DRAINAGE REPORT

BELTA SUBDIVISION
128 BAYBERRY LANE
WESTPORT, CT

Prepared For:

Estate of Dina M. & James S. Belta
128 Bayberry Lane
Westport, CT 06880

PREPARED BY:

800 Main Street South
Southbury, CT 06488
Telephone: (203) 267-1046
Fax: (203) 267-1547
E-Mail: dymar@dymarinc.com

Dated: May 8, 2020
Job #00934

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1.0	**STORMWATER ANALYSIS**	
	1.1 Preamble	1-1
	1.2 Study Purpose	1-1
	1.3 Existing Site Conditions	1-2
	1.4 Proposed Development Plan	1-2
	1.5 Methodology	1-4
	1.6 Summary and Conclusions	1-6
	1.7 Recommendations	1-7

LIST OF APPENDICES — **TITLE**

A **FIGURES & TABLES**

Figure #1 – Location Map
Figure #2 – Pre-Development Drainage Area Map
Figure #3 – Post-Development Drainage Area Map
Figure #4 – Hydrologic Basin Model
Table #1 - Watershed Model Characteristics Pre-Development Analysis
Table #2 - Watershed Model Characteristics Post-Development Analysis
Table #3 – Hydrograph Return Period Recap
Table #4 – Comparison of Pre and Post Development Drainage Estimates
Table #5 – Detention Basin Weir Rating Curve

B **STORMWATER ANALYSIS**

- Rational Method Pre and Post Development Analysis
  - 2 Year Storm Event
  - 5 Year Storm Event
  - 10 Year Storm Event
  - 25 Year Storm Event
  - 50 Year Storm Event
  - 100 Year Storm Event
- Pond Report
- Rational Method Analysis for Stormwater Collection System
- Water Quality Volume Calculations

C **TECHNICAL WORKSHEETS & REFERENCE MATERIAL**

- Technical Worksheets & Reference Material

SECTION 1.0

STORMWATER ANALYSIS

1.1 PREAMBLE

The intent of this report is to summarize the "Final" Stormwater Management Study for the proposed Belta Subdivision development, which is based on DYMAR's evaluation of the regulatory criteria, existing site conditions and the proposed development plan. Reference is made to Figure #1 for the proposed project's site location. It is the objective of the development team to present to the Town of Westport (Town) all of the pertinent site factors which have influenced the plan in an effort to solidify a final design proposal, which can find a balance between quality, technical adequacy, and environmental protection. Specific to this mission is the assessment of the stormwater management opportunities, constraints and the various competing site factors that are important to the design and layout of stormwater systems. The initial goal is to identify a technical approach, which has sufficient merit to minimize impacts based on an evaluation of management approaches for controlling the quantity and quality of water leaving the site. Elements, which were most critical in developing a Stormwater Plan, included the following:

A. An inventory and inspection of the site soils and surficial geology, wetland / watercourses, watershed surface drainage and runoff patterns, general forms of vegetation, topographic shapes, slopes and orientation, and relationships to adjoining properties;

B. The preparation of a viable site development plan;

C. Review of zoning and land use regulations;

D. Review of infrastructure capacity, demands, and standards;

E. Assessment of engineering and construction practices;

F. Identification of any potential off-site impacts; and

G. Identification of stormwater control and the Best Management Practices (BMP) to minimize impacts or improve existing conditions.

1.2 STUDY PURPOSE

The general purpose of this study is to 1) provide estimates for the storm water runoff for the existing conditions, 2) to analyze and provide quantitative estimates of how the development proposal affects the existing infrastructure and downstream properties utilizing accepted engineering methodologies and 3) to provide recommended stormwater practices which align itself with the current guidelines adopted by the Town and the Connecticut Department of Energy and Environmental Protection (CTDEEP) for water quality and water quantity planning, design and implementation. This includes the Town's Site Plan and Storm Water Drainage Design Standards issued 9/16/2014, the "2000 Connecticut Guidelines for Soil Erosion and Sediment Control", the "2004 Connecticut Stormwater Quality

Manual" and the "Connecticut Department of Transportation Drainage Manual". These CTDEEP and CTDOT publications were used for this project and are available to designers and regulators as reference guides in developing technically sound design solutions for source controls and pollution prevention in managing stormwater during construction and over the long term.

This study includes Hydrological and Hydraulic Analyses of the watershed as well as the analysis and design for the proposed on-site collection and conveyance system to demonstrate its suitability in satisfying local regulations. State guidelines for stormwater quantity and quality management were also used in sizing structural and non-structural measures prepared for the site.

1.3 EXISTING SITE CONDITIONS

The project site is located in Westport, CT within the AAA Residential Zone at 128 Bayberry Lane. The Belta family has commercially farmed the property since 1946. The total acreage of the parcel is 23 +/- acres comprised of Parcel A (21.5 ac.) and Parcel B (1.5 ac.) Currently two residential structure, three green houses and miscellaneous accessory uses are located on the property. The land is bounded to the north by the Muddy Brook and an associated wetland system, by other residential properties to the south and east, and by Bayberry Lane to the west. A series of subsurface deep test holes was conducted by DYMAR in February 2018, July 2019, February 2020 and May 2020. The testing consisted of 72 deep test holes and about 35 percolation tests. These include seven test pits conducted with the Town Department of Public Works/Engineering in February of 2020 for feasibility of roof storm water runoff recharge systems. The remainder of the testing was conducted for soil suitability for septic systems. The site subsurface conditions are a combination of naturally occurring soils and bedrock at varying elevations with topsoil fill deposited for farming purposes.

Stormwater runoff crosses the site from the southeast corner and runs to the northwest corner to the existing wetlands. The wetlands follow the northern and western property lines and eventually discharge to the Muddy Brook. A small portion of the brook crosses the property and is conveyed under Bayberry Lane by twin 24" culverts.

The site has access to a public water supply system and natural gas. Properties in the area are served by private septic systems. The property slopes radially from southeast to northwest at an average grade of 4.9 +/- %. The change in grade is from elevation 184.9' +/- near the center of the property to 158.2' at the northeast corner from the southeast corner to elevation 154' near the Muddy Brook. There are 3.45 +/- acres of wetlands on the site.

Refer to Figure #2 for existing conditions.

Refer to Table #1 for runoff characteristics.

1.4 PROPOSED DEVELOPMENT PLAN

The current proposal is to seek approval for an "Open Space Subdivision", creating 9 lots, two of which will serve the Belta Family. The infrastructure will consist of a private 960-

foot long road at 22 feet wide with a 40-foot radius cul-de-sac. The lots are to be served via underground utilities for water, gas and electrical/telephone/cable with private septic systems to service each lot. The storm sewer system consists of a network of catch basins with deep sumps and hooded outlets, and manholes to convey storm water from the pavement to the proposed detention basin. The natural radial topography of the site has been maintained under the proposed grading plan. There are no direct impacts to wetlands or watercourses. The upland review is impacted by an estimated 700 sft that is associated with the outlets for the underdrain needed below the bio swales.

The proposed storm water sewer design has been divided into two parts. The first part is to capture the roof areas' runoff and convey the volume to an underground plastic chamber storage and exfiltration technology. The proposed systems will vary to match the requirements of capturing and storing the first 1" of storm water for each proposed lot. For design purposes, the systems are sized for pure storage with no credit taken for infiltration.

The second part consists of the design, construction and maintenance of an at-grade detention basin to treat and detain the storm water runoff for approximately 6.7 +/- acres of the developed site, including 550 feet of the proposed road. The remainder of the road runoff flows towards Bayberry Lane where it will be captured and conveyed to an underground infiltration chamber, before entering the Bayberry Lane storm sewer infrastructure.

The proposed detention basin shall include a forebay to provide storm water treatment for the private road. The forebay is sized to meet the CTDEEP requirements for the first flush or 1" of storm water volume of the runoff, which is considered by the CTDEEP to be the highest concentration of pollutants. The outlet control structure (OCS#1) consists of a multi stage hydraulic control system comprising of a 12" orifice, 12 feet long x 0.5 high combination weir/orifice, and a double catch basin overflow spillway for the significant storm events. The crest of the basin is set at elevation 165.0 that is 8 feet wide with side slopes at 3H:1V. The freeboard provided at the 100 year storm (el. 163.7) is 1.3 feet. The 18 inch discharge pipe connects to a 24 inch "T" manifold diverter that distributes flow to a modified riprap energy dissipater, which then flows into a 190' bio swale and concrete weir level spreader. The level spreader's overflow discharges to a small stone gravel dissipater strip, which is designed to shed the water to natural occurring soils and the riparian buffer at low velocities. By example, the discharge velocity is estimated at 1.007 feet per second and 1.073 feet per second for the 25 and 100-year storm, respectively. Reference is made to Table #4 for the Detention Basin Weir Rating Curve and predicted velocities for each storm event. It is noted that in Part 654 of the National Engineering Handbook Table 8-4 provides allowable velocities for various channel materials based on shear velocity to minimize erosion. In earth, sandy slit has a mean velocity limit of 2 feet per second and silty clay at 3.5 feet per second. This table can be found in Appendix C.

Refer to Figure #3 for proposed post-development conditions.

Refer to Table #2 for post-development runoff characteristics.

Refer to Table #4 for pre- and post-development runoff comparisons.

Refer to Appendix 'B' for Water Quality Volume calculations.

1.5 METHODOLOGY

The study reviews the impact of the proposed stormwater management plan on the existing downstream drainage system of Bayberry Lane. Conclusions have been drawn based on a hydrological and hydraulic analysis in comparing the pre- and post-development flows for the affected watershed at the Analysis Point #1 (A.P. #1) located at point where the Muddy Brook exits the subject property and A.P. #2 at the existing catch basin near the existing driveway.

The analysis for the watershed was based on TR-55 methodology. The entire drainage area analyzed for the project site for pre-development conditions totals to 19.72 +/- acres. For post-development the drainage area is 21.22 +/- acres to A.P. #1. At A.P. #2 the present drainage area is 4.0 acres and the post-development is approximately 2.5 +/- acres. The proposed storm sewer was sized by the Rational Method for the 25-year storm period.

Drainage Area 'C' that runs off to A.P. #2 will partially enter the Town system via the proposed catch basins located at the end of the subdivision entrance with the remainder as overland flow to the existing catch basins located upstream and downstream of the connection point. The Town sewer then discharges to the Muddy Brook as a 15" HDPE cross culvert from the lower catch basin. The town system was analyzed by the Rational Method for a 25 year storm, HEC 5 for culvert rating curve analysis and Manning's Equation for full flow. The computed flow estimates via the HEC-5 methods show that the maximum safe flow is about 9.25 cfs while maintaining 1 foot of freeboard inside of the catch basin. The Manning's Equation allows for 15.3 cfs full flow capacity, alternately. The Rational Method pipe analysis demonstrates that the HGL of the flow of 17.9 cfs for a 25 year storm tops out at 159.9'+/- which is higher than the top of frame of 159.10'. The TR-55 estimated flow to A.P. #2 is 22.35 cfs under existing conditions and 14.1 cfs under the proposed development; a 36.9% reduction in flow. Although the proposed development does lower the flow to the Town sewer system on Bayberry Lane, the overall performance of the cross culvert under the 25 year storm event appears to be inadequate to provide safe conveyance of storm water to the Muddy Brook.

Refer to Figures #2 and #3 for the pre- and post-development watershed delineations and soil mapping based on NRCS soil maps.

Refer to Table #4 for pre- and post-construction peak flow rate comparisons.

Refer to Appendix 'B' – Rational Method Analysis For Stormwater Collection System

The design storm criteria outlined for the evaluation of storm water management facilities is as follows:

DESIGN APPLICATION	DESIGN FREQUENCY
• Storm Drainage Collection System	25 Year
• Minor Cross Culverts	25 Year
• Evaluation Impact for Development Peak Runoff	2, 5, 10, 25, 50 & 100 Year

• Overflow Spillway Design	100 Year
• Detention Basin Outlet Level Spreader	25 Year

Hydrologic and hydraulic estimates were based on the following technical theorems, methods and practices of drainage analysis and design in the assessment of pre- and post-development conditions:

A. ***Hydrologic Runoff Estimates***

- Hydraulic Concept: The analyses of the proposed detention ponds and the modeling of the existing ponds and existing hydraulic structures downstream of the proposed site were conducted using the "Hydrology Studios" Program, version 2014. HSP computes SCS Method runoff hydrographs by convoluting a rainfall hyetograph through a unit hydrograph. This method is the same as used in the National Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service (SCS), TR-55 program. TR-55 is based upon methodologies and acceptable practices and values published in the National Engineering Handbook, Section 4, Hydrology, commonly referred to as NEH 4.
- Storm Frequencies Analyzed: 2, 5, 10, 25, 50 & 100 year, 24-hour Type III storm
- Runoff Coefficients "CN": Weighted average of soil complex number for the various basin hydrologic soil groups from U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release Number 55, Washington D.C. as amended.
- Time of Concentration: Time of concentration (Tc) values was calculated using the methodologies as described in Technical Release 55 (TR-55), Chapter 3. Input values were obtained from interpretation of the 100 scale topographic map and the USGS quadrangle map and on an assessment of values established by Manning's Kinematic Solution (Overton & Meadows, 1976) and Figure 3-1 (TR-55, Second Edition, June, 1986).
- Rainfall Intensity "I": Precipitation values area based on the recently published NOAA atlas 14, Volume 10 which provides for adjusted rainfall values for New York and the New England States.
- Drainage Areas: Estimated from a digital planimeter utilizing aerial topography.
- Hydrologic Soils Groups: Established from NRCS Soils mapping for Connecticut, prepared by Natural Resources Conservation Service.
- Capacity Analysis of Hydraulic Structures: Location and hydraulic characteristics interpreted from field observations, existing reports, and field survey data; capacities reflect estimates for normal flow and headwater assumptions with of without tail water control, depending on site conditions. Connecticut Department of Transportation "Drainage Manual 2000" and local DPW regulations were used for analysis guidelines. Grate inlets are assumed 50% plugged for the hydraulic effective opening.

- Detention Basin Outlet Level Spreader: Town goal is to minimize potential rill erosion by limiting the flow to 0.2 cfs/10 feet.

B. ***Stormwater Collection System***

An analysis of the proposed stormwater collection system was undertaken to determine the required size of each drainage pipe. This analysis was based on the following assumptions and estimates:

- Hydraulic Concept: Conventional Rational Method to establish peak flows for areas under 100 acres. The peak flow is equal to the formula Q=CIA. Manning's equation to determine the minimum slope and pipe diameter required to convey the peak flows.
- Inlet Design: FHWA HEC No. 22 for inlet interception capacity and carry over flows. Grate inlets are assumed 50% plugged for the hydraulic effective opening.
- Culvert Design: FHWA HDS No. 5 for inlet interception capacity and headwater elevation estimation.
- Storm Frequencies Analyzed: 25-year storm event for stormwater collection systems and 25-year storm event for cross-culverts.
- Runoff Coefficients "C": A weighted value was utilized based on published empirical coefficients representing the relationship between rainfall and runoff.
- Time of Concentration: Overland flow time estimates were made based on Seelye and shallow concentrated charts and Manning's equation for time of concentrations in combination with TR-55 worksheets.
- Rainfall Intensity "I": The 5, 15 and 60-minute precipitation values for the 2 and 100-year storm frequencies from the NOAA Atlas 14, Volume 10 were used to generate the I-D-F curves. The data from these curves was then used to obtain rainfall intensity values for various times of concentrations and storm frequencies.
- Drainage Areas: Estimated from a digital planimeter utilizing field or aerial topography, GIS and USGS mapping.

C. ***Water Quality Volumes and TSS Removal Rates and Efficiencies Calculations***

An analysis of the proposed stormwater treatment train and post development conditions was undertaken to determine the required volume for water quality and the removal rate efficiencies for the treatment train. The analysis was based on the following assumptions and estimates:

- Water Quality Volume: Connecticut Department of Energy and Environmental Protection "2004 Stormwater Quality Manual."

The basic premise is to design bio-retention water quality basins and infiltration systems for the first flush of rainfall, typically established as a one-inch storm event. It is estimated that 85% of the annual rainfall is less than a one-inch storm.

Reference is made to Appendix B, last tab for the Water Quality Volume calculations for each drainage area considered. The subdivision plans provide water quality volumes and suggested capacity requirements but can vary depending on the actual house to be built. The plans demonstrate the feasibility of an infiltration system for the lot utilizing plastic chambers and stone.

1.6 SUMMARY AND CONCLUSIONS

The peak flows for pre- and post-development for the runoff generated by the site are summarized in Table #4. The conclusion of the analysis shows that the proposed drainage network was a net effect of reducing post-development estimated flows to below those generated by existing site conditions. The storm events were adequately retained on site by the proposed stormwater management systems to A.P. #1 and A.P. #2. For the 2-yr and 100-yr storm events the runoff is reduced by 2.7% and 6.8%+/-, respectively. At the 100 year storm the discharge rate is reduced from 67.7 cfs to 63.1 cfs. At A.P. #2, the 2-YR storm reduction is 27.2% and the 100-YR storm is reduced by 30.1%, primarily a result of the reduced watershed drainage area.

Refer to Table No. 4 for pre- and post-development flows.

1.7 RECOMMENDATIONS

The following Best Management Practices should be employed to protect wetlands, watercourses and the quality of water affected by the project:

A. During construction, closely follow the Connecticut Department of Energy and Environmental Protection's (CTDEEP) guidelines for Erosion and Sediment Control.

B. Identify a site monitor to regularly inspect the sediment and erosion controls throughout the construction period and provide reports to the Town.

C. Incorporate three-foot sumps in all catch basins with hooded outlets to trap road sands, debris, and oily water.

D. Stormwater collected from rainfall and snowmelt will be ultimately distributed to surface water treatment systems utilizing Continuous Deflective System technology.

E. During construction, polymer systems can be introduced to provide water quality retention times appropriate to remove particulate materials and pollutants.

F. Employ an annual maintenance program for the inspection and maintenance of permanent stormwater controls to assure that the systems operate effectively.

APPENDIX A – FIGURES & TABLES

DYMAR

800 Main Street South Southbury, Ct. 06488 (203) 267-1046 · Fax (203) 267-1547
ENGINEERING · PLANNING · SURVEYING · DEVELOPMENT SERVICES

BELTA SUBDIVISION

LOCATION MAP

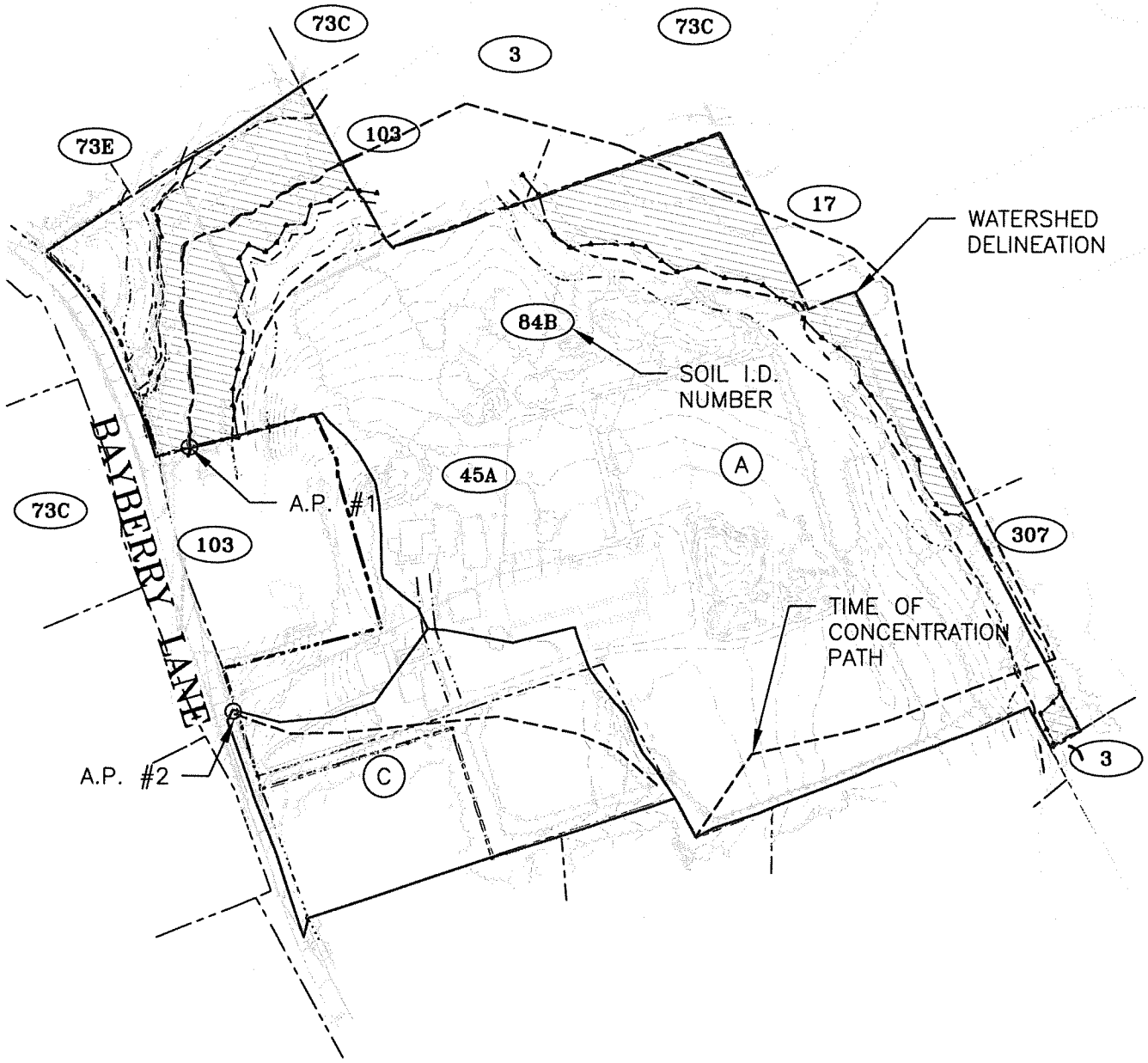
WESTPORT, CONNECTICUT

All measurements are approximate and are subject to final verification by this office.

0" 1" 2"

Job No: 00934
Scale : 1" = 1000'

FIGURE No. 1



(#) WATERSHED SUBAREA

——— WATERSHED DELINEATION

- - - - - TRAVEL PATH

DYMAR
800 Main Street South Southbury, Ct. 06488 (203) 267-1068 · Fax (203) 267-1547
ENGINEERING · PLANNING · SURVEYING · DEVELOPMENT SERVICES

BELTA SUBDIVISION

PRE-DEVELOPMENT WATERSHED MAP

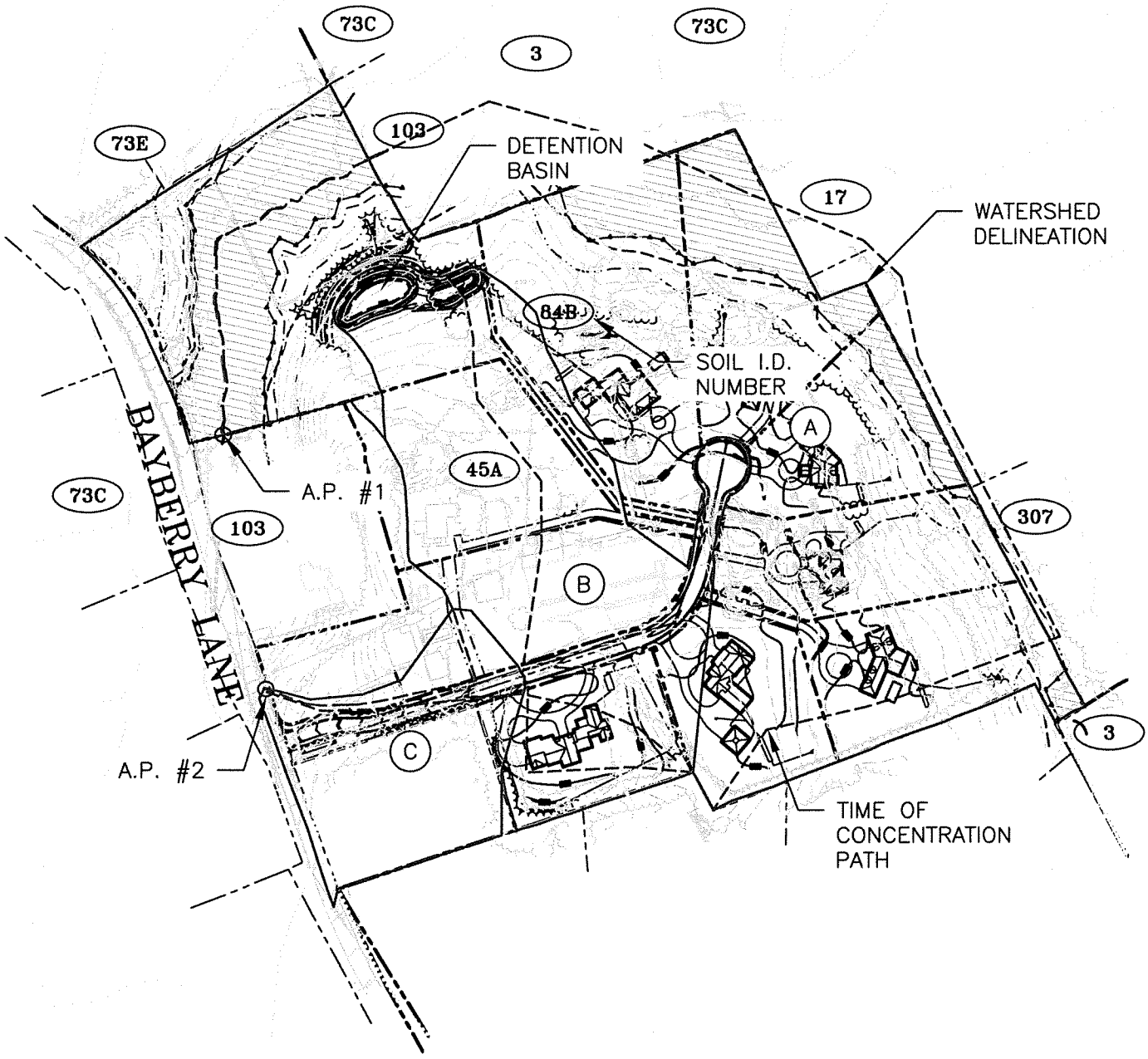
WESTPORT, CONNECTICUT

All measurements are approximate and are subject to final verification by this office.

0" 1" 2"

Job No: 00934
Scale : 1" = 250'

FIGURE No. 2



WATERSHED SUBAREA

WATERSHED DELINEATION

TRAVEL PATH

DYMAR
800 Main Street South Southbury, Ct. 06488 (203) 267-1046 · Fax (203) 267-1547
ENGINEERING · PLANNING · SURVEYING · DEVELOPMENT SERVICES

BELTA SUBDIVISION

POST-DEVELOPMENT WATERSHED MAP

WESTPORT, CONNECTICUT

All measurements are approximate and are subject to final verification by this office.

