BERTIN ENGINEERING
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JOB	22-249: Prop. Multi-Family Building - Jersey City, NJ			
SHEET NO.	1	OF	4	
CALCULATED BY	MBL	DATE	7/28/2023	
CHECKED BY	EMH	DATE	7/28/2023	
SCALE				

STORMWATER DRAINAGE CALCULATIONS

PROPOSED MULTI-FAMILY BUILDING
BLOCK 6806, LOTS 1-2 & 25-27
68-70 OAKLAND AVENUE
JERSEY CITY, HUDSON COUNTY, NEW JERSEY

BE# 22-249

MARCH 7, 2023
REVISED: JULY 28, 2023

Eric M. Hough, NJPE Lic#51893

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JOB	22-249: Prop. Multi-Family Building - Jersey City, NJ		
SHEET NO.	2	OF	4
CALCULATED BY	MBL	DATE	7/28/2023
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SCALE			

1. DETERMINE THE CHANGE IN SURFACE RUNOFF DUE TO THE PROPOSED CONSTRUCTION:

I) Determine Rainfall Intensity (I) for 2, 10 & 100 Year Storms:

1. For exisiting & proposed conditions: T_c = 10 mins

2. Calculate I_2, I_{10} & I_{100}: (Based on Trenton Rainfall Database)

For T_c = 10.0 mins

I_2 = 4.30 in/hr
I_{10} = 5.90 in/hr
I_{100} = 8.00 in/hr

II) Use Rational Formula to Determine Flow for Existing Conditions:

Q = c x I x A where Q = Flow (cfs), c = Runoff Coefficient, I = Rainfall Intensity (in/hr)

use c = 0.30 for Landscape Areas
0.99 for Impervious Areas

Total area = 16,420 sf = **0.377 ac**
Impervious = 10,123 sf = **0.232 ac**
Landscape = 6,297 sf = **0.145 ac**

$$c = \frac{0.30 \times 0.145 + 0.99 \times 0.232}{0.377} = \mathbf{0.72}$$

Q_2 = 0.72 x 4.30 x 0.377 = **1.17 cfs**
Q_{10} = 0.72 x 5.90 x 0.377 = **1.60 cfs**
Q_{100} = 0.72 x 8.00 x 0.377 = **2.17 cfs**

III) Use Rational Formula to Determine Flow for Proposed Conditions:

Total area = 16,420 sf = **0.377 ac**
Impervious = 16,420 sf = **0.377 ac**

$$c = \frac{0.30 \times 0.000 + 0.99 \times 0.377}{0.377} = \mathbf{0.99}$$

Q_2 = 0.99 x 4.30 x 0.377 = **1.60 cfs**
Q_{10} = 0.99 x 5.90 x 0.377 = **2.20 cfs**
Q_{100} = 0.99 x 8.00 x 0.377 = **2.99 cfs**

STORM (year)	EXISTING (cfs)	PROPOSED (cfs)	CHANGE (cfs)	% EXIST
2	1.17	1.60	0.43	136.8%
10	1.60	2.20	0.60	137.5%
100	2.17	2.99	0.82	137.8%

IV) Conclusion:

The calculations indicate that the proposed site redevelopment increases the surface runoff for the three storms. Runoff due to a 2, 10 & 100 year storm are increased by 0.43, 0.6 & 0.82 cfs respectively.

Since the project will disturb greater than 10,000 sf, the project is classified as a Major Development as per JCMUA Stormwater Ordinance. Therefore, the project must meet the required reductions in stormwater. The project is exempt from water qaulity standards since the development does not increase the motor vehicle surfaces by 1/4 acre. The project is also exempt from recharge requirements since it is located in the urban redevelopment area.

2. DETERMINE THE OUTFLOW FOR THE SITE AFTER ROUTING:

The proposed detention system is located beneath the parking area. The outlet control structure drains via a 15" RCP into the existing combined sewer main located in Fleet Street.

I) Calculate the Weighted C for the Proposed Drainage Area to be Routed

Total area =	16,419 sf	=	**0.377 ac**
Impervious =	16,419 sf	=	**0.377 ac**

c = **0.99**

II) Detention System Summary:

Inflow Hydrograph:	At time	0 , inflow equals	0
	At time	T_c , inflow equals	Q_{MAX}
	At time	T_d , inflow equals	Q_{MAX}
	At time	$T_d + T_c$, inflow equals	0

Detention Structure: 4-36 LF OF 36" HDPE w/2-18 LF Headers (Inv. 92.00)
Outflow Structure: 4" dia. Orifice @ 0.0' (Elev. 92.00)
4"x8" dia. Orifice @ 1.80' (Elev. 93.80)
Overflow Weir @3.0' (Elev. 95.00)
31 LF of 15" RCP @ 2.0% (Inv. 91.92)

III) Determine the Critical Value for Storm Duration (T_d):

The critical value for T_d is determined by the time that produces the greatest outflow from the basin. Various times will be checked to determine the critical value.

Time (mins)	Basin Outflow (cfs)		
	Q_2	Q_{10}	Q_{100}
10	0.482	0.743	1.352
15	0.527	1.050	1.706
20	0.527	1.095	**1.734**
30	**0.548**	**1.112**	1.641
45	0.506	0.911	1.326

The critical value for T_d which produces the greatest outflow from the basin varies for the 3 design storms.

