Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930
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Building Safety & Inspection Services Team

M E M O

TO: Pete L'Orange, Planner II
FROM: Michelle Huebner, Plans Examiner Supervisor
DATE: February 2, 2023

RE: Referral Response, Docket SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects: Areas and Activities of State Interest (1041) review for combined projects along Colorado Highway 119 (CO 119) related to safety and mobility improvements and construction of a bikeway from approximately 47th Street/Foothills Parkway in the City of Boulder to milepost 54.2 in the City of Longmont.

Location: Colorado Highway 119 (CO 119) from approximately 47th Street/Foothills Parkway, Boulder, to milepost 54.2, Longmont, in Sections 2, 3, 9, 10, 11, 15, and 16 of T1N, R70W; Sections 25, 35, and 36 of T2N, R70W; and Sections 17, 19, 20, and 30 of T2N, R69W.

Thank you for the referral. We have the following comments for the applicants:

1. **Building Permits.** Building permits and grading permits, plan review and inspection approvals are required for all structures and grading per the adopted building code, including but not limited to; bridges, underpasses, retaining walls and grading. Except if reviewed and permitted through another Authority having Jurisdiction (AHJ), such as the State of Colorado.

   Construction documents must be stamped, signed and sealed by the State of Colorado design professional.

   Please refer to the county's adopted 2015 editions of the International Codes and code amendments, which can be found via the internet under the link:

   2015 Building Code Adoption & Amendments, at the following URL:
   Amendments to Boulder County Building Code effective June 6, 2022

   The Commercial Plan Submittal Checklist: B70 Commercial Plan Checklist (bouldercounty.gov)

2. **Accessibility**. Chapter 11 of the IBC and referenced standard ICC A117.1-09 provide for accessibility for persons with disabilities. Any building permit submittals are to include any applicable accessibility requirements, including accessible parking, signage, accessible routes and accessible fixtures and features.

3. **Design Wind and Snow Loads.** Boulder County is a special wind region with several incremental zones as outlined in the Boulder County Building Code Amendments, https://assets.bouldercounty.org/wp-content/uploads/2017/03/building-code-2015.pdf. To obtain the design wind and ground snow loads for the property please email the plan review team at building@bouldercounty.org or call 720-564-2640.

4. **Ignition-Resistant Construction and Defensible Space.** Please refer to Section R327 of the Boulder County Building Code for wildfire hazard mitigation requirements, including ignition-resistant construction and defensible space. A separate referral response will be forthcoming from one of the county's wildfire mitigation specialists**.**

   Plan Review. The items listed above are a general summary of some of the county's building code requirements. A much more detailed plan review will be performed at the time of building permit(s) application, when full details are available for review, to assure that all applicable minimum building codes requirements are to be met.

If the applicants should have questions or need additional information, we'd be happy to work with them toward solutions that meet minimum building code requirements. Please call (720) 564-2640 or contact us via e-mail at building@bouldercounty.org

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February 16, 2023

TO: Pete L'Orange, Planner II; Community Planning & Permitting, Development Review Team - Zoning

FROM: Anita Riley, Principal Planner; Community Planning & Permitting, Development Review Team – Access & Engineering

SUBJECT: Docket # SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

The Development Review Team – Access & Engineering staff has reviewed the above referenced docket and has the following comments:

General

1. This application involves a multi-agency proposal intended to provide intersection and transit improvements along the CO 119 corridor between the Cities of Boulder and Longmont. A 9-mile bicycle facility is proposed in the same corridor. Additional intersection safety improvements are being considered at various intersections along the corridor and will be determined at a time later in the process.

2. The proposal is supported by various policies in the *Boulder County Comprehensive Plan* (BCCP), including but not limited to:

   a. TR 1.03 Enhance the Bicycle and Pedestrian Network;

   b. TR 1.05 Establish Connections to Development;

   c. TR 1.06 Support Transit Service;

   d. TR 2.02 Facilitate Project Collaboration;

   e. TR 3.01 Prioritize Travel Corridors;

   f. TR 3.02 Prioritize Operations Over Construction;

   g. TR 4.01 Reduce Single-Occupant-Vehicle Travel; and

   h. TR 4.02 Increase Person Capacity.

3. The proposal, or components of it, are identified in the *CDOT FY 2023-FY 2026 Statewide Transportation Improvement Program*, *CDOT 10-Year Plan*, and *Regional Transportation District (RTD) 2050 Metro Vision Regional Transportation Plan*.

4. Nearly all of the improvements proposed in this application are located within the Colorado Department of Transportation (CDOT) right-of-way where CDOT and Federal Highway Administration (FHWA) regulations and requirements supersede Boulder County requirements. As a result, a narrowed scope of engineering review was determined by the Boulder County Public Works Department and CDOT. This review has generally been

contained to those components of the project that are under Boulder County's purview. Where this is not the case, observations and recommendations have been made.

5. While the proposal supports the transportation goals identified in the *Greenhouse Gas (GHG) Pollution Reduction Roadmap* (Roadmap) released by the Colorado Energy Office, a key step in achieving GHG reduction targets in the transportation sector involves the shift to electric vehicle. The applicants should consider the installation of EV charging stations at the 63rs Street and Niwot Road RTD Park and Ride locations to further the goals found in the Roadmap.

Grading

6. There is a portion of grading at or near Station 1031+00 that extends beyond the CO 119 right-of-way. An easement will be required at this location.

Water Resources

7. A consulting engineer from Wright Water Engineers (WWE) provided extensive comments on the drainage studies and plans. The comments are summarized below. Original comments can be found in the attached documents.

Comments for Application Packet

8. Under Section 3.2.2.3, WWE commented on manner in which storm events of various sizes were characterized.

9. Under Section 3.2.2.3, WWE confirmed the approach to review is consistent with their understanding.

RTD Park and Ride Niwot Road and 63rd Street CO 119 Safety and Mobility Improvement Preliminary Drainage Report

10. On the cover page of the Drainage Report, the following major comments were provided:

    a. For FSD ponds, forebays are needed for all concentrated inflows. Please provide design information for forebays or equivalent measures such as a hydrodynamic separator in the next design submittal.

    b. It is unclear if micropools will be provided based on the drawings. If an alternative approach is used to keep small orifices from clogging, please describe and justify the approach.

    c. Design of initial surcharge volume (ISV) and trickle channel is needed in the next submittal.

    d. Need to show spillways and emergency overflow paths in the next design submittal, including freeboard along the emergency overflow path in the event that the outlet becomes plugged. Spillways should be designed for fully developed pond inflows.

11. Additional comments are made throughout the report that may be valuable to water resource engineers as they finalize the report and drainage design. A copy of the annotated pages in the report is attached for reference.

