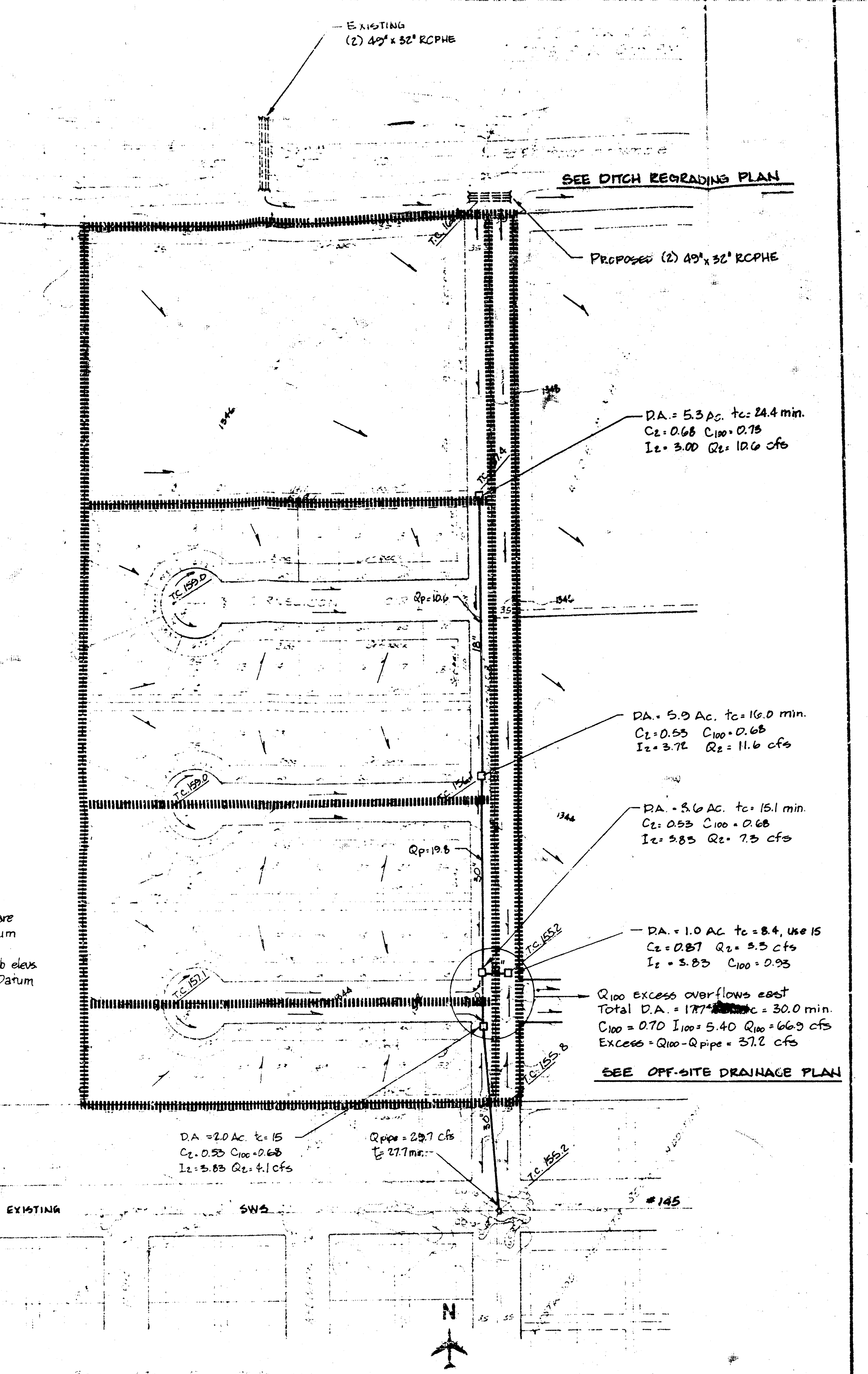
WESTWIND 2ND ADDITION

DRAINAGE PLAN

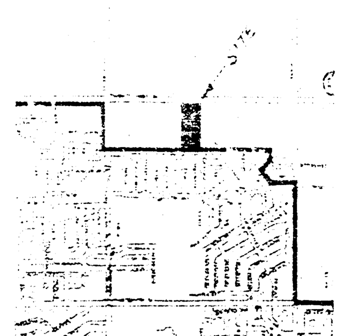
PART OF THE NW1/4 OF SEC 9 TWP 27-S R-1-W SEDGWICK COUNTY KANSAS

WESTWIND ASSOCIATES II



Note: Contours are MSL Datum

Top of Curb elevs are City Datum



VICINITY PLAT

TOPOGRAPHIC MAP OF LANDS LOCATED AT N. HALF OF N.W. QUARTER SECTION 9, 27S, 1W, SEDGWICK COUNTY KANSAS

SURVEYING & ENGINEERING
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
1440 EAST ENGLISH ST. WICHITA, KS 67211

0 100 200 300
1:1200 100'-1"
CONTOUR INTERVAL 2 ft

DRAINAGE PLAN
November 21, 1986
Rev. June 25, 1987

4-22-86

BAUGHMAN COMPANY, P.A.
SURVEYING & ENGINEERING
316 262-7271 · 330 LAURA · WICHITA, KANSAS 67211

29 MAY 86

DRAINAGE PLAN

FOR

WESTWIND 2nd ADDITION

WICHITA, SEDGWICK COUNTY, KANSAS

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

June 1987

JUN 24 1987
DESIGN DIVISION

WESTWIND 2ND ADDITION
REVISED DRAINAGE PLAN
JUNE 25, 1987

This plan supersedes two previously submitted plans dated November, 1986, and March, 1987, and consists of three parts:

I. Diversion of off-site drainage from the north, to the east.

II. Storm sewer system for the initial design storm (2-yr.)

III. Diversion of excess runoff (100-yr.) to the east.

THOMAS CHARLES RUGGLES LICENSED 9621 KANSAS PROFESSIONAL ENGINEER

I. DIVERSION OF OFFSITE DRAINAGE

An area of 68 acres located north of 21st Street naturally drains across the Westwind 2nd Addition site via two culvert pipes under the street. The undeveloped condition runoff from the area is 103 cfs (Q100). This area is to be included in a planned development, with a reduced drainage area of 28.3 acres and peak runoff (Q100) of 99 cfs, approximately equal to the existing condition (see page 3). However, no drainage right of way or easement exists south of 21st Street, and this runoff flows across private property (Westwind 2nd Addition). Since this and other drainage areas were excluded from the design of the storm sewer system to the south (SWS 145), sufficient capacity does not exist in that system to accept this runoff. Part I of this Drainage Plan will divert the flow along the south side of 21st Street within existing street right of way to an existing storm sewer at Ridge Road, thereby eliminating the overland flow to the south.

