

PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

DRAINAGE PLAN
AND
SUPPORTING CALCULATIONS

FOR
HARRISON PARK ADDITION
TO WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
ENGINEERS

SEPTEMBER 25, 1987

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



Date Sept. 22, 1987 Page 1 of 22
 Project Harrison Park Addition
 Item Drainage Plan System 100

I HYDROLOGY

Use Rational Method $Q = CIA$

A. Determine "c"

| <u>Node</u> | <u>Soil Type</u> | <u>Land Use</u> | <u>C₂</u> | <u>C₁₀₀</u> |
|-------------|------------------|------------------------|----------------------|------------------------|
| 115 | D | Cultivated slopes 1-4% | 0.26 | 0.61 |
| 114 | D | Res. 1/8 Ac | 0.57 | 0.79 |
| 113 | D | " | 0.57 | 0.79 |
| 112 | D | " | 0.57 | 0.79 |
| 111 | D | " | 0.57 | 0.79 |
| 110 | D | " | 0.57 | 0.79 |
| 109 | D | " | 0.57 | 0.79 |
| 108 | D | " | 0.57 | 0.79 |
| 107 | D | " | 0.57 | 0.79 |
| 106 | D | " | 0.57 | 0.79 |
| 105 | D | " | 0.57 | 0.79 |
| 104 | D | " | 0.57 | 0.79 |
| 103 | D | " | 0.57 | 0.79 |
| 102 | D | park slope 1-4% | 0.30 | 0.65 |
| 101 | D | Res. 1/4 Ac. | 0.50 | 0.76 |
| 100 | (End Section) | | | |



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B. Determine "I"

| <u>Node</u> | <u>t_c</u> | <u>I_2</u> | <u>I_{100}</u> |
|-------------|--|-------------------------|-----------------------------|
| 115 | $\frac{300' @ 0.29 \text{ fps} = 17}{1200' @ 1.0 \text{ fps} = 20}$ 37 | 2.35 | 4.86 |
| 114 | 15 | 3.83 | 7.37 |
| 113 | 15 | 3.83 | 7.37 |
| 112 | 15 | 3.83 | 7.37 |
| 111 | 15 | 3.83 | 7.37 |
| 110 | 15 | 3.83 | 7.37 |
| 109 | 15 | 3.83 | 7.37 |
| 108 | 15 | 3.83 | 7.37 |
| 107 | 15 | 3.83 | 7.37 |
| 106 | 15 | 3.83 | 7.37 |
| 105 | 15 | 3.83 | 7.37 |
| 104 | 15 | 3.83 | 7.37 |
| 103 | 15 | 3.83 | 7.37 |
| 102 | $\frac{300' @ 0.45 \text{ fps} = 11}{1800' @ 1 \text{ fps} = 30}$ $\frac{200' @ 3 \text{ fps} = 4}{45}$ | 2.08 | 4.38 |
| 101 | 15 | 3.83 | 7.37 |
| 100 | (End Section) | | |



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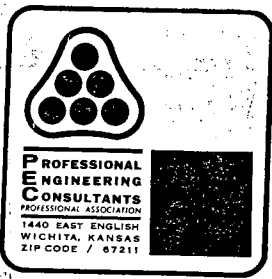
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C. Determine "A"

| <u>Node</u> | <u>Plan. Units</u> | <u>Area SF</u> | <u>Area Ac.</u> |
|-------------|--------------------|----------------|-----------------|
| 115 | 0.46 | 1,840,000 | 42.2 |
| 114 | 2.85 | 28,500 | 0.65 |
| 113 | 15.17 | 151,700 | 3.48 |
| 112 | 23.20 | 232,000 | 5.32 |
| 111 | 26.75 | 267,500 | 6.14 |
| 110 | 2.05 | 20,500 | 0.47 |
| 109 | 27.20 | 272,000 | 6.24 |
| 108 | 7.47 | 74,700 | 1.71 |
| 107 | 21.42 | 214,200 | 4.92 |
| 106 | 14.01 | 140,100 | 3.22 |
| 105 | 12.47 | 124,700 | 2.86 |
| 104 | 10.87 | 108,700 | 2.50 |
| 103 | 7.04 | 70,400 | 1.62 |
| 102 | 0.54 | 2,160,000 | 49.6 |
| 101 | 17.03 | 170,300 | 3.91 |
| 100 | (End Section) | | |

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D. Determine "Q₂"

| <u>Node</u> | <u>C₂</u> | <u>I₂</u> | <u>A</u> | <u>Q₂</u> |
|-------------|----------------------|----------------------|----------|----------------------|
| 115 | 0.26 | 2.35 | 42.2 | 25.8 |
| 114 | 0.57 | 3.83 | 0.65 | 1.4 |
| 113 | 0.57 | 3.83 | 3.48 | 7.6 |
| 112 | 0.57 | 3.83 | 5.32 | 11.6 |
| 111 | 0.57 | 3.83 | 6.14 | 13.4 |
| 110 | 0.57 | 3.83 | 0.47 | 1.0 |
| 109 | 0.57 | 3.83 | 6.24 | 13.6 |
| 108 | 0.57 | 3.83 | 1.71 | 3.7 |
| 107 | 0.57 | 3.83 | 4.92 | 10.7 |
| 106 | 0.57 | 3.83 | 3.22 | 7.0 |
| 105 | 0.57 | 3.83 | 2.86 | 6.2 |
| 104 | 0.57 | 3.83 | 2.50 | 5.5 |
| 103 | 0.57 | 3.83 | 1.62 | 3.5 |
| 102 | 0.30 | 2.08 | 49.6 | 31.0 |
| 101 | 0.50 | 3.83 | 3.91 | 7.5 |
| 100 | (End Section) | | | |



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E Determine "Q₁₀₀"

| <u>Node</u> | <u>C₁₀₀</u> | <u>I₁₀₀</u> | <u>A</u> | <u>Q₁₀₀</u> |
|-------------|------------------------|------------------------|----------|------------------------|
| 115 | 0.61 | 4.86 | 42.2 | 125.1 |
| 114 | 0.79 | 7.37 | 0.65 | 3.8 |
| 113 | 0.79 | 7.37 | 3.48 | 20.3 |
| 112 | 0.79 | 7.37 | 5.32 | 31.0 |
| 111 | 0.79 | 7.37 | 6.14 | 35.7 |
| 110 | 0.79 | 7.37 | 0.47 | 2.7 |
| 109 | 0.79 | 7.37 | 6.24 | 36.3 |
| 108 | 0.79 | 7.37 | 1.71 | 10.0 |
| 107 | 0.79 | 7.37 | 4.92 | 28.6 |
| 106 | 0.79 | 7.37 | 3.22 | 18.7 |
| 105 | 0.79 | 7.37 | 2.86 | 16.7 |
| 104 | 0.79 | 7.37 | 2.50 | 14.6 |
| 103 | 0.79 | 7.37 | 1.62 | 9.4 |
| 102 | 0.65 | 4.38 | 49.6 | 141.2 |
| 101 | 0.76 | 7.37 | 3.91 | 21.9 |
| 100 | (End Section) | | | |



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Project Harrison Park Addition

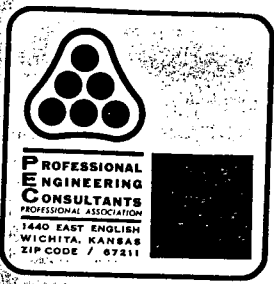
Item Drainage Plan System 100

II FLOOD ROUTING / INLET SIZING (2-YR)

| <u>Node</u> | <u>Inlet Condition</u> | <u>Inlet Length</u> | <u>Q_{approach}*</u> | <u>Q_{intercept}†</u> | <u>Q_{bypass}</u> | <u>Bypass to Node</u> |
|-------------|------------------------|---------------------|------------------------------|-------------------------------|---------------------------|-----------------------|
| 115 | Sump | Catch Basin | 25.8 | 25.8 | 0.0 | - |
| 114 | Sump | 5' | 1.4 | 1.4 | 0.0 | - |
| 113 | Sump | 5' | 7.6 | 7.6 | 0.0 | - |
| 112 | Sump | 10' | 11.6 | 11.6 | 0.0 | - |
| 111 | Sump | 10' | 13.4 | 13.4 | 0.0 | - |
| 110 | On Grade | 5' | 1.0 | 60% = 0.6 | 0.4 | ≠ 104 |
| 109 | Sump | 10' | 13.6 | 13.6 | 0.0 | - |
| 108 | Sump | 5' | 3.7 | 3.7 | 0.0 | - |
| 107 | Sump | 5' | 10.7 | 10.7 | 0.0 | - |
| 106 | Sump | 5' | 7.0 | 7.0 | 0.0 | - |
| 105 | Sump | 5' | 6.2 | 6.2 | 0.0 | - |
| 104 | Sump | 5' | 5.5 + 0.4 = 5.9 | 5.9 | 0.0 | - |
| 103 | On Grade | 5' | 3.5 | 25% = 0.9 | 2.6 | 102 |
| 102 | Sump | 10' | 31.0 + 2.6 = 33.6 | 22.0 | 11.6 | 101 |
| 101 | Sump | 10' | 7.5 + 11.6 = 19.1 | 19.1 | 0.0 | - |
| 100 | (End Section) | | | | | |

* Q_{approach} = Q_z + any Q_{bypass} from upstream nodes

† Q_{intercept} = Q input in "storm" program.



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Item Drainage Plan System 100

| III STREET FLOW - 2 YR | | | | | | |
|------------------------|-----------------------|------------------|--------------|------------|--------------|------------------------|
| Node | Q _{approach} | Distribution | street slope | Flow Depth | Allow. Depth | Comment |
| 115 | 25.1 | (Catch Basin) | N/A | — | — | — |
| 114 | 1.4 | 40% (N) = 0.6 | 0.32 | 0.18 | 0.55 | OK |
| | | 60% (E) = 0.8 | 0.4 | 0.18 | 0.55 | OK |
| 113 | 7.6 | 90% (W) = 6.8 | 1.1 | 0.34 | 0.55 | OK |
| | | 10% (E) = 0.8 | 0.4 | 0.18 | 0.55 | OK |
| 112 | 11.6 | 95% (N) = 11.0 | 0.4 | 0.49 | 0.55 | OK |
| | | 5% (W) = 0.6 | 0.8 | 0.15 | 0.30 | OK |
| 111 | 13.4 | 80% (N) = 10.7 | 0.4 | 0.48 | 0.55 | OK |
| | | 20% (E) = 2.7 | 0.4 | 0.30 | 0.30 | OK |
| 110 | 1.0 | 100% (N) = 1.0 | 0.4 | 0.21 | 0.55 | OK |
| 109 | 13.6 | 80% (W) = 10.9 | 1.0 | 0.42 | 0.55 | OK |
| | | 20% (N) = 2.7 | 1.25 | 0.24 | 0.30 | OK |
| 108 | 3.7 | ≈ 100% (W) = 3.7 | 1.0 | 0.28 | 0.55 | OK |
| 107 | 10.7 | 50% (W) = 5.3 | 1.0 | 0.32 | 0.55 | OK |
| | | 50% (E) = 5.4 | 1.0 | 0.32 | 0.55 | OK |
| 106 | 7.0 | 75% (W) = 5.2 | 1.0 | 0.32 | 0.55 | OK |
| | | 25% (N) = 1.8 | 0.4 | 0.25 | 0.30 | OK |
| 105 | 6.2 | 75% (W) = 4.6 | 2.3 | 0.27 | 0.55 | OK |
| | | 25% (N) = 1.6 | 0.4 | 0.24 | 0.30 | OK |
| 104 | 5.9 | 75% (W) = 4.4 | 1.8 | 0.28 | 0.55 | OK |
| | | 25% (N) = 1.5 | 0.4 | 0.24 | 0.55 | OK |
| 103 | 3.5 | 100% (W) = 3.5 | 1.8 | 0.25 | 0.55 | OK |
| 102 | 33.6 | 30% (N) = 10.1 | 0.4 | 0.48 | 0.55 | OK |
| | | 70% (S) = 23.5 | 0.32 | 0.55 | 0.55 | 11.6cfs will top crown |



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Project Harrison Park Addition

Item Drainage Plan System 100

| Node | Q approach | Distribution | street slope | Flow Depth | Allow. Depth | Comment |
|------|------------|---------------------------------|--------------|--------------|--------------|---------|
| 101 | 19.1 | 80% (S) = 15.3 20% (N) = 3.8 | 0.32 0.4 | 0.58 0.33 | 0.55 0.55 | * OK |

* slightly over max., but based on existing conditions, can't be avoided.

SUMMARY

Use standard curb on Todd Street + Lincoln (E) + Bayley

Goebel / Lincoln Loop is marginal for roll curb. With revisions in street slope, roll curb may be used.

Use roll curb on all other streets.



