5/9/96
10:00 do

PERMIT

SEWAGE DISPOSAL SYSTEM

DEPARTMENT OF HEALTH AND MENTAL HYGIENE

P 56603

A REPAIR

DISTRICT

HOWARD COUNTY HEALTH DEPARTMENT
BUREAU OF ENVIRONMENTAL HEALTH
461-9933

DATE 5/7/96

DATE SYSTEM APPROVED 5/10/96

INDEXED

INSPECTOR [signature]

KME Construction, Inc. IS PERMITTED TO INSTALL X ALTER

ADDRESS 26108 Mullinix Mill Road, Mt. Airy. 21771 PHONE (301)253-5254

SUBDIVISION LOT ROAD 2632 North Rogers Avenue

PROPERTY OWNER Michael Summers

ADDRESS 2632 North Rogers Avenue
Ellicott City, 21043

SEPTIC TANK CAPACITY existing 1500 GALLONS existing 1500 gpd would require

NUMBER OF BEDROOMS 4 Bdr + 2 chair Dental office 4x150 = 600 gpd
2x450 = 900 gpd
1500 gpd

180 SQUARE FEET PER BEDROOM

Septic Design shall be based on

LINEAR FEET OF TRENCH REQUIRED 300 LF of shallow plus 225 lin. ft. of deep Trench

REPAIR - PURPOSE - SEPTIC SYSTEM HAD FAILED

Call for inspection when ground is opened so sanitarian can recommend repair. 6/7/96

300 LF Shallow Trench Bottom at 4-5 ft, 2 ft stone, 3 ft wide, inlet at 2+ ft.
225 LF Deep Trench at 8 ft Bottom, 4 ft stone, 2 ft wide, inlet at 3 or 4 ft as needed to get gravity flow. Based on middle open trench Inspection deep Trench design may be approvable by Sanitarian for more than the 225 LF proposed, with a corresponding reduction in shallow Trench length

PLANS APROVED BY [signature] DATE 5/9/96

COVER NO WORK UNTIL INSPECTED AND APPROVED

NEITHER THE HOWARD COUNTY COUNCIL NOR THE HEALTH DEPARTMENT IS RESPONSIBLE FOR THE SUCCESSFUL OPERATION OF ANY SYSTEM

NOTE: CLEANOUT REQUIRED EVERY 70 FEET OF SEWER LINE AND/OR AT 90° SWEEPS IN LINES FROM HOUSE TO DRAIN FIELDS, 90° ELBOWS NOT ACCEPTABLE.

NOTE: ALL PARTS OF SEPTIC SYSTEMS (I.E. TANK, DISTRIBUTION BOX TRENCHES) TO BE 100 FEET FROM WELL (UNLESS OTHERWISE SPECIFICALLY AUTHORIZED)

NOTE: IF DEEP TRENCH(ES) ARE USED CALL FOR INSPECTION BEFORE AND AFTER PLACING GRAVEL IN TRENCH(ES)

NOTE: NO DRY WELL SHALL EXCEED 15 FOOT IN DIAMETER NO ABSORPTION TRENCH TO EXCEED 100 FEET IN LENGTH

BLDG PERMIT SIGNED AND RETURNED 5/10/96

NOTE: ALL PIPE FROM HOUSE TO SEPTIC TANK MUST BE CAST IRON OR SCHEDULE 35/40 PVC OR ABS

Serial # 64899-
3-CAR garage

PERMIT VOID AFTER TWO YEARS

NOTE: INSTALL STAND PIPE ON SEPTIC TANK AND DRY WELL STAND PIPES MUST BE 6 INCHES IN DIAMETER CAST IRON. CONCRETE OR TERRA COTTA OR PVA OR ABS ACCEPTED. IF TOP OF SEPTIC TANK IS DEEPER THAN 3 FEET. MANHOLE TO GRADE REQUIRED.

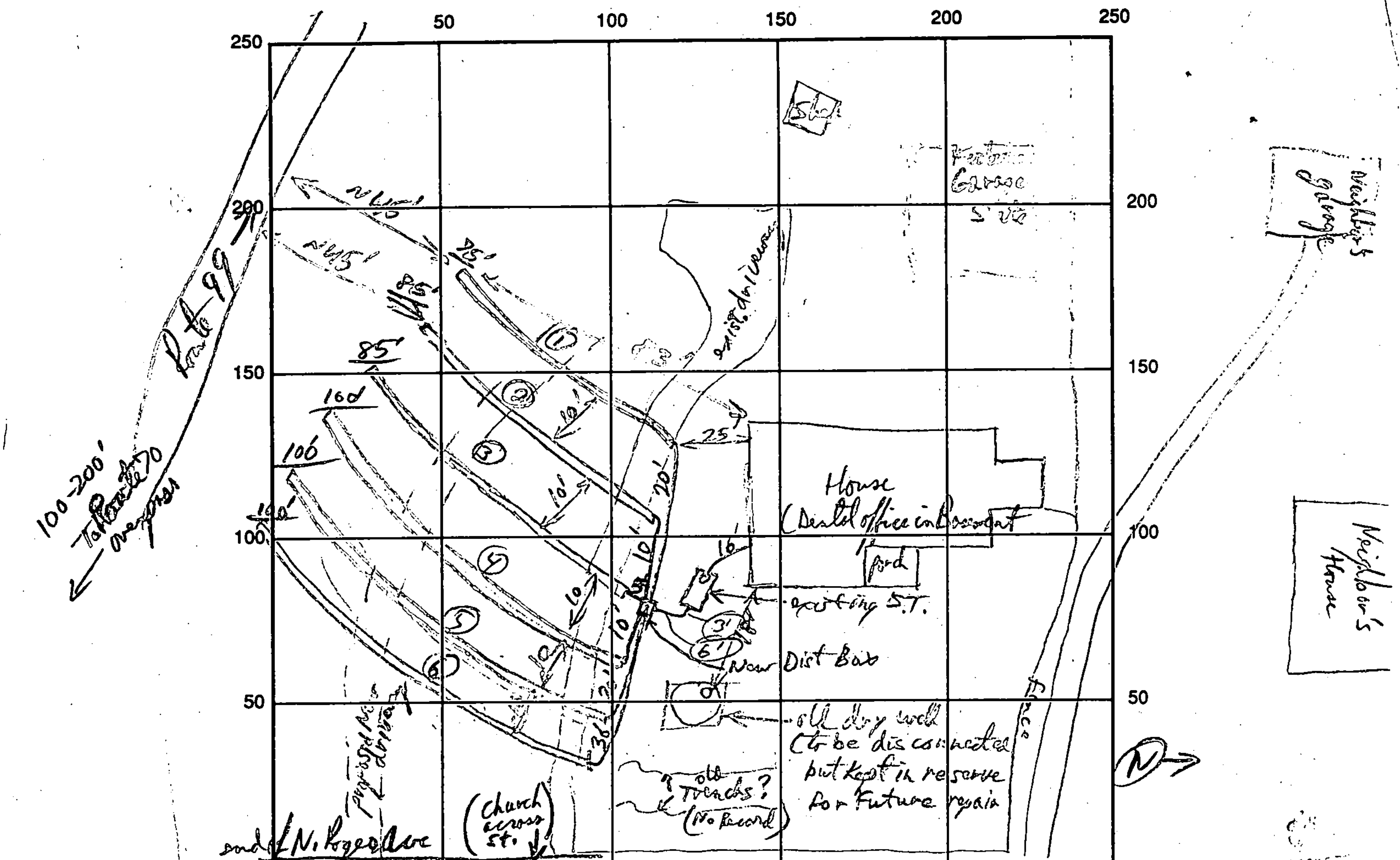
NOTE: DISTRIBUTION BOXES MUST HAVE BAFFLES

P 56603

***INSTALLER IS RESPONSIBLE FOR OBTAINING FINAL APPROVAL ON THIS PERMIT**

***CALL 461-9933 FOR INSPECTION OF SEPTIC SYSTEM.**

HD-260(6-90)