The existing culvert installation across 21st Street (see Plan) includes (2) 49" x 32" Reinforced Concrete Pipes (H.E.). Although the runoff to the culvert inlet is 99 cfs, the pipes will handle only 76 cfs, due to head limits controlled by the elevation of 21st Street. The excess flows east along the north side of the street (see page 4). The 76 cfs discharged by the pipes will be carried east in the south ditch by removing a ditch plug at Woodchuck and regrading the ditch in some areas to the east. A proposed double culvert at Woodchuck and culverts at two driveways downstream will be sized to pass this flow (see pages 4 and 5). Some filling along the south R/W line will be required to contain the flow within the ditch (see Ditch Regrading Plan).

WESTWIND 2ND ADDITION
Determination of Runoff
from area n. of 21st Street — TCR 6-24-87

Undeveloped Condition

D.A. = 68 Ac. Soil Group B, 50% pasture, 50% grass waterway
use Rational Method
$C_5 = 0.22$ $C_{100} = 0.40$ (Attach D)
Length of Watershed = 2300' H = 1366 - 1346 S = 0.87%
1150' @ 1.05 fps / 1150' @ 0.26 fps. $V_{avg} = 0.65$ fps (Attach E)
2300 ÷ 0.65 ÷ 60 = 59.0 tc = 59 min.
I_5 = 2.18"/hr I_{100} = 3.77"/hr (Attach A)
Q_5 = 32.6 cfs Q_{100} 102.5 cfs (use 103 cfs)

Developed Condition — D.A. = 28.3 Ac.

Church Sites	Golf Course	Commercial Sites
Area = 20.0 Ac.	3.0 Ac.	5.3 Ac.
Impervious = 20%	0%	70%

C_5: 20% x 0.86 = 0.172
80% x 0.22 = 0.176
C_5 = 0.35

{Developed conditions per PEC development plan for Reflection Ridge 6-10-87}

C_{100}: 20% x 0.90 = 0.180
80% x 0.41 = 0.323
C_{100} = 0.51

Tc: L = 660', V = 0.44 fps tc = 25 min.

Church Sites	Golf Course	Commercial Sites
I_5 = 3.57 I_{100} = 5.90	I_5 = 3.57 I_{100} = 5.90	I_5 = 4.56 I_{100} = 7.27
Q_5 = 25.0 cfs	Q_5 = 2.4 cfs	Q_5 = 16.2 cfs
Q_{100} = 60.2 cfs	Q_{100} = 7.3 cfs	Q_{100} = 31.2 cfs

Total Q_5 = 43.6 cfs Total Q_{100} = 98.7 (use 99 cfs)

WESTWIND 2ND ADDITION — TCR 6-24-87
Ditch flow east (s. side 21st St.)

(2) 49"x32" RCPHE x 102' long incl. end sections (existing).
Determine discharge using FHWA HEC. No.5.
(FHWA lists 49"x32 as 50"x31")
USFL = 159.40 DSFL = 159.26 Elev. @ ℄ 21st = 162.71
Max. HW = 162.71 - 159.40 = 3.31' Slope = 0.0014
~~w/inlet control~~: HW/D = 3.31 ÷ 2.67 = 1.24 (use Chart 3)
Q = 60 cfs / pipe x 2 = 120 cfs
w/outlet control: Ke = 0.5 H = 3.31 - 2.67 = 0.64' (use Chart 10)
Q = 38 cfs / pipe x 2 = 76 cfs
Outlet control governs ∴ Q = 76 cfs through pipes
Note: High point in N. ditch = elev. 162.0±. When ponding reaches that elev., it begins to flow east ∴ excess flow drains east.

Recommend installing (2) 49" x 32" RCPHE at street and driveway locations along south ditch of 21st St. Maintain HW depth of 3.4' @ all inlet ponds.

Check ditch section capacity in south ditch per plan/profile, to prove capacity ≥ 76 cfs. Typical existing & finished ditch section has 8' bottom,

---

DITCH CAPACITIES — 6-24-87 TCR

Ditch Sta. 0+00 to 3+00: S = 0.0043 $S^{1/2}$ = 0.066
try y = 2.0' A = 32.00 ft² wp = 24.49' r = 1.307 $r^{2/3}$ = 1.196
V = 1.486 (1.196)(0.066) / 0.030 = 3.91 fps Q = 3.91 x 32.00 = 125 cfs > 76

Minimum elev. 161.1 along R/W for reqd HW @ 3+00 culvert exceeds 2.0' depth for this reach ∴ capacity exceeds 76 cfs.

Ditch Sta. 3+55 to 7+00: S = 0.0020 $S^{1/2}$ = 0.045
try y = 2.2' A = 33.60 ft² wp = 26.14' r = 1.285 $r^{2/3}$ = 1.183
V = 1.486 (1.183)(0.045) / 0.030 = 2.64 fps Q = 2.64 (33.60) = 88.6 cfs > 76 cfs

∴ ditch capacity for this reach exceeds 76 cfs @ 2.2' depth.

Ditch Sta. 7+00 to SWS inlet @ 23+90 ±:

Slopes exceed 0.43% (above) ∴ with same ditch section, capacity will exceed 76 cfs @ depths < 2.0'.

II. STORM SEWER

An extension of Storm Sewer 145 will be constructed within Woodchuck right of way, and will drain all the area included in Westwind 2nd Addition (see Plan). This system will be designed to accept runoff from the design storm up to the limits of remaining capacity in the existing system, considering contributions from stormwater detention systems on Westwind 3rd and 4th Additions and Golf Park West, located to the west. (See approve Drainage plans for Westwind 3rd and 4th Addition, May 1987, and Golf Park West, June 1986). Inflow to the storm sewer will be limited by curb inlet capacity, controlled by an overflow to the east at the Westlawn intersection (see Part III).

Runoff from Westwind 2nd Addition was computed using the Rational Method, per City of Wichita Drainage Criteria. The initial design storm was the 2-yr. frequency, and the secondary storm was the 100-yr. frequency. Runoff coefficients used were from Attachment D, and rainfall intensities were from Attachment A of the above Criteria. All soils in the Westwind 2nd drainage area are Hydrologic Group B, per Sedgwick county Soil Survey. A minimum of time of concentrations of 15 minutes was used for inlets.

The excess capacity in the existing storm water sewer has been determined to be 45 cfs at the point of inflow from this system, at a flow time of approximately 35 minutes in the pipe system (refer to analysis of SWS 145 included in the November 1986 plan). The time lag between inflow at the contributing points for the areas mentioned will allow approximately 30 cfs from the proposed storm sewer to enter the system at Woodchuck (see Plan). The contribution from Westwind 2nd Addition will be limited to 29.7 cfs (Q2) per the Drainage Plan. The Q100 excess of 37.2 cfs (66.9-29.7) will overflow at Westlawn Avenue to the east, as described in Part III.

