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Storm Water Detention/Retention Design

Date: 6/7/2007 Revised: 6/20/2007 Design Method: SCS & TR-55 Method Using Hydroflow Hydrographs
Design By: JAG Revised:
Checked By: RWB Revised:

Project: Interstate Commerce Center 1 File No.: 06F070.000
County: Butler City/Township: Fairfield/West Chester Twp.

Design Criteria And Comments:
Reduce 50 year post-developed storm runoff to that of a 10 year pre-developed storm runoff. Check 100 year runoff for post-developed conditions.

Site Area: 29.92 Acres

Soils: See A

Soils Type: ____ % A 45 % B 55 % C ____ % D

Cover: Grass/Cropland/Wooded Area

Present: CN = 79.6 (See A)
Time of Concentration: 1627' @ 3.52%
t_c = 33.40 minutes
Q_{10} = 46.68 cfs (See B)

L (ft) = 1627.00
L' (ft) = 1627.00
Elev 1 = 662.35
Elev 2 = 605.00
s (%) = 3.52
c = 0.40
t_c (min) = 33.40
$=1.8(1.1-c)L^{1/2}/s^{1/3}$

Future: 15.34 Impervious Area 14.58 Grass Area
CN = 83.3 (See A)
t_c = From Storm Sewer Calculations
t_c = 12.84 minutes (See Storm Calcs)
Q_{50} = 112.00 cfs (See C)

Detention/Retention must detain Q_{50} - Q_{10} = 65.32 cfs

Detention to be provided in the northeast corner of the site. Water quality is incorporated in basin design. (See Water Quality Calcs For Orifice Sizing)

Offsite Area: 21.27 Acres
Site Area: 15.34 Acres
Total Drainage Area: 36.61 Acres

Basin Description: Basin A - North East

Soils: See D

Soils Type: ____ % A 84 % B 16 % C ____ % D

Cover: Impervious Area = 11.44 Acres, Grass/Other Area = 25.17 Acres

CN = 78.4 (See D)
Time of Concentration: From Storm Sewer Calculations
t_c = 12.84 minutes (See Storm Calcs)
Q_{50} = 118.25 cfs (See E)

Basin must reduce flow by: 4.94 65.32 cfs 617.22
Detention Volume: ~~5.69~~ Acre-ft at Elevation: ~~617.14~~ (See F)
Outflow Structure: ~~110'-12" Stm. @ 1.82%~~ 117' - 12" Stm @ 1.79%
Inlet Inv. = ~~608.00~~ 608.06 Outlet Inv = ~~606.00~~ 605.97 (See F)

Riser Structure

Orifice	Number - Size (in)	Inv Elev
T/Grate	615.85	~~615.81~~
3		611.77
2	2-2'x6"	~~611.79~~
1	1-2.125" ∅	~~608.00~~ 608.06

Route Through Basin
Basin Reduces Flow By:
118.25 cfs Inflow - 8.81 cfs Outflow 109.44 cfs - OK
Detention/Retention Elevation: 616.81 (See G)
(With Water Quality Orifice And Volume, Outflow = ~~8.51~~ 8.99 cfs; Elev = ~~616.06~~ 616.83) (See H)

100 Year Flow:
CN = 78.4 (See D)
Time of Concentration: From Storm Sewer Calculations
t_c = 12.84 minutes (See Storm Calculations)
Q_{100} = 134.96 cfs (See I)

Rout Through Basin
Basin Reduces Flow By:
134.96 cfs Inflow - 18.80 cfs Outflow 116.16 cfs
$Elev_{100}$ = 617.14 (See J)
(With Water Quality Orifice And Volume, Outflow = ~~9.53~~ 18.85 cfs; Elev = ~~616.84~~ 617.22) (See K)

Spillway: $Q_{100} = C\ L\ H^{3/2}$ C = 2.6 L = 30.00 H = 1.44
Spillway Invert = 616.81 100-Yr Weir Flow = 618.25
Top of Dike Elevation = 618.75 Freeboard = 0.50
Spillway Side Slope (_ : 1) = 3.00

Comments: Detention basin needs to detain 69 CFS. As designed, the basin will detain 109.44 CFS. Detention basin is adequate as designed.

Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Friday, Oct 19, 2007

Pond No. 1 - Basin A-North East

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 608.06 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	608.06	00	0	0
0.94	609.00	672	316	316
1.94	610.00	7,313	3,993	4,308
2.94	611.00	16,811	12,062	16,370
3.94	612.00	24,601	20,706	37,076
4.94	613.00	29,348	26,975	64,051
5.94	614.00	32,722	31,035	95,086
6.94	615.00	35,551	34,137	129,222
7.94	616.00	38,482	37,017	166,239
8.94	617.00	41,454	39,968	206,207
9.94	618.00	44,388	42,921	249,128

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	2.13	6.00	0.00
Span (in)	= 12.00	2.13	24.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 608.06	608.06	611.77	0.00
Length (ft)	= 117.00	0.00	0.00	0.00
Slope (%)	= 1.79	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.61	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	15.00	0.00
Crest El. (ft)	= 615.85	0.00	616.81	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= Riser	---	Broad	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	608.06	0.00	0.00	0.00	---	0.00	---	0.00	---	---	---	0.000
0.09	32	608.15	0.01 ic	0.01 ic	0.00	---	0.00	---	0.00	---	---	---	0.013
0.19	63	608.25	0.04 ic	0.04 ic	0.00	---	0.00	---	0.00	---	---	---	0.038
0.28	95	608.34	0.05 ic	0.05 ic	0.00	---	0.00	---	0.00	---	---	---	0.051
0.38	126	608.44	0.06 ic	0.06 ic	0.00	---	0.00	---	0.00	---	---	---	0.062
0.47	158	608.53	0.07 ic	0.07 ic	0.00	---	0.00	---	0.00	---	---	---	0.071
0.56	190	608.62	0.08 ic	0.08 ic	0.00	---	0.00	---	0.00	---	---	---	0.079
0.66	221	608.72	0.09 ic	0.09 ic	0.00	---	0.00	---	0.00	---	---	---	0.087
0.75	253	608.81	0.10 ic	0.09 ic	0.00	---	0.00	---	0.00	---	---	---	0.094
0.85	284	608.91	0.11 ic	0.10 ic	0.00	---	0.00	---	0.00	---	---	---	0.100
0.94	316	609.00	0.11 ic	0.11 ic	0.00	---	0.00	---	0.00	---	---	---	0.107
1.04	715	609.10	0.11 ic	0.11 ic	0.00	---	0.00	---	0.00	---	---	---	0.113
1.14	1,114	609.20	0.12 ic	0.12 ic	0.00	---	0.00	---	0.00	---	---	---	0.119
1.24	1,514	609.30	0.13 ic	0.12 ic	0.00	---	0.00	---	0.00	---	---	---	0.125
1.34	1,913	609.40	0.13 ic	0.13 ic	0.00	---	0.00	---	0.00	---	---	---	0.130
1.44	2,312	609.50	0.14 ic	0.14 ic	0.00	---	0.00	---	0.00	---	---	---	0.136
1.54	2,711	609.60	0.14 ic	0.14 ic	0.00	---	0.00	---	0.00	---	---	---	0.141
1.64	3,111	609.70	0.15 ic	0.15 ic	0.00	---	0.00	---	0.00	---	---	---	0.146
1.74	3,510	609.80	0.16 ic	0.15 ic	0.00	---	0.00	---	0.00	---	---	---	0.150
1.84	3,909	609.90	0.16 ic	0.15 ic	0.00	---	0.00	---	0.00	---	---	---	0.155
1.94	4,308	610.00	0.16 ic	0.16 ic	0.00	---	0.00	---	0.00	---	---	---	0.159
2.04	5,515	610.10	0.17 ic	0.16 ic	0.00	---	0.00	---	0.00	---	---	---	0.164
2.14	6,721	610.20	0.17 ic	0.17 ic	0.00	---	0.00	---	0.00	---	---	---	0.168
2.24	7,927	610.30	0.18 ic	0.17 ic	0.00	---	0.00	---	0.00	---	---	---	0.172
2.34	9,133	610.40	0.18 ic	0.18 ic	0.00	---	0.00	---	0.00	---	---	---	0.176
2.44	10,339	610.50	0.18 ic	0.18 ic	0.00	---	0.00	---	0.00	---	---	---	0.180
2.54	11,546	610.60	0.19 ic	0.18 ic	0.00	---	0.00	---	0.00	---	---	---	0.184
2.64	12,752	610.70	0.19 ic	0.19 ic	0.00	---	0.00	---	0.00	---	---	---	0.188
2.74	13,958	610.80	0.20 ic	0.19 ic	0.00	---	0.00	---	0.00	---	---	---	0.192
2.84	15,164	610.90	0.20 ic	0.20 ic	0.00	---	0.00	---	0.00	---	---	---	0.195
2.94	16,370	611.00	0.20 ic	0.20 ic	0.00	---	0.00	---	0.00	---	---	---	0.199
3.04	18,441	611.10	0.20 ic	0.20 ic	0.00	---	0.00	---	0.00	---	---	---	0.202

