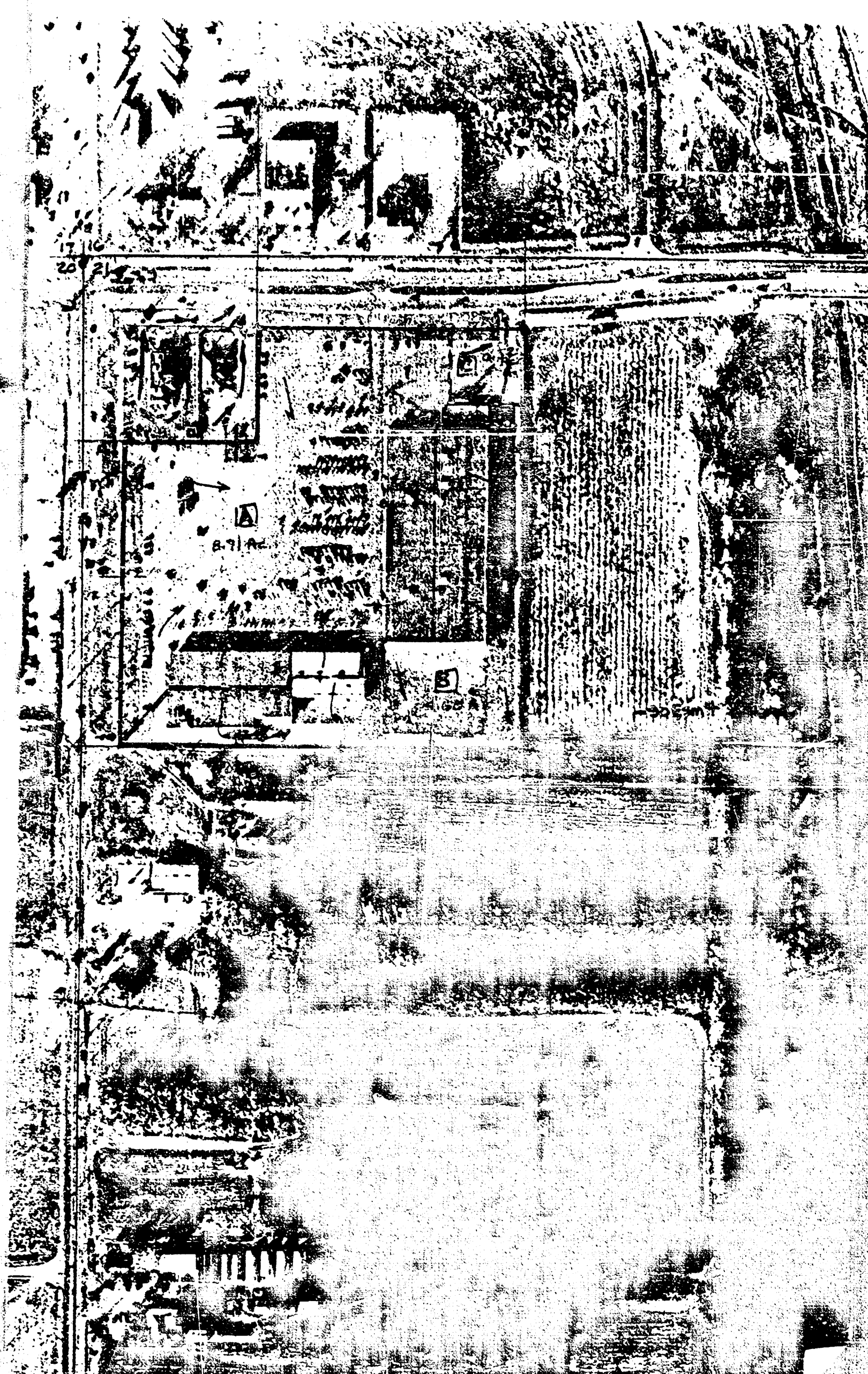




SOUTHEAST ADDN. - IN N.W. 1/4 SEC. 21-28-1E
DRAINAGE EVALUATION
BASIC DATA -
From S.C.S., HYDROLOGIC SOIL GROUPS, GENERALLY ARE:
BASINS "C", "D", "E", "G", "H" = "C" soils
BASINS "A", "B" & "F" = "B" soils

DESIGN STORM FREQUENCY -
RESIDENTIAL - 2 years
COMMERCIAL - 5 years
CHANNELS & POND - 100 Year
STREET CLASSIFICATIONS -
LOCAL, IN RESIDENTIAL AREAS
COLLECTOR, MAIN ENTRANCE DRIVE
BETWEEN COMMERCIAL LOTS

DRAINAGE AREA = 370 Ac. ∴ Use RATIONAL FORMULA
RATIONAL "C" FACTORS To Be Used:
LAND USE % of Basin
% Res. Residential 0.50 0.55
Commercial - - 0.60 0.65
Recreation 0.10 0.20

For T_c , BASIN "A" has the longest travel path.
 $L = 1050'$; $H = 5'$; Ave. Slope = 0.5%
Est'd Velocity BETWEEN 1.4 fps & 2.0 fps
∴ TRAVEL TIME ≈ 9 to 11 min.
Use MIN. $T_c = 15$ minutes

THEN, $I_2 = 3.83$ "/hr.
 $I_5 = 4.56$ "/hr.
 $I_{100} = 7.37$ "/hr.

WITHIN BASIN "A" - All Residential -
AREA = 8.07 Ac. & Soil "B"
 $C = 0.52$
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.

TOTAL BASIN "A" DISCHARGE = $Q_2 = C I_2 A$
 $Q_2 = 0.52 \times 3.83 \times 8.07$
 $Q_2 = 16.03$ cfs
THEN, IN BASIN "A", SUB-BASIN UNIT DISCHARGE (Q_u)
 $= 16.03$ cfs / 8.07 Ac. = 1.986 cfs/Ac.