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Project Harrison Park Addition

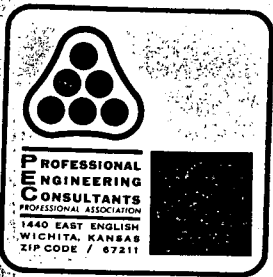
Item Drainage Plan System 100

IV STREET FLOW -100 -YR

Check street flow at various locations

$$Q_{street} = Q_{100} - Q_{pipe}$$

| <u>Location</u> | <u>Contrib. Nodes</u> | <u>Q₁₀₀</u> | <u>Q_{pipe}</u> | <u>Q_{street}</u> | <u>street slope</u> | <u>Q_{max}</u> | <u>Comment</u> |
|----------------------------|---|--------------------------------------|-------------------------|---------------------------|---------------------|-------------------------|-----------------------|
| Approaching Node 109 | 80% 109 | 29.0 | 0.0 | 29.0 | 1.0% | 77.4 (From Page 12) | OK Walk Gr = +0.3' |
| Approaching Nodes 105, 107 | 100% 109 50% 107 100% 108 | 36.3 14.3 10.0 | | | | | |
| | | <u>60.6</u> | 13.6 | 47.0 | 1.0% | 77.4 (From Page 12) | OK Walk Gr = +0.3' |
| Approaching Node 106 | 100% 109 100% 108 100% 107 75% 106 | 36.3 10.0 28.6 14.0 | | | | | |
| | | <u>88.9</u> | 27.7 | 61.2 | 1.0% | 77.4 (From Page 12) | OK Walk Gr = +0.3' |
| Approaching Node 105 | 100% 109 100% 108 100% 107 100% 106 75% 105 | 36.3 10.0 28.6 18.7 12.5 | | | | | |
| | | <u>106.1</u> | 34.4 | 71.7 | 2.3% | 117.4 (From Page 12) | OK Walk Gr = +0.3' |
| Approaching Node 104 | 100% 109 100% 108 | 36.3 10.0 | | | | | |
| From W. | 100% 107 100% 106 100% 105 75% 104 | 28.6 18.7 16.7 11.0 | | | | | |
| | | <u>121.3</u> | 40.3 | 81.0 | 1.8% | 103.8 (From Page 12) | OK Walk Gr = +0.3' |



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Project Harrison Park Addition

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| Location | Contrib. Nodes | Q ₁₀₀ | Q _{pipe} | Q _{street} | street slope | Q _{max} | Comment |
|----------------------------|--|------------------------------|-------------------|---------------------|--------------|------------------|----------------------------------|
| Approaching Node 114 (N) | 100% 115 25% 114 | 125.1 1.0 <u>126.1</u> | 25.8 | 100.3 | 0.4 | 124.8 | OK (From p. 13) WK Gr = +0.6' |
| Approaching Node 113 (N) | 100% 115 100% 114 10% 113 | <u>127.5</u> | 26.6 | 100.9 | 0.4 | 124.8 | OK (From p. 13) WK Gr = +0.6' |
| Approaching Nodes 111, 110 | 100% 115 100% 114 100% 113 100% 112 80% 111 100% 110 | <u>160.3</u> | 37.9 | 122.4 | 0.4 | 124.8 | OK (From p. 13) WK Gr = +0.6' |
| Approaching Node 104 (N) | 100% 115 100% 114 100% 113 100% 112 100% 111 100% 110 25% 104 20% 101 | <u>184.7</u> | 46.0 | 138.7 | 0.4 | 124.8 | OK (From p. 13) WK Gr = +0.6' |



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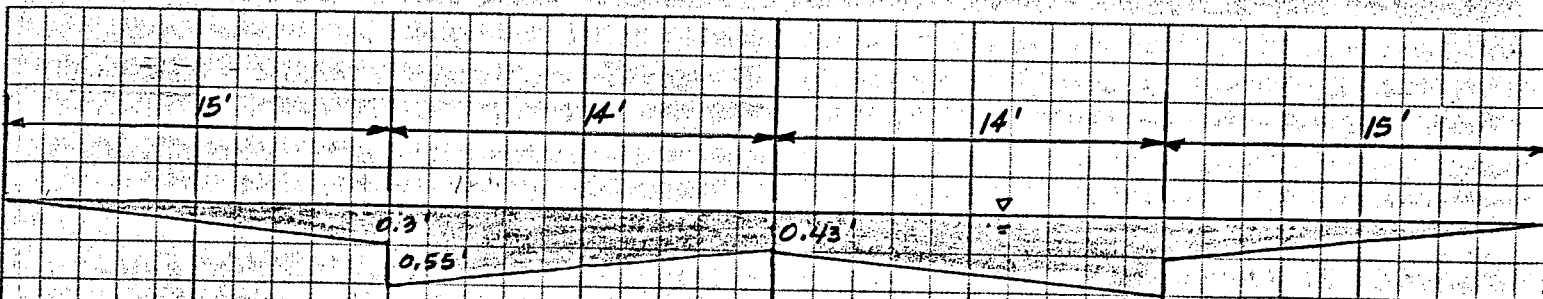
| <u>Location</u> | <u>Contrib. Nodes</u> | <u>Q₁₀₀</u> | <u>Q_{pipe}</u> | <u>Q_{street}</u> | <u>street slope</u> | <u>Q_{max}</u> | <u>Comment</u> |
|-----------------|-----------------------|------------------------|-------------------------|---------------------------|---------------------|------------------------|----------------------|
| Approaching | 115 | | | | | | |
| Nodes 102, 101 | 114 | | | | | | |
| (N) | 113 | | | | | | |
| | 112 | | | | | | |
| | 111 | | | | | | |
| | 110 | | | | | | |
| | 109 | | | | | | |
| | 108 | | | | | | |
| | 107 | | | | | | |
| | 106 | | | | | | |
| | 105 | | | | | | |
| | 104 | | | | | | |
| | 103 | | | | | | |
| | % 102 | | | | | | |
| | % 101 | | | | | | |
| | | <u>271.0</u> | <u>74.3</u> | <u>196.7</u> | <u>0.7</u> | <u>201.2</u> | <u>OK</u> |
| | | | | | | <u>(From p. 14)</u> | <u>NK Gr = +0.7'</u> |



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Project Harrison Park - Addition

Item Drainage Plan - System 100



58' R-O-W, std cb,
+0.3' Walk Grade

Determine Q_{max} in street R-O-W

Use Manning's Equation $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

$$n = \frac{2(14.5 \times 0.03) + 2(3.05 \times 0.013) + 2(12 \times 0.016)}{59.1}$$

$$n = 0.02256$$

$$A = 2(\frac{1}{2} \times 15 \times 0.3) + (28 \times 0.43) + 2(\frac{1}{2} \times 14 \times 0.42)$$

$$A = 22.42 \text{ SF}$$

$$R = A/p = 22.42/59.1 = 0.379357$$

$$R^{2/3} = 0.524041$$

$$Q = \frac{1.486}{0.02256} \times 22.42 \times 0.524041 \times S^{1/2}$$

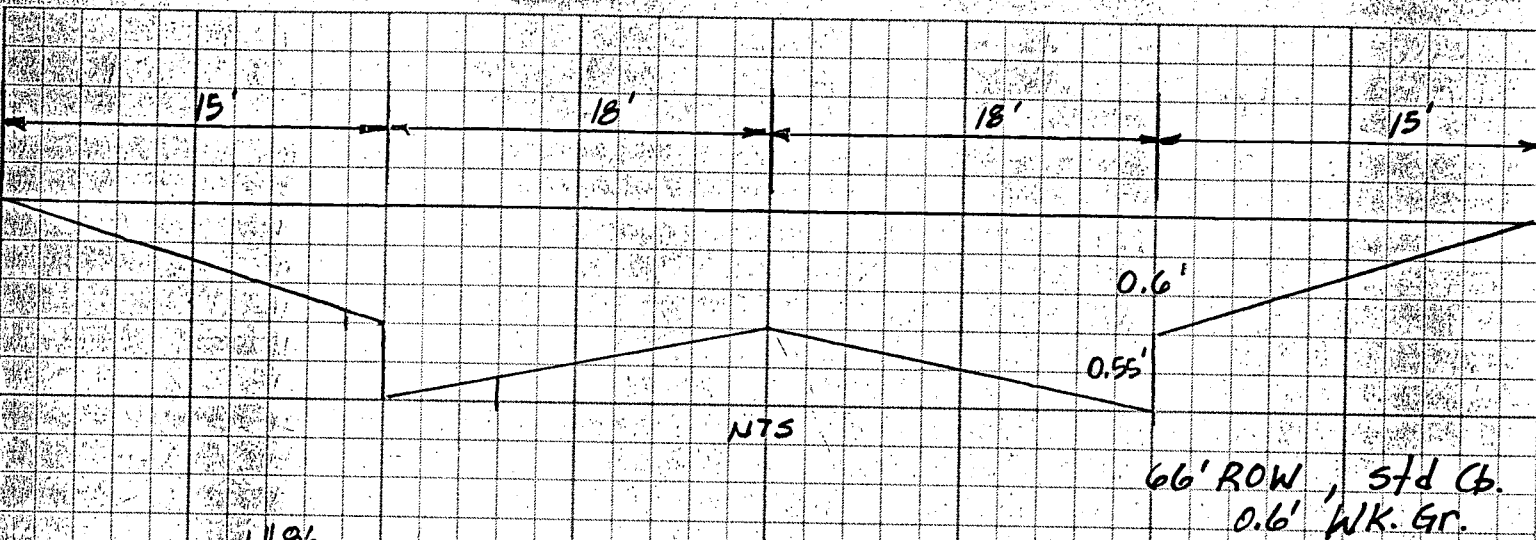
$$Q = 773.89 \sqrt{S}$$



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Project Harrison Park Add.

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$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$n = \frac{2(14.5 \times 0.03) + 2(3.05 \times 0.013) + 2(16 \times 0.016)}{67.1} = \frac{1.4613}{67.1} = 0.021778$$

$$A = 2\left(\frac{1}{2} \times 15 \times 0.6\right) + (0.6 \times 36) + 2\left(\frac{1}{2} \times 18 \times 0.55\right) = 40.5 \text{ SF}$$

$$p = 2(15) + 2(0.55) + 2(18) = 67.1$$

$$R = A/p = 40.5/67.1 = 0.603577$$

$$R^{2/3} = 0.714203$$

$$Q = \frac{1.486}{0.021778} \times 40.5 \times 0.714203 \times S^{1/2}$$

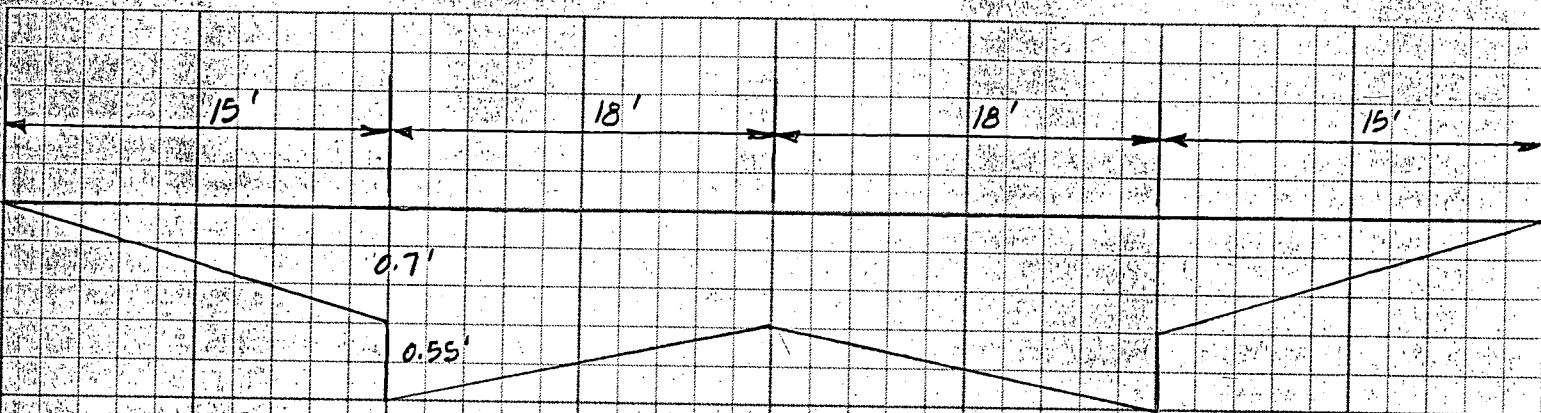
$$Q = 1,973.68 \text{ S}^{1/2}$$



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$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$n = 0.021778 \quad (\text{see page 13})$$

$$A = 2\left(\frac{1}{2} \times 15 \times 0.7\right) + 2\left(\frac{1}{2} \times 18 \times 0.55\right) + (36 \times 0.7) = 45.6 \text{ SF}$$

$$p = 67.1$$

$$R = A/p = 45.6/67.1 = 0.6795'$$

$$R^{2/3} = 0.772968$$

$$Q = \frac{1.486}{0.021778} \times 45.6 \times 0.772968 \times S^{1/2}$$

$$Q = 2,405.1 \text{ } S^{1/2}$$

15/22

100 j, 1342.5000 100 3 16 15
 110 t, harrison park addition
 120 t, drainage plan
 130 t, storm water sewer system 100 analysis