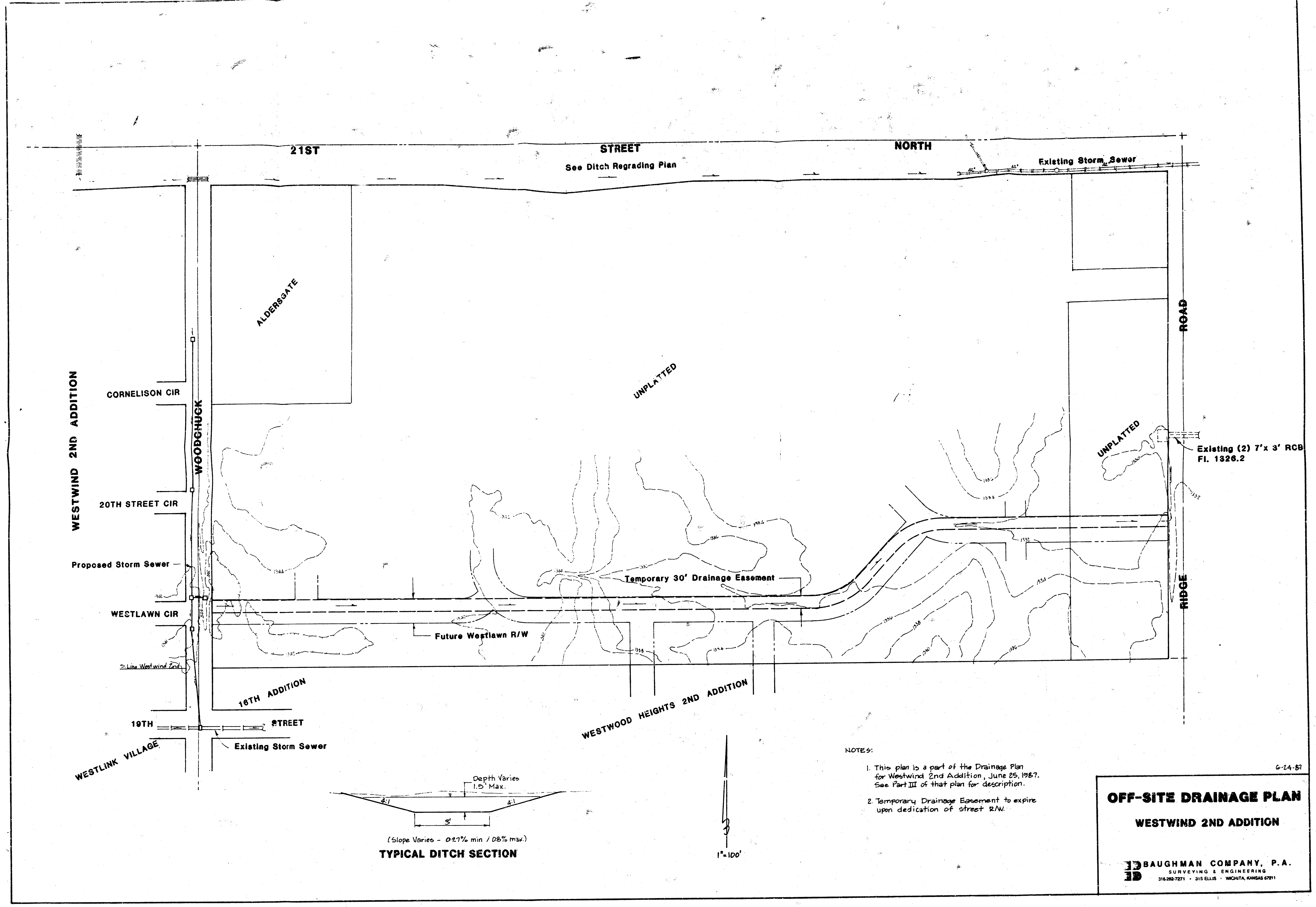
III. DIVERSION OF EXCESS RUNOFF

Runoff in excess of the capacity of the storm sewer will overflow at the intersection of Woodchuck and Westlawn and drain to the east (see plan). This flow will be carried by open ditch through a temporary drainage easement to two existing 7' x 3' RCB's at Ridge Road. Upon development of the land east of Woodchuck, this overflow will be carried in the street section and future storm sewer to Ridge Road (See Off-site Drainage Plan).

A temporary drainage easement and an agreement providing for this ditch will be executed by the Westwind developer and the owner of the property between Woodchuck and Ridge Road. This easement will expire at the time that street right of way is dedicated for the ditch area.

LEGAL DESCRIPTION FOR TEMPORARY DRAINAGE EASEMENT

A strip of land 30 feet wide lying 15 feet either side of the following described centerline: Beginning at a point in the west line of the N½ of the NE¼ of Sec. 9, Twp. 27-S, R-1-W of the 6th P.M., and 153.0 feet north of the S.W. Corner of said N½ of the NE¼ of Sec. 9; thence east parallel with the south line of said N½ of the NE¼ of Sec. 9, 1660.0 feet to the P.C. of a curve to the left having a radius of 195 feet; thence along said curve, through a central angle of 45°00', 153.15 feet; thence northeasterly along the tangent to said curve, 112.0 feet to the P.C. of a curve to the right having a radius of 195 feet; thence along said curve, through a central angle of 45°00', 153.15 feet; thence easterly along the tangent to last described curve, 648 feet more or less to a point 40 feet west of the east line of said Sec. 9.



BAUGHMAN COMPANY, P.A.
SURVEYING & ENGINEERING
316/262-7271 • 330 LAURA • WICHITA, KANSAS 67211

CONFIRMATION MEMO

PROJECT: West Wind Addition
DATE: November 21, 1986
JOB NO.:
COPIES TO:
TO: Vicky Huang
FROM: Tom Ruggles
REFERENCE: Plat

Enclosed is the final drainage plan for the above plat. Attached are drainage calculations (3 pages) ditch plan and profile, and an analysis of Storm Sewer 145 checking available capacity (1 print, 3 pages, and computer print-out).

The final plat is being submitted today to MAPD.

PAGE ___ OF ___

Culvert / Ditch Flow
21st & Woodchuck
By: TCR Date: 11-20-86 Page: 1 Of: 2
MILLCON CORPORATION

2 - 49"x32" RCPHE Across 21st St. L=102'
(Using HEC. No.5, FHwA)
USFL = 159.40 DSFL = 159.26 S = 0.0014
Elev. ℄ 21st St. = 162.71
Max HW = 162.71 - 159.40 = 3.31'
~~w/ Inlet control~~: HW/D = 3.31 ÷ 2.67' = 1.24 (Chart 3)
Q = 60 cfs / pipe
[w/ outlet control] (Chart 10) Ke = .05 H = 3.31 - 2.67 = 0.64
Q = 38 cfs / pipe x 2 = 76 cfs
*Note: When HW elev. exceeds invert, water will flow east in n. ditch
Total Q through pipes = 76 cfs

D.A. n. of 21st flowing to culverts above = 68 ac.
L = 2300' S = (1366 - 1346)/2300 = 0.87% 1/2 distance pasture, 1/2 grass waterway

Avg. velocity = (1.05 + 0.26)/2 = 0.65 fps
"C" for soil group B/C, pasture conditions, 100-yr freq. = 0.40
Tc = 2300' ÷ 0.65 cfs = 59 min I_{100} = 3.77 "/hr.