0" 1" 2"

Job No: 00934
Scale : 1" = 250'

FIGURE No. 3

Fig. No. 4

Basin Model

Hydrology Studio v 3.0.0.14

Project Name: Belta Trial

03-31-2020

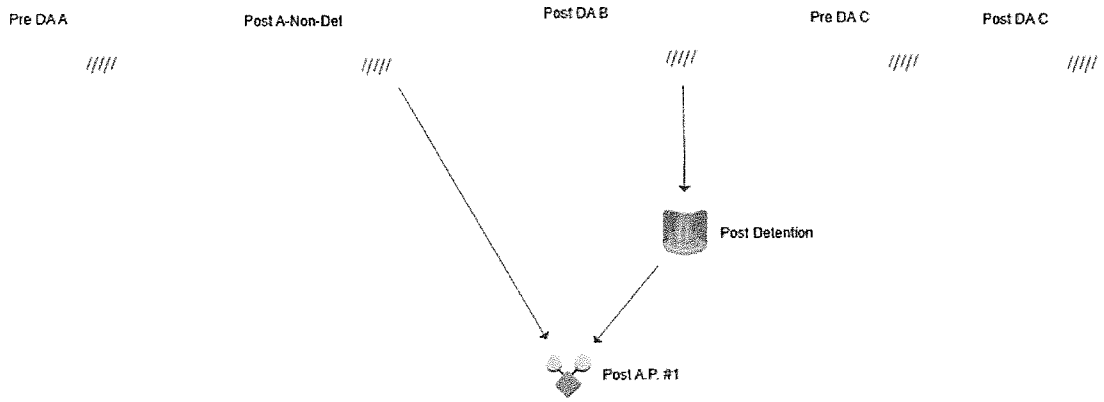


TABLE 1
WATERSHED MODEL CHARACTERISTICS
PRE-DEVELOPMENT ANALYSIS

Drainage Area Pt. No.	Area (Acres)	Weighted CN Value	Time of Concentration (Min.)
A	19.176	78	40
C	4.040	83	5
Total	**23.216**		

TABLE 2
WATERSHED MODEL CHARACTERISTICS
POST-DEVELOPMENT ANALYSIS

Drainage Area Pt. No.	Area (Acres)	Weighted CN Value	Time of Concentration (Min.)
A	14.552	75	48
B	6.669	82	25
C	2.510	84	5
Total	**23.731**		

TABLE No. 3

Hydrograph by Return Period

Project Name: Belta Final

Hydrology Studio v 3.0.0.14

05-07-2020

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Pre DA A		17.56		27.56	36.22	48.48	57.72	67.66
2	NRCS Runoff	Post A-Non-Det		9.948		16.26	21.82	29.78	35.84	42.40
3	NRCS Runoff	Post DA B		8.418		12.61	16.16	21.10	24.79	28.74
4	Pond Route	Post Detention		7.379		12.25	14.50	17.11	18.94	20.68
5	Junction	Post A.P. #1		17.09		27.37	36.12	46.86	54.78	63.05
6	NRCS Runoff	Pre DA C		9.277		13.63	17.27	22.35	26.13	30.17
7	NRCS Runoff	Post DA C		5.953		8.671	10.94	14.10	16.45	18.96

TABLE 4

COMPARISON OF PRE- AND POST-DEVELOPMENT DRAINAGE ESTIMATES

Pt. No. Design Storm	A.P. #1 Pre- (cfs)	Post- (cfs)	Diff. (%)	WSE (Ft.)
2-YR	17.6	17.1	-2.7	160.1
5-YR	27.6	27.4	-0.5	160.3
10-YR	36.2	36.1	-0.4	160.8
25-YR	48.5	46.9	-3.3	161.9
50-YR	57.7	54.8	-5.1	162.7
100-YR	67.7	63.1	-6.8	163.7

Pt. No. Design Storm	A.P. #2 Pre- (cfs)	Post- (cfs)	Diff. (%)
2-YR	9.3	6.0	-35.8
5-YR	13.6	8.7	-36.4
10-YR	17.3	10.9	-36.7
25-YR	22.4	14.1	-36.9
50-YR	26.1	16.5	-37.0
100-YR	30.2	19.0	-37.2

DYMAR
800 Main Street South • Southbury, Ct 06488 • (203) 267-1046 • Fax (203) 267 1547
ENGINEERING • PLANNING • SURVEYING • DEVELOPMENT SERVICES

Project: Belta Subdivision
Westport, CT
Job No. : 00934
Date : 3/31/2020
Designed By : S.A.L.

Table 5 - Detention Basin Weir Rating Curve

Maximum flow rate per Westpost PDW is 0.2 cfs per 10 LF

Weir flow estimated for a Cipolletti Weir model.
Flow = 3.367*L*H^1.5

Weir Length = 190 ft
Max Flow = 3.8 cfs

Stage (ft)	Area (sft)	Flow (cfs)	Flow (cfs/10 lf)	Vel (fps)
0.00	0.00	0.00	0.000	0.00
0.05	9.50	7.15	0.376	0.75
0.10	19.00	20.23	1.065	1.06
0.15	28.50	37.16	1.956	1.30
0.20	38.00	57.22	3.012	1.51
0.25	47.50	79.97	4.209	1.68
0.30	57.00	105.12	5.533	1.84
0.35	66.50	132.46	6.972	1.99
0.40	76.00	161.84	8.518	2.13
0.45	85.50	193.11	10.164	2.26
0.50	95.00	226.18	11.904	2.38

Exact Solutions:

Stage (ft)	Area (sft)	Flow (cfs)	Flow (cfs/10 lf)	Vel (fps)	
0.051	9.700	7.379	0.388	0.761	2yr
0.072	13.599	12.250	0.645	0.901	5yr
0.080	15.217	14.500	0.763	0.953	10yr
0.089	16.992	17.110	0.901	1.007	25yr
0.096	18.183	18.940	0.997	1.042	50yr
0.101	19.281	20.680	1.088	1.073	100yr

APPENDIX B - STORM WATER ANALYSIS

DYMAR

2 YEAR STORM

Hydrograph 2-yr Summary

Project Name: Belta Final

Hydrology Studio v 3.0.0.14

05-07-2020

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DA A	17.56	12.48	107,187	----		
2	NRCS Runoff	Post A-Non-Det	9.948	12.58	68,460	----		
3	NRCS Runoff	Post DA B	8.418	12.33	42,843	----		
4	Pond Route	Post Detention	7.379	12.48	42,839	3	160.10	5,786
5	Junction	Post A.P. #1	17.09	12.52	111,299	2, 4		
6	NRCS Runoff	Pre DA C	9.277	12.08	28,576	----		
7	NRCS Runoff	Post DA C	5.953	12.08	18,344	----		

Hydrograph Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

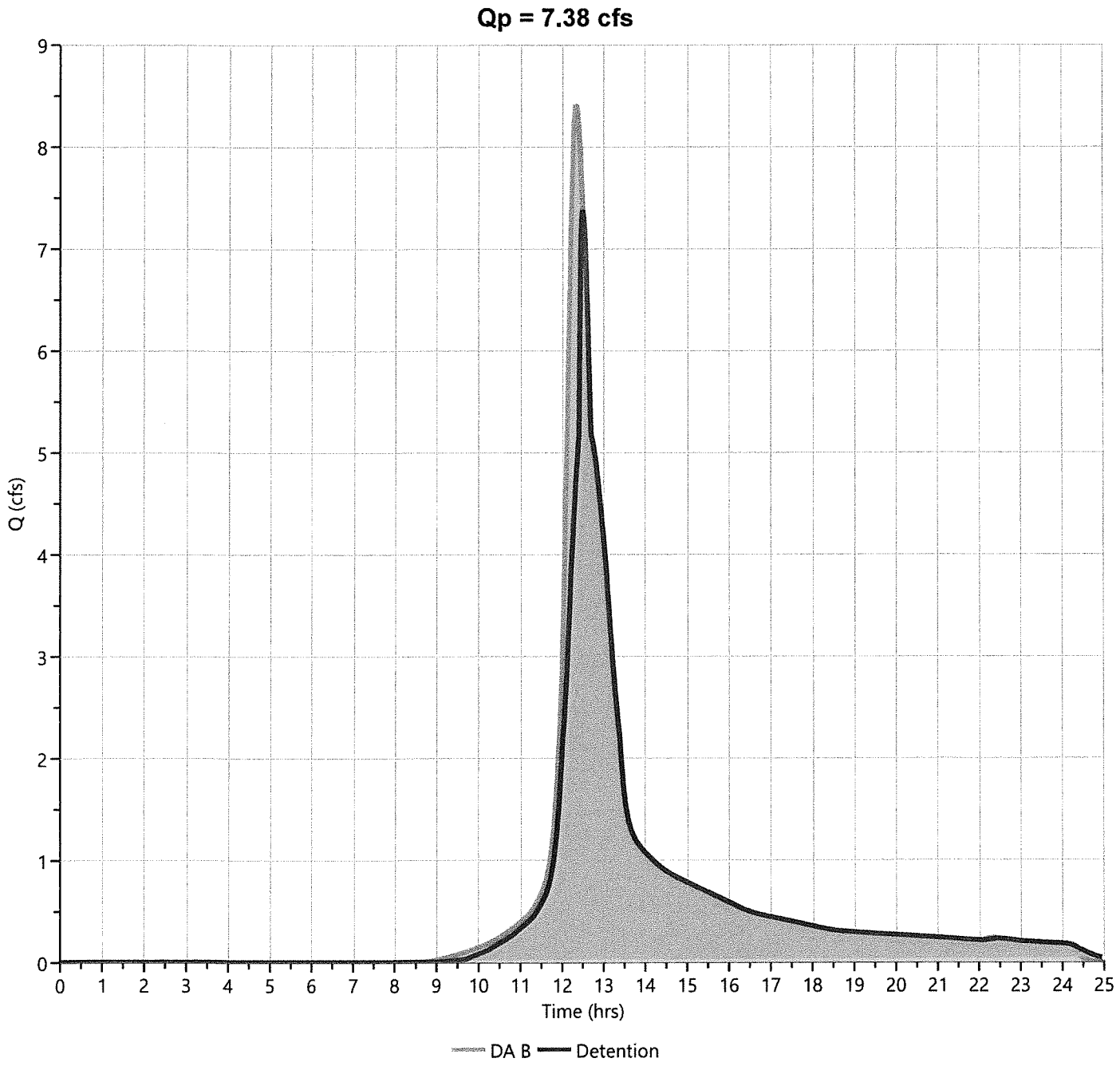
Post Detention

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 7.379 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.48 hrs
Time Interval	= 1 min	Hydrograph Volume	= 42,839 cuft
Inflow Hydrograph	= 3 - DA B	Max. Elevation	= 160.10 ft
Pond Name	= Detention	Max. Storage	= 5,786 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 14 min



Hydrograph Report

Project Name: Belta Trial

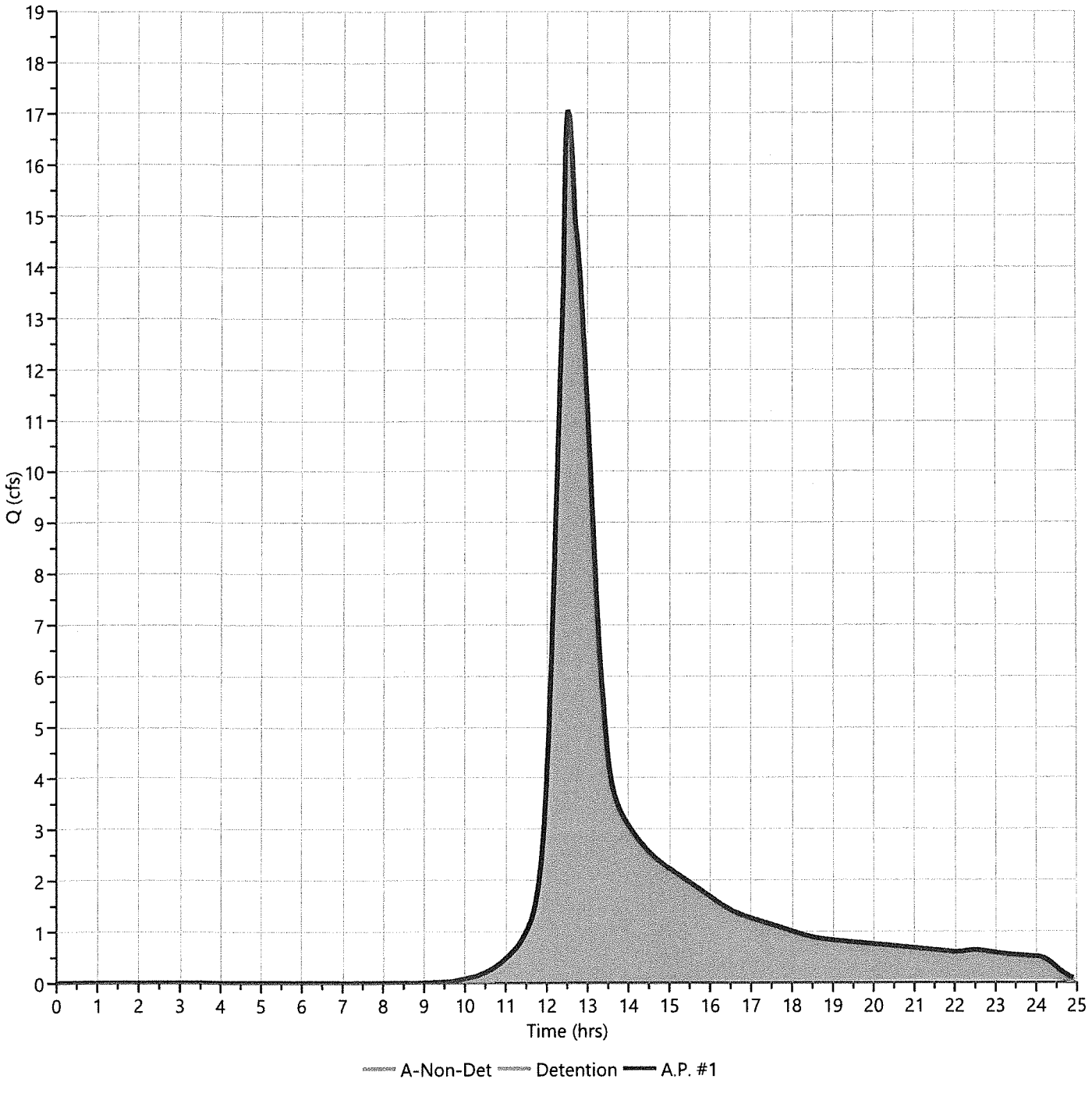
Hydrology Studio v 3.0.0.14

03-31-2020

Post A.P. #1

Hyd. No. 5

Hydrograph Type	= Junction	Peak Flow	= 17.09 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.52 hrs
Time Interval	= 1 min	Hydrograph Volume	= 111,299 cuft
Inflow Hydrographs	= 2, 4	Total Contrib. Area	= 14.55 ac



Hydrograph Report

Project Name: Belta Final

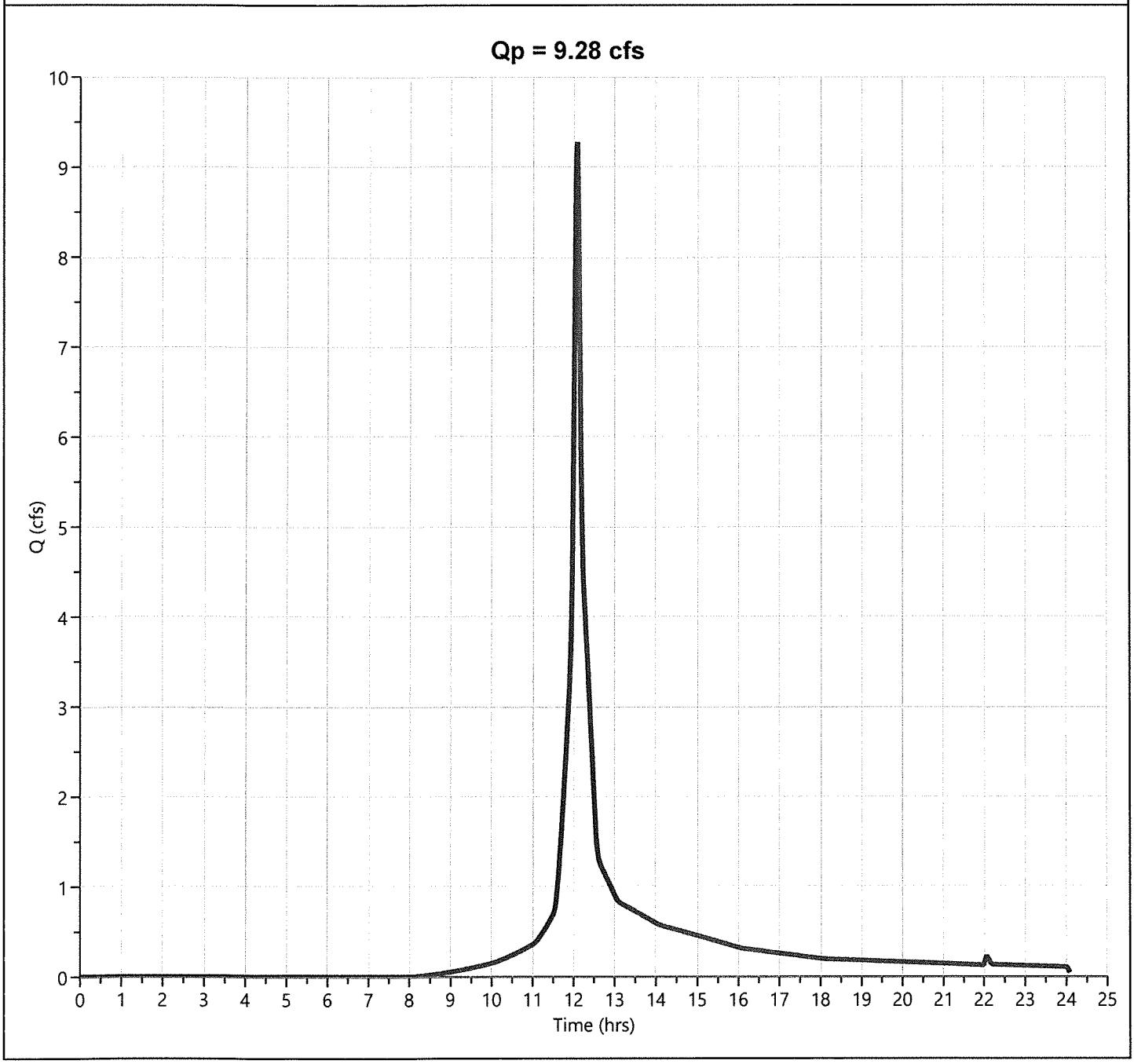
Hydrology Studio v 3.0.0.14

05-07-2020

Pre DA C

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 9.277 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.08 hrs
Time Interval	= 1 min	Runoff Volume	= 28,576 cuft
Drainage Area	= 4.04 ac	Curve Number	= 83.4
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 3.50 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name: Belta Final

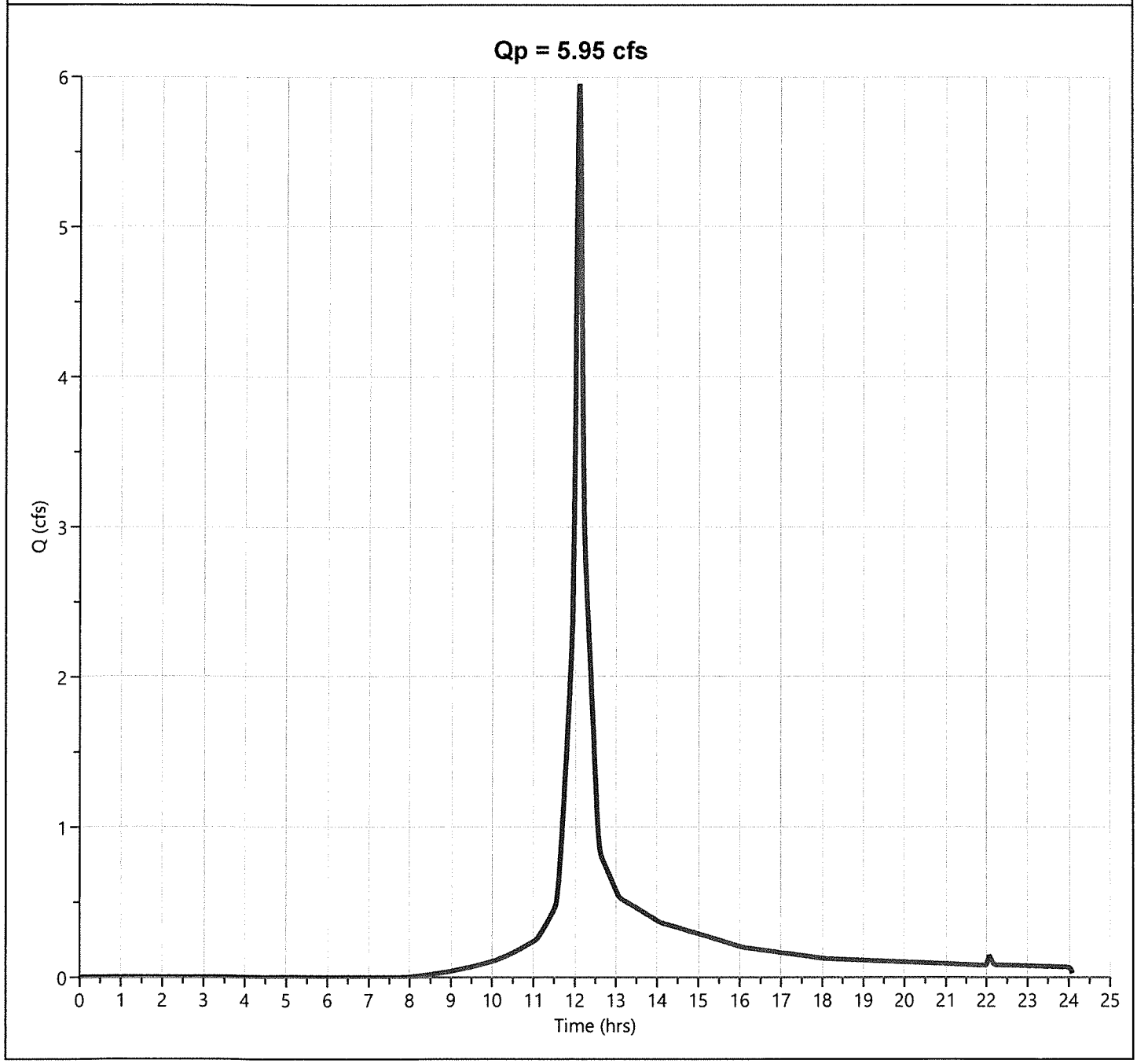
Hydrology Studio v 3.0.0.14

05-07-2020

Post DA C

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 5.953 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.08 hrs
Time Interval	= 1 min	Runoff Volume	= 18,344 cuft
Drainage Area	= 2.51 ac	Curve Number	= 84.2
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 3.50 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



DYMAR

5 YEAR STORM

Hydrograph 5-yr Summary

Project Name: Belta Final

Hydrology Studio v 3.0.0.14

05-07-2020

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DA A	27.56	12.47	165,904	----		
2	NRCS Runoff	Post A-Non-Det	16.26	12.57	109,065	----		
3	NRCS Runoff	Post DA B	12.61	12.32	63,988	----		
4	Pond Route	Post Detention	12.25	12.38	63,984	3	160.34	6,532
5	Junction	Post A.P. #1	27.37	12.48	173,049	2, 4		
6	NRCS Runoff	Pre DA C	13.63	12.08	42,173	----		
7	NRCS Runoff	Post DA C	8.671	12.08	26,892	----		

Hydrograph Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

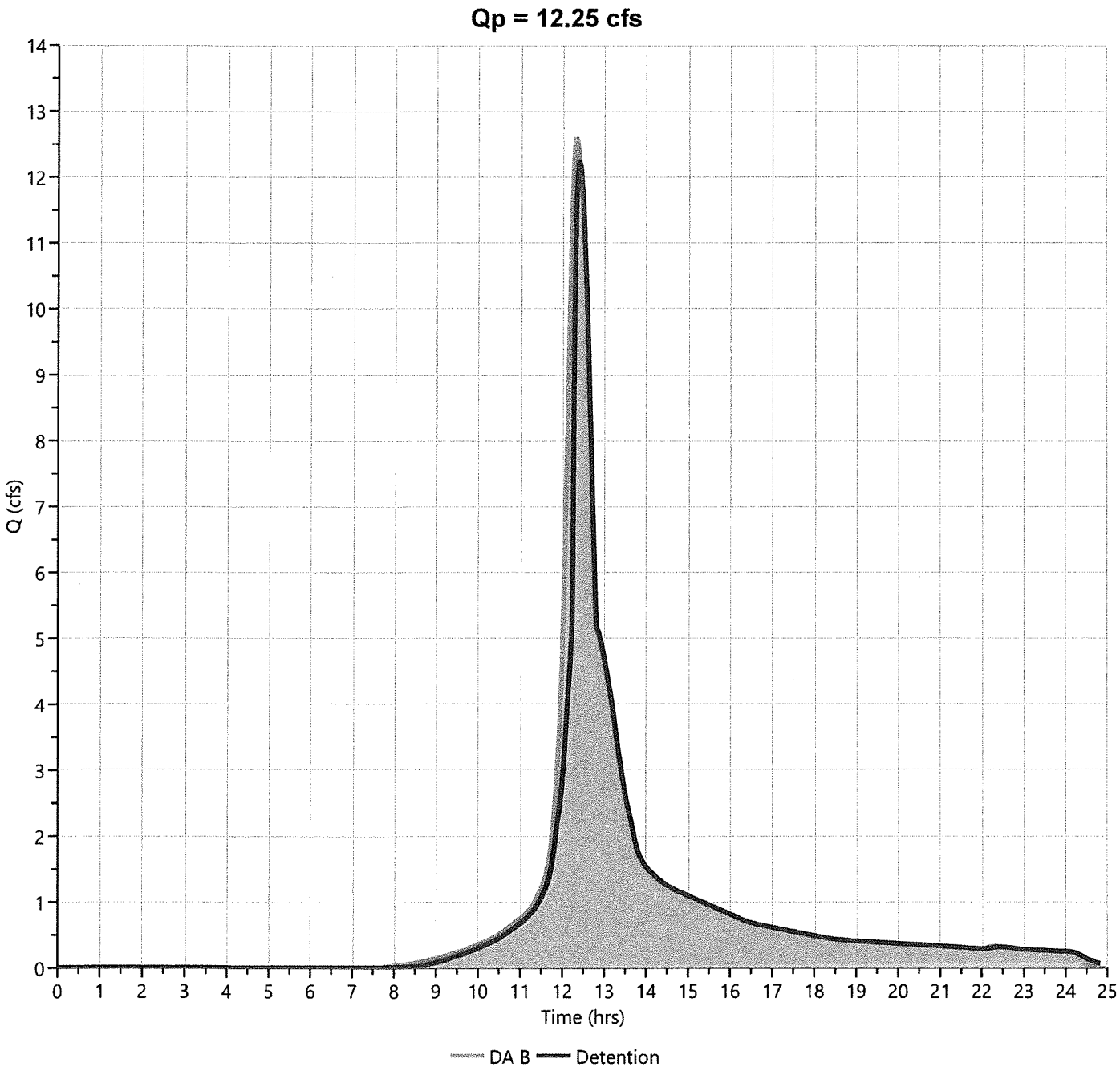
Post Detention

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 12.25 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.38 hrs
Time Interval	= 1 min	Hydrograph Volume	= 63,984 cuft
Inflow Hydrograph	= 3 - DA B	Max. Elevation	= 160.34 ft
Pond Name	= Detention	Max. Storage	= 6,532 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 12 min