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Basin A-North East

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.14	20,512	611.20	0.21 ic	0.21 ic	0.00	---	0.00	---	0.00	---	---	---	0.206
3.24	22,582	611.30	0.21 ic	0.21 ic	0.00	---	0.00	---	0.00	---	---	---	0.210
3.34	24,653	611.40	0.21 ic	0.21 ic	0.00	---	0.00	---	0.00	---	---	---	0.213
3.44	26,723	611.50	0.22 ic	0.22 ic	0.00	---	0.00	---	0.00	---	---	---	0.216
3.54	28,794	611.60	0.22 ic	0.22 ic	0.00	---	0.00	---	0.00	---	---	---	0.219
3.64	30,865	611.70	0.22 ic	0.22 ic	0.00	---	0.00	---	0.00	---	---	---	0.223
3.74	32,935	611.80	0.26 ic	0.23 ic	0.04 ic	---	0.00	---	0.00	---	---	---	0.260
3.84	35,006	611.90	0.56 ic	0.22 ic	0.32 ic	---	0.00	---	0.00	---	---	---	0.543
3.94	37,076	612.00	0.99 ic	0.22 ic	0.75 ic	---	0.00	---	0.00	---	---	---	0.974
4.04	39,774	612.10	1.52 ic	0.22 ic	1.29 ic	---	0.00	---	0.00	---	---	---	1.512
4.14	42,471	612.20	2.14 ic	0.22 ic	1.92 ic	---	0.00	---	0.00	---	---	---	2.139
4.24	45,169	612.30	2.76 ic	0.22 ic	2.55 ic	---	0.00	---	0.00	---	---	---	2.763
4.34	47,866	612.40	3.18 ic	0.21 ic	2.97 ic	---	0.00	---	0.00	---	---	---	3.181
4.44	50,564	612.50	3.55 ic	0.21 ic	3.34 ic	---	0.00	---	0.00	---	---	---	3.546
4.54	53,261	612.60	3.87 ic	0.21 ic	3.67 ic	---	0.00	---	0.00	---	---	---	3.875
4.64	55,958	612.70	4.18 ic	0.21 ic	3.97 ic	---	0.00	---	0.00	---	---	---	4.176
4.74	58,656	612.80	4.46 ic	0.20 ic	4.25 ic	---	0.00	---	0.00	---	---	---	4.455
4.84	61,353	612.90	4.72 ic	0.20 ic	4.52 ic	---	0.00	---	0.00	---	---	---	4.717
4.94	64,051	613.00	4.97 ic	0.20 ic	4.77 ic	---	0.00	---	0.00	---	---	---	4.965
5.04	67,154	613.10	5.20 oc	0.20 ic	5.00 ic	---	0.00	---	0.00	---	---	---	5.200
5.14	70,258	613.20	5.42 oc	0.19 ic	5.23 ic	---	0.00	---	0.00	---	---	---	5.419
5.24	73,361	613.30	5.63 oc	0.18 ic	5.45 ic	---	0.00	---	0.00	---	---	---	5.628
