0	2.082	1.678
30	60.0	40.0	192.0	20.0	2.339	1.817
31	60.0	50.0	197.0	10.0	1.986	1.630
32	60.0	45.0	202.0	15.0	1.986	1.626
33	60.0	40.0	197.0	20.0	2.213	1.748
34	60.0	50.0	202.0	10.0	1.903	1.583
35	60.0	45.0	207.0	15.0	1.896	1.578
36	60.0	40.0	202.0	20.0	2.097	1.685
37	60.0	50.0	207.0	10.0	1.826	1.542
38	60.0	45.0	212.0	15.0	1.811	1.532
39	60.0	40.0	207.0	20.0	1.988	1.626
40	60.0	50.0	212.0	10.0	1.753	1.502
41	60.0	45.0	217.0	15.0	1.732	1.489
42	60.0	40.0	212.0	20.0	1.887	1.571
43	60.0	50.0	217.0	10.0	1.685	1.465
44	60.0	45.0	222.0	15.0	1.657	1.449
45	60.0	40.0	217.0	20.0	1.793	1.521
46	60.0	50.0	222.0	10.0	1.619	1.430
47	60.0	45.0	227.0	15.0	1.588	1.413
48	60.0	40.0	222.0	20.0	1.707	1.474
49	60.0	50.0	227.0	10.0	1.558	1.398
50	60.0	45.0	232.0	15.0	1.523	1.379
51	60.0	40.0	227.0	20.0	1.626	1.432

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	45.0	25.0	227.0	20.0	CIRCLE OUTSIDE SLOPE	
2	45.0	25.0	217.0	20.0	1.243	1.238
3	45.0	35.0	227.0	10.0	CIRCLE OUTSIDE SLOPE	
4	45.0	25.0	237.0	20.0	CIRCLE OUTSIDE SLOPE	
5	45.0	15.0	227.0	30.0	CIRCLE OUTSIDE SLOPE	
6	45.0	25.0	212.0	20.0	1.332	1.282
7	45.0	30.0	217.0	15.0	1.254	1.243
8	45.0	25.0	222.0	20.0	CIRCLE OUTSIDE SLOPE	
9	45.0	20.0	217.0	25.0	CIRCLE OUTSIDE SLOPE	
10	45.0	30.0	212.0	15.0	1.330	1.281
11	45.0	30.0	222.0	15.0	CIRCLE OUTSIDE SLOPE	
12	45.0	20.0	222.0	25.0	CIRCLE OUTSIDE SLOPE	
13	45.0	20.0	212.0	25.0	1.336	1.284

F.S. MINIMUM= 1.243 FOR THE CIRCLE OF CENTER (217.0, 20.0)

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	35.0	10.0	212.0	25.0	CIRCLE OUTSIDE SLOPE	
2	35.0	10.0	202.0	25.0	CIRCLE OUTSIDE SLOPE	
3	35.0	20.0	212.0	15.0	CIRCLE OUTSIDE SLOPE	
4	35.0	10.0	222.0	25.0	CIRCLE OUTSIDE SLOPE	
5	35.0	.0	212.0	35.0	CIRCLE OUTSIDE SLOPE	
6	35.0	.0	207.0	35.0	CIRCLE OUTSIDE SLOPE	
7	35.0	5.0	212.0	30.0	CIRCLE OUTSIDE SLOPE	
8	35.0	.0	217.0	35.0	CIRCLE OUTSIDE SLOPE	
9	35.0	-5.0	212.0	40.0	CIRCLE OUTSIDE SLOPE	
10	35.0	-5.0	207.0	40.0	CIRCLE OUTSIDE SLOPE	
11	35.0	-5.0	217.0	40.0	CIRCLE OUTSIDE SLOPE	
12	35.0	-10.0	212.0	45.0	CIRCLE OUTSIDE SLOPE	
13	35.0	-10.0	207.0	45.0	CIRCLE OUTSIDE SLOPE	
14	35.0	-10.0	217.0	45.0	CIRCLE OUTSIDE SLOPE	
15	35.0	-15.0	212.0	50.0	CIRCLE OUTSIDE SLOPE	
16	35.0	-15.0	207.0	50.0	CIRCLE OUTSIDE SLOPE	
17	35.0	-15.0	217.0	50.0	CIRCLE OUTSIDE SLOPE	
18	35.0	-20.0	212.0	55.0	CIRCLE OUTSIDE SLOPE	
19	35.0	-20.0	207.0	55.0	CIRCLE OUTSIDE SLOPE	
20	35.0	-20.0	217.0	55.0	CIRCLE OUTSIDE SLOPE	
21	35.0	-25.0	212.0	60.0	CIRCLE OUTSIDE SLOPE	
22	35.0	-25.0	207.0	60.0	CIRCLE OUTSIDE SLOPE	
23	35.0	-25.0	217.0	60.0	CIRCLE OUTSIDE SLOPE	
24	35.0	-30.0	212.0	65.0	CIRCLE OUTSIDE SLOPE	
25	35.0	-30.0	207.0	65.0	CIRCLE OUTSIDE SLOPE	
26	35.0	-30.0	217.0	65.0	CIRCLE OUTSIDE SLOPE	
27	35.0	-35.0	212.0	70.0	CIRCLE OUTSIDE SLOPE	
28	35.0	-35.0	207.0	70.0	CIRCLE OUTSIDE SLOPE	
29	35.0	-35.0	217.0	70.0	CIRCLE OUTSIDE SLOPE	
30	35.0	-40.0	212.0	75.0	CIRCLE OUTSIDE SLOPE	
31	35.0	-40.0	207.0	75.0	CIRCLE OUTSIDE SLOPE	
