

Final Drainage Report for

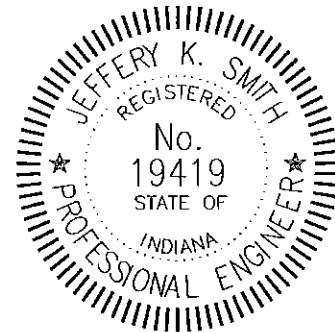
ESI Electric Inc., Building

At

Hurricane Industrial

Park - Lot 13

Dated: March 12, 2020



Calculations Prepared By:

PROJECTS plus

2650 Fairview Place, Suite W
Greenwood, Indiana 46142

LAND PLANNING • ENGINEERING • SURVEYING • PROJECT MANAGEMENT

Certified By:

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TECHNICAL INFORMATION DATA

Development Conditions:

The proposed building for ESI Electric Inc. is located at the 1691 Amy Ln., Franklin, IN 46131 at the southwest corner of Arvin Dr. and Hurricane Rd. on Lot 13 in the Hurricane Industrial Park in the City of Franklin, Johnson County, Indiana. Existing ground cover is grass with soil hydrologic groups type 'B' and 'C'. The proposed development includes the construction of a 5,760 S.F. building with asphalt pavement. Drainage will be by sheet flow and drainage swales. Additional construction activities include a sanitary sewer lateral, domestic water service line, and other utility connections to building.

The drainage watershed for the site is part of an approved drainage system for Hurricane Industrial Park, prepared by Steven B. Williams, Franklin Engineering Dated February 20, 2001. The existing detention pond located within the industrial park was designed and built to provide detention for Lot 13. The project site is located within Basin 'A' in the drainage basin map depicted within the "Approved Post-Development, Detention and Storm Sewer Calculations" section of this report.

Water Quality for the site will be achieved by routing the storm runoff to the existing detention pond, which will provide treatment in addition to the existing vegetated swale which will provide pre-treatment prior to release to the detention pond. The wet detention pond acts as a permanent stormwater control structure providing both detention and treatment of contaminated stormwater runoff. The ponds natural physical, biological and chemical processes then work to remove pollutants.

Additional Detention Pond Information:

Per the drainage report for the Hurricane Industrial Park - Lots 9 & 10, dated April 11, 2011, prepared by Projects Plus, additional Detention Pond Calculations have been included to verify a runoff coefficient of 0.6 by Franklin Engineering, this coefficient was used for the detention pond design in the industrial park per Franklin Engineering's drainage report completed in 2001. We entered the information from Franklin Engineering's drainage report into our HYDRAFLOW program and obtained similar runoff number to the approved runoff calculations, see following calculations. The detention pond storage information and the slope and length of the discharge pipe were not included in the approved drainage report. The size of the existing detention pond was obtained from aerial photography and from the development plan, prepared by Franklin Engineering. The drainage design for the site meets the General Drainage Standards, Chapter 6.19 of the City of Franklin Subdivision Control Ordinance. A summary of the drainage runoff and the dry detention pond are as follows:

Offsite Basin 'A':

Ac. = 81 acres 'C' = 0.4
Q2 = 53.3 cfs, Q10 = 83.45 cfs, Q100 = 122.09 cfs

Onsite Basin 'A':

Ac. = 18.3 acres 'C' = 0.6
Q2 = 24.94 cfs, Q10 = 38.76 cfs, Q100 = 56.2 cfs

Total to Detention Pond:

Q2 = 61.61 cfs, Q10 = 96.37 cfs, Q100 = 140.83 cfs

Release from Detention Pond:

Q2 = 23.13 cfs, Q10 = 30.60 cfs, Q100 = 37.34 cfs

2 yr. = 734.48, 10 yr. = 736.09, 100 yr. = 738.09

Franklin Engineering Detention Pond Release:

Q100 = 38.1 cfs, pond top of bank 738.50

The additional detention pond calculations in our drainage report dated April 11, 2011 revised the overall development's runoff coefficient of 0.6 to a coefficient of 0.7. The 0.7 runoff coefficient for the existing developed sites and all the future development sites. This 0.7 coefficient was determined by researching aerial photography for the 4 developed lots within the development and the assuming the maximum lot coverage for lots # 3, 6-8, 11-12 and 17 of 85%, and lots #9-10, 13-16 of 75% per the current zoning classifications. An average of the weighted 'C' is included within the "Additional Detention Pond Calculation" portion of this report. The following runoff calculations used the revised coefficient:

Offsite Basin 'A':

Ac. = 81 acres 'C' = 0.4

Q2 = 53.3 cfs, Q10 = 83.45 cfs, Q100 = 122.09 cfs

Onsite Basin 'A':

Ac. = 18.3 acres 'C' = 0.7

Q2 = 29.09 cfs, Q10 = 45.22 cfs, Q100 = 65.56 cfs

Total to Detention Pond:

Q2 = 62.99 cfs, Q10 = 98.53 cfs, Q100 = 143.95 cfs

Release from Detention Pond:

Q2 = 23.81 cfs, Q10 = 31.16 cfs, Q100 = 37.97 cfs

2 yr. = 734.58, 10 yr. = 736.24, 100 yr. = 738.30

Based on our calculations using the runoff coefficient of 0.7, the 100 yr. detention pond release will increase by 0.63 cfs and the 100 yr. flood elevation will raise 0.21 feet. It was concluded that the larger runoff coefficient will not increase the potential for flooding and the existing detention pond will still function as originally designed.

Engineering Methodology:

The calculations contained herein have been prepared in compliance with the City of Franklin Subdivision Control Ordinance. The detention facilities were designed using HYDRAFLOW Hydrograph Routing Module. A storm hydrograph is developed using the "SCS Curve Number Method" for each watershed and routed through a user defined detention basin and outlet structure configuration. Water surface elevations and outlet rates are determined by the storage indication method which uses a stage/storage/discharge relationship and inflow hydrograph to set the inflow minus the outflow equal to

the change in storage. The post-developed drainage basins and basin characteristics for each pond are shown on the "Post-Development Drainage Map".

The storm sewer system was designed using the HYDRAFLOW Storm Sewer Module. Discharge rates for each inlet were calculated using the "Rational Method" and input into the HYDRAFLOW Storm Sewer Module to calculate the velocity, capacity, hydraulic grade line, gutter and inlet spreads for each storm sewer system. A weighted coefficient was computed for all storm basins in accordance with Chapter 6.19 of the City of Franklin General Drainage Standards. Individual times of concentration were calculated using Manning Equation. The storm sewer system is sized for a 10-year storm runoff event with no surcharging.

Stormwater Pollution Prevention:

The land disturbing activities will be greater than 1 acre, so a Rule 5 submittal is required. A Stormwater Pollution Prevention Plan (SWPPP) with an activities schedule will be submitted as part of the construction plans. Standard maintenance schedules and details will be included. All swales and pond banks will be mulch-seeded and have an erosion control blanket installed. All drainage easements will be mulch-seeded and the rights-of-way will be temporary seeded. A perimeter filter fence will be installed where needed as well as at all ditch inlets.

Hours	Minutes	Return Period - Rainfall Intensity (in/hr)					
		2	5	10	25	50	100
0.08	5	4.75	6.14	6.99	8.08	8.83	9.69
0.17	10	3.63	4.75	5.48	6.40	7.07	7.77
0.25	15	2.97	3.92	4.55	5.34	5.94	6.53
0.5	30	1.98	2.64	3.09	3.65	4.10	4.50
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	0.76	1.02	1.20	1.40	1.59	1.75
3	180	0.56	0.75	0.88	1.03	1.17	1.29
6	360	0.33	0.44	0.52	0.60	0.68	0.75
12	720	0.20	0.26	0.30	0.35	0.39	0.43
24	1440	0.11	0.15	0.17	0.20	0.22	0.25

Hours	Minutes	Return Period - Rainfall Depth (in)					
		2	5	10	25	50	100
0.08	5	0.40	0.51	0.58	0.67	0.74	0.81
0.17	10	0.61	0.79	0.91	1.07	1.18	1.30
0.25	15	0.74	0.98	1.14	1.34	1.49	1.63
0.5	30	0.99	1.32	1.55	1.83	2.05	2.25
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	1.52	2.04	2.40	2.80	3.18	3.50
3	180	1.68	2.25	2.64	3.09	3.51	3.87
6	360	1.98	2.64	3.12	3.60	4.08	4.50
12	720	2.40	3.12	3.60	4.20	4.68	5.16
24	1440	2.64	3.60	4.08	4.80	5.28	6.00