Q₂ K₀ Street flow

| | | | | | | | |
|----------------|---------|----------|-------|------|-------|-------|---------|
| 140 i, 115 | 0.25 | 42.20 | 0.00 | 0.00 | 25.00 | 37.00 | 1349.70 |
| 150 i, 114 | 0.57 | 0.55 | 0.00 | 0.00 | 1.40 | 15.00 | 1349.00 |
| 160 i, 113 | 0.57 | 3.48 | 0.00 | 0.00 | 7.60 | 15.00 | 1348.30 |
| 170 i, 112 | 0.57 | 5.32 | 0.00 | 0.00 | 11.60 | 15.00 | 1347.10 |
| 180 i, 111 | 0.57 | 6.14 | 0.00 | 0.00 | 13.40 | 15.00 | 1346.60 |
| 190 i, 110 | 0.57 | 0.47 | 0.00 | 0.00 | 0.60 | 15.00 | 1346.60 |
| 200 i, 109 | 0.57 | 6.24 | 0.00 | 0.00 | 13.60 | 15.00 | 1346.50 |
| 210 i, 108 | 0.57 | 1.71 | 0.00 | 0.00 | 3.70 | 15.00 | 1346.50 |
| 220 i, 107 | 0.57 | 4.92 | 0.00 | 0.00 | 10.70 | 15.00 | 1346.50 |
| 230 i, 106 | 0.57 | 3.22 | 0.00 | 0.00 | 7.00 | 15.00 | 1346.50 |
| 240 i, 105 | 0.57 | 2.86 | 0.00 | 0.00 | 6.20 | 15.00 | 1346.50 |
| 250 i, 104 | 0.57 | 2.50 | 0.00 | 0.00 | 5.90 | 15.00 | 1346.00 |
| 260 i, 103 | 0.57 | 1.62 | 0.00 | 0.00 | 0.90 | 15.00 | 1346.00 |
| 270 i, 102 | 0.30 | 49.60 | 0.00 | 0.00 | 22.00 | 45.00 | 1345.40 |
| 280 i, 101 | 0.50 | 3.91 | 0.00 | 0.00 | 19.10 | 15.00 | 1345.40 |
| 290 m, 100 | 1342.50 | | | | | | |
| 300 p, 115 114 | 140.00 | 27 0.013 | 60.00 | 0.00 | | | |
| 310 p, 114 113 | 130.00 | 30 0.013 | 20.00 | 0.00 | | | |
| 320 p, 113 112 | 300.00 | 36 0.013 | 0.00 | 0.00 | | | |
| 330 p, 112 110 | 140.00 | 36 0.013 | 0.00 | 0.00 | | | |
| 340 p, 111 110 | 40.00 | 24 0.013 | 90.00 | 0.00 | | | |
| 350 p, 110 104 | 170.00 | 42 0.013 | 60.00 | 0.00 | | | |
| 360 p, 109 107 | 240.00 | 24 0.013 | 0.00 | 0.00 | | | |
| 370 p, 108 107 | 40.00 | 15 0.013 | 90.00 | 0.00 | | | |
| 380 p, 107 106 | 340.00 | 24 0.013 | 0.00 | 0.00 | | | |
| 390 p, 106 105 | 290.00 | 27 0.013 | 0.00 | 0.00 | | | |
| 400 p, 105 104 | 290.00 | 30 0.013 | 70.00 | 0.00 | | | |
| 410 p, 104 103 | 60.00 | 48 0.013 | 20.00 | 0.00 | | | |
| 420 p, 103 102 | 140.00 | 48 0.013 | 90.00 | 0.00 | | | |
| 430 p, 102 101 | 40.00 | 48 0.013 | 0.00 | 0.00 | | | |
| 440 p, 101 100 | 30.00 | 48 0.013 | 0.00 | 0.00 | | | |
| 450 e | | | | | | | |

Length of pipe

Pipe size in

as defl. angle approx bend @ downstream Node for Band losses

Input File: hpark100

harrison park addition
drainage plan
storm water sewer system 100 analysis

16/22

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

| ***** | | | | | | | | | | | | | ***** | | | | | | | |
|----------------|-----|------|-------|--------|-------|---------|-------|-------|---------|-------|-------|--------|---------------------|--------|--------|-------|--------------|--|--|--|
| Tributary Area | | | | | | | | | | | | | Hydrology Summation | | | | Conduit Data | | | |
| ***** | | | | | | | | | | | | | ***** | | | | ***** | | | |
| Node to | C | Area | Slope | Length | TC(0) | I(0) | Q(0) | TC | I | Q | Sum Q | Size | Velocity | Length | TT | TT+TC | | | | |
| Node | | (Ac) | (%) | (Ft) | (Min) | (In/Hr) | (CFS) | (Min) | (In/Hr) | (CFS) | (CFS) | | (Ft/Sec) | (Ft) | (Min) | (Min) | | | | |
| ***** | | | | | | | | | | | | | ***** | | | | ***** | | | |
| 115 | 114 | 0.26 | 42.20 | 0.00 | 0.0 | 37.00 | 2.46 | 25.80 | 37.00 | 2.46 | 25.80 | 25.80 | 27" | 6.49 | 140.00 | 0.36 | 37.36 | | | |
| 114 | 113 | 0.57 | 0.65 | 0.00 | 0.0 | 15.00 | 4.06 | 1.40 | 37.36 | 2.44 | 0.84 | 26.64 | 30" | 5.43 | 180.00 | 0.55 | 37.91 | | | |
| 113 | 112 | 0.57 | 2.48 | 0.00 | 0.0 | 15.00 | 4.06 | 7.60 | 37.91 | 2.41 | 4.51 | 31.15 | 36" | 4.41 | 300.00 | 1.13 | 39.05 | | | |
| 112 | 110 | 0.57 | 5.32 | 0.00 | 0.0 | 15.00 | 4.06 | 11.60 | 39.05 | 2.36 | 6.73 | 37.89 | 36" | 5.36 | 140.00 | 0.44 | 39.48 | | | |
| 111 | 110 | 0.57 | 6.14 | 0.00 | 0.0 | 15.00 | 4.06 | 13.40 | 15.00 | 4.06 | 13.40 | 13.40 | 24" | 4.27 | 40.00 | 0.16 | 15.16 | | | |
| 110 | 104 | 0.57 | 0.47 | 0.00 | 0.0 | 15.00 | 4.06 | 0.60 | 39.48 | 2.34 | 0.35 | 45.98 | 42" | 4.78 | 170.00 | 0.59 | 40.08 | | | |
| 109 | 107 | 0.57 | 6.24 | 0.00 | 0.0 | 15.00 | 4.06 | 13.60 | 15.00 | 4.06 | 13.60 | 13.60 | 24" | 4.33 | 240.00 | 0.92 | 15.92 | | | |
| 108 | 107 | 0.57 | 1.71 | 0.00 | 0.0 | 15.00 | 4.06 | 3.70 | 15.00 | 4.06 | 3.70 | 3.70 | 15" | 3.02 | 40.00 | 0.22 | 15.22 | | | |
| 107 | 106 | 0.57 | 4.92 | 0.00 | 0.0 | 15.00 | 4.06 | 10.70 | 15.92 | 3.97 | 10.45 | 27.69 | 24" | 0.81 | 340.00 | 0.64 | 16.57 | | | |
| 106 | 105 | 0.57 | 3.22 | 0.00 | 0.0 | 15.00 | 4.06 | 7.00 | 16.57 | 3.90 | 6.73 | 34.42 | 27" | 0.66 | 290.00 | 0.56 | 17.13 | | | |
| 105 | 104 | 0.57 | 2.86 | 0.00 | 0.0 | 15.00 | 4.06 | 6.20 | 17.13 | 3.85 | 5.89 | 40.31 | 30" | 0.21 | 290.00 | 0.59 | 17.71 | | | |
| 104 | 103 | 0.57 | 2.30 | 0.00 | 0.0 | 15.00 | 4.06 | 5.90 | 40.08 | 2.31 | 3.36 | 73.80 | 48" | 5.87 | 60.00 | 0.17 | 40.25 | | | |
| 103 | 102 | 0.57 | 1.62 | 0.00 | 0.0 | 15.00 | 4.06 | 0.90 | 40.25 | 2.30 | 0.51 | 74.32 | 48" | 5.91 | 140.00 | 0.39 | 40.64 | | | |
| 102 | 101 | 0.30 | 49.60 | 0.00 | 0.0 | 45.00 | 2.11 | 22.00 | 40.64 | 2.28 | 19.87 | 94.18 | 48" | 7.49 | 40.00 | 0.09 | 40.73 | | | |
| 101 | 100 | 0.50 | 3.91 | 0.00 | 0.0 | 15.00 | 4.06 | 19.10 | 40.73 | 2.28 | 10.73 | 104.92 | 48" | 8.35 | 30.00 | 0.06 | 40.79 | | | |
| ***** | | | | | | | | | | | | | ***** | | | | ***** | | | |

Input File: hpark100

harrison park addition
drainage plan
storm water sewer system 100 analysis

17/22

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

```

*****
Node      Hyd-Slope  Friction  Bend      Transition  Manhole  Deflection  Junction  Total  Hyd-GI  Desired  Diff.
      (Ft/Ft)   (Ft)     (Ft)      (Ft)        (Ft)     (Ft)       (Ft)     (Ft)   Elevation Elevation (Ft)
*****
115      0.00694    0.9716   0.0000    0.0000     0.0000    0.0000     0.0000    0.9716 1349.0652 1349.7000  0.63
114      0.00422    0.7593   0.0000    0.0393     0.0000    0.2010     -0.1319    0.8677 1348.0936 1349.0000  0.91
113      0.00218    0.6545   0.0000    0.0311     0.0000    0.0375     -0.0218    0.7015 1347.2260 1348.3000  1.07
112      0.00323    0.4517   0.0000    0.0144     0.0000    0.0000     0.3030    0.7692 1346.5245 1347.1000  0.58
111      0.00351    0.1403   0.0000    0.0000     0.0000    0.0000     0.0000    0.1403 1345.8958 1346.6000  0.70
110      0.00209    0.3550   0.0000    0.0183     0.0000    0.0000     0.0753    0.4486 1345.7554 1346.6000  0.84
109      0.00361    0.8674   0.0000    0.0000     0.0000    0.0000     0.0000    0.8674 1360.4813 1363.5000  3.02
108      0.00328    0.1312   0.0000    0.0000     0.0000    0.0000     0.0000    0.1312 1359.7451 1361.5000  1.75
107      0.01498    5.0934   0.0000    0.0915     0.0000    0.0000     1.8803    7.0652 1359.6139 1361.5000  1.89
106      0.01235    3.5826   0.0000    0.0085     0.0000    0.0000     0.5403    4.1314 1352.5487 1359.5000  5.95
105      0.00966    2.8009   0.0000    0.0233     0.0000    0.0000     0.2863    3.1106 1348.4174 1351.5000  3.08
104      0.00264    0.1584   0.0000    0.0181     0.0000    0.1090     0.2938    0.5793 1345.3068 1346.0000  0.69
103      0.00268    0.3747   0.0000    0.0007     0.0000    0.0441     0.0282    0.4477 1344.7274 1346.0000  1.27
102      0.00430    0.1720   0.0000    0.0329     0.0000    0.2715     0.6770    1.1535 1344.2797 1345.4000  1.12
101      0.00533    0.1600   0.0000    0.0210     0.0000    0.0000     0.4451    0.6262 1343.1262 1345.4000  2.27
100      0.00000    0.0000   0.0000    0.0000     0.0000    0.0000     0.0000    0.0000 1342.5000 1342.5000  0.00
*****

```

18/22

Computation of Peak Discharge
Date: 09-24-1987

Title: harrison park

Rainfall 7.8 inches
Recurrence Interval (yrs.) 100
Runoff Curve Number 80
Hyd. Len. 2000 feet
Slope 2 %
% of HLM 0 %
% Imp. 0 %
Area of basin 50 acres

Computed Data
Basic Lag Factor (hrs.) 0.39
Hydr. Length Adj. 1.00
Imp. Area Adj. 1.00
Runoff Volume (in.) 5.44
Computed Time of Conc. (hrs.) 0.65

Peak Discharge by Technical Release No. 55 (1975)

Peak Dis. (cfs) = 181.88 ←
Csm/in. = 428.14
Tc (hrs.) = 0.65

Peak Discharge by Modified Rational Formula (Rossmiller)
Discharge for 100 year freq.

Time of Conc. (Tc) = 39.20 minutes
Intensity = 5.51 inches/hr.
C factor = 0.39
Peak Dis. (cfs) = 108.78 ←

Check of t_c & Q 's for Node 102

$$\text{Avg} = \frac{181.88 + 108.78}{2} = 145.3 \text{ cfs @ } 39.2 \text{ min.}$$

USED 141.2 cfs @ 45 min. (See p.2 & p.5)

19/22

Computation of Peak Discharge
Date: 09-24-1987

Title: Harrison Park Add.:off-site area north

Rainfall 7.8 inches
Recurrence Interval (yrs.) 100
Runoff Curve Number 81
Hyd. Len. 2100 feet
Slope 2 %
% of HLM 0 %
% Imp. 0 %
Area of basin 42 acres

Computed Data

Basic Lag Factor (hrs.) 0.39
Hydr. Length Adj. 1.00
Imp. Area Adj. 1.00
Runoff Volume (in.) 5.55
Computed Time of Conc. (hrs.) 0.66

Peak Discharge by Technical Release No. 55 (1975)

Peak Dis. (cfs) = 155.28 ←
Csm/in. = 426.05
Tc (hrs.) = 0.66

Peak Discharge by Modified Rational Formula (Rossmiller)
Discharge for 100 year freq.