INDICATE NORTH - NAME ADJOINING ROADWAY AS BASE LINE

Note! Main house is gravity feed to S.T., Basement feeds via pump [illegible]

SEPTIC TANK LEVEL existing 1500 gal CLEANOUTS ____

DISTRIBUTION BOX LEVEL ✓ (used Dial-a-Flow's

DRAIN FIELD/TITLE DEPTH 1/2/3/4/5/6: 8/8/7/5½/4½/4' FT. TRENCH WIDTH 1-3/4-6: 2'/3' FT. INLET DEPTH 4/5½/3/2'/2'/2' FT.

EFFECTIVE GRAVEL DEPTH 1/2/3: 4/4/3/2/2/2 FT. TOTAL LENGTH 1/2/3/4/5/6: 75/85/85/100/100/100 FT.

NUMBER OF TRENCHES 6 Total ~~ONE~~ SIDEWALL/BOTTOM AREA 1795 SQ. FT.

900 + 640 + 255 = 1795

DRYWALL INSIDE DIAMETER disconnected FT. EFFECTIVE DEPTH BELOW INLET ____ FT.
but left to dry out, keep for future repair.

ABSORBENT AREA ____ SQ. FT.

REMARKS: Existing Dry well full - water level is 12" above dry well lid - also [illegible] wet spots / surface seepage on ground about 20-25 ft from D.W. cleanout. Pockets of clay. Mottled clay at 4 ft in Tr 3 under old driveway. Trenches 4, 5 & 6 will have to be shallow trench design. Trenches 1 & 2 OK to cover, Trench #3 OK [illegible] (Gravel depth is about 18" cover over drain pipe where future driveway is to go, using perforated 2500 lb crush PVC) OK to gravel fill last trench, OK to cover system when last trench complete. RW 5/10/96

DATE SYSTEM APPROVED 5/10/96 INSPECTOR [signature]

APPLICATION

PERCOLATION TESTING

A Repair

P 56603

BP 64899

for New Detached Garage Addn & change of Driveway Location Pending

HOWARD COUNTY HEALTH DEPARTMENT
BUREAU OF ENVIRONMENTAL HEALTH
3525-H ELLICOTT MILLS DRIVE/ELLICOTT CITY, MARYLAND 21043
TELEPHONE: 313-2640

DISTRICT ____

DATE ____

TO: THE COUNTY HEALTH OFFICER
ELLICOTT CITY, MARYLAND

I HEREBY APPLY FOR THE NECESSARY TEST PRIOR TO APPLICATION FOR PERMIT TO CONSTRUCT (OR RECONSTRUCT) A SEWAGE DISPOSAL SYSTEM.

PROPERTY OWNER Michael Summers

ADDRESS 2632 N. Rogers Ave, EC. PHONE ____

AGENT OR PROSPECTIVE BUYER ____

ADDRESS ____ PHONE ____

PROPERTY LOCATION:

SUBDIVISION ____ LOT NO. ____

ROAD AND DESCRIPTION 2632 N. Rogers Ave – on NW side of N. Rogers Ave at end of Dead End Roadway, between same and Route 99 about 200 ft N of Route 70 overpass

TAX MAP ____ PARCEL # ____

SIZE OF LOT ____ TYPE BLDG. existing 4 Bdr House + 2 Seat Dental office in Basement
(SINGLE FAMILY DWELLING OR COMMERCIAL)

THE SYSTEM INSTALLED UNDER THIS APPLICATION IS ACCEPTABLE ONLY UNTIL PUBLIC FACILITIES BECOME AVAILABLE. I FULLY UNDERSTAND THE FEE CONNECTED WITH THE FILING OF THIS PERC TEST APPLICATION IS NON-REFUNDABLE UNDER ANY CIRCUMSTANCES. I ALSO AGREE TO COMPLY WITH ALL M.O.S.H.A. REQUIREMENTS IN TESTING THIS LOT. ____
(SIGNATURE OF APPLICANT)

APPROVED BY ____ FOR ____ DATE ____

DISAPPROVED BY ____ FOR ____ DATE ____

HOLD PENDING FURTHER TESTS ____

REASONS FOR REJECTION OR HOLDING ____

PERCOLATION TEST PLAT/PRELIMINARY PLAT - TITLE OR I.D. # ____ DATE ____

SITE DEVELOPMENT PLAN/FINAL PLAT - TITLE OR I.D. # ____ DATE ____

THIS IS NOT A PERMIT

HD-216 (3/92)

Repair
P56603
COUNTY #

SOIL PROFILE

0' (M) (Low) A South side

Mix of orange LL and orange SL

2½–3 Mix Color Some Rock Mica Loam C3P and Black Mottles (3–8')

