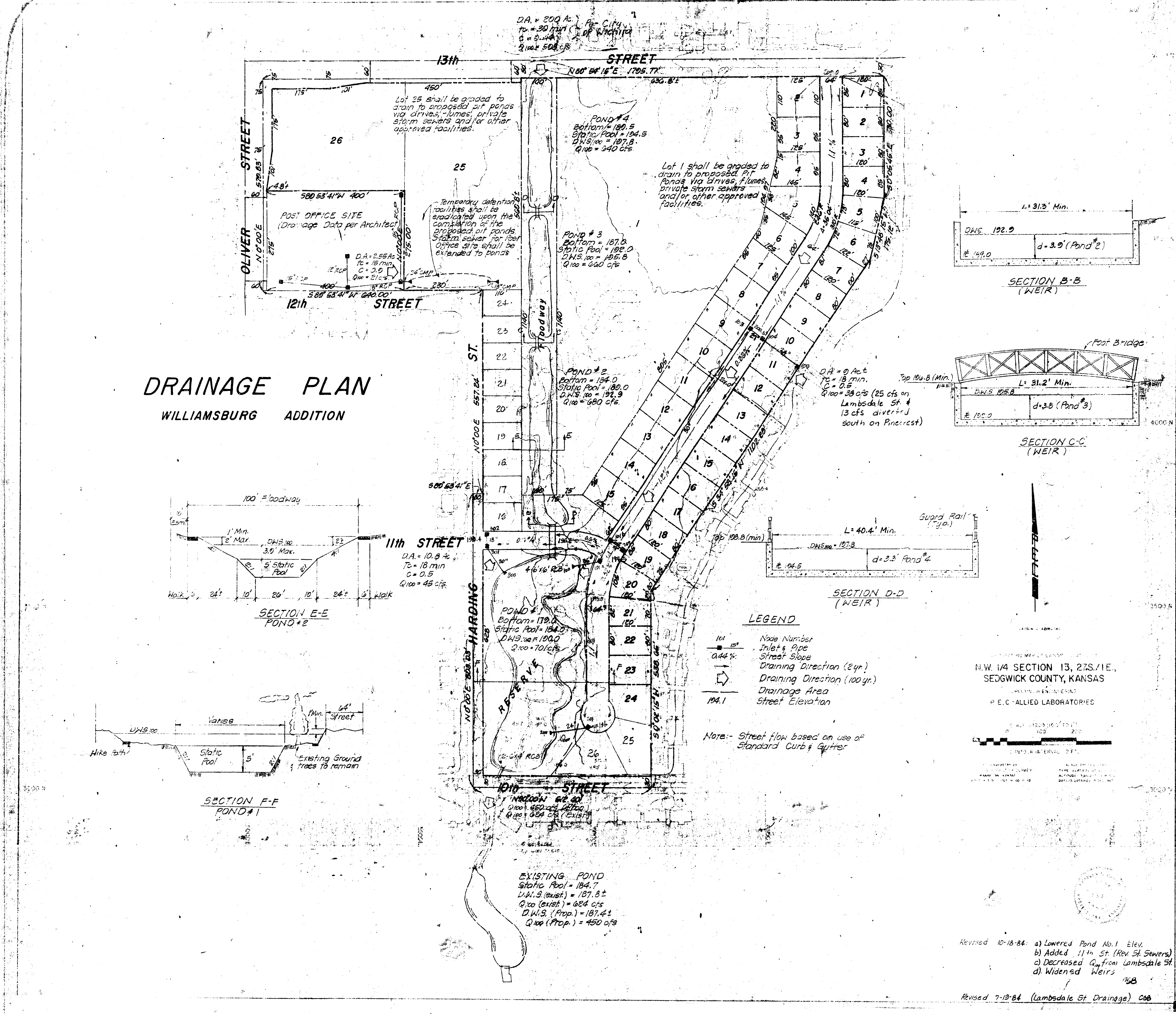


Williamsburg storm sewer - Williamsburg street system
file willsewer

Input File: willsewer

* * * HYDROLOGY * * *

Node to Node		C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
106	107	0.50	0.10	0.00	0.0	15.00	4.06	0.20	20.05	3.62	0.18	41.80	36"	5.91	110.00	0.31	[illegible]
105	106	0.50	1.60	0.00	0.0	15.00	4.06	3.20	15.00	4.06	3.20	3.20	15"	2.61	30.00	0.19	15.19
104	106	0.50	1.80	0.00	0.0	15.00	4.06	1.60	19.84	3.64	1.43	38.75	36"	5.48	70.00	0.21	[illegible]
108	104	0.50	1.40	0.00	0.0	15.00	4.06	1.20	19.01	3.70	1.09	37.31	30"	7.60	380.00	0.83	19.84
102	108	0.50	4.40	0.00	0.0	15.00	4.06	8.90	18.28	3.76	8.24	36.22	30"	7.38	320.00	0.72	[illegible]
103	102	0.50	1.60	0.00	0.0	15.00	4.06	3.20	15.00	4.06	3.20	3.20	15"	[illegible]	35.00	0.22	15.22
101	102	0.50	0.00	0.00	0.0	18.00	3.78	25.00	18.00	3.78	25.00	25.00	24"	7.96	135.00	0.28	18.28

Williamsburg storm sewer - Williamsburg street system
file willsewer

Input File: willsewer

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
102	[illegible]	[illegible]	0.0000	0.0276	0.0000	0.4717	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
101	[illegible]	[illegible]	0.0000	0.0000	0.0000	0.0000	0.0000	[illegible]	[illegible]	[illegible]	[illegible]
103	[illegible]	[illegible]	0.0000	0.0000	0.0000	0.0000	0.0000	[illegible]	[illegible]	[illegible]	[illegible]
108	[illegible]	[illegible]	0.0000	0.0052	0.0000	0.2088	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
104	[illegible]	[illegible]	0.0000	0.0811	0.0000	0.0000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
105	[illegible]	[illegible]	0.0000	0.0000	0.0000	0.0000	0.0000	[illegible]	[illegible]	194.6000	[illegible]
106	[illegible]	[illegible]	0.0000	[illegible]	0.0000	0.0000	[illegible]	[illegible]	[illegible]	194.6000	[illegible]
107	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	187.0000	195.0000	[illegible]

Williamsburg storm sewer - Williamsburg Street
file willsewer-2yr

Input File: willsewer-2yr

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Node to Node		C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
106	107	0.50	0.10	0.00	0.0	15.00	4.06	0.20	20.68	3.58	0.18	33.71	36"	4.77	110.00	0.38	[illegible]
105	106	0.50	1.60	0.00	0.0	15.00	4.06	3.20	15.00	4.06	3.20	3.20	15"	2.61	30.00	0.19	[illegible]
104	106	0.50	1.80	0.00	0.0	15.00	4.06	1.60	20.41	3.60	1.42	30.69	36"	4.34	70.00	0.27	[illegible]
108	104	0.50	1.40	0.00	0.0	15.00	4.06	1.20	19.34	3.68	1.09	29.27	30"	5.96	380.00	1.06	20.41
102	108	0.50	4.40	0.00	0.0	15.00	4.06	8.90	19.42	3.75	8.22	28.19	30"	5.74	320.00	0.93	19.34
103	102	0.50	1.60	0.00	0.0	15.00	4.06	3.20	15.00	4.06	3.20	3.20	15"	2.61	35.00	0.22	15.22
101	102	0.50	0.00	0.00	0.0	18.00	3.78	17.00	18.00	3.78	17.00	17.00	24"	5.41	135.00	0.42	18.42

Williamsburg storm sewer - Williamsburg Street
file willsewer-2yr

Input File: willsewer-2yr

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
102	0.00472	1.5111	0.0000	0.0057	0.0000	0.2273	0.5659	2.3102	[illegible]	[illegible]	[illegible]
101	0.00565	0.7624	0.0000	0.0000	0.0000	0.0000	0.0000	0.7624	[illegible]	[illegible]	[illegible]
103	0.00245	0.0859	0.0000	0.0000	0.0000	0.0000	0.0000	0.0859	[illegible]	[illegible]	[illegible]
108	0.00509	1.9355	0.0000	0.0000	0.0000	0.1368	[illegible]	2.1712	[illegible]	[illegible]	[illegible]
104	0.00212	0.1482	0.0000	0.0000	0.0000	0.0519	0.0000	[illegible]	[illegible]	[illegible]	[illegible]
105	[illegible]	0.0736	0.0000	0.0000	0.0000	0.0000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
106	0.00255	0.2809	0.0000	0.0000	0.0000	0.0000	0.1326	[illegible]	[illegible]	[illegible]	[illegible]
107	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	187.0000	[illegible]	[illegible]

Williamsburg Storm Sewer - Williamsburg Street
file willsewer-100

Input File: willsewer-100

Date: 12-28-1984
Time: 09:56:05

Storm Frequency = 100-Year

* * * HYDROLOGY * * *

Node to Node		C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
[illegible]	107	0.50	0.10	0.00	0.0	15.00	8.97	0.90	19.68	8.58	0.45	61.68	36"	8.73	110.00	0.21	19.85
105	106	0.50	1.60	0.00	0.0	15.00	8.97	11.70	15.00	8.97	11.70	11.70	15"	9.53	30.00	0.05	15.05
104	106	0.50	1.80	0.00	0.0	15.00	8.97	[illegible]	19.48	8.58	1.99	50.49	36"	7.17	70.00	0.16	19.64
108	104	0.50	1.40	0.00	0.0	15.00	8.97	[illegible]	18.84	[illegible]	1.46	48.70	30"	9.92	380.00	0.64	19.48
102	108	0.50	4.40	0.00	0.0	15.00	8.97	[illegible]	18.28	[illegible]	11.11	47.25	30"	9.62	320.00	0.55	18.84
103	102	0.50	1.60	0.00	0.0	15.00	8.97	12.00	15.00	8.97	12.00	12.00	15"	9.78	35.00	0.06	15.06
101	102	[illegible]	[illegible]	0.00	0.0	18.00	8.36	25.00	18.00	8.36	25.00	25.00	24"	7.96	135.00	0.28	18.29

