Rocky Ridge Civil Engineering

PRELIMINARY DRAINAGE REPORT

COAL CREEK VILLAGE

LOUISVILLE, COLORADO

Prepared for:

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Jan 2021

Filename: 2941PDR.doc

"I hereby certify that this report (plan) for the preliminary drainage design of the Coal Creek Village was prepared by me (or under my direct supervision) in accordance with the provisions of City of Louisville Storm Drainage Design and Technical Criteria for the owners thereof."

_____
Registered Professional Engineer
State of Colorado No. 37162

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I. GENERAL LOCATION AND DESCRIPTION

This drainage report is for Coal Creek Village, Louisville, Colorado. The site is located in the northeast quarter of Section 8, Township 1 South, and Range 69 West of the 6th Principal Meridian. South Boulder Road borders the site on the north and State Highway 42 on the east, excluding a portion of the currently developed lands north and east of Cannon. The Colorado and Southern Railroad borders the site on the west and the Robert DiGiacomo Addition borders the site on the south. The site's general location is shown on the vicinity map provided.

The area consists of approximately 10.71 acres in the plat and 14.74 acres if the lots on the southwest corner of Hwy 42 and South Boulder Road are included as offsite basins. The detention pond will release at a rate of 16.03 cfs for the 10-year event and 122.27 cfs for the 100-year event. These release rates assume the pass-through flows connected from the storm sewer running along the north side of S. Boulder Rd which are 15.9 cfs & 121.2 cfs respectively, therefore the net release rates from this development only are 0.14 cfs & 1.07 cfs respectively.

The Goodhue Ditch cuts across the northwest corner of the site, forming a triangle of approximately 0.20 acres. There are three existing buildings and parking lot in the northwest corner of the site. Two of the buildings and the parking lot are on the southeast side of the Goodhue Ditch. The remainder of the site is a vacant lot overgrown with grass and weeds. Sheet flows across the site on slopes varying from 2.5% to 5%, generally from the northwest corner to the southeast corner. Cannon Circle changes from a north-south alignment to an east-west alignment. The 390' of the north-south leg is paved. The connection with Cannon Circle to Hwy 42 will remain.

II. HISTORIC DRAINAGE

The hydrologic type soil for the area (as described by NRCS Websoil Report) is 90% Type B and 10% Type C.

On-site

The Goodhue Ditch segments a portion of the land (leaves a small triangular shaped parcel in the northwest portion of the Site). During the 100-year flow, this ditch is assumed to be full and the runoff continues to the southeast. Drainage continues to sheet flow across the existing developed site to the open field. There is no channelization of flows in this portion of the site. Flows are routed south and east around the north-south leg of Cannon Circle. There is some channelization in the southeast portion of the site that routes flows to the existing outlet pipe in the southeast corner of the site. The approximate historical flow from the 10.7-acre property is 1.07 cfs (cubic feet/second).

Off-site

Developed flows from the existing development to the north and east of Cannon Circle, as well as the south half of South Boulder Road, from Highway 42 to the west property line, also enter the site and combine with on-site flows in the southeast portion of the site. The car wash site, Lot 2, Coal Creek Station Filing No.3, has a detention pond in the southeast corner of the lot. Runoff from the development to the northeast and the rear of the existing buildings to the north flows into this pond. An 8" pipe releases flows into the southeast portion on-site. Fordyce Auto Center has on-site detentioning and a controlled release. Released flows pass under a sidewalk chase into the gutter of Cannon Circle. Release rates from the ponds that serve those properties are being proposed to be piped and conveyed to the north side of the proposed detention/water quality pond.

The City (through Merrick & Company's study) is currently studying the rerouting of stormwater flows through the site in a new 42" RCP. The Goodhue Ditch on the northwest portion of the site will be piped per City direction. Flows from Christopher Village, Coal Train Station, Steel Ranch South, and Christopher Plaza from the north are all currently routed to the 18" storm system in Cannon. This pipe will connect to the proposed 42" RCP coming through the site.

Based on discussions with the City of Louisville staff, a 42" storm pipe is being proposed to traverse the site. This pipe is to carry off-site runoff from properties to the west and north of this site. Currently much of the runoff ends up in the Goodhue Ditch which may be abandoned at some point in time. The proposed 42" storm pipe is conceptually planned to be installed at a location in the Goodhue Ditch on the south side of South Boulder Road near the northwest corner of this site. The pipe will then go east along the south side of South Boulder Road to Cannon Circle where it will intersect and collect the off-site storm runoff from the north that comes under South Boulder Road in a proposed 24" pipe. The 42" pipe will then turn south and continue along or in Cannon Circle to a point on the west side of Highway 42. There is no current plan for the continuation of the 42" storm pipe so it will terminate at Highway 42. Since active storm water runoff from the north is present, a temporary side discharge from the 42" pipe will be installed to discharge the runoff into the site's detention facilities.

Both off-site and on-site flows are routed through the existing 18" pipe in the southeast corner of the site and exit into a roadside ditch, flowing south for approximately 50', before flowing east into the existing 30" pipe under Highway 42 to the eastern side ditch. Flows continue east under an

irrigation ditch berm to the Lastoka Open Space on the east side of Highway 42. This development will continue to utilize the existing 30" pipe under Highway 42. This is the limiting factor for offsite flows passing through the site. Currently, it can pass 43 cfs under the highway.

III. DRAINAGE DESIGN CRITERIA

The drainage design was based on the "Final Drainage Report for Coal Creek Station Subdivision", prepared by Drexel, Barrell & Co, and the "City of Louisville Storm Drainage Design and Technical Criteria Manual." Using the rational formula method for runoff calculations, developed flow rates for each basin were determined for the 10 and 100-year occurring storm. Standard rainfall tables were used to calculate flow. Time of concentration was assumed to be the minimum (per Figure 1 in the Storm Drainage Design and Tech Criteria) of 10 minutes. This is a conservative approach to the stormwater for the Site.

The Mile High Flood District (MHFD) provided a detention pond sizing sheet (version 4.03) which was used in this report. Calculations are provided in the **Appendix** along with the related tables and figures.

IV. DRAINAGE FACILITY DESIGN

On-site

The current design is based on the Final Drainage Report for Coal Creek Station Subdivision done in 1982 for this site. Calculations based on full build-out to the north and east of Cannon Circle were used in the original report. Flows from the additional development that has taken place on the north side of South Boulder Road since the original report was written have been added to this report. The existing outfall point on the west side of Highway 42 will continue to be used. Calculations performed in this report were based on an overall building and hard surface coverage. The actual impervious factor for the Site is 72%.

Several onsite basins have been identified for this development. Specific flows for each of these sub-basins are calculated in the Hydrologic Calculation Section of the **Appendix.**

Basin A has 0.89 acres with an imperviousness of 68% and is located on the southeast corner of the site. It includes several residential units, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows onto the curb and gutter which conveys it south into the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 2.4 cfs & 5.5 cfs respectively.

Basin B has an area of 0.57 acres with an imperviousness of 77% and is located on the southeast of the site. It includes several residential units, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows onto the curb and gutter which conveys it south into the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 1.7 cfs & 3.8 cfs respectively.

Basin C has 0.75 acres with an imperviousness of 63% and is located on the southeast of the site northwest of the detention/water quality pond. It includes several single-family units, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows to the curb and gutter of Street B which conveys it south into the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 1.7 cfs & 4.2 cfs respectively.

Basin D has 0.91 acres with an imperviousness of 67% and is located at the south center of the site. It includes several single-family units, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows to the curb and gutter on Street A which conveys it south into inlet #1.1 which ultimately conveys it east into the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 2.5 cfs & 5.8 cfs respectively.

Basin E has 0.16 acres with an imperviousness of 77% and is located on the southeast corner of the site. It includes the south half of two residential units, landscape areas, sidewalks and asphalt pavement of Lane B. Runoff sheet flows to the curb and gutter of Lane B which conveys it east into inlet #1.0. The 10-yr & 100-yr undetained runoff are estimated to be 0.5 cfs & 1.1 cfs respectively.

Basin F has 2.03 acres with an imperviousness of 72% and is located on the southwest corner of the site. It includes several single-family units, several 4plexes, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows to the curb and gutter on Streets A, and Lane A which conveys it east into inlet #1.3 which ultimately conveys it through the private storm network into the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 5.2 cfs & 11.8 cfs respectively.

Basin G has an area of 0.45 acres with an imperviousness of 62% and is located at the west center of the site. It includes several residential units, 4plexes, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows to the curb and gutter of Front Street which conveys it south into inlet #2.3 which conveys it east through the private network into the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 1.1 cfs & 2.8 cfs respectively.

Basin H has 0.77 acres with an imperviousness of 86% and is located on the center west of the site. It includes a 4plex unit, the south half of Bldg 1, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows southeast to the curb and gutter which conveys it into inlet #2.2 which ultimately sends it east to the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 2.7 cfs & 5.5 cfs respectively.

Basin I consists of 1.99 acres with an imperviousness of 87% and is located on the north center of the site. It includes bldgs 3 & 4, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows south to the curb and gutter south of the parking lot which conveys it into inlet #3.0 which conveys it south to the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 6.9 cfs & 14.2 cfs respectively.

Basin J has 0.53 acres with an imperviousness of 78% and is located on the north center of the site. It includes the east half of Bldg 2, landscape areas, sidewalks and asphalt pavement of Front Street. Runoff sheet flows to the curb and gutter of Front Street which conveys it south into inlet #2.0 which transports it southeast to the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 1.6 cfs & 3.5 cfs respectively.

Basin K has 0.77 acres with an imperviousness of 87% and is located on the northwest corner of the site. It includes several the west half of Bldg 2, the north half of Bldg 1, landscape areas, sidewalks and asphalt pavement. Runoff sheet flows to the curb and gutter which conveys it southeast into inlet #2.1 then to the southeast to the detention/water quality pond. The 10-yr & 100-yr undetained runoff are estimated to be 2.7 cfs & 5.5 cfs respectively.

Basin P has an imperviousness of 10% and is the detention/water quality pond. It has an area of 0.59 acres and it mostly consists of the detention pond and the gravel maintenance access to the pond. The 10-yr & 100-yr undetained runoff are estimated to be 0.3 cfs & 1.9 cfs respectively.

Outfall from Site
Per Section II of this report, the capacity of the 30" RCP under Hwy 42 is 43 cfs.

Detention and Water Quality
There is a detention/water quality pond proposed on this site. It will have a water quality plate for water quality release control, an orifice for the 10-year release. The pond sizing was done using the Modified FAA method from Urban Drainage and the water quality capture volume and the small holes for the water quality plate (on same plate as the 10-year orifice). The mentioned calculations are included in the Detention Pond Section of the **Appendix.**

Off-site
As discussed in Section II of this report, a 42" RCP is being proposed as part of this development due to the urging of the City. It has been designed through the site as shown in the plans. It is

being proposed that a plug be installed at both ends of the pipe until the outfall of this pipe (as it connects to the east side of Hwy 42) is completed.

It has 3 main stormwater collection points:

1. Per the Merrick & Co. report previously referenced, the Goodhue Ditch will contribute 120 cfs at peak to the pipe
2. A newly built 24" RCP bringing water from the north side of South Boulder Road, west of Cannon Circle. The city has verified that there will be 20 cfs coming this way into the storm line.
3. An existing 18" RCP conveys stormwater water from the north side of South Boulder Road, along the east side of Cannon Circle. The city has verified that there will be 20 cfs coming this way into the storm line.

The net total of this flow is 160 cfs (conservative). The calculations of the lower end of the proposed 42" RCP can be found in the Hydraulic Calculations Section of the **Appendix**.

In the interim, no flows from source #1 or #2 (see above) will enter this storm sewer system until the outfall on the east side of Hwy 42 is improved. Therefore, the pipe will fill with stormwater until it overflows though the connection of the storm sewer manhole between the south and north pond. This flow will be directed to the south pond for detentioning.

V. CONCLUSION

In conclusion, this study has been prepared in accordance with City of Louisville Standards and Specifications as outlined in the Drainage Criteria Manual.

The undeveloped 10.71-acre site of the Coal Creek Village will be developed assuming business and residential uses. The complete 14-acre area will be detained for stormwater and provide water quality in a proposed extended sediment basin. The drainage from the Site (and the area on the southwest corner of Hwy 42 and South Boulder) will release into the existing drainage system in the southeast portion of the site which will have detention ponds sized for the build out condition. The results of this study indicate that the proposed development will safely convey runoff from the site with no adverse effects or impacts on the surrounding developments.