WITHIN BASIN "A", THE FOLLOWING SUB-BASIN AREAS & DISCHARGES, AS FOLLOWS:

SUB-BASIN	AREA	DISCHARGE (Q_u)
I	1.72 Ac.	3.41 cfs
II	1.30 Ac.	2.58 cfs
III	0.99 Ac.	1.97 cfs
IV	1.05 Ac.	2.09 cfs
V	1.29 Ac.	2.56 cfs
VI	0.82 Ac.	1.63 cfs
VII	0.90 Ac.	1.79 cfs

⇒ TOTAL BASIN "A" = 8.07 Ac. & 16.03 cfs (Q_2)
30.85 cfs (Q_{100})

WITHIN BASIN "B" - All Residential -
AREA = 4.97 Ac.; $C = 0.52$; Soil "B"
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.
∴ Q_u UNIT DISCHARGE = 1.986 cfs/Ac.

SUB-BASIN	AREA	DISCHARGE (Q_u)
IX	1.44 Ac.	2.86 cfs
X	1.51 Ac.	3.00 cfs
XI	1.30 Ac.	2.58 cfs
TOTAL BASIN "B"	4.25 Ac.	8.44 cfs (Q_2) 17.13 cfs (Q_{100})

WITHIN BASIN "C" - Part Residential & Part Commercial
IN Sub-Basin XII - Soil "C"
Commercial Lot - $A = 1.75$ Ac.

$C = 0.69$
 $I_5 = 4.56$ "/hr.; $I_{100} = 7.37$ "/hr.
 $Q_5 = C I_5 A = 0.69 \times 4.56 \times 1.75$
 $Q_5 = 5.51$ cfs
 $Q_{100} = C I_{100} A = 0.69 \times 7.37 \times 1.75$
 $Q_{100} = 8.94$ cfs

Residential Area - $A = 2.69$ Ac.
 $C = 0.55$ & 0.73
 $I_2 = 3.83$ "/hr.
 $Q_2 = C I_2 A = 0.55 \times 3.83 \times 2.69$
 $Q_2 = 5.67$ cfs

$Q_{100} = C I_{100} A = 0.73 \times 7.37 \times 2.69$
 $Q_{100} = 13.18$ cfs

IN Sub-BASIN XIII - Soil "C"
Commercial Lot - $A = 1.68$ Ac.

$C = 0.69$
 $I_5 = 4.56$ "/hr.
 $Q_5 = C I_5 A = 0.69 \times 4.56 \times 1.68$
 $Q_5 = 5.29$ cfs
 $Q_{100} = C I_{100} A = 0.69 \times 7.37 \times 1.68$
 $Q_{100} = 8.54$ cfs

Residential Area - $A = 1.35$ Ac.
 $C = 0.55$ & 0.73
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.
 $Q_2 = C I_2 A = 0.55 \times 3.83 \times 1.35$
 $Q_2 = 2.84$ (g)

Sub-Basin XIV Cont'd
 $Q_{100} = 0.12 \times 7.37 \times 1.35$
 $Q_{100} = 1.18$ cfs
WITHIN BASIN "D" - Soil "C"
Sub-Basin XIV
Commercial Lot - $A = 2.67$ Ac.
 $C = 0.69$
 $I_5 = 4.56$ "/hr.; $I_{100} = 7.37$ "/hr.
 $Q_5 = C I_5 A = 0.69 \times 4.56 \times 2.67$
 $Q_5 = 8.40$ cfs
 $Q_{100} = C I_{100} A = 0.69 \times 7.37 \times 2.67$
 $Q_{100} = 13.58$ cfs

Residential Area - $A = 0.83$ Ac.
 $C = 0.55$ & 0.73
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.
 $Q_2 = C I_2 A = 0.55 \times 3.83 \times 0.83$
 $Q_2 = 1.75$ cfs
 $Q_{100} = C I_{100} A = 0.73 \times 7.37 \times 0.83$
 $Q_{100} = 4.47$ cfs

Recreation Area - 1.10 Ac.
 $C = 0.26$ & 0.53
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.
 $Q_2 = C I_2 A = 0.26 \times 3.83 \times 1.10$
 $Q_2 = 1.10$ cfs
 $Q_{100} = C I_{100} A = 0.53 \times 7.37 \times 1.10$
 $Q_{100} = 4.30$ cfs

WITHIN BASIN "E" - Soil "B" - Residential Area
 $A = 2.82$ Ac.
 $C = 0.52$ & 0.67
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.

$Q_2 = C I_2 A = 0.52 \times 3.83 \times 2.82$
 $Q_2 = 5.62$ cfs
 $Q_{100} = C I_{100} A = 0.67 \times 7.37 \times 2.82$
 $Q_{100} = 13.92$ cfs

WITHIN BASIN "F" - Residential & Recreation Areas
- Soil "B" = 20%
 $C = 80\%$

Residential Area - $A = 0.86$ Ac.
 $C = (20 \times 0.52) + (80 \times 0.55) = 0.54$; $C_{100} = 0.72$
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.

$Q_2 = C I_2 A = 0.54 \times 3.83 \times 0.86$
 $Q_2 = 1.78$ cfs
 $Q_{100} = C I_{100} A = 0.72 \times 7.37 \times 0.86$
 $Q_{100} = 4.56$ cfs

Recreation Area - 1.41 Ac.
 $C = (20 \times 0.18) + (80 \times 0.26) = 0.24$
 $C_{100} = (20 \times 0.39) + (80 \times 0.53) = 0.50$
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.

$Q_2 = C I_2 A = 0.24 \times 3.83 \times 1.41$
 $Q_2 = 1.30$ cfs
 $Q_{100} = C I_{100} A = 0.50 \times 7.37 \times 1.41$
 $Q_{100} = 5.20$ cfs (5)

WITHIN BASIN "G" - Recreation & Residential Areas
Soil "B" = 20%; Soil "C" = 80%

Residential Area - $A = 1.10$ Ac.
 $C = (20 \times 0.52) + (80 \times 0.55) = 0.54$
 $C_{100} = (20 \times 0.67) + (80 \times 0.73) = 0.72$
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.

$Q_2 = C I_2 A = 0.54 \times 3.83 \times 1.10$
 $Q_2 = 2.28$ cfs
 $Q_{100} = C I_{100} A = 0.72 \times 7.37 \times 1.10$
 $Q_{100} = 5.84$ cfs

Recreation Area - $A = 9.61$ Ac.
 $C = (20 \times 0.18) + (80 \times 0.26) = 0.24$
 $C_{100} = (20 \times 0.39) + (80 \times 0.53) = 0.50$
 $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.