32	35.0	-40.0	217.0	75.0	CIRCLE OUTSIDE SLOPE	
33	35.0	-45.0	212.0	80.0	CIRCLE OUTSIDE SLOPE	
34	35.0	-45.0	207.0	80.0	CIRCLE OUTSIDE SLOPE	
35	35.0	-45.0	217.0	80.0	CIRCLE OUTSIDE SLOPE	

37	35.0	-60.0	207.0	85.0	CIRCLE OUTSIDE SLOPE
38	35.0	-60.0	217.0	85.0	CIRCLE OUTSIDE SLOPE
39	35.0	-55.0	212.0	90.0	CIRCLE OUTSIDE SLOPE
40	35.0	-55.0	207.0	90.0	CIRCLE OUTSIDE SLOPE
41	35.0	-55.0	217.0	90.0	CIRCLE OUTSIDE SLOPE
42	35.0	-60.0	212.0	95.0	CIRCLE OUTSIDE SLOPE
43	35.0	-60.0	207.0	95.0	CIRCLE OUTSIDE SLOPE
44	35.0	-60.0	217.0	95.0	CIRCLE OUTSIDE SLOPE
45	35.0	-65.0	212.0	100.0	CIRCLE OUTSIDE SLOPE
46	35.0	-65.0	207.0	100.0	CIRCLE OUTSIDE SLOPE
47	35.0	-65.0	217.0	100.0	CIRCLE OUTSIDE SLOPE
48	35.0	-70.0	212.0	105.0	CIRCLE OUTSIDE SLOPE
49	35.0	-70.0	207.0	105.0	CIRCLE OUTSIDE SLOPE
50	35.0	-70.0	217.0	105.0	CIRCLE OUTSIDE SLOPE
51	35.0	-75.0	212.0	110.0	CIRCLE OUTSIDE SLOPE

SEARCH IS ABANDONED AFTER 51CIRCLES

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	30.0	-80.0	212.0	110.0	CIRCLE OUTSIDE SLOPE	
2	30.0	-80.0	202.0	110.0	CIRCLE OUTSIDE SLOPE	
3	30.0	-70.0	212.0	100.0	CIRCLE OUTSIDE SLOPE	
4	30.0	-80.0	222.0	110.0	CIRCLE OUTSIDE SLOPE	
5	30.0	-90.0	212.0	120.0	CIRCLE OUTSIDE SLOPE	
6	30.0	-90.0	207.0	120.0	CIRCLE OUTSIDE SLOPE	
7	30.0	-85.0	212.0	115.0	CIRCLE OUTSIDE SLOPE	
8	30.0	-90.0	217.0	120.0	CIRCLE OUTSIDE SLOPE	
9	30.0	-95.0	212.0	125.0	CIRCLE OUTSIDE SLOPE	
10	30.0	-95.0	207.0	125.0	CIRCLE OUTSIDE SLOPE	
11	30.0	-95.0	217.0	125.0	CIRCLE OUTSIDE SLOPE	
12	30.0	-100.0	212.0	130.0	CIRCLE OUTSIDE SLOPE	
13	30.0	-100.0	207.0	130.0	CIRCLE OUTSIDE SLOPE	
14	30.0	-100.0	217.0	130.0	CIRCLE OUTSIDE SLOPE	
15	30.0	-105.0	212.0	135.0	CIRCLE OUTSIDE SLOPE	
16	30.0	-105.0	207.0	135.0	CIRCLE OUTSIDE SLOPE	
17	30.0	-105.0	217.0	135.0	CIRCLE OUTSIDE SLOPE	
18	30.0	-110.0	212.0	140.0	CIRCLE OUTSIDE SLOPE	
19	30.0	-110.0	207.0	140.0	CIRCLE OUTSIDE SLOPE	
20	30.0	-110.0	217.0	140.0	CIRCLE OUTSIDE SLOPE	
21	30.0	-115.0	212.0	145.0	CIRCLE OUTSIDE SLOPE	
22	30.0	-115.0	207.0	145.0	CIRCLE OUTSIDE SLOPE	
23	30.0	-115.0	217.0	145.0	CIRCLE OUTSIDE SLOPE	
24	30.0	-120.0	212.0	150.0	CIRCLE OUTSIDE SLOPE	
25	30.0	-120.0	207.0	150.0	CIRCLE OUTSIDE SLOPE	
26	30.0	-120.0	217.0	150.0	CIRCLE OUTSIDE SLOPE	
27	30.0	-125.0	212.0	155.0	CIRCLE OUTSIDE SLOPE	
28	30.0	-125.0	207.0	155.0	CIRCLE OUTSIDE SLOPE	
29	30.0	-125.0	217.0	155.0	CIRCLE OUTSIDE SLOPE	
30	30.0	-130.0	212.0	160.0	CIRCLE OUTSIDE SLOPE	
31	30.0	-130.0	207.0	160.0	CIRCLE OUTSIDE SLOPE	
32	30.0	-130.0	217.0	160.0	CIRCLE OUTSIDE SLOPE	
33	30.0	-135.0	212.0	165.0	CIRCLE OUTSIDE SLOPE	
34	30.0	-135.0	207.0	165.0	CIRCLE OUTSIDE SLOPE	
35	30.0	-135.0	217.0	165.0	CIRCLE OUTSIDE SLOPE	
36	30.0	-140.0	212.0	170.0	CIRCLE OUTSIDE SLOPE	
37	30.0	-140.0	207.0	170.0	CIRCLE OUTSIDE SLOPE	
38	30.0	-140.0	217.0	170.0	CIRCLE OUTSIDE SLOPE	
39	30.0	-145.0	212.0	175.0	CIRCLE OUTSIDE SLOPE	
40	30.0	-145.0	207.0	175.0	CIRCLE OUTSIDE SLOPE	
