# DRAINAGE PLAN
# RITCHIE INDUSTRIAL PARK
# WICHITA, SEDGWICK COUNTY, KANSAS

*February 28, 2002*

## INTRODUCTION

This report provides information and supporting documentation for the "Drainage Plan" located in Section 29, T-26-S, R-2-E in Wichita, Sedgwick County, Kansas. The "Drainage Plan" being submitted herein in intended to serve as a guide for the design of streets, stormwater sewers, and site grading to the proposed development. Modifications to structures, pipes, etc. may be made as necessary during the final design in order to obtain the most economical design and construction possible.

## INITIAL DATA

The plat contains three separate existing drainage basins. These basins are delineated in the pre-developed drainage section of the report. The general topography of each basin drains from west to east and east to northwest, with the high point approximately three hundred feet west of the east line. The plat's average existing grade is about one percent. The total area of the plat is 24.5 acres with approximately 3.4 acres of offsite draining into the proposed pond.

The existing soil types per S.C.S. "Soil Survey of Sedgwick County" is Farnum loam, Rosehill and Irwin silty clay loam. Eighty-five percent of soils are classified in hydrologic group D with the remaining classified as B.

The tract of land is located in a Federal Emergency Management Agency (FEMA) Zone C as mapped on the Federal Insurance Rate Map (FIRM) community-panel number 200321 0150, effective date June 3, 1986 and FIRM community-panel number 200328 0015, effective date May 15, 1986.

The time of concentration (Tc) for the site was determined using the S.C.S method TR-55 and the standard fifteen-minute minimum. The Tc for the three separate existing drainage areas were calculated using the lengths, average slopes and other input variables found in the pre-developed and Tc sections of the report.

## COMPUTATIONS

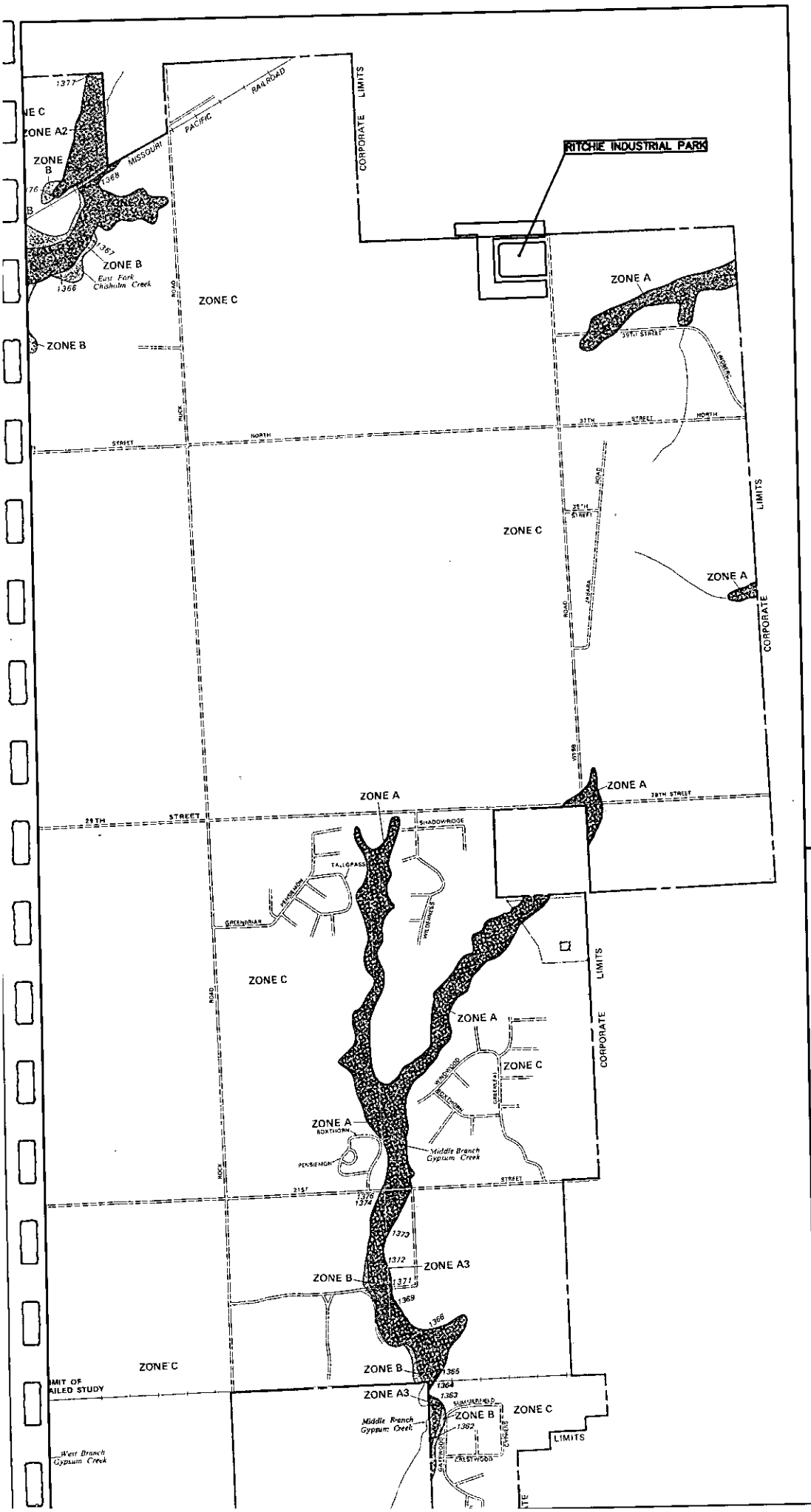
The rational method was used to calculate each individual basin's peak flow rate and the input variables and results are found on the face of the drainage plan sheet. The west drainage basin was routed using PondPack to generate pre/post-developed unit hydrographs. The pond's size and outfall structures were designed to discharge a rate that does not exceed pre-developed conditions. The table's below summarizes the drainage area, stage, and discharge of the proposed pond. See the post-development pond routing section for specific details.