Highway Construction Bid Plans of Proposed CO 119 Bikeway

12. On page 158, WWE noted that more information is needed for the pond features including forebays, trickle channels, initial surcharge volumes, micropools, spillways and emergency overflow paths

CO 119 Bikeway Preliminary Drainage Report

13. On the cover page of the Drainage Report, the following major comments were provided:

    a. The Rational method is only applicable up to 90 acres. This report states 200 acres, which is too large for use of the Rational Formula. This only appears to affect one basin X1029R. Could this basin be subdivided? If not, please provide justification for using the Rational method beyond the published limit. If it is just slightly higher, it appears this can be justified if there is not routing that would affect peak flows.

    b. Table 4 provides a comparison of existing and proposed peak flow rates and shows increases at some design points. However, this report does not discuss in detail nor provide calculations for how flows will be detained to existing levels when the increases exceed 1 cfs. Please add this information to the report and show that flows will be adequately detained.

14. Additional comments are made throughout the report that may be valuable to water resource engineers as they finalize the report and drainage design. A copy of the full annotated report is attached for reference.

Traffic

1. No capacity improvements to the CO 119 corridor are planned. The application proposes improvements to the Level of Service for multi-modal transportation along the corridor by improving transit times and signal timing. While these improvements will likely negatively impact Level of Service for county roads at the point they intersect the State Highway, they also are supported by BCCP policies listed above.

2. The traffic study is more a summary of the methodology used rather than a traffic study itself. Staff requests that quantitative traffic study information be submitted for review. As the focus of this review is on the impact to the county system, it is acceptable to submit only that portion of the study that speaks to traffic impacts to the county transportation system, including impacts to freight, bicycle, and pedestrian traffic. The study should include evaluation of existing and future conditions and accident history and evaluation of safety. It should employ person-based calculations in accordance with Policy TR 4.03, Make Balanced Multimodal Decisions, in the BCCP.

3. The applicants should evaluate and identify any barriers in the pedestrian environment for elderly and sight- and mobility-impaired users. Barriers may include, but are not limited to, the number of lanes at pedestrian crossings, such as at the west side of CO 52; the length of time for crossing signals; the distance from a parking area to the boarding area; and signage and wayfinding.

This concludes our comments at this time.

CO 119 Safety and Mobility Improvements Project

and

CO 119 Bikeway Project

1041 APPLICATION

December 2022

Prepared For:

Boulder County

COLORADO Department of Transportation Region 4

RTD

Prepared By:

CDOT Region 4 Environmental Unit, Greeley, CO

The Project will result in local increases of impervious surface area at all five intersections, with corresponding increases in surface runoff flow rates and amounts. These local increases will not change the larger design flows at any of the regulated flood hazard areas.

3.2.2.2 Map and describe all surface water, including applicable state water quality standards, to be affected by the project

See Figure 6 for delineation of basins draining to various Colorado Department of Public Health and Environment (CDPHE) designated stream segments throughout the corridor. Per CDOT and Boulder County's respective Municipal Separate Storm Sewer System (MS4) permits, it is anticipated that permanent water quality requirements will not be applicable to the detached trail portion of the bikeway. Portions of the trail that are attached to streets for connections to surrounding intersections will be included in the roadway permitting as described in the
n below. The 30 percent drainage report contains full details on the MS4 criteria and on
standards for stormwater quality during construction (Appendix 1 – CO 119 Project
Report(s)).

I would not consider a 5- or 10-year event "average." These are the "minor" events, but "average" has a different meaning. Even 5- or 10-year floods are infrequent. In addition, the 100-year is not "worst case" because there will be larger events. Please refer to this as the "major" storm or the FEMA regulatory design event. Below the "worst case" is referred to as an event greater than the 100-year storm.

for the Mobility Project is within CDOT ROW; the applicable construction stormwater
anent water quality standard is CDOT's MS4 permit issued July 28, 2015. Based on
it, permanent water quality requirements may be triggered for the portions of the
at drain to Left Hand Creek. The 30 percent drainage report contains full details on the
eria and on CDPHE standards for stormwater quality during construction.

Describe the immediate and long-term impact and net effects that the activity will have on the quantity and quality of surface water under both average and worst-case scenarios

of surface water runoff quantity, the project will include a local increase in impervious
rea, with corresponding increases in surface runoff flow rates and amounts. The
ry evaluation included estimated flood frequency flow rates for 5- to 10-year events to
"average" conditions, and for less frequent 100-year events to consider "worst-case"
s.

significant areas of increase correspond to two proposed park-n-ride sites. The
ry design proposed two full spectrum detention ponds to address concentrated runoff
rom the two new park-n-ride facilities. The full spectrum detention concept includes
design for certain "worst case" events such as an event greater than a 100-year storm,
ario with a blocked pond outlet.

Outside of the park-n-ride facilities, no additional runoff mitigation was shown in the preliminary design documents. Additional mitigation is proposed with final design where appropriate. These areas consist of the following:

- The Mobility Project includes an increase in impervious areas on the order of 10 to 15 percent more pavement.
- The Bikeway Project includes an increase in impervious areas on the order of 15 to 20 percent more pavement.
- These increases are distributed over many separate discharge points and are not released to a single outfall.

This approach is consistent with our past discussions.

The Project engaged the 1041 review referral personnel at Boulder County in September 2022 to confirm the approach for these areas going into final design (Appendix 2). The following approach was identified:

- The local increases will be reviewed for impacts to downstream facilities, properties or communities.
- Existing pervious receiving areas are present. These areas may serve to mitigate parts of the proposed pavement and will be presented on a case-by-case basis at final design. For example, if a disconnected impervious area drains to a receiving area twice the size of the impervious area, it will not require further mitigation.
- Small, minimal runoff areas could be acceptable with no additional stormwater facilities. For example, areas that increase the flow less than 1 cubic foot per second and do not present a hazard to the receiving facilities will not require further mitigation.
- Other numerical increases in runoff will be evaluated on a case-by-case basis to identify the potential for impacts and net effects on surface water.
- Any impacts identified as significant, following the approach in the previous bullet points, will be mitigated by providing drainage facilities such as detention ponds, soil amendments for infiltration, or bioretention/rain gardens.
- Provide permanent water quality treatment facilities in accordance with CDOT's MS4 permit, where applicable.