5.34	76,465	613.40	5.83 oc	0.17 ic	5.66 ic	---	0.00	---	0.00	---	---	---	5.829
5.44	79,568	613.50	6.02 oc	0.16 ic	5.86 ic	---	0.00	---	0.00	---	---	---	6.022
5.54	82,672	613.60	6.21 oc	0.16 ic	6.05 ic	---	0.00	---	0.00	---	---	---	6.207
5.64	85,775	613.70	6.29 oc	0.15 ic	6.14 ic	---	0.00	---	0.00	---	---	---	6.292
5.74	88,879	613.80	6.34 oc	0.15 ic	6.18 ic	---	0.00	---	0.00	---	---	---	6.339
5.84	91,982	613.90	6.38 oc	0.16 ic	6.23 ic	---	0.00	---	0.00	---	---	---	6.385
5.94	95,086	614.00	6.43 oc	0.16 ic	6.27 ic	---	0.00	---	0.00	---	---	---	6.431
6.04	98,499	614.10	6.48 oc	0.16 ic	6.32 ic	---	0.00	---	0.00	---	---	---	6.476
6.14	101,913	614.20	6.52 oc	0.16 ic	6.36 ic	---	0.00	---	0.00	---	---	---	6.522
6.24	105,327	614.30	6.57 oc	0.16 ic	6.41 ic	---	0.00	---	0.00	---	---	---	6.566
6.34	108,740	614.40	6.61 oc	0.16 ic	6.45 ic	---	0.00	---	0.00	---	---	---	6.611
6.44	112,154	614.50	6.66 oc	0.16 ic	6.49 ic	---	0.00	---	0.00	---	---	---	6.655
6.54	115,568	614.60	6.70 oc	0.16 ic	6.54 ic	---	0.00	---	0.00	---	---	---	6.699
6.64	118,981	614.70	6.74 oc	0.16 ic	6.58 ic	---	0.00	---	0.00	---	---	---	6.743
6.74	122,395	614.80	6.79 oc	0.17 ic	6.62 ic	---	0.00	---	0.00	---	---	---	6.787
6.84	125,809	614.90	6.83 oc	0.17 ic	6.66 ic	---	0.00	---	0.00	---	---	---	6.830
6.94	129,222	615.00	6.87 oc	0.17 ic	6.70 ic	---	0.00	---	0.00	---	---	---	6.873
7.04	132,924	615.10	6.92 oc	0.17 ic	6.75 ic	---	0.00	---	0.00	---	---	---	6.915
7.14	136,626	615.20	6.96 oc	0.17 ic	6.79 ic	---	0.00	---	0.00	---	---	---	6.958
7.24	140,327	615.30	7.00 oc	0.17 ic	6.83 ic	---	0.00	---	0.00	---	---	---	7.000
7.34	144,029	615.40	7.04 oc	0.17 ic	6.87 ic	---	0.00	---	0.00	---	---	---	7.042
7.44	147,731	615.50	7.08 oc	0.17 ic	6.91 ic	---	0.00	---	0.00	---	---	---	7.083
7.54	151,432	615.60	7.12 oc	0.17 ic	6.95 ic	---	0.00	---	0.00	---	---	---	7.125
7.64	155,134	615.70	7.17 oc	0.18 ic	6.99 ic	---	0.00	---	0.00	---	---	---	7.166
