CERTIFICATE OF AUTHENTICITY

THIS IS TO CERTIFY THAT THE FOLLOWING ELECTRONIC RECORDS ARE TRUE AND ACCURATE REPRODUCTIONS OF THE ORIGINAL RECORDS OF JAMES CITY COUNTY GENERAL SERVICES DEPARTMENT- STORMWATER DIVISION; WERE SCANNED IN THE REGULAR COURSE OF BUSINESS PURSUANT TO GUIDELINES ESTABLISHED BY THE LIBRARY OF VIRGINIA AND ARCHIVES; AND HAVE BEEN VERIFIED IN THE CUSTODY OF THE INDIVIDUAL LISTED BELOW.

BMP NUMBER: **PC094**

DATE VERIFIED: **May 31, 2012**

QUALITY ASSURANCE TECHNICIAN: **Leah Hardenbergh**

Leah Hardenbergh

LOCATION: WILLIAMSBURG, VIRGINIA

Stormwater Division

MEMORANDUM

DATE: February 24, 2010

TO: Michael J. Gillis, Virginia Correctional Enterprises Document Management Services

FROM: Jo Anna Ripley, Stormwater

PO: 270712

RE: Files Approved for Scanning

BMP ID or General File ID PC094

PIN: 3740100019

Subdivision, Tract, Business or Owner Name (if known): Fords Colony

Property Description: Public Service Area

Site Address: 125 Firestone

(For internal use only) **Box:** FC001 **Drawer:** 1

Agreements: (in file as of scan date) **N** **Book or Doc#:** **Page:**

Comments:

No.	DATE	REVISION / COMMENT / NOTE	BY
1	11/1/88	REVISED PER J.C. COMMENTS	JJB

COMMONWEALTH OF VIRGINIA
JAMES H. BENNETT
No. 016125
PROFESSIONAL ENGINEER

AES, a professional corporation
1761 Jamestown Road
Williamsburg, Virginia 23185
804-253-0040
Engineering, Planning, Surveying

OVERALL DRAINAGE PLAN
FORD'S COLONY @ WILLIAMSBURG
SECTION VII-A

OWNER/DEVELOPER: REALTEC, INCORPORATED

BERKELEY DISTRICT — JAMES CITY COUNTY — VIRGINIA

Designed	Drawn AES
Scale NOTED	Date 9/22/88
Project No. 5652	
Drawing No. 16	

PC094_FORDS_COLONY_SEC_7 - 003

FORD'S COLONY, SECTION 7
ALTERNATE DESIGN FOR CULVERTS AND STORM SEWERS
FOR USE WITH ALUMINIZED CORRUGATED STEEL PIPE, TYPE 2 (ACSP-2)

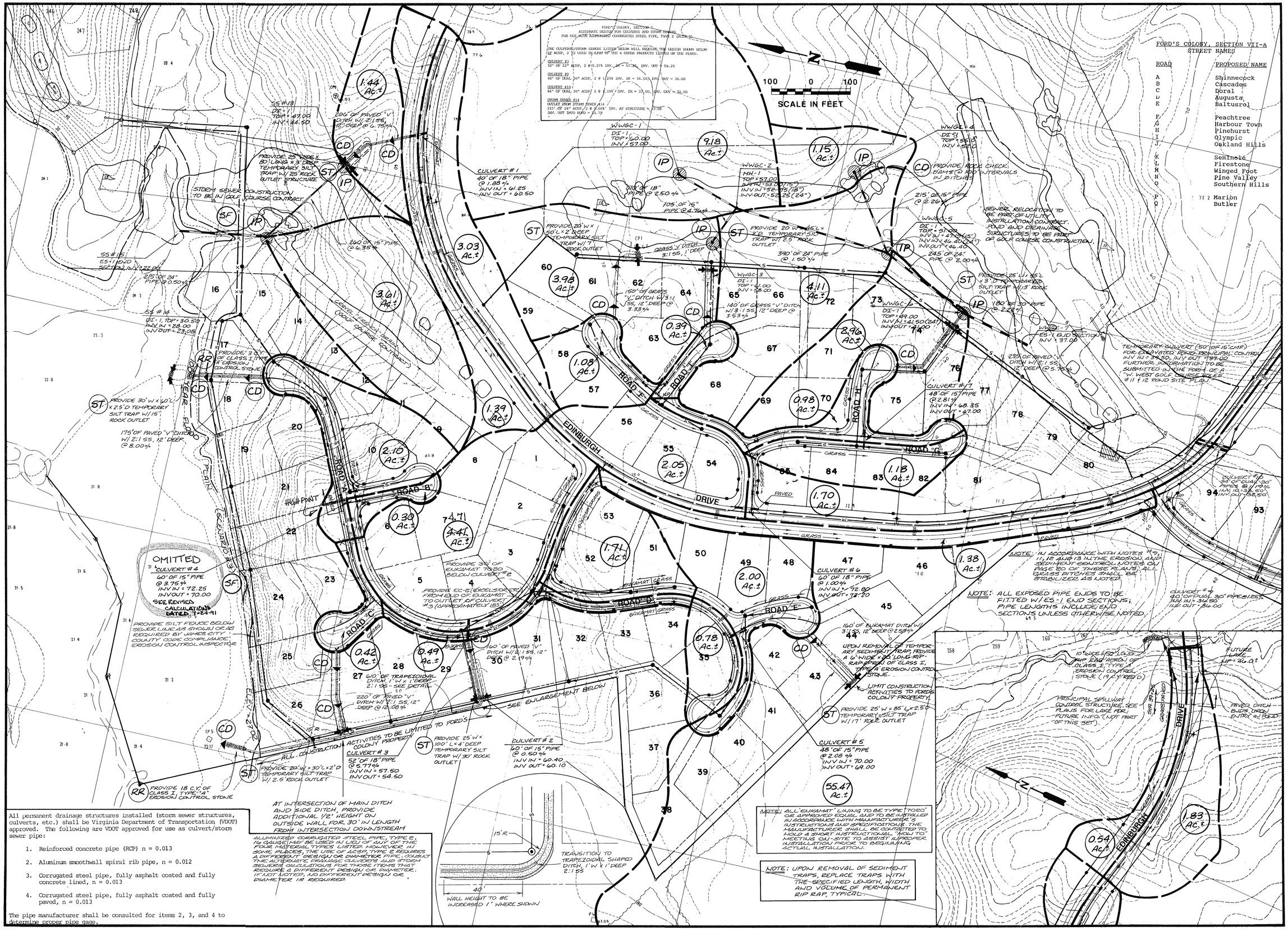
THE CULVERTS/STORM SEWERS LISTED BELOW WILL PROVIDE THE DESIGN SHOWN BELOW IF ACSP, 2 IS USED IN LIEU OF THE 4 OTHER PRODUCTS LISTED ON THE PLANS.

CULVERT #3
52' OF 21" ACSP, 2 @15.27% INV. IN = 57.36, INV. OUT = 54.25

CULVERT #9
40' OF DUAL 36" ACSP, 2 @ 1.25% INV. IN = 36.50, INV. OUT = 36.00

CULVERT #10
84' OF DUAL 36" ACSP, 2 @ 1.19% INV. IN = 33.00, INV. OUT = 32.00

STORM SEWER #14
OUTLET FROM STORM SEWER #14
215' OF 24" ACSP, 2 @ 7.00% INV. AT STRUCTURE = 33.08
INV. OUT INTO POND = 31.79



All permanent drainage structures installed (storm sewer structures, culverts, etc.) shall be Virginia Department of Transportation (VDOT) approved. The following are VDOT approved for use as culvert/storm sewer pipe:

1. Reinforced concrete pipe (RCP) n = 0.013
2. Aluminum smoothwall spiral rib pipe, n = 0.012
3. Corrugated steel pipe, fully asphalt coated and fully concrete lined, n = 0.013
4. Corrugated steel pipe, fully asphalt coated and fully paved, n = 0.013

The pipe manufacturer shall be consulted for items 2, 3, and 4 to determine proper pipe gage.

ALUMINIZED CORRUGATED STEEL PIPE, TYPE 2, 16 GAUGE, MAY BE USED IN LIEU OF ANY OF THE FOUR MATERIAL TYPES LISTED. HOWEVER IN SOME PLACES, THE USE OF ACSP, TYPE 2 REQUIRES A DIFFERENT DESIGN OR DIAMETER PIPE. CONSULT THE ALTERNATE DRAINAGE CULVERTS AND STORM SEWERS CALCULATIONS FOR THOSE ITEMS THAT REQUIRE A DIFFERENT DESIGN OR DIAMETER. IF NOT NOTED, NO DIFFERENT DESIGN OR DIAMETER IS REQUIRED.

FORD'S COLONY, SECTION VII-A
STREET NAMES

ROAD	PROPOSED NAME
A	Shinnecock
B	Cascades
C	Doral
D	Augusta
E	Baltusrol
F	Peachtree
G	Harbour Town
H	Pinehurst
I	Olympic
J	Oakland Hills
K	Seminole
L	Firestone
M	Winged Foot
N	Pine Valley
O	Southern Hills
P	Marion
Q	Butler

No.	DATE	REVISION / COMMENT / NOTE	BY
4.	7/24/91	OMITTED CULVERT # 4, 12, 15	SSL/JWS
3.	11/1/88	REVISED PER VDOT COMMENTS	JWS
2.	10/1/88	REVISED FROM 149 LOTS TO 172 LOTS	JWS
1.	9/1/88		JWS

COMMONWEALTH OF VIRGINIA
JAMES H. BENNETT
No. 018125
PROFESSIONAL ENGINEER

AES, a professional corporation
1761 Jamestown Road
Williamsburg, Virginia 23185
804-253-0040
Engineering, Planning, Surveying

DRAINAGE, SEDIMENT AND EROSION CONTROL PLAN
FORD'S COLONY @ WILLIAMSBURG
SECTION VII-A

OWNER/DEVELOPER: REALTEC, INCORPORATED
BERKELEY DISTRICT JAMES CITY COUNTY VIRGINIA

Designed	Drawn
	AES
Scale	Date
NOTED	9/22/88
Project No.	
5652	
Drawing No.	
18	

All permanent drainage structures installed (storm sewer structures, culverts, etc.) shall be Virginia Department of Transportation (VDOT) approved. The following are VDOT approved for use as culvert/storm sewer pipe:

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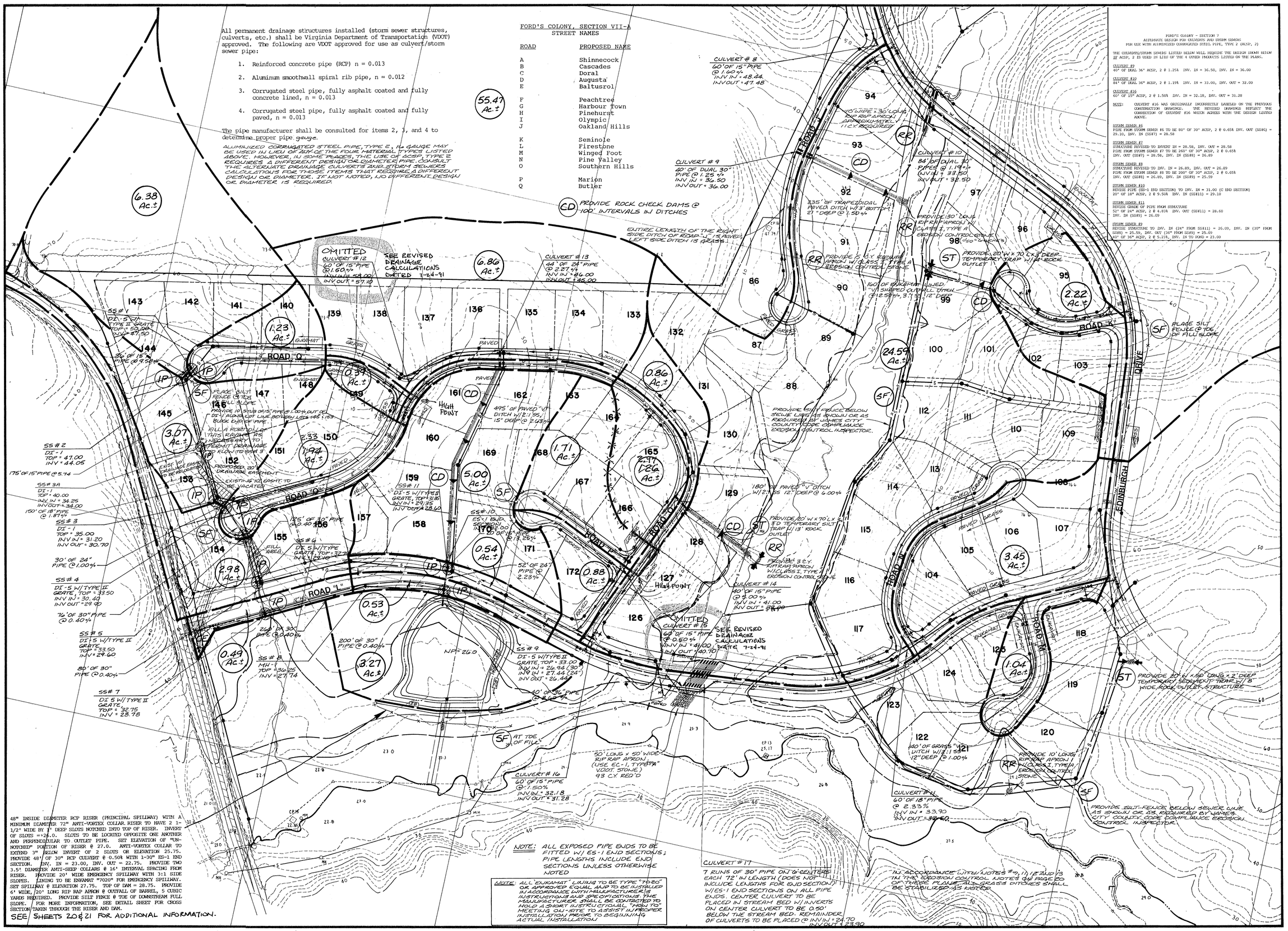
3. Corrugated steel pipe, fully asphalt coated and fully concrete lined, n = 0.013
4. Corrugated steel pipe, fully asphalt coated and fully paved, n = 0.013

The pipe manufacturer shall be consulted for items 2, 3, and 4 to determine proper pipe gauge.

ALUMINIZED CORRUGATED STEEL PIPE, TYPE 2, 14 GAUGE MAY BE USED IN LIEU OF ANY OF THE FOUR MATERIAL TYPES LISTED ABOVE. HOWEVER, IN SOME PLACES, THE USE OF ACSP TYPE 2 REQUIRES A DIFFERENT DESIGN OR DIAMETER PIPE. CONSULT THE ALTERNATE DRAINAGE CULVERTS AND STORM SEWERS CALCULATIONS FOR THOSE ITEMS THAT REQUIRE A DIFFERENT DESIGN OR DIAMETER. IF NOT NOTED, NO DIFFERENT DESIGN OR DIAMETER IS REQUIRED.

FORD'S COLONY, SECTION VII-A
STREET NAMES

ROAD	PROPOSED NAME
A	Shinnecock
B	Cascades
C	Doral
D	Augusta
E	Baltusrol
F	Peachtree
G	Harbour Town
H	Pinehurst
I	Olympic
J	Oakland Hills
K	Seminole
L	Firestone
M	Winged Foot
N	Pine Valley
O	Southern Hills
P	Marion
Q	Butler



48" INSIDE DIAMETER RCP RISER (PRINCIPAL SPILLWAY) WITH A MINIMUM DIAMETER 72" ANTI-VORTEX COLLAR. RISER TO HAVE 2 1-1/2" WIDE BY 1' DEEP SLOTS NOTCHED INTO TOP OF RISER. INVERT OF SLOTS = 26.0. SLOTS TO BE LOCATED OPPOSITE ONE ANOTHER AND PERPENDICULAR TO OUTLET PIPE. SET ELEVATION OF "UN-NOTCHED" PORTION OF RISER @ 27.0. ANTI-VORTEX COLLAR TO EXTEND 3" BELOW INVERT OF 2 SLOTS OR ELEVATION 25.75. PROVIDE 48' OF 30" RCP CULVERT @ 0.50% WITH 1-30" ES-1 END SECTION. INV. IN = 23.00, INV. OUT = 22.75. PROVIDE TWO 3.5' DIAMETER ANTI-SEEP COLLARS @ 16' INTERNAL SPACING FROM RISER. PROVIDE 20' WIDE EMERGENCY SPILLWAY WITH 3:1 SIDE SLOPES. LINING TO BE ENKAMAT "7020" FOR EMERGENCY SPILLWAY. SET SPILLWAY @ ELEVATION 27.75. TOP OF DAM = 28.75. PROVIDE 6' WIDE, 20' LONG RIP RAP APRON @ OUTFALL OF BARREL, 5 CUBIC YARDS REQUIRED. PROVIDE SILT FENCE @ TOE OF DOWNSTREAM FULL SLOPE. FOR MORE INFORMATION, SEE DETAIL SHEET FOR CROSS SECTION TAKEN THROUGH THE RISER AND DAM.

SEE SHEETS 20 & 21 FOR ADDITIONAL INFORMATION.

NOTE: ALL EXPOSED PIPE ENDS TO BE FITTED W/ ES-1 END SECTIONS; PIPE LENGTHS INCLUDE END SECTIONS UNLESS OTHERWISE NOTED

NOTE: ALL 'ENKAMAT' LINING TO BE TYPE "7020" OR APPROVED EQUAL AND TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND SPECIFICATIONS. THE MANUFACTURER SHALL BE CONTACTED TO HOLD A SHORT INSTRUCTIONAL "HOW TO" MEETING ON-SITE TO ASSIST IN PROPER INSTALLATION PRIOR TO BEGINNING ACTUAL INSTALLATION

FORD'S COLONY - SECTION 7
ALTERNATE DESIGN FOR CULVERTS AND STORM SEWERS
FOR USE WITH ALUMINIZED CORRUGATED STEEL PIPE, TYPE 2 (ACSP, 2)

THE CULVERTS/STORM SEWERS LISTED BELOW WILL REQUIRE THE DESIGN SHOWN BELOW IF ACSP, 2 IS USED IN LIEU OF THE 4 OTHER MATERIALS LISTED ON THE PLANS.

CULVERT #9
40' OF DUAL 36" ACSP, 2 @ 1.25% INV. IN = 36.50, INV. IN = 36.00

CULVERT #10
84' OF DUAL 36" ACSP, 2 @ 1.19% INV. IN = 33.00, INV. OUT = 32.00

CULVERT #16
60' OF 15" ACSP, 2 @ 1.50% INV. IN = 32.18, INV. OUT = 31.28

NOTE: CULVERT #16 WAS ORIGINALLY INCORRECTLY LABELED ON THE PREVIOUS CONSTRUCTION DRAWINGS. THE REVISED DRAWINGS REFLECT THE CORRECTION OF CULVERT #16 WHICH AGREES WITH THE DESIGN LISTED ABOVE.

STORM SEWER #6
PIPE FROM STORM SEWER #6 TO BE 80' OF 30" ACSP, 2 @ 0.65% INV. OUT (SS#6) = 29.10, INV. IN (SS#7) = 28.58

STORM SEWER #7
STRUCTURE REVISED TO INVERT IN = 28.58, INV. OUT = 28.58
PIPE FROM STORM SEWER #7 TO BE 260' OF 30" ACSP, 2 @ 0.65%
INV. OUT (SS#7) = 28.58, INV. IN (SS#8) = 26.89

STORM SEWER #8
STRUCTURE REVISED TO INV. IN = 26.89, INV. OUT = 26.89
PIPE FROM STORM SEWER #8 TO BE 200' OF 30" ACSP, 2 @ 0.65%
INV. OUT (SS#8) = 26.89, INV. IN (SS#9) = 25.59

STORM SEWER #10
REVISE PIPE (ES-1 END SECTION) TO INV. IN = 21.00 (C END SECTION)
20' OF 18" ACSP, 2 @ 9.50% INV. IN (SS#11) = 29.10

STORM SEWER #11
REVISE GRADE OF PIPE FROM STRUCTURE
52' OF 24" ACSP, 2 @ 4.83% INV. OUT (SS#11) = 28.60
INV. IN (SS#9) = 26.09

STORM SEWER #9
REVISE STRUCTURE TO INV. IN (24" FROM SS#11) = 26.09, INV. IN (30" FROM SS#8) = 25.59, INV. OUT (30" FROM SS#9) = 25.09
60' OF 36" ACSP, 2 @ 5.23%, INV. IN TO KOB3 = 23.00

NO.	DATE	REVISION / COMMENT / NOTE	BY
4	8/16/91	DRAFTED CULVERT # 8, 12, 15.	SGM
3	2/14/89	REVISED STORM SEWER (SSR 2-3) PER VDOT COMMENTS	JWS
2	1/11/88	REVISED PER J.C. COMMENTS	JWS
1			

COMMONWEALTH OF VIRGINIA
JAMES H. BENNETT
No. 016125
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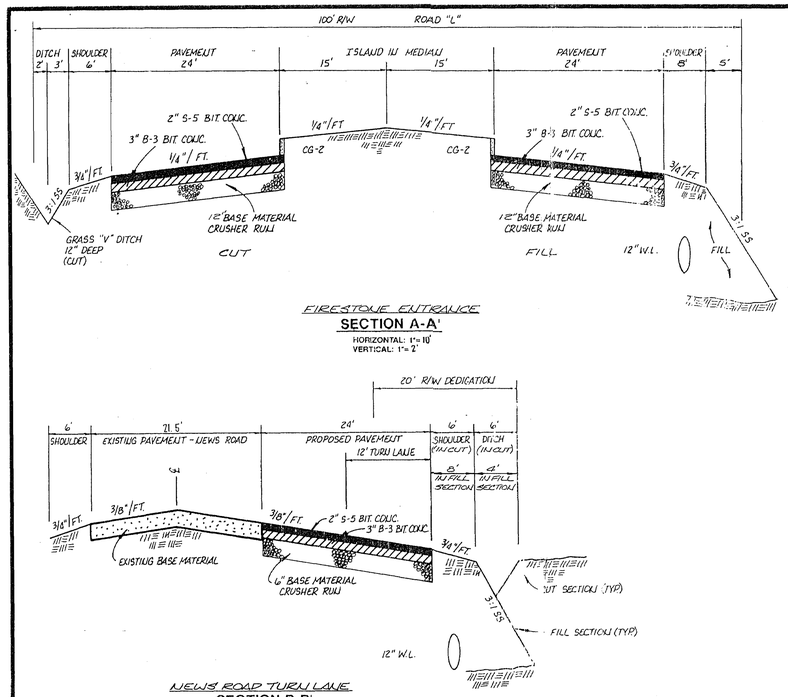
DRAINAGE, SEDIMENT & EROSION CONTROL PLAN
FORD'S COLONY @ WILLIAMSBURG
SECTION VII-A

OWNER/DEVELOPER: REALTEC, INCORPORATED
BERKELEY DISTRICT — JAMES CITY COUNTY — VIRGINIA

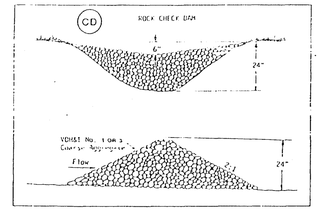
Designed	Drawn
	AES
Scale	Date
1"=100'	9/22/88
Project No.	
5652	
Drawing No.	
19	

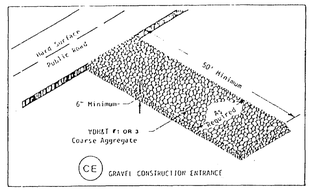
PC094_FORDS_COLONY_SEC_7 - 005

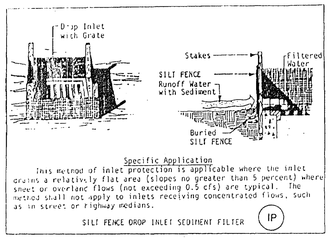


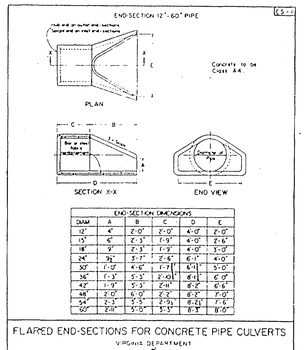
FIRESTONE ENTRANCE
SECTION A-A'
HORIZONTAL: 1"=10'
VERTICAL: 1"=2'

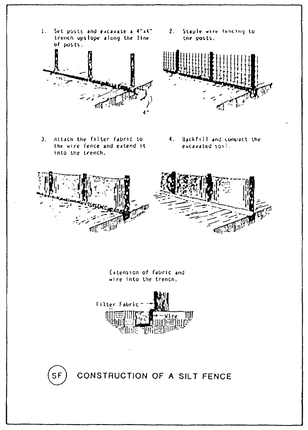
NEWS ROAD TURN LANE
SECTION B-B'
HORIZONTAL: 1"=10'
VERTICAL: 1"=2'







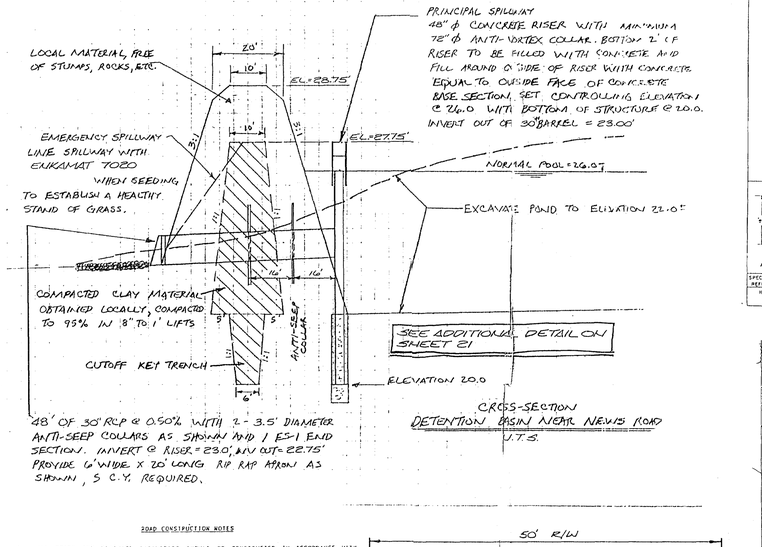




EROSION AND SEDIMENT CONTROL NOTES

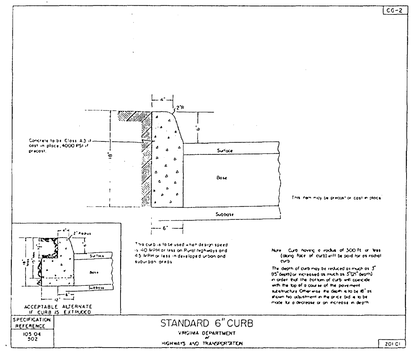
The purpose of the erosion control measures shown on these plans shall be to preclude the transport of all waterborne sediments resulting from construction activities from entering onto adjacent properties or State waters. If field inspection reveals the inadequacy of the plan to confine sediment to the project site, appropriate modifications will be made to correct any plan deficiencies.