VI. REFERENCES

Drexel, Barrell & Co, June 1, 1982. Final Drainage Report for Coal Creek Station Subdivision

WRC Engineering. April 1982. City of Louisville Storm Drainage Design and Technical Criteria Manual

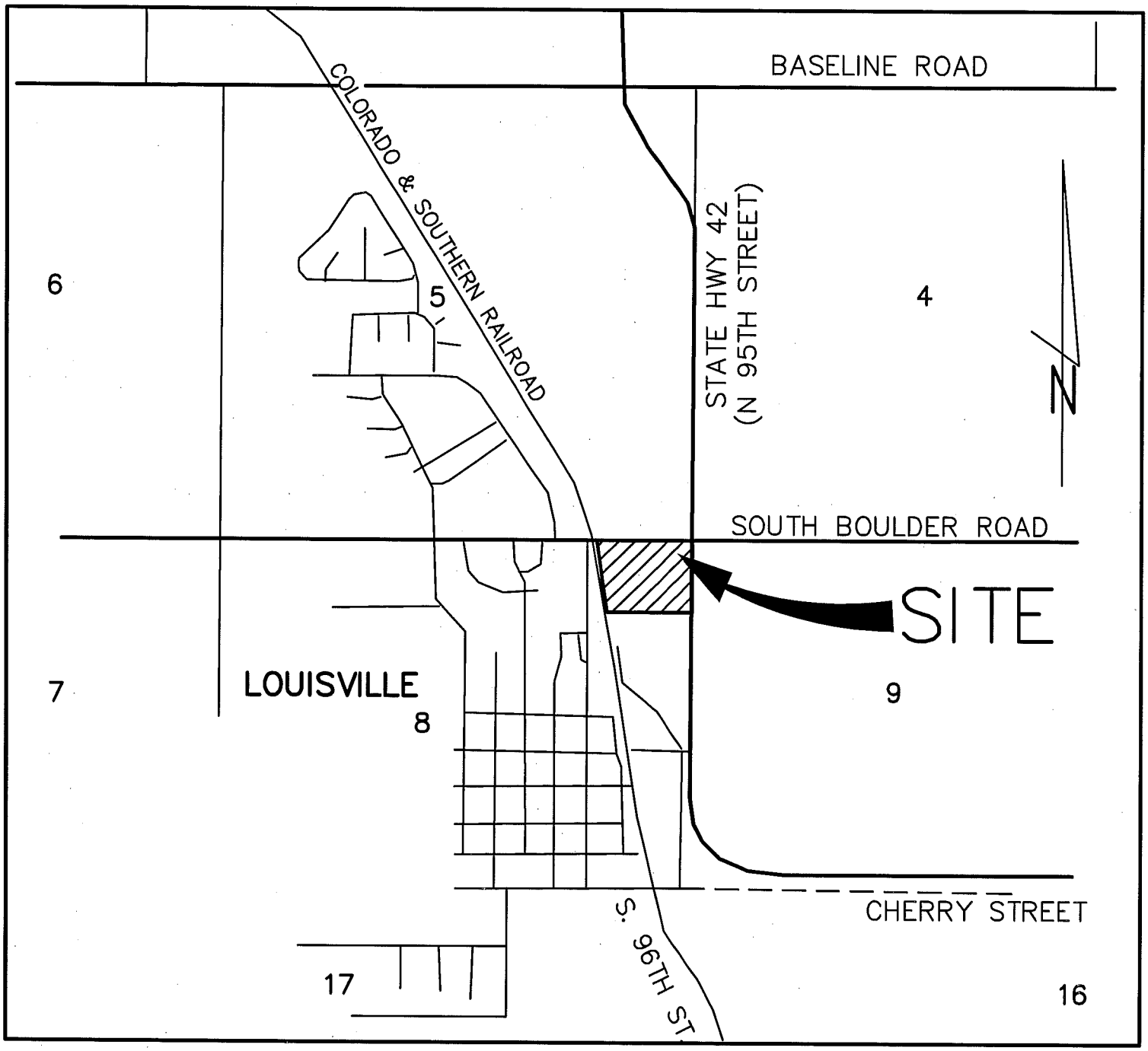
Western Environment and Ecology, Inc, August 24, 2005. Mine Subsidence Investigation – Coal Creek Station Development – see the last section of the **Appendix** for pages of this report.

Mile High Flood District. online. Drainage Criteria Manual,

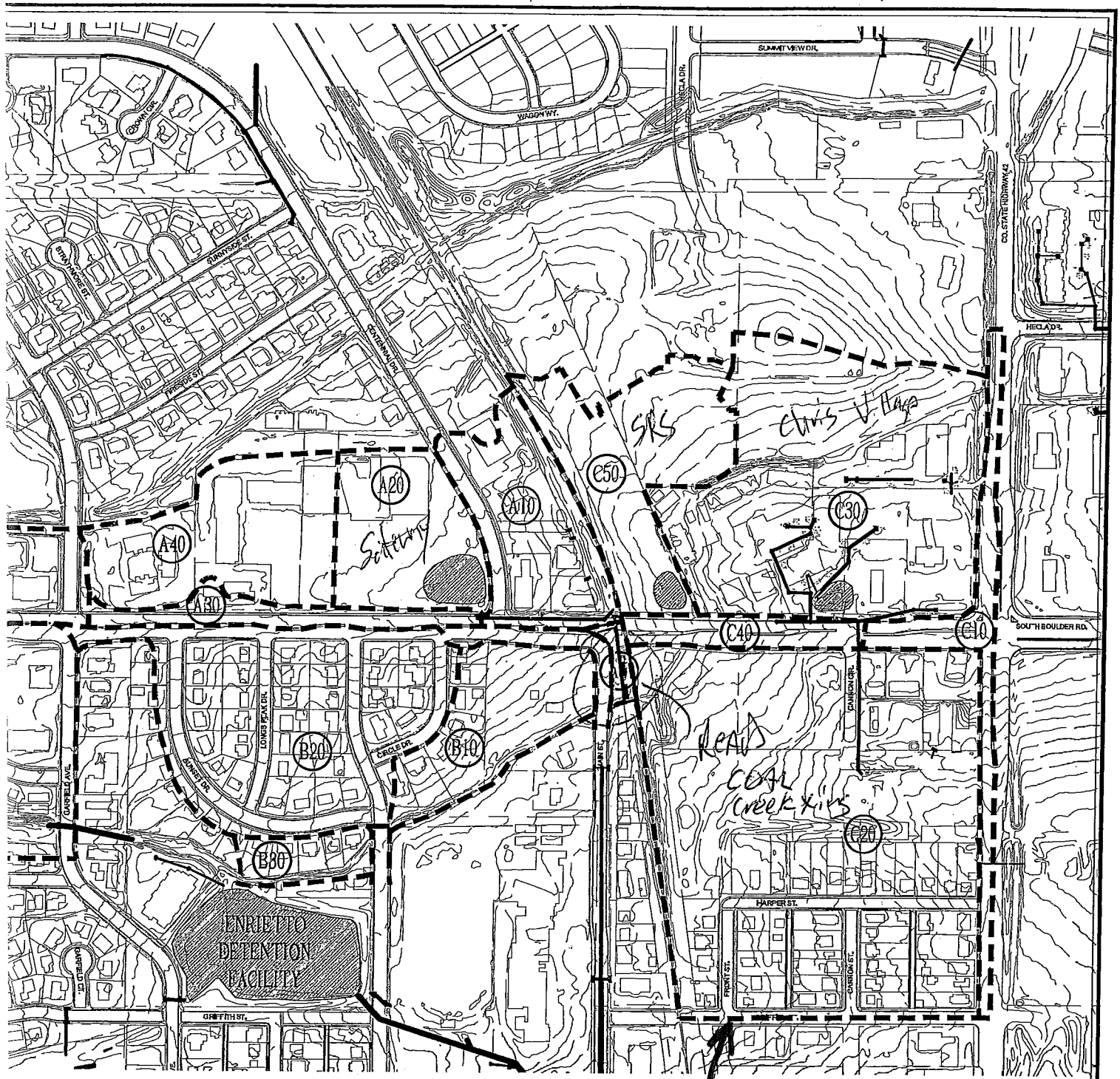
Merrick & Company. December 2012. Lafayette-Louisville Boundary Outfall System Plan, Conceptual Design Report.

APPENDIX

MAPS & FIGURES



VICINITY MAP



GEND

- 2" AND 4" LINE
- 6" AND 8" LINE
- 10" AND 12" LINE
- 14" AND 16" LINE
- 18" – 20" LINE
- 21" – 24" LINE
- 27" LINE
- 30" – 36" LINE
- 42" – 60" LINE

200 0 200 400

1 inch = 200 feet

From Lafayette-Louisville Boundary OSP (May 2011)

LYSIS	PARTIAL PLAN BASIN MAP A	MERRICK & COMPANY	DESIGN: AKA DETAIL: AKA, RDL CHECK: XXX DATE: DECEMBER, 2012	PROJECT NUMBER 65417624 Drawing Number: 1

LOUISVILLE / AKA-DELINEATION..DWG /DECEMBER 4, 2012 / PROJ. 6511737598

HYDROLOGIC CALCULATIONS

CITY OF LOUISVILLE
STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA

TABLE 3

RUNOFF COEFFICIENTS FOR RATIONAL METHOD

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY 2	5	10	100
Business:					
Commercial Areas	95	.87	.88	.90	.93
Neighborhood Areas	65	.60	.65	.70	.80
Residential:					
Single-Family	40	.40	.45	.50	.70
Multi-Unit (detached)	50	.50	.55	.60	.75
Multi-Unit (attached)	70	.65	.70	.70	.80
1/2 Acre Lot or Larger	30	.30	.40	.45	.65
Apartments	70	.65	.70	.70	.80
Industrial:					
Light Areas	80	.75	.80	.80	.85
Heavy Areas	90	.80	.80	.85	.90
Parks, Cemetaries	7	.15	.25	.35	.60
Playgrounds	13	.20	.30	.40	.70
Schools	50	.50	.55	.60	.75
Railroad Yard Areas	40	.40	.45	.50	.70
Undeveloped Areas:					
Historic Flow Analysis Greenbelts, Agricultural	2	.10	.20	.30	.60
Offsite Flow Analysis (when land use not defined)	45	.45	.50	.55	.72
Streets:					
Paved	100	.87	.88	.90	.93
Gravel	7	.15	.25	.35	.65
Drives and Walks	96	.85	.87	.90	.92
Roofs	90	.80	.85	.90	.90
Lawns, Sandy Soil	0	.00	.10	.20	.50
Lawns, Clayey Soil	0	.10	.20	.30	.60

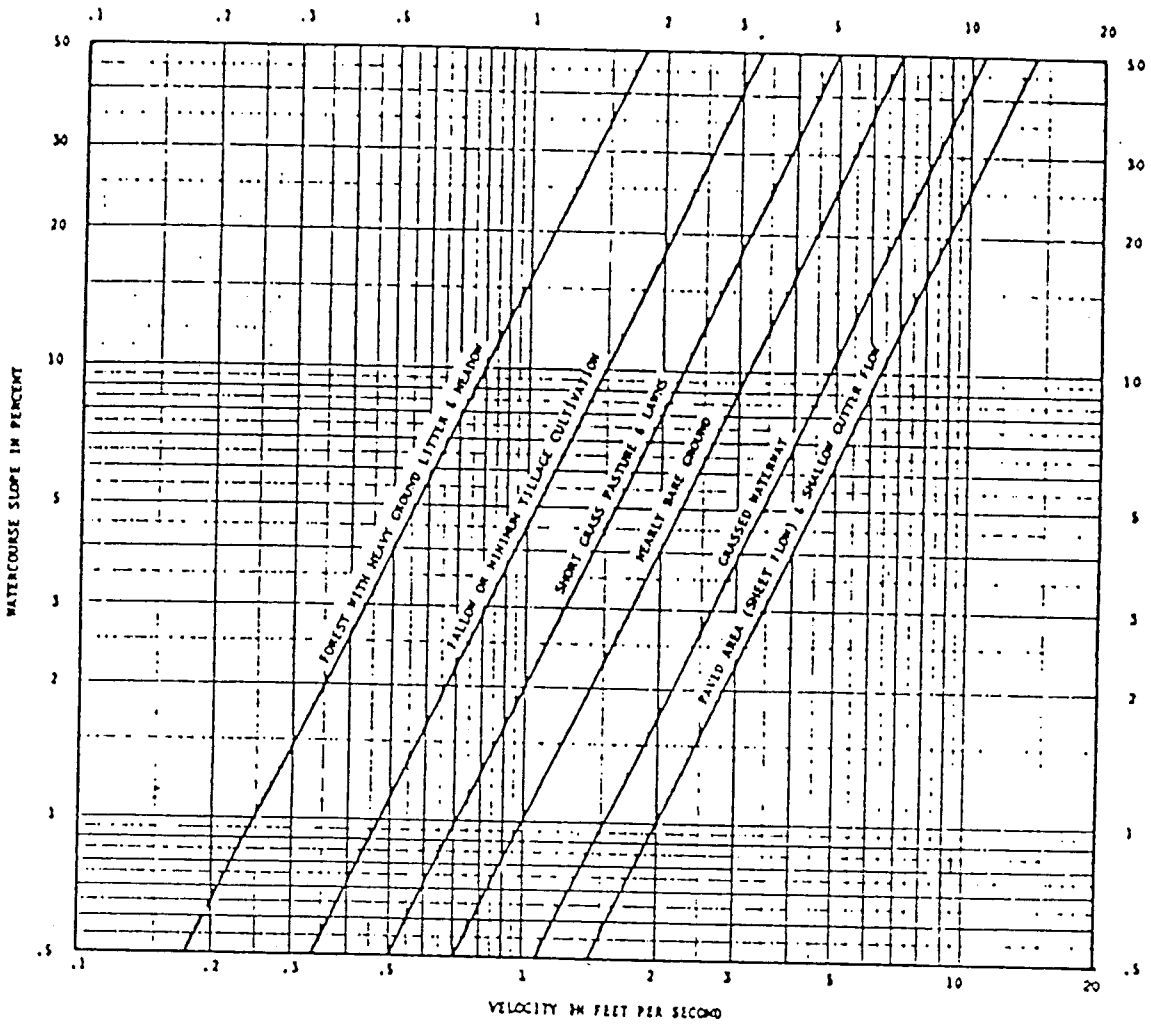
NOTE: These Rational Formula coefficients do not apply for larger basins where the time-of-concentration exceeds 60 minutes.

