PRELIMINARY DRAINAGE REPORT

WILDLAND FIRE STATION
Fire Training Center
6055 Reservoir Road
Boulder, Colorado

May 20, 2013

Prepared for:

Allred & Associates, Inc. /
City of Boulder Facilities and Asset Management

Prepared by:

SCOTT, COX & ASSOCIATES, INC.
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Project No. 12495C

ENGINEER'S STATEMENT

I hereby certify that this report for the preliminary drainage design of the Wildland Fire Station Site Review was prepared under my direct supervision in accordance with the provisions of the City of Boulder Design and Construction Standards for the owners thereof.

_____

Donald P. Ash, P.E.
Registered Professional Engineer
State of Colorado No. 36045

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INTRODUCTION

This report is submitted as the Preliminary Drainage Report of the existing and proposed conditions for the Wildland Fire Station project located at the Fire Training Center, 6055 Reservoir Road, in Boulder, Colorado. The site is located in Section 10, Township 1N, Range 70W of the 6th Principal Meridian in the City of Boulder, Boulder County, State of Colorado. The area of the project site is approximately 2.0 acres. The site is bounded by open space to the north, Highway 119 to the East, the Fire Training Center to the south and the Boulder Reservoir to the west. A vicinity map is included with this report.

This report is being prepared to accompany the Site Review application for the project. The purpose of this Preliminary Drainage Report and Plan is to address specific drainage issues related to the proposed site changes. This study meets the requirements set forth in the City of Boulder Design and Construction Standards and Urban Drainage & Flood Control District (UDFCD) Criteria Manual.

EXISTING ON-SITE DRAINAGE

The 2.0 acre site is currently undeveloped and covered with native grasses. The project site slopes from the south to the north at approximately 1%. The site was graded during the construction of the Fire Training Center circa 2010.

Existing drainage patterns are shown on the Preliminary Grading, Drainage and Erosion Control Plan that is included with this report. The site (Basin HB) generally surface flows to the north and discharges into a drainage swale and culverts that were constructed as part of the Fire Training Center.

OFF-SITE DRAINAGE

The off-site drainage from the Fire Training Center site is shown on the Preliminary Grading, Drainage and Erosion Control Plan. Under proposed conditions, the off-site flows from Basin A will enter the existing storm sewer system adjacent to the proposed site and be routed towards the detention pond at the west corner of the site. The existing drainage patterns for this off-site drainage flow will be maintained and will not impact the site.

PROPOSED ON-SITE DRAINAGE

The Preliminary Grading, Drainage and Erosion Control Plan shows the proposed site plan, on-site grading and overland flow directions. Under proposed conditions, the site will be broken into two (2) major drainage sub-basins.

Basin A consists of the developed portions of the Fire Training Center. Runoff will flow via shallow gutter flow, storm sewer and culverts to the proposed detention pond. Proposed runoff from Basin A is calculated to be 15.91 cfs for the 5-year storm and 38.40 cfs for the 100-year storm.

Basin B consists of the developed portions of the Wildland Fire Station. Runoff will flow via shallow gutter flow, storm sewer and culverts and to the proposed detention pond. Proposed runoff from Basin B is calculated to be 10.88 cfs for the 5-year storm and 27.08 cfs for the 100-year storm.

Proposed runoff calculations for Basins A and B have also been enclosed in Appendix A. These calculations have been based on runoff coefficients from the City of Boulder Design and Construction Standards.

It should be noted the proposed detention pond is not designed to accommodate the future driving course. Detention for the future driving course will need to be designed to accommodate the expected runoff from this area.

DRAINAGE DESIGN CRITERIA

As required in City of Boulder Design and Construction Standards for Drainage Improvements (DCS) for all non-single family residential uses, hydrologic information was developed for an initial storm return period of 5-years and major storm return period of 100-years. The criteria and methodology used in determining the storm runoff peaks and volumes were those outlined in the DCS.

The design rainfall data used in this study was taken from the time-intensity-frequency curve for the City of Boulder (Figure 7-1 DCS) as developed by Urban Drainage and Flood Control District (UD&FCD). Runoff calculations were obtained using the Rational Method as outlined in the DCS for basins having less than 160 acres.

