

Stormwater Management Report

Prepared For

**118 Stuyvesant Avenue
Tax Lot 25, Block 11
Township of Lyndhurst
Bergen County, NJ**

March 2, 2023

Prepared by:



**Engineers . Scientists . Consultants
150 River Road, Suite B3, Montville, NJ 07045
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A handwritten signature in black ink that reads "Adnan Khan".

**Adnan A. Khan, P.E., C.M.E.
New Jersey Professional Engineer
License Number GE39812
AWZ Project No. 22-1001**

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- II Rational Method – Runoff Calculations
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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

229

10-year

319

100-year

433

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 @ 856-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

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

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

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

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

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

Using NOAA Precipitation Intensity Estimates for the Lyndhurst, New Jersey

Assume $t_c = 10$ minutes

$$I_{2\text{-years}} = 3.81$$

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

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

Existing Conditions:

$$A_{\text{Lot}} = 0.218$$

$$A_{\text{Grass}} = 0.051$$

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

$$A_{\text{Roof}} = 0.057$$

$$A_{\text{Pavement}} = 0.111 \quad (\text{Driveway, Concrete, etc.})$$

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

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

$$\Delta C = 0.878$$

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Existing Runoffs:

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

$Q_{2-year} = 0.730$

$Q_{10-year} = 0.964$

$Q_{100-year} = 1.251$

Proposed Conditions:

$A_{Lot} = 0.218$

$A_{Grass} = 0.029$

$A_{Deck} = 0.000$

$A_{Roof} = 0.082$

$A_{Pavement} = 0.107$ (Driveway, Concrete, etc.)

$A_{Dirt} = 0.000$

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

$\Delta C = 0.926$

Proposed Runoffs:

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

$Q_{2-year} = 0.77$

$Q_{10-year} = 1.016$

$Q_{100-year} = 1.319$

Summary:

Storm Event	Existing Runoff	Proposed Runoff	Difference (cfs)
2-year	0.730	0.770	0.040
10-year	0.964	1.016	0.052

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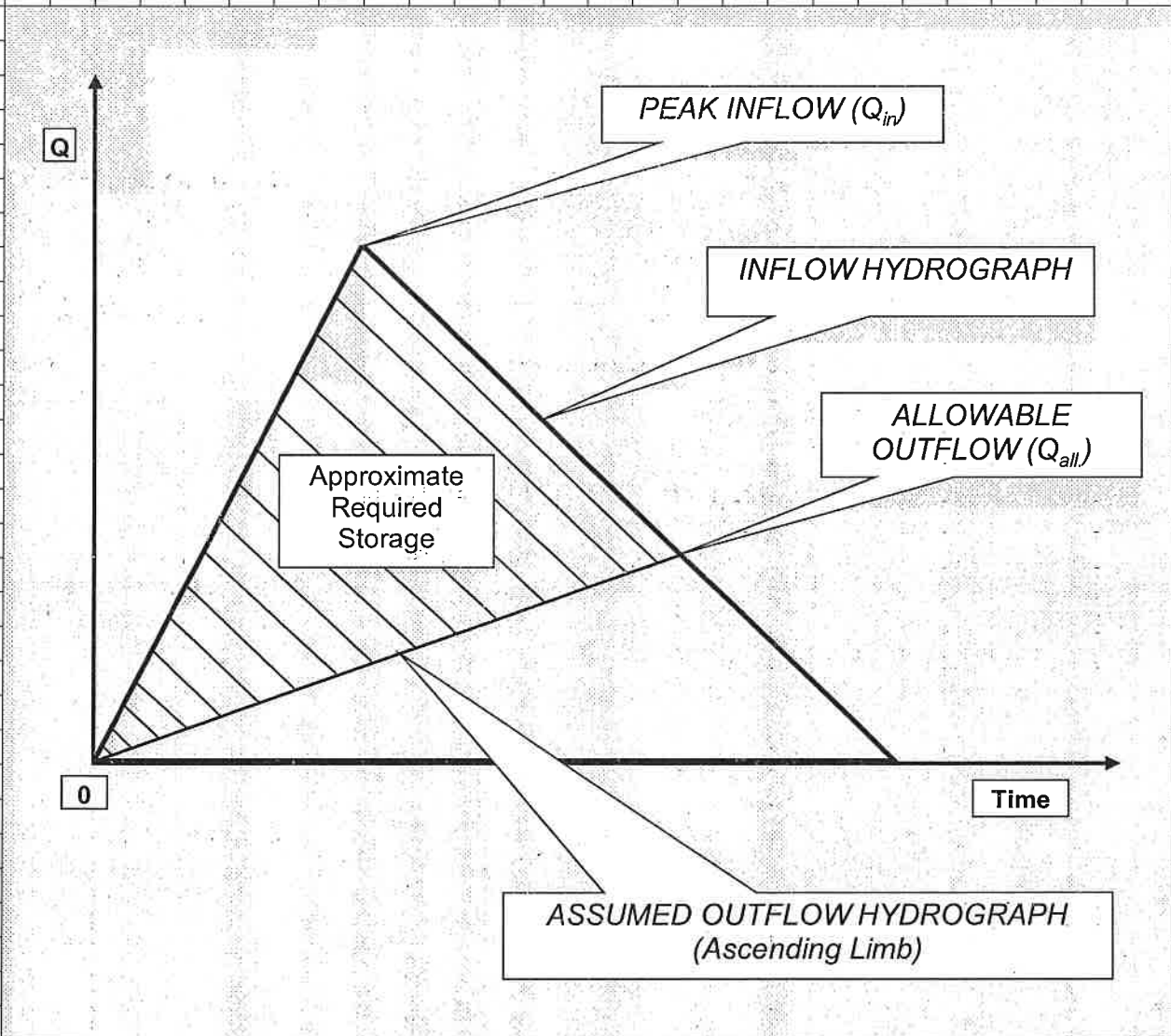
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MODIFIED RATIONAL METHOD