$Q_2 = C I_2 A = 0.24 \times 3.83 \times 9.61$
 $Q_2 = 8.83$ cfs
 $Q_{100} = C I_{100} A = 0.50 \times 7.37 \times 9.61$
 $Q_{100} = 35.41$ cfs

OFF SITE (K-Mart & FPS Addns.) DRAINAGE BASIN -
Contributes to W. End of existing 50' Drainage
Empt. running E-W thru "Southglens"

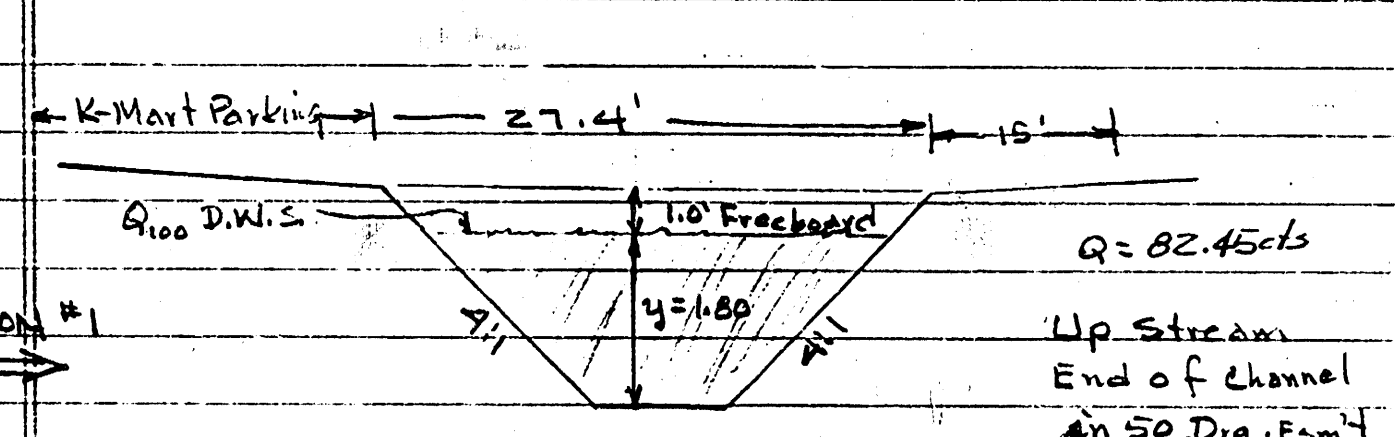
From P.E.C.'s Evaluation, dated 6-19-81
 $T_c = 11$ min.; $D.A. = 13.4$ Ac.; $C = 0.9$; $I_2 = 10.14$ "/hr.
Modify the above, conform to latest City of Wichita
Policy, & Re-compute Q_{100} , as follows:

BASIN "H" - All Residential - Soil "B"
 $A = 1.85$ Ac.; $C = 0.52$; $I_2 = 3.83$ "/hr.; $I_{100} = 7.37$ "/hr.
 $Q_u = 0.67$

$Q_2 = C I_2 A = 0.52 \times 3.83 \times 1.85$
 $Q_2 = 3.68$ cfs
 $Q_{100} = C I_{100} A = 0.67 \times 7.37 \times 1.85$
 $Q_{100} = 9.14$ cfs

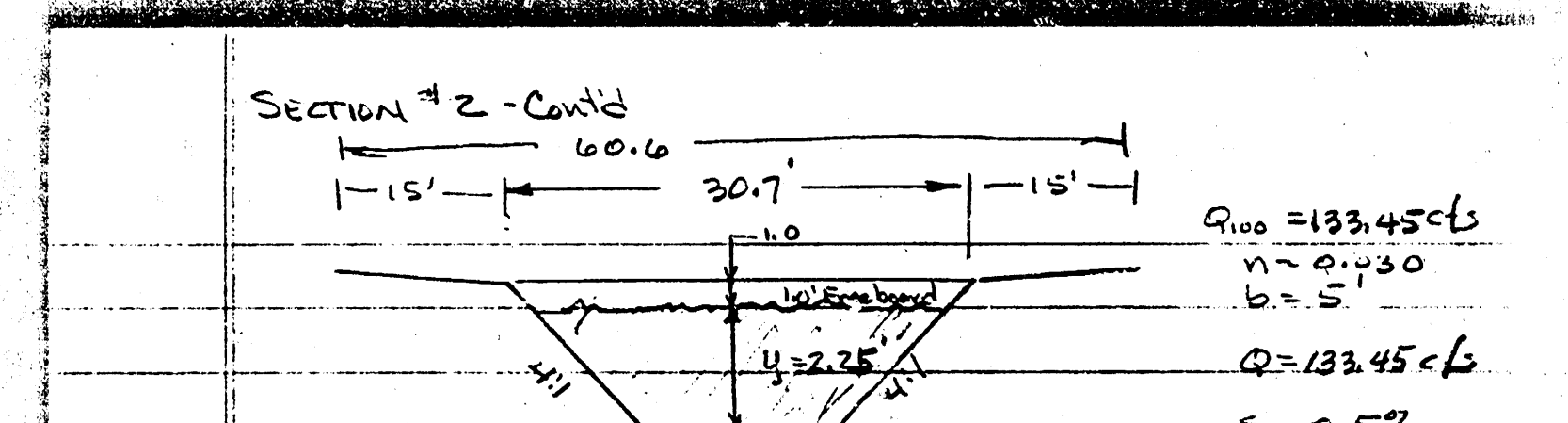
OFF-SITE - Contributing W. End as follows:
Lot 1, K-Mart Add., except the E. 380' = 6.83 Ac.; E. 380' of Lot 1,
K-Mart Add. = 7.0 Ac.; All of FPS Add. = 5.6 Ac.
 T_c (min.) = 15 minutes; $D.A. = 12.43$ Ac.; $I_2 = 3.83$ "/hr.
Roofs = 20% of Area, w/ $C_u = 0.92$
Drives, Parking Lots, Walks, = 80% of Area, w/ $C_u = 0.67$

Weighted $C_{100} = (20 \times 0.92) + (80 \times 0.67) = 0.80$
 $C_{100} = 0.80$
Then, $Q_{100} = C I_{100} A = 0.80 \times 7.37 \times 12.43$
 $Q_{100} = 74.45$ cfs at W. R. Southglens



