

# STORMWATER MANAGEMENT PLAN

FOR

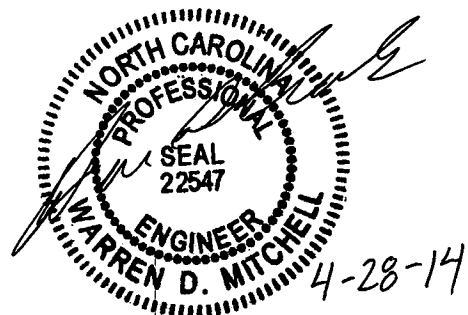
## Countyline Self-Storage

Chatham County, NC

Submitted by:

*Warren D. Mitchell, PE*  
253 Tobacco Farm Way  
Chapel Hill, NC 27516  
919-593-1916

April 28, 2014



## COMPLIANCE STATEMENT

*The design of all stormwater management facilities and practices will control and treat the runoff from the 1 year- 1 hour storm over the total drainage area for the proposed development and provide the same level of treatment for some of the existing facility that will drain to the new – proposed wet ponds. The designs and plans are sufficient to comply with applicable standards and policies found in the NCDENR Stormwater BMP Design Manual, and that the designs and plans ensure compliance with the County's Stormwater Ordinance.*

## INTRODUCTION

This report is being prepared to satisfy the requirements of the Chatham County Stormwater Ordinance for the Conditional Use Rezoning of Countyline Self Storage. This property is a 3.7 acre wooded parcel with a single family brick ranch house. The property is at the top of the ridge for this watershed. There are no streams or wetlands on the property. Stormwater runoff drains from south to north. There is 11,800 square feet of existing impervious area. There is 61.53 feet of property frontage on US Hwy 15-501 North. Wal-Mart is the neighbor to the north and east and the UNC park-and-ride facility is the neighbor to the south. The maximum impervious surface allowed by Chatham County is 36% of the total lot area.

The proposal includes 2 – 4 story self storage buildings. The proposed impervious surface is 57,700 square feet or 36% of the 3.7 acre parcel. The parcel is currently zoned R1. We are proposing to change the zoning to CD-RB. Self-storage is a use allowed in this zoning district.

## SITE ANALYSIS

The majority of the stormwater runoff drains towards the north or northeast corner of the site. The pond will be located at the northeast corner of the site which is the lowest point of the site. The southern boundary is located on the ridge of the watershed. There is no offsite runoff draining to the site. Runoff leaving the property drains to the north and enters a curb inlet in the Wal Mart loading dock area. This property is in the Jordan Lake Watershed – Upper New Hope section. The runoff from the site will eventually enter Wilson Creek.

## PROPOSED DRAINAGE DESIGN

The stormwater will be managed using a Wet Detention Basin. This basin will be located at the northeast corner of the site. The pond will capture 2.1 acres of runoff from the developed site. The entry drive will not drain to the pond because of the elevation. The area of the entry drive that doesn't make it to the pond is 8,850 square feet. This is less than the 11,800 square feet of existing impervious surface on the property today. This runoff from the entry drive will enter curb inlets that will be installed in the driveway at the right-of-way. There is an existing inlet and pipe installed in the r/w that can handle this runoff.

The stormwater basin was designed to meet the minimum requirements of the NCDENR BMP manual. It will perform water quality and quantity mitigation. The drainage area for the pond is 2.1 acres. We chose to size the stormwater basin to capture the 100-year storm event from the site and slowly release it in 48 to 72 hours. This will provide additional quality and quantity benefits to the downstream properties and Jordan Lake. The stormwater basin was designed to capture 90% TSS from the site.

The stormwater conveyance network will consist of drainage pipes + inlets and sheet flow runoff. Runoff from building 2 will be captured by a grass swale and delivered to the stormwater pond. This grass swale was designed to meet the standards for grass-swales in the NCDENR BMP manual and provides water quality benefits. The grass swale will be

The runoff from the new impervious area approved in August 2013 must also meet nitrogen and phosphorous limits set in the new Jordan Lake nutrient loading requirements. These standards are specified in article 4 of the County stormwater ordinance.

#### JORDAN LAKE NUTRIENT LOADING REQUIREMENTS

This property is in the Jordan Lake Watershed – Upper New Hope section. The total allowable Nitrogen Load is 2.2 pounds per acre per year. The total allowable Phosphorous Load is 0.82 pounds per acre per year. We used the Jordan / Falls Lake Stormwater Nutrient Load Accounting Tool to compute the total Nitrogen and Phosphorous loading from the developed site. Using the site data, the accounting tool produced the following results:

Nitrogen loading – Pre Development with BMPs	1.73 lbs/ac/yr
Nitrogen loading - Post-Development Conditions	5.83 lbs/ac/yr
<b>Nitrogen Post Dev with BMPs - total</b>	<b>4.83 lbs/ac/yr</b>
Phosphorus loading – Pre Development with BMPs	0.24 lbs/ac/yr
Phosphorus loading – Post-Development Conditions	0.77 lbs/ac/yr
<b>Phosphorous Post Dev with BMPs – total</b>	<b>0.58 lbs/ac/yr</b>

The total nitrogen is 4.83 lbs/ac/yr and the limit is 2.2 lbs. An offset payment can be made to meet the target loading rate of 2.2 lbs. Phosphorous is lower than the target and an offset payment will not be needed for Phosphorous.

## Wet Pond Design

Drainage Area	2.1 acres (91,476 sf)
Impervious Area	1.05 acres (45,900 sf)
Percent Impervious	1.05 / 2.1 = 50% ( pond drainage area only)
2" Orifice Elevation	266.0
Outlet Structure Elevation	268.0

Area bottom of shelf	3799 sf
Area bottom of pond	463 sf
Area of Permanent Pool	5654 sf
Depth	6 feet

Permanent Pool average depth calculation:

$$D_{av} = [0.25 \times (1 + A_{bot\ shelf} / A_{perm\ pool})] + [(A_{bot\ shelf} + A_{bot\ pond} / 2) \times (Depth / A_{bot\ shelf})]$$

$$D_{av} = [0.25 \times (1 + 3799/5654)] + [(3799 + 463)/2 \times (6 / 3799)]$$

$$D_{av} = 3.78 \text{ feet}$$

Use Table 10-3 (90% TSS)

$$SA/DA = 2.8$$

Therefore

$$91,476 \text{ sf (drainage area)} \times 0.028 = 2561 \text{ square feet - Minimum size of Permanent Pool}$$

Actual size of Permanent Pool = 5654 square feet.

# Hydraflow Table of Contents

## 1 - Year

<b>Summary Report</b> .....	<b>1</b>
<b>Hydrograph Reports</b> .....	<b>2</b>
Hydrograph No. 1, Rational, Pre-development (to pond outlet) .....	2
FAA Tc Worksheet .....	3
Hydrograph No. 2, Rational, Developed Conditions - to pond .....	4
FAA Tc Worksheet .....	5
Hydrograph No. 4, Reservoir, pond .....	6
Pond Report - Wet Pond .....	7

## 2 - Year

<b>Summary Report</b> .....	<b>8</b>
<b>Hydrograph Reports</b> .....	<b>9</b>
Hydrograph No. 1, Rational, Pre-development (to pond outlet) .....	9
Hydrograph No. 2, Rational, Developed Conditions - to pond .....	10
Hydrograph No. 4, Reservoir, pond .....	11

## 10 - Year

<b>Summary Report</b> .....	<b>12</b>
<b>Hydrograph Reports</b> .....	<b>13</b>
Hydrograph No. 1, Rational, Pre-development (to pond outlet) .....	13
Hydrograph No. 2, Rational, Developed Conditions - to pond .....	14
Hydrograph No. 4, Reservoir, pond .....	15

## 25 - Year

<b>Summary Report</b> .....	<b>16</b>
<b>Hydrograph Reports</b> .....	<b>17</b>
Hydrograph No. 1, Rational, Pre-development (to pond outlet) .....	17
Hydrograph No. 2, Rational, Developed Conditions - to pond .....	18
Hydrograph No. 4, Reservoir, pond .....	19

## 100 - Year

<b>Summary Report</b> .....	<b>20</b>
<b>Hydrograph Reports</b> .....	<b>21</b>
Hydrograph No. 1, Rational, Pre-development (to pond outlet) .....	21
Hydrograph No. 2, Rational, Developed Conditions - to pond .....	22
Hydrograph No. 4, Reservoir, pond .....	23

<b>IDF Report</b> .....	<b>24</b>
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# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	1.266	1	19	1,443	---	---	---	Pre-development (to pond outlet)
2	Rational	8.542	1	9	4,613	---	---	---	Developed Conditions - to pond
4	Reservoir	0.079	1	18	4,500	2	566.65	4,565	pond
Countyline Self Storage.gpw					Return Period: 1 Year			Wednesday, Apr 30, 2014	

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 1

Pre-development (to pond outlet)

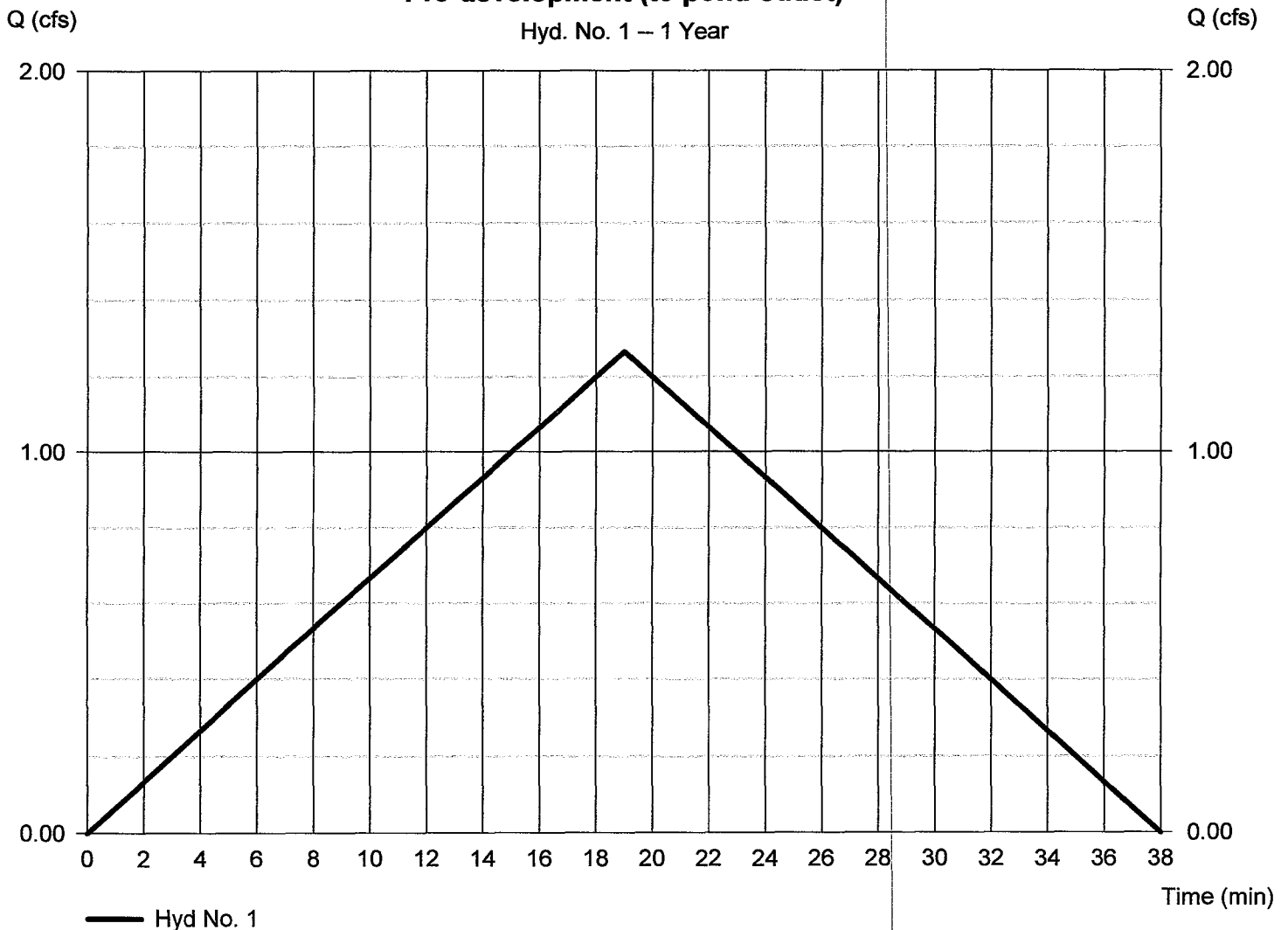
Hydrograph type = Rational  
 Storm frequency = 1 yrs  
 Time interval = 1 min  
 Drainage area = 2.110 ac  
 Intensity = 3.000 in/hr  
 IDF Curve = Chatham County.IDF