Table 1. Ritchie Industrial Park – D.A. = 22.16 ac.

| *Storm Event* | *Q (cfs)* | *Stage (ft)* |
|---|---|---|
| 5-Yr | 19 | 217.3 |
| 10-Yr | 49 | 218.2 |
| 100-Yr | 100.1 | 218.8 |

The proposed subdivision will drain by the combination of storm sewer and overland flow. The runoff will concentrate in the road right-of-way and at the area inlet locations. The storm sewer systems were designed to carry the five-year storm event in the pipe as the hydraulic grade lines indicate in the system reports. Once the system surcharges the drainage will flow overland in the form of a v-ditch/flume constructed to convey runoff equal or greater than the capacity of the proposed v-ditch.

The set of inlets at the upstream end of 41st Street north are bypass inlets. Street hydraulic calculations were performed using HY-22 to determine the maximum possible interception of the inlets and was added to the inlet node for system one StormCad calculations. The bypass runoff was added to the downstream sump inlets. The input variables for this procedure are found in the system one's StormCad section.




NATIONAL FLOOD INSURANCE PROGRAM

# FIRM
## FLOOD INSURANCE RATE MAP

CITY OF
WICHITA,
KANSAS
SEDGWICK COUNTY

PANEL 15 OF 40
(SEE MAP INDEX FOR PANELS NOT PRINTED)

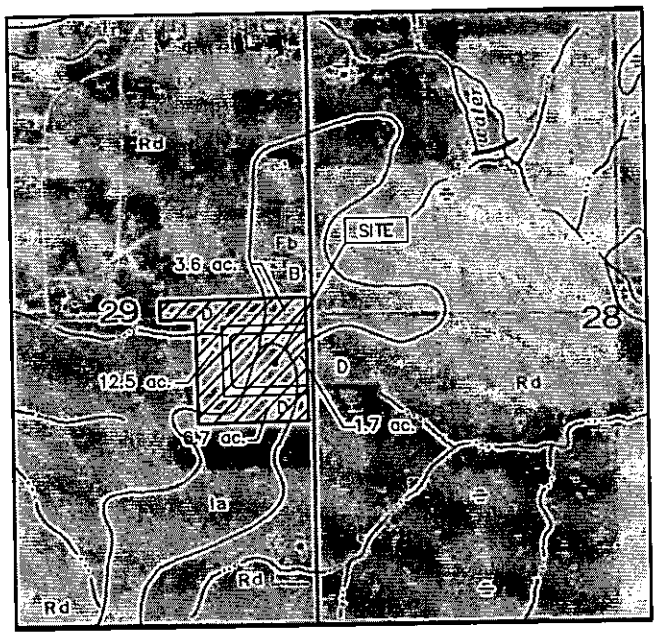
COMMUNITY-PANEL NUMBER
200328 0015 B

EFFECTIVE DATE:
MAY 15, 1986

Federal Emergency Management Agency

# SEDGWICK COUNTY SOIL SURVEY
## FOR
# RITCHIE INDUSTRIAL PARK

Scale – 1:20000




Fb : Farnum loam – Hydrologic Group B (15% of Drainage Basin)
Ia : Irwin silty clay loam – Hydrologic Group D (27% of Drainage Basin)
Rd : Rosehill – Hydrologic Group D (58% of Drainage Basin)

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ENGINEERING, SURVEYING, & PLANNING
316-263-7271 • 315 ELUS • WICHITA, KANSAS 67211

Ritchie Industrial Park – Tc Equations and Calculations for existing conditions

## SCS TR-55 Sheet Flow

$$Tc = \frac{\left[.007\left(n \times L_f\right)^{0.8}\right]}{\left[\left(P^{0.5}\right)\left(S_f^{\ 0.4}\right)\right]}$$

Where: Tc = Time of concentration, hrs
n = Mannings n
$L_f$ = Flow length, ft
P = 2yr, 24hr Rain depth, inches
$S_f$ = Slope, ft/ft

## SCS TR-55 Shallow Concentrated Flow

Unpaved surface:

$$V = 16.1345 \times \left(S_f^{\ 0.5}\right)$$

Paved surface:

$$V = 20.3282 \times (S_f^{\ 0.5})$$

$$Tc = \frac{\left(\frac{L_f}{V}\right)}{\left(3600 \, {}^{\sec}/_{hr}\right)}$$

Where: V = Velocity, ft/sec
$S_f$ = Slope, ft/ft
Tc = Time of concentration, hrs
$L_f$ = Flow length, ft

## SCS Channel Flow

$$R = \left(\frac{Aq}{Wp}\right)$$

$$V = \frac{\left[\left(1.49 \times R^{2/3}\right)\left(\sqrt{S_f}\right)\right]}{n}$$

$$Tc = \frac{\left(\frac{L_f}{V}\right)}{\left(3600 \, {}^{\sec}/_{hr}\right)}$$

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
$S_f$ = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
$L_f$ = Flow length, ft

MASTER DESIGN STORM SUMMARY

Default Network Design Storm File, ID SEDGWICK.RNQ Sedgwick

| Return Event | Total Depth in | Rainfall Type | RNF File | RNF ID |
|---|---|---|---|---|
| Pre..2 | 3.6000 | Synthetic Curve | SCSTYPES | TypeII 24hr |
| Pre..5 | 4.5600 | Synthetic Curve | SCSTYPES | TypeII 24hr |
| Pre.10 | 5.2800 | Synthetic Curve | SCSTYPES | TypeII 24hr |
| Pre100 | 7.6800 | Synthetic Curve | SCSTYPES | TypeII 24hr |