Time of Conc. (Tc) = 39.49 minutes
Intensity = 5.48 inches/hr.
C factor = 0.40
Peak Dis. (cfs) = 92.68 ←

37 min
125.1 cfs

Check of t_c & Q for Node 115

$$\text{Avg} = \frac{155.28 + 92.68}{2} = 124.0 \text{ @ } 39.5 \text{ min}$$

USED: 125.1 cfs @ t_c 37 min (see p.2 + p.5)

20/22

100 j, 1342.5000 100 3 16 15

110 t, harrison park addition

120 t, drainage plan

130 t, storm water sewer system 100 analysis

| | | | | | | | |
|----------------|--------|----------|-------|------|--------|-------|---------|
| 140 i, 115 | 0.61 | 42.20 | 0.00 | 0.00 | 125.10 | 37.00 | 1349.70 |
| 150 i, 114 | 0.79 | 0.65 | 0.00 | 0.00 | 3.80 | 15.00 | 1349.00 |
| 160 i, 113 | 0.79 | 3.48 | 0.00 | 0.00 | 20.30 | 15.00 | 1348.30 |
| 170 i, 112 | 0.79 | 5.32 | 0.00 | 0.00 | 31.00 | 15.00 | 1347.10 |
| 180 i, 111 | 0.79 | 6.14 | 0.00 | 0.00 | 35.70 | 15.00 | 1346.60 |
| 190 i, 110 | 0.79 | 0.47 | 0.00 | 0.00 | 2.70 | 15.00 | 1346.60 |
| 200 i, 109 | 0.79 | 6.24 | 0.00 | 0.00 | 36.30 | 15.00 | 1363.50 |
| 210 i, 108 | 0.79 | 1.71 | 0.00 | 0.00 | 10.00 | 15.00 | 1361.50 |
| 220 i, 107 | 0.79 | 4.92 | 0.00 | 0.00 | 28.60 | 15.00 | 1361.50 |
| 230 i, 106 | 0.79 | 3.22 | 0.00 | 0.00 | 16.70 | 15.00 | 1358.50 |
| 240 i, 105 | 0.79 | 2.86 | 0.00 | 0.00 | 16.70 | 15.00 | 1351.50 |
| 250 i, 104 | 0.79 | 2.50 | 0.00 | 0.00 | 14.60 | 15.00 | 1346.00 |
| 260 i, 103 | 0.79 | 1.62 | 0.00 | 0.00 | 9.40 | 15.00 | 1346.00 |
| 270 i, 102 | 0.65 | 49.60 | 0.00 | 0.00 | 141.20 | 45.00 | 1345.40 |
| 280 i, 101 | 0.76 | 3.91 | 0.00 | 0.00 | 21.90 | 15.00 | 1345.40 |
| 290 a, 100 | | 1342.50 | | | | | |
| 300 p, 115 114 | 140.00 | 27 0.013 | 60.00 | 0.00 | | | |
| 310 p, 114 113 | 180.00 | 30 0.013 | 20.00 | 0.00 | | | |
| 320 p, 113 112 | 300.00 | 36 0.013 | 0.00 | 0.00 | | | |
| 330 p, 112 110 | 140.00 | 36 0.013 | 0.00 | 0.00 | | | |
| 340 p, 111 110 | 40.00 | 24 0.013 | 90.00 | 0.00 | | | |
| 350 p, 110 104 | 170.00 | 42 0.013 | 60.00 | 0.00 | | | |
| 360 p, 109 107 | 240.00 | 24 0.013 | 0.00 | 0.00 | | | |
| 370 p, 108 107 | 40.00 | 15 0.013 | 90.00 | 0.00 | | | |
| 380 p, 107 106 | 340.00 | 24 0.013 | 0.00 | 0.00 | | | |
| 390 p, 106 105 | 290.00 | 27 0.013 | 0.00 | 0.00 | | | |
| 400 p, 105 104 | 290.00 | 30 0.013 | 70.00 | 0.00 | | | |
| 410 p, 104 103 | 60.00 | 48 0.013 | 20.00 | 0.00 | | | |
| 420 p, 103 102 | 140.00 | 48 0.013 | 90.00 | 0.00 | | | |
| 430 p, 102 101 | 40.00 | 48 0.013 | 0.00 | 0.00 | | | |
| 440 p, 101 100 | 30.00 | 48 0.013 | 0.00 | 0.00 | | | |
| 450 e | | | | | | | |

Input File: hpark100-100

harrison park addition
drainage plan
storm water sewer system 100 analysis

21/22

Storm Frequency = 100-Year

*** HYDROLOGY ***

| ***** | | | | | | | | | | ***** | | | | | | | | | |
|----------------|-----|-----------|-----------|-------------|-------------|--------------|---------------------|----------|-----------|---------|--------------|--------|-------------------|-------------|----------|-------------|-------|--|--|
| Tributary Area | | | | | | | Hydrology Summation | | | | Conduit Data | | | | | | | | |
| Node to Node | C | Area (Ac) | Slope (%) | Length (Ft) | TC(0) (Min) | I(0) (In/Hr) | Q(0) (CFS) | TC (Min) | I (In/Hr) | Q (CFS) | Sum Q (CFS) | Size | Velocity (Ft/Sec) | Length (Ft) | TT (Min) | TT+TC (Min) | | | |
| ***** | | | | | | | | | | | | | | | | | | | |
| 115 | 114 | 0.61 | 42.20 | 0.00 | 0.0 | 37.00 | 5.77 | 125.10 | 37.00 | 5.77 | 125.10 | 125.10 | 27" | 31.46 | 140.00 | 0.07 | 37.07 | | |
| 114 | 113 | 0.79 | 0.65 | 0.00 | 0.0 | 15.00 | 8.97 | 3.80 | 37.07 | 5.76 | 2.44 | 127.54 | 30" | 25.98 | 180.00 | 0.12 | 37.19 | | |
| 113 | 112 | 0.79 | 3.48 | 0.00 | 0.0 | 15.00 | 8.97 | 20.30 | 37.19 | 5.75 | 13.00 | 140.54 | 36" | 19.88 | 300.00 | 0.25 | 37.44 | | |
| 112 | 110 | 0.79 | 5.32 | 0.00 | 0.0 | 15.00 | 8.97 | 31.00 | 37.44 | 5.72 | 19.75 | 160.28 | 36" | 22.68 | 140.00 | 0.10 | 37.54 | | |
| 111 | 110 | 0.79 | 6.14 | 0.00 | 0.0 | 15.00 | 8.97 | 35.70 | 15.00 | 8.97 | 35.70 | 35.70 | 24" | 11.36 | 40.00 | 0.06 | 15.06 | | |
| 110 | 104 | 0.79 | 0.47 | 0.00 | 0.0 | 15.00 | 8.97 | 2.70 | 37.54 | 5.70 | 1.72 | 184.73 | 42" | 19.20 | 170.00 | 0.15 | 37.69 | | |
| 109 | 107 | 0.79 | 6.24 | 0.00 | 0.0 | 15.00 | 8.97 | 36.30 | 15.00 | 8.97 | 36.30 | 36.30 | 24" | 11.55 | 240.00 | 0.35 | 15.35 | | |
| 108 | 107 | 0.79 | 1.71 | 0.00 | 0.0 | 15.00 | 8.97 | 10.00 | 15.00 | 8.97 | 10.00 | 10.00 | 15" | 8.15 | 40.00 | 0.00 | 15.00 | | |
| 107 | 106 | 0.79 | 4.92 | 0.00 | 0.0 | 15.00 | 8.97 | 28.60 | 15.35 | 8.89 | 28.35 | 74.58 | 24" | 23.74 | 340.00 | 0.24 | 15.56 | | |
| 106 | 105 | 0.79 | 3.22 | 0.00 | 0.0 | 15.00 | 8.97 | 18.70 | 15.58 | 8.84 | 18.42 | 93.00 | 27" | 23.39 | 290.00 | 0.21 | 15.79 | | |
| 105 | 104 | 0.79 | 2.66 | 0.00 | 0.0 | 15.00 | 8.97 | 16.70 | 15.79 | 8.79 | 16.37 | 109.37 | 30" | 22.28 | 290.00 | 0.22 | 16.01 | | |
| 104 | 103 | 0.79 | 2.50 | 0.00 | 0.0 | 15.00 | 8.97 | 14.60 | 37.69 | 5.69 | 9.25 | 265.06 | 48" | 21.09 | 60.00 | 0.05 | 37.74 | | |
| 103 | 102 | 0.79 | 1.62 | 0.00 | 0.0 | 15.00 | 8.97 | 9.40 | 37.74 | 5.68 | 5.95 | 271.01 | 48" | 21.57 | 140.00 | 0.11 | 37.85 | | |
| 102 | 101 | 0.65 | 49.20 | 0.00 | 0.0 | 45.00 | 4.94 | 141.20 | 37.65 | 5.67 | 110.76 | 389.76 | 48" | 31.02 | 40.00 | 0.02 | 37.87 | | |
| 101 | 100 | 0.76 | 3.91 | 0.00 | 0.0 | 15.00 | 8.97 | 21.90 | 37.87 | 5.66 | 13.82 | 403.59 | 48" | 32.12 | 30.00 | 0.02 | 37.88 | | |
| ***** | | | | | | | | | | | | | | | | | | | |

Input File: hpark100-100

harrison park addition
drainage plan
storm water sewer system 100 analysis

22/22

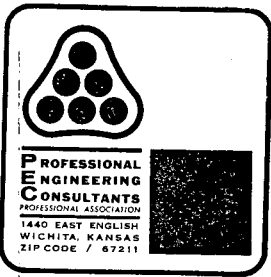
Storm Frequency = 100-Year

* * * HYDRAULICS * * *

```

*****
Node      Hyd-Slope  Friction  Bend  Transition  Manhole  Deflection  Junction  Total  Hyd-61  Desired  Diff.
(Ft/Ft)   (Ft)      (Ft)    (Ft)        (Ft)     (Ft)       (Ft)     (Ft)    Elevation  Elevation  (Ft)
*****
115      0.16316   22.8429  0.0000  0.0000     0.0000    0.0000    0.0000    22.8429  1457.7052  1349.7000 -108.01
114      0.09668   17.4032  0.0000  0.9778     0.0000    4.7248    -3.7074    19.3985  1434.8623  1349.0000 -85.86
113      0.04440   13.3193  0.0000  0.9689     0.0000    0.8621    -2.3456    12.7047  1415.4639  1348.3000 -67.16
112      0.05775   8.0350   0.0000  0.1846     0.0000    0.0000     3.9544    12.2240  1402.7592  1347.1000 -55.66
111      0.02490   0.9961   0.0000  0.0000     0.0000    0.0000     0.0000     0.9961  1391.5312  1346.6000 -44.93
110      0.03371   5.7309   0.0000  0.4520     0.0000    0.0000    -0.0964     6.0845  1390.5352  1346.6000 -43.94
109      0.02575   6.1794   0.0000  0.0000     0.0000    0.0000     0.0000     6.1794  1495.2174  1363.5000 -131.72
108      0.02396   0.9586   0.0000  0.0000     0.0000    0.0000     0.0000     0.9586  1489.9966  1361.5000 -128.50
107      0.10068   36.9518  0.0000  0.6678     0.0000    0.0000    13.7159    51.3355  1489.0300  1361.5000 -127.54
106      0.09918   26.1513  0.0000  0.0511     0.0000    0.0000     4.0377    30.2401  1437.7025  1350.5000 -79.20
105      0.07110   20.6191  0.0000  0.1574     0.0000    0.0000     2.2353    23.0117  1407.4624  1351.5000 -55.96
104      0.03405   2.0429   0.0000  0.1184     0.0000    1.7594     3.5644     7.4052  1384.4507  1346.0000 -38.45
103      0.03359   4.9832   0.0000  0.0314     0.0000    0.5682     0.8028     6.3856  1376.9655  1346.0000 -30.97
102      0.07363   2.9450   0.0000  0.7716     0.0000    3.6109    15.7333    23.0600  1370.5798  1345.4000 -25.18
101      0.07894   2.3682   0.0000  0.1078     0.0000    0.0000     2.5430     5.0190  1347.5190  1345.4000 -2.12
100      0.00000   0.0000   0.0000  0.0000     0.0000    0.0000     0.0000     0.0000  1342.5000  1342.5000  0.00
*****

```



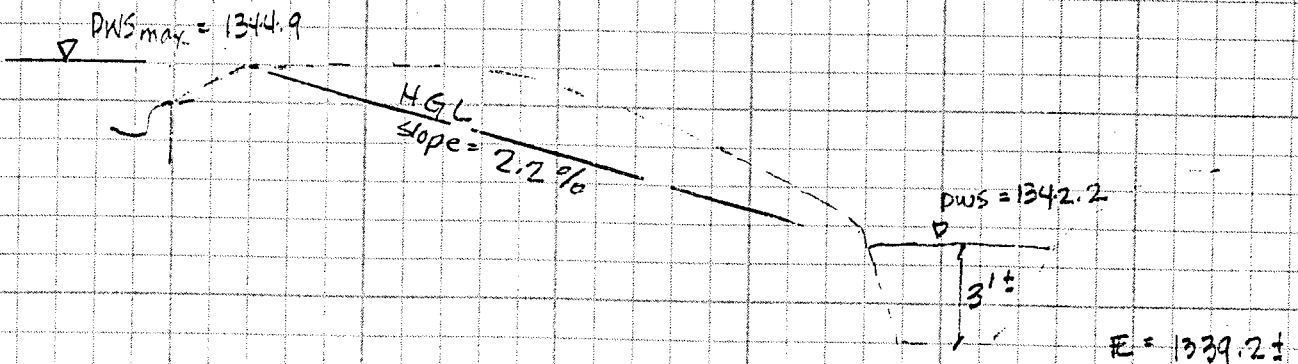
Date Sept. 25, 1987 Page 1 of 7
 Project Harrison Park Addition
 Item Drainage Plan Channel

The 100-year runoff as calculated herein (see page 21, System 100) is 403.6 cfs.