Construction Related Water Quality

The Project proposes to address surface water quality concerns through the following approach:

- Maintain existing patterns of runoff.
- Manage changes in stormwater runoff flows as described above.
- The Project will obtain and comply with a state-issued Stormwater Construction Permit
- A Stormwater Management Plan (SWMP) and SWMP Site Maps are required per the CDOT Stormwater Construction Permit. These documents will be included with the final construction documents. *CDOT Standard Specifications for Road and Bridge Construction*, dated 2022 (CDOT 2022d), include contractual requirements for erosion and sediment control, which are implemented on all projects and are compliant with the Stormwater Construction Permit. CDOT Specifications that are required include: *Section 208 - Erosion Control, Section 212 - Seeding, Fertilizer, Soil Conditioner, and Sodding, Section 213 – Mulching, and Section 216 – Soil Retention Covering*.
- CDOT MS4 permit requires CDOT to audit construction projects for Stormwater Construction Permit compliance. With written permission from each jurisdiction, it is anticipated that CDOT will also audit the areas outside of the CDOT ROW for MS4 permit compliance.

3.2.2.4 Map and describe all groundwater, including aquifers. Describe impacts and net effect of the activity on groundwater

Groundwater measurements were collected in April 2022 at seven locations along the corridor as part of the Project's geotechnical engineering analysis. These locations coincide with the

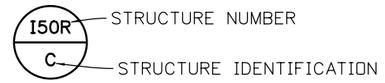
See comments in preliminary drainage report and included plan sheets related to FSD ponds

Need more details on pond features including forebays, trickle channels, initial surcharge volumes, micropools, spillways and emergency overflow paths in next submittal.

DRAINAGE GENERAL NOTES

1. THE MANUFACTURER'S JOINT TOLERANCE FOR ALL PIPE TYPES USED SHALL BE SUPPLIED TO THE ENGINEER. FOR DEFLECTIONS GREATER THAN THE MANUFACTURER'S TOLERANCE, A CONCRETE PIPE COLLAR SHALL BE USED PER THE DRAINAGE DETAIL SHEETS. CONCRETE PIPE COLLARS SHALL BE USED FOR EXISTING PIPE TO PROPOSED PIPE CONNECTIONS. THE COST OF THE CONCRETE PIPE COLLAR SHALL BE INCLUDED IN THE COST OF THE WORK.
2. THE "PIPE CONNECTION" DETAIL SHALL APPLY TO ALL PIPE CONNECTIONS TO PROPOSED PRECAST CONCRETE STRUCTURES AND EXISTING STRUCTURES. THE COST OF THE PIPE CONNECTION SHALL BE INCLUDED IN THE COST OF THE WORK.
3. RUBBER GASKETS SHALL BE USED FOR ALL RCP JOINTS IN ACCORDANCE WITH ASTM C443. THE COST OF ALL JOINT GASKETS SHALL BE INCLUDED IN THE COST OF THE WORK.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING PIPE SIZES, LENGTHS AND LOCATIONS PRIOR TO ORDERING AND DELIVERY OF THE PIPE MATERIAL TO THE SITE.
5. ALL PIPES SHALL BE REINFORCED CONCRETE PIPE (RCP) UNLESS OTHERWISE SPECIFIED. ALL RCP SHALL BE A MINIMUM OF CLASS III (STRENGTH) UNLESS A HIGHER CLASS IS REQUIRED BY CDOT M&S STANDARD M-603-2.
6. ALL END SECTIONS MUST BE INSTALLED WITH JOINT FASTENERS. IN ADDITION, JOINT FASTENERS SHALL BE INSTALLED ON ALL PIPE JOINTS WITHIN 15-FEET OF THE DOWNSTREAM END OF ALL CULVERTS. (INCLUDING END SECTION LENGTH, IF APPLICABLE).
7. STRUCTURE BACKFILL (FLOW-FILL) PER CDOT STANDARD 206.02 SHALL BE USED IN PLACE OF STRUCTURE BACKFILL (CLASS 1) FOR STORM DRAINS THAT ARE LOCATED UNDER ROADWAYS AND HAVE 2 FEET OR LESS OF COVER FROM TOP OF FINISHED SUBGRADE TO TOP OF PIPE. FLOW-FILL WILL NOT BE PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE COST OF THE PIPE.
8. OTHER UTILITIES MAY BE CROSSED OR OTHERWISE IMPACT STORM DRAIN CONSTRUCTION. CONTRACTOR SHALL PROTECT EXISTING UTILITIES IN PLACE. UNLESS NOTED OTHERWISE, PROTECTION OF EXISTING UTILITIES, INCLUDING INCIDENTAL SHORING THAT IS NOT INCLUDED AS A PAY ITEM, WILL NOT BE MEASURED SEPARATELY, BUT SHALL BE INCLUDED IN THE COST OF THE WORK.
9. RIPRAP IS SHOWN ON THE PLAN SHEETS, AND DRAINAGE DETAILS. FILTER MATERIAL (CLASS A) IS REQUIRED BENEATH RIPRAP IN LIEU OF GEOTEXTILE UNLESS OTHERWISE SPECIFIED.
10. THE TOP PORTION OF INLETS AND MANHOLES SHALL FIT THE LONGITUDINAL PROFILE SLOPE AND TYPICAL SECTION REQUIREMENTS. THE CONTRACTOR SHALL CROSS REFERENCE THIS INFORMATION PRIOR TO CONSTRUCTING INLETS AND MANHOLES TO FINAL GRADE.
11. STATION/OFFSET INFORMATION FOR TYPE C INLETS, TYPE D INLETS, AND TYPE 13 INLETS IS TO THE CENTER OF THE STRUCTURE.
12. STATION/OFFSET INFORMATION FOR MANHOLES (SLAB BASE AND BOX BASE) IS TO THE CENTER OF THE STRUCTURE.
13. FOR MANHOLES, RING AND COVER SHALL ALLOW FOR MANHOLES STEPS TO EXTEND TO THE BOTTOM OF THE STRUCTURE.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DEWATERING AND DIVERSION INCLUDING, BUT NOT LIMITED TO, LIVE STREAM FLOW AND GROUNDWATER AND OBTAINING THE APPLICABLE DEWATERING PERMITS FOR CONSTRUCTION AT THE SITE. THIS WILL NOT BE PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT REQUIREMENTS.

DRAINAGE LEGEND:



STRUCTURE IDENTIFICATION	STRUCTURE TYPE
C	CDOT TYPE C INLET (CLOSE MESH)
D	CDOT TYPE D INLET
EX	EXISTING STRUCTURE (TYPE AS NOTED)
FES	FLARED END SECTION
HW	HEADWALL
IRR	IRRIGATION
MHX	MANHOLE SLAB BASE (X DIAMETER)
PC	PIPE CONNECTION
PS	PUMP STATION
13	TYPE 13 INLET

PROPOSED DRAINAGE DITCH

PROPOSED DRAINAGE PIPE

PROPOSED IRRIGATION PIPE

100YR — 100-YR FLOODPLAIN

All seals for this set of drawings are applied to the cover page(s)

Print Date: 6/28/2022
File Name: 500_21015_HY_Gen Notes.dgn
Horiz. Scale: 1"=100' Vert. Scale: As Noted
Unit Information

MULLER ENGINEERING COMPANY

Sheet Revisions

Date:	Comments	Init.