41	30.0	-145.0	217.0	175.0	CIRCLE OUTSIDE SLOPE	

42	30.0	-150.0	212.0	180.0	CIRCLE OUTSIDE SLOPE
43	30.0	-150.0	207.0	180.0	CIRCLE OUTSIDE SLOPE
44	30.0	-150.0	217.0	180.0	CIRCLE OUTSIDE SLOPE
45	30.0	-155.0	212.0	185.0	CIRCLE OUTSIDE SLOPE
46	30.0	-155.0	207.0	185.0	CIRCLE OUTSIDE SLOPE
47	30.0	-155.0	217.0	185.0	CIRCLE OUTSIDE SLOPE
48	30.0	-160.0	212.0	190.0	CIRCLE OUTSIDE SLOPE
49	30.0	-160.0	207.0	190.0	CIRCLE OUTSIDE SLOPE
50	30.0	-160.0	217.0	190.0	CIRCLE OUTSIDE SLOPE
51	30.0	-165.0	212.0	195.0	CIRCLE OUTSIDE SLOPE

SEARCH IS ABANDONED AFTER 51CIRCLES

ATTACHMENT # I (3 of 3)

MCS - 1114.02.00-0001

BY: CB Shen 6/5/90

CHECKED: PMS 8/28/90

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ANALYSIS FOR EXTERIOR SLOPE
MCGUIRE LANDFILL STABILITY I
0.4.7.3.1.0.0.0.62.4 II
1,170,20,6 III
60,45,35,30 IV
0,60,60,60,60,80 V
60,60,60,60,60,80 V
112,35,35,35,35,80 V
160,20,20,20,37,80 V
165,20,20,20,41,80 V
265,55,55,55,55,80 V
399,65,65,65,65,80 V
1..01.26.4.95 VI
1..01.26.4.95 VI
.80 VII
0,80 VII
112,80 VII
160,80 VII
165,80 VII
265,80 VII
399.80 VII
```

File: MCCCBT.DAT Line: 1 Col: 1 Rep

Program STABR -- Version 2.84 (MS-DOS)

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

CONTROL DATA

NUMBER OF SPECIFIED CENTERS	0
NUMBER OF DEPTH LIMITING TANGENTS	4
NUMBER OF VERTICAL SECTIONS	7
NUMBER OF SOIL LAYER BOUNDARIES	3
NUMBER OF PORE PRESSURE LINES	1
NUMBER OF POINTS DEFINING COHESION PROFILE	0

SEISMIC COEFFICIENT S1,S2 = .00, .00

UNIT WEIGHT OF WATER = 62.40

SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER (170.0, 20.0) WITH FINAL GRID OF 5.0

ALL CIRCLES TANGENT TO DEPTH, 60.0, 45.0, 35.0, 10.0,

GEOMETRY

SECTIONS	.0	50.0	112.0	150.0	165.0	265.0	999.0
T. CRACKS	60.0	60.0	35.0	20.0	20.0	55.0	65.0
W IN CRACK	60.0	60.0	35.0	20.0	20.0	55.0	65.0
BOUNDARY 1	60.0	60.0	35.0	20.0	20.0	55.0	65.0
BOUNDARY 2	60.0	60.0	35.0	37.0	41.0	55.0	65.0
BOUNDARY 3	80.0	80.0	80.0	80.0	80.0	80.0	80.0

SOIL PROPERTIES

LAYER	COHESION	FRICTION ANGLE	DENSITY

2	.0	28.4	95.0

PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

SECTIONS	.0	50.0	112.0	150.0	185.0	265.0	999.0
LINE 1	30.0	30.0	80.0	30.0	30.0	80.0	30.0

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	60.0	40.0	170.0	20.0	8.495	6.437
2	60.0	40.0	160.0	20.0	69.009	52.595
3	60.0	50.0	170.0	10.0	8.490	6.920
4	60.0	40.0	180.0	20.0	4.753	3.569
5	60.0	30.0	170.0	30.0	CENTER BELOW INTERPOLATED CRA	
6	60.0	40.0	175.0	20.0	6.026	4.547
7	60.0	45.0	180.0	15.0	4.622	3.619
8	60.0	40.0	185.0	20.0	4.005	2.994
9	60.0	35.0	180.0	25.0	CENTER BELOW INTERPOLATED CRA	
10	60.0	45.0	185.0	15.0	3.847	2.998
11	60.0	40.0	190.0	20.0	3.542	2.647
12	60.0	35.0	185.0	25.0	CENTER BELOW INTERPOLATED CRA	
13	60.0	45.0	190.0	15.0	3.351	2.601
14	60.0	40.0	195.0	20.0	3.224	2.419
15	60.0	35.0	190.0	25.0	CENTER BELOW INTERPOLATED CRA	
16	60.0	45.0	195.0	15.0	3.027	2.349
17	60.0	40.0	200.0	20.0	2.987	2.253
18	60.0	35.0	195.0	25.0	CENTER BELOW INTERPOLATED CRA	