This amount of runoff will be transported out of the proposed Harrison Park Add. via:

1. Existing channel located along the south side of Harrison Park Add (north side of Park Meadows)
2. 18" pipe located at east end of Todd Court.

The estimated capacity of the 18" pipe is as follows:



capacity 18" RCP @ 2.2% = 16 cfs
 (see p.3)

Flow Pipe = $\frac{\text{Flow from Todd Ct Sub-Basin} + \text{Overflow from Harrison Park Add.}}{100}$



Date 9.25.87 Page 2 of 7

Project Harrison Park Add

Item Drainage Plan Channel

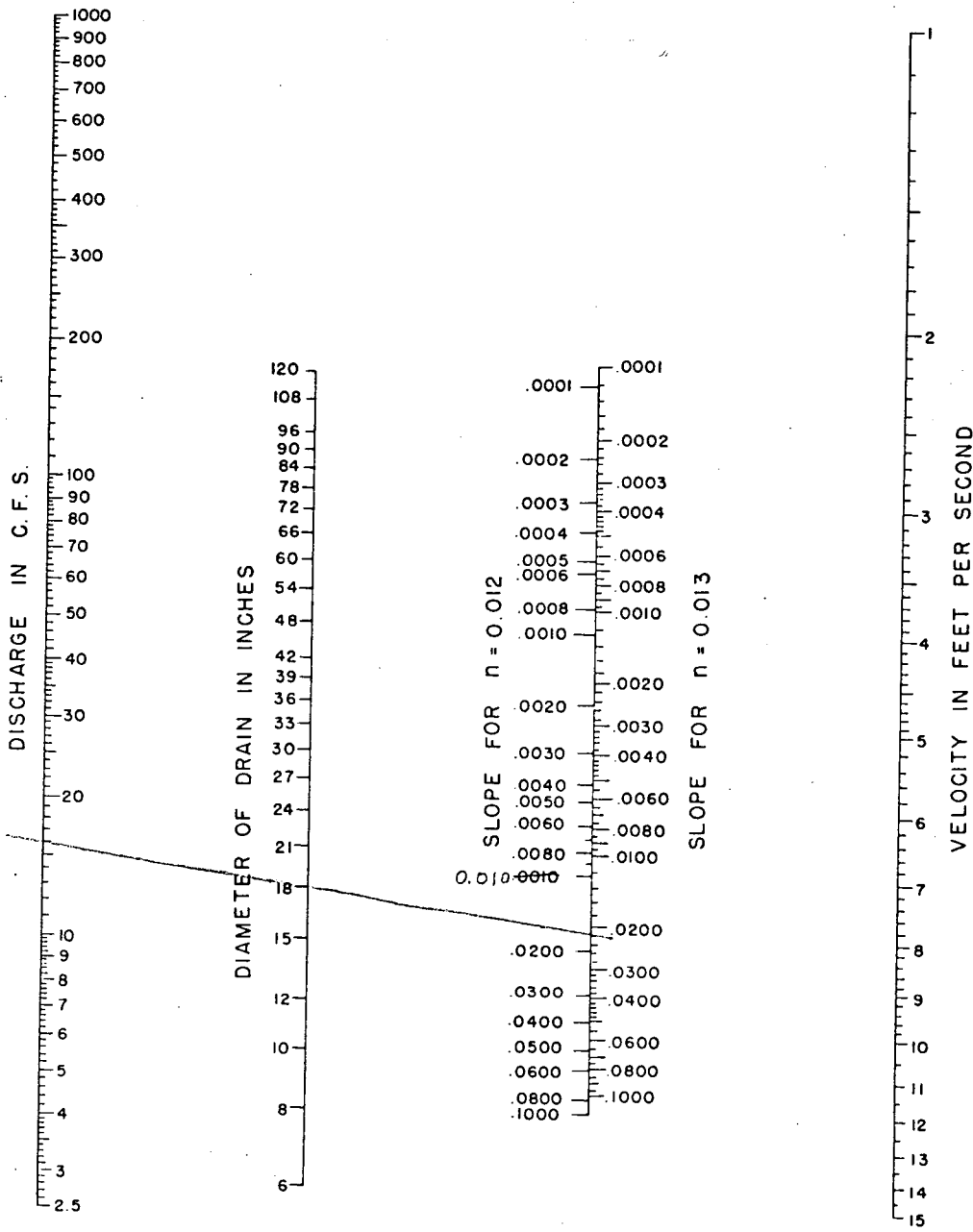
Flow from Todd Ct Sub-Basin

$$= CIA = 0.50 \times 7.37 \times 2.75 A_c = 10.1 \text{ cfs}$$

$$\overset{16}{18} \text{ cfs (in pipe)} = 10.1 \text{ cfs (Todd Ct. Sub-Basin)} + \text{Overflow From Harrison Park Add.}$$

$$\therefore \text{Overflow} = 16.0 - 10.1 = 5.9 \text{ cfs.}$$

$$\text{Channel Flow} = 403.6 \text{ cfs} - 5.9 \text{ cfs} = 397.7 \text{ cfs.}$$



Nomograph for computing required size of circular drain, flowing full - $n = 0.012$ OR 0.013



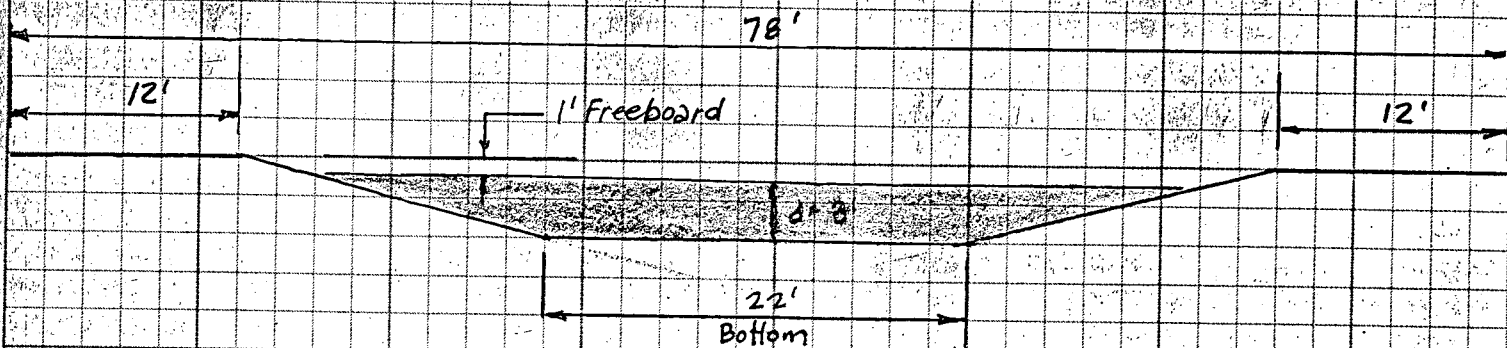
Date 9.25.87 Page 4 of 7

Project Harrison Park Addition

Item Drainage Plan Channel

The original channel was designed for 259 cfs. The channel must carry 398 cfs. The reason for this difference is the runoff coefficients and routing (see Van-Doren-Hazard-Stellings sketches & calcs attached.)

With 78' Right-of-Way available, the following section is proposed:



With known Q , A , R determine slope required to carry the runoff

Use Manning's equation $Q = \frac{1.486}{n} AR^{2/3} s^{1/2}$

| d | A | P | R | $R^{2/3}$ |
|----|-------|-------|-------|-----------|
| 3' | 102.0 | 46.73 | 2.182 | 1.68 |

$$398 = \frac{1.486}{0.03} \times 102.0 \times 1.6825 \times s^{1/2}$$

$$s^{1/2} = 0.04682$$

$$s = 0.0022 = 0.22\% \pm$$

5/7

VAN DOREN - HAZARD - STALLINGS
ARCHITECTS - ENGINEERS
 TOPEKA, KANSAS

Job No. _____

Date 1.10.75

Sheet 1 of _____

Project Park Meadows

By K.H. BENGTSON

Subject _____

Ch'd. _____

| PT. No. | Accum AREA | Comp. "C" | Inches/Hr 1004k | Q cfs | COMMENTS |
|---------|------------|-----------|-----------------|-------|--|
| 1 | 16.5 | .50 | 7.6 | 62.7 | DRAINAGE FROM THE WEST SIDE OF WEBB ROAD |
| 2 | 28.9 | .54 | 7.05 | 110.7 | |
| 3 | 32.9 | .53 | 6.75 | 119.5 | |
| 4 | 40 | .5 | 6.75 | 135 | OFF SITE DRAINAGE FROM SOUTH |
| 5 | 75 | .52 | 6.3 | 247 | |
| 6 | 84 | .50 | 6.3 | 263.6 | |
| 7 | 70 | .50 | 6.1 | 213.5 | OFF SITE DRAINAGE FROM SOUTH |
| 8 | 158.6 | .51 | 6.1 | 490 | |
| 9 | 176.2 | .50 | 5.75 | 495.7 | |
| 10 | 180.86 | .50 | 5.6 | 499 | |
| 11 | 97.5 | .45 | 5.9 | 259 | OFF SITE DRAINAGE FROM NORTH & WEST |