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Storage Node ID | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond ac-ft |
|---|---|---|---|---|---|---|---|---|
| BASIN #3 | AREA | 2 | 2.299 | | 12.1500 | 26.21 | | |
| BASIN #3 | AREA | 5 | 3.394 | | 12.1500 | 38.98 | | |
| BASIN #3 | AREA | 10 | 4.257 | | 12.1500 | 48.89 | | |
| BASIN #3 | AREA | 100 | 7.286 | | 12.1500 | 82.82 | | |
| OFF-SITE | AREA | 2 | .466 | | 12.1500 | 5.40 | | |
| OFF-SITE | AREA | 5 | .688 | | 12.1500 | 8.01 | | |
| OFF-SITE | AREA | 10 | .863 | | 12.1000 | 10.07 | | |
| OFF-SITE | AREA | 100 | 1.476 | | 12.1000 | 17.17 | | |
| *OUTLET | JCT | 2 | 2.765 | | 12.1500 | 31.61 | | |
| *OUTLET | JCT | 5 | 4.081 | | 12.1500 | 46.99 | | |
| *OUTLET | JCT | 10 | 5.119 | | 12.1500 | 58.93 | | |
| *OUTLET | JCT | 100 | 8.763 | | 12.1500 | 99.80 | | |

Type.... Master Network Summary
Name.... Watershed
File.... F:\HYDRO\PROJECTS\RITCHIEN\POST.PPW

## MASTER DESIGN STORM SUMMARY

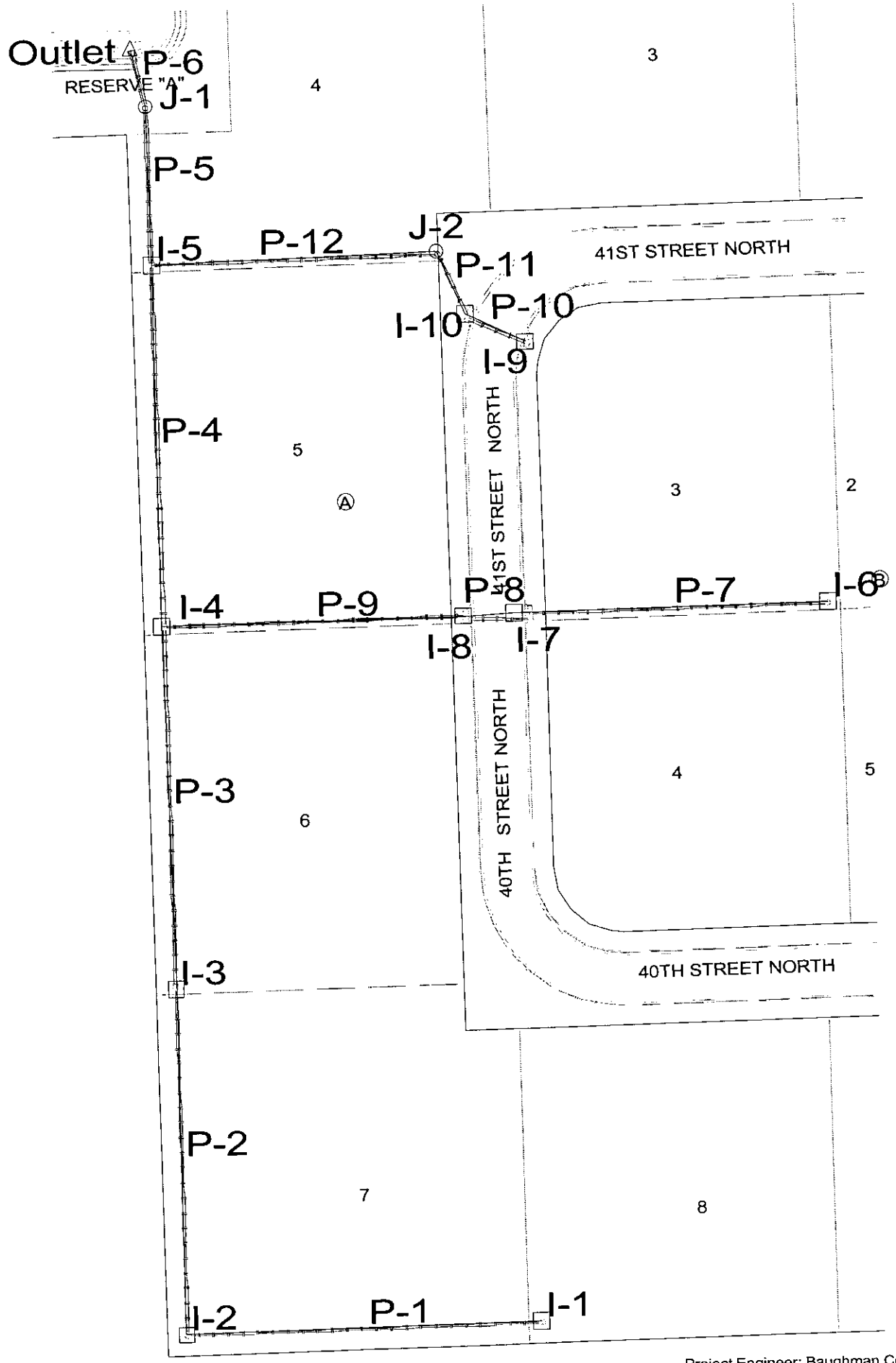
Default Network Design Storm File, ID SEDGWICK.RNQ Sedgwick

| Return Event | Total Depth in | Rainfall Type | RNF File | RNF ID |
|---|---|---|---|---|
| Dev..2 | 3.6000 | Synthetic Curve | SCSTYPES | TypeII 24hr |
| Dev..5 | 4.5600 | Synthetic Curve | SCSTYPES | TypeII 24hr |
| Dev.10 | 5.2800 | Synthetic Curve | SCSTYPES | TypeII 24hr |
| Dev100 | 7.6800 | Synthetic Curve | SCSTYPES | TypeII 24hr |

## MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Storage Node ID | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond ac-ft |
|---|---|---|---|---|---|---|---|---|
| BASIN #3 | AREA | 2 | 4.121 | | 12.1000 | 46.32 | | |
| BASIN #3 | AREA | 5 | 5.559 | | 12.1000 | 61.82 | | |
| BASIN #3 | AREA | 10 | 6.651 | | 12.1000 | 73.40 | | |
| BASIN #3 | AREA | 100 | 10.332 | | 12.1000 | 111.64 | | |
| OFF-SITE | AREA | 2 | .466 | | 12.1500 | 5.40 | | |
| OFF-SITE | AREA | 5 | .688 | | 12.1500 | 8.01 | | |
| OFF-SITE | AREA | 10 | .863 | | 12.1000 | 10.07 | | |
| OFF-SITE | AREA | 100 | 1.476 | | 12.1000 | 17.17 | | |
| *OUTLET | JCT | 2 | 4.585 | | 12.5000 | 18.81 | | |
| *OUTLET | JCT | 5 | 6.245 | | 12.4000 | 32.85 | | |
| *OUTLET | JCT | 10 | 7.512 | | 12.3500 | 48.83 | | |
| *OUTLET | JCT | 100 | 11.806 | | 12.2500 | 100.07 | | |
| POND IN | POND | 2 | 4.587 | | 12.1500 | 51.71 | | |
| POND IN | POND | 5 | 6.247 | | 12.1000 | 69.82 | | |
| POND IN | POND | 10 | 7.513 | | 12.1000 | 83.47 | | |
| POND IN | POND | 100 | 11.808 | | 12.1000 | 128.80 | | |
| POND OUT | POND | 2 | 4.585 | | 12.5000 | 18.81 | 217.32 | 1.745 |
| POND OUT | POND | 5 | 6.245 | | 12.4000 | 32.85 | 217.91 | 2.248 |
| POND OUT | POND | 10 | 7.512 | | 12.3500 | 48.83 | 218.17 | 2.480 |




Project Title: Ritchie Industrial Park
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Project Engineer: Baughman Company, P.A.
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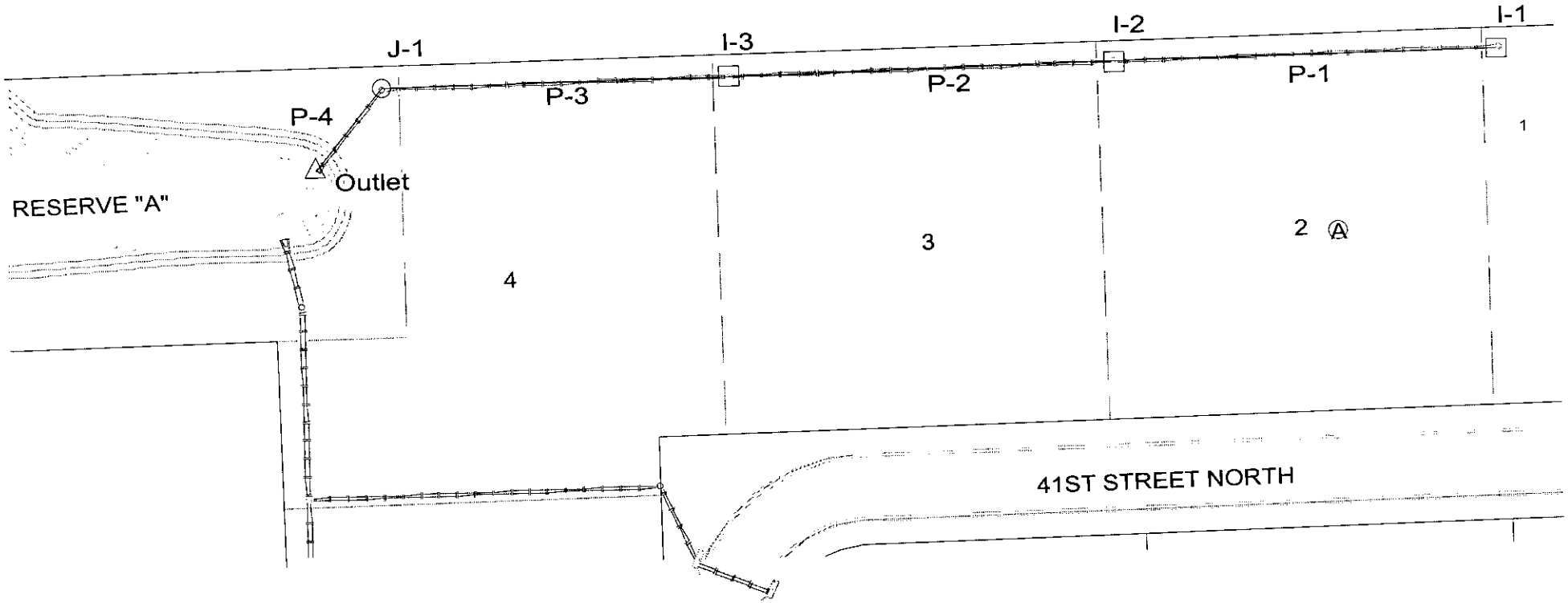
SYSTEM #1