WRC, Inc.	*Reference:* Urban Drainage & Flood Control District Rational Formula Procedure, Hydrology Research Program, August 1979.
Date: Dec, 1981	

CITY OF LOUISVILLE
STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA

FIGURE 3

TIME OF TRAVEL



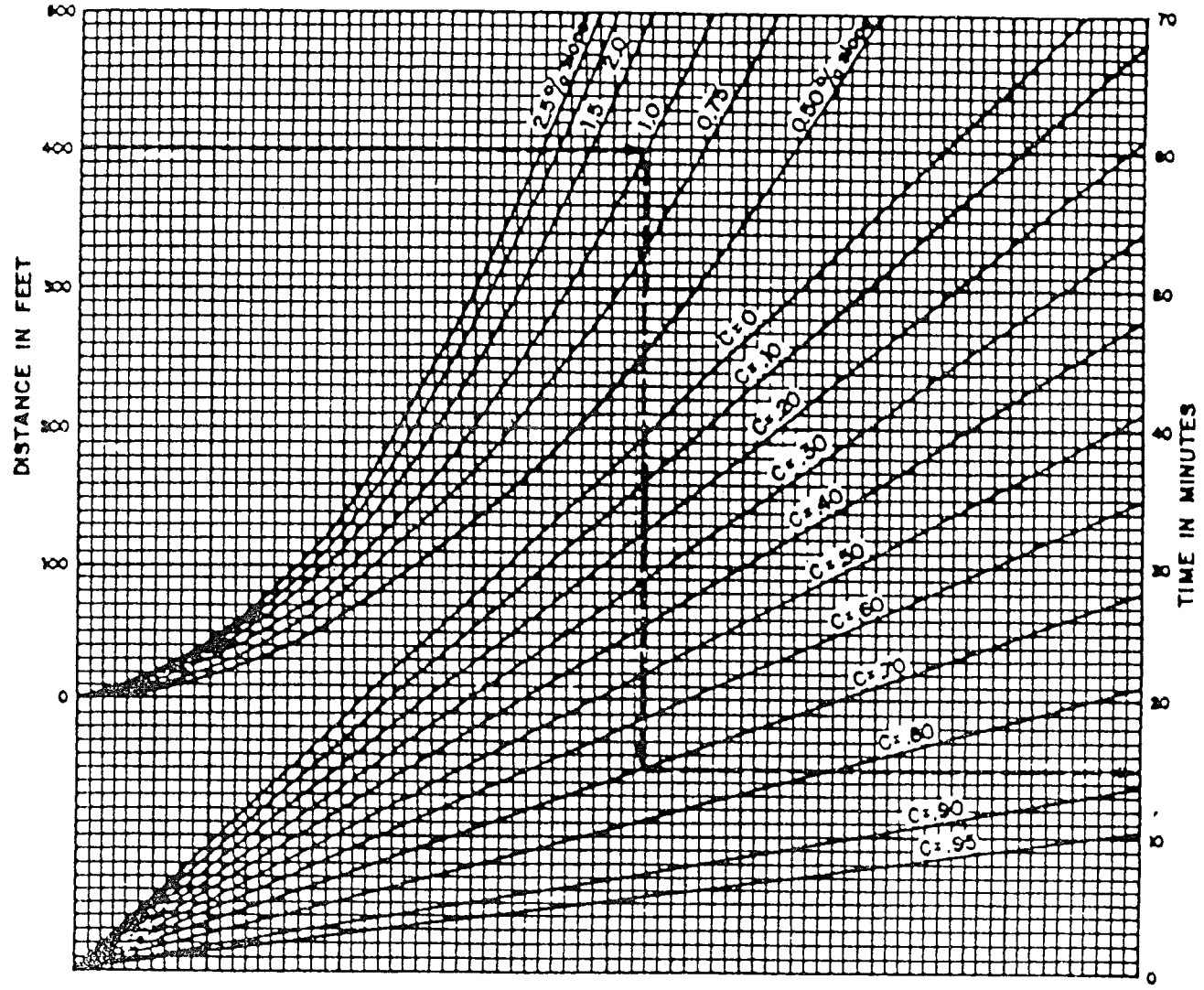
NOTE: 1. The curves can be used with the Rational Method to estimate the time of travel (t_t) portion of the concentration time.

2. See Text, Section 4.3.2 for further explanation.

WRC, Inc.	Reference: "Urban Hydrology For Small Watersheds" Technical Release No. 55, USDA, SCS Jan. 1975.
Date: Dec, 1981	

CITY OF LOUISVILLE STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA	FIGURE 2

OVERLAND TIME OF FLOW



THE ABOVE CURVES ARE A SOLUTION OF THE FOLLOWING EQUATION:

$$t_i = \frac{1.8\,(1.1 - C_5)\,\sqrt{L}}{\sqrt[3]{S}}$$

where: t_i = initial flow time (min.)
S = slope of basin (%)
C_5 = runoff coeficient for 5 year frequency (Table 3)
L = length of basin (ft.)

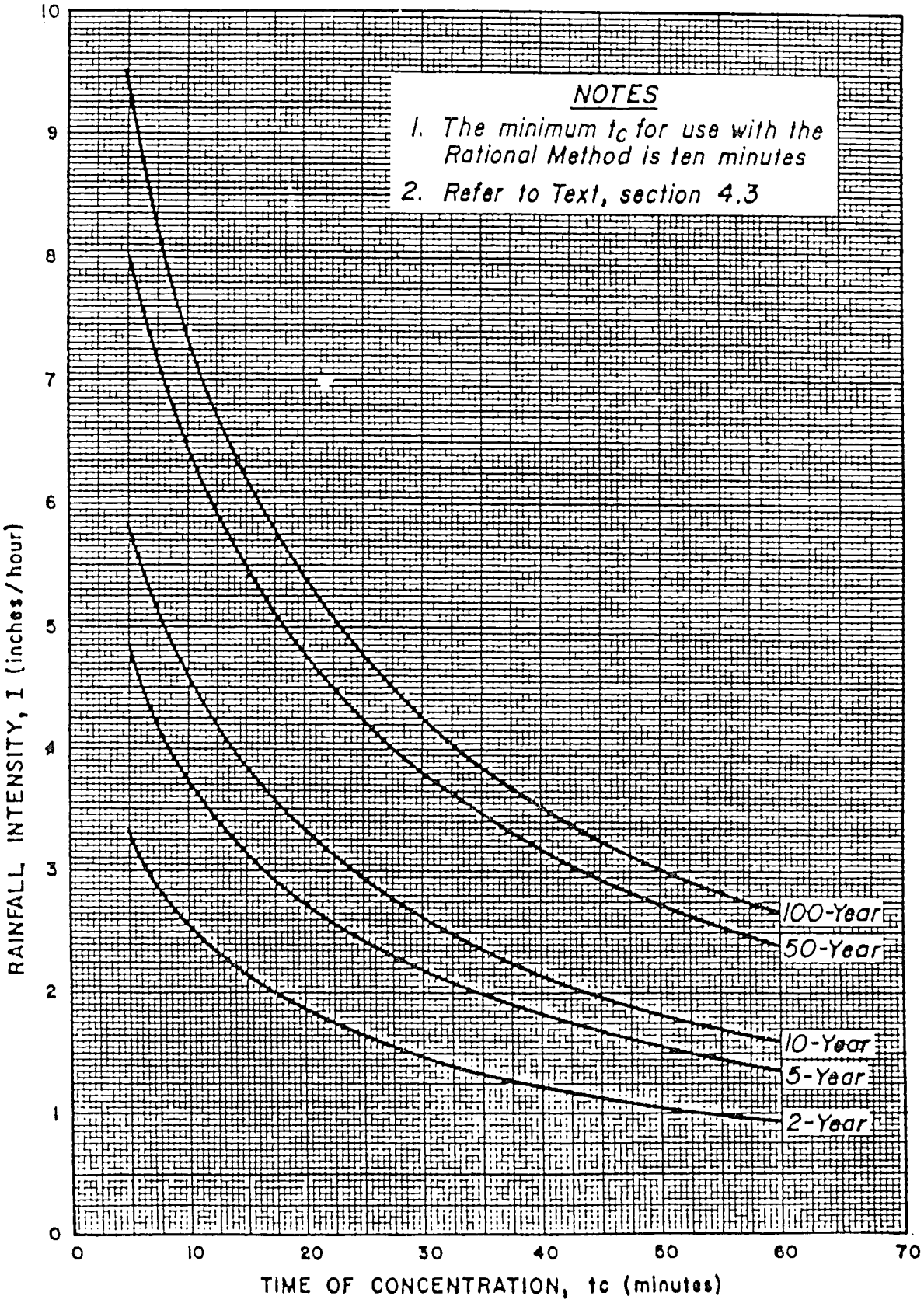
NOTES:
1. The curves are for use with the Rational Method, see Text Section 4·3·2.
2. The curves shall not be used for distances in excess of 300'.
3. See Figure 3 for additional information

WRC, Inc.	Reference: "Urban Storm Drainage Criteria Manual" DRCOG, Denver Colo. 1969
Date: Dec, 1981	

CITY OF LOUISVILLE
STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA

FIGURE 1

TIME-INTENSITY-FREQUENCY CURVES



WRC, Inc.

Date: Dec, 1981

Reference: NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume III - Colorado.

C factors & Impervious % - Proposed

Coal Creek Village

JN - 294-1

ALL (ONSITE + OFFSITE)	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	226882	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	41948	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	2570	0.29	0.32	0.38	0.61	40
ROOFS	109837	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	260837	0.01	0.01	0.07	0.44	2

C2= 0.48
C5= 0.49
C10= 0.52
C100= 0.69

Total Basin Area (Includes Offsite Basins)
14.74 ac 642,074 sq.ft.
Basin Impervious
58%

ONSITE BASINS ONLY	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	196913	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	36242	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	2570	0.29	0.32	0.38	0.61	40
ROOFS	105916	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	111819	0.01	0.01	0.07	0.44	2

C2= 0.60
C5= 0.62
C10= 0.64
C100= 0.76

Total Basin Area
10.41 ac 453,460 sq.ft.
Basin Impervious
72%

BASIN A	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	15507	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1938	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	9692	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	11631	0.01	0.01	0.07	0.44	2

C2= 0.56
C5= 0.58
C10= 0.60
C100= 0.74

Total Basin Area (Includes Offsite Basins)
0.89 ac 38,768 sq.ft.
Basin Impervious
68%

BASIN B	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	12415	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1241	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	6207	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	4966	0.01	0.01	0.07	0.44	2

C2= 0.64
C5= 0.66
C10= 0.68
C100= 0.79

Total Basin Area (Includes Offsite Basins)
0.57 ac 24,829 sq.ft.
Basin Impervious
77%

BASIN C	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	11435	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	3267	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	6534	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	11435	0.01	0.01	0.07	0.44	2

C2= 0.52
C5= 0.53
C10= 0.56
C100= 0.72

Total Basin Area (Includes Offsite Basins)
0.75 ac 32,670 sq.ft.
Basin Impervious
63%

C factors & Impervious % - Proposed

Coal Creek Village

JN - 294-1

BASIN D	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	11892	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	3964	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	11892	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	11892	0.01	0.01	0.07	0.44	2

C2= 0.55
C5= 0.57
C10= 0.59
C100= 0.74

Total Basin Area (Includes Offsite Basins)
0.91 ac 39,640 sq.ft.
Basin Impervious
67%

BASIN E	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	3485	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	697	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	1394	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	1394	0.01	0.01	0.07	0.44	2