Required Storage Volume



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<u>MODIFIED RATIONAL METHOD:</u>	
<u>2-Year Storm:</u>	
t_c (min) =	10.0
$C_{existing}$ =	0.878
$I_{existing}$ (2-years) =	3.81
$A_{existing}$ (acres) =	0.218
$Q = CIA$	
$Q_{existing}$ (cfs) =	0.730
$Q_{allowable} = Q_{existing}$	
$Q_{allowable}$ =	0.73
<u>For Storm Event equal to Time of Concentration</u>	
Peak Storage = Storm Duration (min) x 60 (sec) x Peak Runoff (cfs)	
Allowable Storage = Storm Duration (min) x 60 (sec) x Allowable Runoff (cfs)	
<u>For Storm Event greater than Time of Concentration</u>	
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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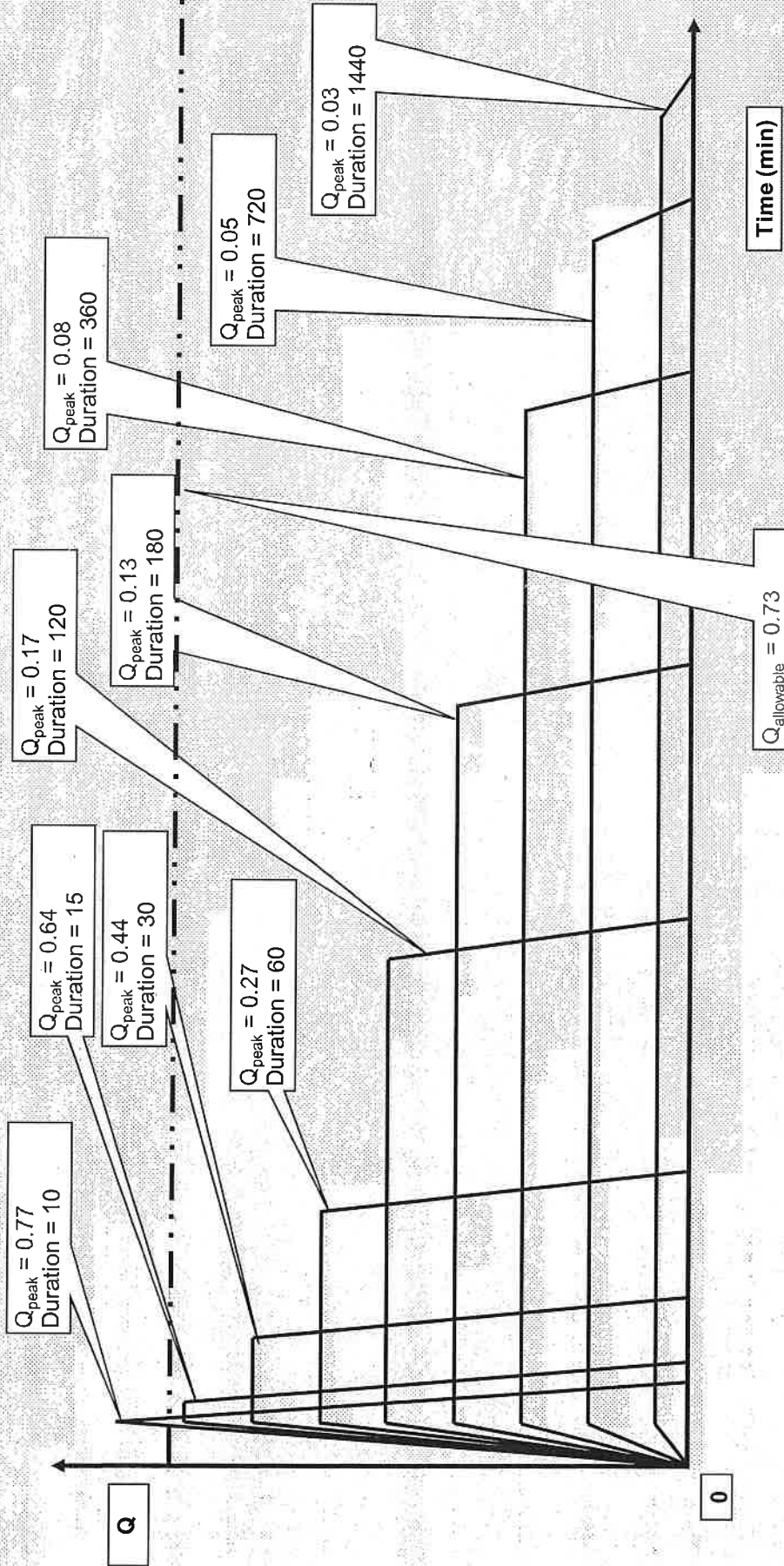
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MODIFIED RATIONAL METHOD:												
<i>Using NOAA Precipitation Intensity Estimates for the Lyndhurst, New Jersey</i>												
Storm Duration (min)	Rainfall Intensity (in/hr)	Runoff Coefficient (C)	Drainage Area (acres)	Peak Runoff (cfs)	Peak Storage (cf)	Allowable Runoff (cfs)	Allowable Storage (cf)	Storage Required (cf)	Storage Required (gallons)			
2-Year Storm:												
10	3.81	0.93	0.218	0.77	461.8	0.73	438	24	178			
15	3.18	0.93	0.218	0.64	578.1	0.73	547	31	229			
30	2.18	0.93	0.218	0.44	792.6	0.73	876	-83	0			
60	1.36	0.93	0.218	0.27	989.0	0.73	1533	-544	0			
120	0.83	0.93	0.218	0.17	1213.0	0.73	2847	-1634	0			
180	0.62	0.93	0.218	0.13	1350.4	0.73	4161	-2810	0			
360	0.40	0.93	0.218	0.08	1745.3	0.73	8103	-6357	0			
720	0.25	0.93	0.218	0.05	2146.7	0.73	15986	-13840	0			
1440	0.14	0.93	0.218	0.03	2425.9	0.73	31754	-29328	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



