



Cover Letter

To: Cameron Fowlkes, PE, City of Louisville

From: Joel Seamons, PE, Rocky Ridge Civil Engineering

Date: March 25, 2024

Re: Cover Letter for Preliminary Drainage Design of Coal Creek Village

On behalf of Markel Homes, Rocky Ridge Civil Engineering would like to present the preliminary drainage report of Coal Creek Village to the City of Louisville for review. The Preliminary Drainage Report/design has been engineered according to the City of Louisville Design Standards and Specifications.



PRELIMINARY DRAINAGE REPORT

COAL CREEK VILLAGE

LOUISVILLE, COLORADO

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Map Pocket – Historic Drainage Plan
Preliminary Drainage Plan

"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

I. GENERAL LOCATION AND DESCRIPTION

A. Location

The site's general location is shown on the vicinity map provided in the *Maps & Figures Section* of the Appendix (**Appendix A**).

The boundaries of the site are as follows:

- East: Cannon Circle and Hwy 42
- West: Colorado and Southern Railroad Right-of-Way
- North: S. Boulder Road
- South: Harper Street

1. City and County

This development is located in the City of Louisville, Boulder County.

2. Township, Range, Section, ¼ Section

This preliminary drainage report is for Coal Creek Village, Louisville, Colorado which is located in the northeast quarter of Section 8, Township 1 South, and Range 69 West of the 6th Principal Meridian.

3. Major Drainage Facilities

There are no Major Drainage Facilities located on the site; however, offsite drainage flows are conveyed through the property from northern developments, a portion of S. Boulder Road and the Goodhue Ditch that carries stormwater that may have historically overtopped its banks thereby contributing to flow through the site.

City of Louisville Drainage Way 7-1 begins just southeast of this development, on the east side of Hwy 42. Drainage Way 7-1 is the major drainage way that ultimately receives runoff from this site. There is a proposed City of Louisville Project to install two- 54" storm sewer culverts under Hwy 42 in order to replace the existing 30" culvert per the Lafayette-Louisville Boundary Outfall System Plan, Conceptual Design Report although these drainage improvements proposed in the 1982 Drexel Barrell report haven't been constructed yet.

There is a Detention/Water Quality Pond being proposed at the southeast corner of the development where all the onsite flows from this development will be conveyed for water quality and detention.

There is also a bypass storm sewer being proposed through the site for the Goodhue Ditch and for offsite flows from a storm sewer system on the north half of S. Boulder Rd Right-of-way. Discussion of the offsite flows to the north is located in Section IV.A.2. of this report.

4. Surrounding Developments

South Boulder Road borders the site on the north boundary and State Highway 42 on the east, excluding a portion of the currently developed lands north and east of Cannon Circle.

The Colorado and Southern Railroad borders the site on the west and the Robert DiGiacomo Addition borders the site on the south.

There is also a surrounding development that contributes flow through the property. The developments and flows expected to pass through the site are detailed in **Appendix F**. These developments include:

- Kestrel
- Steel Ranch South
- Christopher Village/Plaza
- Garden City
- Norwest

B. Description of Property

1. **Area** - The development's area consists of approximately 10.11 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.

2. **Ground Cover (trees, shrubs, vegetation)**

There are three existing buildings and a 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. Cannon Circle changes from a north-south alignment to an east-west alignment. The 390 linear feet of the north-south leg is paved with asphalt.

3. **Hydrologic Soil Group**

The hydrologic type soil for the area (as described by NRCS Report located in the *Websoil Report* Section, **Appendix D**, of this report) is 90% Type B and 10% Type C. This means that the majority of the existing soil on the site is more sandy than clayey soils.

4. **Major Drainage Channels**

The Goodhue Ditch cuts across the northwest corner of the site, forming a triangle of approximately 0.20 acres. City of Louisville Major Drainage Way 7-1 begins across Hwy 42, just southeast of the site. This drainage way is where all runoff from this property is ultimately conveyed.

5. **General Topography**

The topography of the site consists of slopes varying from 2.5% to 5%, generally sloping from the northwest corner to the southeast corner of the site.

II. HISTORIC DRAINAGE

A. Major Basin Description

1. Reference to Basin-wide Planning Study

The Basin-wide Planning Study is the Lafayette-Louisville Boundary Outfall System Plan, Conceptual Design Report by Merrick & Company from December 2012.

2. Major Basin Drainage Characteristics

This site is located in the City of Louisville DW7 Watershed, per the Lafayette-Louisville Boundary Outfall Systems Plan. Drainage Way 7-1 is the major drainage way that ultimately receives runoff from this site.

3. Identification of all nearby irrigation facilities which will influence or be influenced by the local drainage

The Goodhue Ditch is the only irrigation facility within the property boundaries, which crosses the northwest corner of the site, forming a triangle of approximately 0.20 acres.

B. Sub-Basin Description

1. Discussion of historic drainage patterns offsite

Historically, runoff from this site sheet flows southeast until it reaches an existing 18" RCP on a headwall on the southeast corner of the site. From this pipe, it is conveyed east across Hwy 42 through City Storm Sewer into Drainage Way 7-1.

2. Discussion of offsite drainage flow patterns and impact on development

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 onsite 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 onsite. Fordyce Auto Center also has onsite detentioning and a controlled release. Released flows pass under a sidewalk chase into the gutter of Cannon Circle. The storm sewer release from the ponds that serve those properties are proposed to be piped and conveyed to the north side of the proposed detention/water quality pond onsite.

Both off-site and onsite 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 feet, before flowing east into the existing 30" pipe under Highway 42 into Drainage Way 7-1. 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 per calculations located in the *Hydrologic Calculations* Section (**Appendix B**) of this report.

3. Identify historic flows and volumes for all sub-basins.

The historic flows from this site are shown on the *Hydrologic Calculations* Section (**Appendix B**) of this report.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

1. Reference to City and County subdivision regulations

The drainage design criteria for this project is in conformance with the City of Louisville Storm Drainage and Technical Criteria Manual. (SDTCM)

2. Discussion of compliance with or deviation (including a request for variance from the standard) from the City of Louisville Basinwide Major Drainageway Planning Report (Water Resources Consultants 1982a), the Lafayette-Louisville Boundary Outfall System Plan (McLaughlin Water Engineers 2011) and Urban Storm Drainage Design and Technical Criteria Manual

This proposal complies with the Basin-wide Planning Study of the Lafayette-Louisville Boundary Outfall System Plan, Conceptual Design Report.

B. Development Criteria Reference and Constraints

1. Discussion of previous drainage studies for the site that influence or are influenced by the drainage design

The drainage design was based on MHFD criteria while the “Final Drainage Report for Coal Creek Station Subdivision”, prepared by Drexel, Barrell & Co was used as a supplemental reference.

2. Discussion of the drainage impact of site constraints such as streets, irrigation ditches, utilities, railroads, existing structures, and development or site plans

There are no impacts from onsite drainage to public streets, ditches, etc. outside of street conveyance of flow allowed by City Standards.

C. Hydrological Criteria

1. Identify design rainfall source

The hour point precipitation values were obtained from RA1-6 in the USDCM per SDTCM.

2. Identify design storms recurrence intervals

The design frequencies utilized for the report were 10-year for the minor storm and 100-year for the major storm.

3. Identify runoff calculation method

The Hydrologic Criteria used for this Report is the Rational Method as described in the USDCM.

4. Identify detention and water quality volumes and discharges and storage calculation method

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 **Appendix C** along with the related tables and figures.

The USDCM MHFD-Detention_v4 03 Excel software was used to calculate the detention volumes and worksheets are included in **Appendix C**.

D. Hydraulic Criteria

1. Identify various capacity references

The drainage design concepts of this project are intended to be in conformance with the City of Louisville Storm Drainage and Technical Criteria Manual. (SDTCM)

2. Identify detention and water quality outlet design method

The USDCM MHFD-Detention_v4 03 Excel software was used to calculate the detention and water quality outlet design. Worksheets are included in **Appendix C**.

3. Discussion of other drainage facility design criteria used that are not presented in or referenced by the Storm Drainage Design and Technical 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.”

IV. DRAINAGE FACILITY DESIGN

A. General Concept

1. Discussion of concept and typical drainage patterns

The current design is based on the Final Drainage Report for Coal Creek Station Subdivision completed 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 71%.

Several onsite basins have been identified for this development. Specific flows for each of these sub-basins are calculated in the *Hydrologic Calculation (Appendix B)*. Per the landscape architect, the proposed development has a proposed landscape area of 31%, therefore, our impervious percentage for all on-site basins will be 69% (and rounded up to 70% for flows as shown on Table 3 of the SDTCM).

Basin A is 0.63 acres and is located directly north of the east portion of the proposed detention pond. It consists of several smaller units clustered together in the east portion of the development (west of State Hwy 42). The 10-yr & 100-yr detained runoff rates are 2.0 cfs and 3.7 cfs respectively (hereafter formatted at 2.0/3.7cfs). This stormwater will drain to two riprap rundowns into the north side of the proposed detention pond to Design Point 3 (hereafter formatted as DP3).

Just west of Basin A is Basin B which contains the same smaller unit clusters. This area has 0.37 acres. Neither Basin A nor Basin B include pavement in the Cannon Circle ROW – those are Basin OS-9 & OS-10. The stormwater generated by Basin B is 1.2/2.2 cfs and runs down into the pond in the same manner (riprap rundowns) at DP4.

Basin C includes 0.46 acres of area just south of the existing bend in Cannon Circle (or runoff in the east leg of Private Drive C. The stormwater generated by Basin C is 1.5/2.8cfs and runs through a 2' wide curb chase into the west end of the proposed detention pond. Like Basins A & B, it will use a proposed riprap rundown to the pond.

Basin D contains the flow of the middle section of residential for the site and most of Outlot C. There will be a series of drains design in the final plans that will capture and convey the stormwater generated in this 0.95 acre basin. The stormwater will be 3.0/5.6cfs and will have at least a 10' Type R inlet located at the south end of the basin at DP8.

Basin E (0.61 acres) is between Basins C & D and will convey and collect stormwater flowing in Private Drive B to the proposed 10' Type R inlet at DP7. The stormwater generated from this basin is 1.9/3.6cfs.

Basin F (0.77 acres) will have similar hydrologic characteristics as Basin E as it conveys and collects stormwater flowing in Private Drive A. The total amount of proposed stormwater flow of 2.4/4.6cfs will collect at the south end of the site at DP9 into a 10' Type R inlet.

Basin G (1.30 acres) contain the multiunit townhomes on the southwest corner of the site where all of the proposed stormwater flow (4.1/7.7cfs) will be conveyed in an alley to DP29 which is an inlet in the west flowline of Front Street.

The parking area of the proposed commercial buildings with some portion of the roofs (southern portion) is the 1.06 acres of Basin I. This flow (3.3/6.3cfs) will enter a series of proposed inlets to be located at the south end of this parking area at DP11. The stormwater will continue to flow southward in a pipe through the park area labeled as Outlot C (Basin D).

Basin J is the eastern half of Front Street northward the north portion of the site. This stormwater that flows in this area will be conveyed in the east curb and gutter system (public ROW) to the proposed inlet at DP13. The proposed stormwater that will be generated from this basin is 0.9/1.8cfs.

Basin K is the area immediately south of the existing Gooding Hollow Ditch. It has 1.3 acres of area mainly covered in proposed rooftop, parking, and perimeter landscaping. The stormwater that will be generated from this basin (4.1/7.7cfs) will flow into the public ROW (west flowline of Front Street) and into the proposed inlet at DP14.

There is a small area between Basins F & J that collects stormwater in the east flowline of Front Street. This area is marked as Basin M and it will generate 0.5/0.9cfs in the 10-yr and 100-yr events and flow into a proposed inlet at DP16.

Basins N1, N2, and N3 are 3 mini basins that capture the north rooftop and area between South Boulder Road and the proposed commercial buildings. The stormwater flow generated in all 3 of these areas is very small (0.3/0.6cfs, 0.9/1.9cfs, 0.3/0.6cfs respectively). This stormwater will go into the proposed parking lot south of the buildings. Their design points are DP26, DP25, and DP24 respectively.

Basin P has 0.6 acres and is the detention/water quality pond. It mostly consists of the detention pond and the gravel maintenance access to the pond. The 10-yr & 100-yr detained runoff are estimated to be 1.9/3.6cfs draining to the proposed outlet structure at DP1.

Basin Q is a 0.76 area between Basins K & G that drain to the east into the Front Street ROW. Stormwater from this basin (2.4/4.5cfs) will be conveyed by proposed curb and gutter until it reaches the proposed storm inlet at DP28.

2. Discussion of compliance with offsite runoff considerations

There is a bypass storm sewer being proposed through the site for the Goodhue Ditch and for offsite flows from a storm sewer system on the north half of S. Boulder Rd Right-of-way. This proposed storm sewer system is conveyed through the site, under Hwy 42, and

then conveyed into Regional Drainageway 7-1. Discussion of the offsite flows to the north is located in **Appendix F**.

A summary of these offsite flows that flow into this pipe is shown below:

Basin name	Basin Abbrev.	Release rate (cfs)	Design Point	Notes
Steel Ranch South	SR	24.89	West of 32	Steel Ranch South contributes flow
Kestrel	K	14.5	North of 32	Kestrel contributes flow. Include bypass flows
Christopher Village	CV	4.2	32	Christopher Plaza and Village contribute flow
Garden City	GC	2.0	North of 33	Christopher Plaza II contributes all flow
Norwest	NW	3.66	33	Coal Trail Square contributes flow Combined flow at DP33 is 5.66cfs

All flows from DP 32 are offsite stormwater rates that flow from South Boulder Road, into a proposed storm line at the north side of the site, flow to the east parallel to South Boulder Road, then south underground in the west half of Cannon Circle, eventually crossing Hwy 42 and discharging at DP 2.

All flows from DP 33 are rerouted west and flow south in a new storm sewer pipe crossing South Boulder Road to the south directly across from Cannon Circle. This flow is conveyed via RCP TO the west, joins the flow from DP 32 and then flows through the site underground as previously described.

The developer's responsibility for the pipe cost would be a percentage found by the DP 32 flow divided by the total of flow from the overflow of Goodhue Ditch (unknown), DP 32, and DP 33 flow.

3. Discussion of the content of tables, figures, or drawings presented in the report

The historic flows will continue to follow the historical drainage pattern of the site. The proposed development will substantially improve the existing drainage conditions by installing bypass storm infrastructure for the Goodhue Ditch and offsite storm flows that run east along the north ROW of South Boulder Road.

Additionally, a storm sewer is being proposed along the north side of Cannon Circle that will capture the stormwater release from the existing detention ponds of the developments north of Cannon Circle. This proposed storm sewer will convey those release rates into the proposed detention/water quality pond.

B. Specific Details

1. Discussions of drainage problems encountered and solutions at specific design points

All the drainage requirements for this site have been properly accounted for and designed in the site storm sewer design.

The detention/water quality pond, will be designed per the latest Mile High Flood District requirements in order to meet water quality regulations and to provide adequate detention in order to match the historical 10-yr and 100-yr flows.

The City of Louisville has indicated that it will participate in the cost of the Goodhue Ditch bypass storm sewer that is being proposed across this development.

2. Discussion of detention storage, water quality enhancement, and outlet design

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 MHFD-Detention, Version 4.03 (May 2020) spreadsheet from Mile High Drainage. These calculations are included in the *Detention Pond* Section (**Appendix C**). Water quality will be provided in forebay, micropools and water quality outlet plate orifices that will be detailed in the Final Drainage Report.

3. Comparison of historic flows and all developed flows released from the site (detained and undetained)

Release rates from the Detention/Water Quality Pond will be set to match the historic and allowable release rates for this development.

V. CONCLUSION

A. Compliance with Standards

1. Storm Drainage Design and Technical Criteria

The drainage concepts for this project are consistent with current policies and practices for storm drainage management as outlined in the City of Louisville Design Criteria and City Code.

2. Basin-wide Major Drainageway Planning Study

This report complies with the Basin-wide Planning Study is the Lafayette-Louisville Boundary Outfall System Plan, Conceptual Design Report prepared by Merrick & Company on December 2012.

3. Lafayette-Louisville Boundary Outfall System Plan

This study has been prepared in accordance with City of Louisville Standards and Specifications as outlined in the Merrick & Company. December 2012. Lafayette-Louisville Boundary Outfall System Plan, Conceptual Design Report.

4. City of Louisville Subdivision Regulations

This study has been prepared in accordance with City of Louisville Standards and Specifications as outlined in the City of Louisville Storm Drainage and Technical Criteria Manual.

5. Urban Storm Drainage Criteria Manual

This study has been prepared in accordance with Urban Drainage and Flood Control District (USDCM). online. Drainage Criteria Manual, Volume I, II & III.

6. Other master drainage reports

This study has been prepared in accordance with Drexel, Barrell & Co, June 1, 1982. Final Drainage Report for Coal Creek Station Subdivision

B. Drainage Concept

1. Effectiveness of drainage design to control damage from storm runoff

The undeveloped 10.71-acre site of the Coal Creek Village will be developed assuming business and residential uses. The complete site will be detained for stormwater and it will be provided with water quality treatment in a proposed extended detention basin (EDB).

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

WHPacific, Inc. August 2013. City of Louisville Storm Drainage and Technical Criteria Manual (SDTCM)

Western Environment and Ecology, Inc, August 24, 2005. Mine Subsidence Investigation – Coal Creek Station Development – see **Appendix F**.

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

Urban Drainage and Flood Control District (USCDM). online. Drainage Criteria Manual, Volume I, II & III.