The Rational Formula is:

$$Q = CIA$$

Where:
- Q = Peak Discharge (cfs)
- C = Runoff Coefficient (Table 7-2 DCS)
- I = Rainfall Intensity (in/hr) (Figure 7-1 DCS)
- A = Drainage Basin Tributary Area (acres)

The existing and proposed conditions for the entire site were analyzed for the 5- and 100-year storm events. The relevant calculation sheets are provided in Appendix A.

DETENTION STORAGE

A detention pond has been designed to mitigate the increase in runoff from the design basin. The original Fire Training Center pond will be partially removed and replaced by the expanded Wildland Fire Station pond. The calculations for the detention pond and the limited release structure are enclosed in Appendix B.

A limited release orifice plate provides the required 40-hour drain time for the water quality capture volume. The orifice plate meets the requirements for an extended detention basin and the 40-hour drain time as specified in the Urban Drainage and Flood Control District (UDFCD) Drainage Criteria Manual.

The required storage volume for the 10-year and 100-year storm events has also been accommodated for. Release rates are based on the historic, undeveloped runoff from the site. The detention pond has been designed to accommodate the maximum 100-year detention volume plus 50% of the Water Quality Capture Volume. This is in conformance with the City of Boulder Design and Construction Standards.

The berm around the pond provides approximately 1.0 foot of freeboard above the 100-year water surface elevation. In the event the pond was to overflow, the flow will be directed to the emergency overflow spillway at the north end of the pond and spill directly in to the open space to the north. The runoff for the initial and major storm events from the tributary basin can be conveyed directly to the major drainage system without adverse impact upstream, surrounding, or downstream properties and facilities.

STORM WATER QUALITY

The principal form of storm water quality runoff enhancement is the utilization of an Extended Detention Basin (EDB) facility. Surface drainage from the developed surfaces of the site will drain to the detention pond where runoff from the pond will be conveyed

through the water quality outlet structure into the open space to the north. The use of the EDB as a storm water quality runoff enhancement is consistent with the Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual, Volume 3, Best Management Practices. Additionally, grass buffers and swales will be used in drainage routes to help slow runoff and promote infiltration, thus reducing peak volumes.

EROSION CONTROL

Erosion control measures should be implemented prior to demolition or construction, and shall be maintained during all phases of construction project. Erosion control measures will consist of silt fencing along the property being developed, tracking control measures at the access points to the site, hay bales at grass swales, gravel protection at inlets, and re-vegetation with appropriate plant species. Additionally, permanent stone check dams have been placed in the swale on the east side the road entering the site.

FLOOD STATEMENT

Based on the National Flood Insurance Program Flood Insurance Rate Map, FIRM Panel 08013C0404J F dated December 18, 2012, the site is located within Zone X and is outside any mapped 100 year floodplain.

CONCLUSION

The primary consideration for this project was to design a drainage plan for the site to accommodate the proposed development plan without having an adverse impact on the surrounding properties. The drainage plan handles runoff from 5-year and 100-year storm events. All analyses were performed in accordance with the City of Boulder Design and Construction Standard and Urban Drainage & Flood Control District (UDFCD) Criteria Manual.

APPENDIX A

DRAINAGE CALCULATIONS

Table 7-2: Runoff Coefficients for the Rational Method

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	STORM FREQUENCY			
		2-Yr	5-Yr	10-Yr	100-Yr
Business:					
Commercial Areas	95	0.87	0.88	0.90	0.93
Neighborhood Areas	65	0.60	0.65	0.70	0.80
Residential:					
Single-Family	40	0.40	0.45	0.50	0.70
Multi-Unit (detached)	50	0.50	0.55	0.60	0.75
Multi-Unit (attached)	70	0.65	0.70	0.70	0.80
½ Acre Lot	30	0.30	0.40	0.45	0.65
Apartments	70	0.65	0.70	0.70	0.80
Industrial:					
Light Areas	80	0.75	0.80	0.80	0.85
Heavy Areas	90	0.80	0.80	0.85	0.90
Parks, Cemeteries:	7	0.15	0.25	0.35	0.60
Playgrounds:	13	0.20	0.30	0.40	0.70
Schools:	50	0.50	0.55	0.60	0.75
Railroad Yard Areas:	40	0.40	0.45	0.50	0.70
Undeveloped Areas:					
Historic Flow Analysis	2	0.10	0.20	0.30	0.60
Greenbelts, Agricultural	-	-	-	-	-
Offsite Flow Analysis (when offsite land use is not defined)	45	0.45	0.50	0.55	0.72
Streets:					
Paved	100	0.87	0.88	0.90	0.93
Gravel	7	0.15	0.25	0.35	0.65
Drives and Walks:	96	0.85	.087	0.90	0.92
Roofs:	90	0.80	0.85	0.90	0.90
Lawns:					
Sandy Soil	0	0.00	0.10	0.20	0.50
Clayey Soil	0	0.10	0.20	0.30	0.60

NOTE: These rational formula coefficients do not apply for larger basins where the time-of-concentration exceeds 60 minutes.