Hydrograph Report

Project Name: Belta Trial

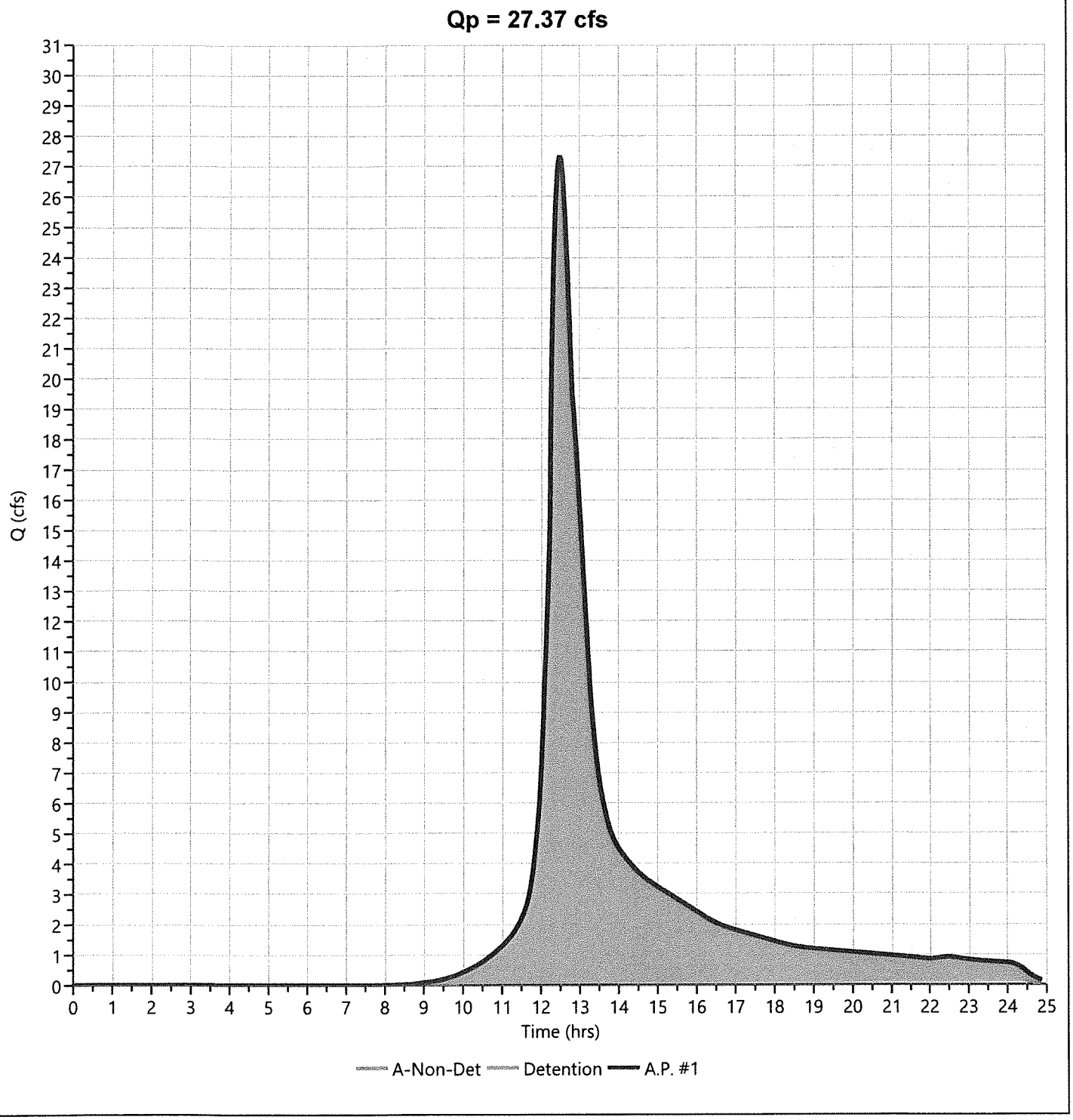
Hydrology Studio v 3.0.0.14

03-31-2020

Post A.P. #1

Hyd. No. 5

Hydrograph Type	= Junction	Peak Flow	= 27.37 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.48 hrs
Time Interval	= 1 min	Hydrograph Volume	= 173,049 cuft
Inflow Hydrographs	= 2, 4	Total Contrib. Area	= 14.55 ac



Hydrograph Report

Project Name: Belta Final

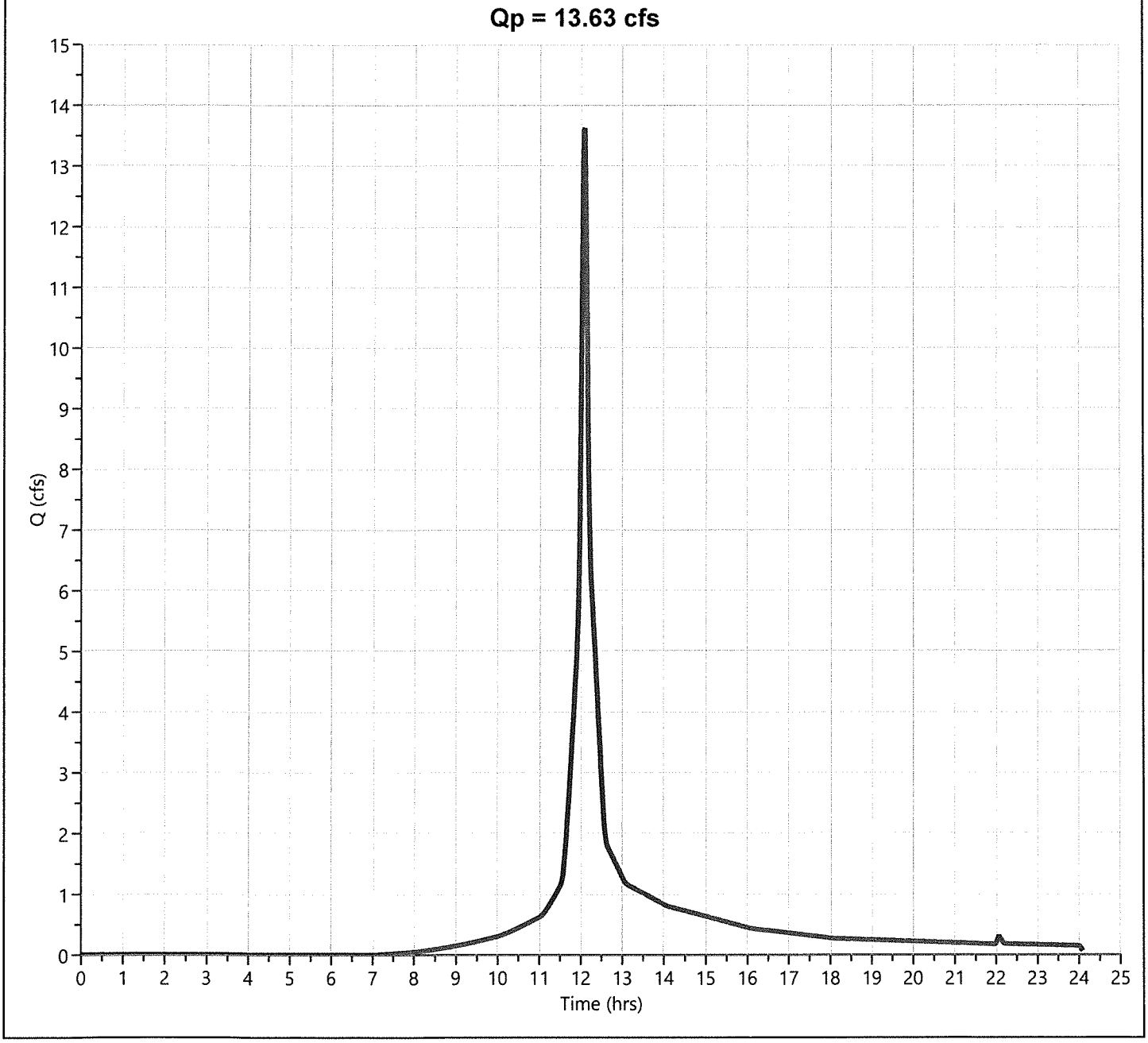
Hydrology Studio v 3.0.0.14

05-07-2020

Pre DA C

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 13.63 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.08 hrs
Time Interval	= 1 min	Runoff Volume	= 42,173 cuft
Drainage Area	= 4.04 ac	Curve Number	= 83.4
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 4.53 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name: Belta Final

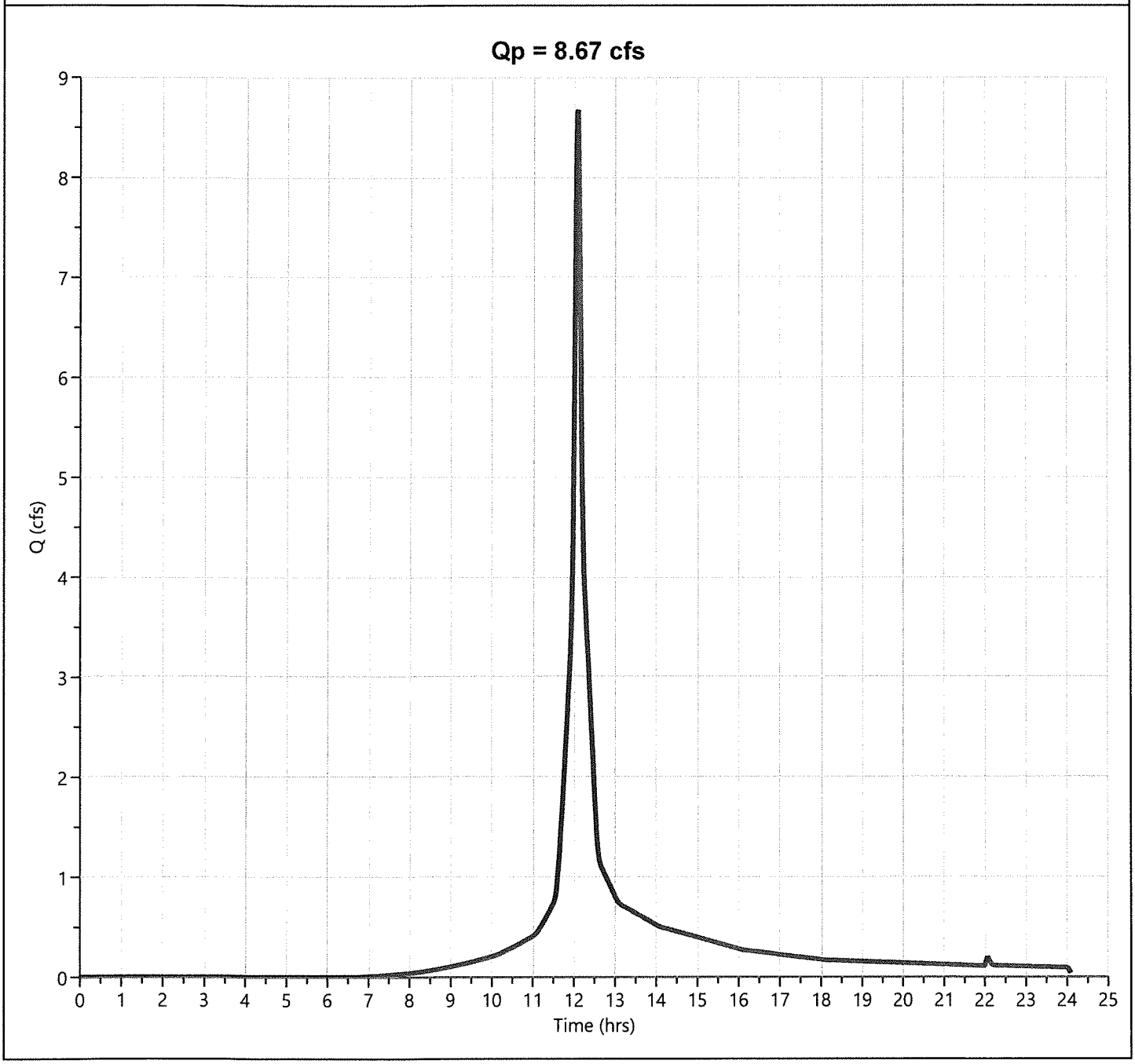
Hydrology Studio v 3.0.0.14

05-07-2020

Post DA C

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 8.671 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.08 hrs
Time Interval	= 1 min	Runoff Volume	= 26,892 cuft
Drainage Area	= 2.51 ac	Curve Number	= 84.2
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 4.53 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



DYMAR

10 YEAR STORM

Hydrograph 10-yr Summary

Project Name: Belta Final

Hydrology Studio v 3.0.0.14

05-07-2020

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DA A	36.22	12.45	217,410	----		
2	NRCS Runoff	Post A-Non-Det	21.82	12.55	145,189	----		
3	NRCS Runoff	Post DA B	16.16	12.32	82,223	----		
4	Pond Route	Post Detention	14.50	12.45	82,218	3	160.75	7,846
5	Junction	Post A.P. #1	36.12	12.53	227,407	2, 4		
6	NRCS Runoff	Pre DA C	17.27	12.08	53,835	----		
7	NRCS Runoff	Post DA C	10.94	12.08	34,201	----		

Hydrograph Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

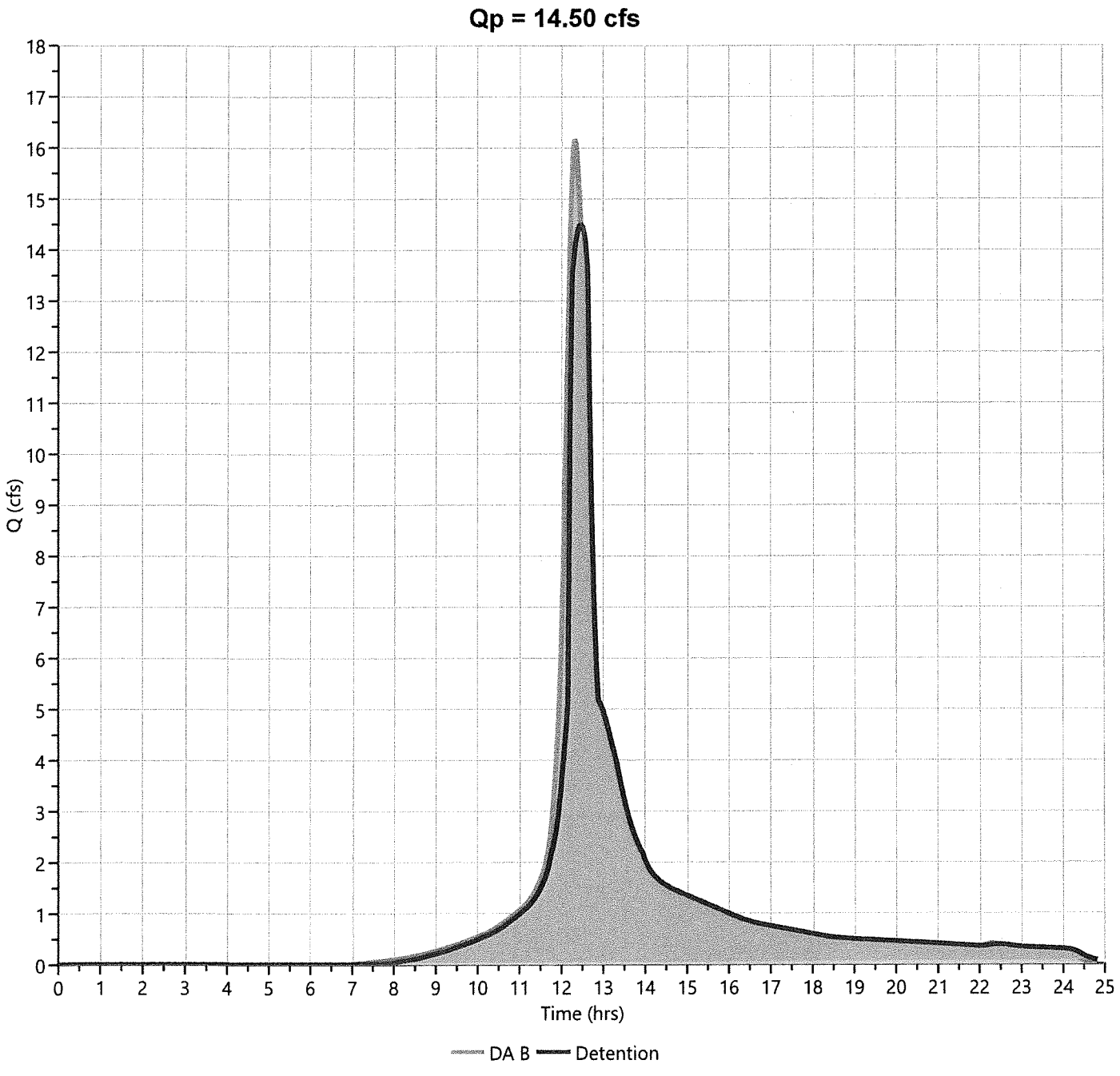
Post Detention

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 14.50 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.45 hrs
Time Interval	= 1 min	Hydrograph Volume	= 82,218 cuft
Inflow Hydrograph	= 3 - DA B	Max. Elevation	= 160.75 ft
Pond Name	= Detention	Max. Storage	= 7,846 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 11 min



Hydrograph Report

Project Name: Belta Trial

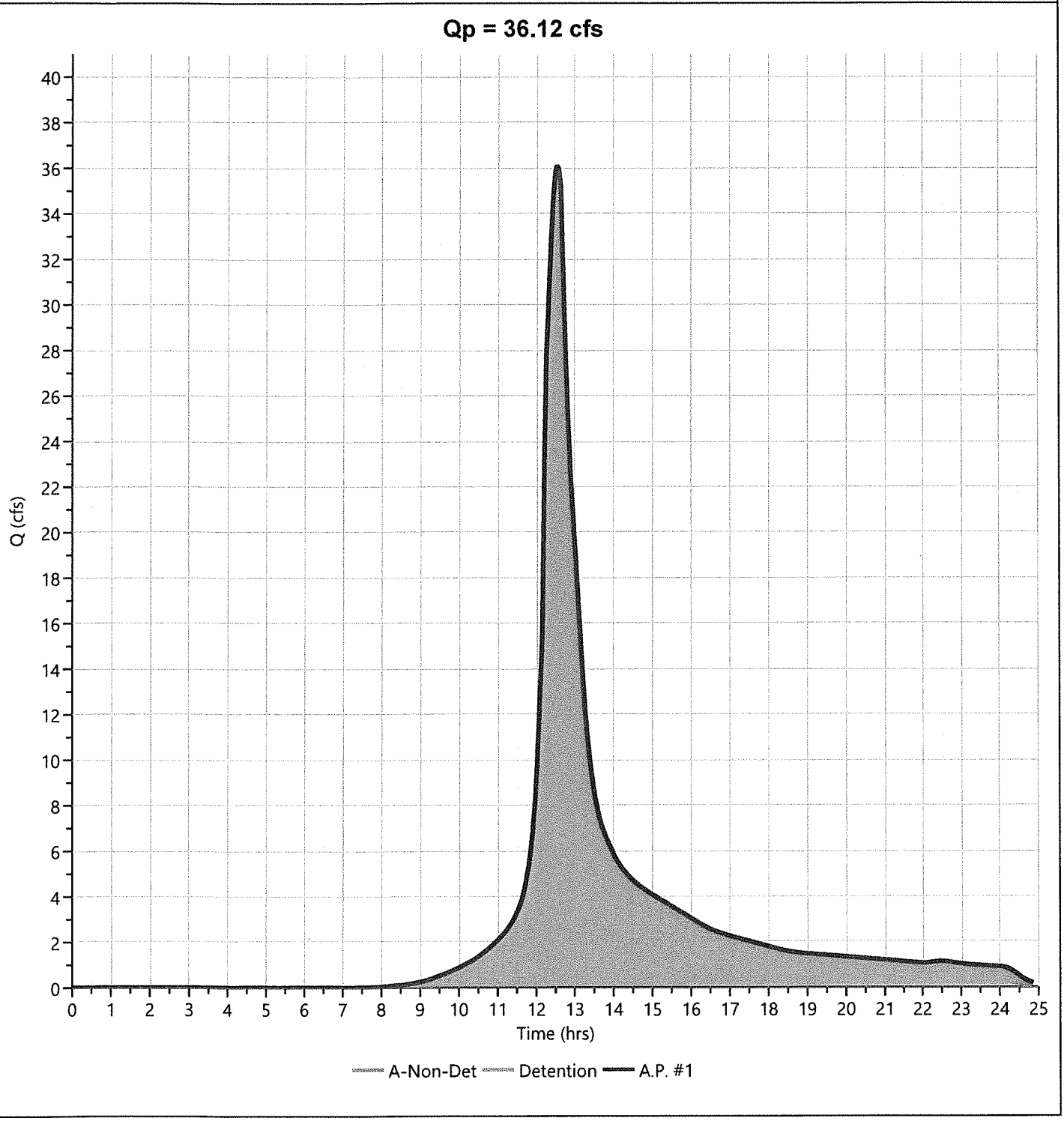
Hydrology Studio v 3.0.0.14

03-31-2020

Post A.P. #1

Hyd. No. 5

Hydrograph Type	= Junction	Peak Flow	= 36.12 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.53 hrs
Time Interval	= 1 min	Hydrograph Volume	= 227,407 cuft
Inflow Hydrographs	= 2, 4	Total Contrib. Area	= 14.55 ac



Hydrograph Report

Project Name: Belta Final

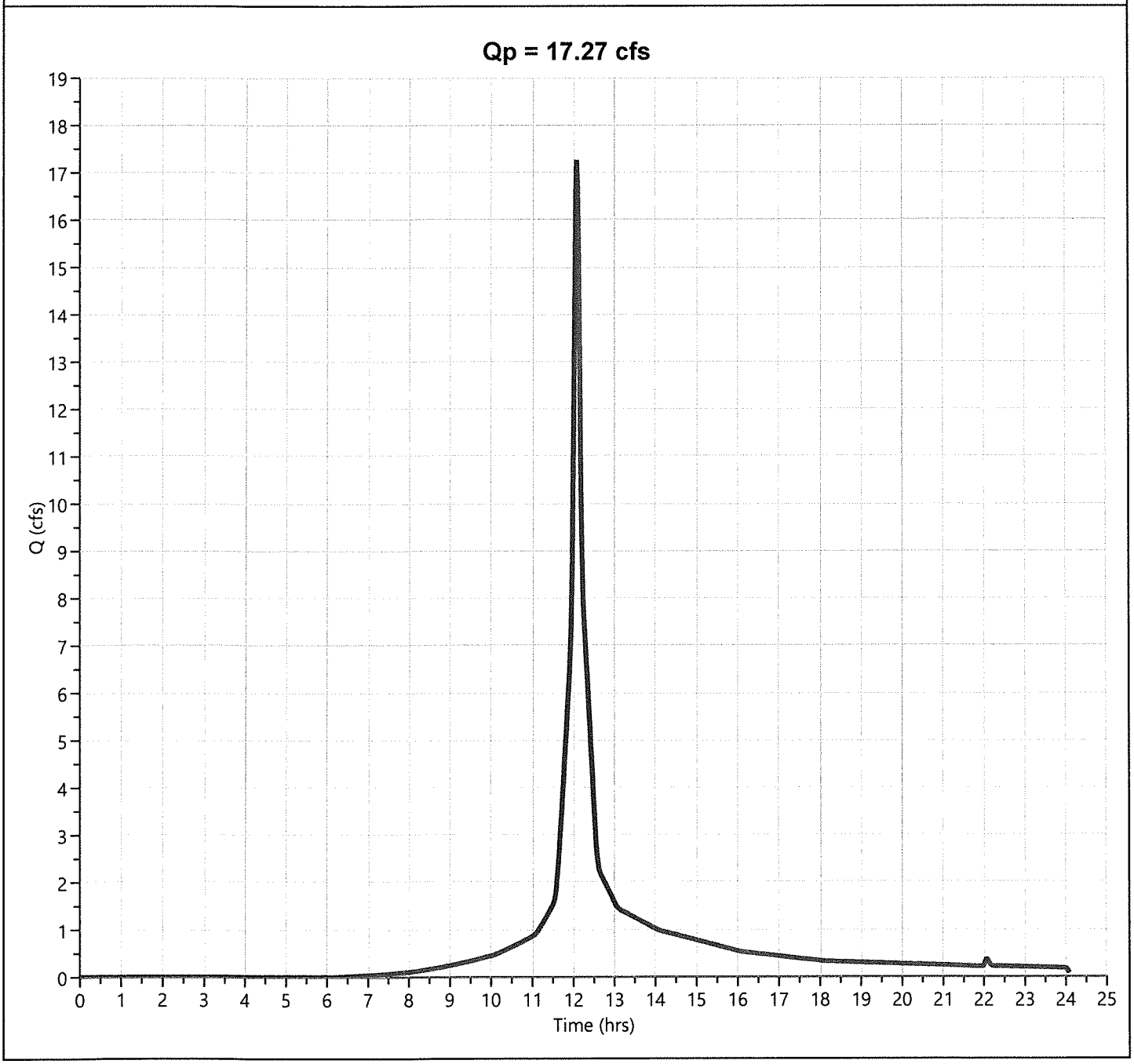
Hydrology Studio v 3.0.0.14

05-07-2020

Pre DA C

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 17.27 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.08 hrs
Time Interval	= 1 min	Runoff Volume	= 53,835 cuft
Drainage Area	= 4.04 ac	Curve Number	= 83.4
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 5.38 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name: Belta Final