Boulder County

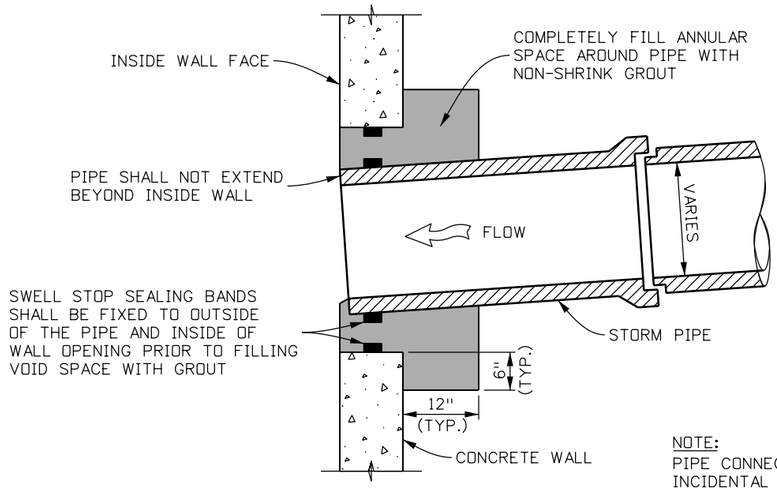
As Constructed
No Revisions:
Revised:
Void:

CO 119 BIKEWAY
DRAINAGE NOTES

Designer: ACF
Detailer: PDP
Sheet Subset: DRN
Structure Numbers:
Subset Sheets: 1 of 1

Project No./Code

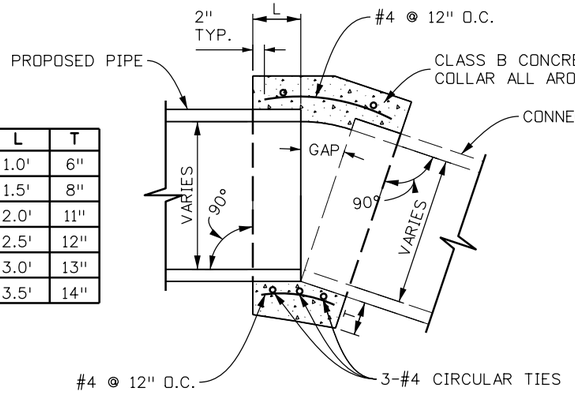
Sheet Number 158



NOTE:
PIPE CONNECTION INCIDENTAL TO COST OF PIPE.

PIPE CONNECTION DETAIL

(EXISTING AND PRECAST WALLS)
NOT TO SCALE



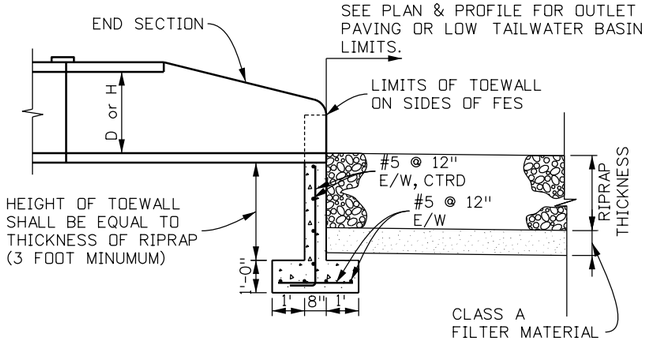
PIPE SIZE	L	T
12"-24"	1.0'	6"
30"-42"	1.5'	8"
48"-60"	2.0'	11"
66"-78"	2.5'	12"
84"-96"	3.0'	13"
102"-114"	3.5'	14"

NOTES:

1. CONCRETE COLLAR WORK SHALL BE INCLUDED IN THE COST OF PIPE.
2. FOR STRAIGHT CSP EXTENSIONS, CONTRACTOR MAY SUBSTITUTE APPROVED CSP BAND FOR CONCRETE COLLAR

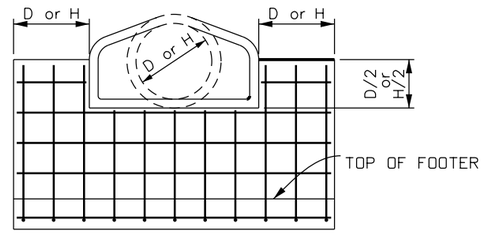
CONCRETE PIPE COLLAR

NOT TO SCALE



TOEWALL DETAIL

NOT TO SCALE



NOTES:

1. TOEWALL SHALL BE USED FOR ALL FLARED END SECTIONS 36" OR LARGER.
2. BACKFILL BOTH SIDES OF WALL EVENLY (WITHIN 1'-0" OF EACH OTHER).
3. JOINT FASTENERS SHALL BE INSTALLED ON ALL FLARED END SECTIONS.
4. TOEWALL AND ALL ASSOCIATED WORK SHALL BE PAID FOR AS CONCRETE CLASS D (WALL) AND REINFORCING STEEL (EPOXY COATED).
5. STRUCTURE EXCAVATION AND BACKFILL WILL BE PAID FOR SEPARATELY.

All seals for this set of drawings are applied to the cover page(s)

Print Date: 6/28/2022
File Name: 510_21015_HY_Details1.dgn
Horiz. Scale: 1"=100' Vert. Scale: As Noted
Unit Information

MULLER ENGINEERING COMPANY

Sheet Revisions		
Date:	Comments	Init.