(Source: Urban Drainage and Flood Control District)

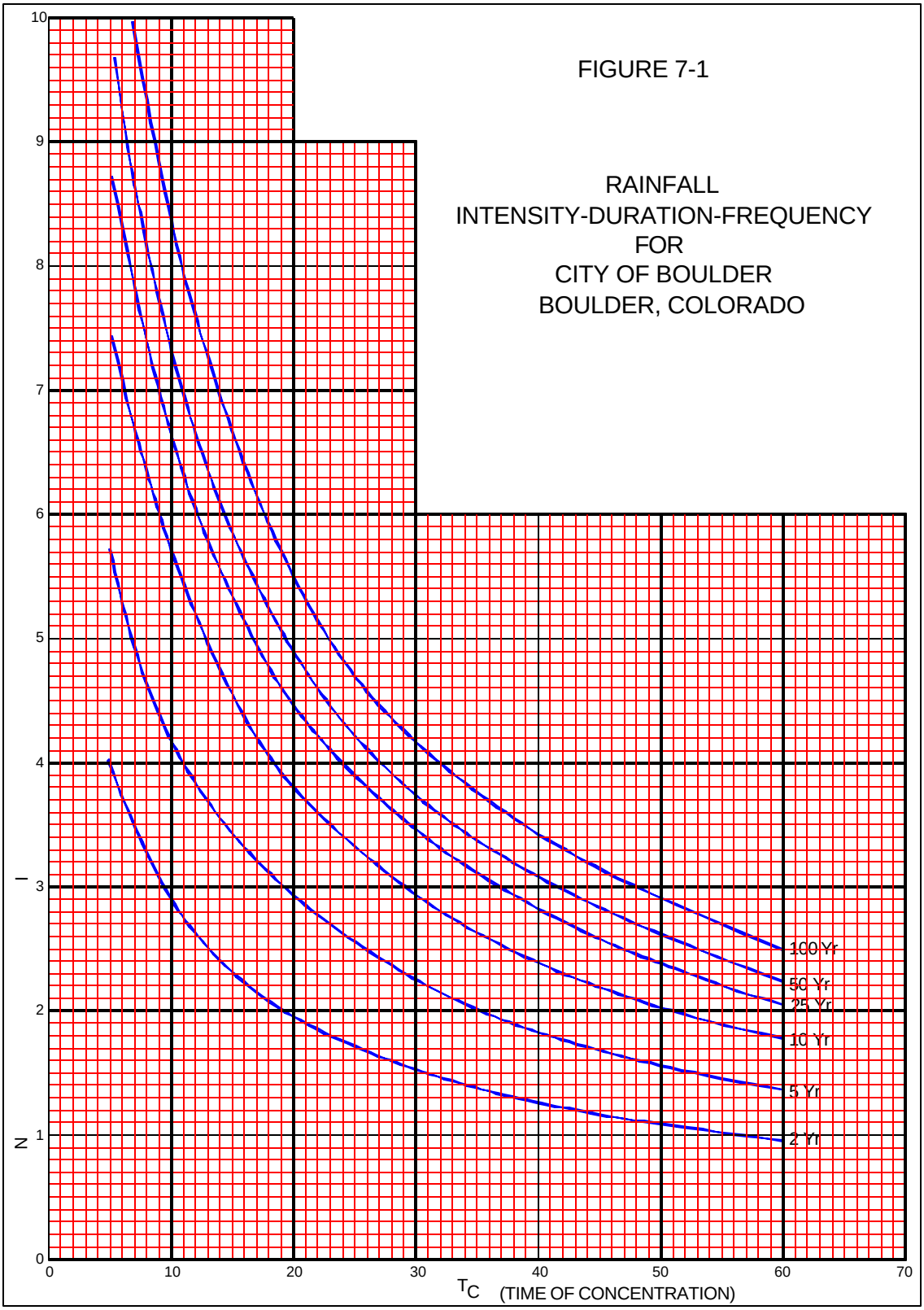
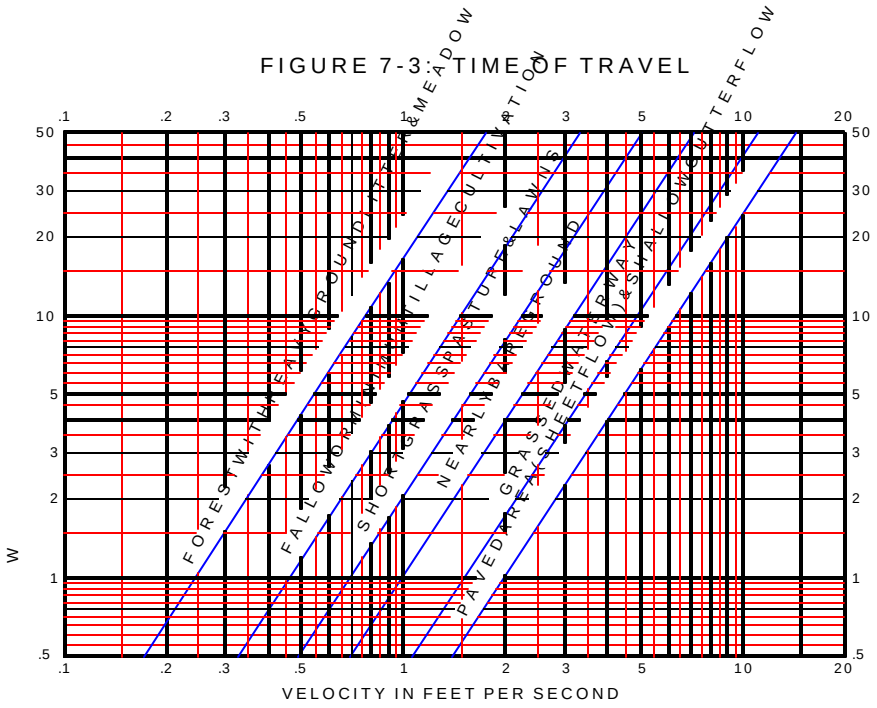