Q_{100} = 0.40(3.77)(68) = 103 cfs *See note above
(try Q_{50}) C_{50} = 0.35 I_{50} = 3.41 Q_{50} = 0.35(3.41)(68) = 81.
(try Q_{10}) C_{10} = 0.3 I_{10} = 2.56 Q_{10} = 0.3(2.56)(68) = 52
∴ pipes are sized for approx. Q_{50}.

Check ditch capacity - new section.
min. slope = 0.12% n = 0.030
V = 1.486 (1.51)(0.035) / 0.030 = 2.64 fps
A = 69 sf, WP = 36.7, R = 1.88, $R^{2/3}$ = 1.52
Q_{ditch} = 2.64 x 69 = 182 cfs

Check Ditch Inlet capacity (sta. 23+82)
42" RCP, FL = 137.02 top elev. 142.18 HW: 5.16' w/inlet control
HW/D = 5.16 ÷ 3.5 = 1.47 (ke = 0.2) Q = 90 cfs (Chart 2)

By: Date: Page: 2 Of:
MILLCON CORPORATION

Check driveway culvert / overtop capacity (sta. 9+74)
29"x18" CMPA w/es. x 48' long
USFL = 155.15 DSFL = 154.79 S = 0.0074 Top elev. 157.3
w/ inlet control HW = 157.3 - 155.15 = 2.15' HW/D = 1.43 Q = 15 cfs
w/ outlet control Q = 15 cfs
∴ Flow will overtop driveway at most frequent storms.

The same culvert size exists @ sta. 14+57
(See profile)
The ditch is plugged by a driveway entrance @ sta. 3+37
∴ No flow is being carried to the east under present conditions.

Recommendation: Install 2-50"x31" RCPHE under Woodchuck in south ditch of 21st (location of existing driveway w/ no culvert).

Replace existing driveway culverts @ sta. 9+74 and 14+57. Regrade ditch to lower flowline from 0-50 to 15+00, to pass Q_{10} @ drives. (Q_{10} = 52 cfs).
Sta. 14+57: HW: 150.4 - 146.7 = 3.7' [L = 30']
try 2 - 29"x18" CMPA HW = 3.7' HW/D = 2.46 22 cfs x 2 = 44 cfs } inlet control
try 2 - 36"x22" CMPA HW = 3.7' HW/D = 2.02 32 cfs x 2 = 64 cfs } chart 6
check outlet control H = (150.4 - 147.8) = 2.6' Q = 29 cfs x 2 = 58 OK } outlet control chart 10-12
try 2 - 30"x19" RCPHE H = 2.6' Q = 29 cfs x 2 = 58 OK
Use [2 - 36"x22" CMPA] or [2 - 30"x19" RCPHE] 30' long

Sta. 9+74: HW = 157.1 - 154.5 = 2.6' [L = 40']
try 2 - 36"x22" CMPA HW = 2.6' HW/D = 1.42 Q = 24 cfs x 2 = 48 cfs no
check outlet control H = 0.77' Q = 15.5 x 2 = 31 cfs no
try 2 - 30" ... dc = 1.57 DSFL = 156.15 tw = 155.72 H = 1.4' Q = 15.5 x 2 = 31 no
... H = 1.7' Q = 24 x 2 = 48 no

100-yr Analysis SWS 145 (II)
By: Date: 11-19-86 Page: 3 Of: 3
MILLCON CORPORATION

Line identification same as 2-yr analysis (Computer output attached)

Values for Q_{100} based on current C of (1) drainage design criteria. See plan worksheet for Q calculations. Storage in sumps ignored.

Note: Orig. design of system provided for Q_{100} of 154.21 cfs in pipe from sump @ Rock & 19th. Current value calculated for Q_{100} at same point = 136 cfs

Orig. design of system provided for Q_{100} of 293.04 cfs in pipe from sump @ Woodchuck & 19th. Current value calculated for Q_{100} at same point = 218 cfs

Line	Q cfs	Size	Slope Hyd. Gr.	Length	V_1	V_2	FL 1	FL 2	HG 1	hf	HG 2	T curb
1	—	8'x4.5'	—	—	—	—	—	—	—	—	136.57	
2	494	↓	.00886	604.61	13.7	13.7	128.64	130.95	136.57	5.36	141.93	
3	494		.00886	213.90	13.7	13.7	130.95	131.80	141.93	1.90	143.83	
4	494		.00886	437.19	13.7	13.7	131.80	133.80	143.83	3.87	147.70	148.70
5	494		.00886	272.50	13.7	13.7	133.80	134.86	147.70	2.41	150.11	
6	410		.00611	100.53	11.6	11.4	134.86	135.25	150.11	0.61	150.72	
7	409		.00607	262.20	11.6	11.4	135.26	136.45	150.72	1.59	152.31	
8	339	↓	.00417	234.31	9.4	9.4	136.45	138.50	152.31	0.98	153.29	
9	234	72"	.00305	549.94	8.3	8.3	138.52	140.92	153.29	1.68	154.97	
10	234		.00305	282.00	8.3	8.3	140.96	142.21	154.97	0.86	155.83	
11	222		.00275	276.60	7.9	7.9	142.23	143.45	155.83	0.76	156.59	
12	218		.00265	137.19	7.7	7.7	143.49	144.07	156.59	0.36	156.95	155.20
13	218	↓	.00265	397.67	7.7	7.7	144.10	144.96	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	149.84	158.89	0.75	159.64	
16	137		.00277	270.00	7.0	7.0	149.81	151.22	159.64	0.75	160.39	
17	137	↓	.00277	580.63	7.0	7.0	151.24	153.78	160.39	1.61	162.00	

WILLIAM L. KORBER, L.S.
JOHN E. LUNDBLADE, L.S.
N. BRENT WOOTEN, P.E.

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

June 25, 1987

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

Dear Vicki,

Transmitted herewith is a revised Drainage Plan for Westwind 2nd Addition. The plan consists of the written report and (3) additional sheets: Drainage Plan, Off-site Drainage Plan, and Ditch Regrading Plan/Profile. This plan is a revision of the one submitted in November, 1986.

A copy has also been submitted to Jim Weber at Sedgwick County. Since part of the subject property is in the County, I am unsure of whose approval is required.

Please review the plan and notify us of your recommendations.

Respectfully submitted,

Tom

Thomas C. Ruggles, P.E.