At T_d =	30 mins.	I_2 =	2.40 in/hr	Q_2 =	**0.90 cfs**
At T_d =	30 mins.	I_{10} =	3.30 in/hr	Q_{10} =	**1.23 cfs**
At T_d =	20 mins.	I_{100} =	5.80 in/hr	Q_{100} =	**2.16 cfs**

For the 2 year storm: Peak Inflow = **0.90 cfs**
Peak Outflow = **0.55 cfs** at 34 minutes after beginning of storm.
Peak Elevation = **93.82 ft**

For the 10 year storm: Peak Inflow = **1.23 cfs**
Peak Outflow = **1.11 cfs** at 31 minutes after beginning of storm.
Peak Elevation = **94.21 ft**

For the 100 year storm: Peak Inflow = **2.16 cfs**
Peak Outflow = **1.73 cfs** at 22 minutes after beginning of storm.
Peak Elevation = **94.94 ft**

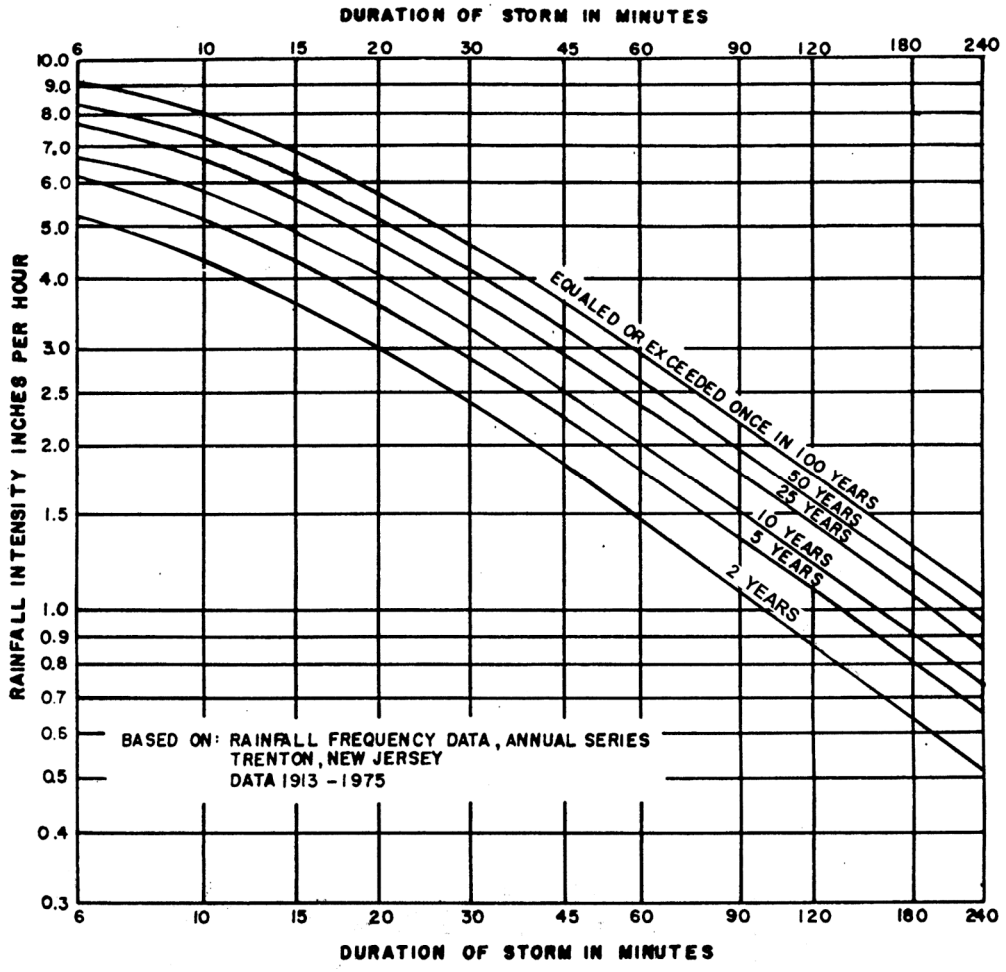
See appendix for calulations of the Inflow and Outflow Hydrographs.

IV) Determine the Total Combined Proposed Outflow

See appendix for calulations of the combined proposed hydrograph.

	Existing Peak	Detained Peak	% of Exist.
Q_2 =	1.17 cfs	0.55 cfs	46.8%
Q_{10} =	1.60 cfs	1.11 cfs	69.5%
Q_{100} =	2.17 cfs	1.73 cfs	79.9%

Figure 5-4: Rainfall Intensity-Duration-Frequency Curves



Note: Adapted from Figure 2.1-2 in the NJDEP *Technical Manual for Stream Encroachment Permits*.

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22-249.gpw

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Watershed Model Schematic

Legend

Hyd.	Origin	Description
1	Mod. Rational	Proposed - Basin
2	Reservoir	Basin Route

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.25

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	Mod. Rational	0.896	1	10	1,612	------	------	------	Proposed - Basin
2	Reservoir	0.548	1	34	1,610	1	93.82	794	Basin Route