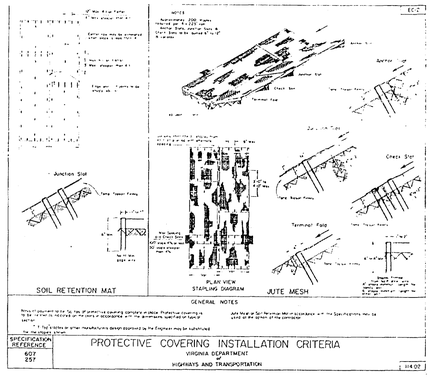
1. All erosion and sediment control measures shall be installed and maintained in accordance with the "Virginia Erosion and Sediment Control Handbook". The contractor shall be thoroughly familiar with all applicable measures contained therein which may be pertinent to this project.
2. All points of construction ingress and egress shall be protected by a temporary construction entrance to prevent tracking of mud onto public right-of-ways. An entrance permit from VDOT is required prior to any construction activities within State right-of-ways.
3. Sediment basins and traps, perimeter dikes, sediment barriers and other measures intended to trap sediment on-site must be constructed as a first step in grading and be made functional before upslope land disturbance takes place. Earthen structures such as dams, dikes, and diversions must be seeded and mulched with 15 days of installation. An on-site pre-construction meeting will be held between the Department of Public Works and the Contractor to identify those measures to be initially installed.
4. Maintenance of all erosion and sediment control measures shall be accomplished in accordance with the "Virginia Erosion and Sediment Control Handbook". Maintenance will include the repair of measures damaged by any subcontractor including those of the public utility companies. At the pre-construction meeting, the contractor will supply Public Works with the name of the individual who will be responsible for ensuring maintenance of installed measures on a daily basis.
5. Surface flows over cut and fill slopes shall be controlled by either redirecting flows from transversing the slopes or by installing mechanical devices to safely lower water downslope without causing erosion. A temporary fill diversion (Std. & Spec. 1.16) shall be installed prior to the end of each working day.
6. Sediment control measures may require minor field adjustments at time of construction to insure their intended purpose is accomplished. Department of Public Works approval will be required for other deviations from the approved plans.
7. The contractor shall strip and pile topsoil at the locations shown on this plan or as directed by the engineer. Silt fence shall be placed at the toe of the stockpile after stripping of topsoil is complete.
8. The contractor shall complete drainage facilities within 30 days following completion of rough grading at any point within the project. The installation of drainage facilities shall take precedence over all underground utilities. Outfall ditches from drainage structures shall be stabilized immediately after construction of same. This includes installation of erosion control stone where required. Any drainage outfalls required for a street must be completed before street grading begins.
9. Permanent or temporary soil stabilization must be applied to all denuded areas within 15 days after final grade is reached on any portion of the site. Soil stabilization must also be applied to denuded areas which may not be at final grade but will remain dormant (undisturbed) for longer than 30 days. Soil stabilization measures include vegetative establishment, mulching and the early application of gravel base material on areas to be paved.
10. No more than 300' of sanitary sewer, storm sewer, or waterlines are to be open at one time. Following installation of any portion of these items, all disturbed areas are to be immediately stabilized (i.e., the same day).
11. If disturbed area stabilization is to be accomplished during the months of December, January, or February, stabilization shall consist of mulching in accordance with Specification 1.75. Seeding will then take place as soon as the season permits.
12. The term Seeding, Final Vegetative Cover or Stabilization, on this site plan shall mean the successful germination and establishment of a stable grass cover from a properly prepared seedbed containing the specified amounts of seed, lime, and fertilizer in accordance with Specification 1.66, Permanent Seeding. Irrigation shall be required as necessary to ensure establishment of grass cover.
13. All slopes steeper than 3:1 shall require the use of erosion control blankets such as excelsior blankets to aid in the establishment of a vegetative cover. Installation shall be in accordance with Specification 1.75, Mulching and Manufacturer's Instructions.
14. Inlet protection in accordance with Specification 1.08 shall be provided for all storm drain inlets as soon as practical following construction of same.
15. Temporary liners, such as polyethylene sheets, shall be provided for all paved ditches until the permanent concrete liner is installed.
16. Paved ditches shall be required wherever erosion is evident. Particular attention shall be paid to those areas where grades exceed 3%.
17. Temporary erosion control measures are not to be removed until all disturbed areas are stabilized. After stabilization is complete, all measures shall be removed within 30 days. Trapped sediment shall be spread and seeded.
18. Off-site waste or borrow areas shall be approved by James City County prior to the approval of any borrow or export of any waste to or from the project site.
19. All pavement and/or piped outfalls will be constructed before road grading and utility installation begins.

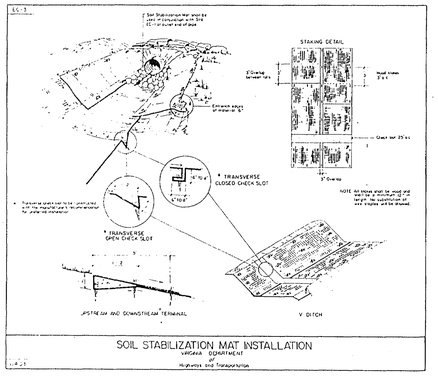


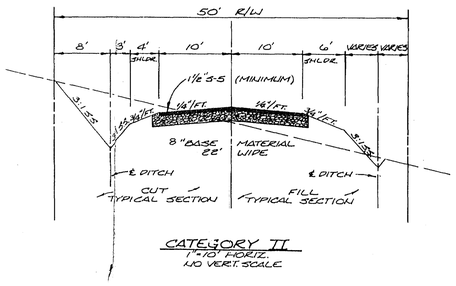
SEE ADDITIONAL DETAIL ON SHEET 21

CROSS-SECTION
DETENTION BASIN NEAR NEWS ROAD
J.C.S.

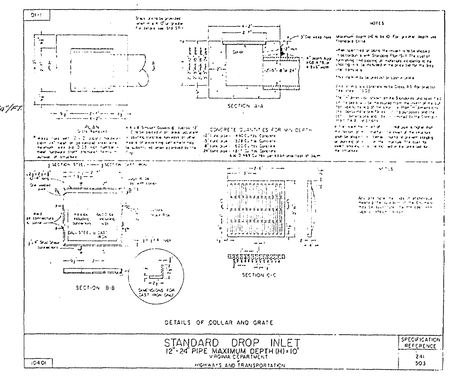


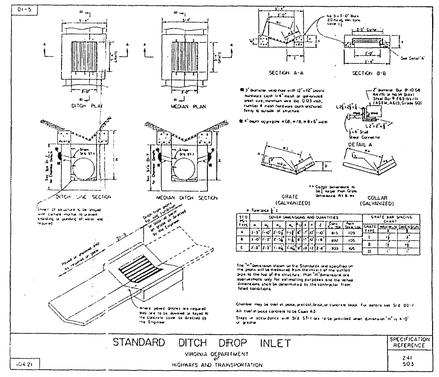






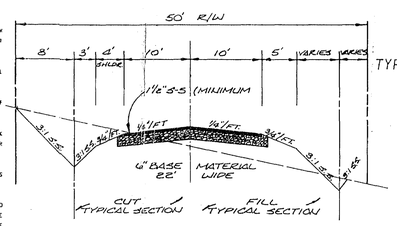
CATEGORY II
1. PROVIDE 2-11' LANES, PAVEMENT WIDTH = 22', SLOPE = 1/4" / FT.
2. PROVIDE 4' SHOULDER WIDTH IN CUT, 8' SHOULDER WIDTH IN FILL SECTION, SLOPE = 3/4" / FT.
3. PROVIDE CBR = 10 OR GREATER
4. PROVIDE 12" AGGREGATE BASE OR CRUSHER RUN MATERIAL.
5. BASE - 6" MINIMUM 1'1/2" (165#) OF BITUMINOUS CONCRETE, TYPE S-5
6. DITCH SIDE SLOPE - 4" PER FOOT MAXIMUM, 1' DEEP





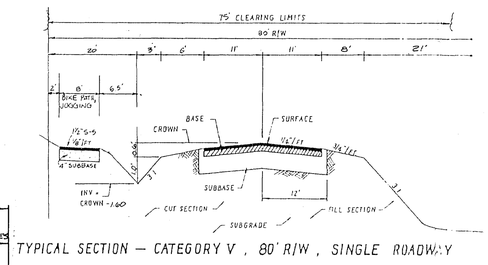
ROAD CONSTRUCTION NOTES

1. ALL ROADS AND DRAINAGE FACILITIES SHOULD BE CONSTRUCTED IN ACCORDANCE WITH CURRENT REGULATIONS, SPECIFICATIONS AND STANDARDS, AND SUBDIVISION STREET REQUIREMENTS OF THE VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT).
2. STANDARD PE-1 ENTRANCES WITH A MINIMUM OF 24" OF 15" CONCRETE CULVERT PIPE SHALL BE REQUIRED FOR ALL DRIVEWAYS.
3. ALL SHOULDERS, DITCHES AND BACKSLOPES, MUST BE STABILIZED PRIOR TO ACCEPTANCE OF ROADS INTO THE STATE SECONDARY ROAD SYSTEM.
4. THE ROAD CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING ALL ITEMS OF ROAD WORK & DRAINAGE WITH EXISTING AND PROPOSED UNDERGROUND UTILITIES (POWER, WATER, SEWER AND TELEPHONE) SUCH THAT NO DUPLICATION OF WORK EFFORT IS INCURRED.
5. UPON COMPLETION, INSPECTION AND ACCEPTANCE, ALL ROADS AND DRAINAGE FACILITIES SHALL BE DEDICATED TO VDOT FOR INCLUSION IN THE STATE SECONDARY ROAD SYSTEM.
6. ALL ITEMS OF ROADWORK AND DRAINAGE NECESSARY FOR THE ROADS TO BE ACCEPTED INTO THE STATE SECONDARY ROAD SYSTEM, WHETHER WRITTEN ON THESE PLANS OR NOT ARE HEREBY EXPRESSLY IMPLIED. NO OMISSIONS, ERRORS OR OVERSIGHTS ON THE PART OF THE ENGINEER OR OWNER SHALL DETRACT FROM THE CONTRACTORS RESPONSIBILITY OF COMPLETING ALL ITEMS OF ROADWORK & DRAINAGE SATISFACTORY IN EVERY RESPECT TO JAMES CITY COUNTY AND VDOT.
7. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE THE RESPONSIBILITY OF THE ROAD CONTRACTOR.
8. LATERAL UNDERDRAINS MAY BE REQUIRED WHERE FIELD CONDITIONS WARRANT. A CHANGE ORDER FOR SAME WILL BE EXECUTED IF REQUIRED BY VDOT, THE ENGINEER, COUNTY OR OWNER.
9. PAVED DITCHES MAY BE REQUIRED WHERE FIELD CONDITIONS WARRANT. GENERALLY, ALL DITCHES WITH SLOPES EXCEEDING 3% SHALL BE PAVED UNLESS OTHERWISE APPROVED BY THE ENGINEER, OWNER, VDOT AND THE LOCAL GOVERNING BODY.



CATEGORY I
1"=10' HORIZ.
NO VERT. SCALE

ITEMS 3, 5 & 6 SHALL APPLY TO PORTION OF SECTION 7-A ROADS TO BE DEDICATED TO V.D.O.T. ITEMS 5 & 6 DO NOT APPLY TO THE REMAINDER OF THE ROADS IN SECTION 7-A; THEY ARE TO REMAIN PRIVATE.



TYPICAL SECTION — CATEGORY V, 80' R/W, SINGLE ROADWAY

1. PROVIDE 2-11' LANES, PAVEMENT WIDTH = 22', SLOPE = 1/4" / FOOT
2. PROVIDE 6' SHOULDER WIDTH IN CUT, 8' SHOULDER WIDTH IN FILL SECTION, SLOPE = 3/4" / FT.
3. PROVIDE CBR = 10 OR GREATER
4. SUBBASE 12" AGGREGATE BASE OR SUBBASE MATERIAL.
5. BASE - 3" BITUMINOUS CONCRETE MATERIAL, TYPE B-1 OR B-3
6. SURFACE - 2.0" BITUMINOUS CONCRETE, TYPE S-4 OR S-5.
7. SIDE SLOPES - 4" PER FOOT (3:1) MAXIMUM

CATEGORY I
1. PROVIDE 2-10' LANES, PAVEMENT WIDTH = 20', SLOPE = 3/4" / FT.
2. PROVIDE 4' SHOULDER WIDTH IN CUT SECTION, 5' SHOULDER WIDTH IN FILL SECTION, 3/4" / FT. SLOPE.
3. PROVIDE CBR = 10 OR GREATER.
4. BASE - 6" OF AGGREGATE BASE OR CRUSHER RUN MATERIAL
5. SURFACE - MINIMUM 1'1/2" (165#) OF BITUMINOUS CONCRETE TYPE S-5
6. DITCH SIDE SLOPES - 4" PER FOOT MAXIMUM 1' DEEP

No.	DATE	REVISION / COMMENT / NOTE	BY
2	2/24/89	REVISED CAT. II ROAD	JHS
1	11/1/88	REVISED PER VDOT COMMENTS	JHS

RECEIVED FEB 1989 JAMES CITY COUNTY PLANNING DIVISION

COMMONWEALTH OF VIRGINIA JAMES H. BENNETT No. 0708125 PROFESSIONAL ENGINEER

AES, a professional corporation
1761 Jamestown Road
Williamsburg, Virginia 23185
804-253-0040
Engineering, Planning, Surveying

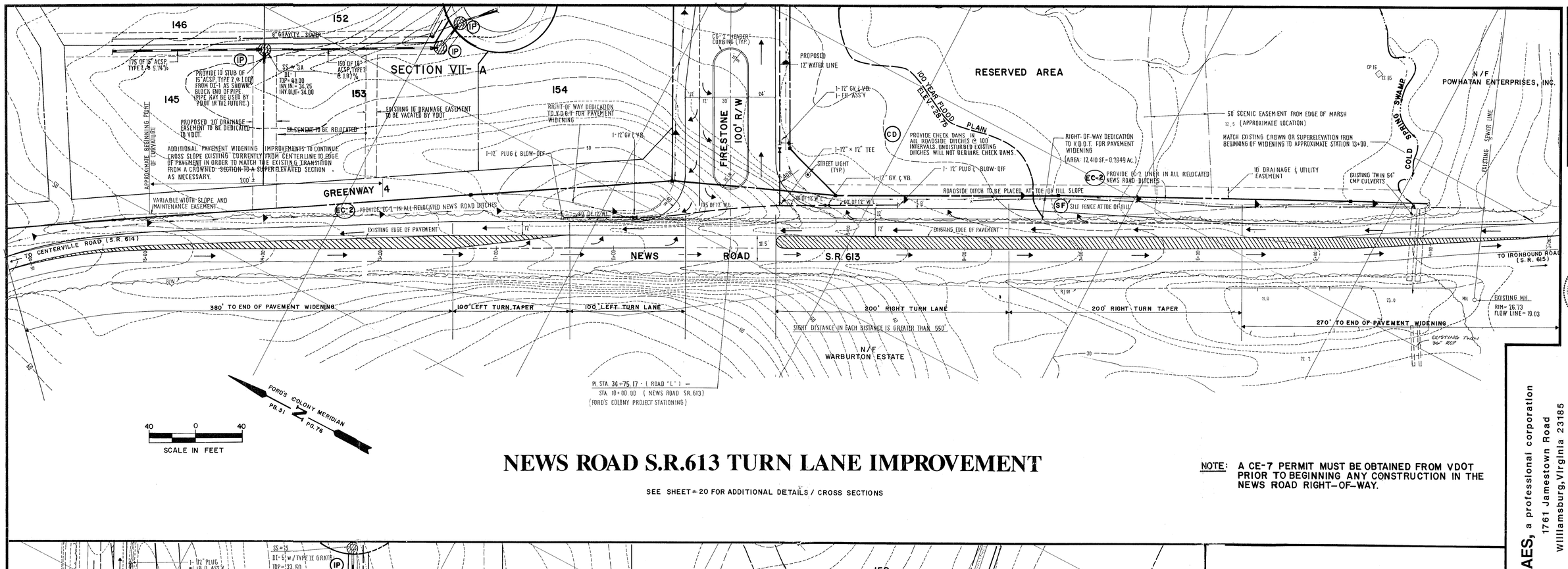
NOTES AND DETAILS
FORD'S COLONY @ WILLIAMSBURG
SECTION VII-A
OWNER/DEVELOPER: REALTEC, INCORPORATED
JAMES CITY COUNTY, VIRGINIA
BERKELEY DISTRICT

THIS PLAN HAS NOT RECEIVED FINAL APPROVAL, AND IS NOT APPROVED FOR CONSTRUCTION.

Designed	Drawn
	AES
Scale	Date
NOTED	9/22/88
Project No.	
5652	
Drawing No.	
20	

S-96-88

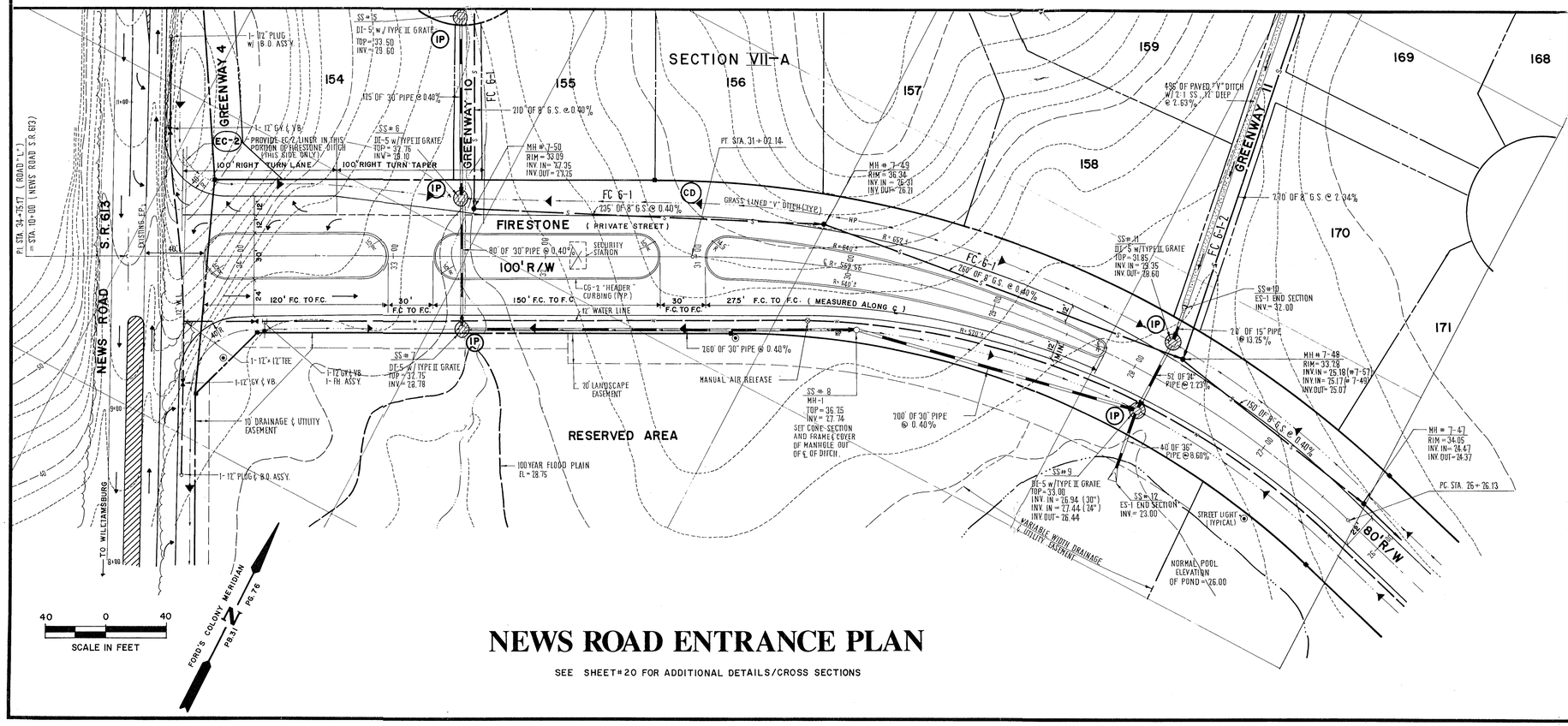
PC094_FORDS_COLONY_SEC_7 - 006



NEWS ROAD S.R.613 TURN LANE IMPROVEMENT

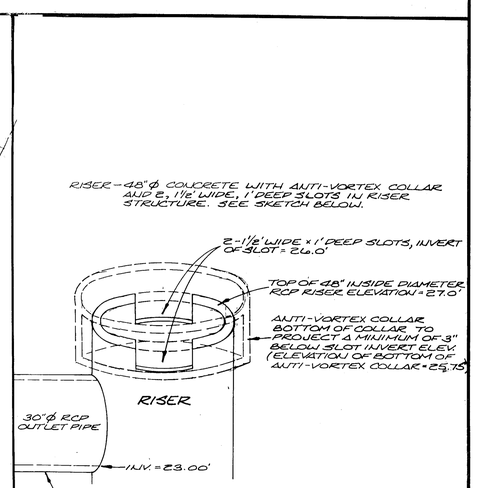
SEE SHEET #20 FOR ADDITIONAL DETAILS / CROSS SECTIONS

NOTE: A CE-7 PERMIT MUST BE OBTAINED FROM VDOT PRIOR TO BEGINNING ANY CONSTRUCTION IN THE NEWS ROAD RIGHT-OF-WAY.



NEWS ROAD ENTRANCE PLAN

SEE SHEET #20 FOR ADDITIONAL DETAILS/CROSS SECTIONS



NEWS ROAD DETENTION BASIN REVISION
N.T.S.