The FEMA Flood Map Service Center (MSC) msc.fema.gov/portal/home

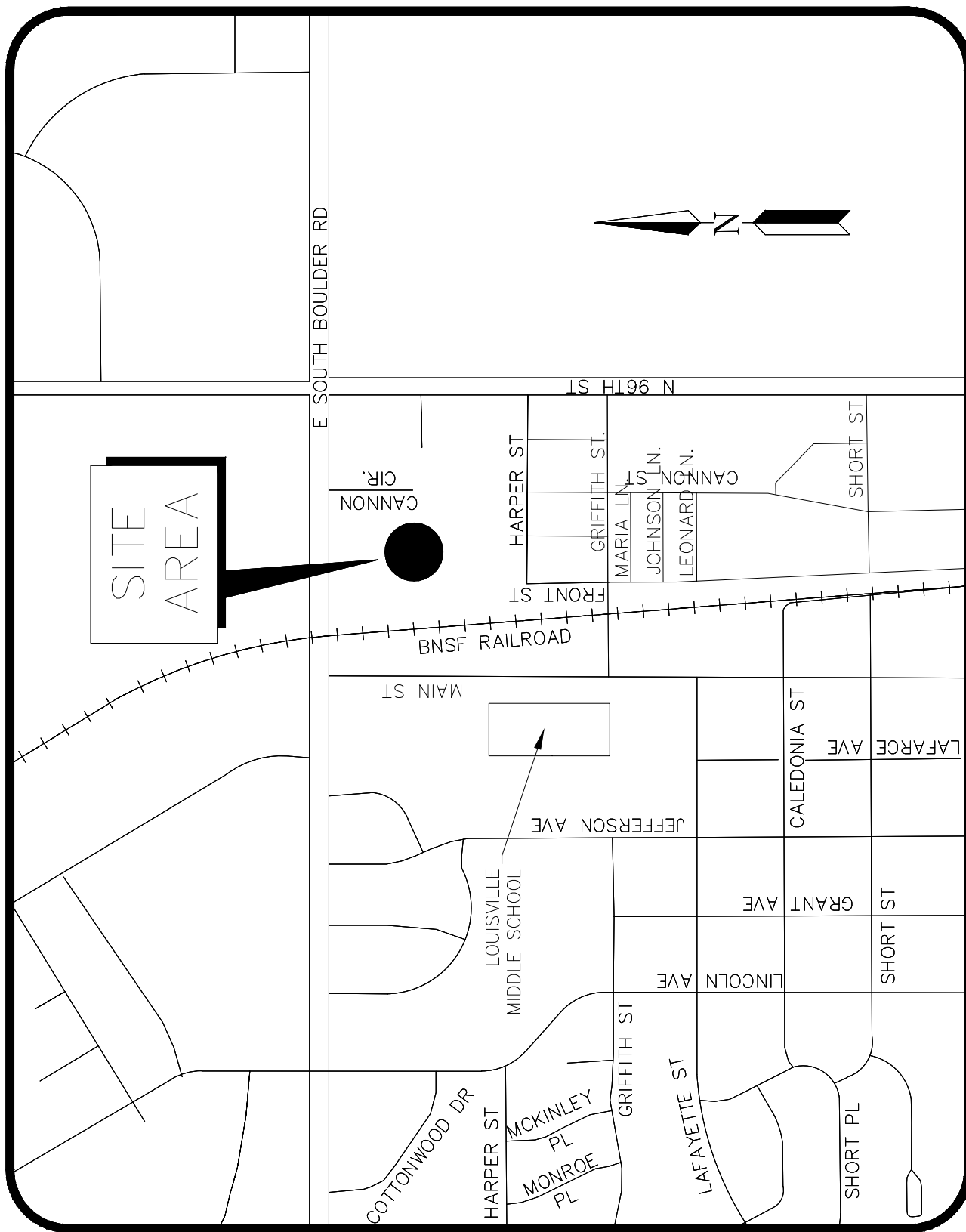
USDA United States Department of Agriculture NRCS Natural Resources Conservation Service

APPENDIX

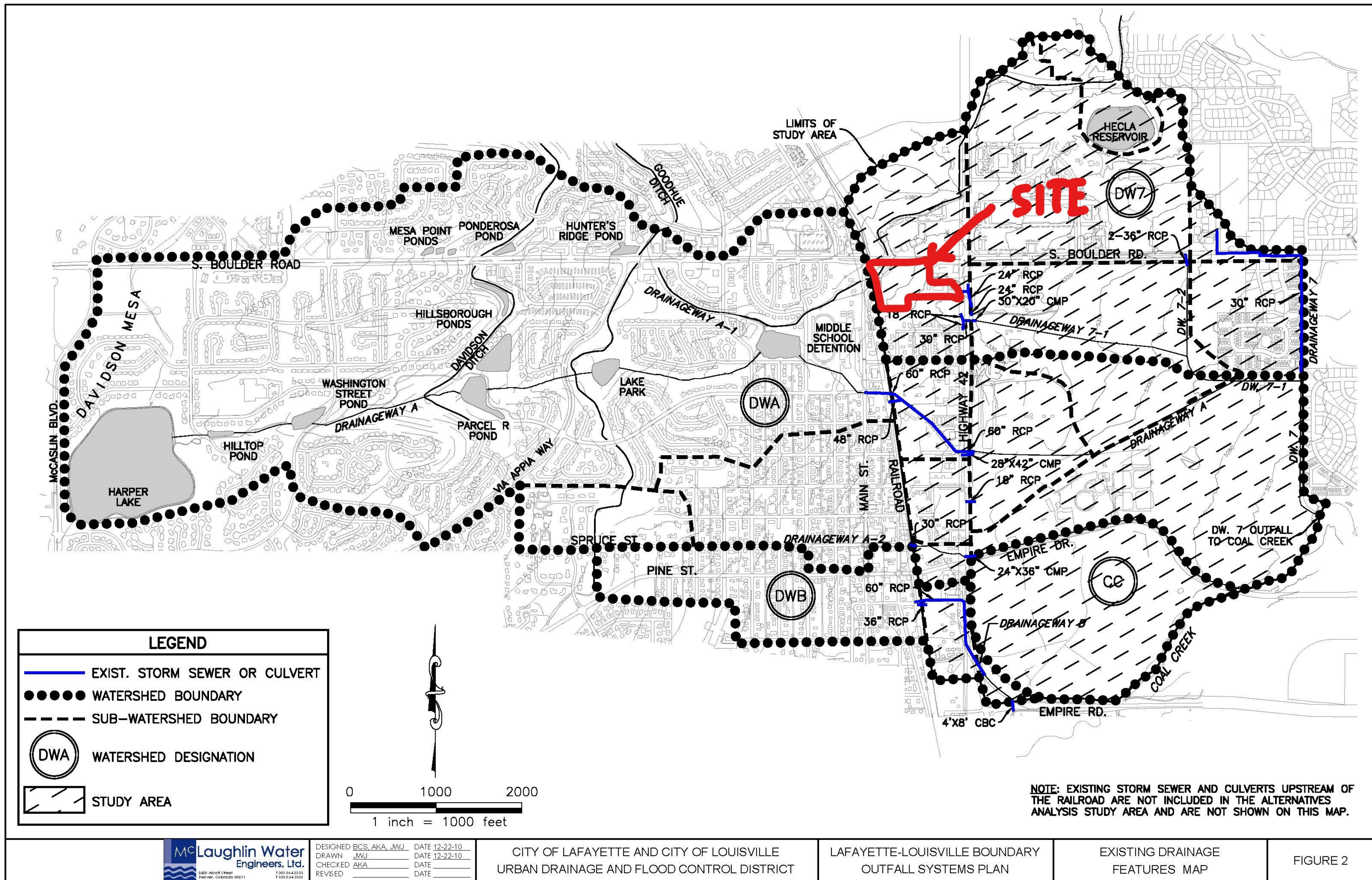


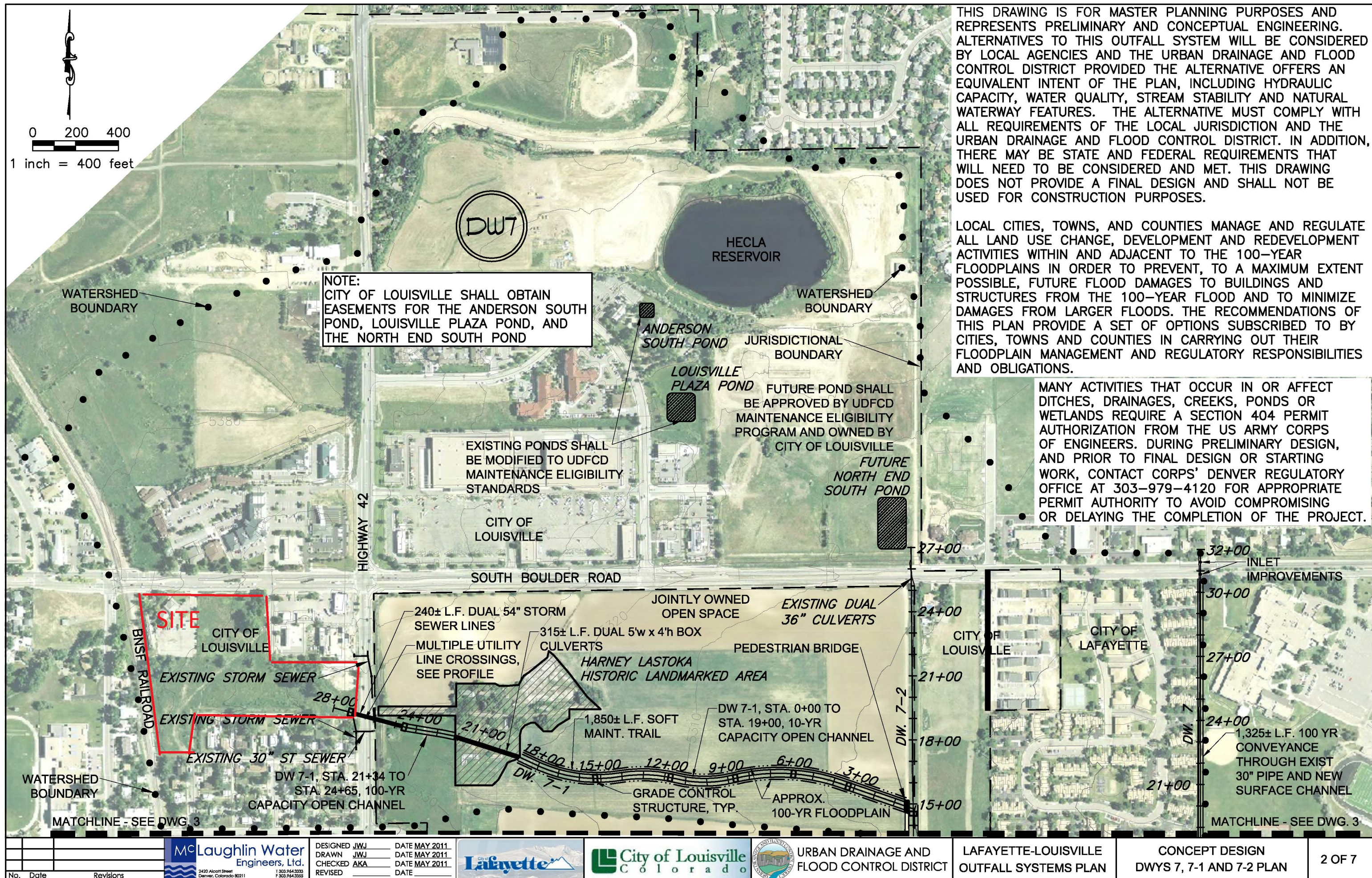
Appendix A

Maps and Figures



VICINITY MAP
Not to scale







Appendix B

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	2	5	10	100
<u>Business:</u>					
Commercial Areas	95	.87	.88	.90	.93
Neighborhood Areas	65	.60	.65	.70	.80
<u>Residential:</u>					
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
<u>Industrial:</u>					
Light Areas	80	.75	.80	.80	.85
Heavy Areas	90	.80	.80	.85	.90
<u>Parks, Cemeteries</u>					
	7	.15	.25	.35	.60
<u>Playgrounds</u>					
	13	.20	.30	.40	.70
<u>Schools</u>					
	50	.50	.55	.60	.75
<u>Railroad Yard Areas</u>					
	40	.40	.45	.50	.70
<u>Undeveloped Areas:</u>					
Historic Flow Analysis	2	.10	.20	.30	.60
Greenbelts, Agricultural					
Offsite Flow Analysis	45	.45	.50	.55	.72
(when land use not defined)					
<u>Streets:</u>					
Paved	100	.87	.88	.90	.93
Gravel	7	.15	.25	.35	.65
<u>Drives and Walks</u>					
	96	.85	.87	.90	.92
<u>Roofs</u>					
	90	.80	.85	.90	.90
<u>Lawns, Sandy Soil</u>					
	0	.00	.10	.20	.50
<u>Lawns, Clayey Soil</u>					
	0	.10	.20	.30	.60

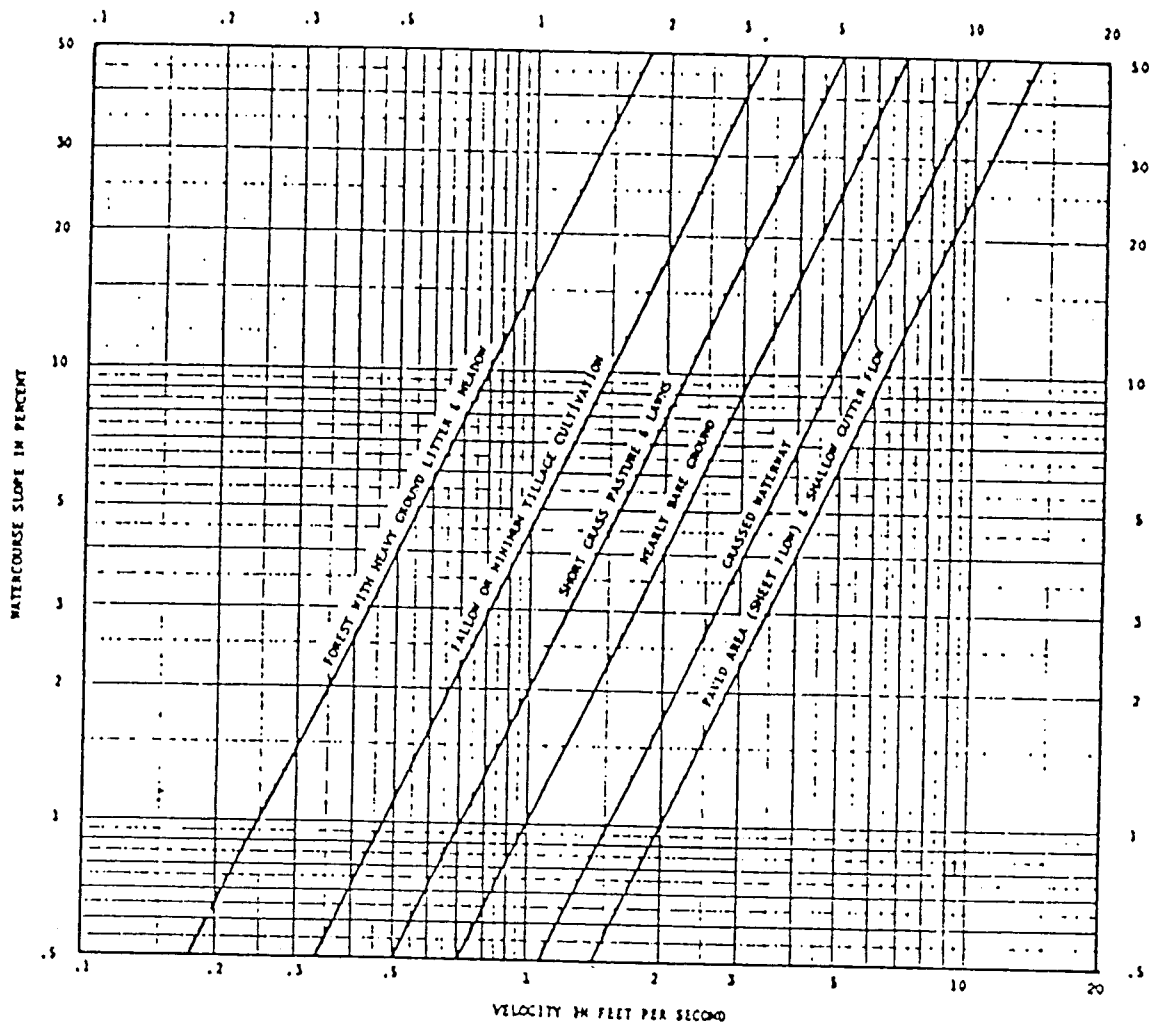
NOTE: These Rational Formula coefficients do not apply for larger basins where the time-of-concentration exceeds 60 minutes.

WRC, Inc.

Reference: Urban Drainage & Flood Control District Rational Formula Procedure, Hydrology Research Program, August 1979.

