DRAINAGE REPORT

FOR

WESTWIND 2nd ADDITION
WESTWIND 3rd ADDITION
WESTWIND RESIDENTIAL C.U.P.
GOLF PARK WEST

WICHITA, SEDGWICK COUNTY, KANSAS

BAUGHMAN COMPANY, P.A.
SURVEYING & ENGINEERING
316/262-7271 • 315 ELLIS • WICHITA, KANSAS 67211

March 1987

WILLIAM L. KORBER, L.S.
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BAUGHMAN COMPANY, P.A.
SURVEYING & ENGINEERING
316/262-7271 • 315 ELLIS • WICHITA, KANSAS 67211

March 13, 1987

Vicki Huang
City Engineer's Office
455 North Main
Wichita, KS 67202

re: Westwind 2nd Addition
Westwind 3rd Addition

Dear Vicki,

Submitted herewith is a drainage report which includes a comprehensive Drainage Plan for the above plats and adjacent areas. A copy is also being submitted to Sedgwick County.

Please review this report as a Final Drainage Plan for Westwind 2nd and Westwind 3rd Additions. The preliminary plat of Westwind 3rd Addition is being submitted today to MAPD.

If you have any questions, please call.

Sincerely,

Tom Ruggles

Thomas C. Ruggles, P.E.

File
TCR/ksb

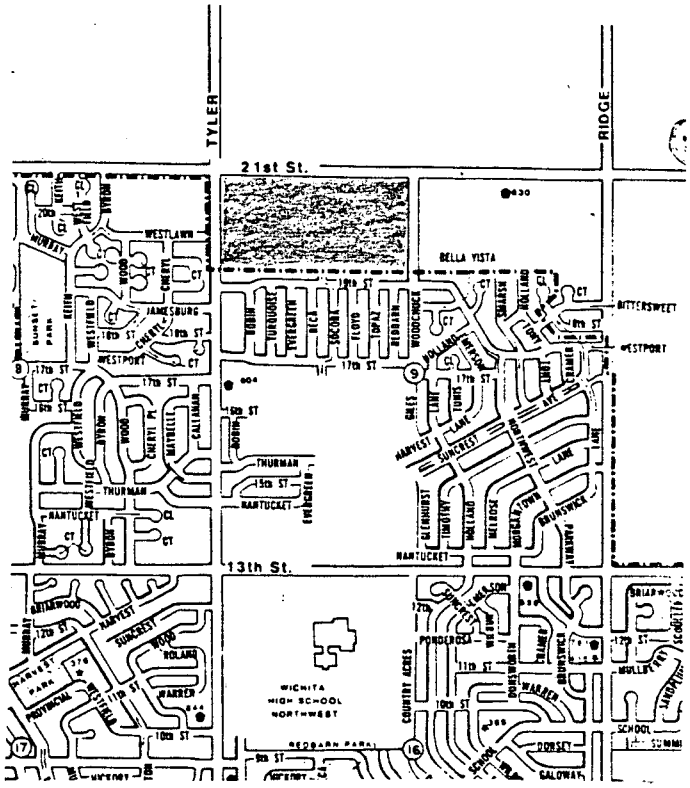
cc: Jim Weber

CONTENTS

DRAINAGE REPORT FOR WESTWIND C.U.P., GOLF PARK WEST, AND WESTWIND 2ND ADDITION, WICHITA, KANSAS

Scope

This report covers drainage of proposed developments on the south side of 21st Street North, between Tyler and Woodchuck. Areas included in the study are the Westwind Residential C.U.P. and the Westwind Commercial C.U.P., a total of 36 acres; Westwind 2nd Addition, a 51-lot residential subdivision; and Golf Park West, a 20-acre recreational area located between the two above mentioned developments. A Drainage Plan exhibit accompanies this report.



LOCATION MAP

Drainage from the study area flows into an existing storm sewer system, SWS 145, which drains east across Ridge Road to the Big Slough. Capacity of SWS 145 has been analyzed as part of the drainage plan for Westwind 2nd Addition, dated November 1986. A drainage plan for Golf Park West has also been prepared by Professional Engineering Consultants, dated June 1986. Any variations from those plans proposed by this study should be considered as revisions to those previously submitted plans.

Runoff calculations, detention, and routing for this study were performed on the Texas A&M University Watershed Model, run on the IBM AT computer. The A&M model methods are described in the Users Manual provided (See page 1, Chapter 1). Please return the manual to Baughman Co. after review.

The area was studied in three parts:

I. C.U.P. area only, with on-site detention
II. Golf Park West and part of Westwind 2nd Addition, with detention on Golf Park site
III. Part of Westwind 2nd Addition, with no detention

The design storm used for detention basins was the 100-year, 24-hour duration rainfall, per City of Wichita criteria.

A preliminary Drainage Plan sheet included with this report delineates the drainage areas and shows the detention and storm sewer systems.

The entire area included in this study naturally drains to a low area near 19th Street and Woodchuck. An area of approximately 70 acres north of 21st Street also drains to the same point. The drainage from north of 21st Street is to be diverted to the east along 21st Street, per the ditch plan and profile sheets and supporting calculations submitted with the November 1986 drainage plan for Westwind 2nd Addition (see attachments). Other developments north of 21st Street will also divert part of the runoff to the east, north of 21st St.

The low area at 19th and Woodchuck has no natural outlet. However, the design of Storm Water Sewer 145 includes a major sump at that location, with the downstream system sized for 100-year design flow. The previously mentioned analysis of SWS 145 indicates excess capacity of 45 cfs at that point, using current City of Wichita drainage criteria. The Drainage Plan described in this report will provide control of runoff to allow the area to be accomodated by the existing storm sewer system.

I. Westwind C.U.P.

The area referred to as "Westwind C.U.P." includes both the Residential and the Commercial C.U.P. areas as shown on the Drainage Plan, less approximately 5.0 acres along the west side which drain to Tyler Road.

Drainage Area = 31.0 Acres
Soil type Ma, Hydrologic Group B
Existing condition, cultivation: CN = 75, 0 % impervious
Proposed developed condition:

Use	% Imp.	Area	CN	Product
Single-family (1/4 ac.)	38	12.0	75	900.0
Multi-family (attached)	65	8.1	85	688.5
Commercial	70	10.9	87	948.3
				2536.8

Weighted CN = 2544.3 / 31.0 Ac. = 81.8 (use 82)
(Curve numbers are from SCS tables w/ AMC II).

Input Data for Watershed file (developed condition)

Subbasin file I.D. no. 300
Precipitation file I.D. no. 500
Drainage Area 31.0 Ac. = 0.0484 sq. mi.
Subbasin height = 1358-1350 = 8 feet
Subbasin length = 1550 feet = 0.294 miles
% impervious = 56.3
% watershed slope = 0.7
% channel improved = 100

Input Data for Precipitation

Precipitation file I.D. no.	500
Start time of storm	0 hours
Storm Duration	24 hours
Incremental time	0.25 hours
Total precipitation	7.8 inches (from U.S. Weather Service Hydro-35)
Type storm distribution	SCS Type II
Return period	100 years

Inflow Hydrograph

Hydrographs for 100 yr., 24-hour runoff, with Developed and Undeveloped conditions are attached (see pages 5-7).

Undeveloped Q peak = 43.3 cfs
Developed Q peak = 61.1 cfs

For comparison of methods, both the Rural and Urban watershed options were run. The Urban model produced a slightly lower Q peak; therefore the higher Q from the Rural Model was used.

Reservoir Routing

The developed Inflow hydrograph was routed through the detention basin shown on the drainage plan. The input stage-storage data for the reservoir is as follows:

Elev.	Area s.f.
1345.2	0
1346.7	35078
1347.7	43286
1348.7	51855
1349.7	60442
1350.7	69390
1351.7	78600
1352.7	100700

Stage-Storage volumes and stage-discharge rates were output, following routing, in the Reservoir file attached (Reservoir I.D. no. 900), page 8.