Boulder County

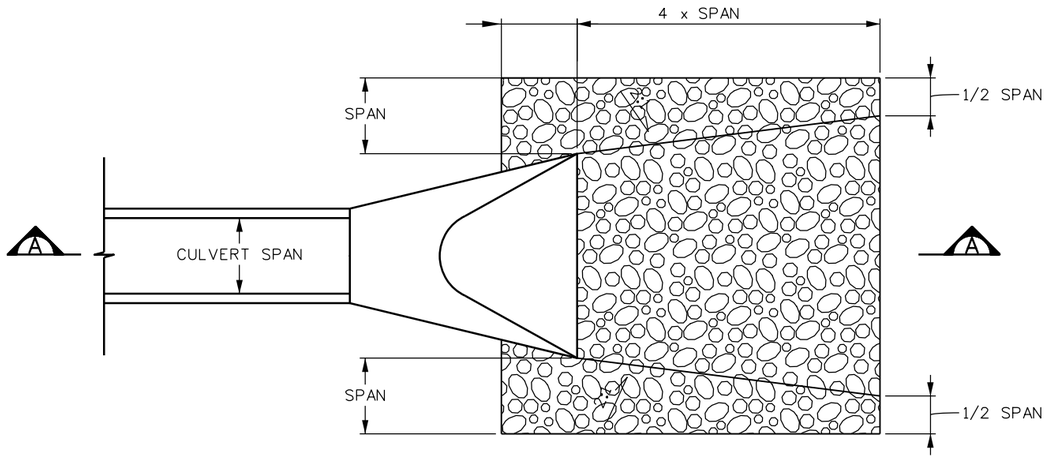
As Constructed
No Revisions:
Revised:
Void:

CO 119 BIKEWAY
DRAINAGE DETAILS

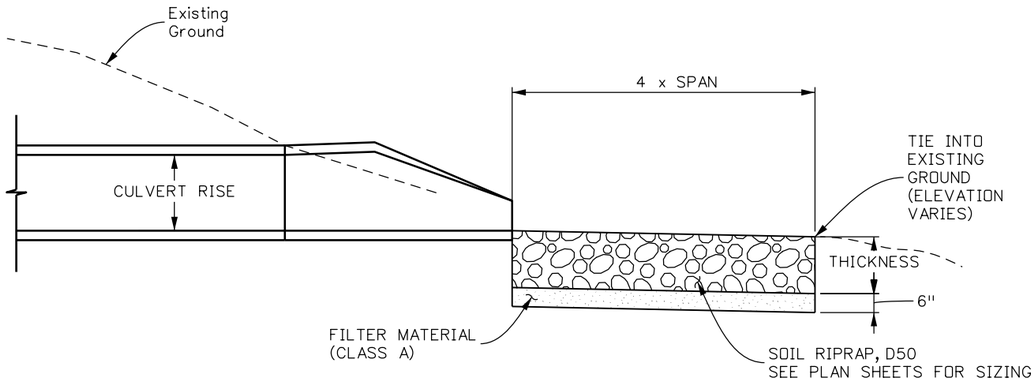
Designer: ACF
Detailer: PDP
Sheet Subset: DRN
Structure Numbers:
Subset Sheets: 1 of 2

Project No./Code

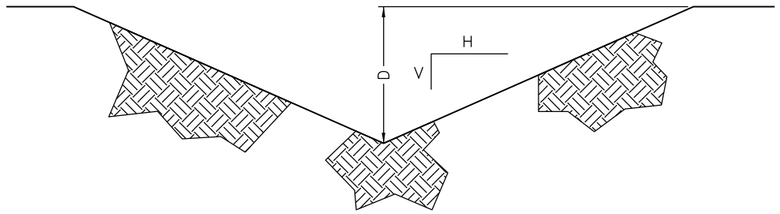
Sheet Number 159



SOIL RIPRAP OUTLET PAVING
SCALE: 1"=4'-0"



SECTION A
SCALE: 1"=4'-0"



GRASS-LINED DITCH DETAIL
N.T.S.

Stationing			Side	Foreslope (H:V)	Backslope (H:V)	Depth (inches)
1002+20	TO	1003+60	LT	4:1	3:1	6"
1006+50	TO	1008+60	LT	4:1	3:1	6"
1010+00	TO	1013+20	RT	4:1	3:1	12"
1013+20	TO	1014+80	RT	4:1	3:1	6"
1020+80	TO	1024+00	LT	3:1	4:1	6"
1024+00	TO	1028+00	LT	3:1	4:1	6"
1028+00	TO	1029+19	LT	4:1	6:1	12"
1028+00	TO	1029+20	RT	4:1	3:1	12"
1043+80	TO	1045+60	RT	3:1	4:1	6"
1063+20	TO	1066+00	RT	3:1	4:1	6"
1067+40	TO	1069+00	LT	4:1	3:1	6"
1069+20	TO	1076+00	LT	4:1	3:1	6"
1084+00	TO	1089+00	RT	4:1	6:1	12"
1089+00	TO	1095+00	RT	4:1	4:6	12"
2000+00	TO	2000+80	LT	3:1	6:1	12"
2000+00	TO	2001+00	RT	3:1	6:1	12"
2019+00	TO	2019+60	RT	3:1	6:1	12"
2036+00	TO	2036+60	LT	3:1	4:1	6"
2073+00	TO	2074+00	RT	3:1	6:1	12"
2074+00	TO	2075+53	LT	3:1	6:1	12"
3010+40	TO	3010+80	RT	3:1	6:1	12"
3010+80	TO	3011+80	RT	3:1	4:1	12"
3011+80	TO	3014+40	RT	3:1	3:1	12"
3014+40	TO	3017+78	RT	3:1	4:1	12"

Stationing			Side	Foreslope (H:V)	Backslope (H:V)	Depth (inches)
3033+20	TO	3035+80	RT	3:1	4:1	12"
3035+80	TO	3036+60	RT	3:1	6:1	12"
3040+80	TO	3042+40	LT	3:1	6:1	6"
3042+40	TO	3044+20	LT	3:1	4:1	6"
3044+20	TO	3044+50	LT	3:1	6:1	6"
3047+00	TO	3048+20	RT	3:1	6:1	12"
3047+40	TO	3048+00	LT	3:1	6:1	12"
4042+00	TO	4043+00	LT	3:1	6:1	6"
4061+06	TO	4064+25	LT	3:1	4:1	12"
4114+00	TO	4115+60	RT	3:1	2:1	12"
4116+00	TO	4018+09	RT	3:1	3:1	12"
5000+00	TO	5008+80	RT	3:1	6:1	12"
5014+80	TO	5017+00	LT	3:1	2:1	6"
5017+00	TO	5021+30	LT	3:1	2:1	12"
5021+30	TO	5022+65	LT	3:1	3:1	12"
5030+60	TO	5031+93	LT	3:1	4:1	12"
5034+00	TO	5035+00	LT	3:1	3:1	12"
5070+20	TO	5072+40	LT	3:1	6:1	12"
5080+60	TO	5088+54	LT	4:1	4:1	24"
5083+40	TO	5086+20	RT	4:1	4:1	12"
5087+10	TO	5088+54	RT	4:1	4:1	12"

All seals for this set of drawings are applied to the cover page(s)

Print Date: 6/28/2022
File Name: 510_21015_HY_Details2.dgn
Horiz. Scale: Vert. Scale: As Noted
Unit Information

MULLER ENGINEERING COMPANY

Sheet Revisions

Date:	Comments	Init.