Date: Dec, 1981

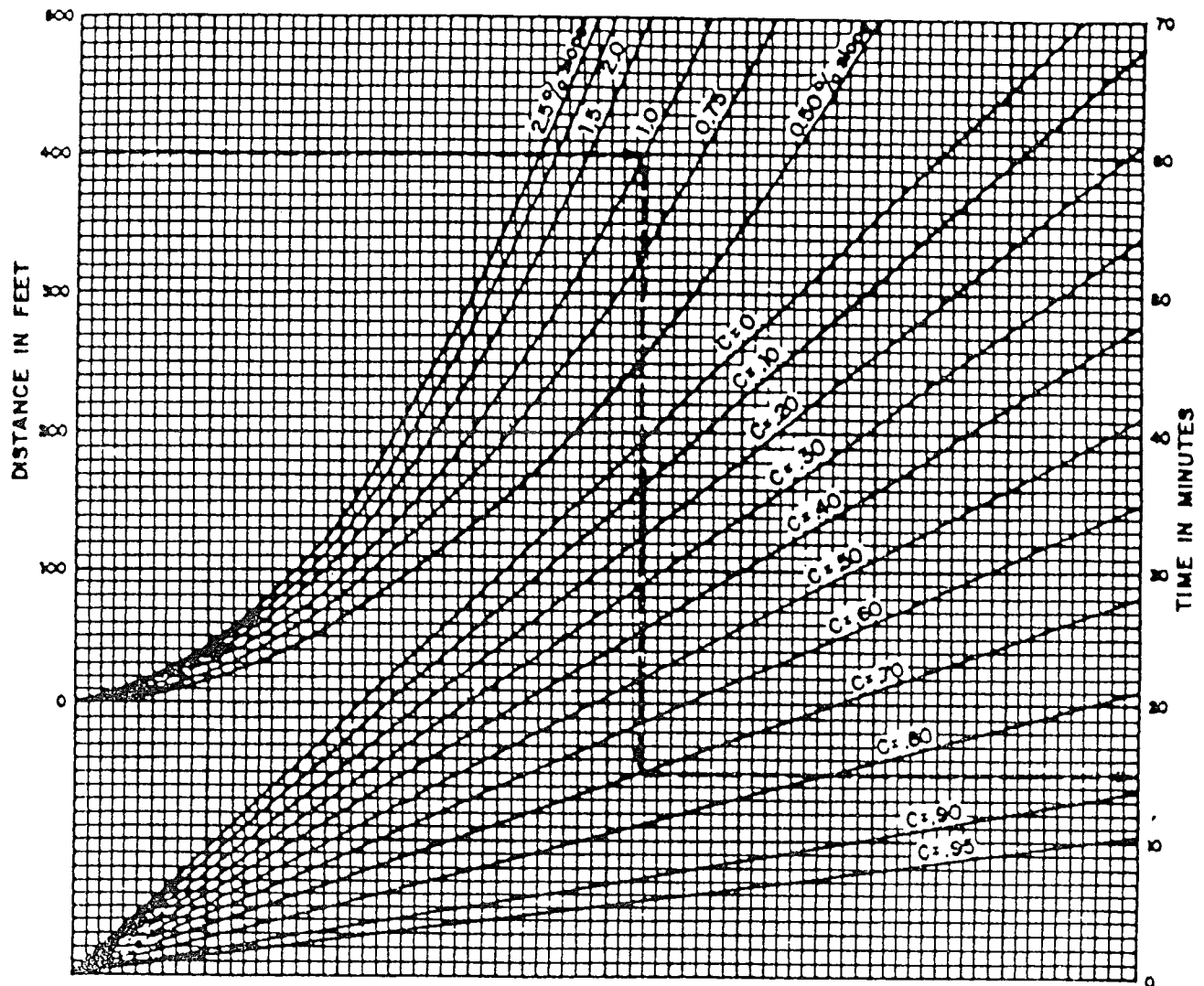
TIME OF TRAVEL



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.

OVERLAND TIME OF FLOW



THE ABOVE CURVES ARE A SOLUTION OF THE FOLLOWING EQUATION:

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

where: t_i = initial flow time (min.)

S = slope of basin (%)

C_s = runoff coefficient for 5 year frequency (Table 3)

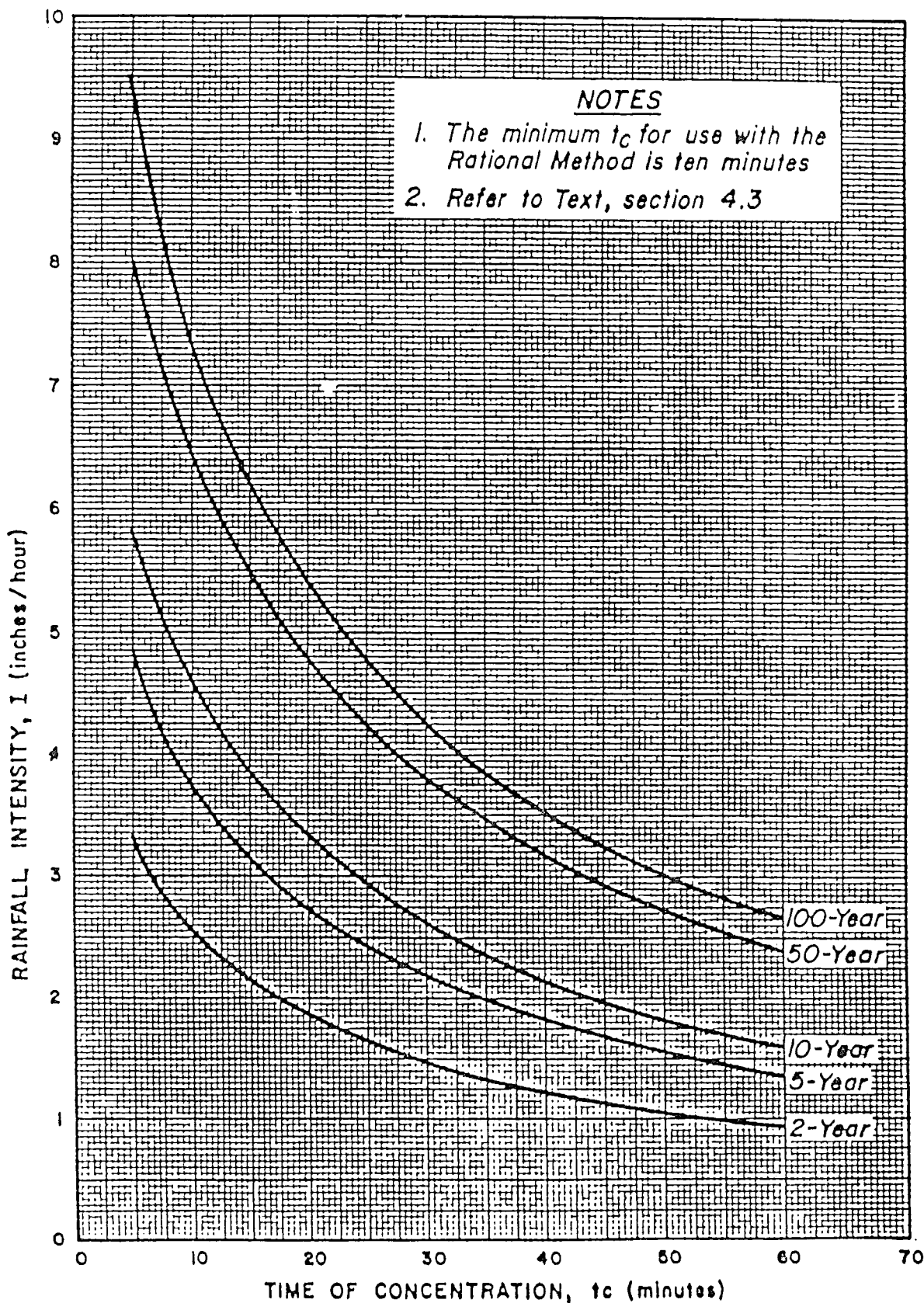
L = length of basin (ft.)

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

TIME-INTENSITY-FREQUENCY CURVES



C factors & Impervious % - Offsite

Coal Creek Village

JN - 294-1

<u>ALL (ONSITE + OFFSITE)</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	206727	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	54392	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	2614	0.29	0.32	0.38	0.61	40
ROOFS	112966	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	263746	0.01	0.01	0.07	0.44	2

C2= 0.47

C5= 0.48

C10= 0.51

C100= 0.69

Total Basin Area (Includes Offsite Basins)

14.70 ac

640,444 sq.ft.

Basin Impervious

57%

<u>ONSITE BASINS ONLY</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	149498	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	47597	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	5227	0.29	0.32	0.38	0.61	40
ROOFS	107346	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	141206	0.01	0.01	0.07	0.44	2

C2= 0.54

C5= 0.55

C10= 0.58

C100= 0.73

Total Basin Area

10.11 ac

440,392 sq.ft.

Basin Impervious

65%

<u>BASIN A</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	10977	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1372	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	8233	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	6861	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)

0.63 ac

27,443 sq.ft.

Basin Impervious

72%

C factors & Impervious % - Offsite

Coal Creek Village

JN - 294-1

<u>BASIN B</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	8059	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	806	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	4029	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	3223	0.01	0.01	0.07	0.44	2

C2=	0.64	Total Basin Area (Includes Offsite Basins)	
C5=	0.66	0.37 ac	16,117 sq.ft.
C10=	0.68	Basin Impervious	
C100=	0.79	77%	

<u>BASIN C</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	8538	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	2439	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	4879	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	5238	0.01	0.01	0.07	0.44	2

C2=	0.60	Total Basin Area (Includes Offsite Basins)	
C5=	0.61	0.48 ac	21,094 sq.ft.
C10=	0.64	Basin Impervious	
C100=	0.76	72%	

<u>BASIN D</u>	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)	13582	0.01	0.01	0.07	0.44	2

C2=	0.53	Total Basin Area (Includes Offsite Basins)	
C5=	0.54	0.95 ac	41,330 sq.ft.
C10=	0.57	Basin Impervious	
C100=	0.72	64%	

C factors & Impervious % - Offsite

Coal Creek Village

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<u>BASIN E</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	3723	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	3189	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	6539	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	13250	0.01	0.01	0.07	0.44	2

C2=	0.39	Total Basin Area (Includes Offsite Basins)	
C5=	0.40	0.61 ac	26,701 sq.ft.
C10=	0.44	Basin Impervious	
C100=	0.65	48%	

<u>BASIN F</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	13288	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	3572	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	8790	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	8030	0.01	0.01	0.07	0.44	2

C2=	0.61	Total Basin Area (Includes Offsite Basins)	
C5=	0.62	0.77 ac	33,680 sq.ft.
C10=	0.64	Basin Impervious	
C100=	0.76	73%	

<u>BASIN G</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	14800	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	6273	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	15682	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	19800	0.01	0.01	0.07	0.44	2

C2=	0.51	Total Basin Area (Includes Offsite Basins)	
C5=	0.52	1.30 ac	56,554 sq.ft.
C10=	0.55	Basin Impervious	
C100=	0.71	62%	

C factors & Impervious % - Offsite

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<u>BASIN I</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	24305	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	6229	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	9344	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	6229	0.01	0.01	0.07	0.44	2

C2= 0.69

C5= 0.71

C10= 0.73

C100= 0.81

Total Basin Area (Includes Offsite Basins)

1.06 ac 46,107 sq.ft.

Basin Impervious

83%

<u>BASIN J</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	6590	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1915	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	1215	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	3230	0.01	0.01	0.07	0.44	2

C2= 0.61

C5= 0.62

C10= 0.64

C100= 0.77

Total Basin Area (Includes Offsite Basins)

0.30 ac 12,950 sq.ft.

Basin Impervious

73%

<u>BASIN K</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	28314	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	5663	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	16988	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	5663	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)

1.30 ac 56,628 sq.ft.

Basin Impervious

86%

C factors & Impervious % - Offsite

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<u>BASIN Q</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	15593	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	2919	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	8756	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	5919	0.01	0.01	0.07	0.44	2

C2=	0.66	Total Basin Area (Includes Offsite Basins)	
C5=	0.67	0.76 ac	33,186 sq.ft.
C10=	0.69	Basin Impervious	
C100=	0.79	79%	

<u>BASIN M</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	3420	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	784	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	1352	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	784	0.01	0.01	0.07	0.44	2

C2=	0.70	Total Basin Area (Includes Offsite Basins)	
C5=	0.72	0.15 ac	6,340 sq.ft.
C10=	0.74	Basin Impervious	
C100=	0.82	85%	

<u>BASIN N1</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	871	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	2178	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	1307	0.01	0.01	0.07	0.44	2

C2=	0.52	Total Basin Area (Includes Offsite Basins)	
C5=	0.54	0.10 ac	4,356 sq.ft.
C10=	0.57	Basin Impervious	
C100=	0.72	64%	

C factors & Impervious % - Offsite

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<u>BASIN N2</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	4116	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	5293	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	2352	0.01	0.01	0.07	0.44	2

C2= 0.59

C5= 0.61

C10= 0.64

C100= 0.76

Total Basin Area (Includes Offsite Basins)

0.27 ac 11,761 sq.ft.

Basin Impervious

72%

<u>BASIN N3</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	871	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	2178	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	1307	0.01	0.01	0.07	0.44	2

C2= 0.52

C5= 0.54

C10= 0.57

C100= 0.72

Total Basin Area (Includes Offsite Basins)

0.10 ac 4,356 sq.ft.

Basin Impervious

64%

<u>BASIN P</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1307	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	2614	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= 0.07

C5= 0.08

C10= 0.14

C100= 0.48

Total Basin Area (Includes Offsite Basins)

0.60 ac 26,136 sq.ft.

Basin Impervious

10%

C factors & Impervious % - Offsite

Coal Creek Village

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<u>BASIN OS1</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	3311	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	331	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	1655	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	27809	0.01	0.01	0.07	0.44	2

C2= 0.14

C5= 0.14

C10= 0.19

C100= 0.51

Total Basin Area (Includes Offsite Basins)

0.76 ac 33,106 sq.ft.

Basin Impervious

17%

<u>BASIN OS2</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	3964	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	793	0.74	0.76	0.78	0.84	90
GRAVEL (PACKED)	0	0.29	0.32	0.38	0.61	40
ROOFS	3964	0.74	0.76	0.78	0.84	90
LAWNS (CLAYEY)	70558	0.01	0.01	0.07	0.44	2

C2= 0.10

C5= 0.10

C10= 0.15

C100= 0.49

Total Basin Area (Includes Offsite Basins)

1.82 ac 79,279 sq.ft.

Basin Impervious

12%

<u>BASIN OS3</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	13242	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1655	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)	1655	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)

0.38 ac 16,553 sq.ft.

Basin Impervious

89%

C factors & Impervious % - Offsite

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<u>BASIN OS4</u>	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)	21950	0.01	0.01	0.07	0.44	2

C2=	0.01	Total Basin Area (Includes Offsite Basins)	
C5=	0.01	0.50 ac	21,950 sq.ft.
C10=	0.07	Basin Impervious	
C100=	0.44	2%	

<u>BASIN OS5</u>	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)	8854	0.01	0.01	0.07	0.44	2

C2=	0.01	Total Basin Area (Includes Offsite Basins)	
C5=	0.01	0.20 ac	8,854 sq.ft.
C10=	0.07	Basin Impervious	
C100=	0.44	2%	

<u>BASIN OS6</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	0	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	784	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)	7057	0.01	0.01	0.07	0.44	2

C2=	0.08	Total Basin Area (Includes Offsite Basins)	
C5=	0.09	0.18 ac	7,841 sq.ft.
C10=	0.14	Basin Impervious	
C100=	0.48	11%	

C factors & Impervious % - Offsite

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<u>BASIN OS7</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	20156	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	1220	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)	2235	0.01	0.01	0.07	0.44	2

C2=	0.76	Total Basin Area (Includes Offsite Basins)	
C5=	0.77	0.54 ac	23,611 sq.ft.
C10=	0.78	Basin Impervious	
C100=	0.84	90%	

<u>BASIN OS8</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	8054	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	375	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)	1025	0.01	0.01	0.07	0.44	2

C2=	0.75	Total Basin Area (Includes Offsite Basins)	
C5=	0.76	0.22 ac	9,454 sq.ft.
C10=	0.77	Basin Impervious	
C100=	0.84	89%	

<u>BASIN OS9</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	2962	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	174	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)	348	0.01	0.01	0.07	0.44	2

C2=	0.75	Total Basin Area (Includes Offsite Basins)	
C5=	0.77	0.08 ac	3,485 sq.ft.
C10=	0.78	Basin Impervious	
C100=	0.84	90%	

C factors & Impervious % - Offsite

Coal Creek Village

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<u>BASIN OS10</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	5184	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	305	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)	610	0.01	0.01	0.07	0.44	2

C2= 0.75

C5= 0.77

C10= 0.78

C100= 0.84

Total Basin Area (Includes Offsite Basins)

0.14 ac 6,098 sq.ft.

Basin Impervious

90%

<u>BASIN OS11</u>	AREA (sf)	C2	C5	C10	C100	% IMPERV
ASPHALT ROAD / PARKING	356	0.84	0.86	0.86	0.89	100
CONCRETE DRIVES & WALKS	2465	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)	2654	0.01	0.01	0.07	0.44	2

C2= 0.39

C5= 0.40

C10= 0.44

C100= 0.65

Total Basin Area (Includes Offsite Basins)

0.13 ac 5,475 sq.ft.