Routing was performed using the Culvert Design option since the reservoir is to have only one outlet spillway (pipe). Input and output data for the pipe design are listed in the attached Culvert Design printout (see page 8). The pipe selected is a 24" R.C.P., with Qpeak outflow = 29.0 cfs at a maximum water surface elevation of 1350.2 (5.0'HW).
(5.0 HW).

Detention Analysis

Inflow Q peak = 61.1 cfs at time 12.5 hours
Outflow Q peak = 29.0 cfs at time 13.58 hours
Time delay from detention = 0.88 hrs. = 52 minutes (to be added to the initial tc for the subbasin).
Since the time of concentration (total) in SWS 145 is approximately 30 minutes at the point of inflow, the detention lag produced will allow the storm sewer peak flow to pass before the peak outflow from the detention basin occurs. The outflow hydrograph is shown superimposed on the inflow hydrograph (page 7).

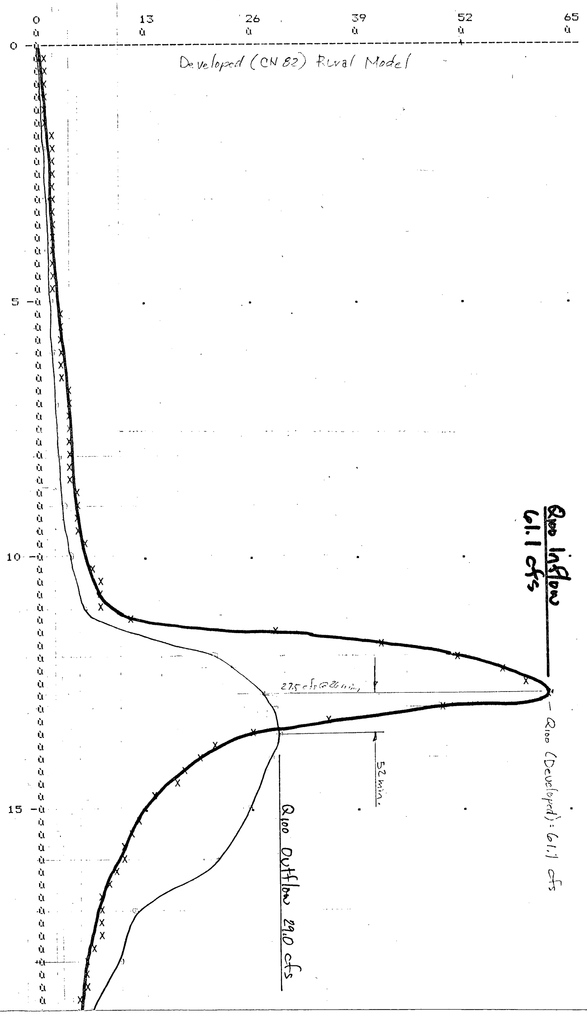
I WESTWIND C.U.P.

A&M WATERSHED MODEL

HYDROGRAPH PLOT

HYDROGRAPH ID NO	0	DRAINAGE AREA IN SQ MI	0.05
INCREMENT TIME STEP HRS	0.25	START TIME HYDRO IN HRS	0.00
BASE FLOW IN CFS	0.00	RIVER STATION IN MILES	0.00
X HYD 0 V IN AC-FT	17		

DISCHARGE IN CFS



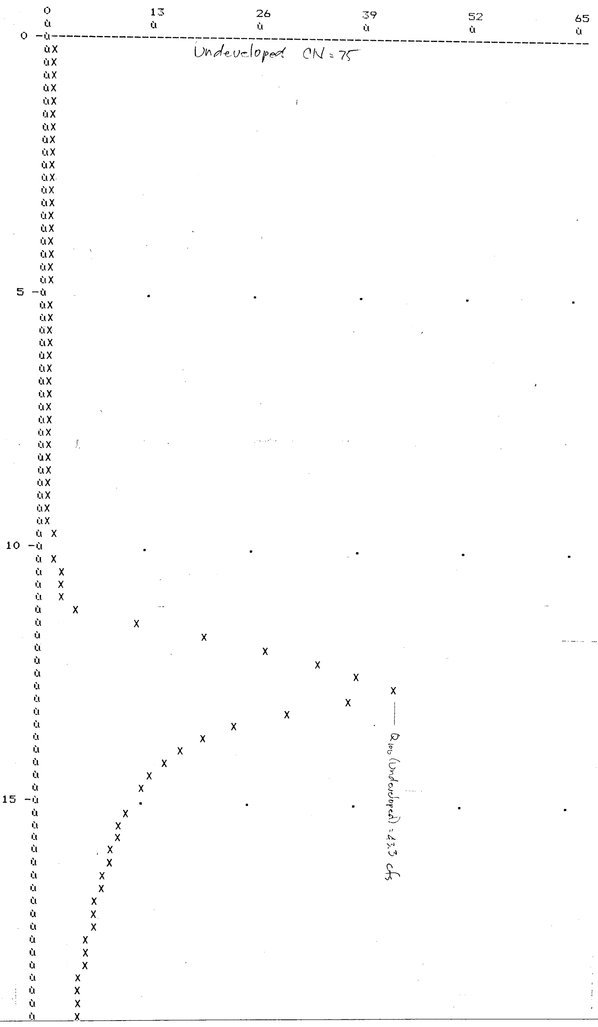
1 Westwind C.U.P.

A&M WATERSHED MODEL

HYDROGRAPH PLOT

HYDROGRAPH ID NO	3	DRAINAGE AREA IN SQ MI	0.05
INCREMENT TIME STEP HRS	0.25	START TIME HYDRO IN HRS	0.00
BASE FLOW IN CFS	0.00	RIVER STATION IN MILES	0.00
X HYD 3 V IN AC-FT	12		

DISCHARGE IN CFS

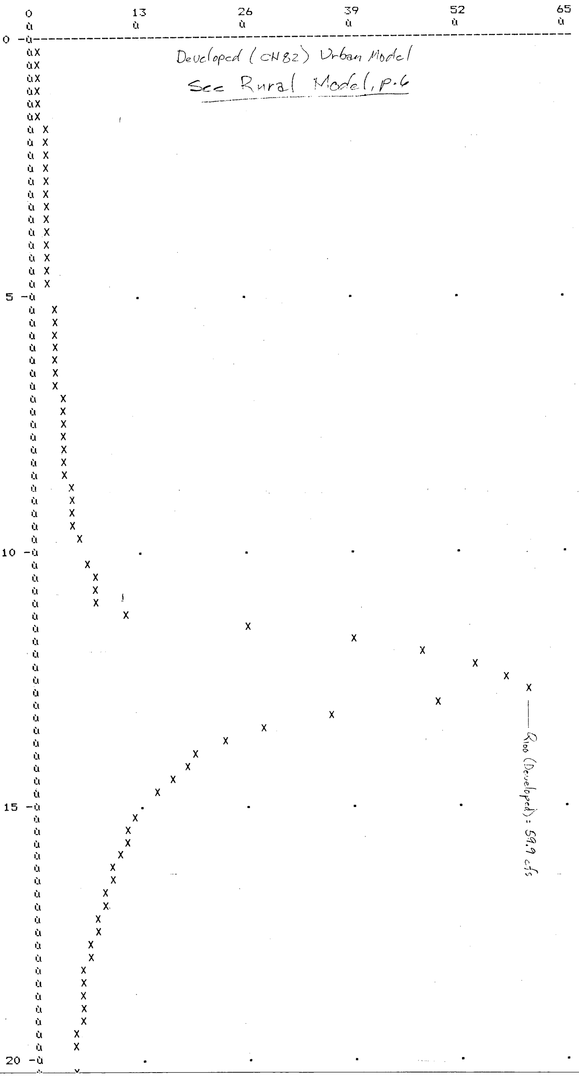


A&M WATERSHED MODEL

HYDROGRAPH PLOT

HYDROGRAPH ID NO	1	DRAINAGE AREA IN SQ MI	0.05
INCREMENT TIME STEP HRS	0.25	START TIME HYDRO IN HRS	0.00
BASE FLOW IN CFS	0.00	RIVER STATION IN MILES	0.70
X HYD 1 V IN AC-FT	17		