VAN DOREN - HAZARD - STALLINGS
ARCHITECTS - ENGINEERS
TOPEKA, KANSAS

Job No. _____

Date 11.21.74

Sheet _____ of _____

Project _____ By _____

Subject _____ Ck'd. _____

NORTH DRAINAGE SWOLE

$n = 0.035$

$S = 0.0021/1'$

$S^{1/2} = .0447214$

$R = 2.062$

$Q = \frac{1.486}{n} R^{2/3} S^{1/2} A$

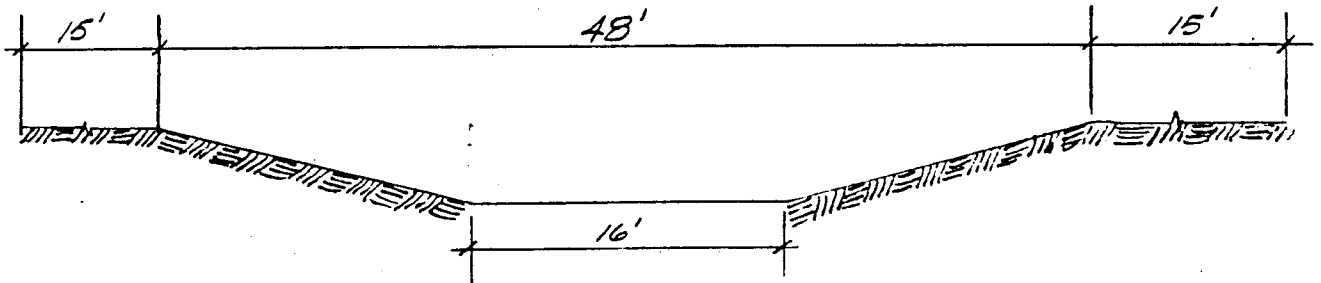
$B = 16'$

$AREA = (16 + 3.4) 3 = 84$

$P = (16 + 4.1231 * 3 * 2) = 40.7386$

$R^{2/3} = 1.6200$

$Q = 258.39 cfs.$



7/7

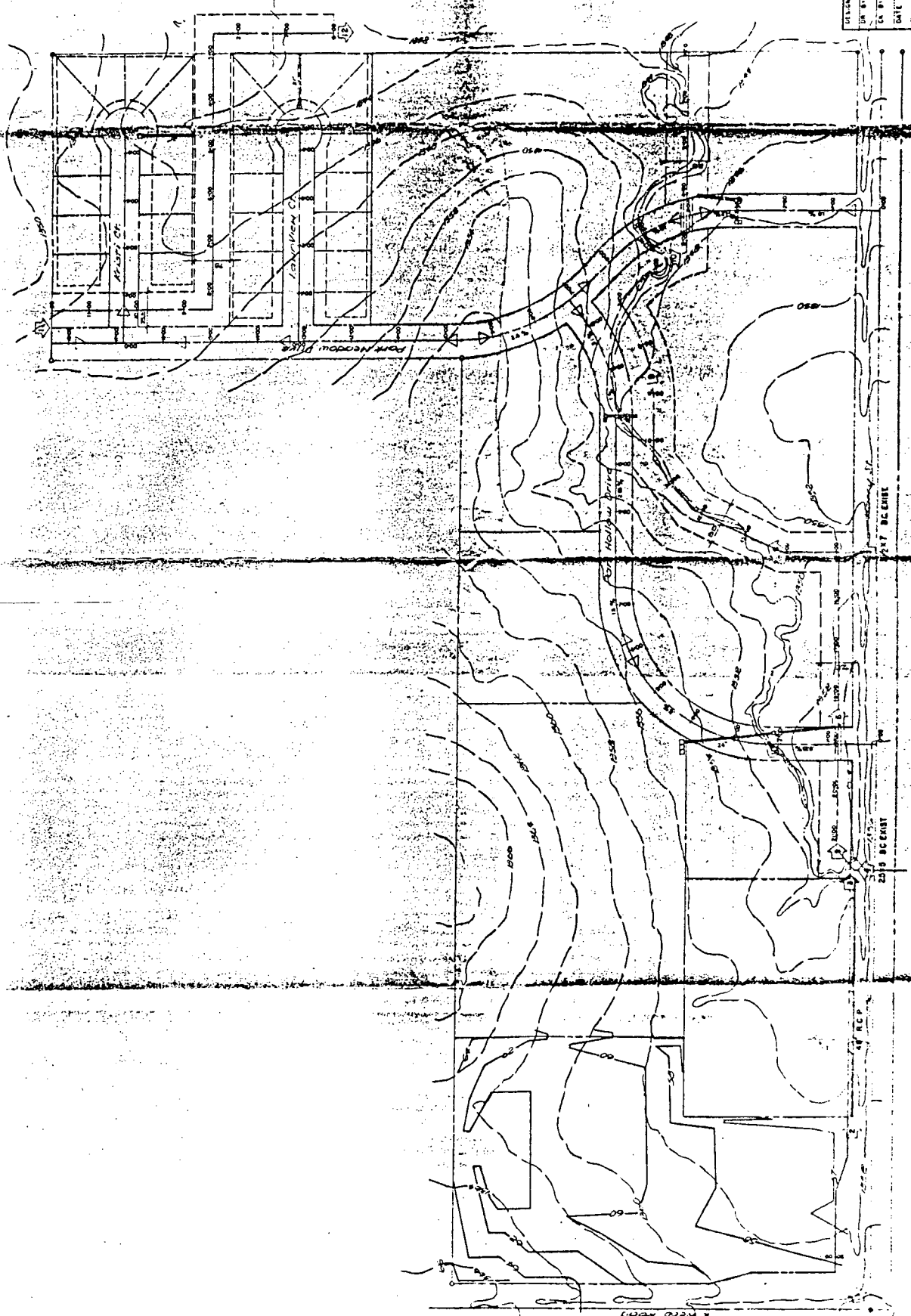
| PT. | Q. 111 | PT. | Q. 111 |
|-----|--------|-----|--------|
| 1 | 527.7 | 9 | 498.7 |
| 2 | 407.7 | 10 | 498.7 |
| 3 | 417.8 | 11 | 538.5 |
| 4 | 378.9 | 12 | 528.4 |
| 5 | 363.6 | | |
| 6 | 213.5 | | |
| 7 | 490 | | |

PRINTED
MAY 2 1951

PRELIMINARY

DRAINAGE PLAN
PARK MEADOW ESTATE

VAN DUSEN HAZARD STUDIOS ARCHITECTS
INCORPORATED
SAN FRANCISCO, CALIF.



217 BECHTOLD

219 BECHTOLD

215 BECHTOLD

213 BECHTOLD

EXHIBIT NO. 1

SOIL LEGEND

| <u>SYMBOL</u> | <u>HYDROLOGIC GROUP</u> | <u>NAME</u> |
|---------------|-------------------------|---|
| Aa | B | Albion-Shellabarger sandy loams, 1 to 4 percent slopes |
| Ab | B | Albion and Shellabarger sandy loams, 7 to 15 percent slopes |
| Ba | C | Blanket silt loam, 0 to 1 percent slopes |
| Bb | C | Blanket silt loam, 1 to 3 percent slopes |
| Ca | B | Canadian fine sandy loam |
| Cb | B | Canadian-Waldeck fine sandy loams |
| Cc | D | Carwile fine sandy loam |
| Cd | B | Clark-Ost clay loams, 1 to 4 percent slopes |
| Ce | C | Cline silty clay, 3 to 6 percent slopes |
| Ea | B | Elandco silt loam |
| Eb | B | Elandco silt loam, occasionally flooded |
| Ec | B | Elandco silt loam, frequently flooded |
| Fa | B | Farnum loam, 0 to 1 percent slopes |
| Fb | B | Farnum loam, 1 to 3 percent slopes |
| Fc | B | Farnum loam, sandy substratum, 0 to 1 percent slopes |
| Ga | D | Goessel silty clay, 0 to 1 percent slopes |
| Gb | D | Goessel silty clay, 1 to 2 percent slopes |
| Ia | D | Irwin silty clay loam, 1 to 3 percent slopes |
| Ib | D | Irwin silty clay loam, 3 to 6 percent slopes |
| Ic | D | Irwin silty clay loam, 2 to 6 percent slopes, eroded |
| La | C | Lesho loam |
| Lb | A | Lincoln soils |
| Ma | B | Milan loam, 1 to 3 percent slopes |
| Mb | B | Milan form, 3 to 6 percent slopes |
| Mc | B | Milan clay loam, 2 to 6 percent slopes, eroded |
| Na | B | Naron fine sandy loam |
| Oc | D | Owens clay loam, 1 to 3 percent slopes |
| Od | D | Owens-Rock outcrop complex, 3 to 10 percent slopes |
| Pa | | Pits |
| Pb | D | Plevna fine sandy loam |
| Pc | A | Pratt loamy fine sand, undulating |
| Pd | A | Pratt-Tivoli complex, rolling |
| Ra | D | Renfrow silty clay loam, 1 to 3 percent slopes |
| Rb | D | Renfrow silty clay loam, 3 to 6 percent slopes |
| Rc | D | Renfrow-Owens clay loams, 1 to 4 percent slopes |
| Rd | D | Rosehill silty clay, 1 to 3 percent slopes |
| Sa | B | Shellabarger sandy loam, 1 to 3 percent slopes |
| Sb | B | Shellabarger sandy loam, 3 to 6 percent slopes |
| Sc- | B | Shellabarger sandy loam, 3 to 6 percent slopes, eroded |
| Ta | D | Tabler silty clay loam |
| Tb | D | Tabler-Drummond complex |
| Ua | B | Urban land-Canadian complex |
| Ub | B | Urban land-Elandco complex |
| Uc | B | Urban land-Farnum complex, 0 to 3 percent slopes |
| Ud | D | Urban land-Irwin complex, 1 to 3 percent slopes |
| Ue | D | Urban land-Tabler complex |
| Va | B | Vanoss silt loam, 0 to 1 percent slopes |
| Vb | B | Vanoss silt loam, 1 to 3 percent slopes |
| Vc | B | Vanoss silt loam, 3 to 6 percent slopes |
| Vd | B | Vanoss silt loam, 3 to 6 percent slopes, eroded |
| Ve | D | Vernon sandy loam, 1 to 3 percent slopes |
| Vf | D | Vernon sandy loam, 3 to 6 percent slopes |
| Wa | C | Waldeck sandy loam |
| Wb | D | Waurika silt loam |

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD
AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

| Land Use or Surface Characteristics | Percent Impervious | Frequency | | | |
|--|-----------------------|-----------|------|------|------|
| | | 2 | 5 | 10 | 100 |
| 1. Business: | | | | | |
| Downtown Areas | 95 | 0.84 | 0.85 | 0.87 | 0.91 |
| Neighborhood Areas | 70 | 0.68 | 0.69 | 0.73 | 0.80 |
| 2. Residential: | | | | | |
| <u>Single Family (Soil Group D)</u> | | | | | |
| 1/8 Acre | 50 | 0.57 | 0.61 | 0.66 | 0.79 |
| 1/4 Acre | 38 | 0.50 | 0.54 | 0.62 | 0.76 |
| 1/3 Acre | 30 | 0.46 | 0.50 | 0.59 | 0.73 |
| 1/2 Acre | 25 | 0.42 | 0.48 | 0.56 | 0.72 |
| 3/4 Acre | 22 | 0.42 | 0.46 | 0.55 | 0.71 |
| 1 Acre | 20 | 0.41 | 0.45 | 0.54 | 0.71 |
| <u>Multi-Family (Soil Group D)</u> | | | | | |
| Multi-Unit (detached) | 60 | 0.62 | 0.66 | 0.72 | 0.82 |
| Multi-Unit (attached) | 65 | 0.64 | 0.68 | 0.73 | 0.83 |
| Apartments | 75 | 0.70 | 0.73 | 0.79 | 0.86 |
| <u>Single Family (Soil Group C)</u> | | | | | |
| 1/8 Acre | 50 | 0.55 | 0.58 | 0.64 | 0.73 |
| 1/4 Acre | 38 | 0.48 | 0.51 | 0.57 | 0.68 |
| 1/3 Acre | 30 | 0.43 | 0.46 | 0.53 | 0.65 |
| 1/2 Acre | 25 | 0.40 | 0.43 | 0.50 | 0.63 |
| 3/4 Acre | 22 | 0.39 | 0.42 | 0.49 | 0.62 |
| 1 Acre | 20 | 0.37 | 0.40 | 0.48 | 0.61 |
| <u>Multi-Family (Soil Group C)</u> | | | | | |
| Multi-Unit (detached) | 60 | 0.60 | 0.63 | 0.69 | 0.77 |
| Multi-Unit (attached) | 65 | 0.63 | 0.66 | 0.71 | 0.79 |
| Apartments | 75 | 0.68 | 0.72 | 0.77 | 0.83 |
| <u>Single-Family (Soil Group B)</u> | | | | | |
| 1/8 Acre | 50 | 0.52 | 0.54 | 0.59 | 0.67 |
| 1/4 Acre | 38 | 0.44 | 0.46 | 0.52 | 0.61 |
| 1/3 Acre | 30 | 0.39 | 0.41 | 0.47 | 0.57 |
| 1/2 Acre | 25 | 0.36 | 0.38 | 0.44 | 0.54 |
| 3/4 Acre | 22 | 0.34 | 0.36 | 0.42 | 0.52 |
| 1 Acre | 20 | 0.33 | 0.35 | 0.40 | 0.51 |
| <u>Multi-Family (Soil Group B)</u> | | | | | |
| Multi-Unit (detached) | 60 | 0.58 | 0.60 | 0.65 | 0.72 |
| Multi-Unit (attached) | 65 | 0.61 | 0.64 | 0.68 | 0.75 |
| Apartments | 75 | 0.67 | 0.70 | 0.74 | 0.80 |

| Land Use or Surface Characteristics | Percent Impervious | Frequency | | | |
|---|-----------------------|-----------|----------|-----------|------------|
| | | <u>2</u> | <u>5</u> | <u>10</u> | <u>100</u> |
| <u>Single Family (Soil Group A)</u> | | | | | |
| 1/8 Acre | 50 | 0.47 | 0.50 | 0.54 | 0.60 |
| 1/4 Acre | 38 | 0.39 | 0.41 | 0.45 | 0.52 |
| 1/3 Acre | 30 | 0.33 | 0.35 | 0.39 | 0.47 |
| 1/2 Acre | 25 | 0.30 | 0.31 | 0.35 | 0.44 |
| 3/4 Acre | 22 | 0.28 | 0.29 | 0.33 | 0.42 |
| 1 Acre | 20 | 0.26 | 0.28 | 0.32 | 0.40 |
| <u>Multi-Family (Soil Group A)</u> | | | | | |
| Multi-Unit (detached) | 60 | 0.55 | 0.57 | 0.61 | 0.67 |
| Multi-Unit (attached) | 65 | 0.58 | 0.60 | 0.64 | 0.70 |
| Apartments | 75 | 0.65 | 0.68 | 0.72 | 0.77 |
| 3. Industrial: | | | | | |
| Light Areas | 70 | 0.68 | 0.69 | 0.73 | 0.80 |
| Heavy Areas | 80 | 0.74 | 0.76 | 0.79 | 0.84 |
| 4. Playgrounds: | 15 | 0.33 | 0.35 | 0.42 | 0.55 |
| 5. Schools: | 40 | 0.49 | 0.51 | 0.56 | 0.66 |
| 6. Railroad Yard Areas: | 30 | 0.43 | 0.45 | 0.50 | 0.62 |
| 7. Undeveloped Urban Areas: Offsite Flow Analysis (when land use not defined) | 45 | 0.52 | 0.54 | 0.59 | 0.68 |
| 8. Streets: | | | | | |
| Paved | 99 | 0.87 | 0.88 | 0.90 | 0.93 |
| Gravel | 00 | 0.24 | 0.26 | 0.33 | 0.48 |
| 9. Drive, Parking Lots and Walks: | 96 | 0.87 | 0.87 | 0.88 | 0.89 |
| 10. Roofs: | 90 | 0.80 | 0.85 | 0.90 | 0.93 |
| 11. Urban Lawn Areas (See Note No. 1 below): | | | | | |
| <u>Soil Group A</u> | | | | | |
| Slope less than 1% | 00 | 0.08 | 0.09 | 0.13 | 0.23 |
| Slope 1% to 4% | 00 | 0.12 | 0.13 | 0.17 | 0.27 |
| Slope more than 4% | 00 | 0.16 | 0.17 | 0.21 | 0.31 |
| <u>Soil Group B</u> | | | | | |
| Slope less than 1% | 00 | 0.16 | 0.18 | 0.24 | 0.37 |
| Slope 1% to 4% | 00 | 0.20 | 0.22 | 0.28 | 0.41 |
| Slope more than 4% | 00 | 0.24 | 0.26 | 0.32 | 0.45 |
| <u>Soil Group C</u> | | | | | |
| Slope less than 1% | 00 | 0.24 | 0.27 | 0.35 | 0.51 |
| Slope 1% to 4% | 00 | 0.26 | 0.29 | 0.37 | 0.53 |
| Slope more than 4% | 00 | 0.28 | 0.31 | 0.39 | 0.55 |

| Land Use or Surface Characteristics | Percent Impervious | Frequency | | | |
|--|-----------------------|-----------|----------|-----------|------------|
| | | <u>2</u> | <u>5</u> | <u>10</u> | <u>100</u> |
| <u>Soil Group D</u> | | | | | |
| Slope less than 1% | 00 | 0.28 | 0.33 | 0.43 | 0.63 |
| Slope 1% to 4% | 00 | 0.30 | 0.35 | 0.45 | 0.65 |
| Slope more than 4% | 00 | 0.32 | 0.37 | 0.47 | 0.67 |

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for basins 320 acres or larger.