Williamsburg Storm Sewer - Williamsburg Street
file willsewer-100

Input File: willsewer-100

Date: 12-28-1984
Time: 09:56:05

Storm Frequency = 100-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
102	0.01326	4.2436	0.0000	0.0454	0.0000	0.4917	2.0392	6.8199	201.5532	200.4000	-1.15
101	0.01221	1.6487	0.0000	0.0000	0.0000	0.0000	0.0000	1.6487	203.2018	204.0000	0.80
103	0.03451	1.2078	0.0000	0.0000	0.0000	0.0000	0.0000	1.2078	202.7610	200.4000	-2.36
108	0.01410	5.3565	0.0000	0.0091	0.0000	0.3551	0.2499	5.9705	194.7333	199.9000	5.17
104	0.00577	0.4047	0.0000	0.1460	0.0000	0.0000	-0.5720	-0.0218	188.7628	195.0000	6.24
105	0.03280	0.9841	0.0000	0.0000	0.0000	0.0000	0.0000	0.9841	189.7687	194.6000	4.83
106	0.00855	0.9408	0.0000	0.0384	0.0000	0.0000	0.8054	1.7845	188.7845	194.6000	5.82
107	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	187.0000	195.0000	8.00

Williamsburg Storm Sewer - Metal Option - Williamsburg Street
file willsew-met

Input File: willsew-met

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Node to Node		C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
106	107	0.50	0.10	0.00	0.0	15.00	4.06	0.20	21.06	3.56	0.18	41.67	48"	3.32	110.00	0.55	21.62
105	106	0.50	1.60	0.00	0.0	15.00	4.06	3.20	15.00	4.06	3.20	3.20	12"	2.61	30.00	0.19	15.19
104	106	0.50	1.80	0.00	0.0	15.00	4.06	1.60	20.69	3.58	1.41	38.68	48"	3.08	70.00	0.38	21.06
108	104	0.50	1.40	0.00	0.0	15.00	4.06	1.20	19.48	3.67	1.06	37.26	36"	[illegible]	380.00	1.20	[illegible]
102	108	0.50	4.40	0.00	0.0	15.00	4.06	8.90	18.44	3.74	8.21	36.19	36"	[illegible]	[illegible]	1.04	19.49
103	102	0.50	1.60	0.00	0.0	15.00	4.06	3.20	15.00	4.06	3.20	[illegible]	15"	[illegible]	[illegible]	[illegible]	[illegible]

Williamsburg Storm Sewer - Metal Option - Williamsburg Street

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

Node	H-d-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	H-d-Gl Elevation	Desired Elevation	Dstr. (Ft)
102	0.01003	3.2093	0.0000	0.0004	0.0000	0.2014	0.3574	3.7685	193.4114	200.4000	3.99
101	0.01286	1.7093	0.0000	0.0000	0.0000	0.0000	0.0000	1.7093	192.1207	204.0000	5.68
103	0.00836	0.2927	0.0000	0.0000	0.0000	0.0000	0.0000	0.2927	196.7041	200.4000	3.70
108	0.01064	4.0427	0.0000	0.0025	0.0000	0.1005	0.1613	4.2470	192.4429	199.9000	7.26
104	0.00247	0.1730	0.0000	0.0569	0.0000	0.0000	-0.2125	0.0174	188.3959	195.0000	6.60
105	0.00836	0.2509	0.0000	0.0000	0.0000	0.0000	0.0000	0.2509	188.6295	194.6000	5.97
106	0.00287	0.3155	0.0000	0.0024	0.0000	0.0000	0.0607	0.3786	188.3786	194.6000	6.22
107	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	188.0000	195.	7.00

Williamsburg Storm Sewer - Metal Option - Williamsburg Street

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

Node	H-d-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	H-d-Gl Elevation	Desired Elevation	Dstr. (Ft)
102	0.00606	1.9402	0.0000	0.0060	0.0000	0.0931	0.3656	2.3449	193.2292	200.4000	7.17
101	0.00585	0.7904	0.0000	0.0000	0.0000	0.0000	0.0000	0.7904	194.0195	204.0000	9.98
103	0.00836	0.2927	0.0000	0.0000	0.0000	0.0000	0.0000	0.2927	193.5219	200.4000	6.88
108	0.00653	2.4831	0.0000	0.0019	0.0000	0.5607	0.0499	3.1156	190.8842	199.9000	9.02
104	0.00155	0.1082	0.0000	0.0346	0.0000	0.0000	-0.1261	0.0167	188.2686	195.0000	6.73
105	0.00836	0.2509	0.0000	0.0000	0.0000	0.0000	0.0000	0.2509	188.5028	194.6000	6.10
106	0.00186	0.2044	0.0000	0.0019	0.0000	0.0000	0.0457	0.2519	188.2519	194.6000	6.35
107	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	188.0000	195.0000	7.00

* * * HYDROLOGY * * *

STORM WATER COLLECTION

PROJ. NO.: AREA: COMPUTED BY: DATE: C'K'D BY:

Frequency = 100yr

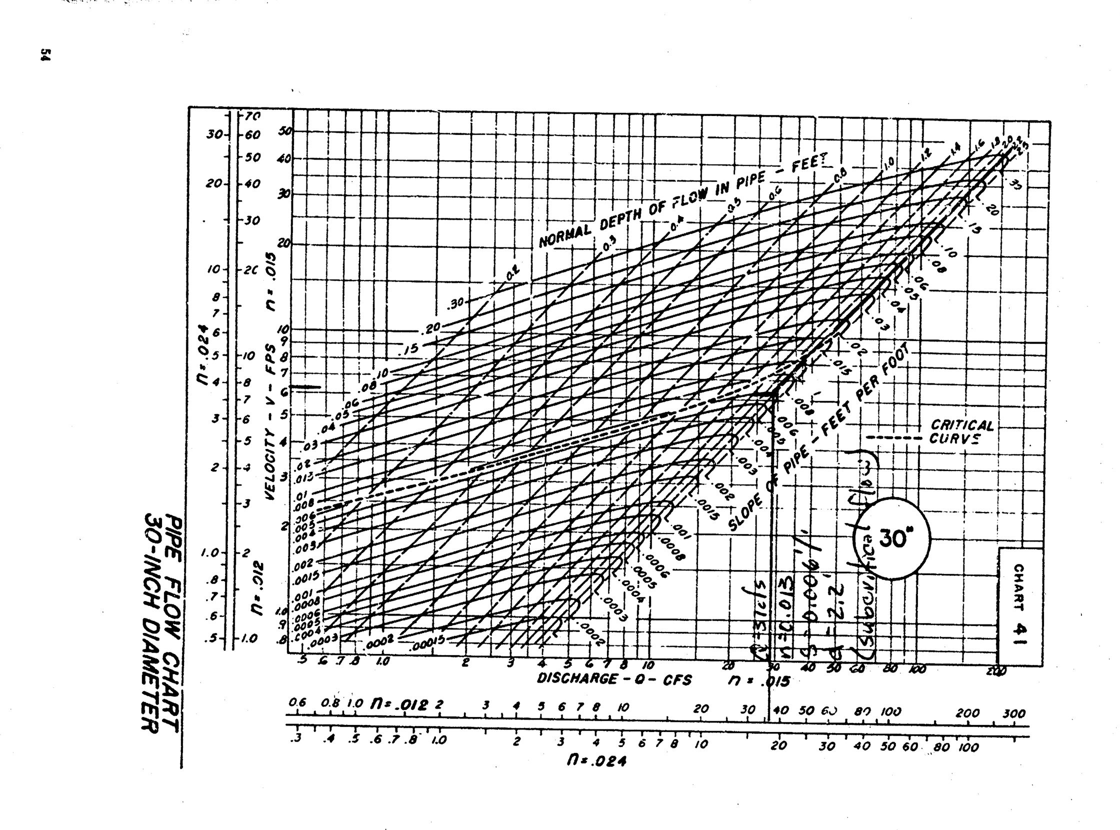
DR. AREA NO.	INLET NO.	LOCATION	S (%)	L (FEET)	T_C (MIN.)	C	A (ACRE)	CA	I (IN/HR.)	Q (CFS)	Q_G	GUTTER SLOPE %	PAV'T SLOPE/FT	W	D	Q_{IN}	BYPASS
1	1				18	0.5	9.0±		8.37	25	–	–	–	–	–	25.0	–
2	2				15	0.5	4.4		8.98	19.8	sump (max depth = 0.30')					12.0	1.5
3	3				15	0.5	1.6		8.98	7.2		"				12.0	1.5
8	8				15	0.5	1.4		8.98	6.3	7.8	1.6%	1/32	-	0.38	1.6	6.2
4	4				15	0.5	1.8		8.98	8.1	14.3	1.3%	1/32	–	0.52	2.2	12.1
5	5				15	0.5	1.6		8.98	7.2	4.5+7.2 11.7	sump (max depth = 0.5')				11.7	0.0
6	6				15	0.5	0.1		8.98	0.5	0.5		"			0.5	–