Boulder County

As Constructed
No Revisions:
Revised:
Void:

CO 119 BIKEWAY
DRAINAGE DETAILS

Designer: ACF
Detailer: PDP
Sheet Subset: DRN
Structure Numbers:
Subset Sheets: 2 of 2

Project No./Code

Sheet Number 160

Reviewer Andrew Earles, Wright Water Engineers, Inc. aearles@wrightwater.com

Comments provided throughout document. Major comments include:
1. For FSD ponds, forebays are needed for all concentrated inflows. Please provide design information for forebays or equivalent measures such as a hydrodynamic separator in next design submittal.
2. It is unclear if micropools will be provided based on drawings. If alternative approach is used to keep small orifices from clogging, please describe and justify approach.
3. Design of initial surcharge volume (ISV) and trickle channel needed in next submittal.
4. Need to show spillways and emergency overflow paths in next design submittal, including freeboard along emergency overflow path in the event that the outlet becomes plugged. Spillways should be designed for fully developed pond inflows.

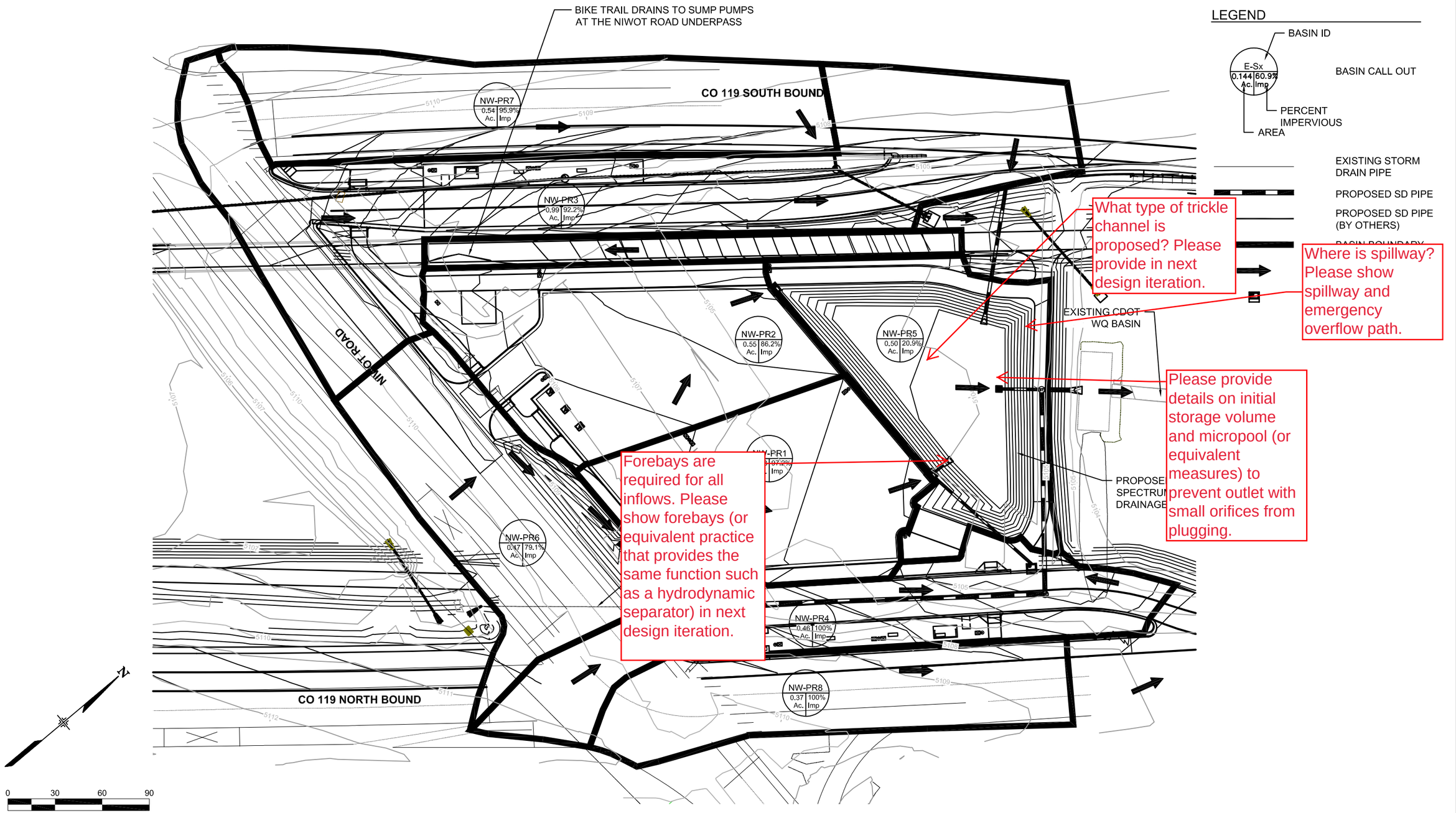
TD Park-n-Ride
Road and 63rd Street
d Mobility Improvement

Y DRAINAGE REPORT

August 4, 2022

Prepared by:

Regional Transportation District
1560 Broadway, Suite 700
Denver, CO 80202



Print Date: $DATE$	Sheet Revisions			Colorado Department of Transportation		CO119 SAFETY & MOBILITY PROJECT NIWOT ROAD PARK–n–RIDE PROPOSED DRAINAGE BASIN MAP	Project No./Code
File Name: $FILES$	Date:	Comments	Init.	1050 Lee Hill Road Boulder, CO 80302 Phone: 303–546–5676 FAX: 303–444–0751	No Revisions:		
Horiz. Scale: Vert. Scale: As Noted					Revised:	Designer: / Structure Numbers	
Unit Information				Region 4 ALG	Void:	Detailer: / Sheet Subset: / Subset Sheets:	FIGURE 3
RTD							

EXISTING 10' X 6' CBC

63-PR4
1.21 Ac. | 76.7% Imp

63-PR6
0.46 Ac. | 100% Imp

CO 119 SOUTH BOUND

BIKE TRAIL DRAINS TO SUMP PUMPS AT THE 63RD STREET UNDERPASS

63-PR1
0.60 Ac. | 88.5% Imp

PROPOSED 10' X 6' CBC

PROPOSED FULL SPECTRUM

Same comments as Niwot FSD basin related to forebays, trickle channel, ISV,, micropool, spillway and emergency overflow path..