4	REVISED DRAINAGE DITCH ALIGNMENT OFF ISLD PER VDOT COMMENTS	JHB
3	REVISED PER VDOT COMMENTS	JHB
2	REVISED AREA, CHECK DAMS PER J.C. COMMENTS	JHB
1	10' DRAINAGE REVISED PER J.C. COMMENTS	JHB
NO.	DATE	REVISIONS / COMMENT / NOTE

AES, a professional corporation
1761 Jamestown Road
Williamsburg, Virginia 23185
804-253-0040
Engineering, Planning, Surveying

NEWS ROAD IMPROVEMENTS
FORD'S COLONY @ WILLIAMSBURG
SECTION VII-A
BERKELEY DISTRICT — JAMES CITY COUNTY — VIRGINIA

Designed JHB	Drawn BB
Scale 1"=40'	Date 10/5/1988
Project No. 5652	
Drawing No. 21	

PC094_FORDS_COLONY_SEC_7 - 007

7-24-91
SOW

FORD'S COLONY, SEC 7

REVISED DRAINAGE CALCS
(refer. to original drainage calcs)

As a result of deleting culvert #15

culvert #14 receives 1.71 Ac of additional watershed

D.A. = 1.26 + 1.71 = 2.97 Ac.
C = 0.4
I_2 = 3.9 in/hr. Q_2 = 4.63 cfs
I_{10} = 5.1 in/hr. Q_{10} = 6.06 cfs

Given: 40 L.F. OF 15" CMP, Type 2 Aluminized @ 5%

INLET CONTROL
Given: Q_{10} = 6.1 cfs
Dia = 15 inches
(chart 2 VDOT Drainage Manual) $\frac{HW}{D}$ = 1.33
HW = 1.66 ft

Designed INVERT IN = 41.00 ft.
Designed EDGE PVT. GRADE = 42.77 ft. (As Built grade is higher, per field inspection)
DIFFERENCE = 1.77 > 1.66 FT GOOD
Therefore Rdwy will not overtop on 10 yr. storm

OUTLET CONTROL
Assume TW elevation is less than the top of the culvert at the outlet
d_c = 1.0 (chart 16, pg. 5-39)

$$TW = h_o = \frac{d_c + D}{2} = \frac{1.0 + 1.25}{2} = 1.125 \text{ ft}$$

H = 2.2 ft (k_e = 0.5 chart 11 pg. 5-34)

LS_o = 40 (0.05) = 2.0

$$HW = H + h_o - LS_o = 2.2 + 1.125 - 2.0 = 1.33$$

1.33 < 1.66 ∴ Inlet Controls

Therefore Culvert #14 will work as designed

and as a result of field change culvert #16 will receive less than the designed quantity of flow. No problem there.

As a result of deleting culvert #12

SS#4 a DI-5 w/ type II grate will receive an additional 0.39 Ac. of watershed.

given: referencing the original drainage calculations and plans

from point SS#4 to SS#5 a 76' of 30" CMP Alum. Type II @ 0.4%

10yr Q_{DESIGN} = 19.40 cfs
10yr. $Q_{CAPACITY}$ = 25.94 cfs

Additional Q => DA. = 0.39
C = 0.35
I_{10} = 4.5 in/hr. } per storm sewer parameters

Q_{10} = 0.61 cfs

19.40 + 0.61 = 20.01 < 25.94 GOOD @ point of inlet.

Check for capacity at each section of pipe all the way to outlet. (ref. original drainage calculations)

given: the above

from pnt	to pnt	Q_{10} original design flow	Q_{10} w/ additional 0.61 cfs	Q_{10} capacity	Remarks
#5	#6	19.85	20.46	25.94	GOOD
#6	#7	24.53	25.14	25.94	GOOD
#7	#8	25.29	25.90	25.94	GOOD
#8	#9	25.29	25.90	25.94	GOOD
#9	#12 (OUTLET)	46.31	46.92	195.61	GOOD

As a result of deleting culvert #4

culvert #3 receives 0.30 Ac of additional watershed

$DA. = 4.41 + 0.30 = 4.71$ Acres
$C = 0.4$
$I_2 = 3.9$ in/hr.
$I_{10} = 5.1$ in/hr. } per original drainage calculations

$Q_2 = 7.35$ cfs
$Q_{10} = 9.61$ cfs

Given: 52 L.F. of 18" CMP Alum. Type II @ 5.77 %

INLET CONTROL

Given: $Q_{10} = 9.61$ cfs
Dia = 18 inches
(chart 2 VDOT Drainage Manual) $\frac{HW}{D} = 1.30$
$HW = 1.95$ FT.

Designed Invert = 57.50
Designed edge of pavement grade = 61.00 ft
difference = 3.50 ft > 1.95 ft GOOD
Therefore roadway will not overtop during a 10 yr. event.

OUTLET CONTROL

Assume TW elevation is less than the top of the culvert at the outlet.
$d_c = 1.2$ ft (chart 16, pg 5-39)

$TW = h_o = \frac{d_c + D}{2} = \frac{1.2 + 1.5}{2} = 1.35$ ft.

$H = 2.2$ ft. ($k_e = 0.5$ chart 11, pg. 5-34)

$LS_o = 52(0.0577) = 3.0$

$HW = H + h_o - LS_o = 2.2 + 1.35 - 3.0 = 0.55$ ft < 1.95 ∴ INLET CONTROLS

Therefore Culvert #3 will work as designed

and as a result of the field change the paved drainage ditch at the cul-de-sac of Shinnecock will receive less than the design quantity of flow. No problem there.

PAGES 1-4, REVISIONS ARE BOXED

IMPORTANT

FORD'S COLONY SEC 7
REVISION CHECKLIST

11/1/98
JHB
1/7

PIPE MATERIAL - ALL CULVERTS, UNLESS OTHERWISE NOTED, TO BE ALUMINIZED CORRUGATED STEEL PIPE, TYPE 2

"N" FACTORS FOR ACSP						(0.012) CULVERTS	(0.013) STORM SEWER
15"	0.013	INCREASE	DESIGN	HWI	BY	1.08	1.00
18"	0.014	"	"	"	"	1.17	1.08
21"	0.015	"	"	"	"	1.25	1.15
24"	0.016	"	"	"	"	1.33	1.23
30"	0.017	"	"	"	"	1.42	1.31
36"	0.018	"	"	"	"	1.50	1.38
42"	0.019	"	"	"	"	1.58	1.46

CULVERT #1 18" ACSP, TYPE 2
HW = (1.37)(1.17) = 1.60' ALLOWABLE HWI = (1.5)(1.15) = 1.73' OK

CULVERT #2 15" ACSP, TYPE 2
HWI = (1.10)(1.08) = 1.19' ALLOWABLE HWI = (1.25)(1.15) = 1.44' OK.

CULVERT #3 18" ACSP, TYPE 2
HWI = (1.77)(1.17) = 2.07' ALLOWABLE HWI = (1.5)(1.15) = 1.73' REVISE

PROVIDE 21" ACSP, TYPE 2
INLET HWI/D = 0.93 HW = (0.93)(1.75) = 1.63
OUTLET H = 0.5 L_{S_o} = 3.00 $h_o = \frac{1.15+1.75}{2} = 1.45$ HWI NEG

INLET CONTROLS, ADJUST FOR ACSP
HW = (1.63)(1.25) = 2.04 ALLOWABLE HWI = (1.75)(1.15) = 2.01 CLOSE ENOUGH

FOR CULVERT #3, REVISE PLANS TO
52' OF 21" ACSP, TYPE 2 @ 5.77% INV IN = 52.25, INV OUT = 54.25

CULVERT #4 15" ACSP, TYPE 2
HW = (0.25)(1.08) = 0.27' ALLOWABLE HWI = (1.25)(1.15) = 1.44' OK

CULVERT #5 15" ACSP, TYPE 2
HWI = (0.71)(1.08) = 0.77' ALLOWABLE HWI = (1.25)(1.15) = 1.44' OK

CULVERT #6 18" ACSP, TYPE 2
HWI = (1.13)(1.17) = 1.32' ALLOWABLE HWI = (1.5)(1.15) = 1.73' OK

CULVERT #7 15" ACSP, TYPE 2
HWI = (0.90)(1.08) = 0.97' ALLOWABLE HWI = (1.25)(1.15) = 1.44' OK.

CULVERT #8 15" ACSP, TYPE 2
HWI = (0.98)(1.08) = 1.06'. ALLOWABLE HWI = (1.25)(1.15) = 1.44' OK

CULVERT #9 30" ACSP, TYPE 2 (DUAL)
HW = (2.88)(1.42) = 4.09' ALLOWABLE HW = (2.5)(1.15) = 2.88' REVISE

PROVIDE 36" ACSP, TYPE 2 DUAL CULVERTS
INLET HW/D = 0.85 HW = (3)(0.85) = 2.55'
OUTLET H = 0.5' LS_o = 0.50 $h_o = \frac{1.7+3.0}{2}$ = 2.35' HW = 2.35'

INLET CONTROLS, ADJUST FOR ACSP
HW = (2.55)(1.50) = 3.83' ALLOWABLE HW = (3.0)(1.15) = 3.45'
• CHECK SHOULDER – INVERT IN DIFFERENCE
SHOULDER EL = 40.65, INV IN = 36.50 Δ = 4.15' 4.15 > 3.83' OK

FOR CULVERT #9, REVISE PLANS TO
40' OF DUAL 36" ACSP, TYPE 2 @ 1.25% INV IN = 36.50 INV OUT = 36.00

CULVERT #10 DUAL 30" ACSP, TYPE 2
HW = (2.63)(1.42) = 3.73' ALLOWABLE HW = (2.5)(1.15) = 2.88' REVISE

PROVIDE DUAL 36" ACSP, TYPE 2 CULVERTS
INLET HW/D = 0.77 HW = (0.77)(3) = 2.31'
OUTLET H = 0.45' LS_o = 1.0' $h_o = \frac{2.3+3.0}{2}$ = 2.65 HW = 2.10

INLET CONTROLS, ADJUST FOR ACSP
HW = (2.31)(1.50) = 3.47' ALLOWABLE HW = (3.0)(1.15) = 3.45' OK

FOR CULVERT #10, REVISE PLANS TO
84' OF DUAL 36" ACSP, TYPE 2 @ 1.19% INV IN = 33.00, INV OUT = 32.0

CULVERT #11 18" ACSP, TYPE 2
HW = (1.50)(1.17) = 1.76' ALLOWABLE HW = (1.5)(1.15) = 1.73' OK
CLOSE ENOUGH

CULVERT #12 15" ACSP, TYPE 2
HW = (0.25)(1.08) = 0.27' ALLOWABLE HW = (1.25)(1.15) = 1.44' OK

CULVERT #13 24" ACSP, TYPE 2
HW = (2.00)(1.33) = 2.66' ALLOWABLE HW = (2.0)(1.15) = 2.30'
• CHECK SHOULDER – INVERT IN DIFFERENCE
SHOULDER ELEVATION = 48.81 INV IN = 46.00 Δ = 2.81' 2.81' > 2.66' OK

CULVERT #14 15" ACSP, TYPE 2
HW = (0.91)(1.08) = 0.98' ALLOWABLE HW = (1.25)(1.15) = 1.44' OK

CULVERT #15 15" ACSP, TYPE 2
HW = (1.06)(1.08) = 1.14 ALLOWABLE HW = (1.25)(1.15) = 1.44' OK

CULVERT #16 15" ACSP, TYPE 2
HW = (1.44)(1.08) = 1.56' ALLOWABLE HW = (1.25)(1.15) = 1.44'
• CHECK SHOULDER — INVERT IN DIFFERENCE
SHOULDER EL = 33.78 INV. IN = 32.48 Δ = 1.30' 1.30' < 1.56'
LOWER INV IN BY 0.30' REVISED INVERT IN = 32.18
Δ = 1.60' 1.60' > 1.56' OK

CHECK OUTLET, CS_o = 0.90 H/W = 0.90 INLET STILL CONTROLS

REVISE CULVERT #16
60' OF 15" ACSP, TYPE 2 @ 4.50% INV IN = 32.18 INV OUT = 31.28

CULVERT #17 7 RUNS OF 30" ACSP, TYPE 2
HW = (2.05)(1.42) = 2.91' ALLOWABLE HW = (2.5)(1.15) = 2.88' OK

SHOULDER ELEVATION = 28.35 INV IN = 24.70 Δ = 3.65'

DESIGN CROSSING FOR 25 YEAR STORM
Q_{10} = 120 CFS I_{10} = 2.8 IN/HR, I_{25} = 3.4 IN/HR RATIO = 3.4/2.8 = 1.21
Q_{100} = 262.8 CFS 25 YEAR MULTIPLIER

Q_{25} = (120)(1.1)(1.21) = 160.3 CFS

EACH CULVERT MUST PASS 160.3/7 = 22.9 CFS
INLET HW/D = 0.96 HW = (2.5)(0.96)(1.42) = 3.41'
OUTLET H = 0.8 CS_o = 0.8 h_o = (1.65+2.5)/2 = 2.08 HW = (2.08)(1.42) = 2.95'

INLET CONTROLS, CULVERTS PASS 25 YR STORM W/ FREEBOARD OF 0.24'
ASSUMING NO DOWNSTREAM FLOW RESTRICTIONS

CULVERT #17 IS OK, DO NOT REVISE

CHECK STORM SEWER ORIGINAL ASSUMPTION, N = 0.13

SS#1 15" ACSP, TYPE 2
CAPACITY = (20.00)/1.00 = 20.0 CFS, REQUIRED CAP. = 1.94 CFS OK

SS #2 15" ACSP, TYPE 2
CAPACITY = (12.92)/1.00 = 12.92 CFS, REQ. CAP. = 11.98 CFS OK

SS #3 24" ACSP, TYPE 2
CAPACITY = (22.62)/1.15 = 19.67 CFS, REQ. CAP = 16.79 CFS OK

SS #4 30" ACSP TYPE 2
CAPACITY = (25.94)/1.23 = 21.09 CFS, REQ. CAP = 19.40 CFS OK

F.C. SEC. 7
REV. CHECKLIST (CONT)

11/1/88
JHB
4/7

SS#5 30" ACSP, TYPE 2
CAPACITY = (25.94)/1.23 = 21.09 CFS REQ. CAP = 19.85 CFS OK

SS#6 30" ACSP, TYPE 2
CAPACITY = (25.94)/1.23 = 21.09 CFS REQ. CAP = 24.53 CFS NOT OK

2 SOLUTIONS - INCREASE SLOPE OR INCREASE PIPE DIA
SLOPE WOULD HAVE TO BE INCREASED FROM 0.40% TO A MAXIMUM OF 0.65% IN ORDER TO PASS REQUIRED FLOW. LOWERS INVERT ELEVATION AT STRUCTURE #9 BY 1.35'. THIS IS ACCEPTABLE

$Q_{CAP} = 0.4632\,(25)^{8/3}(0.0065)^{1/2}(0.017)^{-1} = 25.29$ CFS REVISE SS#6 – SS#9

SS#6 → SS#7	INV IN = 29.10	INV OUT = 28.58	SLOPE = 0.65%
SS#7 → SS#8	INV IN = 28.58	INV OUT = 26.89	SLOPE = 0.65%
SS#8 → SS#9	INV IN = 26.89	INV OUT = 25.59	SLOPE = 0.65%

ALL STORM SEWER BETWEEN SS#6 TO SS#9 TO BE 30" ACSP, TYPE 2

SS#10 15" ACSP, TYPE 2
CAPACITY = (23.52)(1.00) = 23.52 CFS REQ. CAP = 19.29 CFS OK

HOWEVER REVISE SS#10 TO
20' OF 18" ACSP, TYPE 2 @ 9.50% INV IN = 31.00, INV OUT = 29.10

SS#11 24" ACSP, TYPE 2
CAPACITY = (33.79)/1.23 = 27.47 CFS REQ. CAP = 20.16 CFS OK
REVISE INV OUT TO SS#9 (24" LINE) TO 26.09 SLOPE FROM SS#11 TO SS#9 = 4.83%

SS#9 TO SS#12 36" ACSP, TYPE 2
REVISE INV IN (30") = 25.59, INV IN (24") = 26.09, INV OUT (36") = 25.09
INV OUT (36" @ SS#12) = 23.00 SLOPE = 5.23%

CAPACITY = 110.2 CFS REQ. CAP. = 46.31 CFS OK

SS#13 15" ACSP, TYPE 2 OK

SS#14 24" ACSP, TYPE 2
CAPACITY = (16.00)/1.23 = 13.0 CFS REQUIRED CAP. = 14.11 CFS
REVISE INV OUT OF 24" LINE = 21.79 SLOPE = 0.60%

$Q_{CAP} = 0.4632\,(2)^{8/3}(0.016)^{-1}(0.006)^{1/2} = 14.24$ CFS OK

REVISE TO 215' OF 24" ACSP, TYPE 2 @ 0.60% INV IN = 23.08 INV OUT = 21.79

F.C. SEC 7
REV. CHECKLIST (CONT.)

11/1/88
JHB
5/7

WWGC-1 THROUGH WWGC-7 NOT PART OF CONTRACT HOWEVER LINE SIZES WILL BE REVISED IF NECESSARY AT THE END OF THIS CHECKLIST.

CODE COMPLIANCE

6. PROVIDE 30' OF ENKAMAT 7020 BELOW CULVERT #2 AND PROVIDE EC-2 FROM THAT POINT TO OUTLET OF CULVERT #3

8. INCREASE WALL HEIGHT IN PAVED DITCH BELOW CULVERT #3 FROM 1/2' AS SHOWN ON PLANS TO 1'.

9. INCREASE PAVED DITCH DEPTH FROM 12" TO 15" IN PAVED DITCH BETWEEN CULVERTS #13 AND STORM SEWER #10.

10. PROVIDE 140' OF GRASS "V" SHAPED DITCH, 12" DEEP, 3:1 SS, BETWEEN LOTS 120 AND 12

11. ALL CULVERTS AND STORM SEWER PIPING TO BE ALUMINIZED CORRUGATED STEEL PIPE, TYPE 2, 16 GAUGE MINIMUM THICKNESS.

12. PROVIDE 10' WIDE X 30' RIP RAP APRON BELOW CULVERT #10, APPROXIMATELY 11 CUBIC YARDS REQUIRED. RIP RAP APRON AT END OF PAVED DITCH BELOW CULVERT #9 TO BE INSTALLED IN ACCORDANCE WITH GUIDELINES SET FORTH IN THE VIRGINIA EROSION CONTROL HANDBOOK. Q_{10} = 60-70 CFS

15. THE RIGHT SIDE DITCH OF ROAD "J" IS PAVED.

17. PAVE THE LAST 75' OF THE DITCHES ON THE WEST APPROACHES TO THE MULTIPLE 80" CULVERTS ON ROAD L.

20. PRINCIPAL SPILLWAY TO BE REDESIGNED FOR PERMANENT BASIN ADJACENT TO ROAD L. SIZE RISER AND BARREL TO PASS 45.8 CFS AFTER 1' OF STORAGE

A 48" RISER PASSES 46 CFS @ 1.1' HEAD, CLOSE ENOUGH.
A 30" BARREL WILL PASS 46 CFS +.

REVISION: 48" RISER WITH SLOTS CUT INTO TOP TO PASS 2 YEAR STORM. SLOTS EL = 26.0, TOP OF RISER = 27.0, 72" ANTI-VORTEX COLLAR. PROVIDE 48' OF 30" RCP @ 0.50% WITH 1 ES-1 END SECTION. INV IN = 23.00, INV OUT = 22.75
PROVIDE 2 3.5' DIAMETER ANTI-SEEP COLLARS @ 16' CENTERS. FOR MORE INFORMATION, CONSULT ENGINEER.

Q_2 = 6.77 CFS
TRY 2-2' WIDE SLOTS, ASSUME D=1' $Q = [2.67(2-(0.2)(1))(1)^{1.5}]2 = 9.61$ CFS
REDUCE TO 2-1 1/2' WIDE SLOTS, ASSUME D=1' $Q = [2.67(1.5-(0.2)(1))(1)^{1.5}]2 = 6.94$ CFS
CLOSE ENOUGH

SEE ADDITIONAL INFORMATION (NEWS ROAD DETENTION BASIN REVISION)

22. IN ACCORDANCE WITH NOTES #9, 11, 12, AND 13 IN THE EROSION AND SEDIMENT CONTROL NOTES ON PAGE 20 OF THIS PLANS, ALL GRASS DITCHES SHALL BE STABILIZED AS NOTED.

23. PROVIDE SILT FENCE BELOW SEWER LINES 7-68 THROUGH 7-74, 7-68 TO 7-81, 7-81 THROUGH 7-84 INCLUDING 6" CLEAN OUT LINE TO LOT 97, AND 7-1 THROUGH 7-9.

24. ENKAMAT "7020" OR A SIMILAR APPROVED PRODUCT SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND SPECIFICATIONS. THE MANUFACTURER WILL HOLD A SHORT INSTRUCTIONAL "HOW-TO MEETING" ON-SITE TO ASSIST IN PROPER INSTALLATION.

25. CONTRACTOR SHALL PROVIDE CERTIFICATION THAT CONSTRUCTION OF ALL STREETS WAS IN ACCORDANCE WITH VDOT CONSTRUCTION STANDARDS TO SATISFY "ADMINISTRATIVE GUIDELINES FOR CERTIFICATION OF PRIVATE STREET CONSTRUCTION."

PLANNING DEPT.

D. ROAD C HAS BEEN HORIZONTALLY ADJUSTED TO MISS THE 50' SCENIC EASEMENT ADJACENT TO COLD SPRING SWAMP.

E. CATEGORY I DESIGN CRITERIA:

- 6" BASE MATERIAL (AGG. BASE OR CRUSHER RUN TYPE 21A)
  1½" S-5
  20 WIDE PAVEMENT
  4' SHOULDERS IN CUT, 5' SHOULDERS IN FILL
  CBR 10 OR GREATER

CATEGORY II DESIGN CRITERIA:

- AS SHOWN EXCEPT 6' WIDE SHOULDERS IN FILL

CATEGORY V DESIGN CRITERIA

- 6' SHOULDERS IN CUT, 8' SHOULDERS IN FILL
  EVERYTHING ELSE AS SHOWN IN TYPICAL SECTION (NO BIKE PATH TO BE INCLUDED IN CONTRACT)

SECTION A-A, SHEET 20, REVISE 6" BASE MATERIAL CRUSHER RUN TO 12"
8' SHOULDER IN FILL

F.C SEC 7
ROW CHECKLIST (CONT.)

11/1/88
JHB
7/7

FIRE DEPT.

ADD A FIRE HYDRANT BETWEEN LOTS 164 AND 165.

JCSA

1. PROVIDE 4" CLEAN OUT FROM MH 7-7 ALONG PROPERTY LINE OF LOTS 22 AND 24 TO SERVE LOT 23. AN INTERMEDIATE CLEAN OUT WILL BE NECESSARY.

2. MH 7-21 RIM = 73.88 INV IN = 68.43 INV OUT = 68.00
MH 7-20 RIM = 70.70 INV IN = 62.80 INV OUT = 61.10

SLOPE FROM MH 7-21 TO MH 7-20 IS 110' OF 8" G.S. @ 4.73%

GENERAL REVISION

A CULVERT (CONCRETE) WILL BE REQUIRED UNDER EDINBURGH DRIVE FROM SECTION INTO SECTION 7. THE CULVERT WILL EVENTUALLY SERVE AS A RELEASE STRUCTURE FOR A DAM TO BE BUILT ABOVE EDINBURGH DRIVE. EDINBURGH WILL SERVE AS THE DAM AND MUST BE CONSTRUCTED ACCORDINGLY. HOWEVER, FOR THIS BID, DO NOT PRICE THE FILL FOR A DAM BUT FOR JUST A ROAD. THE CULVERT WILL BE APPROXIMATELY 92' OF 18" RCP.