7.74	158,836	615.80	7.21 oc	0.18 ic	7.03 ic	---	0.00	---	0.00	---	---	---	7.207
7.84	162,537	615.90	7.32 oc	0.17 ic	6.85 ic	---	0.30	---	0.00	---	---	---	7.318
7.94	166,239	616.00	7.63 oc	0.15 ic	5.93 ic	---	1.55	---	0.00	---	---	---	7.631
8.04	170,236	616.10	7.99 oc	0.11 ic	4.55 ic	---	3.33	---	0.00	---	---	---	7.992
8.14	174,232	616.20	8.31 oc	0.07 ic	2.76 ic	---	5.48 s	---	0.00	---	---	---	8.307
8.24	178,229	616.30	8.42 oc	0.05 ic	2.05 ic	---	6.33 s	---	0.00	---	---	---	8.422
8.34	182,226	616.40	8.50 oc	0.04 ic	1.64 ic	---	6.82 s	---	0.00	---	---	---	8.498
8.44	186,223	616.50	8.56 oc	0.03 ic	1.36 ic	---	7.17 s	---	0.00	---	---	---	8.558
8.54	190,220	616.60	8.62 oc	0.03 ic	1.15 ic	---	7.44 s	---	0.00	---	---	---	8.614
8.64	194,216	616.70	8.67 oc	0.02 ic	0.99 ic	---	7.65 s	---	0.00	---	---	---	8.662
8.74	198,213	616.80	8.72 oc	0.02 ic	0.87 ic	---	7.82 s	---	0.00	---	---	---	8.711
8.84	202,210	616.90	8.76 oc	0.02 ic	0.77 ic	---	7.97 s	---	1.05	---	---	---	9.804
8.94	206,207	617.00	8.81 oc	0.02 ic	0.69 ic	---	8.10 s	---	3.23	---	---	---	12.03
9.04	210,499	617.10	8.85 oc	0.02 ic	0.62 ic	---	8.21 s	---	6.09	---	---	---	14.93
9.14	214,791	617.20	8.90 oc	0.01 ic	0.56 ic	---	8.30 s	---	9.50	---	---	---	18.38
9.24	219,083	617.30	8.94 oc	0.01 ic	0.51 ic	---	8.40 s	---	13.37	---	---	---	22.30
9.34	223,375	617.40	8.99 oc	0.01 ic	0.47 ic	---	8.47 s	---	17.67	---	---	---	26.63
9.44	227,667	617.50	9.03 oc	0.01 ic	0.44 ic	---	8.55 s	---	22.35	---	---	---	31.34
9.54	231,959	617.60	9.08 oc	0.01 ic	0.41 ic	---	8.64 s	---	27.38	---	---	---	36.43
9.64	236,252	617.70	9.12 oc	0.01 ic	0.38 ic	---	8.69 s	---	32.74	---	---	---	41.81
9.74	240,544	617.80	9.16 oc	0.01 ic	0.35 ic	---	8.74 s	---	38.41	---	---	---	47.51
9.84	244,836	617.90	9.20 oc	0.01 ic	0.33 ic	---	8.83 s	---	44.37	---	---	---	53.54
9.94	249,128	618.00	9.25 oc	0.01 ic	0.31 ic	---	8.89 s	---	50.63	---	---	---	59.84