C2= 0.64
C5= 0.66
C10= 0.68
C100= 0.79

Total Basin Area (Includes Offsite Basins)
0.16 ac 6,970 sq.ft.
Basin Impervious
77%

BASIN F	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	35371	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	8843	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	22107	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	22107	0.01	0.01	0.07	0.44	2

C2= 0.60
C5= 0.61
C10= 0.63
C100= 0.76

Total Basin Area (Includes Offsite Basins)
2.03 ac 88,427 sq.ft.
Basin Impervious
72%

BASIN G	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	5881	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1960	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	4901	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	6861	0.01	0.01	0.07	0.44	2

C2= 0.51
C5= 0.53
C10= 0.56
C100= 0.72

Total Basin Area (Includes Offsite Basins)
0.45 ac 19,602 sq.ft.
Basin Impervious
62%

BASIN H	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	16771	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	3354	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	10062	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	3354	0.01	0.01	0.07	0.44	2

C2= 0.72
C5= 0.74
C10= 0.75
C100= 0.83

Total Basin Area (Includes Offsite Basins)
0.77 ac 33,541 sq.ft.
Basin Impervious
86%

BASIN I	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	52011	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	4334	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	21671	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	8668	0.01	0.01	0.07	0.44	2

C2= 0.73
C5= 0.75
C10= 0.76
C100= 0.83

Total Basin Area (Includes Offsite Basins)
1.99 ac 86,684 sq.ft.
Basin Impervious
87%

C factors & Impervious % - Proposed

Coal Creek Village

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BASIN J	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	13852	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	2309	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	2309	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	4617	0.01	0.01	0.07	0.44	2

C2= 0.65
C5= 0.67
C10= 0.69
C100= 0.79

Total Basin Area (Includes Offsite Basins)
0.53 ac 23,087 sq.ft.
Basin Impervious
78%

BASIN K	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	18295	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	3049	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	9148	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	3049	0.01	0.01	0.07	0.44	2

C2= 0.73
C5= 0.75
C10= 0.76
C100= 0.83

Total Basin Area (Includes Offsite Basins)
0.77 ac 33,541 sq.ft.
Basin Impervious
87%

BASIN P	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1285	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	2570	0.29	0.32	0.38	0.61	40
ROOFS	0	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	21845	0.01	0.01	0.07	0.44	2

C2= 0.07
C5= 0.08
C10= 0.14
C100= 0.48

Total Basin Area (Includes Offsite Basins)
0.59 ac 25,700 sq.ft.
Basin Impervious
10%

BASIN OS1	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	0	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	0	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	28750	0.01	0.01	0.07	0.44	2

C2= 0.01
C5= 0.01
C10= 0.07
C100= 0.44

Total Basin Area (Includes Offsite Basins)
0.66 ac 28,750 sq.ft.
Basin Impervious
2%

BASIN OS2	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	0	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	0	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	71438	0.01	0.01	0.07	0.44	2

C2= 0.01
C5= 0.01
C10= 0.07
C100= 0.44

Total Basin Area (Includes Offsite Basins)
1.64 ac 71,438 sq.ft.
Basin Impervious
2%

BASIN OS3	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	29969	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	3746	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	0	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	3746	0.01	0.01	0.07	0.44	2

C2= 0.75
C5= 0.77
C10= 0.77
C100= 0.84

Total Basin Area (Includes Offsite Basins)
0.86 ac 37,462 sq.ft.
Basin Impervious
89%

C factors & Impervious % - Proposed

Coal Creek Village

JN - 294-1

BASIN OS4	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	0	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	0	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	22216	0.01	0.01	0.07	0.44	2

C2= 0.01
C5= 0.01
C10= 0.07
C100= 0.44

Total Basin Area (Includes Offsite Basins)

0.51 ac 22,216 sq.ft.

Basin Impervious

2%

BASIN OS5	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	0	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	0	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	9148	0.01	0.01	0.07	0.44	2

C2= 0.01
C5= 0.01
C10= 0.07
C100= 0.44

Total Basin Area (Includes Offsite Basins)

0.21 ac 9,148 sq.ft.

Basin Impervious

2%

BASIN OS6	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1960	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	3920	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	13721	0.01	0.01	0.07	0.44	2

C2= 0.23
C5= 0.24
C10= 0.28
C100= 0.56

Total Basin Area (Includes Offsite Basins)

0.45 ac 19,602 sq.ft.

Basin Impervious

28%

Calculation of Peak Runoff using Rational Method

Designer: Jose Ramirez
Company: Rocky Ridge Civil Engineering
Date: 1/6/2021
Project: 294-1 - Coal Creek Village - Developed
Location: Louisville, Colorado

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$= 5 (urban)
$t_{minimum}$= 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.80	1.09	1.35	1.78	2.14	2.54	3.63

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
BASIN A	0.89	C	68	0.54	0.59	0.63	0.70	0.73	0.76	0.80	24.00			0.020	3.62	210.00			0.005	20	1.41	2.47	6.09	17.19	6.09	2.58	3.50	4.33	5.71	6.87	8.15	11.65	1.23	1.82	2.4	3.55	4.44	5.5	8.31
BASIN B	0.57	B	77	0.62	0.65	0.68	0.74	0.76	0.79	0.82	24.00			0.020	3.18	185.00			0.005	20	1.41	2.18	5.36	15.04	5.36	2.67	3.63	4.50	5.93	7.13	8.46	12.09	0.94	1.34	1.7	2.48	3.09	3.8	5.64
BASIN C	0.75	B	63	0.48	0.52	0.56	0.64	0.68	0.72	0.77	20.00			0.020	3.75	282.00			0.005	20	1.41	3.32	7.08	19.08	7.08	2.46	3.34	4.14	5.45	6.56	7.78	11.12	0.89	1.29	1.7	2.63	3.33	4.2	6.38
BASIN D	0.91	B	67	0.52	0.55	0.59	0.67	0.70	0.74	0.78	55.00			0.250	2.54	208.00			0.005	20	1.41	2.45	4.99	17.35	5.00	2.72	3.70	4.58	6.04	7.26	8.62	12.31	1.29	1.85	2.5	3.67	4.62	5.8	8.74
BASIN E	0.16	B	77	0.62	0.65	0.68	0.74	0.76	0.79	0.82	35.00			0.020	3.84	125.00			0.006	20	1.55	1.34	5.18	14.20	5.18	2.70	3.66	4.54	5.98	7.19	8.53	12.20	0.27	0.38	0.5	0.70	0.87	1.1	1.60
BASIN F	2.03	B	72	0.57	0.60	0.64	0.70	0.73	0.76	0.80	24.00			0.020	3.52	405.00			0.007	20	1.67	4.03	7.56	17.99	7.56	2.41	3.27	4.05	5.34	6.41	7.61	10.88	2.78	3.98	5.2	7.59	9.50	11.8	17.66
BASIN G	0.45	B	62	0.48	0.51	0.56	0.64	0.68	0.72	0.76	20.00			0.020	3.78	155.00			0.010	20	2.00	1.29	5.07	16.88	5.07	2.71	3.68	4.56	6.01	7.23	8.58	12.27	0.59	0.85	1.1	1.73	2.20	2.8	4.21
BASIN H	0.77	B	86	0.70	0.73	0.75	0.79	0.81	0.83	0.85	40.00			0.250	1.46	305.00			0.020	20	2.83	1.80	3.26	13.05	5.00	2.72	3.70	4.58	6.04	7.26	8.62	12.31	1.47	2.08	2.7	3.67	4.52	5.5	8.07
BASIN I	1.99	B	87	0.71	0.74	0.76	0.80	0.81	0.83	0.86	40.00			0.020	3.29	315.00			0.020	20	2.83	1.86	5.14	12.93	5.14	2.70	3.67	4.55	5.99	7.21	8.55	12.22	3.83	5.39	6.9	9.50	11.68	14.2	20.80
BASIN J	0.53	B	78	0.63	0.66	0.69	0.74	0.77	0.79	0.82	40.00			0.020	4.02	245.00			0.020	20	2.83	1.44	5.46	14.12	5.46	2.66	3.61	4.47	5.90	7.09	8.41	12.02	0.89	1.26	1.6	2.32	2.88	3.5	5.24
BASIN K	0.77	B	87	0.71	0.74	0.76	0.80	0.82	0.83	0.86	20.00			0.020	2.31	175.00			0.010	20	2.00	1.46	3.77	12.51	5.00	2.72	3.70	4.58	6.04	7.26	8.62	12.31	1.50	2.11	2.7	3.71	4.56	5.5	8.12
BASIN P	0.59	B	10	0.06	0.07	0.14	0.31	0.38	0.47	0.57	30.00			0.250	3.52	335.00			0.005	20	1.41	3.95	7.46	31.84	10.00	2.17	2.95	3.65	4.82	5.79	6.87	9.82	0.07	0.12	0.3	0.89	1.31	1.9	3.32

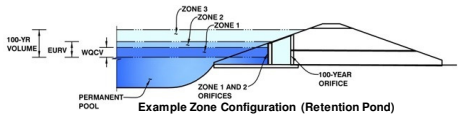
DETENTION POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: 294-1 - Coal Creek Village

Basin ID: All - Onsite Basins



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	10.71	acres
Watershed Length =	1,010	ft
Watershed Length to Centroid =	850	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	72%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	90.0%	percent
Percentage Hydrologic Soil Groups C/D =	10.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Louisville - City Hall	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.280 acre-feet	0.280	acre-feet
Excess Urban Runoff Volume (EURV) =	0.844 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.8 in.) =	0.473 acre-feet		inches
5-yr Runoff Volume (P1 = 1.09 in.) =	0.679 acre-feet		inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.896 acre-feet		inches
25-yr Runoff Volume (P1 = 1.78 in.) =	1.308 acre-feet		inches
50-yr Runoff Volume (P1 = 2.14 in.) =	1.637 acre-feet		inches
100-yr Runoff Volume (P1 = 2.54 in.) =	2.027 acre-feet		inches
500-yr Runoff Volume (P1 = 3.63 in.) =	3.054 acre-feet		inches
Approximate 2-yr Detention Volume =	0.452 acre-feet		
Approximate 5-yr Detention Volume =	0.650 acre-feet		
Approximate 10-yr Detention Volume =	0.859 acre-feet		
Approximate 25-yr Detention Volume =	1.063 acre-feet		
Approximate 50-yr Detention Volume =	1.180 acre-feet		
Approximate 100-yr Detention Volume =	1.335 acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.280	acre-feet
Zone 2 Volume (10-year - Zone 1) =	0.579	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.616	acre-feet
Total Detention Basin Volume =	1.475	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

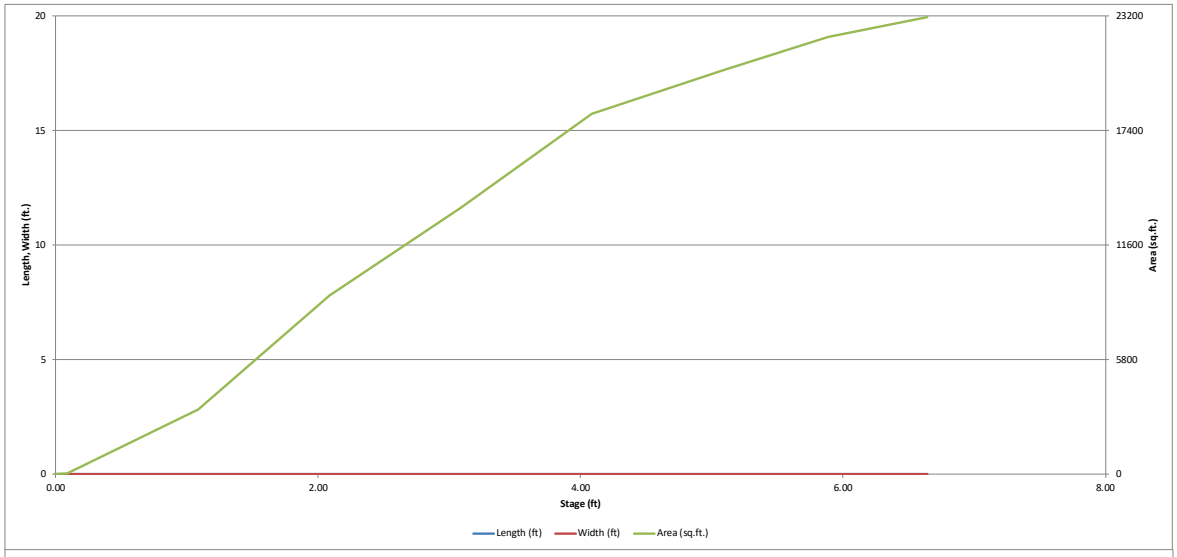
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