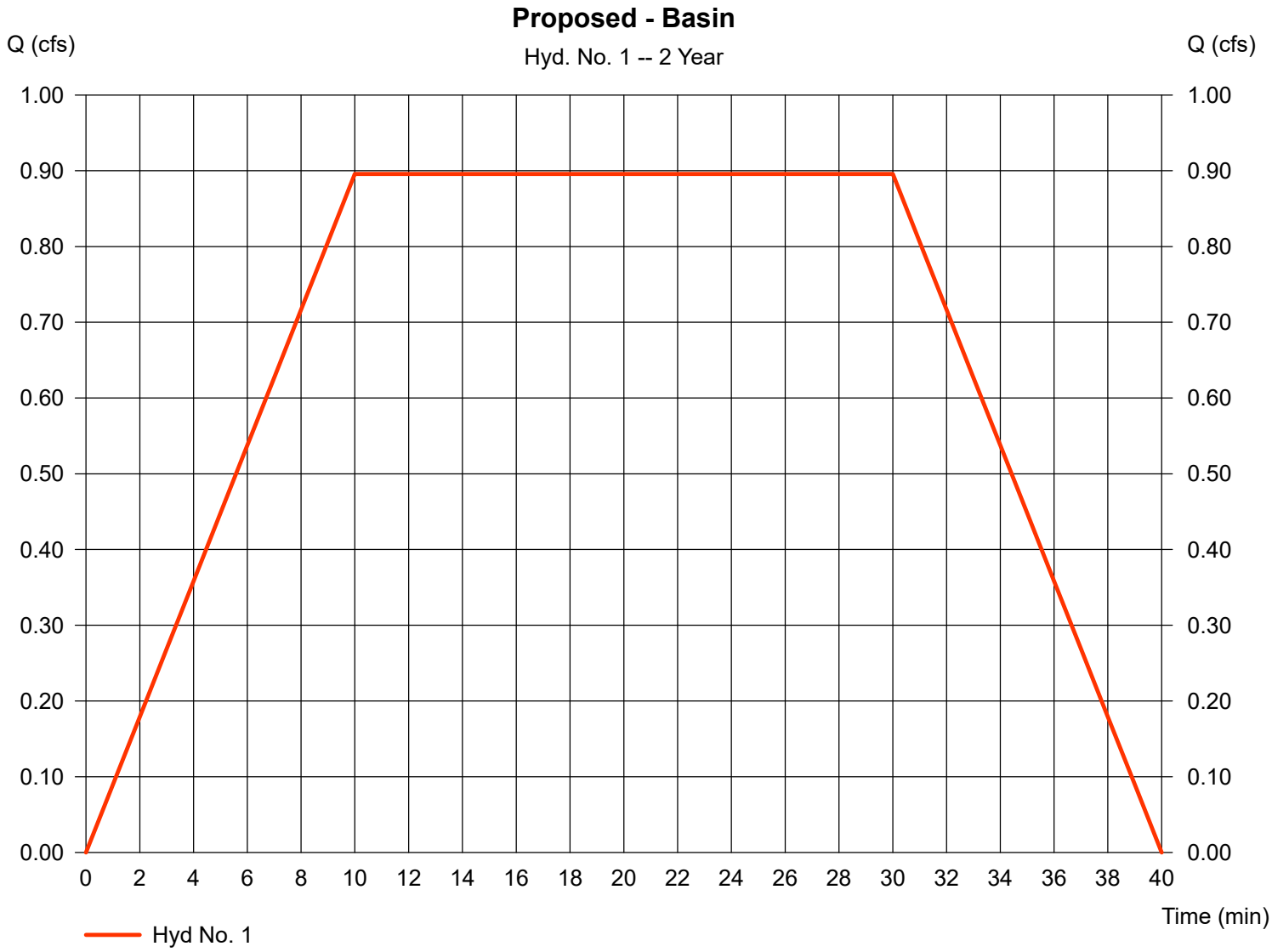
Hydrograph Report

Hyd. No. 1

Proposed - Basin

Hydrograph type	=	Mod. Rational	Peak discharge	=	0.896 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	1,612 cuft
Drainage area	=	0.377 ac	Runoff coeff.	=	0.99*
Intensity	=	2.400 in/hr	Tc by User	=	10.00 min
IDF Curve	=	trenton(10-20) with rev 2 yr.IDF	Storm duration	=	3.0 x Tc
Target Q	=	n/a	Est. Req'd Storage	=	n/a

* Composite (Area/C) = [(0.316 x 0.90) + (0.783 x 0.30)] / 0.377



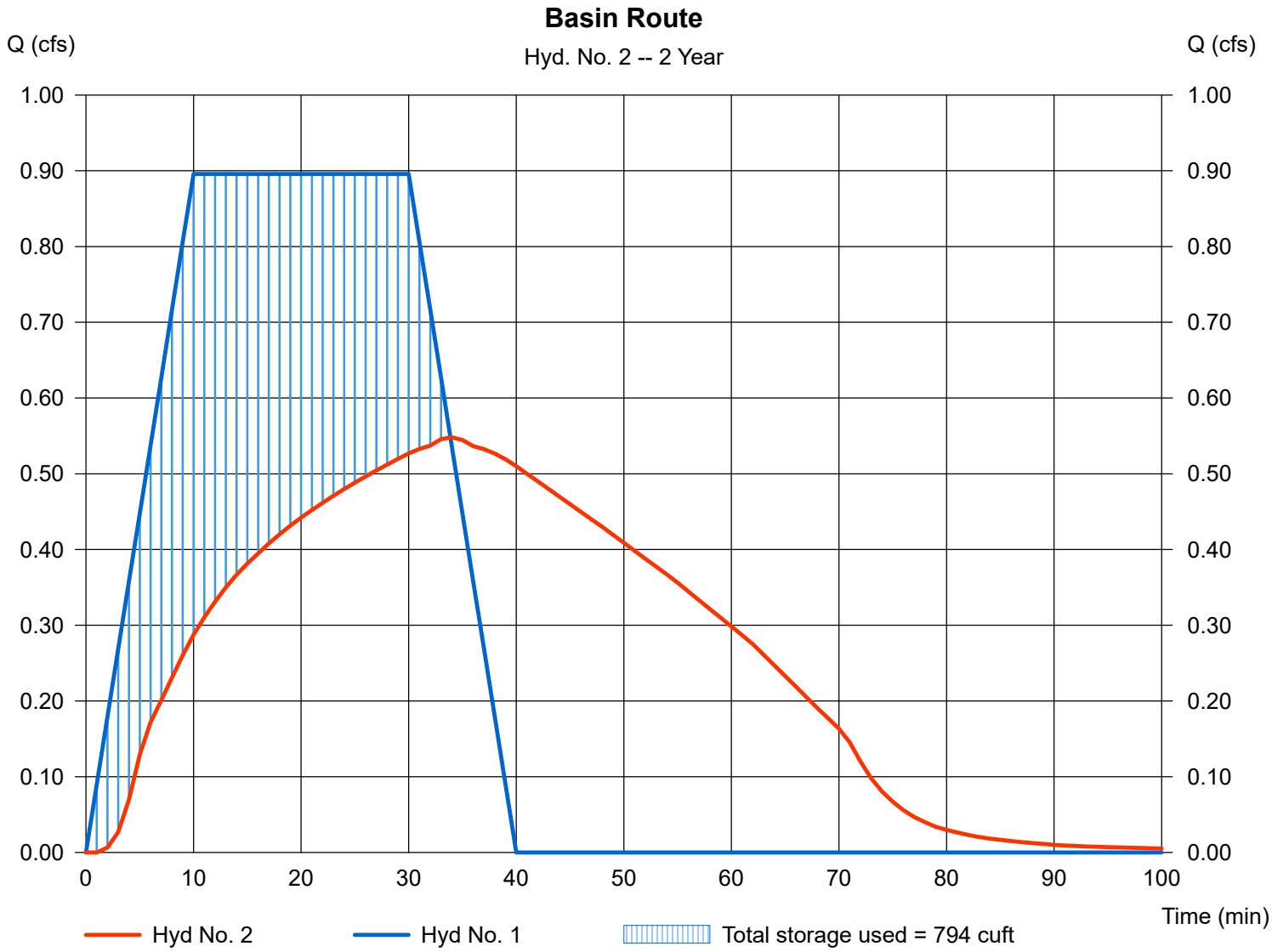
Hydrograph Report

Hyd. No. 2

Basin Route

Hydrograph type	=	Reservoir	Peak discharge	=	0.548 cfs
Storm frequency	=	2 yrs	Time to peak	=	34 min
Time interval	=	1 min	Hyd. volume	=	1,610 cuft
Inflow hyd. No.	=	1 - Proposed - Basin	Max. Elevation	=	93.82 ft
Reservoir name	=	Piping	Max. Storage	=	794 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Piping