Basin Impervious

48%

Runoff
Coal Creek Village
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12/19/2022

SUB-BASIN DATA				T _c CHECK			T _c	10-yr event			100-yr event			DESIGN POINT
BASIN	AREA	VEL.	T _t	COMP T _c	TOTAL	T _c =	MIN	C	I	Q	C	I	Q	
	(Ac)	(fps)	(min)	(min)	LENGTH (ft)	(L/180)+10	(min)		in/hr	cfs		in/hr	cfs	
Historical Basins														
H1	7.76	this is a conservative estimate for time of conc.					10.0	0.07	4.5	2.4	0.44	7.4	25.3	1
H2	0.66	this is a conservative estimate for time of conc.					10.0	0.07	4.5	0.2	0.44	7.4	2.1	17
H3	1.04	this is a conservative estimate for time of conc.					10.0	0.07	4.5	0.3	0.44	7.4	3.4	18
H4	0.55	this is a conservative estimate for time of conc.					10.0	0.07	4.5	0.2	0.44	7.4	1.8	1
Onsite Developed Basins														
A	0.63	this is a conservative estimate for time of conc.					10.0	0.70	4.5	2.0	0.80	7.4	3.7	3
B	0.37	this is a conservative estimate for time of conc.					10.0	0.70	4.5	1.2	0.80	7.4	2.2	4
C	0.48	this is a conservative estimate for time of conc.					10.0	0.70	4.5	1.5	0.80	7.4	2.8	6
D	0.95	this is a conservative estimate for time of conc.					10.0	0.70	4.5	3.0	0.80	7.4	5.6	8
E	0.61	this is a conservative estimate for time of conc.					10.0	0.70	4.5	1.9	0.80	7.4	3.6	7
F	0.77	this is a conservative estimate for time of conc.					10.0	0.70	4.5	2.4	0.80	7.4	4.6	9
G	1.30	this is a conservative estimate for time of conc.					10.0	0.70	4.5	4.1	0.80	7.4	7.7	29
I	1.06	this is a conservative estimate for time of conc.					10.0	0.70	4.5	3.3	0.80	7.4	6.3	11
J	0.30	this is a conservative estimate for time of conc.					10.0	0.70	4.5	0.9	0.80	7.4	1.8	13
K	1.30	this is a conservative estimate for time of conc.					10.0	0.70	4.5	4.1	0.80	7.4	7.7	14
M	0.15	this is a conservative estimate for time of conc.					10.0	0.70	4.5	0.5	0.80	7.4	0.9	16
N1	0.10	this is a conservative estimate for time of conc.					10.0	0.70	4.5	0.3	0.80	7.4	0.6	26
N2	0.27	this is a conservative estimate for time of conc.					10.0	0.70	4.5	0.9	0.80	7.4	1.6	25
N3	0.10	this is a conservative estimate for time of conc.					10.0	0.70	4.5	0.3	0.80	7.4	0.6	24
P	0.60	this is a conservative estimate for time of conc.					10.0	0.70	4.5	1.9	0.80	7.4	3.6	1
Q	0.76	this is a conservative estimate for time of conc.					10.0	0.70	4.5	2.4	0.80	7.4	4.5	28
Offsite Developed Basins														
OS1	0.76	this is a conservative estimate for time of conc.					10.0	0.19	4.5	0.6	0.51	7.4	2.9	19
OS2	1.82	this is a conservative estimate for time of conc.					10.0	0.15	4.5	1.2	0.49	7.4	6.6	20
OS3	0.38	this is a conservative estimate for time of conc.					10.0	0.77	4.5	1.3	0.84	7.4	2.4	30
OS4	0.50	this is a conservative estimate for time of conc.					10.0	0.07	4.5	0.2	0.44	7.4	1.6	18
OS5	0.20	this is a conservative estimate for time of conc.					10.0	0.07	4.5	0.1	0.44	7.4	0.7	17
OS6	0.18	this is a conservative estimate for time of conc.					10.0	0.14	4.5	0.1	0.48	7.4	0.6	31
OS7	0.54	this is a conservative estimate for time of conc.					10.0	0.76	4.5	1.8	0.84	7.4	3.4	12
OS8	0.22	this is a conservative estimate for time of conc.					10.0	0.76	4.5	0.8	0.84	7.4	1.4	21
OS9	0.08	this is a conservative estimate for time of conc.					10.0	0.76	4.5	0.3	0.84	7.4	0.5	22
OS10	0.14	this is a conservative estimate for time of conc.					10.0	0.76	4.5	0.5	0.84	7.4	0.9	23
OS11	0.13	this is a conservative estimate for time of conc.					10.0	0.43	4.5	0.3	0.64	7.4	0.6	35



Appendix C

Detention Pond Calculations

MHFD-Detention, Version 4.03 (May 2020)

Basin ID: All - Onsite Basins

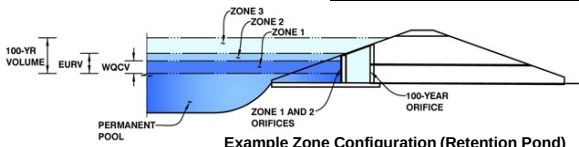


DETENTION BASIN OUTLET STRUCTURE DESIGN

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)	4.14	0.540	Circular Orifice
Zone 3 (100+1/2WQCV)	5.47	0.605	Weir&Pipe (Restrict)
Total (all zones)		1.425	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

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)

Calculated Parameters for Plate

Invert of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 2.54 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = 10.00 inches
Orifice Plate: Orifice Area per Row = 1.04 sq. inches (diameter = 1-1/8 inches)

WQ Orifice Area per Row = 7.222E-03 ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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)

Calculated Parameters for Vertical Orifice

	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)	0.27	N/A
Depth at top of Zone using Vertical Orifice =	4.23	N/A	ft (relative to basin bottom at Stage = 0 ft)	0.29	N/A
Vertical Orifice Diameter =	7.00	N/A	inches		
Vertical Orifice Area =			ft ²		
Vertical Orifice Centroid =			feet		

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

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, H _o =	4.23	N/A	ft (relative to basin bottom at Stage = 0 ft)	4.98	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	3.09	N/A
Overflow Weir Grate Slope =	4.00	N/A	H:V	4.90	N/A
Horiz. Length of Weir Sides =	3.00	N/A	feet	8.66	N/A
Overflow Grate Open Area % =	70%	N/A	% , grate open area/total area	4.33	N/A
Debris Clogging % =	50%	N/A	%		
Height of Grate Upper Edge, H _u =			feet		
Overflow Weir Slope Length =			feet		
Grate Open Area / 100-yr Orifice Area =			ft ²		
Overflow Grate Open Area w/o Debris =			ft ²		
Overflow Grate Open Area w/ Debris =					

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	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)	1.77	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	0.75	N/A
Restrictor Plate Height Above Pipe Invert =	18.00		inches	3.14	N/A
Outlet Orifice Area =			ft ²		
Outlet Orifice Centroid =			feet		
Half-Central Angle of Restrictor Plate on Pipe =			radians		

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

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

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).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.80	1.09	1.35	1.78	2.14	2.54	3.63
One-Hour Rainfall Depth (in)	N/A	N/A	0.801	0.647	0.860	1.273	1.600	1.992	3.017
CUHP Runoff Volume (acre-ft)	0.280	0.801	0.449	0.647	0.860	1.273	1.600	1.992	3.017
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.449	0.647	0.860	1.273	1.600	1.992	3.017
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	6.4	9.2	12.2	19.0	24.0	30.1	45.1
Peak Outflow Q (cfs)	0.1	1.6	0.5	1.1	1.4	3.2	6.7	12.0	19.3
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	8.5	1.0	0.6	0.8	1.0	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	Outlet Plate 1
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	0.1	0.5	1.1	1.9
Max Velocity through Gate 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	46	45	44	42	40	35
Time to Drain 99% of Inflow Volume (hours)	43	51	50	51	52	52	50	49	46
Maximum Ponding Depth (ft)	2.53	4.09	2.96	3.37	3.80	4.52	4.83	5.14	5.87
Area at Maximum Ponding Depth (acres)	0.25	0.42	0.30	0.34	0.39	0.44	0.46	0.47	0.51
Maximum Volume Stored (acre-ft)	0.280	0.802	0.395	0.525	0.685	0.986	1.125	1.269	1.627



Appendix D

Websoil Report



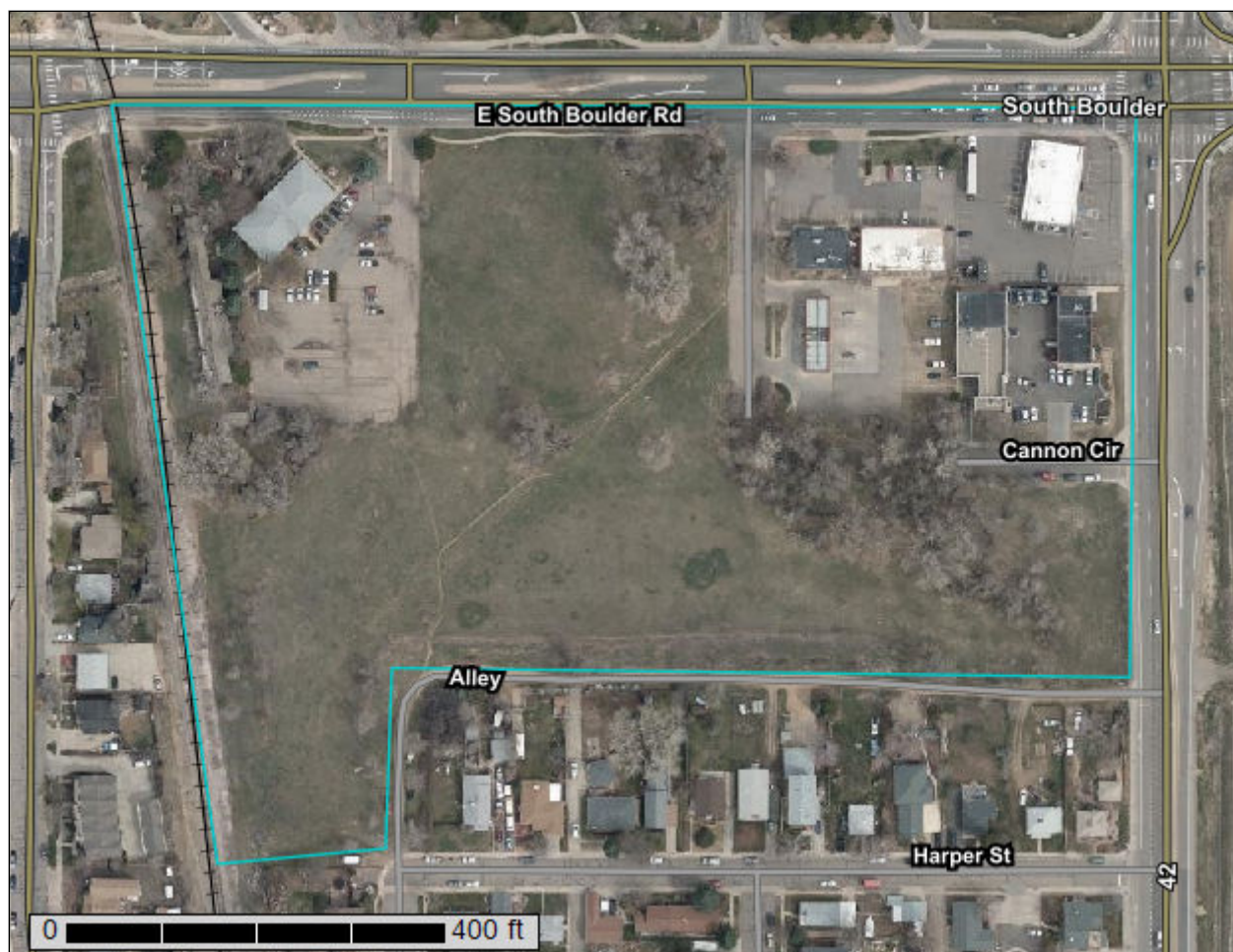
United States
Department of
Agriculture

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**



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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HaD—Hargreave fine sandy loam, 3 to 9 percent slopes.....	11

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 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: 2tInt
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



Appendix E

Excerpt of Mine Subsidence Report

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.

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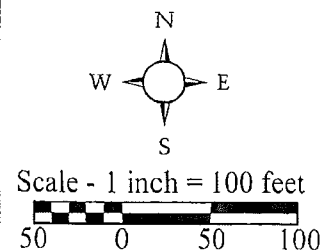
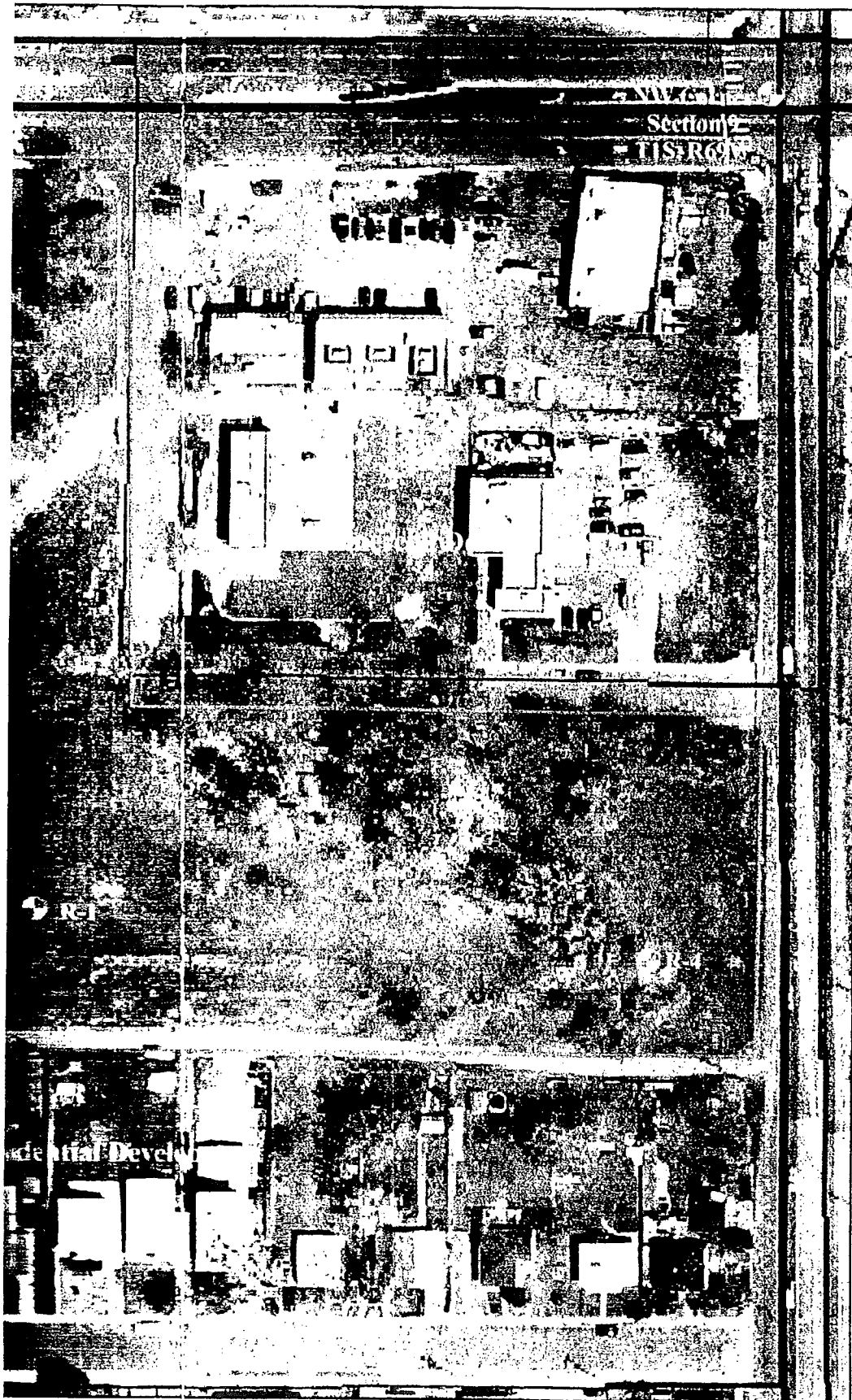


Figure 2A - Site Map
Coal Creek Station

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6.0 REGIONAL GEOLOGY

6.1 Outcropping Units

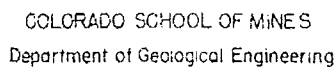
Outcropping units within and surrounding the Lafayette and Louisville area are the Pierre Shale, the Fox Hills Sandstone, the Laramie Formation and Quaternary gravels and soils (Figure 5).

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.

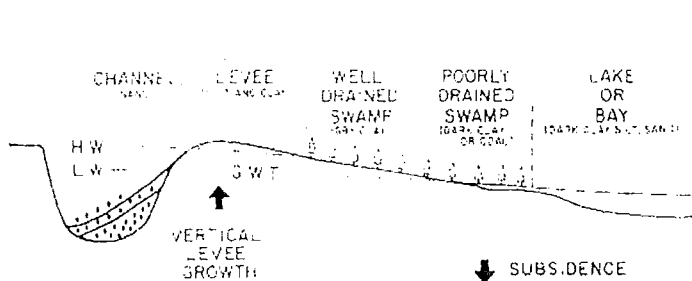
The Fox Hills Sandstone is a massive to crossbedded sandstone. It was deposited in a beach and/or delta-front environment and comfortably overlies the Pierre Shale. The lower two-thirds of the formation is a fine to coarse grained, bluff colored sandstone which weathers to a light tan to tan color. The 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.