DISCHARGE IN CFS



RESERVOIR FILE

RESERVOIR ID NO. 900
RESERVOIR W.S. EL. 1345.2 FEET
DOWNSTREAM CH EL 1344.2 FEET

LINE NO.	ELEVATION FEET	STORAGE AC-FT	DISCHARGE CFS
1	1345.2	0.0	0.0
2	1345.6	0.0	1.3
3	1346.0	0.2	2.9
4	1346.4	0.4	6.0
5	1346.8	0.7	9.7
6	1347.2	1.0	11.2
7	1347.6	1.4	12.6
8	1348.0	1.8	21.7
9	1348.4	2.2	23.2
10	1348.8	2.7	24.6
11	1349.1	3.1	26.0
12	1349.5	3.7	27.2
13	1349.9	4.2	28.4
14	1350.3	4.8	29.6
15	1350.7	5.4	30.7
16	1351.1	6.1	31.8
17	1351.5	6.7	32.8
18	1351.9	7.5	33.9
19	1352.3	8.3	34.8
20	1352.7	9.1	35.8

CULVERT DESIGN

OUTLET CONDUIT 900
HEADLOSS COEFFICIENTS

1. MANNING N .013
2. K EXIT 1
3. K ENTRANCE .5
4. K OTHER 0

CULVERT

5. LENGTH 180
6. NO. OF PIPES 1
7. DIAMETER 2
9. DESIGN DISCHARGE (Q) 30
10. RESERVOIR W.S.EL AT DESIGN Q 1351.7
11. MAX TAILWATER ELEVATION 1345.1
12. CENTERLINE ELEV OF INLET 1346.2
13. CENTERLINE ELEV OF OUTLET 1345.2

PEAK INFLOW DISCHARGE 61.10025
RESULTS OF RESERVOIR ROUTING
PEAK OUTFLOW DISCHARGE 29.02421
MAX W.S. ELEV IN RESERVOIR 1350.135
STARTING W.S. ELEV IN RES. 1345.2
DESIGN STORMS

A. RAINFALL IN. 7.80 DURATION 24.00

I WESTWIND C.U.P.

OUTFLOW

HYDROGRAPH LISTING

HYDROGRAPH ID NO 900
INCREMENT TIME STEP HRS .25
RUNOFF IN. 6.197136
TIME TO CENTROID HRS 14.59

DRAINAGE AREA IN SQ MI .0484
MAX. WATER SURFACE EL FEET 1350.1
PEAK DISCHARGE CFS 29.02421

ITEM	FLOW	ITEM	FLOW	ITEM	FLOW	ITEM	FLOW	ITEM	FLOW	ITEM	FLOW
1	0.0	51	27.5	101	1.4	151	0.0	201	0.0	251	0.0
2	0.1	52	28.6	102	1.0	152	0.0	202	0.0	252	0.0
3	0.3	53	29.0	103	0.6	153	0.0	203	0.0	253	0.0
4	0.4	54	29.0	104	0.4	154	0.0	204	0.0	254	0.0
5	0.6	55	28.6	105	0.3	155	0.0	205	0.0	255	0.0
6	0.7	56	28.2	106	0.2	156	0.0	206	0.0	256	0.0
7	0.8	57	27.7	107	0.2	157	0.0	207	0.0	257	0.0
8	0.9	58	27.1	108	0.1	158	0.0	208	0.0	258	0.0
9	1.0	59	26.5	109	0.1	159	0.0	209	0.0	259	0.0
10	1.1	60	25.7	110	0.1	160	0.0	210	0.0	260	0.0
11	1.2	61	24.9	111	0.0	161	0.0	211	0.0	261	0.0
12	1.2	62	23.9	112	0.0	162	0.0	212	0.0	262	0.0
13	1.3	63	23.0	113	0.0	163	0.0	213	0.0	263	0.0
14	1.3	64	21.9	114	0.0	164	0.0	214	0.0	264	0.0
15	1.3	65	17.4	115	0.0	165	0.0	215	0.0	265	0.0
16	1.4	66	13.2	116	0.0	166	0.0	216	0.0	266	0.0
17	1.4	67	12.2	117	0.0	167	0.0	217	0.0	267	0.0
18	1.4	68	11.7	118	0.0	168	0.0	218	0.0	268	0.0
19	1.4	69	11.2	119	0.0	169	0.0	219	0.0	269	0.0
20	1.5	70	10.8	120	0.0	170	0.0	220	0.0	270	0.0
21	1.6	71	10.3	121	0.0	171	0.0	221	0.0	271	0.0
22	1.7	72	9.8	122	0.0	172	0.0	222	0.0	272	0.0
23	1.8	73	8.7	123	0.0	173	0.0	223	0.0	273	0.0
24	1.9	74	7.7	124	0.0	174	0.0	224	0.0	274	0.0
25	2.0	75	6.8	125	0.0	175	0.0	225	0.0	275	0.0
26	2.1	76	6.2	126	0.0	176	0.0	226	0.0	276	0.0
27	2.1	77	5.7	127	0.0	177	0.0	227	0.0	277	0.0
28	2.2	78	5.2	128	0.0	178	0.0	228	0.0	278	0.0
29	2.3	79	4.8	129	0.0	179	0.0	229	0.0	279	0.0
30	2.4	80	4.4	130	0.0	180	0.0	230	0.0	280	0.0
31	2.4	81	4.2	131	0.0	181	0.0	231	0.0	281	0.0
32	2.5	82	4.0	132	0.0	182	0.0	232	0.0	282	0.0
33	2.6	83	3.8	133	0.0	183	0.0	233	0.0	283	0.0
34	2.7	84	3.7	134	0.0	184	0.0	234	0.0	284	0.0
35	2.9	85	3.5	135	0.0	185	0.0	235	0.0	285	0.0
36	3.1	86	3.4	136	0.0	186	0.0	236	0.0	286	0.0
37	3.3	87	3.4	137	0.0	187	0.0	237	0.0	287	0.0
38	3.4	88	3.3	138	0.0	188	0.0	238	0.0	288	0.0
39	3.6	89	3.3	139	0.0	189	0.0	239	0.0	289	0.0
40	4.0	90	3.2	140	0.0	190	0.0	240	0.0	290	0.0
41	4.4	91	3.2	141	0.0	191	0.0	241	0.0	291	0.0
42	4.9	92	3.1	142	0.0	192	0.0	242	0.0	292	0.0
43	5.3	93	3.0	143	0.0	193	0.0	243	0.0	293	0.0
44	5.6	94	2.9	144	0.0	194	0.0	244	0.0	294	0.0
45	6.4	95	2.9	145	0.0	195	0.0	245	0.0	295	0.0
46	9.6	96	2.9	146	0.0	196	0.0	246	0.0	296	0.0
47	11.9	97	2.7	147	0.0	197	0.0	247	0.0	297	0.0
48	21.8	98	2.4	148	0.0	198	0.0	248	0.0	298	0.0
49	23.9	99	2.1	149	0.0	199	0.0	249	0.0	299	0.0
50	25.8	100	1.7	150	0.0	200	0.0	250	0.0	300	0.0

II. GOLF PARK WEST / PART OF WESTWIND 2ND ADDITION

This drainage area includes Golf Park West, except the north 150'; and Lot 1, except the North 150', Lots 5-15 and 24-30 in Westwind 2nd Addition. The north 150' will drain to the 21st Street ditch previously described. Adjacent Street R/W areas are also included in the drainage area.
Drainage Area - 26.4 Acres
Soil type Ma, Hydrologic Group B
Existing condition, cultivation: CN = 75, 0% Impervious
Proposed developed condition

Use	% imp.	Area ac.	CN	Product
Single-family (1/4 Ac.)	38	3.7	75	277.5
Commercial (Church)	70	3.0	87	295.8
Commercial (Golf)	70	7.5	87	652.5
Open space (Golf)	0	10.0	61	610.0

Weighted CN = 75 (Note: In this case the developed and undeveloped Curve Numbers are equal).