Neutral Brn mica loam

5 — gray FSL

7 — gray + grey brn

8' Mica FSL — water level

9 Rocky Bottom

B

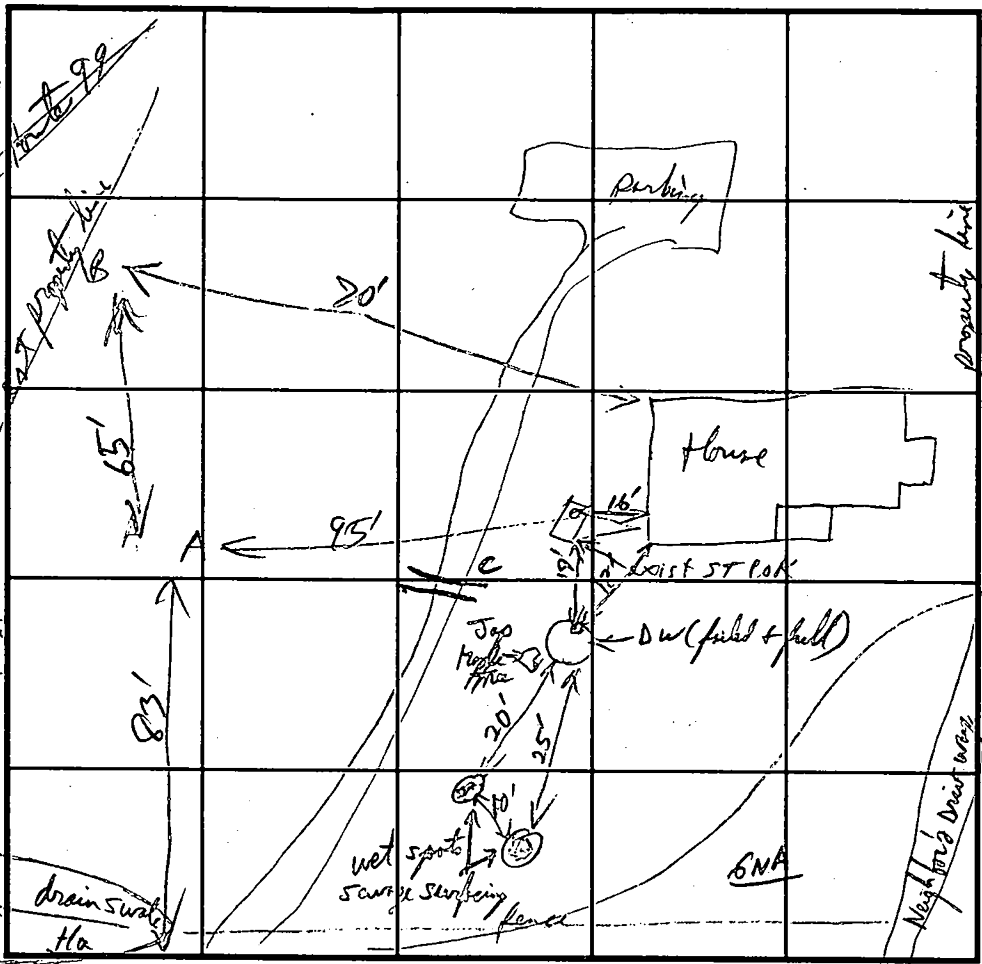
Reddish Yel – yel Red Mica SiCL – LL

Mott Brn Mica Loam

8–9' grey Brn + grey Mica FSL

12½ water seepage

14 water level



N Roger Ave
INDICATE NORTH - NAME ADJOINING ROADWAY AS BASE LINE.

SOIL PROFILE

0'

300 LF Standard 3 ft w/ 2 ft stone Bottom 4 ft

300 LF @ deep 4 ft stone

300 / 3 = 4 | 900 sq ft
225' ≈ 4 ft stone
300 ≈ ..

450 LF 4 ft deep

equiv to 6 + 4 = 10 Bdrm

3 | 1800 sq ft
600 LF
700
560

3 | 1260
70 | 420 LF

DATE	TEST NO.	DEPTH	PRE-WET START	PRE-WET STOP	TEST - 1" DROP START	TEST - 1" DROP STOP	TIME
5/9/96	A		OK soils & Low 2½–3 ft, Not Tested	Mica loam below 4 ft			
		V 9'	begin perc water table @ 8½ at 10:30, 8 ft at 11:30				
	B		OK Loams between 3 and 5 ft (L SL orange at 3–5) Not Tested				
		V 14	water level at 13½ @ 11 AM, water seepage @ 12½ ft				
(fyio)	C		section of Trench #3 under original drainage area at Failed Drywell had a gray SiCL Horizon with Mottled boundaries Typical of Glenville Soils.				

300
225
525

REMARKS Limited depth at different elevations to water tables – split system design

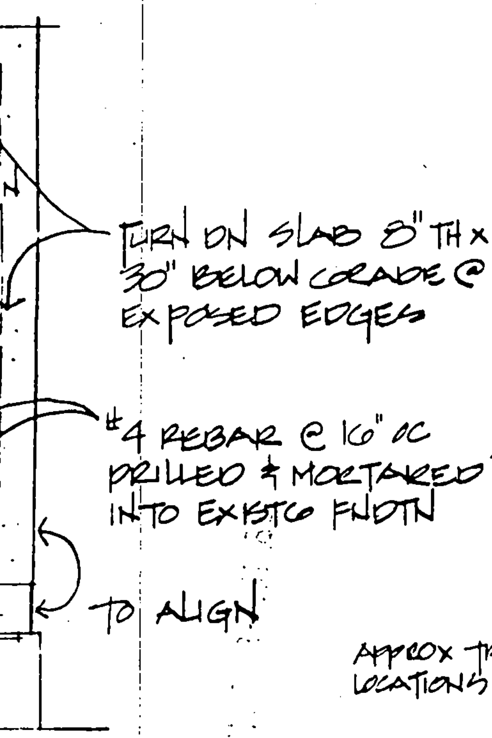
TYPE OF SOIL GhB2, GLB2, (GnA, Ha) Chester, Glenelg on high side, Glenville, Hatboro on low side

TESTED BY [signature] ALSO PRESENT owner, Bldg + Septic Contractors

TRENCH DESIGN DATA: AVERAGE PERCOLATION TIME est 5–10 min in Loam – SL TRENCH WIDTH

INLET DEPTH MAXIMUM BOTTOM DEPTH SQ. FT/BEDROOM

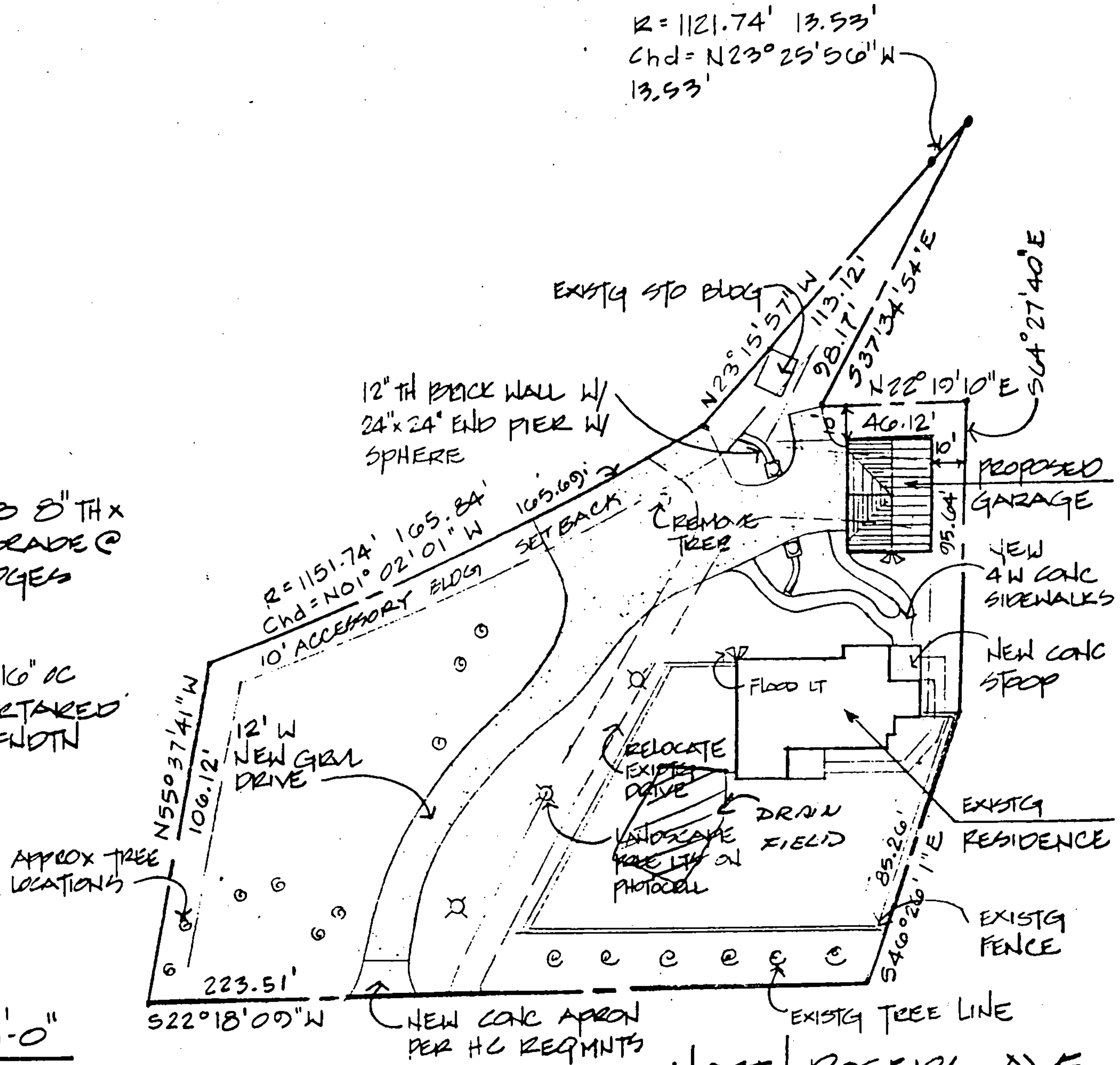
split trench design – see Septic Repair in Permit