TABLE 202-02: IDF and IDD Tables for Indianapolis, IN

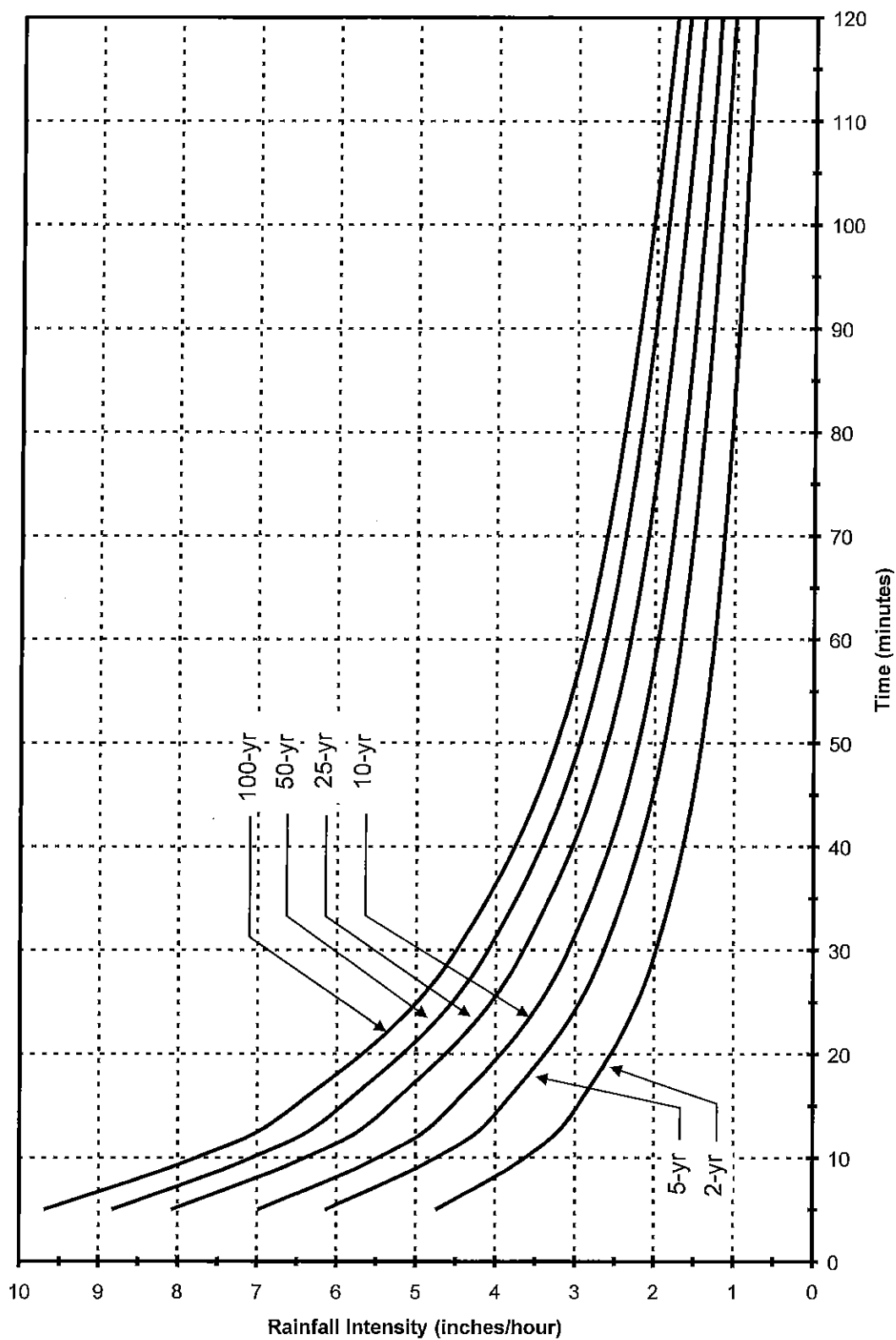


FIGURE 202-01: Indianapolis IDF Curve

Surface Description	n
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated Soils:	
Residue cover $\leq 20\%$	0.06
Residue cover $> 20\%$	0.17
Grass:	
Short grass prairie	0.15
Dense grasses	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods:	
Light underbrush	0.40
Dense underbrush	0.80

TABLE 203-01: Roughness coefficients (Manning's n) for sheet flow

<u>TYPE OF SURFACE</u>	<u>RUNOFF COEFFICIENT</u> ®
<u>Non-Urban Areas</u>	
Bare earth	0.55
Steep grassed areas (slope 2:1)	0.60
Turf meadows	0.25
Forested areas	0.20
Cultivated fields	0.30
<u>Urban Areas</u>	
All watertight roof surfaces	0.90
Pavement	0.85
Gravel	0.85
Impervious soils (heavy)	0.55
Impervious soils (with turf)	0.45
Slightly pervious soil	0.25
Slightly pervious soil (with turf)	0.20
Moderately pervious soil	0.15
Moderately pervious soil (with turf)	0.10
Business, Commercial & Industrial	0.85
Apartments & Townhouses	0.70
Schools & Churches	0.55
Single Family Lots < 10,000 SF	0.45
Lots < 12,000 SF	0.45
Lots < 17,000 SF	0.40
Lots > ½ acre	0.35
Park, Cemetery or Unimproved Area	0.30

TABLE 204-01: Runoff Coefficients® for Use in the Rational Method

[Absence of an entry indicates the feature is not a concern. The symbol < means less than; > means greater than]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	
Brookston: Br.....	B/D	Frequent	Brief	Dec-May	0-1.0	Apparent	Dec-May	High.
Crosby: CrA.....	C	None			1.0-3.0	Apparent	Jan-Apr	High.
¹ CrB2: Crosby part.....	C	None			1.0-3.0	Apparent	Jan-Apr	High.
Miami part.....	B	None			>6.0			Moderate.
Eel: Ee.....	C	Frequent	Brief	Oct-Jun	3.0-6.0	Apparent	Jan-Apr	High.
Fox: FoA, FoB2, ¹ FxC2.....	B	None			>6.0			Moderate.
Genesee: Ge.....	B	Frequent	Brief	Oct-Jun	>6.0			Moderate.
Hennepin: HeF.....	B	None			>6.0			Moderate.
Martinsville: MgA, MgB2.....	B	None			>6.0			Moderate.
Miami: MmA, MmB2, MmC2, ¹ MxD2, MxE2.....	B	None			>6.0			Moderate.
Ockley: OcA, OcB2.....	B	None			>6.0			Moderate.
Rensselaer: Re.....	B/D	None			0-1.0	Apparent	Dec-May	High.
Shoals: Sh.....	C	Frequent	Brief	Oct-Jun	1.0-3.0	Apparent	Jan-Apr	High.
Sleeth: Sk.....	C	None			1.0-3.0	Apparent	Jan-Apr	High.
Sloan: Sn.....	B/D	Frequent	Long	Oct-Jun	0-0.5	Apparent	Nov-Jun	High.
Urban land: ¹ Ub: Brookston part.....	B/D	Frequent	Brief	Dec-May	0-1.0	Apparent	Dec-May	High.
¹ Uc: Crosby part.....	C	None			1.0-3.0	Apparent	Jan-Apr	High.
¹ UfA: Fox part.....	B	None			>6.0			Moderate.
¹ UfC: Fox part.....	B	None			>6.0			Moderate.
¹ Ug: Genesee part.....	B	Frequent	Brief	Oct-Jun	>6.0			Moderate.
¹ Umb: Miami part.....	B	None			>6.0			Moderate.
¹ Umc: Miami part.....	B	None			>6.0			Moderate.
¹ Uw: Westland part.....	B/D	Frequent	Brief	Dec-May	0-1.0	Apparent	Dec-May	High.
Westland: We.....	B/D	Frequent	Brief	Dec-May	0-1.0	Apparent	Dec-May	High.
Whitaker: Wh.....	C	None			1.0-3.0	Apparent	Jan-Apr	High.

¹ This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 205-01: Soil and Water Features for Marion County, Indiana
(SOURCE: NRCS, Soil Survey of Marion county, Indiana, 1991)

Cover Description	Curve Numbers for Hydrologic Soil Groups				
Cover Type and Hydrologic Condition	Average Percent ² Impervious Area	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) ²		68	79	86	89
Poor condition (grass cover < 50%)		49	69	79	84
Fair condition (grass cover 50% to 75%)		39	61	74	80
Good condition (grass cover > 75%)					
Impervious Areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and Roads:					
Paved; curbs and storm drains (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban Districts:					
Commercial and Business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential Districts by Average Lot Size:					
0.125 acre or less (townhouses)	65	77	85	90	92
0.25 acre	38	61	75	83	87
0.33 acre	30	57	72	81	86
0.50 acre	25	54	70	80	85
1.00 acre	20	51	68	79	84
2.00 acre	12	46	65	77	82
Developing Urban Areas					
Newly graded areas (pervious area only, no vegetation)		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in <u>Table 205-04</u>).					