Input Data for Watershed file (developed condition)

Subbasin file I.D. no.	305
Precipitation file I.D. no.	500
Drainage Area	24.6 Ac. = 0.0384 sq. mi.
Subbasin height	6.6 feet
Subbasin length	1450 feet = 0.275 miles
% Impervious	36.7
% Watershed slope	0.5
% Channel improved	100

The Input Data for Precipitation are identical to those for the previous basin (file no. 500), page 3.

Inflow Hydrograph

Hydrographs for 100-yr., 24-hour runoff, with Developed vs. Undeveloped conditions, are attached (see pages 12-13).

Undeveloped Q peak = 34.5 cfs
Developed Q peak = 45.5 cfs

Both hydrographs were generated on the Rural Model.

Reservoir Routing

The developed Inflow hydrograph was routed through the detention basin in the south part of Golf Park West. The input stage-storage data for the reservoir are as follows:

Elev.	Area s.f.
1341.4	0
1342.0	1533
1343.0	17733
1344.0	41026
1345.0	68643
1346.0	98523

Stage-storage volumes and stage-discharge rates were output following routing, in the Reservoir file attached (Reservoir I.D. no. 902).

Routing was performed using the Culvert Design option. Input and output data for the pipe design are listed in the Culvert Design printout. The pipe selected is a 24" R.C.P., with Q peak outflow = 22.6 cfs at a maximum water surface elevation of 1345.2 (3.8' HW).

Detention Analysis

Inflow Q peak = 45.5 cfs at time 12.75 hours
Outflow Q peak = 22.6 cfs at time 13.25 hours
Time delay from detention = 0.5 hrs. = 30 minutes (to be added to the initial tc for the subbasin).
The detention lag produced will allow the storm sewer peak flow (at approximate time 30 minutes) to pass before the peak outflow from the detention basin occurs. The outflow hydrograph is shown superimposed on the inflow hydrograph (page 13).

II GOLF PARK WEST / WESTWIND 2ND

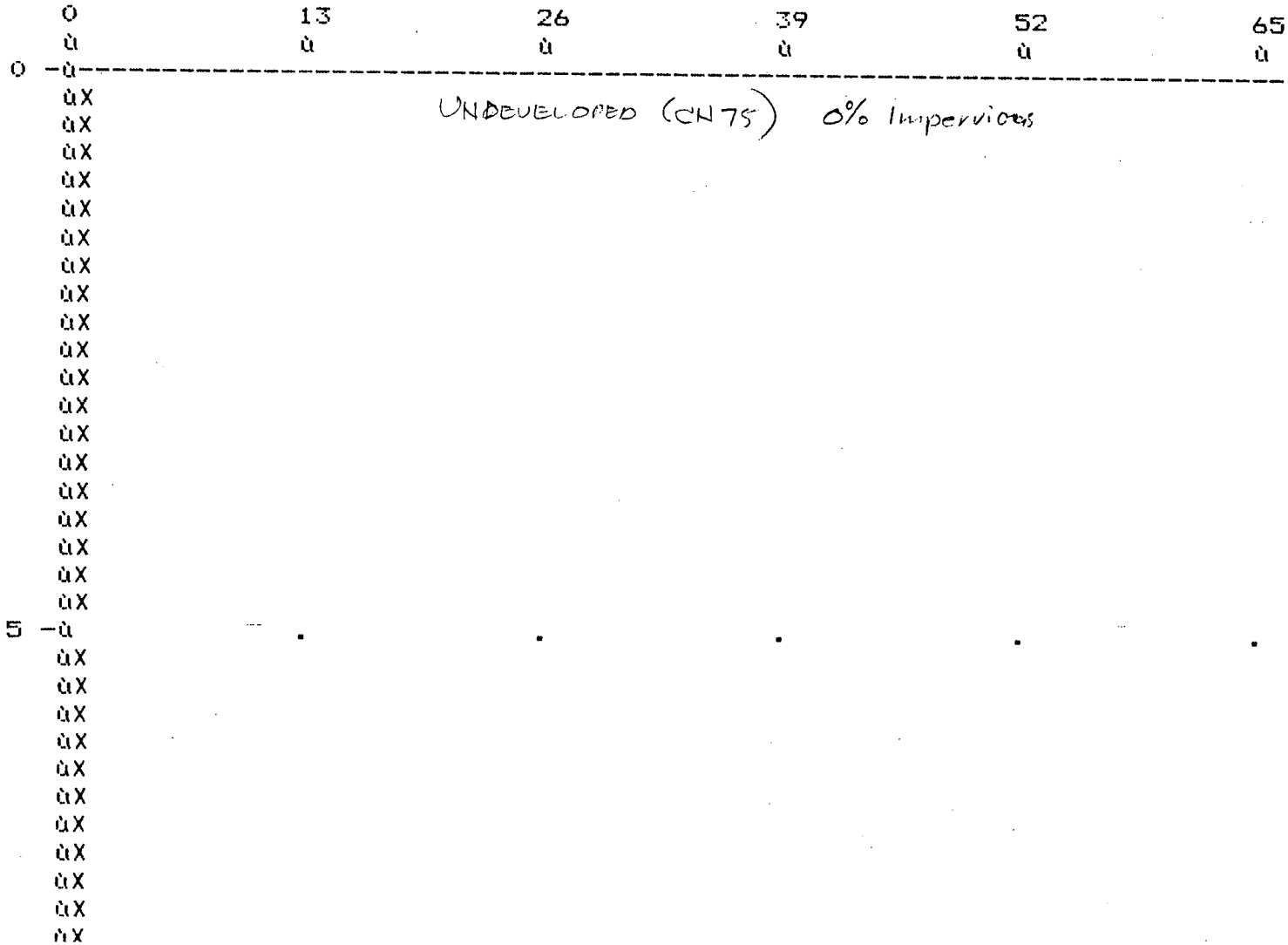
A&M WATERSHED MODEL

UNDEVELOPED

HYDROGRAPH PLOT

HYDROGRAPH ID NO	3	DRAINAGE AREA IN SQ MI	0.04
INCREMENT TIME STEP HRS	0.25	START TIME HYDRO IN HRS	0.00
BASE FLOW IN CFS	0.00	RIVER STATION IN MILES	0.00
X HYD 3 V IN AC-FT	9		