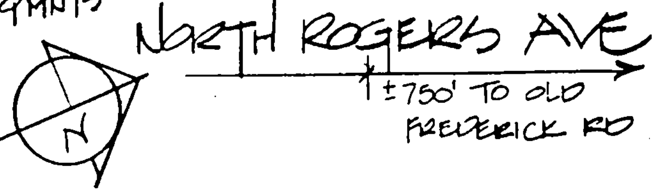


PLAN 1/4" = 1'-0"

-ROUND TO GARAGE,
OUSE OR FRONT OF

S @ HOUSE TO BE
TS TO BE PROVIDED
SENSORS.





SITE PLAN
1" = 50'

SITE INFORMATION
2632 NORTH ROGERS AVE
HOWARD COUNTY, MARYLAND

SIN
9014 BL

...S & ALTERATIONS FOR
...HAEL & HOLLY SUMMERS
...TH ROGERS AVENUE, ELLICOTT CITY, MARYLAND 21043

File

PERMIT

P 45936

SEWAGE DISPOSAL SYSTEM

MARYLAND STATE DEPARTMENT OF HEALTH*

A REPAIR

DISTRICT

HOWARD COUNTY

BUREAU OF ENVIRONMENTAL HEALTH

461-9933

DATE 5/17/90

INDEXED

DATE SYSTEM APPROVED 4/3/90

INSPECTOR C.B.

Jack Fyock IS PERMITTED TO INSTALL ______ ALTER X

ADDRESS 13775 Triadelphia Road, Glenelg, Maryland 21737 PHONE 988-9270

SUBDIVISION ______ ROAD 2632 N. Rogers Ave. LOT ______

PROPERTY OWNER Ms. Holly Summers

ADDRESS 2632 N. Rogers Ave.
Ellicott City, Maryland 21043

~~XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX~~

~~XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX~~

SEPTIC TANK CAPACITY ______ GALLONS NUMBER OF BEDROOMS ______

REPAIR - CALL FOR INSPECTION WHEN GROUND IS OPENED SO SANITARIAN CAN RECOMMEND REPAIR.

4/3/90 (1) - 1500 New Gallon - INSTALLED

C.B.

PLANS APPROVED BY Craig Williams cm DATE 04/02/90

COVER NO WORK UNTIL INSPECTED AND APPROVED

NEITHER THE HOWARD COUNTY COUNCIL NOR THE HEALTH DEPARTMENT IS RESPONSIBLE FOR THE SUCCESSFUL OPERATION OF ANY SYSTEM

NOTE CLEANOUT REQUIRED EVERY 70 FEET OF SEWER LINE AND/OR AT 90° SWEEPS IN LINES FROM HOUSE TO DRAIN FIELDS

NOTE ALL PARTS OF SEPTIC SYSTEMS (I.E., TANK, DISTRIBUTION BOX, TRENCHES) TO BE 100 FEET FROM WELL (UNLESS OTHERWISE SPECIFICALLY AUTHORIZED)

NOTE IF DEEP TRENCH(ES) ARE USED CALL FOR INSPECTION BEFORE AND AFTER PLACING GRAVEL IN TRENCH(ES)

NOTE NO DRY WELL SHALL EXCEED 15 FOOT IN DIAMETER. NO ABSORPTION TRENCH TO EXCEED 100 FEET IN LENGTH

NOTE ALL PIPE FROM HOUSE TO SEPTIC TANK MUST BE CAST IRON OR SCHEDULE 40 PVC OR ABS

PERMIT VOID AFTER TWO YEARS

NOTE INSTALL STAND PIPE ON SEPTIC TANK AND DRY WELL. STAND PIPES MUST BE 6 INCHES IN DIAMETER. CAST IRON, CONCRETE OR TERRA COTTA OR PVC OR ABS ACCEPTED. IF TOP OF SEPTIC TANK IS DEEPER THAN 3 FEET, MANHOLE TO GRADE REQUIRED