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MODIFIED RATIONAL METHOD:	
10-Year Storm:	
t_c (min) =	10.0
$C_{existing}$ =	0.878
$I_{existing}$ (10-years) =	5.03
$A_{existing}$ (acres) =	0.218
$Q = CIA$	
$Q_{existing}$ (cfs) =	0.964
$Q_{allowable} = Q_{existing}$	
$Q_{allowable}$ =	0.96
<u>For Storm Event equal to Time of Concentration</u>	
Peak Storage = Storm Duration _(min) x 60 _(sec) x Peak Runoff _(cfs)	
Allowable Storage = Storm Duration _(min) x 60 _(sec) x Allowable Runoff _(cfs)	
<u>For Storm Event greater than Time of Concentration</u>	
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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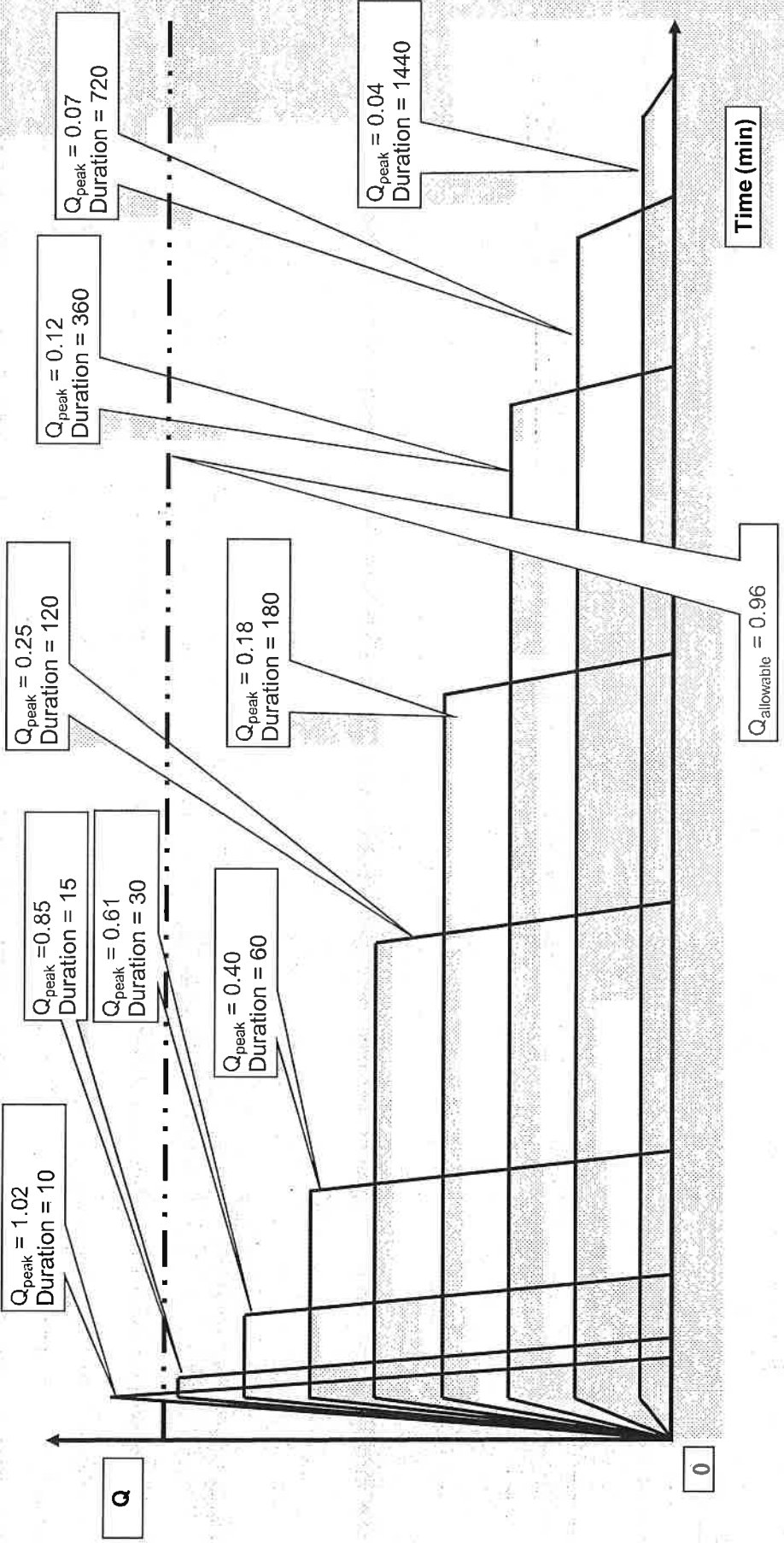
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SCALE _____

