Stormwater Management Report

Prepared For

755 Avenue E
Tax Lot 8, Block 72
City of Bayonne
Hudson County, NJ

August 25, 2021

Prepared by:

AWZ ENGINEERING, INC.
Engineers . Scientists . Consultants
150 River Road, Suite B3, Montville, NJ 07045
Phone: 973.588.7080 Fax: 973.588.7079
www.awzengineering.com

Adnan A. Khan, P.E., C.M.E.
New Jersey Professional Engineer
License Number GE39812
AWZ Project No. 21-0612

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SECTION - I

STORAGE VOLUME SUMMARY

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STORAGE VOLUME SUMMARY:

Storage Volume (gallons)	
Storm Event	Modified Rational Method
2-year	460
10-year	705
100-year	1,046

Due to increase in the post-development runoff, on-site detention is proposed for this project
Provide One (1) Dry Well System (total proposed volume @ 1,081-gallons)

NOTES:

1. Dry well dimensions may be adjusted to suit site, as long as total storage volume is maintained
2. Total volume may be split among multiple downspouts/trenches to fit site.
3. Where applicable, splash block should be directed to avoid discharging to adjacent properties.
4. Subgrade soil shall be protected from compaction during construction.
5. Bottom of dry well system must be a minimum of 2 feet above the seasonal high water table or bedrock and be as level as practical.
6. Drywell system(s) of equivalent design may be substituted.
7. The dry well system should be located at least 10 feet away from the foundation of the nearest building to prevent foundation damage.
8. The calculated storage volume and dimensions of the dry well system is based on the proposed increase in impervious surface and estimated soil permeability.

SECTION - II

RATIONAL METHOD
RUNOFF CALCULATIONS

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RATIONAL METHOD:

Rational Method will be used to calculate the peak flow to account for the increase in the stormwater runoff as a result of this project.

$Q_p = CIA$

where,

Q_p = the peak runoff rate in cubic feet per second
C = the runoff coefficient
I = the average rainfall intensity in inches per hour occurring at the time of concentration t_c
t_c = the time of concentration in minutes
A = the size of the drainage area in acres

$C_{Pavement}$ =	0.99	
C_{Roof} =	0.99	
C_{Grass} =	0.51	(Good Condition)
C_{Deck} =	0.84	
C_{Dirt} =	0.80	

Using NOAA Precipitation Intensity Estimates for the Bayonne, New Jersey

Assume t_c = 10 minutes

$I_{2\text{-years}}$ =	3.81
$I_{10\text{-years}}$ =	5.03
$I_{100\text{-years}}$ =	6.52

Existing Conditions:

A_{Lot} =	0.049	
A_{Grass} =	0.048	
A_{Deck} =	0.000	
A_{Roof} =	0.000	
$A_{Pavement}$ =	0.001	(Driveway, Concrete, etc.)
A_{Dirt} =	0.000	

$\Delta C = (A_{(roof\ \&\ pavement)} * C_{(roof\ \&\ pavement)} + A_{grass} * C_{grass} + A_{deck} * C_{deck} + A_{dirt} * C_{dirt}) / A_{LOT}$

ΔC = 0.523

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Existing Runoffs:

$Q_p = \Delta C I A_{Lot}$

$Q_{2\text{-year}}$ = 0.098

$Q_{10\text{-year}}$ = 0.130

$Q_{100\text{-year}}$ = 0.168

Proposed Conditions:

A_{Lot} = 0.049
A_{Grass} = 0.007
A_{Deck} = 0.000
A_{Roof} = 0.032
$A_{Pavement}$ = 0.011 (Driveway, Concrete, etc.)
A_{Dirt} = 0.000

$\Delta C = (A_{(roof\ \&\ pavement)} * C_{(roof\ \&\ pavement)} + A_{grass} * C_{grass} + A_{deck} * C_{deck} + A_{dirt} * C_{dirt}) / A_{LOT}$

ΔC = 0.924

Proposed Runoffs:

$Q_p = \Delta C I A_{Lot}$

$Q_{2\text{-year}}$ = 0.17

$Q_{10\text{-year}}$ = 0.229

$Q_{100\text{-year}}$ = 0.297

Summary:

Storm Event	Existing Runoff	Proposed Runoff	Difference (cfs)
2-year	0.098	0.173	0.075
10-year	0.130	0.229	0.099
100-year	0.168	0.297	0.129

SECTION - III

MODIFIED RATIONAL METHOD STORAGE VOLUME CALCULATIONS

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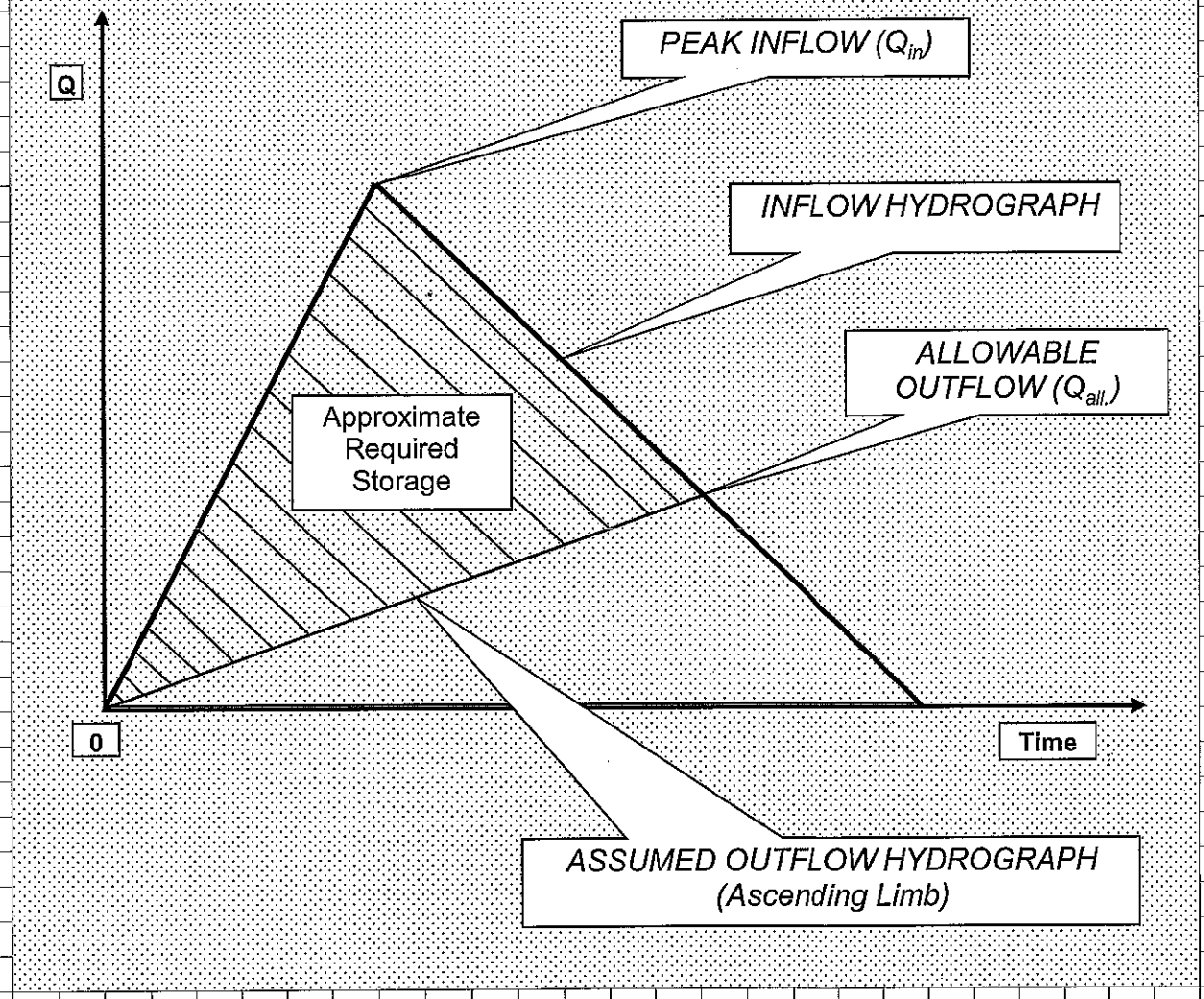
MODIFIED RATIONAL METHOD

Required Storage Volume



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MODIFIED RATIONAL METHOD:

2-Year Storm:

$t_{c\ (min)}$=	10.0
$C_{existing}$ =	0.523
$I_{existing\ (2\text{-}years)}$ =	3.81
$A_{existing\ (acres)}$ =	0.049

$Q = CIA$

$Q_{existing\ (cfs)}$ =	0.098

$Q_{allowable} = Q_{existing}$

$Q_{allowable}$ =	0.10

For Storm Event equal to Time of Concentration

Peak Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Peak Runoff$_{(cfs)}$

Allowable Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Allowable Runoff$_{(cfs)}$

For Storm Event greater than Time of Concentration

Peak Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Peak Runoff$_{(cfs)}$

Allowable Storage = 1/2 [Storm Duration $_{(min)}$ + Time of Concentration $_{(min)}$] x 60 $_{(sec)}$ x Allowable Runoff$_{(cfs)}$

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MODIFIED RATIONAL METHOD:

2-Year Storm:

Using NOAA Precipitation Intensity Estimates for the Bayonne, New Jersey

Storm Duration (min)	Rainfall Intensity (in/hr)	Runoff Coefficient (C)	Drainage Area (acres)	Peak Runoff (cfs)	Peak Storage (cf)	Allowable Runoff (cfs)	Allowable Storage (cf)	Storage Required (cf)	Storage Required (gallons)
10	3.81	0.92	0.049	0.17	104.0	0.10	59	45	337
15	3.18	0.92	0.049	0.14	130.2	0.10	74	57	423
30	**2.19**	**0.92**	**0.049**	**0.10**	**179.3**	**0.10**	**118**	**62**	**460**
60	1.37	0.92	0.049	0.06	224.4	0.10	206	18	0
120	0.85	0.92	0.049	0.04	276.8	0.10	383	-106	0
180	0.63	0.92	0.049	0.03	307.1	0.10	559	-252	0
360	0.40	0.92	0.049	0.02	395.0	0.10	1090	-695	0
720	0.24	0.92	0.049	0.01	479.5	0.10	2150	-1670	0
1440	0.14	0.92	0.049	0.01	542.4	0.10	4270	-3727	0

Legend

30	Critical Storm based on Allowable Runoff
0	Storm Durations with Peak Runoff Equal to or Less than Allowable Runoff

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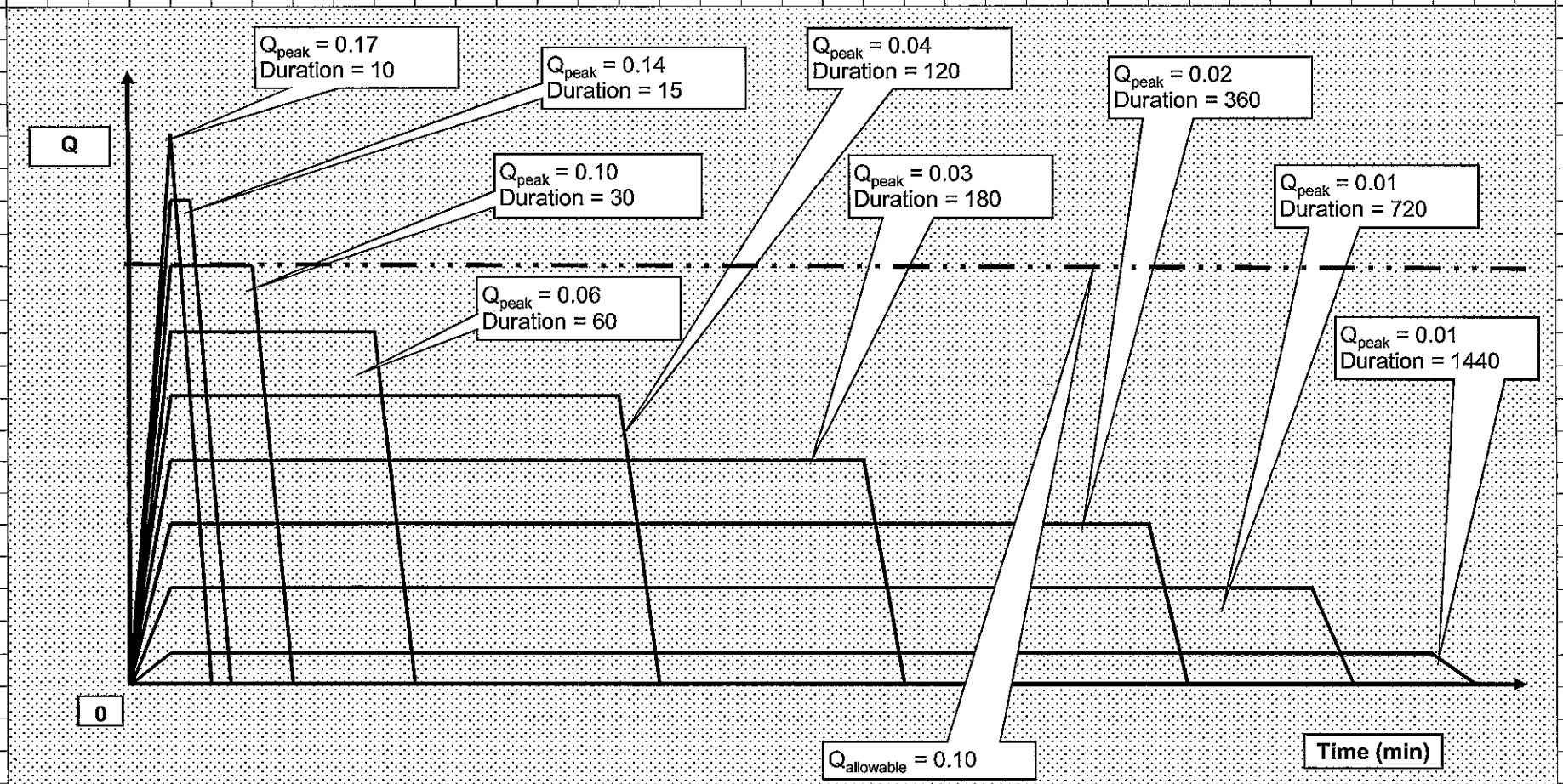
MODIFIED RATIONAL METHOD

Individual Range of Storm Runoff Hydrographs
2 -Year Storm



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MODIFIED RATIONAL METHOD:

10-Year Storm:

$t_{c\ (min)}$=	10.0
$C_{existing}$ =	0.523
$I_{existing\ (10\text{-}years)}$ =	5.03
$A_{existing\ (acres)}$ =	0.049

$Q = CIA$

$Q_{existing\ (cfs)}$ = 0.130

$Q_{allowable} = Q_{existing}$

$Q_{allowable}$ = 0.13

For Storm Event equal to Time of Concentration

Peak Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Peak Runoff$_{(cfs)}$

Allowable Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Allowable Runoff$_{(cfs)}$

For Storm Event greater than Time of Concentration

Peak Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Peak Runoff$_{(cfs)}$

Allowable Storage = 1/2 [Storm Duration $_{(min)}$ + Time of Concentration $_{(min)}$] x 60 $_{(sec)}$ x Allowable Runoff$_{(cfs)}$

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MODIFIED RATIONAL METHOD:

10-Year Storm:

Using NOAA Precipitation Intensity Estimates for the Bayonne, New Jersey

Storm Duration (min)	Rainfall Intensity (in/hr)	Runoff Coefficient (C)	Drainage Area (acres)	Peak Runoff (cfs)	Peak Storage (cf)	Allowable Runoff (cfs)	Allowable Storage (cf)	Storage Required (cf)	Storage Required (gallons)
10	5.03	0.92	0.049	0.23	137.3	0.13	77.8	60	445
15	4.22	0.92	0.049	0.19	172.8	0.13	97.2	76	565
30	**3.05**	**0.92**	**0.049**	**0.14**	**249.8**	**0.13**	**155.5**	**94**	**705**
60	1.98	0.92	0.049	0.09	324.3	0.13	272.1	52	0
120	1.24	0.92	0.049	0.06	406.2	0.13	505.4	-99	0
180	0.92	0.92	0.049	0.04	453.0	0.13	738.6	-286	0
360	0.59	0.92	0.049	0.03	581.7	0.13	1438.4	-857	0
720	0.36	0.92	0.049	0.02	715.4	0.13	2837.9	-2123	0
1440	0.21	0.92	0.049	0.01	821.5	0.13	5637.0	-4816	0

Legend

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0	Storm Durations with Peak Runoff Equal to or Less than Allowable Runoff

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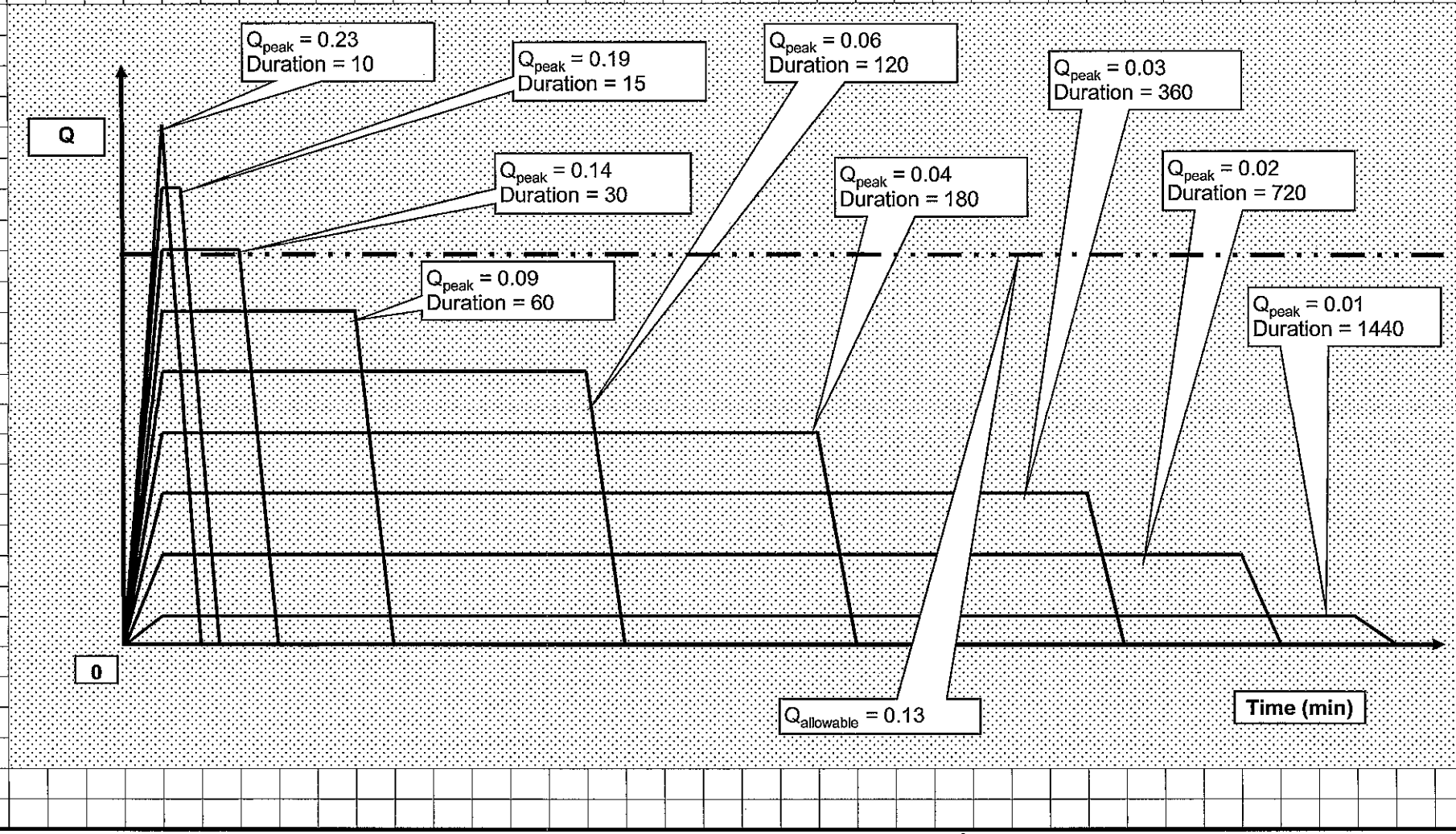
MODIFIED RATIONAL METHOD

Individual Range of Storm Runoff Hydrographs
10 -Year Storm



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MODIFIED RATIONAL METHOD:

100-Year Storm:

$t_{c\ (min)}$=	10.0
$C_{existing}$ =	0.523
$I_{existing\ (100\text{-}years)}$ =	6.52
$A_{existing\ (acres)}$ =	0.049

Q = CIA

$Q_{existing\ (cfs)}$ =	0.168

$Q_{allowable} = Q_{existing}$

$Q_{allowable}$ =	0.17

For Storm Event equal to Time of Concentration

Peak Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Peak Runoff$_{(cfs)}$

Allowable Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Allowable Runoff$_{(cfs)}$

For Storm Event greater than Time of Concentration

Peak Storage = Storm Duration $_{(min)}$ x 60 $_{(sec)}$ x Peak Runoff$_{(cfs)}$

Allowable Storage = 1/2 [Storm Duration $_{(min)}$ + Time of Concentration $_{(min)}$] x 60 $_{(sec)}$ x Allowable Runoff$_{(cfs)}$

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100-Year Storm:

Using NOAA Precipitation Intensity Estimates for the Bayonne, New Jersey

Storm Duration (min)	Rainfall Intensity (in/hr)	Runoff Coefficient (C)	Drainage Area (acres)	Peak Runoff (cfs)	Peak Storage (cf)	Allowable Runoff (cfs)	Allowable Storage (cf)	Storage Required (cf)	Storage Required (gallons)
10	6.52	0.92	0.049	0.30	178.0	0.17	100.8	77	577
15	5.48	0.92	0.049	0.25	224.4	0.17	126.0	98	736
30	**4.17**	**0.92**	**0.049**	**0.19**	**341.5**	**0.17**	**201.6**	**140**	**1046**
60	2.87	0.92	0.049	0.13	470.0	0.17	352.7	117	0
120	1.89	0.92	0.049	0.09	619.1	0.17	655.1	-36	0
180	1.41	0.92	0.049	0.06	692.8	0.17	957.4	-265	0
360	0.92	0.92	0.049	0.04	903.1	0.17	1864.5	-961	0
720	0.58	0.92	0.049	0.03	1145.8	0.17	3678.6	-2533	0
1440	0.35	0.92	0.049	0.02	1363.9	0.17	7306.8	-5943	0

Legend

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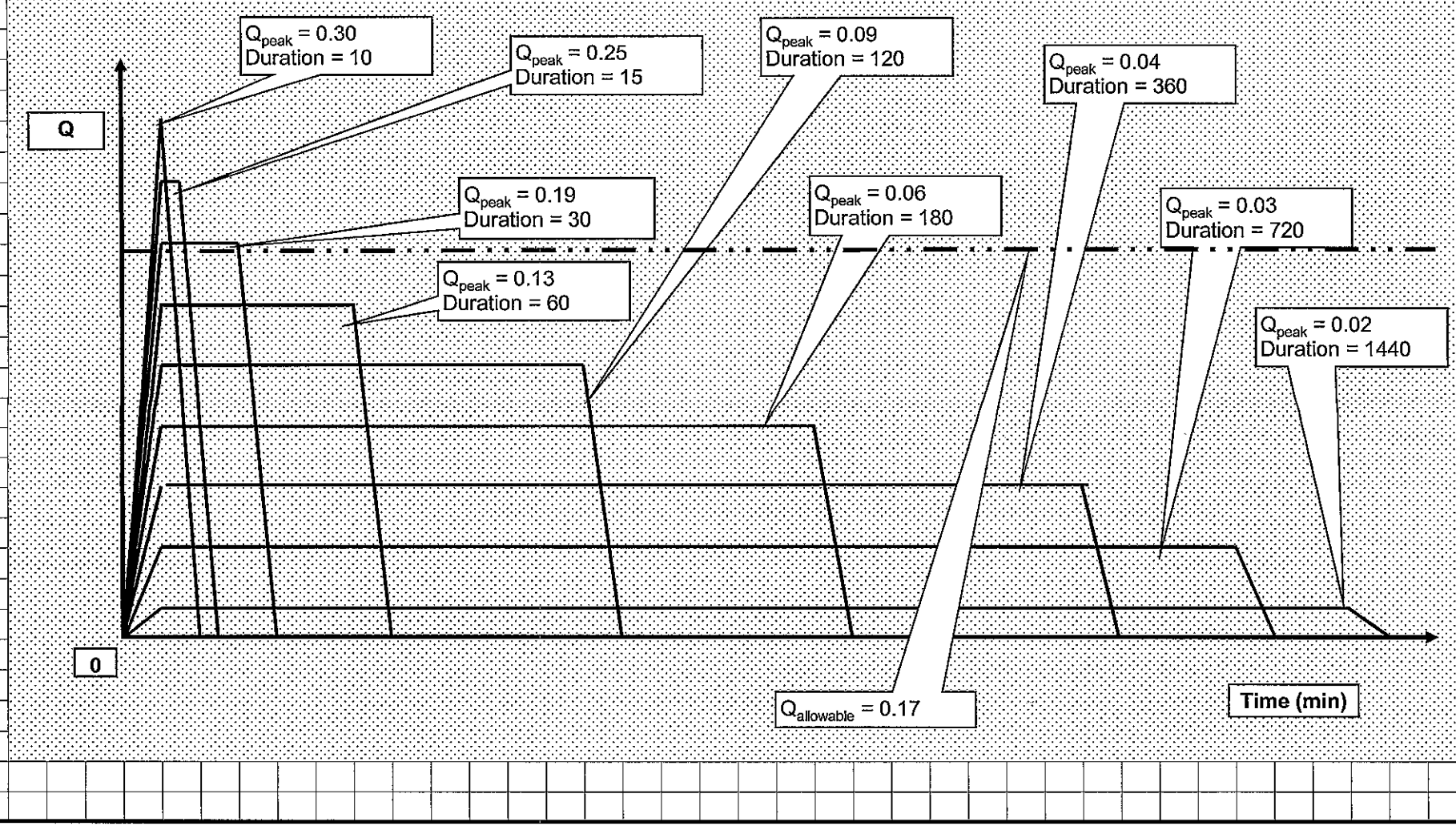

APPENDIX - A

NOAA RAINFALL DATA
BAYONNE, NEW JERSEY

NOAA Atlas 14, Volume 2, Version 3
Location name: Bayonne, New Jersey, USA*
Latitude: 40.6688°, Longitude: -74.1175°
Elevation: 37.27 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

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	4.01 (3.66-4.40)	4.78 (4.37-5.26)	5.65 (5.16-6.22)	6.30 (5.74-6.92)	7.13 (6.46-7.84)	7.69 (6.92-8.45)	8.26 (7.40-9.07)	8.77 (7.81-9.66)	9.42 (8.29-10.4)	9.95 (8.69-11.0)
10-min	3.19 (2.92-3.50)	3.81 (3.49-4.19)	4.52 (4.12-4.97)	5.03 (4.58-5.53)	5.65 (5.11-6.20)	6.08 (5.48-6.69)	6.52 (5.84-7.17)	6.91 (6.15-7.61)	7.40 (6.51-8.19)	7.74 (6.76-8.60)
15-min	2.65 (2.43-2.92)	3.18 (2.91-3.50)	3.80 (3.46-4.18)	4.22 (3.84-4.64)	4.76 (4.31-5.23)	5.12 (4.62-5.64)	5.48 (4.91-6.03)	5.81 (5.17-6.40)	6.21 (5.46-6.87)	6.48 (5.66-7.20)
30-min	1.81 (1.66-1.99)	2.19 (2.01-2.41)	2.69 (2.45-2.96)	3.05 (2.78-3.35)	3.51 (3.18-3.86)	3.84 (3.46-4.22)	4.17 (3.74-4.59)	4.48 (3.99-4.94)	4.90 (4.31-5.42)	5.21 (4.55-5.78)
60-min	1.13 (1.03-1.24)	1.37 (1.25-1.51)	1.72 (1.57-1.89)	1.98 (1.80-2.18)	2.33 (2.11-2.56)	2.59 (2.34-2.85)	2.87 (2.57-3.15)	3.14 (2.79-3.46)	3.50 (3.08-3.88)	3.78 (3.30-4.20)
2-hr	0.694 (0.632-0.767)	0.845 (0.769-0.934)	1.07 (0.972-1.18)	1.24 (1.13-1.37)	1.49 (1.34-1.64)	1.68 (1.51-1.86)	1.89 (1.68-2.08)	2.10 (1.85-2.32)	2.40 (2.09-2.66)	2.63 (2.27-2.93)
3-hr	0.514 (0.469-0.567)	0.625 (0.570-0.691)	0.792 (0.721-0.875)	0.922 (0.837-1.02)	1.10 (0.995-1.22)	1.25 (1.12-1.38)	1.41 (1.25-1.55)	1.57 (1.38-1.73)	1.79 (1.56-1.98)	1.97 (1.70-2.18)
6-hr	0.331 (0.302-0.366)	0.402 (0.367-0.444)	0.507 (0.461-0.558)	0.592 (0.536-0.650)	0.713 (0.641-0.782)	0.813 (0.726-0.892)	0.919 (0.814-1.01)	1.03 (0.906-1.13)	1.19 (1.03-1.32)	1.33 (1.13-1.47)
12-hr	0.201 (0.184-0.221)	0.244 (0.223-0.268)	0.309 (0.282-0.339)	0.364 (0.330-0.398)	0.443 (0.399-0.482)	0.511 (0.456-0.555)	0.583 (0.515-0.634)	0.663 (0.578-0.721)	0.779 (0.667-0.849)	0.877 (0.740-0.957)
24-hr	0.114 (0.105-0.124)	0.138 (0.127-0.150)	0.176 (0.162-0.191)	0.209 (0.192-0.227)	0.258 (0.236-0.279)	0.300 (0.272-0.325)	0.347 (0.312-0.375)	0.399 (0.355-0.432)	0.477 (0.417-0.518)	0.544 (0.469-0.592)
2-day	0.066 (0.061-0.073)	0.080 (0.074-0.088)	0.103 (0.094-0.112)	0.121 (0.111-0.132)	0.149 (0.135-0.162)	0.172 (0.155-0.187)	0.198 (0.177-0.216)	0.226 (0.200-0.247)	0.267 (0.233-0.294)	0.302 (0.260-0.334)
3-day	0.047 (0.043-0.051)	0.057 (0.052-0.062)	0.072 (0.066-0.078)	0.085 (0.078-0.092)	0.104 (0.095-0.113)	0.120 (0.108-0.130)	0.137 (0.123-0.149)	0.156 (0.139-0.170)	0.184 (0.161-0.201)	0.207 (0.179-0.228)
4-day	0.037 (0.034-0.040)	0.045 (0.041-0.049)	0.057 (0.052-0.062)	0.067 (0.061-0.073)	0.081 (0.074-0.088)	0.093 (0.085-0.101)	0.107 (0.096-0.116)	0.121 (0.108-0.132)	0.142 (0.125-0.155)	0.159 (0.138-0.175)
7-day	0.025 (0.023-0.027)	0.030 (0.028-0.032)	0.037 (0.034-0.040)	0.043 (0.040-0.047)	0.052 (0.048-0.056)	0.059 (0.054-0.064)	0.067 (0.061-0.072)	0.075 (0.067-0.081)	0.087 (0.077-0.095)	0.097 (0.085-0.106)
10-day	0.020 (0.018-0.021)	0.023 (0.022-0.025)	0.029 (0.027-0.031)	0.033 (0.031-0.036)	0.039 (0.036-0.042)	0.044 (0.041-0.048)	0.050 (0.046-0.054)	0.056 (0.050-0.060)	0.064 (0.057-0.069)	0.070 (0.062-0.077)
20-day	0.013 (0.012-0.014)	0.016 (0.015-0.017)	0.019 (0.017-0.020)	0.021 (0.020-0.022)	0.024 (0.023-0.026)	0.027 (0.025-0.029)	0.029 (0.027-0.031)	0.032 (0.029-0.034)	0.035 (0.032-0.038)	0.038 (0.035-0.041)
30-day	0.011 (0.010-0.012)	0.013 (0.012-0.014)	0.015 (0.014-0.016)	0.017 (0.016-0.018)	0.019 (0.018-0.020)	0.021 (0.019-0.022)	0.022 (0.021-0.024)	0.024 (0.022-0.026)	0.026 (0.024-0.028)	0.028 (0.025-0.030)
45-day	0.009 (0.009-0.010)	0.011 (0.010-0.012)	0.013 (0.012-0.013)	0.014 (0.013-0.015)	0.016 (0.015-0.016)	0.017 (0.016-0.018)	0.018 (0.017-0.019)	0.019 (0.018-0.020)	0.021 (0.019-0.022)	0.022 (0.020-0.023)
60-day	0.008 (0.008-0.009)	0.010 (0.009-0.010)	0.011 (0.011-0.012)	0.012 (0.012-0.013)	0.014 (0.013-0.014)	0.015 (0.014-0.015)	0.015 (0.015-0.016)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.018 (0.017-0.019)

[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.

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PF graphical

APPENDIX - B

DRY WELL STORAGE VOLUME CALCULATION

AWZ ENGINEERING, INC.
150 River Road, Suite B3
Montville, NJ 07045
(973) 588-7080
www.awzengineering.com

JOB 21-0612
SHEET NO. 1 OF 1
CALCULATED BY LF DATE 8/25/2021
CHECKED BY AAK DATE
SCALE

STORAGE VOLUME CALCULATIONS

Dry Well Volume: (Precast Concrete)

Overall Diameter =	6.50	ft.
Overall Length =	3.00	ft.
Storage Diameter =	6.00	ft.
Storage Length =	2.67	ft.
Overall Area =	33.18	ft^2
Overall Volume =	99.55	ft^3
Overall Volume =	744.6299	Gallons
Storage Area =	28.27	ft^2
Storage Volume =	75.49	ft^3
Storage Volume =	564.69	Gallons

Stone Volume Around Dry Well (2" - 2 1/2")

Excavation Length =	8.00	ft.
Excavation Width =	8.00	ft.
Excavation Depth =	4.25	ft. (to the top of the Dry Well)
Excavation Volume =	272.00	ft^3

Total Stone Volume = Excavation Volume - Overall Dry Well Volume

Total Stone Volume =	172.45	ft^3
Total Stone Volume =	1289.93	Gallons
Water Storage Volume in Stone Voids (40%) =	68.98	ft^3
Water Storage Volume in Stone Voids (40%) =	515.97	Gallons

Proposed Water Retention Volume

Total Water Retention Volume = Dry Well Storage Volume + Storage Volume in Stone Voids

Total Water Retention Volume =	144.47	ft^3
Total Water Retention Volume =	1080.66	Gallons

Provide One (1) Dry Well System with Approximately 1,081-gallons Total Storage Volume