FIGURE 7-1
RAINFALL
INTENSITY-DURATION-FREQUENCY
FOR
CITY OF BOULDER
BOULDER, COLORADO
100 Yr
50 Yr
25 Yr
10 Yr
5 Yr
2 Yr
I
N
T
0
1
2
3
4
5
6
7
8
9
10
0
10
20
30
40
50
60
70
TC (TIME OF CONCENTRATION)

FIGURE 7-3: TIME OF TRAVEL



ESTIMATE OF AVERAGE FLOW VELOCITY FOR USE WITH THE RATIONAL METHOD

SCOTT, COX & ASSOCIATES, INC.
consulting engineers - surveyors

PROJECT #: 12495C
DATE: 5/20/2013
BY: DPA

BASIN HA - HISTORIC

2 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.85	
ROOF	0.00	0.80	
LANDSCAPE	8.42	0.10	
TOTAL AREA	8.42	**0.10**	= WEIGHTED C

5 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.87	
ROOF	0.00	0.85	
LANDSCAPE	8.42	0.20	
TOTAL AREA	8.42	**0.20**	= WEIGHTED C

10 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.90	
ROOF	0.00	0.90	
LANDSCAPE	8.42	0.30	
TOTAL AREA	8.42	**0.30**	= WEIGHTED C

100 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.92	
ROOF	0.00	0.90	
LANDSCAPE	8.42	0.60	
TOTAL AREA	8.42	**0.60**	= WEIGHTED C

PERCENT IMPERVIOUS 0.00

SCOTT, COX & ASSOCIATES INC.
consulting engineers - surveyors

PROJECT NO.: 12495C
DATE: 5/20/2013
BY: DPA

STORM RUNOFF HYDROLOGY
Rational Method

Condition: HISTORIC
Land Use: UNDEVELOPED
Basin Area (A) = 8.42 acres

Basin Identification: BASIN HA
Design Frequencies: 2, 5, 10 & 100 year
Comments:

Runoff Coefficients (C) =

2 year	5 year	10 year	100 year
0.10	0.20	0.30	0.60

Given

Overland flow length (Lo)	500	feet (500 feet maximum)
Overland flow slope (S)	1.0	%
Channel travel length (Lc)	700.0	feet
Channel velocity (V)	1.0	feet/second

Ti, Initial time of Concentration:

Urban Basin

Ti = 1.8*(1.1-C5)*(Lo^0.5)/(S^0.333) (intial design pt.) Ti = 36.2 min.

