Stormwater Management Report

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JUN 19 2014

Town of Acton
Planning Department

For

848 Main Street
Acton, MA

January 22, 2014
Revised – June 3, 2014

Applicant: Acorn Deck House Company
852 Main Street
Acton, MA 01720

Stamski And McNary, Inc.
Engineering - Planning – Surveying
1000 Main Street; Acton, MA 01720 (978) 263-8585
www.stamskiandmcnary.com

SM-72B File: 72B-StormwaterReportCover.doc

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Narrative

Stormwater Management

The proposed project is to add a paved surface to the site as well as stormwater BMP's to treat and infiltrate runoff from impervious surfaces on the site.

Pre Development-

The existing site is approximately 8.33 ac and contains an existing building, roofed storage areas, a fire pond, and associated bituminous concrete pavement and gravel. The building is currently being used to manufacture modular homes. Approximately 45,626 sf of pavement and 7,758 sf of gravel have been added to the site without providing treatment for the added runoff. The site has been divided into 4 subcatchments as shown on the attached drainage map.

Subcatchment 1 is located to the south and drains in to an existing detention basin which overflows to a catch basin in Main Street. Subcatchment 2 is the southern portion of the building roof and a portion of pavement. This subcatchment drains to 3 existing leaching catch basins on site. Subcatchment 3 is the northwest area of the site that drains to the fire pond on site. Therefore, subcatchments 2 and 3 are not contributing to the total off-site runoff and volume tables shown below. Subcatchment 4 is the area of roof and pavement on the eastern portion of the site. This area drains off the site towards Eastern Road.

Post Development-

The proposed work is to bring the site into compliance with the Town of Acton Zoning Bylaws and the Rules and Regulations for Site Plan Special Permits. This requires the removal of pavement on the southern portion of the site and the addition of pavement in the western portion of the site. Stormwater controls are proposed to treat and infiltrate the runoff created by the added impervious areas on site as well as the impervious areas that were added without providing treatment. The proposed subcatchments are shown on the attached drainage map.

The pavement parking area in Subcatchment 1 will drain to a deep sump hooded catch basin and manhole with a diversion wall to direct the first inch of runoff from the impervious area to a clay lined retention basin prior to discharging into the existing basin. This will provide pre-treatment for stormwater before infiltrating in the existing basin. The existing outlet structure will have the v-notch mortared closed and re-cut 6" higher to reduce the discharge off-site. Subcatchment 2 will not be adjusted and will continue to drain to the 3 leaching catch basins. Impervious areas in subcatchment 3 will drain to a catch basin and VortSentry HS36 unit before discharging to the fire pond. The VortSentry unit will provide pretreatment of the runoff. Subcatchment 4 will no longer be draining off site. An infiltration trench will be installed to capture and infiltrate the roof runoff and all other impervious in the subcatchment will be sent to deep sump hooded catch basins and manholes and a Contech CDS 2015-4 unit for pre-treatment

prior to discharging to the fire pond. Therefore, subcatchments 2, 3 and 4 are not contributing to the total off-site runoff and volume tables shown below.

In accordance with the Town of Acton Zoning Bylaw, Section 10.4.3.1, the peak rate of stormwater runoff will not exceed the existing rate based on a 10-year storm event. The peak off site runoff was decreased due to infiltrating roof runoff and redirecting the impervious area of Subcatchment 4 to the existing fire pond on site. The peak runoff rates have been summarized in the following tables.

Discharge Summary Tables

Total Runoff

2-year Storm		10-year Storm	
Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)
2.439	0.000	5.015	0.032

Total Volume

2-year Storm		10-year Storm	
Pre (cf)	Post (cf)	Pre (cf)	Post (cf)
7,642	0	15,495	69

In accordance with the Rules and Regulations for Site Plan Special Permits, water balance calculations have also been performed. Detailed calculations for water balance, infiltration trench sizing, inlet grate capacity, and pipe sizing are attached.

Design Basis

1. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine offsite rates of runoff.
2. The twenty-four hour rainfall, taken from N.R.C.S. publications, is 4.5 inches for the 10-year storm, and 3.1 inches for the 2-year storm event.
3. The hydrologic calculations were performed using the computer program: "Hydraflow Hydrographs 2007" by Intelisolve.
4. The soil types of the site were taken from the N.R.C.S. Soil Survey Map for Acton.
5. Soil conditions and observed seasonal high groundwater table were based on on-site soil evaluations.
6. The Natural Resources Conservation Service (N.R.C.S.) soil survey indicated the presences of Merrimac-Urban land complex. This soil group rates as Hydrologic Group A.

Pre-Development Hydrology

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.697	2	726	2,943	---	-----	-----	E1
2	SCS Runoff	3.098	2	724	10,402	---	-----	-----	E2
3	SCS Runoff	0.262	2	740	2,502	---	-----	-----	E3
4	SCS Runoff	2.439	2	724	7,585	---	-----	-----	E4
5	Reservoir	0.224	2	752	2,940	1	95.28	601	Existing Basin
6	Diversion1	0.215	2	752	2,883	5	-----	-----	Exfiltration
7	Diversion2	0.009	2	752	57	5	-----	-----	Overflow
8	Combine	2.439	2	724	7,642	4, 7	-----	-----	Total Runoff

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	2.238	2	724	7,348	----	------	------	E1
2	SCS Runoff	4.532	2	724	15,485	----	------	------	E2
3	SCS Runoff	2.025	2	726	8,484	----	------	------	E3
4	SCS Runoff	4.987	2	724	14,963	----	------	------	E4
5	Reservoir	0.773	2	746	7,345	1	95.83	1,784	Existing Basin
6	Diversion1	0.637	2	746	6,812	5	------	------	Exfiltration
7	Diversion2	0.136	2	746	532	5	------	------	Overflow
8	Combine	5.015	2	724	15,495	4, 7	------	------	Total Runoff

Worksheet 2: Runoff curve number and runoff **SM-0072B**

Project: 848 Main Street By WJH Date 06/04/14

Location: Acton, MA Checked _____ Date _____

Circle one: Present Developed Subcatchment 1

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Woods- Good Condition	30			0.00	
A	Open Space- Good Condition	39			0.89	34.83
A	Pavement	98			0.50	49.29
A	Roof	98			0.00	
A	Gravel	76			0.36	26.98
					Totals = 1.75	111.10

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{111.10}{1.75} = 63.45$; Use CN = 63.5

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency..... yr	2	10	100
Rainfall, P (24-hour)..... in	3.1	4.5	6.4
Runoff, Q..... in (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	0.49	1.23	2.50
Runoff, Q..... cf	3129	7822	15902

D-2 (210-VI-TR-55, Second Ed., June 1986)

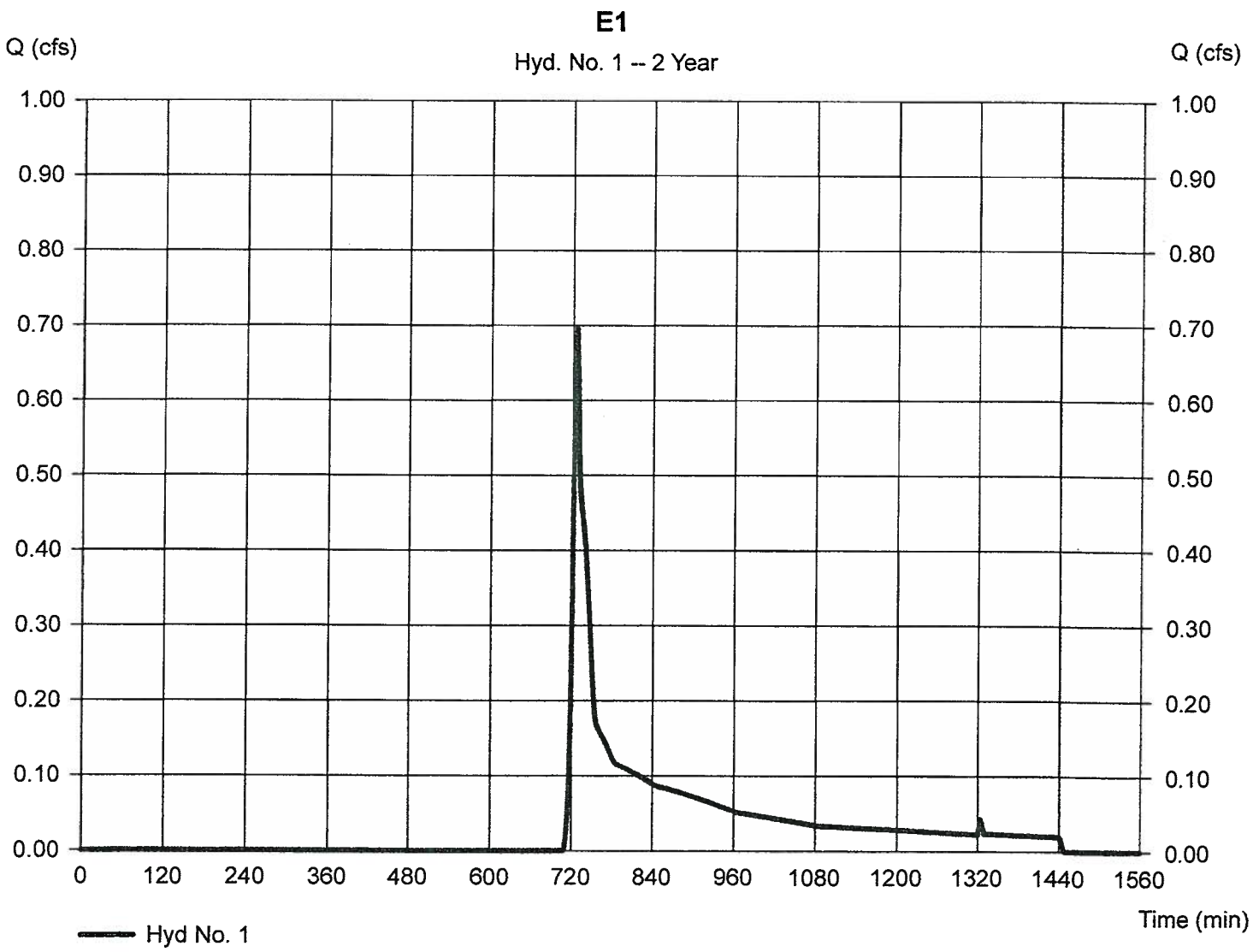
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.697 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 2,943 cuft
Drainage area	= 1.750 ac	Curve number	= 63.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



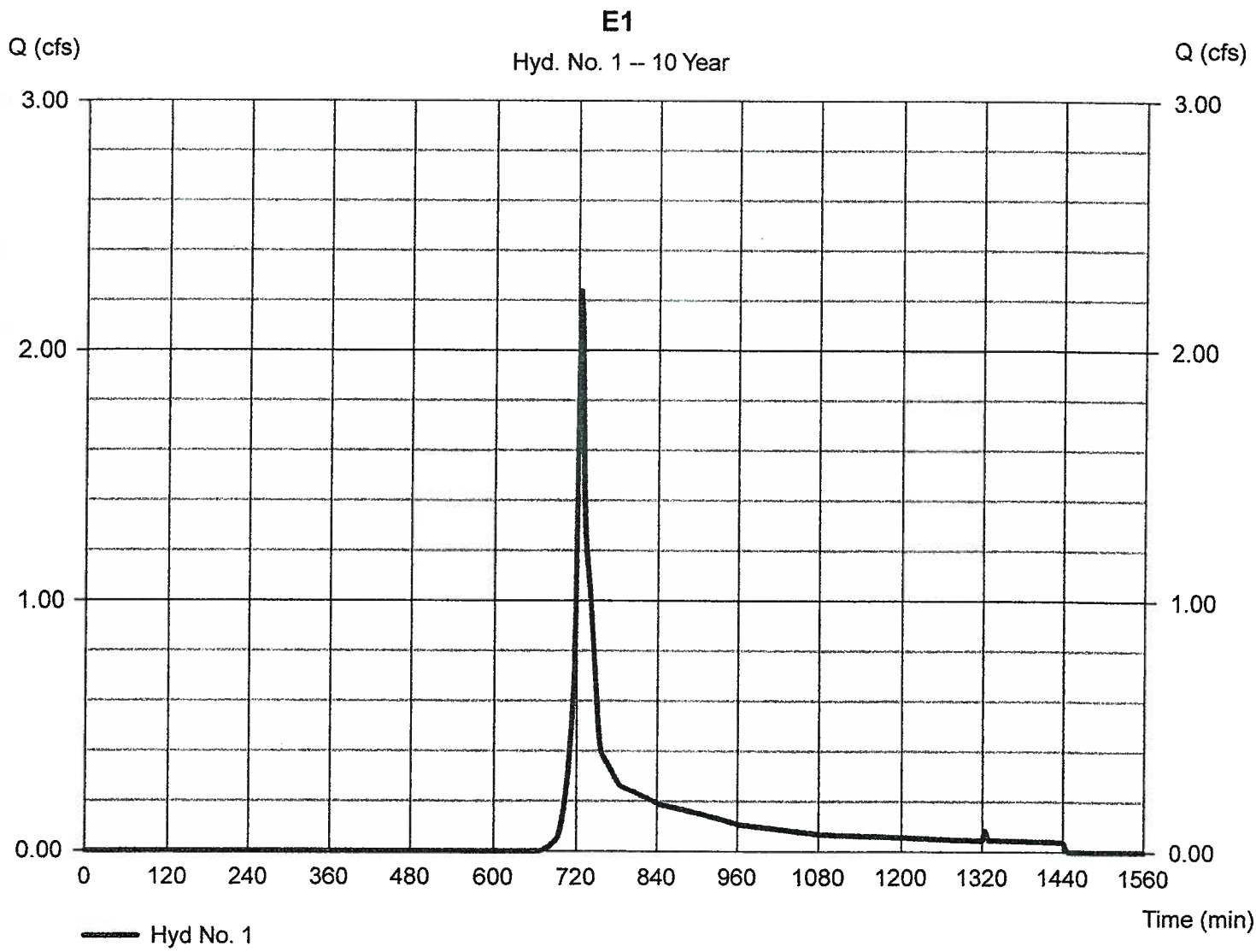
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.238 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 7,348 cuft
Drainage area	= 1.750 ac	Curve number	= 63.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



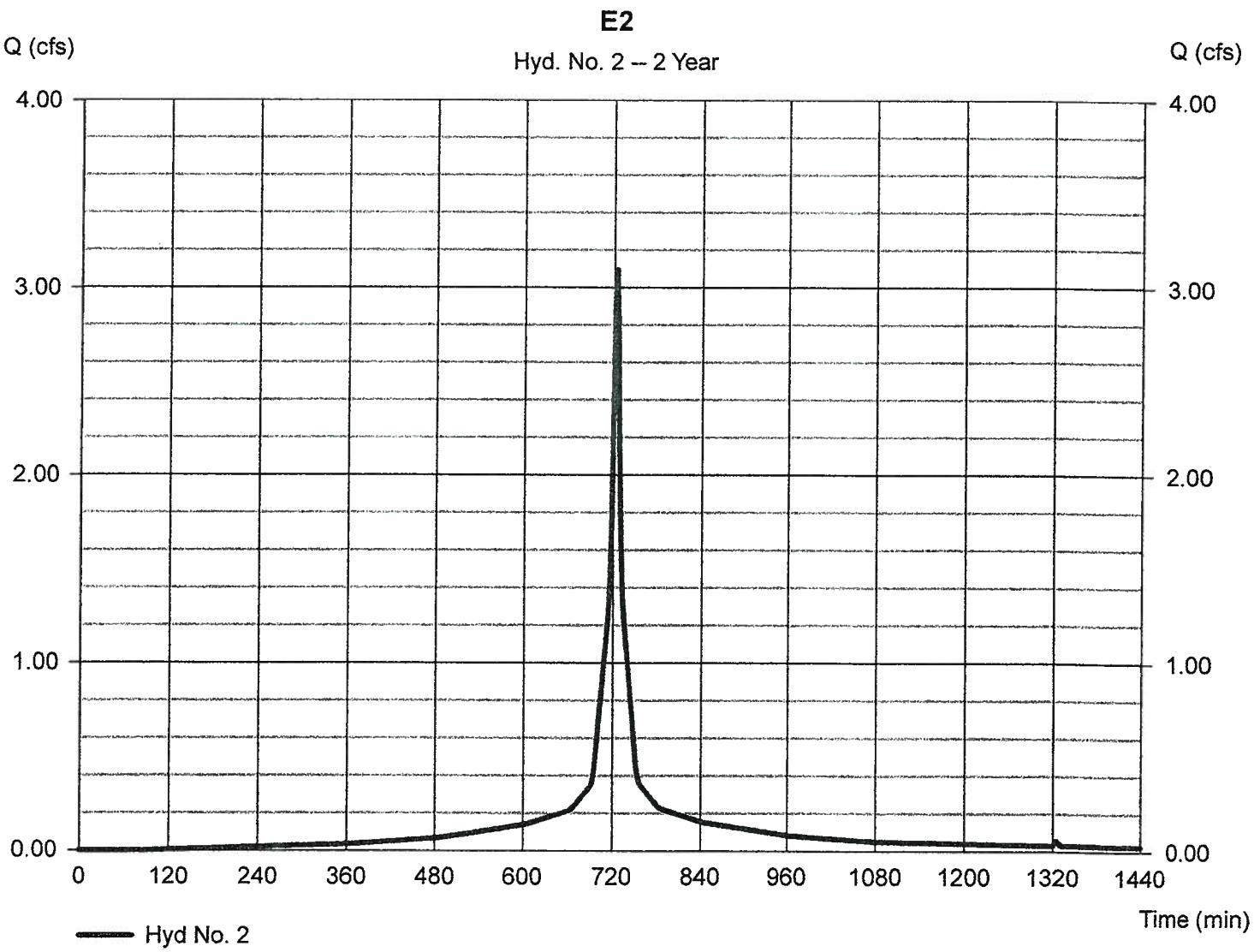
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 2

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.098 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 10,402 cuft
Drainage area	= 1.070 ac	Curve number	= 97.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



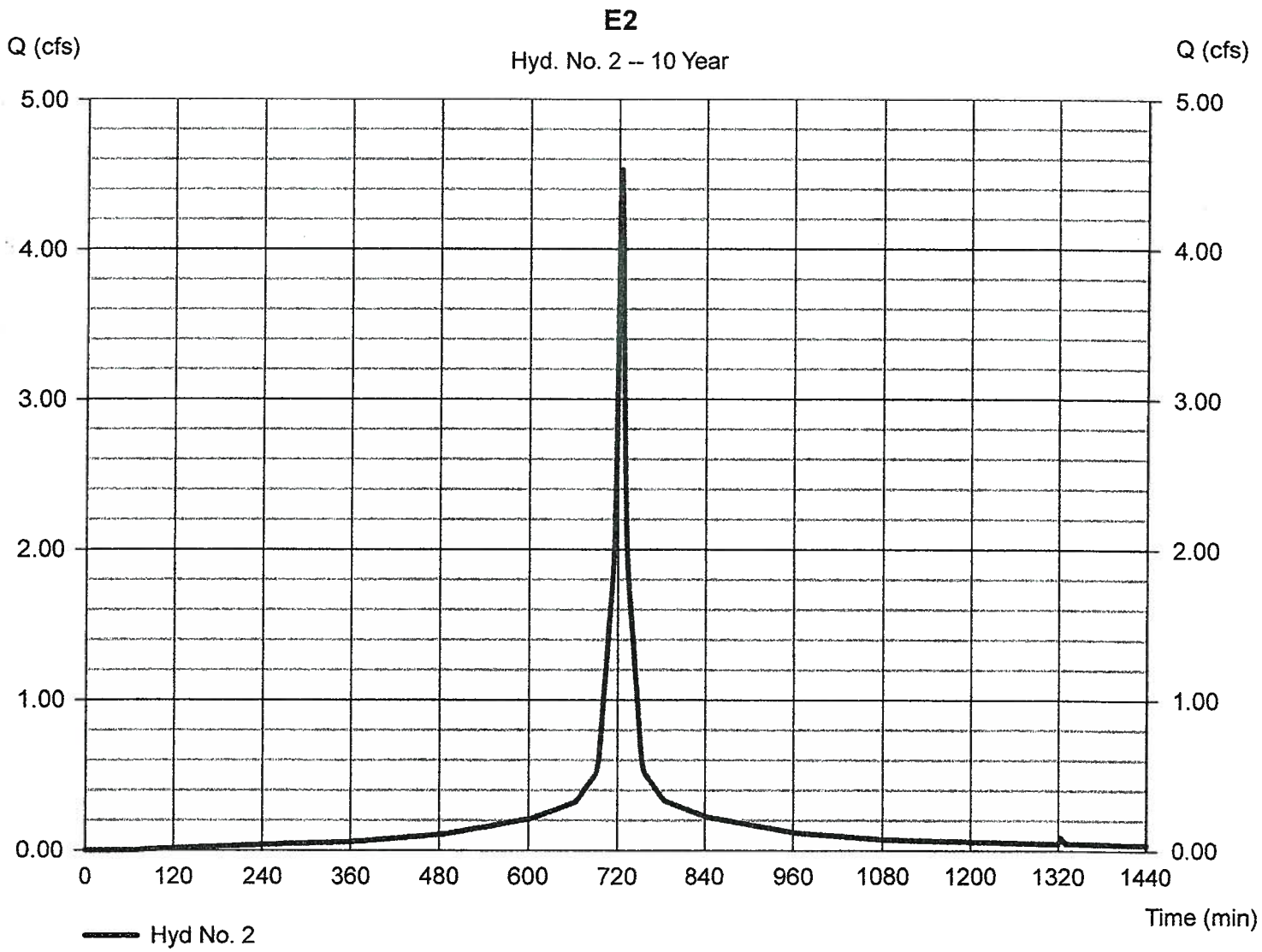
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 2

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 4.532 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 15,485 cuft
Drainage area	= 1.070 ac	Curve number	= 97.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



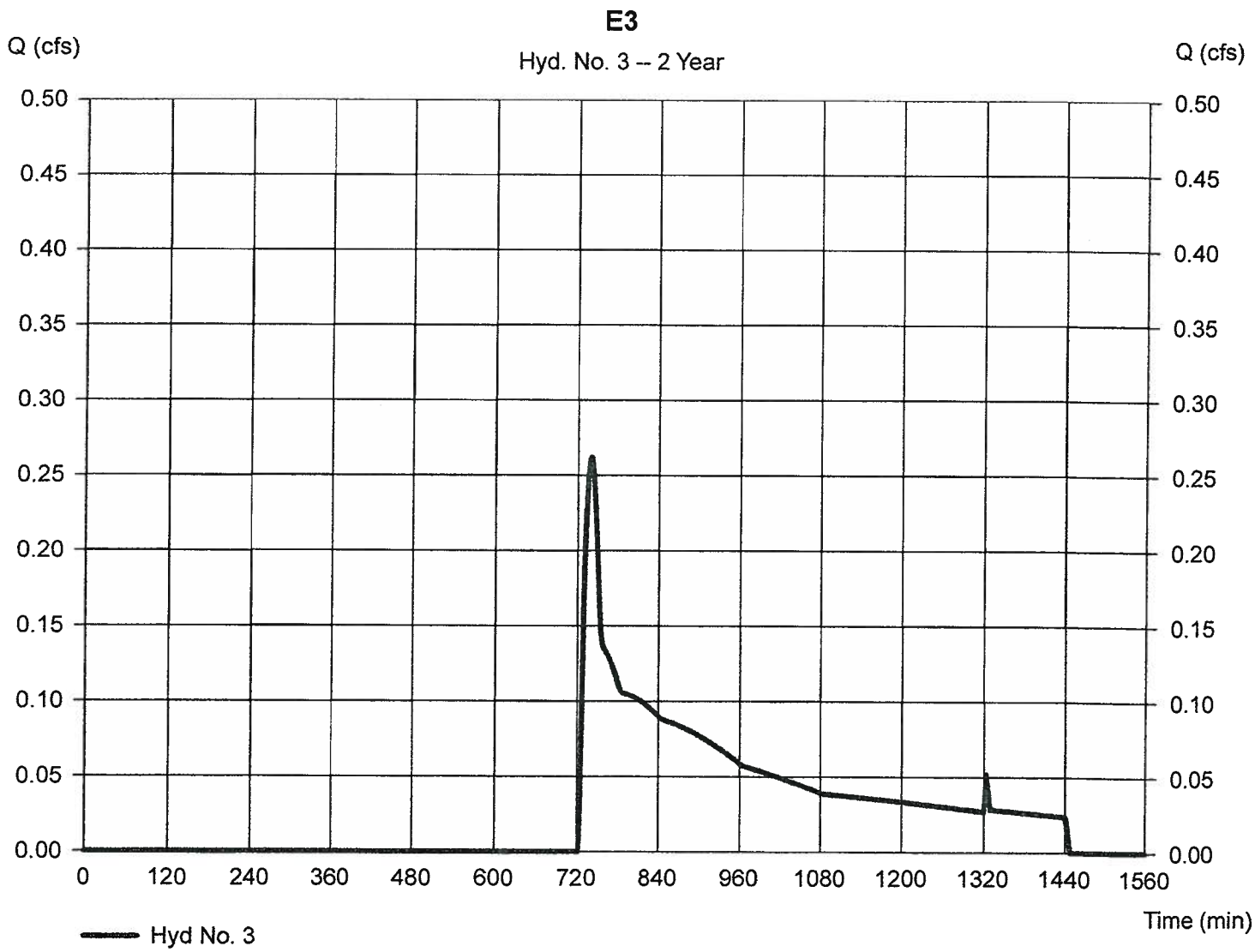
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 3

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.262 cfs
Storm frequency	= 2 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 2,502 cuft
Drainage area	= 3.430 ac	Curve number	= 54.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