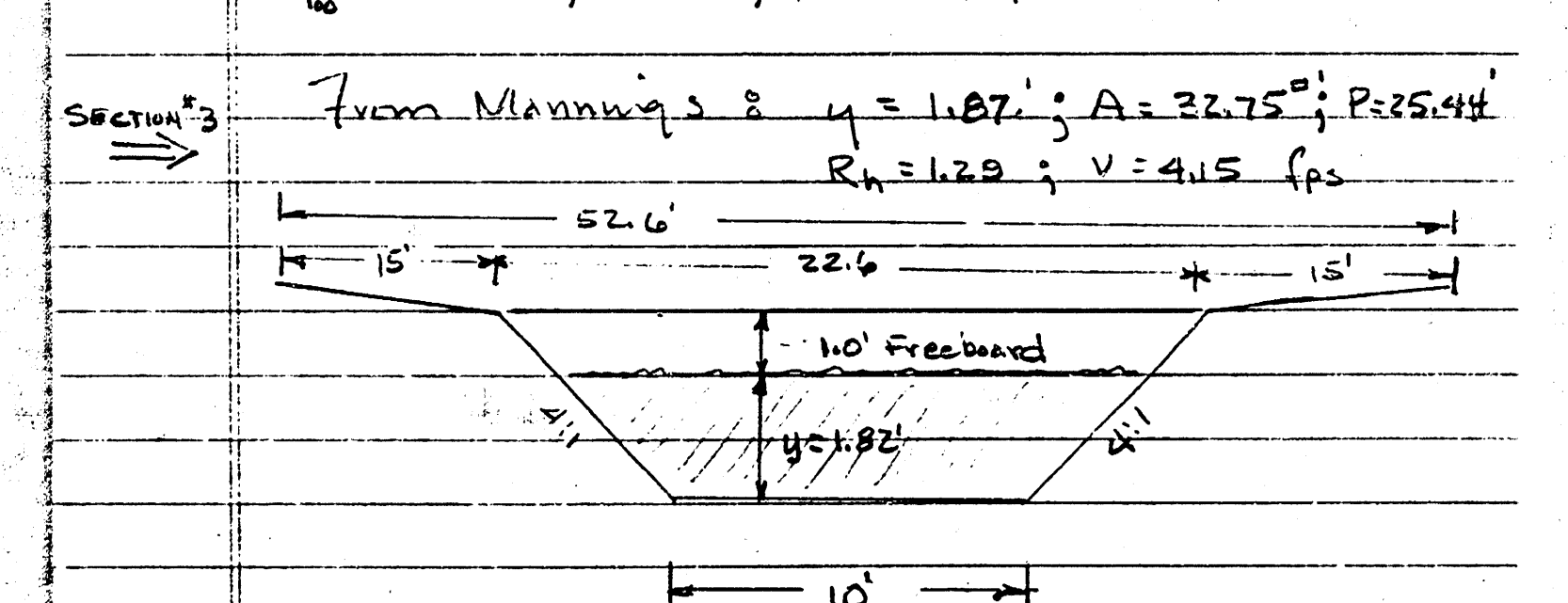
From Mannings, $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$
w/ $S = 0.5\%$; $n = 0.030$; $Q_{100} = 82.45$ cfs
Then Normal Depth of flow (y_n) = 1.80' (open channel)
 $A = 21.99$ sq ft; $P = 17.856$; $R_h = 1.1075$; $V = 3.75$ ft/s

AT DOWNSTREAM END of 50' DEEP CHANNEL,
(Being also up stream end of 30' deep channel
at S.E. Cor. of K-Mart Addn.), AN
ADDITIONAL 7.0 Ac. of CONTRIBUTING D.A.,
+ W. End of Basin "H" (7.0%) = 4.57 cfs
Then, $Q_{100} = C I_{100} A = 0.80 \times 7.37 \times 10.43$
 $Q_{100} = 78.88$ cfs + 4.57 = 133.45 cfs
 $y_n = 2.25$
 $A = 36.42$; $P = 23.57$; $R_h = 1.39$; $V = 4.25$ ft/s



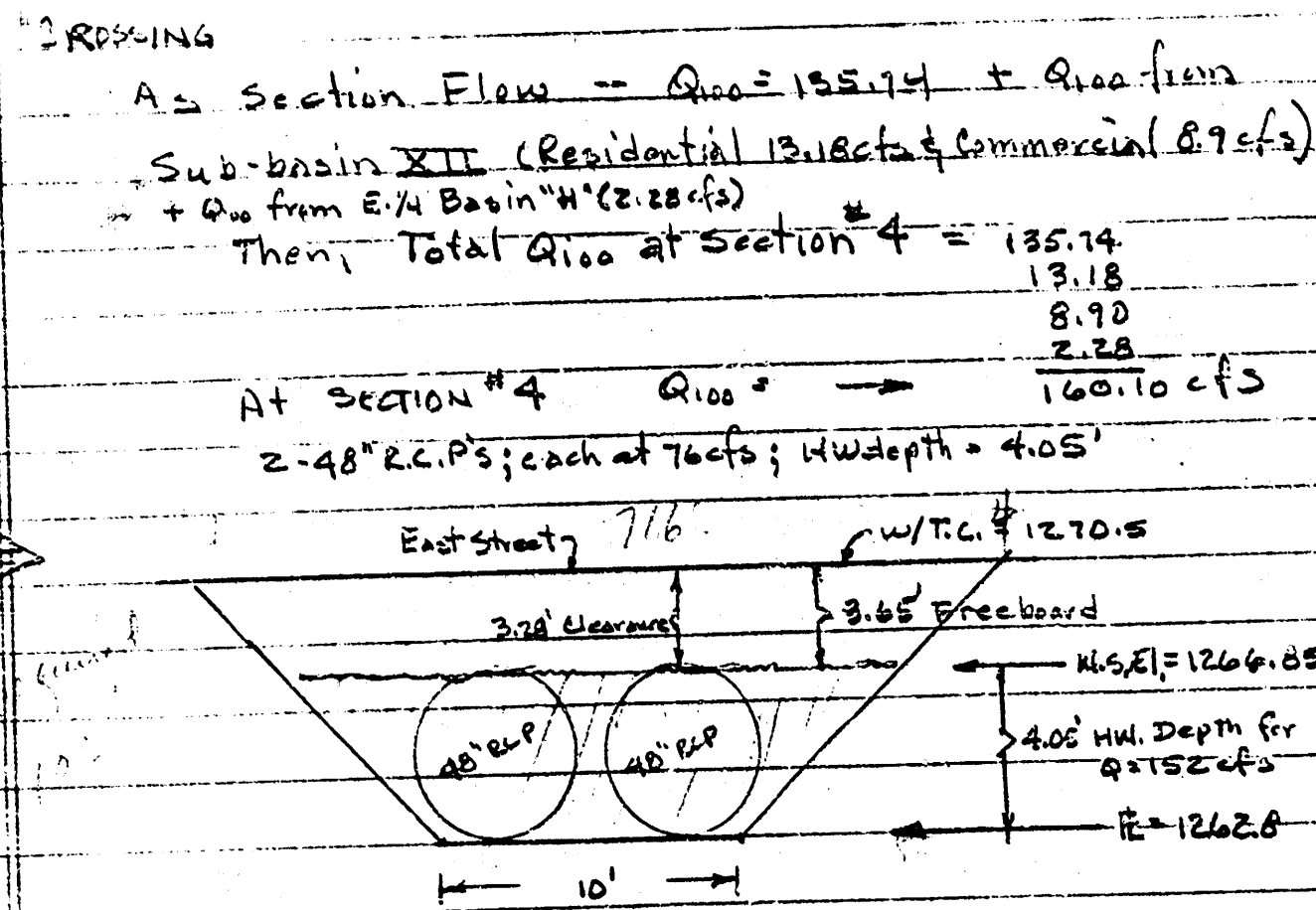
From Mannings: $y = 2.25$; $A = 31.42$ sq ft; $P = 23.57$
 $R_h = 1.34$; $V = 4.25$ ft/s