19	60.0	45.0	200.0	15.0	2.795	2.177
20	60.0	40.0	205.0	20.0	2.820	2.146
21	60.0	35.0	200.0	25.0	CENTER BELOW INTERPOLATED CRA	
22	60.0	45.0	195.0	15.0	3.027	2.349
23	60.0	50.0	200.0	10.0	2.681	2.147
24	60.0	45.0	205.0	15.0	2.621	2.052
25	60.0	50.0	205.0	10.0	2.504	2.012
26	60.0	45.0	210.0	15.0	2.497	1.973
27	60.0	40.0	205.0	20.0	2.820	2.146
28	60.0	50.0	210.0	10.0	2.369	1.914
29	60.0	45.0	215.0	15.0	2.396	1.920
30	60.0	40.0	210.0	20.0	2.686	2.074
31	60.0	50.0	205.0	10.0	2.504	2.012
32	60.0	55.0	210.0	5.0	2.292	1.892
33	60.0	50.0	215.0	10.0	2.274	1.857
34	60.0	55.0	215.0	5.0	2.187	1.815
35	60.0	50.0	220.0	10.0	2.195	1.815
36	60.0	45.0	215.0	15.0	2.396	1.920
37	60.0	55.0	210.0	5.0	2.292	1.892
38	60.0	60.0	215.0	.0	2.133	1.800
39	60.0	55.0	220.0	5.0	2.112	1.773
40	60.0	60.0	220.0	.0	2.050	1.741
41	60.0	55.0	225.0	5.0	2.048	1.739
42	60.0	50.0	220.0	10.0	2.195	1.815
43	60.0	60.0	225.0	.0	1.991	1.710
44	60.0	55.0	230.0	5.0	1.986	1.707
45	60.0	50.0	225.0	10.0	2.119	1.776
46	60.0	60.0	230.0	.0	1.936	1.681
47	60.0	55.0	235.0	5.0	1.926	1.676
48	60.0	50.0	230.0	10.0	2.047	1.739
49	60.0	60.0	235.0	.0	1.883	1.654
50	60.0	55.0	240.0	5.0	1.869	1.647
51	60.0	50.0	235.0	10.0	1.978	1.703

SEARCH IS ABANDONED AFTER 31CIRCLES

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	45.0	35.0	235.0	10.0	1.510	1.465
2	45.0	35.0	225.0	10.0	1.650	1.535
3	45.0	45.0	235.0	.0	1.506	1.463
4	45.0	35.0	245.0	10.0	CIRCLE OUTSIDE SLOPE	
5	45.0	25.0	235.0	20.0	1.518	1.469
6	45.0	45.0	230.0	.0	1.558	1.489
7	45.0	30.0	235.0	-5.0	1.505	1.462
8	45.0	45.0	240.0	.0	1.457	1.438
9	45.0	40.0	235.0	5.0	1.508	1.463
10	45.0	50.0	240.0	-5.0	1.460	1.440
11	45.0	45.0	245.0	.0	CIRCLE OUTSIDE SLOPE	
12	45.0	40.0	240.0	5.0	1.452	1.436
13	45.0	40.0	235.0	5.0	1.508	1.463
14	45.0	40.0	245.0	5.0	CIRCLE OUTSIDE SLOPE	
15	45.0	35.0	240.0	10.0	1.447	1.433
16	45.0	35.0	235.0	10.0	1.510	1.465
17	45.0	35.0	245.0	10.0	CIRCLE OUTSIDE SLOPE	
18	45.0	30.0	240.0	15.0	1.440	1.430
19	45.0	30.0	235.0	15.0	1.514	1.466
20	45.0	30.0	245.0	15.0	CIRCLE OUTSIDE SLOPE	
21	45.0	25.0	240.0	20.0	1.431	1.426
22	45.0	25.0	235.0	20.0	1.518	1.469
23	45.0	25.0	245.0	20.0	CIRCLE OUTSIDE SLOPE	
24	45.0	20.0	240.0	25.0	CIRCLE OUTSIDE SLOPE	
25	45.0	30.0	235.0	15.0	1.514	1.466
26	45.0	30.0	245.0	15.0	CIRCLE OUTSIDE SLOPE	
27	45.0	20.0	245.0	25.0	CIRCLE OUTSIDE SLOPE	
28	45.0	20.0	235.0	25.0	1.525	1.472

F.O. MINIMUM= 1.431 FOR THE CIRCLE OF CENTER (240.0, 20.0)

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	35.0	10.0	235.0	25.0	CIRCLE OUTSIDE SLOPE	
2	35.0	10.0	225.0	25.0	CIRCLE OUTSIDE SLOPE	
3	35.0	20.0	235.0	15.0	CIRCLE OUTSIDE SLOPE	
4	35.0	10.0	245.0	25.0	CIRCLE OUTSIDE SLOPE	
5	35.0	.0	235.0	35.0	CIRCLE OUTSIDE SLOPE	
6	35.0	.0	230.0	35.0	CIRCLE OUTSIDE SLOPE	
7	35.0	5.0	235.0	30.0	CIRCLE OUTSIDE SLOPE	
8	35.0	.0	240.0	35.0	CIRCLE OUTSIDE SLOPE	
9	35.0	-5.0	235.0	40.0	CIRCLE OUTSIDE SLOPE	
10	35.0	-5.0	230.0	40.0	CIRCLE OUTSIDE SLOPE	