Pond Data

UG Chambers - Invert elev. = 92.00 ft, Rise x Span = 3.00 x 3.00 ft, Barrel Len = 36.00 ft, No. Barrels = 4, Slope = 0.00%, Headers = Yes

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	92.00	n/a	0	0
0.30	92.30	n/a	65	65
0.60	92.60	n/a	113	178
0.90	92.90	n/a	138	316
1.20	93.20	n/a	152	467
1.50	93.50	n/a	158	626
1.80	93.80	n/a	158	784
2.10	94.10	n/a	152	936
2.40	94.40	n/a	138	1,073
2.70	94.70	n/a	113	1,186
3.00	95.00	n/a	65	1,251

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	4.00	4.00	0.00
Span (in)	= 15.00	4.00	8.00	0.00
No. Barrels	= 2	1	1	0
Invert El. (ft)	= 91.92	92.00	93.80	0.00
Length (ft)	= 31.00	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	Yes	No

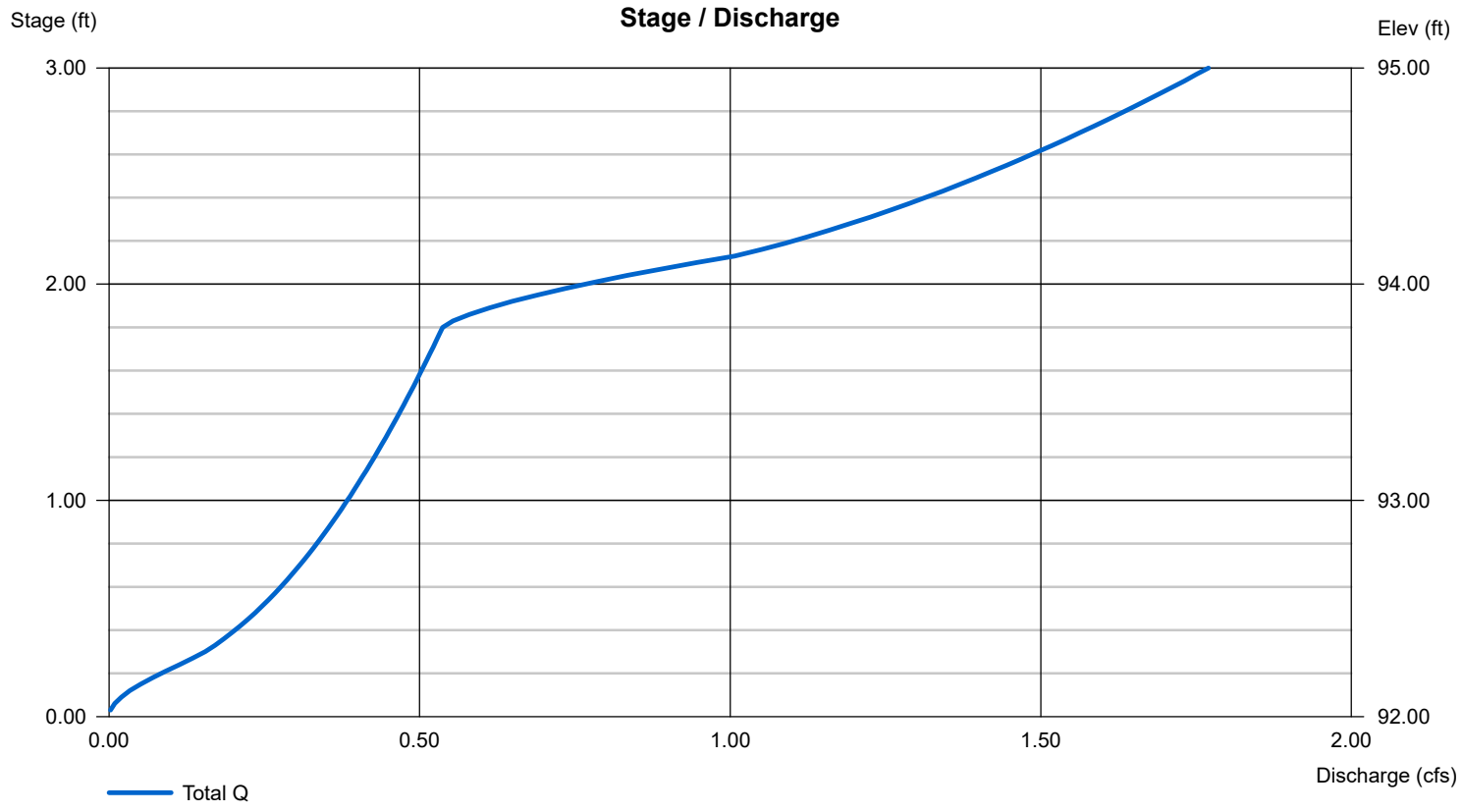
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	0.00	0.00	0.00
Crest El. (ft)	= 95.00	0.00	0.00	0.00
Weir Coeff.	= 3.20	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
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 Summary Report

Hydraflow Hydrographs by Intelisolve v9.25

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	Mod. Rational	1.232	1	10	2,217	------	------	------	Proposed - Basin
2	Reservoir	1.112	1	31	2,214	1	94.21	986	Basin Route