NOTE DISTRIBUTION BOXES MUST HAVE BAFFLES

P 45936

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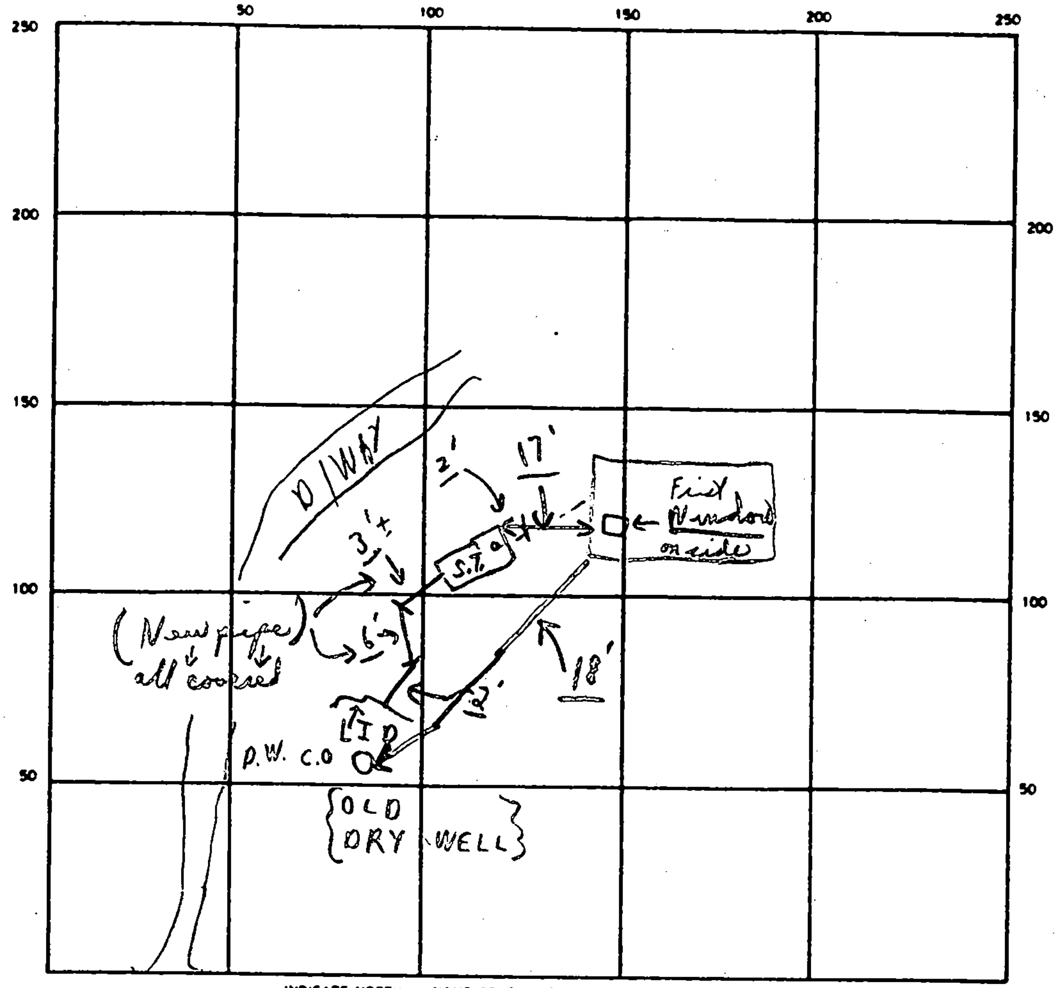
*CALL 461-9933 FOR INSPECTION OF SEPTIC SYSTEMS.

HD-260



INDICATE NORTH — NAME ADJOINING ROADWAY AS BASE LINE

ROGERS AVE

SEPTIC TANK LEVEL OK CLEANOUTS New S.T. OK

DISTRIBUTION BOX LEVEL N/A

DRAIN FIELD/TILE FIELD DEPTH — FT TRENCH WIDTH — FT INLET DEPTH — FT

EFFECTIVE GRAVEL DEPTH — FT TOTAL LENGTH — FT

NUMBER OF TRENCHES — ONE SIDEWALL/BOTTOM AREA — SQ FT

DRYWELL INSIDE DIAMETER — FT EFFECTIVE DEPTH BELOW INLET — FT

ABSORBENT AREA — SQ FT

REMARKS 4/3/90 OK TO COVER ALL WORK, FINAL (1 New septic tank installed) C.B.S.

DATE SYSTEM APPROVED 4/3/90 INSPECTOR Charles Bryan Strack

SAND MOUND SYSTEMS ON SLOWLY PERMEABLE SOILS PERFORMANCE ASSESSMENT

Jay Prager[1] Barry Glotfelty[1]

ABSTRACT

An enhanced environmental protection ethic stemming from Federal and State Initiatives to restore the Chesapeake Bay, along with increasing development pressure throughout Maryland, resulted in a statewide study being conducted to evaluate a variety of innovative and alternative onsite sewage disposal technologies including sand mounds on slowly permeable soils. Maryland's interest in sand mounds was heightened by sand mound use in other states, especially Pennsylvania, which borders Maryland to the North. In 1985 Maryland adopted regulations that conventionalized the use of Wisconsin sand mounds but restricted their use to permeable soils.

Maryland has about 200 soil series including numerous series with slowly permeable soils, frequently in combination with seasonally high tables, perched water tables, shallow depths to bedrock, or fragipans. These soil conditions, coupled with an abundance of failing septic systems and homes without indoor plumbing have provided a fertile laboratory to study sand mounds on slowly permeable soils. As part of Maryland's Innovative and Alternative Onsite Sewage Disposal Program, 36 sand mound systems were installed in soils with infiltration rates ranging from 47 min/cm (120 min/in) to slower than 400 min/cm (1,000 min/in) using controlled site evaluation, design, and construction procedures. These systems were, and continue to be, closely monitored for hydraulic performance. Of these 36 systems, 7 have exhibited either seasonal or continuous effluent seepage. For this paper we have included detailed studies of 16 systems that typify our experience with sand mounds in slowly permeable soils.

This paper will present a performance assessment of sand mound systems in slowly permeable soils including site evaluation, design, and construction procedures which have proven optimal in the Maryland experience.
Keywords: Soil absorption system, Wastewater loading, Septic tank effluent

EXPERIMENTAL APPROACH

To evaluate the performance of sand mounds on slowly permeable soils, sites with failing septic systems or no indoor plumbing were selected. Participating property owners were required to recognize their voluntary participation in an experimental program and were required to sign an Agreement and Easement outlining the conditions of the experiment and granting monitoring access for State and County personnel. Costs were borne by the property owner; however, in most cases individual homeowners were eligible for partial grants and/or low interest loans.

[1]Jay Prager, Division Chief, Innovative and Alternative Onsite Sewage Disposal Division, Maryland Department of the Environment; Barry Glotfelty, Project Manager, Innovative and Alternative Onsite Sewage Disposal Division, Maryland Department of the Environment.

During normal operations to repair failing septic systems or provide indoor plumbing, County personnel would note soil and site conditions, referring sites where normal code conditions could not be met to the State Innovative and Alternative Onsite Sewage Disposal Division. Upon receiving a referral, a more detailed evaluation was conducted by State personnel, and specifications for plans were prepared for those properties deemed suitable for inclusion in the program. Final plans and system construction were jointly approved and inspected by the State and County.

SITE EVALUATION

The site evaluation for each applicant included the following and is summarized in table A.:

1. Soil classification from Soil Survey;
2. Depth to groundwater and/or bedrock;
3. Soil percolation rates and vertical permeability rates as measured in the most restrictive horizon in the top 61 cm (24 in) of the soil profile. Vertical permeabilties were measured using a falling head test from 15.2 cm (6 in) to 12.7 cm (5 in) in a single ring infiltrometer;
4. Detailed USDA soil profile descriptions, from either backhoe test pits or auger holes;
5. Topography and surface drainage information;
6. Slope; and
7. Estimated design flow.

DESIGN

All of the systems in the study followed the principles of design and construction of Wisconsin mounds as described by Converse (1978) and others (Converse and Tyler, 1978; USEPA, 1980). Where possible, all of the projects were designed with the long axis of the mound as long as possible on contour. Where sufficient area was available a basal design loading rate of 0.6 cm/d (0.15 gpd/ft^2) was used. Design parameters and actual loading rates are summarized in table B. To make the design process more user friendly, a standard bed depth of 25.4 cm (10 in) was incorporated into Maryland's Design and Construction Manual for Sand Mound Systems (1987). For individual residential applications, this depth provides adequate depth around the distribution network and enough cover to provide protection; while not significantly affecting the size of the system. 5 677 L (1,500 gal) double compartment septic tanks with 2/3 of the tank capacity in the first compartment were specified as pretreatment units. In an attempt to minimize infiltration of ground water into the systems, top seam tanks were typically used to keep the seam of the septic tank and pumping chamber above the elevation of the high water table. On some of the sites an existing tank was maintained as the first pretreatment compartment, but this practice was abandoned when copious infiltration into some of these tanks became evident.