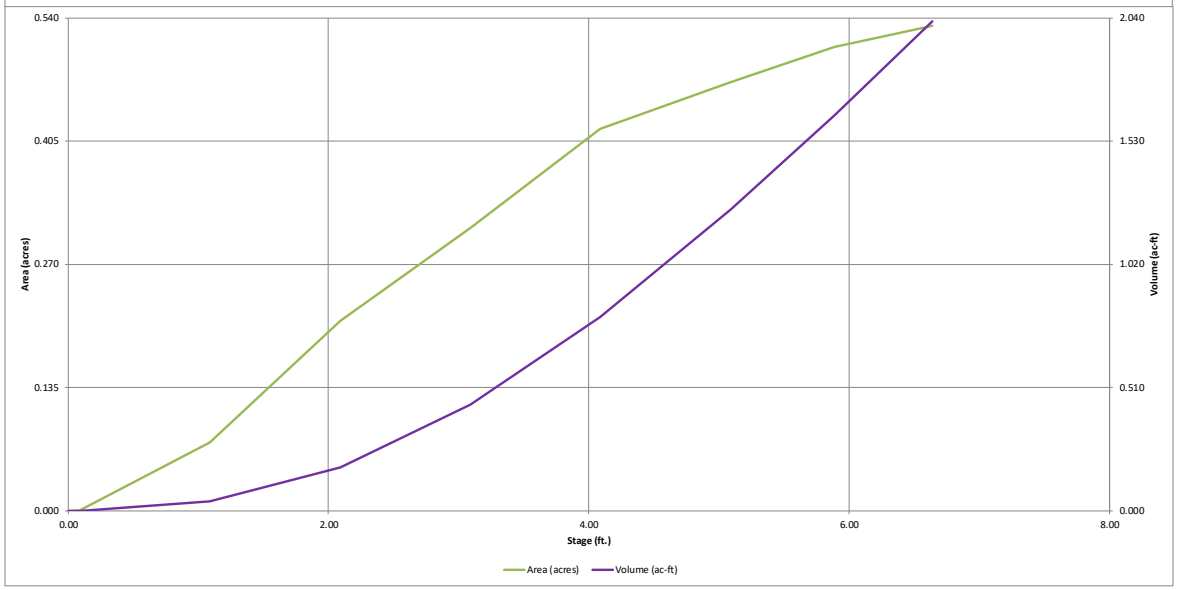
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.09	--	--	--	30	0.001	1	0.000
	--	1.09	--	--	--	3,261	0.075	1,647	0.038
	--	2.09	--	--	--	9,045	0.208	7,800	0.179
	--	3.09	--	--	--	13,488	0.310	19,066	0.438
	--	4.09	--	--	--	18,233	0.419	34,927	0.802
	--	5.09	--	--	--	20,449	0.469	54,268	1.246
	--	5.89	--	--	--	22,124	0.508	71,297	1.637
	--	6.64	--	--	--	23,145	0.531	88,273	2.026

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



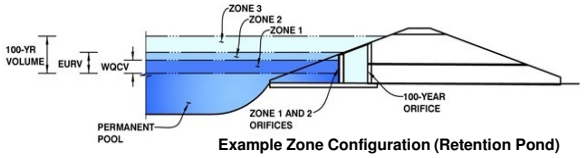


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: 294-1 - Coal Creek Village

Basin ID: All - Onsite Basins



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.54	0.280	Orifice Plate
Zone 2 (10-year)	4.23	0.579	Circular Orifice
Zone 3 (100+1/2WQCV)	5.57	0.616	Weir&Pipe (Restrict)
Total (all zones)		1.475	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	7.222E-03	ft²
Depth at top of Zone using Orifice Plate =	2.54	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.04	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60					
Orifice Area (sq. inches)	1.04	1.04	1.04					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.54	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.27	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.23	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.29	N/A	feet
Vertical Orifice Diameter =	7.00	N/A	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.23	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.98	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	3.09	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.90	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	8.66	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	4.33	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A	feet
Restrictor Plate Height Above Pipe Invert =	18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.89	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.36 feet
Spillway Crest Length =	45.00	feet	Stage at Top of Freeboard =	6.75 feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.53 acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	2.03 acre-ft

Calculated Parameters for Spillway

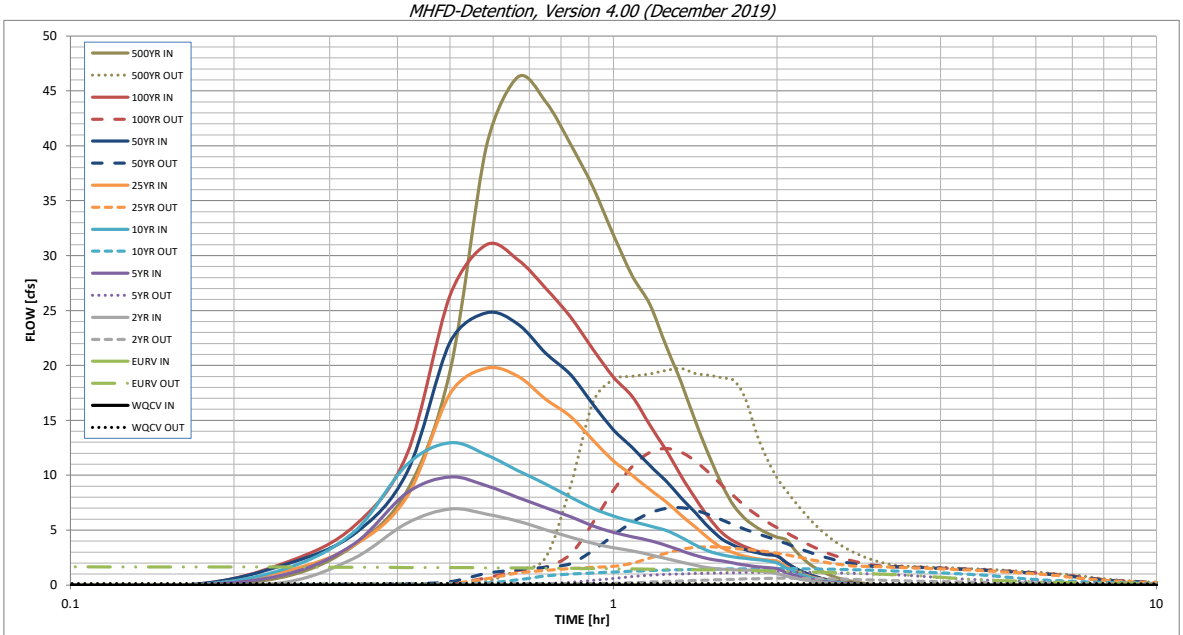
Routed Hydrograph Results

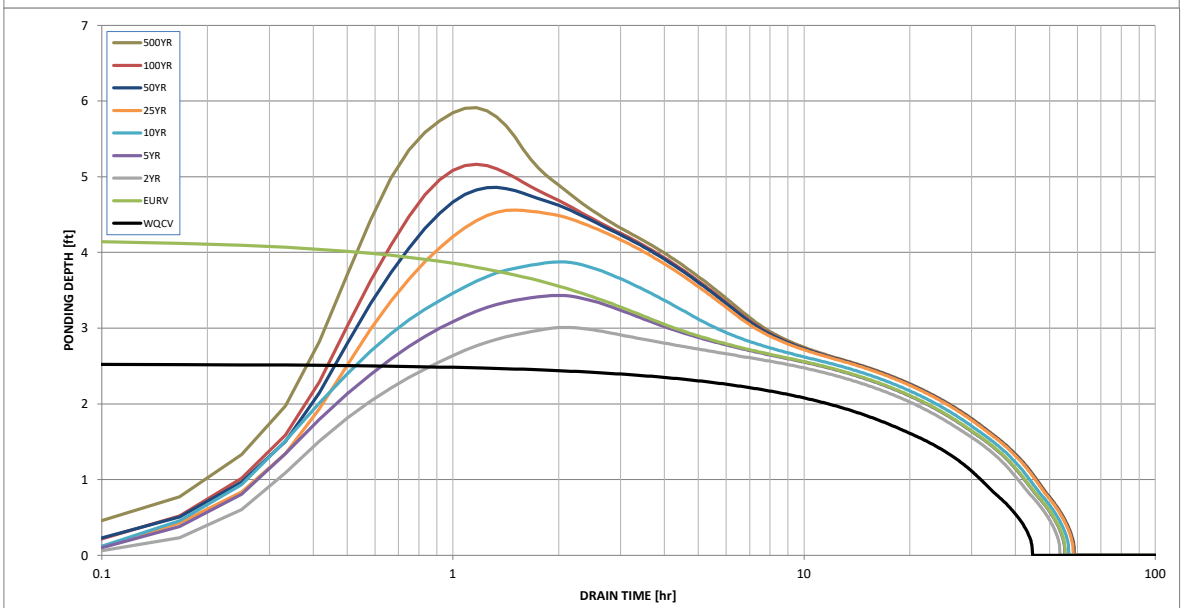
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

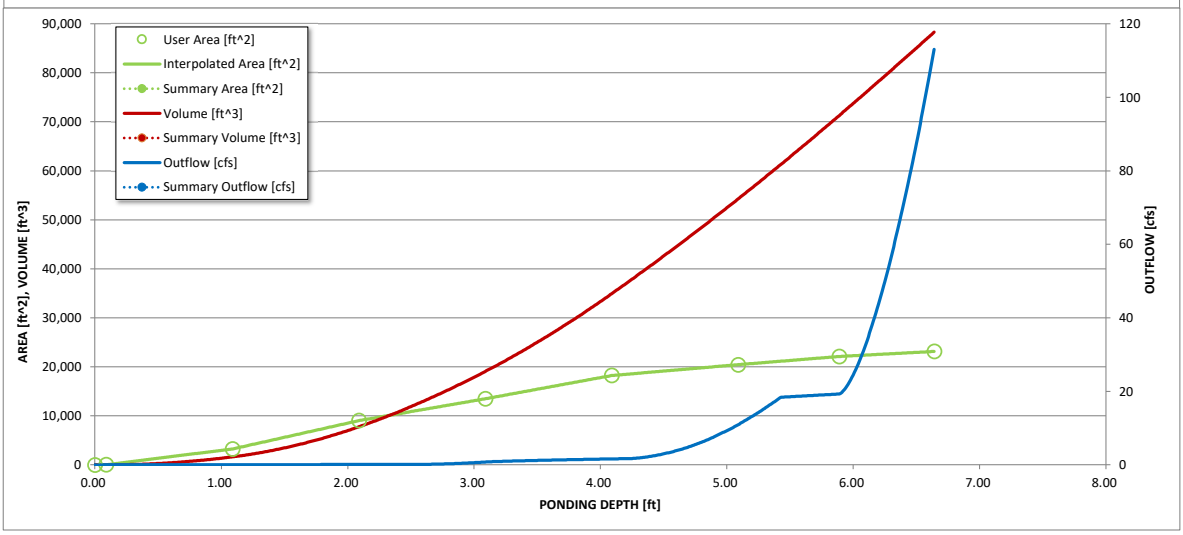
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.80	1.09	1.35	1.78	2.14	2.54	3.63
CUHP Runoff Volume (acre-ft) =	0.280	0.844	0.473	0.679	0.896	1.308	1.637	2.027	3.054
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.473	0.679	0.896	1.308	1.637	2.027	3.054
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	1.5	5.6	8.1	11.6	19.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.14	0.52	0.76	1.08	1.83
Peak Inflow Q (cfs) =	N/A	N/A	6.9	9.8	12.9	19.7	24.8	31.0	46.3
Peak Outflow Q (cfs) =	0.1	1.7	0.6	1.2	1.5	3.5	7.0	12.4	19.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	8.9	1.0	0.6	0.9	1.1	1.0
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.2	0.6	1.2	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	44	46	45	45	44	42	40	35
Time to Drain 99% of Inflow Volume (hours) =	**43**	51	51	51	52	52	50	49	46
Maximum Ponding Depth (ft) =	2.53	4.20	3.01	3.43	3.88	4.56	4.86	5.16	5.91
Area at Maximum Ponding Depth (acres) =	0.25	0.42	0.30	0.35	0.39	0.44	0.46	0.47	0.51
Maximum Volume Stored (acre-ft) =	0.280	0.848	0.410	0.549	0.712	1.000	1.139	1.279	1.647