MODIFIED RATIONAL METHOD:												
<i>Using NOAA Precipitation Intensity Estimates for the Lyndhurst, New Jersey</i>												
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	0.93	0.218	1.02	609.6	0.96	578.2	31	235			
15	4.21	0.93	0.218	0.85	765.4	0.96	722.8	43	319			
30	3.03	0.93	0.218	0.61	1101.7	0.96	1156.5	-55	-410			
60	1.96	0.93	0.218	0.40	1425.3	0.96	2023.8	-598	0			
120	1.23	0.93	0.218	0.25	1788.9	0.96	3758.5	-1970	0			
180	0.91	0.93	0.218	0.18	1991.8	0.96	5493.1	-3501	0			
360	0.59	0.93	0.218	0.12	2569.9	0.96	10697.2	-8127	0			
720	0.37	0.93	0.218	0.07	3185.1	0.96	21105.2	-17920	0			
1440	0.21	0.93	0.218	0.04	3665.0	0.96	41921.4	-38256	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*



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MODIFIED RATIONAL METHOD:

100-Year Storm:

t_c (min) = 10.0

$C_{existing}$ = 0.878

$I_{existing}$ (100-years) = 6.53

$A_{existing}$ (acres) = 0.218

$Q = CIA$

$Q_{existing}$ (cfs) = 1.251

$Q_{allowable} = Q_{existing}$

$Q_{allowable}$ = 1.25