AT UPSTREAM SIDE of STREET (W) CROSSING
SECTION #3 - Existing channel, w/ 10' bottom & 4:1 S/P
1) As open channel flow, w/ $Q_{100} = 133.45$ cfs & $V = 3.75$ ft/s
 $Q = 133.45$; $b = 10$; $S = 0.5\%$; $n = 0.030$

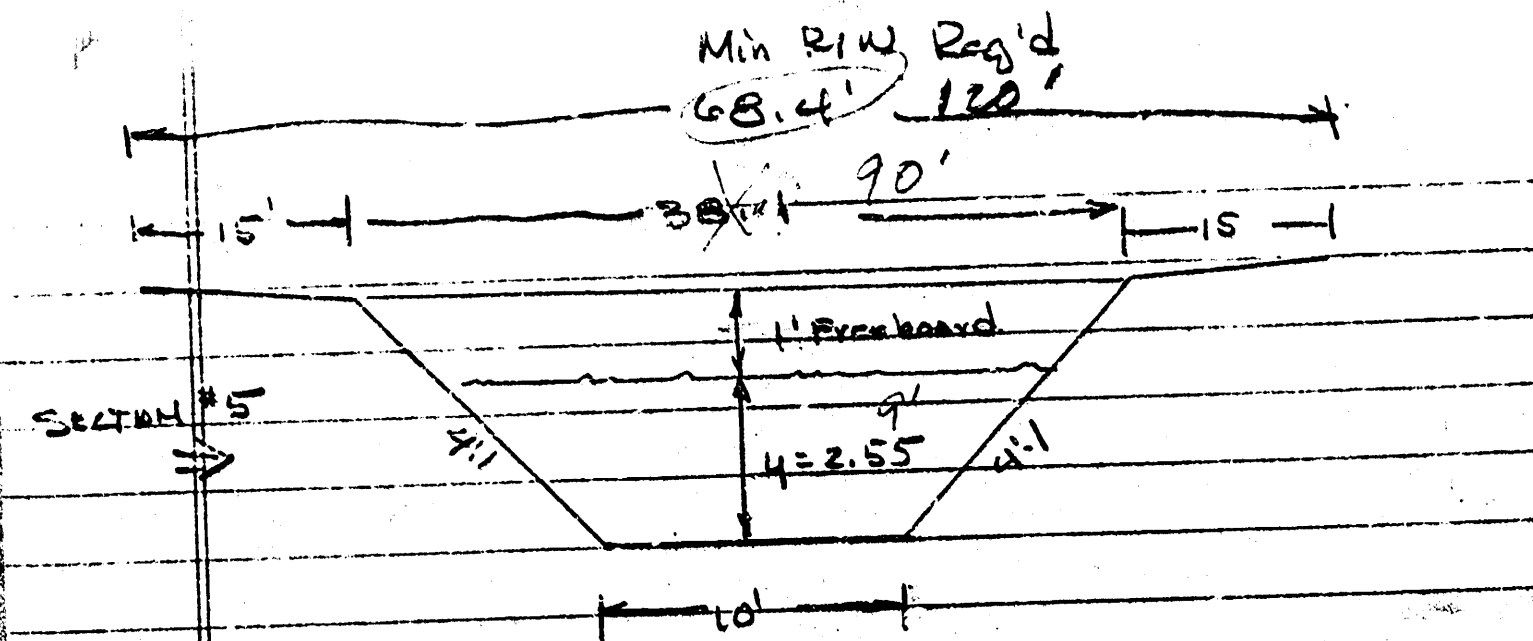
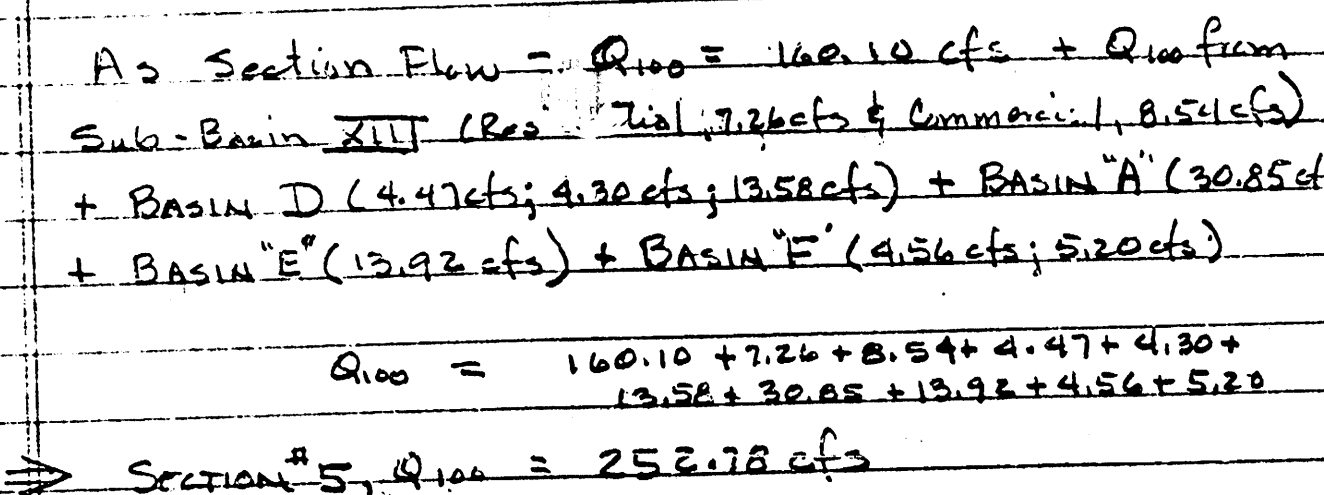