| | Node Report | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Node | Area (acres) | Runoff Coefficient | Tc (min) | Rainfall Intensity (in/hr) | Added Flow (cfs) | Discharge (cfs) | Ground Elevation (ft) | HGL In (ft) | HGL Out (ft) |
| 5-yr | I-9 | 1.15 | 0.85 | 15 | 4.56 | 5.22 | 5.22 | 224.00 | 220.66 | 220.59 |
| | I-10 | 1.15 | 0.85 | 15 | 4.52 | 5.22 | 10.44 | 224.00 | 220.47 | 220.39 |
| | J-2 | N/A | N/A | N/A | 4.49 | N/A | 10.44 | 224.50 | 220.28 | 220.14 |
| | I-6 | 2.34 | 0.85 | 15 | 4.56 | 9 | 9 | 230.00 | 229.08 | 228.66 |
| | I-7 | 1.1 | 0.85 | 15 | 4.49 | 3.53 | 12.53 | 226.00 | 224.14 | 223.75 |
| | I-8 | 1.1 | 0.85 | 15 | 4.48 | 3.53 | 16.06 | 226.00 | 223.21 | 223.00 |
| | I-1 | 1.22 | 0.85 | 15 | 4.56 | 4.7 | 4.7 | 233.00 | 230.08 | 229.88 |
| | I-2 | 0.81 | 0.85 | 15 | 4.43 | 3.1 | 7.8 | 229.00 | 227.49 | 227.08 |
| | I-3 | 0.81 | 0.85 | 15 | 4.36 | 3.1 | 10.9 | 224.00 | 222.50 | 222.31 |
| | I-4 | 1.39 | 0.85 | 15 | 4.24 | 5.4 | 32.36 | 222.00 | 221.88 | 221.34 |
| | I-5 | 1.39 | 0.85 | 15 | 4.17 | 5.4 | 48.2 | 220.00 | 219.69 | 219.11 |
| | J-1 | N/A | N/A | N/A | 4.14 | N/A | 48.2 | 220.00 | 218.50 | 218.14 |
| | Outlet | N/A | N/A | N/A | 4.13 | N/A | N/A | 220.00 | 217.91 | 217.91 |
| 100-yr | I-9 | 1.15 | 0.91 | 15 | 7.37 | 10.1 | 10.1 | 224.00 | 223.63 | 223.38 |
| | I-10 | 1.15 | 0.91 | 15 | 7.34 | 10.1 | 20.2 | 224.00 | 222.93 | 222.61 |
| | J-2 | N/A | N/A | N/A | 7.32 | N/A | 20.2 | 224.50 | 222.20 | 221.69 |
| | I-6 | 2.34 | 0.91 | 15 | 7.37 | 15.6 | 15.6 | 230.00 | 230.00 | 230.00 |
| | I-7 | 1.1 | 0.91 | 15 | 7.31 | 4.95 | 20.55 | 226.00 | 226.00 | 226.00 |
| | I-8 | 1.1 | 0.91 | 15 | 7.3 | 4.95 | 25.5 | 226.00 | 225.35 | 224.83 |
| | I-1 | 1.22 | 0.91 | 15 | 7.37 | 8.2 | 8.2 | 233.00 | 233.00 | 233.00 |
| | I-2 | 0.81 | 0.91 | 15 | 7.25 | 5.5 | 13.7 | 229.00 | 229.00 | 228.34 |
| | I-3 | 0.81 | 0.91 | 15 | 7.14 | 5.5 | 19.2 | 224.00 | 224.00 | 223.93 |
| | I-4 | 1.39 | 0.91 | 15 | 7.01 | 9.3 | 54 | 222.00 | 222.00 | 222.00 |
| | I-5 | 1.39 | 0.91 | 15 | 6.95 | 9.3 | 83.5 | 220.00 | 220.00 | 220.00 |
| | J-1 | N/A | N/A | N/A | 6.92 | N/A | 83.5 | 220.00 | 220.00 | 219.46 |
| | Outlet | N/A | N/A | N/A | 6.91 | N/A | N/A | 220.00 | 218.77 | 218.77 |