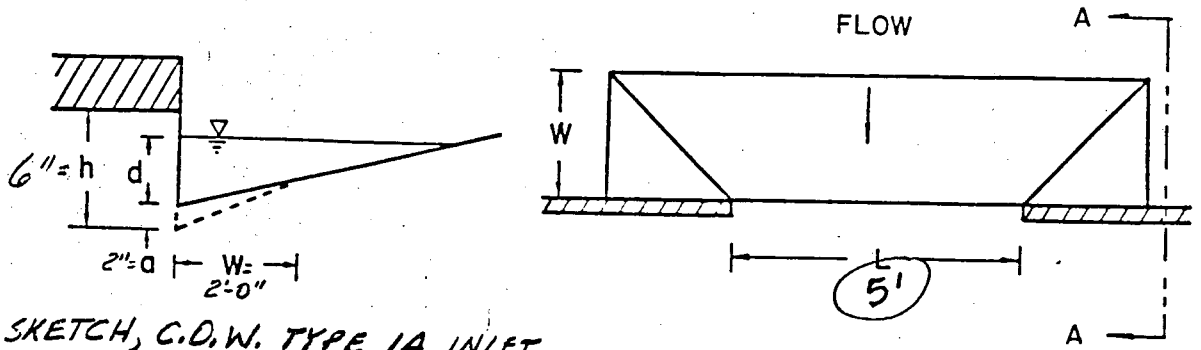
ATTACHMENT E

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

AVERAGE OVERLAND FLOW VELOCITY FOR USE WITH URBANIZED AREAS

| Surface Type | VELOCITY IN FEET/SECOND FOR SLOPES IN PERCENT SHOWN | | | | | | | | | | | | | | | | | | | |
|---|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 20.0 |
| Forest with Heavy Ground Litter or Meadow | 0.03 | 0.04 | 0.06 | 0.07 | 0.08 | 0.09 | 0.10 | 0.11 | 0.12 | 0.13 | 0.16 | 0.21 | 0.28 | 0.33 | 0.39 | 0.46 | 0.53 | 0.60 | 0.72 | 1.10 |
| Fallow or Minimum Tillage Cultivation | 0.06 | 0.08 | 0.10 | 0.12 | 0.13 | 0.14 | 0.16 | 0.17 | 0.18 | 0.19 | 0.29 | 0.40 | 0.51 | 0.66 | 0.78 | 0.91 | 1.05 | 1.20 | 1.44 | 2.10 |
| Short Grass Pasture or Lawns | 0.09 | 0.13 | 0.15 | 0.18 | 0.20 | 0.21 | 0.23 | 0.25 | 0.26 | 0.28 | 0.45 | 0.60 | 0.77 | 0.96 | 1.17 | 1.33 | 1.50 | 1.68 | 1.98 | 3.20 |
| Almost Bare Ground | 0.16 | 0.22 | 0.28 | 0.31 | 0.35 | 0.38 | 0.41 | 0.44 | 0.46 | 0.49 | 0.70 | 0.85 | 1.05 | 1.26 | 1.50 | 1.75 | 2.03 | 2.32 | 2.79 | 4.40 |
| Grassed Waterway | 0.35 | 0.48 | 0.58 | 0.67 | 0.77 | 0.84 | 0.91 | 0.98 | 1.05 | 1.12 | 1.54 | 1.82 | 2.10 | 2.58 | 2.78 | 3.20 | 3.66 | 4.14 | 4.56 | 7.00 |
| Paved Areas (Sheet Flow) or Shallow Gutter Flow | 0.44 | 0.62 | 0.77 | 0.91 | 1.05 | 1.12 | 1.19 | 1.26 | 1.33 | 1.40 | 2.00 | 2.55 | 3.20 | 3.83 | 4.41 | 5.04 | 5.70 | 6.00 | 6.20 | 9.00 |



DEF. SKETCH, C.D.W. TYPE 1A INLET

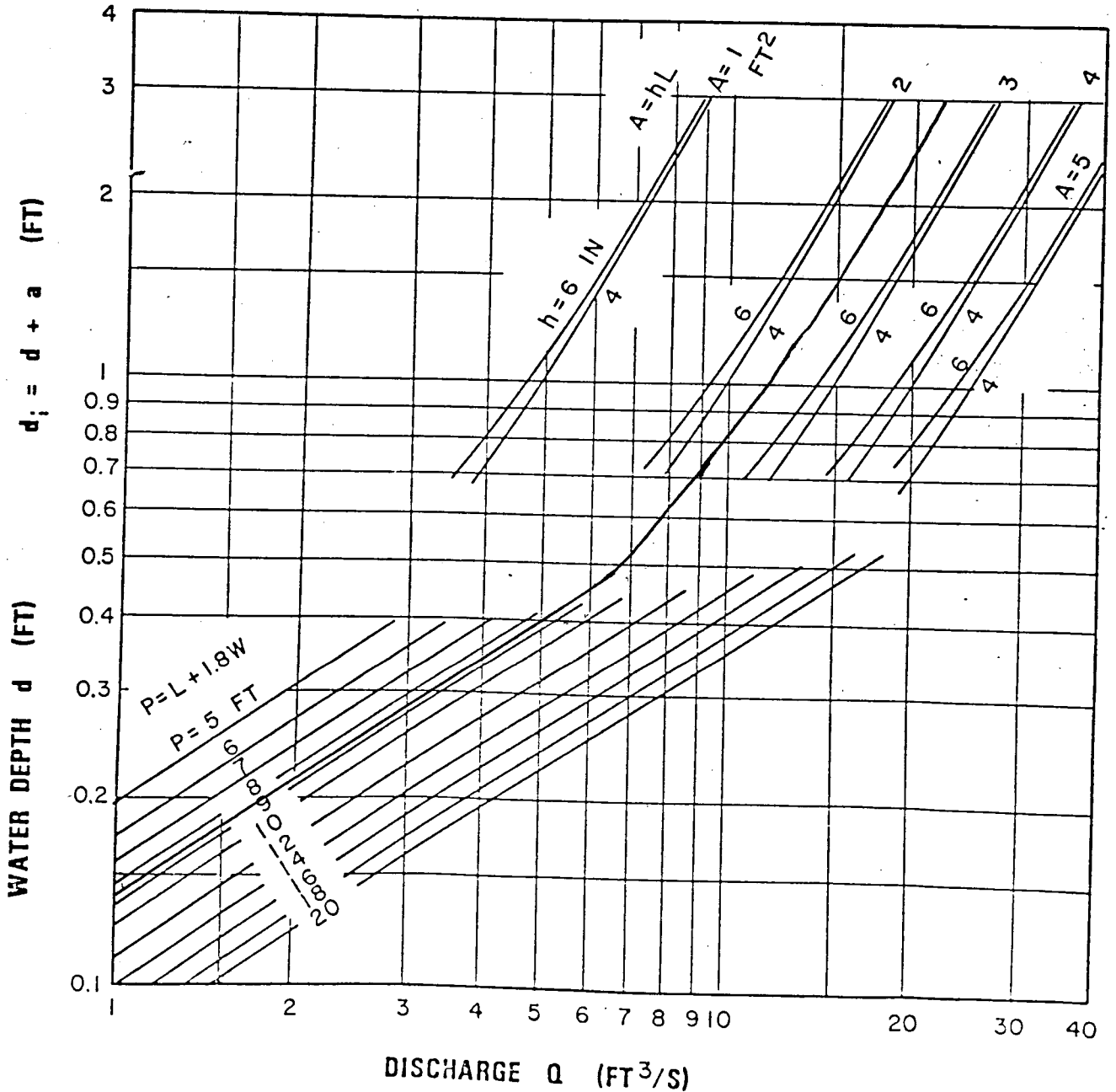
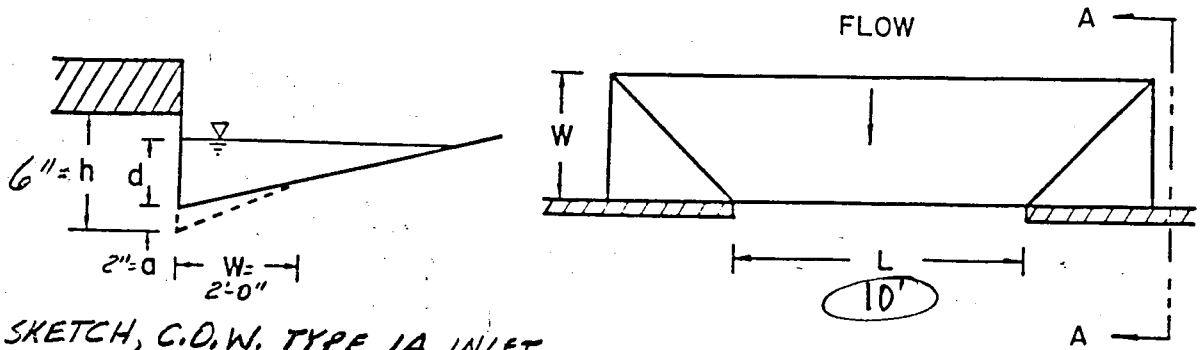


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1974



DEF. SKETCH, C.D.W. TYPE 1A INLET

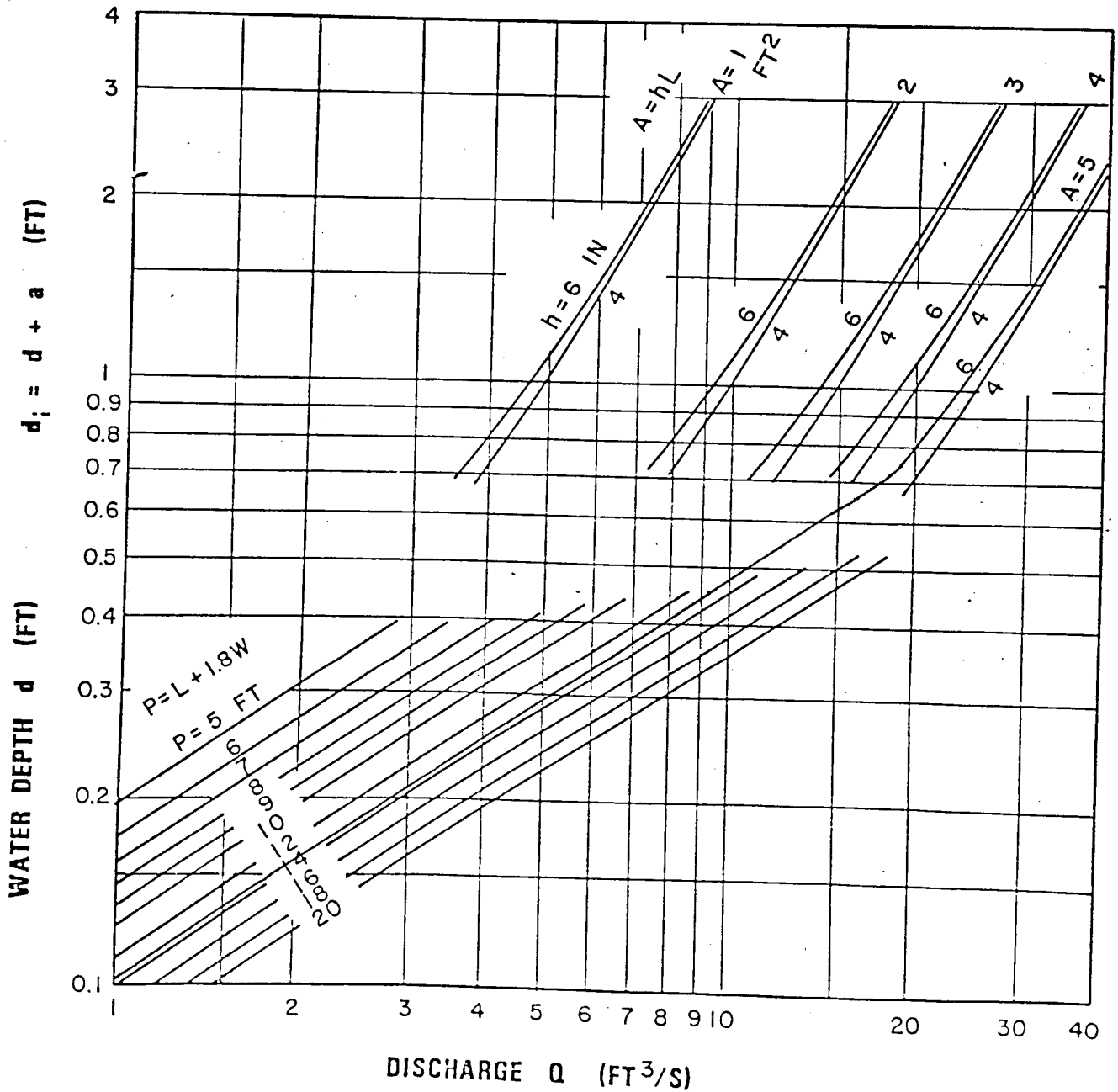
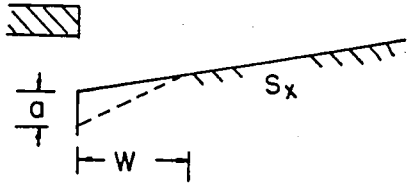


CHART 12. Depressed curb-opening inlet capacity in sump locations.