STORM WATER COLLECTION

PROJ. NO.: AREA: COMPUTED BY: DATE: C'K'D BY:

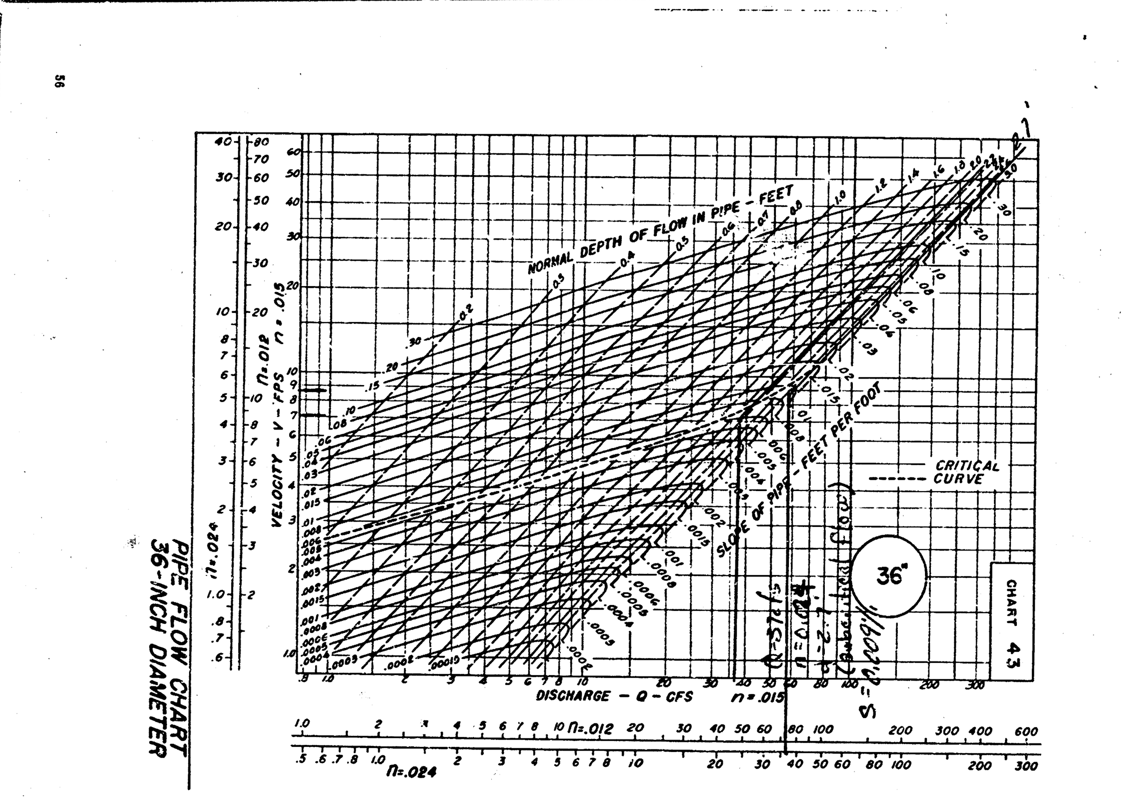
2yr

DR. AREA NO.	INLET NO.	LOCATION	S (%)	L (FEET)	T_C (MIN.)	C	A (ACRE)	CA	I (IN/HR.)	Q (CFS)	Q_G	GUTTER SLOPE %	PAV'T SLOPE/FT	W	D	Q_{IN}	BYPASS
1	1				18	0.5	9±	–	3.78	25	–					25.0	–
2	2				15	0.5	4.4	–	4.06	8.9	sump - d max = 0.30'					8.9	–
3	3				15	0.5	1.6	-	4.06	3.2	"					3.2	–
8	8				15	0.5	1.4	-	4.06	2.8	3.7	1.6	1/32	–	0.33	1.2	2.5
4	4				15	0.5	1.8	-	4.06	3.7	6.2	1.3	1/32	–	0.37	1.6	4.6
5	5				15	0.5	1.6	-	4.06	3.2	3.2	sump				3.2	–
6	6				15	0.5	0.1	-	4.06	0.2	0.2	"				0.2	–



PIPE FLOW CHART 30-INCH DIAMETER

CHART 41



PIPE FLOW CHART 36-INCH DIAMETER

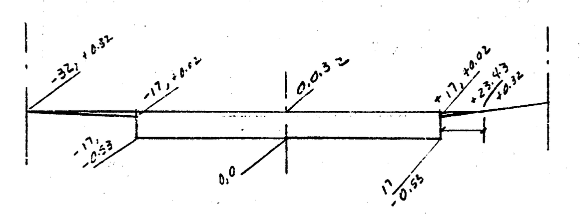
CHART 43

PROFESSIONAL ENGINEERING CONSULTANTS

Date 12/26/84 Page 1 of 1

Project Williamsburg Storm Sewer

Item Q_{100} - depth of flow



$\frac{.7}{15} = \frac{.3}{x}$ $x = 6.43'$

$A = \frac{15 \cdot 0.3}{2} = 2.25$ $WP = 15'$ $R^{2/3} = 0.28$ $AR^{2/3} = 0.63$ $n = 0.02$

$A = \frac{6.43 \cdot 0.3}{2} = 0.96$ $WP = 6.43$ $R^{2/3} = 0.28$ $AR^{2/3} = 0.27$ $n = 0.02$

$A = 2 \cdot (17)(\frac{0.55 + 0.32}{2})$ $WP = 35.10$ $R^{2/3} = 0.56$ $AR^{2/3} = 8.29$ $n = 0.0$

$= 14.79$

$Q_{max} = \frac{1.49}{n} \cdot AR^{2/3} \cdot S^{1/2}$ $(67.05 + 771.89)\, S^{1/2}$

Location	S(%)	Qmax	Qact.
10+50	0.0036	50.3 (11 cfs to cr - ½ street)	27.8 *
15+00	0.0132	96.4	28.1
20+00	0.0040	53.1 (11.4 cfs to cr - ½ st)	27.0

* Q act will overtop left curb before getting to theo. depth.

RECEIVED OCT 19 1984 DESIGN DIVISION

PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION

October 18, 1984

The City of Wichita
Engineering Department
City Hall - 7th Floor
455 N. Main
Wichita, KS 67202

Attention: Mr Chris Breitenstein, P.E.
Drainage & Flood Control Engineer

Reference: Williamsburg Addition
Revised Drainage Plan
PEC File No. 36-83324-1540

Dear Mr. Breitenstein:

Transmitted herewith are two (2) copies of the Revised Drainage Plan and accompanying support calculations for Williamsburg, an Addition to Wichita.

The following revisions have been made:

a) The static pool, pond bottom, and design water surface elevations have been lowered by 1 foot. The static pool of 184.0 now matches the existing creek flowline elevation.

b) The street layout has been revised to add 11th Street and add a cul-de-sac on the south end of Williamsburg Circle. As a result, the alignments of Storm Sewer Systems 100, 200, and 300 were revised.

c) The 100-year Q on Lambsdale Street entering the east side of Williamsburg Addition has been reduced. During a major storm, some of the runoff will overtop the crown of Lambsdale Street and flow southward on Pinecrest. This results in a decreased Q entering Node 105 and results in smaller pipe sizes within Storm Sewer System 100.

1440 EAST ENGLISH
WICHITA, KANSAS 67211
(316) 262-2691

City of Wichita
October 18, 1984
Page 2

d) The required length of the weirs used as control structures for Pond No's 2, 3, and 4 have been increased. The increase in length will balance the decrease in efficiency due to the weirs being submerged. Increases range from 1.2 to 5.4 feet.

If you have any questions or need any additional information concerning this property, please advise.

Very truly yours,

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

Charles S. Brown

Charles S. Brown, P.E.
Project Engineer

cc: Mr. Bill Morin
Kansas General Properties, Inc.

Enc: As noted

GSB:ddd

THE CITY OF WICHITA

OFFICE OF City Engineer DATE June 27, 1984

TO Jack Galbraith, Chief Planner - Current Plans Division

FROM Mike Lindebak, City Engineer

SUBJECT Williamsburg Residential C.U.P.

The drainage plan as presented more than adequately meets detention storage requirements. The post development flow from the C.U.P. site will be 450 cfs; current flow from the site is 624 cfs.

One area of concern, however, is the drainage from the existing paved Lambsdale Street. An open concrete flume is proposed. However, with the current lotting arrangement, two 90° turns would be required. We would suggest a different lotting arrangement or placing the drainage underground.

We would also suggest a 66 ft. wide street right-of-way.