Peak discharge = 1.266 cfs  
 Time to peak = 19 min  
 Hyd. volume = 1,443 cuft  
 Runoff coeff. = 0.2\*  
 Tc by FAA = 19.00 min  
 Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(2.110 x 0.20)] / 2.110

### Pre-development (to pond outlet)

Hyd. No. 1 -- 1 Year



# FAA Formula Tc Worksheet

Tc = 1.8(1.1 - C) x Flow length^0.5 / Watercourse slope^0.5  
Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

## Hyd. No. 1

Pre-development (to pond outlet)

### Description

Flow length (ft)	= 475.00
Watercourse slope (%)	= 6.70
Runoff coefficient (C)	= 0.20
<b>Time of Conc. (min)</b>	<b>= 19</b>



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 2

Developed Conditions - to pond

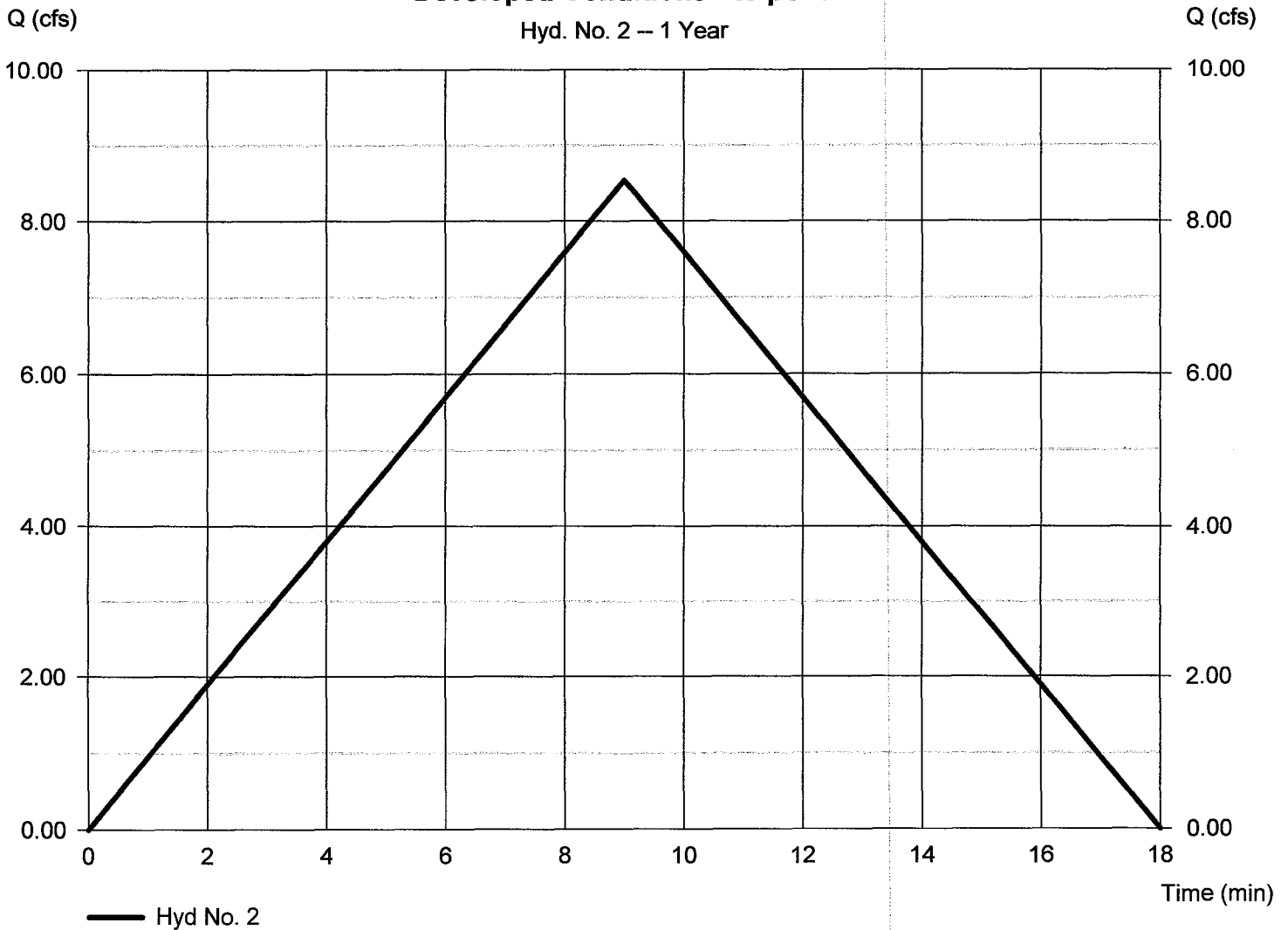
Hydrograph type = Rational  
Storm frequency = 1 yrs  
Time interval = 1 min  
Drainage area = 2.420 ac  
Intensity = 4.202 in/hr  
IDF Curve = Chatham County.IDF

Peak discharge = 8.542 cfs  
Time to peak = 9 min  
Hyd. volume = 4,613 cuft  
Runoff coeff. = 0.84\*  
Tc by FAA = 9.00 min  
Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(1.150 x 1.00) + (1.270 x 0.70)] / 2.420

Developed Conditions - to pond

Hyd. No. 2 -- 1 Year



# FAA Formula Tc Worksheet

$T_c = 1.8(1.1 - C) \times \text{Flow length}^{0.5} / \text{Watercourse slope}^{0.5}$  Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

## Hyd. No. 2

Developed Conditions - to pond

### Description

Flow length (ft) = 385.00

Watercourse slope (%) = 1.00

Runoff coefficient (C) = 0.84

**Time of Conc. (min) = 9**

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

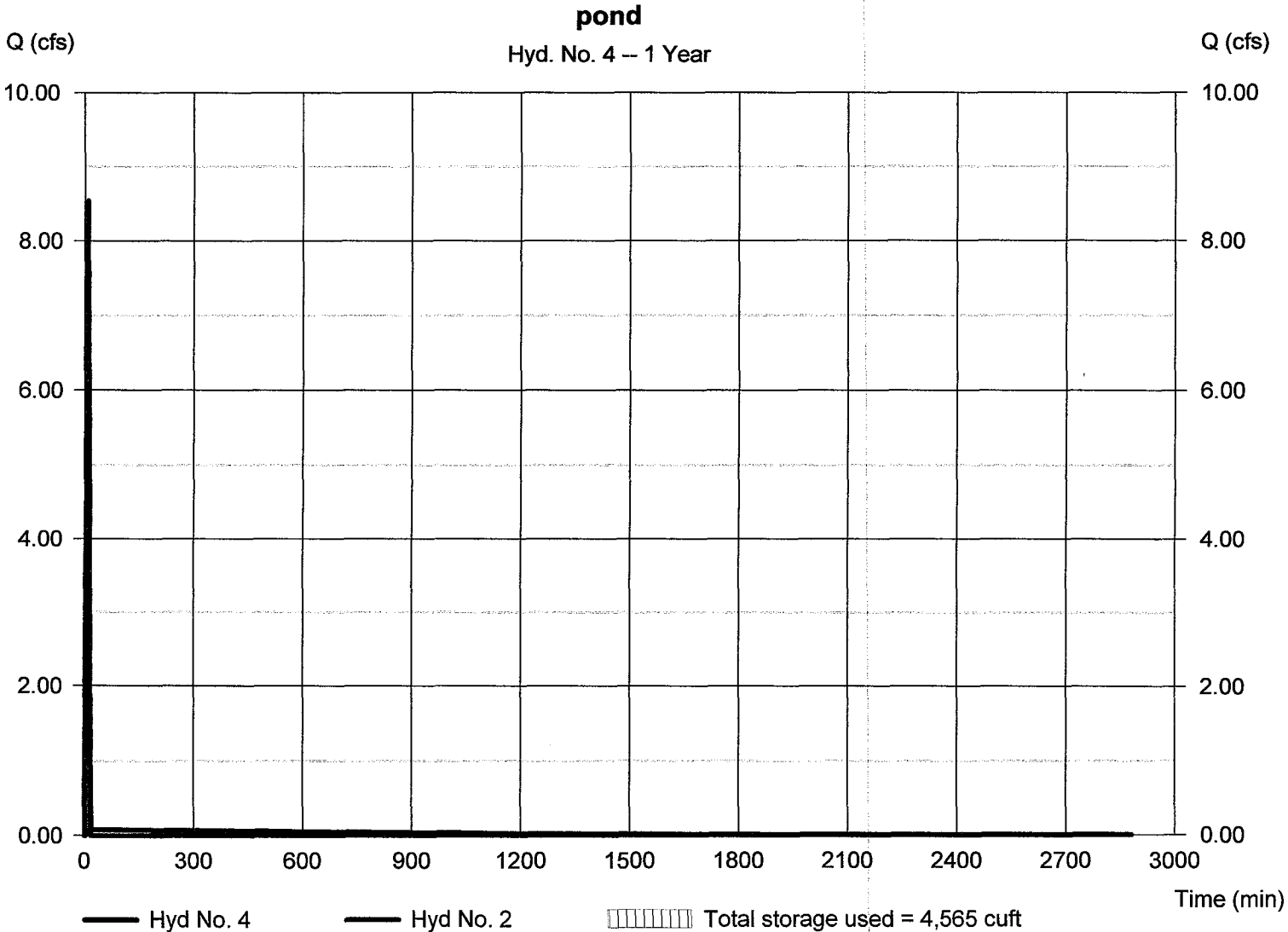
## Hyd. No. 4

pond

Hydrograph type = Reservoir  
 Storm frequency = 1 yrs  
 Time interval = 1 min  
 Inflow hyd. No. = 2 - Developed Conditions - to pond  
 Reservoir name = Wet Pond

Peak discharge = 0.079 cfs  
 Time to peak = 18 min  
 Hyd. volume = 4,500 cuft  
 Max. Elevation = 566.65 ft  
 Max. Storage = 4,565 cuft

Storage Indication method used.