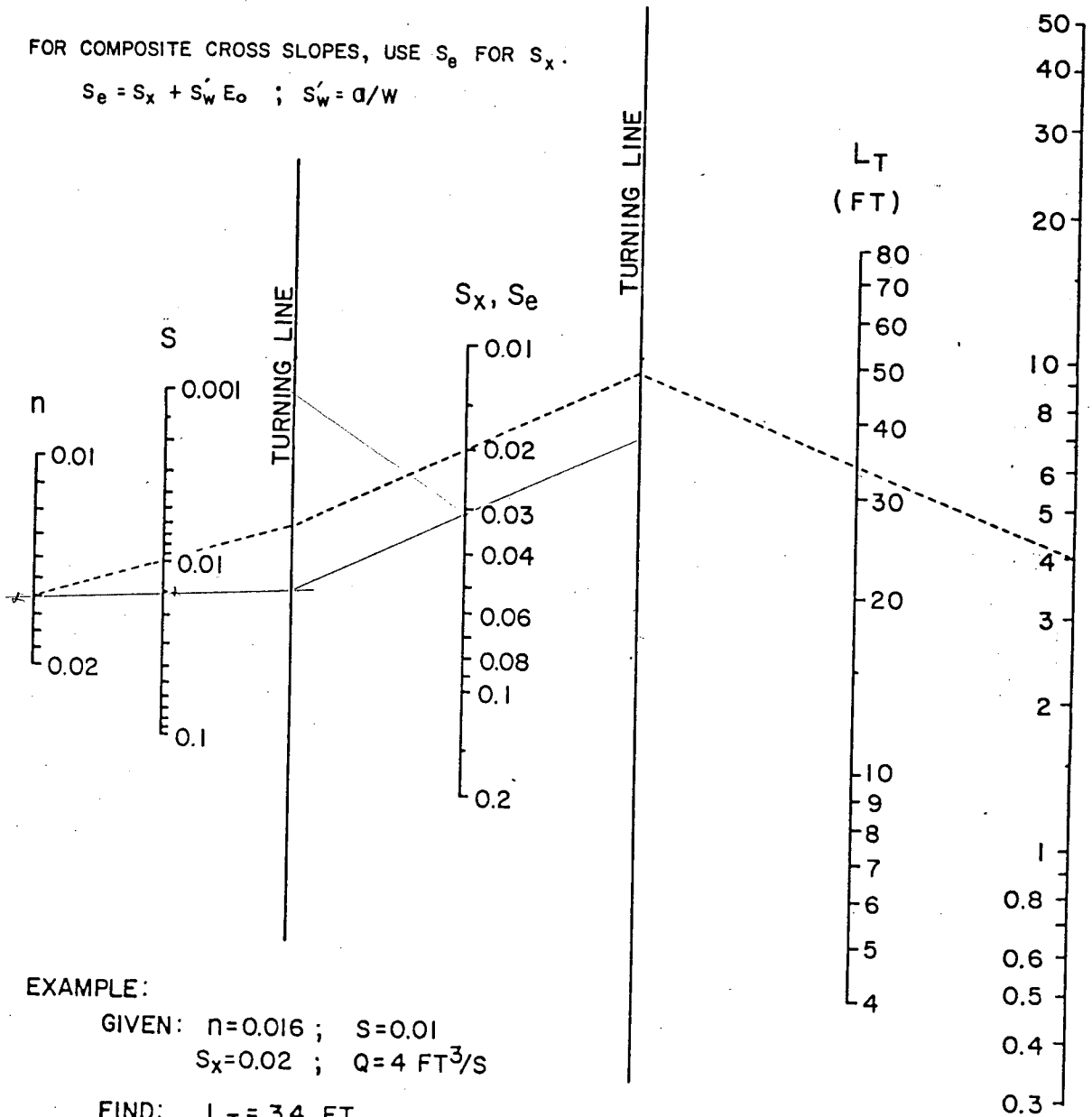
FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1974



$$L_T = 0.6Q^{0.42} S^{0.3} (1/nS_x)^{0.6}$$

FOR COMPOSITE CROSS SLOPES, USE S_e FOR S_x .

$$S_e = S_x + S'_w E_o ; S'_w = a/W$$



EXAMPLE:

GIVEN: $n=0.016$; $S=0.01$
 $S_x=0.02$; $Q=4 \text{ FT}^3/\text{S}$

FIND: $L_T = 34 \text{ FT}$

CHART 9. Curb-opening and slotted drain inlet length for total interception.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR. 1964.

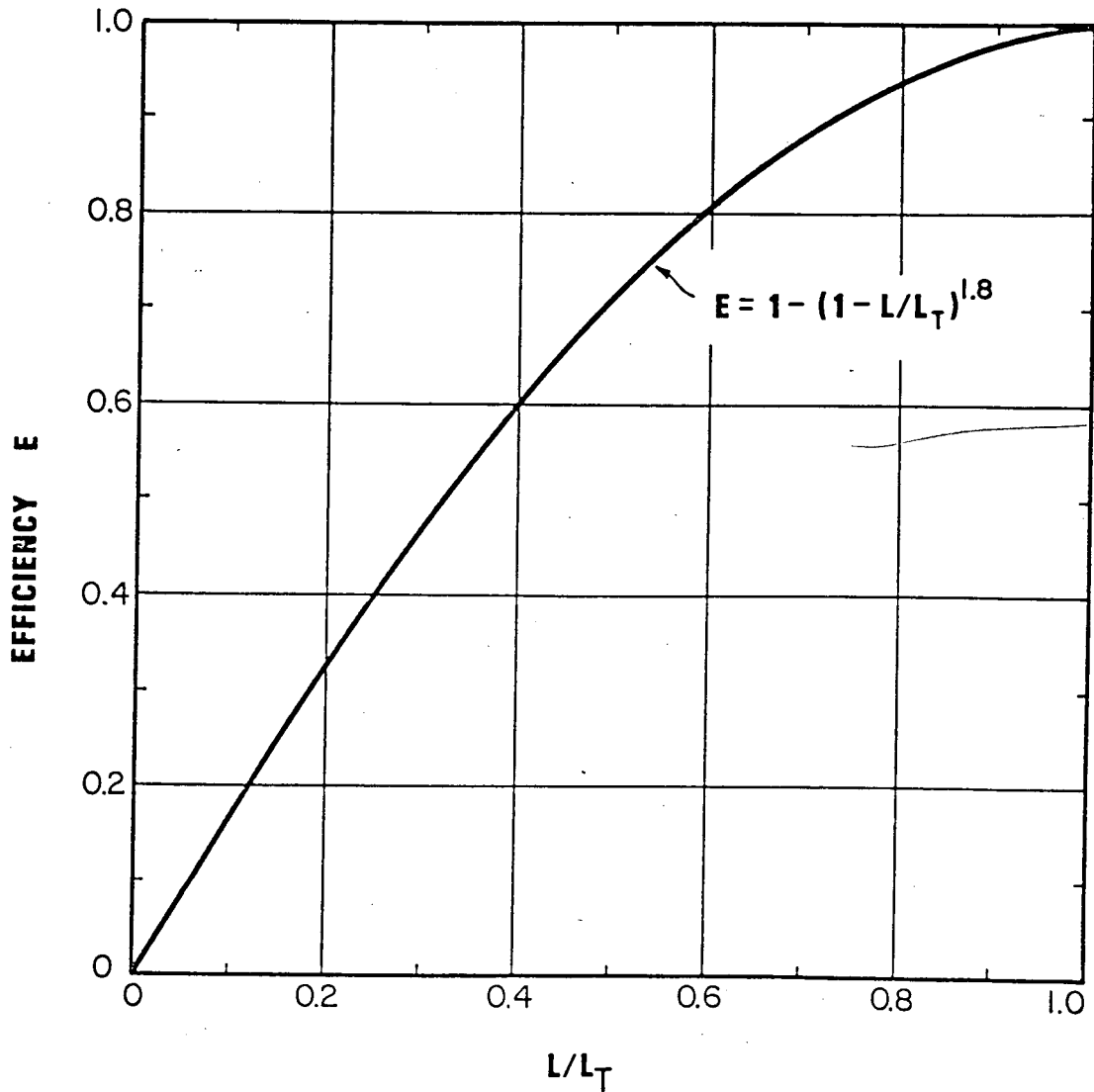
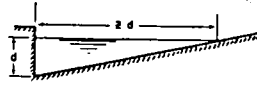


CHART 10. Curb-opening and slotted drain inlet interception efficiency.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, FHWA, Mar. 1954

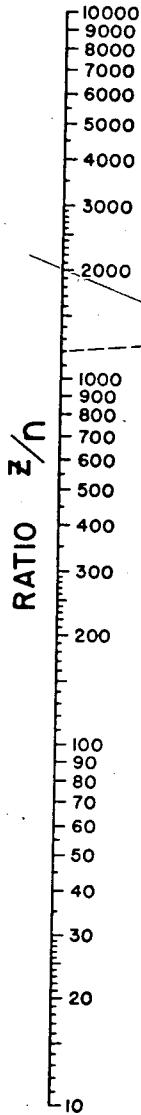
Chart 1



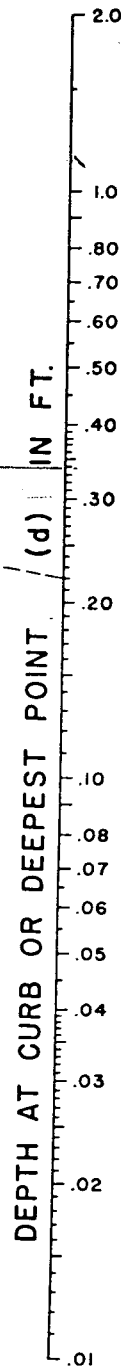
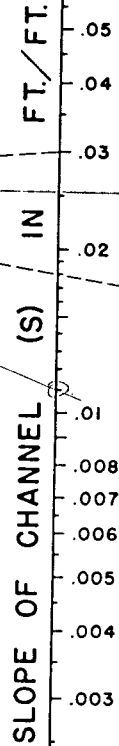
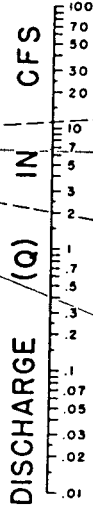
EQUATION: $Q = 0.36 \left(\frac{z}{n}\right) s^{3/2} d^{5/2}$
 n IS ROUGHNESS COEFFICIENT IN MANNING
 FORMULA APPROPRIATE TO MATERIAL IN
 BOTTOM OF CHANNEL
 z IS RECIPROCAL OF CROSS SLOPE
 REFERENCE: H. R. B. PROCEEDINGS 1948,
 PAGE 150, EQUATION (14)

EXAMPLE (SEE INSTRUCTION 1)

GIVEN: $s = 0.03$
 $z = 24$
 $n = .02$ $z/n = 1200$
 $Q = 200$ CFS
 FIND: $d = 0.22$ BY FOLLOWING
 DASHED LINES



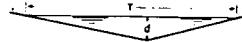
TURNING LINE



INSTRUCTIONS

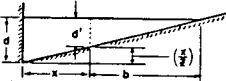
1. CONNECT z/n RATIO WITH SLOPE (S) AND CONNECT DISCHARGE (Q) WITH POINT WHERE LINE CROSSES TURNING LINE READ DEPTH AT CURB (d) Q CAN BE FOUND FROM d BY CONNECTING d WITH CROSSING OF TURNING LINE.

2. FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH AS EXPLAINED IN INSTRUCTION 1 BUT WITH $z = \frac{T}{d}$



3. TO DETERMINE DISCHARGE Q_0 IN PORTION OF CHANNEL HAVING WIDTH X:

DETERMINE DEPTH d FOR TOTAL DISCHARGE IN ENTIRE SECTION AS EXPLAINED IN 1. THEN USE NOMOGRAPH TO DETERMINE Q_0 IN SECTION OF WIDTH b FOR DEPTH $d' = d - (\frac{x}{z})$ THEN $Q_0 = Q - Q_0$.



4. TO DETERMINE DISCHARGE (Q_0) IN COMPOSITE SECTION:-

FOLLOW INSTRUCTION 3. TO OBTAIN DISCHARGE (Q_0) IN SECTION a AT ASSUMED DEPTH d BASED ON AN EXTENSION OF SLOPE RATIO z_0 TO INTERSECT WATER SURFACE; OBTAIN Q_0 FOR SLOPE RATIO z_b AND DEPTH d' ; $d' = d - \frac{x}{z_0}$ THEN $Q_0 = Q_0 + Q_0$.