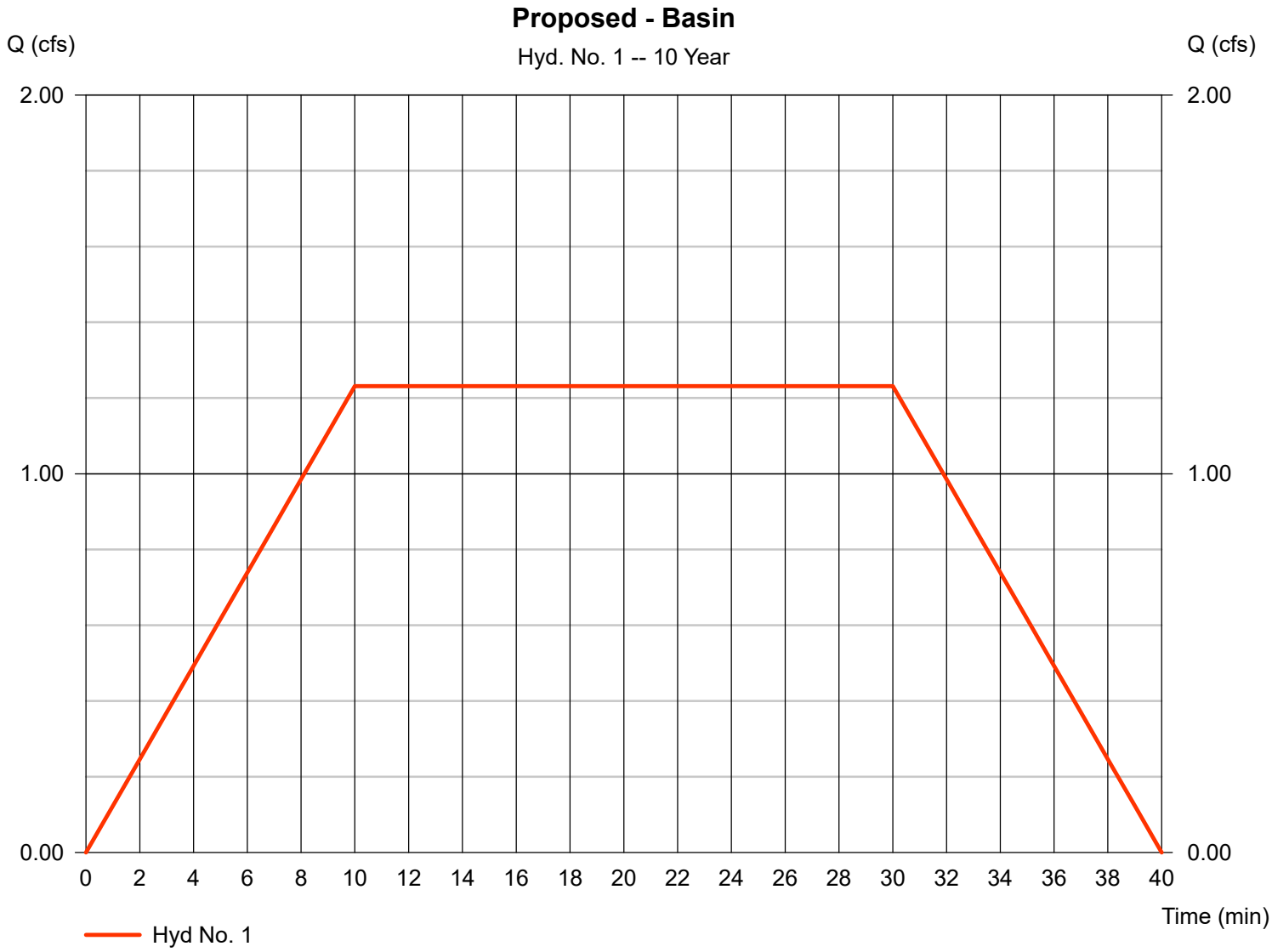
Hydrograph Report

Hyd. No. 1

Proposed - Basin

Hydrograph type	=	Mod. Rational	Peak discharge	=	1.232 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	2,217 cuft
Drainage area	=	0.377 ac	Runoff coeff.	=	0.99*
Intensity	=	3.300 in/hr	Tc by User	=	10.00 min
IDF Curve	=	trenton(10-20) with rev 2 yr.IDF	Storm duration	=	3.0 x Tc
Target Q	=	n/a	Est. Req'd Storage	=	n/a