11	35.0	-5.0	240.0	40.0	CIRCLE OUTSIDE SLOPE	
12	35.0	-10.0	235.0	45.0	CIRCLE OUTSIDE SLOPE	
13	35.0	-10.0	230.0	45.0	CIRCLE OUTSIDE SLOPE	
14	35.0	-10.0	240.0	45.0	CIRCLE OUTSIDE SLOPE	
15	35.0	-15.0	235.0	50.0	CIRCLE OUTSIDE SLOPE	
16	35.0	-15.0	230.0	50.0	CIRCLE OUTSIDE SLOPE	
17	35.0	-15.0	240.0	50.0	CIRCLE OUTSIDE SLOPE	
18	35.0	-20.0	235.0	55.0	CIRCLE OUTSIDE SLOPE	
19	35.0	-20.0	230.0	55.0	CIRCLE OUTSIDE SLOPE	

21	35.0	-25.0	235.0	60.0	CIRCLE OUTSIDE SLOPE
22	35.0	-25.0	230.0	60.0	CIRCLE OUTSIDE SLOPE
23	35.0	-25.0	240.0	60.0	CIRCLE OUTSIDE SLOPE
24	35.0	-30.0	235.0	65.0	CIRCLE OUTSIDE SLOPE
25	35.0	-30.0	230.0	65.0	CIRCLE OUTSIDE SLOPE
26	35.0	-30.0	240.0	65.0	CIRCLE OUTSIDE SLOPE
27	35.0	-35.0	235.0	70.0	CIRCLE OUTSIDE SLOPE
28	35.0	-35.0	230.0	70.0	CIRCLE OUTSIDE SLOPE
29	35.0	-35.0	240.0	70.0	CIRCLE OUTSIDE SLOPE
30	35.0	-40.0	235.0	75.0	CIRCLE OUTSIDE SLOPE
31	35.0	-40.0	230.0	75.0	CIRCLE OUTSIDE SLOPE
32	35.0	-40.0	240.0	75.0	CIRCLE OUTSIDE SLOPE
33	35.0	-45.0	235.0	80.0	CIRCLE OUTSIDE SLOPE
34	35.0	-45.0	230.0	80.0	CIRCLE OUTSIDE SLOPE
35	35.0	-45.0	240.0	80.0	CIRCLE OUTSIDE SLOPE
36	35.0	-50.0	235.0	85.0	CIRCLE OUTSIDE SLOPE
37	35.0	-50.0	230.0	85.0	CIRCLE OUTSIDE SLOPE
38	35.0	-50.0	240.0	85.0	CIRCLE OUTSIDE SLOPE
39	35.0	-55.0	235.0	90.0	CIRCLE OUTSIDE SLOPE
40	35.0	-55.0	230.0	90.0	CIRCLE OUTSIDE SLOPE
41	35.0	-55.0	240.0	90.0	CIRCLE OUTSIDE SLOPE
42	35.0	-60.0	235.0	95.0	CIRCLE OUTSIDE SLOPE
43	35.0	-60.0	230.0	95.0	CIRCLE OUTSIDE SLOPE
44	35.0	-60.0	240.0	95.0	CIRCLE OUTSIDE SLOPE
45	35.0	-65.0	235.0	100.0	CIRCLE OUTSIDE SLOPE
46	35.0	-65.0	230.0	100.0	CIRCLE OUTSIDE SLOPE
47	35.0	-65.0	240.0	100.0	CIRCLE OUTSIDE SLOPE
48	35.0	-70.0	235.0	105.0	CIRCLE OUTSIDE SLOPE
49	35.0	-70.0	230.0	105.0	CIRCLE OUTSIDE SLOPE
50	35.0	-70.0	240.0	105.0	CIRCLE OUTSIDE SLOPE
51	35.0	-75.0	235.0	110.0	CIRCLE OUTSIDE SLOPE

SEARCH IS ABANDONED AFTER 51CIRCLES

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

MCGUIRE LANDFILL STABILITY

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	30.0	-80.0	235.0	110.0	CIRCLE OUTSIDE SLOPE	
2	30.0	-80.0	225.0	110.0	CIRCLE OUTSIDE SLOPE	
3	30.0	-70.0	235.0	100.0	CIRCLE OUTSIDE SLOPE	
4	30.0	-80.0	245.0	110.0	CIRCLE OUTSIDE SLOPE	
5	30.0	-90.0	235.0	120.0	CIRCLE OUTSIDE SLOPE	
6	30.0	-90.0	230.0	120.0	CIRCLE OUTSIDE SLOPE	
7	30.0	-85.0	235.0	115.0	CIRCLE OUTSIDE SLOPE	
8	30.0	-90.0	240.0	120.0	CIRCLE OUTSIDE SLOPE	
9	30.0	-95.0	235.0	125.0	CIRCLE OUTSIDE SLOPE	
10	30.0	-95.0	230.0	125.0	CIRCLE OUTSIDE SLOPE	
11	30.0	-95.0	240.0	125.0	CIRCLE OUTSIDE SLOPE	
12	30.0	-100.0	235.0	130.0	CIRCLE OUTSIDE SLOPE	
13	30.0	-100.0	230.0	130.0	CIRCLE OUTSIDE SLOPE	
14	30.0	-100.0	240.0	130.0	CIRCLE OUTSIDE SLOPE	
15	30.0	-105.0	235.0	135.0	CIRCLE OUTSIDE SLOPE	
16	30.0	-105.0	230.0	135.0	CIRCLE OUTSIDE SLOPE	
17	30.0	-105.0	240.0	135.0	CIRCLE OUTSIDE SLOPE	
18	30.0	-110.0	235.0	140.0	CIRCLE OUTSIDE SLOPE	
19	30.0	-110.0	230.0	140.0	CIRCLE OUTSIDE SLOPE	