# Pond Report

## Pond No. 1 - Wet Pond

### Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 566.00 ft

### Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	566.00	5,654	0	0
1.00	567.00	8,373	7,014	7,014
2.00	568.00	9,700	9,037	16,050
3.00	569.00	12,267	10,984	27,034
4.00	570.00	13,983	13,125	40,159

### Culvert / Orifice Structures

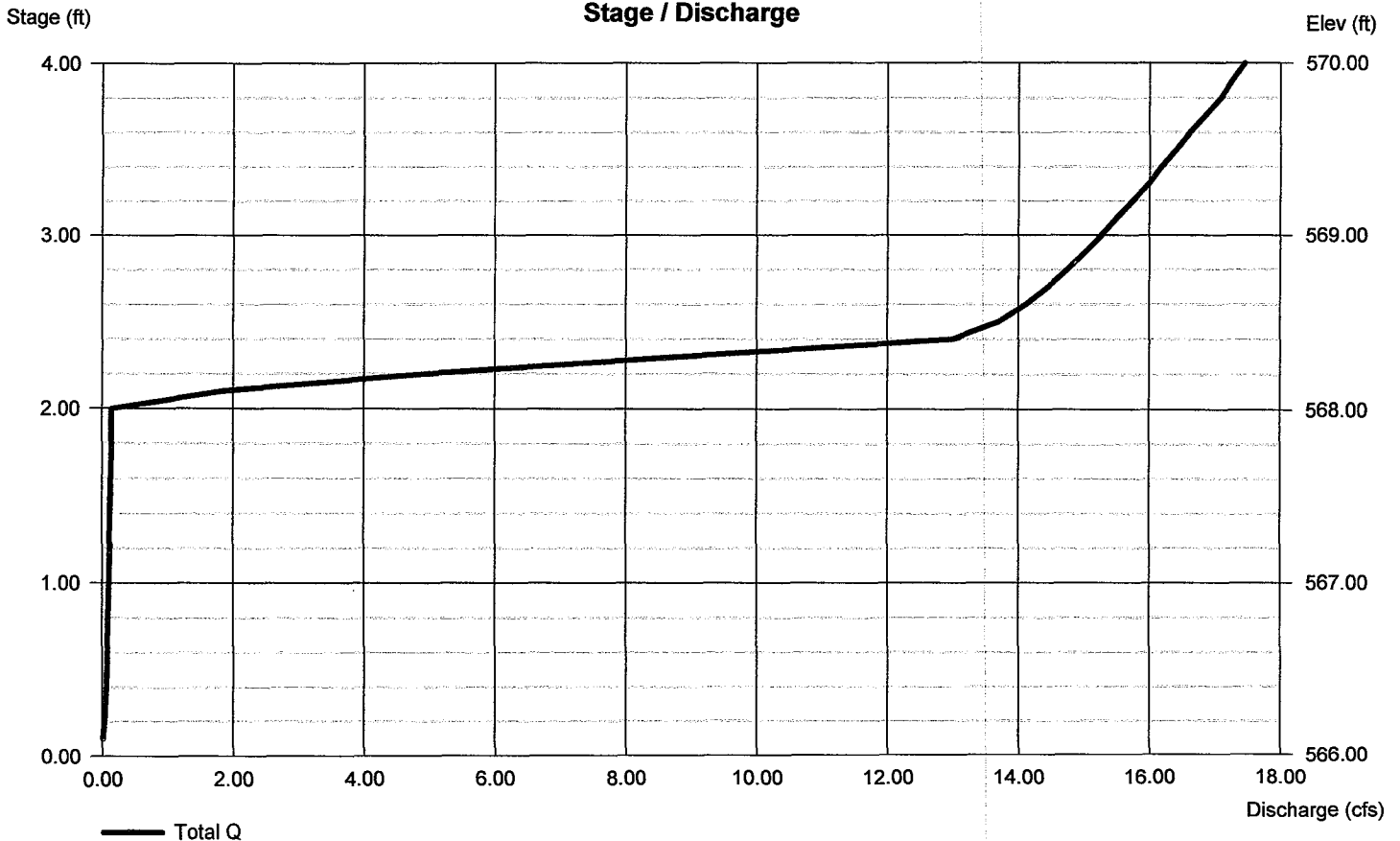
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	2.00	0.00	0.00
Span (in)	= 18.00	2.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 565.00	566.00	0.00	0.00
Length (ft)	= 50.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

### Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 568.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	—	—	—
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (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).

### Stage / Discharge



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	1.514	1	19	1,725	—	—	—	Pre-development (to pond outlet)
2	Rational	10.18	1	9	5,498	—	—	—	Developed Conditions - to pond
4	Reservoir	0.087	1	18	5,358	2	566.78	5,445	pond
Countyline Self Storage.gpw					Return Period: 2 Year			Wednesday, Apr 30, 2014	

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 1

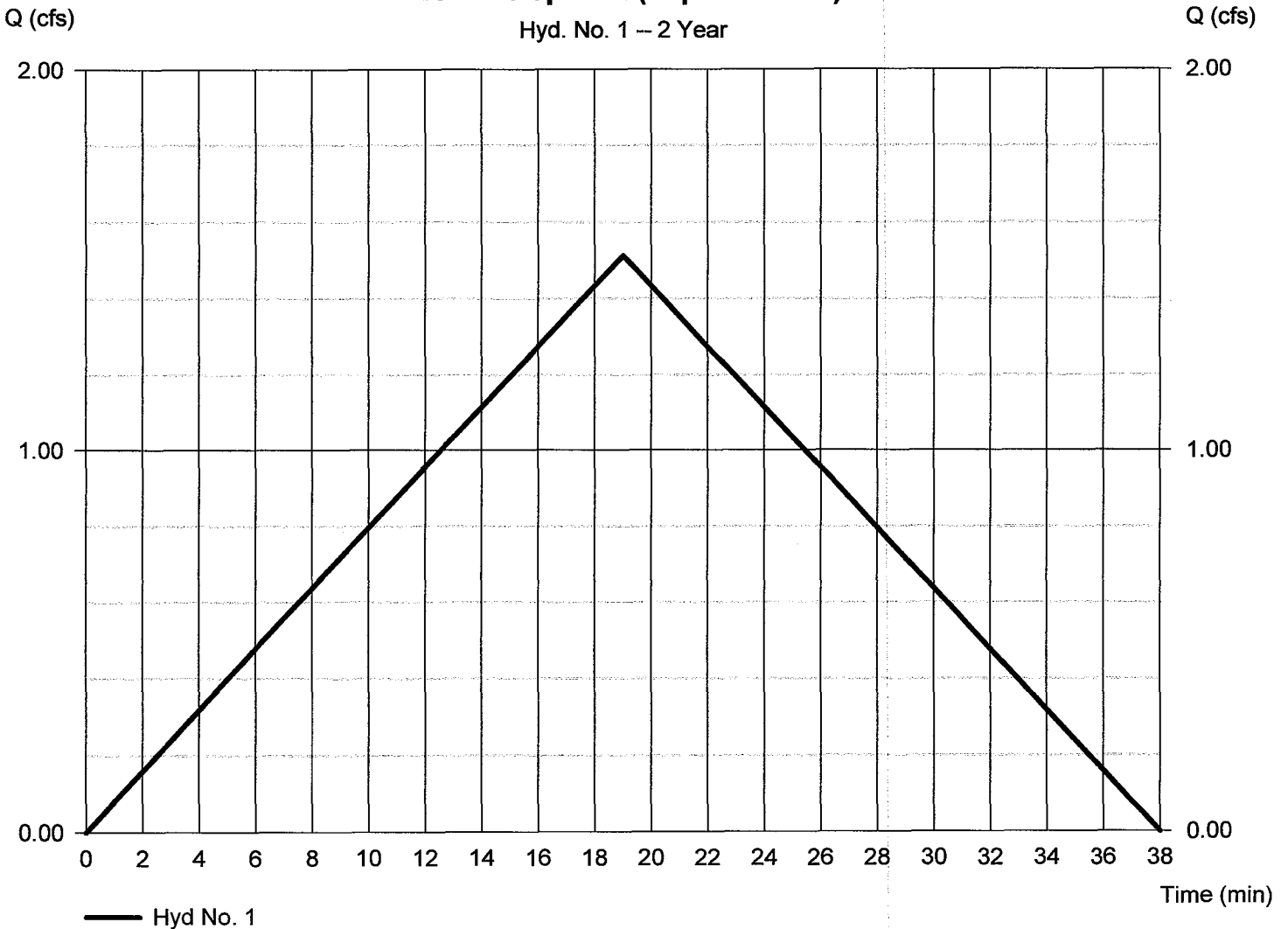
Pre-development (to pond outlet)

Hydrograph type = Rational  
Storm frequency = 2 yrs  
Time interval = 1 min  
Drainage area = 2.110 ac  
Intensity = 3.587 in/hr  
IDF Curve = Chatham County.IDF

Peak discharge = 1.514 cfs  
Time to peak = 19 min  
Hyd. volume = 1,725 cuft  
Runoff coeff. = 0.2\*  
Tc by FAA = 19.00 min  
Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(2.110 x 0.20)] / 2.110