¹ Average runoff condition, and $I_a = 0.2S$

² The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: Impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. If the impervious area is not connected, the NRCS method has an adjustment to reduce the effect.

³ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

TABLE 205-02: Runoff Curve Numbers for Urban Areas
(SOURCE: 210-VI-TR-55, Second Ed., June 1986)

Cover Description	Curve Numbers for Hydrologic Soil Groups			
Cover Type and Hydrologic Condition	A	B	C	D
Cultivated Land (Row Crops)	72	81	88	91
With conservation treatment	62	71	78	81
Without conservation treatment				
Pasture or Range Land	68	79	86	89
Poor condition	39	61	74	80
Good condition				
Meadow	30	58	71	78
Good condition				
Wood or Forest Land				
Thin stand, poor cover, no mulch	45	66	77	83
Good cover	25	55	70	77

TABLE 205-03: Runoff Curve Numbers for Undeveloped Areas
(SOURCE: 210-VI-TR-55, Second Ed., June 1986)

Cover Description	Curve Numbers for Hydrologic Soil Groups			
Cover Type and Hydrologic Condition	A	B	C	D
Pasture, grassland or range with continuous forage for grazing.				
Poor	68	79	86	89
Fair	49	69	79	84
Good	39	61	74	80
Meadow with continuous grass, protected from grazing and generally mowed for hay.	30	58	71	78
Brush/brush-weed-grass mixture with brush being the major element.				
Poor	48	67	77	83
Fair	35	56	70	77
Good	30	48	65	73
Woods and grass combination (orchard or tree farm).				
Poor	57	73	82	86
Fair	43	65	76	82
Good	32	58	72	79
Woods				
Poor	45	66	77	83
Fair	36	60	73	79
Good	30	55	70	77
Farmsteads	59	74	82	86

TABLE 205-04: Runoff Curve Numbers for Agricultural Lands
(SOURCE: 210-VI-TR-55, Second Ed., June 1986)

Approved Post-Development, Detention and Storm Sewer Calculations

**Prepared by Steven B. Williams, Franklin Engineering
for the
Hurricane Industrial Park
Dated February 20, 2001**

HURRICANE INDUSTRIAL PARK
DRAINAGE REPORT
REVISED: OCTOBER 2, 2000
REV: 2-20-01


Original Conditions:

Onsite A = 24 Acres
C = .4 cropland D = 1200' H = 12' S = 1%
T = 30 min.
 $I_{10} = 3.1$
 $Q_{10} = 24 (.4) 3.1 = 30 \text{ cfs}$

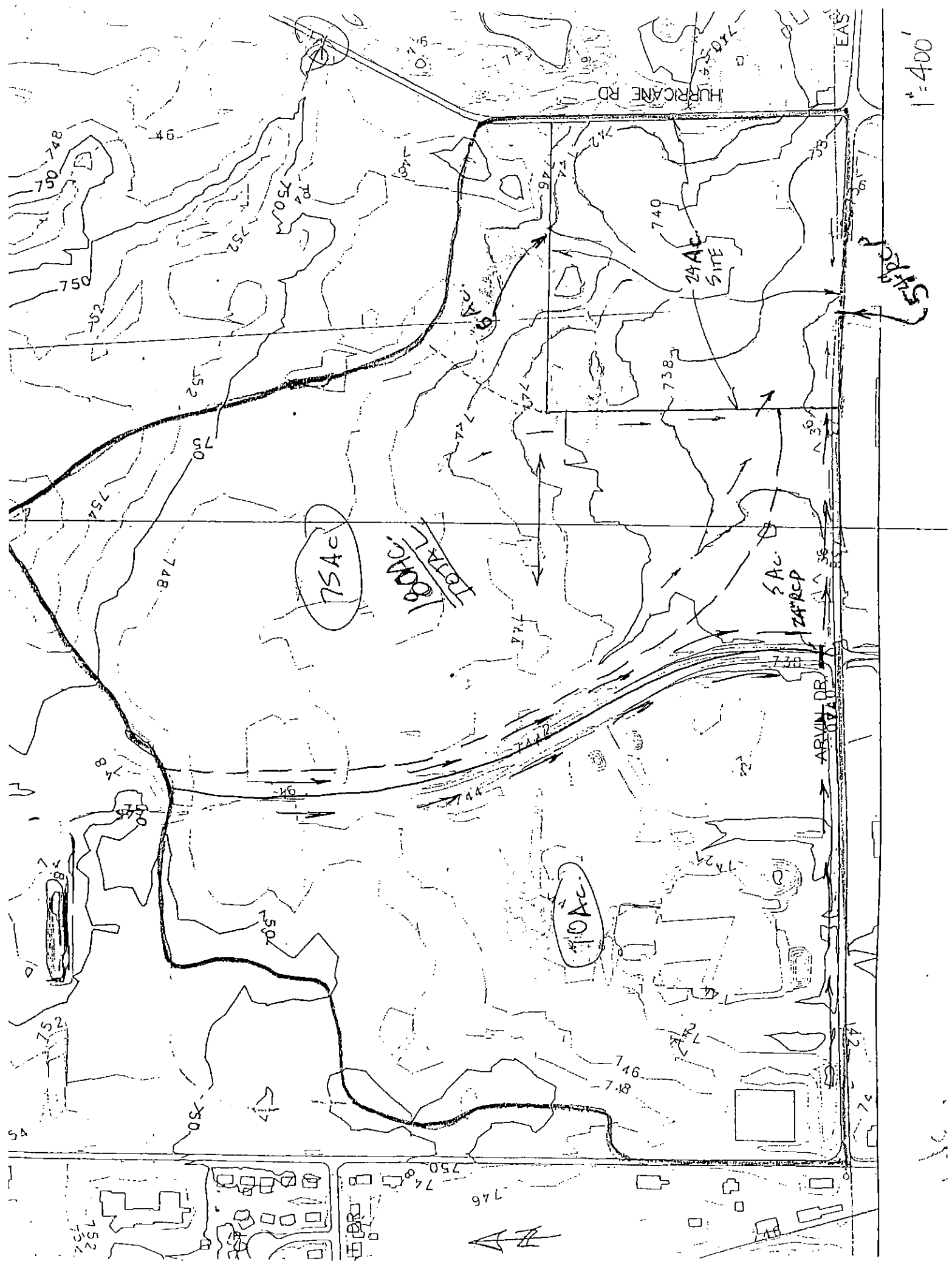
Future Conditions:

Onsite A = 24 Acres
C = .6 (estimated) D = 1500' C = .3 S = 1%
T = 40 min.
 $I_{100} = 3.9$
 $3.9 (.6) (24) = 56 \text{ cfs}$
Required Storage = 26 cfs
Area to Pond = 81 Acres (offsite) & 18.3 Acres (onsite) = 99.3 acres
81 Acres @ C = .4 CA = 32.4
18.3 Acres @ C = .6 CA = 11.0
TOTAL CA = 43.4
D = 4500' C = .3 S = .5%
Tc = 77 min.
 $I_{10} = 1.87$ $I_{100} = 2.72$
 $Q_{100} \text{ to Pond} = 2.72 (43.4) = 118 \text{ cfs}$
Use 24" RCP @ .3% restrictive outlet pipe
@ HW/D = 3.375 Qcap 36.5 cfs
Peak Storage Required = 8 acre/feet
Storage Provided in pond and ditches = 8 acre/feet
Flow Stored at Peak = 80 cfs
Area to 36" east-west pipe under road = 82 acres
75 acres @ C = .4 CA = 30
7 Acres @ C = .6 CA = 4.2
TOTAL CA = 34.2
 $Q = 34.2 (1.87) = 63.9 \text{ cfs}$
Qcap 36" = 63.6 cfs
Qcap 54" RCP = 120 cfs
Flow to 54" = 63.3 + 38.1 + 5 + 5 = 111.4 cfs