* Composite (Area/C) = [(0.316 x 0.90) + (0.783 x 0.30)] / 0.377



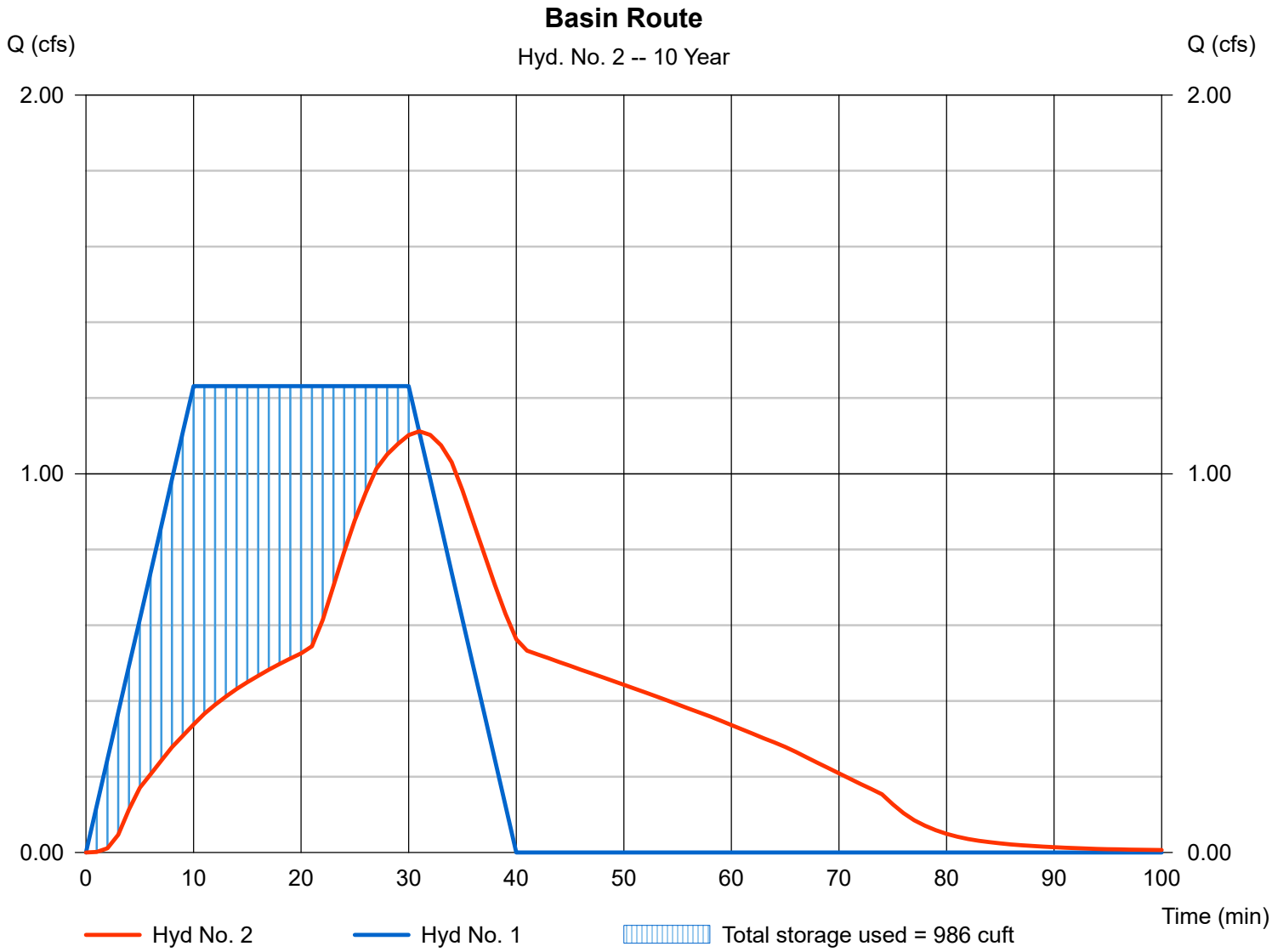
Hydrograph Report

Hyd. No. 2

Basin Route

Hydrograph type	=	Reservoir	Peak discharge	=	1.112 cfs
Storm frequency	=	10 yrs	Time to peak	=	31 min
Time interval	=	1 min	Hyd. volume	=	2,214 cuft
Inflow hyd. No.	=	1 - Proposed - Basin	Max. Elevation	=	94.21 ft
Reservoir name	=	Piping	Max. Storage	=	986 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.25

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	Mod. Rational	2.165	1	10	2,598	------	------	------	Proposed - Basin
2	Reservoir	1.734	1	22	2,595	1	94.94	1,239	Basin Route