SYSTEM #1

**Pipe Report**

| | Pipe Section | Upstream Node | Downstream Node | Discharge (cfs) | Constructed (ft/ft) | Length (ft) | Section Size | Mannings n | Upstream Invet (ft) | Downstream Invert (ft) | Upstream Ground (ft) | Downstream Ground (ft) | Upstream HGL (ft) | Downstream HGL (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-yr | P-10 | I-9 | I-10 | 5.22 | 0.010417 | 48 | 18 inch | 0.013 | 218.00 | 217.50 | 224.00 | 224.00 | 220.59 | 220.47 |
| | P-11 | I-10 | J-2 | 10.44 | 0.005882 | 51 | 24 inch | 0.013 | 217.00 | 216.70 | 224.00 | 224.50 | 220.39 | 220.28 |
| | P-12 | J-2 | I-5 | 10.44 | 0.00283 | 212 | 24 inch | 0.013 | 216.60 | 216.00 | 224.50 | 220.00 | 220.14 | 219.69 |
| | P-7 | I-6 | I-7 | 9 | 0.009657 | 233 | 15 inch | 0.013 | 224.00 | 221.75 | 230.00 | 226.00 | 228.66 | 224.14 |
| | P-8 | I-7 | I-8 | 12.53 | 0.013158 | 38 | 18 inch | 0.013 | 220.50 | 220.00 | 226.00 | 226.00 | 223.75 | 223.21 |
| | P-9 | I-8 | I-4 | 16.06 | 0.00852 | 223 | 24 inch | 0.013 | 219.90 | 218.00 | 226.00 | 222.00 | 223.00 | 221.88 |
| | P-1 | I-1 | I-2 | 4.7 | 0.010456 | 263 | 15 inch | 0.013 | 229.00 | 226.25 | 233.00 | 229.00 | 229.88 | 227.49 |
| | P-2 | I-2 | I-3 | 7.8 | 0.017647 | 255 | 18 inch | 0.013 | 226.00 | 221.50 | 229.00 | 224.00 | 227.08 | 222.30 |
| | P-3 | I-3 | I-4 | 10.9 | 0.011194 | 268 | 24 inch | 0.013 | 221.00 | 218.00 | 224.00 | 222.00 | 222.31 | 221.88 |
| | P-4 | I-4 | I-5 | 32.36 | 0.009057 | 265 | 30 inch | 0.013 | 217.50 | 215.10 | 222.00 | 220.00 | 221.34 | 219.69 |
| | P-5 | I-5 | J-1 | 48.2 | 0.008547 | 117 | 36 inch | 0.013 | 215.00 | 214.00 | 220.00 | 220.00 | 219.11 | 218.50 |
| | P-6 | J-1 | Outlet | 48.2 | 0.056818 | 44 | 36 inch | 0.013 | 213.50 | 211.00 | 220.00 | 220.00 | 218.14 | 217.91 |
| 100-yr | P-10 | I-9 | I-10 | 10.1 | 0.010417 | 48 | 18 inch | 0.013 | 218.00 | 217.50 | 224.00 | 224.00 | 223.38 | 222.93 |
| | P-11 | I-10 | J-2 | 20.2 | 0.005882 | 51 | 24 inch | 0.013 | 217.00 | 216.70 | 224.00 | 224.50 | 222.61 | 222.20 |
| | P-12 | J-2 | I-5 | 20.2 | 0.00283 | 212 | 24 inch | 0.013 | 216.60 | 216.00 | 224.50 | 220.00 | 221.69 | 220.00 |
| | P-7 | I-6 | I-7 | 15.6 | 0.009657 | 233 | 15 inch | 0.013 | 224.00 | 221.75 | 230.00 | 226.00 | 239.59 | 226.00 |
| | P-8 | I-7 | I-8 | 20.55 | 0.013158 | 38 | 18 inch | 0.013 | 220.50 | 220.00 | 226.00 | 226.00 | 226.80 | 225.35 |
| | P-9 | I-8 | I-4 | 25.5 | 0.00852 | 223 | 24 inch | 0.013 | 219.90 | 218.00 | 226.00 | 222.00 | 224.83 | 222.00 |
| | P-1 | I-1 | I-2 | 8.2 | 0.010456 | 263 | 15 inch | 0.013 | 229.00 | 226.25 | 233.00 | 229.00 | 233.24 | 229.00 |
| | P-2 | I-2 | I-3 | 13.7 | 0.017647 | 255 | 18 inch | 0.013 | 226.00 | 221.50 | 229.00 | 224.00 | 228.34 | 224.00 |
| | P-3 | I-3 | I-4 | 19.2 | 0.011194 | 268 | 24 inch | 0.013 | 221.00 | 218.00 | 224.00 | 222.00 | 223.93 | 222.00 |
| | P-4 | I-4 | I-5 | 54 | 0.009057 | 265 | 30 inch | 0.013 | 217.50 | 215.10 | 222.00 | 220.00 | 224.59 | 220.00 |
| | P-5 | I-5 | J-1 | 83.5 | 0.008547 | 117 | 36 inch | 0.013 | 215.00 | 214.00 | 220.00 | 220.00 | 221.83 | 220.00 |
| | P-6 | J-1 | Outlet | 83.5 | 0.056818 | 44 | 36 inch | 0.013 | 213.50 | 211.00 | 220.00 | 220.00 | 219.46 | 218.77 |

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Project Engineer: Baughman Company, P.A.
StormCAD v1.0