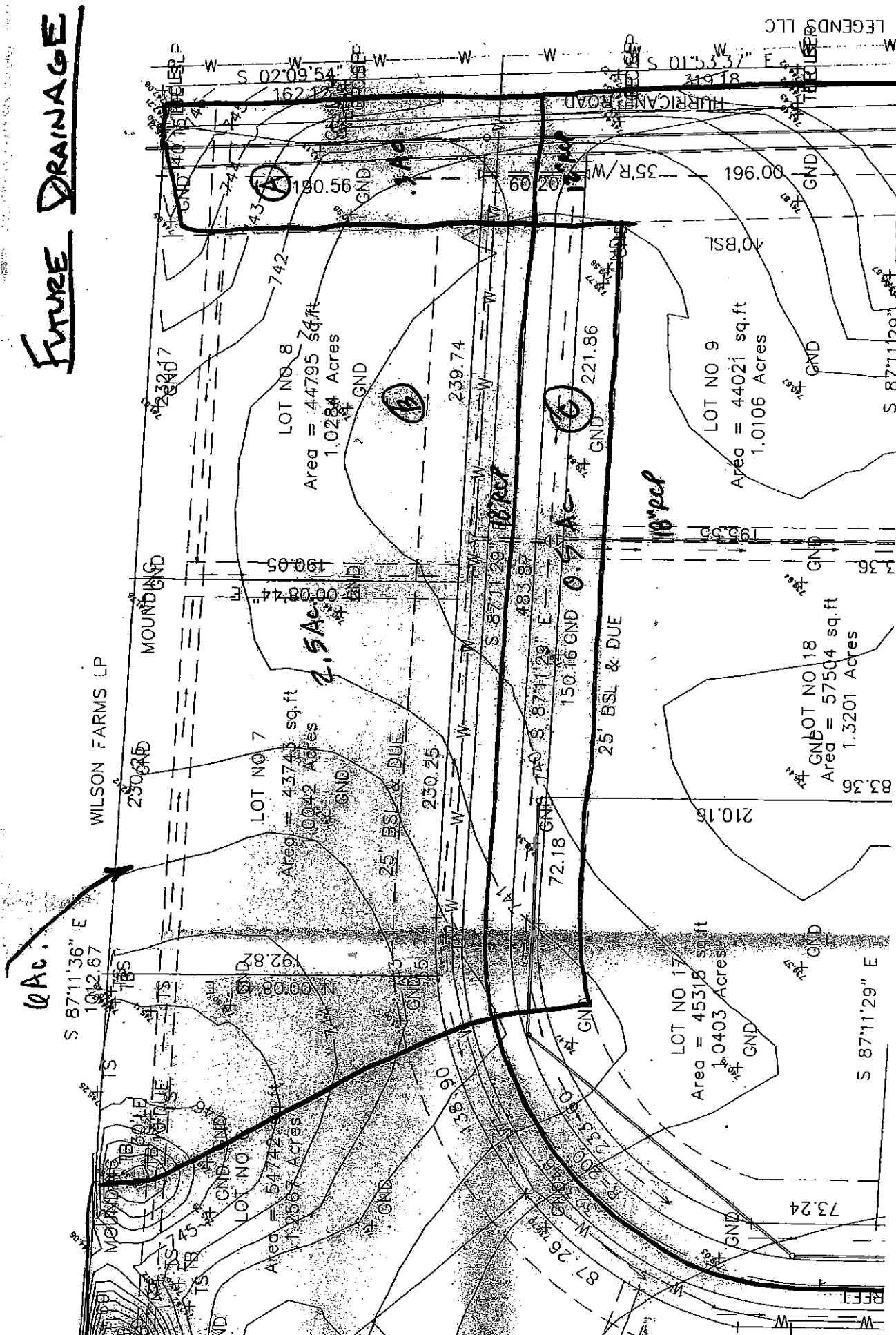
Prepared by:


Steven B. Williams





6A2



Project D&S HURRICANE PARK Detention Facility Design Return Period 100 yrs.
Designer SBW Release Rate Return Period 10 yrs.

Watershed Area 180 acres
Time of Concentration (undeveloped watershed) 77 minutes
Rainfall Intensity (i_u) 1.87 inches/hr
Undeveloped Runoff Coefficient (C_u) 0.4
Undeveloped Runoff Rate ($O = C_u i_u A_u$) 135 cfs
Developed Runoff Coefficient (C_D) 0.6

Storm Duration t_d (hrs)	Rainfall Intensity i_d (inches/hr)	Inflow Rate $I(t_d)$ $(C_D i_d A_D)$ (cfs) $CA = 43.4$	Outflow Rate O $(C_u i_u A_u)$ (cfs) 38.1	Storage Rate $I(t_d) - O$ (cfs)	Required Storage $\left[I(t_d) - O \right] \frac{t_d}{12}$ (acre-ft)
0.17					
0.25					
0.33					
0.42					
0.50	4.50	195.3		157.2	6.5
0.67					
0.83					
1.00	3.00	130.2		92.1	7.6
1.25					
1.50					
1.75					
2.00	2.00	86.8		48.7	8.0 ← PEAK
2.25					
2.50					
2.75					
3.00	1.50	65.1		27.0	6.7
3.25					
4.00	1.30	56.4		18.3	6.0

Figure 6.2 Computation Sheet for Detention Storage
Calculations Using the Rational Method

OUTLET STRUCTURE REPORT

RECORD NUMBER : 1
 TYPE : CIRCULAR CONCRETE w/ square edge w/ headwall
 DESCRIPTION : 54"RCP

[RATING CURVE LIMIT]

Minimum Elevation..... = 729.60 (ft)
 Maximum Elevation..... = 735.00 (ft)
 Elevation Increment..... = 0.10 (ft)

[OUTLET STRUCTURE INFORMATION]

Circular Radius..... = 2.25000 (ft)
 Culvert Invert Elevation..... = 729.59998 (ft)
 Slope..... = 0.00000
 Manning's N-value..... = 0.01300
 Orifice Coefficient..... = 0.60000
 Tailwater..... = 730.29999 (ft)
 Number barrels..... = 1

[UNSUBMERGED EQUATION]

$H/Diam = H_c/Diam + K * (Q/(A * Diam^{0.5}))^N - 0.5 * S^2$
 Coefficient K..... = 0.00980
 coefficient M..... = 2.00000

[SUBMERGED EQUATION]

$H/Diam = c * (Q/(A * Diam^{0.5}))^Z + Y - 0.5 * S^2$
 Coefficient c..... = 0.03980
 Coefficient Y..... = 0.67000

[DEFINITIONS]

H = Headwater depth above inlet control section invert, (ft)
 Diam = Interior height of culvert barrel, (ft)
 Hc = Specific head at critical depth $(d_c + V_c^2/2g)$, (ft)
 Q = Discharge, (cuft/s)
 A = Full cross sectional area of culvert barrel, (sqft)
 S = Culvert barrel slope, (ft/ft)

OUTLET STRUCTURE REPORT

RECORD NUMBER : 1
TYPE : CIRCULAR CONCRETE w/ square edge w/ headwall
DESCRIPTION : 54"RCP

(Culvert Weir Discharge Value vs. Stage)
(the elevation increment is 1.0)

STAGE	ELEVATION (ft)	FLOW (cfs)
3.00	732.60	23.20
4.00	733.60	67.64
5.00	734.60	104.78

OUTLET STRUCTURE REPORT

RECORD NUMBER : 2
 TYPE : CIRCULAR CONCRETE w/ square edge w/ headwall
 DESCRIPTION : 24"RCP

[Culvert Weir Discharge Value vs. Stage]
 (the elevation increment is 1.0)

STAGE	ELEVATION (ft)	FLOW (cfs)
1.00	732.25	0.45
2.00	733.25	11.93
3.00	734.25	20.07
4.00	735.25	25.70
5.00	736.25	30.14
6.00	737.25	34.00
7.00	738.25	37.47
7.25	738.50	38.1

OUTLET STRUCTURE REPORT

RECORD NUMBER : 2
 TYPE : CIRCULAR CONCRETE w/ square edge w/ headwall
 DESCRIPTION : 24"RCP

[RATING CURVE LIMIT]

Minimum Elevation..... = 731.25 (ft)
 Maximum Elevation..... = 738.50 (ft)
 Elevation Increment..... = 0.10 (ft)

[OUTLET STRUCTURE INFORMATION]

Circular Radius..... = 1.00000 (ft)
 Culvert Invert Elevation..... = 731.25000 (ft)
 Slope..... = 0.00300
 Manning's N-value..... = 0.01300
 Orifice Coefficient..... = 0.60000
 Tailwater..... = 731.13000 (ft)
 Number barrels..... = 1