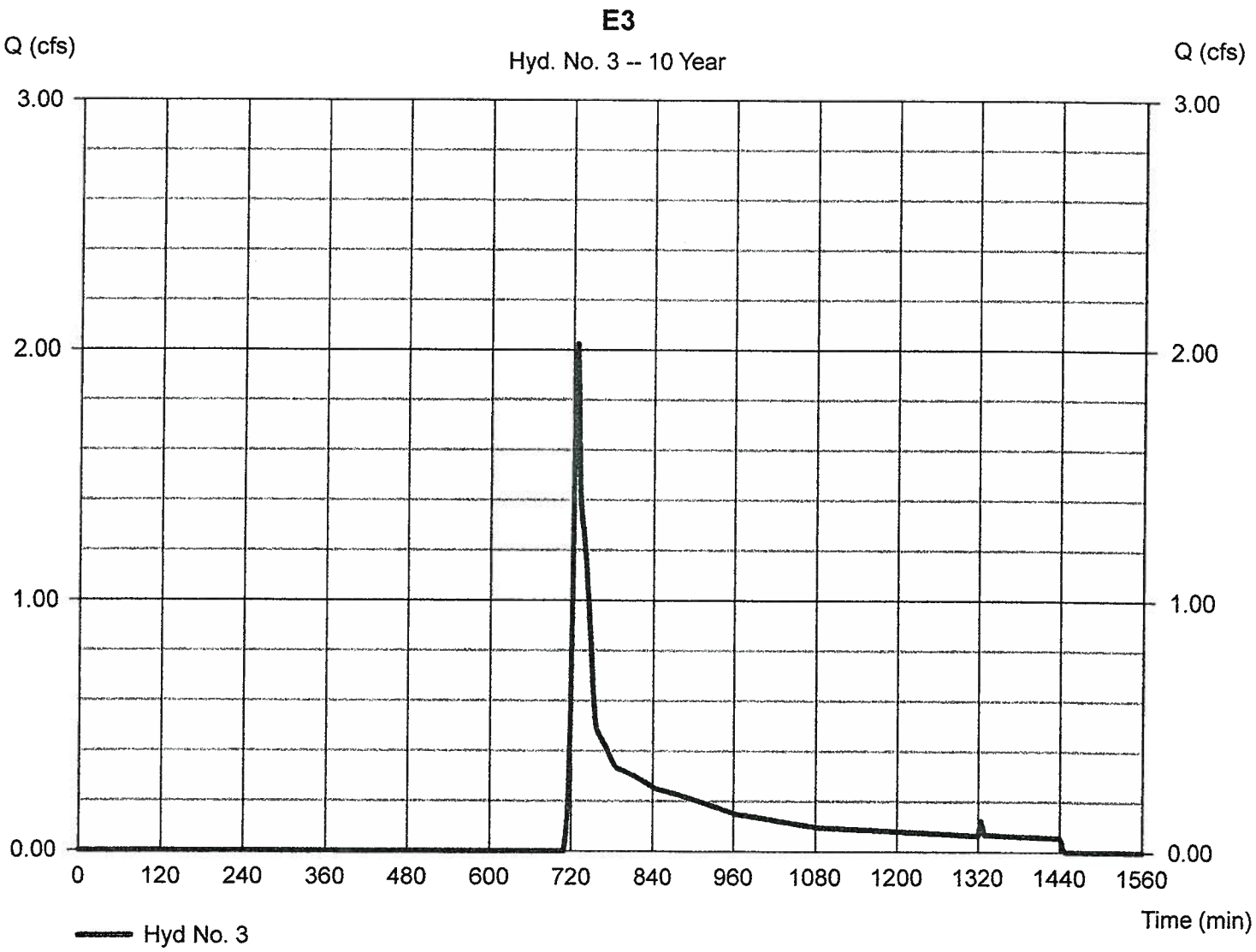
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 3

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 2.025 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 8,484 cuft
Drainage area	= 3.430 ac	Curve number	= 54.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-0072B**

Project: 848 Main Street By WJH Date 06/04/14

Location: Acton, MA Checked _____ Date _____

Circle one: Present Developed Subcatchment 4

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Woods- Good Condition	30			0.00	
A	Open Space- Good Condition	39			0.76	29.48
A	Pavement	98			0.23	22.25
A	Roof	98			1.03	100.45
A	Gravel	76			0.07	5.55
					Totals = 2.08	157.73

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{157.73}{2.08} = 75.79$; Use CN = 75.8

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency..... yr	2	10	100
Rainfall, P (24-hour)..... in	3.1	4.5	6.4
Runoff, Q..... in (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	1.07	2.11	3.71
Runoff, Q..... cf	8092	15964	28000

(210-VI-TR-55, Second Ed., June 1986)

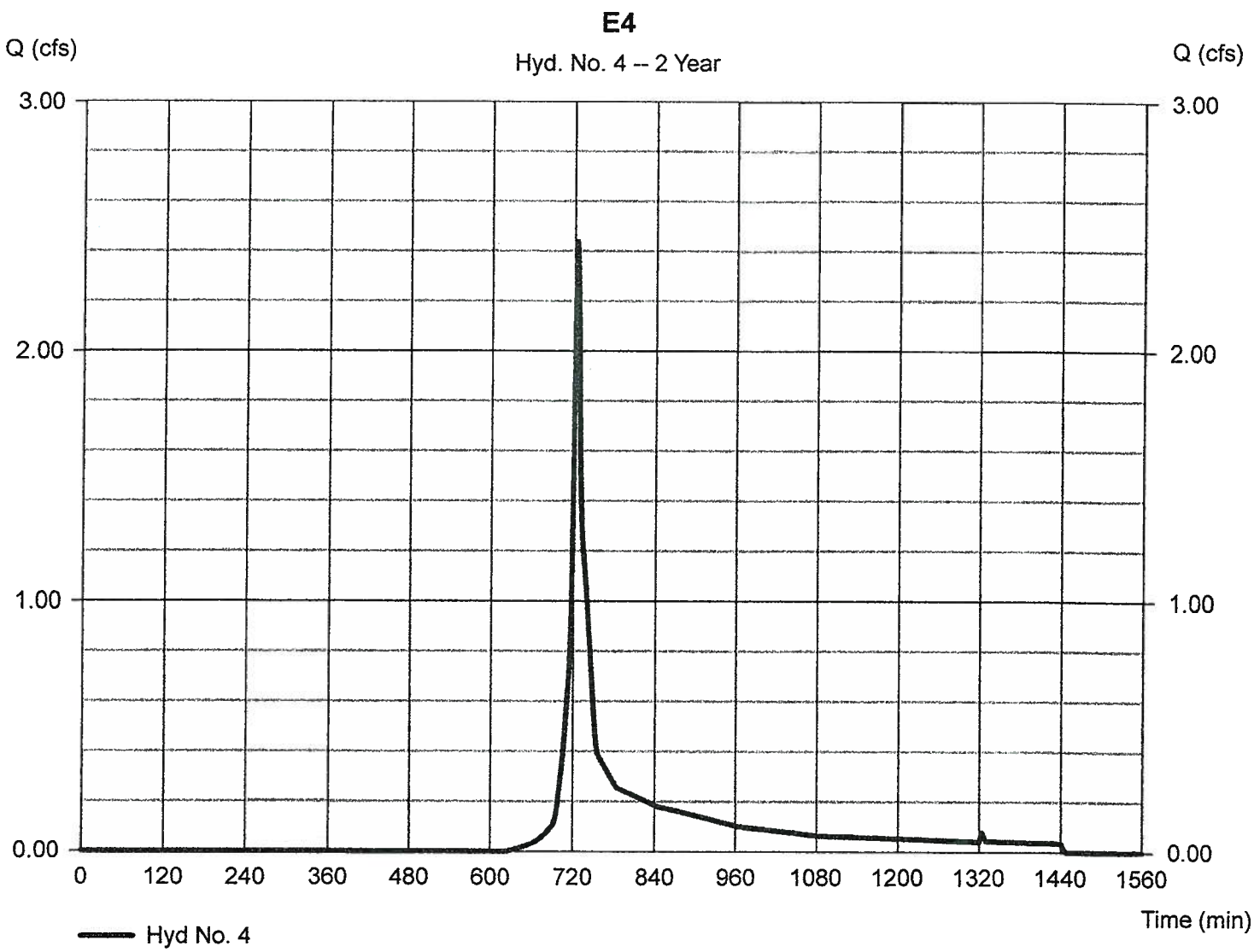
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 4

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 2.439 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 7,585 cuft
Drainage area	= 2.080 ac	Curve number	= 75.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



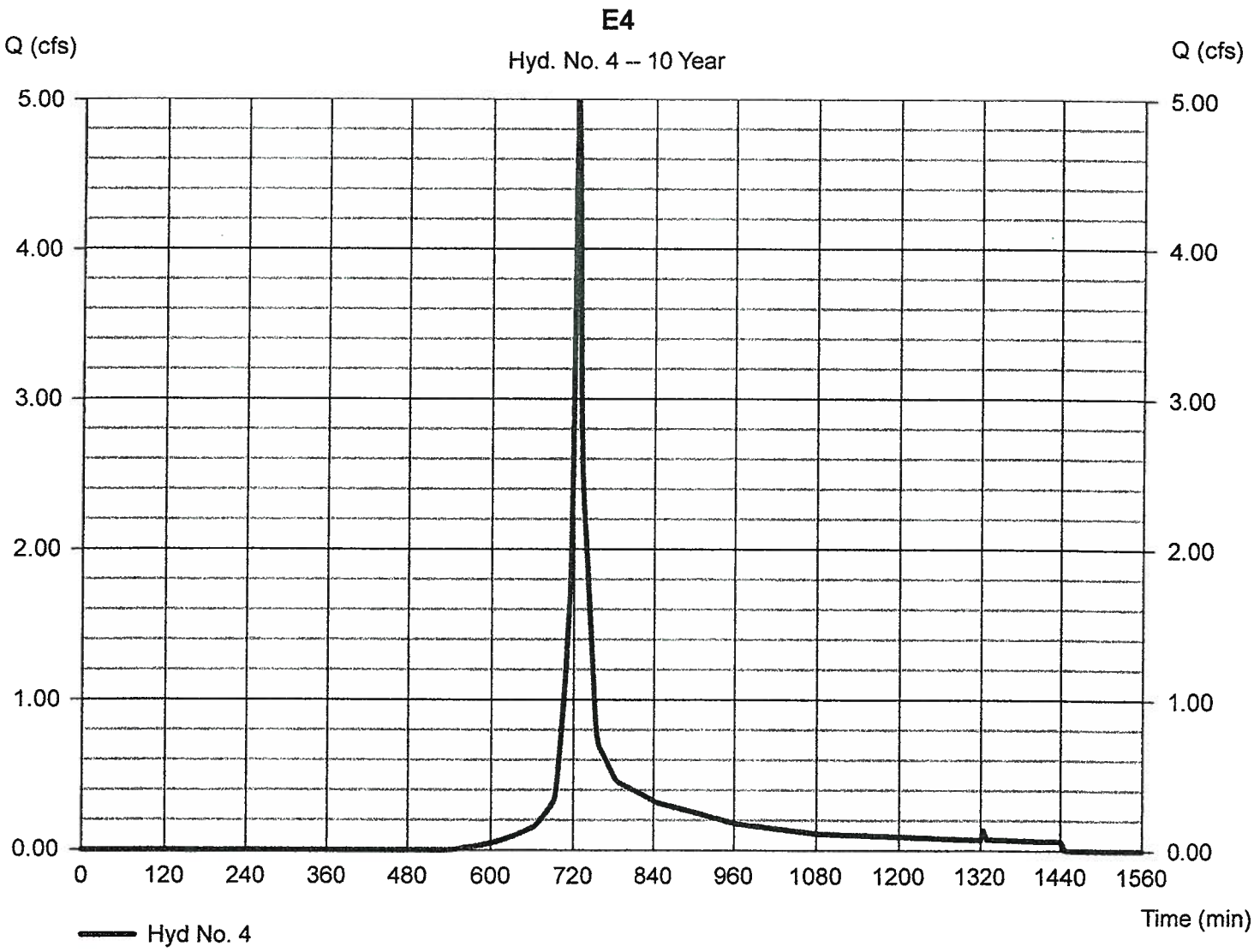
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 4

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 4.987 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 14,963 cuft
Drainage area	= 2.080 ac	Curve number	= 75.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

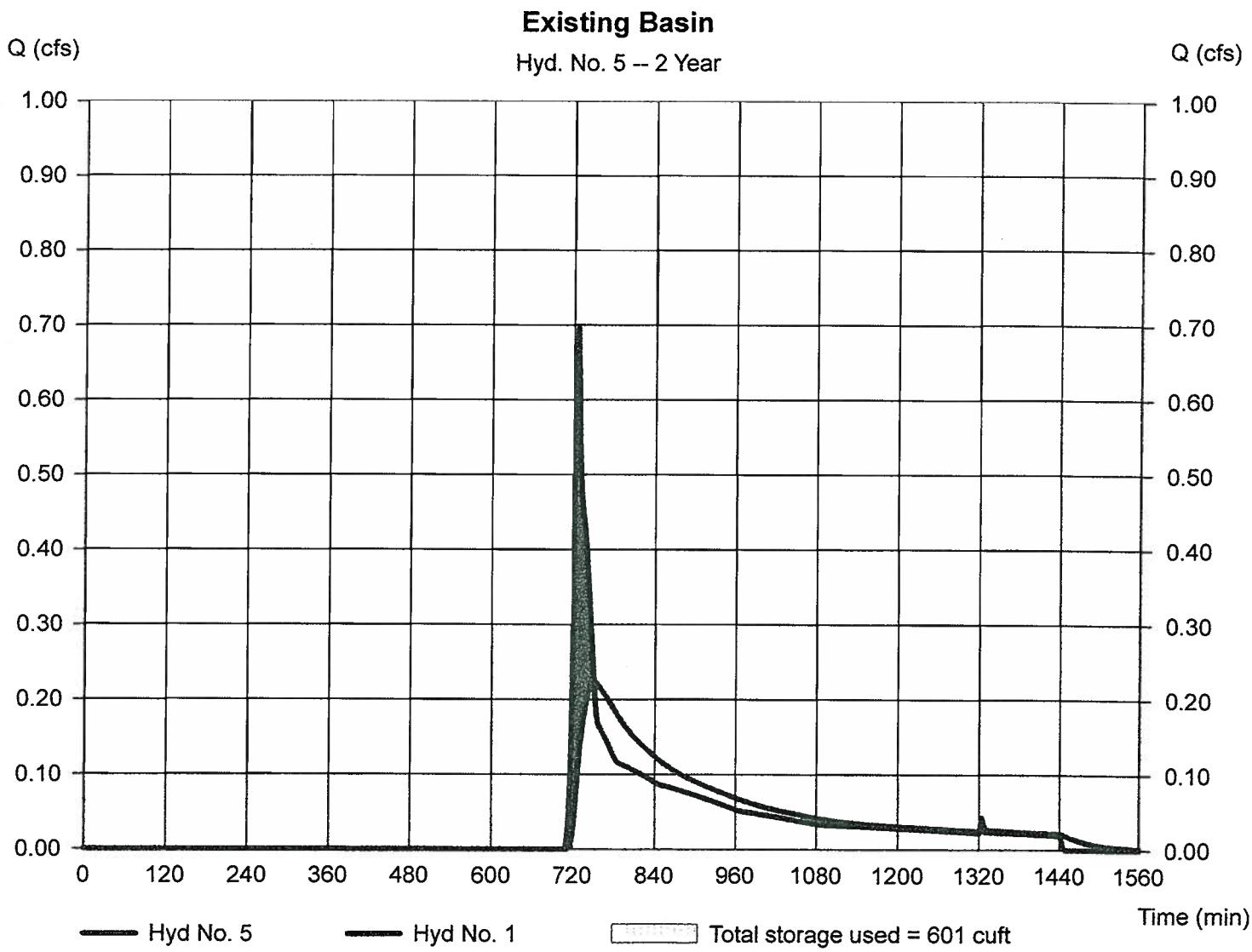
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 5

Existing Basin

Hydrograph type	= Reservoir	Peak discharge	= 0.224 cfs
Storm frequency	= 2 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 2,940 cuft
Inflow hyd. No.	= 1 - E1	Max. Elevation	= 95.28 ft
Reservoir name	= Existing Basin	Max. Storage	= 601 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

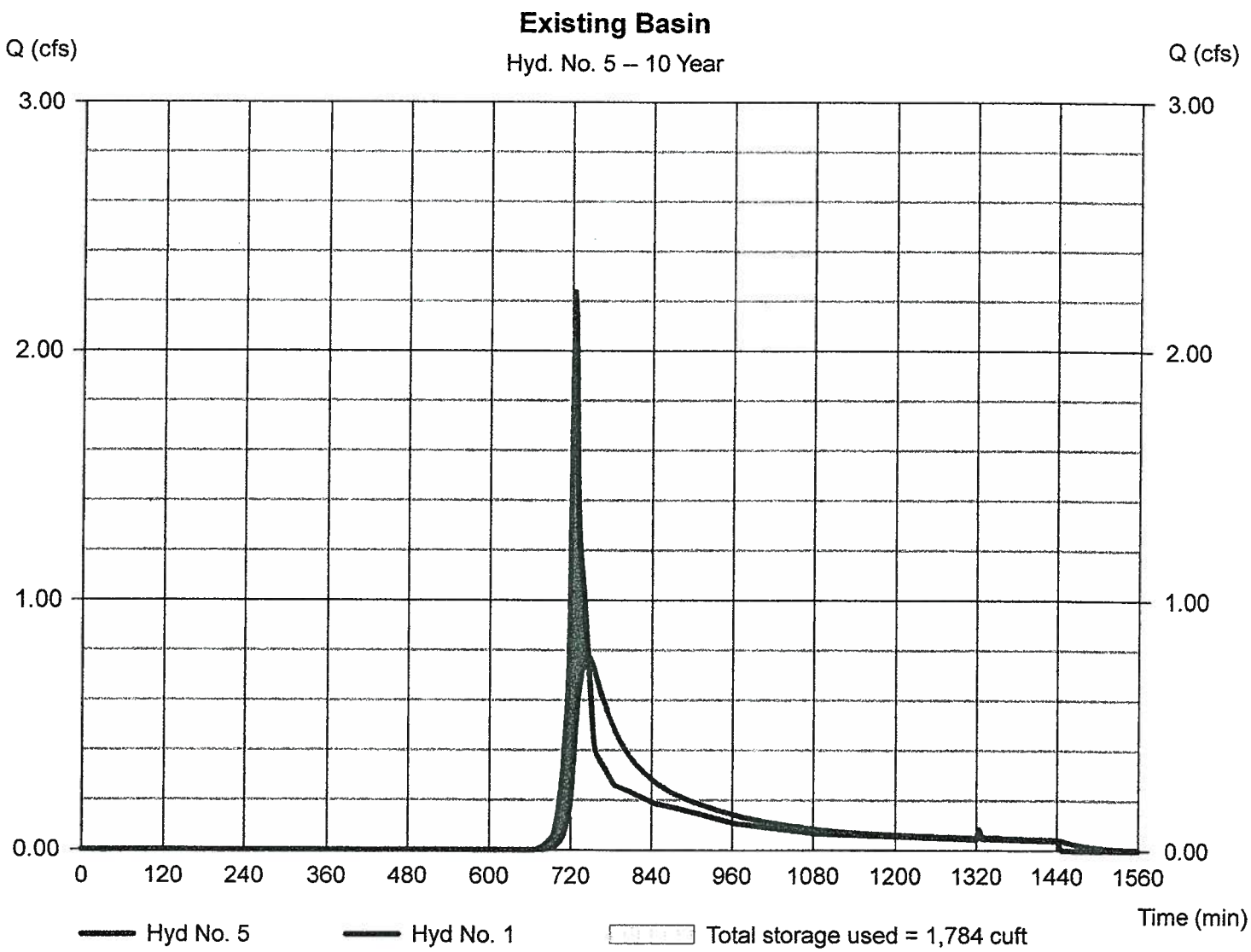
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 5

Existing Basin

Hydrograph type	= Reservoir	Peak discharge	= 0.773 cfs
Storm frequency	= 10 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 7,345 cuft
Inflow hyd. No.	= 1 - E1	Max. Elevation	= 95.83 ft
Reservoir name	= Existing Basin	Max. Storage	= 1,784 cuft

Storage Indication method used. Outflow includes exfiltration.



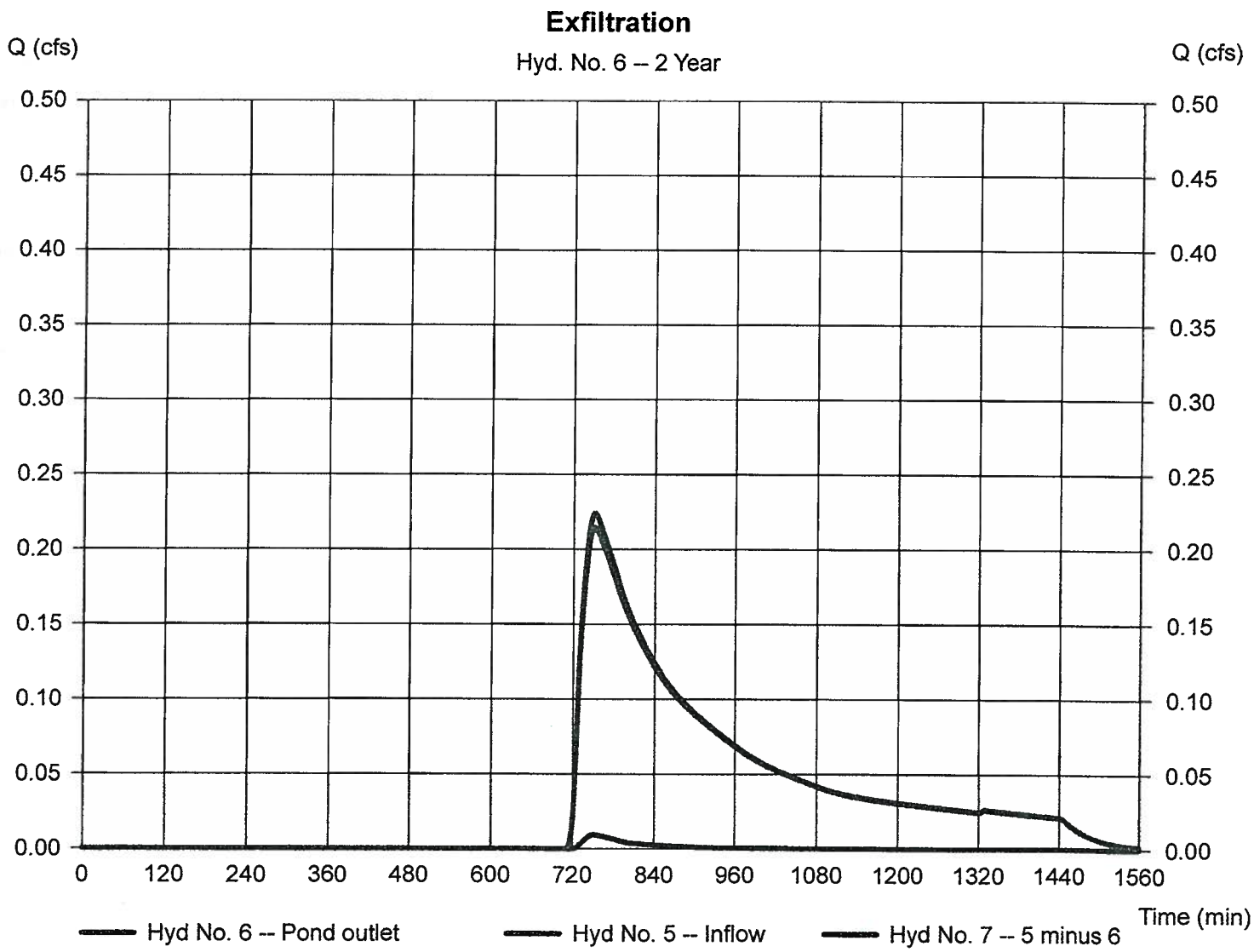
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 6

Exfiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.215 cfs
Storm frequency	= 2 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 2,883 cuft
Inflow hydrograph	= 5 - Existing Basin	2nd diverted hyd.	= 7
Diversion method	= Pond - Existing Basin	Pond structure	= Exfiltration



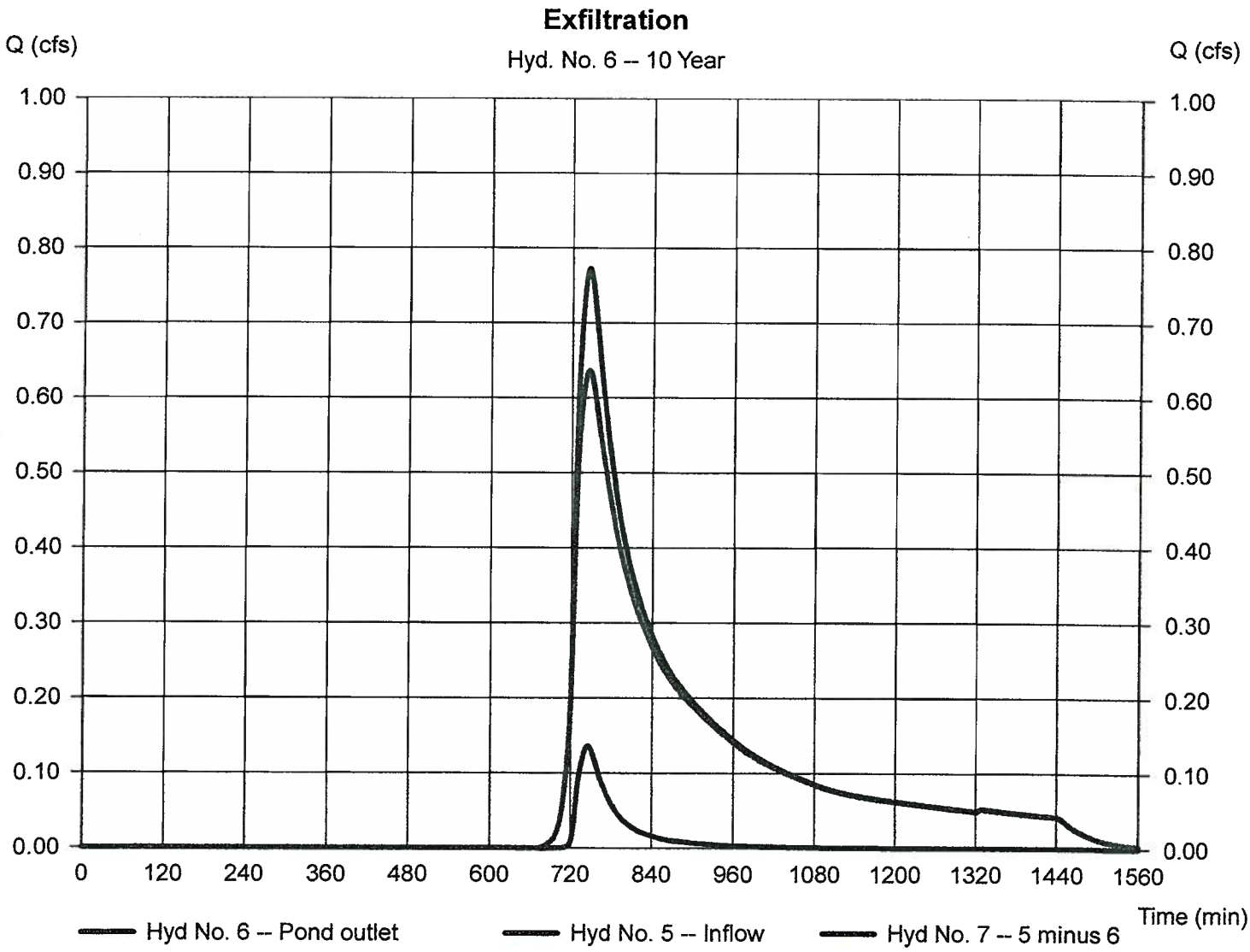
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 6