CONSTRUCTION

Code of Maryland Regulation requires any contractor who installs sand mounds to attain certification by attending a course of study and passing an examination on sand mound construction. The State offers a full day workshop on sand mound construction at least once per year. The same workshop is attended by contractors, regulators, and inspectors. Actual construction of mounds in the experimental project was closely monitored to assure

Table A: Site Characteristics for the 16 Systems Included in the Study

Depth cm	Color[1] Matrix	Mottle	Texture[2]	Structure[2] Consistence	Perc.[3] Rate min/cm	Vert. Perm. min/cm
System 1: Penn sil, fine-loamy, mixed, mesic, Ultic Hapludalf, <2% slope, convex, summit slope, 97 cm to rock, limiting horizon 86 cm						
0 - 20	5YR 5/4		lt.sil	2 sbk/gr		
20 - 33	5YR 5/4		sil	sbk		
33 - 86	2.5YR 5/4		hsil	dense	42	236 - 394
86 - 97	2.5YR 3/4		saprolite			
System 2: Penn sil, fine-loamy, mixed, mesic, Ultic Hapludalf, <2% slope, linear to concave, < 20 cm to high ground water (HGW), limiting horizon 48 cm						
0 - 20	2.5YR 3/6		sil	3 sbk		
20 - 46	2.5YR 4/6		gsil	2 sbk		132
System 3: Penn loam, fine-loamy, mixed, mesic, Ultic Hapludalf, <2% slope, convex, side slope, limiting horizon 46 cm						
0 - 25	rd - br		sil	3 gr		
25 - 61	rd - br		hsil	1 sbk	moderate	
61 - 76	rd - br		sil	saprolite		
76 - 122	gr - br		sl	perm. rock		
System 4: Huntington sil, fine-silty, mixed mesic, Fluventic Hapludoll, 4% slope, linear footslope, 100% limestone at 79 cm						
0 - 20	10YR 3/3		gl	2 gr		
20 - 56	10YR 4/4		sil	2 sbk	4	63
56 - 79	10YR 5/6		hsil	3 sbk	moderate	
System 5: Manor sil, coarse-loamy, micaceous, mesic, Typic Dystrochrept, 8% slope, linear sideslope, dense massive sicl at 64 cm, 142cm to HGW						
0 - 23	7.5YR 3/2		sil	3 mgr		
23 - 41	10 YR 6/4		hsil	2 msbk	moderate	35
41 - 64	7.5YR 5/8		sicl	1 - 2 msbk	75	236
64 - 142	5YR 5/8	2.5Y 7/4	sicl	massive		
System 6: Lantz sil, fine-loamy, mixed mesic, Mollic Ochraqualf, 4 % slope, slightly concave sideslope, limiting horizon at 53 cm, HGW 61 cm						
0 - 25	yel - br		sil	1 gr - sbk		
25 - 53	red - yel		sil	sbk	21	63
53 - 61	red - yel		sil			≈ ∞
System 7: Augusta gl, fine-loamy, mixed mesic, Ultic Hapludalf, 8% linear sideslope, limiting horizon 58 cm, HGW at 69 cm						
0 - 25	10YR 5/3		l - sil	3 sbk		
25 - 38	10YR 6/3	10YR 6/3	sil	1 - 2 sbk		
38 - 48	7.5YR 4/6	10YR 6/2	hsil	pl - sbk	8	31
48 - 58	7.5YR 4/6	d 5Y 6/2-3	hsil	pl	moderate	
58 - 69	10 YR 5/6	5Y 6/2 black	sil	pl		est. > 47
System 8: Penn sil, fine-loamy, mixed, mesic, Ultic Hapludalf, <2% slope, linear sideslope, limiting horizon at 51 cm, HGW at 55 cm						
0 - 23	5YR 3/4		sil	3 gr, mvfr		
23 - 33	5YR 4/4		l	2 sbk, mvfr		
33 - 51	2.5YR 3/4		hsil	1 sbk, mvfr	moderate	63
51 - 81	2.5YR 3/4	faint	l	dense		

Depth cm	Color[1] Matrix	Mottle	Texture[2]	Structure[2] Consistence	Perc.[3] Rate min/cm	Vert. Perm. min/cm
System 9: Old Alluvium, 4% convex footslope terrace, limiting horizon at 61 cm, HGW at 84 cm						
0 - 15	10YR 4/4		sil - l	3 gr		
15 - 61	7.5YR 5/8		sil	1 - 2 msbk		
61 - 74	10YR 6/8	10YR 6/1	hsil - sicl	2 msbk	33	290
74 - 91	7.5YR 6/0		sicl	2msbkdense		
System 10: Mattapex fsl, fine silty, mixed mesic, Aquic Hapludult, < 3% slope, limiting horizon 41 cm, HGW at 56 cm						
0 - 23	light br		sil	2 g		
23 - 41	br		sil			
41 - 61	7.5YR 6/6	10YR 6/2	hsil	1 sbk		> 236
61 - 109	7,5YR 6/6	YR 6/1	l	fragic		
System 11: Beltsville, fine-loamy, mixed mesic, Typic Fragiudult, slope < 2%, limiting horizon at 36 cm, HGW 56 cm (perched)						
0 - 20	olive/grey		sil			
20 - 36			sicl			
36 - 56	10YR 6/4	10YR 6/3	scl	sbk - pl		250
56 - 81	10YR 5/4	10YR 6/1	l	pl, fragipan		>300
81 - 114	10YR 6/2	10YR 5/8	l - scl	massive		
System 12: Beltsville, fine-loamy, mixed mesic, Typic Fragiudult, slope < 2%, limiting horizon at 73 cm, HGW 43 cm (perched)						
0 - 20	10YR 5/3	10YR 6/6	l			
20 - 43	10YR 5/6	10YR 5/3	sil			
43 - 76	10YR 5/6	10YR 7/1	cl	pl, fragipan		84
76 - 102	10YR 5/6	10YR 7/2	sicl	massive		
System 13: Alluvial, sideslope terrace, 2 - 4 % slope, depth to HGW and limiting horizon = 66 cm						
0 - 28	10YR 5/3	10YR 6/4	sl			
28 - 66	7.5YR 5/6	10YR 6/3	scl - cl			
66 - 91	7.5YR 6/6	5YR 7/1	scl			189
System 14: Beltsville, fine-loamy, mixed mesic, Typic Fragiudult, sideslope 3%, limiting horizon at 56 cm, HGW 43 cm (perched)						
0 - 23	10YR 5/6	2.5Y 7/4	hl - sil			
23 - 41	10YR 5/6	10YR 7/3	sil			>400
41 - 56	10YR 6/8	10YR 7/2	hl	pl, fragic		
56 - 91	10YR 5/6	10YR 6/1	hl	pl, fragipan		
91 - 117	10YR 7/1	10YR 5/8	l - sil	massive		
System 15: Fill, Percolation rate at 5 to 20 cm ≈ 150 min/cm, vertical permeability at 33 cm ≈ > 400 min/cm, HGW at 30 cm, artificially drained to 61 cm						
System 16: Beltsville, fine-loamy, mixed mesic, Typic Fragiudult, slope = 4%, upland sideslope,limiting horizon at 53 cm, HGW 69 cm (perched)						
0 - 28	10YR 5/4		fsl - l			
28 - 53	10YR 6/4		hsil			
53 - 76	10YR 5/8	10YR 6/3	cl			275