Ti minimum for Urban Basins = 5 min.

Greater of Calculated Ti and 5 minutes Ti = 36.2 min.

Urban Basin

Ti = (Lo/180) + 10 min. (initial design pt.) Ti = 12.8 min.

Tt, Travel time of Flow:

Urban and Non-Urban Basins

Travel time, Tt = Lc/V(fps)*60 sec./min. Tt = 11.7 min.

Tc, Time of Concentration (Tc = Ti + Tt)

Non-Urban Tc = 47.9 min.
Urban Tc = 24.4 min.

Intensity (I) From Intensity - Duration - Frequency Curve
City of Boulder Design and Construction Standards, Figure 7-1

2 year	5 year	10 year	100 year
1.75	2.60	3.35	4.75

Peak Flow (Q) = C*I*A (cfs)

2 year	5 year	10 year	100 year
1.47	4.38	8.46	24.00

SCOTT, COX & ASSOCIATES, INC.
consulting engineers - surveyors

PROJECT #: 12495C
DATE: 5/20/2013
BY: DPA

BASIN HB - HISTORIC

2 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.85	
ROOF	0.00	0.80	
LANDSCAPE	2.00	0.10	
TOTAL AREA	2.00	**0.10**	= WEIGHTED C

5 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.87	
ROOF	0.00	0.85	
LANDSCAPE	2.00	0.20	
TOTAL AREA	2.00	**0.20**	= WEIGHTED C

10 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.90	
ROOF	0.00	0.90	
LANDSCAPE	2.00	0.30	
TOTAL AREA	2.00	**0.30**	= WEIGHTED C

100 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.00	0.92	
ROOF	0.00	0.90	
LANDSCAPE	2.00	0.60	
TOTAL AREA	2.00	**0.60**	= WEIGHTED C

PERCENT IMPERVIOUS 0.00

SCOTT, COX & ASSOCIATES INC.
consulting engineers - surveyors

PROJECT NO.: 12495C
DATE: 5/20/2013
BY: DPA

STORM RUNOFF HYDROLOGY
Rational Method

Condition: HISTORIC
Land Use: UNDEVELOPED
Basin Area (A) = 3.72 acres

Basin Identification: BASIN HB
Design Frequencies: 2, 5, 10 & 100 year
Comments:

Runoff Coefficients (C) =

2 year	5 year	10 year	100 year
0.10	0.20	0.30	0.60

Given

Overland flow length (Lo)	300	feet (500 feet maximum)
Overland flow slope (S)	1.0	%
Channel travel length (Lc)	0.0	feet
Channel velocity (V)	1.0	feet/second

Ti, Initial time of Concentration:

Urban Basin

Ti = 1.8*(1.1-C5)*(Lo^0.5)/(S^0.333) (intial design pt.) Ti = 28.1 min.

Ti minimum for Urban Basins = 5 min.

Greater of Calculated Ti and 5 minutes Ti = 28.1 min.

Urban Basin

Ti = (Lo/180) + 10 min. (initial design pt.) Ti = 11.7 min.

Tt, Travel time of Flow:

Urban and Non-Urban Basins

Travel time, Tt = Lc/V(fps)*60 sec./min. Tt = 0.0 min.

Tc, Time of Concentration (Tc = Ti + Tt)

Non-Urban Tc = 28.1 min.
Urban Tc = n/a min.

Intensity (I) From Intensity - Duration - Frequency Curve
City of Boulder Design and Construction Standards, Figure 7-1

2 year	5 year	10 year	100 year
1.50	2.25	2.90	4.20

Peak Flow (Q) = C*I*A (cfs)

2 year	5 year	10 year	100 year
0.56	1.67	3.24	9.37

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PROJECT NO.: 12495C
DATE: 5/20/2013
BY: DPA

STORM RUNOFF HYDROLOGY
Rational Method

Condition: HISTORIC
Land Use: UNDEVELOPED
Basin Area (A) = 12.14 acres

Basin Identification: BASINS HA AND HB
Design Frequencies: 2, 5, 10 & 100 year
Comments:

Runoff Coefficients (C) =

2 year	5 year	10 year	100 year
0.10	0.20	0.30	0.60

Given

Overland flow length (Lo)	500	feet (500 feet maximum)
Overland flow slope (S)	1.0	%
Channel travel length (Lc)	700.0	feet
Channel velocity (V)	1.0	feet/second

Ti, Initial time of Concentration:

Urban Basin

Ti = 1.8*(1.1-C5)*(Lo^0.5)/(S^0.333) (intial design pt.) Ti = 36.2 min.