FORD'S COLONY, SECTION 7
JOB NO 5652
9/22/00
SHEET 1 OF 8

CALCULATION OF 100 YEAR FLOOD ELEVATION FOR SPECIFIC POINTS ALONG COLD SPRING SWAMP

→ FIRST POINT OF CONSIDERATION ON COLD SPRING SWAMP IS LOCATED APPROXIMATELY 2200 FEET UPSTREAM OF NEWS ROAD, SOUTHEAST OF LOT 117 IN SECTION 7 OF FORD'S COLONY

FIRST FIND RUNOFF BY PEAK DISCHARGE METHOD
DRAINAGE AREA = 526.95 Ac
HYDRAULIC LENGTH = 6900 FT
AVERAGE SLOPE OF WATERSHED = 0.0150 FT/FT

FIND CURVE NUMBER (CN) FOR DRAINAGE AREA

APPROXIMATELY 180 ACRE HIGH DENSITY RESIDENTIAL
BUT WITH CONSIDERABLE OPEN AREA (34%)
REMAINDER WILL BE LOW DENSITY RESIDENTIAL (66%)

A PREVIOUSLY EVALUATION OF SOIL GROUPS FOR THE WATERSHED S
5% SOIL GROUP A
20% SOIL GROUP B
55% SOIL GROUP C
20% SOIL GROUP D

SOIL GROUP	COMMERCIAL	HIGH DENSITY RESIDENTIAL	LOW DENSITY RESIDENTIAL	WOODED
A	0%	0%	0%	5%
B	0%	7%	13%	0%
C	0%	19%	36%	0%
D	0%	7%	13%	0%

FORMING A WEIGHTED CN FACTOR

A (527)(0.05)(45) = 1185.75

B (527)(0.07)(75) + (527)(0.13)(72) = 2766.75 + 4932.72 = 7699.47

C (527)(0.19)(83) + (527)(0.36)(81) = 8310.79 + 15,367.32 = 23,678.11

D (527)(0.07)(87) + (527)(0.13)(86) = 3209.43 + 5,891.86 = 9101.29

$$CN = \frac{1185.75 + 7699.47 + 23678.11 + 9101.29}{527} = 79$$

FIND RAINFALL DEPTH FOR 100 YEAR STORM (PLATE 5-11)
RAINFALL DEPTH$_{100}$ = 8 INCHES

FIND RUNOFF DEPTH FOR 100 YEAR STORM (PLATE 5-12)
RUNOFF DEPTH$_{100}$ = 5.5 INCHES

VOLUME OF RUNOFF = 5.5 INCHES × $\frac{526.95 \text{ Ac}}{12 \text{ IN/FT}}$ = 241.5 AC FT

= 5.5 INCHES × $\frac{22953942 \text{ SQ.FT.}}{12 \text{ IN/FT}}$ = 10,520,557 CF

FIND PEAK RATE OF RUNOFF FOR 100 YEAR STORM ADJUSTED FOR WATERSHED SHAPE
FROM PLATE 5-8, AN EQUIVALENT DRAINAGE AREA = 340 Ac

FIND EQUIVALENT DISCHARGE RATE FOR DRAINAGE AREA PER INCH OF RUNOFF FROM PLATE 5-13 = 87 CFS / INCH OF RUNOFF

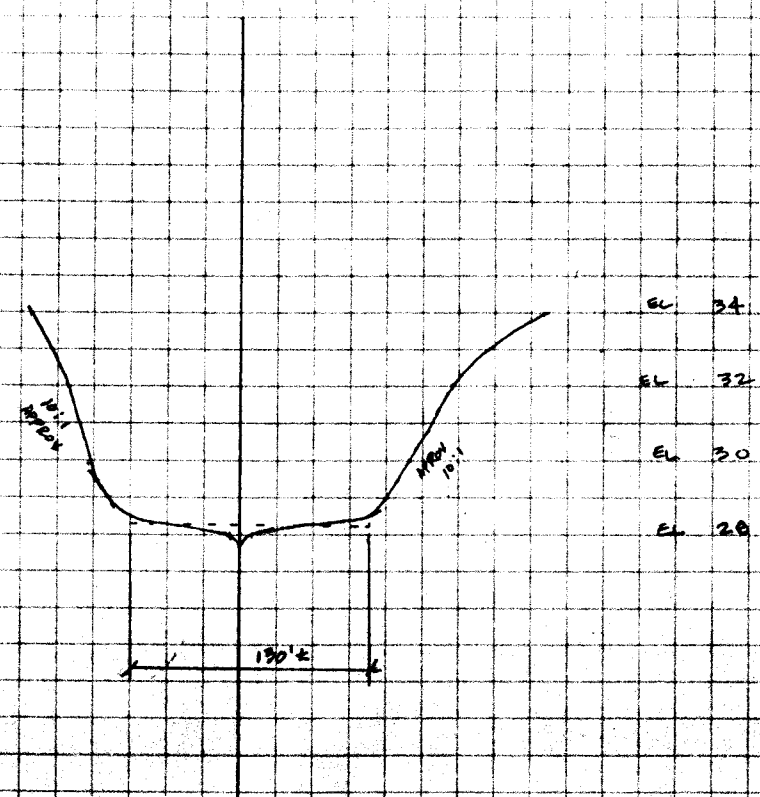
ACTUAL PEAK DISCHARGE = EQ DISCHARGE × $\frac{\text{ACTUAL DA}}{\text{EQ. DA}}$

= 87 CFS / INCH OF RUNOFF × $\frac{526.95 \text{ Ac}}{340 \text{ Ac}}$

= 134.8 CFS / INCH OF RUNOFF

THUS ACTUAL PEAK DISCHARGE AT POINT OF CONSIDERATION =
134.8 CFS / INCH OF RUNOFF × 5.5 INCHES = 742 CFS

CROSS-SECTION OF COLD SPRING SWAMP AT POINT UNDER CONSIDERATION



AN APPROXIMATION OF THE CROSS-SECTION WOULD BE TRAPEZOIDAL SHAPE 130' BOTTOM, 10:1 SIDE SLOPES

FINALLY, APPROXIMATE THE DEPTH OF FLOW OF THE 100 YEAR FLOOD EVENT AT THIS LOCATION.

ASSUME A DEPTH OF 1.7'

A = AREA OF CROSS-SECTION = $(1.7)(130) + (2)(\frac{1}{2})(1.7)(1.7) = 221 + 28.9 = 250$

P = WETTED PERIMETER = $130 + 2\sqrt{1.7^2 + 17^2} = 130 + (2)(17.08) = 164.17$

A/P = 1.52

$V = 1.486\,(A/P)^{2/3}(S_o)^{1/2} f^{-1}$ where $S_o = 0.0025$ FT/FT, $f^{-1} = 0.05$

$= 1.486\,(1.52)^{2/3}(0.0025)^{1/2}(0.05)^{-1} = 1.96$ FPS

$Q = VA = (1.96)\,250 = 490$ CFS

TOO LOW

ASSUME A DEPTH OF 2.0'

$A = (2)(130) + (2)(1/2)(2)(20) = 260 + 40 = 300$

$P = 130 + 2\sqrt{(20)^2 + (2)^2} = 130 + (2)(20.1) = 170.2$

$A/P = 300 / 170.2 = 1.76$

$V = 1.486\,(1.76)^{.66}\,(0.0025)^{1/2}\,(0.05)^{-1}$

$= 2.17$ FPS

$Q = VA = (2.17)(300) = 650$ CFS

TOO LOW

ASSUME A DEPTH OF 2.2'

$A = (2.2)(130) + (2)(1/2)(2.2)(22) = 286 + 48.4 = 334.4$

$P = 130 + 2\sqrt{(22)^2 + (2.2)^2} = 130 + (2)(22.1) = 174.2$

$A/P = 334.4 / 174.2 = 1.92$

$V = 1.486\,(1.92)^{2/3}\,(0.0025)^{1/2}\,(0.05)^{-1}$

$= 2.30$ FPS

$Q = VA = (334.4)(2.30) = 767.7$ CFS GOOD AND CLOSE

THUS AT POINT OF CONSIDERATION, 100 YEAR FLOOD HAS A DEPTH OF FLOW OF 2.2 FEET.

→ SECOND POINT OF CONSIDERATION ON COLD SPRING SWAMP IS LOCATED APPROXIMATELY 800 FEET DOWNSTREAM OF THE FIRST POINT (OR 1400 FEET UPSTREAM OF NEWS ROAD), SOUTHWEST OF LOT 120 IN SECTION 7 OF FORD'S COLONY

FIRST FIND RUNOFF BY PEAK DISCHARGE METHOD
DRAINAGE AREA = 576.7 Ac
HYDRAULIC LENGTH = 7600 FT
AVERAGE SLOPE OF WATERSHED = 0.0150 FT/FT

FIND CURVE NUMBER (CN) OF DRAINAGE AREA
STILL HAVE APPROXIMATELY 100 ACRES OF
HIGH DENSITY RESIDENTIAL W/ OPEN AREA (31%)
REMAINDER LOW DENSITY RESIDENTIAL (69%)

BREAKDOWN OF SOIL GROUP (ASSUME SAME)
5% SOIL GROUP A
20% SOIL GROUP B
55% SOIL GROUP C
20% SOIL GROUP D

SOIL GROUP	COMMERCIAL	HIGH DENSITY RESIDENTIAL	LOW DENSITY RESIDENTIAL	WOODED
A	0%	0%	0%	5%
B	0%	6%	14%	0%
C	0%	17%	38%	0%
D	0%	6%	14%	0%

FORMING A WEIGHTED CN FACTOR

A (576.7)(0.05)(45) = 1297.575

B (576.7)(0.06)(75) + (576.7)(0.14)(72) = 2595.15 + 5813.14 = 8408.3

C (576.7)(0.17)(83) + (576.7)(0.38)(81) = 8137.24 + 17750.8 = 25888

D (576.7)(0.06)(87) + (576.7)(0.14)(86) = 3010.4 + 6943.4 = 9953.8

$$CN = \frac{1297.58 + 8408.3 + 25888 + 9953.8}{576.7} = \frac{45,547.7}{576.7} = 79 \quad \underline{\text{SAME}}$$

RAINFALL DEPTH FOR 100 YEAR STORM (PLATE 5-11) = 8 INCHES

RUNOFF DEPTH FOR 100 YEAR STORM (PLATE 5-12) = 5.5 INCHES

VOLUME OF RUNOFF = 5.5 INCHES × $\frac{576.7 \text{ Ac}}{12 \text{ IN/FT}}$ = 264 AC.FT

= 5.5 INCHES × $\frac{25\,121052 \text{ SQ FT}}{12 \text{ IN/FT}}$ = 11,513,815 CF

PEAK RATE OF RUNOFF FOR 100 YEAR STORM ADJUSTED FOR WATERSHED SHAPE

FROM PLATE 5-8, EQUIVALENT DRAINAGE AREA = 400 AC

EQUIVALENT DISCHARGE RATE FOR DRAINAGE AREA PER INCH OF RUNOFF FROM PLATE 5-13 = 98 CFS / INCH OF RUNOFF

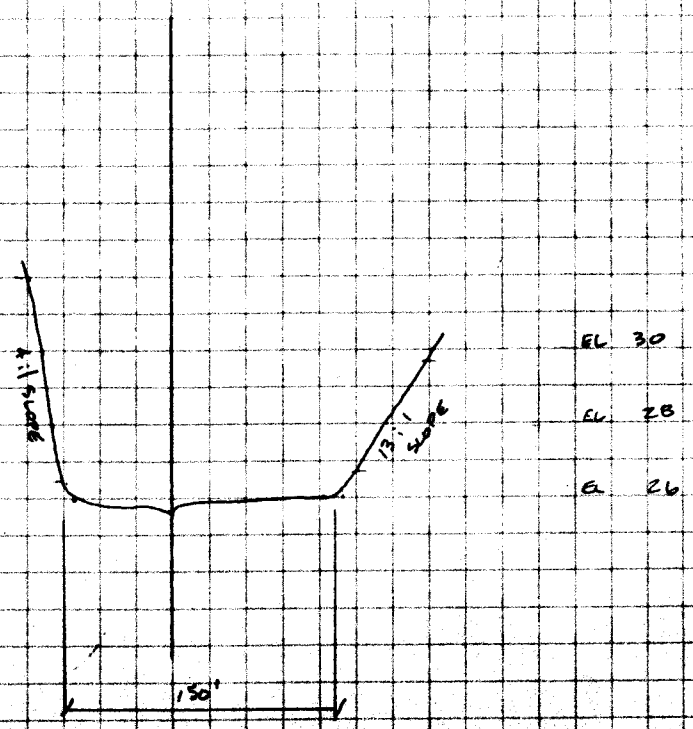
ACTUAL PEAK DISCHARGE = EQ DISCHARGE × $\frac{\text{ACTUAL DA}}{\text{EQ DA}}$

= 98 CFS / INCH × $\frac{576.7}{400}$ 1.44

= 141.3 CFS / INCH

THUS ACTUAL PEAK DISCHARGE AT POINT OF CONSIDERATION = 141.3 CFS / INCH × 5.5 = 777 CFS

CROSS-SECTION OF COLD SPRING SWAMP AT POINT UNDER CONSIDERATION



AN APPROXIMATION OF THE CROSS-SECTION WOULD BE TRAPEZOIDAL SHAPE 150' BOTTOM W/ 4:1 SS & 13:1 SS

FINALLY THE GOOD PART, APPROXIMATE THE DEPTH OF FLOW OF 100 YEAR FLOOD EVENT AT THIS LOCATION

ASSUME A DEPTH OF 2'

$A = (2)(150) + \frac{1}{2}(2)(8) + \frac{1}{2}(2)(26) = 300 + 8 + 26 = 334$

$P = 130 + \sqrt{4+64} + \sqrt{4+676} = 130 + 8.2 + 26.1 = 164.3$

$A/P = 334/164.3 = 2.03$

$V = 1.486(2.03)^{2/3}(S_o)^{1/2}(0.05)^{-1}$, WHERE $S_o = 0.004$

$= 1.486(2.03)^{2/3}(0.004)^{1/2}(0.05)^{-1}$

$= 3.01$ FPS

$Q = VA = (3.01)(334) = 1006$ CFS

ASSUME A DEPTH OF 1.8'

$A = (1.8)(150) + 1/2(1.8)(7.2) + 1/2(1.8)(23.4) = 270 + 6.5 + 21 = 318$

$P = 130 + \sqrt{1.8^2 + (7.2)^2} + \sqrt{(1.8)^2 + (23.4)^2} = 130 + 7.4 + 23.7 = 161$

$A/P = 318/161 = 1.98$

$V = 1.486(1.98)^{2/3}(0.004)^{1/2}(0.05)^{-1}$
$= 2.96$ FPS

$Q = VA = (2.96)(318) = 942$ CFS

ASSUME A DEPTH OF 1.6'

$A = (1.6)(150) + (1/2)(1.6)(6.4) + (1/2)(1.6)(20.8) = 261.8$

$P = 130 + \sqrt{1.6^2 + 6.4^2} + \sqrt{(1.6)^2 + 20.8^2} = 130 + 6.6 + 20.7 = 157.3$

$A/P = 261.8/157.3 = 1.66$

$V = 1.486(1.66)^{2/3}(0.004)^{1/2}(0.05)^{-1}$
$= 2.63$ FPS

$Q = VA = (2.63)(261.8) = 690$ CFS

THUS AT POINT OF CONSIDERATION, 100 YEAR FLOOD EVENT HAS DEPTH OF FLOW OF 1.7 FEET

FORD'S COLONY SEC 7 #5652 1)

DRAINAGE CALCULATIONS

CULVERT #1

D.A. = 3.03 ACR C = 0.40

T_c = 15 MIN. I_2 = 3.9 IN/HR I_{10} = 5.1 IN/HR

Q_2 = CIA = (0.40)(3.9)(3.03) = 5.04 CFS

Q_{10} = (0.40)(5.1)(3.03) = 6.18 CFS

TRY 40 OF 18 PIPE @ 1.00%

INLET HW/D = 0.91 HW = 1.37

OUTLET HW = H + h_o - LS_o

H = 0.38 h_o = $\frac{0.88+1.50}{2}$ = 1.15 LS_o = (40)(.0188) = 0.75

HW = 0.38 + 1.15 - 0.75 = 0.78 INLET CONTROLS

USE 40' OF 18" PIPE @ 1.00%
INV. IN = 61.35'
INV. OUT = 60.50'

CULVERT #2

D.A. = 1.71 AC C = 0.40 I_2 = 3.9 IN/HR I_{10} = 5.1 IN/HR

Q_2 = (0.40)(3.9)(1.71) = 2.66 CFS

Q_{10} = (0.40)(5.1)(1.71) = 3.49 CFS

TRY 60' OF 15" PIPE @ 0.50%

INLET HW/D = 0.88 HW = 1.10

OUTLET H ≈ 0.30 h_o = $\frac{0.75+1.25}{2}$ = 1.00 LS_o = (60)(.0050) = 0.30

HW = 0.30 + 1.0 - 0.30 = 1.00 INLET CONTROLS

USE 60' OF 15" PIPE @ 0.50%
INV. IN = 60.40'
INV. OUT = 60.10'

DRAINAGE CALCULATIONS

CULVERT #3

D.A. = 4.41 Ac. C = 0.40 I_2 = 3.9 in/hr I_{100} = 5.1 in/hr.

Q_2 = (0.40)(3.9)(4.41) = 6.88 cfs

Q_{100} = (0.40)(5.1)(4.41) = 8.99 cfs

TRY 52' OF 18" PIPE @ 5.77%

INLET H_w/D = 1.18 H_w = 1.77

OUTLET H = 0.78 h_o = $\frac{1.1+1.50}{2}$ = 1.30 LS = (52)(.0577) = 3.00

H_w = 0.78 + 1.30 − 3.0 = NEG. INLET CONTROLS

USE 52' OF 18" PIPE @ 5.77%
INV. IN: 57.50
INV OUT: 54.50'

CULVERT #4

D.A. = 0.30 Ac C = 0.40 I_2 = 3.9 in/hr I_{100} = 5.1 in/hr

Q_2 = (0.40)(3.9)(0.30) = 0.47 cfs

Q_{100} = (0.40)(5.1)(0.30) = 0.62 cfs

TRY 60' OF 15" PIPE @ 3.75%

INLET H_w/D = 0.20 H_w = 0.25

OUTLET H = NEG. h_o = $\frac{0.40+1.25}{2}$ = 0.83 LS = (60)(.0375) = 2.25

H_w = 0.83 − 2.25 = NEG. INLET CONTROLS

USE 60' OF 15" PIPE @ 3.75%
INV. IN: 72.25'
INV. OUT: 70.00

DRAINAGE CALCULATIONS

CULVERT #5

D.A = 0.78 Ac. C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(0.78) = 1.21 CFS

Q_{10} = (0.40)(5.1)(0.78) = 1.59 CFS

TRY 48' OF 15" PIPE @ 2.08%

INLET HW/D = 0.59 HW = 0.71

OUTLET H = NGL. h_o = $\frac{0.45+1.25}{2}$ = 0.85 LS_u = (48)(.0208) = 1.00

HW = 0.85-1.00 = NEG. INLET CONTROLS

USE 48' OF 15" PIPE @ 2.08%
INV. IN. = 70.00'
INV. OUT = 69.00'

CULVERT #6

D.A. = 2.05 Ac. C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(2.05) = 3.20 CFS

Q_{10} = (0.40)(5.1)(2.05) = 4.18 CFS

TRY 60' OF 18" PIPE @ 1.00%

INLET HW/D = 0.75 HW = 1.13'

OUTLET H = 0.20 h_o = $\frac{0.75+1.5}{2}$ = 1.10 LS_u = (60)(.0100) = 0.60

HW = 0.20+1.10+0.60 HW = 1.90 INLET CONTROLS

USE 60' OF 18" PIPE @ 1.00%
INV. IN = 72.80'
INV. OUT = 72.20

DRAINAGE CALCULATIONS

CULVERT #7

D.A. = 1.18 Ac. C = 0.40 I_2 = 3.9 in/hr. I_{10} = 5.1 in/hr.

Q_2 = (0.40)(3.9)(1.18) = 1.84 cfs

Q_{10} = (0.40)(5.1)(1.18) = 2.41 cfs

TRY 48' OF 15" PIPE @ 2.81%

INLET HW/D = 0.72 HW = 0.90

OUTLET H = NEG. h_o = $\frac{0.55+1.25}{2}$ = 0.90 LS = (48)(.0281) = 1.35

HW = 0.90 - 1.35 = NEG. INLET CONTROLS

USE 40' OF 15" PIPE @ 3.00%
INV. IN = 68.35'
INV. OUT = 67.00'

CULVERT #8

D.A. = 1.38 Ac C = 0.40 I_2 = 3.9 in/hr I_{10} = 5.1 in/hr

Q_2 = (0.40)(3.9)(1.38) = 2.15 cfs

Q_{10} = (0.40)(5.1)(1.38) = 2.81 cfs

TRY 60' OF 15" PIPE @ 1.60%

INLET HW/D = 0.78 HW = 0.98

OUTLET H = NEG. h_o = $\frac{0.65+1.25}{2}$ = 0.95 LS = (60)(.016) = 0.96

HW = 0.95 - 0.96 = NEG. INLET CONTROLS

USE 60' OF 15" PIPE @ 1.60%
INV. IN = 49.44
INV. OUT = 47.48'

DRAINAGE CALCULATIONS

CULVERT #9

D.A. = 55.47 AC. C = 0.30 T_c = 30 MIN I_2 = 2.7 in/HR I_{10} = 3.6 in/HR

Q_2 = (0.30)(2.7)(55.47) = 44.93 CFS

Q_{10} = (0.30)(3.6)(55.47) = 59.91 CFS

TRY 40' OF DUAL 30" PIPE @ 1.25%

INLET HW/D = 1.15 HW = 2.88

OUTLET H = 1.05 h_o = $\frac{1.8+2.5}{2}$ = 2.15 LS_o = (40)(.0125) = 0.50

HW = 1.05 + 2.15 - 0.50 HW = 2.70 INLET CONTROLS

> USE 40' OF DUAL 30" PIPE @ 1.25%
> INV. IN = 36.50'
> INV. OUT = 36.00'

CULVERT #10

D.A. = 17.49 AC. C = 0.30 T_c = 30 MIN I_2 = 2.7 in/HR I_{10} = 3.6 in/HR
D.A. = 3.76 AC. C = 0.40 T_c = 15 MIN I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_{10} = (0.30)(3.6)(17.49) = 18.89 CFS 25 CFS FROM POND
Q_{10} = (0.40)(5.1)(3.76) = 7.67 CFS

Q_{10} = 18.89 + 7.67 1.25 = 51.56 CFS

TRY 84' OF DUAL 30" PIPE @ 1.19%

INLET HW/D = 1.05 HW = 2.63

OUTLET H = 0.90 h_o = $\frac{2.8+2.5}{2}$ = 2.40 LS_o = (84)(.0119) = 1.0

HW = 0.90 + 2.40 - 1.0 HW = 2.30 INLET CONTROLS

> USE 84' OF DUAL 30" PIPE @ 1.19%
> INV. IN = 33.50'
> INV. OUT = 32.50'

DRAINAGE CALCULATIONS

CULVERT #11

$T_c = 15$ MIN

D.A = 3.45 AC. C = 0.40 $I_2 = 3.9$ in/HR $I_{10} = 5.1$ in/HR

$Q_2 = (0.40)(3.9)(3.45) = 5.38$ CFS

$Q_{10} = (0.40)(5.1)(3.45) = 7.04$ CFS

TRY 60' OF 18" PIPE @ 3.17 %

INLET HW/D = 1.00 HW = 1.50

OUTLET H = 0.55 $S_o = \frac{1+1.5}{2} = 1.25$ $\Delta S = (60)(.0350) = 1.90$

HW = 0.55 + 1.25 − 1.90 = NEG INLET CONTROLS

USE 60' OF 15" PIPE @ 3.17 %
INV. IN = 34.40'
INV. OUT = 32.50'

CULVERT #12

D.A. = 0.39 AC. C = 0.40 $I_2 = 3.9$ in/HR $I_{10} = 5.1$ in/HR

$Q_2 = (0.40)(3.9)(0.39) = 0.61$ CFS

$Q_{10} = (0.40)(5.1)(0.39) = 0.80$ CFS

TRY 60' OF 15" PIPE @ 1.50 %

INLET HW/D ≈ 0.20 HW = 0.25

OUTLET H = NEG. $S_o = \frac{0.35+1.25}{2} = 0.80$ $\Delta S = (60)(.015) = 0.90$

HW = 0.80 − 0.90 HW = NEG. INLET CONTROLS

TRY 60' OF 15" PIPE @ 1.50 %
INV. IN = 58.00'
INV. OUT = 57.10'

FORD'S COLONY SEC 7 #5652

DRAINAGE CALCULATIONS

7)