Mike Lindebak
City Engineer

ML:bgr

PROFESSIONAL ENGINEERING CONSULTANTS

HYDROLOGY DATA SHEET

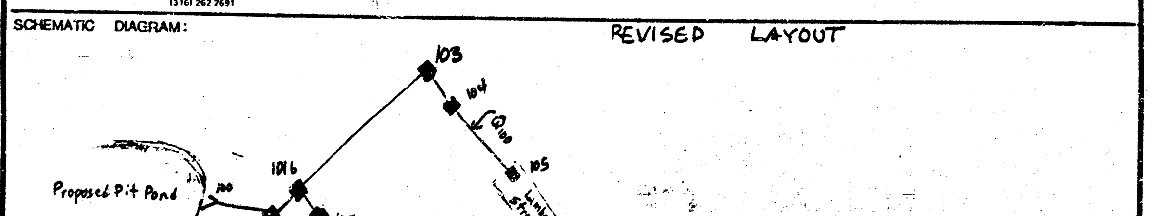
PAGE 1 OF 4

PROJECT: WILLIAMSBURG PROJECT NO. 36-83324-1540

ITEM: STORM SEWER SYSTEM 100 DATE: Oct. 17, 1984

RETURN PERIOD: 2 COMPUTATIONS BY: CSB REVISIONS BY:

SCHEMATIC DIAGRAM: REVISED LAYOUT



SUB-BASIN	C	AREA (acres)	SLOPE (%)	LENGTH (feet)	T_c	I_c	Q_c	T_c	I	Q	ΣQ	PIPE (inches)	SLOPE (%)	VELOCITY	LENGTH (feet)	T_t	$T_c + T_t$
105	(SEE ATTACHED)						25	18		25	25						
104	0.5	2.3			13	4.06	9.1	18.3	3.75	8.4	33.6	24	1.3	8	130	0.3	18.3
103	0.5	2.			15	4.06	5.1	18.3	3.75	3.9	37.3	27	1.0	8	30	-	18.3

PROFESSIONAL ENGINEERING CONSULTANTS

HYDROLOGY DATA SHEET

PAGE 2 OF 4

PROJECT: WILLIAMSBURG PROJECT NO. 36-83324-1540

ITEM: Storm Sewer System 100 (Cont'd) DATE: Oct. 17, 1984

RETURN PERIOD: 2 COMPUTATIONS BY: CSB REVISIONS BY:

SCHEMATIC DIAGRAM:

PROFESSIONAL ENGINEERING CONSULTANTS

HYDROLOGY DATA SHEET

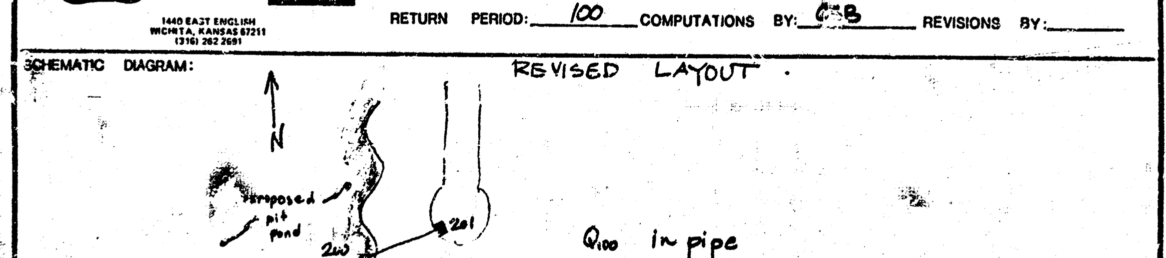
PAGE 3 OF 4

PROJECT: WILLIAMSBURG PROJECT NO. 36-83324-1540

ITEM: STORM SEWER SYSTEM 200 DATE: Oct. 17, 1984

RETURN PERIOD: 100 COMPUTATIONS BY: CSB REVISIONS BY:

SCHEMATIC DIAGRAM: REVISED LAYOUT



PROFESSIONAL ENGINEERING CONSULTANTS

HYDROLOGY DATA SHEET

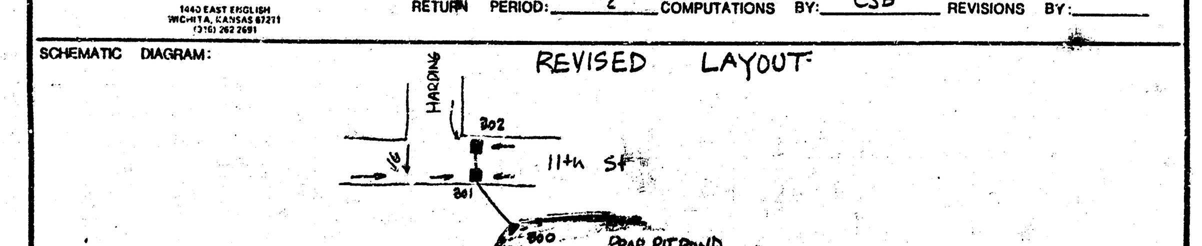
PAGE 4 OF 4

PROJECT: WILLIAMSBURG PROJECT NO. 36-83324-1540

ITEM: STORM SEWER SYSTEM 300 DATE:

RETURN PERIOD: 2 COMPUTATIONS BY: CSB REVISIONS BY:

SCHEMATIC DIAGRAM: REVISED LAYOUT



Date [illegible] Page 8 of [illegible]
Project Williamsburg Storm Drain
Item Pond No. 1

STAGE - STORAGE CURVE

ELEV ft. COW datum	Area Ac.	Δh ft.	Avg Area Ac.	Incr. Vol Ac-ft	Σ Vol Ac-ft
					0
184		12	1.76	21.1	
					21.1
185		12	1.93	23.6	
					[illegible]
186		12	2.27	27.2	
					72.1
187		12	2.67	31.4	
					103.6
188		[illegible]	2.93	35.2	
					138.7
189		[illegible]	3.17	38.0	
					176.5
190		[illegible]	3.42 [illegible]	41.0	
					217.5
191		[illegible]	3.75 [illegible]	45.0	
					262.5
192					

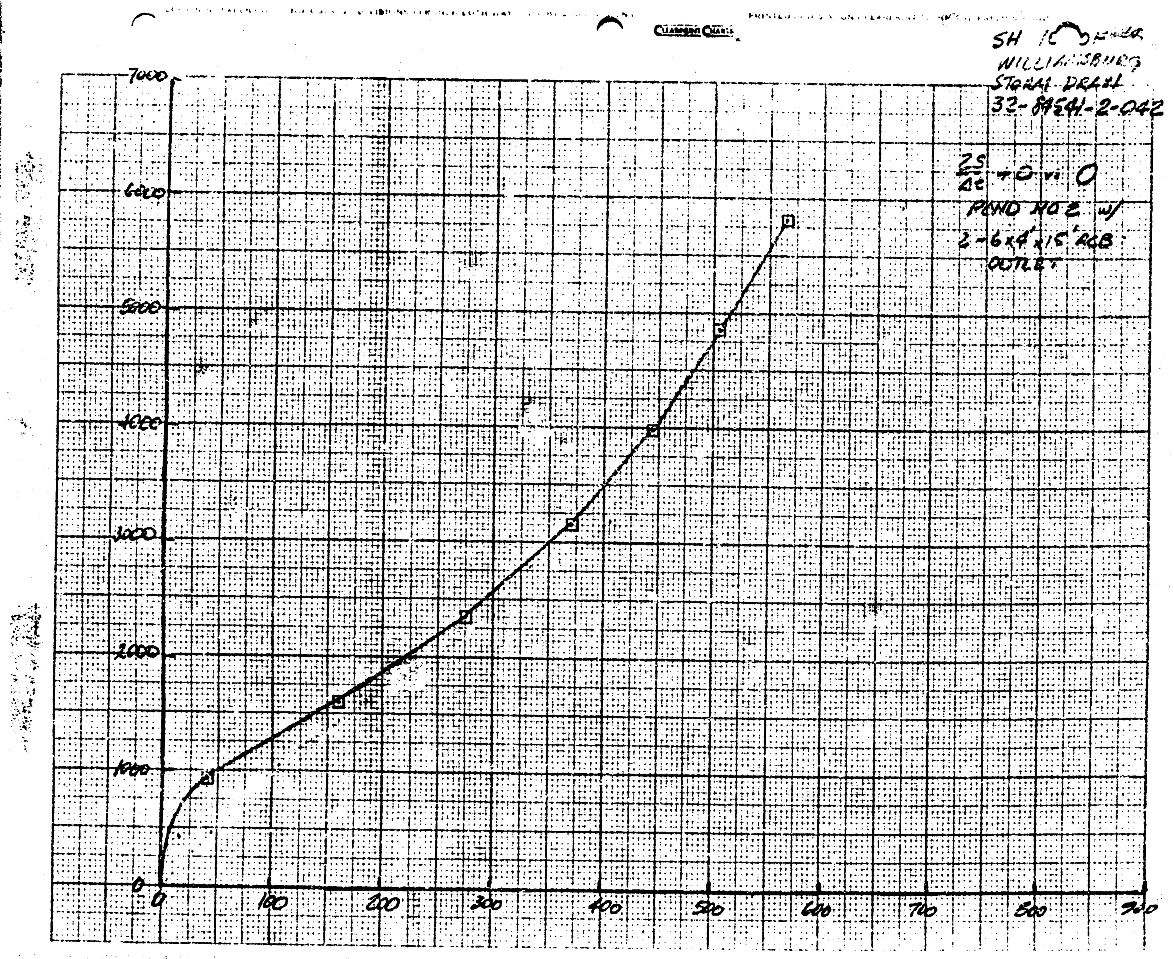
[illegible] computation

Date 12-[illegible]-84 Page 9 of [illegible]
Project Williamsburg Storm Drain
Item Pond No. 1