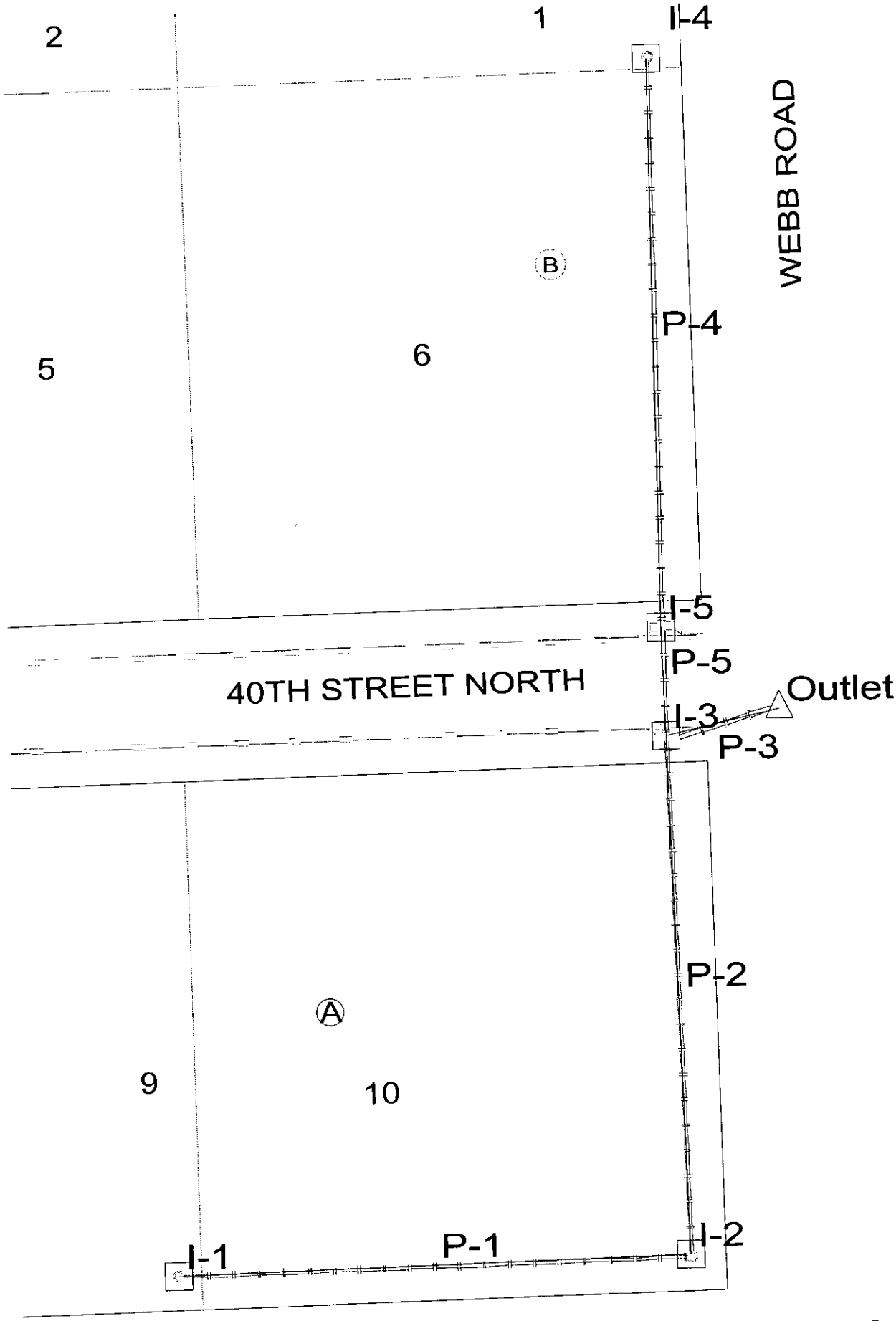
SYSTEM #2

| | Node Report | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Node | Area (acres) | Runoff Coefficient | Tc (min) | Rainfall Intensity (in/hr) | Added Flow (cfs) | Discharge (cfs) | Ground Elevation (ft) | HGL In (ft) | HGL Out (ft) |
| 5-yr | I-1 | 1.2 | 0.85 | 15 | 4.56 | 4.7 | 4.7 | 231.00 | 227.40 | 227.29 |
| | I-2 | 1.21 | 0.85 | 15 | 4.43 | 4.7 | 9.4 | 230.00 | 226.08 | 225.86 |
| | I-3 | 1.21 | 0.85 | 15 | 4.34 | 4.7 | 14.1 | 227.00 | 224.02 | 223.52 |
| | J-1 | N/A | N/A | N/A | 4.29 | N/A | 14.1 | 223.00 | 219.76 | 219.06 |
| | Outlet | N/A | N/A | N/A | 4.28 | N/A | N/A | 222.00 | 217.91 | 217.91 |
| 100-yr | I-1 | 1.2 | 0.91 | 15 | 7.37 | 8 | 8 | 231.00 | 231.00 | 231.00 |
| | I-2 | 1.21 | 0.91 | 15 | 7.26 | 8.1 | 16.1 | 230.00 | 230.00 | 230.00 |
| | I-3 | 1.21 | 0.91 | 15 | 7.18 | 8.1 | 24.2 | 227.00 | 227.00 | 227.00 |
| | J-1 | N/A | N/A | N/A | 7.13 | N/A | 24.2 | 223.00 | 223.00 | 222.17 |
| | Outlet | N/A | N/A | N/A | 7.12 | N/A | N/A | 222.00 | 218.77 | 218.77 |

SYSTEM #2

**Pipe Report**

| | Pipe Section | Upstream Node | Downstream Node | Discharge (cfs) | Constructed (ft/ft) | Length (ft) | Section Size | Mannings n | Upstream Invet (ft) | Downstream Invert (ft) | Upstream Ground (ft) | Downstream Ground (ft) | Upstream HGL (ft) | Downstream HGL (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-yr | P-1 | I-1 | I-2 | 4.7 | 0.008734 | 229 | 15 inch | 0.013 | 226.00 | 224.00 | 231.00 | 230.00 | 227.29 | 226.08 |
| | P-2 | I-2 | I-3 | 9.4 | 0.011957 | 230 | 18 inch | 0.013 | 223.75 | 221.00 | 230.00 | 227.00 | 225.86 | 224.02 |
| | P-3 | I-3 | J-1 | 14.1 | 0.01866 | 209 | 18 inch | 0.013 | 220.90 | 217.00 | 227.00 | 223.00 | 223.52 | 219.76 |
| | P-4 | J-1 | Outlet | 14.1 | 0.046875 | 64 | 18 inch | 0.013 | 215.00 | 212.00 | 223.00 | 222.00 | 219.06 | 217.91 |
| 100-yr | P-1 | I-1 | I-2 | 8 | 0.008734 | 229 | 15 inch | 0.013 | 226.00 | 224.00 | 231.00 | 230.00 | 233.51 | 230.00 |
| | P-2 | I-2 | I-3 | 16.1 | 0.011957 | 230 | 18 inch | 0.013 | 223.75 | 221.00 | 230.00 | 227.00 | 232.40 | 227.00 |
| | P-3 | I-3 | J-1 | 24.2 | 0.01866 | 209 | 18 inch | 0.013 | 220.90 | 217.00 | 227.00 | 223.00 | 234.09 | 223.00 |
| | P-4 | J-1 | Outlet | 24.2 | 0.046875 | 64 | 18 inch | 0.013 | 215.00 | 212.00 | 223.00 | 222.00 | 222.17 | 218.77 |