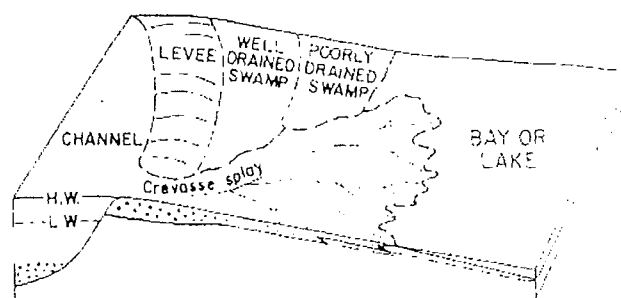
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**WESTERN ENVIRONMENT
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Littleton, Colorado 80120

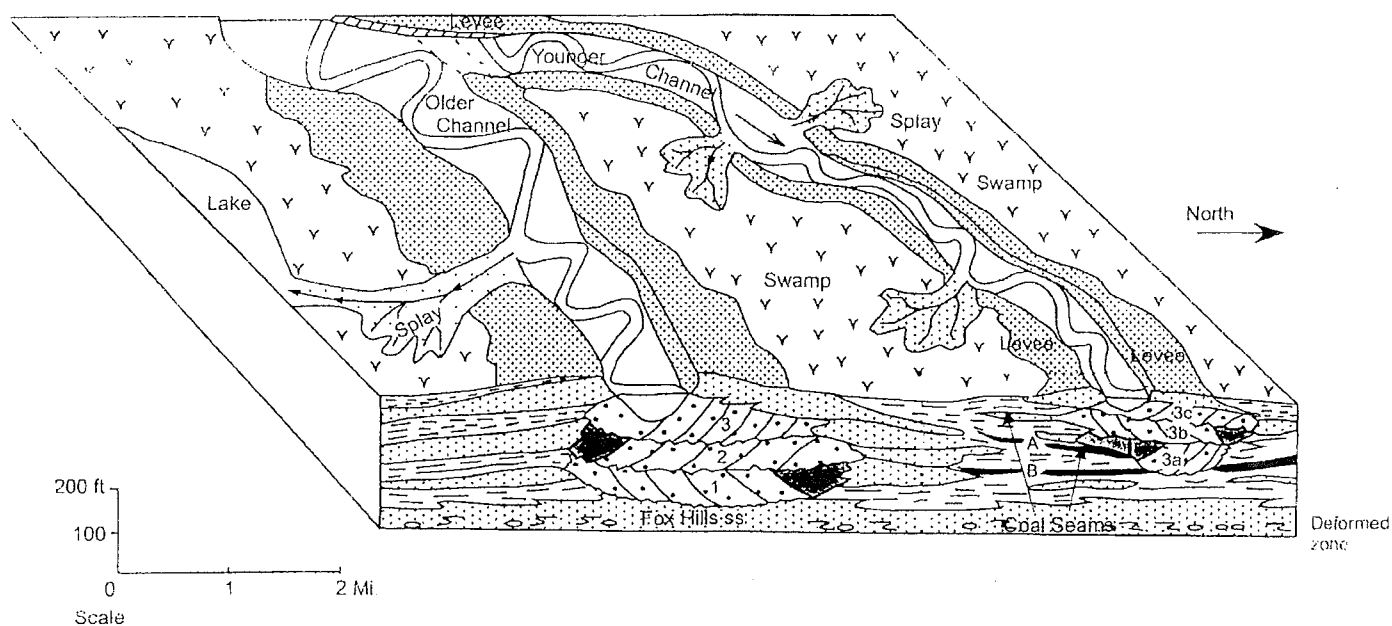


Channel and channel margin environments for lithologies in Laramie Formation.



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 Laramide vertical Movement
Weimer, R.J. 1973

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AND ECOLOGY, INC**

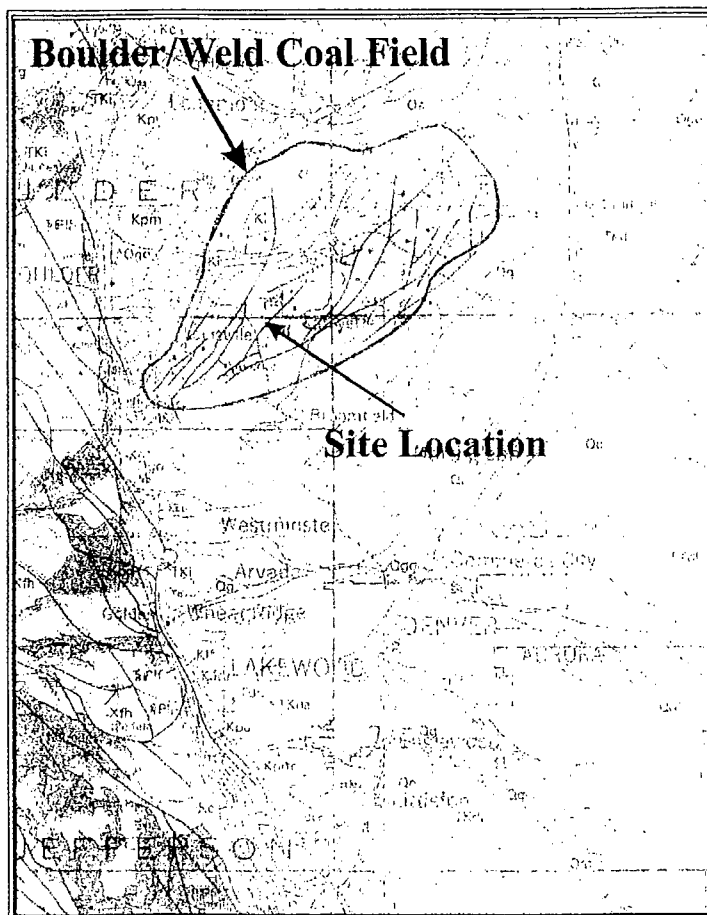
2217 West Powers Avenue
Littleton, Colorado 80120

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-Julesburg 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 to 17 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 to 144 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 to 16 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 to 10 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 to 12 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.



Appendix F

Offsite Flows from North

OFFSITE FLOWS FROM NORTH
(North of South Boulder Road)

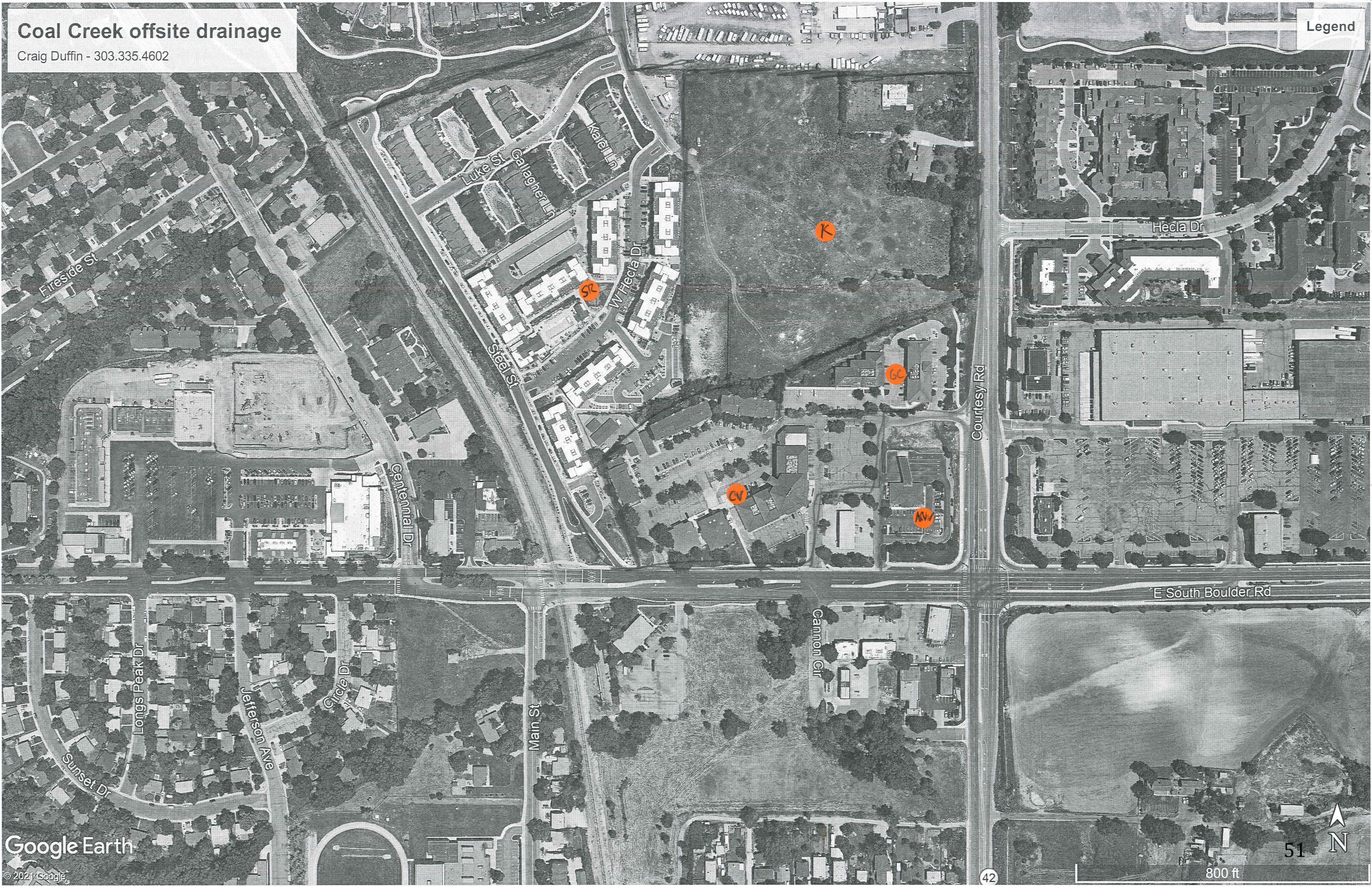
SUMMARY

Basin name	Basin Abbrev.	Release rate (cfs)	Design Point	Notes
Steel Ranch South	SR	24.89	West of 32	Steel Ranch South contributes flow
Kestrel	K	14.5	North of 32	Kestrel contributes flow. Include bypass flows
Christopher Village	CV	4.2	32	Christopher Plaza and Village contribute flow
Garden City	GC	2.0	North of 33	Christopher Plaza II contributes all flow
Norwest	NW	3.66	33	Coal Trail Square contributes flow Combined flow at DP33 is 5.66cfs

Coal Creek offsite drainage

Craig Duffin - 303.335.4602

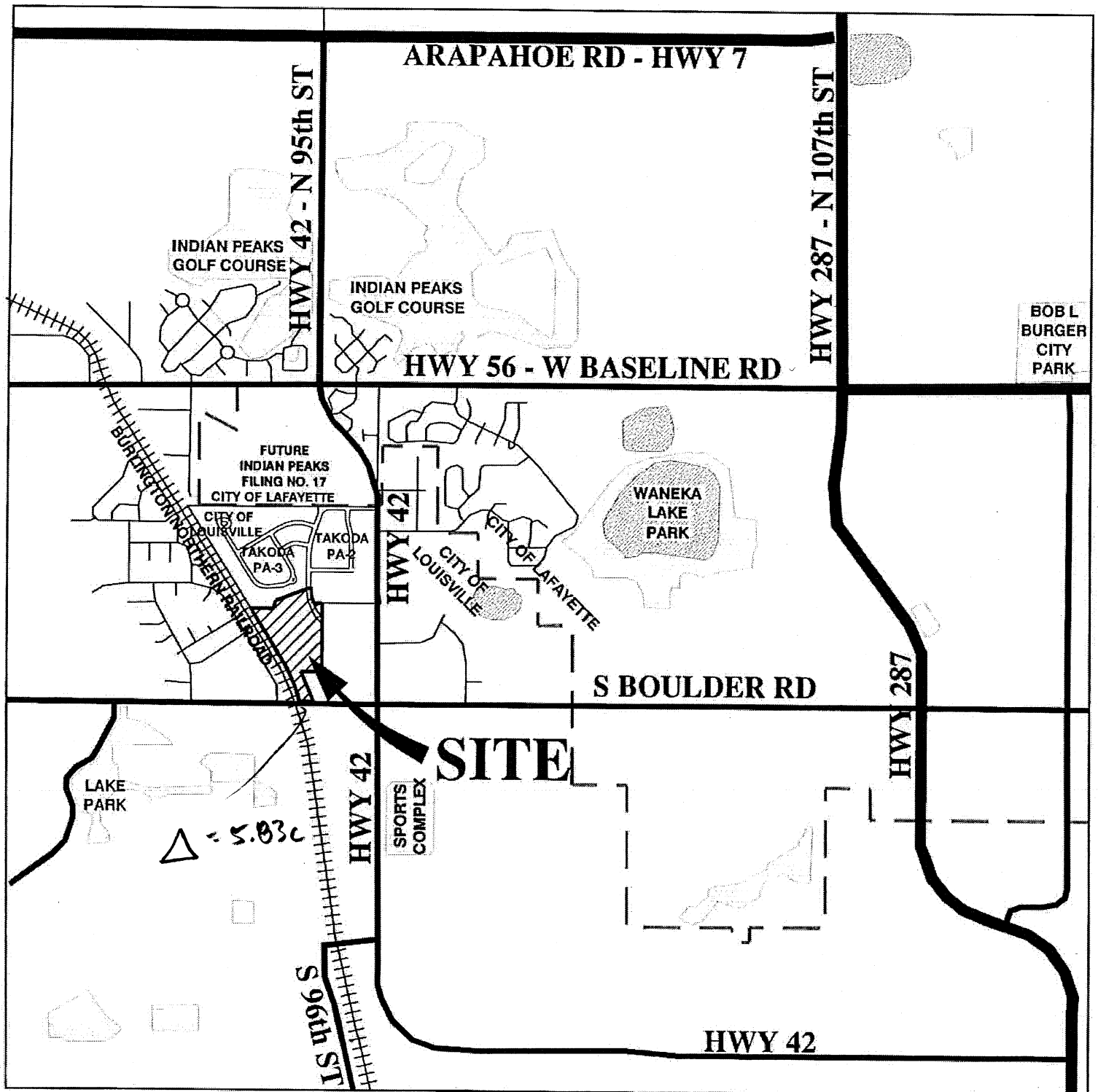
Legend



OFFSITE FLOWS FROM NORTH
(north of South Boulder Road)

STEEL RANCH SOUTH (SR)

Steel Ranch South
(SK)



VICINITY MAP

SCALE: 1" = 2000'

**FINAL DRAINAGE REPORT
FOR
Steel Ranch South**

May 25, 2012

Prepared for:

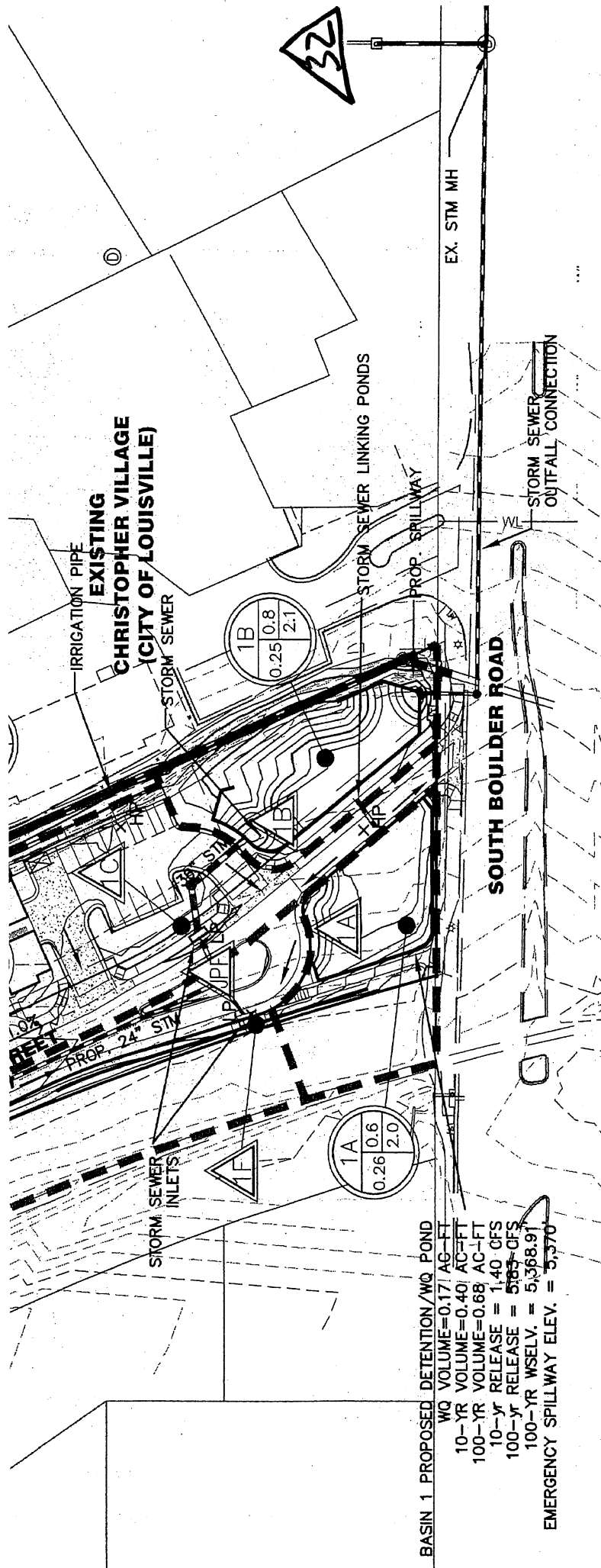
RMCS, LLC
950 Spruce Street, Suite 2A
Louisville CO 80027
Phone: 303-475-2106
Contact: Justin McClure