[UNSUBMERGED EQUATION]

$H/Diam = H_c/Diam + K * (Q/(A*Diam^{0.5}))^M - 0.5*S^2$
 Coefficient K..... = 0.00980
 coefficient M..... = 2.00000

[SUBMERGED EQUATION]

$H/Diam = c*(Q/(A*Diam^{0.5}))^Z + Y - 0.5*S^2$
 Coefficient c..... = 0.03980
 Coefficient Y..... = 0.67000

[DEFINITIONS]

H = Headwater depth above inlet control section invert, (ft)
 Diam = Interior height of culvert barrel, (ft)
 Hc = Specific head at critical depth ($d_c + V_c^2/2g$), (ft)
 Q = Discharge, (cuft/s)
 A = Full cross sectional area of culvert barrel, (sqft)
 S = Culvert barrel slope, (ft/ft)

OUTLET STRUCTURE REPORT

RECORD NUMBER : 3
 TYPE : CIRCULAR CONCRETE w/ square edge w/ headwall
 DESCRIPTION : 36" RCP

[RATING CURVE LIMIT]

Minimum Elevation..... = 729.80 (ft)
 Maximum Elevation..... = 735.00 (ft)
 Elevation Increment..... = 0.10 (ft)

[OUTLET STRUCTURE INFORMATION]

Circular Radius..... = 1.50000 (ft)
 Culvert Invert Elevation..... = 729.79999 (ft)
 Slope..... = 0.00500
 Manning's N-value..... = 0.01300
 Orifice Coefficient..... = 0.60000
 Tailwater..... = 729.59998 (ft)
 Number barrels..... = 1

[UNSUBMERGED EQUATION]

$H/Diam = H_c/Diam + K * (Q/(A*Diam^{0.5}))^M - 0.5*S^2$
 Coefficient K..... = 0.00980
 coefficient M..... = 2.00000

[SUBMERGED EQUATION]

$H/Diam = c * (Q/(A*Diam^{0.5}))^Z + Y - 0.5*S^2$
 Coefficient c..... = 0.03980
 Coefficient Y..... = 0.67000

[DEFINITIONS]

H = Headwater depth above inlet control section invert, (ft)
 Diam = Interior height of culvert barrel, (ft)
 Hc = Specific head at critical depth ($d_c + V_c^2/2g$), (ft)
 Q = Discharge, (cutf/s)
 A = Full cross sectional area of culvert barrel, (sqft)
 S = Culvert barrel slope, (ft/ft)

OUTLET STRUCTURE REPORT

RECORD NUMBER : 3
 TYPE : CIRCULAR CONCRETE w/ square edge w/ headwall
 DESCRIPTION : 36"RCP ~~---STRUCTURE---~~

{Culvert Weir Discharge Value vs. Stage}
 {the elevation increment is 1.0}

STAGE	ELEVATION (ft)	FLOW (cfs)
2.00	731.80	12.71
3.00	732.80	33.84
4.00	733.80	50.09
5.00	734.80	61.35
6.20	735.00	43.6

RAINFALL INTENSITY VALUES

Indianapolis, Indiana

Duration (Minutes)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
5	4.50	5.50	6.30	7.30	8.00	8.50
6	4.30	5.30	6.00	7.00	7.70	8.20
7	4.10	5.10	5.75	6.75	7.40	7.90
8	3.90	4.90	5.50	6.50	7.10	7.60
9	3.70	4.70	5.25	6.25	6.80	7.30
10	3.50	4.50	5.00	6.00	6.50	7.00
15	2.90	3.70	4.40	5.10	5.60	6.10
20	2.50	3.30	3.80	4.50	5.00	5.50
25	2.25	2.95	3.45	4.05	4.50	5.00
30	2.00	2.60	3.10	3.60	4.00	4.50
40	1.65	2.25	2.60	3.10	3.50	3.90
50	1.45	2.00	2.30	2.75	3.10	3.40
60	1.25	1.75	2.10	2.50	2.70	3.00
120	0.78	1.10	1.30	1.60	1.70	2.00
180	0.58	0.80	1.00	1.20	1.30	1.50
240	0.47	0.65	0.80	0.95	1.10	1.30

For Additional Values See Referenced Publications

Values taken from graph prepared by U.S. Department of Commerce
Weather Bureau based on recorded rainfalls from 1903 to 1951
See Technical Paper No. 25, Page 14, or Indiana State Highway
Commission Hydraulic Design of Drainage Culverts, Page 35