Exfiltration

Hydrograph type	=	Diversion1	Peak discharge	=	0.637 cfs
Storm frequency	=	10 yrs	Time to peak	=	746 min
Time interval	=	2 min	Hyd. volume	=	6,812 cuft
Inflow hydrograph	=	5 - Existing Basin	2nd diverted hyd.	=	7
Diversion method	=	Pond - Existing Basin	Pond structure	=	Exfiltration



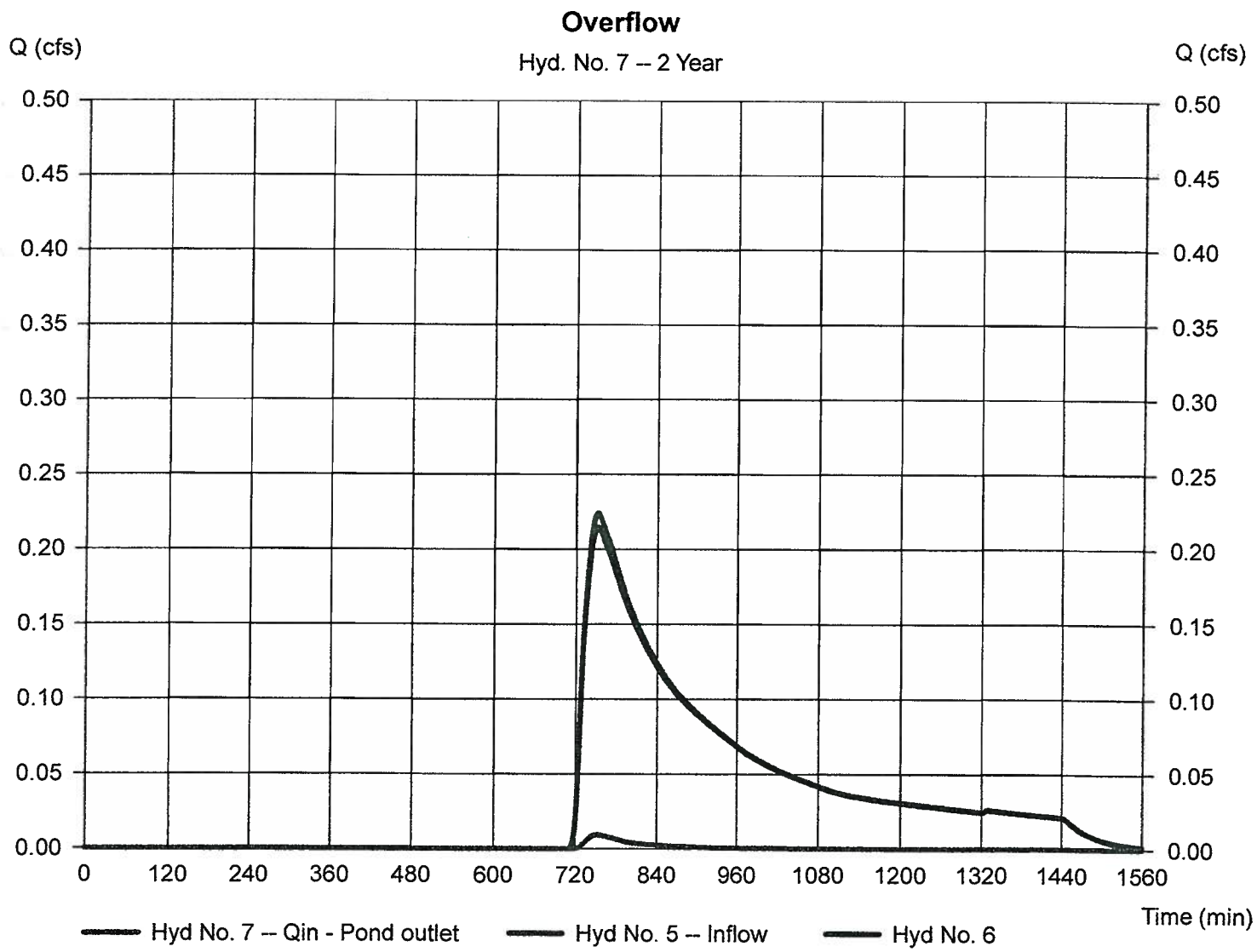
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 7

Overflow

Hydrograph type	= Diversion2	Peak discharge	= 0.009 cfs
Storm frequency	= 2 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 57 cuft
Inflow hydrograph	= 5 - Existing Basin	2nd diverted hyd.	= 6
Diversion method	= Pond - Existing Basin	Pond structure	= Exfiltration



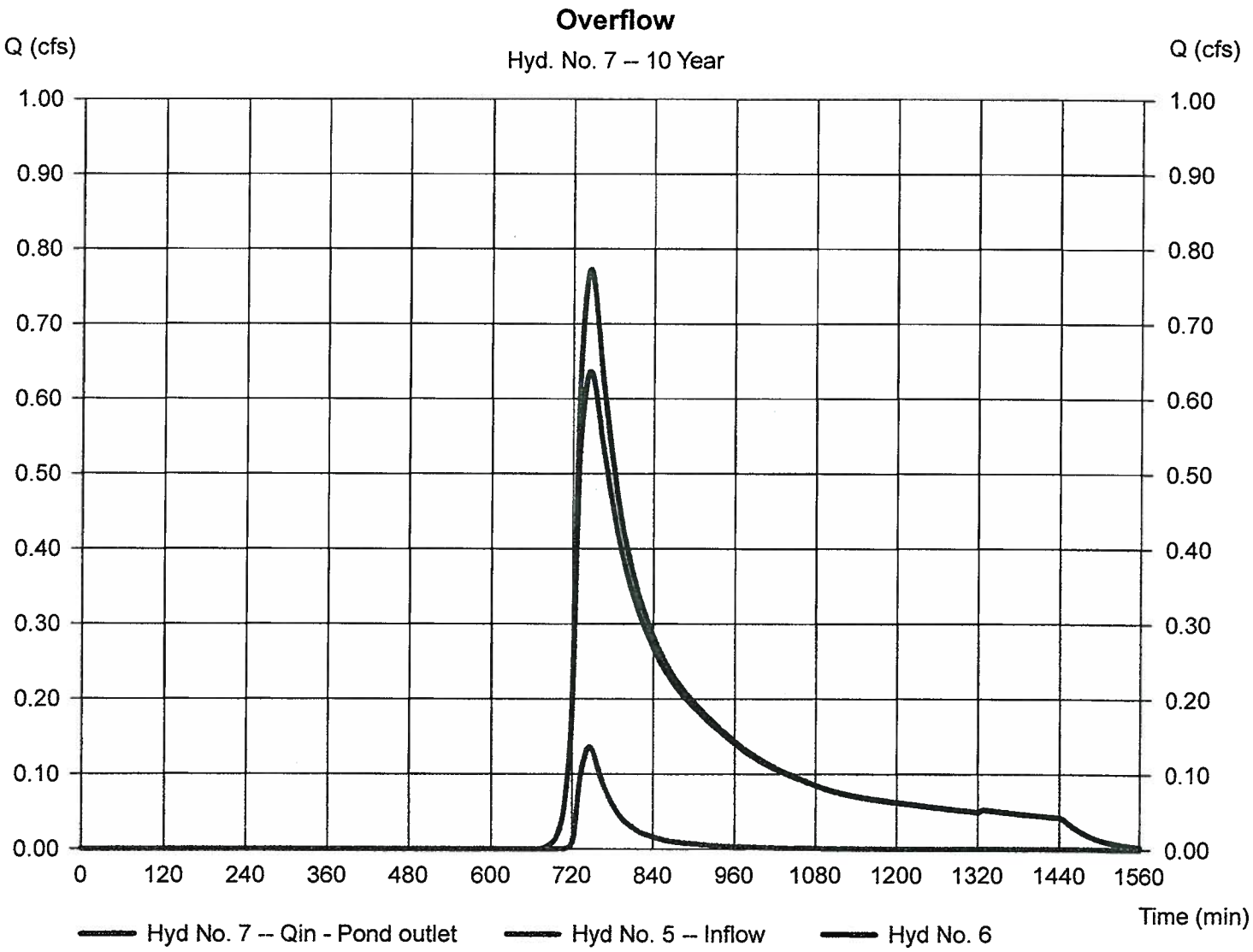
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 7

Overflow

Hydrograph type	= Diversion2	Peak discharge	= 0.136 cfs
Storm frequency	= 10 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 532 cuft
Inflow hydrograph	= 5 - Existing Basin	2nd diverted hyd.	= 6
Diversion method	= Pond - Existing Basin	Pond structure	= Exfiltration



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Pond No. 1 - Existing Basin

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 95.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	95.00	728	0	0
1.00	96.00	3,990	2,140	2,140
2.00	97.00	4,847	4,411	6,552
3.00	98.00	8,291	6,492	13,044

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 95.00	0.00	0.00	0.00
Length (ft)	= 68.00	0.00	0.00	0.00
Slope (%)	= 0.44	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

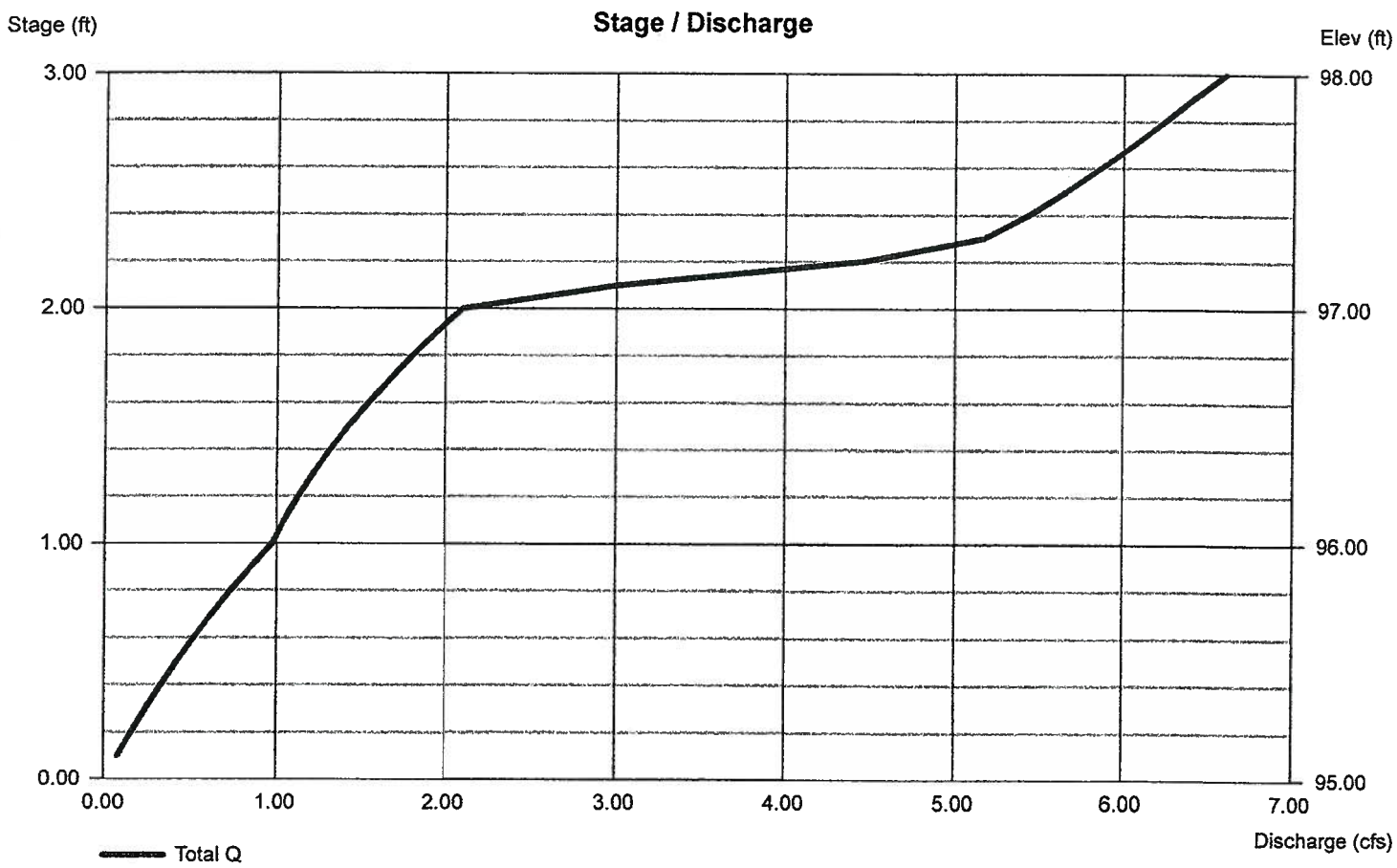
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 97.00	95.00	0.00	0.00
Weir Coeff.	= 3.33	0.22	3.33	3.33
Weir Type	= Riser	10 degV	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 8.270 (by Contour)

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).



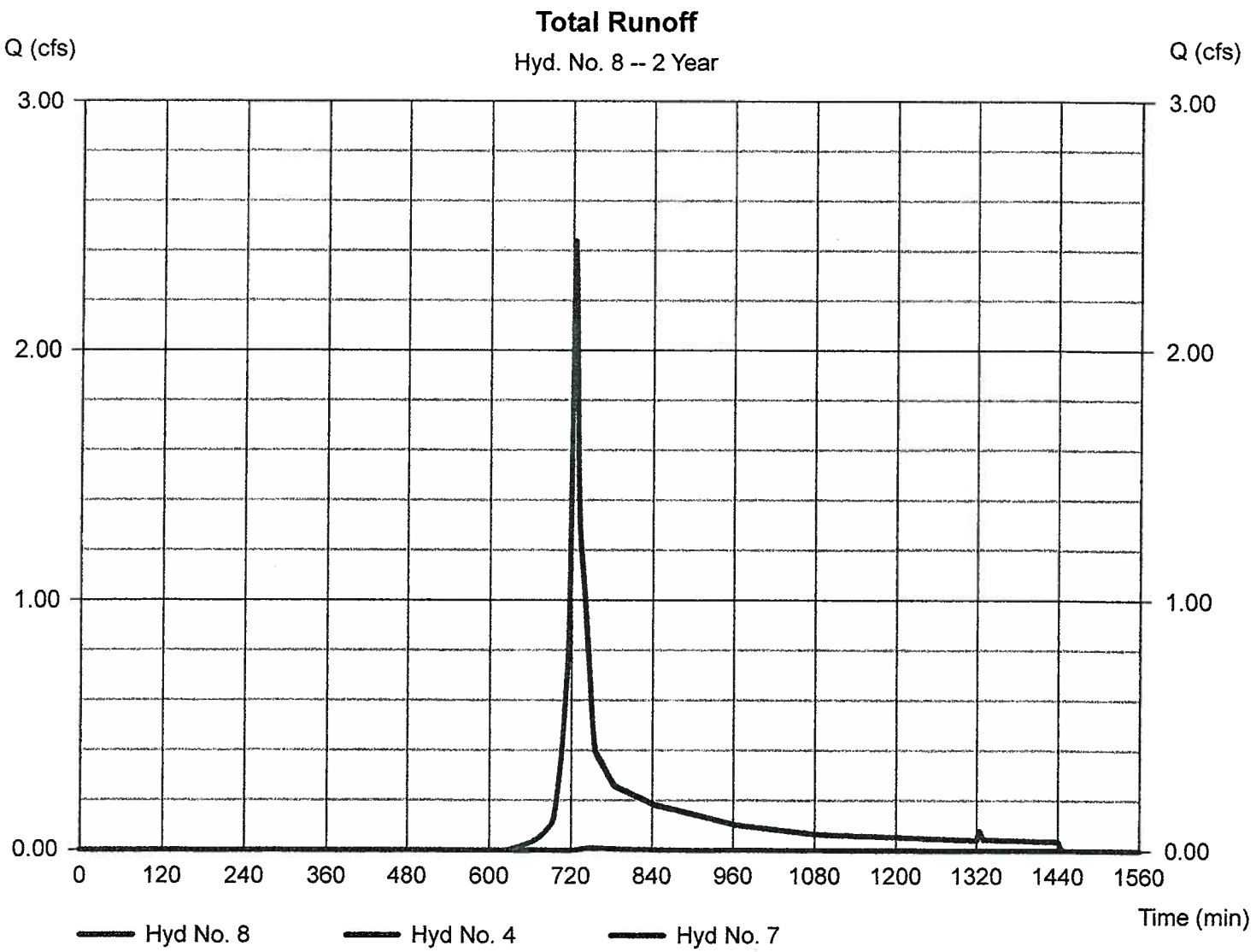
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 8

Total Runoff

Hydrograph type	= Combine	Peak discharge	= 2.439 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 7,642 cuft
Inflow hyds.	= 4, 7	Contrib. drain. area	= 2.080 ac



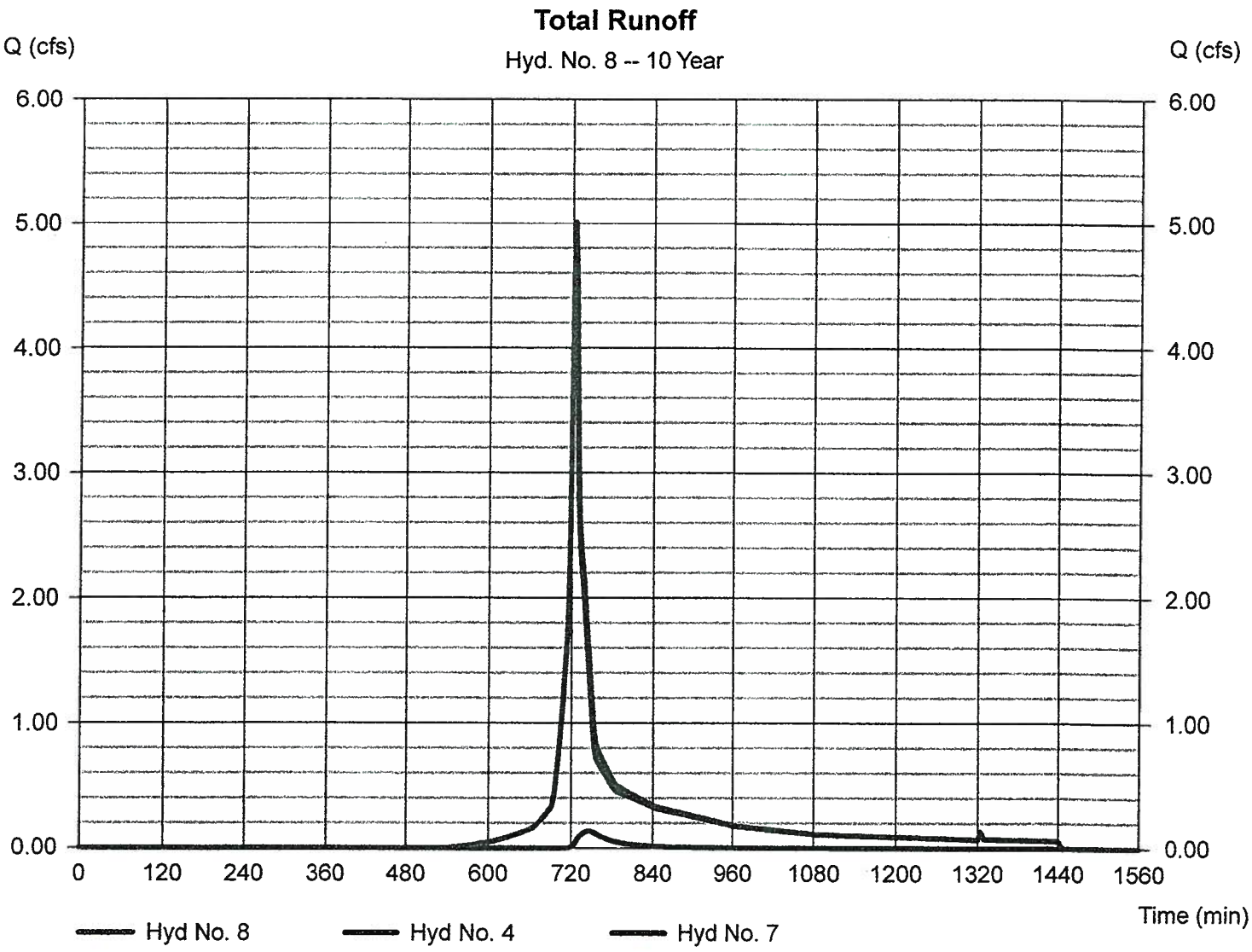
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jun 4, 2014

Hyd. No. 8

Total Runoff

Hydrograph type	= Combine	Peak discharge	= 5.015 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 15,495 cuft
Inflow hyds.	= 4, 7	Contrib. drain. area	= 2.080 ac



Post-Development Hydrology

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	1.573	2	724	5,141	----	------	------	P1
2	Reservoir	0.231	2	770	3,004	1	97.58	2,249	First Flush Basin
3	SCS Runoff	3.098	2	724	10,402	----	------	------	P2
4	SCS Runoff	0.484	2	728	3,510	----	------	------	P3
5	SCS Runoff	1.609	2	724	4,902	----	------	------	P4
6	Reservoir	0.141	2	838	3,001	2	95.19	396	Existing Basin
7	Diversion1	0.141	2	838	3,001	6	------	------	Exfiltration
8	Diversion2	0.000	2	830	0	6	------	------	Overflow
9	Combine	1.934	2	726	8,412	4, 5,	------	------	To Fire Pond

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	3.550	2	724	10,797	----	-----	-----	P1
2	Reservoir	2.630	2	728	8,660	1	97.90	2,721	First Flush Basin
3	SCS Runoff	4.532	2	724	15,485	----	-----	-----	P2
4	SCS Runoff	2.779	2	724	10,430	----	-----	-----	P3
5	SCS Runoff	3.110	2	724	9,295	----	-----	-----	P4
6	Reservoir	0.762	2	754	8,657	2	95.96	2,046	Existing Basin
7	Diversion1	0.730	2	754	8,588	6	-----	-----	Exfiltration
8	Diversion2	0.032	2	754	69	6	-----	-----	Overflow
9	Combine	5.889	2	724	19,725	4, 5,	-----	-----	To Fire Pond

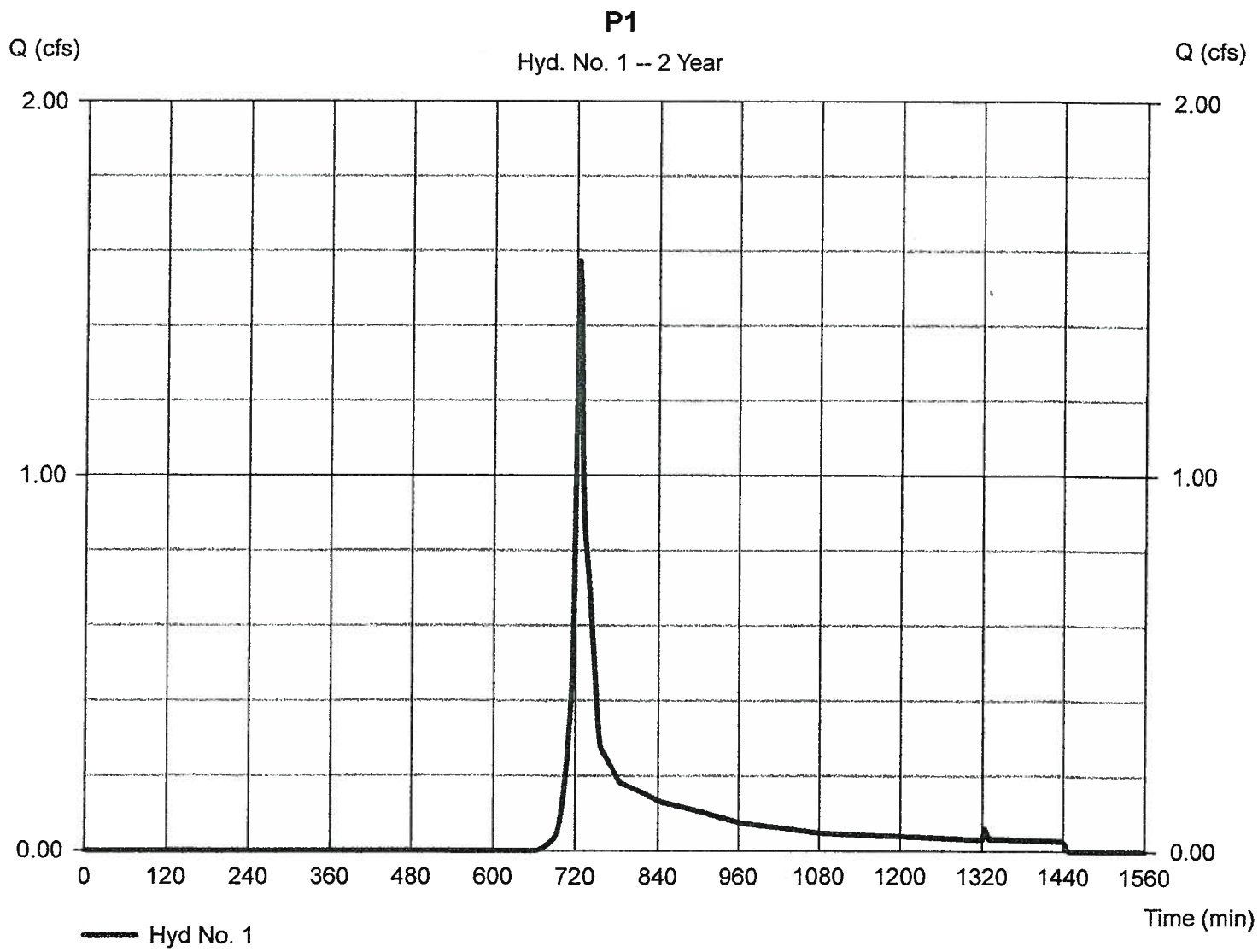
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 1