**Pre-development (to pond outlet)**  
Hyd. No. 1 -- 2 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 2

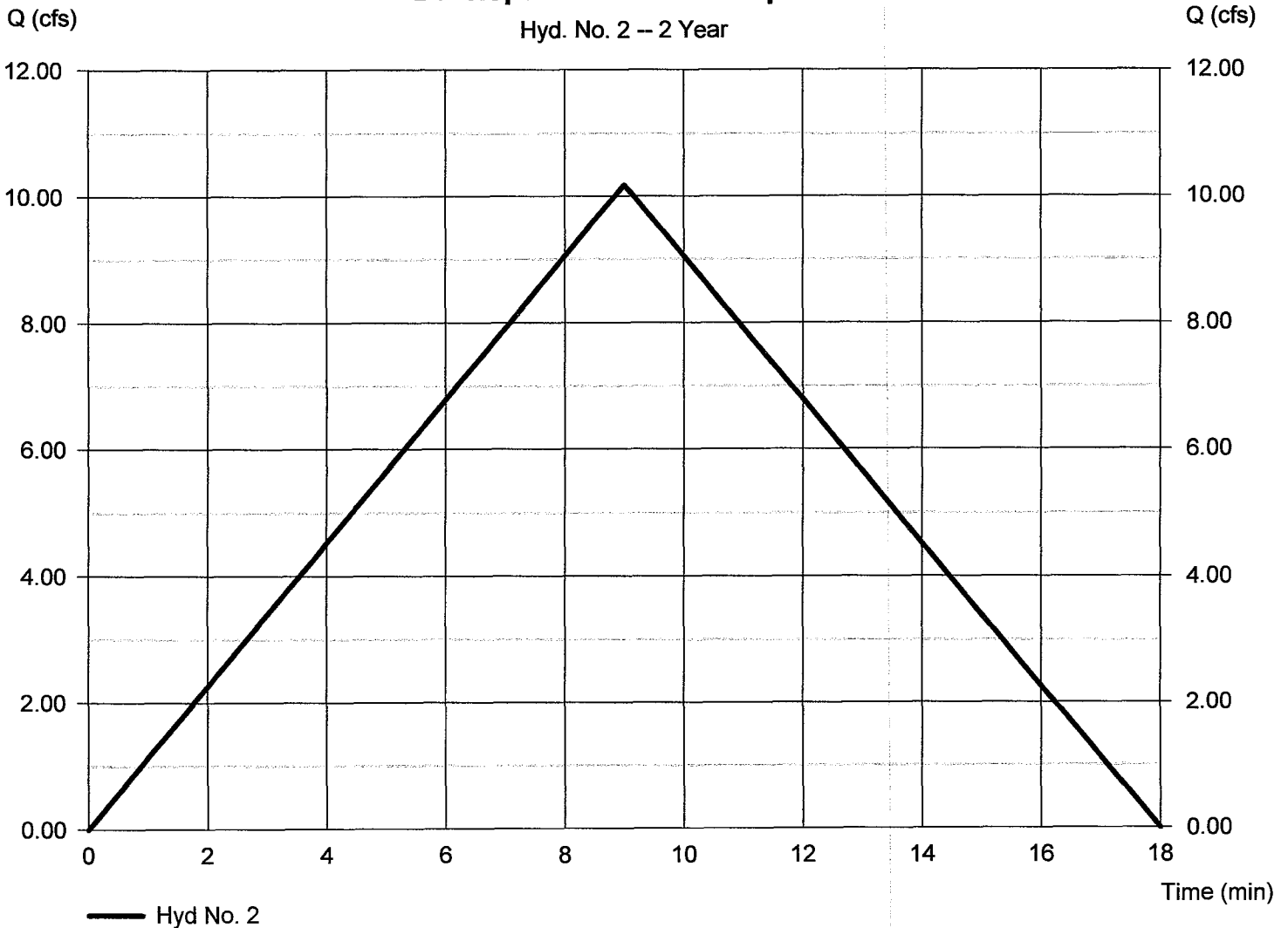
### Developed Conditions - to pond

Hydrograph type = Rational  
 Storm frequency = 2 yrs  
 Time interval = 1 min  
 Drainage area = 2.420 ac  
 Intensity = 5.009 in/hr  
 IDF Curve = Chatham County.IDF

Peak discharge = 10.18 cfs  
 Time to peak = 9 min  
 Hyd. volume = 5,498 cuft  
 Runoff coeff. = 0.84\*  
 Tc by FAA = 9.00 min  
 Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(1.150 x 1.00) + (1.270 x 0.70)] / 2.420

**Developed Conditions - to pond**  
Hyd. No. 2 -- 2 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 4

pond

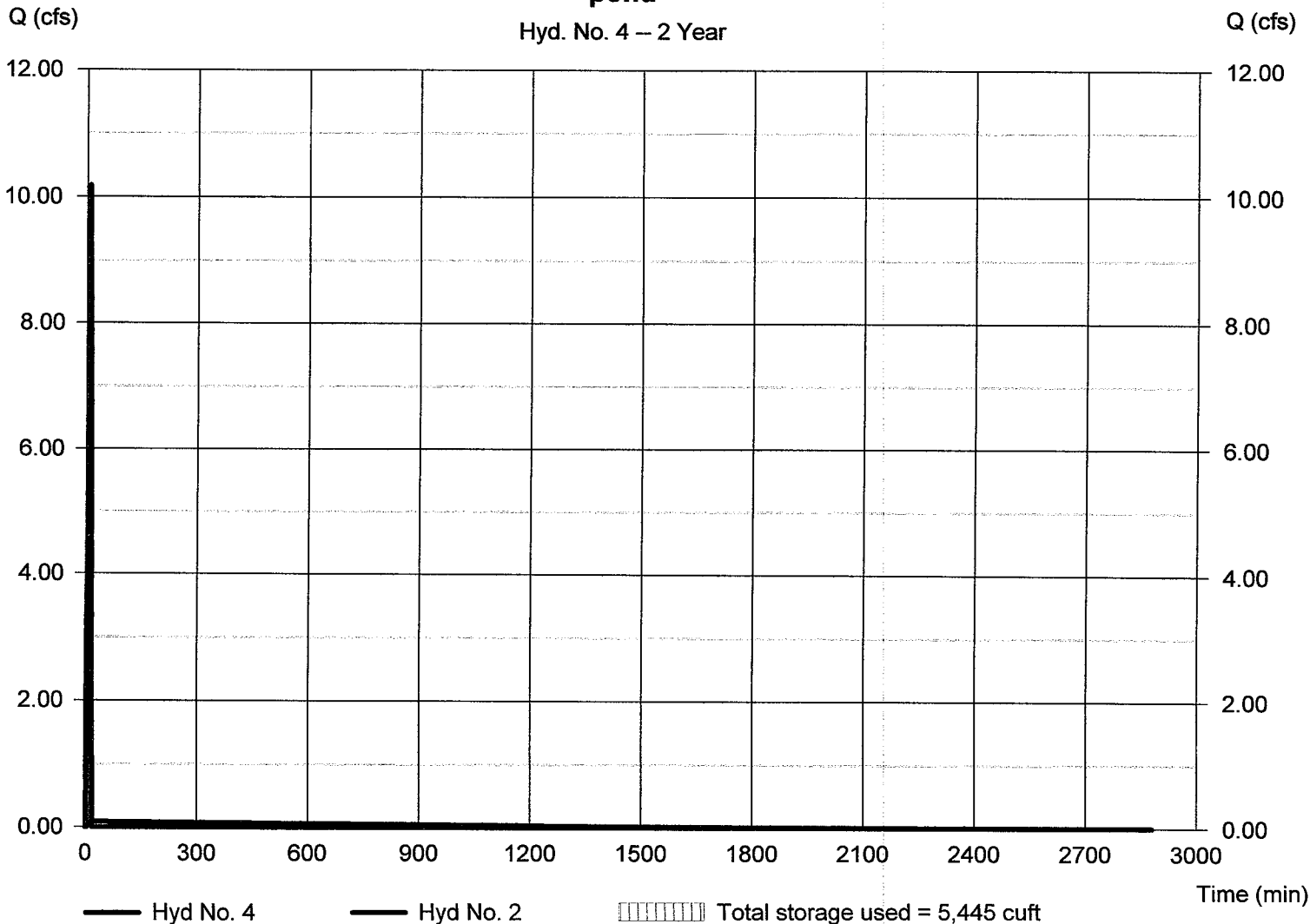
Hydrograph type = Reservoir  
 Storm frequency = 2 yrs  
 Time interval = 1 min  
 Inflow hyd. No. = 2 - Developed Conditions - to pond  
 Reservoir name = Wet Pond

Peak discharge = 0.087 cfs  
 Time to peak = 18 min  
 Hyd. volume = 5,358 cuft  
 Max. Elevation = 566.78 ft  
 Max. Storage = 5,445 cuft

Storage Indication method used.

### pond

Hyd. No. 4 -- 2 Year





# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	1.989	1	19	2,267	---	---	---	Pre-development (to pond outlet)	
2	Rational	13.02	1	9	7,032	---	---	---	Developed Conditions - to pond	
4	Reservoir	0.100	1	18	6,835	2	566.99	6,969	pond	
Countyline Self Storage.gpw					Return Period: 10 Year			Wednesday, Apr 30, 2014		

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 1

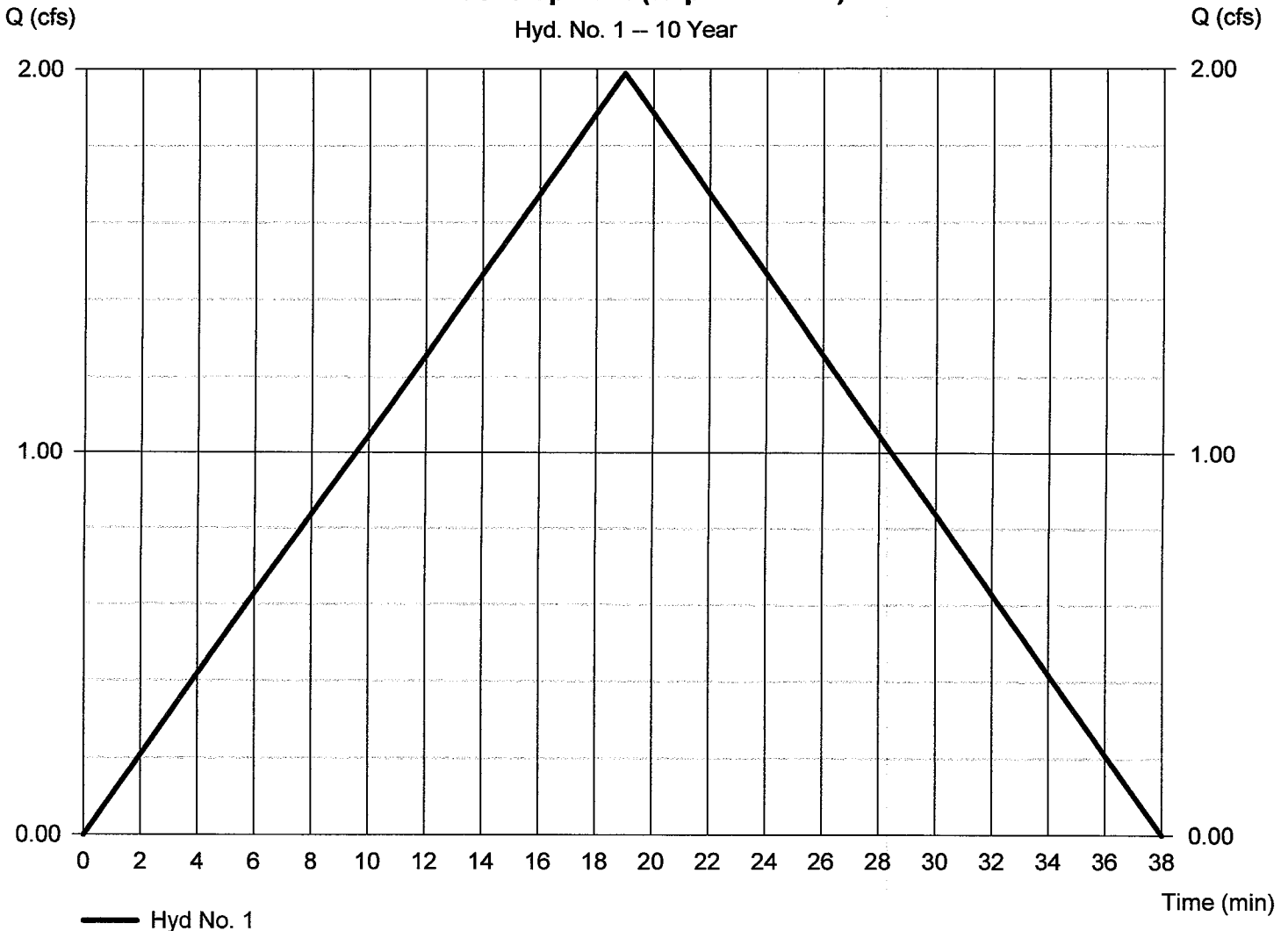
Pre-development (to pond outlet)

Hydrograph type = Rational  
 Storm frequency = 10 yrs  
 Time interval = 1 min  
 Drainage area = 2.110 ac  
 Intensity = 4.712 in/hr  
 IDF Curve = Chatham County.IDF

Peak discharge = 1.989 cfs  
 Time to peak = 19 min  
 Hyd. volume = 2,267 cuft  
 Runoff coeff. = 0.2\*  
 Tc by FAA = 19.00 min  
 Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(2.110 x 0.20)] / 2.110