Ti minimum for Urban Basins = 5 min.

Greater of Calculated Ti and 5 minutes Ti = 36.2 min.

Urban Basin

Ti = (Lo/180) + 10 min. (initial design pt.) Ti = 12.8 min.

Tt, Travel time of Flow:

Urban and Non-Urban Basins

Travel time, Tt = Lc/V(fps)*60 sec./min. Tt = 11.7 min.

Tc, Time of Concentration (Tc = Ti + Tt)

Non-Urban Tc = 47.9 min.
Urban Tc = 24.4 min.

Intensity (I) From Intensity - Duration - Frequency Curve
City of Boulder Design and Construction Standards, Figure 7-1

2 year	5 year	10 year	100 year
1.75	2.60	3.35	4.75

Peak Flow (Q) = C*I*A (cfs)

2 year	5 year	10 year	100 year
2.12	6.31	12.20	34.60

SCOTT, COX & ASSOCIATES, INC.
consulting engineers - surveyors

PROJECT #: 12495C
DATE: 5/20/2013
BY: DPA

BASIN A - PROPOSED

2 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	4.97	0.85	
ROOF	0.49	0.80	
GRAVEL	0.25	0.15	
LANDSCAPE	2.71	0.10	
TOTAL AREA	8.42	**0.58**	= WEIGHTED C

5 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	4.97	0.87	
ROOF	0.49	0.85	
GRAVEL	0.25	0.25	
LANDSCAPE	2.71	0.20	
TOTAL AREA	8.42	**0.63**	= WEIGHTED C

10 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	4.97	0.90	
ROOF	0.49	0.90	
GRAVEL	0.25	0.35	
LANDSCAPE	2.71	0.30	
TOTAL AREA	8.42	**0.69**	= WEIGHTED C

100 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	4.97	0.92	
ROOF	0.49	0.90	
GRAVEL	0.25	0.65	
LANDSCAPE	2.71	0.60	
TOTAL AREA	8.42	**0.81**	= WEIGHTED C

PERCENT IMPERVIOUS 61.90

SCOTT, COX & ASSOCIATES INC.
consulting engineers - surveyors

PROJECT NO.: 12495C
DATE: 5/20/2013
BY: DPA

STORM RUNOFF HYDROLOGY
Rational Method

Condition: PROPOSED
Land Use: COMMERCIAL
Basin Area (A) = 8.42 acres

Basin Identification: BASIN A
Design Frequencies: 2, 5, 10 & 100 year
Comments:

Runoff Coefficients (C) =

2 year	5 year	10 year	100 year
0.58	0.63	0.69	0.81

Given

Overland flow length (Lo)	300	feet (500 feet maximum)
Overland flow slope (S)	2.0	%
Channel travel length (Lc)	800.0	feet
Channel velocity (V)	1.5	feet/second

Ti, Initial time of Concentration:

Urban Basin

Ti = 1.8*(1.1-C5)*(Lo^0.5)/(S^0.333) (intial design pt.) Ti = 11.6 min.

Ti minimum for Urban Basins = 5 min.

Greater of Calculated Ti and 5 minutes Ti = 11.6 min.

Urban Basin

Ti = (Lo/180) + 10 min. (initial design pt.) Ti = 11.7 min.

Tt, Travel time of Flow:

Urban and Non-Urban Basins

Travel time, Tt = Lc/V(fps)*60 sec./min. Tt = 8.9 min.

Tc, Time of Concentration (Tc = Ti + Tt)

Non-Urban Tc = 20.5 min.
Urban Tc = 20.5 min.