From Mannings: $y = 1.87$; $A = 32.75$ sq ft; $P = 25.44$
 $R_h = 1.28$; $V = 4.15$ ft/s
2) As Culvert Flow - Under Street (West) Crossing
w/ $Q_{100} = 133.45$ cfs; $2-42" R.P.'s$, each @ 6.5 cfs
@ W width = 3.95', W depth = 8.36'
w/ $T.C. = 1270.5$
w/ W width = 3.95', W depth = 8.36'
w/ W width = 3.95', W depth = 8.36'
 $R = 1263.8$

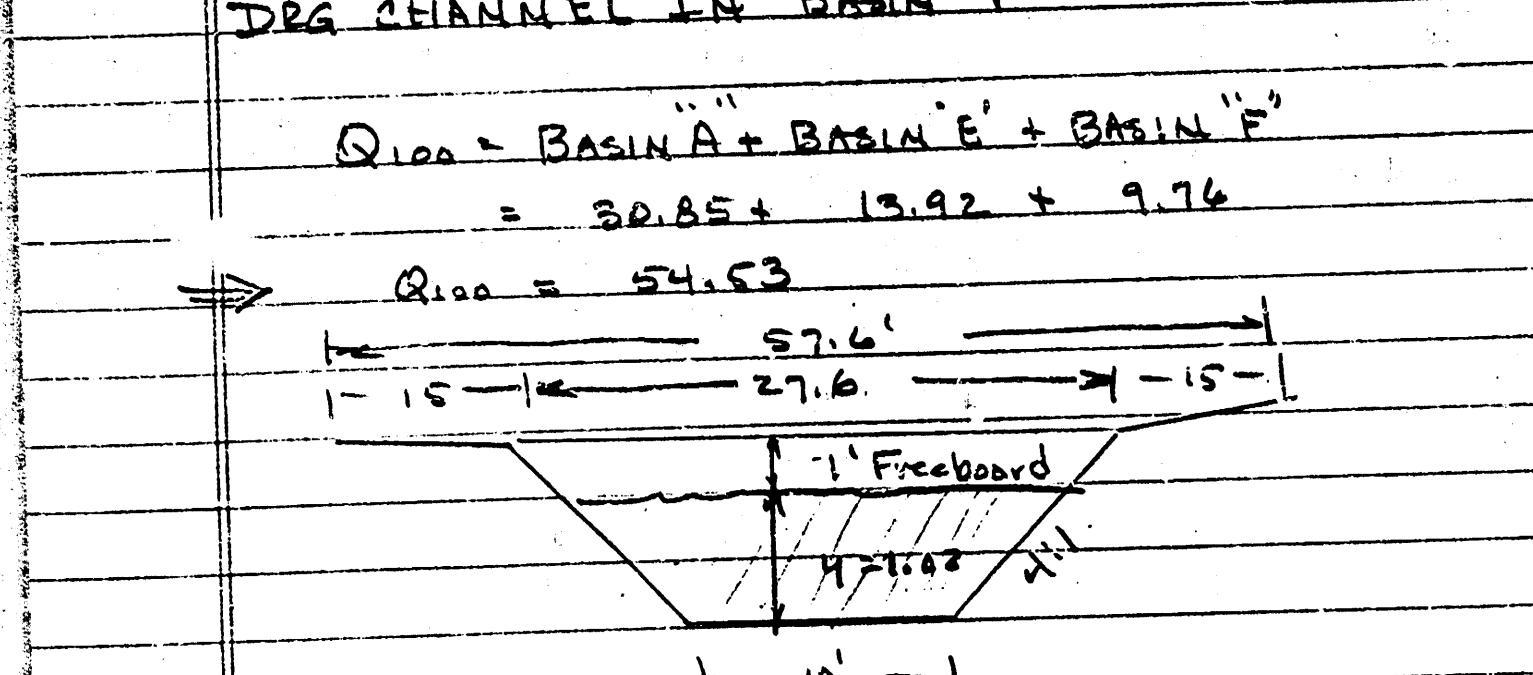
SECTION #4 - AT UPSTREAM SIDE OF STREET (cont.)