DISCHARGE IN CFS

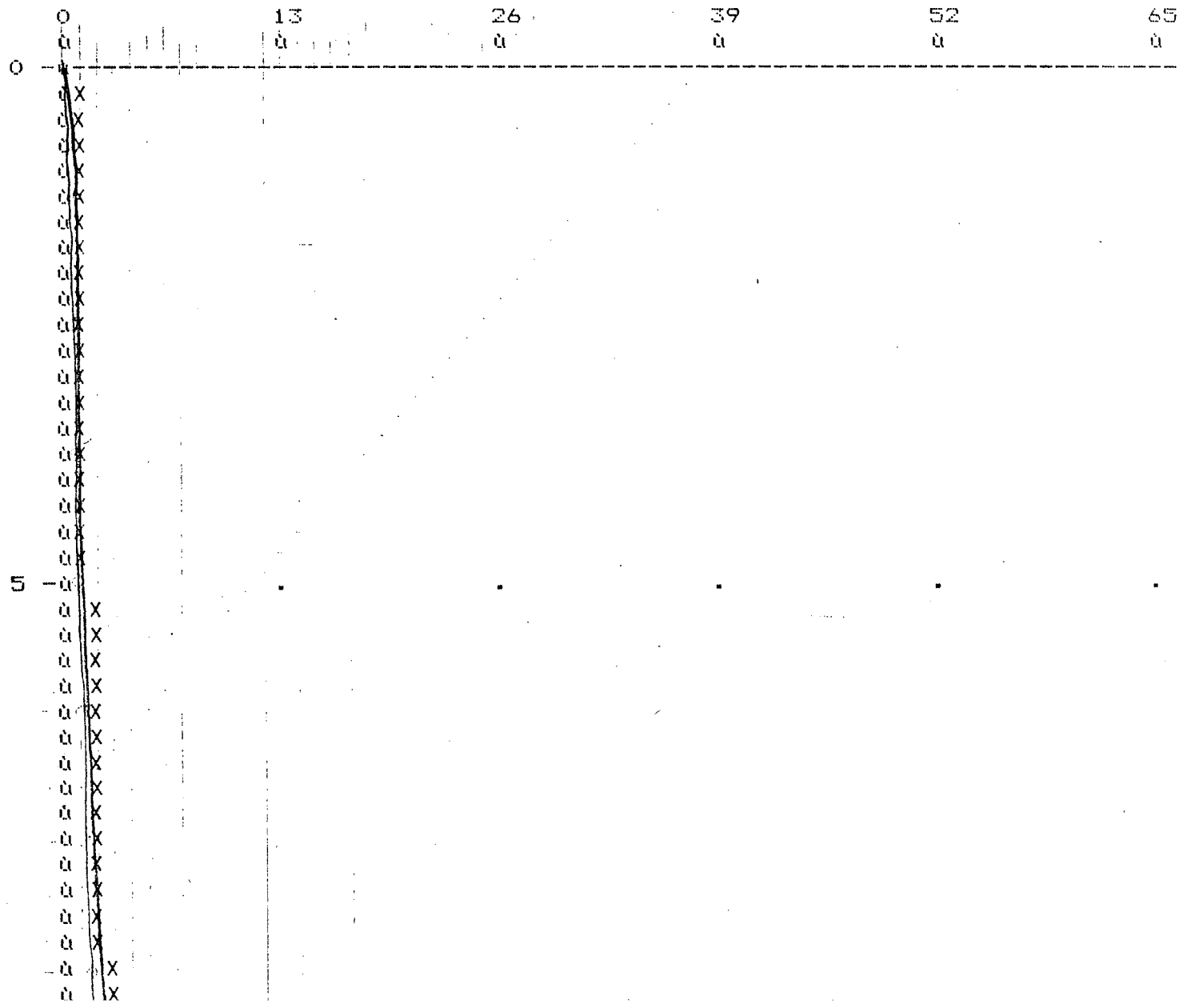


A&M WATERSHED MODEL

HYDROGRAPH PLOT

HYDROGRAPH ID NO	1	DRAINAGE AREA IN SQ MI	0.04
INCREMENT TIME STEP HRS	0.25	START TIME HYDRO IN HRS	0.00
BASE FLOW IN CFS	0.00	RIVER STATION IN MILES	0.00
X HYD 1 V IN AC-FT	11		

DISCHARGE IN CFS



RESERVOIR FILE

RESERVOIR ID NO. 902
RESERVOIR W.S. EL. 1341.4 FEET
DOWNSTREAM CH EL 1341.2 FEET

LINE NO.	ELEVATION FEET	STORAGE AC-FT	DISCHARGE CFS
1	1341.4	0.0	0.0
2	1341.6	0.0	0.6
3	1341.9	0.0	1.1
4	1342.1	0.0	1.7
5	1342.4	0.1	2.9
6	1342.6	0.1	4.4
7	1342.9	0.2	6.2
8	1343.1	0.3	8.1
9	1343.3	0.4	10.1
10	1343.6	0.6	12.0
11	1343.8	0.7	16.6
12	1344.1	1.0	17.8
13	1344.3	1.2	19.0
14	1344.5	1.5	20.0
15	1344.8	1.9	21.0
16	1345.0	2.2	22.0
17	1345.3	2.6	22.9
18	1345.5	3.1	23.8
19	1345.8	3.6	24.6
20	1346.0	4.1	25.5

CULVERT DESIGN

OUTLET CONDUIT 902
HEADLOSS COEFFICIENTS
1. MANNING N .013
2. K EXIT 1
3. K ENTRANCE .5
4. K OTHER 0
CULVERT
5. LENGTH 180
6. NO. OF PIPES 1
7. DIAMETER 2
9. DESIGN DISCHARGE (Q) 21
10. RESERVOIR W.S.EL AT DESIGN Q 1344.8
11. MAX TAILWATER ELEVATION 1342.02
12. CENTERLINE ELEV OF INLET 1342.4
13. CENTERLINE ELEV OF OUTLET 1342.2
PEAK INFLOW DISCHARGE 43.41179
RESULTS OF RESERVOIR ROUTING
PEAK OUTFLOW DISCHARGE 22.63171
MAX W.S. ELEV IN RESERVOIR 1345.201
STARTING W.S. ELEV IN RES. 1341.4
DESIGN STORMS
A. RAINFALL IN. 7.80 DURATION 24.00