63-PR2
0.54 Ac. | 95.9% Imp

63RD STREET

63-PR7
0.93 Ac. | 89.3% Imp

63-PR3
0.64 Ac. | 91.0% Imp

NW-PR8
0.32 Ac. | 100% Imp

CO 119 NORTH BOUND

EXISTING 10' X 6' CBC

FLOWS FROM OFFSITE BASIN P172C

0 30 60 90

LEGEND

- BASIN ID
- BASIN CALL OUT (E-Sx; 0.144 Ac. | 60.9% Imp)
- PERCENT IMPERVIOUS AREA
- EXISTING STORM DRAIN PIPE
- PROPOSED SD PIPE
- PROPOSED SD PIPE (BY OTHERS)
- BASIN BOUNDARY
- SURFACE FLOW DIRECTION
- PROPOSED SD INLET

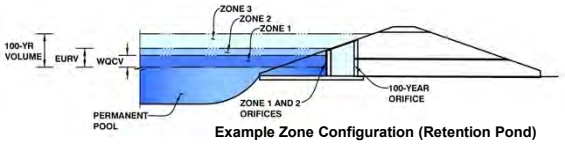
Print Date: $DATE$	Sheet Revisions	Colorado Department of Transportation		CO119 SAFETY & MOBILITY PROJECT 63RD STREET PARK-n-RIDE PROPOSED DRAINAGE BASIN MAP	Project No./Code
File Name: $FILES$	Date: / Comments / Init.	1050 Lee Hill Road Boulder, CO 80302 Phone: 303-546-5676 FAX: 303-444-0751	No Revisions:		
Horiz. Scale: Vert. Scale: As Noted		Region 4 ALG	Revised:	Designer: / Structure Numbers	
Unit Information			Void:	Detailer:	FIGURE 5
RTD				Sheet Subset: / Subset Sheets:	

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: SH119 BRT - Niwot Road Station PnR

Basin ID: Proposed Condition Basins PR1 thru PR5



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.87	0.083	Orifice Plate
Zone 2 (EURV)	1.65	0.154	Orifice Plate
Zone 3 (100-year)	2.41	0.174	Weir&Pipe (Restrict)
Total (all zones)		0.411	

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	ft^2
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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.944E-03	ft^2
Depth at top of Zone using Orifice Plate =	1.65	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.00	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

These are tiny orifices that will be susceptible to plugging. Please explain how design addresses this issue.

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)	...optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40			
Orifice Area (sq. inches)	1.00	1.00	1.00			

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

...d 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 =	1.70	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.41	N/A	feet
Overflow Weir Front Edge Length =	2.92	N/A	feet	Overflow Weir Slope Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	9.51	N/A	
Horiz. Length of Weir Sides =	2.83	N/A	feet	Overflow Grate Open Area w/o Debris =	5.93	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.96	N/A	ft^2
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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.62	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.34	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.90		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.34	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.70	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.52	feet
Spillway Crest Length =	10.00	feet	Stage at Top of Freeboard =	4.22	feet
Spillway End Slopes =	0.00	H:V	Basin Area at Top of Freeboard =	0.33	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.94	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).

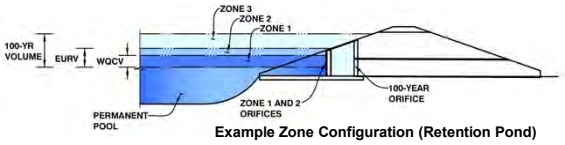
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.79	1.07	1.35	1.81	2.23	2.69	3.98
CUHP Runoff Volume (acre-ft) =	0.083	0.237	0.141	0.202	0.269	0.386	0.491	0.609	0.935
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.141	0.202	0.269	0.386	0.491	0.609	0.935
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.2	0.8	2.3	3.4	4.7	8.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.08	0.28	0.79	1.16	1.59	2.73
Peak Inflow Q (cfs) =	N/A	N/A	2.6	3.7	4.8	7.1	9.0	11.3	17.2
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	0.7	1.6	3.1	7.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.1	0.3	0.5	0.7	0.9
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 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	0.0	0.1	0.3	0.5	0.8
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) =	38	64	51	61	68	68	67	65	59
Time to Drain 99% of Inflow Volume (hours) =	**40**	68	53	64	72	74	73	73	70
Maximum Ponding Depth (ft) =	0.87	1.65	1.13	1.43	1.73	2.03	2.23	2.46	2.88
Area at Maximum Ponding Depth (acres) =	0.17	0.21	0.19	0.20	0.22	0.23	0.24	0.25	0.27
Maximum Volume Stored (acre-ft) =	0.084	0.238	0.132	0.190	0.253	0.320	0.367	0.426	0.534

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: SH119 BRT - 63rd Street Station PnR

Basin ID: RTD PnR Onsite Full Spectrum Detention Basin (63-PR1 thru 63-PR5)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.81	0.084	Orifice Plate
Zone 2 (EURV)	1.46	0.165	Orifice Plate
Zone 3 (100-year)	2.09	0.183	Weir&Pipe (Restrict)
Total (all zones)		0.433	

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	ft^2
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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	7.292E-03	ft^2
Depth at top of Zone using Orifice Plate =	1.46	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.05	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

Same comment on small orifices.

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row	ional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40				
Orifice Area (sq. inches)	1.05	1.05	1.05				

	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)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	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 =	1.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.21	N/A	feet
Overflow Weir Front Edge Length =	2.92	N/A	feet	Overflow Weir Slope Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.51	N/A	
Horiz. Length of Weir Sides =	2.83	N/A	feet	Overflow Grate Open Area w/o Debris =	5.93	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.96	N/A	ft^2
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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.70	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.36	N/A	feet
Restrictor Plate Height Above Pipe Invert =	7.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.40	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.53	feet
Spillway Crest Length =	10.00	feet	Stage at Top of Freeboard =	4.03	feet
Spillway End Slopes =	0.00	H:V	Basin Area at Top of Freeboard =	0.38	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.09	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	0.79	1.06	1.33	1.78	2.17	2.61	3.82
CUHP Runoff Volume (acre-ft) =	0.084	0.250	0.148	0.215	0.288	0.425	0.541	0.677	1.040
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.148	0.215	0.288	0.425	0.541	0.677	1.040
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.2	0.8	2.4	3.5	5.0	8.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.06	0.24	0.69	1.00	1.41	2.39
Peak Inflow Q (cfs) =	N/A	N/A	2.5	3.6	4.8	7.2	9.2	11.6	17.7
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	0.8	1.6	3.1	7.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.1	0.3	0.5	0.6	0.9
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 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	0.0	0.1	0.3	0.5	0.9
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) =	39	69	53	64	74	74	73	70	65
Time to Drain 99% of Inflow Volume (hours) =	**40**	73	55	68	78	80	80	79	77
Maximum Ponding Depth (ft) =	0.81	1.46	1.04	1.28	1.54	1.83	2.03	2.26	2.67
Area at Maximum Ponding Depth (acres) =	0.21	0.28	0.26	0.27	0.28	0.29	0.30	0.31	0.32
Maximum Volume Stored (acre-ft) =	0.085	0.252	0.137	0.203	0.274	0.357	0.416	0.485	0.615