**Pre-development (to pond outlet)**



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 2

Developed Conditions - to pond

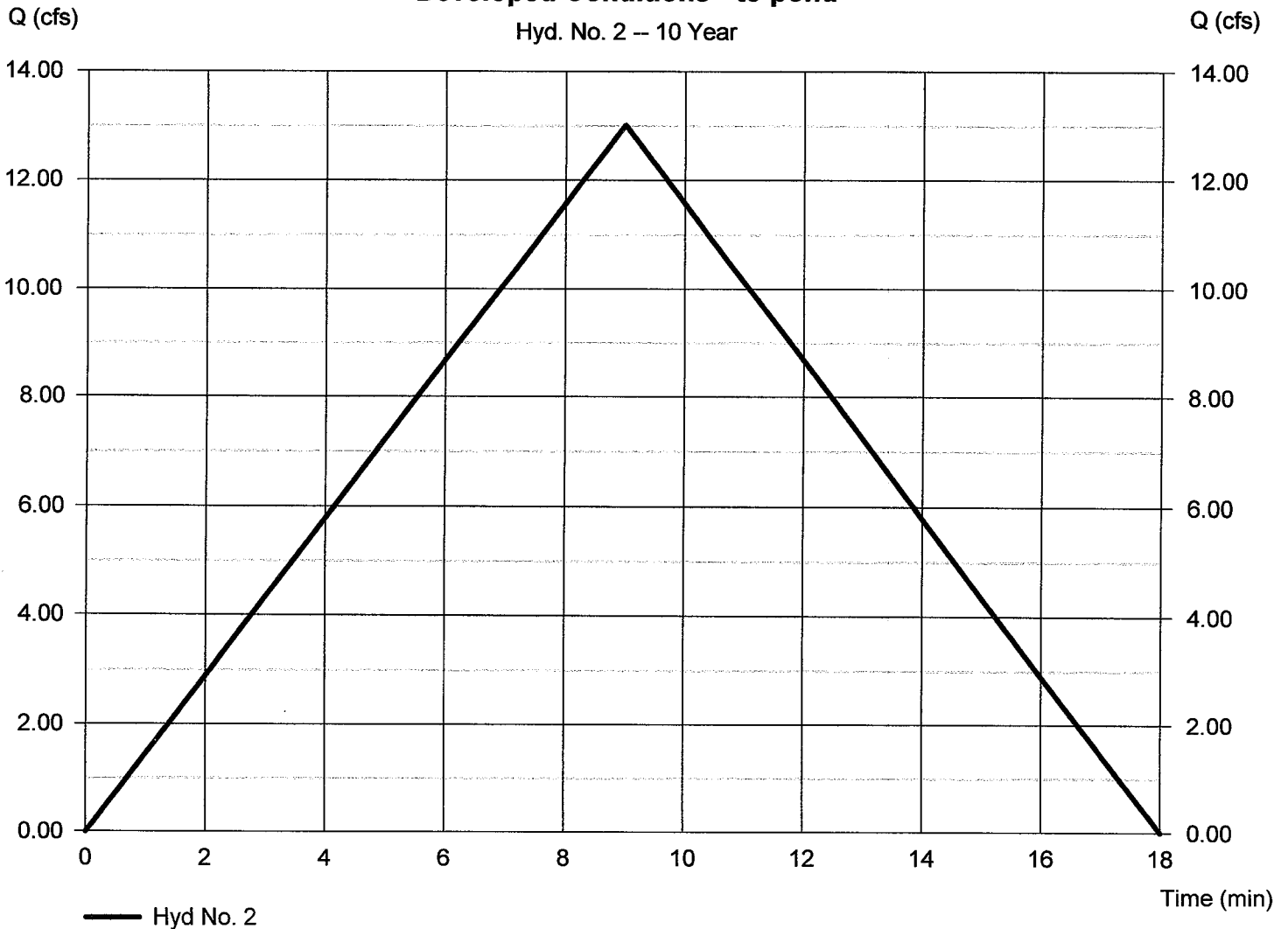
Hydrograph type = Rational  
 Storm frequency = 10 yrs  
 Time interval = 1 min  
 Drainage area = 2.420 ac  
 Intensity = 6.406 in/hr  
 IDF Curve = Chatham County.IDF

Peak discharge = 13.02 cfs  
 Time to peak = 9 min  
 Hyd. volume = 7,032 cuft  
 Runoff coeff. = 0.84\*  
 Tc by FAA = 9.00 min  
 Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(1.150 x 1.00) + (1.270 x 0.70)] / 2.420

### Developed Conditions - to pond

Hyd. No. 2 -- 10 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

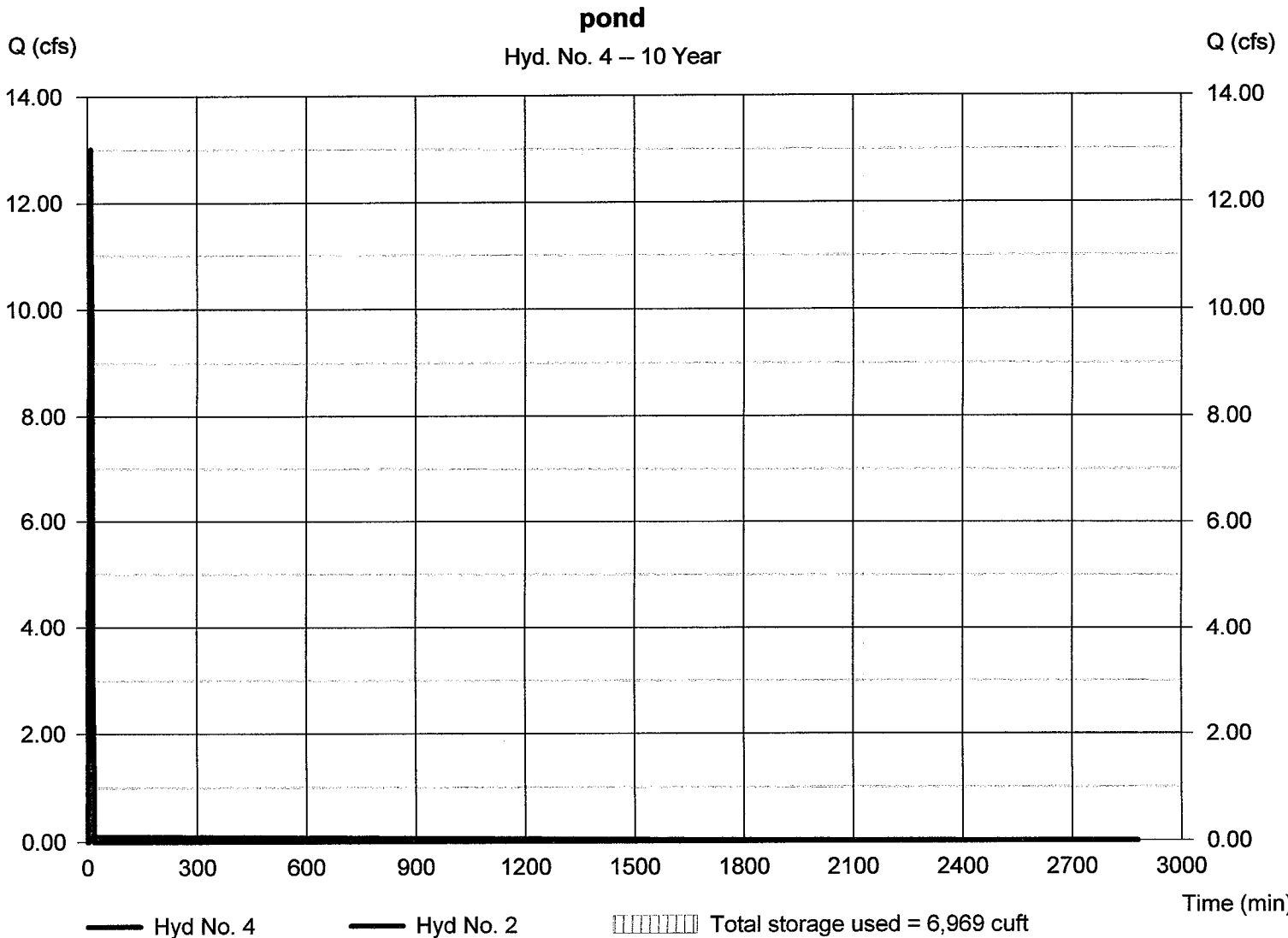
Wednesday, Apr 30, 2014

## Hyd. No. 4

pond

Hydrograph type	= Reservoir	Peak discharge	= 0.100 cfs
Storm frequency	= 10 yrs	Time to peak	= 18 min
Time interval	= 1 min	Hyd. volume	= 6,835 cuft
Inflow hyd. No.	= 2 - Developed Conditions - to pond	Max. Elevation	= 566.99 ft
Reservoir name	= Wet Pond	Max. Storage	= 6,969 cuft

Storage Indication method used.



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	2.199	1	19	2,507	---	---	---	Pre-development (to pond outlet)
2	Rational	14.27	1	9	7,708	---	---	---	Developed Conditions - to pond
4	Reservoir	0.104	1	18	7,481	2	567.07	7,641	pond
Countyline Self Storage.gpw					Return Period: 25 Year			Wednesday, Apr 30, 2014	

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 1

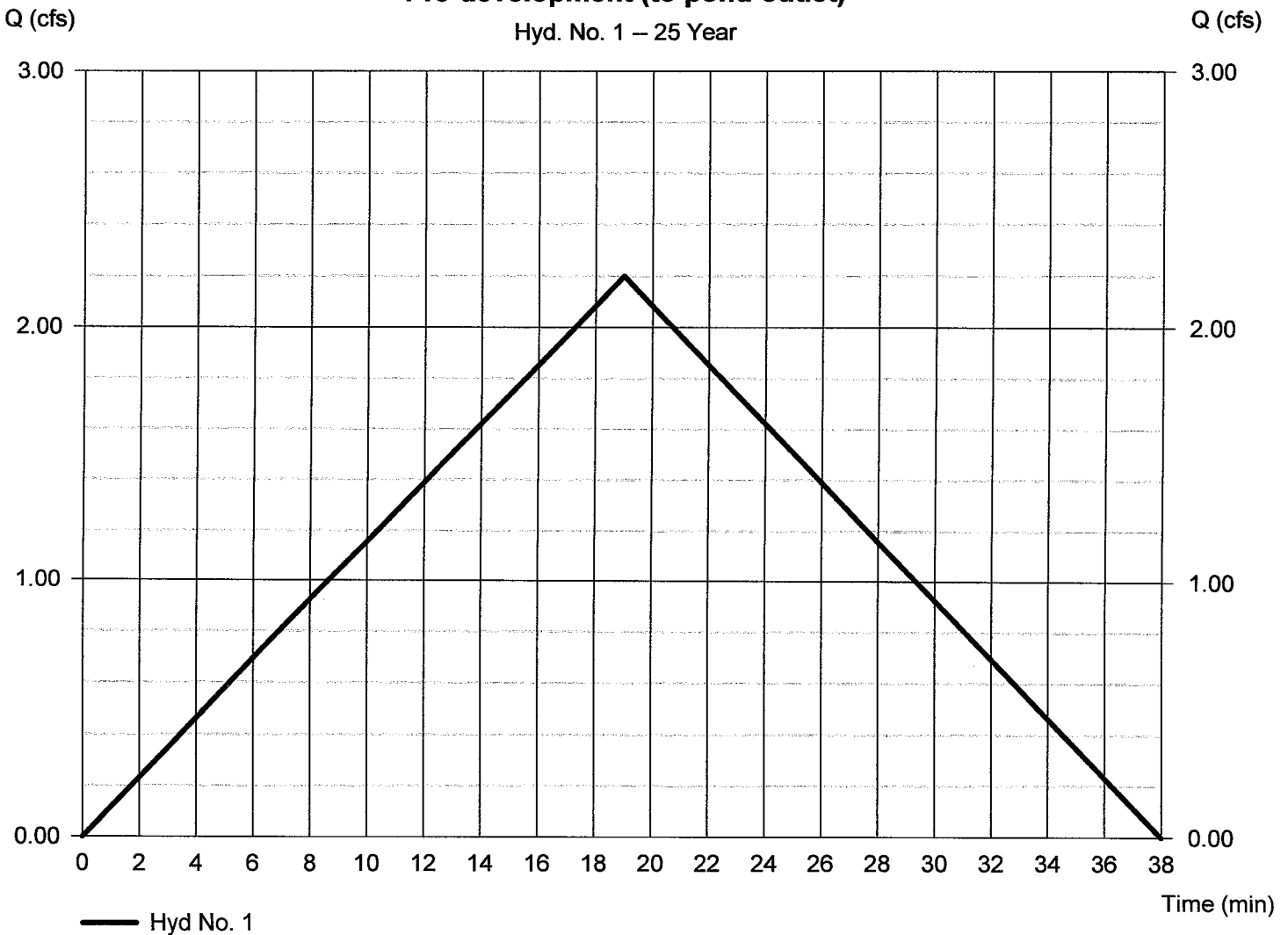
Pre-development (to pond outlet)

Hydrograph type	= Rational	Peak discharge	= 2.199 cfs
Storm frequency	= 25 yrs	Time to peak	= 19 min
Time interval	= 1 min	Hyd. volume	= 2,507 cuft
Drainage area	= 2.110 ac	Runoff coeff.	= 0.2*
Intensity	= 5.212 in/hr	Tc by FAA	= 19.00 min
IDF Curve	= Chatham County.IDF	Asc/Rec limb fact	= 1/1

\* Composite (Area/C) = [(2.110 x 0.20)] / 2.110

**Pre-development (to pond outlet)**

Hyd. No. 1 – 25 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 2

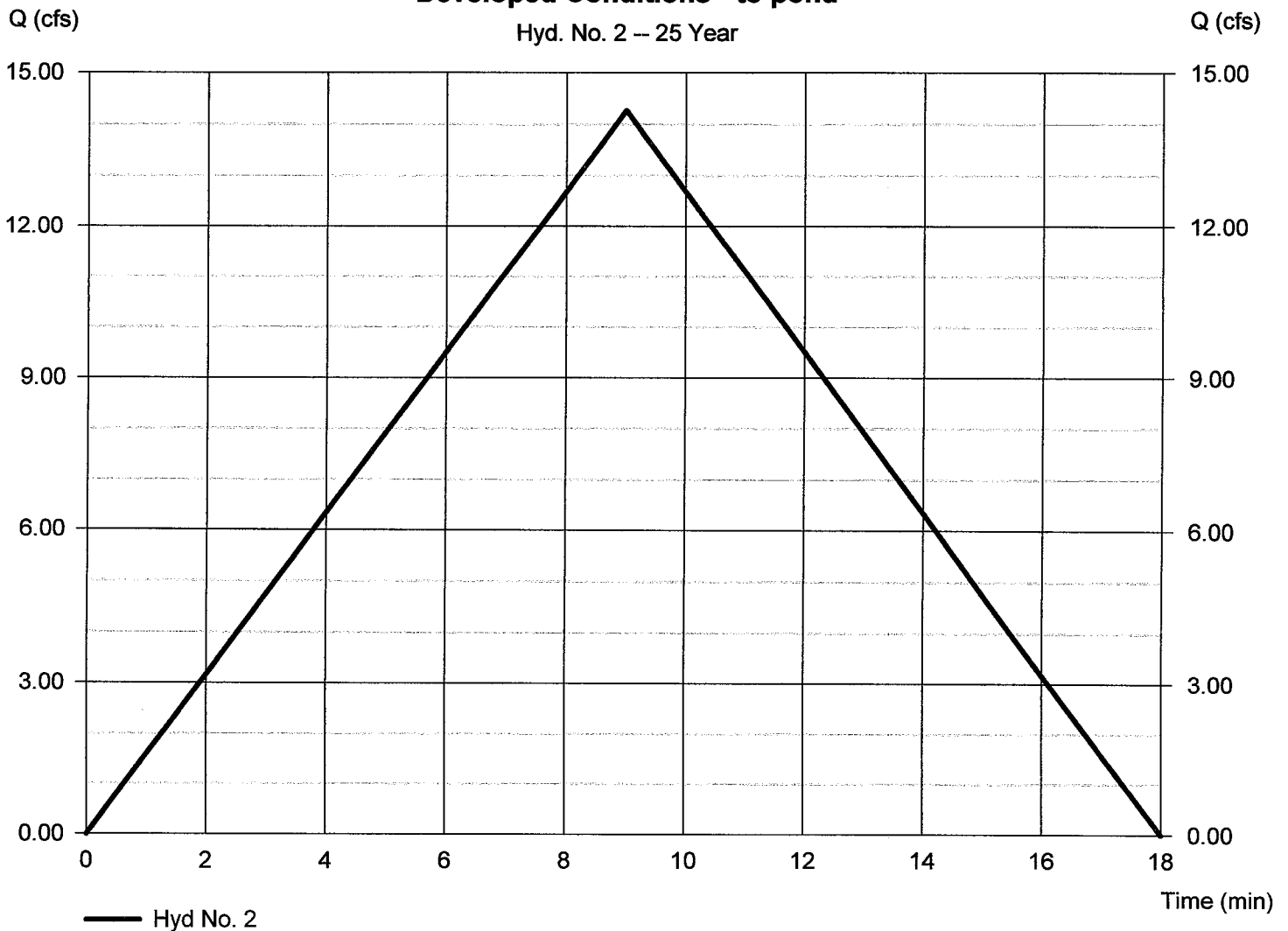
Developed Conditions - to pond

Hydrograph type = Rational  
 Storm frequency = 25 yrs  
 Time interval = 1 min  
 Drainage area = 2.420 ac  
 Intensity = 7.021 in/hr  
 IDF Curve = Chatham County.IDF

Peak discharge = 14.27 cfs  
 Time to peak = 9 min  
 Hyd. volume = 7,708 cuft  
 Runoff coeff. = 0.84\*  
 Tc by FAA = 9.00 min  
 Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(1.150 x 1.00) + (1.270 x 0.70)] / 2.420

**Developed Conditions - to pond**  
 Hyd. No. 2 -- 25 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

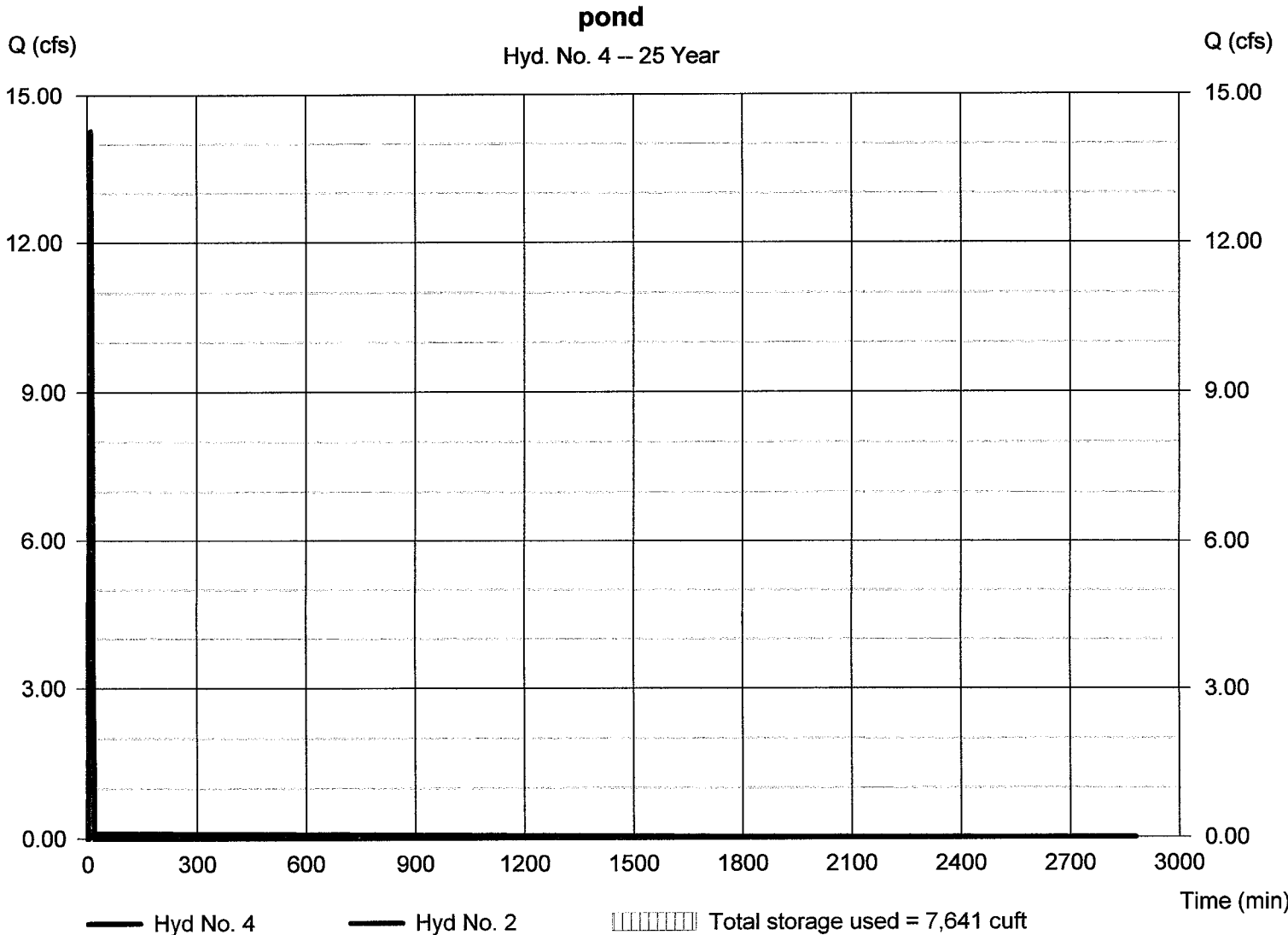
Wednesday, Apr 30, 2014

## Hyd. No. 4

pond

Hydrograph type	= Reservoir	Peak discharge	= 0.104 cfs
Storm frequency	= 25 yrs	Time to peak	= 18 min
Time interval	= 1 min	Hyd. volume	= 7,481 cuft
Inflow hyd. No.	= 2 - Developed Conditions - to pond	Max. Elevation	= 567.07 ft
Reservoir name	= Wet Pond	Max. Storage	= 7,641 cuft

Storage Indication method used.





# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	2.482	1	19	2,829	---	---	---	Pre-development (to pond outlet)	
2	Rational	15.94	1	9	8,605	---	---	---	Developed Conditions - to pond	
4	Reservoir	0.109	1	18	8,335	2	567.17	8,535	pond	
Countyline Self Storage.gpw					Return Period: 100 Year			Wednesday, Apr 30, 2014		

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 1

Pre-development (to pond outlet)

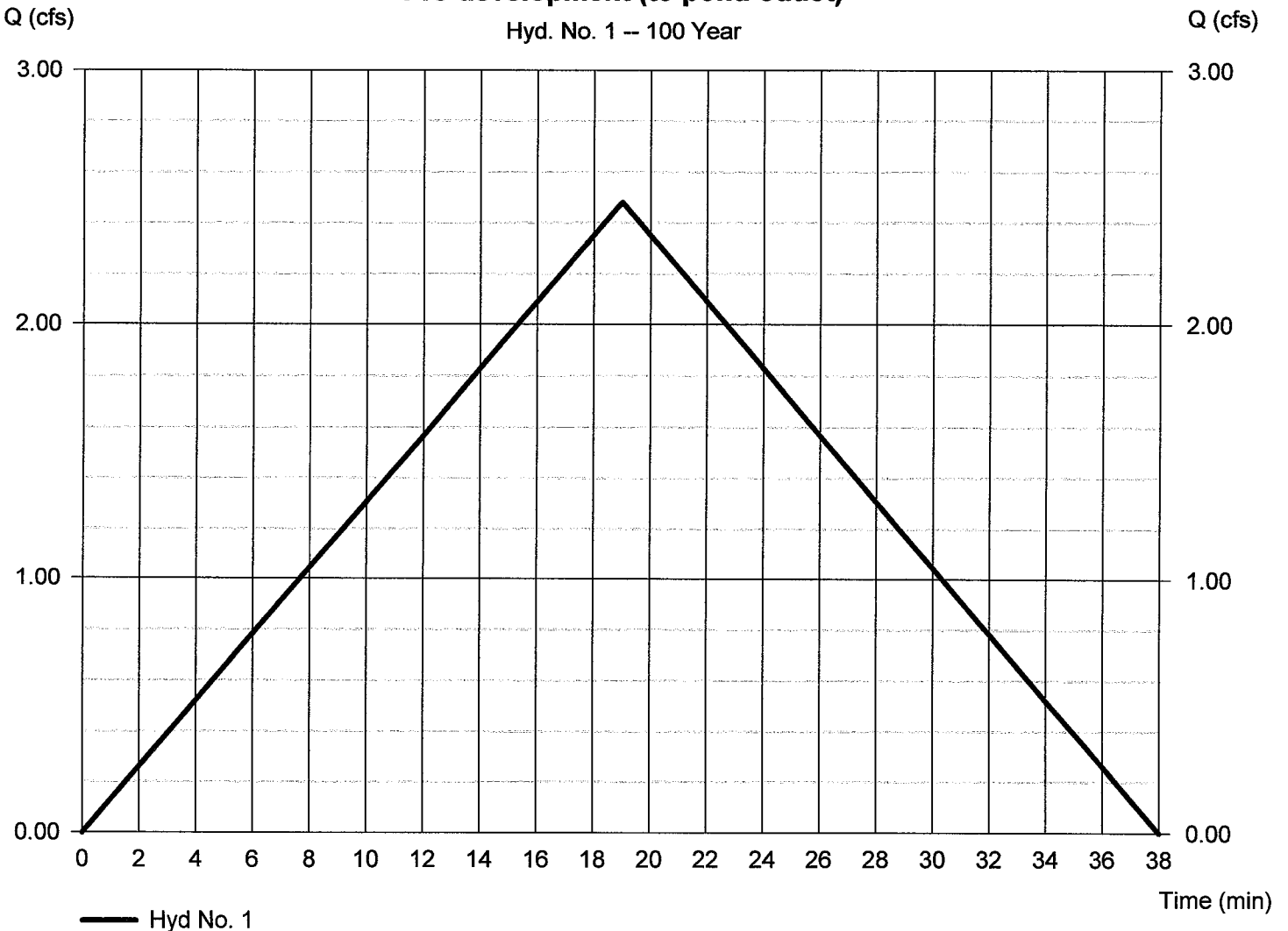
Hydrograph type = Rational  
 Storm frequency = 100 yrs  
 Time interval = 1 min  
 Drainage area = 2.110 ac  
 Intensity = 5.881 in/hr  
 IDF Curve = Chatham County.IDF

Peak discharge = 2.482 cfs  
 Time to peak = 19 min  
 Hyd. volume = 2,829 cuft  
 Runoff coeff. = 0.2\*  
 Tc by FAA = 19.00 min  
 Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(2.110 x 0.20)] / 2.110

### Pre-development (to pond outlet)

Hyd. No. 1 -- 100 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 2

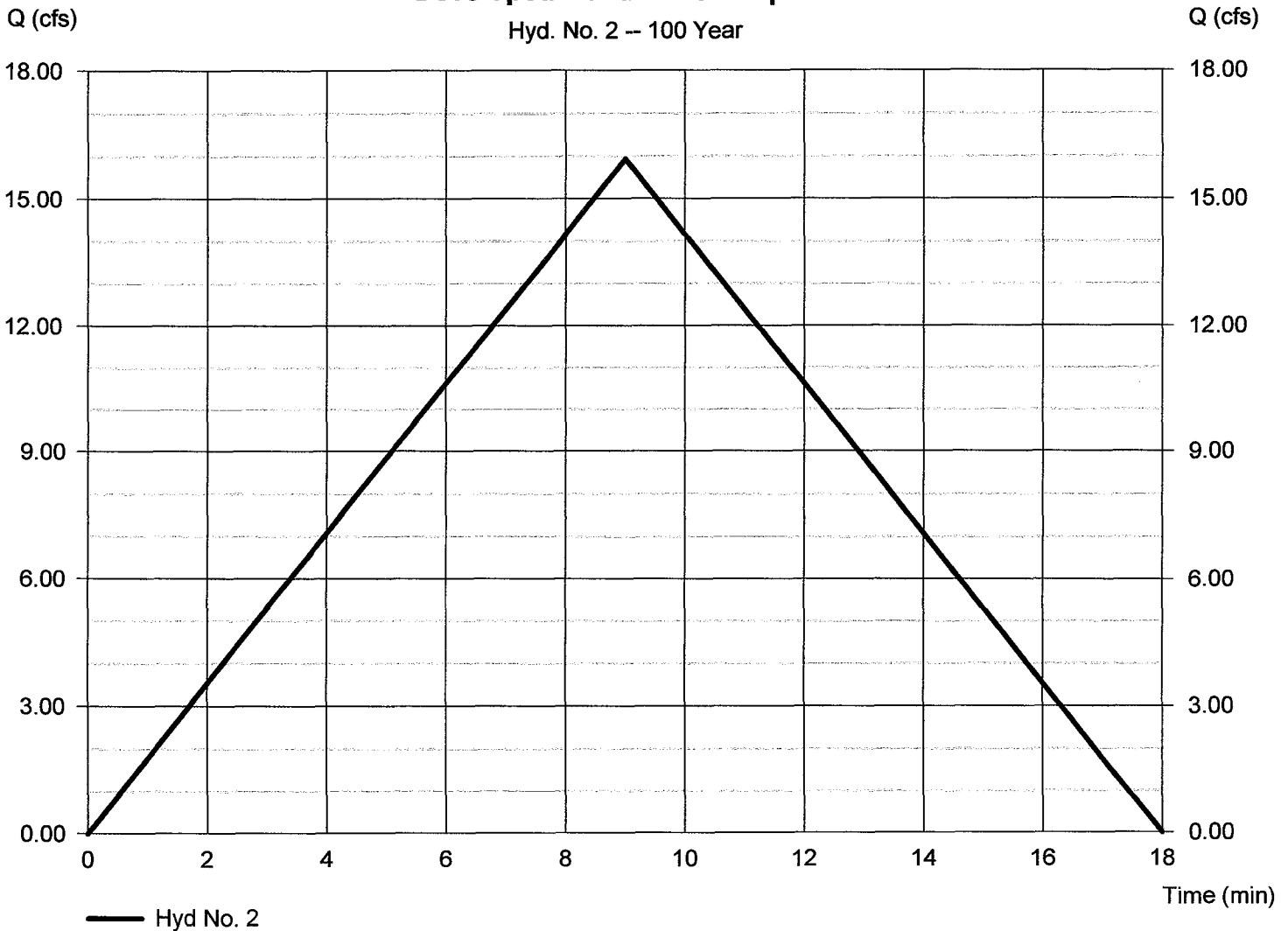
Developed Conditions - to pond

Hydrograph type = Rational  
 Storm frequency = 100 yrs  
 Time interval = 1 min  
 Drainage area = 2.420 ac  
 Intensity = 7.839 in/hr  
 IDF Curve = Chatham County.IDF

Peak discharge = 15.94 cfs  
 Time to peak = 9 min  
 Hyd. volume = 8,605 cuft  
 Runoff coeff. = 0.84\*  
 Tc by FAA = 9.00 min  
 Asc/Rec limb fact = 1/1

\* Composite (Area/C) = [(1.150 x 1.00) + (1.270 x 0.70)] / 2.420

**Developed Conditions - to pond**  
 Hyd. No. 2 -- 100 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Apr 30, 2014

## Hyd. No. 4

pond

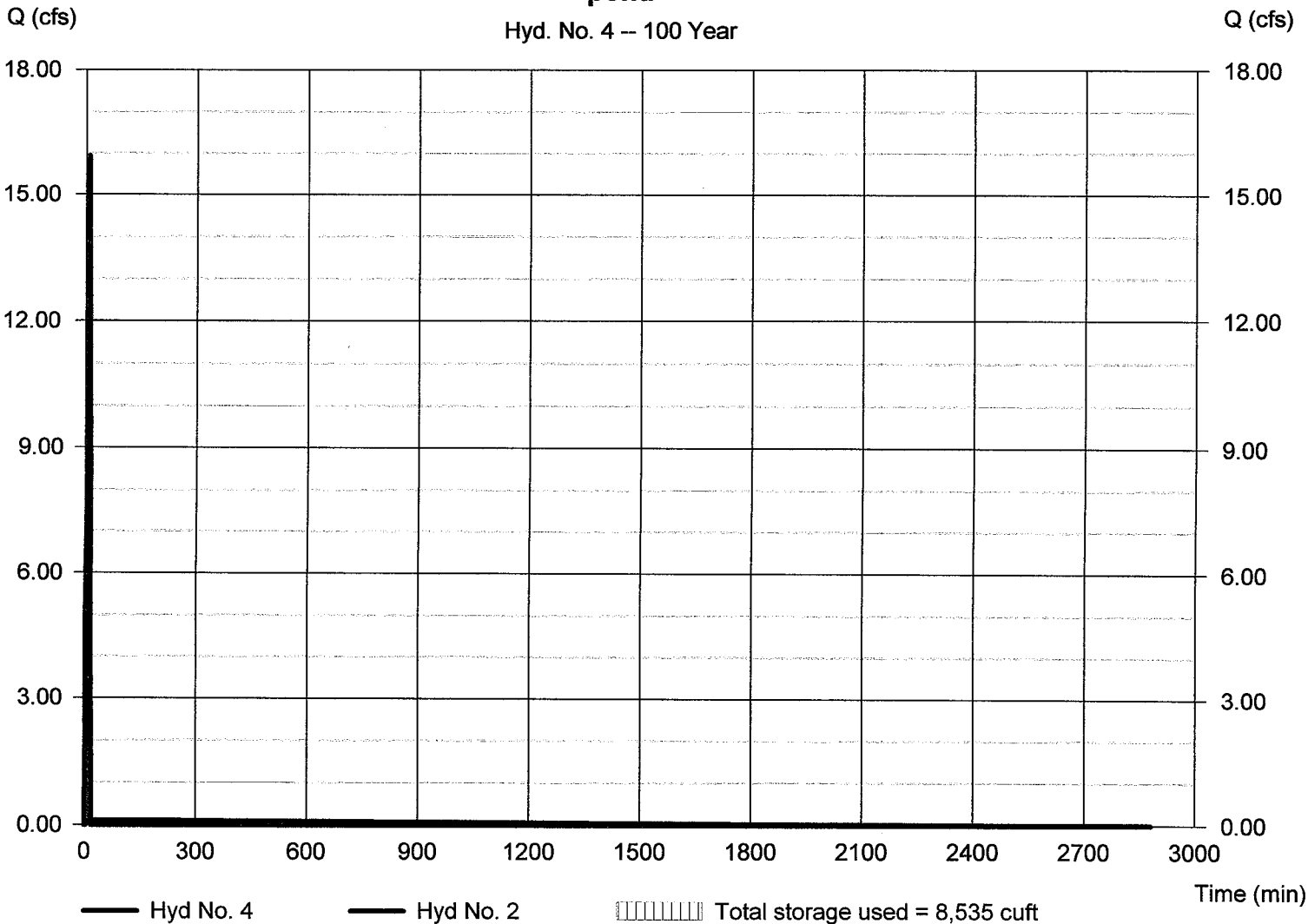
Hydrograph type = Reservoir  
 Storm frequency = 100 yrs  
 Time interval = 1 min  
 Inflow hyd. No. = 2 - Developed Conditions - to pond  
 Reservoir name = Wet Pond