OVERLAND FLOW AND RUN-OFF COEFFICIENT

FIGURE 5.3

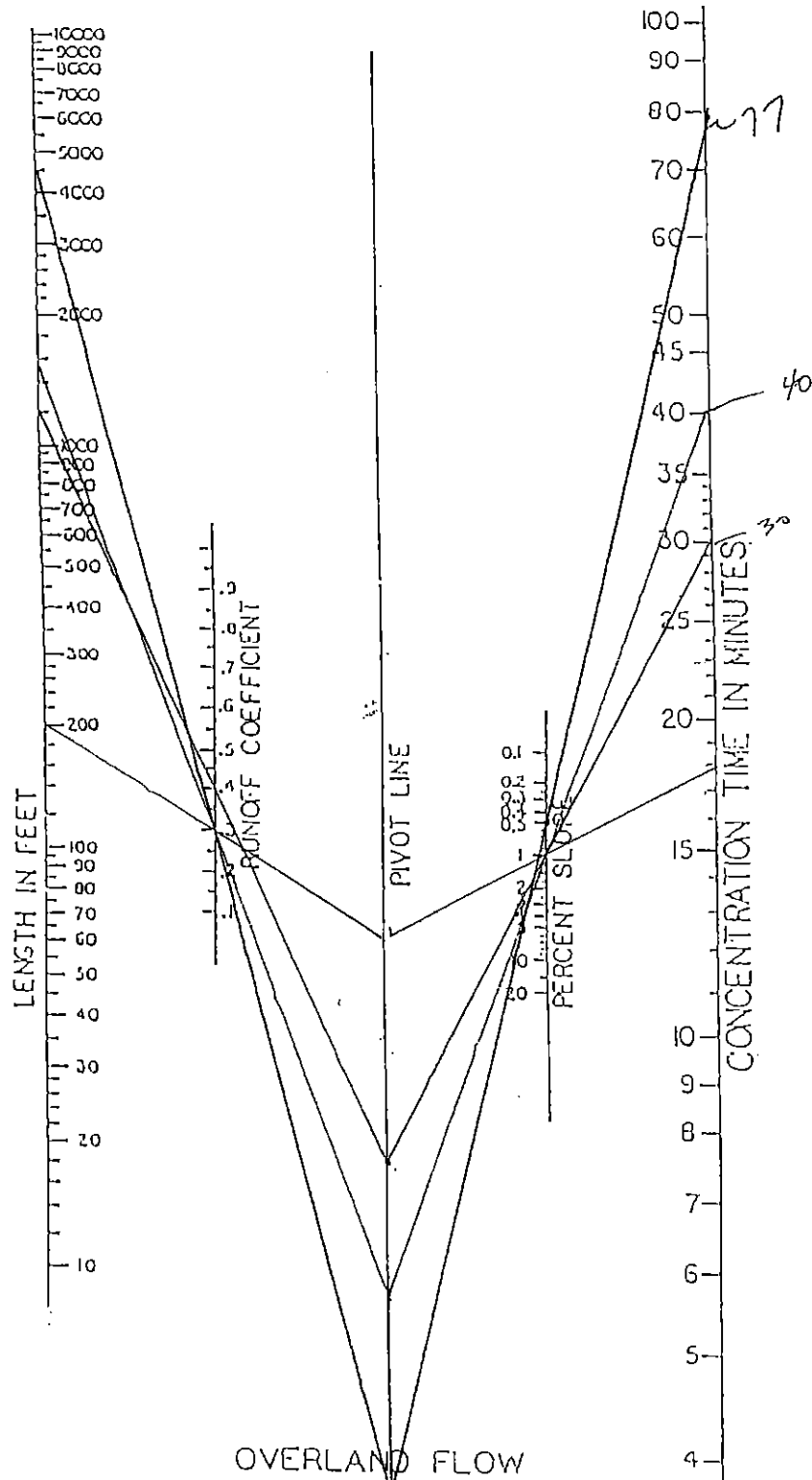


FIGURE 5

FLOW FOR CIRCULAR PIPE FLOWING FULL
BASED ON MANNING'S EQUATION $n=0.013$

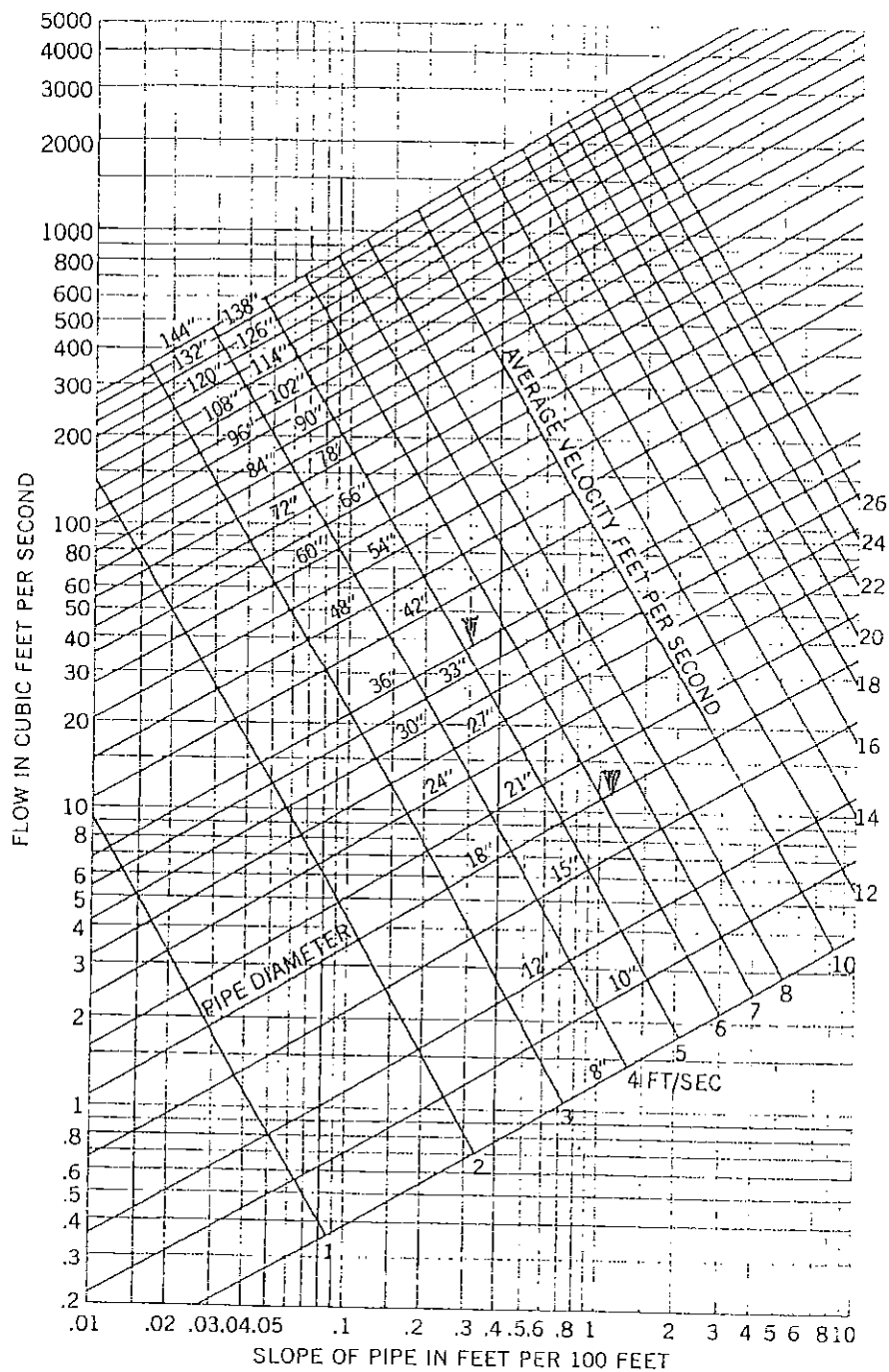
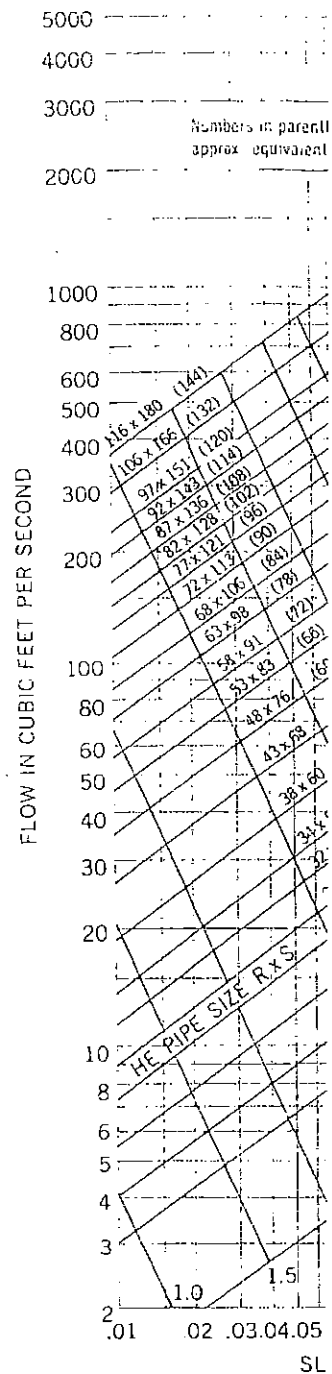


FIGURE 6

FLOW FOR HORI
BASED (



[illegible]

Reference:

Additional Detention Pond Calculations

**Prepared by Projects Plus
for the
Hurricane Industrial Park - Lots 9 & 10
Dated April 11, 2011**

4/11/11

Hurricane Industrial

Storm Sewer Calculations

		Ac.	%		"C"		
LOT #1	"C" Factor = Lawn	0.32	13%	0.132	x	0.15 =	0.02
	Asphalt	1.56	64%	0.645	x	0.85 =	0.55
	Roof	0.54	22%	0.223	x	0.90 =	0.20
	Cultivated Field	0.00	0%	0.000	x	0.30 =	0.00
	Area =					Weighted 'C'	0.77
2.42 Acres							
LOT #2	"C" Factor = Lawn	0.54	23%	0.234	x	0.15 =	0.04
	Asphalt	1.23	53%	0.532	x	0.85 =	0.45
	Roof	0.54	23%	0.234	x	0.90 =	0.21
	Cultivated Field	0.00	0%	0.000	x	0.30 =	0.00
	Area =					Weighted 'C'	0.70
2.31 Acres							
LOT #15	"C" Factor = Lawn	0.50	43%	0.435	x	0.15 =	0.07
	Asphalt	0.46	40%	0.400	x	0.85 =	0.34
	Roof	0.19	17%	0.165	x	0.90 =	0.15
	Cultivated Field	0.00	0%	0.000	x	0.30 =	0.00
	Area =					Weighted 'C'	0.55
1.15 Acres							
LOT #16	"C" Factor = Lawn	0.56	49%	0.487	x	0.15 =	0.07
	Asphalt	0.43	37%	0.374	x	0.85 =	0.32
	Roof	0.16	14%	0.139	x	0.90 =	0.13
	Cultivated Field	0.00	0%	0.000	x	0.30 =	0.00
	Area =					Weighted 'C'	0.52
1.15 Acres							
Lot #3,6-8 11-12,17	"C" Factor = Lawn	1.37	15%	0.150	x	0.15 =	0.02
	Asphalt	7.74	85%	0.850	x	0.85 =	0.72
	Roof	0.00	0%	0.000	x	0.90 =	0.00
	Cultivated Field	0.00	0%	0.000	x	0.30 =	0.00
	Area =					Weighted 'C'	0.74
9.11 Acres							
Lots # 13-16	"C" Factor = Lawn	1.24	25%	0.250	x	0.15 =	0.04
	Asphalt	3.72	75%	0.750	x	0.85 =	0.64
	Roof	0.00	0%	0.000	x	0.90 =	0.00
	Cultivated Field	0.00	0%	0.000	x	0.30 =	0.00
	Area =					Weighted 'C'	0.68
4.96 Acres							
Lots # 9-10	"C" Factor = Lawn	0.74	29%	0.290	x	0.15 =	0.04
	Asphalt	1.31	51%	0.514	x	0.85 =	0.44
	Roof	0.50	20%	0.196	x	0.90 =	0.18
	Cultivated Field	0.00	0%	0.000	x	0.30 =	0.00
	Area =					Weighted 'C'	0.66
2.55 Acres							
		Lawn	5.27	22%	0.223	x	0.15 = 0.03
		Asphalt	16.45	70%	0.696	x	0.85 = 0.59
		Roof	1.93	8%	0.082	x	0.90 = 0.07
		Cultivated Field	0.00	0%	0.000	x	0.30 = 0.00
						Weighted 'C'	0.70

EXISTING
LOTS

FUTURE
DEV.