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.03	0.80
	0:15:00	0.00	0.00	0.27	0.99	1.53	1.31	1.92	2.08	3.64
	0:20:00	0.00	0.00	2.47	3.79	4.89	3.64	4.69	5.39	8.58
	0:25:00	0.00	0.00	5.64	8.40	10.99	8.06	10.26	11.94	19.46
	0:30:00	0.00	0.00	6.93	9.84	12.94	17.42	22.10	26.35	39.95
	0:35:00	0.00	0.00	6.47	9.04	11.86	19.74	24.79	30.99	46.26
	0:40:00	0.00	0.00	5.81	7.98	10.42	19.01	23.75	29.63	44.03
	0:45:00	0.00	0.00	5.04	7.03	9.20	16.92	21.12	27.04	40.15
	0:50:00	0.00	0.00	4.36	6.22	8.01	15.35	19.15	24.40	36.23
	0:55:00	0.00	0.00	3.79	5.39	6.98	13.18	16.46	21.47	31.86
	1:00:00	0.00	0.00	3.39	4.80	6.27	11.30	14.13	18.92	28.13
	1:05:00	0.00	0.00	3.12	4.39	5.79	9.98	12.51	17.16	25.55
	1:10:00	0.00	0.00	2.75	4.05	5.37	8.69	10.88	14.56	21.76
	1:15:00	0.00	0.00	2.41	3.61	4.96	7.57	9.46	12.28	18.42
	1:20:00	0.00	0.00	2.09	3.12	4.34	6.35	7.92	9.90	14.85
	1:25:00	0.00	0.00	1.79	2.69	3.62	5.27	6.57	7.85	11.76
	1:30:00	0.00	0.00	1.57	2.38	3.07	4.21	5.23	6.10	9.15
	1:35:00	0.00	0.00	1.45	2.21	2.76	3.40	4.20	4.77	7.20
	1:40:00	0.00	0.00	1.39	1.98	2.56	2.92	3.60	3.98	6.03
	1:45:00	0.00	0.00	1.36	1.81	2.42	2.62	3.21	3.47	5.27
	1:50:00	0.00	0.00	1.34	1.68	2.32	2.42	2.95	3.12	4.74
	1:55:00	0.00	0.00	1.18	1.59	2.21	2.27	2.76	2.87	4.37
	2:00:00	0.00	0.00	1.05	1.47	2.01	2.18	2.64	2.69	4.10
	2:05:00	0.00	0.00	0.81	1.13	1.54	1.68	2.03	2.03	3.09
	2:10:00	0.00	0.00	0.61	0.85	1.15	1.25	1.50	1.49	2.27
	2:15:00	0.00	0.00	0.46	0.64	0.86	0.93	1.12	1.11	1.69
	2:20:00	0.00	0.00	0.34	0.47	0.63	0.69	0.83	0.83	1.26
	2:25:00	0.00	0.00	0.25	0.34	0.46	0.51	0.61	0.61	0.93
	2:30:00	0.00	0.00	0.18	0.24	0.34	0.36	0.44	0.44	0.67
	2:35:00	0.00	0.00	0.13	0.17	0.24	0.27	0.32	0.32	0.49
	2:40:00	0.00	0.00	0.09	0.12	0.17	0.19	0.22	0.23	0.34
	2:45:00	0.00	0.00	0.05	0.08	0.11	0.12	0.15	0.15	0.23
	2:50:00	0.00	0.00	0.03	0.05	0.06	0.07	0.09	0.09	0.13
	2:55:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.06
	3:00:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WEBSOIL REPORT

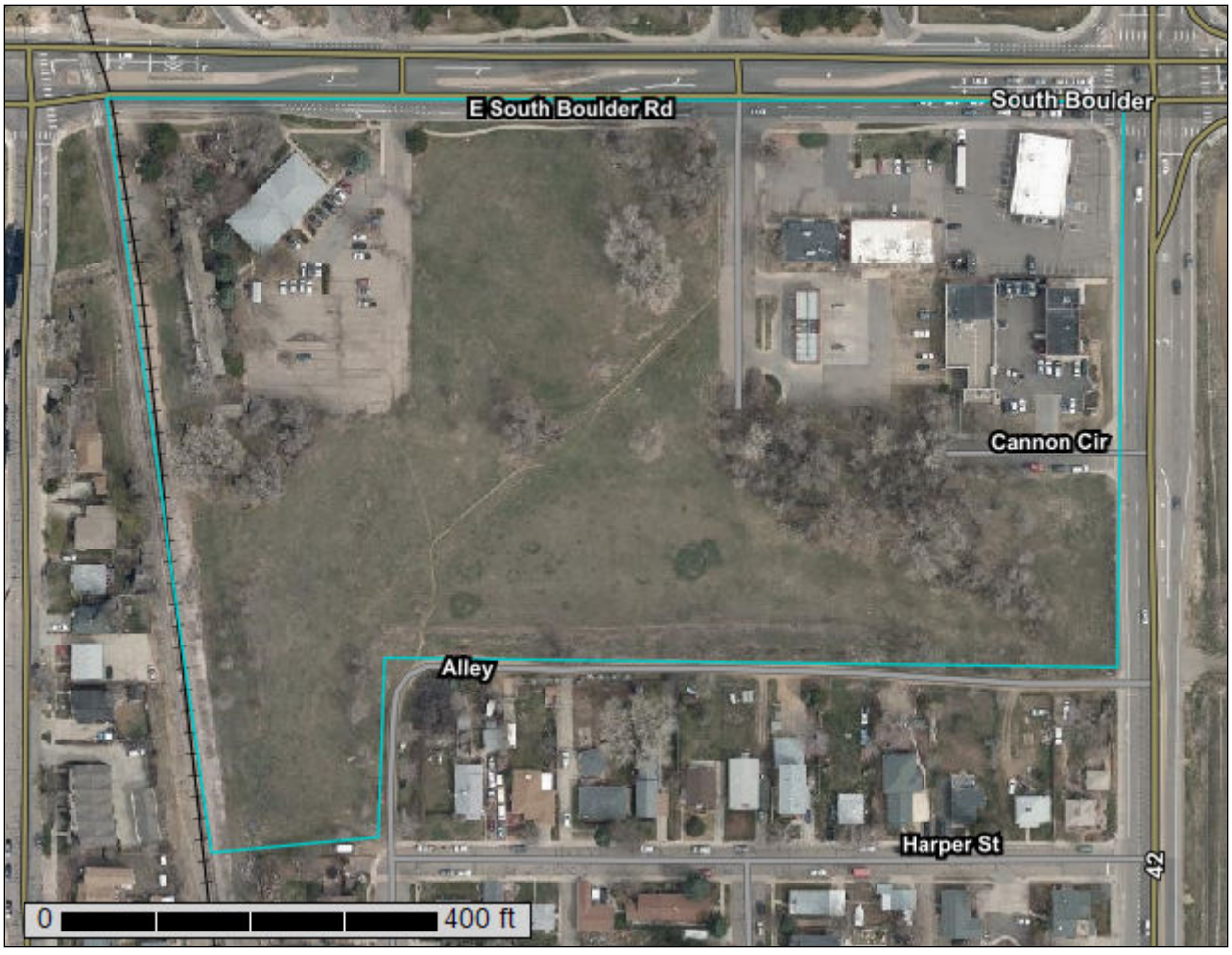
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Boulder County Area, Colorado



December 27, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,070 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 17, Jun 5, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 25, 2018—Apr 9, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AcC	Ascalon sandy loam, 3 to 5 percent slopes	13.4	88.3%
HaD	Hargreave fine sandy loam, 3 to 9 percent slopes	1.8	11.7%
Totals for Area of Interest		**15.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boulder County Area, Colorado

AcC—Ascalon sandy loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2tlnt
Elevation: 3,550 to 5,970 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.1 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R072XY111KS - Sandy Plains, R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Stoneham

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R072XY100KS - Loamy Tableland , R067BY002CO - Loamy Plains
Hydric soil rating: No

Vona

Percent of map unit: 8 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope, footslope, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R072XY111KS - Sandy Plains, R067BY024CO - Sandy Plains
Hydric soil rating: No

Platner

Percent of map unit: 2 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R072XY100KS - Loamy Tableland , R067BY002CO - Loamy Plains
Hydric soil rating: No

HaD—Hargreave fine sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: jprs
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hargreave and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hargreave

Setting

Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy residuum weathered from sandstone

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 13 inches: sandy clay loam
H3 - 13 to 27 inches: fine sandy loam
H4 - 27 to 31 inches: weathered bedrock

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R067XB042CO - Clayey
Hydric soil rating: No

Minor Components

Terry

Percent of map unit: 8 percent
Hydric soil rating: No

Nelson

Percent of map unit: 6 percent
Hydric soil rating: No

Mollic haplaquepts

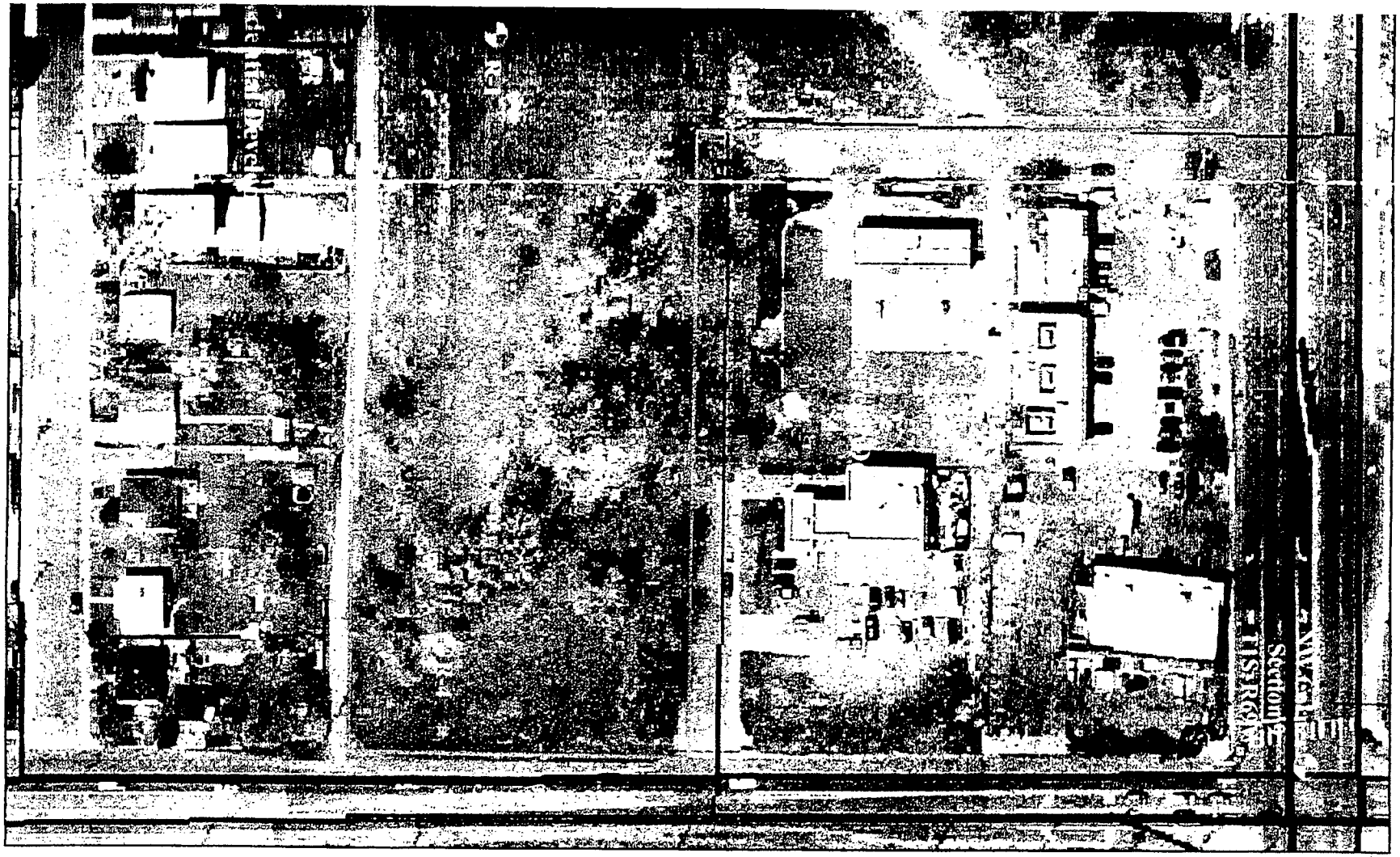
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

EXCERPT OF MINE SUBSIDENCE RESPORT

MINE SUBSIDENCE INVESTIGATION

Coal Creek Station Development
Approximately 11 Acres in the Northeast 1/4 of Section 8,
Township 1 South, Range 69 West,
Louisville, Colorado

WESTERN ENVIRONMENT AND ECOLOGY, INC.
2217 West Powers Avenue
Littleton, Colorado 80210
phone (303) 730-3452
fax (303) 730-3461
www.westernenvironment.com
westernlt@aol.com



Scale - 1 inch = 100 feet

50 0 50 100

W N S E

WESTERN ENVIRONMENT AND ECOLOGY, INC.