File
TCR/ksb

RECEIVED

Westwind Add. - 21st St. Ditch (Revision)
By: TCR Date: 11-25-86 Page: 1 Of: 1
MILLCON CORPORATION

Minimum ditch section (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 = 1.486 ($R^{2/3}$)($S^{1/2}$) = 1.486 (0.997)(.035) / .030 = 1.75 fps
V = 1.75 fps Q = 31.6 cfs no

Lower ditch @ 8+00 to elev. 154.78 y = 2.5' S = 0.00532
$S^{1/2}$ = 0.0730 A = 43.75 WP = 25.8' R = 1.695 $R^{2/3}$ = 1.422
V = 1.486 (1.422)(0.073) / 0.030 = 5.14 fps Q = 5.14(43.8) = 225 cfs >> Q_{50} ok
Actual depth ≈ 1.5' @ 52 cfs

Recheck culverts @ sta. 9+74 HW = 157.1 - 153.3 = 3.8 ... outlet control
Use try [2 - 30"x19" RCPHE] dc = 1.57 DSFL = 152.59 tw = 154.16 H = 157.1 - 154.16 = 2.9'
Q = 32 cfs x 2 = 64 cfs > 52 cfs (Q_{10}) < 76 cfs (Q_{50})
Same try 3 - 36"x22" CMPA dc = 1.33 DSFL = 152.59 tw = 153.92 H = 157.1 - 153.9 = 3.2'
? Q = 34 cfs x 3 = 102 cfs > Q_{50}
or try [2 - 36"x22" CMPA] dc = 1.63 DSFL = 152.59 tw = 154.22 H = 157.1 - 154.2 = 2.9'
Q = 33 cfs x 2 = 66 cfs
? try 3 - 30"x19" RCPHE dc = 1.50 DSFL = 152.59 tw = 154.1 H = 157.1 - 154.1 = 3.0'
Q = 32 cfs x 3 = 96 cfs > Q_{50}
~~try 3 - 23"x14" RCPHE~~ dc = 1.50 DSFL = 152.59 tw = 154.1 H = 157.1 - 154.1 = 3.0'
Q = 17 cfs x 3 = 51 cfs < Q_{10} No

Recheck culverts @ sta. 14+57 outlet control
try 2 - 30"x19" RCPHE DSFL = 146.1 dc = 1.62' tw = 147.8 H = 149.6 - 147.28 = 2.8'
Q = 26 cfs x 2 = 48 < 52 cfs (Q_{10})
Use [2 - 30"x19" RCPHE] ≥ 76 cfs (Q_{50})

Westwind Add. - SWS Analysis
By: TCR Date: 11-18-86 Page: 1 Of: 3
MILLCON CORPORATION

Analysis of SWS 145 using current design criteria
(Original design was based on old rainfall frequency-duration-intensity curves)

Per current design standards, initial design storm frequency is 2-yr (use Q_2). 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), Drainage Criteria Manual, Att. A.

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

Analysis used Civilsoft "Storm" program on IBM-PC.
Q values used are for 2-yr frequency (Q_2) except that Q_{100} was routed through street and storm sewer.

Analysis I: existing system under existing conditions (Q_2).
Analysis II: existing system with effect of Q_{100}

These analyses considered the flow in laterals for the first section only above their junctions with the main line (points 7, 3, and ...) 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 ...