OUTFLOW HYDROGRAPH LISTING

HYDROGRAPH ID NO 902
INCREMENT TIME STEP HRS .25
RUNOFF IN. 5.340816
TIME TO CENTROID HRS 14.45

DRAINAGE AREA IN SQ MI .0384
MAX. WATER SURFACE EL FEET 1345.2
PEAK DISCHARGE CFS 22.63171

ITEM	FLOW	ITEM	FLOW	ITEM	FLOW	ITEM	FLOW	ITEM	FLOW	ITEM	FLOW
1	0.0	51	21.6	101	0.3	151	0.0	201	0.0	251	0.0
2	0.1	52	22.4	102	0.3	152	0.0	202	0.0	252	0.0
3	0.3	53	22.6	103	0.2	153	0.0	203	0.0	253	0.0
4	0.3	54	22.5	104	0.2	154	0.0	204	0.0	254	0.0
5	0.4	55	22.2	105	0.1	155	0.0	205	0.0	255	0.0
6	0.4	56	21.7	106	0.1	156	0.0	206	0.0	256	0.0
7	0.4	57	21.2	107	0.1	157	0.0	207	0.0	257	0.0
8	0.5	58	20.7	108	0.1	158	0.0	208	0.0	258	0.0
9	0.6	59	20.0	109	0.0	159	0.0	209	0.0	259	0.0
10	0.6	60	19.2	110	0.0	160	0.0	210	0.0	260	0.0
11	0.6	61	18.3	111	0.0	161	0.0	211	0.0	261	0.0
12	0.6	62	17.2	112	0.0	162	0.0	212	0.0	262	0.0
13	0.7	63	14.4	113	0.0	163	0.0	213	0.0	263	0.0
14	0.7	64	11.5	114	0.0	164	0.0	214	0.0	264	0.0
15	0.7	65	10.2	115	0.0	165	0.0	215	0.0	265	0.0
16	0.7	66	8.8	116	0.0	166	0.0	216	0.0	266	0.0
17	0.7	67	7.6	117	0.0	167	0.0	217	0.0	267	0.0
18	0.8	68	6.5	118	0.0	168	0.0	218	0.0	268	0.0
19	0.8	69	5.7	119	0.0	169	0.0	219	0.0	269	0.0
20	0.8	70	5.1	120	0.0	170	0.0	220	0.0	270	0.0
21	0.9	71	4.7	121	0.0	171	0.0	221	0.0	271	0.0
22	1.0	72	4.3	122	0.0	172	0.0	222	0.0	272	0.0
23	1.1	73	3.9	123	0.0	173	0.0	223	0.0	273	0.0
24	1.1	74	3.6	124	0.0	174	0.0	224	0.0	274	0.0
25	1.1	75	3.4	125	0.0	175	0.0	225	0.0	275	0.0
26	1.1	76	3.3	126	0.0	176	0.0	226	0.0	276	0.0
27	1.1	77	3.2	127	0.0	177	0.0	227	0.0	277	0.0
28	1.1	78	3.1	128	0.0	178	0.0	228	0.0	278	0.0
29	1.2	79	2.9	129	0.0	179	0.0	229	0.0	279	0.0
30	1.2	80	2.8	130	0.0	180	0.0	230	0.0	280	0.0
31	1.2	81	2.7	131	0.0	181	0.0	231	0.0	281	0.0
32	1.3	82	2.6	132	0.0	182	0.0	232	0.0	282	0.0
33	1.3	83	2.6	133	0.0	183	0.0	233	0.0	283	0.0
34	1.5	84	2.5	134	0.0	184	0.0	234	0.0	284	0.0
35	1.6	85	2.5	135	0.0	185	0.0	235	0.0	285	0.0
36	1.8	86	2.4	136	0.0	186	0.0	236	0.0	286	0.0
37	1.8	87	2.4	137	0.0	187	0.0	237	0.0	287	0.0
38	1.9	88	2.4	138	0.0	188	0.0	238	0.0	288	0.0
39	2.1	89	2.4	139	0.0	189	0.0	239	0.0	289	0.0
40	2.4	90	2.4	140	0.0	190	0.0	240	0.0	290	0.0
41	2.8	91	2.3	141	0.0	191	0.0	241	0.0	291	0.0
42	3.1	92	2.2	142	0.0	192	0.0	242	0.0	292	0.0
43	3.3	93	2.2	143	0.0	193	0.0	243	0.0	293	0.0
44	3.5	94	2.1	144	0.0	194	0.0	244	0.0	294	0.0
45	4.3	95	2.1	145	0.0	195	0.0	245	0.0	295	0.0
46	7.2	96	2.1	146	0.0	196	0.0	246	0.0	296	0.0
47	11.4	97	1.9	147	0.0	197	0.0	247	0.0	297	0.0
48	17.2	98	1.4	148	0.0	198	0.0	248	0.0	298	0.0
49	18.9	99	0.8	149	0.0	199	0.0	249	0.0	299	0.0
50	20.3	100	0.4	150	0.0	200	0.0	250	0.0	300	0.0

III. SOUTH PART OF Westwind 2ND ADDITION

This drainage area includes Lots 2-4, 16-23, 31-52, and adjacent streets, in Westwind 2nd Addition. This area will drain directly to the storm sewer system with no detention required. Therefore the peak discharge was calculated by the Rational Method, using the 100-yr frequency rainfall, per City of Wichita drainage criteria.

Drainage area	8.5 Acres
C100	0.67
Time of concentration	15 minutes
I100	7.37 in./hr.
Q100	42.0 cfs

A major sump will be located at Woodchuck and Westlawn Circle, with inlet and outflow pipe capacity for the Q100. The outflow system will discharge directly into the 72" SWS 145 at Woodchuck and 19th Street. Extension of the storm sewer system north of Westlawn Circle will be designed for the initial storm (Q2).

The time of concentration for this area is 15 minutes, compared to 35 minutes in the SWS 145 system. By reducing the Q100 by the ratio of the times of concentration, the adjusted Q100 into the storm sewer is 42 cfs x (15 / 35) = 18 cfs. — Rainfall Intensities

?

5.0/7.37 = 28.5 cfs

ANALYSIS OF SWS 145 USING CURRENT CRITERIA Revised 2-16-87

Note: Original City of Wichita design was based on old rainfall frequency-intensity-duration curves.

Per current design standards, intial design storm frequency is 2-yr. (use Q2). Runoff coefficients (for Rational Method) are 0.41 for 2-yr and 0.61 for 100-yr, based on 1/3 acre residential lot size, 50% Soil Group B and 50% Soil Group C.

New I and Q values are based on Rainfall Intensity Table for Sedgwick County (April 15, 1986). C of W Drainage Criteria Manual, Attachment A.

Times of concentration and drainage areas are per original design by C of W (Kerby).

Analysis I used Civilsoft "Storm" program on IBM-AT Computer. Q values used are for 2-yr frequency (Q2) under existing conditions (no development north of 19th Street).

Analysis II was for existing system with effect of Q100. Excess flow was routed through streets.

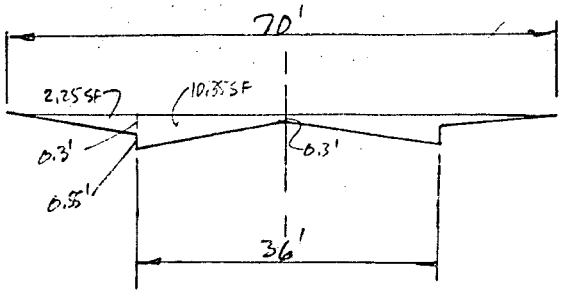
These analyses considered the flow in laterals for the first section only above their junctions with the main line (points 7,3, and 2 in the original design), since Q (Max Q) at those points was added to mainline flow as adjusted Q (ADJ Q). Laterals were not analyzed in detail upstream from these points.

(See attached printout for Q2 analysis and worksheet for Q100 analysis.)

STREET FLOW CAPACITIES FOR ANALYSIS II

Ignoring storage in sumps,
Pipe Q = Q100 - overflow in street

Street section (70' R/W), typical for 19th, Westport, and Northwest Parkway:



A=25.2 sf wp=67.4' r=0.295 $r^{2/3}$=0.44

n = 0.015 $V = \frac{1.486}{n} r^{2/3} s^{1/2}$

$V = \frac{1.486(.44)s^{1/2}}{0.015}$ $V = \frac{Q}{A} = \frac{Q}{25.2}$

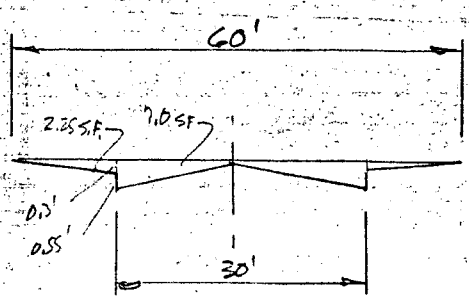
$Q = 43.7\sqrt{s}$ $Q = 1101.2\sqrt{s}$

Capacity various slopes:

(Sump at Reca)
for S = 0.004, Q = 22.0
for S = 0.0107, Q = 114.1
for S = 0.0070, Q = 92.4
for S = 0.0120, Q = 120.8

(Sump at Woodchuck)
for S = 0.0077, Q = 96.6
for S = 0.0035, Q = 65.2
for S = 0.0018, Q = 46.3
for S = 0.0011, Q = 36.4
for S = 0.0115, Q = 118.2
for S = 0.0020, Q = 49.4
for S = 0.0033, Q = 63.3

Street Section (60'R/W), for Cramer Street:



A=18.5 wp=61.2 r=0.30 $r^{2/3}$=0.45

n=0.015

$Q = \frac{1.486(0.45)\sqrt{s}\,(18.5)}{0.015}$

$Q = 827.0\sqrt{s}$

ANALYSIS II SUMMARY

Line identification same as 2-yr analysis (see printout attached)

Values for Q100 based on current City of Wichita drainage design criteria. See plan worksheet for Q calculations. Storage in sumps ignored.

Note: Original design of system provided for Q100 of 154.21 cfs in pipe from sump at Reca & 19th. Current value calculated for Q100 at same point = 136 cfs.