Intensity (I) From Intensity - Duration - Frequency Curve
City of Boulder Design and Construction Standards, Figure 7-1

2 year	5 year	10 year	100 year
1.97	3.00	3.85	5.63

Peak Flow (Q) = C*I*A (cfs)

2 year	5 year	10 year	100 year
9.62	15.91	22.37	38.40

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PROJECT #: 12495C
DATE: 5/20/2013
BY: DPA

BASIN B - PROPOSED

2 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.69	0.85	
ROOF	0.20	0.80	
GRAVEL	0.00	0.15	
LANDSCAPE	2.84	0.10	
TOTAL AREA	3.72	**0.28**	= WEIGHTED C

5 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.69	0.87	
ROOF	0.20	0.85	
GRAVEL	0.00	0.25	
LANDSCAPE	2.84	0.20	
TOTAL AREA	3.72	**0.36**	= WEIGHTED C

10 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.69	0.90	
ROOF	0.20	0.90	
GRAVEL	0.00	0.35	
LANDSCAPE	2.84	0.30	
TOTAL AREA	3.72	**0.44**	= WEIGHTED C

100 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	0.69	0.92	
ROOF	0.20	0.90	
GRAVEL	0.00	0.65	
LANDSCAPE	2.84	0.60	
TOTAL AREA	3.72	**0.67**	= WEIGHTED C

PERCENT IMPERVIOUS 22.49

SCOTT, COX & ASSOCIATES INC.
consulting engineers - surveyors

PROJECT NO.: 12495C
DATE: 5/20/2013
BY: DPA

STORM RUNOFF HYDROLOGY
Rational Method

Condition: PROPOSED
Land Use: COMMERCIAL
Basin Area (A) = 3.72 acres

Basin Identification: BASIN B
Design Frequencies: 2, 5, 10 & 100 year
Comments:

Runoff Coefficients (C) =

2 year	5 year	10 year	100 year
0.60	0.65	0.70	0.80

Given

Overland flow length (Lo)	120	feet (500 feet maximum)
Overland flow slope (S)	2.0	%
Channel travel length (Lc)	500.0	feet
Channel velocity (V)	6.0	feet/second

Ti, Initial time of Concentration:

Urban Basin

Ti = 1.8*(1.1-C5)*(Lo^0.5)/(S^0.333) (intial design pt.) Ti = 7.0 min.

Ti minimum for Urban Basins = 5 min.

Greater of Calculated Ti and 5 minutes Ti = 7.0 min.

Urban Basin

Ti = (Lo/180) + 10 min. (initial design pt.) Ti = 10.7 min.

Tt, Travel time of Flow:

Urban and Non-Urban Basins

Travel time, Tt = Lc/V(fps)*60 sec./min. Tt = 1.4 min.

Tc, Time of Concentration (Tc = Ti + Tt)

Non-Urban Tc = 8.4 min.
Urban Tc = 8.4 min.

Intensity (I) From Intensity - Duration - Frequency Curve
City of Boulder Design and Construction Standards, Figure 7-1

2 year	5 year	10 year	100 year
3.20	4.50	6.20	9.10

Peak Flow (Q) = C*I*A (cfs)

2 year	5 year	10 year	100 year
7.14	10.88	16.14	27.08

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consulting engineers - surveyors

PROJECT #: 12495C
DATE: 5/20/2013
BY: DPA

BASINS A AND B - PROPOSED

2 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	5.66	0.85	
ROOF	0.69	0.80	
GRAVEL	0.25	0.15	
LANDSCAPE	5.55	0.10	
TOTAL AREA	12.14	**0.49**	= WEIGHTED C

5 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	5.66	0.87	
ROOF	0.69	0.85	
GRAVEL	0.25	0.25	
LANDSCAPE	5.55	0.20	
TOTAL AREA	12.14	**0.55**	= WEIGHTED C

10 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	5.66	0.90	
ROOF	0.69	0.90	
GRAVEL	0.25	0.35	
LANDSCAPE	5.55	0.30	
TOTAL AREA	12.14	**0.61**	= WEIGHTED C

100 YEAR WEIGHTED RUNOFF COEFFICIENT

SURFACE	AREA	C	
DRIVES	5.66	0.92	
ROOF	0.69	0.90	
GRAVEL	0.25	0.65	
LANDSCAPE	5.55	0.60	
TOTAL AREA	12.14	**0.77**	= WEIGHTED C