P1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.573 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 5,141 cuft
Drainage area	= 1.750 ac	Curve number	= 71.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



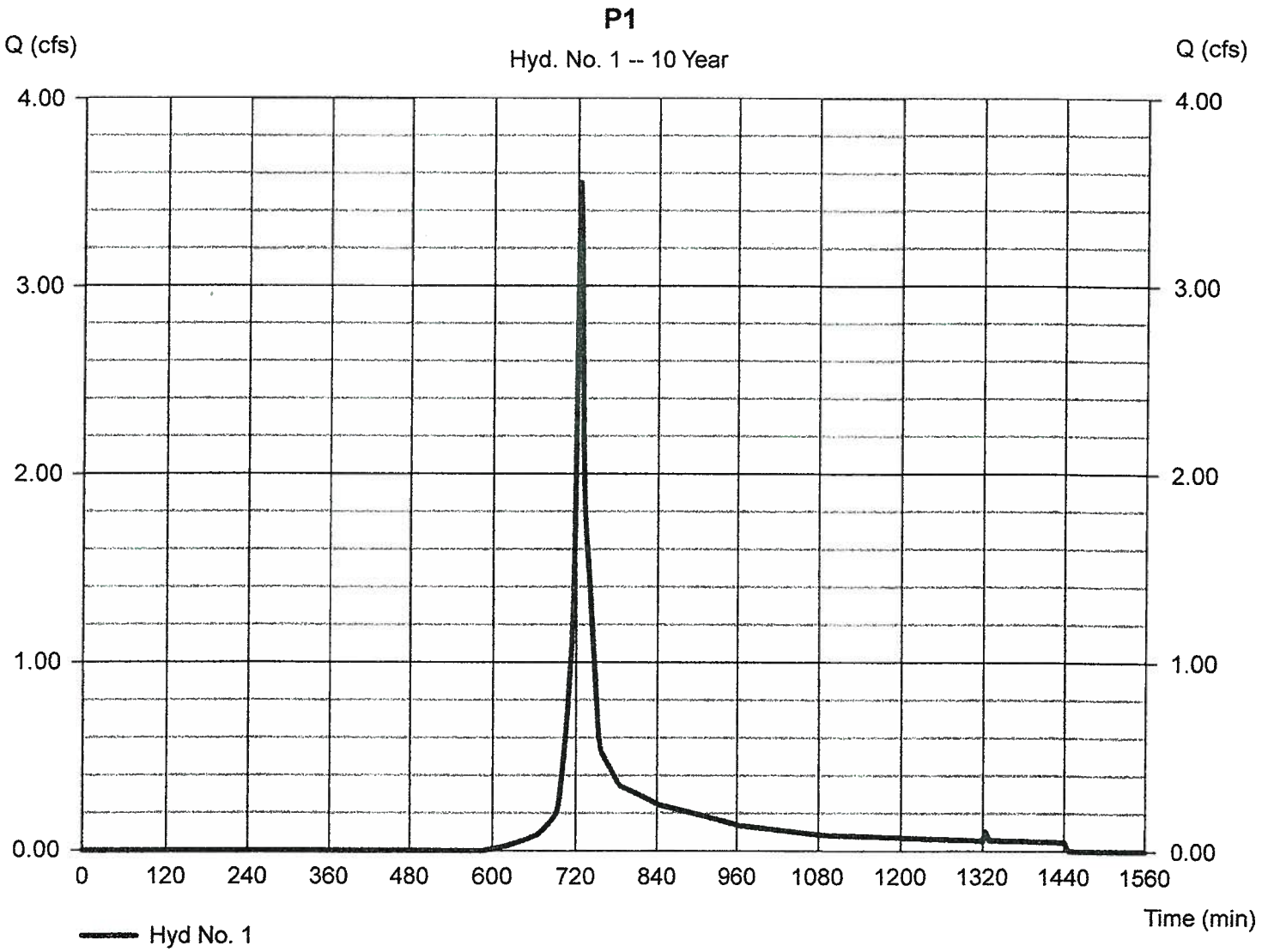
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 1

P1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.550 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 10,797 cuft
Drainage area	= 1.750 ac	Curve number	= 71.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

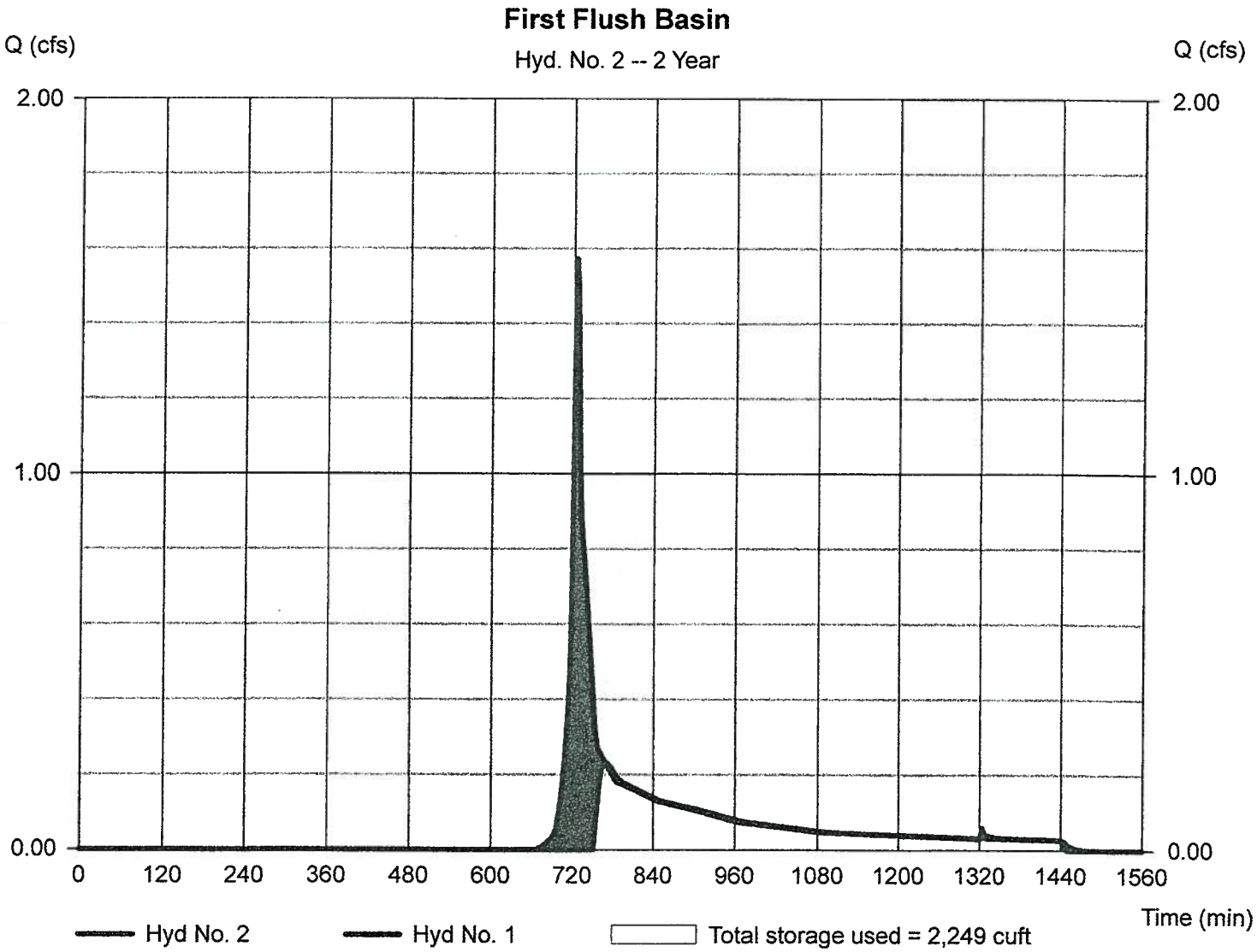
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 2

First Flush Basin

Hydrograph type	= Reservoir	Peak discharge	= 0.231 cfs
Storm frequency	= 2 yrs	Time to peak	= 770 min
Time interval	= 2 min	Hyd. volume	= 3,004 cuft
Inflow hyd. No.	= 1 - P1	Max. Elevation	= 97.58 ft
Reservoir name	= Sub 1 First Flush Basin	Max. Storage	= 2,249 cuft

Storage Indication method used.



Hydrograph Report

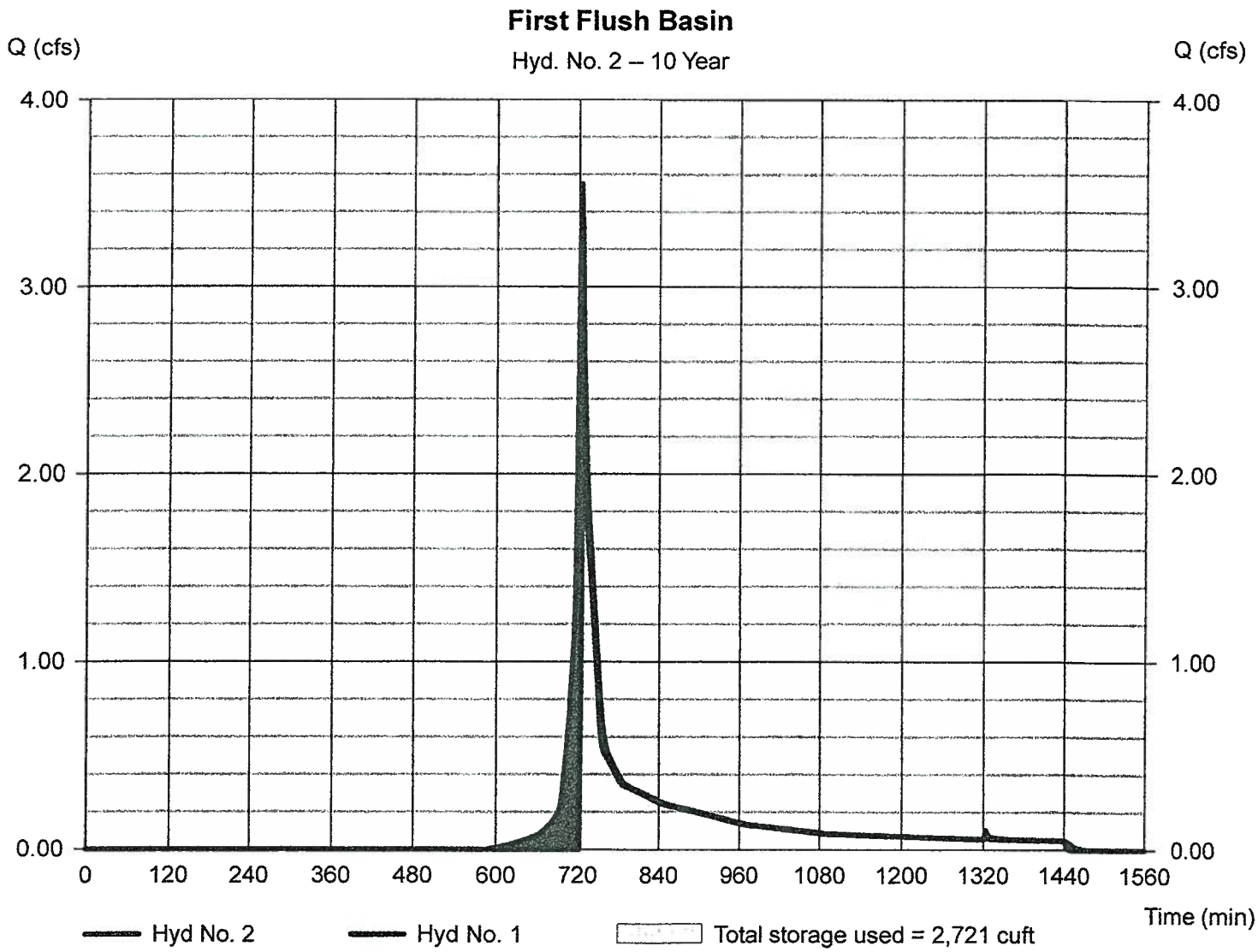
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 2

First Flush Basin

Hydrograph type	= Reservoir	Peak discharge	= 2.630 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 8,660 cuft
Inflow hyd. No.	= 1 - P1	Max. Elevation	= 97.90 ft
Reservoir name	= Sub 1 First Flush Basin	Max. Storage	= 2,721 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Pond No. 2 - Sub 1 First Flush Basin

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 95.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	95.00	422	0	0
1.00	96.00	751	579	579
2.00	97.00	1,136	937	1,515
2.50	97.50	1,350	621	2,136
3.00	98.00	1,578	731	2,867

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 96.00	0.00	0.00	0.00
Length (ft)	= 38.00	0.00	0.00	0.00
Slope (%)	= 2.00	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

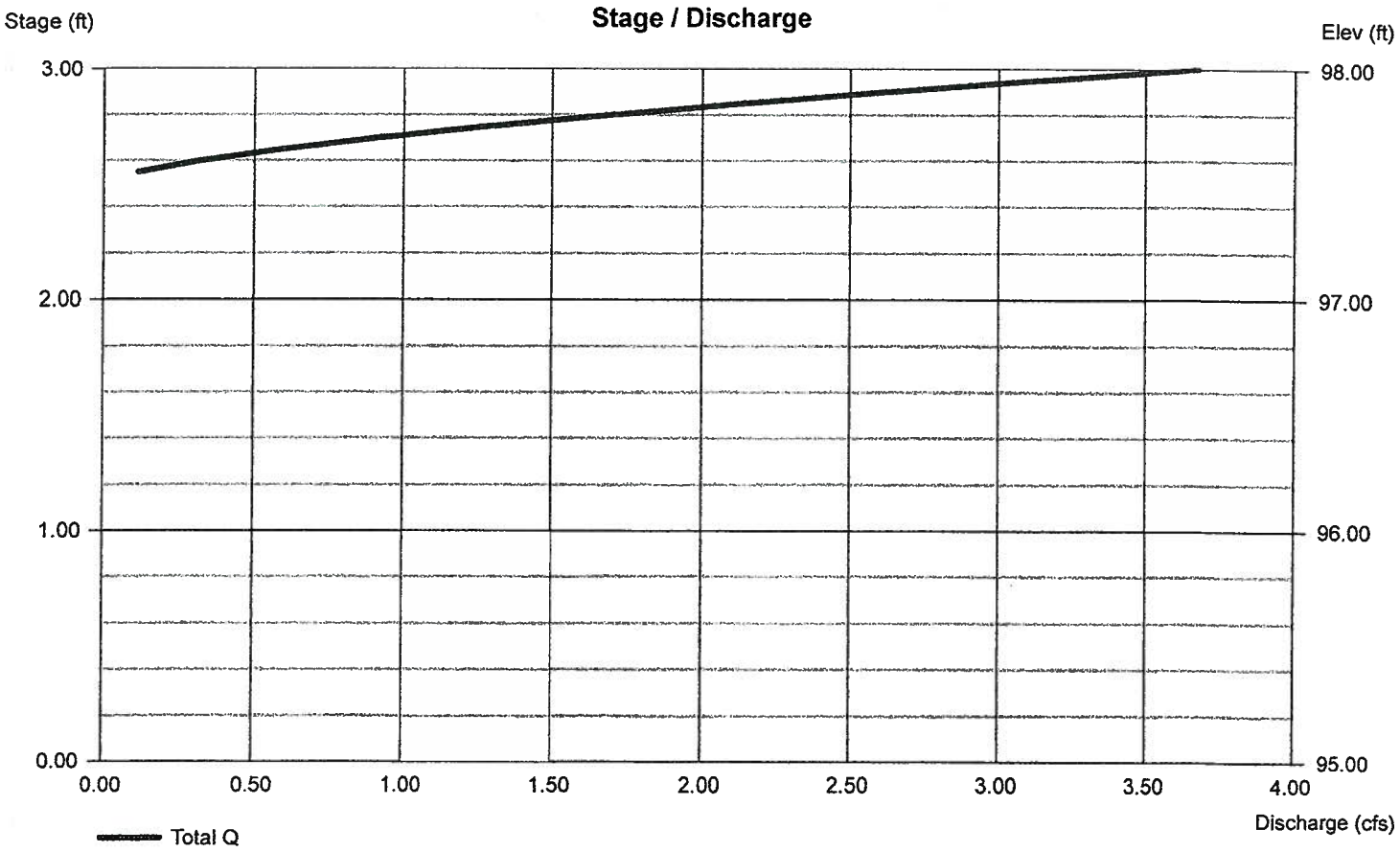
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	0.00	0.00	0.00
Crest El. (ft)	= 97.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= 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).



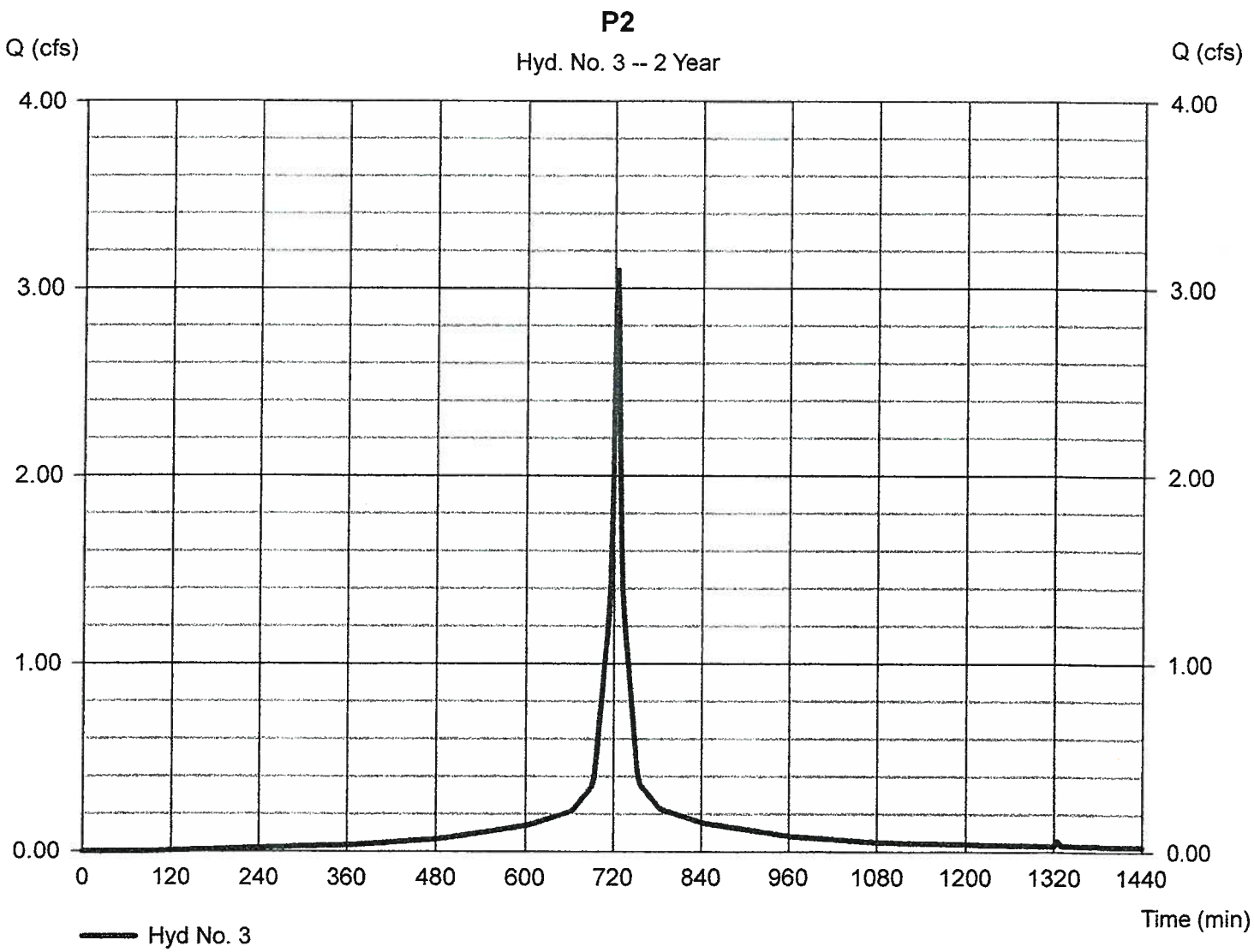
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 3

P2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.098 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 10,402 cuft
Drainage area	= 1.070 ac	Curve number	= 97.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



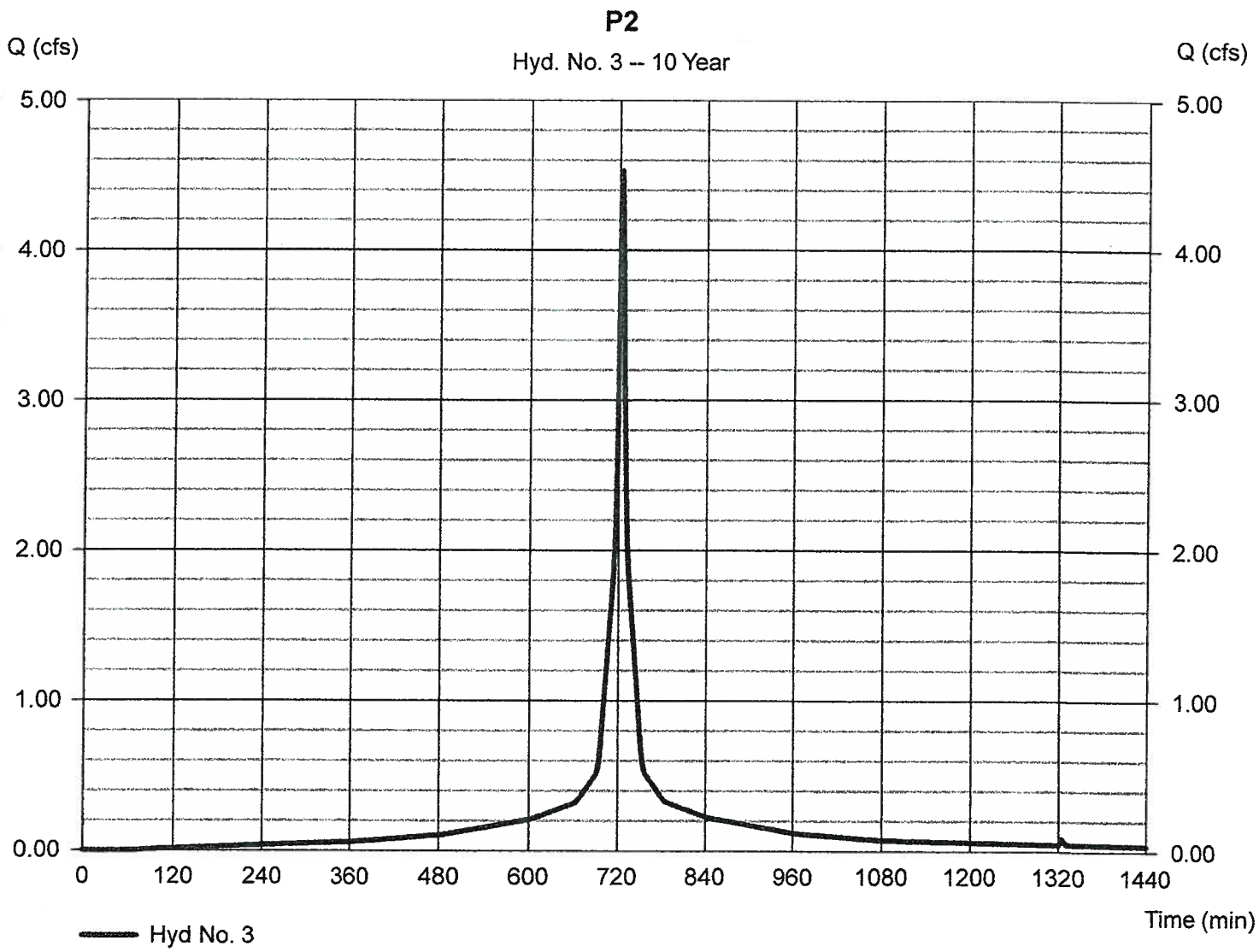
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 3

P2

Hydrograph type	= SCS Runoff	Peak discharge	= 4.532 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 15,485 cuft
Drainage area	= 1.070 ac	Curve number	= 97.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