Original design of system provided for Q100 of 263.19 cfs in pipe from sump at Woodchuck & 19th. Current value calculated for Q100 at same point = 218 cfs.

Based on this analysis, the available capacity for additional area to drain into the system is 45 cfs at the 19th and Woodchuck sump location.

Line	Q cfs	SIZE	Slope Hyd. Gr.	LENGTH	V_1	V_2	FL 1	FL 2	HG 1	hf	HG 2	Top of Curb
1	—	8x45	—	—	—	—	—	—	—	—	136.57	
2	494		.01886	60.61	13.7	13.7	128.64	130.95	136.57	5.36	141.93	
3	494		.01886	213.90	13.7	13.7	130.45	134.80	141.93	1.90	143.83	
4	494		.01886	437.19	13.7	13.7	134.80	138.90	143.83	3.87	147.70	148.70
5	494		.01886	272.50	13.7	13.7	138.80	134.86	147.70	2.41	150.11	
6	410		.01611	100.53	11.6	11.4	134.86	135.25	150.11	0.61	150.72	
7	409		.01607	262.20	11.6	11.4	135.25	136.45	150.72	1.59	152.31	
8	339	↓	.01017	234.31	9.6	9.6	136.45	138.50	152.31	0.98	153.29	
9	234	72"	.00305	549.94	8.3	8.3	138.52	140.96	153.29	1.66	154.97	
10	234		.00305	203.00	8.3	8.3	140.96	142.21	154.97	0.86	155.83	
11	222		.00275	276.64	7.9	7.9	142.23	143.45	155.83	0.76	156.59	
12	218		.00265	137.19	7.7	7.7	143.47	144.07	156.59	0.36	156.95	155.20
13	218	↓	.00265	397.67	7.7	7.7	144.12	144.98	156.95	1.05	158.00	
14	137	60"	.00277	320.98	7.0	7.0	145.09	145.73	158.00	0.89	158.89	
15	137		.00277	269.50	7.0	7.0	148.00	149.86	158.89	0.75	159.64	
16	137		.00277	270.00	7.0	7.0	149.89	151.22	159.64	0.75	160.39	
17	137	↓	.00277	508.63	7.0	7.0	151.24	153.78	160.39	1.41	161.80	
18	42.0	42"	.00179	36.82	4.4	4.4	155.28	155.49	161.80	0.06	161.86	161.45
19	22.3	36"	.00112	267.00	3.2	3.2	156.00	157.14	161.86	0.18	162.04	
20	22.3	30"	.00296	274.00	4.5	4.5	157.71	158.75	162.04	0.81	162.85	
21	13.1	24"	.00835	234.40	4.2	4.2	159.25	161.23	162.85	0.79	163.64	
22	13.1	21"	.00684	65.59	5.4	5.4	161.48	162.67	163.64	0.47	164.11	166.0

Check Culvert Capacity Sta. 9+74

(outlet control)

1. try 2 - 30"x 19" rcphe dc = 1.57' dsfl = 152.59 TW = 154.16

H = 157.1 - 154.16 = 2.9', Q = 32 cfs x 21 = 64 cfs > 52 cfs (Q10)

2. try 3 - 36"x 22" cmpe dc = 1.33' DSFL = 152.59 TW = 153.92

H = 157.1 - 153.9 = 3.2', Q = 34 cfs x 3 = 102 cfs > Q50

3. try 2 - 36"x 22" cmpe dc = 1.63' dsfl = 152.59 TW = 154.22

H = 157.1 - 154.2 = 2.9', Q = 33 cfs x 2 = 66 cfs

4. try 3 - 30"x 19" rcphe dc = 1.50' dsfl = 152.59 TW = 154.1

H = 157.1 - 154.1 = 3.0', Q = 32 cfs x 3 = 90 cfs >Q50

Use option 2 or 4. for Q50

Use 1 or 3 for Q10 only

Check Culvert Capacity Sta. 14+57

(outlet control)

1. try 2 - 30"x 19" rcphe dc = 1.62' dsfl = 146.2 TW = 147.8

H = 149.6 - 147.8 = 1.8', Q = 24 cfs x 2 = 48 cfs < Q10

2. try 3 - 29"x 18" cmpe dc = 1.38' dsfl = 146.2 TW = 147.6

H = 149.6 - 147.6 = 2.0', Q = 16.5 cfs x 3 = 49.5 cfs < Q10

3. try 2 - 38"x 24" rcphe dc = 1.75' dsfl = 146.2 TW = 148.0

H = 149.6 - 148.0 = 1.6', Q = 37 cfs x 2 = 74 cfs Q50

4. try 2 - 43"x 27" cmpe dc = 1.56' dsfl = 146.2 TW = 147.8

H = 149.6 - 147.8 = 1.8', Q = 40 cfs x 2 = 80 cfs > Q50

Use option 3 or 4.

CHECK DITCH CAPACITY - S. side 21st St. (Westwind 2nd Addition)
TCR Revised 2-20-87 Note: Elev. are city datum

Drainage Area north of 21st Street flowing to culverts = 68 acres
(from Nov 86 calculations) Q10 = 52 cfs
Q50 = 81 cfs
Q100 = 103 cfs

Existing culverts are 2 - 49"x 32" nopheo length = 102'
usfl = 159.40 dsfl = 159.26 s = 0.0014
Max. HW = 162.71 - 159.40 = 3.31'

~~w/ inlet control~~: HW/D = 3.31/2.67 = 1.24
~~from~~ FHwA chart 3, Q = 60 cfs per pipe

w/ outlet control: (chart 10) Ke = 0.5 H = 3.31 - 2.67 = 0.64'
Q = 38 cfs per pipe

Outlet control governs. Q = 76 cfs ≃ Q50. Note: When HW elevation exceeds 162.0, water will flow east along n. side of 21st.

DITCH CAPACITY@MIMIMUM SECTION

Minimum ditch section is at Sta. 8+00

Slope = 0.00125 A = 18.1 sf wp = 18.2'

r = 0.995 $r^{2/3}$ = 0.997 n = 0.030

$$v = \frac{1.486(r^{2/3})(s^{1/2})}{n}$$

$$v = \frac{1.486(0.977)(0.035)}{0.030} = 1.75 \text{ fps}$$

Q = AV = 18.1 (1.75) = 31.6 cfs

Existing ditch section is insufficient for Q50.

Lower ditch Sta. 8+00 to elev. 154.78

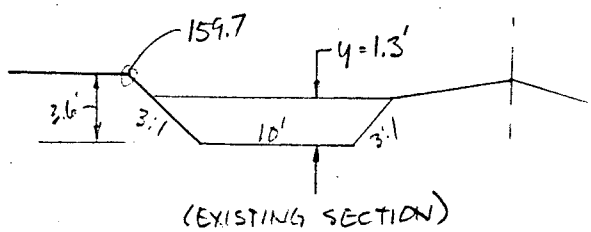
y = 2.5' s = 0.00532 s = 0.0730

A = 43.75 wp = 25.6 r = 1.695 $r^{2/3}$ = 1.422

$$V = \frac{1.486\ (1.422)(0.073)}{0.030} = 5.14 \text{ fps}$$

Q = 5.14(43.8) = 225 cfs >>> Q50

Actual depth y@ 52 cfs ≃ 1.5'



(EXISTING SECTION)