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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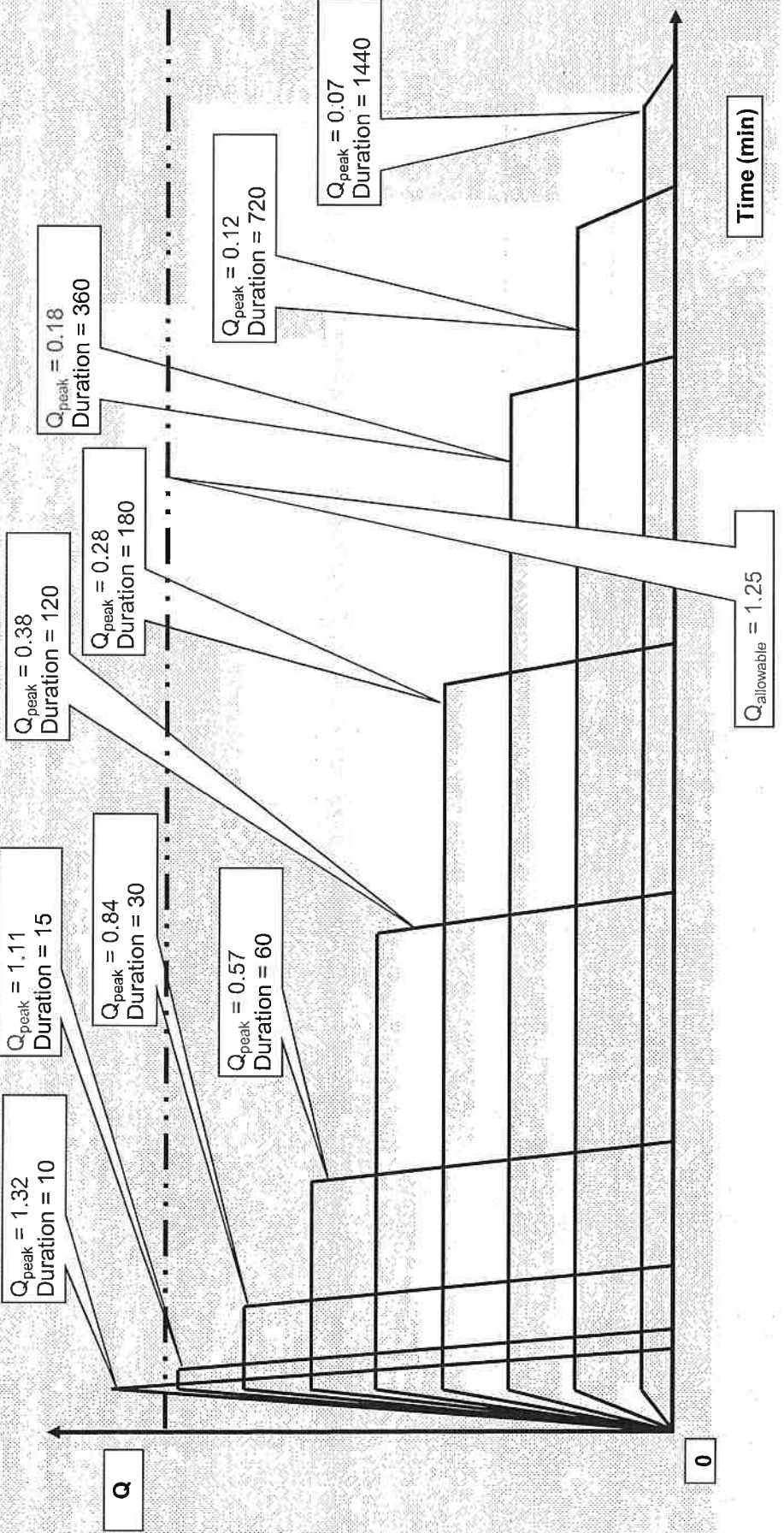
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MODIFIED RATIONAL METHOD:										
<i>Using NOAA Precipitation Intensity Estimates for the Lyndhurst, New Jersey</i>										
Storm Duration (min)	Rainfall Intensity (in/hr)	Runoff Coefficient (C)	Drainage Area (acres)	Peak Runoff (cfs)	Peak Storage (cf)	Allowable Runoff (cfs)	Allowable Storage (cf)	Storage Required (cf)	Storage Required (gallons)	
10	6.53	0.93	0.218	1.32	791.4	1.25	750.7	41	305	
15	5.48	0.93	0.218	1.11	996.3	1.25	938.3	58	433	
30	4.15	0.93	0.218	0.84	1508.9	1.25	1501.3	8	57	
60	2.84	0.93	0.218	0.57	2065.2	1.25	2627.3	-562	0	
120	1.86	0.93	0.218	0.38	2705.1	1.25	4879.3	-2174	0	
180	1.39	0.93	0.218	0.28	3032.4	1.25	7131.3	-4099	0	
360	0.92	0.93	0.218	0.18	3992.3	1.25	13887.2	-9895	0	
720	0.59	0.93	0.218	0.12	5113.6	1.25	27399.1	-22285	0	
1440	0.35	0.93	0.218	0.07	6125.9	1.25	54422.8	-48297	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