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Project Engineer: Baughman Company, P.A.
StormCAD v1.0

SYSTEM #3

| | Node Report | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Node | Area (acres) | Runoff Coefficient | Tc (min) | Rainfall Intensity (in/hr) | Added Flow (cfs) | Discharge (cfs) | Ground Elevation (ft) | HGL In (ft) | HGL Out (ft) |
| 5-yr | I-4 | 2.37 | 0.85 | 15 | 4.56 | 9.4 | 9.4 | 229.00 | 227.96 | 227.74 |
| | I-5 | 0.28 | 0.85 | 15 | 4.47 | 1.1 | 10.5 | 229.00 | 225.63 | 225.49 |
| | I-1 | 0.28 | 0.85 | 15 | 4.56 | 4.7 | 4.7 | 230.00 | 228.83 | 228.72 |
| | I-2 | 1.22 | 0.85 | 15 | 4.43 | 4.7 | 9.4 | 228.00 | 227.53 | 227.31 |
| | I-3 | 1.22 | 0.85 | 15 | 4.35 | 1.1 | 21 | 229.00 | 225.49 | 225.04 |
| | Outlet | N/A | N/A | N/A | 4.33 | N/A | N/A | 227.00 | 224.33 | 224.33 |
| 100-yr | I-4 | 2.37 | 0.91 | 15 | 7.37 | 15.8 | 15.8 | 229.00 | 229.00 | 229.00 |
| | I-5 | 0.28 | 0.91 | 15 | 7.28 | 1.9 | 17.7 | 229.00 | 227.51 | 227.26 |
| | I-1 | 0.28 | 0.91 | 15 | 7.37 | 8.2 | 8.2 | 230.00 | 230.00 | 230.00 |
| | I-2 | 1.22 | 0.91 | 15 | 7.26 | 8.2 | 16.4 | 228.00 | 228.00 | 228.00 |
| | I-3 | 1.22 | 0.91 | 15 | 7.19 | 1.9 | 36 | 229.00 | 226.97 | 225.95 |
| | Outlet | N/A | N/A | N/A | 7.17 | N/A | N/A | 227.00 | 224.62 | 224.62 |

SYSTEM #3

**Pipe Report**

| | Pipe Section | Upstream Node | Downstream Node | Discharge (cfs) | Constructed (ft/ft) | Length (ft) | Section Size | Mannings n | Upstream Invet (ft) | Downstream Invert (ft) | Upstream Ground (ft) | Downstream Ground (ft) | Upstream HGL (ft) | Downstream HGL (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-yr | P-4 | I-4 | I-5 | 9.4 | 0.006073 | 247 | 18 inch | 0.013 | 226.00 | 224.50 | 229.00 | 229.00 | 227.74 | 225.68 |
| | P-5 | I-5 | I-3 | 10.5 | 0.010638 | 47 | 24 inch | 0.013 | 224.00 | 223.50 | 229.00 | 229.00 | 225.49 | 225.49 |
| | P-1 | I-1 | I-2 | 4.7 | 0.004444 | 225 | 15 inch | 0.013 | 226.00 | 225.00 | 230.00 | 228.00 | 228.72 | 227.53 |
| | P-2 | I-2 | I-3 | 9.4 | 0.005507 | 227 | 18 inch | 0.013 | 224.75 | 223.50 | 228.00 | 229.00 | 227.31 | 225.49 |
| | P-3 | I-3 | Outlet | 21 | 0.013922 | 51 | 24 inch | 0.013 | 223.40 | 222.69 | 229.00 | 227.00 | 225.04 | 224.33 |
| 100-yr | P-4 | I-4 | I-5 | 15.8 | 0.006073 | 247 | 18 inch | 0.013 | 226.00 | 224.50 | 229.00 | 229.00 | 233.10 | 227.51 |
| | P-5 | I-5 | I-3 | 17.7 | 0.010638 | 47 | 24 inch | 0.013 | 224.00 | 223.50 | 229.00 | 229.00 | 227.26 | 226.97 |
| | P-1 | I-1 | I-2 | 8.2 | 0.004444 | 225 | 15 inch | 0.013 | 226.00 | 225.00 | 230.00 | 228.00 | 231.63 | 228.00 |
| | P-2 | I-2 | I-3 | 16.4 | 0.005507 | 227 | 18 inch | 0.013 | 224.75 | 223.50 | 228.00 | 229.00 | 232.51 | 226.97 |
| | P-3 | I-3 | Outlet | 36 | 0.013922 | 51 | 24 inch | 0.013 | 223.40 | 222.69 | 229.00 | 227.00 | 225.95 | 224.62 |

# Ritchie Industrial Park
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Project File | f:\hydro\projects\ritchien\ditch.fm2 |
| Worksheet | V-Ditch |
| Flow Element | Triangular Channel |
| Method | Manning's Formula |
| Solve For | Discharge |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Channel Slope | 0.010000 | ft/ft |
| Depth | 1.50 | ft |
| Left Side Slope | 4.000000 | H : V |
| Right Side Slope | 4.000000 | H : V |

| Results | | |
|---|---|---|
| Discharge | 36.06 | cfs |
| Flow Area | 9.00 | $ft^2$ |
| Wetted Perimeter | 12.37 | ft |
| Top Width | 12.00 | ft |
| Critical Depth | 1.38 | ft |
| Critical Slope | 0.015443 | ft/ft |
| Velocity | 4.01 | ft/s |
| Velocity Head | 0.25 | ft |
| Specific Energy | 1.75 | ft |
| Froude Number | 0.82 | |
| Flow is subcritical. | | |