CULVERT #13

D.A. = 6.86 Ac. C = 0.40 I_2 = 3.9 in/HR. I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(6.86) = 10.70 cfs

Q_{10} = (0.40)(5.1)(6.86) = 14.00 cfs + 0.80 cfs = 14.80 cfs

TRY 44' of 24" PIPE @ 2.27%

INLET HW/D = 1.00 HW = 2.00

OUTLET H = 0.60 $h_o = \frac{1.3+2}{2}$ = 1.65 LS = (44)(.0227) = 1.0

HW = 0.60 + 1.65 - 1.0 = 1.25 INLET CONTROLS

USE 44' of 24" PIPE @ 2.27%
INV. IN = 46.00'
INV. OUT = 45.00'

CULVERT #14

D.A. = 1.26 Ac. C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(1.26) = 1.97 cfs

Q_{10} = (0.40)(5.1)(1.26) = 2.57 cfs

TRY 40' of 15" PIPE @ 5.00%

INLET HW/D = 0.73 HW = 0.91

OUTLET H = NOG $h_o = \frac{0.55+1.25}{2}$ = 0.90 LS = (40)(.05) = 2.0

HW = 0.90 - 2.0 = NOG INLET CONTROLS

USE 40' of 15" PIPE @ 5.00%
INV. IN = 41.00
INV. OUT = 39.00'

DRAINAGE CALCULATIONS

CULVERT #15

D.A. = 1.71 AC ± C = 0.40 I_2 = 3.9 IN/HR I_{10} = 5.1 IN/HR

Q_2 = (0.40)(3.9)(1.71) = 2.46 CFS

Q_{10} = (0.40)(5.1)(1.71) = 3.49 CFS

TRY 60 OF 15" PIPE @ 0.50%

INLET HW/D = 0.85 HW = 1.06

OUTLET H = 0.28 h_o = $\frac{0.65+1.25}{2}$ = 0.95 LS_o = (60)(.005) = 0.30

HW = 0.28 + 0.95 − 0.30 = 0.93 INLET CONTROLS

USE 60 OF 15" PIPE @ 0.50%
INV. IN = 41.00'
INV. OUT = 40.70'

CULVERT #16

D.A. = 0.88 AC ± C = 0.40 I_2 = 3.9 IN/HR I_{10} = 5.1 IN/HR

Q_2 = (0.40)(3.9)(0.88) = 1.37 CFS

Q_{10} = (0.40)(5.1)(0.88) = 1.79 CFS + 3.49 CFS = 5.28 CFS

TRY 60' OF 15" PIPE @ 2.00%

INLET HW/D = 1.15 HW = 1.44

OUTLET H = 0.70 h_o = $\frac{0.95+1.25}{2}$ = 1.1 LS_o = (60)(.020) = 1.20

HW = 0.70 + 1.1 − 1.20 = 0.60 INLET CONTROLS

USE 60' OF 15" PIPE @ 2.00%
INV. IN = 32.48
INV. OUT = 31.28

DRAINAGE CALCULATIONS

CULVERT #17

DRAINAGE AREA AND FLOWS PREVIOUSLY CALCULATED IN "100-YR. FLOOD PLAIN CALCULATIONS

$Q_{10} = 120$ CFS
$Q_{100} = 262.8$ CFS

TRY 7 RUNS OF 30" PIPE INVERT IN = 24.70, INV OUT = 23.90
℄ ROAD ELEVATION = ~~31.99~~ 29.08

INLET Q_{10} EACH PIPE MUST PASS 120/7 = 17.14 CFS
HW/D = 0.82 HW = 2.05'

OUTLET Q_{10}
H = 0.45 LS_0 = 0.8 $h_0 = \frac{2.5+1.33}{2} = 1.93$ HW = 1.58' INLET CONTROLS

INLET Q_{100} EACH PIPE MUST PASS 262.8/7 = 37.5 CFS
HW/D = 1.40 HW = 3.5'

OUTLET Q_{100}
H = 2.0' LS_0 = 0.80' $h_0 = \frac{2.5+2.1}{2} = 2.3$ HW = 3.5' CRITICAL FLOW

PROVIDE 7 RUNS OF 30" PIPE ON 6' CENTERS, EACH 72' IN LENGTH (DOES NOT INCLUDE LENGTHS FOR END SECTIONS) WITH ES-1 END SECTIONS ON ALL PIPE ENDS. CENTER CULVERT TO BE PLACED IN STREAM BED WITH INVERTS ON CENTER CULVERT TO BE 0.5' BELOW THE STREAM BED. REMAINDER OF CULVERTS TO BE PLACED AT INVERT IN = 24.70, INVERT OUT = 23.90.

100-YR. HIGH WATER = 24.7 + 3.5' = 28.2

DRAINAGE CALCULATIONS

OUTFALL DITCH FROM CULVERT #1 TO SS #13

D.A. = 4.42 Ac. = C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(4.42) = 6.90 cfs

Q_{10} = (0.40)(5.1)(4.42) = 9.02 cfs

TRY 200' OF PAVED 'V' DITCH w/2:1 SS, 12" DEEP @ 6.75%
V_2 = 10.5 FPS D_{10} = 7.8 in.

OUTFALL DITCH BETWEEN LOTS 17 & 18

D.A. = 2.40 Ac. = C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(2.40) = 3.74 cfs

Q_{10} = (0.40)(5.1)(2.40) = 4.90 cfs

TRY 175' OF PAVED 'V' DITCH w/2:1 SS, 12" DEEP @ 8.00%
V_2 = 9.00 FPS D_{10} = 6.1 in.

OUTFALL DITCH BETWEEN LOTS 26 & 27

D.A. = 0.42 Ac. = C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(0.42) = 0.66 cfs

Q_{10} = (0.40)(5.1)(0.42) = 0.86 cfs

TRY 220' OF PAVED 'V' DITCH w/2:1 SS, 12" DEEP, @ 12.00%
V_2 = 4.5 FPS D_{10} = 1.0 in.

OUTFALL DITCH FROM CULVERT #3 BETWEEN LOTS 29 & 30

D.A. = 4.90 Ac. = C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(4.90) = 7.64 cfs

Q_{10} = (0.40)(5.1)(4.90) = 10.00 cfs

TRY 160' OF PAVED 'V' DITCH w/2:1 SS, 12" DEEP, @ 2.19%
V_2 = 7.4 FPS D_{10} = 9.9 in.

FORD'S COLONY SEC 7 ~5652 (1)

DRAINAGE CALCULATIONS

OUTFALL DITCH BETWEEN LOTS 43 & 44

D.A. = 2.78 Ac. ± C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(2.78) = 4.34 CFS

Q_{10} = (0.40)(5.1)(2.78) = 5.67 CFS

TRY 160' OF GRASS V-DITCH w/3:1 SS, 12" DEEP @ 2.50%
V_2 = 2.8 FPS D_{10} = 9.5 IN. V_{10} = 3.1 FPS

OUTFALL DITCH BETWEEN LOTS 61 & 62

D.A. = 1.08 Ac. ± C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(1.08) = 1.68 CFS

Q_{10} = (0.40)(5.1)(1.08) = 2.20 CFS

TRY 160' OF GRASS V-DITCH w/2:1 SS, 12" DEEP, @ 3.33%
V_2 1.7 FPS D_{10} = 3.20 IN

OUTFALL DITCH BETWEEN LOTS 64 & 65

D.A. = 0.39 Ac. ± C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(0.39) = 0.61 CFS

Q_{10} = (0.40)(5.1)(0.39) = 0.80 CFS

TRY 170' OF GRASS V-DITCH w/2:1 SS, 12" DEEP, @ 3.53%
V_2 = 1.90 D_{10} = 5.60 IN

OUTFALL DITCH BETWEEN LOTS 74, 75, & 76

D.A. = 2.16 Ac. ± C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(2.16) = 3.37

Q_{10} = (0.40)(5.1)(2.16) = 4.41

TRY 200' OF PAVED V-DITCH w/2:1 SS, 12" DEEP, @ 5.75%
V_2 = 8.25 FPS D_{10} = 6.1 IN.

FORD'S COLONY SEC 7

11/8/88

REVISED DRAINAGE

OUTFALL DITCH FROM CULVERT #9 BETWEEN LOTS 92 & 93

1.376 CHANNEL 21" DEEP, 1.45% SLOPE d_{50} = 0.33 FOOT OR 4 INCHES

1.37c B/d = 3/1.75 = 1.71, k_1 = 0.80, z = 1

1.37d d_{50} = 4 INCHES ϕ = 40°

1.37e z = 2, ϕ = 40° k_2 = 0.70

$d_{50} \times k_1/k_2 = d'_{50}$ = 0.33 × 0.80/0.70 = 0.38 FT.

$0.38' \times \frac{12 \text{ INCHES}}{1 \text{ FOOT}}$ = 4.56 USE d'_{50} = 6 INCHES

DRAINAGE CALCULATIONS

OUTFALL DITCH FROM CULVERT #13 TO SS #10

D.A. = 5.00 AC ± C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(5.00) = 7.80 CFS + 14.80 CFS = 22.60 CFS

Q_{10} = (0.40)(5.1)(5.00) = 10.20 CFS + 14.80 CFS = 25.00 CFS

TRY 495' OF PAVED V-DITCH W/3:1 SS, 12" DEEP, @ 2.68%
V_2 = 10.5 FPS D_{10} = 10.50 IN.

OUTFALL DITCH FROM CULVERT #14 BETWEEN LOTS 125 & 126

D.A. = 2.12 AC ± C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(2.12) = 3.31 CFS

Q_{10} = (0.40)(5.1)(2.12) = 4.32 CFS

TRY 180' OF PAVED V-DITCH W/2:1 SS, 12" DEEP @ 6.00%
V_2 = 8.4 FPS D_{10} = 6.0 IN.

OUTFALL DITCH FROM CULVERT #9 BETWEEN LOTS 92 & 93

ASSUME T_c = 30 MINUTES
D.A. = 55.91 AC ± C = 0.30 I_2 = 2.7 in/HR I_{10} = 3.6 in/HR

Q_2 = (0.30)(2.7)(55.91) = 44.93 CFS

Q_{10} = (0.30)(3.6)(55.91) = 52.91 CFS DESIGN STORM = 60-70 CFS

TRY 250' OF PAVED TRAPEZOIDAL DITCH W/3' BOTTOM, 2.1' DEEP, @ 1.45%, 1:1 SS
V_{10} = 11.3 FPS D_{10} = 1.45 FT.

OUTFALL DITCH BETWEEN LOTS 117 & 118

D.A. = 1.04 AC ± C = 0.40 I_2 = 3.9 in/HR I_{10} = 5.1 in/HR

Q_2 = (0.40)(3.9)(1.04) = 1.62 CFS

Q_{10} = (0.40)(5.1)(1.04) = 2.12 CFS

TRY 20' OF GRASS V-DITCH W/2:1 SS, 12" DEEP @ 3.00%
V_2 = 2.2 FPS D_{10} = 8.3 IN.

DRAINAGE CALCULATIONS

OUTFALL DITCH BETWEEN LOTS 98 & 99

D.A. = 2.22 ac. ± C_2 = 0.40 I_2 = 3.9 in/HR. I_{10} = 5.1 in/HR.

Q_2 = (0.40)(3.9)(2.22) = 3.46 CFS

Q_{10} = (0.40)(5.1)(2.22) = 4.53 CFS

TRY 160' OF ENKAMAT LINED 'V'-DITCH w/3:1 SS, 12" DEEP, @ 2.50 %
V_2 = 2.7 FPS D_{10} = 9.0 IN V_{10} = 3.0 FPS

STORM SEWER DESIGN COMPUTATIONS

L & D 229

ROUTE _____ PROJ. FORD'S COLONY SEC. 7
COUNTY JAMES CITY DISTRICT _____
DESCRIPTION _____

T_c = 20 min I_{10} = 4.5 in/hr

SHEET 1 OF 1

FROM POINT	TO POINT	AREA DRAIN. "A" ACRES	RUN-OFF COEF. C	CA INCREMENT	CA ACCUMULATED	INLET TIME MINUTES	RAIN FALL IN./HR.	RUNOFF Q C.F.S.	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH FT.	SLOPE FT./FT.	DIA. IN.	CAPACITY C.F.S.	VEL. F.P.S.	FLOW TIME SEC.	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
SS # 1	SS # 2	1.23	0.35	0.43	0.43	20	4.5	1.94	47.50	44.05	36	.0958	15	20.00			
SS # 2	SS # 3	6.38	0.35	2.23	2.66	20	4.5	11.98	44.05	31.45	315	.04	15	12.92			n = 0.013
SS # 3	SS # 4	3.07	0.35	1.07	3.73	20	4.5	16.79	30.70	30.40	30	.01	24	22.62			"
SS # 4	SS # 5	1.65	0.35	0.58	4.31	20	4.5	19.40	29.90	29.60	76	.0040	30	25.94			"
SS # 5	SS # 6	0.29	0.35	0.10	4.41	20	4.5	19.85	29.60	29.10	125	.0040	30	25.94			"
SS # 6	SS # 7	2.98	0.35	1.04	5.45	20	4.5	24.53	29.10	28.78	80	.0040	30	25.94			"
SS # 7	SS # 8	0.49	0.35	0.17	5.62	20	4.5	25.29	28.78	27.74	260	.0040	30	25.94			"
SS # 8	SS # 9	–	–	–	5.62	20	4.5	25.29	27.74	26.94	200	.0040	30	25.94			"
SS # 10	SS # 11	12.25	0.35	4.29	4.29	20	4.5	19.29	32.00	29.35	20	.1325	15	23.52			"
SS # 11	SS # 9	0.54	0.35	0.19	4.48	20	4.5	20.16	28.60	27.44	52	.0223	24	33.78			"
SS # 9	SS # 12	0.53	0.35	0.19	10.29	20	4.5	46.31	26.44	23.00	40	.0860	36	195.61			"
SS # 13	SS # 14	1.44	0.35	0.50	0.50	20	4.5	8.43	44.50	28.00	260	.0635	15	16.51			"
SS # 14	SS # 15	3.61	0.35	1.26	1.76	20	4.5	14.11	23.00	22.00	215	.0050	24	16.00			"
WW4C-1	WW4C-2	9.18	0.40	3.67	3.67	20	4.5	16.52	57.00	52.75	170	.025	18	16.61			"
WW4C-3	WW4C-2	5.06	0.30	1.52	1.52	20	4.5	6.83	58.00	53.00	105	.0476	15	14.09			"
WW4C-2	WW4C-5	–	–	–	5.19	20	4.5	23.36	52.25	46.40	390	.015	24	27.71			"
WW4C-4	WW4C-5	1.15	0.30	0.35	0.35	20	4.5	1.58	52.00	47.15	215	.0226	15	9.71			"
WW4C-5	WW4C-6	4.50	0.30	1.35	6.89	20	4.5	31.01	46.40	41.50	245	.02	24	32.00			"
WW4C-6	WW4C-7	5.12	0.30	1.54	8.43	20	4.5	37.94	41.00	37.00	180	.0222	30	61.12			"

FORD'S COLONY SEC. 7 #5652 1)

C = 0.40

DITCH CALCULATIONS T_c = 15 MIN I_2 = 3.9 IN/HR I_{10} = 5.1 IN/HR

RD. STA.	D.A. (AC)	Q_2 (CFS)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (IN.)	DESCRIPTION
ROAD "A"								
11+00 LT	0.06	0.09	6.10	1.35	GRASS	0.12	2.50	TRANSITION FROM GRASS 'V'-DITCH TO ENKAMAT 'V'-DITCH, 12" DEEP
11+00 RT	0.21	0.32	6.10	1.90	GRASS	0.42	4.00	TRANSITION FROM GRASS 'V'-DITCH TO ENKAMAT 'V'-DITCH, 12" DEEP
13+55 LT	1.91	2.98	2.80	2.50	GRASS	3.90	10.70	GRASS 'V'-DITCH W/2:1 SS, 18" DEEP
15+30 RT	2.40	3.74	2.80	2.60	(7020) ENKAMAT	4.89	11.40	ENKAMAT 'V'-DITCH W/2:1 SS, 12" DEEP
15+40 LT	2.01	3.14	5.40	2.50	ENKAMAT	4.10	10.70	ENKAMAT 'V'-DITCH W/2:1 SS, 12" DEEP
15+40 LT	2.01	3.14	2.80	2.40	GRASS	4.10	10.80	GRASS 'V'-DITCH W/2:1 SS, 18" DEEP
15+50 LT	0.14	0.22	5.40	1.70	ENKAMAT	0.29	3.40	ENKAMAT 'V'-DITCH W/2:1 SS, 12" DEEP
18+00 RT	0.12	0.19	3.00	1.30	GRASS	0.24	3.80	TRANSITION FROM GRASS 'V'-DITCH
			5.40	1.45	ENKAMAT		3.30	TO ENKAMAT 'V'-DITCH W/2:1 SS, 12" DEEP
18+20 LT	0.09	0.14	3.00	1.15	GRASS	0.18	3.20	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
20+30 LT	0.06	0.10	3.00	1.10	GRASS	0.13	2.90	TRANSITION FROM GRASS 'V'-DITCH TO
			7.00	4.00	PAVED		1.00	PAVED 'V'-DITCH W/2:1 SS, 12" DEEP
20+90 RT	0.45	0.70	9.00	6.50	PAVED	0.92	3.20	PAVED 'V'-DITCH W/2:1 SS, 12" DEEP
24+75 LT	0.36	0.56	4.00	4.60	PAVED	0.74	3.30	PAVED 'V'-DITCH W/2:1 SS 12" DEEP
24+75 RT	1.74	2.71	4.00	6.70	PAVED	3.55	6.00	PAVED 'V'-DITCH W/2:1 SS, 12" DEEP
ROAD "B"								
10+25 RT	0.23	0.36	5.00	4.40	PAVED	0.47	2.70	PAVED 'V'-DITCH W/2:1 SS, 12" DEEP
10+25 LT	0.25	0.39	5.00	4.40	PAVED	0.52	2.70	PAVED 'V'-DITCH W/2:1 SS, 12" DEEP

FORD'S COLONY SEC. 7 *5652 2)

C = 0.49

DITCH CALCULATIONS T_c = 15 MIN I_2 = 3.9 in/HR I_{10} = 5 in/HR

RD STA	C A (AC)	Q_2 (CFS)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (IN.)	DESCRIPTION
ROAD "C"								
11+70 RT	0.26	0.41	4.00	1.70	GRASS	0.53	4.60	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
11+70 LT	0.16	0.25	4.00	1.50	GRASS	0.33	3.90	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
ROAD "D"								
10+25 LT	0.85	1.33	4.74	2.50	ENKAMAT	1.73	7.00	ENKAMAT 'V'-DITCH W/2:1 SS, 12" DEEP
10+25 RT	0.25	0.40	4.74	1.85	ENKAMAT	0.52	4.50	ENKAMAT 'V'-DITCH W/2:1 SS, 12" DEEP
15+00 LT	0.37	0.57	2.50	1.55	GRASS	0.75	5.90	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
15+45 RT	0.24	0.37	2.50	1.40	GRASS	0.49	5.00	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
15+35 RT	0.54	0.84	1.50	1.50	GRASS	1.10	7.50	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
15+55 LT	0.21	0.32	1.50	1.10	GRASS	0.42	5.10	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
ROAD "E"								
12+20 LT	1.20	1.87	2.08	2.10	GRASS	2.45	9.10	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
12+20 LT	1.58	2.46	2.08	2.20	GRASS	3.22	10.00	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
ROAD "F"								
10+25 RT	0.11	0.17	0.62	0.75	GRASS	0.22	4.50	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
10+25 LT	0.48	0.75	0.62	1.15	GRASS	0.98	8.00	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
11+85 RT	0.14	0.22	0.62	0.82	GRASS	0.29	5.00	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
16+85 RT	0.17	0.27	2.00	1.20	GRASS	0.35	4.50	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP
16+85 LT	0.91	1.42	2.00	1.85	GRASS	1.86	8.20	GRASS 'V'-DITCH W/2:1 SS, 12" DEEP

FORD'S COLONY SEC. 7 — 75652 — 3)

C = 0.40

DITCH CALCULATIONS — T_c = 15 MIN — I_2 = 3.9 in/HR — I_{10} = 5.1 in/HR

RD. STA.	D.A. (AC)	Q_2 (CFS)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (IN.)	DESCRIPTION
ROAD "G"								
12+75 LT	0.33	0.51	1.56	1.30	GRASS	0.67	6.00	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
13+20 RT	0.69	1.08	1.56	1.55	GRASS	1.41	8.00	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
13+30 RT	0.49	0.77	0.50	1.10	GRASS	1.00	8.10	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
13+30 LT	0.17	0.27	0.50	0.85	GRASS	0.35	5.40	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
ROAD "H"								
12+50 RT	1.55	2.42	2.08	2.15	GRASS	3.16	10.00	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
12+50 LT	0.61	0.95	2.08	1.75	GRASS	1.24	9.00	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
ROAD "I"								
12+60 RT	0.24	0.37	2.08	1.35	GRASS	0.49	5.00	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
12+60 LT	0.22	0.34	2.08	1.30	GRASS	0.45	4.90	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
ROAD "J"								
13+40 LT	0.23	0.37	3.81	1.60	GRASS	0.48	4.70	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
13+40 RT	2.21	3.45	3.81	7.00	PAVED	4.51	6.90	PAVED 'V'-DITCH w/2:1 SS, 12" DEEP
13+60 LT	0.31	0.48	2.50	1.50	GRASS	0.63	5.20	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
13+60 RT	2.07	3.23	2.50	6.20	PAVED	4.22	7.00	PAVED 'V'-DITCH w/2:1 SS, 12" DEEP

FORD'S COLONY SEC. 7 #5652 4)

C = 0.40

DITCH CALCULATIONS

T_c = 15 MIN I_2 = 3.9 IN/HR. I_{10} = 5.1 IN/HR.