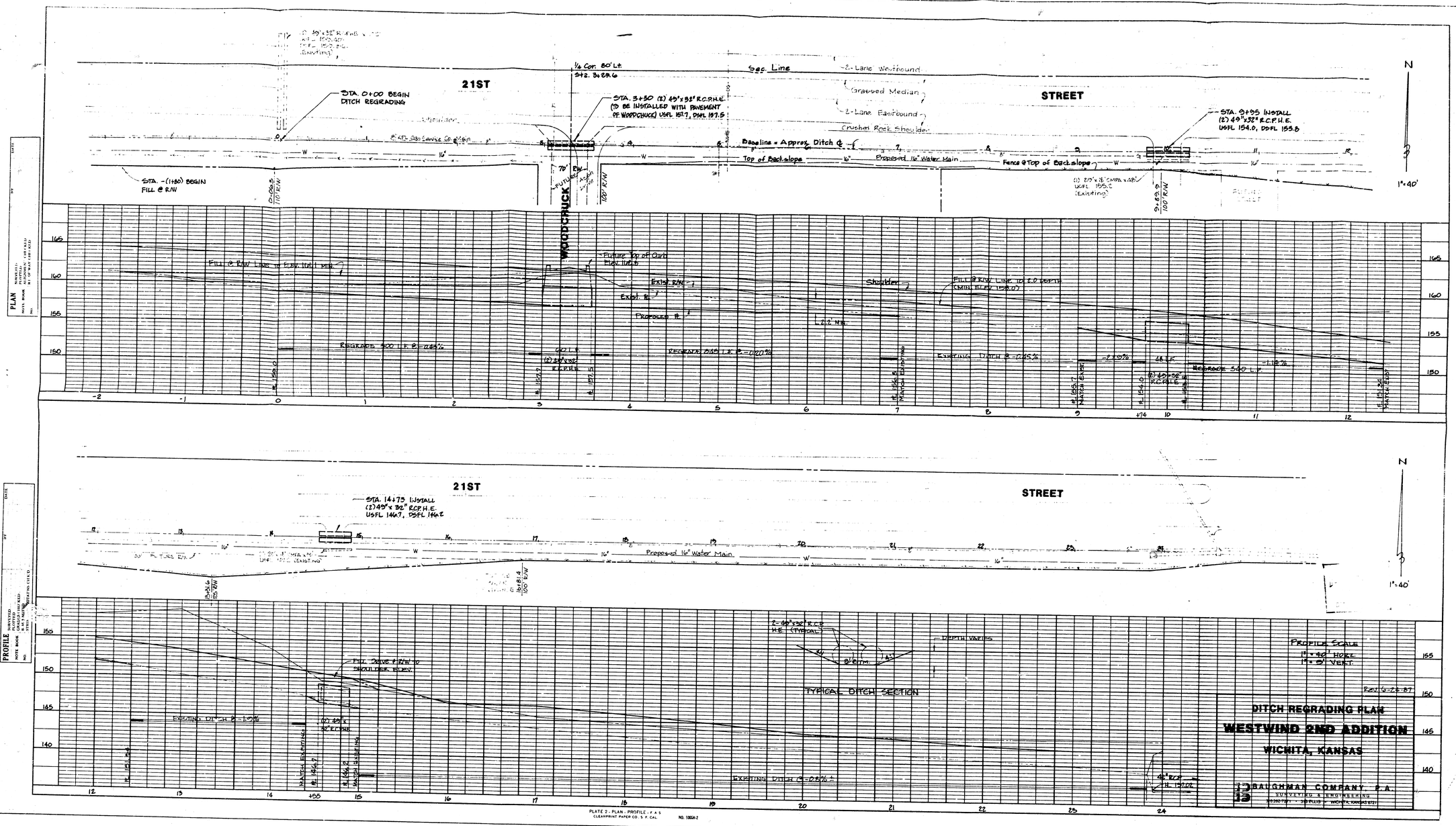


PLATE 2 - PLAN, PROFILE - 1 x 5
CLEARPRINT PAPER CO. S. P. CAL. NO. 1000H-2

Drainage Sub Areas - See plan
Westwind
By Date Sheet 2 of 3

MILLCON CORPORATION

Part of Church parcel to drain to Wdt st. 150' x 560' = 2.0 Ac.
$C_2 = 0.62$ ... $Q_2 = 5.20$ ... $C_{100} = 0.75$ ... $Q_{100} = 10.76$ $T_c = 15$ min
$I_2 = 3.83$ ... $I_{100} = 7.37$
Sump point on church parcel: $A = 2.9$ Ac. $Q_2 = 7.6$ ... $Q_{100} = 15.6$
(same runoff factors as above)

HP. Ft. N. 2 places
Fr. Ave (1.5 Ac. lots) $C_2 = 0.55$ $C_{100} = 0.65$ Lot = 3.6 Ac.
Overland flow 100' entryway @ 0.2 fps = 15 min
400' gutter @ 1.05 fps = 7 min
$T_c = 22.1$
$I_2 = 3.37$ in/hr $I_{100} = 6.25$ in/hr.
$Q_2 = 0.55(3.37)(3.6) = 6.5$ cfs $Q_{100} = 0.65(6.25)(3.6) = 15.3$ cfs

S. Elk - Factors same except Drainage Area = 3.7 Ac.
$Q_2 = 6.6$ cfs $Q_{100} = 15.7$ cfs

Installed 8-22" cl pipe Woodchuck drains east (per MCSS)

Sump @ Woodchuck & West Lawn Circle
Area 13.8 Ac. Composite = 0.69 $T_c = 22.1 + 15$ min $t_f = 24.0$ min.

(T_c in main line @ Woodchuck = 37.0 min)
Hydraulic Gradient from sump @ 19th & Woodchuck = .003 (0.3%)
Use 42" RCP (@ 0.003, Q = 52.1 cfs)

Time of concentration in Sump 145 @ Woodchuck & 19th = 35.0 min.
during peak Q in 42" by proportion of T_c,
$= \frac{24}{35} = 39.2$ cfs.

Hydrologic II
Sumps 19th & Woodchuck
By Date 11-10-86 Proj. Sheet 2 of 3

MILLCON CORPORATION

Ignoring storage in sumps,
Pipe Q = Q_{100} = overflow in street

(Westport / NW Parkway)

Street section (70' R/W)

Input data for 66' Qu
$A = 26.20$ $WP = 67.4$ $R = 0.390$ $R^{2/3} = 0.44$
$V = \frac{1.49}{0.015}(0.44)S^{1/2}$ $V = \frac{Q}{A} = \frac{Q}{26.2}$
$Q = 43.7\ S^{1/2}$ $Q = 110.2\ S^{1/2}$

Compute Q
for $S = 0.0004$, $Q = 22.0$
for $S = 0.0100$, $Q = 110.1$
for $S = 0.0070$, $Q = 92.2$
for $S = 0.0128$, $Q = 100.8$
Sump @ Woodchuck
for $S = 0.0077$, $Q = 96.6$
0.0070 ... 92.2
0.0110 ... 106
0.0115 ... 110.1
0.0120 ... 114.6
0.0122 ... 117.3

(Cramer)
$A = 6.5$ $WP = 61.2$ $R = 0.10$ $R^{2/3} = 0.45$
$Q = \frac{1.49}{0.015}(0.45)(6.5)S^{1/2}$
$Q = 52.0\ S^{1/2}$

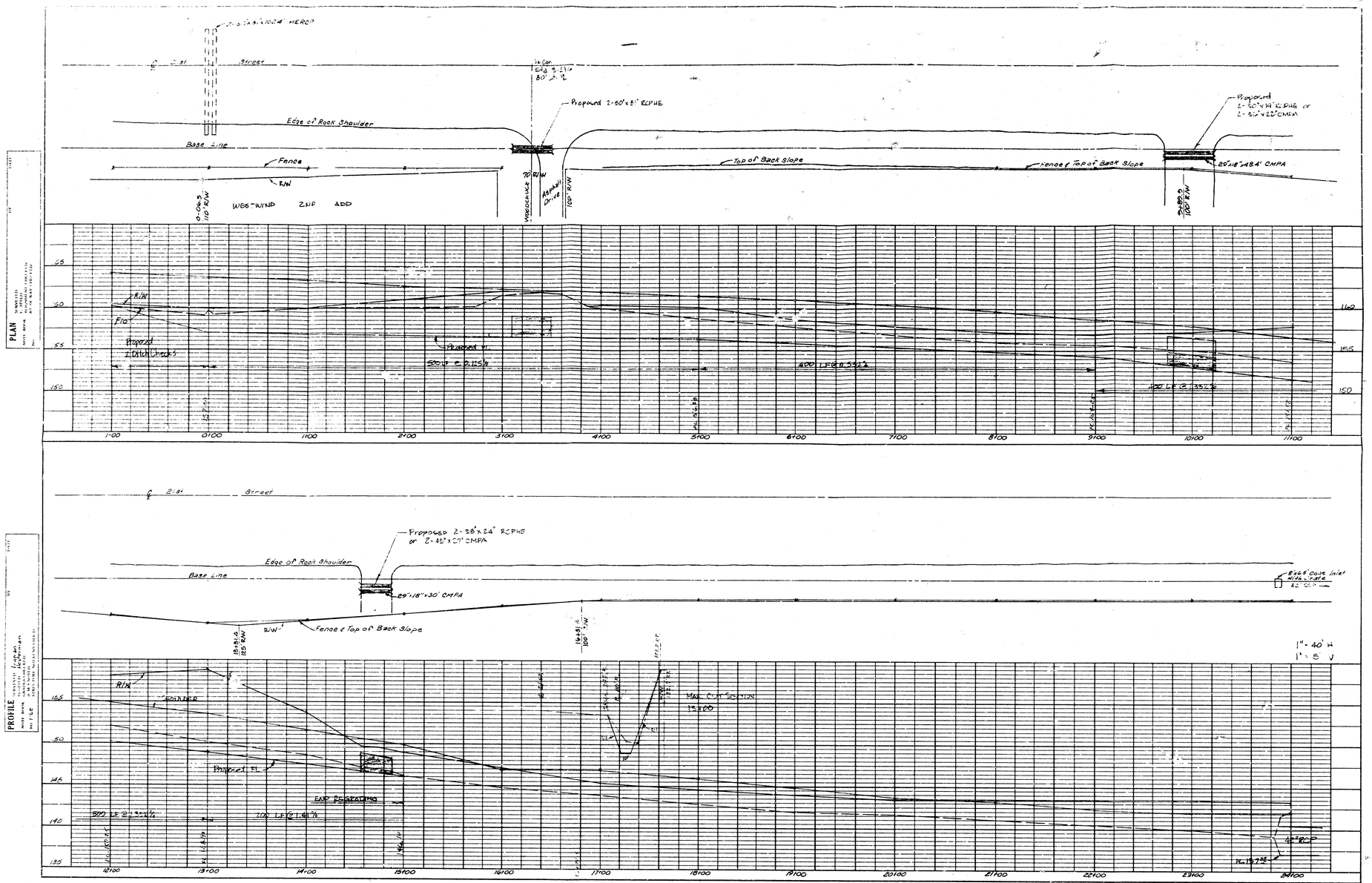
for $S = 0.003$, $Q =$

(I)