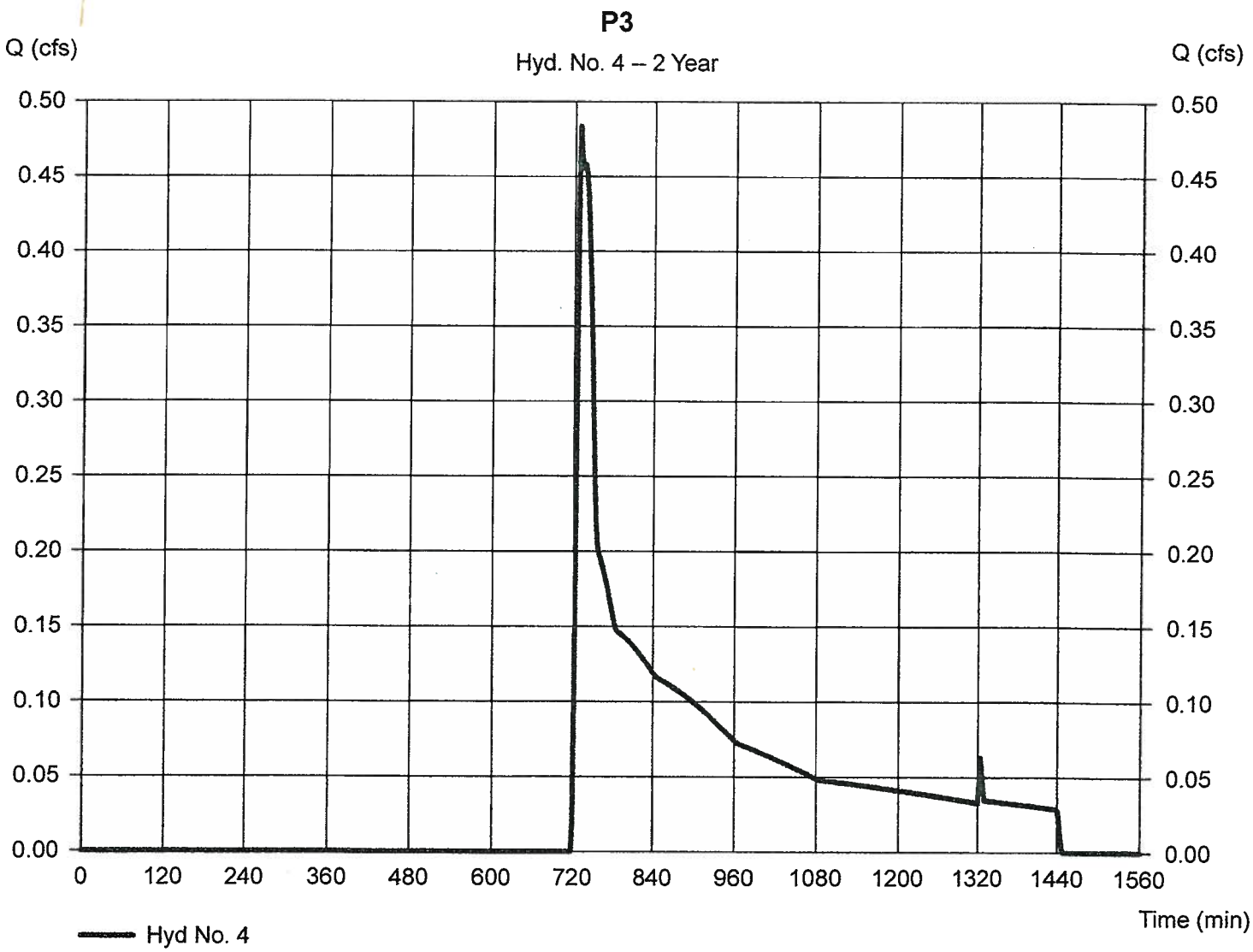
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 4

P3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.484 cfs
Storm frequency	= 2 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 3,510 cuft
Drainage area	= 3.430 ac	Curve number	= 57.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



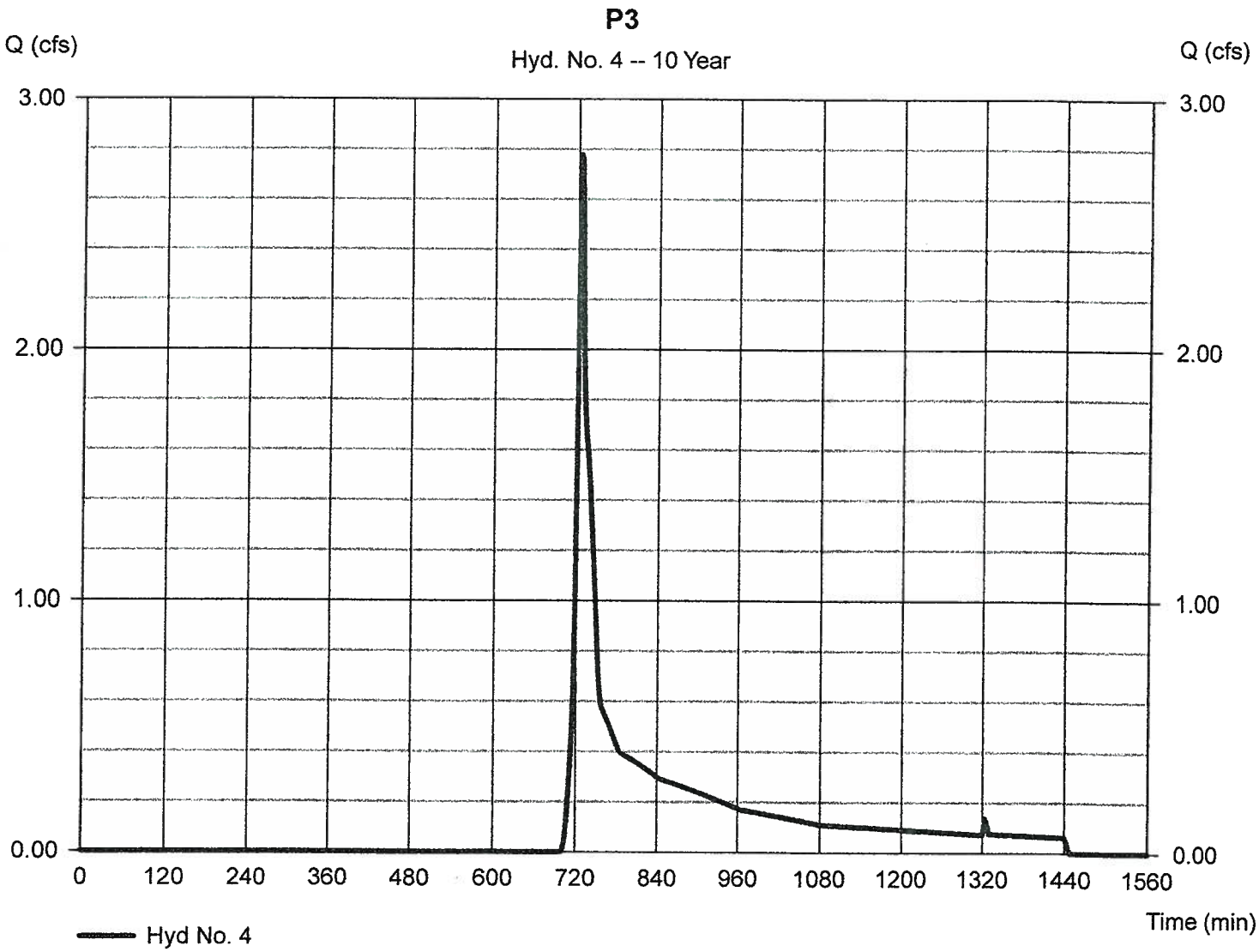
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 4

P3

Hydrograph type	= SCS Runoff	Peak discharge	= 2.779 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 10,430 cuft
Drainage area	= 3.430 ac	Curve number	= 57.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



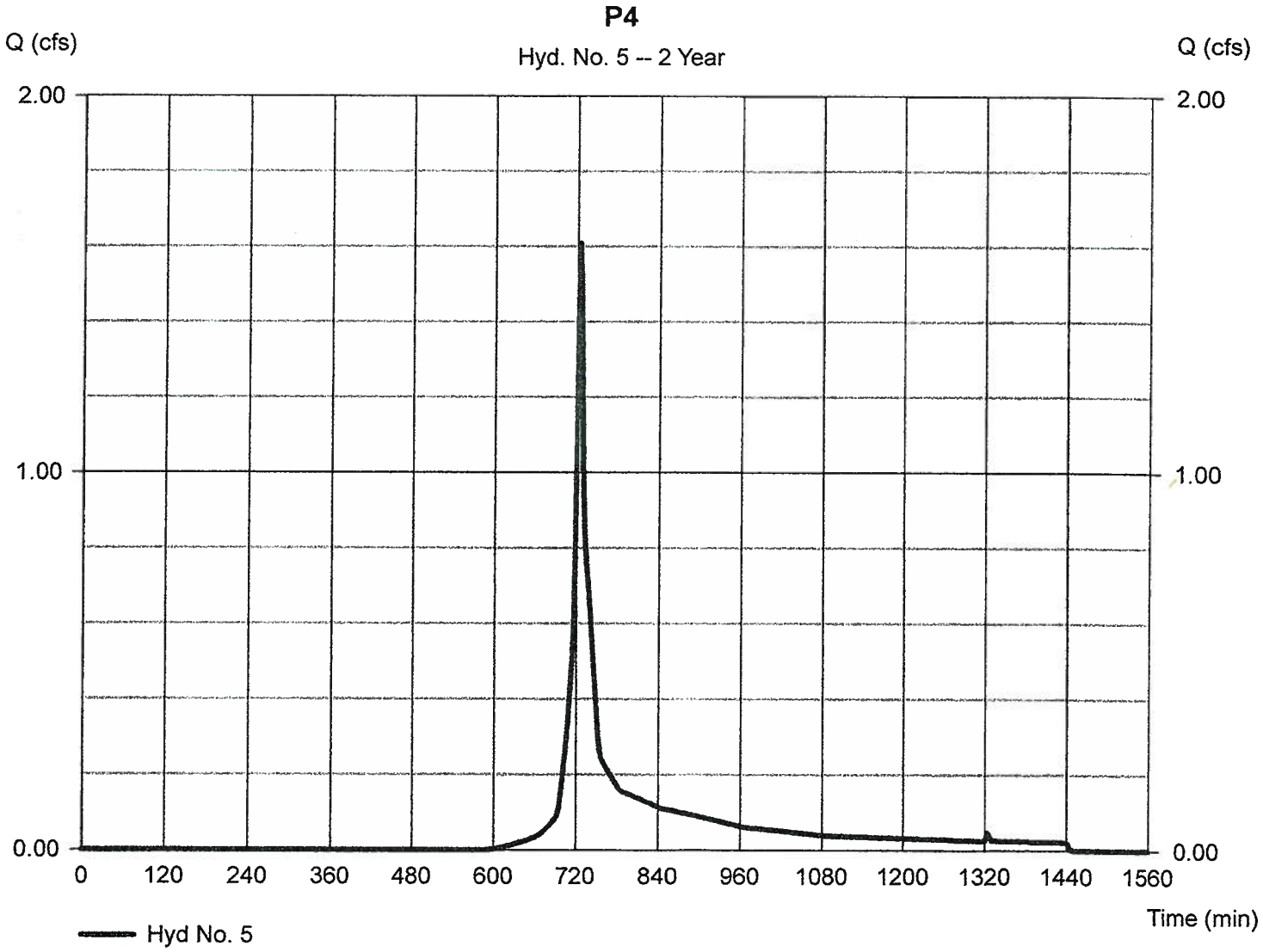
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 5

P4

Hydrograph type	= SCS Runoff	Peak discharge	= 1.609 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 4,902 cuft
Drainage area	= 1.170 ac	Curve number	= 78.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



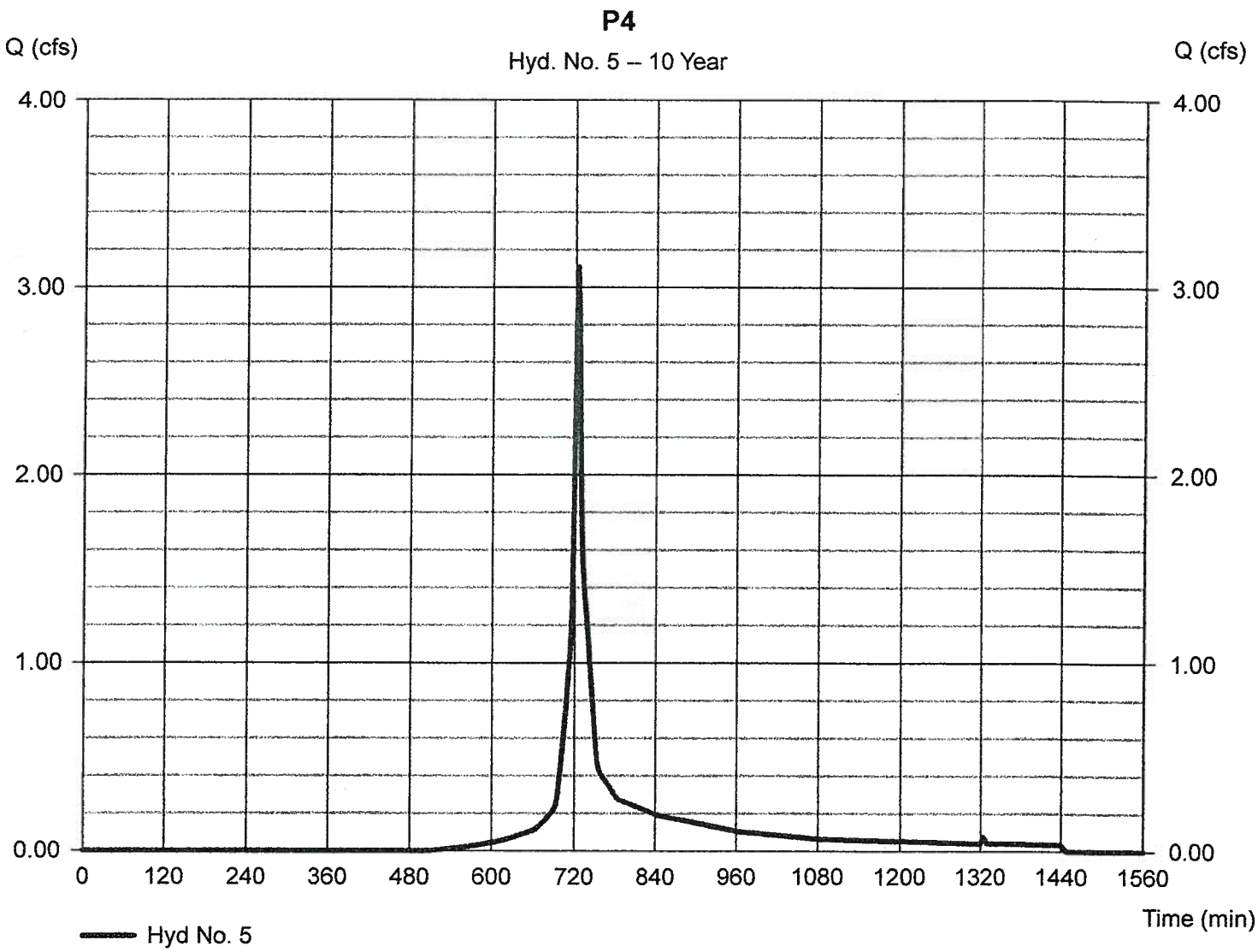
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 5

P4

Hydrograph type	= SCS Runoff	Peak discharge	= 3.110 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 9,295 cuft
Drainage area	= 1.170 ac	Curve number	= 78.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

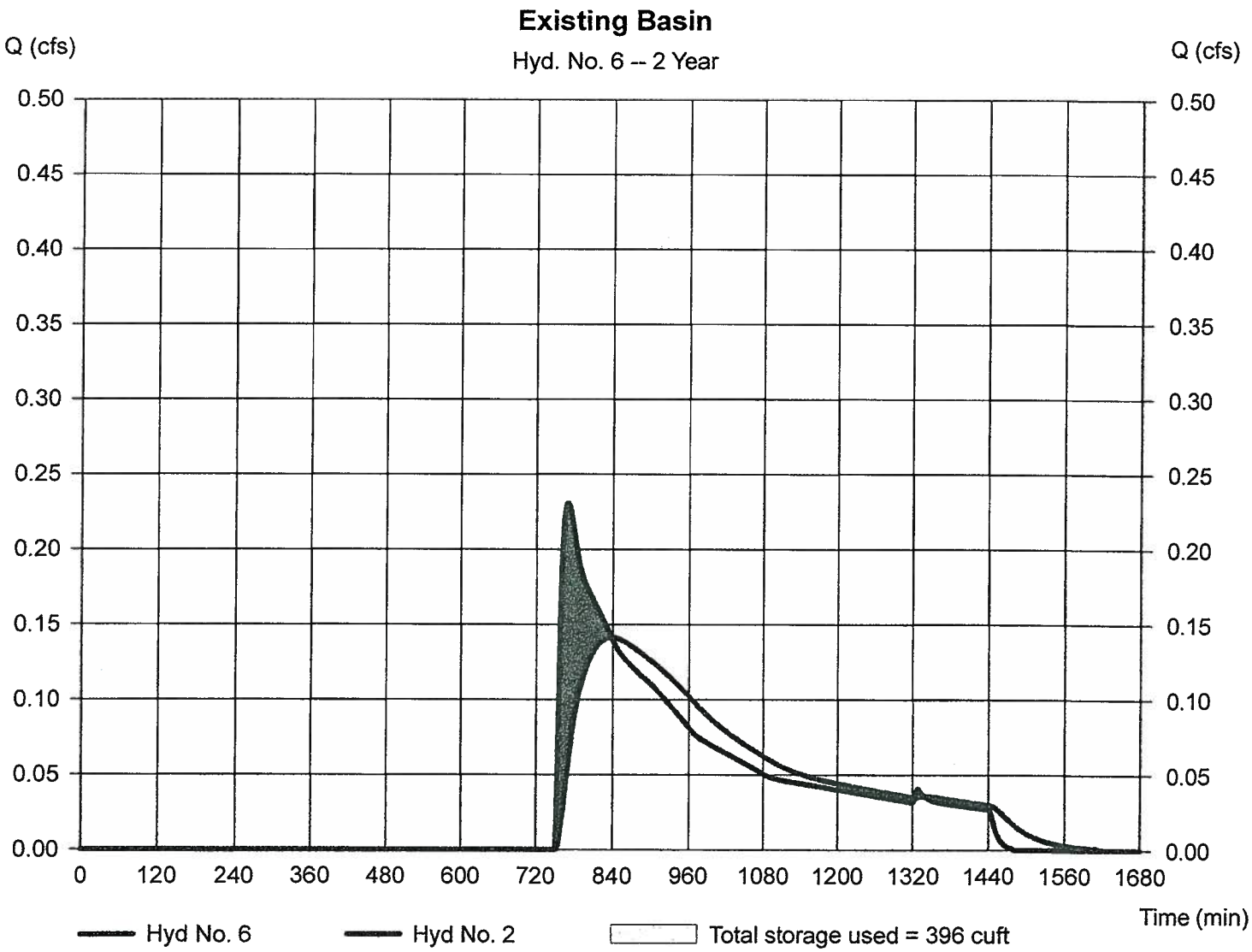
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 6

Existing Basin

Hydrograph type	= Reservoir	Peak discharge	= 0.141 cfs
Storm frequency	= 2 yrs	Time to peak	= 838 min
Time interval	= 2 min	Hyd. volume	= 3,001 cuft
Inflow hyd. No.	= 2 - First Flush Basin	Max. Elevation	= 95.19 ft
Reservoir name	= Existing Basin	Max. Storage	= 396 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

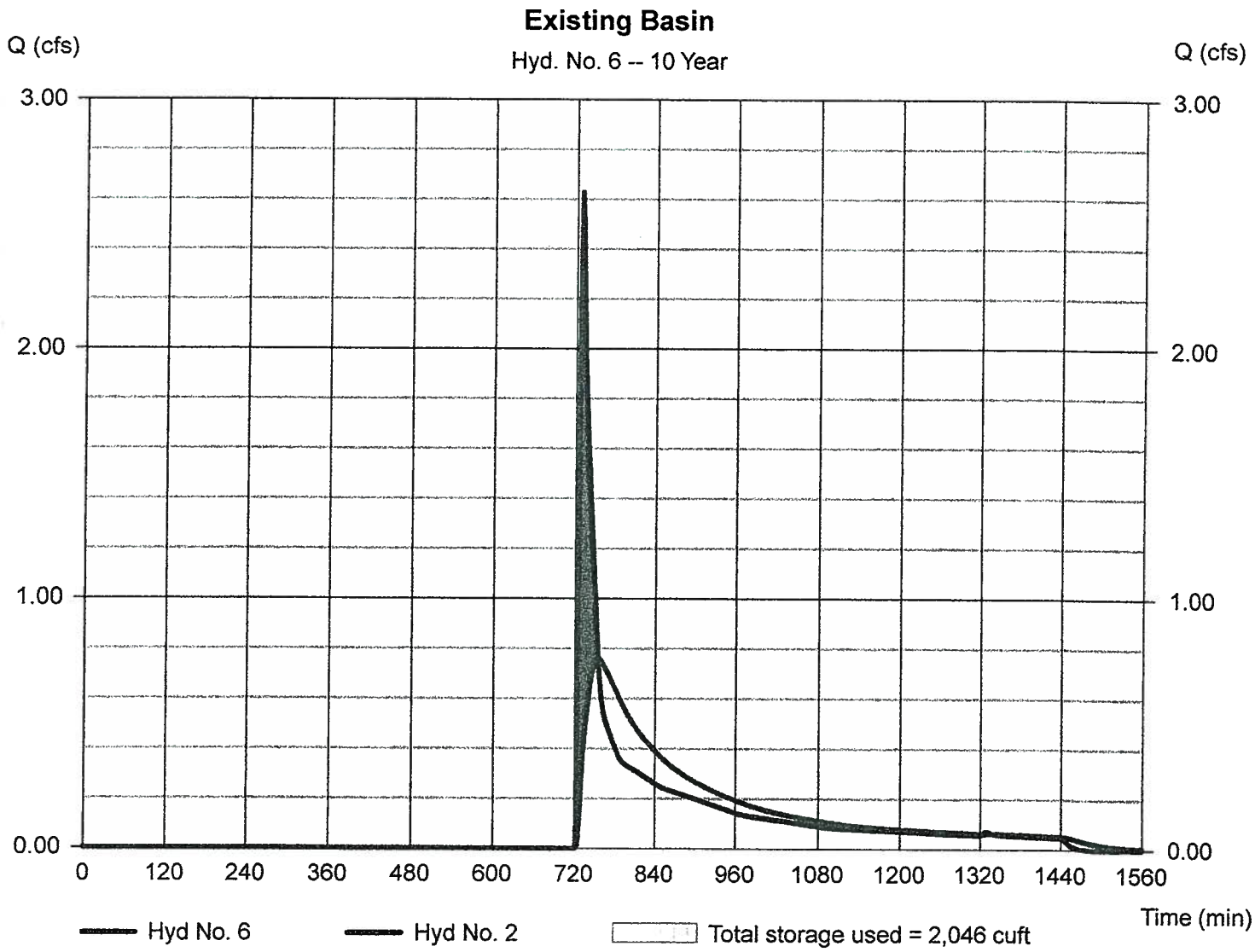
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 6

Existing Basin

Hydrograph type	= Reservoir	Peak discharge	= 0.762 cfs
Storm frequency	= 10 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 8,657 cuft
Inflow hyd. No.	= 2 - First Flush Basin	Max. Elevation	= 95.96 ft
Reservoir name	= Existing Basin	Max. Storage	= 2,046 cuft

Storage Indication method used. Outflow includes exfiltration.