100 - Year Storm



APPENDIX - A

**NOAA RAINFALL DATA
LYNDHURST, NEW JERSEY**



NOAA Atlas 14, Volume 2, Version 3
Location name: Lyndhurst, New Jersey, USA*
Latitude: 40.8121°, Longitude: -74.1246°
Elevation: m/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 & aeriels](#)

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)	4.80 (4.38-5.26)	5.68 (5.18-6.23)	6.32 (5.76-6.94)	7.16 (6.49-7.85)	7.73 (6.97-8.47)	8.34 (7.48-9.14)	8.87 (7.90-9.73)	9.56 (8.42-10.5)	10.1 (8.78-11.1)
10-min	3.19 (2.92-3.49)	3.81 (3.48-4.18)	4.52 (4.12-4.96)	5.03 (4.58-5.51)	5.65 (5.12-6.20)	6.10 (5.50-6.68)	6.53 (5.86-7.16)	6.92 (6.17-7.61)	7.42 (6.54-8.19)	7.76 (6.79-8.60)
15-min	2.64 (2.42-2.90)	3.18 (2.90-3.48)	3.79 (3.45-4.16)	4.21 (3.83-4.61)	4.75 (4.30-5.20)	5.12 (4.62-5.62)	5.48 (4.92-6.01)	5.81 (5.18-6.38)	6.21 (5.47-6.85)	6.49 (5.68-7.19)
30-min	1.80 (1.64-1.97)	2.18 (1.99-2.39)	2.67 (2.44-2.93)	3.03 (2.75-3.32)	3.48 (3.15-3.81)	3.81 (3.44-4.18)	4.15 (3.72-4.55)	4.46 (3.97-4.89)	4.87 (4.29-5.37)	5.17 (4.52-5.72)
60-min	1.12 (1.02-1.22)	1.36 (1.24-1.49)	1.70 (1.55-1.87)	1.96 (1.78-2.15)	2.30 (2.09-2.53)	2.57 (2.32-2.81)	2.84 (2.54-3.11)	3.10 (2.77-3.41)	3.47 (3.05-3.82)	3.74 (3.27-4.14)
2-hr	0.686 (0.626-0.754)	0.834 (0.760-0.919)	1.06 (0.961-1.16)	1.23 (1.12-1.35)	1.47 (1.32-1.61)	1.66 (1.49-1.83)	1.86 (1.66-2.05)	2.07 (1.83-2.28)	2.36 (2.06-2.61)	2.60 (2.24-2.87)
3-hr	0.509 (0.466-0.560)	0.619 (0.566-0.682)	0.784 (0.716-0.863)	0.913 (0.831-1.00)	1.09 (0.988-1.20)	1.24 (1.11-1.36)	1.39 (1.24-1.53)	1.55 (1.37-1.70)	1.77 (1.55-1.95)	1.95 (1.68-2.15)
6-hr	0.330 (0.303-0.362)	0.400 (0.367-0.439)	0.505 (0.462-0.553)	0.590 (0.537-0.645)	0.710 (0.642-0.775)	0.810 (0.727-0.883)	0.915 (0.815-0.998)	1.03 (0.906-1.12)	1.19 (1.03-1.30)	1.32 (1.13-1.45)
12-hr	0.202 (0.185-0.223)	0.246 (0.224-0.270)	0.311 (0.283-0.342)	0.366 (0.332-0.401)	0.445 (0.400-0.487)	0.513 (0.457-0.560)	0.586 (0.517-0.639)	0.665 (0.581-0.727)	0.782 (0.670-0.856)	0.880 (0.743-0.965)