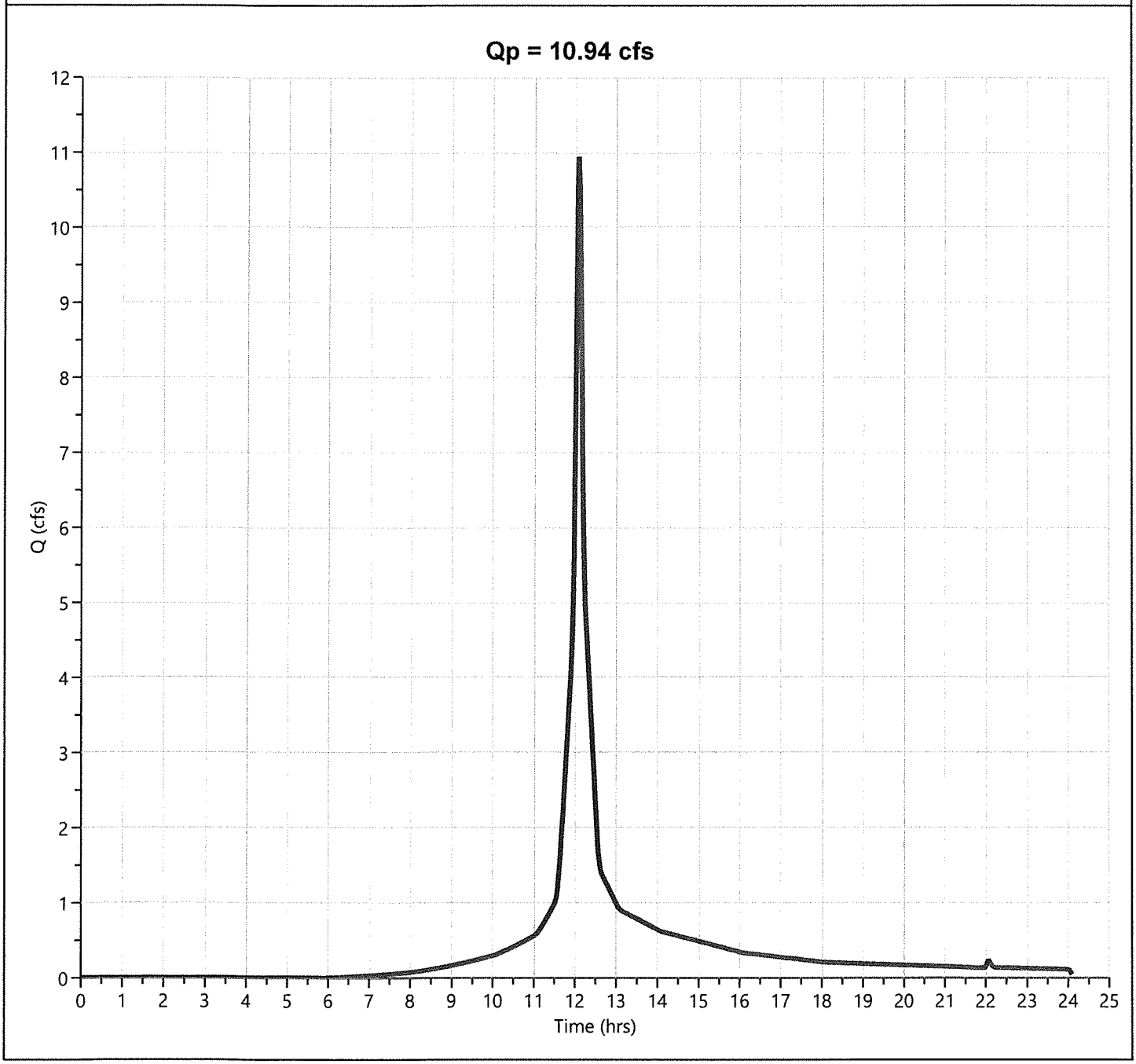
Hydrology Studio v 3.0.0.14

05-07-2020

Post DA C

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 10.94 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.08 hrs
Time Interval	= 1 min	Runoff Volume	= 34,201 cuft
Drainage Area	= 2.51 ac	Curve Number	= 84.2
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 5.38 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



DYMAR

25 YEAR STORM

Hydrograph 25-yr Summary

Project Name: Belta Final

Hydrology Studio v 3.0.0.14

05-07-2020

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DA A	48.48	12.45	291,255	----		
2	NRCS Runoff	Post A-Non-Det	29.78	12.55	197,500	----		
3	NRCS Runoff	Post DA B	21.10	12.32	108,057	----		
4	Pond Route	Post Detention	17.11	12.52	108,052	3	161.93	11,590
5	Junction	Post A.P. #1	46.86	12.53	305,552	2, 4		
6	NRCS Runoff	Pre DA C	22.35	12.07	70,295	----		
7	NRCS Runoff	Post DA C	14.10	12.07	44,496	----		

Hydrograph Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

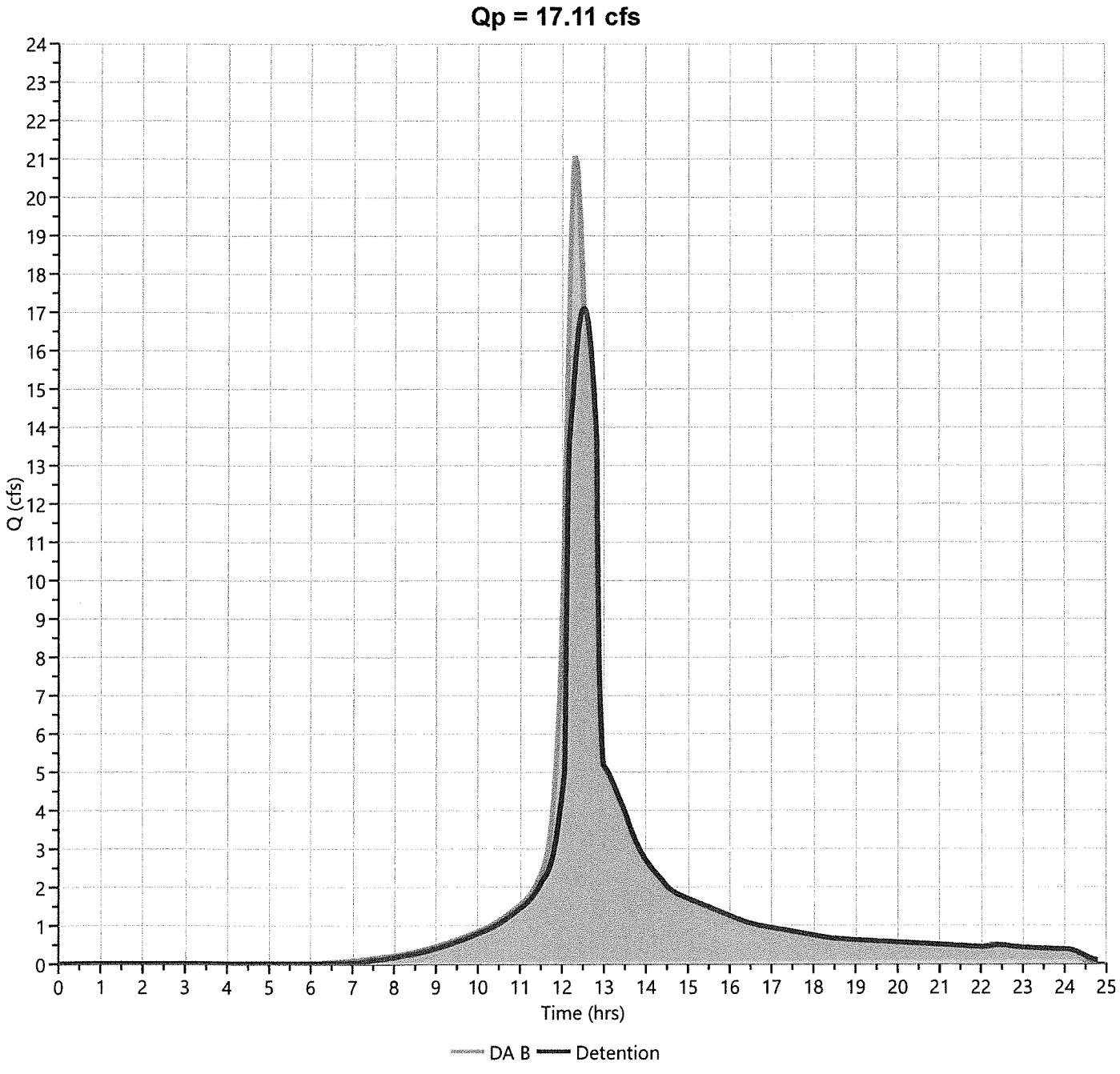
Post Detention

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 17.11 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.52 hrs
Time Interval	= 1 min	Hydrograph Volume	= 108,052 cuft
Inflow Hydrograph	= 3 - DA B	Max. Elevation	= 161.93 ft
Pond Name	= Detention	Max. Storage	= 11,590 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 11 min



Hydrograph Report

Project Name: Belta Trial

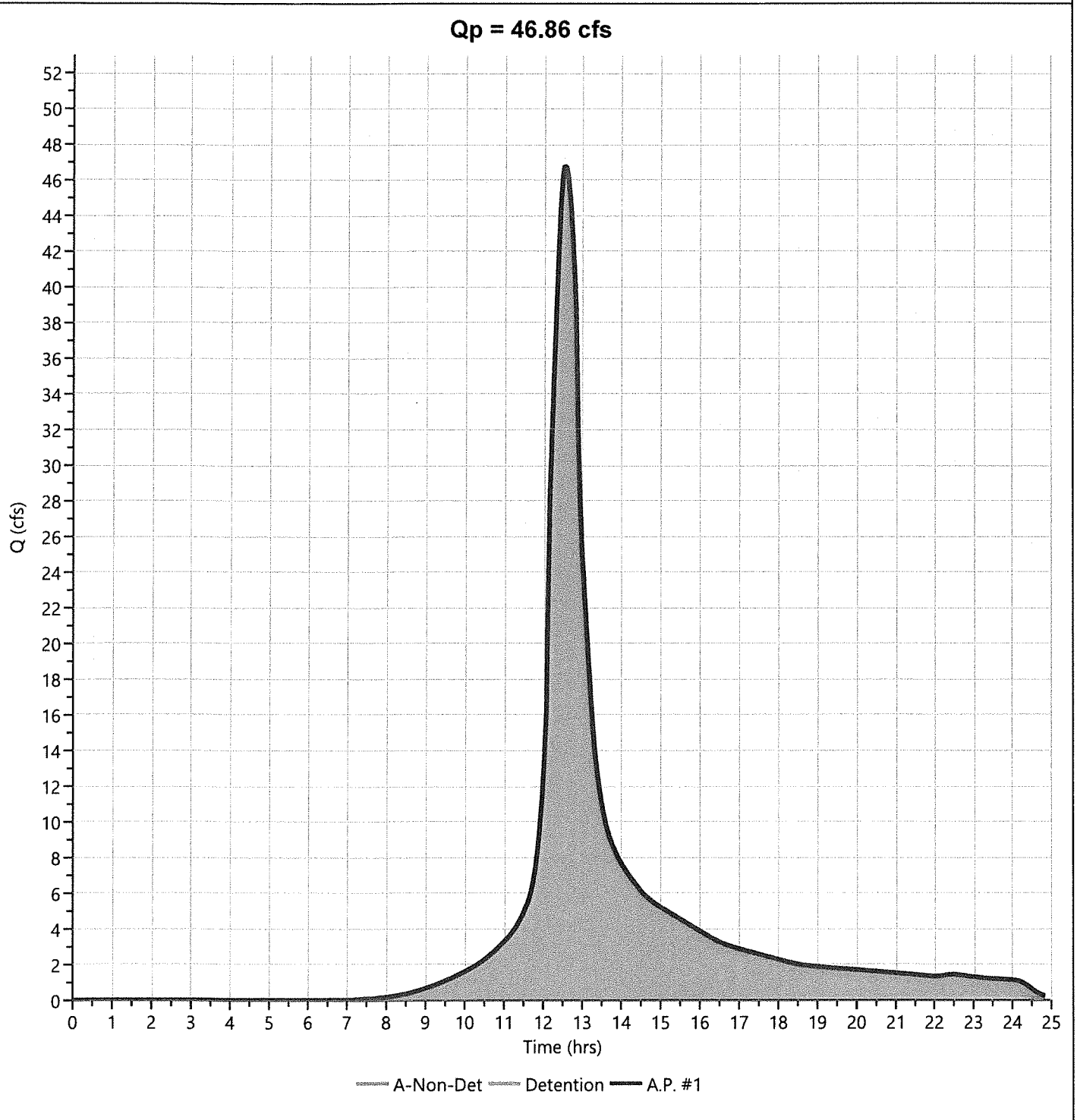
Hydrology Studio v 3.0.0.14

03-31-2020

Post A.P. #1

Hyd. No. 5

Hydrograph Type	= Junction	Peak Flow	= 46.86 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.53 hrs
Time Interval	= 1 min	Hydrograph Volume	= 305,552 cuft
Inflow Hydrographs	= 2, 4	Total Contrib. Area	= 14.55 ac



Hydrograph Report

Project Name: Belta Final

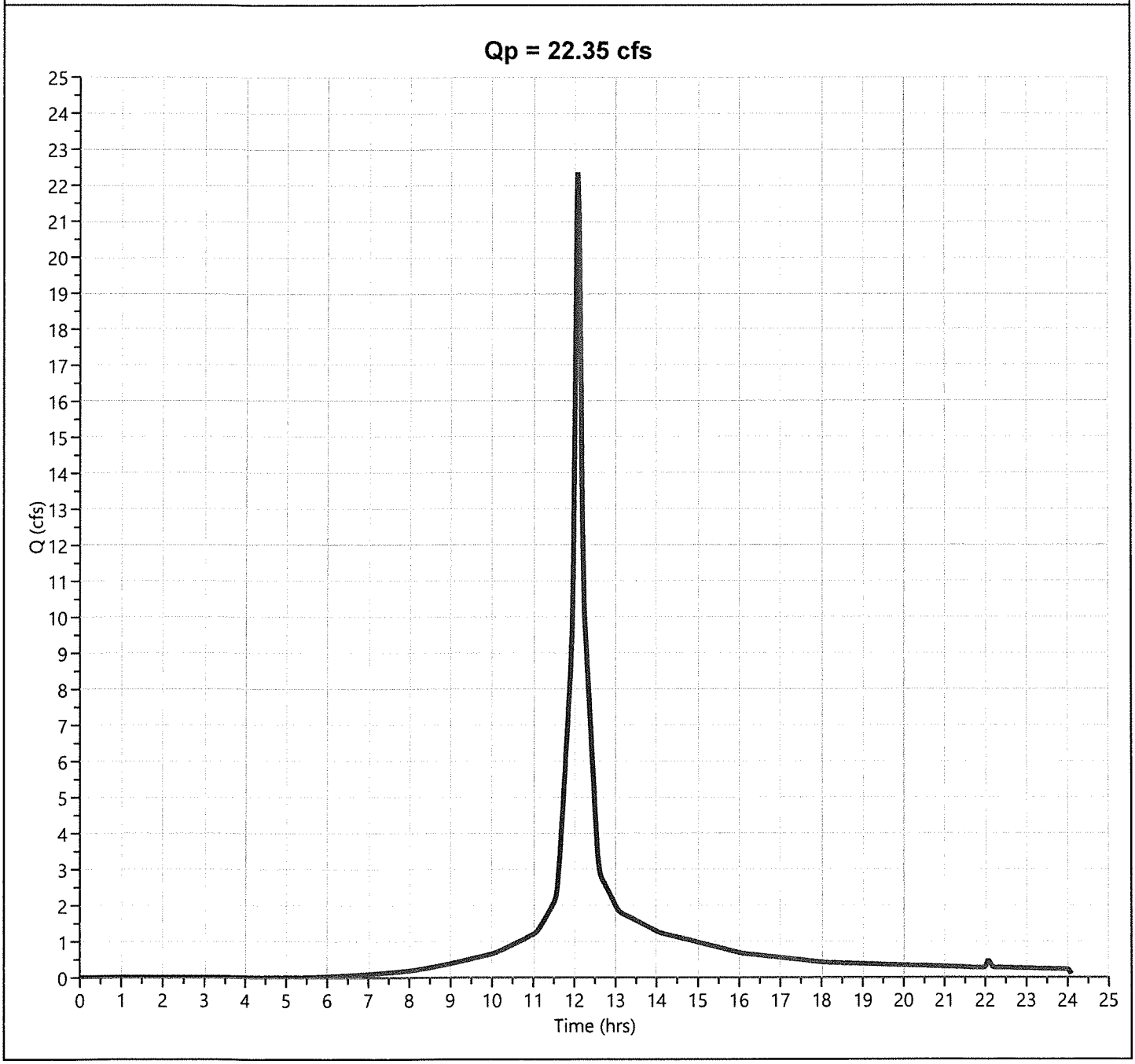
Hydrology Studio v 3.0.0.14

05-07-2020

Pre DA C

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 22.35 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.07 hrs
Time Interval	= 1 min	Runoff Volume	= 70,295 cuft
Drainage Area	= 4.04 ac	Curve Number	= 83.4
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 6.55 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name: Belta Final

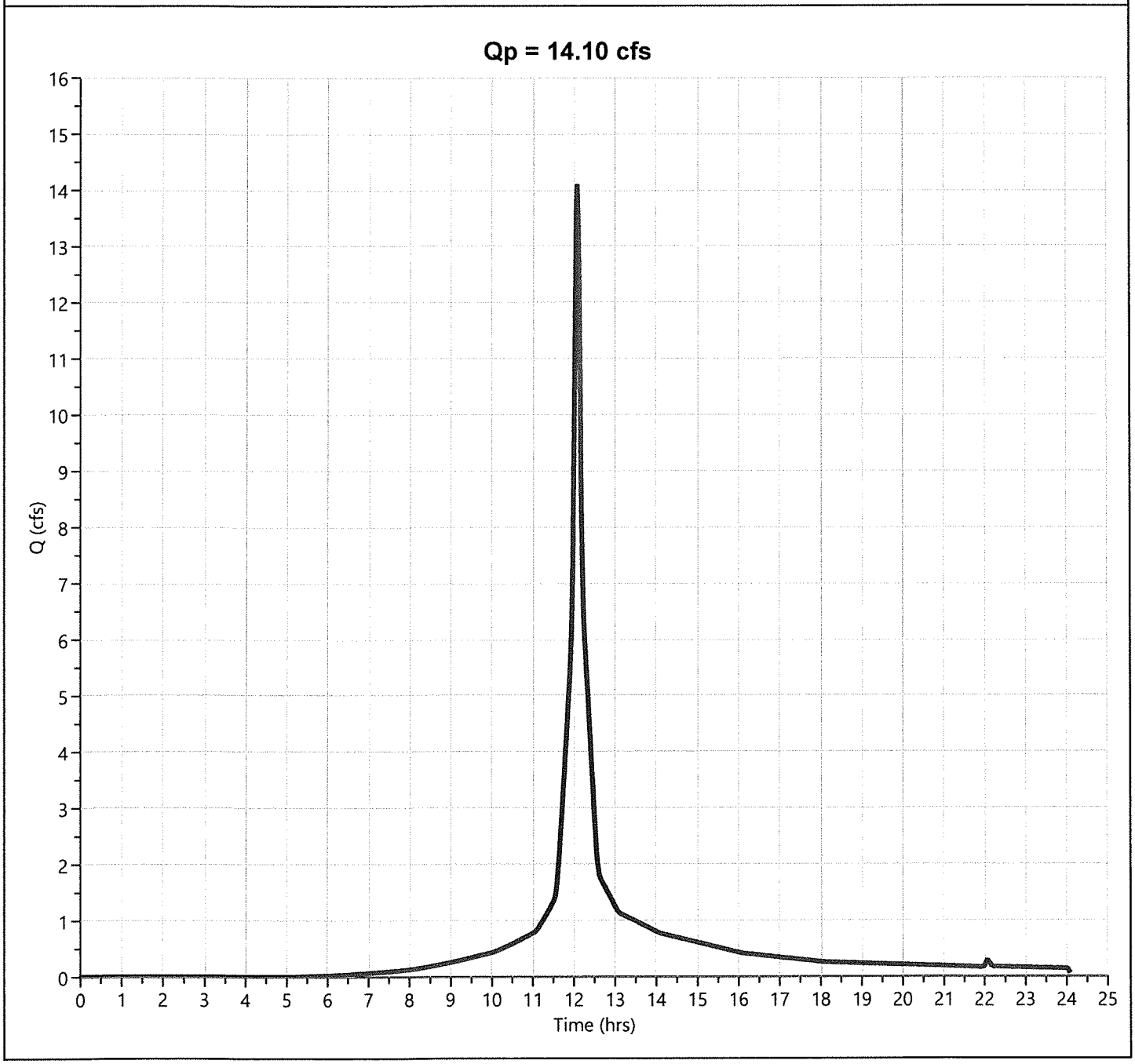
Hydrology Studio v 3.0.0.14

05-07-2020

Post DA C

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 14.10 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.07 hrs
Time Interval	= 1 min	Runoff Volume	= 44,496 cuft
Drainage Area	= 2.51 ac	Curve Number	= 84.2
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 6.55 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



DYMAR

50 YEAR STORM

Hydrograph 50-yr Summary

Project Name: Belta Final

Hydrology Studio v 3.0.0.14

05-07-2020

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DA A	57.72	12.45	347,719	----		
2	NRCS Runoff	Post A-Non-Det	35.84	12.53	237,784	----		
3	NRCS Runoff	Post DA B	24.79	12.32	127,644	----		
4	Pond Route	Post Detention	18.94	12.53	127,640	3	162.72	14,983
5	Junction	Post A.P. #1	54.78	12.53	365,423	2, 4		
6	NRCS Runoff	Pre DA C	26.13	12.07	82,742	----		
7	NRCS Runoff	Post DA C	16.45	12.07	52,269	----		

Hydrograph Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

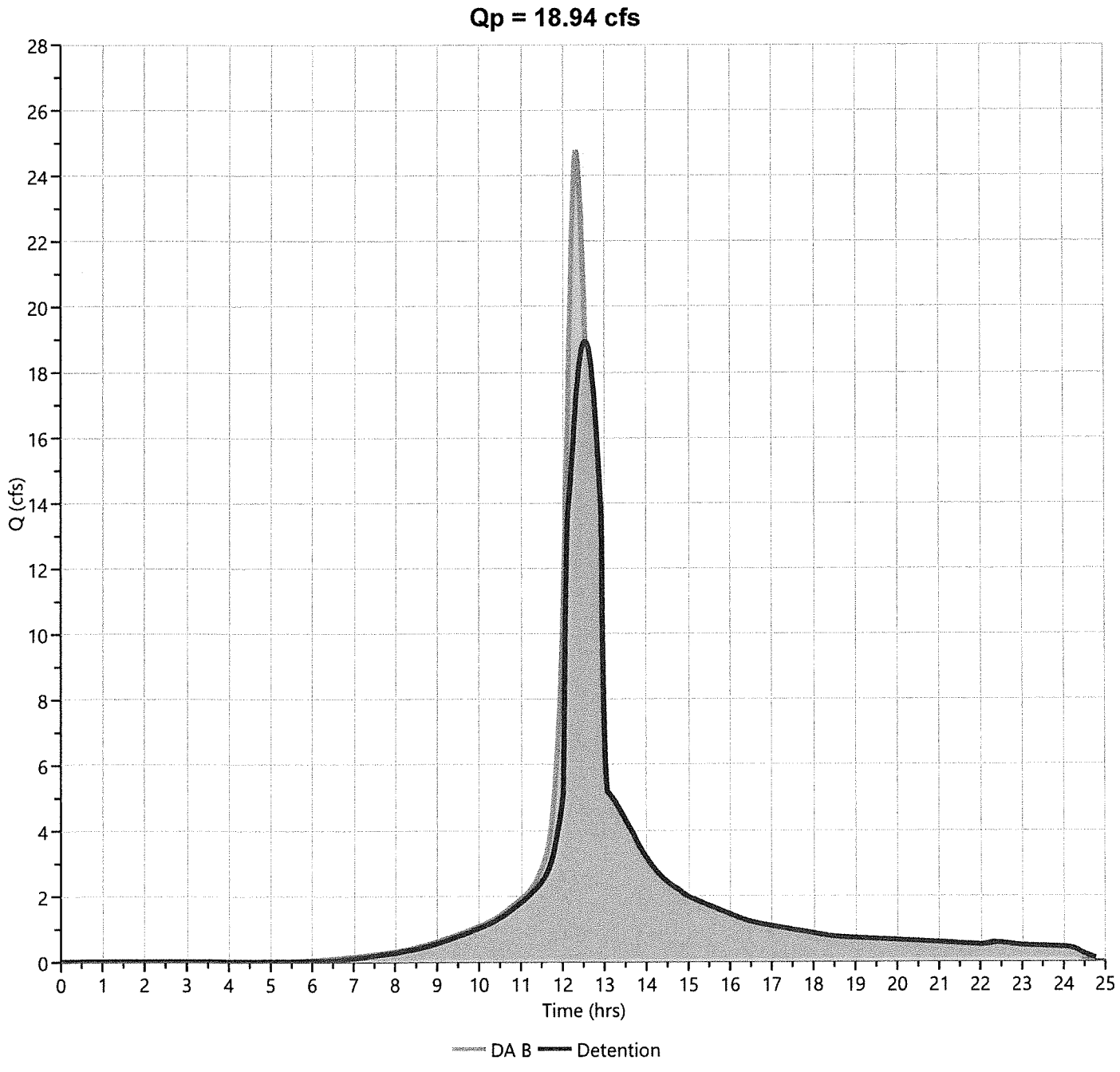
Post Detention

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 18.94 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.53 hrs
Time Interval	= 1 min	Hydrograph Volume	= 127,640 cuft
Inflow Hydrograph	= 3 - DA B	Max. Elevation	= 162.72 ft
Pond Name	= Detention	Max. Storage	= 14,983 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 12 min



Hydrograph Report

Project Name: Belta Trial

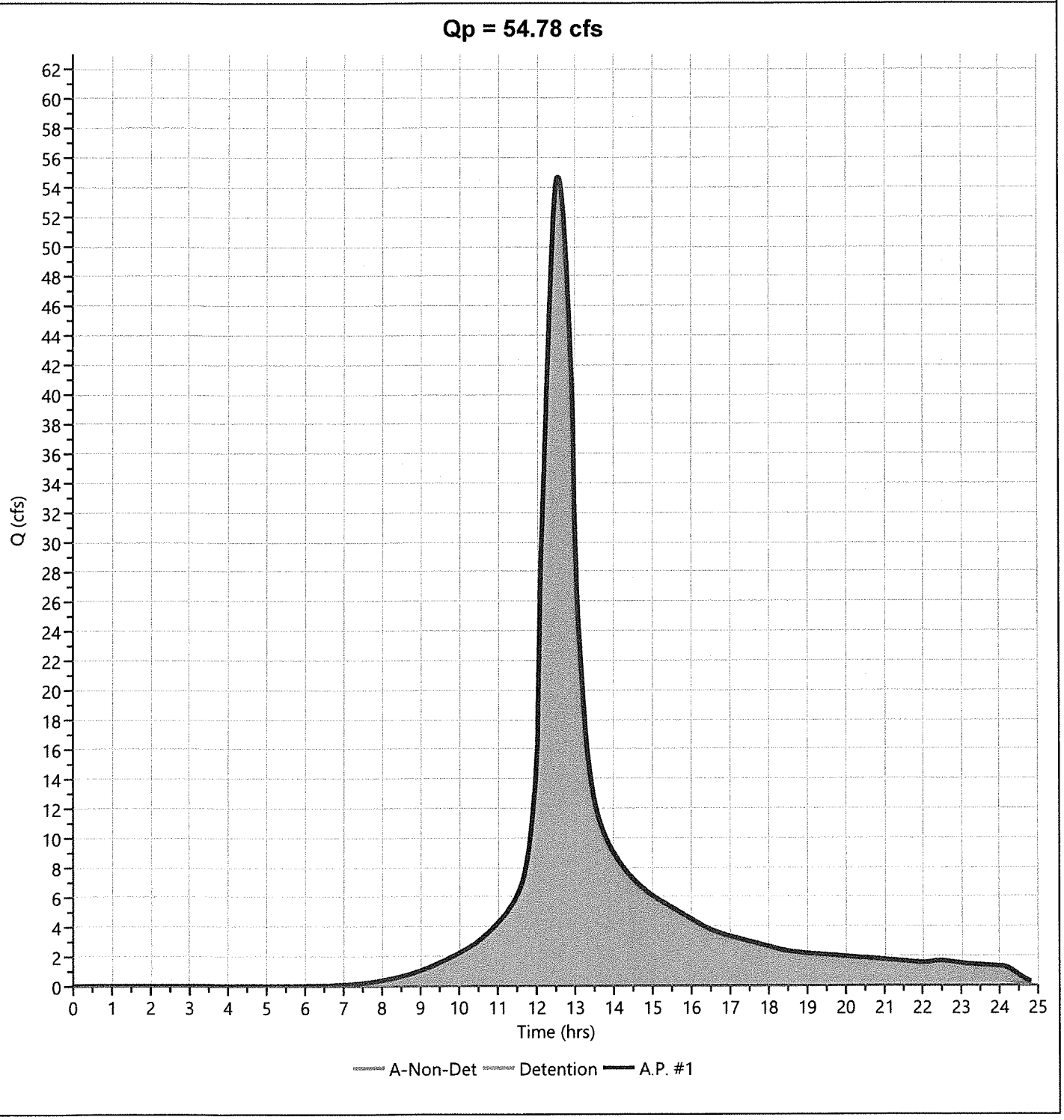
Hydrology Studio v 3.0.0.14

03-31-2020

Post A.P. #1

Hyd. No. 5

Hydrograph Type	= Junction	Peak Flow	= 54.78 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.53 hrs
Time Interval	= 1 min	Hydrograph Volume	= 365,423 cuft
Inflow Hydrographs	= 2, 4	Total Contrib. Area	= 14.55 ac



Hydrograph Report

Project Name: Belta Final

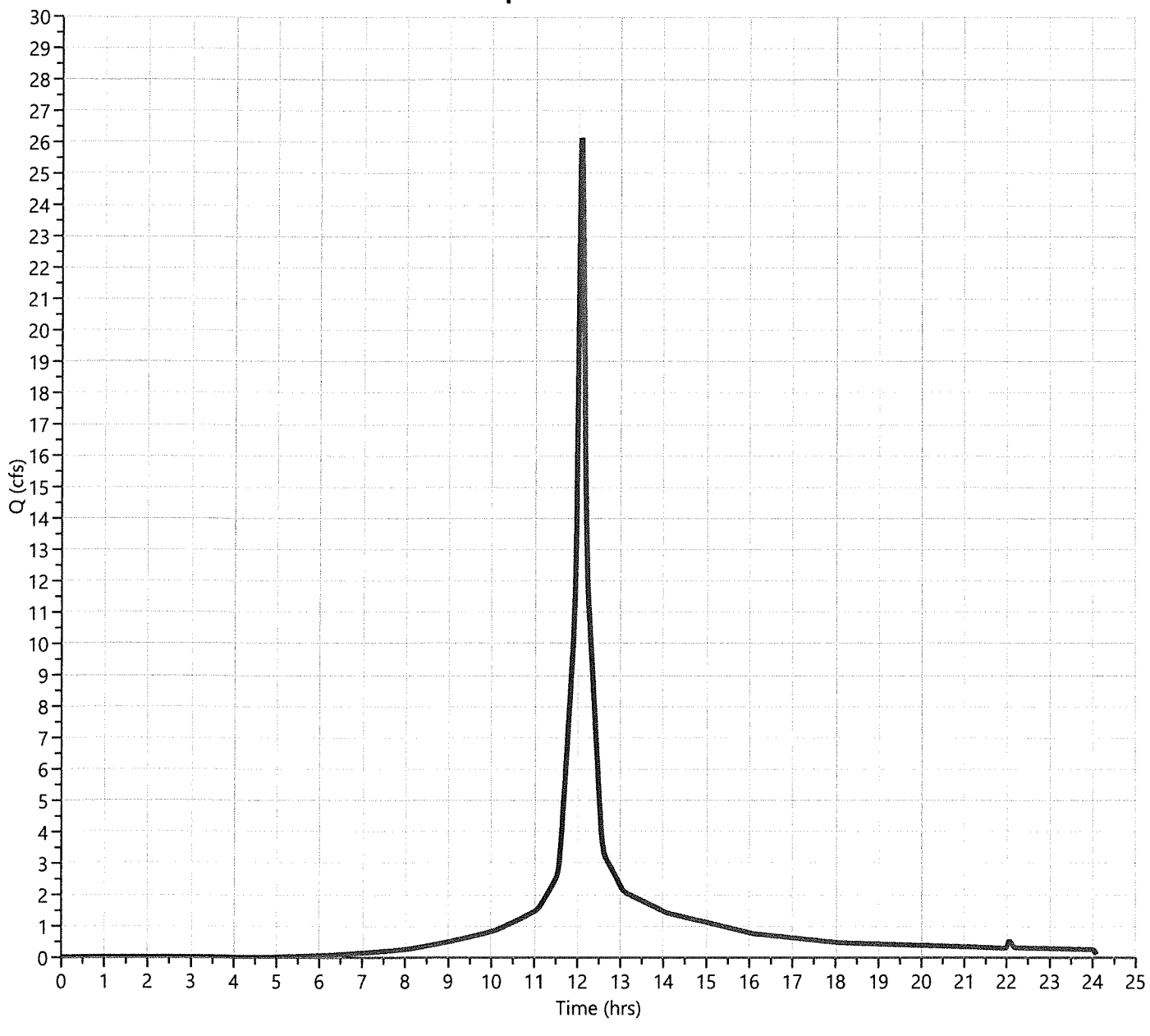
Hydrology Studio v 3.0.0.14

05-07-2020

Pre DA C

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 26.13 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.07 hrs
Time Interval	= 1 min	Runoff Volume	= 82,742 cuft
Drainage Area	= 4.04 ac	Curve Number	= 83.4
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 7.42 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name: Belta Final

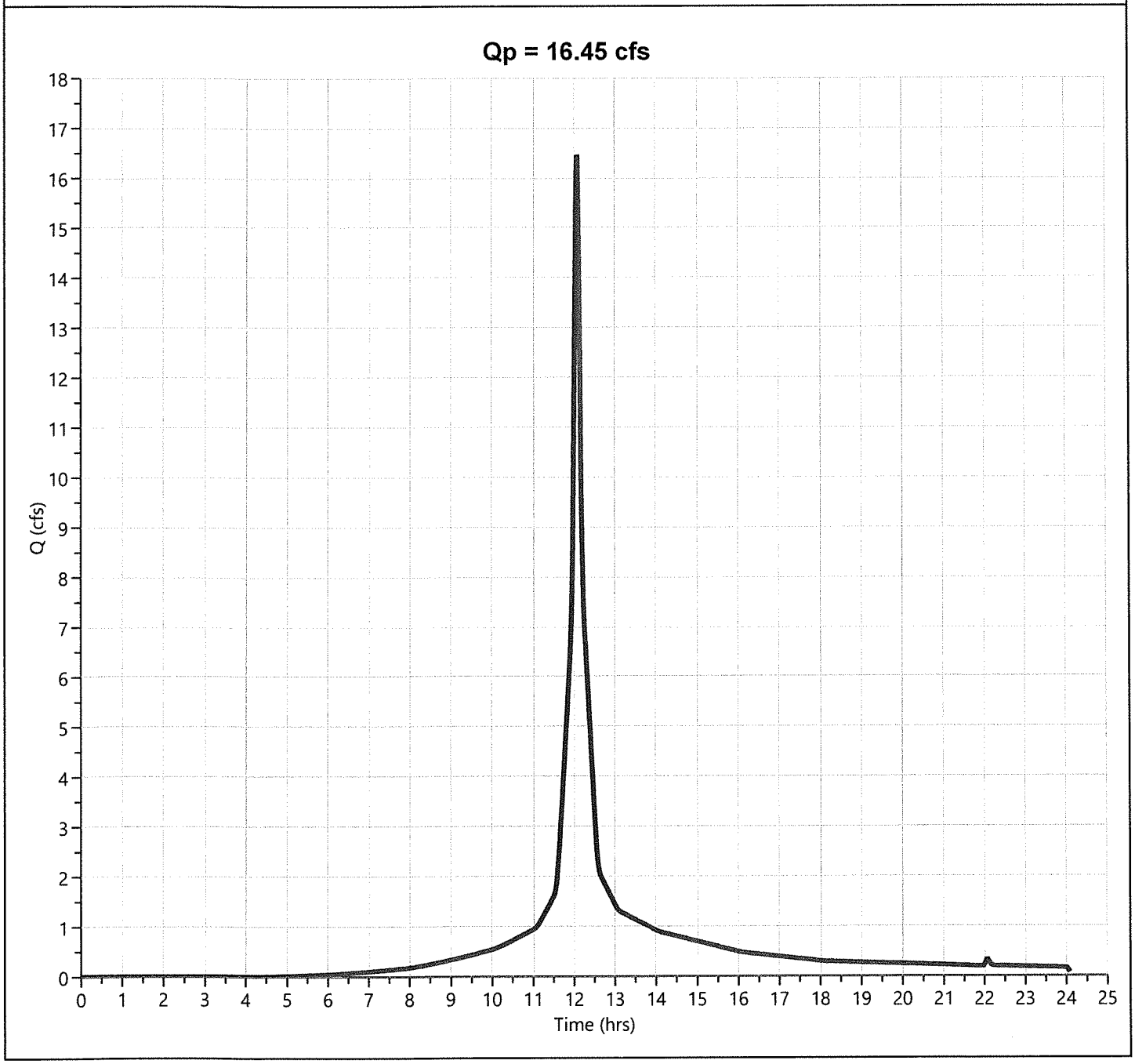
Hydrology Studio v 3.0.0.14

05-07-2020

Post DA C

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 16.45 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.07 hrs
Time Interval	= 1 min	Runoff Volume	= 52,269 cuft
Drainage Area	= 2.51 ac	Curve Number	= 84.2
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 7.42 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



DYMAR

100 YEAR STORM

Hydrograph 100-yr Summary

Project Name: Belta Final

Hydrology Studio v 3.0.0.14

05-07-2020

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DA A	67.66	12.45	409,131	----		
2	NRCS Runoff	Post A-Non-Det	42.40	12.53	281,801	----		
3	NRCS Runoff	Post DA B	28.74	12.32	148,835	----		
4	Pond Route	Post Detention	20.68	12.57	148,830	3	163.66	19,111
5	Junction	Post A.P. #1	63.05	12.53	430,631	2, 4		
6	NRCS Runoff	Pre DA C	30.17	12.07	96,185	----		
7	NRCS Runoff	Post DA C	18.96	12.07	60,657	----		

Hydrograph Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

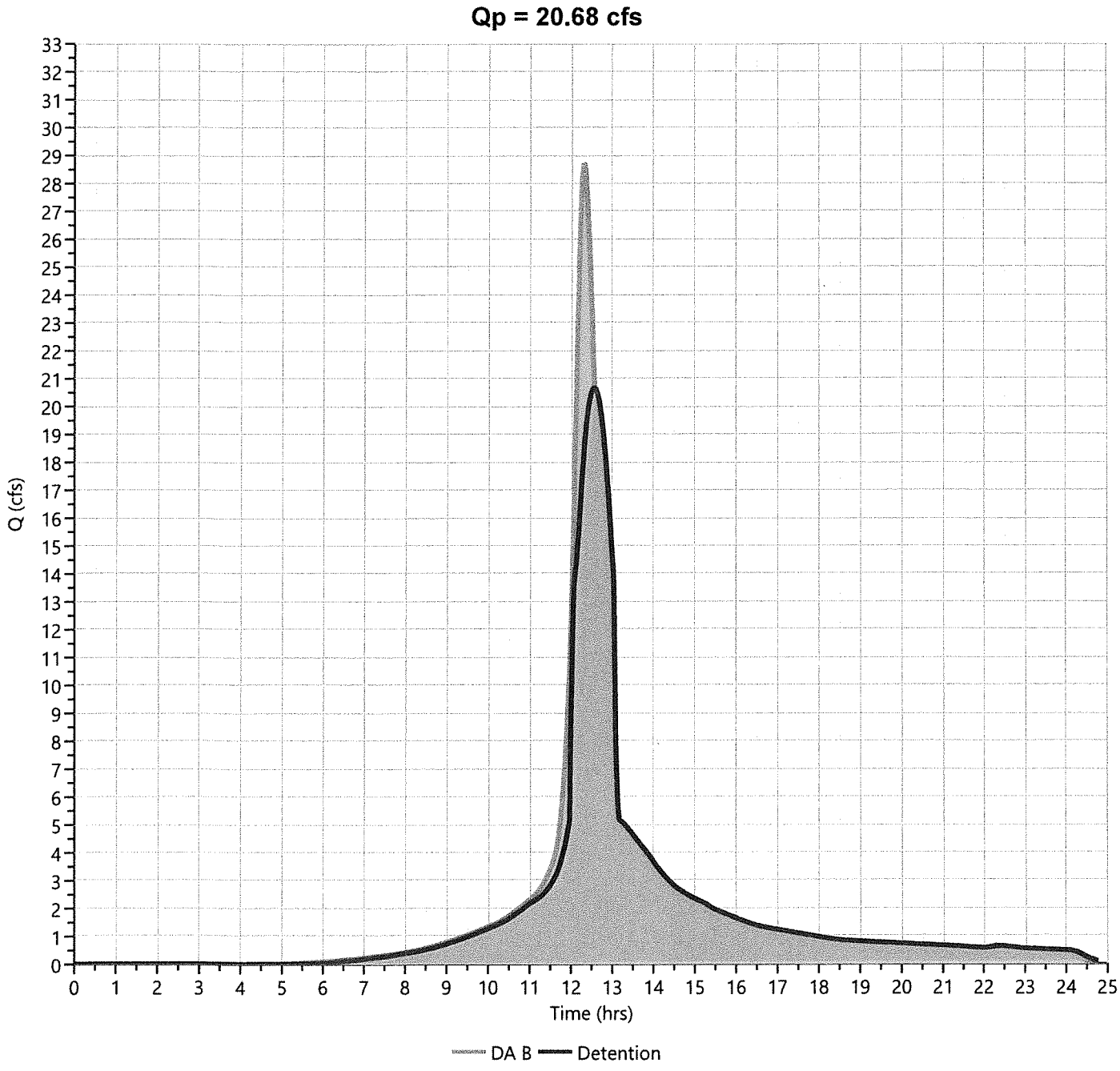
Post Detention

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 20.68 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.57 hrs
Time Interval	= 1 min	Hydrograph Volume	= 148,830 cuft
Inflow Hydrograph	= 3 - DA B	Max. Elevation	= 163.66 ft
Pond Name	= Detention	Max. Storage	= 19,111 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 12 min



Hydrograph Report

Project Name: Belta Trial

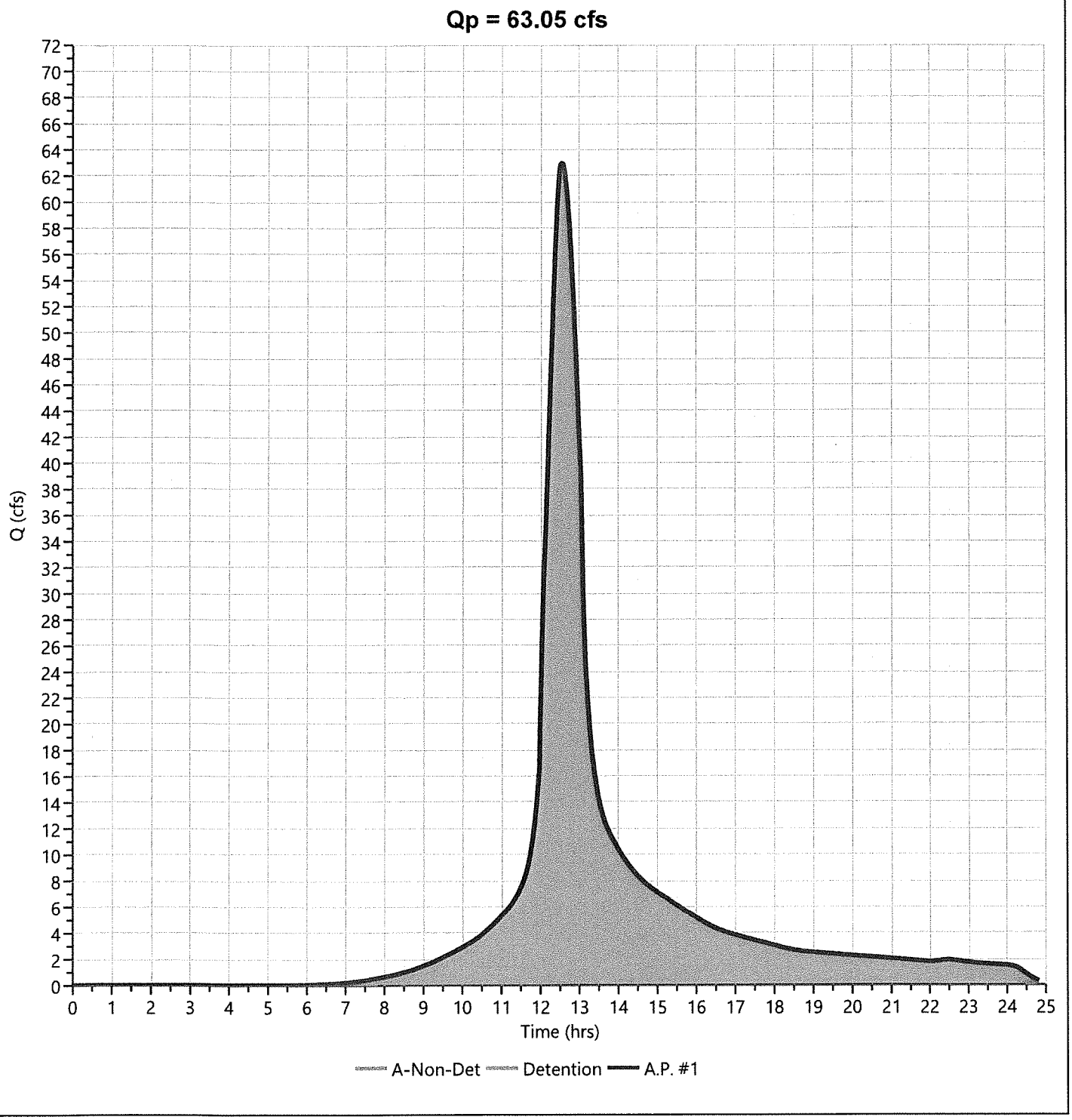
Hydrology Studio v 3.0.0.14

03-31-2020

Post A.P. #1

Hyd. No. 5

Hydrograph Type	= Junction	Peak Flow	= 63.05 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.53 hrs
Time Interval	= 1 min	Hydrograph Volume	= 430,631 cuft
Inflow Hydrographs	= 2, 4	Total Contrib. Area	= 14.55 ac



Hydrograph Report

Project Name: Belta Final

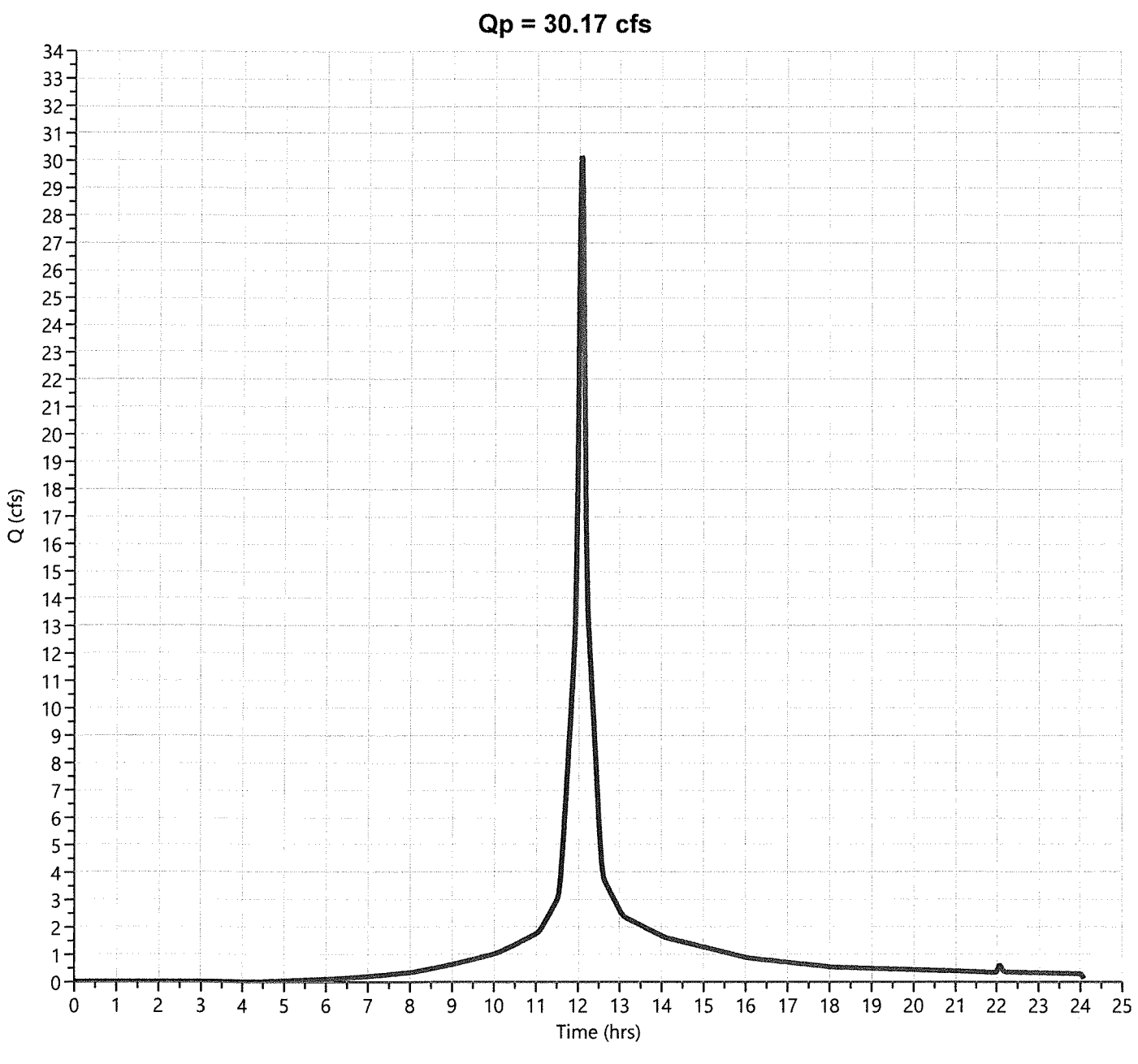
Hydrology Studio v 3.0.0.14

05-07-2020

Pre DA C

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 30.17 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.07 hrs
Time Interval	= 1 min	Runoff Volume	= 96,185 cuft
Drainage Area	= 4.04 ac	Curve Number	= 83.4
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 8.35 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name: Belta Final

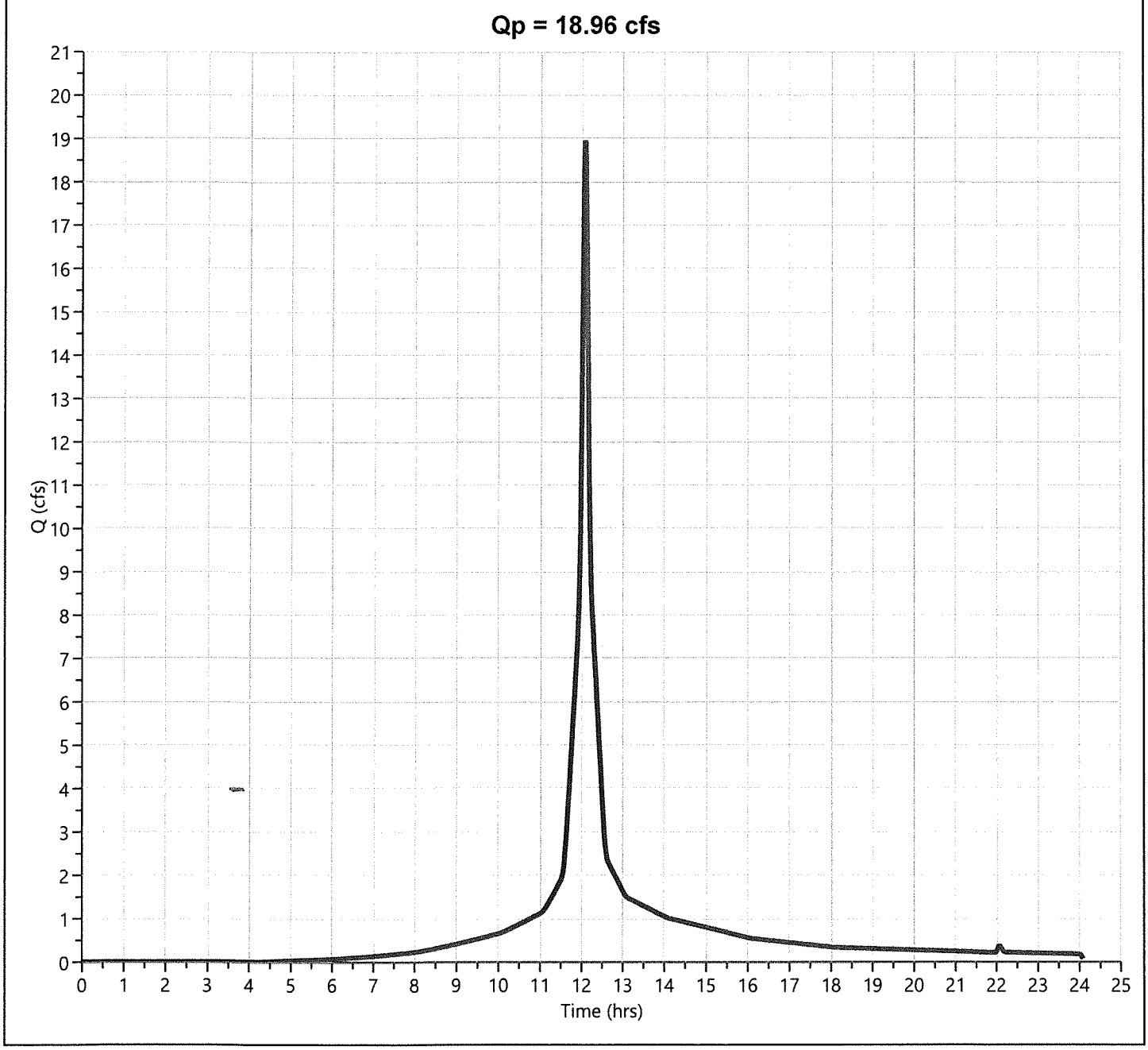
Hydrology Studio v 3.0.0.14

05-07-2020

Post DA C

Hyd. No. 7

Hydrograph Type	= NRCS Runoff	Peak Flow	= 18.96 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.07 hrs
Time Interval	= 1 min	Runoff Volume	= 60,657 cuft
Drainage Area	= 2.51 ac	Curve Number	= 84.2
Tc Method	= User	Time of Conc. (Tc)	= 5.0 min
Total Rainfall	= 8.35 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



DYMAR

POND REPORT

Pond Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

Detention

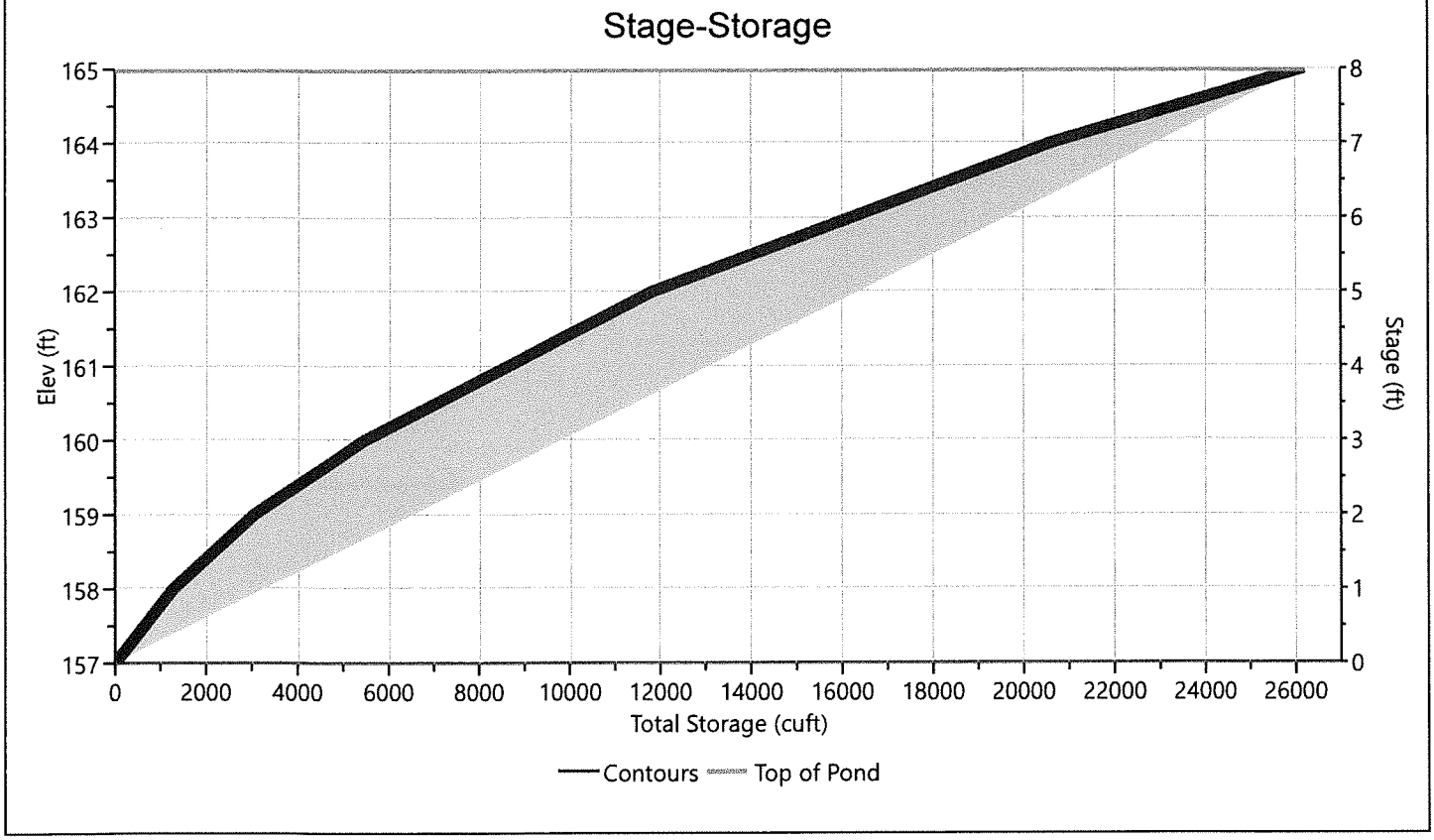
Stage-Storage

User Defined Contours

Description	Input
Bottom Elevation, ft	157.00
Voids (%)	40.00
Volume Calc	None

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	157.00	2,800	0.000	0.000
1.00	158.00	3,600	1,280	1,280
2.00	159.00	5,300	1,780	3,060
3.00	160.00	6,700	2,400	5,460
5.00	162.00	9,200	6,360	11,820
7.00	164.00	12,800	8,800	20,620
8.00	165.00	15,100	5,580	26,200



Pond Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

Detention

Stage-Discharge

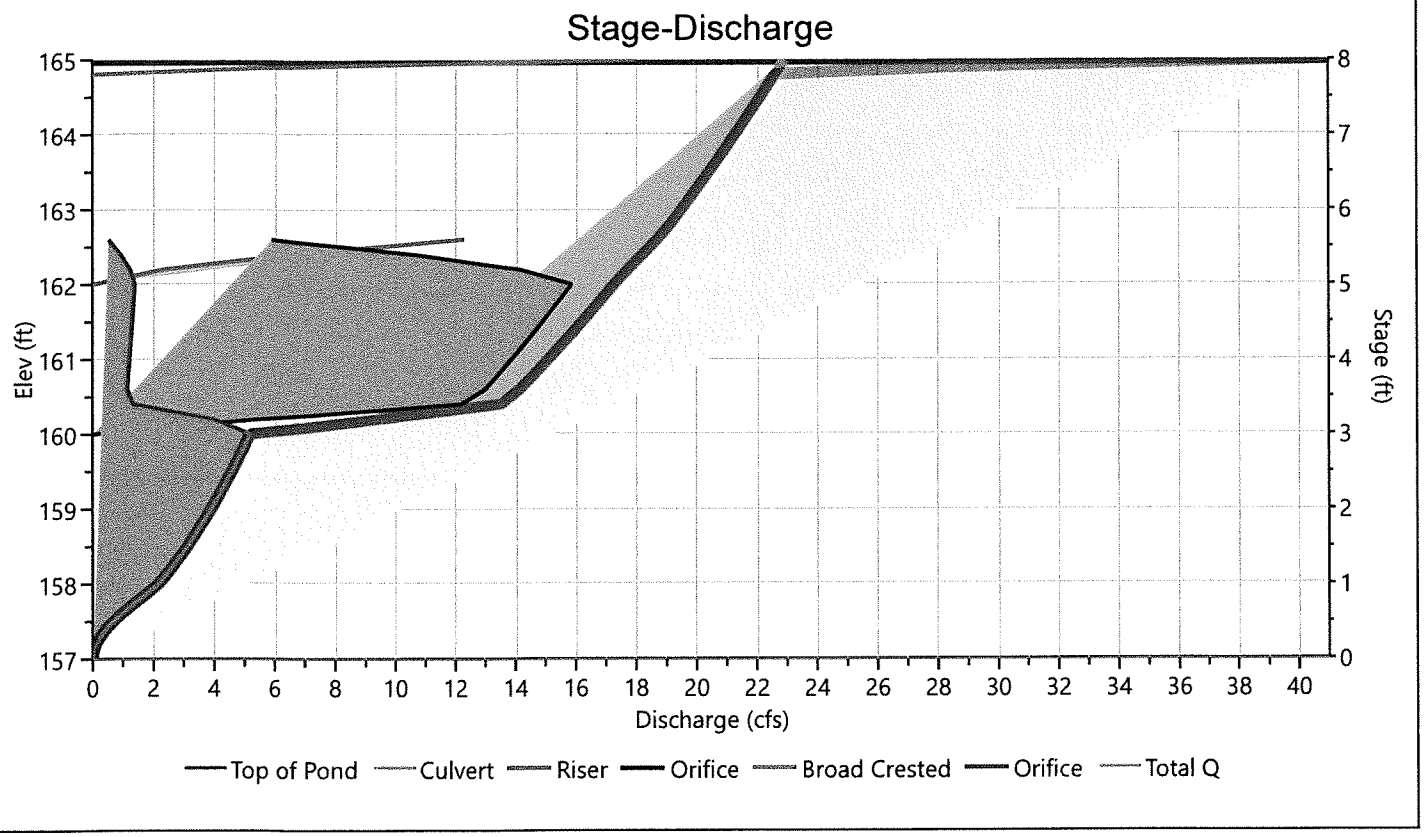
Culvert / Orifices	Culvert	Orifices		
		1*	2*	3
Rise, in	18	6	12	
Span, in	18	36	12	
No. Barrels	1	6	1	
Invert Elevation, ft	157.00	160.00	157.01	
Orifice Coefficient, Co	0.60	0.60	0.60	
Length, ft	45			
Barrel Slope, %	1			
N-Value, n	0.013			

Weirs	Riser*	Weirs		
		1	2	3
Shape / Type	Box	Broad Crested		
Crest Elevation, ft	162	164.8		
Crest Length, ft	8	60		
Angle, deg		11.3 (5:1)		
Weir Coefficient, Cw	3.3	3.3		

Orifice Plate	
Orifice Dia, in	
No. Orifices	
Invert Elevation, ft	
Height, ft	
Orifice Coefficient, Co	

Ancillary	
Exfiltration, in/hr	

*Routes through Culvert.



Pond Report

Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

Detention

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	157.00	0.000	0.000	0.000	0.000		0.000	0.000						0.000
1.00	158.00	1,280	2.168 ic	0.000	2.168		0.000	0.000						2.168
2.00	159.00	3,060	3.889 ic	0.000	3.889		0.000	0.000						3.889
3.00	160.00	5,460	5.173 ic	0.000	5.173		0.000	0.000						5.173
5.00	162.00	11,820	17.26 ic	15.87	1.385		0.000	0.000						17.26
7.00	164.00	20,620	21.27 ic	0.000	0.000		0.000	0.000						21.27
8.00	165.00	26,200	22.91 ic	0.000	0.000		0.000	17.95						40.85

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

Pond Report

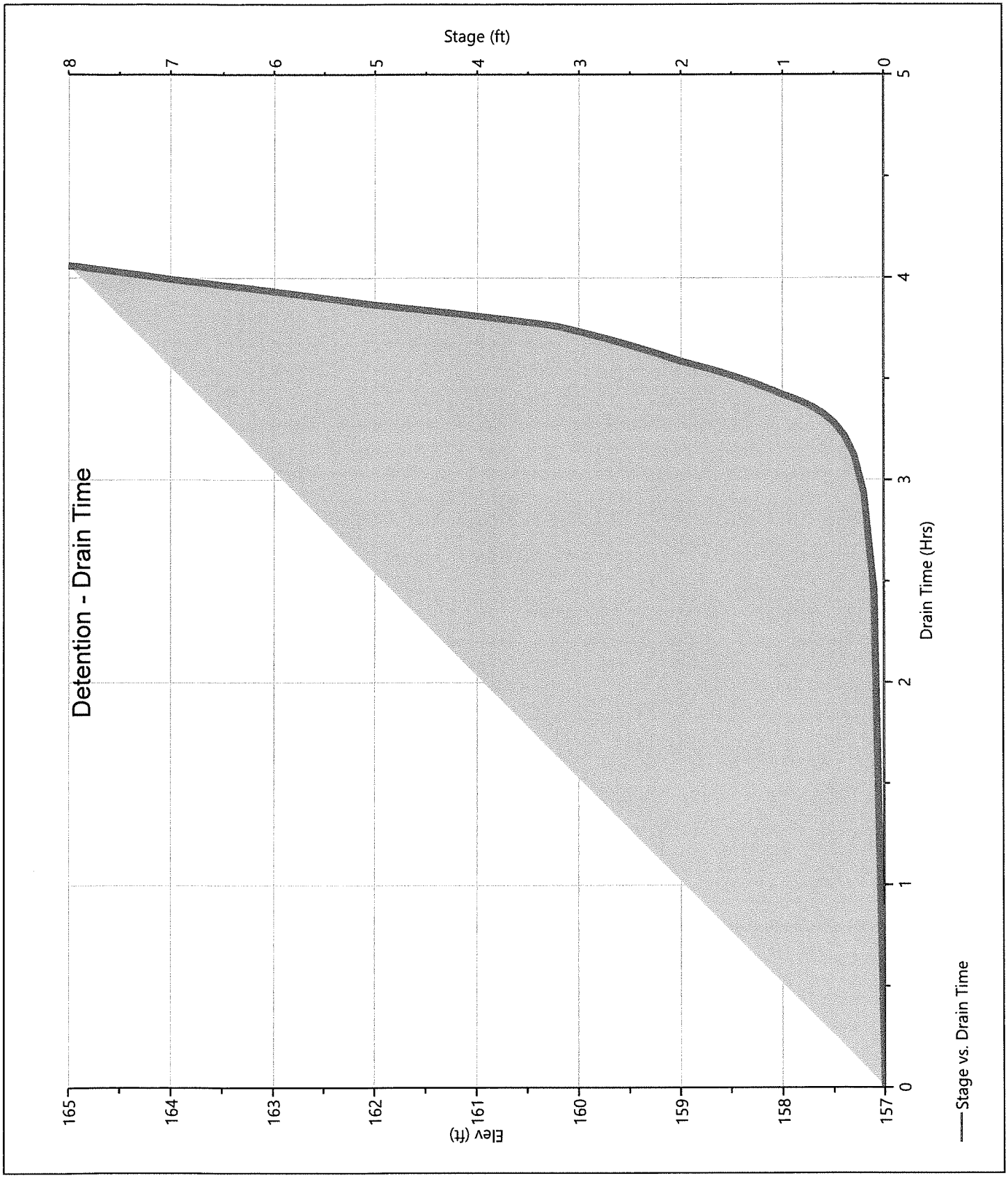
Project Name: Belta Trial

Hydrology Studio v 3.0.0.14

03-31-2020

Detention

Pond Drawdown



DYMAR

RATIONAL METHOD ANALYSIS FOR STORMWATER COLLECTION SYSTEM

DYMAR
325 Main Street South • Southbury, Ct 06488 • (203) 267-1046 • Fax (203) 267 1547
ENGINEERING • PLANNING • SURVEYING • DEVELOPMENT SERVICES

Project: Belta Subdivision
Westport, CT
Job No. : 00934
Date : 3/31/2020
Designed By : S.A.L.

Drainage Structure Summary Chart

Upstream Structure	Downstream Structure	Drainage Area (Acres)	Runoff Coeff.	Tc (Min.)	Compound_Tc (Min.)	Rainfall Intensity (In./Hr.)	Pipe Material	Diameter (In.)
CB1	MH4	0.33	0.65	10.20	10.20	6.04	HDPE	15.00
MH4	MH3	0.00	0.50	5.00	13.97	5.09	HDPE	15.00
MH3	MH2	0.00	0.50	5.00	14.68	4.95	HDPE	15.00
MH2	MH1	0.00	0.50	5.00	16.26	4.66	HDPE	15.00
MH1	FE1	0.00	0.50	5.00	16.46	4.63	HDPE	15.00
CB3	CB2	0.10	0.65	10.20	10.20	6.04	HDPE	15.00
CB2	MH5	0.09	0.65	11.00	11.00	5.80	HDPE	15.00
MH5	MH4	0.00	0.50	5.00	12.58	5.39	HDPE	15.00

Upstream Structure	Downstream Structure	Manning's n	Upstream Rim Elevation	Upstream Invert	Downstream Rim Elevation	Downstream Invert	Pipe Length (Feet)	Slope Percent (%)
CB1	MH4	0.012	179.21	174.00	181.93	172.00	131.03	1.53
MH4	MH3	0.012	181.93	171.90	180.72	170.00	145.19	1.31
MH3	MH2	0.012	180.72	169.90	170.00	163.65	329.76	1.90
MH2	MH1	0.012	170.00	163.55	167.71	161.90	76.57	2.15
MH1	FE1	0.012	167.71	159.25	166.37	159.00	21.97	1.14
CB3	CB2	0.012	180.98	174.90	180.98	174.65	22.00	1.14
CB2	MH5	0.012	180.98	174.65	183.97	173.00	252.07	0.65
MH5	MH4	0.012	183.97	172.90	181.93	172.00	166.65	0.54

DYMAR
325 Main Street South • Southbury, Ct 06488 • (203) 267-1046 • Fax (203) 267 1547
ENGINEERING • PLANNING • SURVEYING • DEVELOPMENT SERVICES

Project: Belta Subdivision
Westport, CT
Job No. : 01010
Date : 3/31/2020
Designed By : S.A.L.

Drainage HGL Summary Chart

Flow elevations, depths and quantities based on 25 Year Storm event.

Upstream Structure	Downstream Structure	Runoff (CFS)	Inlet (CFS)	Bypass (CFS)	Flow Carryy Over (CFS)	Full (CFS)	Max (CFS)	Total (CFS)
CB1	MH4	1.42	1.42	0.00	0.00	8.67	9.33	1.42
MH4	MH3	0.00	0.00	0.00	0.00	8.03	8.63	1.88
MH3	MH2	0.00	0.00	0.00	0.00	9.66	10.39	1.83
MH2	MH1	0.00	0.00	0.00	0.00	10.30	11.08	1.72
MH1	FE1	0.00	0.00	0.00	0.00	7.49	8.05	1.71
CB3	CB2	0.42	0.42	0.06	0.00	7.48	8.05	0.36
CB2	MH5	0.37	0.44	0.07	0.06	5.68	6.11	0.71
MH5	MH4	0.00	0.07	0.00	0.07	5.16	5.55	0.72

		HGL Elevation		Flow Depth		Velocity			
Upstream Structure	Downstream Structure	Upstream (Ft)	Downstream (Ft)	Upstream (In.)	Downstream (In.)	Upstream (FPS)	Downstream (FPS)	Average (FPS)	Full (FPS)
CB1	MH4	174.47	172.63	5.66	7.57	3.36	2.29	2.82	7.06
MH4	MH3	172.45	170.61	6.54	7.28	3.65	3.18	3.42	6.54
MH3	MH2	170.44	164.23	6.45	6.90	3.62	3.32	3.47	7.87
MH2	MH1	163.90	162.25	4.15	4.15	6.23	6.23	6.23	8.39
MH1	FE1	159.66	159.41	4.88	4.88	4.94	4.94	4.94	6.10
CB3	CB2	175.13	175.05	2.78	4.76	2.28	1.06	1.67	6.10
CB2	MH5	174.98	173.34	3.94	4.13	2.74	2.58	2.66	4.63
MH5	MH4	173.23	172.61	3.98	7.28	2.76	1.22	1.99	4.20

DYMAR
www.dymarinc.com
800 Main Street South, Suite 132 • Southbury, CT 06488-2210
(203) 264-1046 • Fax (203) 267-1547 • dymar@dymarinc.com
ENGINEERING • PLANNING • ENVIRONMENTAL • SURVEYING SERVICES

PROJECT: Belta Subdivision PAGE: 1
CLIENT: Belta JOB #: 934
SUBJECT: D.A. 'C' Computations DATE: 4/24/20
DONE BY: SAL CHECKED BY:

Recalculate D.A. 'C' for impact to DWD's CB @ AP #2 Tie-in.

D.A. = 175859 sqft = 4.04 Ac = (Existing Conditions)

$CN_w = 83.4$

Proposed Conditions

D.A = 2.513 Ac.

$CN_w = 84.2$

Refer to Computer Generated Printouts for CN Computation

Refer to App. B for Runoff Computations.

DYMAR
www.dymarinc.com
800 Main Street South, Suite 132 • Southbury, CT 06488-2210
(203) 264-1046 • Fax (203) 267-1547 • dymar@dymarinc.com
ENGINEERING • PLANNING • ENVIRONMENTAL • SURVEYING SERVICES

PROJECT: Delta Subdivision PAGE: 1
CLIENT: Delta JOB #: 934
SUBJECT: Town Drainage Review DATE: 4/21/20
DONE BY: GHL. CHECKED BY:

@ A.P. #2 Analyze Existing 15" Culvert for Capacity To Handle Runoff

Existing Conditions

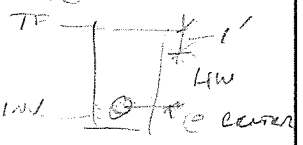
15" C.P.P. Inv. In = 155.00' Inv. Out = 152.80' ΔH = 2.20'

L = 46'

S = 2.20/46 = 0.048 ft/ft.

TR = 159.10

ΔH = 159.10 − 155 − 1.25/2 − 1 = 2.475' or HGL w/ 1' FB.



Per Manning

$$Q_F = \frac{1.49}{0.012} \times \frac{\pi}{4}(1.25)^2 \times \left(\frac{1.25}{4}\right)^{2/3} \sqrt{0.048}$$

= 15.3 cfs. ✓

@ 2.46' HGL per ~~HDS~~ HEC 5

$$\frac{HW}{D} = \frac{2.46'}{1.25'} = 1.96 \text{ say } 2$$ ✓

Per Chart 1B @ 15" CPP, Q = 8 cfs. ✓ Computer output 9.25 cfs

Q_{25} (existing) = 22.35 cfs

Q_{25} (proposed) = 14.10 cfs < 15.3 cfs OK

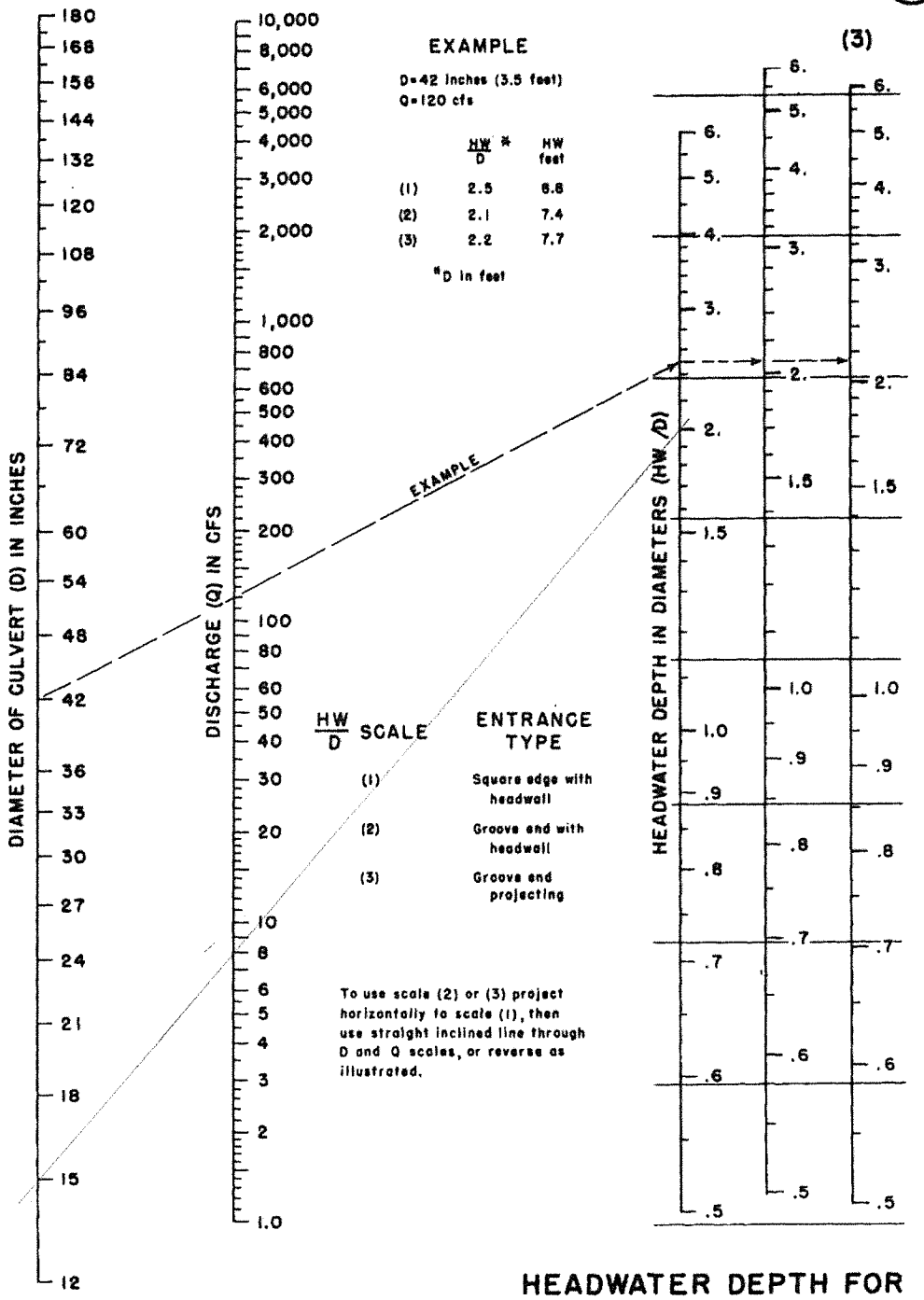
Flow to Town System Reduced By 36.9%

Under Flooded Conditions w/ 1' freeboard in CB.

Q_{25} capacity = 14.10 cfs > 9.25 cfs. PASS

Cross Culvert of insufficient Capacity To Convey Stormwater at 25 yr Storm w/ 1' FB.

CHART 1B



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

Culvert Report

Project filename: Outfall.cst

Culvert Studio v 2.0.0.17

05-07-2020

Culvert 1

Culvert 1

CULVERT

Shape	= Circular
Inlet Edge	= Square Edge/ Hdwall
Material	= HDPE
Manning's n	= 0.012
Rise	= 15 in
Span	= 15 in
Invert Elev. Down	= 152.80 ft
Length	= 46.0 ft
Slope	= 0.048 ft/ft
Invert Elev. Up	= 155.00 ft
No. Barrels	= 1
Plan Skew Angle	= 0 degrees

EMBANKMENT

Top Width	= 26.00 ft
Top Elevation	= 159.10 ft
Crest Length	= 100.00 ft

DISCHARGE

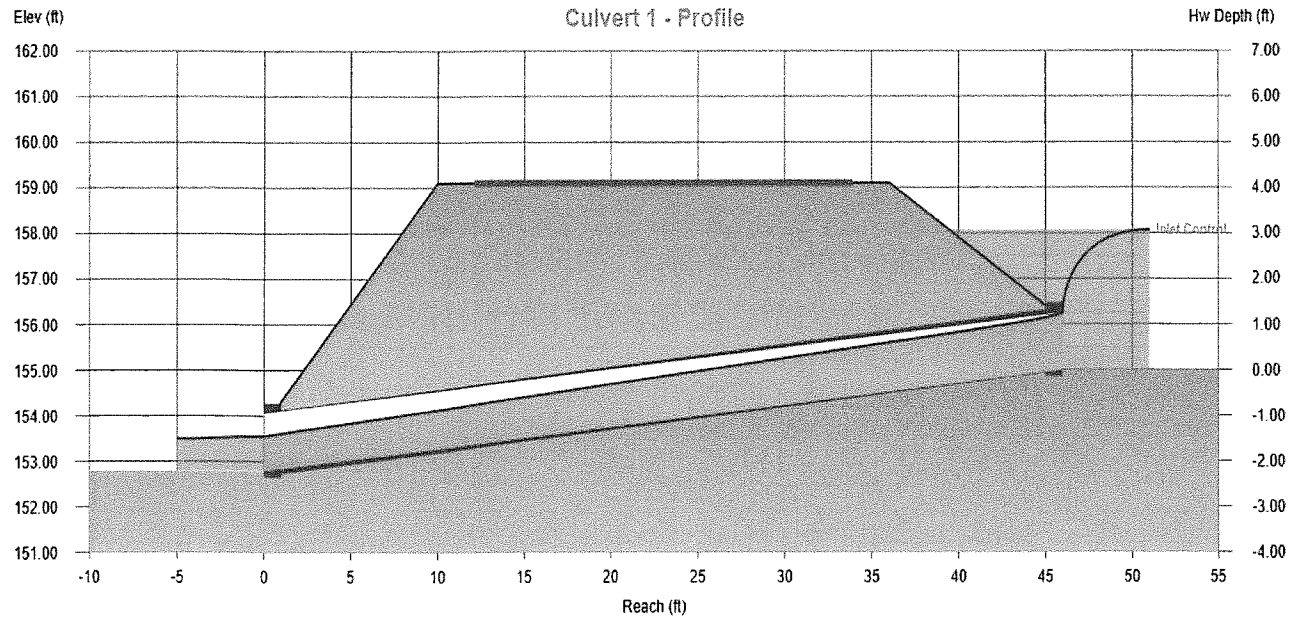
Method	= Qmin to Qmax
Q Min	= 8.00 cfs
Q Max	= 10.00 cfs
Q Increment	= 0.25 cfs

TAILWATER

Tailwater Elevation	= Normal Depth

CALCULATION SAMPLE

Discharge			Velocity		Depth		HGL @ Hw/D = 2.46		
Total	Culvert	Over Top	Down	Up	Down	Up	Down	Up	Hw
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)
9.25	9.25	0.00	11.94	7.77	9.1	14.0	153.55	156.17	158.07



Energy Grade Line Calculations

Project Name: Belta Subdivision

Stormwater Studio 2020 v 3.0.0.18

05-08-2020

Line No	Line Size	Q	Downstream							Length	Upstream							Pipe		Junction		
			Invert Elev	Depth	Area	HGL Elev	Vel	Vel Head	EGL Elev		Invert Elev	Depth	Area	HGL Elev	Vel	Vel Head	EGL Elev	n Value	Enrgy Loss	HGLa Elev	EGLa Elev	Enrgy Loss
	(in)	(cfs)	(ft)	(ft)	(sqft)	(ft)	(ft/s)	(ft)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft)	(ft/s)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)
1	15	17.92	152.80	1.25[3]	1.23	154.05	14.61	3.32	157.37	46.00	154.90	1.25	1.23	157.07	14.61	3.32	160.39	0.012	3.021	159.69	163.01	2.62
2	15	7.29	155.00	0.61‡	0.59	155.61	12.37	2.38	163.23	136.09	163.01	1.08[2]	1.13	164.09	6.47	0.65	164.74	0.012	1.515	164.09	164.74	0.00

Notes: Return Period = 25-yrs. [2] Critical depth. [3] Normal depth. ‡ Supercritical.

Project File: Ex-CBs.sws

DYMAR

WATER QUALITY VOLUME CALCULATIONS

DYMAR
800 Main Street South • Southbury, Ct 06488 • (203) 267-1046 • Fax (203) 267 1547
ENGINEERING • PLANNING • SURVEYING • DEVELOPMENT SERVICES

Project: Belrta Subdivision
Westport, CT
Job No. : 00934
Date : 3/31/2020
Designed By : S.A.L.

Water Quality Volume Calculations

(Based on Conn. DEP 2004 Stormwater Quality Manual)

Post Construction Development

WQV = 1"xRxA/12
WQV = Water Quality Volume (ac-ft)
R = Volumetric Runoff Coeffecient = 0.05+0.009xI
I = Percent Impervious Cover
A = Site Area (ac)

Stormwater Management Area (Drainage Area)	Drainage Area	Impervious Cover	Vol. Runoff Coefficient	Required Water Quality Volume		Provided Water Quality Volume	
	(ac)	%		(ac-ft)	(cf)	(ac-ft)	(cf)
Drainage Area A*	14.55	16.27	0.20	0.24	10,375	0.000	0
Drainage Area B	6.67	12.23	0.16	0.09	3,874	0.092	4,008
Drainage Area C**	0.28	100.00	0.95	0.02	968	0.024	1,045

* Impervious area restricted to paved surfaces; roof runoff to separte lot recharger systems.
** System sized for 100% capture of proposed road, existing house not included.

Water Quality Flow Calculations

(Based on Conn. DEP 2004 Stormwater Quality Manual)

Post Construction Development

WQF = (qu)x(A)x(Q)
WQF = Water Quality Flow (cfs)
qu = TR-55 Peak Unit Discharge (cfs/mi2/in)
Q = Watershed Runoff Depth (in)
A = Site Area (mi2)
P = 1 in of Rainfall

Stormwater Management Area (Drainage Area)	Drainage Area	Impervious Cover	Watershed Runoff	CN	Ia/P	Tc	Unit Discharge	Water Quality Flow
	(mi2)	%	(in)		(in)	(hrs)	(cfs/mi2/in)	(cfs)
Drainage Area A*	0.0227	16.27	0.20	75	0.703	0.67	180	0.8
Drainage Area B	0.0104	12.23	0.16	82	0.439	0.78	220	0.4
Drainage Area C**	0.0004	100.00	0.95	98	0.041	0.083	660	0.3

APPENDIX C – TECHNICAL WORKSHEETS AND REFERENCE MATERIALS

NOAA Atlas 14, Volume 10, Version 3
Location name: Westport, Connecticut, USA*
Latitude: 41.1646°, Longitude: -73.323°
Elevation: 178.08 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.361 (0.284-0.454)	0.423 (0.333-0.533)	0.525 (0.411-0.661)	0.609 (0.475-0.773)	0.725 (0.545-0.955)	0.813 (0.598-1.09)	0.904 (0.643-1.25)	1.00 (0.677-1.42)	1.14 (0.738-1.67)	1.24 (0.788-1.86)
10-min	0.512 (0.403-0.643)	0.600 (0.472-0.755)	0.744 (0.584-0.940)	0.863 (0.672-1.10)	1.03 (0.772-1.35)	1.15 (0.847-1.55)	1.28 (0.911-1.77)	1.42 (0.960-2.02)	1.61 (1.05-2.36)	1.76 (1.12-2.63)
15-min	0.602 (0.474-0.757)	0.705 (0.555-0.888)	0.874 (0.685-1.10)	1.01 (0.791-1.29)	1.21 (0.909-1.59)	1.36 (0.996-1.82)	1.51 (1.07-2.09)	1.67 (1.13-2.37)	1.90 (1.23-2.78)	2.07 (1.31-3.10)
30-min	0.838 (0.660-1.05)	0.983 (0.773-1.24)	1.22 (0.955-1.54)	1.42 (1.10-1.80)	1.68 (1.26-2.22)	1.89 (1.39-2.53)	2.10 (1.49-2.90)	2.32 (1.57-3.29)	2.62 (1.70-3.83)	2.85 (1.80-4.25)
60-min	1.08 (0.846-1.35)	1.26 (0.991-1.59)	1.56 (1.23-1.97)	1.81 (1.41-2.30)	2.16 (1.62-2.84)	2.42 (1.78-3.24)	2.69 (1.91-3.71)	2.97 (2.01-4.21)	3.34 (2.17-4.89)	3.62 (2.29-5.41)
2-hr	1.38 (1.09-1.72)	1.64 (1.30-2.05)	2.06 (1.63-2.59)	2.41 (1.89-3.04)	2.90 (2.19-3.80)	3.27 (2.42-4.36)	3.64 (2.61-5.02)	4.06 (2.75-5.72)	4.64 (3.02-6.75)	5.10 (3.24-7.57)
3-hr	1.59 (1.26-1.98)	1.90 (1.51-2.36)	2.40 (1.90-3.00)	2.82 (2.22-3.54)	3.40 (2.58-4.44)	3.84 (2.85-5.11)	4.29 (3.09-5.91)	4.80 (3.26-6.74)	5.53 (3.61-8.02)	6.12 (3.89-9.04)
6-hr	2.00 (1.60-2.47)	2.40 (1.92-2.97)	3.06 (2.44-3.80)	3.61 (2.86-4.50)	4.36 (3.34-5.67)	4.93 (3.69-6.53)	5.52 (4.00-7.58)	6.21 (4.23-8.66)	7.20 (4.71-10.4)	8.03 (5.12-11.8)
12-hr	2.46 (1.99-3.02)	2.97 (2.39-3.65)	3.80 (3.05-4.68)	4.48 (3.57-5.55)	5.43 (4.18-7.01)	6.13 (4.62-8.09)	6.88 (5.02-9.41)	7.75 (5.31-10.8)	9.04 (5.93-12.9)	10.1 (6.47-14.7)
24-hr	2.87 (2.33-3.50)	3.50 (2.84-4.27)	4.53 (3.65-5.54)	5.38 (4.31-6.61)	6.55 (5.07-8.41)	7.42 (5.62-9.74)	8.35 (6.14-11.4)	9.46 (6.51-13.0)	11.1 (7.34-15.8)	12.6 (8.06-18.2)
2-day	3.19 (2.60-3.86)	3.95 (3.23-4.79)	5.21 (4.23-6.33)	6.25 (5.05-7.63)	7.68 (6.00-9.84)	8.74 (6.68-11.4)	9.89 (7.35-13.5)	11.3 (7.80-15.5)	13.5 (8.92-19.1)	15.4 (9.92-22.1)
3-day	3.43 (2.82-4.14)	4.28 (3.50-5.16)	5.65 (4.61-6.84)	6.80 (5.51-8.27)	8.37 (6.56-10.7)	9.53 (7.31-12.4)	10.8 (8.05-14.7)	12.4 (8.55-16.9)	14.8 (9.79-20.8)	16.9 (10.9-24.2)
4-day	3.68 (3.02-4.42)	4.56 (3.75-5.49)	6.02 (4.92-7.26)	7.22 (5.87-8.76)	8.88 (6.98-11.3)	10.1 (7.77-13.1)	11.4 (8.55-15.5)	13.1 (9.06-17.8)	15.6 (10.4-21.9)	17.8 (11.5-25.5)
7-day	4.38 (3.63-5.24)	5.35 (4.42-6.40)	6.92 (5.70-8.31)	8.23 (6.73-9.93)	10.0 (7.91-12.7)	11.4 (8.76-14.6)	12.8 (9.56-17.1)	14.5 (10.1-19.6)	17.1 (11.4-23.9)	19.4 (12.5-27.5)
10-day	5.08 (4.22-6.05)	6.09 (5.05-7.26)	7.74 (6.39-9.26)	9.12 (7.47-11.0)	11.0 (8.69-13.8)	12.4 (9.57-15.9)	13.9 (10.4-18.5)	15.7 (10.9-21.1)	18.2 (12.2-25.3)	20.4 (13.2-28.8)
20-day	7.18 (6.00-8.49)	8.30 (6.93-9.83)	10.1 (8.43-12.0)	11.7 (9.63-13.9)	13.8 (10.9-17.0)	15.4 (11.9-19.4)	17.0 (12.6-22.1)	18.8 (13.2-25.1)	21.3 (14.2-29.3)	23.2 (15.1-32.6)
30-day	8.91 (7.48-10.5)	10.1 (8.48-11.9)	12.1 (10.1-14.3)	13.7 (11.4-16.3)	16.0 (12.7-19.7)	17.7 (13.7-22.2)	19.5 (14.4-25.1)	21.3 (15.0-28.2)	23.7 (15.9-32.5)	25.5 (16.6-35.7)
45-day	11.1 (9.32-13.0)	12.4 (10.4-14.5)	14.5 (12.1-17.1)	16.3 (13.5-19.2)	18.7 (14.9-22.8)	20.6 (15.9-25.6)	22.4 (16.7-28.6)	24.3 (17.1-32.1)	26.6 (18.0-36.4)	28.4 (18.5-39.5)
60-day	12.9 (10.9-15.0)	14.2 (12.0-16.7)	16.5 (13.9-19.4)	18.4 (15.3-21.7)	20.9 (16.7-25.5)	22.9 (17.8-28.4)	24.9 (18.5-31.6)	26.7 (18.9-35.2)	29.1 (19.7-39.6)	30.8 (20.1-42.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

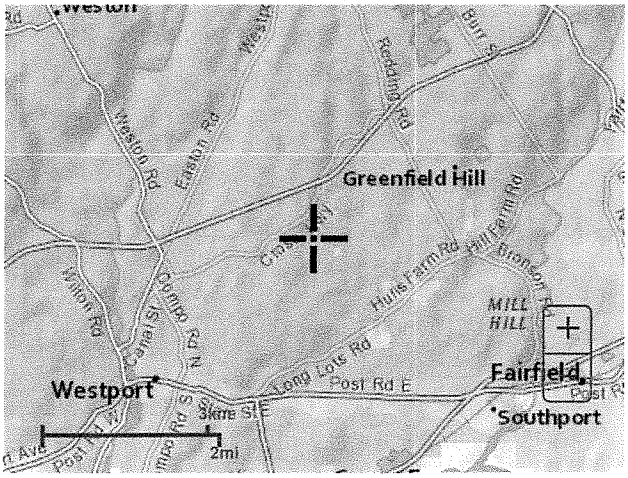
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

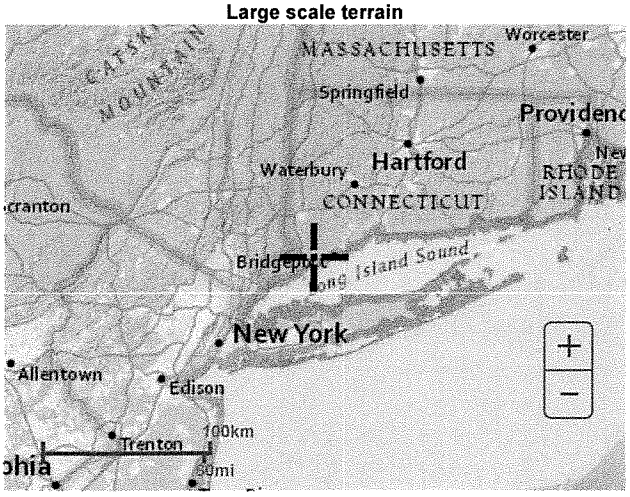
Back to Top

Maps & aerials

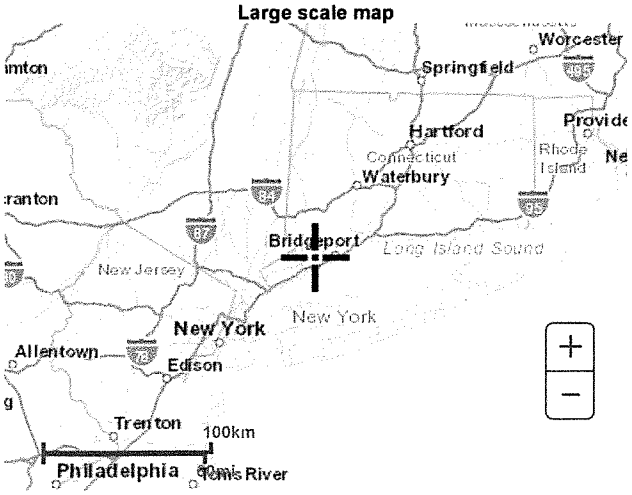
Small scale terrain



Large scale terrain



Large scale map



NOAA Atlas 14, Volume 10, Version 3
Location name: Westport, Connecticut, USA*
Latitude: 41.1646°, Longitude: -73.323°
Elevation: 178.08 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	4.33 (3.41-5.45)	5.08 (4.00-6.40)	6.30 (4.93-7.93)	7.31 (5.70-9.28)	8.70 (6.54-11.5)	9.76 (7.18-13.1)	10.8 (7.72-15.0)	12.0 (8.12-17.1)	13.6 (8.86-20.0)	14.9 (9.46-22.3)
10-min	3.07 (2.42-3.86)	3.60 (2.83-4.53)	4.46 (3.50-5.64)	5.18 (4.03-6.57)	6.16 (4.63-8.11)	6.91 (5.08-9.27)	7.68 (5.47-10.6)	8.51 (5.76-12.1)	9.66 (6.27-14.2)	10.6 (6.70-15.8)
15-min	2.41 (1.90-3.03)	2.82 (2.22-3.55)	3.50 (2.74-4.41)	4.06 (3.16-5.15)	4.83 (3.64-6.36)	5.42 (3.98-7.27)	6.02 (4.28-8.34)	6.68 (4.51-9.48)	7.58 (4.92-11.1)	8.30 (5.25-12.4)
30-min	1.68 (1.32-2.11)	1.97 (1.55-2.47)	2.44 (1.91-3.08)	2.83 (2.21-3.59)	3.37 (2.53-4.43)	3.78 (2.77-5.06)	4.20 (2.98-5.79)	4.64 (3.14-6.58)	5.23 (3.40-7.67)	5.69 (3.60-8.51)
60-min	1.08 (0.846-1.35)	1.26 (0.991-1.59)	1.56 (1.23-1.97)	1.81 (1.41-2.30)	2.16 (1.62-2.84)	2.42 (1.78-3.24)	2.69 (1.91-3.71)	2.97 (2.01-4.21)	3.34 (2.17-4.89)	3.62 (2.29-5.41)
2-hr	0.690 (0.547-0.862)	0.820 (0.649-1.02)	1.03 (0.814-1.29)	1.21 (0.946-1.52)	1.45 (1.10-1.90)	1.63 (1.21-2.18)	1.82 (1.30-2.51)	2.03 (1.38-2.86)	2.32 (1.51-3.38)	2.55 (1.62-3.79)
3-hr	0.529 (0.421-0.658)	0.632 (0.502-0.787)	0.800 (0.634-0.999)	0.940 (0.740-1.18)	1.13 (0.860-1.48)	1.28 (0.949-1.70)	1.43 (1.03-1.97)	1.60 (1.09-2.25)	1.84 (1.20-2.67)	2.04 (1.30-3.01)
6-hr	0.333 (0.267-0.412)	0.401 (0.321-0.496)	0.511 (0.407-0.634)	0.602 (0.477-0.751)	0.728 (0.557-0.946)	0.822 (0.615-1.09)	0.922 (0.669-1.27)	1.04 (0.707-1.45)	1.20 (0.787-1.73)	1.34 (0.855-1.97)
12-hr	0.204 (0.165-0.251)	0.246 (0.198-0.303)	0.315 (0.253-0.388)	0.372 (0.297-0.461)	0.450 (0.347-0.582)	0.509 (0.383-0.671)	0.571 (0.417-0.781)	0.644 (0.441-0.893)	0.750 (0.493-1.07)	0.839 (0.537-1.22)
24-hr	0.120 (0.097-0.146)	0.146 (0.118-0.178)	0.189 (0.152-0.231)	0.224 (0.180-0.276)	0.273 (0.211-0.351)	0.309 (0.234-0.406)	0.348 (0.256-0.474)	0.394 (0.271-0.543)	0.464 (0.306-0.660)	0.523 (0.336-0.758)
2-day	0.066 (0.054-0.080)	0.082 (0.067-0.100)	0.108 (0.088-0.132)	0.130 (0.105-0.159)	0.160 (0.125-0.205)	0.182 (0.139-0.238)	0.206 (0.153-0.281)	0.236 (0.162-0.323)	0.281 (0.186-0.397)	0.321 (0.207-0.461)
3-day	0.048 (0.039-0.057)	0.059 (0.049-0.072)	0.079 (0.064-0.095)	0.094 (0.077-0.115)	0.116 (0.091-0.148)	0.132 (0.102-0.173)	0.150 (0.112-0.204)	0.172 (0.119-0.234)	0.206 (0.136-0.289)	0.235 (0.151-0.336)
4-day	0.038 (0.031-0.046)	0.048 (0.039-0.057)	0.063 (0.051-0.076)	0.075 (0.061-0.091)	0.093 (0.073-0.118)	0.105 (0.081-0.137)	0.119 (0.089-0.161)	0.136 (0.094-0.185)	0.163 (0.108-0.228)	0.186 (0.120-0.265)
7-day	0.026 (0.022-0.031)	0.032 (0.026-0.038)	0.041 (0.034-0.049)	0.049 (0.040-0.059)	0.060 (0.047-0.075)	0.068 (0.052-0.087)	0.076 (0.057-0.102)	0.086 (0.060-0.117)	0.102 (0.068-0.142)	0.115 (0.075-0.164)
10-day	0.021 (0.018-0.025)	0.025 (0.021-0.030)	0.032 (0.027-0.039)	0.038 (0.031-0.046)	0.046 (0.036-0.057)	0.052 (0.040-0.066)	0.058 (0.043-0.077)	0.065 (0.046-0.088)	0.076 (0.051-0.106)	0.085 (0.055-0.120)
20-day	0.015 (0.012-0.018)	0.017 (0.014-0.020)	0.021 (0.018-0.025)	0.024 (0.020-0.029)	0.029 (0.023-0.036)	0.032 (0.025-0.040)	0.035 (0.026-0.046)	0.039 (0.027-0.052)	0.044 (0.030-0.061)	0.048 (0.031-0.068)
30-day	0.012 (0.010-0.015)	0.014 (0.012-0.017)	0.017 (0.014-0.020)	0.019 (0.016-0.023)	0.022 (0.018-0.027)	0.025 (0.019-0.031)	0.027 (0.020-0.035)	0.030 (0.021-0.039)	0.033 (0.022-0.045)	0.035 (0.023-0.050)
45-day	0.010 (0.009-0.012)	0.011 (0.010-0.013)	0.013 (0.011-0.016)	0.015 (0.013-0.018)	0.017 (0.014-0.021)	0.019 (0.015-0.024)	0.021 (0.015-0.027)	0.022 (0.016-0.030)	0.025 (0.017-0.034)	0.026 (0.017-0.037)
60-day	0.009 (0.008-0.010)	0.010 (0.008-0.012)	0.011 (0.010-0.013)	0.013 (0.011-0.015)	0.015 (0.012-0.018)	0.016 (0.012-0.020)	0.017 (0.013-0.022)	0.019 (0.013-0.024)	0.020 (0.014-0.027)	0.021 (0.014-0.030)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

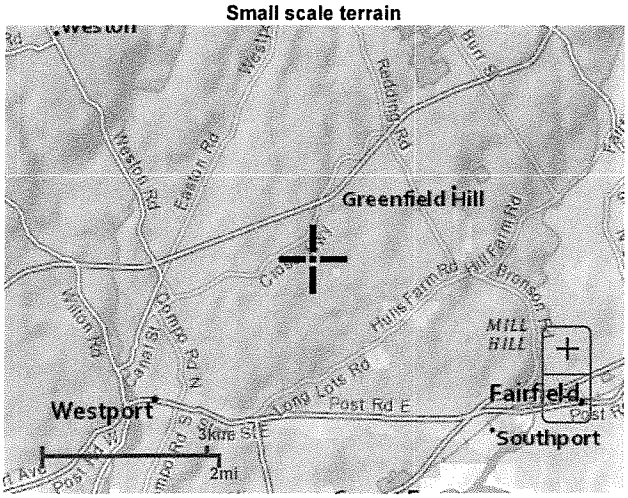
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

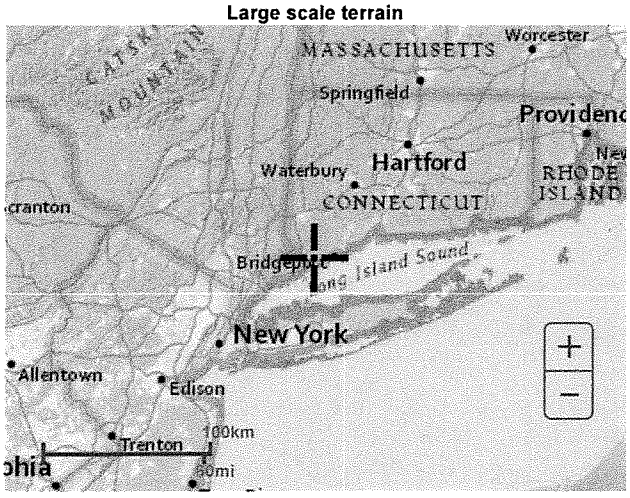
Back to Top

Maps & aerials

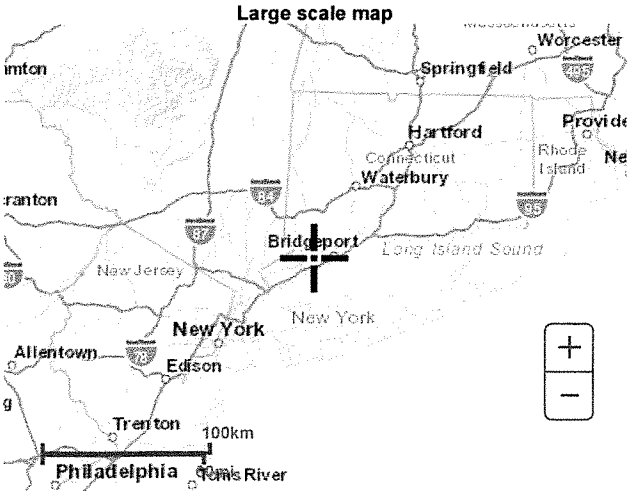
Small scale terrain



Large scale terrain



Large scale map



Runoff Curve Number and Runoff Wed Mar 18 13:48:26 2020

Project: Belta Subdivision By: S.A.L. Date: 03/18/20
Location: Bayberry Lane Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Acre)
Dirt Streets (including ROW)	87	C	0.306
Paved Lots Roofs & Driveways	98	C	0.058
Woods (Good)	55	B	0.683
Row Crops - SR (Good)	85	C	3.153
Brush (Good)	48	B	0.010
Meadow (continuous grass)	71	C	0.624
Brush (Fair)	70	C	0.605
Brush (Good)	65	C	1.240
Brush (Poor)	77	C	0.636
Brush (Fair)	77	D	0.116
Open Space-Good (>75% grass)	80	D	0.871
Meadow (continuous grass)	78	D	0.365
Brush (Good)	73	D	0.886
Woods (Good)	70	C	3.030
Row Crops - SR (Good)	89	D	0.421
Woods (Good)	77	D	3.566
Paved Lots Roofs & Driveways	98	D	0.537
Dirt Streets (including ROW)	89	D	0.240
Open Space-Poor (<50% grass)	79	B	0.433
Open Space-Poor (<50% grass)	86	C	0.819
Open Space-Poor (<50% grass)	89	D	1.117

CN (weighted): 77.5
Total Area: 19.716 Acre

2. Runoff

Return Period:	2 YEAR	
Rainfall, P:	3.50	in
Runoff, Q:	1.4656	in
Runoff Volume:	2.4079	Acre-Ft

Runoff Curve Number and Runoff Tue Mar 31 11:46:00 2020

Project: Belta Subdivision By: S.A.L. Date: 03/31/20
Location: D.A. A Checked: Date:
Developed

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Acre)
Brush (Good)	48	B	0.010
Meadow (continuous grass)	71	C	0.094
Brush (Fair)	70	C	0.148
Brush (Fair)	77	D	0.041
Meadow (continuous grass)	78	D	0.011
Woods (Good)	55	B	0.683
Brush (Good)	65	C	0.577
Brush (Good)	73	D	0.886
Open Space-Good (>75% grass)	74	C	4.417
Open Space-Good (>75% grass)	80	D	0.406
Woods (Good)	70	C	2.285
Woods (Good)	77	D	3.082
Paved Streets w/Curbs & Sewers	98	D	0.133
Paved Streets w/Curbs & Sewers	98	C	0.428
Open Space-Poor (<50% grass)	79	B	0.432
Open Space-Poor (<50% grass)	86	C	0.622
Open Space-Poor (<50% grass)	89	D	0.297

CN (weighted): 74.7
Total Area: 14.552 Acre

2. Runoff

Return Period:	2 YEAR	
Rainfall, P:	3.50	in
Runoff, Q:	1.2825	in
Runoff Volume:	1.5553	Acre-Ft

Runoff Curve Number and Runoff Thu Mar 19 15:41:32 2020

Project: Belta Subdivision By: S.A.L. Date: 03/19/20
Location: Detention Checked: Date:
Developed

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Acre)
Meadow (continuous grass)	71	C	0.398
Brush (Fair)	70	C	0.162
Brush (Fair)	77	D	0.074
Meadow (continuous grass)	78	D	0.337
Open Space-Good (>75% grass)	74	C	0.562
Open Space-Good (>75% grass)	80	D	1.553
Woods (Good)	70	C	0.338
Woods (Good)	77	D	0.570
Paved Lots Roofs & Driveways	98	D	0.206
Paved Streets w/Curbs & Sewers	98	C	0.323
Paved Streets w/Curbs & Sewers	98	D	0.287
Open Space-Poor (<50% grass)	86	C	0.367
Open Space-Poor (<50% grass)	89	D	1.492

CN (weighted): 82.4
Total Area: 6.669 Acre

2. Runoff

Return Period:	2 YEAR	
Rainfall, P:	3.50	in
Runoff, Q:	1.8099	in
Runoff Volume:	1.0059	Acre-Ft

Runoff Curve Number and Runoff Thu May 7 16:24:20 2020

Project: Belta Subdivision By: S.A.L. Date: 05/07/20
Location: D.A. 'C' Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Acre)
Row Crops - SR (Good)	85	C	0.063
Woods (Good)	70	C	0.109
Paved Lots Roofs & Driveways	98	B	0.014
Woods (Good)	55	B	0.007
Open Space-Good (>75% grass)	61	B	0.041
Open Space-Good (>75% grass)	80	D	0.872
Woods (Good)	77	D	1.020
Row Crops - SR (Good)	89	D	0.762
Paved Lots Roofs & Driveways	98	D	0.255
Dirt Streets (including ROW)	89	D	0.112
Open Space-Poor (<50% grass)	79	B	0.105
Open Space-Poor (<50% grass)	86	C	0.077
Open Space-Poor (<50% grass)	89	D	0.603

CN (weighted): 83.4
Total Area: 4.040 Acre

2. Runoff

Return Period:	2 YEAR	
Rainfall, P:	3.50	in
Runoff, Q:	1.8889	in
Runoff Volume:	0.6359	Acre-Ft

Runoff Curve Number and Runoff Thu May 7 16:26:33 2020

Project: Belta Subdivision By: S.A.L. Date: 05/07/20
Location: D.A. 'C' Checked: Date:
Developed

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Acre)
Paved Streets w/Curbs & Sewers	98	B	0.015
Woods (Good)	55	B	0.014
Paved Lots Roofs & Driveways	98	B	0.003
Open Space-Good (>75% grass)	61	B	0.037
Paved Lots Roofs & Driveways	98	D	0.231
Woods (Good)	77	D	0.561
Open Space-Good (>75% grass)	80	D	0.856
Paved Streets w/Curbs & Sewers	98	D	0.304
Open Space-Poor (<50% grass)	79	B	0.097
Open Space-Poor (<50% grass)	89	D	0.395

CN (weighted): 84.2
Total Area: 2.513 Acre

2. Runoff

Return Period:	2 YEAR	
Rainfall, P:	3.50	in
Runoff, Q:	1.9561	in
Runoff Volume:	0.4096	Acre-Ft

DYMAR
www.dymarinc.com
800 Main Street South, Suite 132 • Southbury, CT 06488-2210
(203) 264-1046 • Fax (203) 267-1547 • dymar@dymarinc.com
ENGINEERING • PLANNING • ENVIRONMENTAL • SURVEYING SERVICES

PROJECT: BELTA SUBDIVISION PAGE: 1
CLIENT: BELTA JOB #: 934
SUBJECT: DRAINAGE Comps. DATE: 5/17/20
DONE BY: S.A.L CHECKED BY:

PRE-DEVELOPMENT (EXISTING BELTA FARM w/ 2 HOUSES + GREEN HOUSES
(W DISTURBER)

RUNOFF Comps ARE EST. BY TR-55 METHOD w/ NRCS SOILS MAPPING FOR SITE.

TOTAL D.A. = 857593 SF. = 19.7 AC±
(P.O.G."A")

SOIL ID	HSG.
73E	B
73C	B
103	D
84B	C
45A	D
3	D
17	D

DYMAR
www.dymarinc.com
800 Main Street South, Suite 132 • Southbury, CT 06488-2210
(203) 264-1046 • Fax (203) 267-1547 • dymar@dymarinc.com
ENGINEERING • PLANNING • ENVIRONMENTAL • SURVEYING SERVICES

PROJECT: Bracka Subdivision		PAGE: 2	
CLIENT: Bracka		JOB #: 934	
SUBJECT: Drainage Comps		DATE: 3/19/20	
DONE BY: SAC	CHECKED BY:		

EXISTING CONDITIONS TIME OF CONC
(BASED ON TR-55)

Sheet Flow

$$T_T = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}(S)^{0.4}}$$

$n = 0.12$ (mix of Cultivated Soils + Pasture > 20%)
$L = 150$
$P_2 = 3.5$
$S = (169 - 164.5)/150 = .3\%$

$= 0.154$ hrs.
≈ 19.2 min

SHALLOW CONC. FLOW

$$T_T = \frac{L}{V \times 3600}$$

$L = 1825$
$S = \frac{164.5 - 154}{1825} = 1.6\%$

$T_T = 0.247$ hrs
≈ 14.8 min

$\Rightarrow V = 2.05$ fps (UNPAVED)

CHANNEL FLOW (MUDDY BROOK)

$$T_T = \frac{L}{V\ 3600}$$

$L = 799$
$S = \frac{154 - 149.5}{799} \approx 0.0059$ ft/ft

$= 0.221$ hrs.
≈ 16.2 min

$$V = \frac{1.49}{n} R^{2/3} \sqrt{S}$$

$S = 0.0059$ ft/ft
$n = 0.08$ (NAT'L w/pools)
$R = 6.5 \times 6.5/(6.5+1)$
$R = 0.43$ ft

$V = 0.82$ fps.

$\sum T_T = 19.2 + 14.8 + 16.2$

$\sum T_T \approx 40.2$ min

DYMAR
www.dymarinc.com
800 Main Street South, Suite 132 • Southbury, CT 06488-2210
(203) 264-1046 • Fax (203) 267-1547 • dymar@dymarinc.com
ENGINEERING • PLANNING • ENVIRONMENTAL • SURVEYING SERVICES

PROJECT: BELTA Subdivision PAGE: 3
CLIENT: Belta JOB #: 934
SUBJECT: Drainage Comps DATE:
DONE BY: SAL CHECKED BY:

Post Development Time of Conc.

DA A (Now Determined)

Sheet Flow

$$T_T = \frac{0.007 (nL)^{0.8}}{(P_2)^{0.5} (S)^{0.4}}$$

$n = 0.24$
$L = 150$
$P_2 = 3.50$
$S = (159 - 154.5)/150 = 0.03$ ft/ft

$= 0.267$ hrs. $\simeq 16$ min

Shallow Conc. Flow (unpaved)

$$T_T = \frac{L}{V\,3600} = \frac{1825}{2 \times 3600}$$

$S = \frac{159.5 - 154}{1825} = 4.65\%$

$= 0.253$ hrs $\simeq 15.2$ min

$\Rightarrow V = 2$ fps

Channel Flow (Sandy Brook)

Channel

$$T_T = \frac{799}{0.82 \times 3600} = 0.277 \text{ hrs} \simeq 16.6 \text{ min}$$

$\Sigma T_T = 47.8$ min.

DYMAR
www.dymarinc.com
800 Main Street South, Suite 132 • Southbury, CT 06488-2210
(203) 264-1046 • Fax (203) 267-1547 • dymar@dymarinc.com
ENGINEERING • PLANNING • ENVIRONMENTAL • SURVEYING SERVICES

PROJECT: BRETA SUBDIVISION PAGE: 4
CLIENT: BRETA JOB #: 934
SUBJECT: DRAINAGE CALCS DATE: 3/20/20
DONE BY: SLL CHECKED BY:

POST-DEVELOPMENT CONT.

D.A. B (DETENTION) TIME OF CONC.

SHEET FLOW

$$T_T = \frac{0.007\,(n\,L)^{0.8}}{(P_2)^{0.5}\,(S)^{0.4}}$$

$n = 0.24$
$L = 150'$
$P_2 = 3.5"$
$S = \frac{182 - 180.5}{150} = 0.01$ ft/ft.

$T_T = 0.415$ hrs
≈ 24.9 min.

SHALLOW CONC. FLOW

$$T_T = \frac{L}{V \times 3600}$$

$L = 520$ ft
$S = \frac{180.5 - 166}{520} = 0.028$ ft/ft

$T_T = 0.056$ hrs
≈ 3.3 min

$V = 2.6$ fps (UNPAVED)

NO CHANNEL FLOW

$\Sigma T_T = 24.9 + 3.3 = 28.2$ min

D.A. C (CENTERLINE TO PRIVATE RD.)

SHEET FLOW $T_T = 1.4$ min @ $L = 126$

$n = 0.011$, $S = \frac{182.4 - 180}{126} = 0.019$ ft/ft

SHALLOW CONC. $T_T = \frac{332}{4 \times 3600}$ $P_2 = 3.5"$

$= 0.023$ hrs.
≈ 1.38 min

$\rightarrow S = \frac{180 - 155.3}{332} = 6.2\%$

$V = 4$ fps

NO CHANNEL FLOW

$\Sigma T_T = 2.78$ min use 5 min.

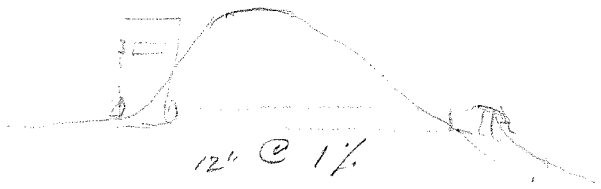
DYMAR
www.dymarinc.com
800 Main Street South, Suite 132 • Southbury, CT 06488-2210
(203) 264-1046 • Fax (203) 267-1547 • dymar@dymarinc.com
ENGINEERING • PLANNING • ENVIRONMENTAL • SURVEYING SERVICES

PROJECT: Beech Subdivision		PAGE: 5	
CLIENT: Balta		JOB #: 934	
SUBJECT: Drainage Calcs		DATE: 3/19/20	
DONE BY: SAL	CHECKED BY:		

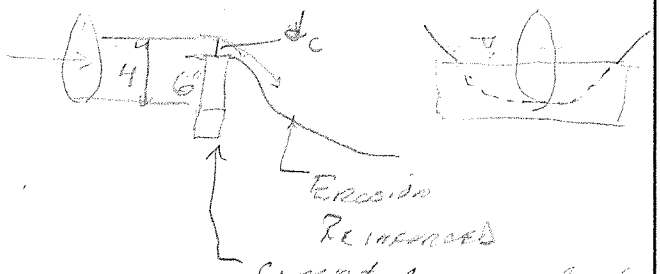
STAGE / SOURCE of Pump Pond.

STAGE	AREA	VOLUME	VOL TOTAL
0	6652	0	0
1	9211	15863	15863
2	12773	21984	37847

RATING Curve FOR LEVEL SPREADER.



Allowed 0.2 cfs per LF.



FOR 1 UNIT LF

STAGE	H	AREA	Flow	Vel.
0	0	0	0	0
0.05	0.05	0.05	0.037	0.74
0.10	0.10	0.10	0.105	1.05
0.15	0.15	0.15	0.193	1.29
0.20	0.20	0.20	0.298	1.49
0.25	0.25	0.25	0.416	1.67
0.30	0.30	0.30	0.547	1.82

$Q = VA \quad A = w \times H$

$Q = 3.387 L H^{3/2}$

L = Length

H = Height of flow

Design Storm Report

Custom Storm filename:

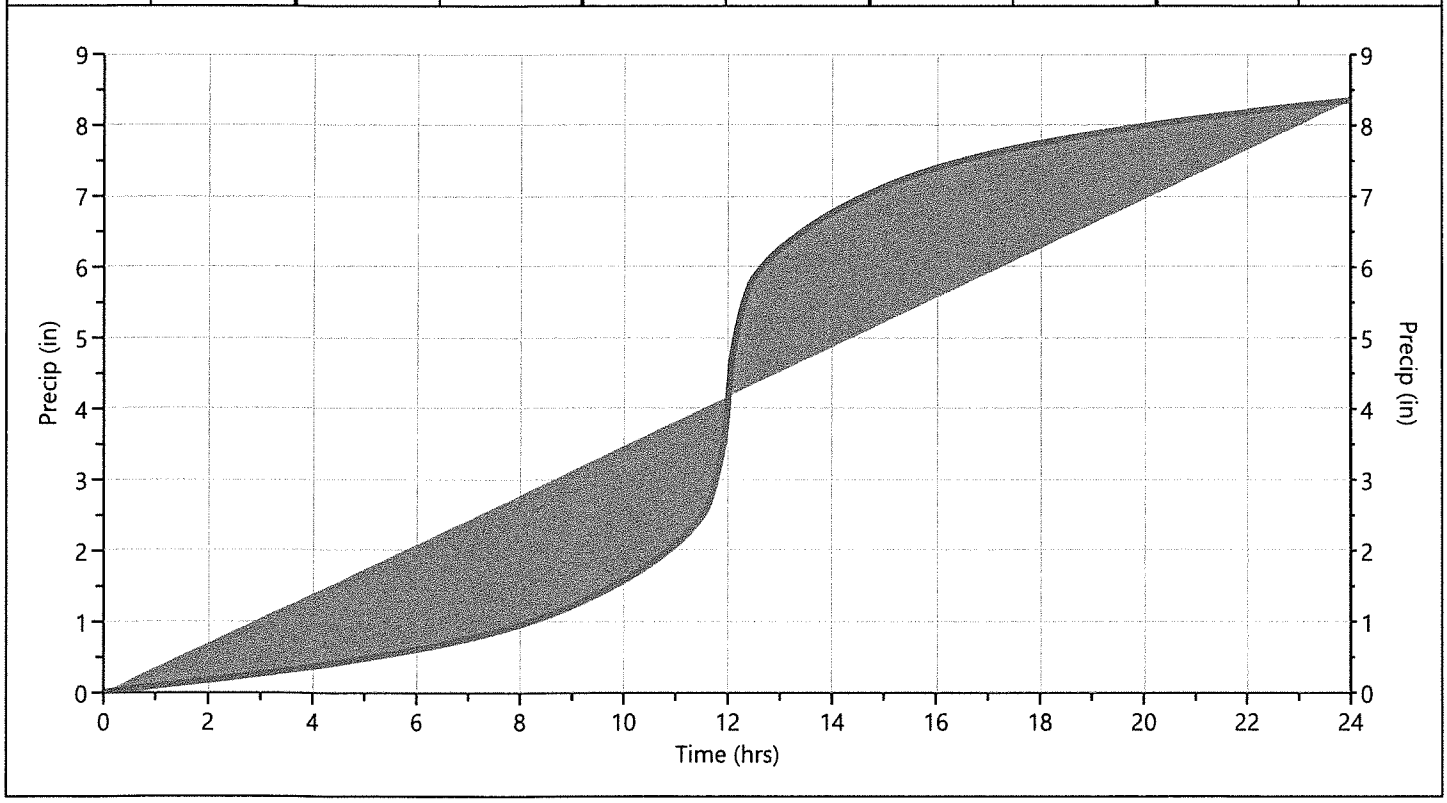
Hydrology Studio v 3.0.0.14

03-31-2020

Storm Distribution: NRCS/SCS - Type III

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	✔ 100-yr	
24 hrs	2.87	3.50	0.00	4.53	5.38	6.55	7.42	8.35	

Incremental Rainfall Distribution, 100-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.50	1.645422	11.68	3.799224	11.87	6.044459	12.05	12.545820	12.23	5.023909
11.52	1.753402	11.70	4.003358	11.88	6.248593	12.07	10.834070	12.25	4.819822
11.53	1.962233	11.72	4.207468	11.90	6.452680	12.08	9.122276	12.27	4.615688
11.55	2.166367	11.73	4.411578	11.92	7.434464	12.10	7.410574	12.28	4.411602
11.57	2.370453	11.75	4.615688	11.93	9.122419	12.12	6.477213	12.30	4.207468
11.58	2.574587	11.77	4.819798	11.95	10.834170	12.13	6.248617	12.32	4.003382
11.60	2.778697	11.78	5.023909	11.97	12.545920	12.15	6.044483	12.33	3.799248
11.62	2.982783	11.80	5.228019	11.98	14.257690	12.17	5.840349	12.35	3.595161
11.63	3.186917	11.82	5.432129	**12.00**	**15.969420**	12.18	5.636263	12.37	3.391027
11.65	3.391027	11.83	5.636263	12.02	15.931080	12.20	5.432129	12.38	3.186941
11.67	3.595138	11.85	5.840349	12.03	14.257570	12.22	5.228043	12.40	2.982807



IDF Report

IDF filename: WestportCT.idf

Hydrology Studio v 3.0.0.14

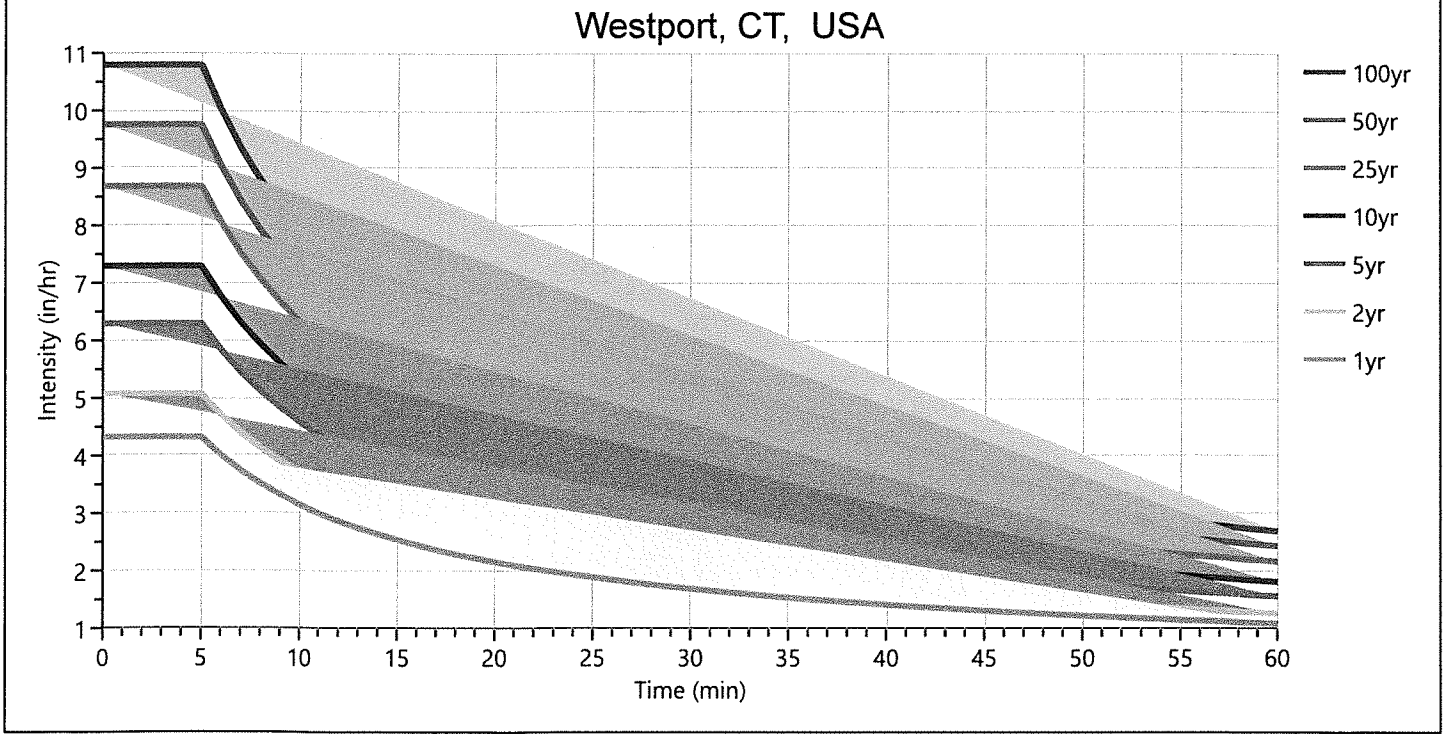
03-31-2020

Equation Coefficients	Intensity = B / (Tc + D)^E (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
B	19.1512	23.4447	0.0000	29.1010	33.6846	39.3431	42.7720	49.6031	
D	3.6000	3.8000	0.0000	3.8000	3.8000	3.7000	3.5000	3.8000	
E	0.6924	0.7035	0.0000	0.7041	0.7035	0.6986	0.6909	0.7013	

Minimum Tc = 5 minutes

Tc (min)	Intensity Values (in/hr)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
Cf	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
5	4.32	5.08	0	6.29	7.29	8.68	9.75	10.79	
10	3.14	3.70	0	4.58	5.31	6.32	7.08	7.87	
15	2.53	2.98	0	3.69	4.28	5.09	5.70	6.34	
20	2.15	2.52	0	3.12	3.62	4.31	4.83	5.37	
25	1.88	2.20	0	2.73	3.17	3.77	4.23	4.70	
30	1.68	1.97	0	2.44	2.83	3.37	3.78	4.20	
35	1.53	1.79	0	2.21	2.57	3.06	3.43	3.81	
40	1.40	1.64	0	2.03	2.36	2.81	3.16	3.50	
45	1.30	1.52	0	1.88	2.19	2.61	2.93	3.25	
50	1.22	1.42	0	1.76	2.04	2.43	2.74	3.03	
55	1.14	1.33	0	1.65	1.92	2.29	2.57	2.85	
60	1.08	1.26	0	1.56	1.81	2.16	2.43	2.69	

Cf = Correction Factor applied to Rational Method runoff coefficient.



Precipitation Report

Precipitation filename: WestportCT.pcp

Hydrology Studio v 3.0.0.14 (Rainfall totals in Inches)

03-31-2020

	Active	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Active			✔		✔	✔	✔	✔	✔
SCS Storms	**> SCS Dimensionless Storms**								
SCS 6hr		2.00	2.40	0	3.06	3.61	4.36	4.93	5.52
Type I, 24-hr		2.87	3.50	0	4.53	5.38	6.55	7.42	8.35
Type IA, 24-hr		2.87	3.50	0	4.53	5.38	6.55	7.42	8.35
Type II, 24-hr		2.87	3.50	0	4.53	5.38	6.55	7.42	8.35
Type II FL, 24-hr		2.87	3.50	0	4.53	5.38	6.55	7.42	8.35
Type III, 24-hr	✔	2.87	3.50	0	4.53	5.38	6.55	7.42	8.35
Synthetic Storms	**> IDF-Based Synthetic Storms**								
1-hr		1.08	1.26	0	1.56	1.81	2.16	2.43	2.69
2-hr		1.36	1.58	0	1.96	2.27	2.72	3.07	3.38
3-hr		1.56	1.80	0	2.22	2.58	3.09	3.50	3.84
6-hr		1.94	2.22	0	2.75	3.19	3.84	4.37	4.76
12-hr		2.41	2.74	0	3.39	3.93	4.75	5.43	5.88
24-hr		2.98	3.37	0	4.16	4.84	5.86	6.74	7.24
Huff Distribution	**> 1st Quartile (0 to 6 hrs)**								
1-hr		1.08	1.26	0	1.56	1.81	2.16	2.43	2.69
2-hr		1.38	1.64	0	2.06	2.41	2.90	3.27	3.64
3-hr		1.59	1.90	0	2.40	2.82	3.40	3.84	4.29
6-hr		2.00	2.40	0	3.06	3.61	4.36	4.93	5.52
Huff Distribution	**> 2nd Quartile (>6 to 12 hrs)**								
8-hr		0	0	0	0	0	0	0	0
12-hr		2.46	2.97	0	3.80	4.48	5.43	6.13	6.88
Huff Distribution	**> 3rd Quartile (>12 to 24 hrs)**								
18-hr		0	0	0	0	0	0	0	0
24-hr		2.87	3.50	0	4.53	5.38	6.55	7.42	8.35
Custom Storms	**> Custom Storm Distributions**								
My Custom Storm 1		0	0	0	0	0	0	0	0
My Custom Storm 2		0	0	0	0	0	0	0	0
My Custom Storm 3		0	0	0	0	0	0	0	0
My Custom Storm 4		0	0	0	0	0	0	0	0
My Custom Storm 5		0	0	0	0	0	0	0	0
My Custom Storm 6		0	0	0	0	0	0	0	0
My Custom Storm 7		0	0	0	0	0	0	0	0
My Custom Storm 8		0	0	0	0	0	0	0	0
My Custom Storm 9		0	0	0	0	0	0	0	0
My Custom Storm 10		0	0	0	0	0	0	0	0

Table 8–4 Allowable velocities

Channel material	Mean channel velocity (ft/s)	(m/s)
Fine sand	2.0	0.61
Coarse sand	4.0	1.22
Fine gravel	6.0	1.83
Earth		
Sandy silt	2.0	0.61
Silt clay	3.5	1.07
Clay	6.0	1.83
Grass-lined earth (slopes <5%)		
Bermudagrass		
Sandy silt	6.0	1.83
Silt clay	8.0	2.44
Kentucky bluegrass		
Sandy silt	5.0	1.52
Silt clay	7.0	2.13
Poor rock (usually sedimentary)	10.0	3.05
Soft sandstone	8.0	2.44
Soft shale	3.5	1.07
Good rock (usually igneous or hard metamorphic)	20.0	6.08

Figure 8–3 Allowable velocity-depth grain chart