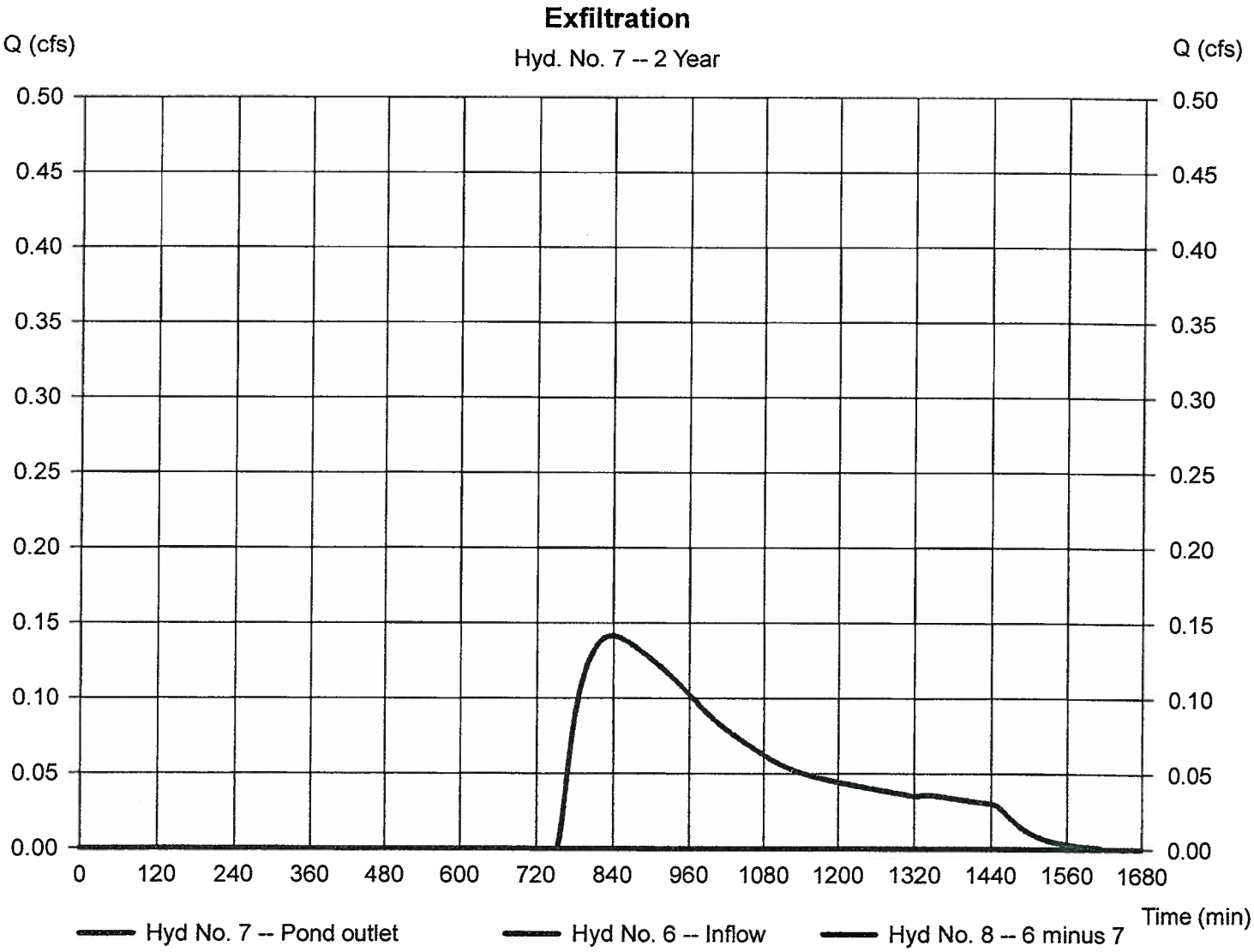
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 7

Exfiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.141 cfs
Storm frequency	= 2 yrs	Time to peak	= 838 min
Time interval	= 2 min	Hyd. volume	= 3,001 cuft
Inflow hydrograph	= 6 - Existing Basin	2nd diverted hyd.	= 8
Diversion method	= Pond - Existing Basin	Pond structure	= Exfiltration



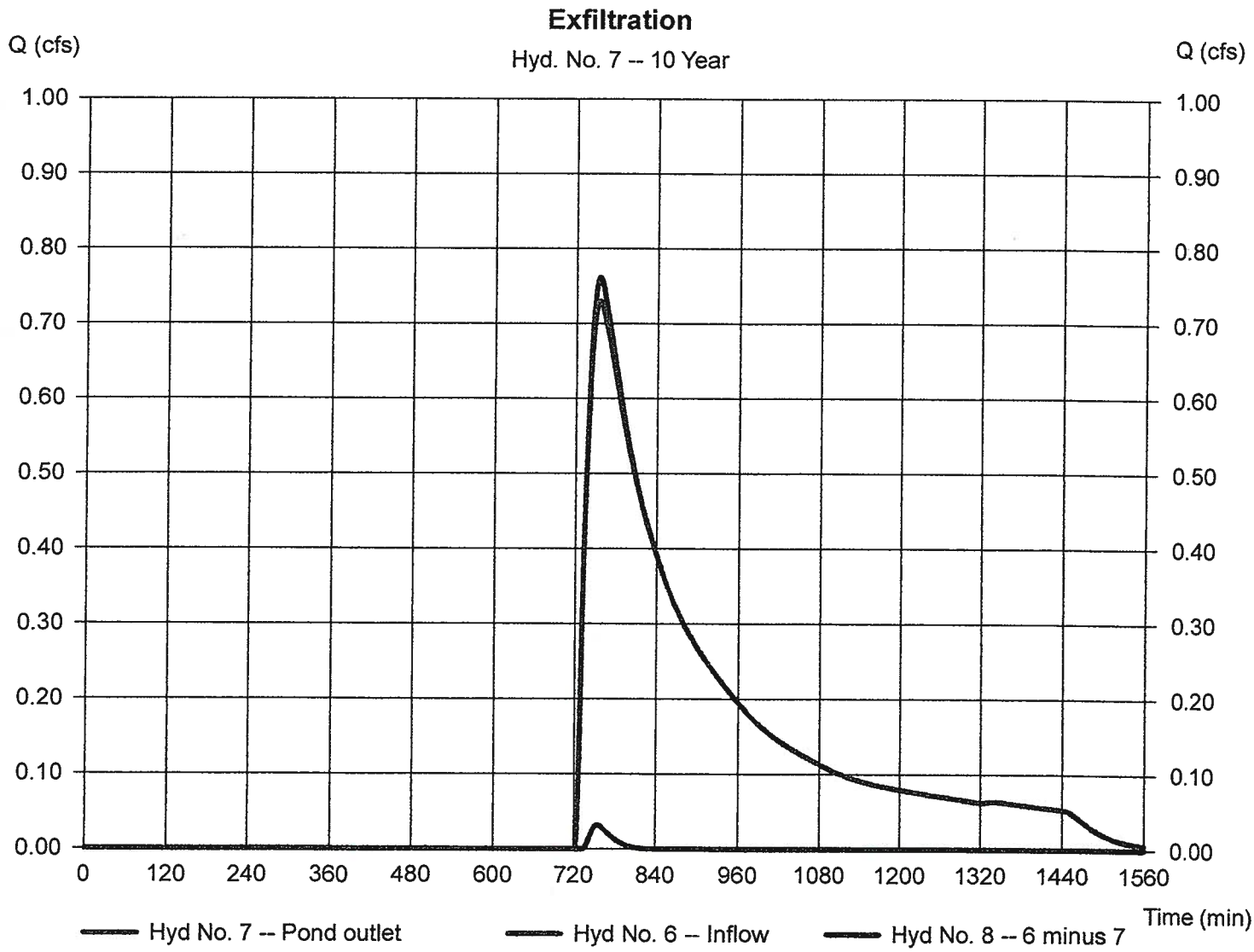
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 7

Exfiltration

Hydrograph type	=	Diversion1	Peak discharge	=	0.730 cfs
Storm frequency	=	10 yrs	Time to peak	=	754 min
Time interval	=	2 min	Hyd. volume	=	8,588 cuft
Inflow hydrograph	=	6 - Existing Basin	2nd diverted hyd.	=	8
Diversion method	=	Pond - Existing Basin	Pond structure	=	Exfiltration



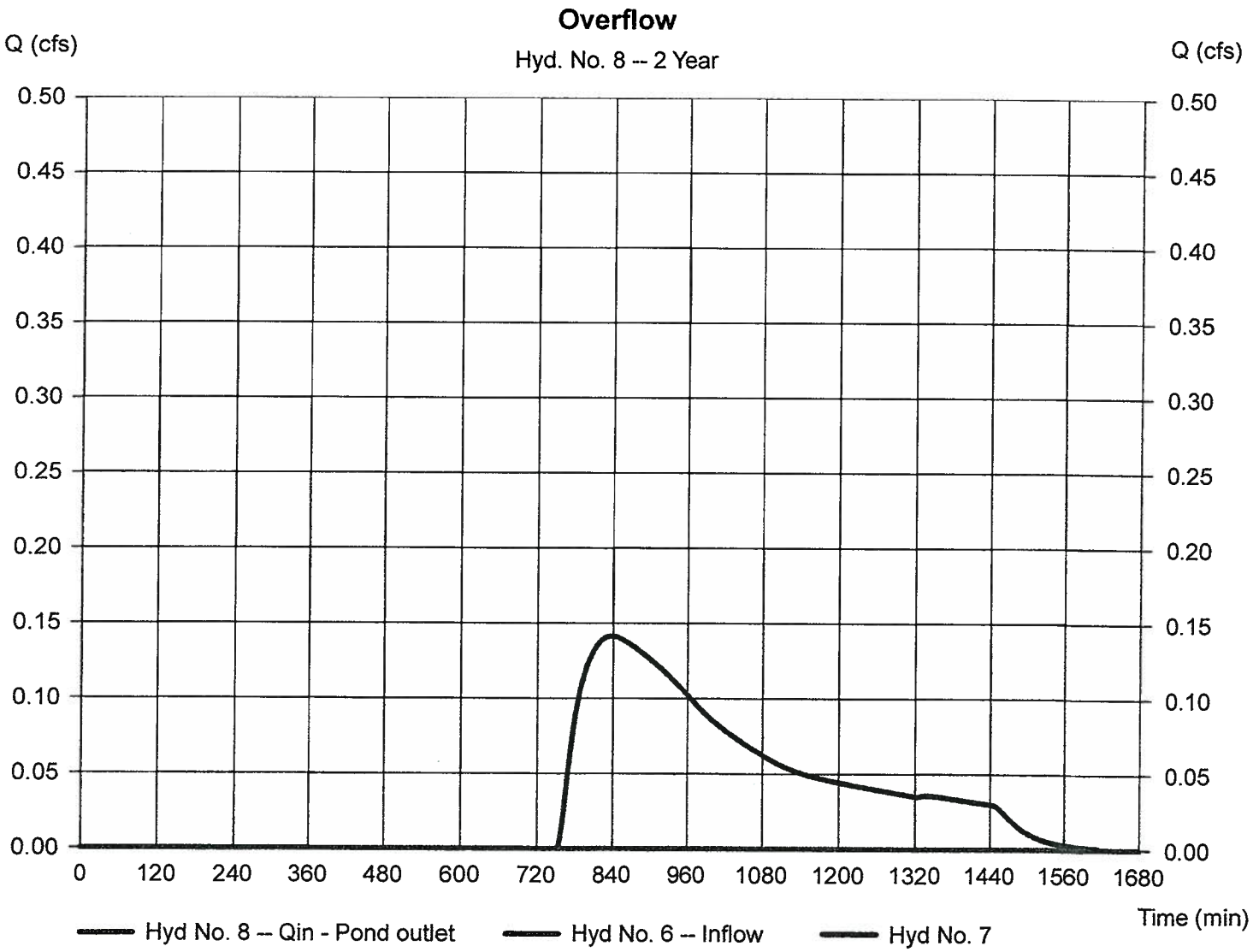
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 5, 2014

Hyd. No. 8

Overflow

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 830 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hydrograph	= 6 - Existing Basin	2nd diverted hyd.	= 7
Diversion method	= Pond - Existing Basin	Pond structure	= Exfiltration



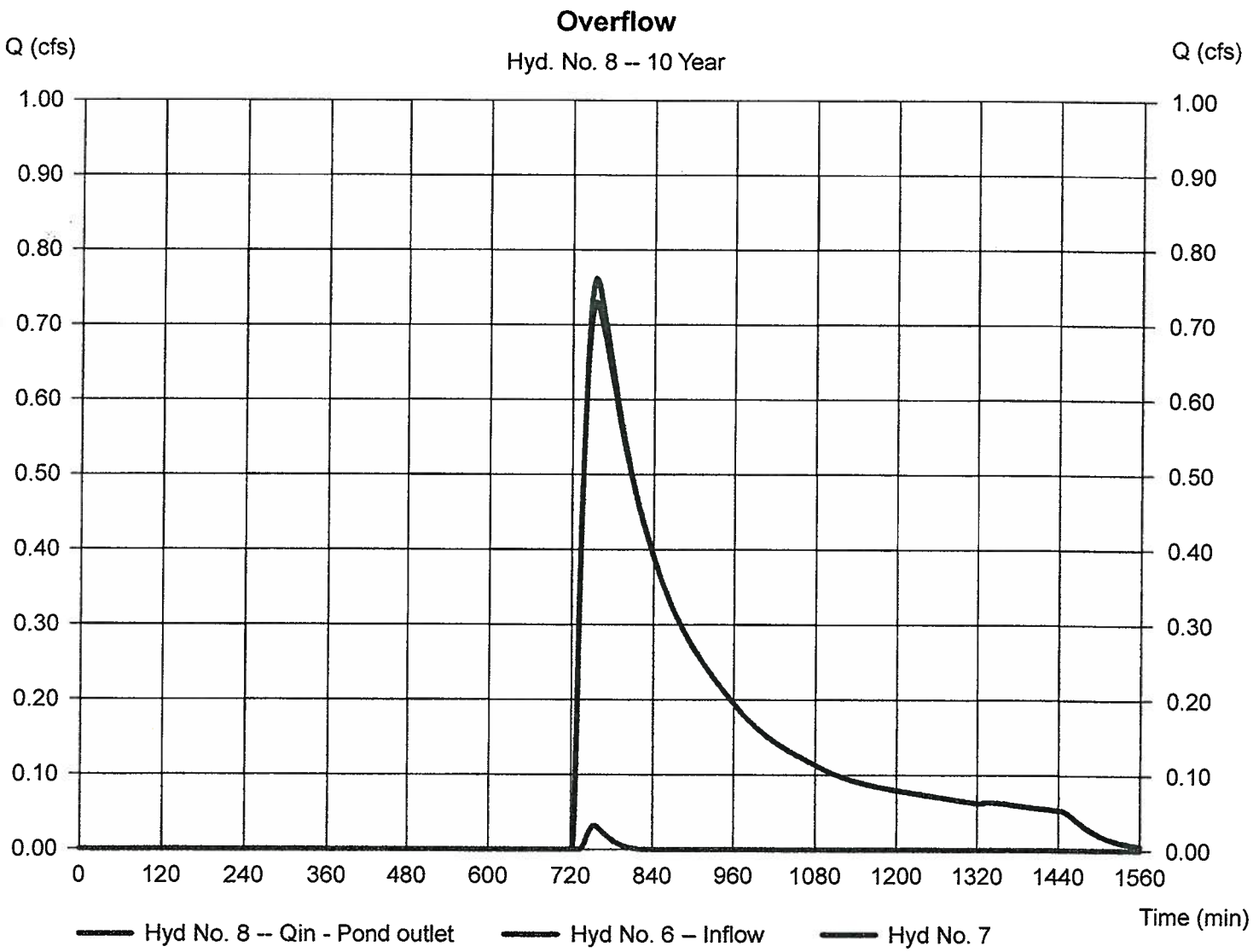
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 8

Overflow

Hydrograph type	= Diversion2	Peak discharge	= 0.032 cfs
Storm frequency	= 10 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 69 cuft
Inflow hydrograph	= 6 - Existing Basin	2nd diverted hyd.	= 7
Diversion method	= Pond - Existing Basin	Pond structure	= Exfiltration



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Pond No. 1 - Existing Basin

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 95.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	95.00	728	0	0
1.00	96.00	3,990	2,140	2,140
2.00	97.00	4,847	4,411	6,552
3.00	98.00	8,291	6,492	13,044

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 95.00	0.00	0.00	0.00
Length (ft)	= 68.00	0.00	0.00	0.00
Slope (%)	= 0.44	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

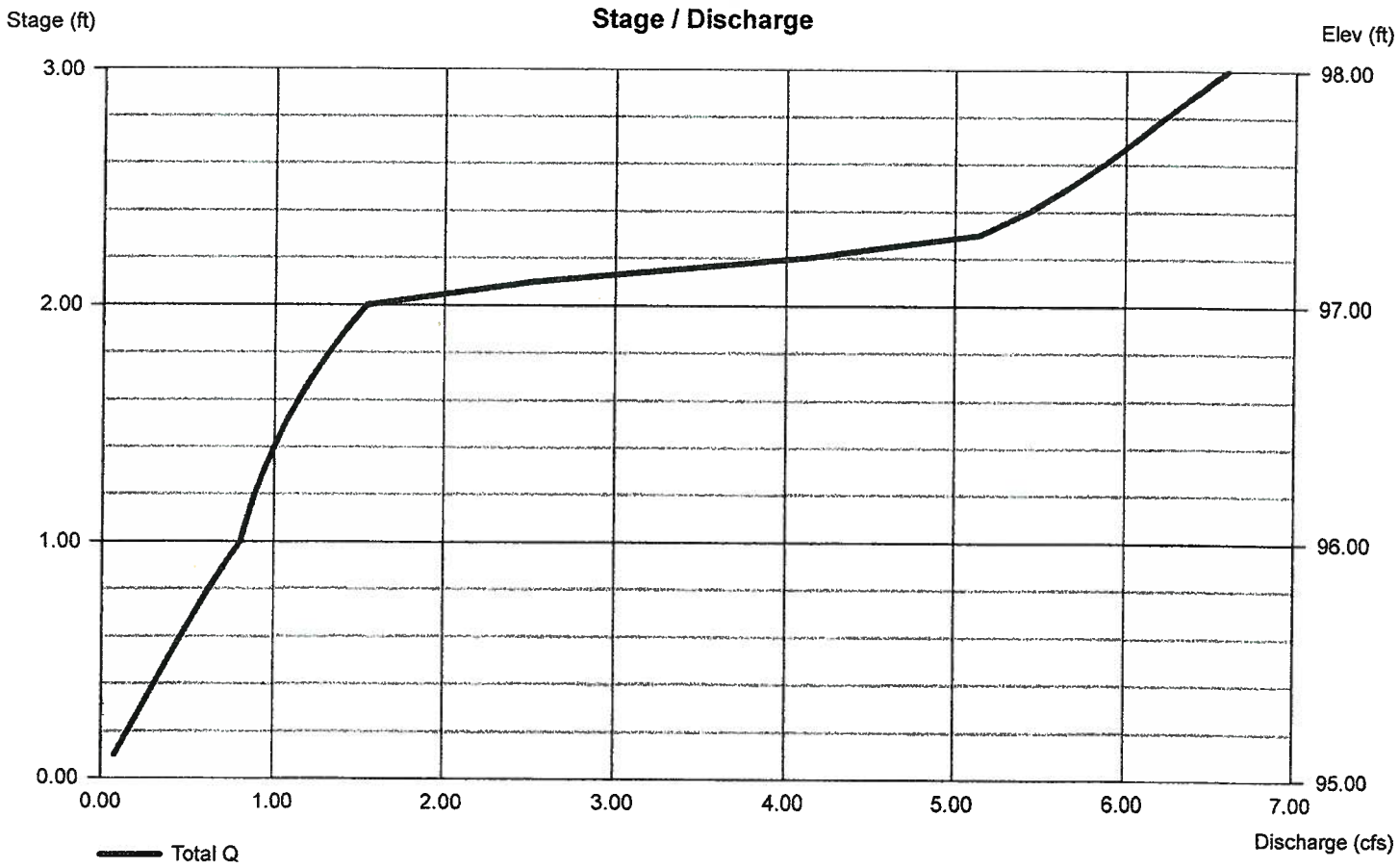
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 97.00	95.50	0.00	0.00
Weir Coeff.	= 3.33	0.22	3.33	3.33
Weir Type	= Riser	10 degV	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 8.270 (by Contour)

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).



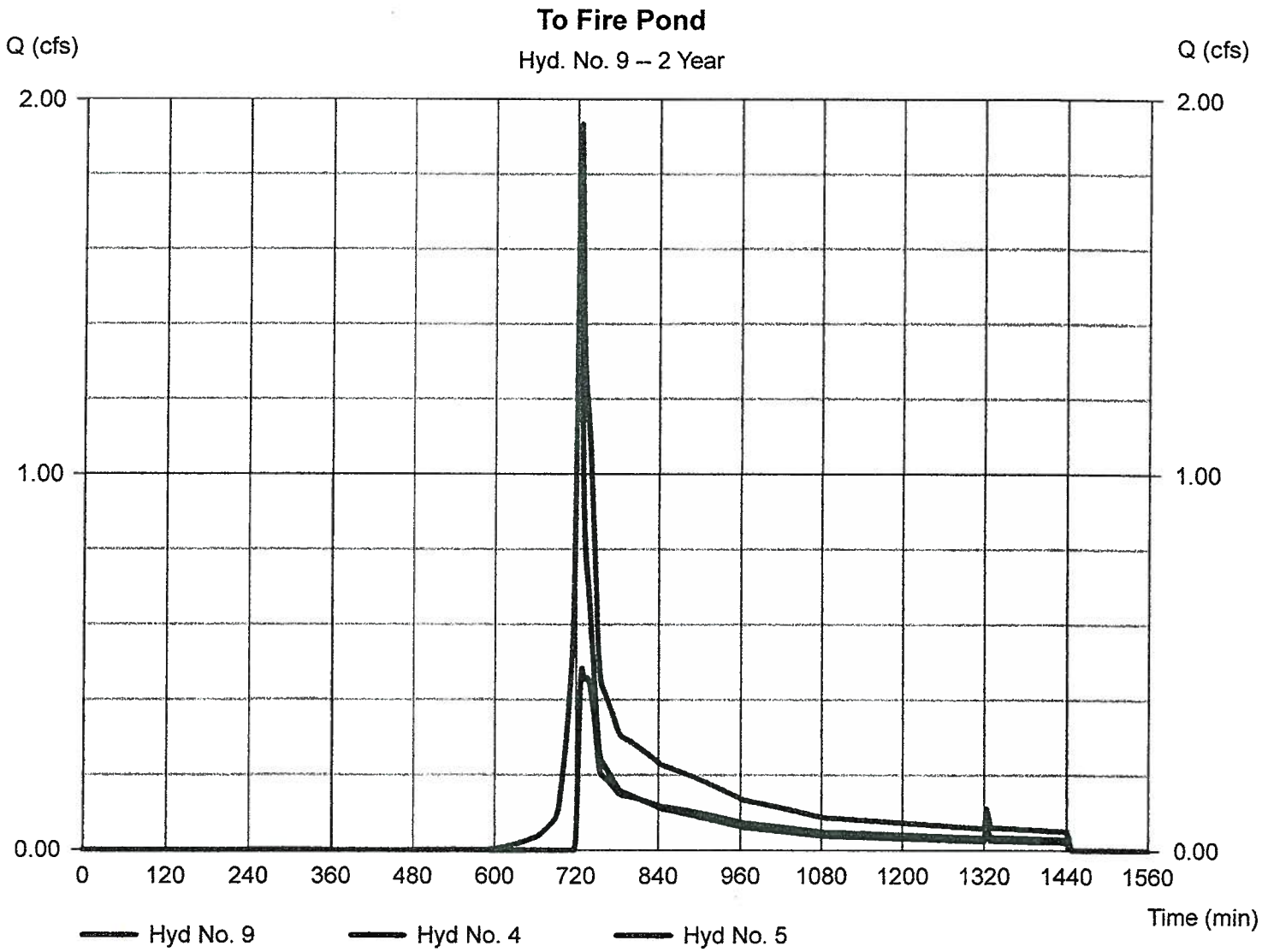
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 9

To Fire Pond

Hydrograph type	= Combine	Peak discharge	= 1.934 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 8,412 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 4.600 ac



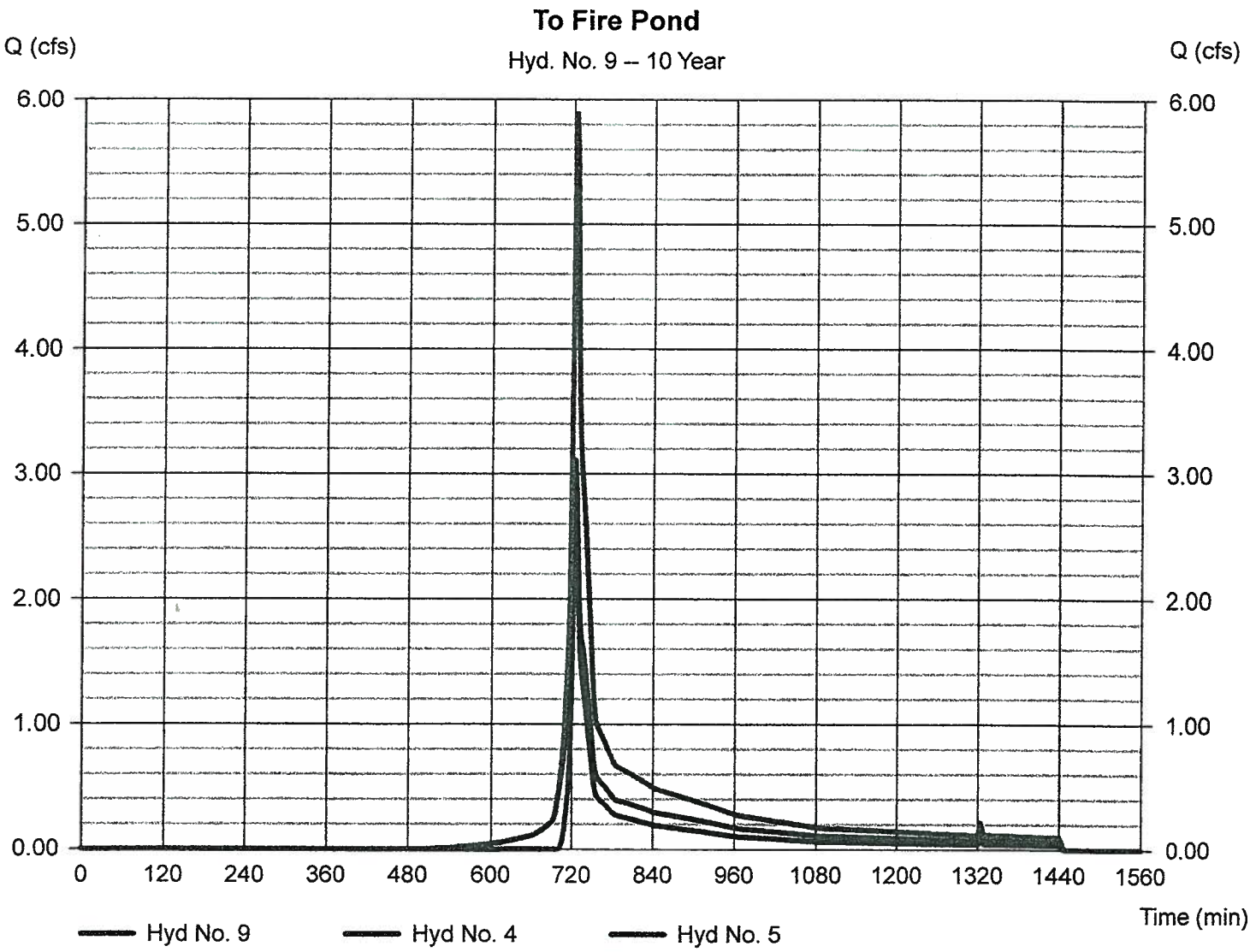
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 5, 2014

Hyd. No. 9

To Fire Pond

Hydrograph type	= Combine	Peak discharge	= 5.889 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 19,725 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 4.600 ac



First Flush Volume Calculation

STAMSKI AND McNARY, INC.
1000 Main Street
ACTON, MASSACHUSETTS 01720
TEL (978) 263-8585
FAX (978) 263-9883

JOB Acton Beechhouse
SHEET NO. _____ OF _____
CALCULATED BY WJH DATE _____
CHECKED BY _____ DATE _____
SCALE _____

FIRST FLUSH CALCULATIONS

SUBCATCHMENT 1

IMPERVIOUS AREA = 23,210 SF

BASIN VOLUME REQUIRED = $\frac{1''}{12} \times 23{,}210$ SF

$V_{REQ} = 1{,}934$ CF

DRAWDOWN CALCULATION:

MUST DRAIN WITHIN 72 HOURS

BOTTOM AREA = 422 SF
V = 1,934 CF

$$T = \frac{V}{K \times \text{BOT. AREA}}$$

$$72 = \frac{1{,}934 \text{ CF}}{K \times 422 \text{ SF}}$$

$$3.0384 \text{ K HRS/SF} = 1{,}934 \text{ CF}$$

$$K = 0.06365 \text{ FT/HR}$$

$$\boxed{K = 0.7638 \text{ IN/HR MAX PERMEABILITY}}$$

Pipe Sizing Calculations

DESIGN STORM: 10 YEAR
DATE: 06/05/14
DONE BY: WJH
FILE: 72B-RATIONAL METHOD.wb3

STORM SEWER DESIGN

(PVC)"n"= 0.010
(Cast Iron)"n"= 0.011
(ADS)"n"= 0.012

PROJECT: SM-72B
LOCATION: ACTON, MA

FROM	TO	LENGTH (FT)	TRIBUTARY AREA INCR. (ACRES)	TRIBUTARY AREA TOTAL (ACRES)	TIME OF FLOW TO UPPER END (MIN)	TIME OF FLOW TIME IN SECTION (MIN)	RUNOFF COEFF. "C"	RAINFALL INTENSITY (IN/HR)	"Q" TOTAL RUNOFF (CFS)	SLOPE of PIPE (FT/FT)	DIAM (IN)	MANN. "n"	CAPACITY FULL (CFS)	VELOCITY FULL (FPS)	DESIGN FLOW VELOCITY (FPS)	DESIGN FLOW VELOCITY HEAD (FT)	DESIGN FLOW DEPTH OF FLOW (FT)	DESIGN FLOW TOTAL ENERGY HEAD (FT)	MANHOLE INVERT DROP (FT)	FALL IN PIPE (FT)	DRAIN INV. ELEVATION UPPER END	DRAIN INV. ELEVATION LOWER END
CB-1	DMH-1	23	0.00	0.59	6	0.06	0.86	4.5	2.29	0.020	12	0.012	5.45	6.94	6.64	0.68	0.45	1.14		0.46	96.00	95.54
DMH-1	Basin	17	0.00	0.59	6	0.04	0.86	4.5	2.29	0.021	12	0.012	5.61	7.14	6.78	0.71	0.45	1.16		0.36	95.44	95.08
DMH-1	Basin	38	0.00	0.59	6	0.10	0.86	4.5	2.29	0.020	12	0.012	5.41	6.89	6.61	0.68	0.45	1.13		0.75	96.00	95.25
CB-2	DMH-2	273	0.53	0.53	6	1.26	0.68	4.5	1.62	0.005	12	0.012	2.72	3.46	3.62	0.20	0.56	0.76		1.36	96.86	95.50
CB-3	DMH-2	9	0.52	0.52	6	0.02	0.62	4.5	1.45	0.010	12	0.012	3.85	4.91	4.56	0.32	0.43	0.75		0.06	95.56	95.50
DMH-2	Contech	178	0.00	1.05	6	0.70	0.65	4.5	3.07	0.005	15	0.012	4.94	4.03	4.25	0.28	0.71	0.99		0.89	95.50	94.61
Contech	Fire Pond	128	0.00	1.05	6	0.50	0.65	4.5	3.07	0.005	15	0.012	4.94	4.03	4.25	0.28	0.71	0.99		0.64	94.61	93.97
CB-4	Contech	21	0.00	1.07	6	0.06	0.98	4.5	3.74	0.010	15	0.012	6.99	5.70	5.79	0.52	0.65	1.17		0.21	95.46	95.25
Contech	Fire Pond	21	0.00	1.07	6	0.06	0.98	4.5	3.74	0.010	15	0.012	6.99	5.70	5.79	0.52	0.65	1.17		0.21	95.25	95.04

Closed Drainage System SM-72B

Project: 848 Main Street By WJH Date 06/05/14

Location: Acton, MA Checked _____ Date _____

Rational Method

Q = peak flow rate, (cfs)
C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

i = rainfall intensity inches/hour
A = area (ac)

CB-1

Surface Cover	A (ac)	C	Product A x C
impervious	0.559	0.90	0.503
lands/grass	0.034	0.20	0.007
woods	0.000	0.15	0.000
sum =	0.593	sum =	0.510

C = 0.86 = total product / total area

CB-2

Surface Cover	A (ac)	C	Product A x C
impervious	0.364	0.90	0.328
lands/grass	0.163	0.20	0.033
woods	0.000	0.15	0.000
sum =	0.527	sum =	0.360

C = 0.68 = total product / total area

CB-3

Surface Cover	A (ac)	C	Product A x C
impervious	0.313	0.90	0.282
lands/grass	0.207	0.20	0.041
woods	0.000	0.15	0.000
sum =	0.520	sum =	0.323

C = 0.62 = total product / total area

DMH-2

Surface Cover	A (ac)	C	Product A x C
CB-2	0.527	0.68	0.360
CB-3	0.520	0.62	0.323
sum =	1.047	sum =	0.683

C = 0.65 = total product / total area

CB-4

Surface Cover	A (ac)	C	Product A x C
impervious	0.883	0.90	0.795
lands/grass	0.185	0.20	0.037
woods	0.000	0.15	0.000
sum =	1.067	sum =	0.832

C = 0.78 = total product / total area

Soil Evaluations

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Owner Name: TOM TRUDEAU

Street Address: 848 MAIN STREET

City: ALTON | State: MA | Map/Lot #: | Zip Code: 01720

B. Site Information

1. (Check one) ☐ New Construction ☐ Upgrade ☑ Repair

2. Published Soil Survey Available? ☑ Yes ☐ No — If yes: Year Published: NE SOIL; Publication Scale: 1:25000; Soil Map Unit: 626B

   Soil Name: MERRIMAC-URBAN LAND COMPLEX; Soil Limitations:

3. Surficial Geological Report Available? ☑ Yes ☐ No — If yes: Year Published: OLIVER; Publication Scale: 1:25000; Map Unit:

   Geologic Material: SAND + GRAVEL; Landform:

4. Flood Rate Insurance Map

   Above the 500-year flood boundary? ☑ Yes ☐ No — Within the 100-year flood boundary? ☐ Yes ☑ No

   Within the 500-year flood boundary? ☐ Yes ☑ No — Within a velocity zone? ☐ Yes ☑ No

5. Wetland Area: National Wetland Inventory Map — Map Unit: — Name: —

   Wetlands Conservancy Program Map — Map Unit: — Name: —

6. Current Water Resource Conditions (USGS): 1/14 (Month/Year) — Range: ☐ Above Normal ☐ Normal ☑ Below Normal

7. Other references reviewed:

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

848 MAIN
Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 1/7/14 (Date) 8:00 (Time) 10° WINDY (Weather)

1. Deep Observation Hole Logs

Deep Hole Number TP-1 Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: COMMERCIAL USE (e.g. woodland, agricultural field, vacant lot, etc.) FEW (Surface Stones) 0-5 (Slope (%))

Vegetation _____ Landform _____ Position on landscape (attach sheet) _____

3. Distances from: Open Water Body — feet Drainage Way — feet Possible Wet Area >100 feet

Property Line >10 feet Drinking Water Well — feet Other _____

4. Parent Material: DRIFT Unsuitable Materials Present: Yes ☐ No ☑

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☑

If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

Estimated Depth to High Groundwater: 78 inches _____ elevation

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

848 MAIN
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-1

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-18	FILL	—	—	—	—	—	—	—	—	—	
18-120	C	10YR5/4	78"	MEDIUM LOW	2	SAND	2	—	SG	LOOSE	

Additional Notes STRATIFIED LAYERS

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

848 MAIN
Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 1/7/14 (Date) 8:30 (Time) 10° WINDY (Weather)

1. Deep Observation Hole Logs

Deep Hole Number TP-2 Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: COMMERCIAL USE (e.g. woodland, agricultural field, vacant lot, etc.) FEW Surface Stones D-5 Slope (%)

Vegetation _____ Landform _____ Position on landscape (attach sheet) _____

3. Distances from: Open Water Body — feet Drainage Way — feet Possible Wet Area >100 feet

Property Line >10 feet Drinking Water Well — feet Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☑

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☑

If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

Estimated Depth to High Groundwater: 78 inches _____ elevation

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

848 MAIN
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-2

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-18	FILL	—	—	—	—	—	—	—	—	—	—
18-78	C	10YR5/4	—	—	—	SAND	2	—	SG	LOOSE	

Additional Notes STRATIFIED LAYERS

Commonwealth of Massachusetts
City/Town of
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Tom Taudeau
Owner Name

248 Main St
Street Address or Lot #

Acton — City/Town
MA — State
01720 — Zip Code

Contact Person (if different from Owner)
Telephone Number

B. Test Results

	Date: 1/7/14	Time: 8:45	Date:	Time:
Observation Hole #	PT-A			
Depth of Perc	44"			
Start Pre-Soak	8:45			
End Pre-Soak	24 GAL			
Time at 12"	COULD NOT SATURATE			
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)	<2 MPI			
	Test Passed: ☑ Test Failed: ☐		Test Passed: ☐ Test Failed: ☐	

Stanski and Mercier Inc - Bill Hall
Test Performed By:

Acton BOH - Evan Carlone
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

☐ Depth observed standing water in observation hole	A. SEE inches	B. SEE inches
☐ Depth weeping from side of observation hole	A. SOIL inches	B. SOIL inches
☐ Depth to soil redoximorphic features (mottles)	A. LOGS inches	B. LOGS inches
☐ Groundwater adjustment (USGS methodology)	A. inches	B. inches

2. Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment Factor _____ Adjusted Groundwater Level _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☑ Yes ☐ No

b. If yes, at what depth was it observed? Upper boundary: SEE SOIL LOGS inches Lower boundary: SEE SOIL LOGS inches

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator: Bill Hall — Date: 1/7/14

Typed or Printed Name of Soil Evaluator / License #: WILLIAM HALL SE 13592 — Date of Soil Evaluator Exam: 7/2012

Name of Board of Health Witness: EVAN CARLONE — Board of Health: ALTON

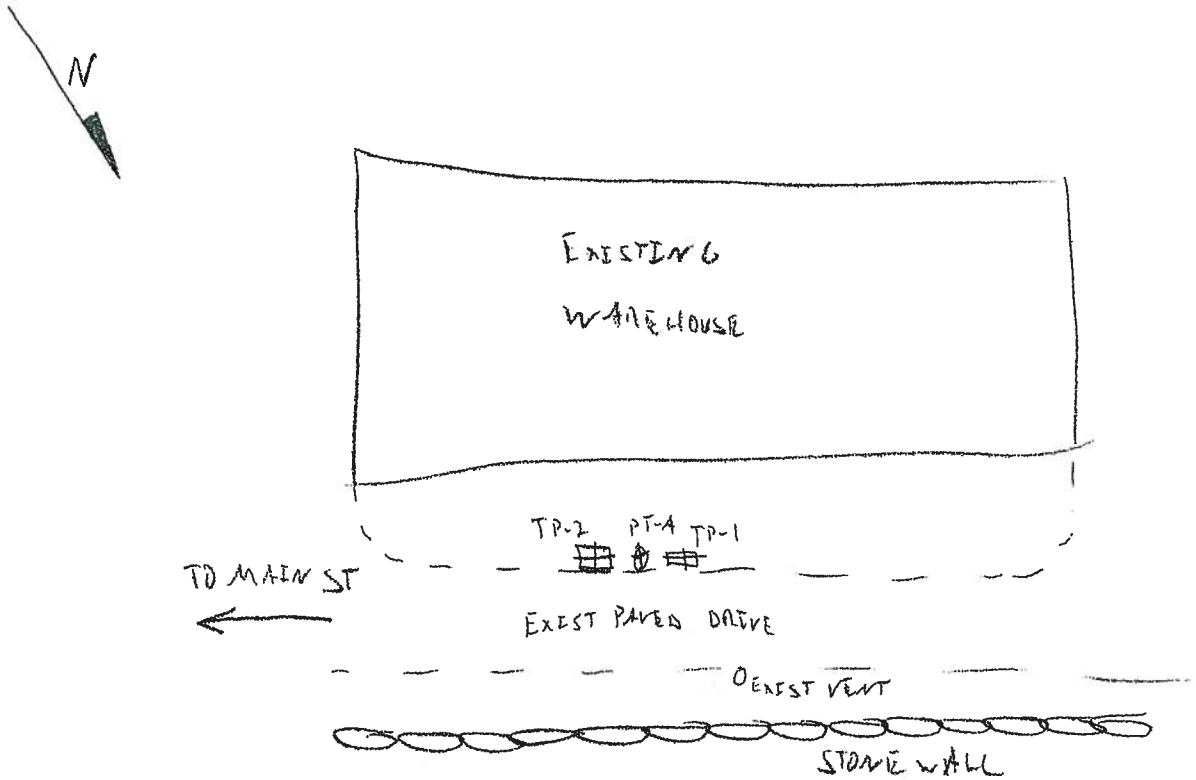
Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Field Diagrams

Use this sheet for field diagrams:



SOIL TEST INFORMATION

Client : Deck House	Inspector : Edw	STAMSKI AND MCNARY INC	
Lot No. : Lot C	Weather : Clear Dry	229 CENTRAL ST.	
Street : Main St	Date : 9/9/85	ACTON, MA. 01720	
Town : Acton			
Party : CT Peterson			
Job No. : SM-72			

Area Fill [illegible] w/ clean Sill according to Title 5 Section 15 [illegible] 17

[illegible] Monitor Pipe

	Test Pit 1	Test Pit 2	Test Pit 3	Test Pit
	Elev.=	Elev.=	Elev.=	Elev.=
Depth in Feet 1	old Leaching Bed	Fill		
2			Fill	
3				
4	Coarse			
5	Sand			
6	Gravel			
7			Coarse	
8			Sand	
9			Gravel	
10	(No Water)	(No Water)	(No Water)	

	Perc. 1	Perc.	Perc.	Perc.
Start Presoak	2:47			
Start Test	2:51			
1st 3" Drop	2:52			
2nd 3" Drop				
Elapsed Time				
Rate : Min./Inch	< 2 min/in.			

Structure size :
No. of Bedrooms :
Preferred System Location :
Water Supply :
Garbage Disposal :
Washing Machine Pit :
Sketch :

NOTE: Indicate Watertable

Field Sheet of Sheets

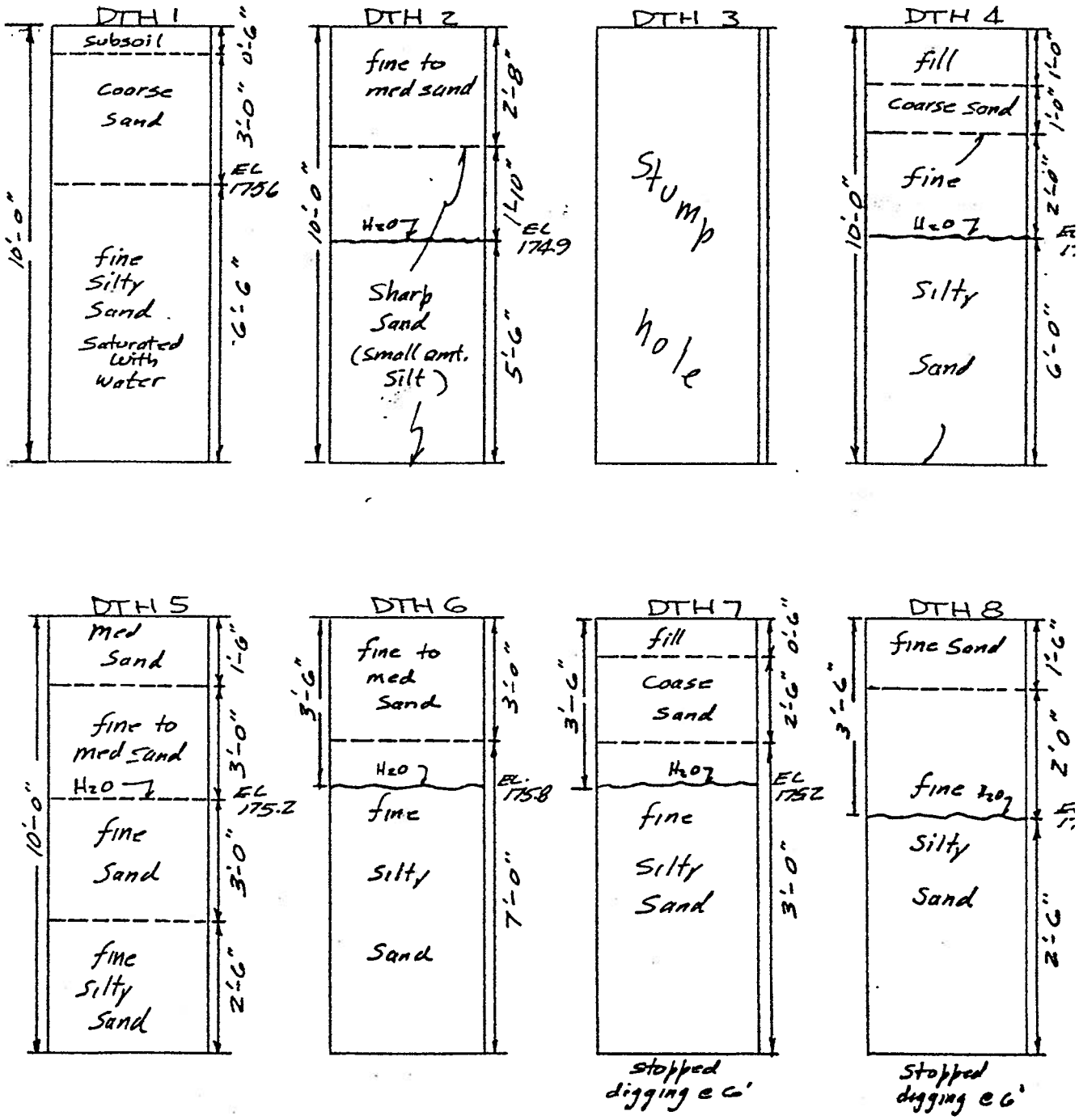
ACTON SURVEY & ENGINEERING, INC.

JOHN E. DUNPHY, JR., President

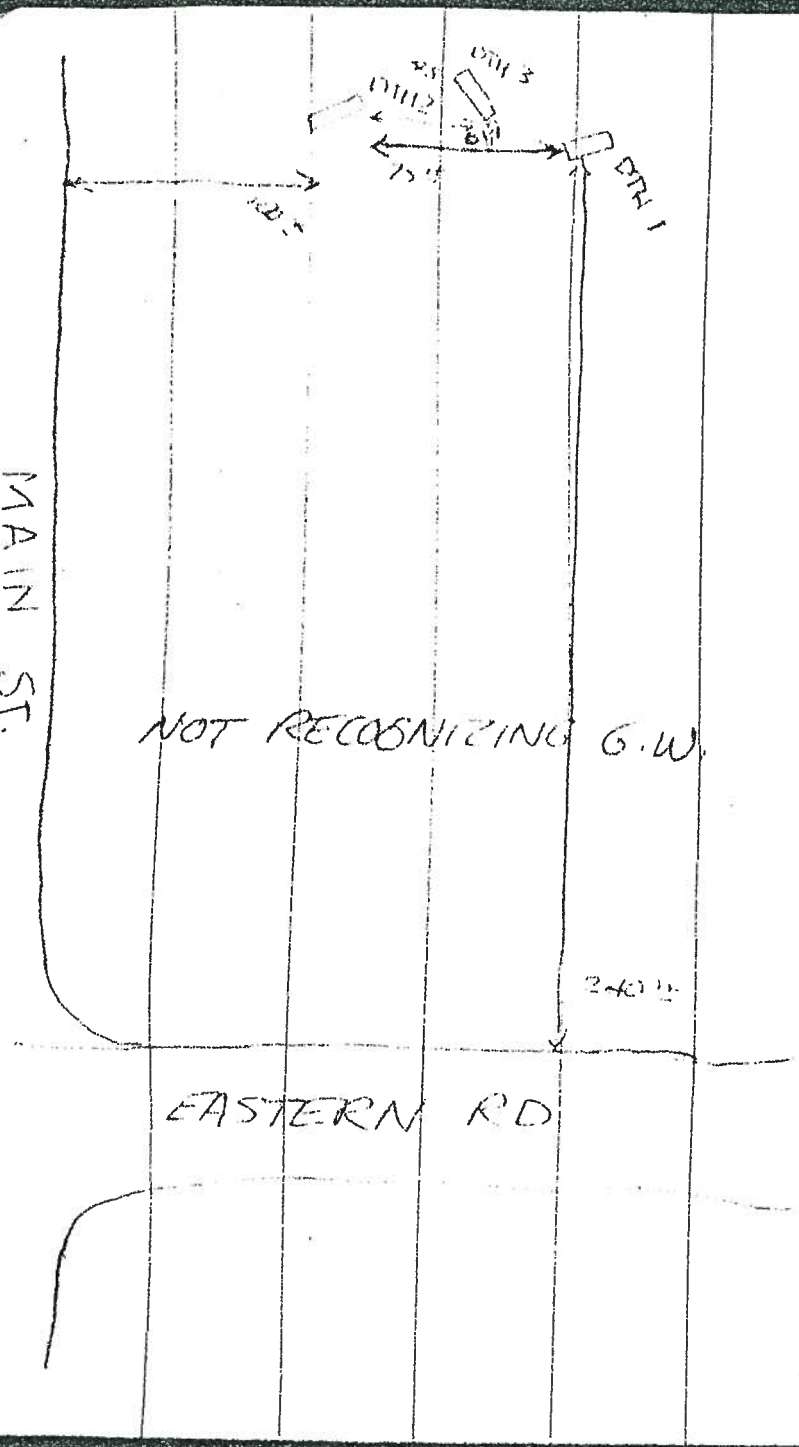
P.O. BOX 666 • ACTON, MASS. 01720

DEEP TEST HOLE SECTIONS
LOT X EASTERN RD.
ACTON, MASS

DEC. 2, 1982



Office: 277 Central Street, West Acton (617) 263-3666



LOT 6 EASTERN RD (54) 2/12/85

OWNER ACTON FOREIGN AUTO. INC. EW

ENGINEER ACTON SURVEY RUSS SCOT LEN

DTH 1

246'± FROM EASTERN RD.

1' TOP & SUBSOIL

9' SAND & GRAVEL

H_2O @ 5'

DTH 2

75'± FROM DTH 1

1' TOP & SUBSOIL

9' SAND & GRAVEL

H_2O @ 9'

DTH 3

45'± FROM DTH 2

1' TOP & SUBSOIL

9' SAND & GRAVEL

H_2O @

PT 1 66'

5'± FROM DTH 3

START SOAK 12:44 AM

24 GALLONS IN AT

12:47 AM

HOLE DRY @ 12:44 AM

<2 MPI

Stormwater Operation and Maintenance Manual

Schedule for Inspection and Maintenance:

Deep Sump and Hooded Catch Basins and Manholes:
The deep sump for the catch basins shall be inspected and cleaned annually. The catch basins shall have a four foot deep sump and the water level is maintained by the discharged pipe at four feet. The discharge pipe is hidden from view by a hooded outlet. The depth of the sediment in a basin shall not exceed a depth of 18 inches as determined by probing with a stick. If the stick hits the bottom within 30 inches of the water level, more than 18 inches of sediment has accumulated and must be removed. Licensed persons should remove and dispose of the contents of the sump in accordance with applicable regulations.

Contech CDS and VortSentry Units:
See attached Contech Stormwater Solutions Operation, Design, Performance and Maintenance Guides.

Drainage Basins:
In each of the first three years after construction, two inspections are required in both the growing and non-growing seasons. After successful establishment of all required vegetation and surfaces withstand erosion, inspection and maintenance should continue on a yearly basis. The following observations and corrective measures should be made during each inspection:

-Side slopes of the channel shall be inspected for erosion. All eroded areas shall receive 6" of loam and be reseeded per original design plan. Areas of continued erosion shall be stabilized with 3" minus riprap.

-Remove all sediment from the channel once the sediment reaches 10% of channel volume or 3-inch depth.

Infiltration Trench
Inspect the infiltration trench after the first several rainfall events, after all major storms, and on regularly scheduled dates every six months. If the top of the trench is grassed, it must be mowed on a seasonal basis. Grass height must be no more than four inches. Routinely remove debris from the top of the trench.

Emergency Contacts:
In the event of a hazardous materials spill on the site the following parties shall be contacted:
Fire Department: ph: 978-264-9645

Records:
The Owner shall maintain an inspection log of all elements of the storm water management plan. The owner shall maintain a maintenance log documenting the inspection and maintenance of the drainage structures under his control. A copy of the erosion control and storm water maintenance plan and inspection logs shall be kept onsite at all times.

Responsibility Party:
The Owner shall be responsible for all inspection and maintenance of the items included in the Manual.