[1]Munsell
[2]USDA designation
[3]Soil Conservation Service

Table B: Design Parameters and Actual Loading Rates

System	Measured Flow L/d	% Design Flow	Age mo.	Bed				Basal		Linear Load L/m/d
				Length m	Width m	Area m^2	Load cm/d	Area m^2	Load cm/d	
1	1 817	106	46	19.1	1.8	35.0	5.2	240[1]	0.4	95.0
2	1 817	80	55	25.3	1.8	46.3	3.9	283[1]	0.5	71.8
3	1 014	36	24	15.8	3.7	57.8	1.8	250[1]	0.3	64.0
4	719	32	33	21.6	2.1	46.3	1.6	276	0.2	33.3
5	541	32	43	19.0	1.8	35.0	1.5	168	0.3	28.0
6	397	23	31	12.8	2.7	35.0	1.1	164	0.2	31.0
7	2 127	75	44	24.5	2.3	68.0	3.6	280	0.7	83.0
8	889	39	27	25.3	1.8	46.3	1.9	224	0.4	35.0
9	4 386	96	32	50.9	2.7	139.5	3.1	644	0.7	86.0
10	2 891	76	60	64.0	4.9	312.0	0.9	975	0.3	40.0
11	477	14	49	39.0	2.7	107.0	0.4	533[1]	0.1	9.5
12	882	39	44	27.4	1.5	42.0	2.1	377[1]	0.2	25.0
13	360	21	35	27.0	2.7	73.0	0.5	274	0.1	45.0
14	780	46	31	19.2	1.8	35.0	2.2	281	0.3	40.6
15	984	58	40	19.2	1.8	35.0	2.8	170	0.6	51.0
16	477	28	47	19.2	1.8	35.0	1.4	193	0.2	25.0

[1]The entire mound perimeter was considered basal area due to slope < 2%.
The remaining basal area was calculated from under the bed and downslope to the mound toe.

controls on materials, system location, soil moisture during site preparation, and all other aspects of construction. This degree of inspection was an attempt to isolate soil and site conditions as the main variables affecting system performance. The importance of not compacting the areas where sand mounds were proposed was emphasized. Roto-tilling was not permitted and systems could not be started unless the soils were sufficiently dry to allow plowing without smearing the soil surfaces. At least one lateral in each mound's distribution network terminated above ground so that discharge head could be measured. Many of these lateral turn-ups have been damaged by mowing or other equipment. We now recommend that access and protection could both be provided by terminating distal turn-ups below grade and sleeving them in a larger diameter pipe that terminates with a screw cap at or above grade.

Systems 1-9 used sand from the same supplier. Sieve analysis showed the effective size to be between 0.25 and 0.30 mm with a uniformity coefficient between 2.5 and 2.9. Systems 11-16 used sand with an effective size between 0.28 and 0.37 mm with uniformity coefficients between 2.7 and 3.6. System 10 used sand with an effective size of 0.20mm.

MONITORING

Routine monitoring visits (usually monthly) were made to each system. Visual observations were made of the sand mound and surrounding areas. Flow measurements were calculated from event counters and elapsed time meters installed on each mound's pumping system. Changes in the average pump run time could indicate either clogging in the distribution network or a change in the dose. Observations and measurements of internal ponding were made in observation ports, located and labeled as per fig. A.

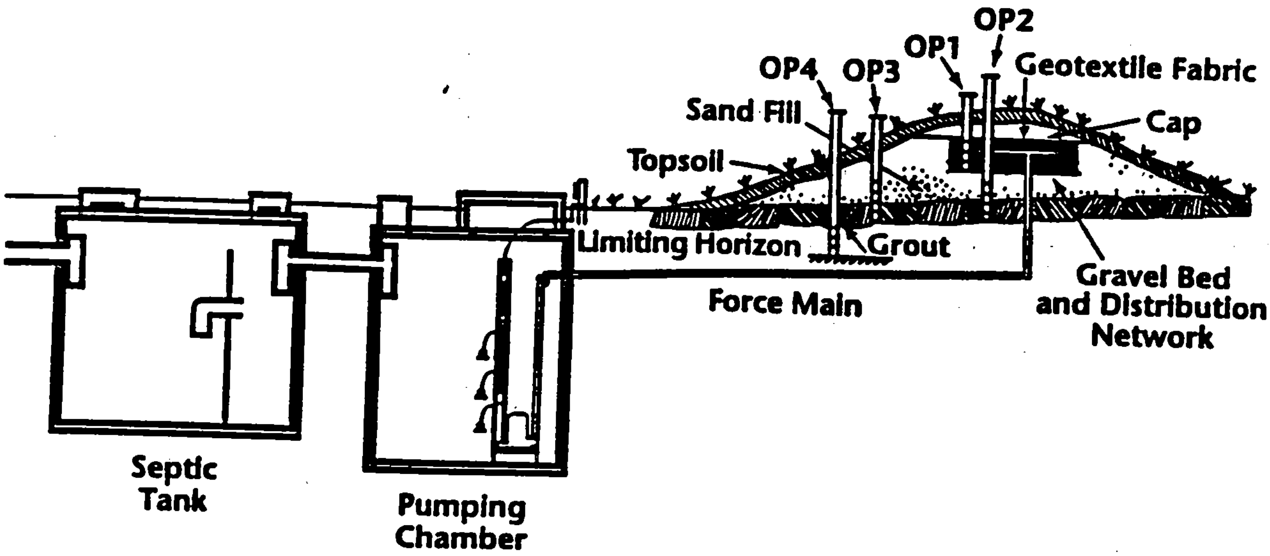


Figure A: Cross Section of Sand Mound Showing Observation Ports

SYSTEM PERFORMANCE

A summary of system performance can be found in Table C. Three of the systems had continuous ponding in the bed, two of the systems had intermittent ponding in the bed, and four of the systems had effluent seepage from the mound.

LE 1. SUMMARY OF SYSTEM PERFORMANCE

System	OP1	OP2	OP3	OP4	Seepage	Wet Area[1]
1	O	■	■	■	No	Yes
2	■	■	■	NA	Yes	Yes
3	X	■	X	O	No	No
4	X	X	X	O	No	No
5	X	■	■	■	No	Yes
6	X	X	X	X	No	No
7	■	■	X	X	Yes	No
8	X	O	O	O	No	Yes
9	O	X	X	O	No	No
10	■	■	NA	NA	No	Yes
11	X	■	■	■	No	No
12	X	■	O	■	No	Yes
13	X	X	X	X	No	No
14	X	O	X	X	Yes	Yes
15	X	■	X	O	No	Yes
16	X	■	O	O	Yes	Yes

X No Ponding, O Intermittent Ponding, ■ Continuous Ponding
[1]Indicates wet surface conditions not attributed to the mound.