CURRENT
DEV.

← AVERAGE 'C'
FOR DEVELOPMENT

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	53.30	1	40	127,912	----	-----	-----	Offsite - Frnk Eng
2	Rational	24.94	1	24	35,909	----	-----	-----	Onsite - Frnk Eng
3	Combine	61.61	1	40	163,821	1, 2	-----	-----	Total to Pond
4	Reservoir	23.13	1	63	163,476	3	734.48	111,407	Thru Pond
7	Rational	53.30	1	40	127,912	----	-----	-----	Offsite - Frnk Eng
8	Rational	29.09	1	24	41,894	----	-----	-----	Onsite - revised Proj +
9	Combine	62.99	1	40	169,806	7, 8	-----	-----	Total to Pond
10	Reservoir	23.81	1	62	169,459	9	734.58	114,967	Thru Pond
10009post-dra.gpw					Return Period: 2 Year			Monday, Apr 11 2011, 12:10 PM	

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	83.45	1	40	200,284	----	-----	-----	Offsite - Frnk Eng
2	Rational	38.76	1	24	55,816	----	-----	-----	Onsite - Frnk Eng
3	Combine	96.37	1	40	256,100	1, 2	-----	-----	Total to Pond
4	Reservoir	30.60	1	65	255,737	3	736.09	176,734	Thru Pond
7	Rational	83.45	1	40	200,284	----	-----	-----	Offsite - Frnk Eng
8	Rational	45.22	1	24	65,119	----	-----	-----	Onsite - revised Proj +
9	Combine	98.53	1	40	265,403	7, 8	-----	-----	Total to Pond
10	Reservoir	31.16	1	65	265,039	9	736.24	183,416	Thru Pond
10009post-dra.gpw					Return Period: 10 Year			Monday, Apr 11 2011, 12:10 PM	

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	122.09	1	40	293,027	---	-----	-----	Offsite - Frnk Eng
2	Rational	56.20	1	24	80,922	---	-----	-----	Onsite - Frnk Eng
3	Combine	140.83	1	40	373,949	1, 2	-----	-----	Total to Pond
4	Reservoir	37.34	1	68	373,565	3	738.09	269,751	Thru Pond
7	Rational	122.09	1	40	293,027	---	-----	-----	Offsite - Frnk Eng
8	Rational	65.56	1	24	94,409	---	-----	-----	Onsite - revised Proj +
9	Combine	143.95	1	40	387,436	7, 8	-----	-----	Total to Pond
10	Reservoir	37.97	1	68	387,051	9	738.30	280,257	Thru Pond
10009post-dra.gpw					Return Period: 100 Year			Monday, Apr 11 2011, 12:10 PM	

Hydrograph Report

Hydratation Hydrographs by Intersolva

Monday, Apr 11 2016 12:12 PM

Hvd. No. 1

Offsite - Frnk Eng

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 81.0 ac
Intensity = 3.768 in/hr
IDF Curve = MARION.IDF

Peak discharge = 122.09 cfs
Time Interval = 1 min
Runoff coeff. = 0.4
Tc by User = 40 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 293,027 cuft
(Parted volume = 30% of Qp)

Hydrograph Discharge Table

Time - Outflow (hrs cfs)		Time - Outflow (hrs cfs)	
0.33	61.05	0.90	79.36
0.35	64.10	0.92	78.31
0.37	67.15	0.93	73.26
0.38	70.20	0.95	70.20
0.40	73.26	0.97	67.15
0.42	76.31	0.98	64.10
0.43	79.36		
0.45	82.41		
0.47	85.47	...End	
0.48	88.52		
0.50	91.57		
0.52	94.62		
0.53	97.68		
0.55	100.73		
0.57	103.78		
0.58	106.83		
0.60	109.89		
0.82	112.94		
0.63	115.99		
0.65	119.04		
0.67	122.09		
0.68	119.04		
0.70	115.99		
0.72	112.94		
0.73	109.88		
0.75	106.83		
0.77	103.78		
0.78	100.73		
0.80	97.68		
0.82	94.62		
0.83	91.57		
0.85	88.52		
0.87	85.47		
0.88	82.41		

Hydrograph Report

Hydraflow Hydrographs by Intelligiver

Monday, Aug 11, 2014 12:16 PM

Hyd. No. 3

Total to Pend

Hydrograph type = Combine
Storm frequency = 100 yrs
Inflow hyds. = 1, 2

Peak discharge = 140.83 cfs
Time interval = 1 min

Hydrograph Volume = 373,940 cu ft
(Printed values \pm 87% of Obs)

Hydrograph Discharge Table

Time (hrs)	Hyd. 1 + (cfs)	Hyd. 2 = (cfs)	Outflow (cfs)
0.40	73.26	56.20 <<	129.45
0.42	76.31	53.85	130.16
0.43	79.36	51.51	130.87
0.45	82.41	49.17	131.59
0.47	85.47	46.83	132.30
0.48	88.52	44.49	133.01
0.50	91.57	42.15	133.72
0.52	94.62	39.81	134.43
0.53	97.68	37.46	135.14
0.55	100.73	35.12	135.85
0.57	103.78	32.78	136.56
0.58	106.83	30.44	137.27
0.60	109.89	28.10	137.98
0.62	112.94	25.76	138.69
0.63	115.99	23.42	139.40
0.65	119.04	21.07	140.12
0.67	122.09 <<	18.73	140.83
0.68	119.04	16.39	135.43
0.70	115.99	14.05	130.04

Hydrograph Report

Hard alloy hardcoatings by Intelisolve

Monday, Apr 11 2011, 12:13 PM

Hyd. No. 2

Onsite - Frnk Eng

Hydrograph type	= Rational
Storm frequency	= 100 yrs
Drainage area	= 18.3 ac
Intensity	= 5.118 in/hr
IDF Curve	= MARION.IDF

Peak discharge = 56.20 cfs
Time Interval = 1 min
Runoff coeff. = 0.6
Tc by User = 24 min
Asc/Reo flmb fact = 1/1

Hydrograph Volume = 80,922 cu ft
(Printed volume is 50% of Obs.)

Hydrograph Discharge Table

Time - Outflow (hrs cls)	
0.20	28.10
0.22	30.44
0.23	32.78
0.25	35.12
0.27	37.46
0.28	39.81
0.30	42.15
0.32	44.49
0.33	46.83
0.35	49.17
0.37	51.51
0.38	53.85
0.40	56.20 <<
0.42	53.85
0.43	51.51
0.45	49.17
0.47	46.83
0.48	44.49
0.50	42.15
0.52	39.81
0.53	37.46
0.55	35.12
0.57	32.78
0.58	30.44

...End

Hydrograph Report

Hydroflow Hydrographs by Intellisolve

Monday, Apr 11 2011, 12:17 PM

Hvd. No. 4

Thru Pond

Hydrograph type	= Reservoir
Storm frequency	= 100 yrs
Inflow hyd. No.	= 3
Max. Elevation	= 738.09 ft

Peak discharge = 37.34 cfs
Time interval = 1 min
Reservoir name = Detention Pond
Max. Storage = 269,751 cu ft

Storage/Indication method used.