RD. STA	D.A. (AC)	Q_2 (CFS)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (IN.)	DESCRIPTION
ROAD "K"								
12+80 RT	0.64	1.00	6.00	2.60	ENKAMAT	1.31	6.10	ENKAMAT "V" DITCH w/2:1 SS, 12" DEEP
12+80 LT	0.62	0.97	6.00	2.50	ENKAMAT	1.26	7.70	ENKAMAT "V" DITCH w/2:1 SS, 12" DEEP
ROAD "L"								
12+00 LT	0.14	0.21	2.08	1.30	GRASS	0.28	3.20	GRASS "V" DITCH w/3:1 SS, 12" DEEP
13+00 RT	2.07	3.22	2.08	2.50	GRASS	4.21	8.90	TRANSITION GRASS "V" DITCH w/3:1 SS, 12" DEEP
			8.00	10.00	PAVED		4.40	TO PAVED "V" DITCH w/3:1 SS, 12" DEEP
21+20 RT	4.87	7.60	1.00	5.60	PAVED	7.93	8.50	PAVED "V" DITCH w/3:1 SS, 12" DEEP
16+00 LT	0.37	0.58	8.00	2.70	ENKAMAT	0.76	3.70	TRANSITION ENKAMAT "V" DITCH w/3:1 SS, 12" DEEP
			1.00	1.20	GRASS		5.40	TO GRASS "V" DITCH w/3:1 SS, 12" DEEP
21+20 LT	1.45	2.26	1.00	1.65	GRASS	2.96	9.00	GRASS "V" DITCH w/3:1 SS, 12" DEEP
21+50 LT	0.29	0.46	1.38	1.25	GRASS	0.60	4.8	GRASS "V" DITCH w/3:1 SS, 12" DEEP
21+50 RT	3.05	4.76	1.38	2.15	GRASS	6.22	11.10	GRASS "V" DITCH w/3:1 SS, 12" DEEP
27+90 LT	0.28	0.43	1.00	1.10	GRASS	0.56	5.30	GRASS "V" DITCH w/3:1 SS, 12" DEEP
27+90 RT	0.40	0.62	1.00	1.20	GRASS	0.82	5.60	GRASS "V" DITCH w/3:1 SS, 12" DEEP
28+10 LT	0.23	0.36	3.00	1.60	GRASS	0.47	3.80	GRASS "V" DITCH w/3:1 SS, 12" DEEP
28+10 RT	0.72	1.12	3.00	2.15	GRASS	1.46	5.80	GRASS "V" DITCH w/3:1 SS, 12" DEEP
32+70 LT	0.20	0.32	3.06	1.60	GRASS	0.41	3.50	GRASS "V" DITCH w/3:1 SS, 12" DEEP
32+70 RT	0.61	0.95	3.06	2.10	GRASS	1.24	5.60	GRASS "V" DITCH w/3:1 SS, 12" DEEP

FORD'S COLONY SEC. 7 #5652 5)

DITCH CALCULATIONS T_c = 15 min I_2 = 3.9 in/hr I_{10} = 5.1 in/hr

RD. STA.	C.A. (ac)	Q_2 (cfs)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (in)	DESCRIPTION
ROAD "L"								
32+80 LT	0.29	0.45	3.33	1.75	GRASS	0.59	4.00	GRASS 'V'-DITCH w/3:1 SS, 12" DEEP
32+80 RT	2.69	4.20	3.33	3.1	GRASS	5.49	8.80	GRASS 'V'-DITCH w/3:1 SS, 12" DEEP
ROAD "M"								
10+50 RT	.03	0.05	2.08	0.85	GRASS	0.07	2.50	TRANSITION GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
			6.87	1.30	TO ENKAMAT		1.90	TO ENKAMAT 'V'-DITCH w/2:1 SS, 12" DEEP
10+50 LT	0.23	0.35	2.08	1.30	GRASS	0.46	4.90	TRANSITION GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
			6.87	2.05	TO ENKAMAT		4.00	TO ENKAMAT 'V'-DITCH w/2:1 SS, 12" DEEP
14+00 RT	0.76	1.19	4.00	2.20	ENKAMAT	1.55	7.80	ENKAMAT 'V'-DITCH w/2:1 SS, 12" DEEP
14+00 LT	0.28	0.43	4.00	1.80	ENKAMAT	0.56	4.80	ENKAMAT 'V'-DITCH w/2:1 SS, 12" DEEP
ROAD "N"								
10+25 LT	0.32	0.47	7.80	5.60	PAVED	0.64	2.80	PAVED 'V'-DITCH w/2:1 SS, 12" DEEP
10+25 RT	1.91	2.98	7.80	2.70	PAVED	3.90	5.50	PAVED 'V'-DITCH w/2:1 SS, 12" DEEP
15+00 LT	0.11	0.17	3.00	1.10	GRASS	0.22	2.20	TRANSITION GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
			7.80	4.55	PAVED		1.80	TO PAVED 'V'-DITCH w/2:1 SS, 12" DEEP
15+00 RT	0.57	0.90	3.00	1.90	GRASS	1.17	6.50	TRANSITION GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
			7.80	6.60	PAVED		3.50	TO PAVED 'V'-DITCH w/2:1 SS, 12" DEEP
ROAD "O"								
10+30 LT	2.51	3.92	7.00	9.10	PAVED	5.12	6.30	PAVED 'V'-DITCH w/2:1 SS, 12" DEEP
10+30 RT	0.20	0.31	7.00	2.00	ENKAMAT	0.41	3.80	ENKAMAT 'V'-DITCH w/2:1 SS, 12" DEEP
14+00 LT	0.43	0.67	3.00	1.70	GRASS	0.88	5.90	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP
14+00 RT	0.08	0.13	3.00	1.15	GRASS	0.17	3.20	GRASS 'V'-DITCH w/2:1 SS, 12" DEEP

FORD'S COLONY SEC. 7 — 5692 — 9

C = 0.42

DITCH CALCULATIONS — T_c = 15 MIN — I_2 = 3.9 IN/HR — I_{10} = 5.1 IN/HR

RD. STA.	D.A. (AC)	Q_2 (CFS)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (IN)	DESCRIPTION
ROAD "O"								
14+20 LT	0.83	1.29	4.86	2.50	GRASS	1.69	6.90	GRASS V-DITCH W/2:1 SS, 12" DEEP
14+20 RT	0.86	1.34	4.86	2.50	GRASS	1.75	7.00	GRASS V-DITCH W/2:1 SS, 12" DEEP
21+00 LT	0.21	0.32	3.14	1.45	GRASS	0.42	4.40	GRASS V-DITCH W/2:1 SS, 12" DEEP
21+00 RT	2.81	4.37	3.14	2.95	ENKAMAT	5.74	11.70	ENKAMAT V-DITCH W/2:1 SS, 12" DEEP
21+25 LT	0.23	0.35	8.00	5.20	PAVED	0.46	2.50	PAVED V-DITCH W/2:1 SS, 12" DEEP
21+25 RT	4.44	6.93	8.00	10.50	PAVED	9.06	7.50	PAVED V-DITCH W/2:1 SS, 12" DEEP
26+00 LT	0.10	0.16	2.40	1.15	GRASS	0.21	2.30	TRANSITION GRASS V-DITCH W/2:1 SS, 12" DEEP
			7.00	4.20	PAVED		1.80	TO PAVED V-DITCH W/2:1 SS, 12" DEEP
26+00 RT	0.69	1.07	2.40	1.90	GRASS	1.41	7.20	TRANSITION GRASS V-DITCH W/2:1 SS, 12" DEEP
			7.00	6.60	PAVED		3.90	TO PAVED V-DITCH W/2:1 SS, 12" DEEP
ROAD "P"								
10+25 LT	0.26	0.41	3.82	1.65	GRASS	0.53	4.80	GRASS V-DITCH W/2:1 SS, 12" DEEP
10+25 RT	1.65	2.58	3.82	2.60	GRASS	3.38	9.20	GRASS V-DITCH W/2:1 SS, 12" DEEP
ROAD "Q"								
10+25 LT	0.35	0.55	8.88	6.20	PAVED	0.71	2.90	PAVED V-DITCH W/2:1 SS, 12" DEEP
10+25 RT	0.46	0.72	8.88	6.60	PAVED	0.94	3.10	PAVED V-DITCH W/2:1 SS, 12" DEEP
11+50 LT	0.05	0.07	8.88	3.60	PAVED	0.09	1.00	TRANSITION PAVED V-DITCH W/2:1 SS, 12" DEEP
			3.50	1.05	GRASS		2.50	TO GRASS V-DITCH W/2:1 SS, 12" DEEP
11+50 RT	0.08	0.12	8.88	4.60	PAVED	0.16	1.60	TRANSITION PAVED V-DITCH W/2:1 SS, 12" DEEP
			3.50	1.20	GRASS		3.10	TO GRASS V-DITCH W/2:1 SS, 12" DEEP

FORD'S COLONY SEC. 7 — 7)

C = 0.40

DITCH CALCULATIONS — T_c = 15 MIN — I_2 = 3.9 IN/HR — I_{10} = 5.1 IN/HR

RD. STA.	D.A. (AC)	Q_2 (CFS)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (IN)	DESCRIPTION
ROAD "Q"								
12+50 LT	0.02	0.03	3.00	0.88	GRASS	0.04	1.70	TRANSITION GRASS V-DITCH w/2:1 SS, 12" DEEP
			6.80	1.10	ENKAMAT		1.50	TO ENKAMAT V-DITCH w/2:1 SS, 12" DEEP
12+50 RT	0.04	0.06	3.00	0.95	GRASS	0.08	2.50	TRANSITION GRASS V-DITCH w/2:1 SS, 12" DEEP
			6.80	1.30	ENKAMAT		2.10	TO ENKAMAT V-DITCH w/2:1 SS, 12" DEEP
"EDINBURGH DRIVE"								
38+00 LT	1.79	2.79	3.00	2.70	GRASS	3.65	7.90	GRASS V-DITCH w/3:1 SS, 12" DEEP
38+00 RT	0.62	0.97	3.00	2.15	GRASS	1.26	5.30	GRASS V-DITCH w/3:1 SS, 12" DEEP
46+90 LT	0.69	1.07	3.00	2.10	GRASS	1.41	5.50	GRASS V-DITCH w/3:1 SS, 12" DEEP
46+90 RT	0.40	0.62	3.00	1.80	GRASS	0.82	4.60	GRASS V-DITCH w/3:1 SS, 12" DEEP
47+10 LT	2.34	3.65	3.33	3.00	ENKAMAT	4.77	8.50	ENKAMAT V-DITCH w/3:1 SS, 12" DEEP
47+00 RT	0.99	1.54	3.33	2.40	GRASS	2.02	6.10	GRASS V-DITCH w/3:1 SS, 12" DEEP
50+00 LT	1.60	2.50	3.33	2.60	GRASS	3.26	7.50	TRANSITION GRASS TO ENKAMAT
56+45 RT	0.14	0.21	0.75	0.80	GRASS	0.28	4.00	GRASS V-DITCH w/3:1 SS, 12" DEEP
66+65 LT	3.20	4.99	0.75		GRASS	1.41	4.60	GRASS V-DITCH w/3:1 SS, 12" DEEP
MODIFIED TO PAVED DITCH @ OUTFALL OF CULVERT #6 D_{10} = 8" MAX								
68+00 LT		4.45	0.75	1.60	GRASS	5.82	12.00	TRANSITION GRASS V-DITCH w/3:1 SS, 18" DEEP
			5.50	9.20	PAVED		5.40	TO PAVED V-DITCH w/3:1 SS, 12" DEEP
68+00 RT	1.04	1.62	0.75	1.20	GRASS	2.12	8.50	TRANSITION GRASS V-DITCH w/3:1 SS, 12" DEEP
			5.50	6.30	PAVED		5.70	TO PAVED V-DITCH w/3:1 SS, 12" DEEP

FORD'S COLONY SEC. 7 *5692

DITCH CALCULATIONS

C = 0.40 T_c = 15 MIN I_2 = 3.9 IN/HR I_{10} = 5.1 IN/HR

RD. STA.	D.A. (AC)	Q_2 (CFS)	SLOPE (%)	V_2 (FPS)	LINING TYPE	Q_{10} (CFS)	DEPTH (IN)	DESCRIPTION
"EDINBURGH DRIVE"								
77+00 LT	2.98	4.66	1.00	2.10	ENKAMAT	6.09	11.60	TRANSITION ENKAMAT V-DITCH W/3:1 SS, 12" DEEP
			5.00	9.40	PAVED		5.50	TO PAVED V-DITCH W/3:1 SS, 12" DEEP
77+00 LT	0.28	0.43	1.00	1.10	GRASS	0.56	4.90	TRANSITION GRASS V-DITCH W/3:1 SS, 12" DEEP
			5.00	1.65	PAVED		2.30	TO PAVED V-DITCH W/3:1 SS, 12" DEEP
80+50 LT	0.31	0.48	5.00	2.10	ENKAMAT	0.63	3.80	ENKAMAT V-DITCH W/3:1 SS, 12" DEEP
86+50 RT	0.77	1.21	3.67	2.25	GRASS	1.58	5.80	GRASS V-DITCH W/3:1 SS, 12" DEEP
88+30 RT	0.14	0.21	3.67	1.55	GRASS	0.28	2.90	GRASS V-DITCH W/3:1 SS, 12" DEEP
88+30 LT	0.49	0.77	3.67	2.10	GRASS	1.01	5.00	GRASS V-DITCH W/3:1 SS, 12" DEEP

DETENTION BASIN NEAR NEWS ROAD

DRAINAGE AREA OF BASIN INCLUDING BASIN = 32.68 ACRES
TIME OF CONCENTRATION = 25 MINUTES

• DETENTION BASIN WILL ALSO SERVE BOTH RESERVED AREAS SOUTH OF ROAD "L"

COEFFICIENT OF RUNOFF = 0.35
$I_2 = 3.0$ IN/HR $I_{10} = 4.0$ IN/HR

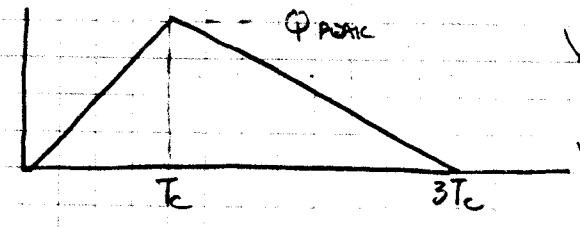
$Q_2 = (32.68\ Ac)(0.35)(3.0) = 34.3$ CFS
$Q_{10} = (32.68\ Ac)(0.35)(4.0) = 45.8$ CFS } POST DEVELOPMENT

PRE-DEVELOPMENT
TIME OF CONCENTRATION = 30 MINUTES
$I_2 = 2.7$ IN/HR $I_{10} = 3.6$ IN/HR
COEFFICIENT OF RUNOFF = 0.25

$Q_{2\ PRE} = (32.68)(0.25)(2.7) = 22.1$ CFS
$Q_{10\ PRE} = (32.68)(0.25)(3.6) = 29.4$ CFS

$Q_{2\ POST} - Q_{2\ PRE} = 34.3 - 22.1 = 12.2$ CFS
$Q_{10\ POST} - Q_{10\ PRE} = 45.8 - 29.4 = 16.4$ CFS

STORM VOLUME



$V_{2\ POST} = (34.3)(75\ MIN)(60\ SEC/MIN)/2 = 77{,}175$ CF
OR 1.77 AC·FT

$V_{10\ POST} = (45.8)(75\ MIN)(60\ SEC/MIN)/2 = 103{,}050$ CF
OR 2.37 AC·FT

WE DESIRE TO ONLY RELEASE 5 CFS FROM BASIN WHICH WILL DECREASE BOTH VOLUMES BY (5 CFS)(75 MIN)(60 SEC/MIN) = 22,500 CF OR 0.52 AC·FT

THEREFORE $V_{2\ POST} = 1.77 - 0.52 = 1.25$ AC·FT
$V_{10\ POST} = 2.37 - 0.52 = 1.85$ AC·FT

POND NORMAL POOL ELEVATION = 26.0 ; SURFACE AREA AT EL. 26 = 1.26 AC
SET EMERGENCY SPILLWAY AT ELEVATION 27.0

STORAGE AVAILABLE AT ELEVATION 27.0 = 1.30 AC·FT
THEREFORE THE 2-YEAR POST DEVELOPMENT STORM CAN BE COMPLETELY STORED EXCEPT FOR A DISCHARGE OF 5 CFS. THIS RESULTS IN A REDUCTION FROM PRE-DEVELOPMENT RUNOFF OF 17.1 CFS OR 77%.

RISER AND PRINCIPAL SPILLWAY DESIGN

PROVIDE 36" ϕ CONCRETE RISER WITH ANTI-VORTEX COLLAR (DIAMETER - 54" OR GREATER)

- SET PRINCIPAL SPILLWAY AT ELEVATION 26.0

SET INVERT OUT OF RISER AT 23.5

PROVIDE 48' OF 12" RCP PIPE @ 0.50 % WITH ANTI-SEEP COLLARS (SIZED BELOW) AND AN ES-1 END SECTION INV OUT = 23.25

CAPACITY OF RISER AT DEPTH OF 1.0' = 29 CFS

CAPACITY OF 12" RCP CULVERT

H = 27.0 - 23.25 = 3.75

FLOW AT 70' LENGTH, 3' H, = 5.57 CFS
FLOW AT 70' LENGTH, 4' H, = 6.43 CFS
Δ DIFFERENCE 0.86 CFS
3/4 DIFFERENCE 0.65 CFS

FLOW AT 3.75' DEPTH, 70' LENGTH = 6.22 CFS

CORRECTION FACTOR FOR 50' LONG PIPE = 1.09
ACTUAL FLOW = (6.22)(1.09) = 6.77 CFS

SO ACTUAL REDUCTION FROM PREDEVELOPMENT 2 YEAR STORM = 22.1 - 6.77 = 15.3 CFS OR 69 %. POST-DEVELOPMENT IS LIKEWISE REDUCED FROM 34.3 CFS TO 6.77 CFS OR A REDUCTION OF 27.5 CFS OR 80 %.

LENGTH OF SATURATED ZONE

$L_s = Y_1(2+4)(1+ S/(0.25-s))$
$L_s = 4'(3+4)(1+0.005/(0.25-0.005))$
$L_s = 28.6'$

FROM CHARTS, WE NEED 2 ANTI-SEEP COLLARS, EACH 2.25' x 2.25' OR 2.25' ϕ PLACE 1ST ANTI-SEEP COLLAR 12' FROM RISER AND THE SECOND ANTI-SEEP COLLAR 24' FROM THE RISER.

DESIGN EMERGENCY SPILLWAY NEEDS TO PASS 45.8 - 6.77 = 39 CFS

- TRY 20' WIDE, 3:1 SIDE SLOPE TYPICAL SECTION

Q AT D = 0.5' = $3.0(20 - 0.2(0.5))(0.5)^{1.5}$
= 21.1 CFS

- TRY DEPTH = 0.75'

Q = $3.0(20 - 0.2(0.75))(0.75)^{1.5}$
= 38.7 CFS CLOSE ENOUGH

APPROXIMATE VELOCITY = Q/A = 38.75/17.25 = 2.25 FPS

FREEBOARD AVAILABLE AT 10 YEAR STORM EVENT = 0.75' SINCE EM. SPILLWAY IS SET @ ELEVATION 27.0 AND THE TOP OF THE DAM IS 28.5.

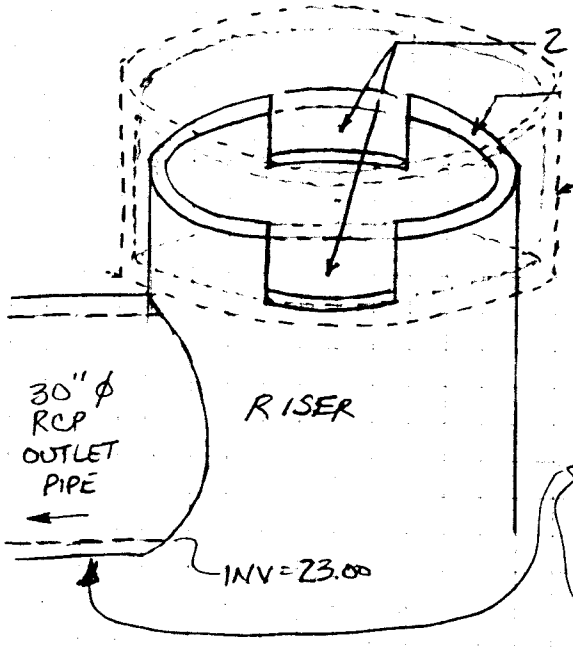
LINE EMERGENCY SPILLWAY WITH EXCELSIOR BLANKET OR JUTE MESH WHEN SEEDING TO ESTABLISH A GOOD, THICK STAND OF GRASS.

-SEE NEWS ROAD DETENTION BASIN REVISION-

NEWS ROAD DETENTION BASIN REVISION

JHE
11/14/88

RISER - 48" ϕ CONCRETE WITH ANTI-VORTEX COLLAR AND 2 1½' WIDE, 1' DEEP SLOTS IN RISER STRUCTURE SEE SKETCH BELOW



2 - 1½' WIDE x 1' DEEP SLOTS, INVERT OF SLOT = 26.0

TOP OF 48" INSIDE DIAMETER RCP RISER ELEVATION = 27.0

ANTI-VORTEX COLLAR (BOTTOM OF COLLAR TO PROJECT A MINIMUM OF 3" BELOW SLOT INVERT ELEVATION (ELEVATION OF BOTTOM OF ANTI-VORTEX COLLAR = 25.75)

30" I.D. RCP BARREL OUT OF RISER
INV @ RISER = 23.00
PROVIDE 48' OF 30" RCP @ 0.50% WITH 1-30" ES-1 END SECTION. INV OUT (@ ES-1) = 22.75
PROVIDE 2 - ANTI-SEEP COLLARS (3.5' ϕ) AT 16' CENTERS FROM RISER (1 @ 16' AWAY, THE NEXT @ 32' FROM RISER)

Q_{PASSED} (@ DEPTH = 1.0') $= \left(2.67(1.5 - 0.2(1))(1)^{1.5}\right)2 = 6.94$ CFS

Q_{PASSED} (@ DEPTH = 1.5') $= 14 + \left[(2.67)(1.5-0.2(1.5))(1.5)^{1.5} - (2.67)(1.5-0.2(.5))(.5)^{1.5}\right]2 = 23.1$ CFS

Q_{PASSED} (@ DEPTH = 2.0') $= 39 + \left[(2.67)(1.5-0.2(2.0))(2.0)^{1.5} - 3.47\right]2 = \underline{48.67}$ CFS

THEREFORE @ ELEVATION 27.0 + 1.9'± = 28.9'± THE 10 YR STORM RATE IS PASSED. ACTUAL 10 YR STORM VOLUME ELEVATION WILL BE LESS THAN ELEVATION 28.9'

	Q_{pre}	Q_{post}	Q_{rel}	V_s	MAX D
2	12.5	25.9	10.0	1.5	1.0
10	29.9	49.2	31.5	2.4	1.6
100	62.4	87.2	45.8	2.9	2.0

FORDS COLONY-SECTION 1 100 YR. FLOOD PLAIN CALCULATIONS JN 5652 1/5

DRAINAGE AREA AT CULVERT # 10

DRAINAGE AREA OF BASIN ABOVE POND = 92.23 Ac

OTHER DRAINAGE AREAS BELOW POND AND ABOVE CULVERT #10 = 17.49 Ac + 3.76 Ac = 21.25 Ac

TOTAL D.A. = 92.23 Ac. + 21.25 Ac = 113.48 Ac.

TIME OF CONCENTRATION @ POND BASIN = 35 MINUTES. USE 35 MINUTES FOR THE DRAINAGE BASIN ABOVE CULVERT #10

$I_{100} = 4.8$ IN/HR

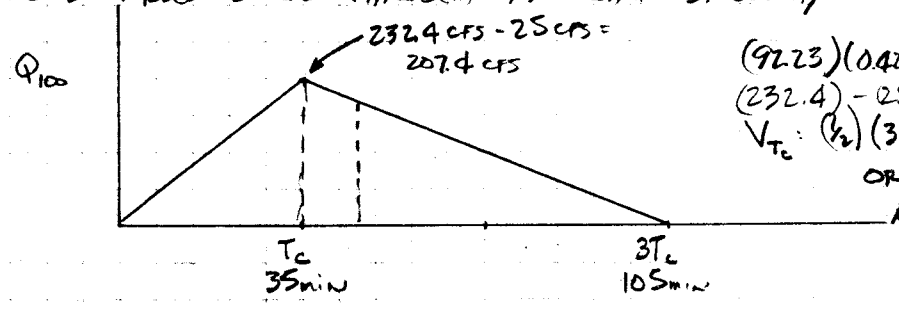
COEFFICIENT OF RUNOFF = 0.42 (PER 1987 F.C. MASTER STORMWATER MANAGEMENT PLAN)

$Q_{100} = (113.48\ Ac)(0.42)(4.8)(1.25) = \underline{\underline{286.0\ CFS}}$

REDUCE Q_{100} BY AMOUNT OF STORAGE POND HAS

V_{STORED} BY POND = 7.32 AC·FT

POND PASSES 25 CFS THROUGH PRINCIPAL SPILLWAY



(92.23)(0.42)(4.8)(1.25) = 232.4 CFS

(232.4) - 25 CFS) = 207.4

V_{T_c}: (½)(35)(60)(207.4) = 217,770 CF

OR 5.00 CFS

EXCESS STORAGE = 2.32 AC·FT

DETERMINE POINT WHERE V_{100} EXCEEDS V_{POND} TOO MUCH

TRY $V_{45} = V_{T_c} + [(207.4 - 6/7(207.4))/2](10)(60)$

$= 5.00 + 2.65$

$= 7.65$ AC·FT EXCEEDS STORAGE = 0.33 AC·FT CLOSE

REMAINING VOLUME NOT STORED $[(6/7)(232.4)/2](60)(60) = 358{,}560$ CF OR 8.23 AC·FT

Q_{100} FROM POND = 177.77 CFS + 25 CFS = 202.77 CFS OR A REDUCTION OF 29.6 CFS

Q_{100} FROM OTHER TWO AREAS = (21.25)(0.42)(4.8)(1.25) = 53.55 CFS

VOLUME OF AREA BELOW POND FROM T=45 TO T=105 = [(6/7)(53.55)/2](60)(60) = 82,620 CF OR 1.9 AC·F

TOTAL Q_{100} = (202.77 CFS) + (53.55 CFS) = 256.32 CFS MAXIMUM

TOTAL VOLUME PASSED = (8.23 + 1.9) = 10.13 AC·FT

REDUCTION AT EDINBURGH DRIVE (CULVERT #10)

℄ ELEVATION EDINBURGH = 41.50

INVERT IN OF DUAL 30" CULVERT = 33.50 84' OF DUAL 30" RCP OR EQUAL

INVERT OUT OF DUAL 30" CULVERT = 32.50

CULVERTS PASS 51.56 CFS @ HEADWATER DEPTH = 2.63' OR ELEVATION 36.13

AT ELEVATION 38, THE AVAILABLE STORAGE ABOVE THE CULVERTS IS 2.56 AC·FT AND THE CULVERTS PASS 94 CFS

INLET: HW/D = 1.80 HW = 4.5 Q_{EACH} = 47 CFS TOTAL = 94 CFS

OUTLET: H = 3.05, CS_0 = 1.0' $h_0 = \frac{2.5' + 2.3}{2} = 2.4'$ HW = 4.45' OKAY

AT ELEVATION 40, THE AVAILABLE STORAGE ABOVE THE CULVERTS IS 6.29 AC-FT AND THE DUAL 30" RCP PASS 118 CFS

INLET HW/D = 2.60 H/W = 6.5' Q_{EACH} = 61 CFS TOTAL = 122 CFS

OUTLET: H = 5.2 LS_o = 1.0' $h_o = \frac{2.5 + 2.5}{2}$ = 2.5 H/W = 6.7 ACTUAL PASSED IS SLIGHTLY LESS THAN 61 CFS EACH

ACTUAL PASSED = 59 CFS EACH OR 118 CFS TOTAL

THEREFORE, IT SEEMS REASONABLE TO ASSUME THAT THE MAXIMUM ELEVATION REACHED DURING THE 100 YR. STORM ABOVE EDINBURGH DRIVE WOULD BE APPROXIMATELY ELEVATION 40.0. SINCE REQUIRED STORAGE IS 10.13 AC-FT VS. AVAILABLE STORAGE OF 6.29 AC-FT AND MAXIMUM FLOWS OF 256.32 CFS VS 118 CFS. IN OTHER WORDS, WHILE THE VOLUME OF WATER IS PONDING UPSTREAM OF EDINBURGH, THE CULVERTS ARE PASSING A GOOD PERCENTAGE OF IT (UP TO 46%) UNDER EDINBURGH DRIVE.