Project : STORM WATER SEWER NO. 149 (Westwind 2nd Addition)

INPUT DATA LISTING

CO	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
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	0	0	16.	0.	0.	4.00	.013
2	3	171.0	171.0	213.90	130.95	131.80	.00	54.	96.	3	.00	.00	.00	0	4	23	0	8.	20.	0.	4.00	.013
2	4	163.0	163.0	437.19	131.80	133.80	.00	54.	96.	3	.00	.00	.00	0	5	24	0	90.	90.	0.	4.00	.013
2	5	157.0	157.0	272.50	133.80	134.86	.00	54.	96.	3	.00	.00	.00	0	6	0	0	21.	0.	0.	4.00	.013
2	6	151.0	151.0	100.53	134.86	135.25	.00	54.	96.	3	.00	.00	.00	0	7	0	0	23.	0.	0.	4.00	.013
2	7	151.0	151.0	262.20	135.25	136.45	.00	54.	96.	3	.00	.00	.00	0	8	0	0	11.	0.	0.	4.00	.013
2	8	147.0	147.0	234.31	136.45	138.50	.00	54.	96.	3	.00	.00	.00	0	9	25	0	43.	90.	0.	4.00	.013
2	9	81.3	81.3	549.94	138.52	140.94	.00	72.	0.	3	.00	.00	.00	0	10	0	0	2.	0.	0.	4.00	.013
2	10	76.1	76.1	283.00	140.96	142.21	.00	72.	0.	3	.00	.00	.00	0	11	0	0	0.	0.	0.	4.00	.013
2	11	72.2	72.2	276.64	142.23	143.45	.00	72.	0.	3	.00	.00	.00	0	12	0	0	30.	0.	0.	4.00	.013
2	12	72.2	72.2	137.19	143.47	144.07	.00	72.	0.	3	.00	.00	.00	0	13	0	0	21.	0.	0.	4.00	.013
2	13	71.5	71.5	397.67	144.10	144.98	.00	72.	0.	3	.00	.00	.00	0	14	0	0	0.	0.	0.	4.00	.013
2	14	58.1	58.1	320.98	145.09	145.73	.00	60.	0.	3	.00	.00	.00	0	15	0	0	0.	0.	0.	4.00	.013
2	15	54.4	54.4	269.50	148.00	149.84	.00	60.	0.	3	.00	.00	.00	0	16	0	0	0.	0.	0.	4.00	.013
2	16	51.2	51.2	270.00	149.87	151.22	.00	60.	0.	3	.00	.00	.00	0	17	0	0	0.	0.	0.	4.00	.013
2	17	48.9	48.9	508.63	151.24	153.78	.00	60.	0.	3	.00	.00	.00	0	18	0	0	0.	0.	0.	4.00	.013
2	18	42.6	42.6	36.84	155.28	155.49	.00	42.	0.	3	.00	.00	.00	0	19	0	0	26.	0.	0.	4.00	.013
2	19	22.3	22.3	163.00	156.00	157.14	.00	36.	0.	3	.00	.00	.00	0	20	0	0	0.	0.	0.	4.00	.013
2	20	22.3	22.3	274.00	157.71	158.75	.00	30.	0.	3	.00	.00	.00	0	21	0	0	13.	0.	0.	4.00	.013
2	21	13.1	13.1	234.40	159.25	161.23	.00	24.	0.	3	.00	.00	.00	0	22	0	0	0.	0.	0.	4.00	.013
2	22	13.1	13.1	48.50	161.48	162.67	.00	21.	0.	1	.00	.00	.00	0	0	0	0	0.	0.	0.	4.00	.013