Peak discharge = 0.109 cfs  
 Time to peak = 18 min  
 Hyd. volume = 8,335 cuft  
 Max. Elevation = 567.17 ft  
 Max. Storage = 8,535 cuft

Storage Indication method used.

### pond

Hyd. No. 4 -- 100 Year





**Table 10-3**

Surface Area to Drainage Area Ratio for Permanent Pool Sizing to Achieve 90 Percent TSS Pollutant Removal Efficiency in the *Mountain and Piedmont* Regions, Adapted from Driscoll, 1986

Percent Impervious Cover	Permanent Pool Average Depth (ft)												
	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
10%	0.9	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4
20%	1.5	1.3	1.1	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.7	0.7
30%	1.9	1.8	1.7	1.5	1.4	1.4	1.3	1.1	1.0	1.0	1.0	0.9	0.9
40%	2.5	2.3	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.4	1.3	1.2	1.1
50%	3.0	2.8	2.5	2.3	2.0	1.9	1.9	1.8	1.7	1.6	1.6	1.5	1.5
60%	3.5	3.2	2.8	2.7	2.5	2.4	2.2	2.1	1.9	1.9	1.8	1.8	1.7
70%	4.0	3.7	3.3	3.1	2.8	2.7	2.5	2.4	2.2	2.1	2.0	2.0	1.9
80%	4.5	4.1	3.8	3.5	3.3	3.0	2.8	2.7	2.6	2.4	2.3	2.1	2.0
90%	5.0	4.5	4.0	3.8	3.5	3.3	3.0	2.9	2.8	2.7	2.6	2.5	2.4

**Table 10-4**

Surface Area to Drainage Area Ratio for Permanent Pool Sizing to Achieve 90 Percent TSS Pollutant Removal Efficiency in the *Coastal Region*, Adapted from Driscoll, 1986

Percent Impervious Cover	Permanent Pool Average Depth (ft)									
	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5'
10%	1.3	1.0	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
20%	2.4	2.0	1.8	1.7	1.5	1.4	1.2	1.0	0.9	0.6
30%	3.5	3.0	2.7	2.5	2.2	1.9	1.6	1.3	1.1	0.8
40%	4.5	4.0	3.5	3.1	2.8	2.5	2.1	1.8	1.4	1.1
50%	5.6	5.0	4.3	3.9	3.5	3.1	2.7	2.3	1.9	1.5
60%	7.0	6.0	5.3	4.8	4.3	3.9	3.4	2.9	2.4	1.9
70%	8.1	7.0	6.0	5.5	5.0	4.5	3.9	3.4	2.9	2.3
80%	9.4	8.0	7.0	6.4	5.7	5.2	4.6	4.0	3.4	2.8
90%	10.7	9.0	7.9	7.2	6.5	5.9	5.2	4.6	3.9	3.3
100%	12	10.0	8.8	8.1	7.3	6.6	5.8	5.1	4.3	3.6

The engineering design of a wet detention basin must include a 10-foot-wide (minimum) vegetated shelf around the full perimeter of the basin. The inside edge of the shelf shall be no deeper than 6" below the permanent pool level, and the outside edge shall be 6" above the permanent pool level. For a 10' wide shelf, the resulting slope is 10:1. With half the required shelf below the water (maximum depth of 6 inches), and half the required shelf above the water, the vegetated shelf will provide a location for a diverse population of emergent wetland vegetation that enhances biological pollutant removal, provides a habitat for wildlife, protects the shoreline from erosion, and improves sediment trap efficiency. A 10' wide shelf also provides a safety feature prior to the deeper permanent pool.

Short-circuiting of the stormwater must be prevented. The most direct way of minimizing short-circuiting is to maximize the length of the flow path between the inlet and the outlet: basins with long and narrow shapes can maximize the length of the flow path. Long and narrow but irregularly shaped wet detention basins may appear more

Physiographic/Geologic Region:	Piedmont
Soil Hydrologic Group	C
Precipitation location:	Carboro

Total Development Area (ft <sup>2</sup> ):	160,301
Development Name:	Countyline Self Storage
Model Prepared By:	wdrm

**COLUMN 1 -- NON-RESIDENTIAL LAND USES**

	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft <sup>2</sup> )	Post-Development (ft <sup>2</sup> )
<b>COMMERCIAL</b>				
Parking lot	1.44	0.16	8,800	27,325
Roof	1.08	0.15	3,000	30,375
Open/landscaped	2.24	0.44	10,000	68,360
<b>INDUSTRIAL</b>				
Parking lot	1.44	0.39		
Roof	1.08	0.15		
Open/landscaped	2.24	0.44		
<b>TRANSPORTATION</b>				
High Density (interstate, main)	3.67	0.43		
Low Density (secondary, feeder)	1.4	0.52		
Rural	1.14	0.47		
Sidewalk	1.4	1.16		
<b>PERVIOUS</b>				
Managed pervious	3.06	0.59		
Unmanaged (pasture)	3.61	1.56		
Forest	1.47	0.25	138,501	23,541
<b>JURISDICTIONAL LANDS*</b>				
Natural wetland	--	--		
Riparian buffer	--	--		
Open water	--	--		
LAND TAKEN UP BY BMPs	1.08	0.15		10,700

\*Jurisdictional land uses are not included in nutrient/flow calculations.

**COLUMN 2 -- RESIDENTIAL LAND USES**

	Age (yrs)	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft <sup>2</sup> )	Post-Development (ft <sup>2</sup> )
<b>PART A</b>					
1/4-ac lots	--	--	--		
1/4-ac lots	--	--	--		
1/2-ac lots	--	--	--		
1-ac lots	--	--	--		
2-ac lots	--	--	--		
Multi-family	--	--	--		
Townhomes	--	--	--		
Custom Lot Size	--	--	--		
<b>PART B</b>					
Roadway	--	1.4	0.52		
Driveway	1.0	1.44	0.39		
Parking lot	--	1.44	0.39		
Roof	--	1.08	0.15		
Sidewalk/Patio	--	1.4	1.16		
Lawn	--	2.24	0.44		
Managed pervious	--	3.06	0.59		
Forest	--	1.47	0.25		
Natural wetland*	--	--	--		
Riparian buffer*	--	--	--		
Open water*	--	--	--		
LAND TAKEN UP BY BMPs	--	1.08	0.15		

**LAND USE AREA CHECK**

Total Development Area Entered (ft <sup>2</sup> ):	160,301
Total Pre-Development Calculated Area (ft <sup>2</sup> ):	160,301





Development: Piedmont  
 Prepared By: 160301  
 Date: April 30, 2014

**WATERSHED SUMMARY**

REGION	Piedmont
TOTAL DEVELOPMENT AREA (ft <sup>2</sup> )	160,301
Percent Impervious (%)	74%
Annual Runoff Volume (c-ft)	71,009
Total Nitrogen EMC (mg/L)	1.42
Total Nitrogen Loading (lb/acre/yr)	1.73
Total Phosphorus EMC (mg/L)	0.20
Total Phosphorus Loading (lb/acre/yr)	0.34

**Percent Difference Between:**

Pre-Dev. & Post-Dev. with BMPs	Pre-Development & Post-Development with BMPs	Post-Development w/ BMPs
Percent Impervious (%)	74%	42.7%
Annual Runoff Volume (c-ft)	71,009	249,259
Total Nitrogen EMC (mg/L)	1.42	1.14
Total Nitrogen Loading (lb/acre/yr)	1.73	4.83
Total Phosphorus EMC (mg/L)	0.20	0.14
Total Phosphorus Loading (lb/acre/yr)	0.34	0.53

\*Negative percent difference values indicate a decrease in runoff volume, pollutant concentration or pollutant loading. Positive values indicate an increase.

**BMP VOLUME REDUCTIONS/EFFLUENT CONCENTRATIONS**

BMP	Volume Reduction (%)	TN Effluent Conc. (mg/L)	TP Effluent Conc. (mg/L)
Bio-retention with IWS	50%	0.95	0.12
Bio-retention without IWS	55%	1.00	0.12
Dry Detention Pond	0%	1.20	0.20
Grassed Swale	0%	1.71	0.26
Green Roof	50%	1.08	0.15
Level Spot Filter Strip	40%	1.20	0.15
Permeable Pavement	0%	1.44	0.39
Sand Filter	5%	0.92	0.14
Water Harvesting	user defined	1.08	0.15
Wet Detention Pond	10%	1.01	0.11
Wetland	20%	1.08	0.12

\*Treating commercial parking lot, TP effluent concentration = 0.13 mg/L

**BMP SUMMARY**

	CATCHMENT 1			CATCHMENT 2			CATCHMENT 3			CATCHMENT 4			CATCHMENT 5			CATCHMENT 6			
	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	
Total Area Treated (ft <sup>2</sup> )																			
Total Inflow Volume (c-ft)	0.77	2.10																	
Percent Volume Reduced (%)	0%	10%																	
Inflow Nitrogen EMC (mg/L)	1.18	1.22																	
Total Inflow Nitrogen (lb/acre/yr)	4.73	6.52																	
Inflow Phosphorus EMC (mg/L)	0.174	0.181																	
Total Inflow Phosphorus (lb/acre/yr)	0.70	0.98																	
BMP Outflow Nitrogen (lb/acre/yr)	4.85	5.97																	
BMP Outflow Phosphorus (lb/acre/yr)	1.03	0.70																	
Catchment Outflow Nitrogen EMC (mg/L)	1.03	1.03																	
Catchment Outflow Nitrogen (lb/acre/yr)	5.97	5.97																	
Percent Reduction in Nitrogen Load (%)	1%	1%																	
Catchment Outflow Phosphorus EMC (mg/L)	0.121	0.121																	
Catchment Outflow Phosphorus (lb/acre/yr)	0.697	0.697																	
Percent Reduction in Phosphorus Load (%)	23%	23%																	

Return to Instructions

Return to Watershed Characteristics

Return to BMP Characteristics

Print Summary