...End

Hydrograph Report

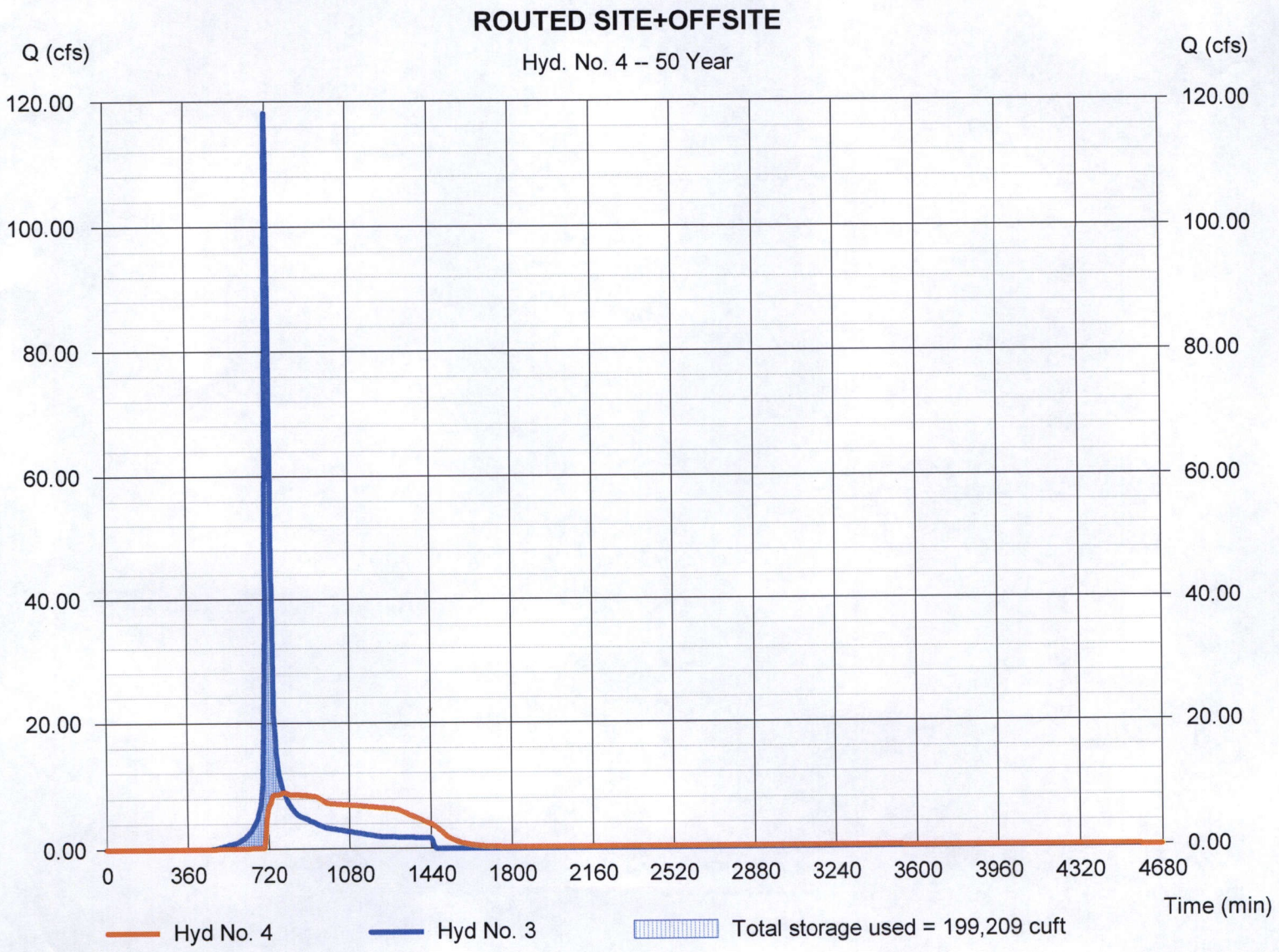
Hydraflow Hydrographs by Intelisolve v9.2 — Friday, Oct 19, 2007

Hyd. No. 4

ROUTED SITE+OFFSITE

Hydrograph type	= Reservoir	Peak discharge	= 8.982 cfs
Storm frequency	= 50 yrs	Time to peak	= 792 min
Time interval	= 6 min	Hyd. volume	= 363,678 cuft
Inflow hyd. No.	= 3 - POST-DEVELOPED SITE+OFFSITE	Max. Elevation	= 616.83 ft
Reservoir name	= Basin A-North East	Max. Storage	= 199,209 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Friday, Oct 19, 2007

Hyd. No. 4

ROUTED SITE+OFFSITE

Hydrograph type	= Reservoir	Peak discharge	= 18.85 cfs
Storm frequency	= 100 yrs	Time to peak	= 750 min
Time interval	= 6 min	Hyd. volume	= 414,612 cuft
Inflow hyd. No.	= 3 - POST-DEVELOPED SITE+OFFSITE	Max. Elevation	= 617.22 ft
Reservoir name	= Basin A-North East	Max. Storage	= 215,289 cuft

Storage Indication method used.