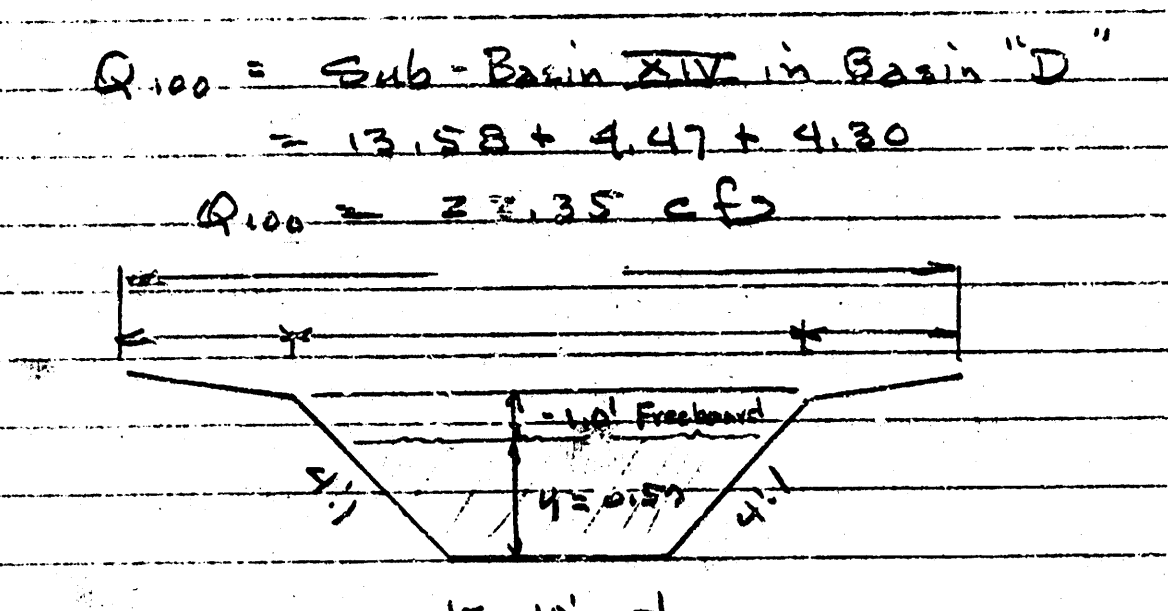
SECTION #5 - AT DISCHARGE INTO RIVERSIDE DRG DISTRICT CHANNEL



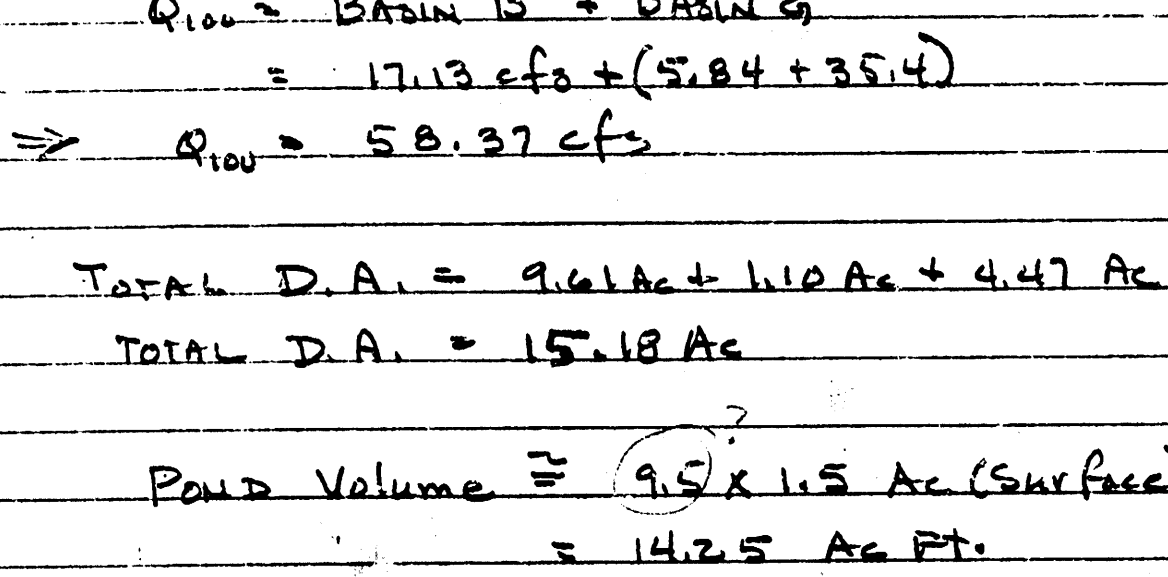
DRG CHANNEL IN BASIN "F"



DRAINAGE CHANNEL IN BASIN "D"



DETENTION POND -



If Runoff uses 100%,
 Detention Volume = 1.42 x Runoff

AVAILABLE STORAGE IS MORE THAN ADEQUATE WITHOUT DISCHARGE

Out-let Pipe to Riverside Drg. Dist. channel to be capable of discharging within 4 days

A culvert pipe capable of discharging 126 cfs would accomplish this end

A more analytical approach will be made

RE-EVALUATION OF DRAINAGE REQUIREMENTS ASSOCIATED WITH EXISTING 50' DRAINAGE EASEMENT - INVESTIGATE FEASIBILITY OF REDUCTION OF EASEMENT WIDTH

From the data available, it appears that the 50' wide Drainage Easement (Recorded at Film 502 Pg. 1015) was established to accommodate the peak discharge for the 100-year event, from both "K-Mart Plaza-South" and F.P.S. First Addition.

The total area of F.P.S. First Addition is approximately 5.61 Ac. Hydrologic computations for F.P.S. First Addition by P.E.C. used a value of 3.47 Ac. contributing from F.P.S. toward the West end of the 50' easement in question. Presumably, the difference in drainage area is to be directed toward Broadway.

P.E.C.'s computations assumed DA = 3.47 Ac.; Rational "C" = 0.90, resulting in $Q = 25 \text{ cfs}$. Therefore, the assumed rainfall intensity was 8"/hr.

Modify the above findings, to conform to the Inter. City of Wichita Design Criteria, as follows:

- a/ Soil is C_u, Hydrologic Soil Group "B"
- b/ 100-yr. storm for channel evaluation
- c/ Rational "C" Factor = 0.80 (Unsur. Commercial)
- d/ Min. T₀ = 15 min.
- e/ T₁₀₀ = 1.37 1/hr.
- f/ D.A. = 3.47 Ac.

$Q_{100} \text{ (F.P.S. First Add'n)} = 0.80 \times 1.37 \times 3.47 = 38.5 \text{ cfs}$

The only other contributing drainage area upstream of the 50' wide drainage easement here being evaluated, is the K-Mart Plaza South Addition.

The total area of this subdivision is approx. 13.84 Ac. An area, approx. 1.50 Ac., near the N.E. corner of the plat, is directed into the storm sewers in 47th St. S. (Sub-basin C). The remaining 12.34 Ac. is served by a system of storm sewers that discharges at the S.E. corner of the plat, into an existing drainage channel, within a 90' wide drainage easement.