PRELIMINARY DITCH PROFILES Rev. 11-25-86

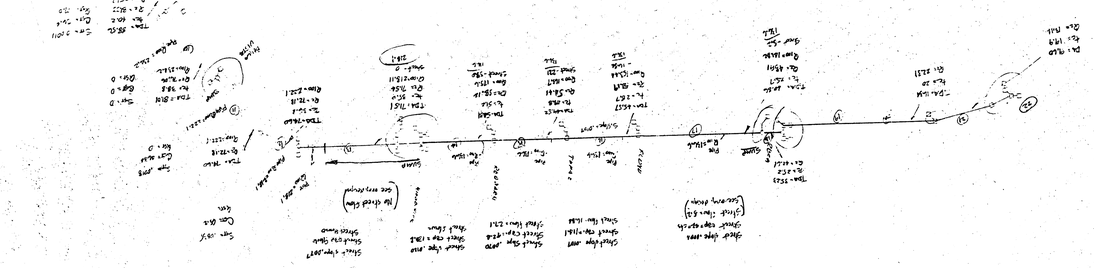
21st St Ditch - Westwind Addition 11-21-86

```
1Project : STORM WATER SEWER NO. 145                                   Date: 11/18/1986          Time: 9:35: 4

                                   STORM DRAIN ANALYSIS RESULTS  I

Line  Q     D   W   Dn    Dc   Flow  St-full  V 1  V 2  FL 1   FL 2   HG 1   HG 2   O 1   O 2   TW    TW
 No  (cfs) (in) (in) (ft)  (ft)  Type  (ft/ft) (fps) (fps) (+s)   (ft)   Calc   Calc   (ft)  (ft)  Calc  CK
---- ----- ---- ---- ----  ----  ----  ------ ----- ----- ------ ------ ------ ------ ----- ----- ----- ----

  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  7.93  6.28   .00   .00

  3 171.0  54   96 2.30  2.42  Full   .00106  4.8   4.8 130.95 131.80 137.28 137.50  6.33  5.70   .00   .00

  4 163.0  54   96 2.12  2.34  Seal   .00097  4.5   5.0 131.80 133.80 137.59 137.91  5.78  4.11   .00   .00
        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  4.84  3.89   .00   .00
        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  4.02  3.63   .00   .00

  7 151.0  54   96 2.01  2.23  Part   .00083  5.1  10.3 135.25 136.45 138.96 138.20  3.71  1.83   .00   .00 HJ
        X =    .00 X(N) =    .00 X(J) = 214.91 F(J) =  61.02 D(BJ) =  1.90 D(AJ) =  2.59

  8 147.0  54   96 1.58  2.19  Part   .00078 11.5   8.4 136.45 138.50 138.05 140.69  1.60  2.19   .00   .00

  9  81.3  72    0 2.21  2.41  Part   .00037  4.3   7.6 138.52 140.94 142.35 143.35  3.83  2.41   .00   .00 HJ
        X =    .00 X(N) = 409.98 X(J) = 239.52 F(J) =  30.43 D(BJ) =  2.21 D(AJ) =  2.62

 10  76.1  72    0 2.13  2.33  Part   .00032  5.6   7.5 140.96 142.21 143.85 144.54  2.89  2.33   .00   .00 HJ
        X =    .00 X(N) = 190.01 X(J) =  56.85 F(J) =  27.97 D(BJ) =  2.13 D(AJ) =  2.54

 11  72.2  72    0 2.07  2.27  Part   .00029  5.8   7.4 142.23 143.45 144.96 145.72  2.73  2.27   .00   .00 HJ
        X =    .00 X(N) = 171.16 X(J) =  40.70 F(J) =  26.15 D(BJ) =  2.07 D(AJ) =  2.47

 12  72.2  72    0 2.08  2.27  Part   .00029  5.8   7.4 143.47 144.07 146.19 146.34  2.72  2.27   .00   .00 HJ
        X =    .00 X(N) =    .00 X(J) =  40.09 F(J) =  26.14 D(BJ) =  2.08 D(AJ) =  2.47

 13  71.5  72    0 2.48  2.26  Part   .00028  6.1   6.5 144.10 144.98 146.70 147.46  2.60  2.48   .00   .00
        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  2.84  1.20   .00   .00 HJ
        X =    .00 X(N) =    .00 X(J) = 187.59 F(J) =  22.01 D(BJ) =  1.67 D(AJ) =  2.67

 15  54.4  60    0 1.71  2.07  Part   .00044  9.1   7.1 148.00 149.84 149.71 151.90  1.71  2.07   .00   .00
        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  2.43  2.01   .00   .00 HJ
        X =    .00 X(N) = 174.24 X(J) =  29.48 F(J) =  12.54 D(BJ) =
```

```
 21  13.1  24    0 1.15  1.30  Seal   .00329  4.2  10.4 159.25 161.22 161.65 162.08  2.00   .35   .00   .00 HJ
        X =    .86 X(N) = 130.98 X(J) =  70.59 F(J) =   3.77 D(BJ) =  1.15 D(AJ) =  1.46

 22  13.1  21    0 1.00  1.35  Part   .00684  8.9   6.6 161.48 162.67 162.51 164.02  1.03  1.35 164.69   .00

  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  1.16  1.36 145.44   .00

1Project : STORM WATER SEWER NO. 145                                   Date: 11/18/1986          Time: 9:35: 4

                                   STORM DRAIN ANALYSIS RESULTS  (cont.)

Line  Q     D   W   Dn    Dc   Flow  St-full  V 1  V 2  FL 1   FL 2   HG 1   HG 2   O 1   O 2   TW    TW
 No  (cfs) (in) (in) (ft)  (ft)  Type  (ft/ft) (fps) (fps) (ft)   (ft)   Calc   Calc   (ft)  (ft)  Calc  CK
---- ----- ---- ---- ----  ----  ----  ------ ----- ----- ------ ------ ------ ------ ----- ----- ----- ----

  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  1.41  3.35 148.03   .00
        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  1.73  2.53 147.49   .00
1
```

LIST OF ABBREVIATIONS

```
  V 1, FL 1, O 1 and HG 1  refer to downstream end
0 V 2, FL 2, O 2 and HG 2  refer to upstream end
0 X    - Distance in feet from downstream end to point where HG intersects soffit in seal condition
0 X(N) - Distance in feet from downstream end to point where water surface reaches normal depth by either drawdown or backwater
0 X(J) - Distance in feet from downstream end to point where hydraulic jump occurs in line
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 jump
0 HJU   indicates that hydraulic jump occurs at the junction at the upstream end of the line
0 HJD   indicates that hydraulic jump occurs at the junction at the downstream end of the line
1
```



WESTWIND 2ND ADDITION
(Drainage)

Street slope .0084
Street cap = 82 cfs
Street flow = 5.2
see orig. design
Street slope .0107
Street cap. = 114.1
Street flow 16.84
Street Slope .0070
Street cap. = 92.4
Street flow = 27.1
Street slope .0120
Street cap = 130.6
Street flow =
Street slope .0077
Street cap 96.6
Street flow 0
No street flow
See orig. design
SUMP
Pipe
Q100 = 136.6
FLOYD
TOPAZ
S. Slope = .0107
22
21
19
17
16
15
14
13
12
11
10
DA = 9.60
tc = 19.9
Q2 = 13.14
T.D.A. = 16.34
tc = 20
Q2 = 22.31
TDA = 35.23
tc = 25.2
Q2 = 42.61
T.D.A. = 40.86
tc = 25.7
Q2 = 43.91
Q100 = 141.82
Street -5.2
136.6
TDA = 45.57
tc = 28.7
Q2 = 52.19
Q100 = 153.44
-16.84
136.6
TDA = 49.52
tc = 29.8
Q2 = 58.41
Q100 = 163.7
Street -27.1
136.6
TDA = 58.21
tc = 31.2
Q2 = 58.12
Q100 = 175.6
Street -38.0
136.6
TDA = 71.51
tc = 35.0
Q2 = 71.54
Q100 = 218.11
Street - 0
218.1
Pipe
Q100 = 218.1
Pipe Q100 = 218.1
TDA = 74.60
tc = 36.8
Q2 = 72.18
Q100 = 222.1
TDA = 74.60
Q2 = 72.18
Q100 = 222.1
SST = .0036
CST = 65.2
QST =
SST = .0018
CST = 36.36
QST = 0
Pipe Q100 = 222.1
SUMP
BELLA VISTA
TDA = 81.01
tc = 38.8
Q2 = 76.06
Q100 = 236.2
SST = 0
CST = 0
QST = 0
Pipe Q100 = 236.2
HOLLAND
TDA = 88.52
tc = 40.2
Q2 = 81.33
Q100 = 251.2
SST = 0.0011
CST = 36.6
QST = 17.0
Pipe Q100 = 236.2
Q100 = 457.47

Analysis I: Input filename SWS145.DAT
3-1/2 PC DISC

Output filename SWS 145-1.OUT
3-1/2 DISC # 3

II Input SWS145A.DAT
Output SWS 145-2.OUT

IIB Input SWS145B.DAT
Output SWS145-3.OUT

All copied on Eng. Projects I disk

STORM. [illegible] SMAIN.EXE