Prepared by:



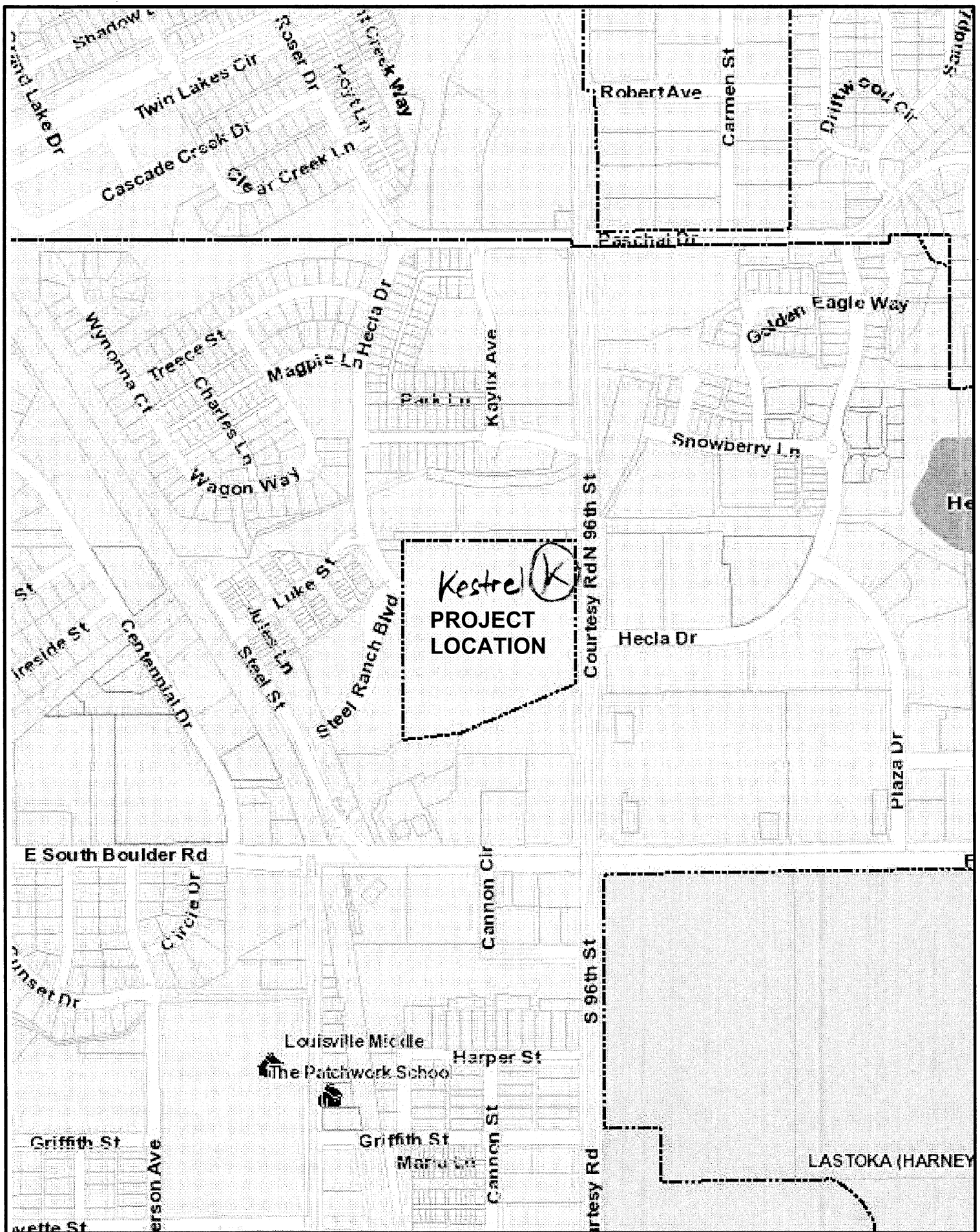
3151 South Vaughn Way
Suite 680
Aurora, Colorado 80014
Phone: 303-368-5601
Fax: 303-368-5603
Contact: Jason Margraf, P.E.

Job No. 03000531



OFFSITE FLOWS FROM NORTH
(north of South Boulder Road)

KESTREL (K)



014-2332

VICINITY MAP

MOLSSON
ASSOCIATES

5285 McWhinney Boulevard
Suite 160
Loveland, CO 80538
TEL 970.431.7733
Page 11 of 164

57

KESTREL

245 N. 96TH STREET, LOUISVILLE, CO

FINAL DRAINAGE REPORT

RECEIVED
JUN 13 2016
Public Works

PREPARED FOR:

Milender White Construction Company

12655 W 54th Drive

Arvada, CO 80002

(303) 216-0420

Contact: Bob Hutchinson

Approved
8/15/2016
[Signature]

PREPARED BY:

Olsson Associates

5285 McWhinney Blvd, Suite 160

Loveland, CO 80538

(970) 461-7733

Contact: Josh Erramouspe, PE

June 10, 2016

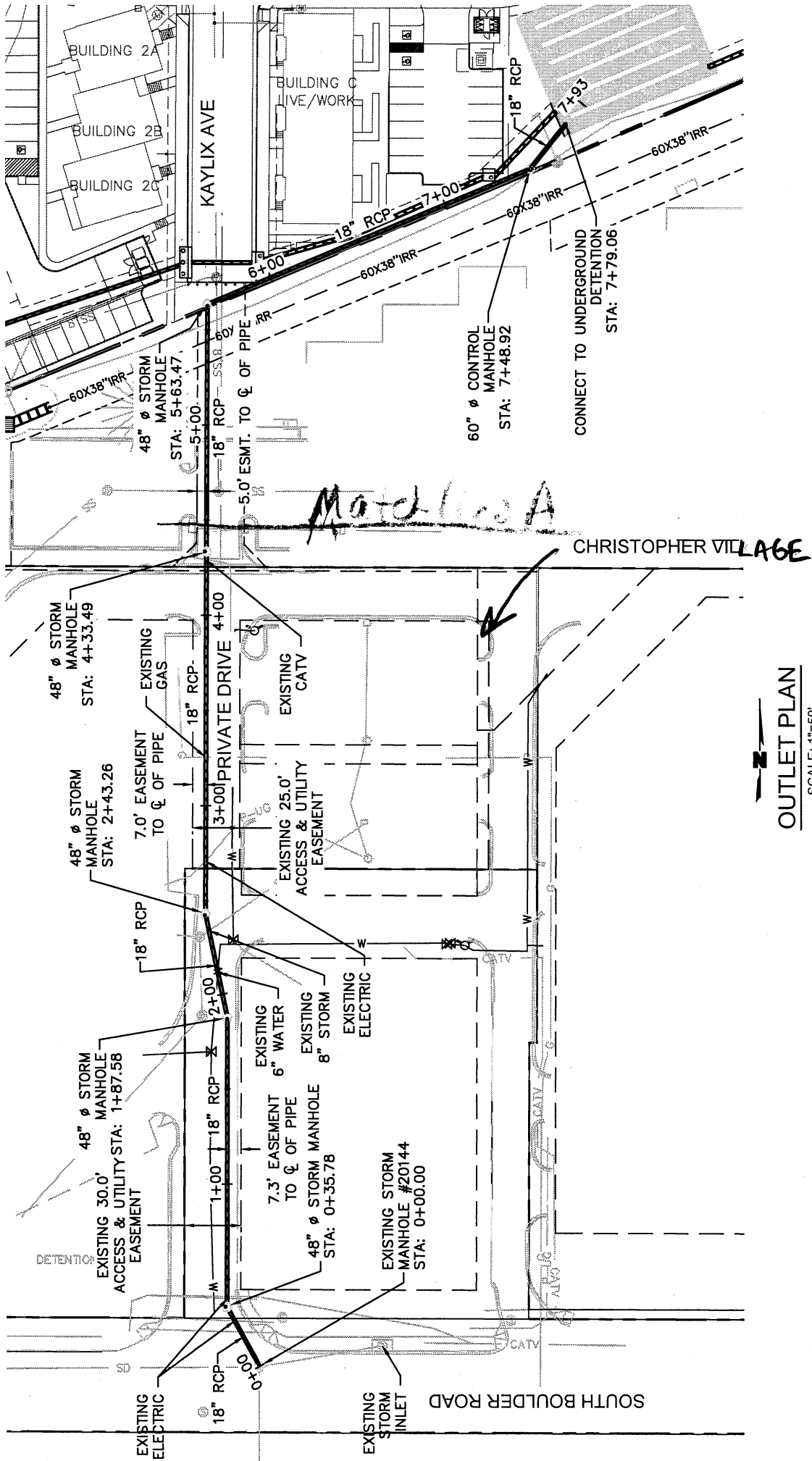
Olsson Project No. 014-2332

OLSSON[®]
ASSOCIATES

Table 5.4-1 South Boulder Road Storm Sewer

Description	10-Year Flow (cfs)	100-Year Flow (cfs)	Supporting Drainage Study
Kestrel	3.9	12.2	This report
Christopher Village	0.53	2.23	Christopher Village Drainage Study, 1979 (Page 33 of 110)
Christopher Plaza-Lot 8	0.45	1.1	Final Drainage Report for Christopher Plaza –Lot 8, 1995 (Page 10 of 40)
Norwest Bank (Including flow from Christopher Plaza II)	0.87	3.66	Final Drainage Study for Norwest Bank, 1994. (Page 72 of 72)
Steel Ranch South	11.53	24.89	Final Drainage Report for Steel Ranch South, 2012 (Page 18 of 109, named page 15)
South Boulder Road	3.14	5.15	State Highway No. 42 Intersection at South Boulder Road, Final Hydraulics Report, 2010 (Pages 15-16 of 50)

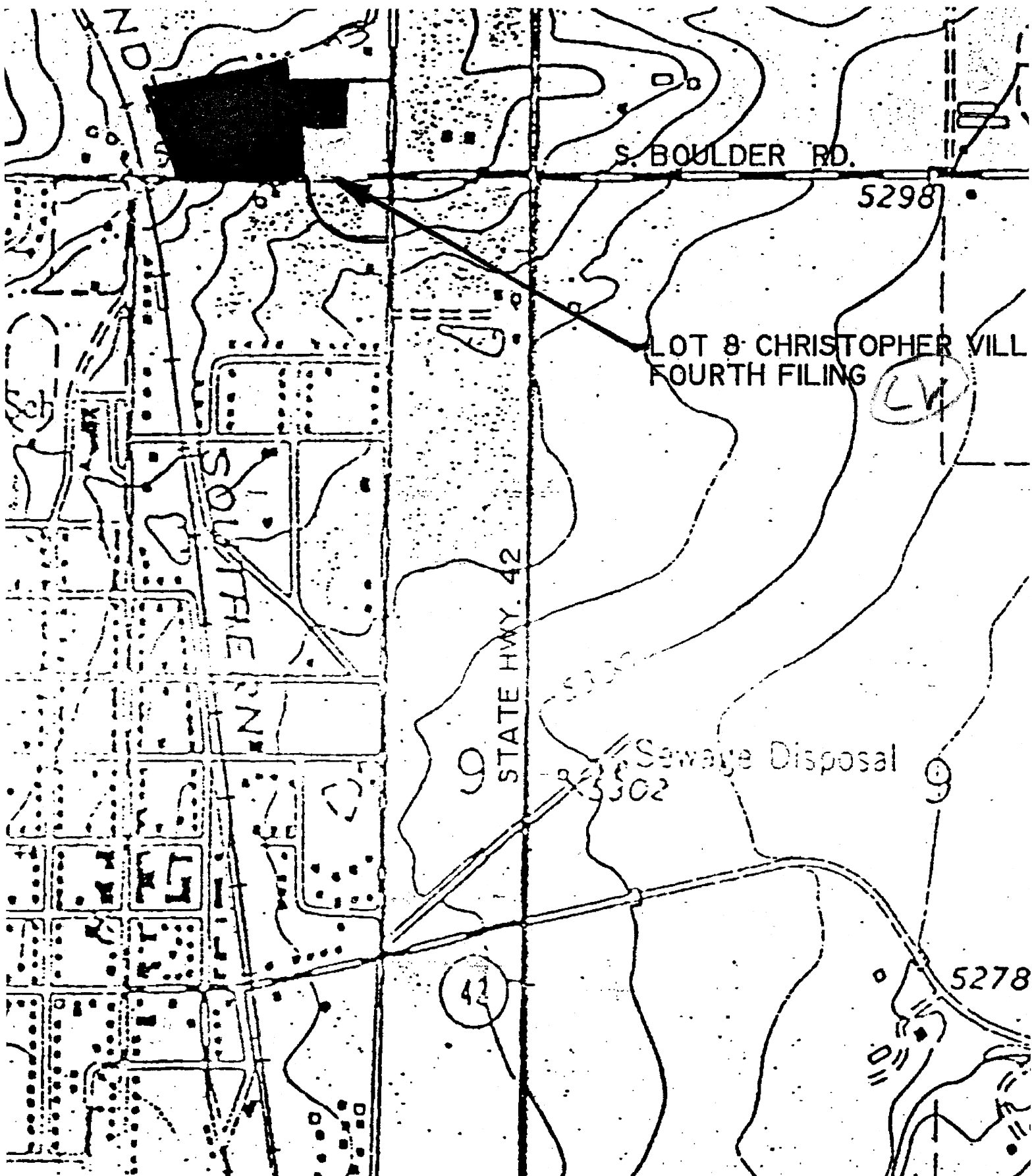
With the additional flow from the Kestrel site, the existing storm sewer system that discharges south of Cannon Circle is undersized. Our analysis of the downstream infrastructure shows that the existing 18 inch main line would need to be upsized to a 24 inch pipe to convey the needed flows for the 100-year event. For details and routing assumptions please see Appendix C. A




OUTLET PLAN
 SCALE: 1"=50'

OFFSITE FLOWS FROM NORTH
(north of South Boulder Road)

CHRISTOPHER VILLAGE (CV)



Project CHRISTOPHER PLAZA - LOT 8
FINAL DRAINAGE

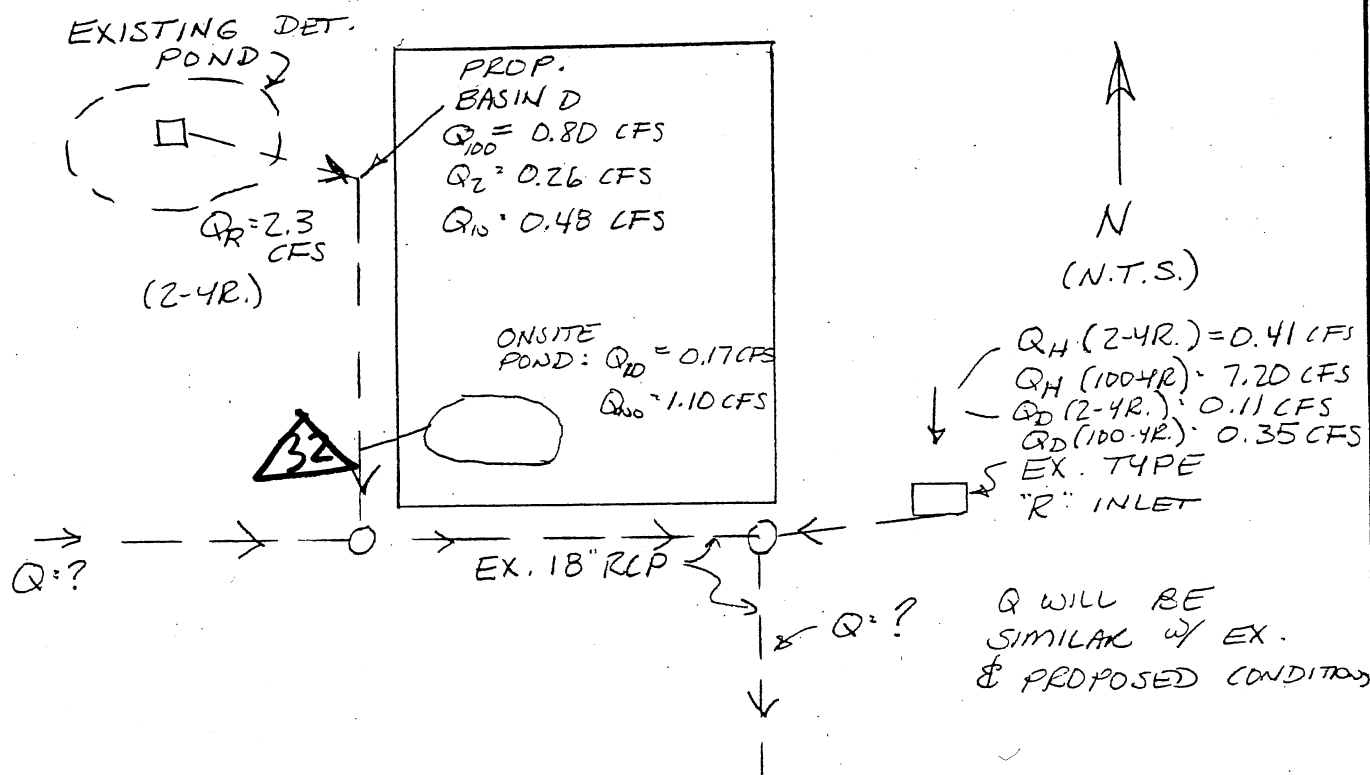
Job No
E-4621

Client HARTRONFT ASSOCIATES

By
RM

Date
5/31/95

COMPARE EXISTING & PROPOSED CONDITIONS @ OUTFALL



COMPARE FLOW TO TYPE "R" INLET & EASTERLY ST.S.