8	1						136.57								
2	2	173.0	173.0	604.61	128.64	130.95	.00	54.	96.	3	.00	.00	.00	1	3
2	3	171.0	171.0	213.90	130.95	131.80	.00	54.	96.	3	.00	.00	.00	0	4
2	4	163.0	163.0	437.19	131.80	133.80	.00	54.	96.	3	.00	.00	.00	0	5
2	5	157.0	157.0	272.50	133.80	134.86	.00	54.	96.	3	.00	.00	.00	0	6
2	6	151.0	151.0	100.53	134.86	135.25	.00	54.	96.	3	.00	.00	.00	0	7
2	7	151.0	151.0	262.20	135.25	136.45	.00	54.	96.	3	.00	.00	.00	0	8
2	8	147.0	147.0	234.31	136.45	138.50	.00	54.	96.	3	.00	.00	.00	0	9
2	9	81.3	81.3	549.94	138.52	140.94	.00	72.	0.	3	.00	.00	.00	0	10
2	10	76.1	76.1	283.00	140.96	142.21	.00	72.	0.	3	.00	.00	.00	0	11
2	11	72.2	72.2	276.64	142.23	143.45	.00	72.	0.	3	.00	.00	.00	0	12
2	12	72.2	72.2	137.19	143.47	144.07	.00	72.	0.	3	.00	.00	.00	0	13
2	13	71.5	71.5	397.67	144.10	144.98	.00	72.	0.	3	.00	.00	.00	0	14
2	14	58.1	58.1	320.98	145.09	145.73	.00	60.	0.	3	.00	.00	.00	0	15
2	15	54.4	54.4	269.50	148.00	149.84	.00	60.	0.	3	.00	.00	.00	0	16
2	16	51.2	51.2	270.00	149.87	151.22	.00	60.	0.	3	.00	.00	.00	0	17
2	17	48.9	48.9	508.63	151.24	153.78	.00	60.	0.	3	.00	.00	.00	0	18
2	18	42.6	42.6	36.84	155.28	155.49	.00	42.	0.	3	.00	.00	.00	0	19
2	19	22.3	22.3	163.00	156.00	157.14	.00	36.	0.	3	.00	.00	.00	0	20
2	20	22.3	22.3	274.00	157.71	158.75	.00	30.	0.	3	.00	.00	.00	0	21
2	21	13.1	13.1	234.40	159.25	161.23	.00	24.	0.	3	.00	.00	.00	0	22
2	22	13.1	13.1	68.50	161.48	162.67	.00	21.	0.	1	.00	.00	.00	0	0
2	23	15.3	12.7	27.00	143.23	143.50	.00	27.	0.	1	.00	.00	.00	3	0
2	24	15.4	8.2	164.00	141.86	143.50	.00	18.	0.	1	.00	.00	.00	4	0
2	25	75.3	69.2	253.65	140.00	143.92	.00	54.	0.	1	.00	.00	.00	8	0

Line No	Q (cfs)	D (in)	W (in)	Dn (ft)	Dc (ft)	Flow Type	Sf-full (ft/ft)	V 1 (fps)	V 2 (fps)	FL 1 (ft)	FL 2 (ft)	HG 1 Calc	HG 2 Calc
1	Hydraulic grade line control = 136.57												
2	173.0	54	96	2.35	2.44	Full	.00109	4.8	4.8	128.64	130.95	136.57	137.23
3	171.0	54	96	2.30	2.42	Full	.00106	4.8	4.8	130.95	131.80	137.28	137.50
4	163.0	54	96	2.12	2.34	Seal	.00097	4.5	5.0	131.80	133.80	137.58	137.91
	X = 353.57			X(N) = .00									
5	157.0	54	96	2.18	2.28	Seal	.00090	4.4	5.0	133.80	134.86	138.64	138.75
	X = 112.85			X(N) = .00									
6	151.0	54	96	2.13	2.23	Part	.00083	4.7	5.2	134.86	135.25	138.88	138.88
7	151.0	54	96	2.01	2.23	Part	.00083	5.1	10.3	135.25	136.45	138.96	138.28
	X = .00			X(N) = .00		X(J) = 214.91		F(J) = 61.02		D(BJ) = 1.90		D(AJ)	
8	147.0	54	96	1.58	2.19	Part	.00078	11.5	8.4	136.45	138.50	138.05	140.69
9	81.3	72	0	2.21	2.41	Part	.00037	4.3	7.6	138.52	140.94	142.35	143.35
	X = .00			X(N) = 409.98		X(J) = 239.52		F(J) = 30.43		D(BJ) = 2.21		D(AJ)	
10	76.1	72	0	2.13	2.33	Part	.00032	5.6	7.5	140.96	142.21	143.85	144.54
	X = .00			X(N) = 190.01		X(J) = 56.85		F(J) = 27.97		D(BJ) = 2.13		D(AJ)	
11	72.2	72	0	2.07	2.27	Part	.00029	5.8	7.4	142.23	143.45	144.96	145.72
	X = .00			X(N) = 171.16		X(J) = 40.70		F(J) = 26.15		D(BJ) = 2.07		D(AJ)	
12	72.2	72	0	2.08	2.27	Part	.00029	5.8	7.4	143.47	144.07	146.19	146.34
	X = .00			X(N) = .00		X(J) = 40.09		F(J) = 26.14		D(BJ) = 2.08		D(AJ)	
13	71.5	72	0	2.48	2.26	Part	.00028	6.1	6.5	144.10	144.98	146.70	147.46
	X = .00			X(N) = 368.53									
14	58.1	60	0	2.49	2.13	Part	.00050	5.0	15.9	145.09	145.73	147.93	146.93
	X = .00			X(N) = .00		X(J) = 187.59		F(J) = 22.01		D(BJ) = 1.67		D(AJ)	
15	54.4	60	0	1.71	2.07	Part	.00044	9.1	7.1	148.00	149.84	149.71	151.90
	X = .00			X(N) = 66.34									
16	51.2	60	0	1.80	2.01	Part	.00039	5.4	7.0	149.87	151.22	152.30	153.23
	X = .00			X(N) = 174.24		X(J) = 29.48		F(J) = 17.56		D(BJ) = 1.80		D(AJ)	
17	48.9	60	0	1.76	1.96	Part	.00035	5.5	13.5	151.24	153.78	153.56	154.98
	X = .00			X(N) = 134.99		X(J) = 20.82		F(J) = 16.55		D(BJ) = 1.76		D(AJ)	

3	Hydraulic grade line control =						137.25						
23	15.3	27	0	1.12	1.36	Part	.00244	7.4	6.1	143.23	143.50	144.39	144.86

1Project : STORM WATER SEWER NO. 145 Date:

STORM DRAIN ANALYSIS RESULTS (Cont.)

Line No	Q (cfs)	D (in)	W (in)	Dn (ft)	Dc (ft)	Flow Type	Sf-full (ft/ft)	V 1 (fps)	V 2 (fps)	FL 1 (ft)	FL 2 (ft)	HG 1 Calc	HG 2 Calc
4	Hydraulic grade line control =						137.54						
24	15.4	18	0	1.50	1.41	Seal	.02149	8.9	8.7	141.86	143.50	143.27	146.85
	X =	3.29	X(N) =	.00									
7	Hydraulic grade line control =						138.16						
25	75.3	54	0	1.71	2.53	Part	.00147	13.4	8.2	140.00	143.92	141.73	146.45

1 LIST OF ABBREVIATIONS

V 1, FL 1, D 1 and HG 1 refer to downstream end
0 V 2, FL 2, D 2 and HG 2 refer to upstream end
0 X - Distance in feet from downstream end to point where HG intersects soffit in seal
0 X(N) - Distance in feet from downstream end to point where water surface reaches normal
0 X(J) - Distance in feet from downstream end to point where hydraulic jump occurs in lir
0 F(J) - The computed force at the hydraulic jump
0 D(BJ) - Depth of water before the hydraulic jump (upstream side)
0 D(AJ) - Depth of water after the hydraulic jump (downstream side)
0 SEAL indicates flow changes from part to full or from full to part
0 HJ indicates that flow changes from supercritical to subcritical through a hydraulic
0 HJU indicates that hydraulic jump occurs at the junction at the upstream end of the li
0 HJD indicates that hydraulic jump occurs at the junction at the downstream end of the
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