THEREFORE, Q_{100} FROM CULVERT #10 = 118 CFS

POST Q_{100} = 286.0 CFS REDUCED TO 118 CFS
PRE Q_{100} = (13.48)(0.20)(4.2)(1.25) = 119.2 CFS T_c INCREASED FROM 35 MINUTES TO 45 MINUTES FOR PRE-DEVELOPMENT CONDITION

DRAINAGE AREA OF CULVERT #8 = 1.38 AC
DRAINAGE AREA OF CULVERT #9 = 55.47 AC

$$\text{COMBINED } C = \frac{(1.38)(0.40) + (55.47)(0.30)}{56.85} = 0.3024$$

Q_{100} = (56.85)(0.3024)(4.8)(1.25) = 103.16 CFS

UPPER END OF RAVINE 100 YEAR FLOW (BEHIND LOTS 92 & 93) = (103.16) + (118) = 221.2 CFS

LOWER END OF RAVINE (INCREASE TIME OF CONCENTRATION TO 45 MINUTES, ASSUMES FLOW RATE OF ABOUT 2 FPS)

ADDITIONAL DOWNSTREAM DRAINAGE AREA = 35.10 AC

Q_{100} = 118 CFS + (35.10 + 56.85)(0.30)(4.2)(1.25) = 262.8 CFS AT ROAD "L" MAJOR STREAM CROSSING

Q_{100} = (17.49 + 35.10 + 55.47)(0.30)(2.8) + (3.76)(0.40)(2.8) + 25 CFS = 120 CFS AT ROAD "L" MAJOR STREAM CROSSING

"100 YR. FLOOD PLAIN CALCULATIONS

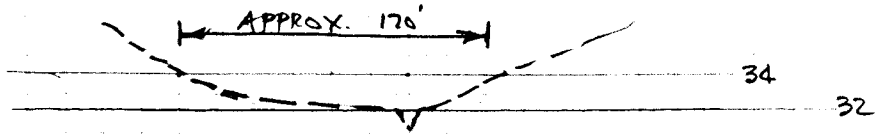
FLOOD PLAIN ELEVATION AT REAR OF LOTS 92, 93

$Q_{100} = 221.2$ CFS

SLOPE OF BOTTOM - APPROXIMATELY 6' FALL IN 1000' SAMPLE CHANNEL

SLOPE = 0.6%

APPROXIMATE CROSS-SECTION OF CHANNEL



ASSUME 130' CHANNEL WITH 10:1 SIDE SLOPES, FLOW DEPTH = 2', CALCULATE CAPACITY. ASSUME COEFFICIENT OF FRICTION = 0.05

$A = (130)(2) + [(1/2)(2)(20)]2 = 300$ CF

$P = 130' + 2(\sqrt{2^2 + 20^2}) = 170.2$

$R = A/P = 280/170.2 = 1.645$

$V = 1.486(1.645)^{2/3}(0.05)^{-1}(0.006)^{1/2}$

$V = 3.2$ FPS

$Q = (300)(3.2) = 898$ CFS MUCH IN EXCESS OF Q NEEDED

TRY DEPTH = 1.0'

$A = (130)(1) + (1/2)(1)(10)(2) = 140$ CF

$P = 130' + 2(\sqrt{1^2 + 10^2}) = 150.1$

$R = A/P = 140/150.1 = 0.93$

$V = 1.486(0.93)^{2/3}(0.05)^{-1}(0.006)^{1/2}$

$V = 2.20$ FPS

$Q = V \cdot A = (2.20)(140) = 307.7$ CFS >> 221.2

TRY DEPTH = 0.75'

$A = (130)(0.75) + 1/2(0.75)(7.5)(2) = 103.1$ CF

$P = 130 + 2\sqrt{.75^2 + 7.5^2} = 145.07$

$R = A/P = 103.1 / 145.07 = 0.7107$

$V = 1.486(0.7107)^{2/3}(0.05)^{-1}(0.006)^{1/2}$

$V = 1.83$ FPS

$Q = V \cdot A = (103.1)(1.83) = 189.0$ CFS < 221.2

TRY DEPTH = 0.85'

$A = (130)(0.85) + 1/2(0.85)(8.5)(2) = 117.7$ CF

$P = 130 + 2(\sqrt{.85^2 + 8.5^2}) = 147.08$

$R = 117.7 / 147.08 = 0.80$

$V = 1.486(0.80)^{2/3}(0.05)^{-1}(0.006)^{1/2}$

$V = 1.98$ FPS

$Q = V \cdot A = (1.98)(117.7) = 233.5$ CFS ≈ 221.2 CFS

THEREFORE, BEHIND LOTS 92 AND 93, IT IS APPARENT THAT THE 100YR FLOOD PLAIN IS SLIGHTLY LESS THAN 1' OR APPROXIMATELY 33.0'

100 YR FLOOD PLAIN CALCULATIONS

ELEVATION OF FLOOD PLAIN AT ROAD "L" (LOCATION OF 7 30" CULVERTS) IS 3.5' PLUS THE INVERT IN ELEVATION (24.7). 3.5' IS REQUIRED TO PASS THE FLOW THROUGH THE 7 CULVERTS.

$ELEVATION_{100} = 24.7 + 3.5 = 28.2$

UPSTREAM OF ELEVATION 29.0' ±, THE 100 YR. FLOOD PLAIN WILL BE APPROXIMATELY 1.0' ABOVE THE ELEVATION ALONG THE SIDE OF THE STREAM BANK.

• REVISE DUE TO TAILWATER CONDITION CAUSED BY NEWS ROAD
TAILWATER ELEVATION AT OUTLET OF 7 CULVERTS = 29.0
DETERMINE ΔH NECESSARY FOR CULVERTS TO PASS Q_{100}

EQUATION

$$V = \sqrt{\frac{H}{(1 + K_e/2g) + (n^2 L / 2.21 R^{4/3})}}$$

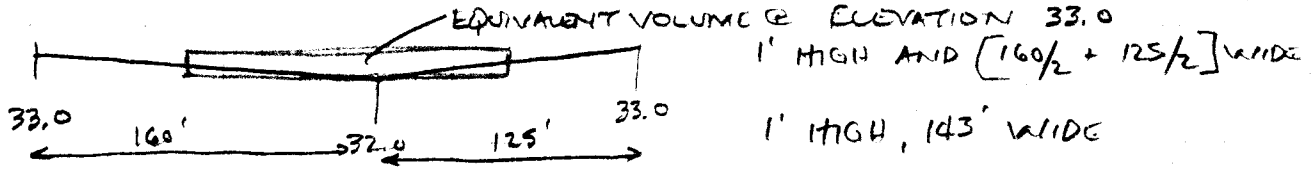
ASSUME $H = 1'$ $\quad R = \cancel{30''\ \text{OR}\ 2.5'} \rightarrow R = A/P = 4.91 / 2\pi R$
$K_e = 0.5$ $\quad g = 32.2$ $\quad = 4.91 / 7.85 = 0.625$
$n = 0.015$
$L = 72'$

$V = 0.99$ FPS
$A = \pi R^2 = (3.14)(1.25)^2 = 4.91\ FT^2$
$Q = V \cdot A = 4.86$ CFS / PIPE
OR 34 CFS TOTAL

TRY $H = 2$
$V = 1.40$ FPS
$Q = (1.40)(4.91) = 6.87$ CFS
OR 48 CFS TOTAL

TRY $H = 4'$
$V = 1.98$ FPS
$Q = (1.98)(4.91) = 9.72$ CFS
OR 68.01 CFS TOTAL

HOWEVER, THE CENTERLINE LOW POINT OF ROAD "L" IS 32.0'
SO AT $H = 3.0$, WATER BEGINS TO TOP THE ROAD



$Q_{WEIR} = (3.00)(143 - 0.2(1.0))(1.0)^{1.5} = 428$ CFS $\gg Q_{100}$

WEIR NEEDS TO PASS APPROXIMATELY 200 CFS, SINCE CULVERTS PASS 60CFS ± P/D

TRY $H = 0.67'$

$$Q_{WEIR} = (3.00)(143 - 0.2(0.67))(0.67)^{1.5} = 235 \text{ CFS}$$

TRY $H = 0.6'$

$$Q_{WEIR} = (3.00)(143 - 0.2(0.60))(0.60)^{1.5} = 199 \text{ CFS}$$ BINGO!

THEREFORE, THE UPSTREAM FLOOD PLAIN DUE TO THE DOWNSTREAM TAILWATER CONDITION IS ELEVATION 32.6.

REPORT #1 DAM #3 FORD'S COLONY SECTION 7/13

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FROEHLING & ROBERTSON, INC.
FULL SERVICE LABORATORIES • ENGINEERS & CHEMISTS
"OVER ONE HUNDRED YEARS OF SERVICE"

Greenbrier Commerce Park
833 Professional Place, W.
Chesapeake, Virginia 23320
Telephone: (804) 436-1111

Fax. No.: (804) 436-1674

January 31, 1989

Key Construction Company
P. O. Box 698
Clarkesville, Virginia 23927

Attn: Mr. Bill Nunn

Re: Subsurface Exploration and Geotechnical Analysis
Proposed Dam III, Fords Colony
James City County, Virginia
F&R Record No. P-61-207

Gentlemen:

Froehling and Robertson, Inc. (F&R) has completed the subsurface exploration and analysis for the referenced project as per your request.

The purpose of our investigation was to evaluate the existing soils relative to support capacity and permeability.

Project Information

We understand that the proposed dam will be an earth fill with an impervious core. The dam will have a length of approximately 300 feet along its top. Edinbrough Drive will extend along the top of the dam.

The top of the dam will be at elevation 53.00. The bottom of the existing ravine is at approximately 37.00. The normal pool elevation will be 46.00.

Scope of Exploration

Four soil test borings were performed at the proposed site on January 11, 1989 to depths of 20 feet below the existing ground surface. The borings were performed along the proposed centerline of the core at 60 to 70 foot spacings. Borings B-1

and B-4 were located on opposite abutments at approximately the normal pool elevation. Borings B-2 and B-3 were located along the base area of the dam, with B-3 near the lowest area of the existing ravine.

Laboratory tests consisting of sieve analyses, Atterberg limits and natural moisture content determinations were performed on selected split spoon samples. The purpose of these tests were to provide data for correlations with support strength and permeability properties. The results of these tests are included on PLATES 5A and 5B.

Subsurface Conditions

A surficial layer of organic SILTS and CLAYS was encountered to depths of approximately 1.5 feet. Beneath this material, the borings generally encountered interbedded layers of firm to very stiff fine sandy to silty CLAYS (CL) and loose to medium dense silty to clayey SANDS (SM to SC). These materials contained varying amounts of shell fragments below depths of 7.5 to 18 feet (elev. 28 to 34 +/-).

The borings located on the abutments generally encountered sandy to silty CLAYS to depths of 12 to 15 feet. Silty SANDS containing appreciable amounts of fines were predominate below these depths.

The borings located in the base area encountered very nonuniform soil conditions. Boring B-2 (STA 37+40) encountered silty to clayey SANDS to a depth of 10 feet. Below this depth, boring B-2 encountered fine sandy CLAYS. Boring B-3 (STA 38+00) encountered silty to sandy CLAYS to a depth of approximately 7.5 feet. Below this depth, boring B-3 encountered predominantly silty to clayey SANDS.

The permeability of the sandy to silty CLAYS is estimated to be in the range of $1X10^{-5}$ to $1X10^{-6}$ cm/sec.

The permeability of the nonplastic relatively clean SANDS (SM) is estimated to be on the order of $1X10^{-2}$ to $1X10^{-3}$ cm/sec.

The permeability of the silty to clayey SANDS (SM to SC) containing appreciable amounts of fines is estimated to be on the order of $1X10^{-4}$ to $1X10^{-5}$ cm/sec.

Analysis and Recommendations

The soils encountered beneath the surficial layer of organic soils (1.5' +/-) are judged to be suitable for support of the

SINCE F&R 1881

proposed dam material. A possible exception to this is the organic sands that were encountered between the depths of approximately 7.5 to 12.0 feet at boring B-4. It is recommended that the organic content, relative density and extent of these soils be evaluated relative to possible undercutting during the initial construction procedures.

Due to the highly varying soil conditions that were encountered, there does not appear to be a uniform stratum for the placement of the key trench. Based on the results of the soil test borings, the following trench depths are anticipated. Due to the varying soil conditions, these depths will likely need to be adjusted during construction and will be dependent upon the soils that are encountered.

The key trench along the abutments should extend to depths of approximately 10 to 12 feet after site stripping. These depths are based on the soil borings, which were performed vertically. The actual depth as measured perpendicular to the ground surface is expected to be slightly less than this amount.

The key trench in the base are (below elev. 40 +/-) is expected to extend to a depth on the order of 12 to 14 feet after site stripping. This is the area where the greatest variations in soil conditions were encountered. As a result, the greatest amount in adjustments of the key trench depth are expected in this area.

Acknowledgement

Froehling and Robertson, Inc. appreciates the opportunity to work with you on this project. If there are any questions or if we may be of further service, please contact our firm.

COMMONWEALTH OF VIRGINIA
JOHN P. SENSABAUGH
No.
15788
PROFESSIONAL ENGINEER

Respectfully Submitted,
FROEHLING & ROBERTSON, INC.

John P. Sensabaugh

John P. Sensabaugh, P.E.
GEOTECHNICAL ENGINEER

JPS/dgg

SOIL ENGINEERING

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D 2487 - 83
(Based on Unified Soil Classification System)

			Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]	Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay[K,L,M,P] Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥30% plus no. 200, predominantly sand, add "sandy" to to group name.

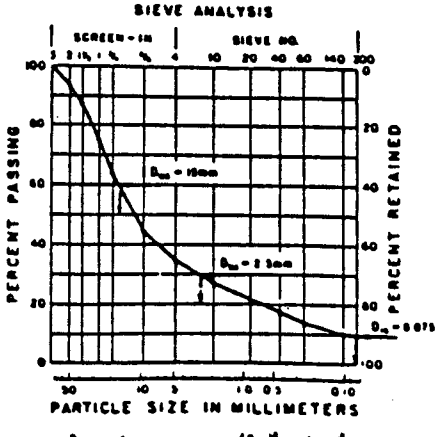
[M] If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

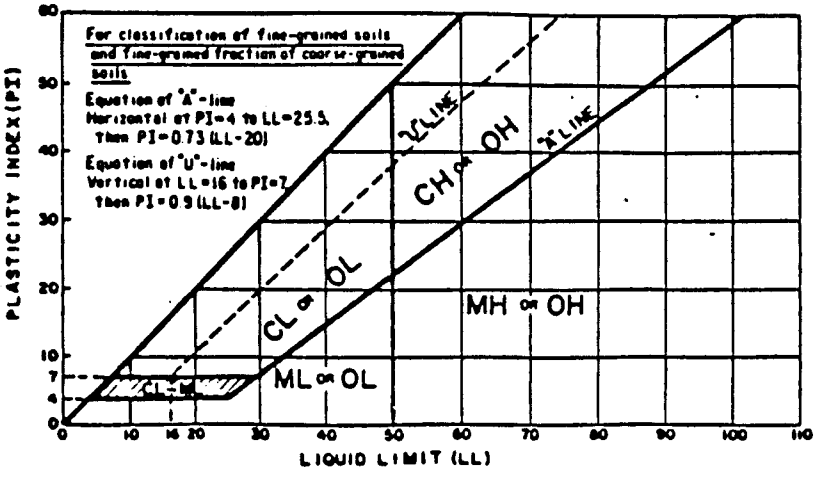
[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.





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KEY TO BORING LOG SOIL CLASSIFICATIONS

Soils Identification

IDENTIFICATION OF SOIL TYPE IS MADE ON THE BASIS OF AN ESTIMATE OF PARTICLE SIZE FOR PREDOMINANTLY COARSE-GRAINED SOILS AND ON THE BASIS OF COHESIVENESS (PLASTICITY) FOR PREDOMINANTLY FINE-GRAINED SOILS. WHEN A SOIL SAMPLE CONSISTS OF TWO OR MORE SOIL TYPES, THE PERCENTAGES OF THE TYPES ARE ESTIMATED BY WEIGHT AND INDICATED BY DESCRIPTIVE TERMINOLOGY.

Soil Type	Particle Size
Boulder	12 in.
Cobble	3 - 12 in.
Gravel-Coarse	3/4 - 3 in.
-Fine	#4 - 3/4 in.
Sand - Coarse	#10 - #4
- Medium	#40 - #10
- Fine	#200 - #40
Silt (non-cohesive)	#200
Clay (cohesive)	#200

Soil Component	Descriptive Term	Percentage
Major	Uppercase Letters	over 50%
Secondary	Adjective	35 - 50%
Others	Some	20 - 35%
	Little	10 - 20%
	Trace	0 - 10%

Notes: 1) Particle size is designated by U.S. Standard Sieve Sizes

2) Atterberg Limit determinations are often used to classify fine-grained soils (silts and clays).

Relative Density or Consistency

THE STANDARD PENETRATION RESISTANCE VALUES (N-VALUES) ARE USED TO DESCRIBE THE RELATIVE DENSITY OF COARSE-GRAINED SOILS OR THE CONSISTENCY OF FINE-GRAINED SOILS.

RELATIVE DENSITY

Term	N-Value
Very Loose	0 - 4
Loose	5 - 9
Medium-Dense	10 - 30
Dense	31 - 50
Very Dense	over 50

CONSISTENCY

Term	N-Value
Very Soft	0 - 1
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 16
Very Stiff	17 - 30
Hard	31 - 50
Very Hard	over 50

Form No. 500

BORING LOG

PLATE 3A

SINCE 1881

FROEHLING & ROBERTSON, INC.
FULL SERVICE LABORATORIES • ENGINEERING/CHEMICAL
"ONE HUNDRED YEARS OF SERVICE"

Report No. **P-61-207** DATE **January 27, 1989**

Client:	**Key Construction Company**
Project:	**Proposed Dam III, Fords Colony, James City County, Virginia**
Boring No.: **B-1**	Total Depth: **20.5'** Elevation: **46±** Location: **STA 36 = 70, 24' Left of**
Type of Boring: **H.S. Auger**	Started: **1-11-89** Completed: **1-11-89** Driller: **Hill**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	Sample Blows*	Sample Depth (Feet)	% Core Recovery	REMARKS
	0.0					
	0.3	NOTE (1)				
		Stiff to Hard Light Brown and Tan Fine Sandy CLAY (CL)	5 8 8	1.5		GROUNDWATER DATA
			11 13 16	3.0		Groundwater encountered at a depth of 10.0 feet during drilling.
			14 15 15	4.5		
			9 13 19	6.0		
			8 12 18	7.5		
	7.0	NOTE (2)				
	7.5	Medium Dense Reddish Brown Clayey Fine to Medium SAND (SC)	8 13 14	9.0		
	9.0	Hard Tan and Light Brown Fine Sandy CLAY (CL)	13 17 19	10.5		NOTE (1): Stiff Brown organic Fine Sandy SILT (MH)
	13.0	Stiff Reddish Brown Silty CLAY (CL)		14.0		
	15.0	Medium Dense Reddish Brown Silty Fine SAND with trace of clay (SM)	8 7 9	15.5		NOTE (2): Hard Reddish Brown Silty CLAY with little fine sand (CL)
	18.0	Very Stiff Tan Clayey SILT and SHELL FRAGMENTS with trace of fine sand (MH)	6 10 13	19.0		
	20.5	**Boring Terminated at 20.5'**		20.5		**Note: Location STA 36 + 70, 24' left of centerline**

*No. of blows req'd. for a 140 lb. hammer dropping 30 in. to drive 2 in O.D., 1.375 in. I.D. sampler a total of 18 inches in three 6 in. increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

Scale 1"=5' unless otherwise noted

Form No. 500

BORING LOG

PLATE 3B

SINCE 1881

FROEHLING & ROBERTSON, INC.
FULL SERVICE LABORATORIES • ENGINEERING/CHEMICAL
"ONE HUNDRED YEARS OF SERVICE"

Report No. **P-61-207** DATE **January 27, 1989**

Client: **Key Construction Company**

Project: **Proposed Dam III, Fords Colony, James City County, Virginia**

Boring No.: **B-2** | Total Depth: **20.5'** | Elevation: **41'** | Location: **STA 37 + 40, 24' left of**

Type of Boring: **H.S. Auger** | Started: **1-11-89** | Completed: **1-11-89** | Driller: **Hill**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	Sample Blows*	Sample Depth (Feet)	% Core Recovery	REMARKS
	0.0					
	0.7	NOTE (1) (SM)	3 5 4	1.5		GROUNDWATER DATA
	1.5	NOTE (2) (MH)				Groundwater encountered at a depth of 7.0 feet during drilling.
	3.0	Loose Light Brown and Light Gray Clayey Fine SAND (SC)	4 4 5	3.0		
	5.0	Medium Dense Light Brown and Tan Silty Fine to Medium SAND with trace of clay (SM)	6 8 9	4.5		
	6.0	NOTE (3) (SM)	4 6 8	6.0		
	7.5	Loose Light Brown and Tan Clayey Fine to Medium SAND (SC)	4 3 3	7.5		
	9.0	Loose Tan Silty Fine to Medium SAND (SM)	7 5 3	9.0		
	10.0	NOTE (4) (SM)	6 3 4	10.5		
		Very Stiff Greenish Gray Fine Sandy CLAY with trace of shell fragments at 20'	6 8 14	14.0		NOTE (1): Loose Light Brown and Gray Silty Fine to Medium SAND (Fill)
				15.5		NOTE (2): Stiff Dark Brown Organic SILT with little fine sand
	20.5	(CL)	7 8 13	19.0		NOTE (3): Medium Dense Light Gray Silty Fine to Medium SAND
		Boring Terminated at 20.5'		20.5		NOTE (4): Medium Dense Tan Silty Fine SAND with trace of clay

*No. of blows req'd. for a 140 lb. hammer dropping 30 in. to drive 2 in O.D., 1.375 in. I.D. sampler a total of 18 inches in three 6 in. increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

Scale 1"=5' unless otherwise noted

Form No. 500

BORING LOG

PLATE 3C

SINCE 1881

FROEHLING & ROBERTSON, INC.
FULL SERVICE LABORATORIES • ENGINEERING/CHEMICAL
"ONE HUNDRED YEARS OF SERVICE"

Report No. P-61-207 DATE January 27, 1989

Client:	Key Construction Company
Project:	Proposed Dam III, Fords Colony, James City County, Virginia
Boring No.: B-3	Total Depth: 20.5' · Elevation: 37± · Location: STA 38 + 00, 24' left of
Type of Boring: H. S. Auger	Started: 1-11-89 · Completed: 1-11-89 · Driller: Hill