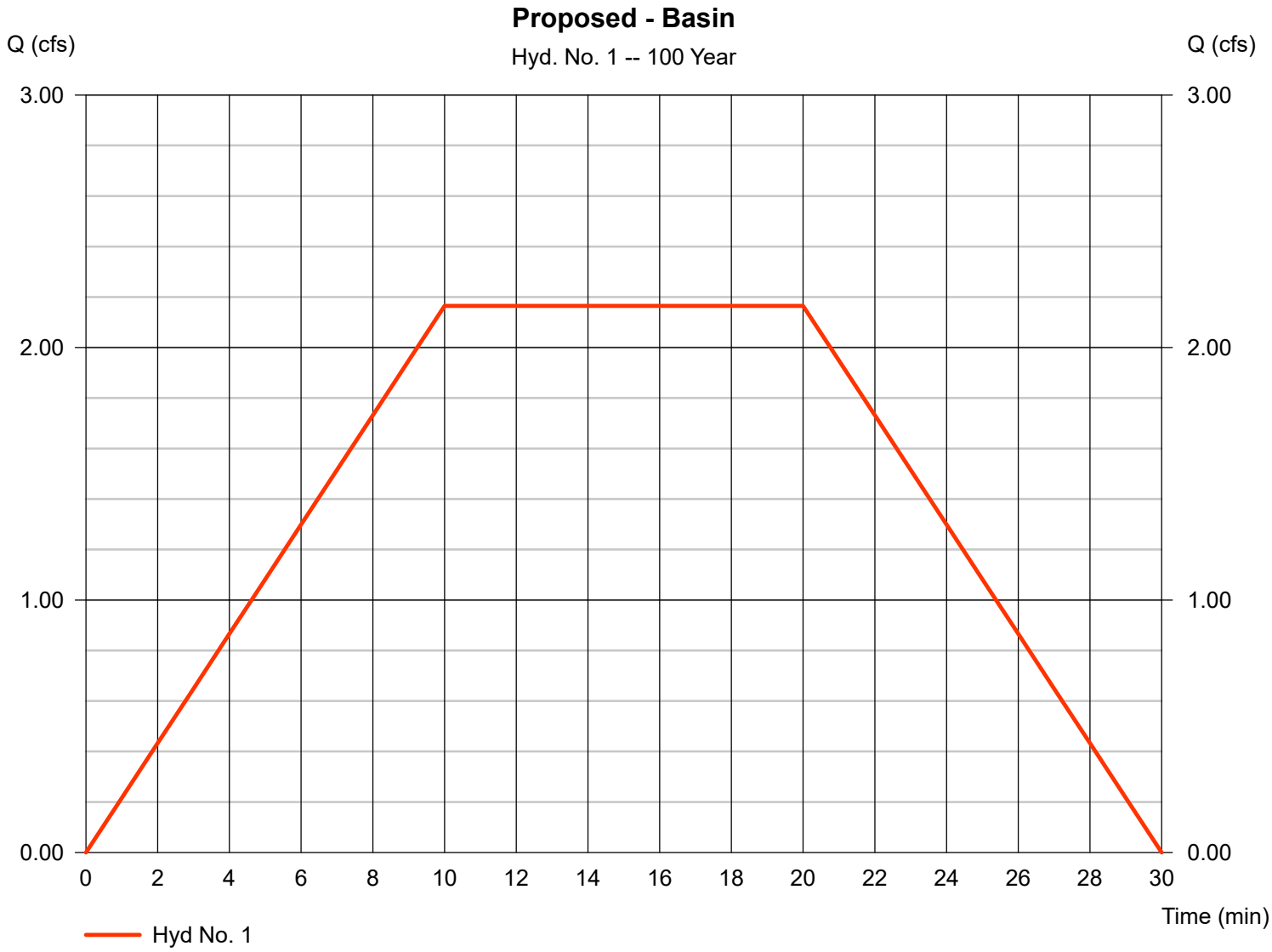
Hydrograph Report

Hyd. No. 1

Proposed - Basin

Hydrograph type	=	Mod. Rational	Peak discharge	=	2.165 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	2,598 cuft
Drainage area	=	0.377 ac	Runoff coeff.	=	0.99*
Intensity	=	5.800 in/hr	Tc by User	=	10.00 min
IDF Curve	=	trenton(10-20) with rev 2 yr.IDF	Storm duration	=	2.0 x Tc
Target Q	=	n/a	Est. Req'd Storage	=	n/a

* Composite (Area/C) = [(0.316 x 0.90) + (0.783 x 0.30)] / 0.377



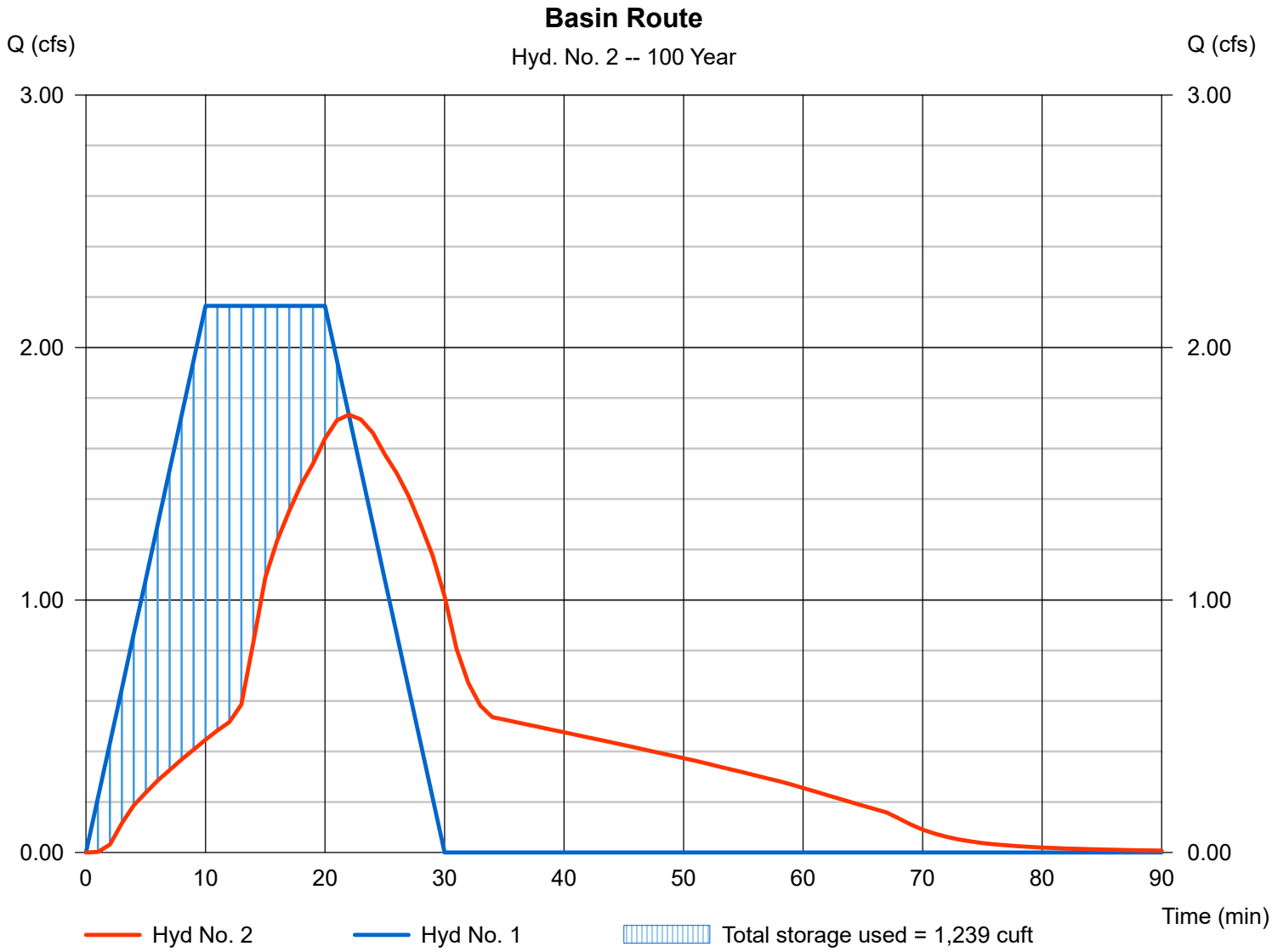
Hydrograph Report

Hyd. No. 2

Basin Route

Hydrograph type	=	Reservoir	Peak discharge	=	1.734 cfs
Storm frequency	=	100 yrs	Time to peak	=	22 min
Time interval	=	1 min	Hyd. volume	=	2,595 cuft
Inflow hyd. No.	=	1 - Proposed - Basin	Max. Elevation	=	94.94 ft
Reservoir name	=	Piping	Max. Storage	=	1,239 cuft

Storage Indication method used.