Figure 2A - Site Map
Coal Creek Station

6.0 REGIONAL GEOLOGY

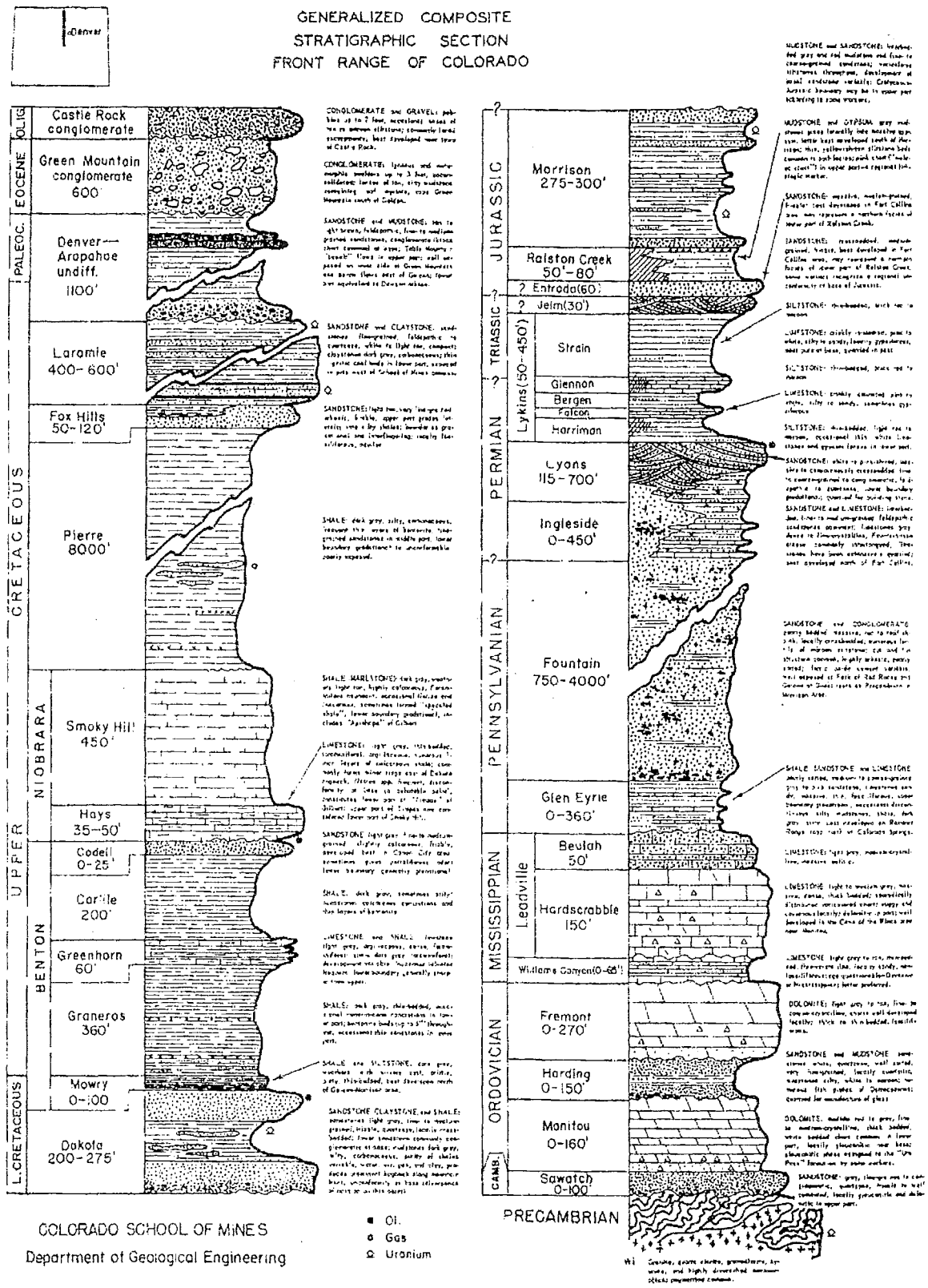
6.1 Outcropping Units

Outcropping units within and surrounding the Lafayette and Louisville area are the Pierre Shale, the Fox Hills Sandstone, the Laramie Formation and Quaternary gravels and soils (Figure 5).

The Pierre Shale is a lead gray to brown and black shale of marine origin. Total thickness in the area is greater than 7,000 feet (Blair 1951), with the majority of the formation made up of shale. Near the top of the Pierre Shale it becomes increasingly sandy and contains beds of fine sandstones and siltstones as it grades into the Fox Hills Sandstone. This unit does not outcrop on the site but can be seen approximately one mile east of Harper Lake on the west side of the Town of Louisville.

The Fox Hills Sandstone is a massive to crossbedded sandstone. It was deposited in a beach and/or delta-front environment and comfortably overlies the Pierre Shale. The lower two-thirds of the formation is a fine to coarse grained, bluff colored sandstone which weathers to a light tan to tan color. The Fox Hills Sandstone contains numerous iron colored calcareous concretions, ranging in size from fractions of an inch to several feet. The upper one-third of the Fox Hills Sandstone is a fine to medium grained, light grey to pale yellow in color, crossbedded sandstone. The total thickness of the formation near this location is about 140 feet as measured in the NW 1/4 of Section 28, T1S, R70W. Thickness varies from 60 feet near Ralston Creek (Van Horn, 1957) to 250 feet near Baseline Reservoir.

The Laramie Formation, which directly underlies the site is predominantly a fresh water deltaic sequence, consisting of clays, sands, silts and coals (Figure 6). The lower portion is approximately 100 feet thick and is composed of sandstones, sandy shales, claystones, and coal beds. These coals have been economically mined in the past. The upper unit has a thickness of approximately 600 feet and is made up of mostly clay shales, very fine sandy shales, and lenticular beds of sandstone. The shales are largely carbonaceous and in places becomes lignitic. The Laramie Formation lies comfortably on the Fox Hills Sandstone.



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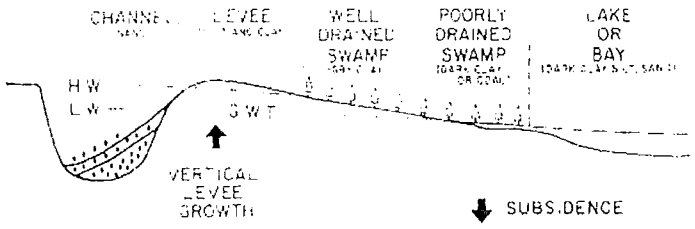
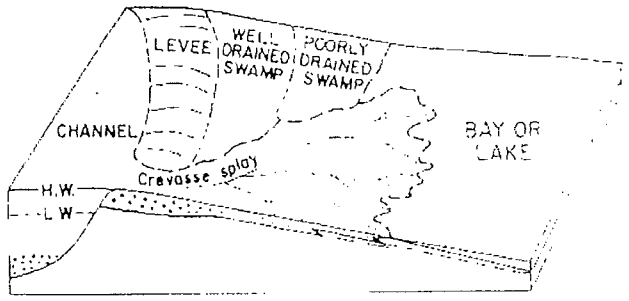
Littleton, Colorado 80120

Figure 5 - Generalized Stratigraphic Section
Coal Creek Station Development
Approximately 11 Acres in Section 8,
Township 1 South, Range 69 West,
Louisville, Colorado

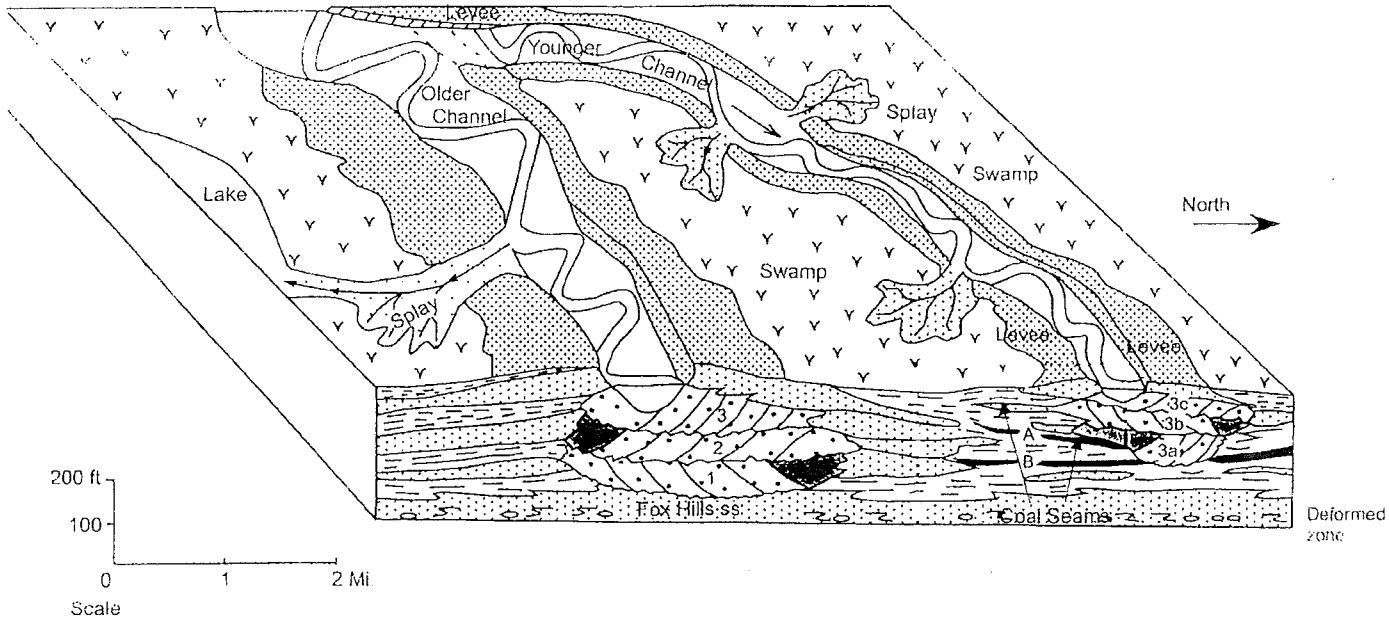


Channel and channel margin environments for lithologies in Laramie Formation.



LARAMIE ENVIRONMENTS OF DEPOSITION

Relationship of channel margin environments to crevasse splay deltas.



Figures from: A Guide to the uppermost Cretaceous stratigraphy, central Front Range Colorado, deltaic sedimentation, growth faulting and early Lamide vertical Movement
Weimer, R.J. 1973

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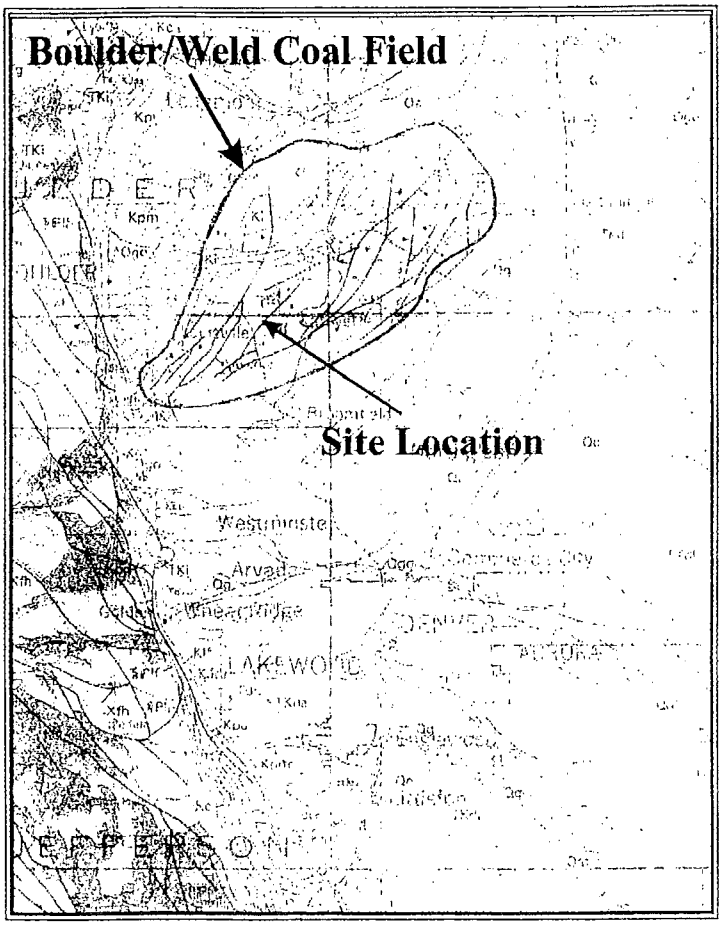
Littleton, Colorado 80120

Figure 6 - Generalized Stratigraphic Models of the Laramie Formation
Coal Creek Station Development
Approximately 11 Acres in Section 8, Township 1 South, Range 69 West, Louisville, Colorado

6.2 Structure

The Coal Creek Station development lies on the western edge of the Denver-Julesberg Basin against the Front Range Uplift. This basin contains up to 13,000 feet of sediments derived from the ancestral Rockies which laid to the west. Two kinds of faulting occur in this portion of the basin. A basement-controlled late Cretaceous Laramide faulting is the most prevalent and is the result of deformation associated with uplift. The second basin has been described by Davis and Weimer (1976) as growth-faulting as a result of differential loading of the deltaic sequence at the time of deposition.