HISTORIC TO INLET FROM SITE (FROM ENTIRE SITE)

$$Q_{2H} = 0.41 \text{ CFS} \quad Q_{100H} = 7.2 \text{ CFS}$$

DEVELOPED FROM SITE TO INLET (BASIN B ONLY):

$$Q_{2D} = 0.11 \text{ CFS} \quad Q_{100D} = 0.35 \text{ CFS}$$

(DEVELOPED < EXISTING TO INLET - OK)

Project	CHRISTOPHER PLAZA - LOT 8 FINAL DRAINAGE		Job No	E-4621
Client	HARTONFT ASSOCIATES	By	RM	Date 5/31/95

COMPARE FLOWS FROM SITE TO WESTERLY
STORM SEWER :

EXISTING OFFSITE DET. POND TO WEST $Q = 2.3$ CFS
(2-4R - 100-YR. SIMILAR DUE TO RESTRICTION)

PROPOSED :

EX. POND TO WEST $Q = 2.3$ CFS

BASIN D. - 100-YR. $Q = 0.8$ CFS

ONSITE POND RELEASE $Q = 1.1$ CFS
(100-YR.)

APPROX. Q_{100} FROM NORTH = 4.2 CFS 
(VS. 2.3 EX.)

DETAILED INFO. ON DESIGN Q & GRADE OF
SOUTH BOULDER ROAD ST.S. NOT AVAILABLE
ESTIMATE CAPACITY BASED ON ROAD SLOPE

$S \approx 1.25\%$ (@ FLATEST PORTION)

$D = 18"$

$n = 0.13$

$\Rightarrow Q \approx 25.3$ CFS (CAPACITY)

SYSTEM CAPACITY RELATIVELY HIGH WITH RESPECT
TO SITE Q - DIFFERENCE SHOULD NOT BE
SIGNIFICANT.

TOTAL Q FROM SITE :

HISTORIC - $Q_{2H} = 0.41$ CFS $Q_{10H} = 2.11$ CFS

$Q_{100H} = 7.2$ CFS

$\left\{ \begin{array}{l} \text{DEVELOPED - } Q_{10} = 0.45 \text{ CFS (POND)} + 0.48 \text{ (D)} + 0.21 \text{ (B)} \\ Q_{10} = 1.14 \text{ CFS} \\ Q_{100} = 1.10 \text{ CFS (POND)} + 0.80 \text{ (D)} + 0.35 \text{ (B)} \\ Q_{100} = 2.25 \text{ CFS} \end{array} \right.$
 < HIST. FOR ALL CONDITIONS

FINAL DRAINAGE REPORT
FOR
CHRISTOPHER PLAZA - LOT 8
LOUISVILLE, COLORADO

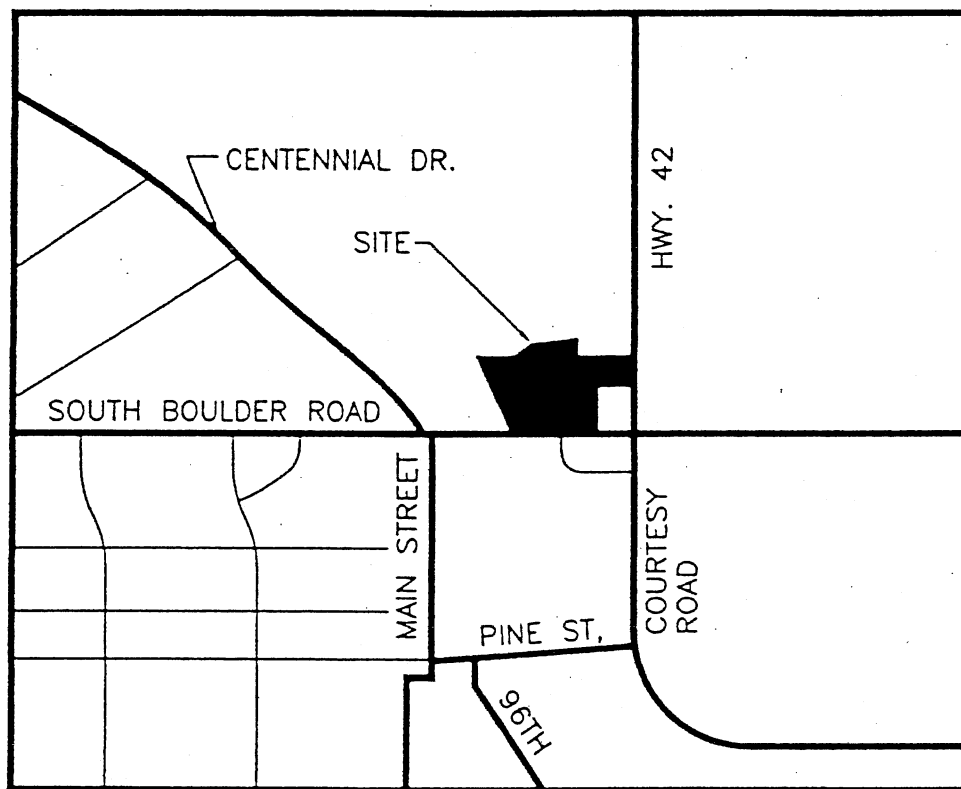
Prepared By:

Drexel Barrell & Co.
4840 Pearl East Circle, Suite #114
Boulder, Colorado 80301
(303) 442-4338

Prepared For:

Hartronft Associates
1021 South Boulder Road, Suite J
Louisville, Colorado 80026
(303) 673-9304

Date: April 28, 1995
Rev: May 31, 1995
Rev. October 10, 1995
Job No.: E4621



VICINITY MAP

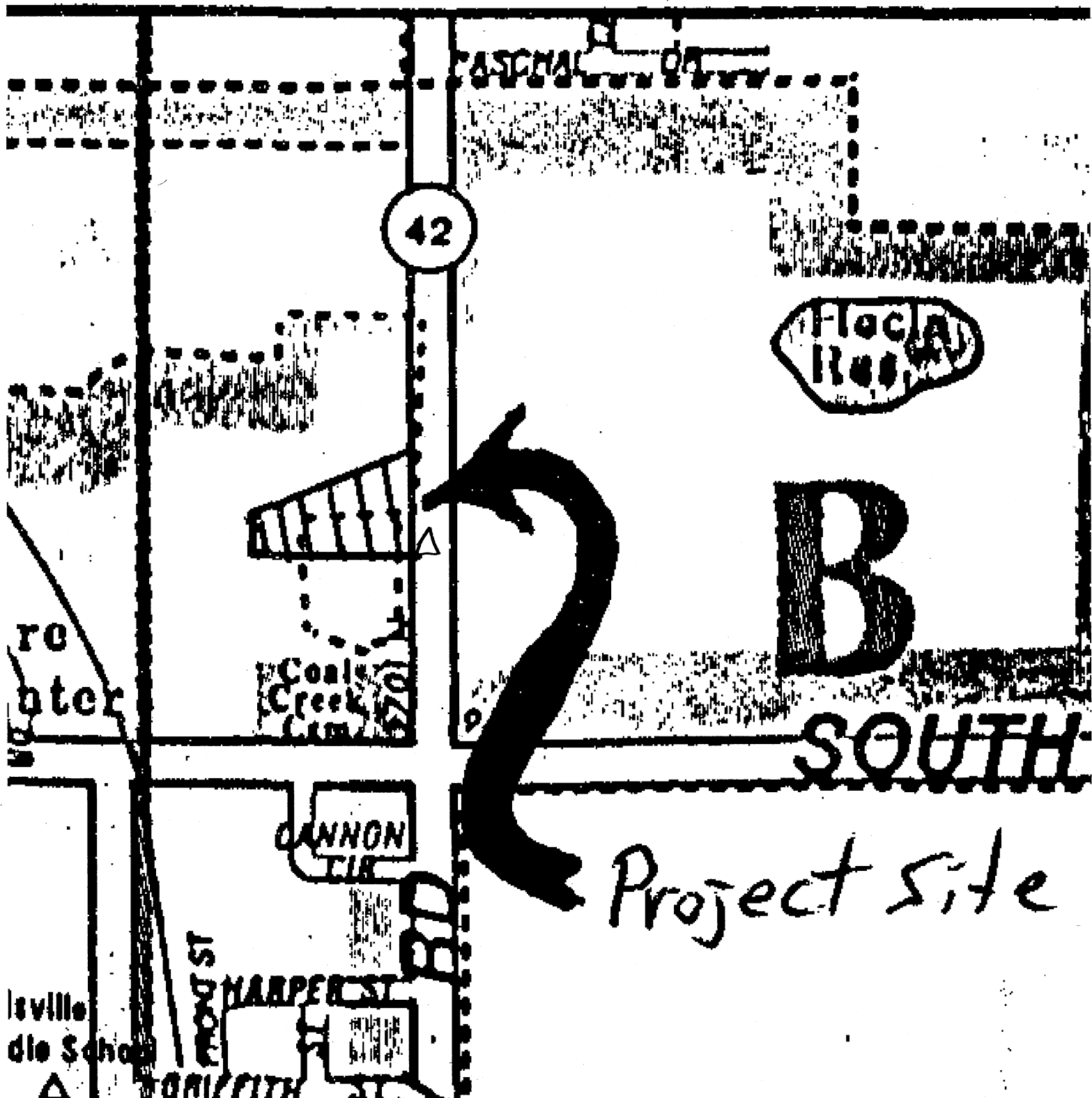
NTS

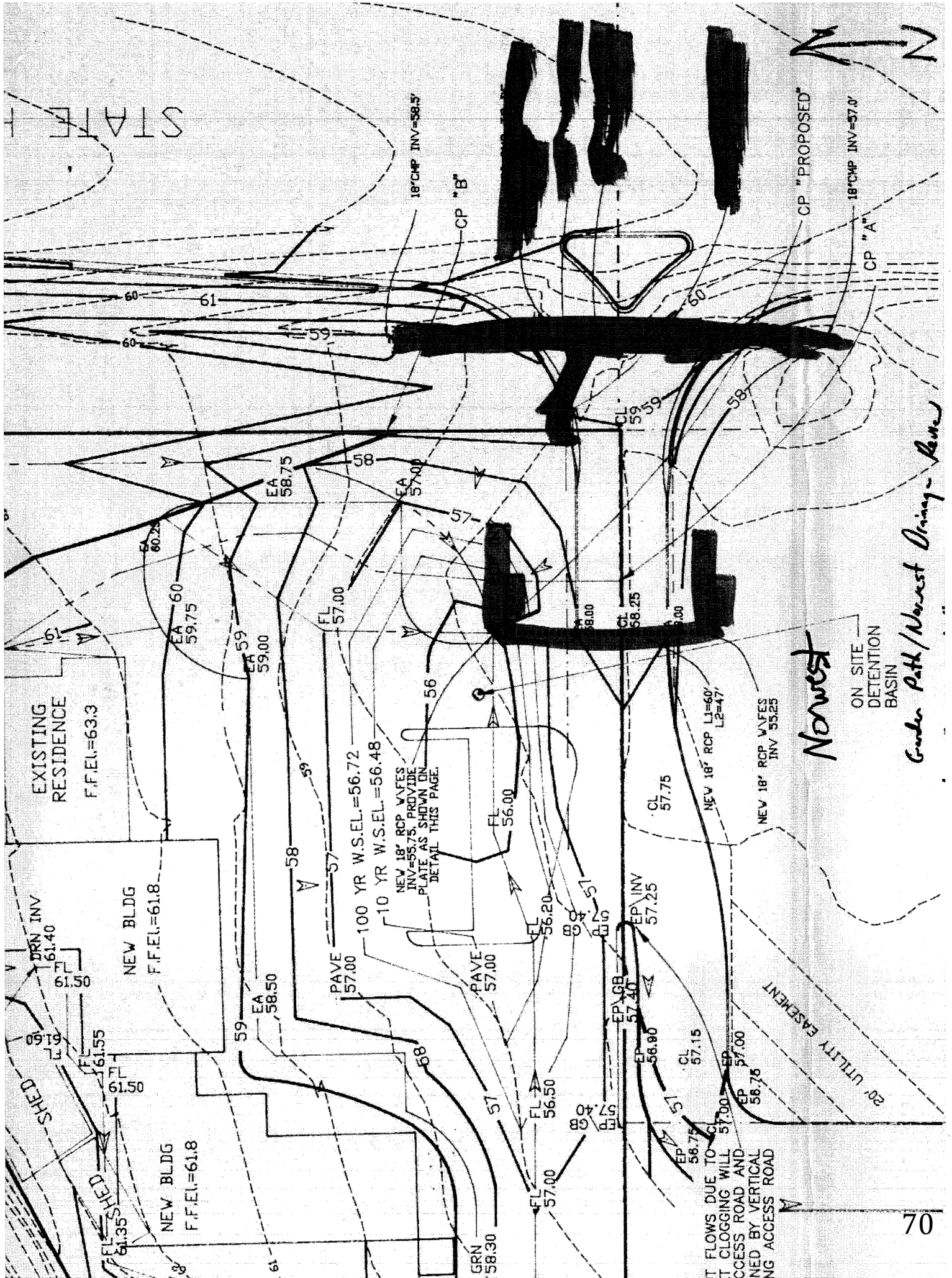
OFFSITE FLOWS FROM NORTH
(north of South Boulder Road)

GARDEN CITY (GC)

CPII or → Garden City
1994

$\Delta = 2ch$





OFFSITE FLOWS FROM NORTH
(north of South Boulder Road)

NORWEST (NW)