All four of the systems where the bed was loaded at greater than 3.0 cm/d (0.74 gpd/ft^2) had at least intermittent ponding. The remaining system (No. 10) with ponding in the bed had fine sand instead of medium sand and the gravel was dirty. The presence of ponding in the sand may exacerbate ponding in the bed by providing for a less aerobic environment.

System 1:
Extremely wet Marches in 1993 and 1994 resulted in infiltration which elevated flows from normal 84% of capacity to 106% over the entire monitoring period. This infiltration was responsible for ponding levels in OP2 spiking into the gravel bed and ponding in the bed. Continuous ponding has been observed in OP2, OP3, and OP4 since 2 months after start up. There is ponded water on the surface of the ground around the mound after extended wet periods or intense rains. This ponded water has never given any indication of being seepage from the mound. We attribute the success of this mound to the lack of a shallow limiting horizon or ground water and to its convex summit landscape position.

System 2:
OP1 intermittently ponded after 17 months and continuously ponded after 28 months. After 37 months ponding in the bed caused recycling. Continuous ponding has been observed in OP2 and OP3 after 2 months. After 17 months intermittent seepage began in the wet season. A shallow observation well installed ten feet from the toe of the mound has shown saturated conditions within 8 cm of the surface during the wet season. This sogginess can extend 10 meters or more from the toe. Surface water from a puddle 10 meters downslope of the mound was analyzed for fecal coliform and could not be differentiated from normal surface water. This system seeps during the wet season due to poor landscape position, and a shallow limiting horizon and perched water table. Infiltration into the preexisting side-seam septic tank also contributed to the seepage.

System 3:
Intermittent ponding began in OP4 after 2 months. Continuous ponding began in OP2 after 9 months.

System 4:
Ponding only in OP4 which after 5 months has light intermittent ponding during wetter, cooler periods.

System 5:
Only 15 cm (6 in) upslope sand fill depth was used under the bed. OP1 has not ponded except for one instance when the ponding level in OP2 was observed to spike into the bed. OP2 and OP3 had continuous ponding since start up. OP4 ponded intermittently after 7 months and continuously soon thereafter.

System 6:
No ponding has been observed in any of the observation ports.

System 7:
The predominant slope is 18% under the downslope setback. The bed was placed over a bench with less than 10% slope. Ground under the bed also sloped approximately 1% from one bed end to the other. The depth to the restrictive soil horizon and high ground water decreased moving from the downslope setback to under the bed. OP3 and OP4 have not ponded. OP1 continuously ponded after 7 months. After 20 months bed ponding became severe enough to cause recycling for 3 months. Since then, ponding in OP1 has been continuous but not severe enough to cause recycling. Ponding in OP2 was continuous after 2 months with levels often nearing and sometimes intruding into the bed. One small intermittent area of seepage has occurred at the downgradient end of the mound in an area approximately the elevation and location of the bed. This seepage is related to ponding in and directly beneath the bed. Better orientation of the system or more sand fill may have prevented seepage from occurring.

System 8:
OP1 has not ponded. Intermittent ponding occurs in OP2, OP3 and OP4. OP2 has often been dry even when OP3 and OP4 had ponding. During the extremely cold winter of 1993 -1994, the force main developed a leak in an area where it was installed 22 cm below grade. It has been determined that this leak was due to the contractor not gluing a coupler.

System 9:
This large mound serves a group home with kitchen facilities. Kitchen effluent passes through a grease trap then joins the remaining waste and proceeds through a series of septic tanks. Effluent is discharged to separate beds via alternating pumps. Intermittent ponding has been observed in OP4 during the wet season. OP1 has shown light intermittent ponding during the wet season.

System 10:
One bed permanently ponds when in use and is used as part of an alternating system. Intermittent ponding began in OP2 eighteen months after installation and became permanent after thirty months. The site has an upslope curtain drain.

System 11:
OP1 has never ponded. OP2 and OP3 had intermittent ponding after one month; continuous after 15 months. OP4 had intermittent ponding after 1 month.

System 12:
OP1 has not ponded. OP2 ponded continuously after one month. OP3 ponded intermittently after 30 months. OP 4 ponded intermittently after one month; continuously after 16 months. No seepage has been observed.

System 13:
No significant ponding has been observed. The system has not seeped.

System 14:
OP1 has never ponded. OP2 intermittently ponded after three months. OP3 and OP4 have not ponded, yet there is an identifiable area of seepage from the toe of the mound about six inches higher than the normal grade of the site. The lack of ponding in OP3 and OP4 is attributed to uneven surface topography under the mound and less than optimal orientation. Construction damage may have occurred preparing the basal area. This damage, poor orientation, and some of the least permeable soils in the study led to effluent seepage.

System 15:
OP1 has never ponded. OP2 ponded continuously after 4 months. OP3 has never ponded. OP4 ponded intermittently after 38 months. The system was installed on fill with an upslope curtain drain.

System 16:
OP1 has never ponded. OP2 continuously ponded after 1 month. OP3 and OP4 intermittently ponded after 1 month. Seepage from the toe of the mound has been observed during the wet season beginning after 30 months.

CONCLUSIONS

Maryland's experience, thus far, indicates that sand mounds can function on some sites with slowly permeable soils, even in combination with other site constraints such as shallow depth to groundwater and fragipans. Landscape position seemed to be the factor most closely related to seepage. All of the systems that had seepage shared the characteristic of poor landscape position. Curtain drains have been used successfully to mitigate the impact of very high ground water or a very shallow depth to a limiting horizon. Using low loading rates also helps mounds perform satisfactorily on sites with these limitations.

Factors that we found affecting the performance of sand mounds include: infiltration, size of the sand, loading rates, preparation of the ground surface, mound orientation, trees, depth to a limiting horizon, and soil permeability. The nature of sites with slowly permeable soils indicates that problems multiply and may result in seepage or failure of the system if not addressed. Slowly permeable soils, especially those with high water tables, are slow to dry out. Often, only a small window of time exists when moisture conditions are optimal for construction so that damage to the basal area does not occur. Where trees are present, basal area is reduced, and the basal area can be further compromised when optimal methods of plowing or otherwise preparing the basal area can't be employed. High groundwater or limiting horizons can exacerbate infiltration into the septic tank or pumping chamber. Roof drains not directed away from the disposal area can also cause infiltration. Heavy equipment, even mowers, operated downslope of the mound when soils are wet can create ruts where effluent might pond. Consider a poor design that results in an improperly orientated mound, or one with a high linear loading rate. Combine this design with infiltration to further overload a sand mound constructed when soils were very moist or wet. The result will probably be a sand mound that functions poorly or not at all, on a site that could have supported a properly functioning mound.

Success with mounds on slowly permeable soils depends on having a high degree of oversight and inspection. Site evaluators, designers, homeowners, contractors, and regulators must all be educated so that mounds are sited, constructed and operated appropriately. Although considerable manpower must be invested in this effort, it is essential if mounds are expected to adequately function on sites with slowly permeable soils.

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