20	30.0	-110.0	240.0	140.0	CIRCLE OUTSIDE SLOPE	
21	30.0	-115.0	235.0	145.0	CIRCLE OUTSIDE SLOPE	
22	30.0	-115.0	230.0	145.0	CIRCLE OUTSIDE SLOPE	
23	30.0	-115.0	240.0	145.0	CIRCLE OUTSIDE SLOPE	
24	30.0	-120.0	235.0	150.0	CIRCLE OUTSIDE SLOPE	
25	30.0	-120.0	230.0	150.0	CIRCLE OUTSIDE SLOPE	
[illegible]	[illegible]	[illegible]	[illegible]	150.0	CIRCLE OUTSIDE SLOPE	

27	30.0	-125.0	235.0	155.0	CIRCLE OUTSIDE SLOPE
28	30.0	-125.0	230.0	155.0	CIRCLE OUTSIDE SLOPE
29	30.0	-125.0	240.0	155.0	CIRCLE OUTSIDE SLOPE
30	30.0	-130.0	235.0	160.0	CIRCLE OUTSIDE SLOPE
31	30.0	-130.0	230.0	160.0	CIRCLE OUTSIDE SLOPE
32	30.0	-130.0	240.0	160.0	CIRCLE OUTSIDE SLOPE
33	30.0	-135.0	235.0	165.0	CIRCLE OUTSIDE SLOPE
34	30.0	-135.0	230.0	165.0	CIRCLE OUTSIDE SLOPE
35	30.0	-135.0	240.0	165.0	CIRCLE OUTSIDE SLOPE
36	30.0	-140.0	235.0	170.0	CIRCLE OUTSIDE SLOPE
37	30.0	-140.0	230.0	170.0	CIRCLE OUTSIDE SLOPE
38	30.0	-140.0	240.0	170.0	CIRCLE OUTSIDE SLOPE
39	30.0	-145.0	235.0	175.0	CIRCLE OUTSIDE SLOPE
40	30.0	-145.0	230.0	175.0	CIRCLE OUTSIDE SLOPE
41	30.0	-145.0	240.0	175.0	CIRCLE OUTSIDE SLOPE
42	30.0	-150.0	235.0	180.0	CIRCLE OUTSIDE SLOPE
43	30.0	-150.0	230.0	180.0	CIRCLE OUTSIDE SLOPE
44	30.0	-150.0	240.0	180.0	CIRCLE OUTSIDE SLOPE
45	30.0	-155.0	235.0	185.0	CIRCLE OUTSIDE SLOPE
46	30.0	-155.0	230.0	185.0	CIRCLE OUTSIDE SLOPE
47	30.0	-155.0	240.0	185.0	CIRCLE OUTSIDE SLOPE
48	30.0	-160.0	235.0	190.0	CIRCLE OUTSIDE SLOPE
49	30.0	-160.0	230.0	190.0	CIRCLE OUTSIDE SLOPE
50	30.0	-160.0	240.0	190.0	CIRCLE OUTSIDE SLOPE
51	30.0	-165.0	235.0	195.0	CIRCLE OUTSIDE SLOPE

SEARCH IS ABANDONED AFTER 51CIRCLES

Attachment II

PLEXCO Information

MCS-1114.02-00-0001

ATTACHMENT II (1 of 3)
MCS-1114.02-00-0001
BY: CB Thom 7/6/90
CHECKED: P.M. Sanford 8/28/90

PLEXCO®

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Figure 1
BUREAU OF RECLAMATION VALUES OF E^1 FOR IOWA FORMULA
(For Initial Flexible Pipe Deflection)

Soil type-pipe bedding material (Unified Classification System 1/)	E^1 for degree of compaction of bedding (lb/in²) 4/			
	Dumped	Slight <85% Procter <40% rel. den.	Moderate 85-95% Proctor 40-70% rel. den.	High >95% Proctor >70% rel. den.
Fine-grained Soils (LL > 50) 2/ Soils with medium to high plasticity CH, MH, CH-MH	No data available; consult a competent Soils Engineer; Otherwise use $E^1 = 0$			
Fine-grained Soils (LL < 50) Soils with medium to no plasticity CL, ML, ML-CL, with less than 25 percent coarse-grained particles	50	200	400	1,000
Fine-grained Soils (LL < 50) Soils with medium to no plasticity CL, ML, ML-CL, with more than 25 percent coarse-grained particles; Coarse-grained Soils with Fines GM, GC, SM, SC 3/ contains more than 12 percent fines	100	400	1,000	2,000
Coarse-grained Soils with Little or No Fines GW, GP, SW, SP 3/ contains less than 12 percent fines	200	1,000	2,000	3,000
Crushed Rock	1,000	3,000		

1/ ASTM Designation D-2487, USBR Designation E-3.