The enclosed area of the aerial photo of this drainage area, is marked in red outlining the 2 drainage sub-basins.

Basin "A" includes all the paved parking and drive areas in front of the two commercial buildings, together with the adjacent 1/2 of the building roof areas.

Basin "A" contains 8.71 acres. The storm water runoff concentrates to several grouted drop inlets in the parking lot. The grading of the parking lot is such that water in excess of inlet capacity and/or the capacity of the connected storm sewers will pond and be temporarily detained in the parking lots. The overflow out-let elevations, from Basin "A"

to Basin "B", are approximately 24" above the grate elevation of the drop inlets, and so it is relatively safe to say that virtually all runoff in excess of the inlet and storm sewer capacity will be detained within Basin "A".

Sub-basin "B" (4.66 Ac.) encompasses the rear 1/2 of the building roof areas, together with the adjacent paved areas on the south and East side of the buildings.

The paved areas are sloped to the perimeter curb and gutters, which are constructed along the East and South property lines. There are a total of 5 or 6 standard curb inlets along these two edge sections. The excess storm water not intercepted by the curb inlets, is directed to a paved (concrete) flume at the S.E. corner of the property. The flume discharges directly into the (24" R/W) drainage channel, near the outlet of the storm sewer. Both of these discharges flow East toward the Riverside Ditch, in an existing channel, constructed within a 90' Drg. Easmt.

Then, evaluate the capability of the combined storm sewer and the outlet flume to convey the runoff from the weyr event, independently of channel capacity planned in the 50' Drainage Easement.

SUB-BASIN A - 100-yr event -
 Contribution will be only the Q_5 discharge as conveyed thru the system of storm water sewers, the excess being detained on the parking lot.

Basic Data - T₀ = 15 min; A = 8.71 Ac.
 $I_5 = 4.56"/hr$ (Inter. retained)
 Roofs = 20% of Area, w/ C_u = 0.93
 Drives, Parking Lots, Walks = 80% of Area, w/ C_u = 0.67

Weighted C_u = $\frac{(8.71 \times 0.93) + (8.71 \times 0.67)}{100} = 0.70$

Then $Q_5 = C I A = 0.90 \times 4.56 \times 8.71$
 $Q_5 = 35.75 \text{ cfs}$ [Sub-Basin "A"]

SUB-BASIN "B" - 100-yr Event -

Basic Data - T₀ = 15 min; A = 4.66 Ac.
 $I_{100} = 7.37"/hr$; weighted C_u = 0.70

$Q_{100} = 0.90 \times 7.37 \times 4.66$
 $Q_{100} = 30.51 \text{ cfs}$ [Sub-Basin "B"]

TOTAL CONTRIBUTION - 100-yr event - K-Mart Plaza
 SUB-BASIN "A" = 35.75 cfs (thru sewer)
 SUB-BASIN "B" = 30.51 cfs (in sewer & flume)
 SUB-BASIN "C" = 0 (toward 47th St.)
 66.26 cfs

Note: This discharge is partly in storm sewer & the excess overland, outleting @ Flume

ESTIMATE STORM SEWER CAPACITY

The downstream segment of existing storm sewer is 45" x 29" H.E.C.P.; w/ gradient = 0.4% and "n" = 0.012, the Mannings formula would indicate the maximum flow to be as follows: (Non-Pressure conditions)

For 45" x 29" H.E.C.P.
 $A = 7.4 \text{ sq ft}; R_h = 0.730'; R_h^{3/2} = 0.82$

$Q = \frac{1.486}{0.012} \times A \times R_h^{3/2} \times S^{1/2} = \frac{1.486}{0.012} \times 7.4 \times 0.82 \times 0.002^{1/2}$
 $Q = 47.52 \text{ cfs}$

Then, of the total Q_{100} (66.26 cfs) that is directed to the S.E. corner of K-Mart Basins, 47.52 cfs can be conveyed in the storm sewer.

The excess $66.26 \text{ cfs Total} - 47.52 \text{ cfs sewer} = 18.74 \text{ cfs}$ would have to discharge thru the concrete flume

The concrete flume as constructed, has a width of 40' at its narrowest construction, and a gradient of approximately 0.8%. The flume has concrete curbs approx. 0.55' high on each side.

Then from Mannings, as open channel flow, the normal flow depth for 18.74 cfs would be determined as follows:

$n = 0.015; S = 0.008$; bottom width = 4';
 Vertical side slopes; $Q = 18.74 \text{ cfs}$

$A = 1.46$
 $P = 0.91$
 $R_h = 1.28 \text{ fps}$

Consequently, it appears that the runoff from the K-Mart Plaza watershed can be reasonably accommodated by the combined capacity of the storm sewer and the concrete flume.

That being the case, the proposed drainage channel parallel with and adjacent to the East 380' of the South Pl. of K-Mart Plaza-South, is needed only for the conveyance of runoff from F.P.S. First Addition (20.5 cfs from p. 10) together with that part of Sub-basin "H" as outlined in previous drainage evaluation for Southalen.

Therefore, at the East Pl. of F.P.S. First Addition, the channel requirement is determined as follows:

$Q_{100} = 20.5 \text{ cfs (from F.P.S. Add'n)}$
 $n = 0.030; S = 0.5\%$
 "V" bottom channel, w/ side slopes 4:1
 $(4.62) \times 15 = 69.3 - \text{Use } 35' \text{ R/W}$

$A = 1.46$
 $P = 11.97$
 $R_h = 0.670$
 $V = 3.68$

At E. Pl. of K-Mart Plaza (Extended) the channel requirement is determined as follows:

$Q_{100} = 20.5 + 4.57 \text{ (from South Pl. w/ 45' Basin "H")}$
 $n = 0.030$
 $(10 \times 2) + 15 = 35.0' \text{ R/W}$

$A = 8.89$
 $P = 12.29$
 $R_h = 0.723$

Since it has been demonstrated that a 35' wide R/W is adequate, we would propose that the existing 50' Drainage Easement as recorded at Film 502 Pg. 1015 be vacated and concurrently re-platted as a 35' Drainage Easmt. adjacent to the South line of K-Mart Plaza South.