Growth faulting is the major structural feature seen in the area. A zone is present with dominant faults trending in a northeasterly direction. This system is ten miles wide and thirty miles long. These faults are high-angle, normal structures near the surface, but seismic work has shown that they tend to flatten and die out at depth. Work by Davis and Weimer (1976) shows that these listric normal faults do not continue below the Hygiene Member of the Pierre Shale. Antithetic faults resulting from tension then form horst and grabens. This effect had resulted in the increased thickness of sediments in the graben areas. The Fox Hills Sandstone has been reported to have a thickness near a growth fault of 484 feet (Spencer, 1961). The Laramie Formation also has increased thickness in these zones and this is believed to be the reason for the increased thickness of the coal seams in the Boulder-Weld coal field.



Boulder/Weld Coal Field

7.0 SITE GEOLOGY

Four distinct geological units were encountered during drilling on the Coal Creek Station Development. The uppermost unit is a sandy, argillaceous soil which occurs from a depth of 0 to a maximum of 15 feet below existing grade. A fine to course-grained, water-saturated gravel was the second unit penetrated. When present, it occurred at depths of 15 to 25 feet below existing grade.

The next unit penetrated was the Cretaceous Age Laramie Formation. This unit consists primarily of medium to dark gray claystone. The Laramie Formation claystones are interbedded with minor non-continuous coals and thin, well-cemented, fine grained, gray sandstone and silts. The Rex Mine extracted coal from a seam ranging in depth from 130 to 147 feet, the Hecla seam occurred from 197 to 218 feet. The contact between the Laramie Formation and the Fox Hills Formation was encountered in holes R-6 and R-7, at 260 feet and 255 feet, respectively. The Fox Hills Formation is characterized by fine-grained, well-sorted, gray sandstone.

Two faults are shown on the mine maps to underlay the Coal Creek Station site (Figure 2b). One structure strikes northeast and underlies the western portion of the project. This fault likely was the reason that no undermining occurs on the northwestern corner of the property. The second fault strikes northwest and occurs beneath the central portion of the property. Displacement on these faults appears to be approximately 20 feet.

Lithologic samples

8.0 DESCRIPTION OF HOLES

The description of each rotary hole drilled on the Coal Creek Station Development were derived from the electric logs and the lithologic logs taken from the cutting samples. Geophysical and lithologic logs from the 1984 and current investigations are included as Appendix B.

Hole R-1 Dark brown sandy soil occurred from 5 feet. From 5 to 15 feet, light brown argillaceous sand was penetrated. Light brown medium to coarse grained, water saturated gravel occurred from 15 to 25 feet. From 25 to 55 feet, light brown claystone was present. From 55 to 75 feet, light gray claystone was penetrated. Medium gray siltstone and claystone was drilled from 75 to 96 feet. A hard sandstone ledge was encountered from 96 to 98 feet. Medium gray claystone with carbonaceous intervals was drilled from 98 to 135 feet. Coal (Rex seam) and claystone was penetrated from 135 to 150 feet. Light gray very fine-grained quartzose sandstone was drilled from 150 to 160 feet. A well cemented sandstone was encountered from 150 to 155 feet,. Coal with clay was penetrated from 160 to 175. Light gray very fine-grained, well cemented quartzose sandstone occurred from 175 to 180 feet. Light gray siltstone with claystone was drilled from 180 to 197 feet. Circulation was lost at 197 feet. The drill penetrated 4 feet of loose rubble (Hecla seam interval) from 197 to 201 feet. Total depth of the hole was 208 feet. Due to caving surface gravel, no geophysical log could be completed on this boring.

Hole R-2 From 0 to 5 feet, poorly consolidated fill composed of very fine-grained sand and silt occurred. Light brown claystone was drilled from 5 to 55 feet. From 55 to 80 feet, medium gray claystone was penetrated. Medium gray siltstone and claystone was encountered from 80 to 100 feet. From 100 to 129 feet, medium gray claystone with carbonaceous intervals was penetrated. Six feet of hard vitreous coal (Rex seam) was drilled from 129 to 135 feet. Four feet of medium gray claystone separated this seam from 9 feet of light gray very fine grained quartzose

sandstone which occurred from 139 to 148 feet. From 148 feet to 176 feet, medium to dark gray claystone with carbonaceous intervals was drilled. Light gray very fine grained quartzose sandstone and siltstone was encountered from 176 to 204 feet. The Hecla "main" seam interval occurred from 204 to 209 feet. The caliper log indicated collapse was complete with a maximum deflection of 10 inches. Circulation was lost at 204 feet. Total depth of the hole was 220 feet.

Hole R-3 From 0 to 5 feet, brown argillaceous soil was encountered. Greenish gray claystone was drilled from 5 to 65 feet. From 65 to 100 feet, medium gray claystone was encountered. From 100 to 111 feet, light gray siltstone with claystone was penetrated. Medium gray claystone with minor carbonaceous stringers occurred from 111 to 135 feet. The Rex "main" seam interval occurred from 135 to 141 feet. Circulation was lost at 143 feet. The caliper log indicated collapse was complete with a maximum deflection of 5.75 inches. Total depth of the hole was 160 feet.

Hole R-4 Light brown, silty sand occurred from 0 to17 feet. Light gray to brown claystone was encountered from 17 feet to 55 feet. Interbedded gray claystone and light gray sandstone occurred from 55 to 140 feet. Circulation was lost at 140 feet. The Rex "main" seam interval was penetrated from 138 to144 feet. Maximum caliper deflection was 10.5 inches at 142.5 feet. Total depth of the hole was 160 feet. Collapse was complete with no open voids.

Hole R-5 Light brown, silty sand occurred from 0 to16 feet. Light gray to brown claystone was encountered from 16 feet to 75 feet. Interbedded gray claystones and light gray sandstone occurred from 75 to 206 feet. The Rex seam, which was not mined, was penetrated from 132 to 139 feet. Circulation was lost at 206 feet. The Hecla "main" seam interval was penetrated from 212 to 218 feet. Maximum caliper deflection was 11.75 inches at 215 feet. Total depth of the hole was 240 feet.

Hole R-6 Light brown, silty sand occurred from 0 to10 feet. Fine to coarse grained gravel with sand occurred from 10 to 25 feet. Light gray to brown claystone was encountered from 25 feet to 110 feet. Interbedded gray claystone and light gray sandstone occurred from 110 to 260 feet. The Rex "main" seam was penetrated from 141 to 147 feet. No workings were encountered. The Hecla "main" seam occurred from 218 to 226 feet. Also, no mine workings were penetrated. The Fox Hills Sandstone was occurred at 248 feet. Total depth of the hole was 260 feet.

Hole R-7 Light brown, sandy soil occurred from 0 to12 feet. Light gray to brown claystone was encountered from 20 feet to 66 feet. Interbedded gray claystones and light gray sandstones occurred from 66 to 255 feet. The Fox Hills Formation occurred at 255 feet. The Rex "main" seam was penetrated from 158 to 165 feet. No Hecla seam was identified in this boring. Total depth of the hole was 260 feet. Circulation was not lost. No mine workings were encountered.

PRELIMINARY DRAINAGE PLAN

SEE NOTE #1

EX. 42" CMP
INV (N)=5363.80

EX. 24" RCP

THE 10yr & 100yr FLOWS TO THIS POINT ARE 15.9 CFS & 121.2 CFS RESPECTIVELY FROM OFFSITE. BASINS INCLUDE CHRISTOPHER VILLAGE, STEEL RANCH SOUTH, COAL TRAIN STATION, CHRISTOPHER PLAZA

SOUTH BOULDER RD.

EX. 42" CMP
INV (S)=5364.40
RTD BUS STOP

INSTALL 42" FES

PROP. 42" RCP

24" STORM

INSTALL STORM MH A

20' PUBLIC ROW

42" STM

18" STORM

INSTALL 4'Ø STORM MANHOLE TO DIVERT EX. FLOWS WEST

INSTALL STORM MH B

Ex'g. Coffee Shop

Bldg.2

Bldg.3

Bldg.4

GEODRAIN DITCH (TO BE PIPED)

FRONT STREET (STANDARD)

PARCEL 1

PARCEL 2

STATE HWY. 42

CANNON CIRCLE (EX. 60' ROW)

BLOCK 4

BLOCK 6

DRIVE

DOUBLE COMBINATION TYPE 13 INLET #2.1

DOUBLE COMBINATION TYPE 13 INLET #2.0

18" STM

INSTALL STORM MH D

STREET C

DOUBLE TYPE 13 INLET #3.0

Bldg.1

COLORADO AND SOUTHERN RAILROAD

PARK BLOCK 3

DOUBLE COMBINATION TYPE 13 INLET #2.2

STREET A

BLOCK 2

LANE A

BLOCK 5

FRONT STREET (SOUTH END)

STREET B

LANE B

INSTALL STORM MH C

INSTALL 42" FES #2

DETENTION POND (24,849SF)

EX. ALLEY

POCKET PARK BLOCK 1

EX. DETENTION AREA

EX. 18" CMP
IN (N)=5335.3

EX. CONC INLET
TOP=5338.17
6" PVC
IN(N)=5336.00
OUT(S)=5335.80

EX. 12" CMP
IN (E)=5337.20
OUT(W)=5336.90

EX. STORM MH
RIM=5338.52

INSTALL STORM MH #1.3

INSTALL STORM MH #1.2

OUTLET STRUCTURE
INV. 18" OUT=5329.91' (SE)

EX. STORM CATCH BASIN GRATE

18" CMP

EX. 18" FES

EX. 30" STM

EX. 30" FES
INV. 30" OUT=5326.00' (W)

REMOVE EXISTING HEADWALL & INSTALL STORM MH F
4' DIA
INV. 18" IN=5327.30' (S)
INV. 18" OUT=5327.30' (S)

EX. 18" RCP

EX. 10' TYPE R INLET
INV. 18" IN=5326.90' (N)
INV. 18" OUT=5326.90' (N)
INV. 30" OUT=5326.70 (E)

DOUBLE COMBINATION TYPE 13 INLET #1.3

DOUBLE COMBINATION TYPE 13 INLET #1.1

DOUBLE COMBINATION TYPE 13 INLET #1.0

ROBERT DIGIACOMO ADDITION

BOOK #46, PAGE 505

LOT 1
HUNT – PUSKAS SUBDIVISION

HARPER STREET

FRONT ST

OS1 0.63 .07 .44
OS2 1.62 .07 .44
OS3 0.77 .77 .84
OS4 0.51 .07 .44
OS5 0.21 .07 .44
OS6 0.45 .28 .56
A 0.98 .60 .74
B 0.58 .68 .79
C 0.72 .56 .72
D 0.91 .59 .74
E 0.16 .68 .79
F 2.03 .63 .76
G 0.45 .56 .72
H 0.77 .75 .83
I 2.10 .76 .83
J 0.51 .69 .79
K 0.70 .76 .83
P 0.59 .14 .48

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Peak Flow, Q (cfs) 10-yr	100-yr
BASIN A	0.89	C	68	2.4	5.5
BASIN B	0.57	B	77	1.7	3.8
BASIN C	0.75	B	63	1.7	4.2
BASIN D	0.91	B	67	2.5	5.8
BASIN E	0.16	B	77	0.5	1.1
BASIN F	2.03	B	72	5.2	11.8
BASIN G	0.45	B	62	1.1	2.8
BASIN H	0.77	B	86	2.7	5.5
BASIN I	1.99	B	87	6.9	14.2
BASIN J	0.53	B	78	1.6	3.5
BASIN K	0.77	B	87	2.7	5.5
BASIN P	0.59	B	10	0.3	1.9

DRAINAGE LEGEND

W 13.0 .65 .80
BASIN OR SUB-BASIN
C VALUE 10-YR STORM
C VALUE 100-YR STORM
AREA (ACRES)
1 DESIGN POINT
BASIN LIMIT
RUNOFF FLOW DIRECTION

NOTES:
1. OFFSITE FLOWS TO BE ROUTED ACROSS THE SITE IN A 42" RCP. SEE DRAINAGE REPORT FOR ADDITIONAL DETAILS.

50 0 25 50 100
ORIGINAL SCALE: 1"=50'

NO.	DATE	DESCRIPTION	BY

Rocky Ridge Civil Engineering
420 21st Ave, Suite 101
Longmont, CO 80501
303.651.8626
www.rockyridgecivil.com

COAL CREEK VILLAGE

OVERALL DRAINAGE & GRADING PLAN

DATE 01/25/2120
CAD NO 2941BASE
JOB NO 294-1

SHEET NO C2

PRELIMINARY
THIS DRAWING IS UNCHECKED
NOT FOR CONSTRUCTION