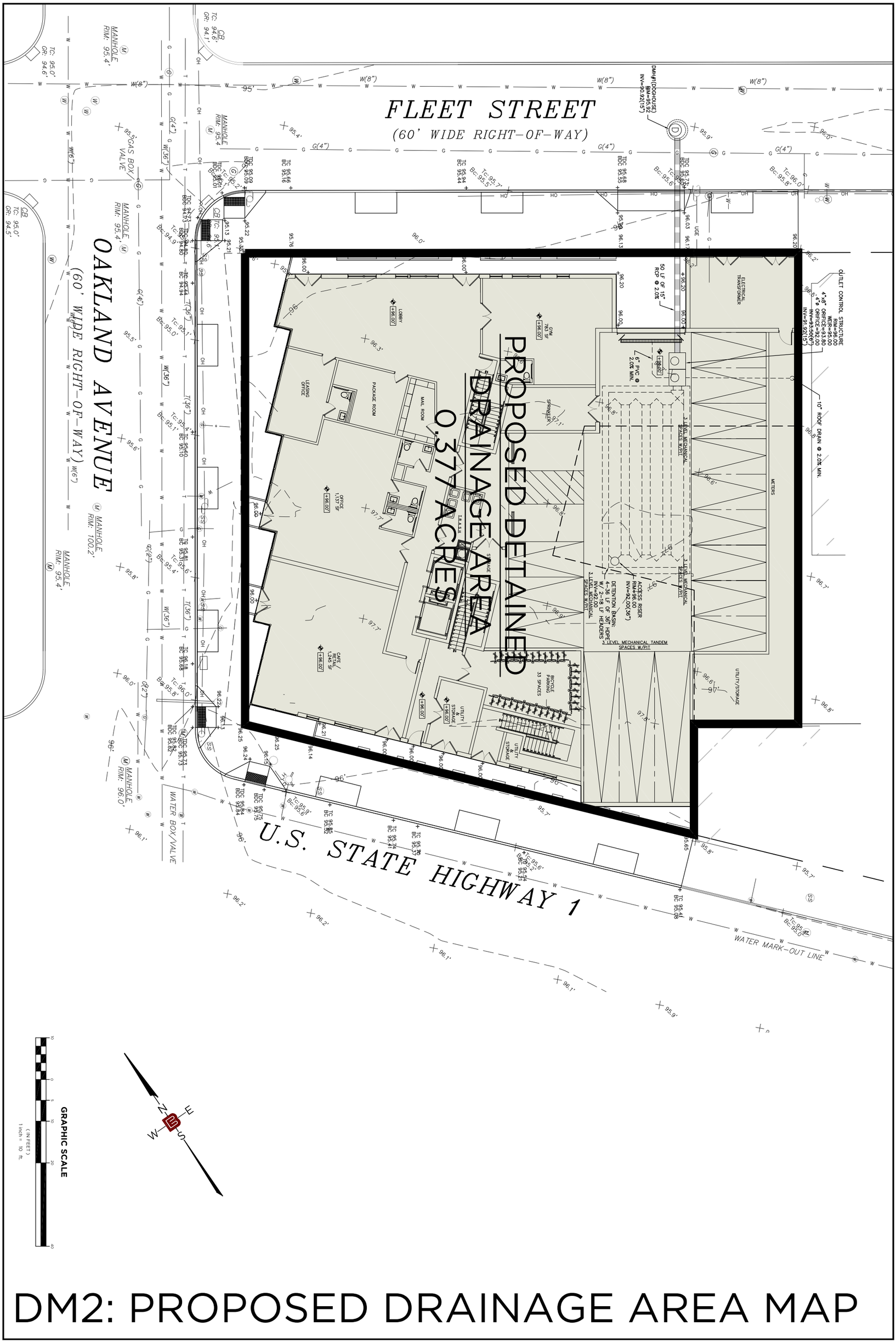


DM1: EXISTING DRAINAGE AREA MAP

EXISTING DRAINAGE AREA
0.377 ACRES

TAX LOT 3
2 STORY FRAME DWELLING W BRICK FRONT
WALL 0.5' SE
CONCRETE WALL
GRASS AREA
FRAME GARAGE
CNC WALL 7.0'
CHAIN LINK FENCE
2 STORY FRAME DWELLING NO. 77
ONE STORY
HITCH
CONCRETE
FLAT
ENTR.: 99.0'
TAX LOT 2
DEED BOOK 8745, PAGE 677
TAX LOT 22
ONE STORY BRICK BUILDING
(113.00')
CHAIN LINK FENCE
(38')
CHAIN LINK FENCE (25')
POLE
METAL FENCE
ON LINE
TAX LOT 27
DEED BOOK 5474, PAGE 185 TRACT II TAX LOT 1
DEED BOOK 5474, PAGE 185 TRACT I TAX LOT 27
DEED BOOK 3319 PAGE 1024 TAX LOT 26
GRASS AREA
CHAIN LINK FENCE
WIRE FENCE
CONCRETE
DEED BOOK 9121 PAGE 162 TAX LOT 25
BRICK GARAGE
ONE STORY BRICK GARAGE
AC
AC
DECK
CONCRETE
CONCRETE
ENTR.: 106.5'
BLDG. 1.5' SW
ON LINE
(107.6' (D))
(107.67')
2 ½ STORY FRAME DWELLING NO. 68
2 ½ STORY FRAME DWELLING NO. 66
2 ½ STORY FRAME DWELLING NO. 64
GRASS AREA
CHAIN LINK FENCE
CONCRETE
SILL: 102.0'
SILL: 101.8'
PLAT
PLAT
PLAT
PLAT
PLAT
(38')
(25')
(25')
CHAIN LINK FENCE
CONC. WALL
CONC. WALL
CONC. WALL
CONCRETE
CONCRETE-CURB W/ METAL FENCE
WATER MARK-OUT LINE
HIGHWAY 1
U.S. STATE
TRAFFIC SIGNAL
RBR
DC
DOT
CURB
WATER BOX/VALVE
GAS BOX/VALVE
FLEET STREET
(60' WIDE RIGHT-OF-WAY)
OAKLAND AVENUE
(60' WIDE RIGHT-OF-WAY)
CB TC: 94.6' GR: 94.1'
MANHOLE RIM: 95.4
CB TC: 95.1' GR: 94.6'
MANHOLE RIM: 95.4'
MANHOLE RIM: 100.2'
MANHOLE RIM: 96.0'
MANHOLE RIM: 95.4'
CB TC: 95.0' GR: 94.6'
CB TC: 95.0' GR: 94.5'

GRAPHIC SCALE
10 0 5 10 20 40
(IN FEET)
1 inch = 10 ft.



DM2: PROPOSED DRAINAGE AREA MAP