2/ LL = Liquid limit.

3/ Or any borderline soil beginning with one of these symbols (i.e., GM-GC, GC-SC.).

4/ 1 lb/in² = 0.07 kg/cm².

FIGURE 2
Variation In Soil Stress With Cover Depth Below H-20 Wheel Load

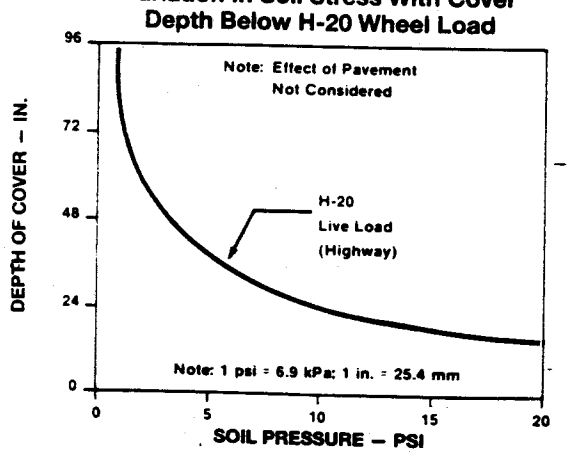
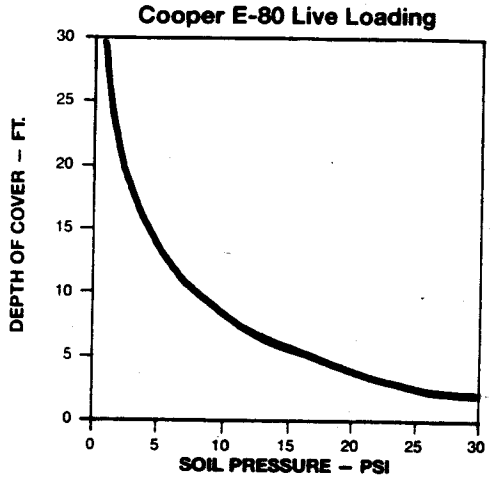


FIGURE 3
Cooper E-80 Live Loading



ATTACHMENT II (2 of 3)
MCS-1114.02-00-0001
BY: CB [illegible] 7/6/90
CHECKED: [illegible] 8/28/90

ESTIMATED DEFLECTION

$$\% \text{ deflection} = \frac{\text{Calculated deflection} \times 100}{\text{Outside diameter of pipe}}$$

X = Calculated deflection

$$X = \frac{K \times D \times W}{(0.149 \times PS + 0.061 \times E^1)}$$

$$W = \frac{DC \times OD \times SD}{144}$$

$$PS = \frac{E \times I}{0.149 \times R^3}$$

Where
- OD = Outside diameter of pipe (inch)
- K = Bedding Factor = 0.1
- D = Deflection Lag Factor = 1.5
- W = Weight per Lineal Inch (#/inch)
- PS = Pipe Stiffness (PSI)
- E^1 = Soil Modulus (See Figure 1)
- E = Flexural Modulus (PSI)
  - = 133,000 PSI for PE 3408
  - = 100,000 PSI for PE 2406
- DC = Depth of cover (feet)
- SD = Soil Density (#/ft^3)
- SDR = Standard Dimentional Ratio
- t = Average Wall Thickness (inch)

$$t = \frac{OD \times 1.06}{SDR}$$

- I = Moment of Inerta = $t^3/12$
- R = Mean Radii of the pipe (inch)

$$R = \frac{(OD - t)}{2}$$

Safe design limits for the allowable deflection of polyethylene pipe of different dimension ratios have been determined[1] and are given below:

DIMENSION RATIO (SDR)	SAFE DEFLECTION AS % OF DIAMETER
32.5	8.5
26.0	7.0
21.0	6.0
17.0	5.0
11.0	3.0
9.0	2.5

EXAMPLE

As an example, assume a PLEXCO 12 inch SDR 11 PE 3408 polyethylene pipe is to be buried 25 feet in the ground. This pipe is to be buried in a coarse grained soil with little or no fines and compacted to a proctor density of 90%. From Figure 1 a value of 2000 PSI is obtained for E^1. Soil density is assumed to be 120 #/ft^3.

OD = 12.75 inches
t = (12.75 × 1.06)/11 = 1.229
I = $(1.229)^3/12$ = 0.1547
R = (12.75 − 1.229)/2 = 5.761
PS = (133,000 × 0.1547)/(0.149 × 5.761^3)
= 722.4
W = (25 × 12.75 × 120)/144 = 265.6

$$X = \frac{1.5 \times 0.1 \times 265.6}{(0.149 \times 722.4 + 0.061 \times 2000)}$$

X = 0.173 inch deflection

$$\% \text{ deflection} = \frac{0.173 \times 100}{12.75} = 1.36\%$$

Since 1.36% is less than the allowable 3.0%, this would be an adequate burial situation.