**ACKLAM
ASSOCIATES, INC.**

SURVEYING - ENGINEERING

**FINAL
DRAINAGE STUDY
NORWEST BANK**

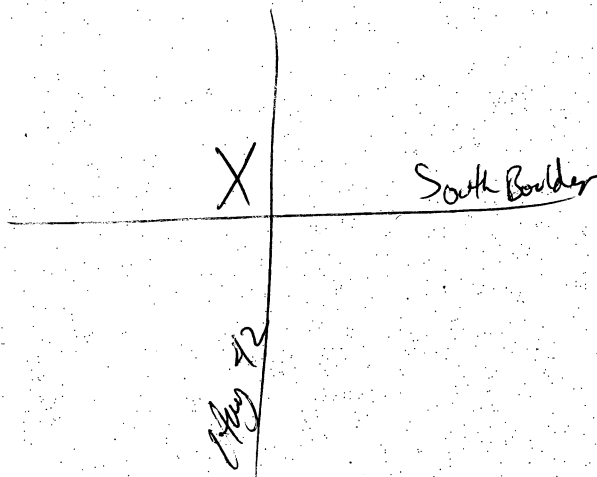
NW

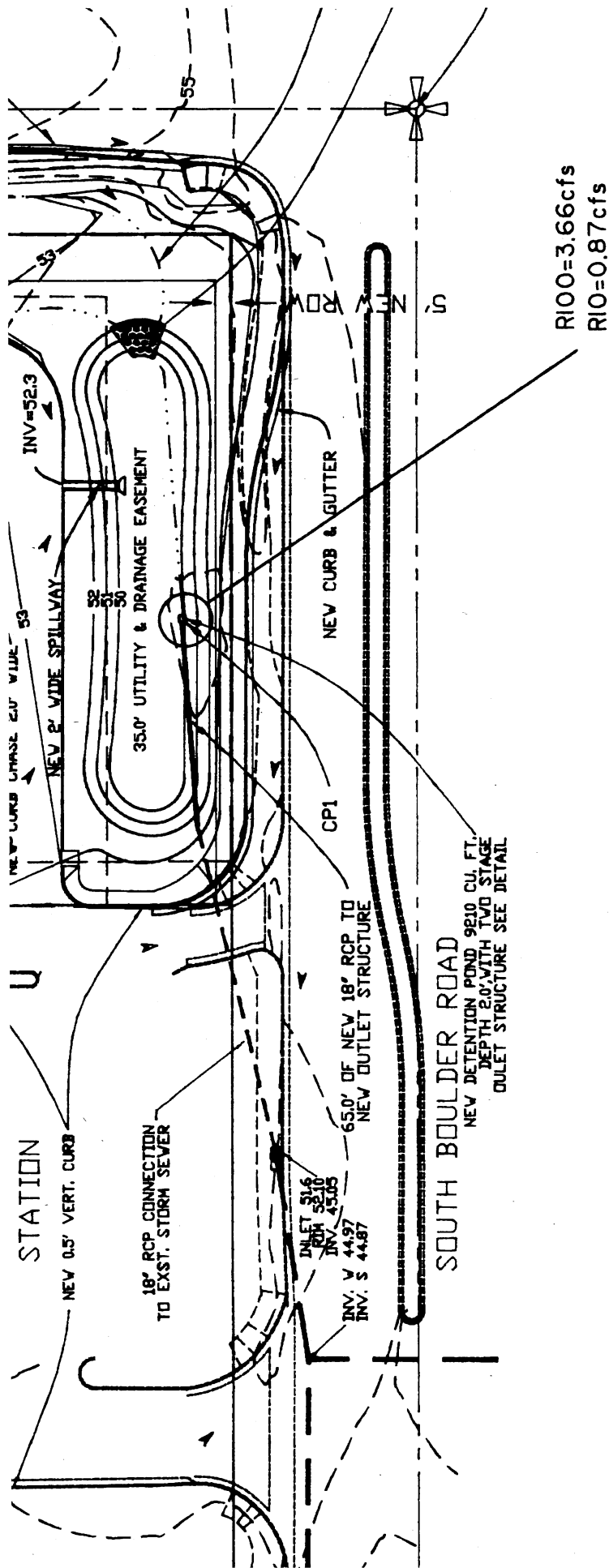
**LOUISVILLE, COLORADO
BOULDER COUNTY**

**APRIL 14, 1994
REVISED: SEPT. 7, 1994**

PROJECT NO. 4120

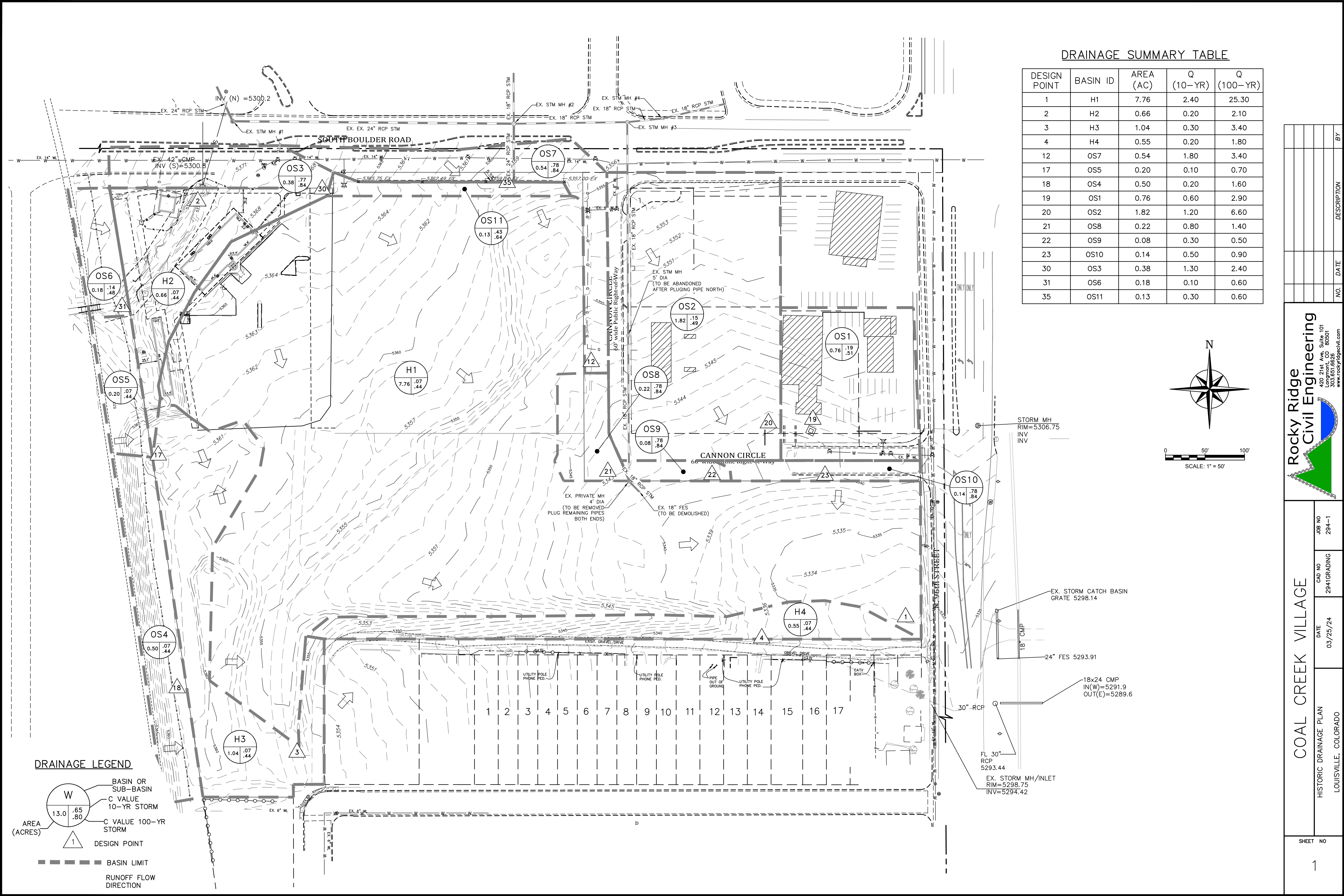
$\Delta = 3.66 \text{ cfs}$





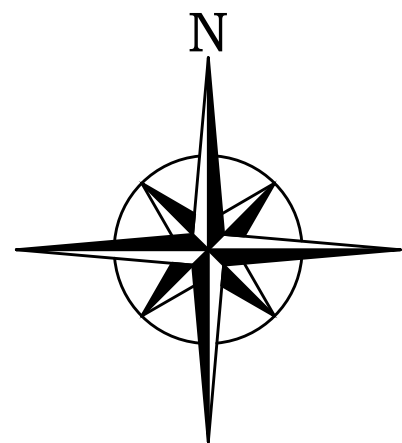
Planners	PROJECT NORWEST BANK SITE LOUISVILLE, CO.	SHT. NAME DRAINAGE
--	---	----------------------------------

PRELIMINARY DRAINAGE PLAN



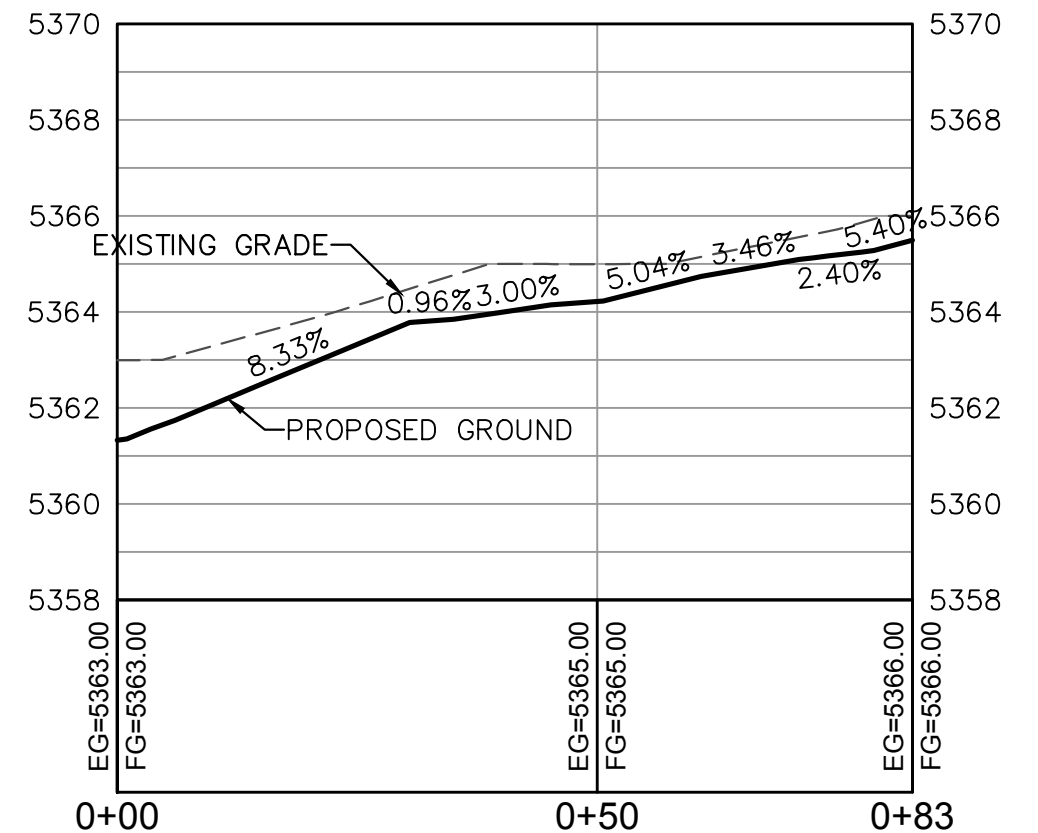
LEGEND

- 5075----- EXISTING 5' CONTOUR
-----5074----- EXISTING 1' CONTOUR
-----5075----- PROPOSED 5' CONTOUR
-----5074----- PROPOSED 1' CONTOUR

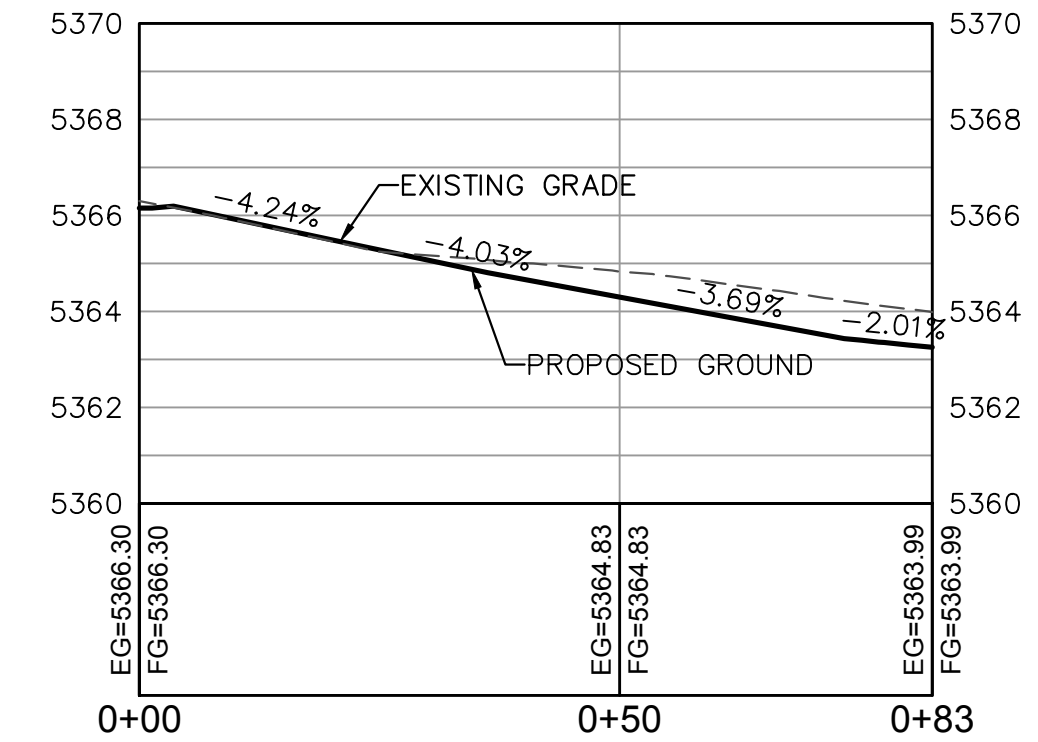


DRAINAGE SUMMARY TABLE

Design Point	Basin	Area	Q (10-yr)	Q (100-yr)
1	P	0.60	1.9	3.6
3	A	0.63	2.0	3.7
4	B	0.37	1.2	2.2
6	C	0.48	1.5	2.8
8	D	0.95	3.0	5.6
7	E	0.61	1.9	3.6
9	F	0.77	2.4	4.6
11	I	1.06	3.3	6.3
12	OS7	0.54	1.8	3.4
13	J	0.30	0.9	1.8
14	K	1.30	4.1	7.7
16	M	0.15	0.5	0.9
17	OS5	0.20	0.1	0.7
18	OS4	0.50	0.2	1.6
19	OS1	0.76	0.6	2.9
20	OS2	1.82	1.2	6.6
21	OS8	0.22	0.8	1.4
22	OS9	0.08	0.3	0.5
23	OS10	0.14	0.5	0.9
24	N3	0.10	0.3	0.6
25	N2	0.27	0.9	1.6
26	N1	0.10	0.3	0.6
28	Q	0.76	2.4	4.5
29	G	1.30	4.1	7.7
30	OS3	0.38	1.3	2.4
31	OS6	0.18	0.1	0.6
35	OS11	0.13	0.3	0.6

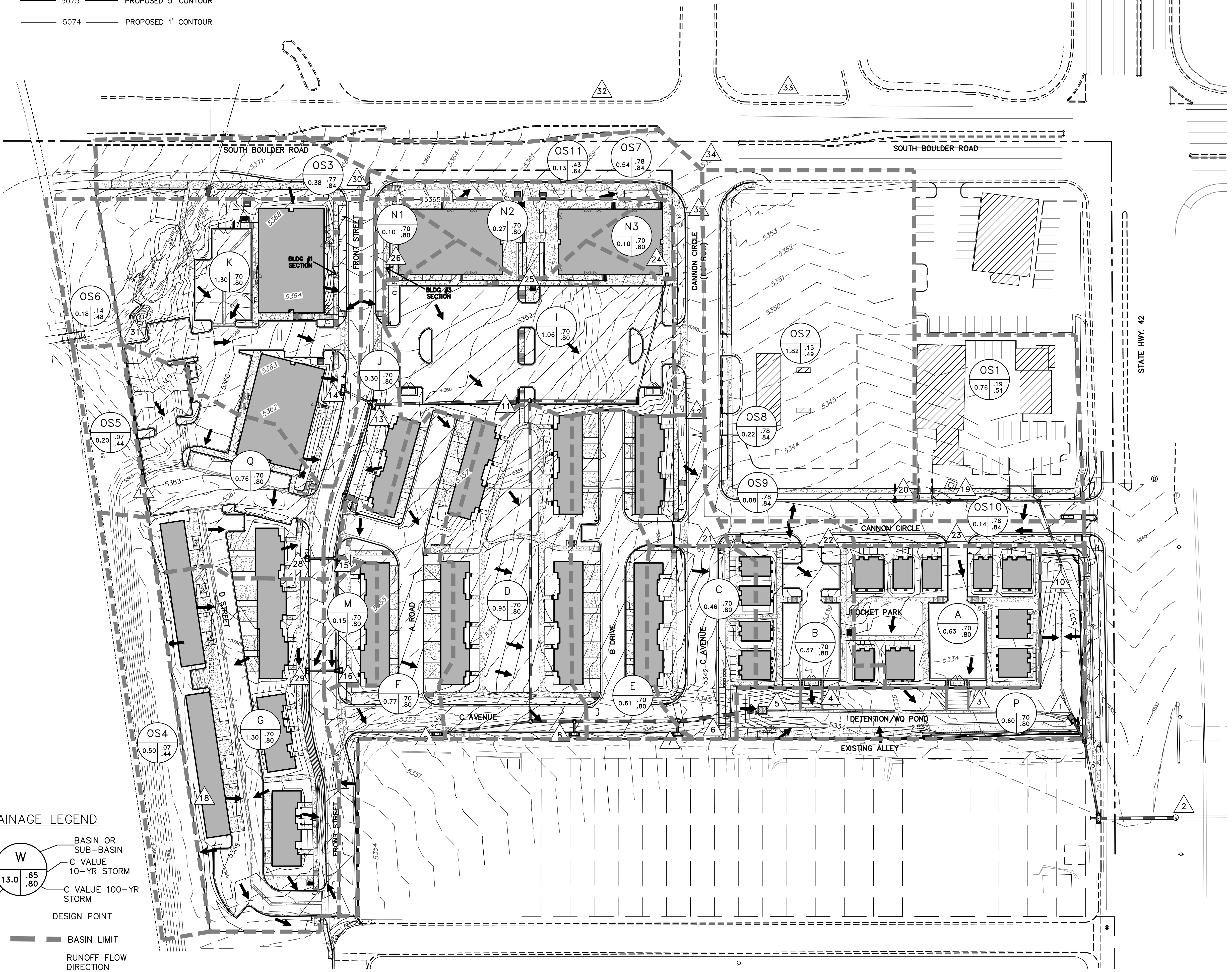
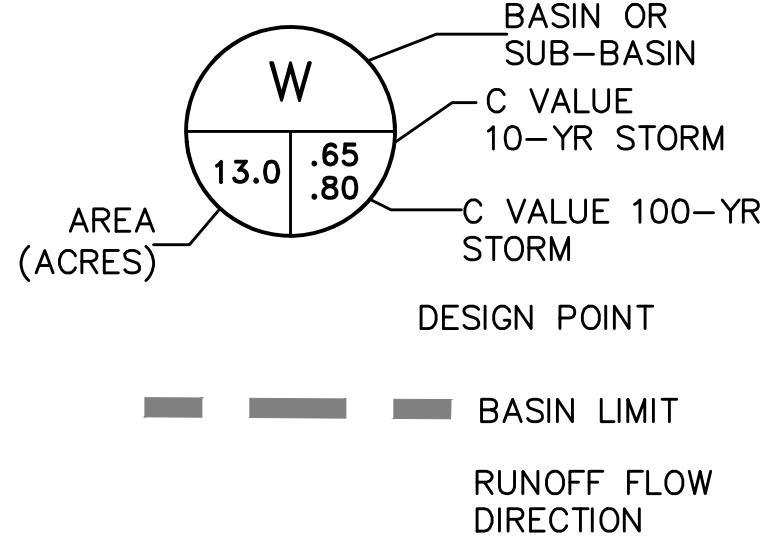


Ramp Bldg #1 PROFILE
SCALE: (H) 1" = 10.00' (V) 1" = 2.00'
START STA: 0+00.00, END STA: 0+82.79



Ramp Bldg #3 PROFILE
SCALE: (H) 1" = 10.00' (V) 1" = 2.00'
START STA: 0+00.00, END STA: 0+82.53

DRAINAGE LEGEND



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

COAL CREEK VILLAGE
DRAINAGE & GRADING PLAN
PRELIMINARY PUD
LOUISVILLE, COLORADO

NO.	DATE	DESCRIPTION	BY