PERCENT IMPERVIOUS 49.83

APPENDIX B

STORM WATER DETENTION / WATER QUALITY CALCULATIONS

SCOTT, COX & ASSOCIATES, INC.
consulting engineers - surveyors

PROJECT #: 12495C
DATE: 5/20/2013
BY: DPA

DETENTION POND STORAGE REQUIREMENTS

Based on FAA Method, per Urban Storm Drainage Criteria Manual, Vol. 2, Storage - Section 5

Design Storm	=	10	Year
Allowable Release Rate	=	12.2	cfs
Composite "C" Factor	=	0.7	
Basin Designation	=	A & B	
Basin Size	=	12.14	acres

TIME min	TIME sec	C	A acres	CXA	I in/hr	INFLOW cfs	OUTFLOW cfs	STORAGE cf
5.0	300	0.70	12.14	8.50	7.40	18866	3660	15,206
10.0	600	0.70	12.14	8.50	5.70	29063	7320	21,743
15.0	900	0.70	12.14	8.50	4.55	34799	10980	23,819
20.0	1200	0.70	12.14	8.50	3.80	38751	14640	24,111
25.0	1500	0.70	12.14	8.50	3.35	42702	18300	24,402
30.0	1800	0.70	12.14	8.50	2.90	44360	21960	22,400
35.0	2100	0.70	12.14	8.50	2.65	47291	25620	21,671
40.0	2400	0.70	12.14	8.50	2.40	48948	29280	19,668
45.0	2700	0.70	12.14	8.50	2.20	50478	32940	17,538
50.0	3000	0.70	12.14	8.50	2.05	52263	36600	15,663
55.0	3300	0.70	12.14	8.50	1.90	53282	40260	13,022
60.0	3600	0.70	12.14	8.50	1.80	55067	43920	11,147
							Maximum Volume:	24,402
							110%	26,843

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DETENTION POND STORAGE REQUIREMENTS

Based on FAA Method, per Urban Storm Drainage Criteria Manual, Vol. 2, Storage - Section 5

Design Storm	=	100	Year
Allowable Release Rate	=	34.6	cfs
Composite "C" Factor	=	0.8	
Basin Designation	=	A & B	
Basin Size	=	12.14	acres

TIME min	TIME sec	C	A acres	CXA	I in/hr	INFLOW cf	OUTFLOW cf	STORAGE cf
5.0	300	0.80	12.14	9.71	10.40	30301	10380	19921
10.0	600	0.80	12.14	9.71	8.30	48366	20760	27606
15.0	900	0.80	12.14	9.71	6.60	57689	31140	26549
20.0	1200	0.80	12.14	9.71	5.50	64099	41520	22579
25.0	1500	0.80	12.14	9.71	4.70	68470	51900	16570
30.0	1800	0.80	12.14	9.71	4.15	72549	62280	10269
35.0	2100	0.80	12.14	9.71	3.75	76482	72660	3822
40.0	2400	0.80	12.14	9.71	3.45	80415	83040	-2625
45.0	2700	0.80	12.14	9.71	3.15	82601	93420	-10819
50.0	3000	0.80	12.14	9.71	2.90	84494	103800	-19306
55.0	3300	0.80	12.14	9.71	2.70	86534	114180	-27646
60.0	3600	0.80	12.14	9.71	2.50	87408	124560	-37152
							Maximum Volume:	27,606
							110%	30,366

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Calculate Water Quality Capture Volume
Reference UDFCD Manual - Volume 3

1. Basin Storage Volume

A. Imperviousness Ratio ($I = I_a / 100$) I_A = 65.00%
i = 0.650

B. Contributing Watershed A = 12.14 Acres

C. Water Quality Capture Volume (WQCV)

$WQCV = 1.0 \times (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$

WQCV = 0.254 in / acre

D. Design Volume

Volume = (WQCV / 12) * Area * 1.2 Volume = 0.3085 acre - feet
For Extended Detention type pond 13,439 cubic feet

WATER QUALITY CAPTURE VOLUME (WQCV) = 13,439 cubic feet

Required Pond Volume for both Water Quality and Detention

10-year Storm Water Detention Volume	FAA	26,843	cubic feet
100% of required Water Quality Volume		13,439	cubic feet
Required Total Volume		40,282	cubic feet
100-year Storm Water Detention Volume	FAA	30,366	cubic feet
50% of required Water Quality Volume		6,720	cubic feet
Required Total Volume		37,086	cubic feet
Larger of the two required Volumes		40,282	cubic feet