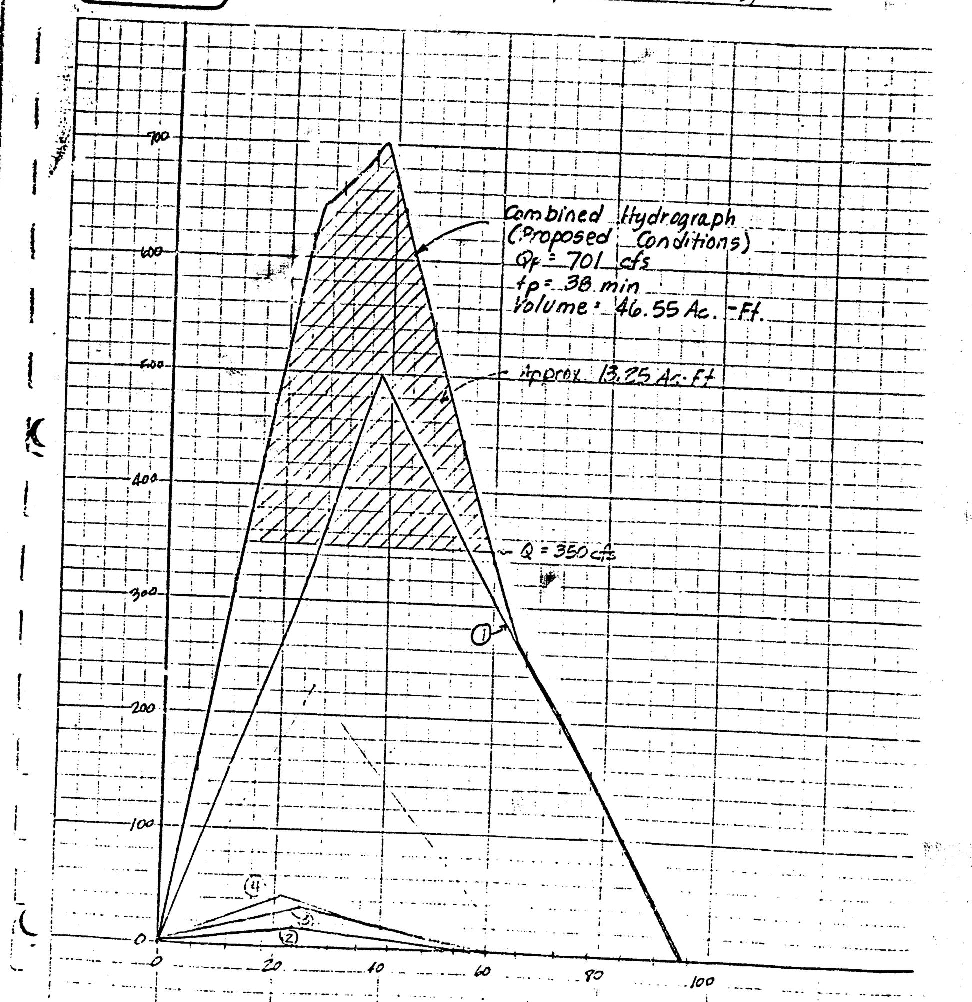
2S/Δt + O vs. O
[illegible] hr

ELEV ft. [illegible]	Storage, S Ac-ft	2S/Δt Ac-ft/hr	2S/Δt + O [illegible]	Discharge, O Ac-ft/Hr
184	0	0	0	0
185	21.1	422	437	15
186	44.[illegible]	898	938	40
187	[illegible]	1442	1602	160
188	[illegible]	2072	2347	275
189	138.7	2774	3144	370
190	176.8	3536	3981	445
191	[illegible]	4356	4861	505
192	[illegible]	5256	5820	564

* [illegible]



Date 5-1-84 Page 7 of [illegible]
Project Williamsburg C.U.P.
Item Hydrograph (Proposed Conditions)



Project:
Job No.:

RESERVOIR ROUTING TABLE

Date: [illegible]
By: [illegible]
Page 12 of [illegible]

(1) Time	(2) I_1	(3) I_1+I_2	(4) $\frac{2S_1}{\Delta t} - O_1$	(5) $\frac{2S_2}{\Delta t} + O_2$	(6) Outflow O_2	(7) Elev.	(8) Storage S_2
0	0	160	0	—	0	184	
0.1	[illegible]	[illegible]	150	160	5	184.6	
0.2	[illegible]	[illegible]	601	625	12	[illegible]	
0.3	[illegible]	[illegible]	1156	1336	115	186.8	
[illegible]	615	[illegible]	1721	[illegible]	260	187.7	
0.5	660	[illegible]	2296	2996	350	188.8	
0.6	690	1350	2816	3646	415	189.5	
[illegible]	6[illegible]0	1[illegible]50	3336	4146	455	190.1	
[illegible]	[illegible]	930	3466	4416	47[illegible]	190.4	
[illegible]	4[illegible]0	[illegible]	3486	4146	480	190.5	
[illegible]	[illegible]45	6[illegible]	3341	[illegible]	465	190.2	
1.1	255	455	3061	3941	440	189.9	
1.2	200	350	2706	3516	405	189.4	
1.3	150	245	2346	3056	355	188.0	
1.4	95	145	1981	2591	305	188.3	

$(3)_n + (4)_n = (5)_{n+1}$ $(5)_n - 2 \times (6)_n = (4)_{n+1}$

Project:
Job No.:

RESERVOIR ROUTING TABLE

Date: [illegible]
By: [illegible]
Page 3 of [illegible]

(1) Time	(2) I_1	(3) I_1+I_2	(4) $\frac{2S_1}{\Delta t} - O_1$	(5) $\frac{2S_2}{\Delta t} + O_2$	(6) Outflow O_2	(7) Elev.	(8) Storage S_2
[illegible]	50	50	1646	[illegible]	240	187.6	
[illegible]	0	0	1296	1696	175	187.1	
[illegible]			1086	1296	105	186.7	
[illegible]			946	1086	70	186.5	
			866	946	40	186.0	
[illegible]			806	866	30	185.7	
2.1			[illegible]	806	25	185.5	
[illegible]			716	756	20	185.3	
2.3			682	716	17	185.2	
2.4			652	682	15	185.1	
2.5			624	652	14	185.0	
2.6			600	624	12	184.8	
2.7			576	600	12	184.8	
2.8			556	576	10	184.7	
2.9				556	9	184.7	

$(3)_n + (4)_n = (5)_{n+1}$ $(5)_n - 2 \times (6)_n = (4)_{n+1}$

Sh. No. 14 of 14

Design Procedure:

Our design procedure uses the linear reservoir flood routing method. We assume that our reservoir can be represented by the simple hydrologic budget equation

$$I\Delta t - O\Delta t = \Delta S \qquad (2)$$

In our design, the reservoir is assumed to be initially empty, with outflow equal to zero. Discharge occurs only thru a principal spillway, which is a pipe through the embankment. Assuming that the rate of inflow is constant and the rate of outflow is constant for a short time increment Δt

$$I = \frac{1}{2}(I_t + I_{t+\Delta t})$$

$$O = \frac{1}{2}(O_t + O_{t+\Delta t})$$

$$\Delta S = S_{t+\Delta t} - S_t$$

With the above substitutions, equation (2) becomes

$$\frac{1}{2}(I_t + I_{t+\Delta t})\Delta t - \frac{1}{2}(O_t + O_{t+\Delta t})\Delta t = S_{t+\Delta t} - S_t$$

$$(I_t + I_{t+\Delta t}) - O_t - O_{t+\Delta t} = \frac{2}{\Delta t}(S_{t+\Delta t} - S_t)$$

$$(I_t + I_{t+\Delta t}) + \left(\frac{2S_t}{\Delta t} - O_t\right) = \frac{2S_{t+\Delta t}}{\Delta t} + O_{t+\Delta t} \qquad (3)$$

We will use equation (3) in developing our flood routing table.

The inflow hydrograph, stage-storage curve, and stage-discharge curve must be known. From these, a 2S/Δt+O vs.O curve is generated. Then, the values for the routing table may be computed as outlined below:

Col. (1): Time, increment, hours
Col. (2): The inflow hydrograph ordinate for time t
Col. (3): The value of I from Col (2) in this row + from Col. (2) of next row
Col. (5): (5) = [(3) from previous row + (4) previous row]
Col. (6): Outflow, O, corresponding to 2S/Δt + O on this row. The value is read from the 2S/Δt + O vs. O curve. (This col. is blank in row 1)
Col. (4): (4) = (5) - 2 x (6)
[2S/Δt - O = 2S/Δt + O - 2O]
Col. (7): The stage h corresponding to value of O in Col. (6) is read from the stage-discharge curve.

WILLIAMSBURG
RESIDENTIAL COMMUNITY UNIT PLAN

GENERAL

TOTAL GROSS AREA = 34.8 ACRES ±
TOTAL NET AREA = 30.8 ACRES ± (EXCLUSIVE OF PUBLIC STREET RIGHT-OF-WAY)

THIS DEVELOPMENT IS PROPOSED TO BE GARDEN APARTMENTS, ATTACHED SINGLE FAMILY WITH ACCOMMODATIONS FOR 1, 2, 3, or 4 DWELLING UNITS, AND ASSOCIATED COMMUNITY FACILITIES.

THE DENSITY PROPOSED FOR THIS DEVELOPMENT SHALL NOT EXCEED 14.8 D.U'S/NET ACRE OR A TOTAL OF 456 DWELLING UNITS.