Outflow hydrograph volume = 373,565 cu ft
(Printed volume as 97% of Out)

Hydrograph Discharge Table

[illegible]

End

Hydrograph Report

Hydroflow Hydrographs by Intelsolve

Monday, Apr 11 2011, 12:14 PM

Hyd. No. 7

Offsite - Frnk Eng

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 81.0 ac
Intensity = 3.768 in/hr
IDF Curve = MARION IDF

Peak discharge = 122.09 cfs
Time Interval = 1 min
Runoff coeff. = 0.4
Tc by User = 40 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 293,027 cuft
(Printed values = 50% of Qp)

Hydrograph Discharge Table

Time - (hrs)	Outflow (cfs)	Time - (hrs)	Outflow (cfs)
0.33	61.05	0.90	79.36
0.35	64.10	0.92	76.31
0.37	67.15	0.93	73.26
0.38	70.20	0.95	70.20
0.40	73.25	0.97	67.15
0.42	76.31	0.98	64.10
0.43	79.36		
0.45	82.41		
0.47	85.47	...End	
0.48	88.52		
0.50	91.57		
0.52	94.62		
0.53	97.68		
0.55	100.73		
0.57	103.78		
0.58	106.83		
0.60	109.88		
0.62	112.94		
0.63	115.99		
0.65	119.04		
0.67	122.09 <<		
0.68	119.04		
0.70	115.99		
0.72	112.94		
0.73	109.88		
0.75	106.83		
0.77	103.78		
0.78	100.73		
0.80	97.68		
0.82	94.62		
0.83	91.57		
0.85	88.52		
0.87	85.47		
0.88	82.41		

Hydrograph Report

Hydroflow Hydrographs by Intelsolve

Monday, Apr 11 2011, 12:15 PM

Hyd. No. 8

Onsite - revised Proj +

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 18.3 ac
Intensity = 5.118 in/hr
IDF Curve = MARION IDF

Peak discharge = 65.56 cfs
Time Interval = 1 min
Runoff coeff. = 0.7
Tc by User = 24 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 94,409 cuft
(Printed values = 50% of Qp)

Hydrograph Discharge Table

Time - (hrs)	Outflow (cfs)
0.20	32.78
0.22	35.51
0.23	38.24
0.25	40.98
0.27	43.71
0.28	46.44
0.30	49.17
0.32	51.90
0.33	54.64
0.35	57.37
0.37	60.10
0.38	62.83
0.40	65.56 <<
0.42	62.83
0.43	60.10
0.45	57.37
0.47	54.64
0.48	51.90
0.50	49.17
0.52	46.44
0.53	43.71
0.55	40.98
0.57	38.24
0.58	35.51
0.60	32.78

...End

Hydrograph Report

Hydroflow Hydrographs by Intelsolve

Monday, Apr 11 2011, 12:16 PM

Hyd. No. 9

Total to Pond

Hydrograph type = Combine
Storm frequency = 100 yrs
Inflow hyds. = 7, 8

Peak discharge = 143.95 cfs
Time interval = 1 min

Hydrograph Volume = 387,436 cuft
(Printed values = 50% of Qp)

Hydrograph Discharge Table

Time (hrs)	Hyd. 7 + (cfs)	Hyd. 8 = (cfs)	Outflow (cfs)
0.38	70.20	62.83	133.03
0.40	73.25	65.56 <<	138.82
0.42	76.31	62.83	139.14
0.43	79.36	60.10	139.46
0.45	82.41	57.37	139.78
0.47	85.47	54.64	140.10
0.48	88.52	51.90	140.42
0.50	91.57	49.17	140.74
0.52	94.62	46.44	141.06
0.53	97.68	43.71	141.38
0.55	100.73	40.98	141.70
0.57	103.78	38.24	142.02
0.58	106.83	35.51	142.35
0.60	109.88	32.78	142.67
0.62	112.94	30.05	142.99
0.63	115.99	27.32	143.31
0.65	119.04	24.59	143.63
0.67	122.09 <<	21.85	143.95 <<
0.68	119.04	19.12	138.16
0.70	115.99	16.39	132.38

...End

Hydrograph Report

Hydroflow Hydrographs by Intelsolve

Monday, Apr 11 2011, 12:18 PM

Hyd. No. 10

Thru Pond

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Inflow hyd. No. = 9
Max. Elevation = 738.30 ft

Peak discharge = 37.97 cfs
Time interval = 1 min
Reservoir name = Detention Pond
Max. Storage = 280,257 cuft

Storage Indication method used:

Outflow hydrograph volume = 387,051 cuft
(Printed values = 50% of Qp)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Civ A cfs	Civ B cfs	Civ C cfs	Civ D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.90	79.36	737.96	36.93									36.93
0.92	75.31	738.01	37.08									37.08
0.93	73.26	738.06	37.22									37.22
0.95	70.20	738.10	37.35									37.35
0.97	67.15	738.14	37.48									37.48
0.98	64.10	738.17	37.57									37.57
1.00	61.05	738.20	37.66									37.66
1.02	57.99	738.22	37.74									37.74
1.03	54.94	738.25	37.80									37.80
1.05	51.89	738.27	37.86									37.86
1.07	48.84	738.28	37.90									37.90
1.08	45.79	738.29	37.94									37.94
1.10	42.73	738.30	37.96									37.96
1.12	39.68	738.30	37.97									37.97
1.13	36.63	738.30 <<	37.97									37.97 <<
1.15	33.58	738.30	37.96									37.96
1.17	30.52	738.29	37.94									37.94
1.18	27.47	738.28	37.91									37.91
1.20	24.42	738.27	37.87									37.87
1.22	21.37	738.25	37.81									37.81
1.23	18.31	738.23	37.75									37.75
1.25	15.26	738.20	37.67									37.67
1.27	12.21	738.18	37.59									37.59
1.28	9.16	738.14	37.49									37.49
1.30	6.10	738.11	37.38									37.38
1.32	3.05	738.07	37.26									37.26
1.33	0.00	738.03	37.13									37.13
1.35	0.00	737.98	36.99									36.99
1.37	0.00	737.93	36.84									36.84

...End

Pond No. 1 - Detention Pond

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	731.00	26,323	0	0
1.00	732.00	29,098	27,711	27,711
2.00	733.00	32,500	30,799	58,510
3.00	734.00	36,500	34,500	93,010
4.00	735.00	39,500	38,000	131,010
5.00	736.00	43,500	41,500	172,510
6.00	737.00	46,000	44,750	217,260
7.00	738.00	49,500	47,750	265,010
7.50	738.50	51,000	25,125	290,135

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 731.00	0.00	0.00	0.00
Length (ft)	= 30.00	0.00	0.00	0.00
Slope (%)	= 0.30	0.00	0.00	0.00
N-Value	= .013	.000	.000	.000
Orif. Coeff.	= 0.60	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

[illegible]

Storm Sewer Calculations

ESI Electric Inc., Building

Storm Sewer Calculations

STR. #	Weighted "C" Factor =	Ac.	(%)	Coefficient	
601		Roof	0.20	16.3	x 0.03 = 0.00
		Pavement	0.69	56.1	x 0.45 = 0.25
		Lawn/Grass/Woods	0.34	27.6	x 0.20 = 0.06
Area = Acres				Weighted 'C'	0.31
1.23 Acres					

"T/c" =

$$1. \text{ Sheet Flow } T.C. = \frac{0.007}{2.64^{0.50}} \times \left(\frac{0.17}{1.00\%^{0.40}} \times 100 \right)^{0.80} = 15.73 \text{ Minutes}$$

2. Shallow Concentrated

$$\text{Unpaved: } T.C. = 16.135 \times 0.50\%^{0.5} = 1.14 \text{ ft/sec}$$

$$= \frac{170 \text{ feet}}{1.14 \text{ ft/sec}} = 2.48 \text{ Minutes}$$

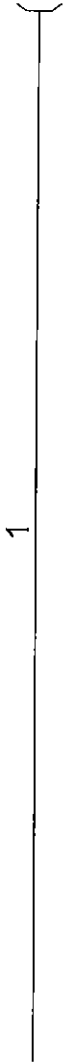
$$\text{Paved: } T.C. = 20.328 \times 0.30\%^{0.5} = 1.11 \text{ ft/sec}$$

$$= \frac{85 \text{ feet}}{1.11 \text{ ft/sec}} = 1.27 \text{ Minutes}$$

$$T/c \text{ Total} = 19.5 \text{ Minutes}$$

$$\text{Min. } 5.00 \text{ Minutes}$$

Hydraflow Plan View



Project file: 19028 600-601 Storm Design.stm	IDF file: MARION.IDF	No. Lines: 1	02-03-2020
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Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	Dns line No.
1	601	1.49	12 c	55.0	737.80	738.00	0.364	738.32	738.66	0.00	End
Project File: 19028 600-601 Storm Desig		IDF File: MARION.IDF				Total No. Lines: 1			Run Date: 02-03-2020		
NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.											

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Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID	
Line	To Line		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)		Up (ft)
1	End	55.0	1.23	1.23	0.31	0.38	0.38	20.0	20.0	3.9	1.49	2.15	3.17	12	0.36	738.00	737.80	738.66	738.32	740.80	0.00	601	
Project File: 19028 600-601 Storm Design.stm												IDF File: MARION.IDF				Total number of lines: 1				Run Date: 02-03-2020			
NOTES: Intensity = 57.92 / (Inlet time + 9.10) ^ 0.80; Return period = 10 Yrs. ; Initial tailwater elevation = 738.32 (ft)																							

Watershed Basin Maps

Storm Sewer Basin Map