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	Sample Blows*	Sample Depth (Feet)	% Core Recovery	REMARKS
	0.0	Firm Black Silty Organic CLAY with roots and wood (CH)	2 3 3	1.5		GROUNDWATER DATA
	1.5	Firm Black to Dark Gray Silty CLAY with little organics (CH)	6 4 4	3.0		Groundwater encountered at a depth of 5.5 feet during drilling.
	3.0	Loose Dark Gray Clayey Fine SAND (SC)	4 3 3	4.5		
			5 3 2	6.0		
	6.0	Firm Dark Greenish Brown Fine Sandy CLAY with little organics (CL)	3 2 3	7.5		
	7.5	NOTE (1) (SM)	7 4 5	9.0		
	9.0	Medium Dense Greenish Gray Silty Fine to Medium SAND and SHELL FRAGMENTS (SM)	7 7 5	10.5		
	13.0	Loose Greenish Gray Clayey Fine to Medium SAND and SHELL FRAGMENTS (SC)	3 3 4	14.0		
				15.5		NOTE (1): Loose Greenish Brown Silty Fine to Medium SAND with trace of clay and shell fragments
			4 4 5	19.0		
	20.5	**Boring Terminated at 20.5'**		20.5		

*No. of blows req'd. for a 140 lb. hammer dropping 30 in. to drive 2 in O.D., 1.375 in. I.D. sampler a total of 18 inches in three 6 in. increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

Scale 1"=5' unless otherwise noted

Form No. 500

BORING LOG

PLATE 3D

SINCE 1881

FROEHLING & ROBERTSON, INC.
FULL SERVICE LABORATORIES • ENGINEERING/CHEMICAL
"ONE HUNDRED YEARS OF SERVICE"

Report No. **P-61-207** DATE **January 27, 1989**

Client: **Key Construction Company**

Project: **Proposed Dam III, Fords Colony, James City County, Virginia**

Boring No.: **B-4** | Total Depth: **20.5'** | Elevation: **46±** | Location: **STA 38 + 60, 24' left of**

Type of Boring: **H.S. Auger** | Started: **1-11-89** | Completed: **1-11-89** | Driller: **Hill**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	Sample Blows*	Sample Depth (Feet)	% Core Recovery	REMARKS
	0.0	Stiff Brown and Gray Clayey SILT and ORGANICS (MH)	5 5 8	1.5		GROUNDWATER DATA
	1.5	Very Stiff Tan and Brown Fine Sandy SILT (ML)	6 7 11	3.0		Groundwater encountered at a depth of 10 feet during drilling
	3.0	Very Stiff Tan and Brown Fine Sandy CLAY (CL)	9 8 14	4.5		
	4.5	NOTE (1) (CL)	9 9 12	6.0		
	6.0	Loose Light Gray to Dark Gray Silty Fine to Medium SAND (SM)	2 2 3	7.5		
	7.5	Loose Black to Greenish Brown Organic Silty Fine SAND (SM)	2 2 2	9.0		
			2 2 3	10.5		
	12.0	Medium Dense Light Brown and Tan Silty Fine SAND with trace to little shell fragments (SM)	10 13 9	14.0		NOTE (1): Medium Dense Tan and Light Brown Silty Fine to Medium SAND with trace of clay
				15.5		
	17.0	Very Stiff Greenish Gray Silty CLAY with trace of fine sand (CL)	5 10 14	19.0		
	20.5	**Boring Terminated at 20.5'**		20.5		

*No. of blows req'd. for a 140 lb. hammer dropping 30 in. to drive 2 in O.D., 1.375 in. I.D. sampler a total of 18 inches in three 6 in. increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

Scale 1"=5' unless otherwise noted

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PLATE 4

FIELD EXPLORATION PROCEDURES

Disturbed Sampling

Soil test borings were drilled in accordance with ASTM D-1586 procedures with a CME-45 all terrain mounted drill rig, by mechanically advancing hollow stem auger flights into the ground. At regular intervals, the plug was removed from the auger head, and soil samples were obtained with a standard 1.4" I.D., 2" O.D. 20" long split tube sampler. The sampler was attached to the end of "AW" size drill rods and lowered through the augers to sampling elevation. The sampler was first seated to penetrate loose cuttings and disturbed soil, then driven an additional foot with blows of a 140 lb. hammer falling 30". The sampler was then extracted from the soil, the plug reinserted into the auger head, and the auger advanced to the next sampling elevation. The number of blows required to drive the sampler each 6" increment of penetration was recorded and is shown on the boring logs. The number of blows required to drive the sampler the final 12" is termed the penetration resistance. The penetration resistance, when properly evaluated, is an index to soil density, strength and foundation support capacity.

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Client: Key Construction Company

PLATE 5A

Project: Dam III, Fords Colony
James City County, Virginia

Date: January 27, 1989

LABORATORY TEST RESULTS

Sample Location	B-1	B-1	B-2	B-2
Sample Depth (ft.)	4.5-6.0	9.0-10.5	3.0-4.5	14.0-15.5
Percent Passing Sieve Size				
No. 4		100		
No. 10		99		
No. 20	100	95		
No. 40	98	84	100	100
No. 60	96	70	86	92
No. 100	84	64	24	80
No. 200	51.9	60.5	14.2	51
Natural Moisture (%)	18.5	23.4	20.0	26.0
Liquid Limit	42	40	NP*	47
Plasticity Index	18	20	NP	24
Classification	CL	CL	SM	CL
Estimated Permeability (cm/sec)				
Upper Range	$1X10^{-5}$	$1X10^{-5}$	$1X10^{-2}$	$1X10^{-5}$
Lower Range	$1X10^{-6}$	$1x10^{-6}$	$1X10^{-3}$	$1X10^{-6}$

* NP - denotes nonplastic

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Client: Key Construction Company

PLATE 5B

Project: Dam III, Fords Colony
James City County, Virginia

Date: January 27, 1989

LABORATORY TEST RESULTS

Sample Location	B-3	B-3	B-4	B-4
Sample Depth (ft.)	3.0-4.5	9.0-10.5	3.0-4.5	9.0-10.5
Percent Passing Sieve Size				
1"		100		
3/4"		93		
1/2"		92		
3/8"		89		
No. 4	100	84		100
No. 10	99	77		98
No. 20	97	68	100	93
No. 40	89	55	99	83
No. 60	72	37	94	62
No. 100	47	21	86	36
No. 200	32.4	13.6	67.4	24.1
Natural Moisture (%)	23.1	17.4	22.4	38.9
Liquid Limit	27	NP*	37	49
Plasticity Index	9	NP	16	17
Classification	SC	SM	CL	SM
Estimated Permeability (cm/sec)				
Upper Range	$1X10^{-4}$	$1X10^{-2}$	$1X10^{-6}$	$1X10^{-4}$
Lower Range	$1X10^{-5}$	$1x10^{-3}$	$1X10^{-7}$	$1X10^{-5}$

* NP - denotes nonplastic

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage,* to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

Published by

ASFE THE ASSOCIATION OF ENGINEERING FIRMS PRACTICING IN THE GEOSCIENCES

8811 Colesville Road/Suite G106/Silver Spring, Maryland 20910/(301) 565-2733

0788/3M

REPORT #2 DAM #3 FORDS COLONY SECTION 7/13

SINCE 1881

FROEHLING & ROBERTSON, INC.
FULL SERVICE LABORATORIES • ENGINEERS & CHEMISTS
"OVER ONE HUNDRED YEARS OF SERVICE"

Greenbrier Commerce Park
833 Professional Place, W.
Chesapeake, Virginia 23320
Telephone: (804) 436-1111

Fax. No: (804) 436-1674

February 28, 1989

Key Construction Company
P. O. Box 698
Clarkesville, Virginia 23927

Attn: Mr. Bill Nunn

Re: Construction Observations and Soils Testing
Dam III, Fords Colony
James City County, Virginia
F&R Record No. P-61-207

Gentlemen:

As per your request, Froehling and Robertson, Inc. has performed soil testing and site inspections for the referenced project.

The initial excavation for the key trench was observed on February 2, 1989. This excavation was started on the left abutment and extended to approximately STA 38+50. The excavation was performed to depths of approximately 17 to 18 feet in the area of STA 38+50 and tapered to shallower depths towards the top of the abutment.

The soils encountered by the excavation at the time of our observations on February 2 were judged to correlate very well with the previous soil test borings. The soils at the base of the excavation consisted of a greenish gray silty clay to clayey fine sand. These soils were judged to possess very low permeability properties and were judged to be suitable for the base of the key trench.

The black to greenish brown organic silty fine sand that was encountered by boring B-4 (7.5' to 12.0' depths) was observed in the sides of the excavation. Some concern was expressed in our original report (1-31-89) regarding the support capacity of this material. This concern was due to possible heavy concentrations

of organic matter and very loose densities. The observations of this material in the sides of the excavation revealed no concentrations of organic matter and the material appeared to be loose to medium dense. Based on these observations, this stratum of material was judged to be suitable for support of the dam material.

We understand that material for construction of the core will be obtained from the roadway cut located west of the dam site. A sample of this material was obtained from a site stockpile on February 2 for laboratory classification and proctor testing. The results of these tests are attached to this report. Based on these results, this material was judged to be suitable for use in the core area of the dam.

The writer returned to the site on February 14, 1989. At this time, they key trench excavation had been completed and the core material had been placed to approximately the original site grades. These construction procedures were discussed with Mr. Mark Nunn on this date. We understand that the key trench excavation was extended across the dam site at a depth of approximately 17 feet and that the base soils remained relatively consistent with those that were observed on February 2. We also understand that the depth of the key trench excavation tapered to shallower depths towards the top of the right abutment.

Several test pits were excavated into the recently placed core material. This material appeared to be very well compacted. It was recommended that field density tests be performed on this material for the purpose of verifying and documenting the degree of compaction. These tests were scheduled for the following day.

Six field density tests were performed on the recently placed core material at varying elevations on February 15, 1989. Based on these results, it was suspected that a slight change in material had occurred. A second sample for proctor testing was obtained from the core on February 16. The results of this proctor were used in calculating the percent compaction of our tests on February 15. Although a slight change in material was apparent, this material was also judged to be suitable for construction of the core.

The results of the field density tests revealed that this material was very well compacted. It is important to note that the moisture content of this material was slightly higher than its optimum moisture content. This is a very desirable condition for the proper construction of a dam.

In conclusion, it appears that the construction of the dam is proceeding in a proper manner. It is recommended that additional field density tests be performed as the dam material is placed. The purpose of these tests is to verify and document that proper compaction and moisture contents are achieved.

Froehling and Robertson, Inc., appreciates the opportunity to work with you on this project. If you should have any questions or if we may be of further service, please contact our firm.

Respectfully Submitted,
FROEHLING & ROBERTSON, INC.

John P. Sensabaugh, P.E.
GEOTECHNICAL ENGINEER

cc: AES
Attn: Mr. James Bennett, P.E.

SINCE F&R 1881

REPORT OF SOIL CLASSIFICATION

Client: Key Construction Company
P. O. Box 698
Clarksville, Virginia 23927

Project: Fords Colony, Dam III
James City County, Virginia

Date Sampled: 02-02-89

Sample Location: Site Stockpile (from roadway cut)
Sample Description: Orange silty CLAY with little fine sand

Test Method: ASTM D422, ASTM D1140

TEST RESULTS

Sieve Size	% Passing
No. 4	100
No. 10	99.6
No. 20	99.4
No. 40	99.3
No. 60	97.9
No. 100	94.2
No. 200	85.3
Liquid Limit	39
Plastic Limit	23
Plasticity Index	16
Classification	CL

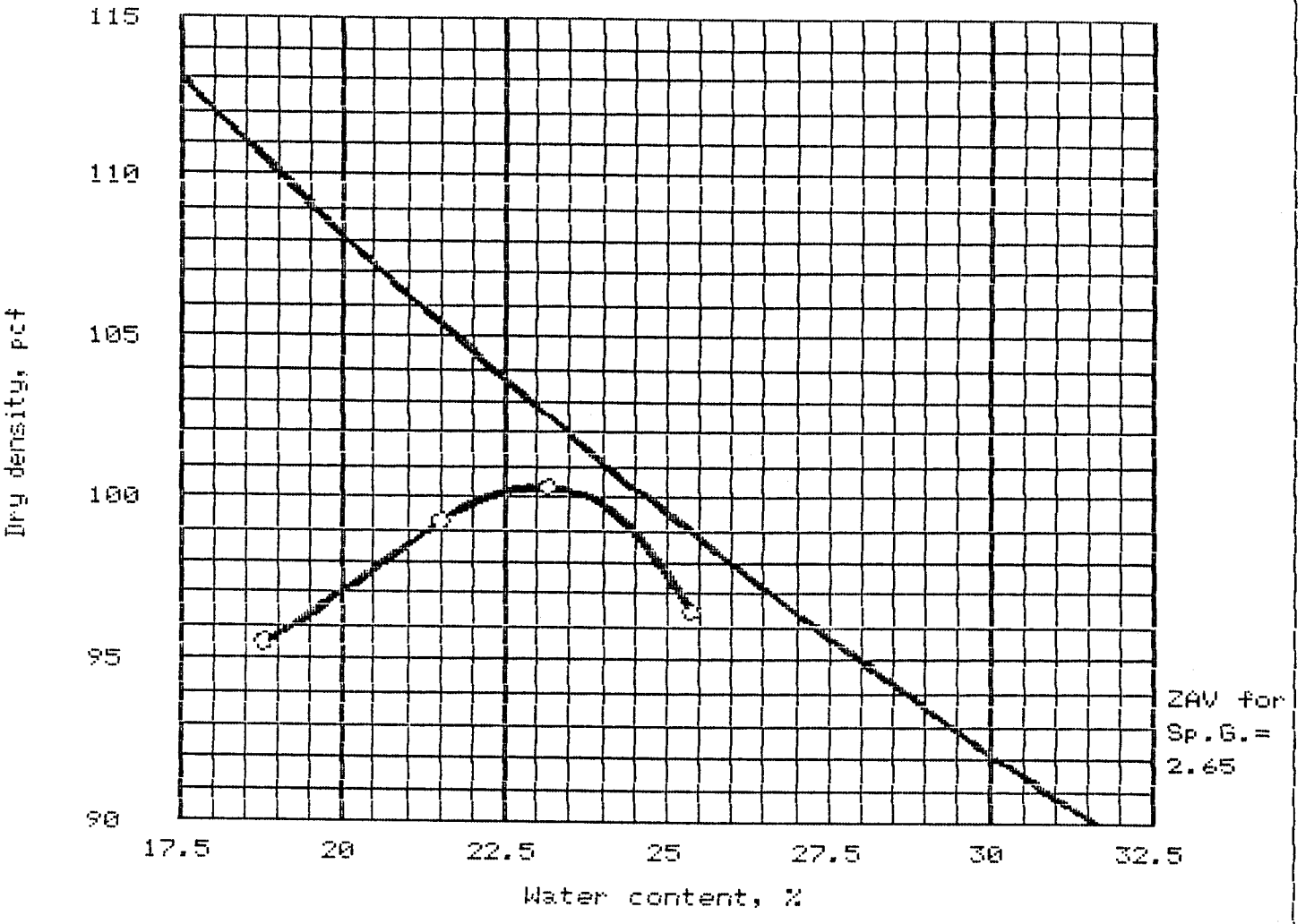
Respectfully submitted,
FROEHLING & ROBERTSON, INC.

April B. Saunders
April B. Saunders
MATERIAL TESTING SERVICES

John P. Sensabaugh
John P. Sensabaugh, P.E.
GEOTECHNICAL ENGINEER

/re

PROCTOR TEST REPORT

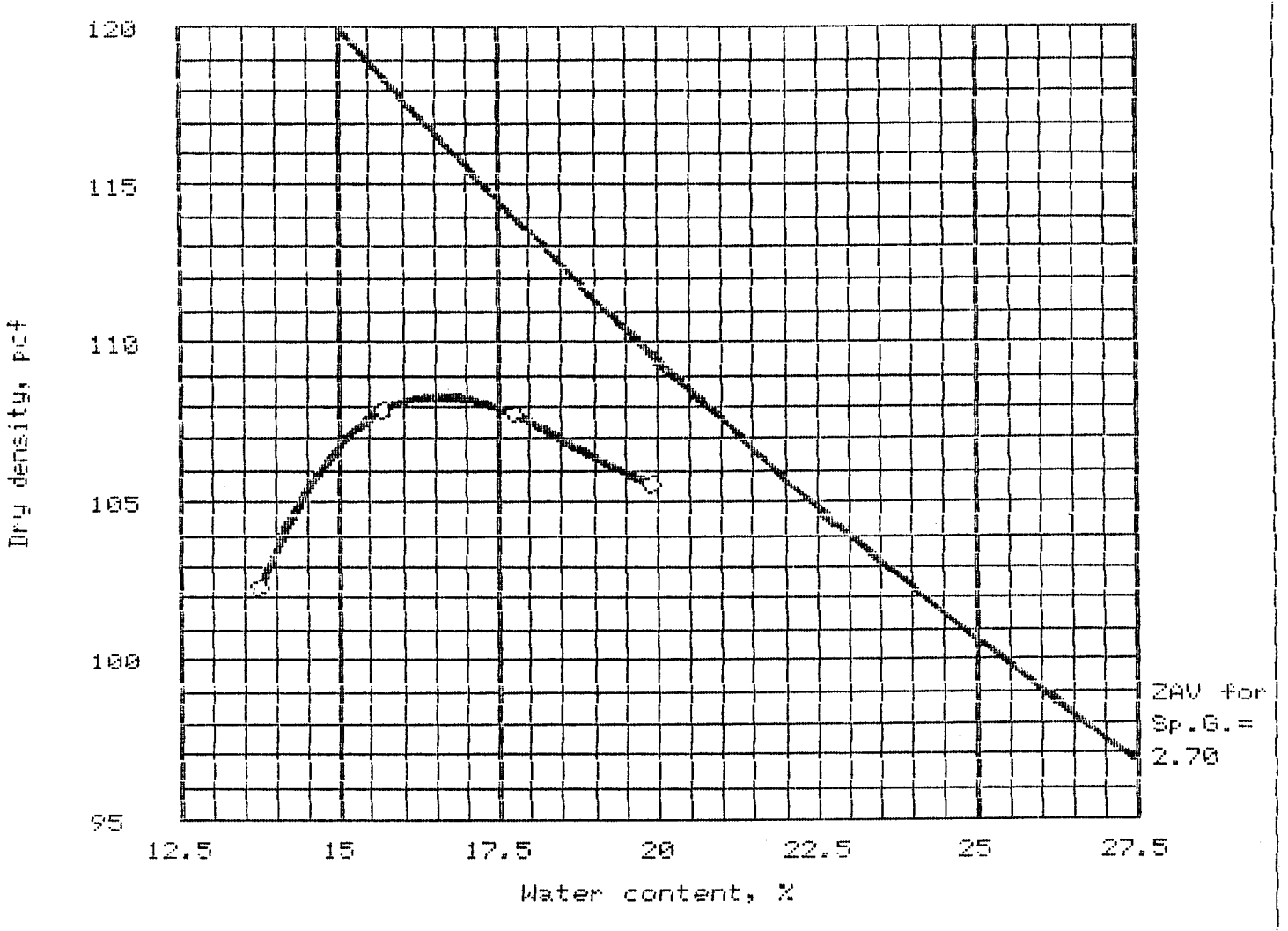


"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			%	2.65	39	16	0 %	85.3 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 23.1 % Maximum dry density = 100.4 pcf	Orange Slightly Silty Fine Sandy CLAY
Project No.: Key Constrution Company Project: Fords Colony Dam III Location: James City County, Virginia	Remarks: 2-2-89 Site Stockpile
PROCTOR TEST REPORT FROEHLING & ROBERTSON, INC.	Fig. No. _____

PROCTOR TEST REPORT



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			%				%	%

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 16.6 % Maximum dry density = 108.4 pcf	Orange Silty CLAY with Little Fine Sand
Project No.: Key Construction Company Project: Fords Colony, Dam III Location: James City County, Virginia	Remarks: 2-16-89 Dam Core
PROCTOR TEST REPORT FROEHLING & ROBERTSON, INC.	Fig. No. _____

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FROEHLING & ROBERTSON, INC.
FULL SERVICE LABORATORIES • ENGINEERS & CHEMISTS
"OVER ONE HUNDRED YEARS OF SERVICE"

833 Professional Place, W.
Chesapeake, Virginia 23320
Telephone: (804) 436-1111

Fax. No.: (804) 436-1674

Record No.: P-61-207 February 23, 1989

REPORT OF FIELD DENSITY TESTS

Client: Key Construction Company
P. O. Box 698
Clarksville, Virginia 23927

Project: Proposed Dam III
Fords Colony
James City County, Virginia

Date Made: 02-15-89

Test No.	Field Density (PCF)	Field Moisture (%)	Optimum Moisture (%)	Maximum Density (PCF)	Percent Compaction
1	108.5	19.3	16.6	108.4	100.1
2	110.0	19.1	16.6	108.4	101.5
3	108.8	20.4	16.6	108.4	100.4
4	110.2	19.3	16.6	108.4	101.7
5	115.2	17.2	16.6	108.4	106.3
6	115.0	17.4	16.6	108.4	106.1

Test Locations: (All Distances are approximate)

1) Station 38+50 on center line of core, elevation 43.35', 1.5' below grade.

2) Station 38+00 on center line of core, elevation 38.25', 3.5' below grade.

3) Station 37+50 on center line of core, elevation 38.08', 2.0' below grade.

4) Station 37+00 on center line of core, elevation 37.65', 2.0' below grade.

5) Station 36+50 on center line of core, elevation 39.00', 3.0' below grade.

6 Station 39+00 on center line of core, elevation 47.20', final grade.

Maximum density in accordance with: ASTM D-698
Field density in accordance with: ASTM D-2922

Testing Technician: K. McMath

Respectfully Submitted,
FROEHLING & ROBERTSON, INC.

April B. Saunders
MATERIALS TESTING SERVICES

John P. Sensabaugh, P.E.
GEOTECHNICAL ENGINEER

/re

AES, A PROFESSIONAL CORPORATION
Engineering & Surveying
1761 Jamestown Road
WILLIAMSBURG, VIRGINIA 23185

(804) 253-0040

—HAND DELIVER—

LETTER OF TRANSMITTAL

DATE	JOB NO.
MARCH 14, 1989	5652

ATTENTION: DARRYL COOK

RE: FORD'S COLONY SECTION 7 AND 13 – DAM #3

TO JCC CODE COMPLIANCE
P.O. BOX JC
WMSBG, VA 23187

3-15-89

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☒ COPY OF REPORTS

COPIES	DATE	NO.	DESCRIPTION
1	~~1/27/89~~ 1/31/89		SUBSURFACE EXPLORATION AND GEOTECHNICAL ANALYSIS
1	2/28/89		CONSTRUCTION OBSERVATIONS AND SOILS TESTING

THESE ARE TRANSMITTED as checked below:

☒ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

☒ As requested ☐ Returned for corrections ☐ Return _____ corrected prints

☒ For review and comment ☐ _____

☐ FOR BIDS DUE _____ 19____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS
PLEASE CALL IF YOU HAVE ANY COMMENTS.

COPY TO _____ SIGNED: James H. Barnett

If enclosures are not as noted, kindly notify us at once.

PC094_FORDS_COLONY_SEC_7 - 079

AES CONSULTING ENGINEERS
Engineering, Surveying and Planning
5248 Olde Towne Road, Suite 1
WILLIAMSBURG, VIRGINIA 23188

(804) 253-0040

LETTER OF TRANSMITTAL

DATE	JOB NO.
7-29-91	5652

ATTENTION: Darryl Cook

RE: Ford's Colony @ Wmsbg
Section 7
"Field Change"

TO James City County
Code Compliance

WE ARE SENDING YOU ☐ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1			Section 7 Drainage Plan Sheet 18 & 19
1			Revised Drainage calculations

RECEIVED

THESE ARE TRANSMITTED as checked below:

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☐ For review and comment ☐ _____

☐ FOR BIDS DUE _____ 19____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS

Darryl,
Please give me a call should you have any questions, ~~or~~ want to schedule a field trip or be in the need of additional information!

COPY TO _____ SIGNED: Steven Chilly

PRODUCT 239 AES Inc. Groton, Mass. 01471 To Order PHONE TOLL FREE 1-800-225-6380

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