GENERAL PROVISIONS

1.) ACCESS CONTROL IS AS INDICATED ON THE PLAN.
2.) ALL UTILITIES SHALL BE INSTALLED UNDERGROUND.
3.) DRAINAGE: DRAINAGE SHALL BE IN ACCORDANCE WITH THE APPROVED DRAINAGE PLAN ON FILE WITH THE ENGINEERING DEPARTMENT OF THE CITY OF WICHITA.
4.) IDENTIFICATION SIGNS SHALL BE IN ACCORDANCE WITH THE CODE OF THE CITY OF WICHITA.
5.) BUILDING SETBACKS SHALL BE AS SHOWN ON THE PLAN, OR AS INDICATED IN THE PARCEL DESCRIPTIONS.
6.) THE MAXIMUM NUMBER OF DRIVEWAYS PER LOT SHALL NOT EXCEED TWO (2).
7.) A HOMEOWNERS ASSOCIATION AGREEMENT PROVIDING FOR THE MAINTENANCE OF THE RESERVE. LOCATED IN PARCEL THREE (3), WILL BE SUBMITTED WITH THE FINAL PLAT.

MEMO

TO: Mr. M. E. Lindebak, P.E.
City Engineer
Wichita, KS 67202
ATTN: Mr. Don Schneider, P.E.

PROJECT NO. 32-84541-2,3,&4-04
PROJECT: Williamsburg Addtn. - Streets, Storm Sewer & Storm Drain
DATE: January 9, 1985

COPIES TO: File

FROM: Brent E. Remsberg, P.E.
REFERENCE: Concept Review

PLEASE ADVISE IMMEDIATELY OF ANY MISCONCEPTIONS OR OMISSIONS YOU BELIEVE TO BE CONTAINED HEREIN.

Transmitted herewith are the following items for the referenced project.

1. Hardshell showing proposed street grades.
2. Geometric concept plan for street improvements.
3. Design computations for the proposed storm sewer.
4. Proposed profile for the storm water sewer.
5. Design computations for the proposed detention pond.
6. Detention pond layout.

We wish to discuss this project with you at your earliest convenience. Several items must be resolved before we can complete the design. They include:

1. Pavement type for Harding.
2. Geometrics at 10th and Harding and at 11th and Harding.
3. The proposed hammerhead design.
4. The inlet, typical section, and miscellaneous details desired for this project.

Carl has street

PARCEL DESCRIPTIONS

PARCEL ONE

PROPOSED USE - GARDEN APARTMENTS AND ASSOCIATED COMMUNITY FACILITIES
GROSS AREA - 14.1 AC.±
NET AREA - 14.1 AC±
DENSITY - 23.4 D.U.'S/NET ACRE OR 330 D.U.'S
MAXIMUM BUILDING HEIGHT - 35 FEET
PARKING RATIO - 1.5/D.U.

PARCEL TWO

PROPOSED USE - ATTACHED SINGLE FAMILY WITH ACCOMMODATIONS FOR 2, 3, or 4 DWELLING UNITS PER PLATTED LOT
GROSS AREA - 4.9 AC.±
NET AREA - 3.9 AC.±
DENSITY - 14.4 D.U.'S/NET ACRE OR 56 D.U.'S
MAXIMUM BUILDING HEIGHT - 35 FEET
PARKING RATIO - 2.0/D.U.
REAR YARD SETBACK - 20 FEET
SIDE YARD SETBACK - 6 FEET

PARCEL THREE

PROPOSED USE - ATTACHED SINGLE FAMILY WITH ACCOMMODATIONS FOR 1 or 2 DWELLING UNITS PER PLATTED LOT, AND PEDESTRIAN OPEN SPACE AND DRAINAGE.
GROSS AREA - 15.8 AC.±
NET AREA - 12.8 AC±
DENSITY - 5.5 D.U.'S/NET ACRE OR 70 D.U.'S
MAXIMUM BUILDING HEIGHT - 35 FEET
PARKING RATIO - 2.0/D.U.
REAR YARD SETBACK - 20 FEET
SIDE YARD SETBACK - 6 FEET

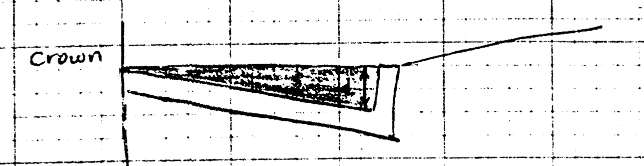
Date Oct. 17, 1984 Page 1 of 1
Project Williamsburg
Item Revised Drainage Plan

Determine street flow on Lambsdale St during 100 year storm.

Previous calculations for this sub-basin indicate $Q_{100} = 33$ cfs.

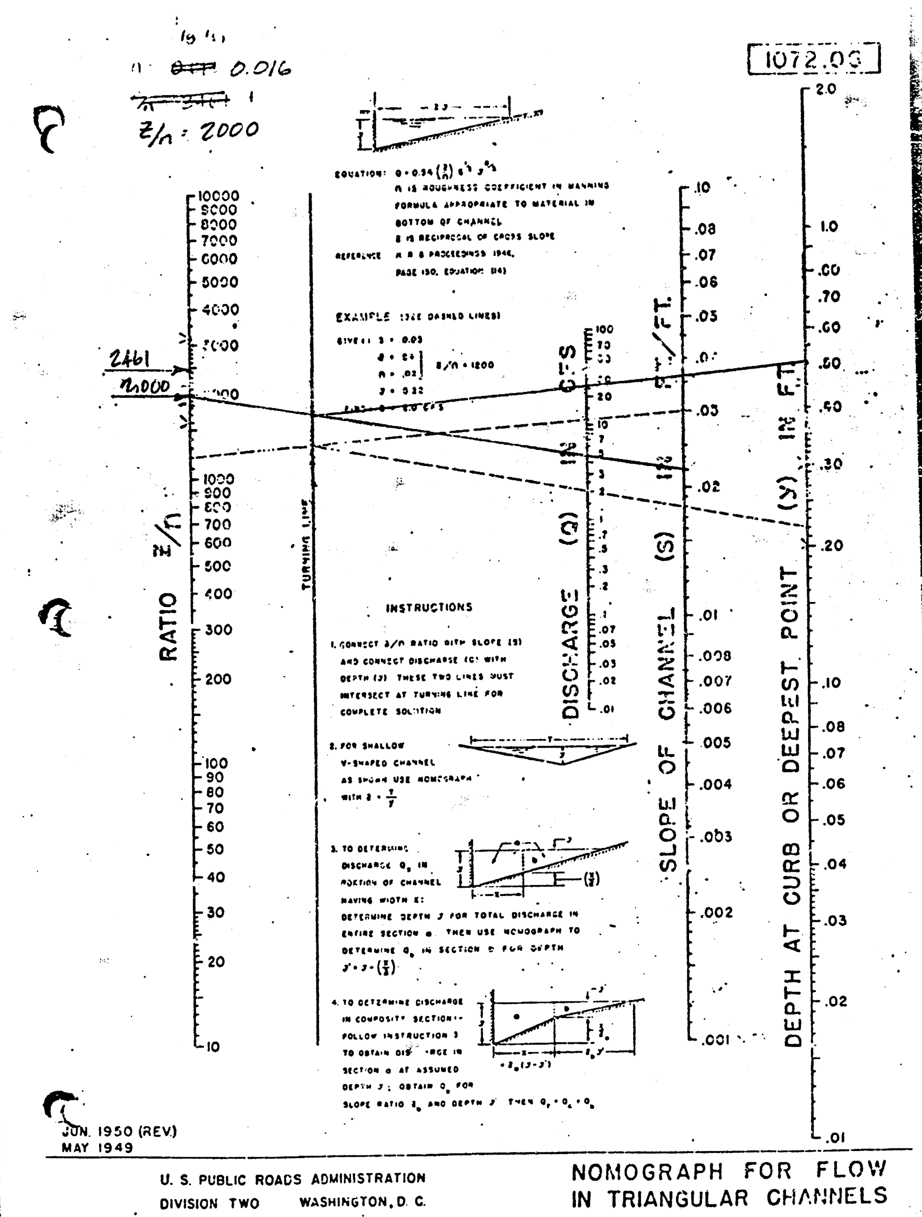
During major storms, however, the water overtops crown on Lambsdale street and flows southward on Pinecrest.

Q on Lambsdale street determined as follows:



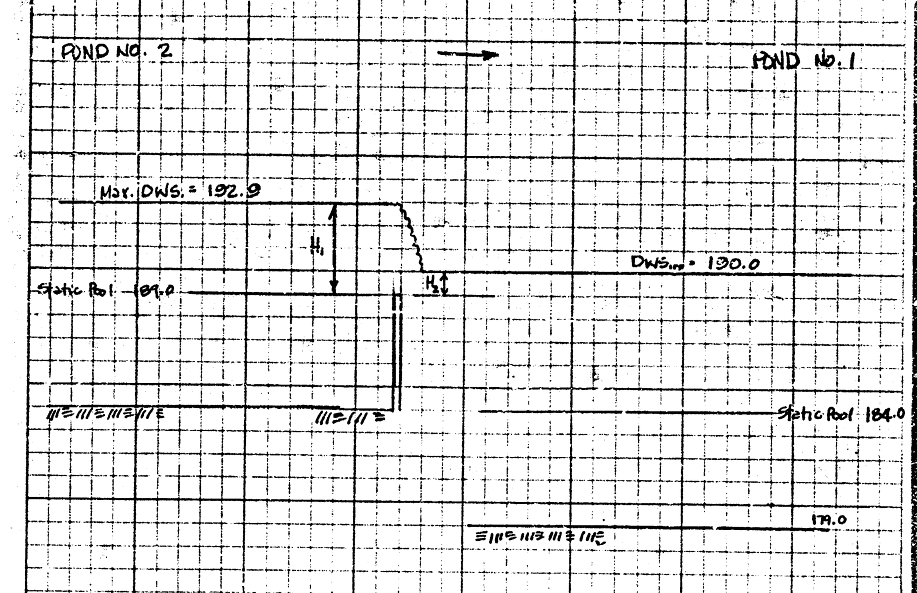
a. Crown & T.C. assumed same elev.
b. $n = 0.016$, cross-slope = 3/8"/ft.
c. $d = 0.5'$, Long. slope = 2.3%

From attached graph $Q = 25$ cfs.



NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

Date October 17, 1984 Page 1 of 4
Project Williamsburg Addition
Item Weir sizes.



$H_1 = 3.9'$
$H_2 = 1.0'$

$H_2/H_1 = \frac{1.0}{3.9} = 0.256$

From "Handbook of Hydraulics" King, 6th Ed. p 5-18
w/ $H_2/H_1 = 0.256$ $Q/Q_1 = 0.94$

Q submerged = 680 cfs
Q design (increased from actual Q due to submerged condition) $= \frac{680}{.94} = 723$

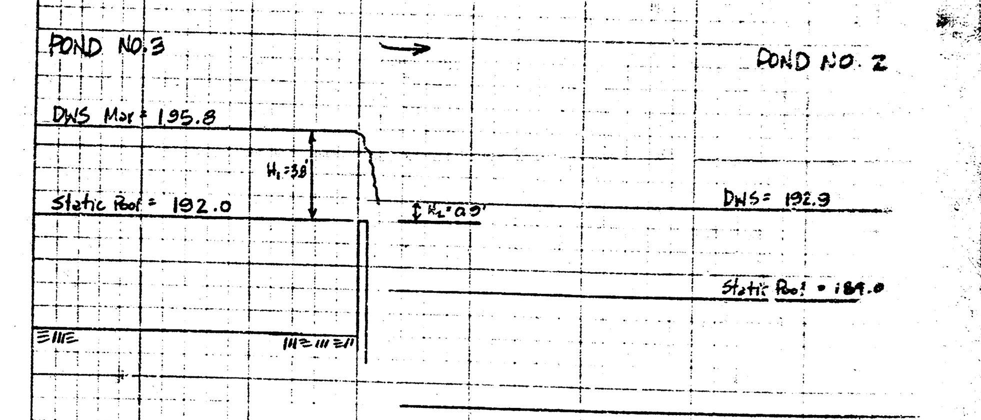
Date Oct 17 84 Page 2 of 4
Project Williamsburg
Item Weir Sizes

Using weir equation, $Q = cLH^{3/2}$

$723 = 3.0 \times L \times 3.9^{3/2}$

L req'd = 31.3'

Date Oct 18 84 Page 3 of 4
Project Williamsburg
Item Weir sizes



$H_2/H_1 = \frac{0.9}{3.8} = 0.236$

$Q/Q_1 = 0.95$

w/ Q submerged = 660

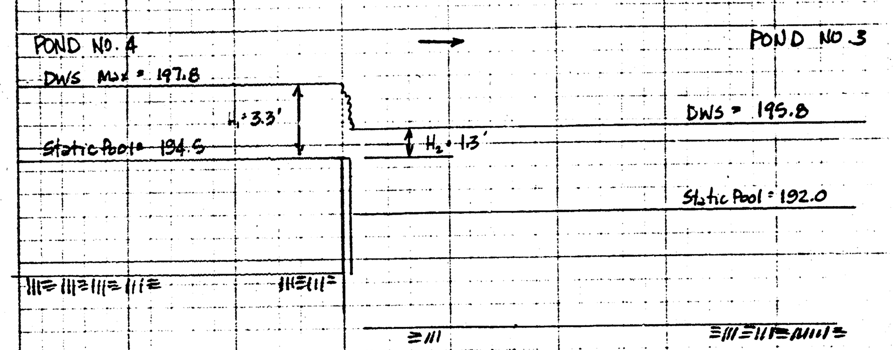
Q design = 660/0.95 = 694

$Q = cLH^{3/2}$

$694 = 3.0 \times L \times 3.8^{3/2}$

L req'd = 31.2'

Date Oct 18 84 Page 4 of 4
Project Williamsburg
Item Weir Sizes



$H_2/H_1 = 1.3/3.3 = 0.394$

$Q/Q_1 = 0.88$

Q submerged = 640

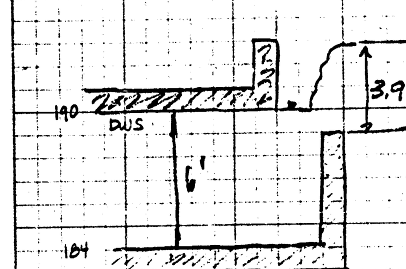
Q design = 640/0.88 = 727

$Q = cLH^{3/2}$

$727 = 3.0 \times L \times 3.3^{3/2}$

L = 40.4'

Date Oct. 18, 1984 Page 1 of 1
Project Williamsburg
Item Structure @ 11th



Area of flow over weir = 3.9 × 31.3 = 122.07 ft²

Allow 6' depth of water req'd width = 20.34

Use 4 - 6'×6'
Area = 144 ft²
width = 24'
height = 6'

Set weir upstream of box so that box does not affect flow over weir

Date 12/28/84 Page 1 of 14
Project Williamsburg Storm Drain
Item Pond No. 1

RESERVOIR ROUTING

Given [illegible] inflow hydrograph, stage-storage, and stage-discharge relationships, determine the effect of detention pond no. 1 on the peak rate of runoff and also the maximum pond elevation. No detention is assumed from pond nos. 2 thru 4.

The outlet control structure will be a 2-6'x4'x15' RCB culvert, [illegible] radiused crown entrance and 45° wings. The static pool elevation is 184 (C.O.W datum). Stage-discharge relationships were [illegible] plotted for both inlet & outlet control (See Sh Nos 2-7). Outlet control governs up to an elevation of 187.4. Above that point inlet control governs.

The stage-storage relationship was developed using the plane area of [illegible] of the proposed pond configuration. The pond geometry [illegible] with consideration of these factors: ① [illegible] controlling elevation, [illegible] ② gentle (6:1) side slopes; ③ sparing of large trees [illegible] in order to reduce the [illegible] of a man-made pond.

The [illegible] hydrograph was [illegible] as part of "Drainage Plan [illegible] for Williamsburg Addition…", by P.E.C. dated 6-1-84. It is reproduced here as [illegible]. The maximum [illegible] cfs, occurs at [illegible].

The [illegible] method of routing is based on the hydrologic budget equation, $I - O = \Delta S$. A detailed explanation of the routing table (Sh Nos 12-13) is given in Sh No. 14.

[illegible]

Using [illegible] a outlet structure [illegible] the maximum [illegible] discharge from the pond [illegible] 450 cfs at an elevation of 190.5. The proposed [illegible] 192 [illegible] 1.5 ft of freeboard. The discharge peak is [illegible]. Thus the pond & outlet as proposed is deemed acceptable.

190.0

Date 12-28-84 MWB Page 2 of 14
Project Williamsburg Storm Drain
Item Pond No. 1

Select 2-6x4 RCB outlet, 45° Wings. Rounded top. $K_e = 0.2$, $L = 15'$, $E = 184.0$

Determine inlet control curve:

ELEV	HW	HW/D	Q/B	Q	Approx V
184	0	0	0	0	
185	1	0.25	—	—	
186	2	0.50	8.5	102	4.25
187	3	0.75	15.5	186	5.17
188	4	1.00	23	276	5.75
189	5	1.25	31	372	7.75
190	6	1.50	37	444	9.25
191	7	1.75	42	504	10.5

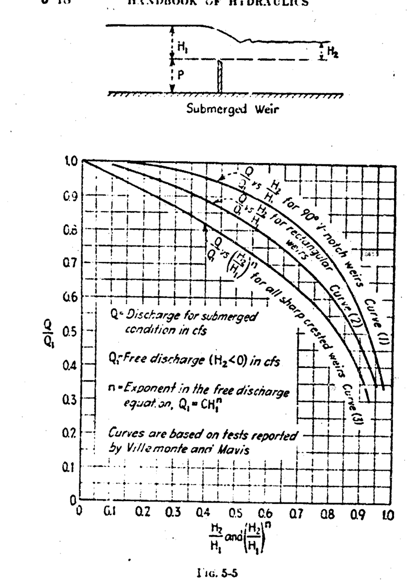


FIG. 5-5

WEIRS 5-19

the upstream side of the weir, H_1, but also to the head on the downstream side, H_2, and to a lesser extent, to the height of the weir crest above the floor of the channel, P. Early experiments by Francis (1848, 1883), Fteley and Stearns (1882), Bazin (1891), Cone (1916), and Cox (1928) have been summarized by Vennard and Weston.[1] They showed that the various test data could be presented in an orderly manner by selecting as variables Q/Q_1 and H_2/H_1, where Q_1 is the discharge at the head H_1, computed from the equation for free discharge (unsubmerged), which is expressed in general terms as follows:

$$Q_1 = CH_1^n \qquad (5\text{-}49)$$

By plotting Q/Q_1 against H_2/H_1, they found that the various data tended to fall on a single curve, except for small values of P/H_1.