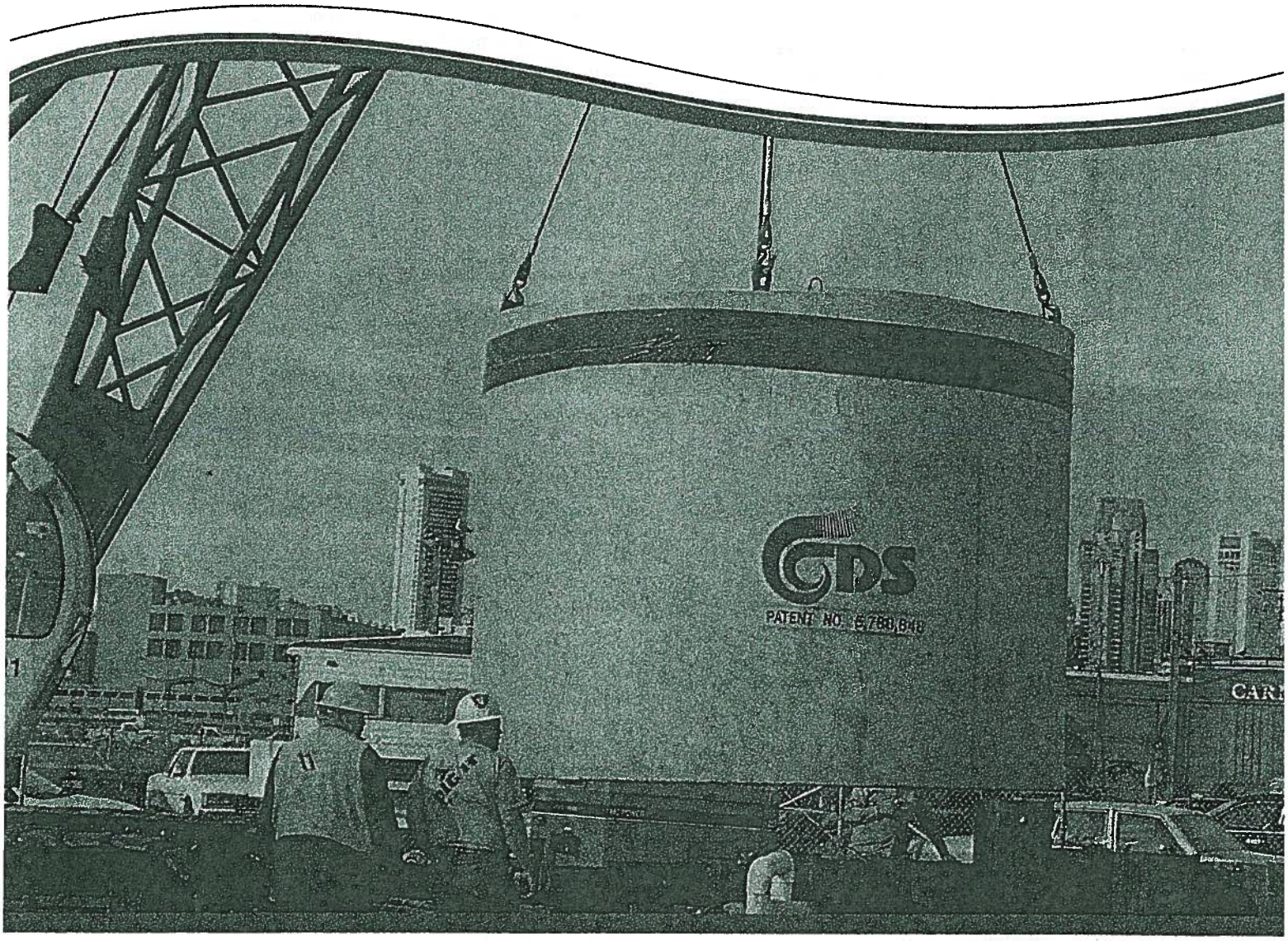
Name: _____

Signature: _____

Date: _____

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance



CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

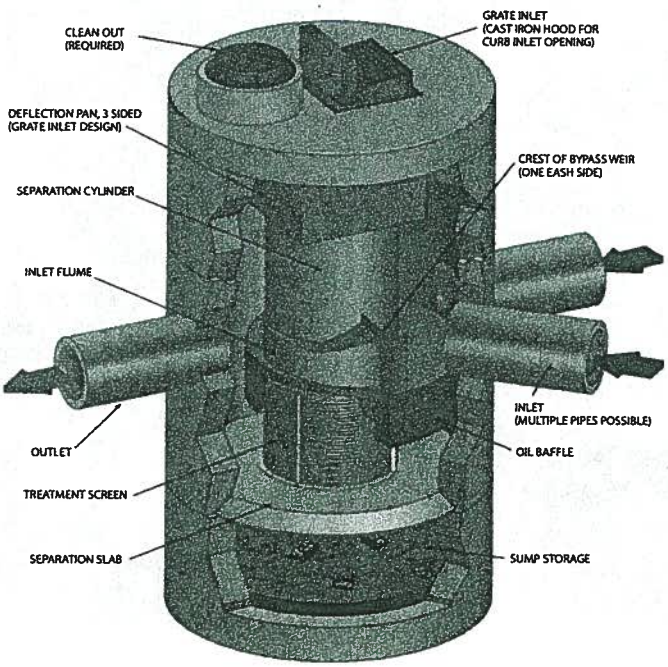
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

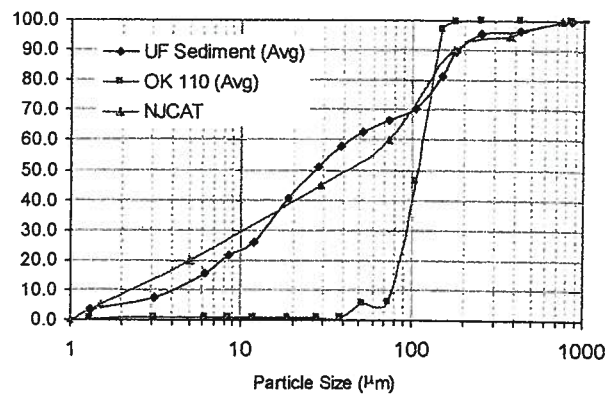


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

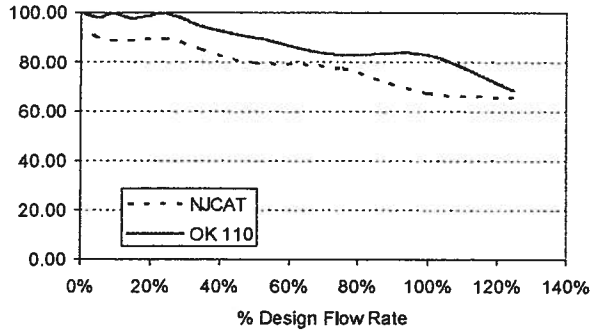


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

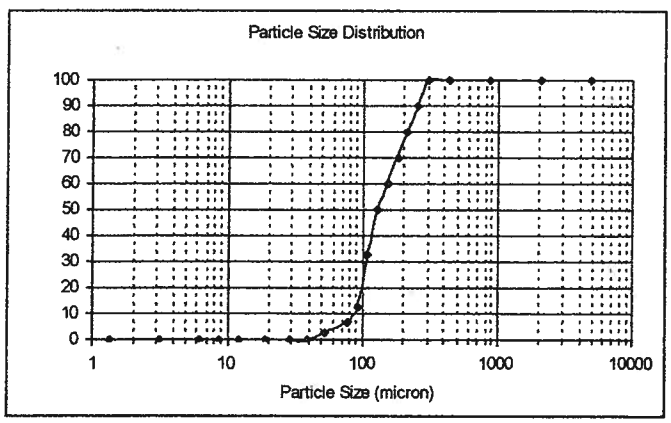


Figure 3. WASDOE PSD

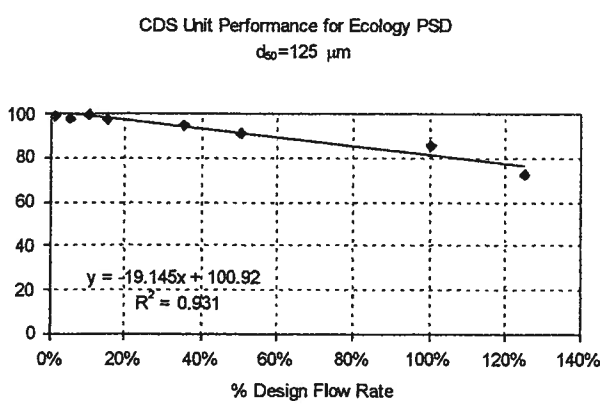


Figure 4. Modeled performance for WASDOE PSD.

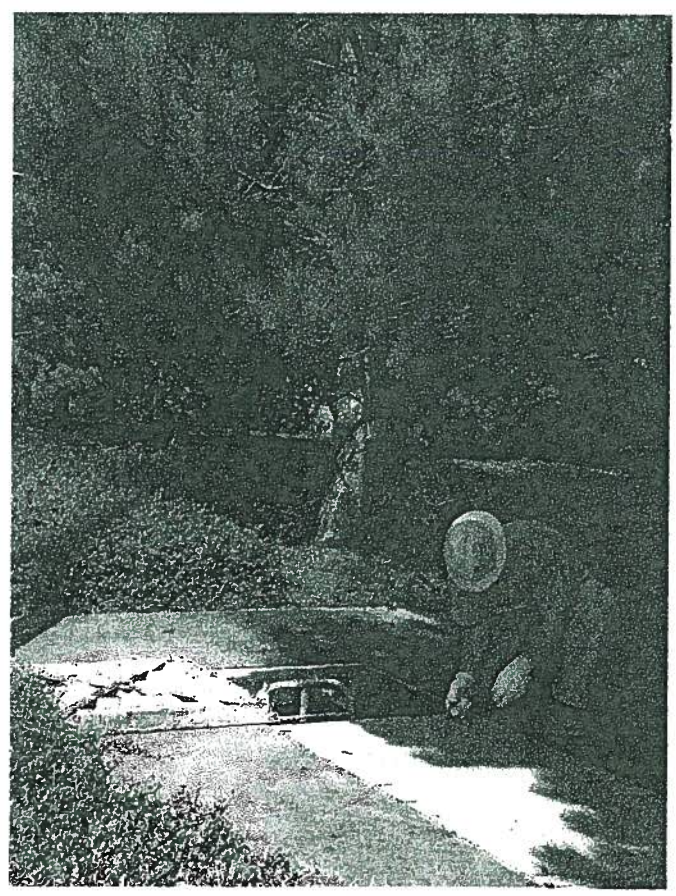
Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified



during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

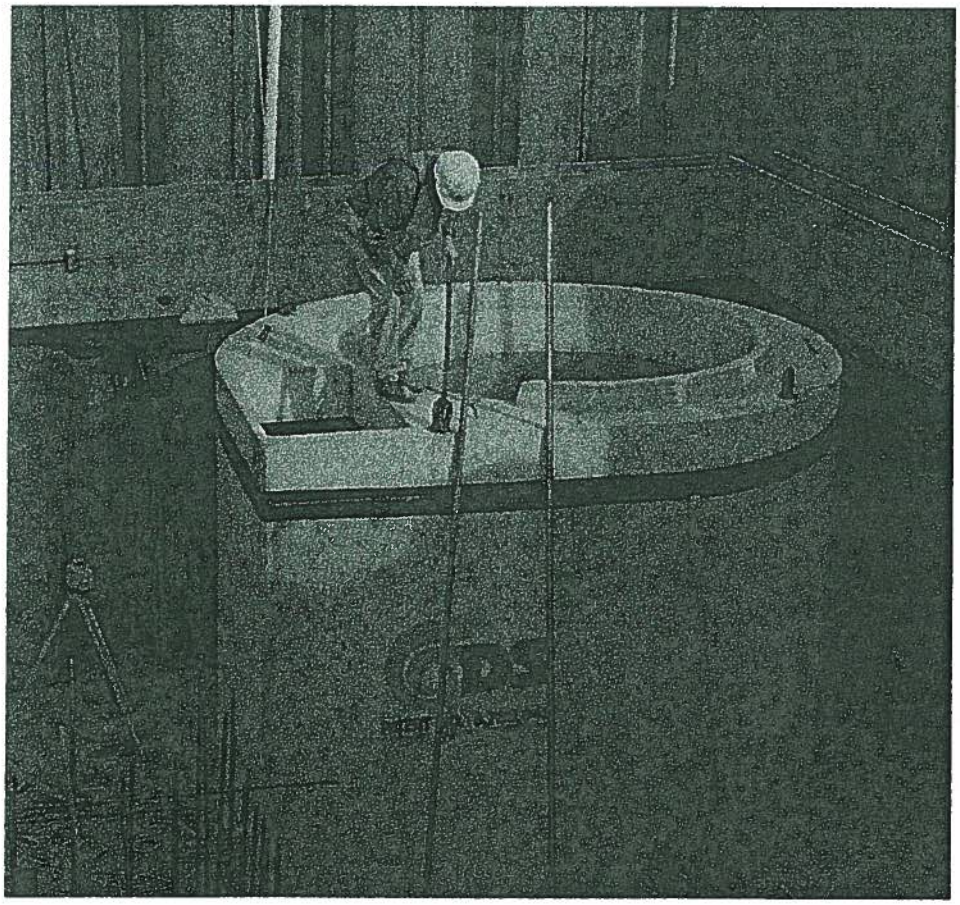
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Support

- Drawings and specifications are available at www.ContechES.com/urbangreen.
- Site-specific design support is available from our engineers.

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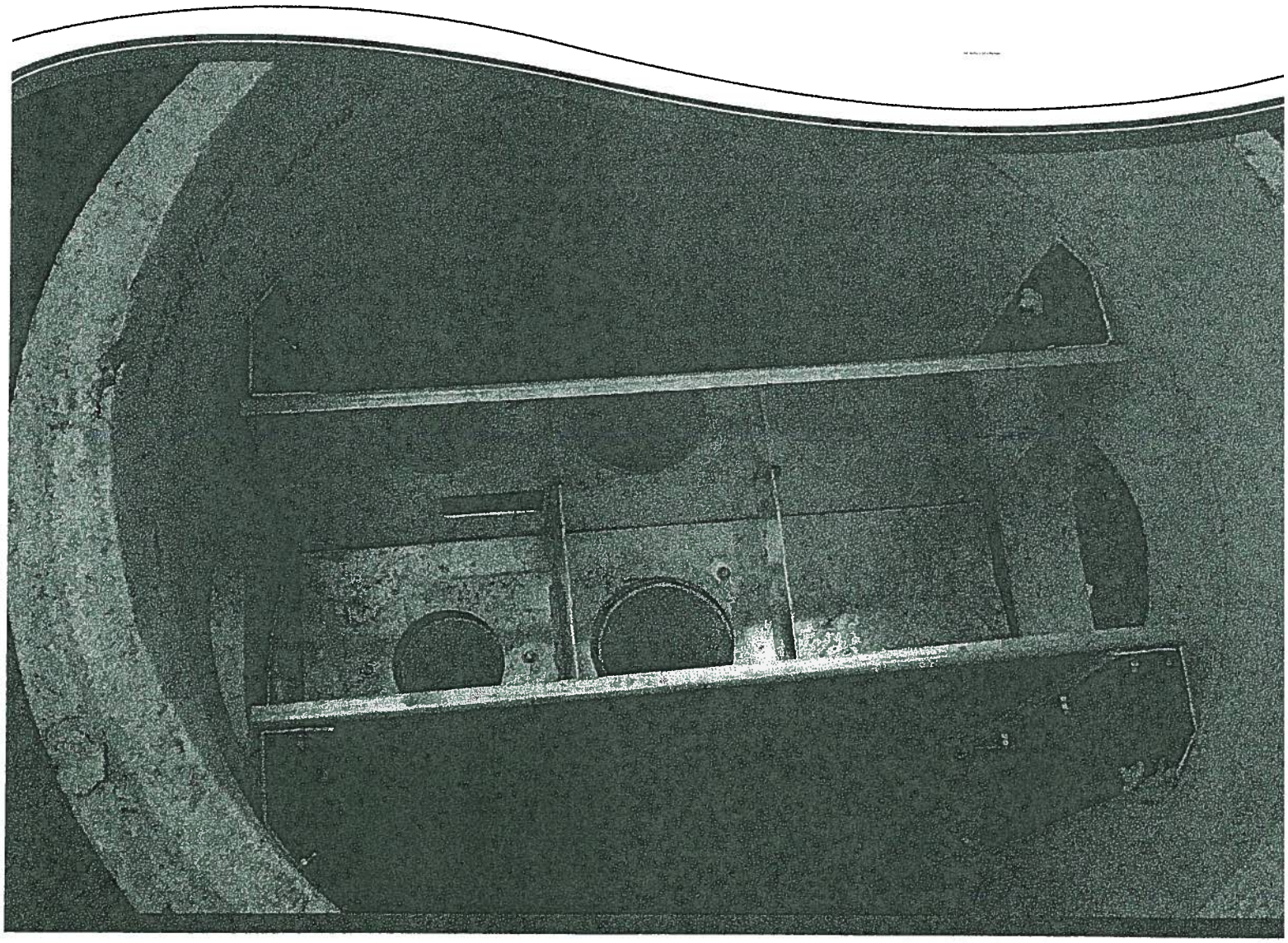
CONTECH®
STORMWATER SOLUTIONS™

VortSentry® HS Guide
Operation, Design, Performance and Maintenance



VortSentry® HS

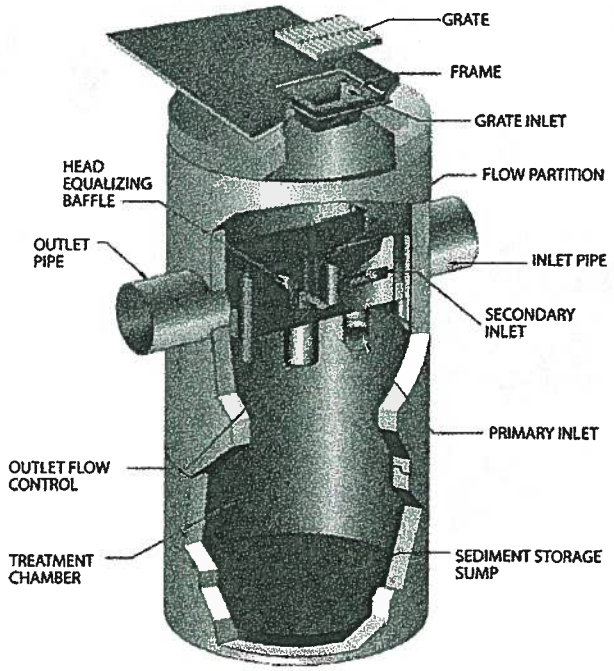
The VortSentry HS is a compact, below grade stormwater treatment system that employs helical flow technology to enhance gravitational separation of floating and settling pollutants from stormwater flows. With the ability to accept a wide range of pipe sizes, the VortSentry HS can treat and convey flows from small to large sites. A unique internal bypass design means higher flows can be diverted without the use of external bypass structures. The VortSentry HS is also available in a grate inlet configuration, which is ideal for retrofit installations.

Operation Overview

Low, frequently occurring storm flows are directed into the treatment chamber through the primary inlet. The tangentially oriented downward pipe induces a swirling motion in the treatment chamber that increases capture and containment abilities. Moderate storm flows are directed into the treatment chamber through the secondary inlet, which allows for capture of floating trash and debris. The secondary inlet also provides for treatment of higher flows without significantly increasing the velocity or turbulence in the treatment chamber. This allows for a more quiescent separation environment. Settleable solids and floating pollutants are captured and contained in the treatment chamber.

Flow exits the treatment chamber through the outlet flow control, which manages the amount of flow that is treated and helps maintain the helical flow patterns developed within the treatment chamber.

Flows exceeding the system's rated treatment flow are diverted away from the treatment chamber by the flow partition. Internal diversion of high flows eliminates the need for external bypass structures. During bypass, the head equalizing baffle applies head on the outlet flow control to limit the flow through the treatment chamber. This helps prevent re-suspension of previously captured pollutants.



Design Basics

There are two primary methods of sizing a VortSentry HS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow for a defined particle size. The summation process of the Rational Rainfall Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically, VortSentry HS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a particle gradation with an average particle size (d_{50}) of 240-microns (μm).

Water Quality Flow Rate Method

In many cases, regulations require that a specific flow rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval (i.e. the six-month storm) or a water quality depth (i.e. 1/2-inch of rainfall).

The VortSentry HS is designed to treat all flows up to the WQQ. Due to its internal bypass weir configuration, flow rates in the treatment chamber only increase minimally once the WQQ is surpassed. At influent rates higher than the WQQ, the flow partition will allow most flow exceeding the treatment flow rate to bypass the treatment chamber. This allows removal efficiency to remain relatively constant in the treatment chamber and reduces the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the VortSentry HS will remove a specific gradation of sediment at a specific removal efficiency. Therefore they are variable based on the gradation and removal efficiency specified by the design engineer and the unit size is scaled according to the project goal.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. The Rational Rainfall Method is a sizing program CONTECH developed to estimate a net annual sediment load reduction for a particular VortSentry HS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics. For more information on the Rational Rainfall Method, see *Vortechs Technical Bulletin 4: Modeling Long Term Load Reduction: The Rational Rainfall Method*, available at www.contechstormwater.com.

Treatment Flow Rate

The outlet flow control is sized to allow the WQQ to pass entirely through the treatment chamber at a water surface elevation equal to the crest of the flow partition. The head equalizing baffle applies head on the outlet flow control to limit the flow through the treatment chamber when bypass occurs, thus helping to prevent re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The VortSentry HS is available in three standard configurations: inline (with inlet and outlet pipes at 180° to each other), grated inlet, and a combination of grate and pipe inlets. All three configurations are available in 36-inch (900-mm) through 96-inch (2400-mm) diameter manholes.

The configuration of the system is determined by the suffix of the model name:

- A model name without a suffix denotes a standard pipe inlet (Example HS48).
- A "G" at the end of the model designation denotes a grate inlet (Example HS48G).
- A "GP" at the end of the model designation denotes a combination of grate and pipe inlets (Example HS48GP).

Performance

Full-Scale Laboratory Test Results

Laboratory testing of the VortSentry HS was conducted using F-55 Silica, a commercially available sand product with an average particle size of 240-μm (Table 1). This material was metered into a model HS48 VortSentry HS at an average concentration of between 250-mg/L and 300-mg/L at flow rates ranging from 0.50-cfs to 1.5-cfs (14-L/s to 56-L/s).

US Standard Sieve Size	Particle Size Micron (μm)	Cumulative Passing %
30	600	99.7%
40	425	95.7%
50	300	74.7%
70	212	33.7%
100	150	6.7%
140	106	0.7%

Table 1 : US Silica F-55 Particle Size Distribution

Removal efficiencies at each flow rate were calculated based on net sediment loads passing the influent and effluent sampling points. Results are illustrated in Figure 1.

Assuming that sediment in the inlet chamber is ideally mixed, removal rates through the system will decay according to the percentage of flow bypassed. This effect has been observed in the laboratory where the test system is designed to produce a

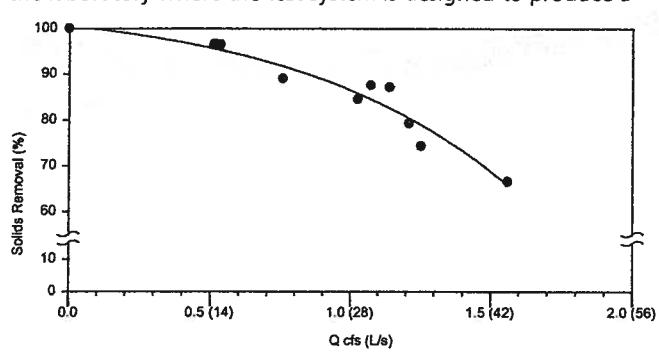


Figure 1: VortSentry HS Removal Efficiencies for 240-μm Particle Gradation

thoroughly mixed inlet stream. All VortSentry HS models have the same aspect ratio regardless of system diameter (i.e. an increase in diameter results in a corresponding increase in depth). Operating rates are expressed volumetrically.

Removal efficiency at each operating rate is calculated according to the average of volumetric and Froude scaling methods and is described by Equation 1.

Equation 1: $$\left(\frac{\text{Diameter Prototype}}{\text{Diameter Model}}\right)^{2.75} = \left(\frac{\text{Flow Rate Prototype}}{\text{Flow Rate Model}}\right)$$

Equation 1 and actual laboratory test results were used to determine the flow rate which would be required for the various VortSentry HS models to remove 80% of solids.

View full report at www.contechstormwater.com

Maintenance

The VortSentry HS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit, i.e., unstable soils or heavy winter sanding will cause the treatment chamber to fill more quickly, but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations of a large volume of sediment. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is available for download at www.contechstormwater.com.

The VortSentry HS should be cleaned when the sediment has accumulated to a depth of two feet in the treatment chamber. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the distance given in Table 2, the VortSentry HS should be maintained to ensure effective treatment.

Cleaning

Cleaning of the VortSentry HS should be done during dry weather conditions when no flow is entering the system. Cleanout of the VortSentry HS with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole cover and insert the vacuum hose into the sump. All pollutants can be removed from this one access point from the surface with no requirements for Confined Space Entry.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads, which solidify the oils. These are usually much easier to remove from the unit individually, and less expensive to dispose than the oil/water emulsion that may be

created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

Disposal of all material removed from the VortSentry HS should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

VortSentry HS Model	Diameter		Distance Between Water Surface and Top of Storage Sump		Sediment Storage		Oil Spill Storage	
	in.	m	ft.	m	yd^3	m^3	gal.	liter
HS36	36	0.9	3.6	1.1	0.5	0.4	83	314
HS48	48	1.2	4.7	1.4	0.9	0.7	158	598
HS60	60	1.5	6.0	1.8	1.5	1.1	258	978
HS72	72	1.8	7.1	2.2	2.1	1.6	372	1409
HS84	84	2.1	8.4	2.6	2.9	2.2	649	2458
HS96	96	2.4	9.5	2.9	3.7	2.8	845	3199

Table 2: VortSentry HS Maintenance Indicators and Sediment Storage Capacities.

Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile. Finer, silty particles at the top of the pile may be more difficult to feel with the measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.

Logon to www.contechstormwater.com to download the VortSentry HS Inspection and Maintenance Log.

For assistance with maintaining your VortSentry HS, contact us regarding the CONTECH Maintenance compliance certification program.

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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Operation and Maintenance Inspection Log

Year: _____

Inspection Items:	**Frequency:**
Contech Units	**Two times per year**
Catch Basins	**Four times per year**
Drainage Basin	**Once per year**
Infiltration Trench	**Twice per year**

Contech Units

Previous Inspection Date: _____

Inspection Date: _____

Inspector Name: _____

Comments:

Action Required:

Catch Basins:

Previous Inspection Date: _____

Inspection Date: _____

Inspector Name: _____

Sediment Depth: _____ (Remove if depth greater than 18")

Comments:

Action Required:

Drainage Basin:

Previous Inspection Date: _____

Inspection Date: _____

Inspector Name: _____

Sediment Forebay: _____

Erosion in Basin: _____

Outlet Structure: _____

Comments:

Action Required:

Infiltration Trench:

Previous Inspection Date: _____

Inspection Date: _____

Inspector Name: _____

Comments:

Action Required: