

Stormwater Management Report

Prepared For

664 Valley Brook Avenue
Tax Lot 19, Block 102
Township of Lyndhurst
Bergen County, NJ

August 12, 2020

Prepared by:



Engineers . Scientists . Consultants

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www.awzengineering.com

A handwritten signature in black ink that reads 'Adnan Khan'. The signature is written in a cursive, flowing style.

Adnan A. Khan, P.E., C.M.E.
New Jersey Professional Engineer
License Number GE39812
AWZ Project No. 20-0701

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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

493

10-year

671

100-year

891

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 @ 937-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

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

$$C_{\text{Pavement}} = 0.99$$

$$C_{\text{Roof}} = 0.99$$

$$C_{\text{Grass}} = 0.51 \quad (\text{Good Condition})$$

$$C_{\text{Deck}} = 0.84$$

$$C_{\text{Dirt}} = 0.80$$

Using NOAA Precipitation Intensity Estimates for the Lyndhurst, New Jersey

Assume $t_c = 10$ minutes

$$I_{2\text{-years}} = 3.80$$

$$I_{10\text{-years}} = 5.03$$

$$I_{100\text{-years}} = 6.53$$

Existing Conditions:

$$A_{\text{Lot}} = 0.223$$

$$A_{\text{Grass}} = 0.099$$

$$A_{\text{Deck}} = 0.000 \quad (\text{Wood})$$

$$A_{\text{Roof}} = 0.044$$

$$A_{\text{Pavement}} = 0.080 \quad (\text{Driveway, Concrete, etc.})$$

$$A_{\text{Dirt}} = 0.000$$

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

$$\Delta C = 0.776$$

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Existing Runoffs:

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

$$Q_{2\text{-year}} = 0.658$$

$$Q_{10\text{-year}} = 0.871$$

$$Q_{100\text{-year}} = 1.131$$

Proposed Conditions:

$$A_{Lot} = 0.223$$

$$A_{Grass} = 0.052$$

$$A_{Deck} = 0.000$$

$$A_{Roof} = 0.074$$

$$A_{Pavement} = 0.098 \quad (\text{Driveway, Concrete, etc.})$$

$$A_{Dirt} = 0.000$$

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

$$\Delta C = 0.879$$

Proposed Runoffs:

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

$$Q_{2\text{-year}} = 0.75$$

$$Q_{10\text{-year}} = 0.986$$

$$Q_{100\text{-year}} = 1.281$$

Summary:

Storm Event	Existing Runoff	Proposed Runoff	Difference (cfs)
2-year	0.658	0.745	0.087
10-year	0.871	0.986	0.115
100-year	1.131	1.281	0.150

SECTION - III

**MODIFIED RATIONAL METHOD
STORAGE VOLUME CALCULATIONS**

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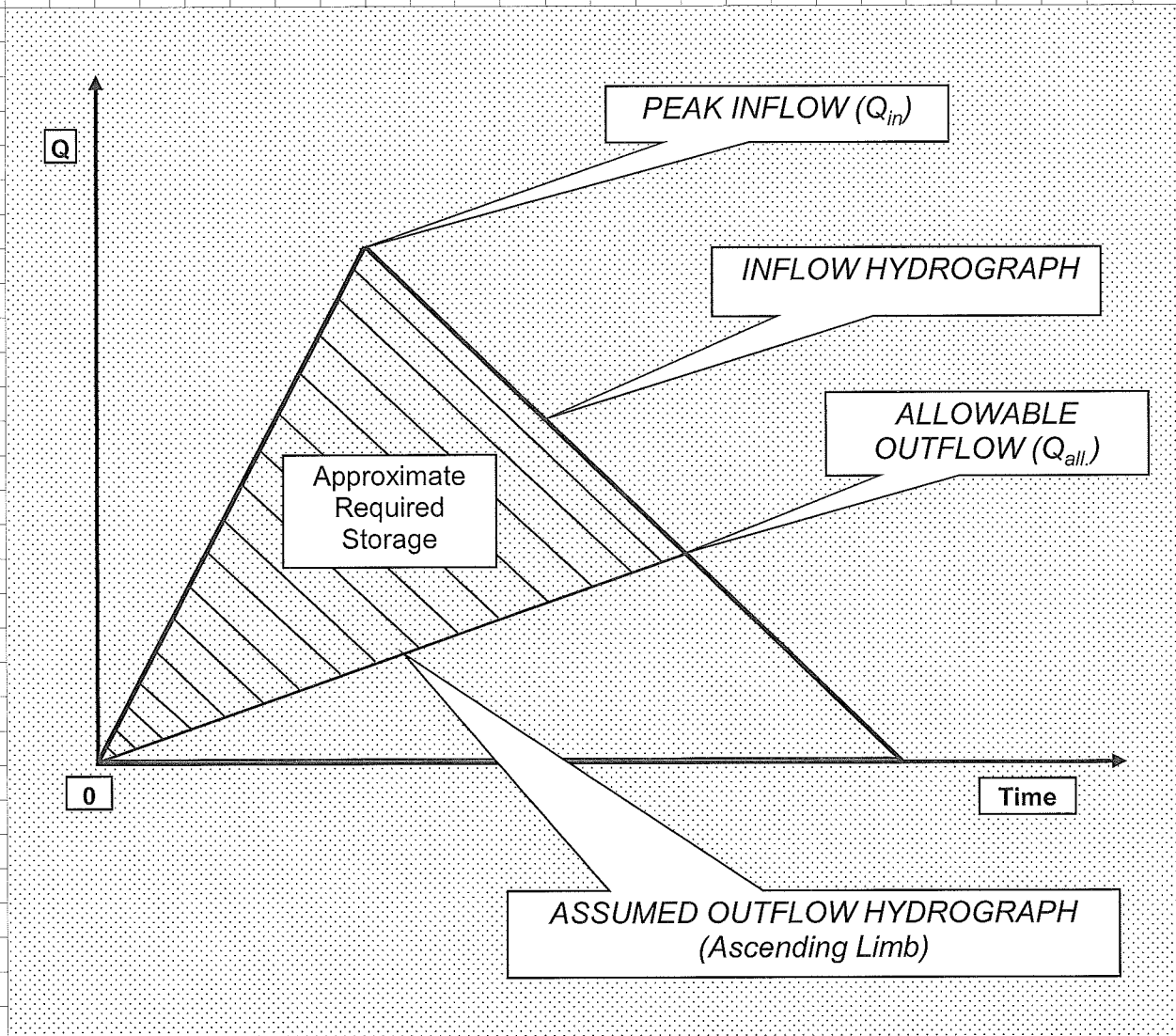
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MODIFIED RATIONAL METHOD

Required Storage Volume



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MODIFIED RATIONAL METHOD:

2-Year Storm:

t_c (min) = 10.0

$C_{existing}$ = 0.776

$I_{existing}$ (2-years) = 3.80

$A_{existing}$ (acres) = 0.223

$Q = CIA$

$Q_{existing}$ (cfs) = 0.658

$Q_{allowable} = Q_{existing}$

$Q_{allowable}$ = 0.66

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 Lyndhurst, 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	3.80	0.88	0.223	0.75	447.1	0.66	395	52	391
15	3.17	0.88	0.223	0.62	559.5	0.66	494	66	493
30	2.18	0.88	0.223	0.43	769.5	0.66	790	-20	0
60	1.36	0.88	0.223	0.27	960.1	0.66	1382	-422	0
120	0.83	0.88	0.223	0.16	1177.6	0.66	2566	-1389	0
180	0.62	0.88	0.223	0.12	1311.0	0.66	3751	-2440	0
360	0.40	0.88	0.223	0.08	1694.4	0.66	7305	-5610	0
720	0.25	0.88	0.223	0.05	2075.6	0.66	14412	-12336	0
1440	0.14	0.88	0.223	0.03	2355.2	0.66	28626	-26271	0

Legend

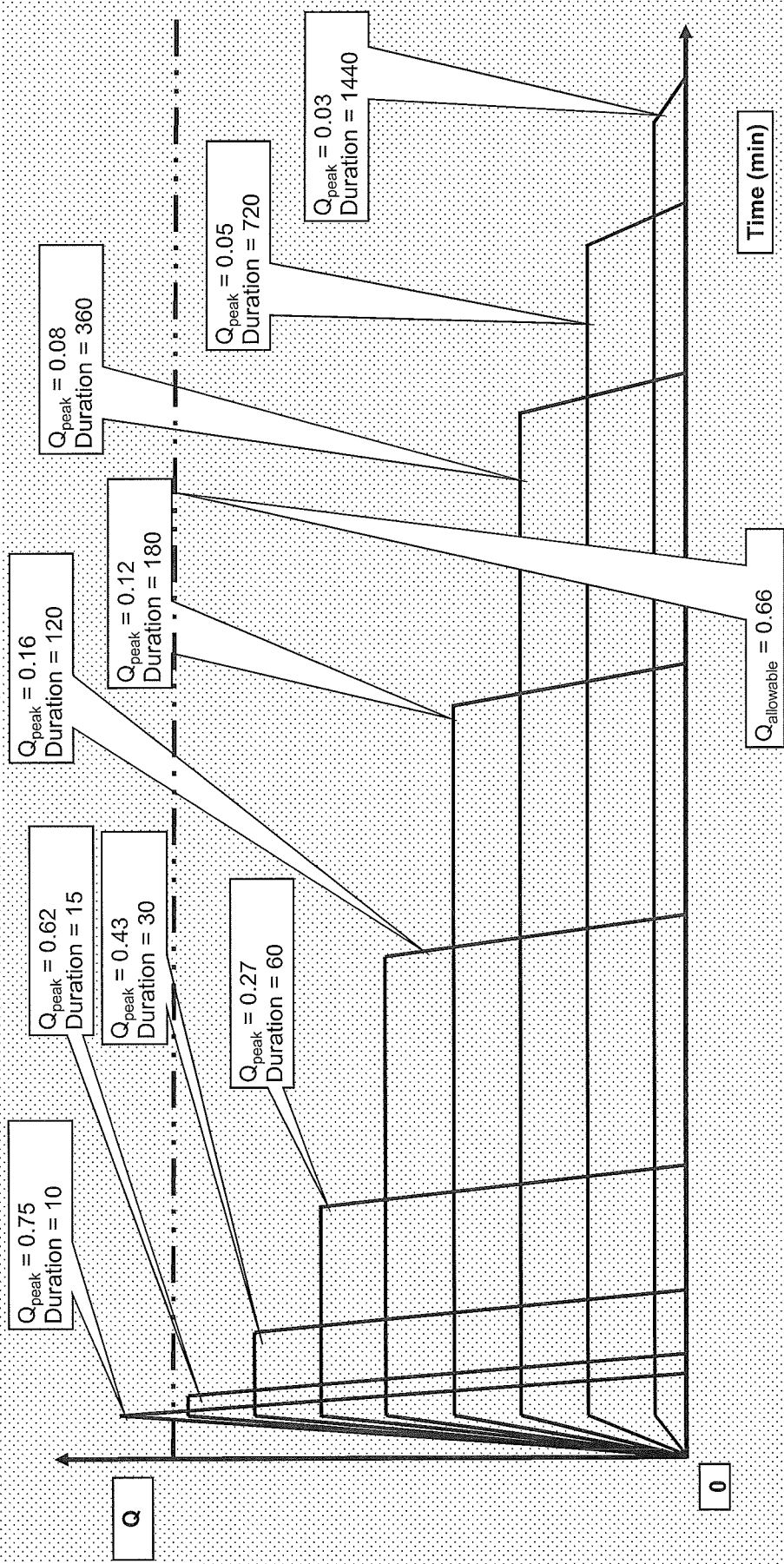
15 Critical Storm based on Allowable Runoff

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

MODIFIED RATIONAL METHOD

Individual Range of Storm Runoff Hydrographs

2 - Year Storm



MODIFIED RATIONAL METHOD:

10-Year Storm:

t_c (min) = 10.0

$C_{existing}$ = 0.776

$I_{existing}$ (10-years) = 5.03

$A_{existing}$ (acres) = 0.223

$Q = CIA$

$Q_{existing}$ (cfs) = 0.871

$Q_{allowable} = Q_{existing}$

$Q_{allowable}$ = 0.87

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 Lyndhurst, New Jersey

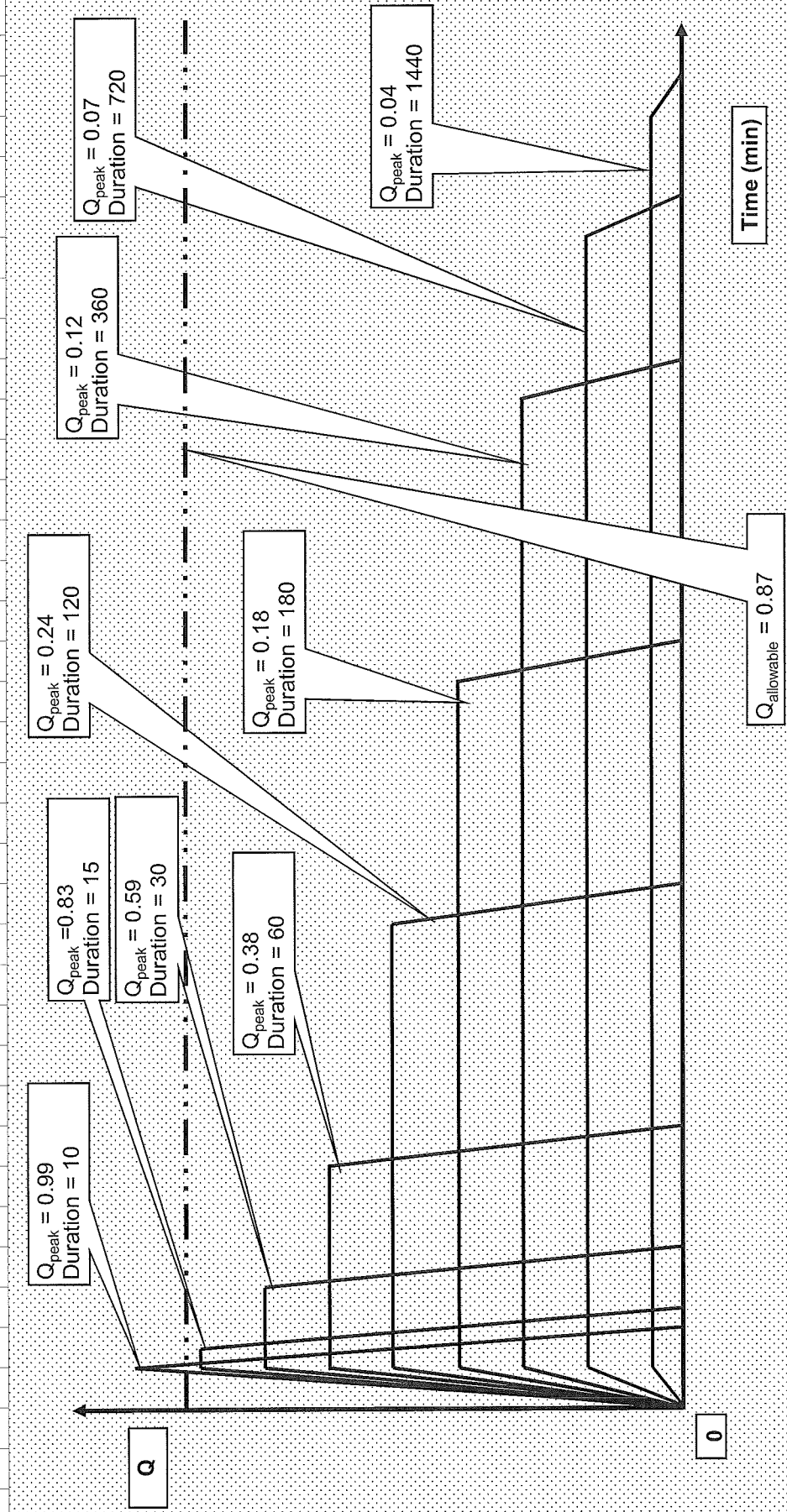
Storm Duration (min)	Rainfall Intensity (in/hr)	Runoff Coefficient (C)	Drainage Area (acres)	Peak Runoff (cfs)	Peak Storage (cf)	Allowable Runoff (cfs)	Allowable Storage (cf)	Storage Required (cf)	Storage Required (gallons)
10	5.03	0.88	0.223	0.99	591.8	0.87	522.6	69	518
15	4.21	0.88	0.223	0.83	743.0	0.87	653.3	90	671
30	3.02	0.88	0.223	0.59	1066.0	0.87	1045.3	21	155
60	1.96	0.88	0.223	0.38	1383.7	0.87	1829.2	-446	0
120	1.23	0.88	0.223	0.24	1736.7	0.87	3397.2	-1660	0
180	0.91	0.88	0.223	0.18	1933.7	0.87	4965.1	-3031	0
360	0.59	0.88	0.223	0.12	2494.9	0.87	9668.9	-7174	0
720	0.37	0.88	0.223	0.07	3092.2	0.87	19076.4	-15984	0
1440	0.21	0.88	0.223	0.04	3558.1	0.87	37891.4	-34333	0

Legend

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

MODIFIED RATIONAL METHOD

*Individual Range of Storm Runoff Hydrographs
10 - Year Storm*



MODIFIED RATIONAL METHOD:

100-Year Storm:

t_c (min) = 10.0

C_{existing} = 0.776

I_{existing} (100-years) = 6.53

A_{existing} (acres) = 0.223

$Q = CIA$

Q_{existing} (cfs) = 1.131

$Q_{\text{allowable}} = Q_{\text{existing}}$

$Q_{\text{allowable}}$ = 1.13

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)

MODIFIED RATIONAL METHOD

Individual Range of Storm Runoff Hydrographs

100 - Year Storm

$Q_{\text{peak}} = 1.28$
Duration = 10

$Q_{\text{peak}} = 1.07$
Duration = 15

$Q_{\text{peak}} = 0.36$
Duration = 120

$Q_{\text{peak}} = 0.18$
Duration = 360

$Q_{\text{peak}} = 0.81$
Duration = 30

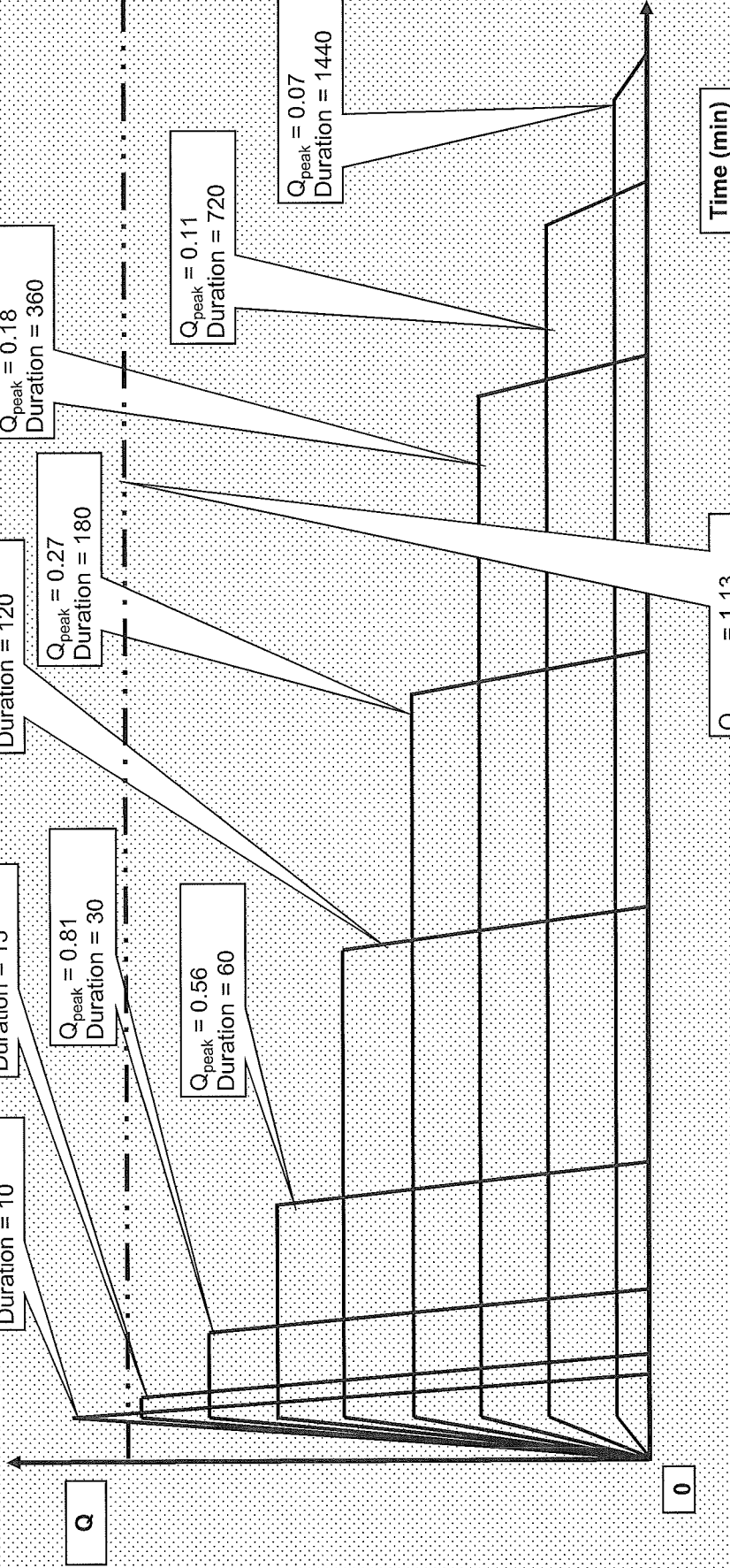
$Q_{\text{peak}} = 0.27$
Duration = 180

$Q_{\text{peak}} = 0.56$
Duration = 60

$Q_{\text{peak}} = 0.11$
Duration = 720

$Q_{\text{peak}} = 0.07$
Duration = 1440

$Q_{\text{allowable}} = 1.13$



APPENDIX - A

**NOAA RAINFALL DATA
LYNDHURST, NEW JERSEY**



NOAA Atlas 14, Volume 2, Version 3
 Location name: Lyndhurst, New Jersey, US*
 Latitude: 40.8088°, Longitude: -74.1189°
 Elevation: 60 ft*
 * source: Google Maps



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	4.02 (3.67-4.40)	4.79 (4.38-5.26)	5.68 (5.17-6.23)	6.32 (5.75-6.94)	7.15 (6.49-7.85)	7.73 (6.97-8.47)	8.34 (7.48-9.14)	8.87 (7.90-9.74)	9.58 (8.42-10.6)	10.1 (8.78-11.1)
10-min	3.19 (2.91-3.49)	3.80 (3.48-4.17)	4.51 (4.12-4.95)	5.03 (4.58-5.51)	5.65 (5.12-6.19)	6.10 (5.50-6.68)	6.53 (5.86-7.17)	6.93 (6.17-7.61)	7.43 (6.54-8.20)	7.77 (6.79-8.61)
15-min	2.64 (2.41-2.89)	3.17 (2.90-3.48)	3.78 (3.45-4.15)	4.21 (3.83-4.61)	4.74 (4.30-5.20)	5.12 (4.62-5.62)	5.48 (4.92-6.01)	5.81 (5.18-6.38)	6.22 (5.47-6.86)	6.50 (5.68-7.20)
30-min	1.80 (1.64-1.97)	2.18 (1.99-2.39)	2.67 (2.43-2.93)	3.02 (2.75-3.31)	3.48 (3.15-3.81)	3.81 (3.44-4.18)	4.15 (3.72-4.55)	4.46 (3.97-4.90)	4.87 (4.29-5.37)	5.17 (4.52-5.73)
60-min	1.11 (1.02-1.22)	1.36 (1.24-1.49)	1.70 (1.55-1.87)	1.96 (1.78-2.15)	2.30 (2.09-2.52)	2.57 (2.31-2.81)	2.84 (2.54-3.11)	3.10 (2.77-3.41)	3.47 (3.05-3.83)	3.74 (3.27-4.15)
2-hr	0.686 (0.625-0.754)	0.834 (0.760-0.918)	1.05 (0.960-1.16)	1.23 (1.11-1.35)	1.47 (1.32-1.61)	1.66 (1.49-1.82)	1.86 (1.66-2.05)	2.07 (1.83-2.28)	2.36 (2.06-2.60)	2.59 (2.24-2.87)
3-hr	0.509 (0.465-0.560)	0.619 (0.565-0.682)	0.784 (0.715-0.863)	0.913 (0.830-1.00)	1.09 (0.987-1.20)	1.24 (1.11-1.36)	1.39 (1.24-1.53)	1.55 (1.37-1.70)	1.77 (1.54-1.95)	1.95 (1.68-2.15)
6-hr	0.330 (0.303-0.362)	0.400 (0.367-0.439)	0.505 (0.461-0.552)	0.589 (0.536-0.644)	0.709 (0.641-0.774)	0.808 (0.726-0.882)	0.913 (0.813-0.996)	1.02 (0.904-1.12)	1.19 (1.03-1.30)	1.32 (1.13-1.45)
12-hr	0.202 (0.184-0.223)	0.245 (0.224-0.270)	0.311 (0.283-0.342)	0.365 (0.331-0.401)	0.444 (0.399-0.486)	0.511 (0.456-0.559)	0.584 (0.515-0.637)	0.663 (0.578-0.725)	0.778 (0.667-0.852)	0.876 (0.739-0.961)
24-hr	0.114 (0.106-0.125)	0.139 (0.128-0.151)	0.177 (0.164-0.193)	0.210 (0.194-0.228)	0.260 (0.237-0.281)	0.302 (0.274-0.328)	0.350 (0.314-0.379)	0.402 (0.357-0.436)	0.481 (0.420-0.524)	0.549 (0.472-0.600)
2-day	0.067 (0.062-0.073)	0.081 (0.075-0.089)	0.104 (0.095-0.113)	0.123 (0.112-0.134)	0.150 (0.137-0.164)	0.174 (0.157-0.190)	0.200 (0.179-0.219)	0.229 (0.203-0.251)	0.271 (0.236-0.299)	0.307 (0.263-0.340)
3-day	0.047 (0.043-0.051)	0.057 (0.053-0.062)	0.073 (0.067-0.079)	0.085 (0.079-0.093)	0.104 (0.095-0.113)	0.120 (0.109-0.131)	0.138 (0.124-0.150)	0.157 (0.140-0.171)	0.185 (0.162-0.203)	0.208 (0.180-0.230)
4-day	0.037 (0.034-0.040)	0.045 (0.042-0.049)	0.057 (0.053-0.062)	0.067 (0.062-0.073)	0.081 (0.075-0.088)	0.094 (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 (0.035-0.040)	0.043 (0.040-0.047)	0.052 (0.048-0.056)	0.060 (0.054-0.064)	0.067 (0.061-0.073)	0.076 (0.068-0.082)	0.088 (0.078-0.095)	0.097 (0.085-0.107)
10-day	0.020 (0.019-0.021)	0.024 (0.022-0.026)	0.029 (0.027-0.031)	0.034 (0.031-0.036)	0.040 (0.037-0.043)	0.045 (0.042-0.049)	0.051 (0.046-0.055)	0.057 (0.051-0.061)	0.065 (0.058-0.070)	0.072 (0.063-0.078)
20-day	0.013 (0.013-0.014)	0.016 (0.015-0.017)	0.019 (0.018-0.020)	0.022 (0.020-0.023)	0.025 (0.023-0.026)	0.027 (0.026-0.029)	0.030 (0.028-0.032)	0.033 (0.030-0.035)	0.036 (0.033-0.039)	0.039 (0.035-0.042)
30-day	0.011 (0.011-0.012)	0.013 (0.012-0.014)	0.016 (0.015-0.016)	0.017 (0.016-0.018)	0.019 (0.018-0.021)	0.021 (0.020-0.022)	0.023 (0.021-0.024)	0.025 (0.023-0.026)	0.027 (0.025-0.028)	0.028 (0.026-0.030)
45-day	0.010 (0.009-0.010)	0.011 (0.011-0.012)	0.013 (0.012-0.014)	0.014 (0.013-0.015)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.018 (0.017-0.019)	0.020 (0.018-0.021)	0.021 (0.020-0.022)	0.022 (0.021-0.024)
60-day	0.009 (0.008-0.009)	0.010 (0.010-0.011)	0.011 (0.011-0.012)	0.013 (0.012-0.013)	0.014 (0.013-0.015)	0.015 (0.014-0.016)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.018 (0.017-0.019)	0.018 (0.017-0.020)

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**

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OF 1

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DATE

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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 ft²Overall Volume = 99.55 ft³

Overall Volume = 744.6299 Gallons

Storage Area = 28.27 ft²Storage Volume = 75.49 ft³

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 = 3.50 ft. (to the top of the Dry Well)

Excavation Volume = 224.00 ft³

Total Stone Volume = Excavation Volume - Overall Dry Well Volume

Total Stone Volume = 124.45 ft³

Total Stone Volume = 930.89 Gallons

Water Storage Volume in Stone Voids (40%) = 49.78 ft³

Water Storage Volume in Stone Voids (40%) = 372.36 Gallons

Proposed Water Retention Volume

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

Total Water Retention Volume = 125.27 ft³

Total Water Retention Volume = 937.04 Gallons

Provide One (1) Dry Well System with Approximately 937-gallons Total Storage Volume