In 1947, Villemonte[2] presented the results of a series of tests on submerged sharp-crested weirs. He conducted tests on rectangular, triangular, parabolic, cusped, and proportional weirs. He showed that the results for all types could be represented by the single equation

$$\frac{Q}{Q_1} = \left[1 - \left(\frac{H_2}{H_1}\right)^n\right]^{0.385} \qquad (5\text{-}50)$$

where n is the exponent in the free-discharge equation [Eq. (5-49)], and the other terms are as previously defined. This equation was found to satisfy all test results, with a maximum deviation of 5 per cent for some of the individual test results.

In 1949, Mavis[3] presented results of tests on rectangular, triangular, parabolic, circular, sutro, and cusped weirs. He found that a single equation could be used to express the results for all the tests. His equation with subscripts changed to conform with usage in this book is

$$\frac{Q}{Q_1} = 1 - \left(0.45S + \frac{0.40}{[illegible]}\right) \qquad (5\text{-}51)$$

[1] John K. Vennard and Ray F. Weston, Submergence Effect on Sharp-crested Weirs, Eng. News-Record, June 3, 1943, p. 818.
[2] James R. Villemonte, Submerged-weir Discharge Studies, Eng. News-Record, Dec. 25, 1947, p. 866.
[3] F. T. Mavis, How to Calculate Flow over Submerged Thin-plate Weirs, Eng. News-Record, July 7, 1949, p. 65.

3/14

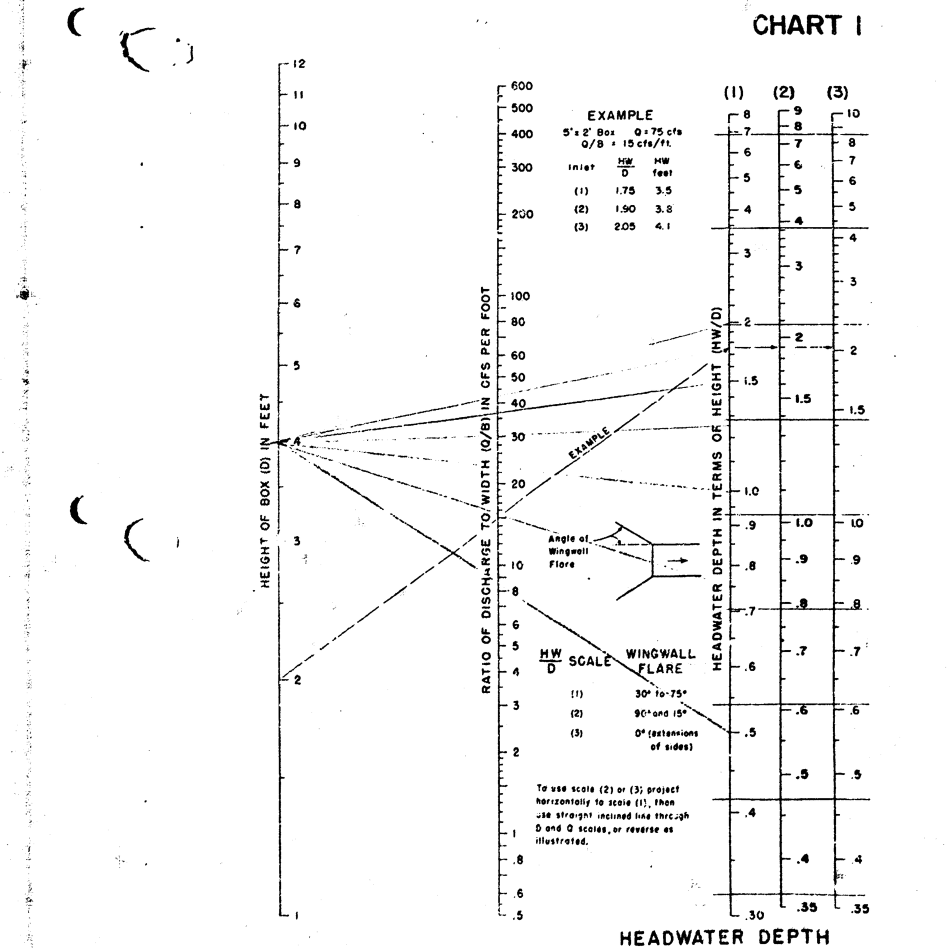


CHART I

HEADWATER DEPTH

Date 12-28-84 MWB Page 4 of 14
Project Williamsburg Storm Drain
Item Pond No. 1

Select 2-6x4 RCB outlet. 45° Wings. Rounded top, $K_e = 0.2$
$L = 15'$, $E = 184.0$. TW Elev from Weir calc @ downstream dam (See Sh No 6)
Assume $LS_o = 0$

DETERMINE OUTLET CONTROL CURVE

Assumed Q	H	Q/B	d_c	$\frac{d_c+D}{2}$	TW Elev	TW	h_o	HW	Elev	Vel
0	—	0			0			—	—	-
100	—	8.33	1.3	2.65	186.3	2.3	2.65	2.65	186.7	-
200	0.3	16.67	2.0	3.0	186.7	2.7	3.0	3.3	187.3	5.1
300	0.7	25.00	2.7	3.35	187.0	3.0	3.35	4.05	188.1	6.25
400	1.3	33.33	3.2	3.6	187.3	3.3	3.6	4.9	188.9	8.33
500	2.1	41.67	3.8	3.9	187.55	3.55	3.9	6.0	190	10.42
600	3.1	50.00	4	4	187.75	3.75	4.0	7.1	191.1	12.50
700	4.2	58.33	4	4	187.90	3.9	4.0	8.2	192.2	14.58
800	5.6	66.67	[illegible]	4	[illegible]	4.2	4.2	9.8	193.8	16.67

5/14

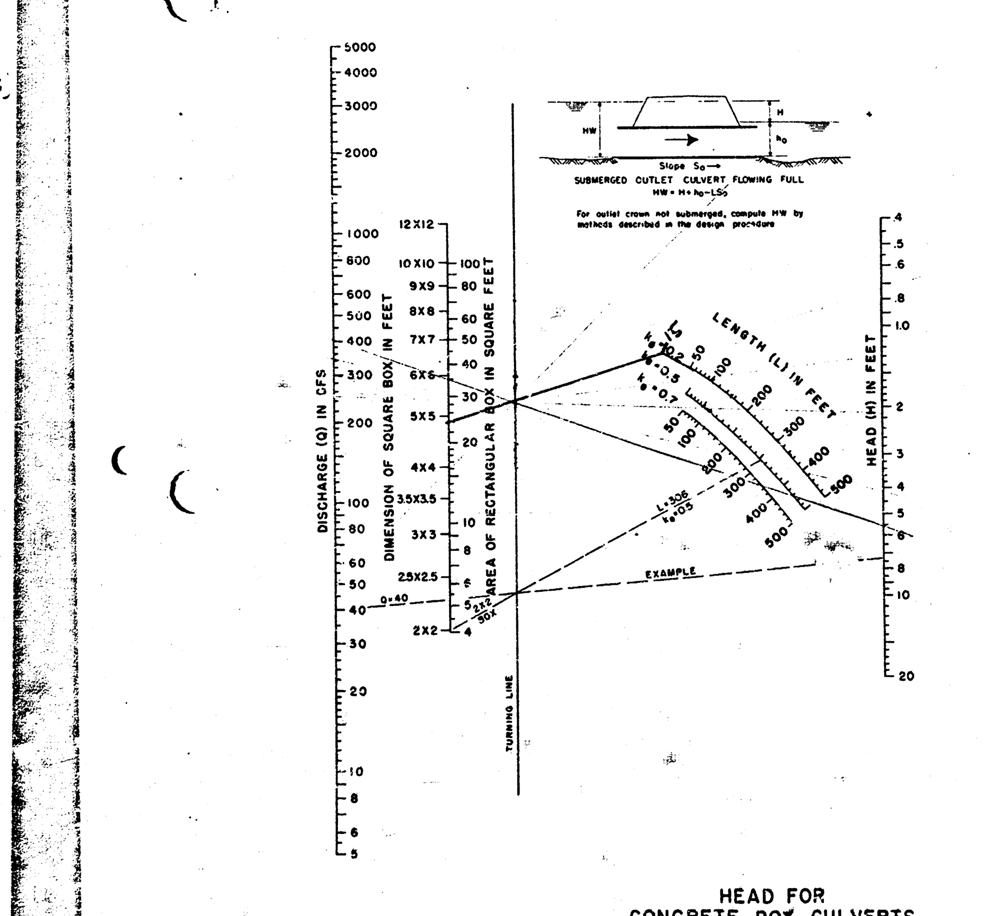
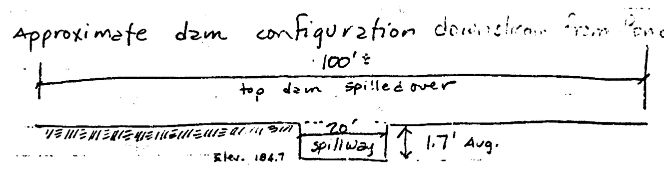


CHART 8

HEAD FOR CONCRETE BOX CULVERTS

6/14

Approximate dam configuration downstream from Pond No 2



Use weir Equation $Q = cLH^{3/2}$

h (ft above spillway fl)	Q spillway	Q over dam	Q total
1'	60	0	60
1.7'	133	0	133
2.0	133	49	182
2.5	133	215	348
2.7	133	300	433
2.8	133	346	479
3.0	133	445	578
3.2	133	551	684

With Q_{100} proposed = 450 cfs h = 2.75 Elev = 187.
With Q_{100} exist. = 624 cfs h = 3.1 Elev = 187

Therefore the Flood Elev. downstream pond will be lowered approx. 0.4'