The method presented for calculating deflection represents one of many methods and should be adequate in most cases. However, when special installation conditions exist, other methods of calculating deflection may need to be used. The final design is left to the discretion of the responsible engineer.

PE 3408 Industrial Piping System
Pipe Data and Pressure Ratings

PLEXCO

(Pipe weights are calculated in accordance with PPI TR-7)

Pressure Ratings are for water at 73°F. For other fluids and service temperatures refer to Application Note No. 6 Chemical and Environmental Considerations.

IPS* PIPE SIZE	O.D. SIZE (INCHES)	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT	MIN. WALL (INCHES)	WEIGHT LB/FT
1½"	1.900	—	—	—	—	.173	.41	—	—	—	—	—	—	—	—	—	—	—	—
2"	2.375	.325	.91	.264	.76	.216	.64	—	—	—	—	—	—	—	—	—	—	—	—
3"	3.500	.479	1.98	.389	1.65	.318	1.39	.259	1.15	.226	1.02	.206	.93	—	—	—	—	—	—
4"	4.500	.616	3.27	.500	2.74	.409	2.30	.333	1.90	.290	1.67	.265	1.54	.214	1.26	—	—	—	—
†5"	5.563	.762	5.00	.618	4.18	.506	3.50	.412	2.91	.359	2.57	.327	2.35	.265	1.93	.214	1.58	—	—
6"	6.625	.908	7.09	.736	5.93	.602	4.97	.491	4.13	.427	3.64	.390	3.34	.316	2.74	.255	2.23	.204	1.80
7"	7.125	—	—	—	—	—	—	—	—	—	—	.420	3.87	.340	3.17	.274	2.58	.220	2.09
8"	8.625	1.182	12.01	.958	10.05	.785	8.43	.639	7.00	.556	6.16	.508	5.66	.411	4.64	.332	3.79	.265	3.05
10"	10.750	1.473	18.66	1.194	15.62	.978	13.10	.797	10.89	.694	9.59	.633	8.80	.512	7.21	.413	5.87	.331	4.75
12"	12.750	1.747	26.25	1.417	21.97	1.160	18.43	.945	15.31	.823	13.47	.750	12.36	.608	10.14	.490	8.26	.392	6.67
14"	14.000	1.918	31.64	1.556	26.49	1.273	22.20	1.037	18.44	.903	16.24	.824	14.91	.667	12.22	.538	9.96	.431	8.05
16"	16.000	2.192	41.34	1.778	34.61	1.455	29.00	1.185	24.09	1.032	21.21	.941	19.46	.762	15.97	.615	13.02	.492	10.51
18"	18.000	2.466	52.31	2.000	43.79	1.636	36.69	1.333	30.48	1.161	26.85	1.059	24.65	.857	20.19	.692	16.48	.554	13.29
20"	20.000	2.740	64.57	2.222	54.05	1.818	45.30	1.481	37.64	1.290	33.13	1.176	30.42	.952	24.92	.769	20.34	.615	16.41
22"	22.000	—	—	2.444	65.41	2.000	54.82	1.630	45.56	1.419	40.09	1.294	36.81	1.048	30.19	.846	24.62	.677	19.87
24"	24.000	—	—	2.667	77.85	2.182	65.24	1.778	54.22	1.548	47.72	1.412	43.82	1.143	35.92	.923	29.29	.738	23.62
†26"	26.000	—	—	2.889	91.35	2.364	76.58	1.926	63.63	1.677	56.02	1.529	51.40	1.238	42.13	1.000	34.39	.800	27.74
†28"	28.000	—	—	—	—	2.545	88.79	2.074	73.76	1.806	64.94	1.647	59.62	1.333	48.86	1.077	39.89	.862	32.20
†30"	30.000	—	—	—	—	2.727	101.94	2.222	84.68	1.935	74.56	1.765	68.45	1.429	56.13	1.154	45.78	.923	36.92
†32"	32.000	—	—	—	—	2.909	115.99	2.370	96.35	2.065	84.88	1.882	77.86	1.524	63.83	1.231	52.10	.985	42.04
†34"	34.000	—	—	—	—	3.090	130.92	2.519	108.80	2.194	95.83	2.000	87.91	1.619	72.06	1.308	58.79	1.046	47.44
†36"	36.000	—	—	—	—	—	—	—	—	2.323	107.40	2.118	98.56	1.714	80.79	1.385	65.93	1.108	53.18

*Industrial PE (polyethylene) pipe sizes are identified by IPS (iron pipe size) diameters which designate the nominal diameter for 12" IPS AND SMALLER PIPE, AND O.D. (outside diameter) for 14" IPS and larger pipe.

Check with your PLEXCO sales office for availability of dimensions not listed.

† SUBJECT TO MINIMUM ORDER QUANTITIES, AND AVAILABILITY OF TOOLING.

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ATTACHMENT II (3 of 3)
MCS-1114.02-00-001
BY: CBT CHECKED: MG 3/28/00

ATTACHMENT III

SOILS REPORT

(SEE APPENDIX D IN PREVIOUSLY SUBMITTED "PROJECT MANUAL")

ATTACHMENT IV

CUT AND FILL SECTIONS

(SEE ATTACHMENT #9 IN PREVIOUSLY SUBMITTED "PERMIT APPLICATION REPORT")