24-hr	0.115 (0.106-0.125)	0.139 (0.128-0.151)	0.178 (0.164-0.193)	0.211 (0.194-0.229)	0.260 (0.238-0.282)	0.303 (0.275-0.328)	0.351 (0.315-0.380)	0.403 (0.358-0.438)	0.483 (0.421-0.525)	0.551 (0.474-0.602)
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)	0.151 (0.137-0.164)	0.174 (0.158-0.190)	0.200 (0.180-0.219)	0.229 (0.203-0.251)	0.271 (0.237-0.299)	0.307 (0.264-0.340)
3-day	0.047 (0.044-0.051)	0.057 (0.053-0.062)	0.073 (0.067-0.079)	0.086 (0.079-0.093)	0.105 (0.096-0.114)	0.121 (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)	0.082 (0.075-0.088)	0.094 (0.085-0.101)	0.107 (0.097-0.116)	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)	0.044 (0.040-0.047)	0.052 (0.048-0.056)	0.060 (0.055-0.064)	0.067 (0.061-0.073)	0.076 (0.068-0.082)	0.088 (0.078-0.095)	0.098 (0.085-0.107)
10-day	0.020 (0.019-0.022)	0.024 (0.022-0.026)	0.029 (0.027-0.032)	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 (0.058-0.071)	0.072 (0.063-0.078)
20-day	0.014 (0.013-0.014)	0.016 (0.015-0.017)	0.019 (0.018-0.020)	0.022 (0.020-0.023)	0.025 (0.023-0.027)	0.028 (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 (0.013-0.014)	0.016 (0.015-0.016)	0.017 (0.016-0.018)	0.020 (0.018-0.021)	0.021 (0.020-0.023)	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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JOB 22-1001

SHEET NO. 1 OF 1

CALCULATED BY LF DATE 3/2/2023

CHECKED BY AK DATE

SCALE

STORAGE VOLUME CALCULATIONSDry 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 = 7.50 ft.

Excavation Width = 7.50 ft.

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

Excavation Volume = 196.88 ft³

Total Stone Volume = Excavation Volume - Overall Dry Well Volume

Total Stone Volume = 97.33 ft³

Total Stone Volume = 728.00 Gallons

Water Storage Volume in Stone Voids (40%) = 38.93 ft³

Water Storage Volume in Stone Voids (40%) = 291.20 Gallons

Proposed Water Retention Volume

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

Total Water Retention Volume = 114.42 ft³

Total Water Retention Volume = 855.88 Gallons

Provide One (1) Dry Well System with Approximately 856-gallons Total Storage Volume