Reviewer: Andrew Earles, Wright Water Engineers, Inc. (WWE), aearles@wrightwater.com

Comments provided as text call outs in document. Major comments include:

1. Rational method is only applicable up to 90 acres. This report states 200 acres, which is too large for Rational Formula. This only appears to affect one basin X1029R. Could this basin be subdivided? If not, please provide justification for using rational method beyond published limit. If is is just slightly higher, I think this can be justified if there is not routing that would affect peak flows.
2. Table 4 provides a comparison of existing and proposed peak flow rates and shows increases at some design points. However, this report does not discuss in detail or provide calculations for how flows will be detained to existing levels when the increases exceed 1 cfs. Please add this information to the report and show that flows will be adequately detained.

CO 119 BIKEWAY

PRELIMINARY DRAINAGE REPORT

July 2022

Prepared for:

Boulder County Community Planning & Permitting

2045 13th Street

Boulder, Colorado 80302

Prepared by:

Muller Engineering Company

777 South Wadsworth Boulevard

Suite 4-100

Lakewood, Colorado 80226

303.988.4939

Muller Project Number: 21-015.01

MULLER ENGINEERING COMPANY

This report has been prepared based on certain key assumptions made by Muller Engineering Company (Muller) which substantially affect the conclusions and recommendations. These assumptions, although thought to be reasonable and appropriate, may not prove to be true in the future. The conclusions and recommendations of Muller are conditioned upon these assumptions.

This report for the CO 119 Bikeway Project was prepared by me or under my direct supervision in accordance with the provisions of the *Boulder County Storm Drainage Criteria Manual, Boulder County Multimodal Transportation Standards, and Colorado Department of Transportation Drainage Design Manual* and was designed to comply with the provisions thereof.

Alejandra C. Ferrufino, P.E.

Registered Professional Engineer

State of Colorado No. 54974

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APPENDICES

APPENDIX A

Maps and References

Hydrologic Criteria Table
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Existing Basin Map
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Irrigation Crossing Inventory Map
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Point Precipitation Data (NOAA Atlas 2)
FEMA Flood Zone Maps

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Hydrology

Existing Hydrology Calculations
Proposed Hydrology Calculations

APPENDIX C

Hydraulics

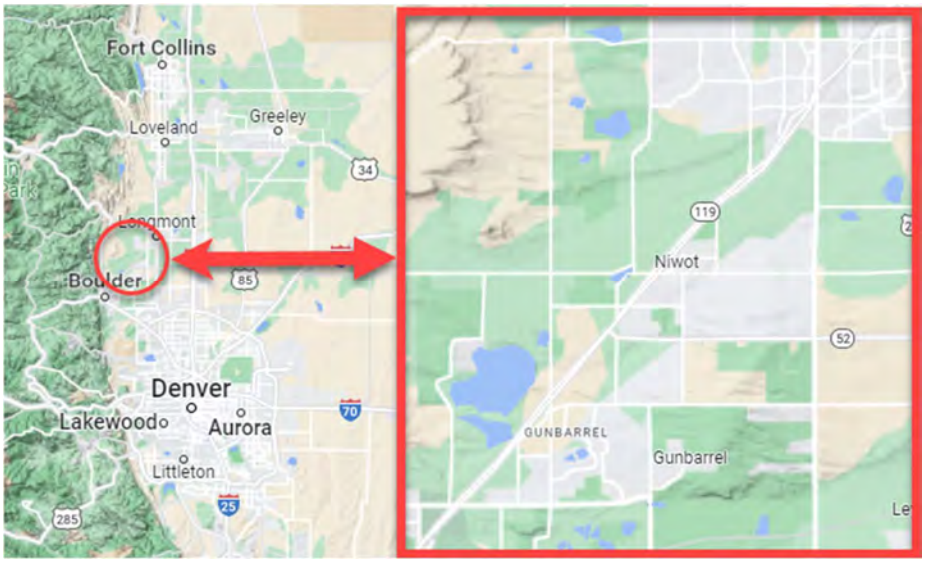
1 INTRODUCTION

Muller Engineering Company, Inc. (Muller), on behalf of Boulder County, has prepared the following drainage report for the CO 119 Bikeway project. This report describes the project, the existing site conditions, the drainage design criteria, the hydrologic and hydraulic analyses, and the proposed drainage design improvements recommended for the project.

1.1 Location and Project Area Description

The CO 119 Bikeway project is located along Colorado State Highway 119 (CO 119) in Boulder County, Colorado. The proposed bikeway is located primarily in the median of CO 119 with some sections slightly outside of the highway. The project traverses unincorporated Boulder County, the City of Boulder, and the City of Longmont. The south end of the project starts just south of 47th Street in the City of Boulder and the north end of the project is at Hover Street in the City of Longmont. Please refer to **Figure 1**.

Figure 1. ***Vicinity Map***



The project is specifically located in Sections 2, 3, 10, 15, 16, 20, and 21 of Township 1 North, Range 70 West of the Sixth Meridian, Sections 25, 35, and 36 of Township 2 North, Range 70 West of the Sixth Meridian, and Sections 17, 19, 20, 30 of Township 2 North, Range 69 West of the Sixth Meridian in Boulder County, Colorado.

CO 119 is functionally classified as a Principal Arterial/Freeway Expressway. Generally, the project area is bound by undeveloped, farmland with some areas of suburban development. Suburban development, industrial development, and commercial development occurs beyond the immediate undeveloped land in all directions.

The project area is primarily located in Colorado Department of Transportation (CDOT) right-of-way. Adjacent parcels of land are owned by other government agencies, businesses, and individual property owners. The Burlington Northern and Santa Fe (BNSF) Railroad Company owns property adjacent to the northbound CO 119 lanes through the majority of the project area.

There are approximately 41 irrigation crossings through the project area. Irrigation ditch companies include Boulder and Whiterock, Boulder Creek Supply Canal, Star Ditch, Williamson Ditch, and Holland Ditch.

Table 1. *Existing Site Information*

Legal Description	Townships 1 and 2 North, Range 69 and 70 West of the Sixth Colorado Meridian
City and County	Unincorporated Boulder County, City of Boulder, and City of Longmont
Adjacent Land Use	Undeveloped, residential development, commercial development
Major Drainageways	Fourmile Canyon Creek, Boulder Creek, Dry Creek, and Lefthand Creek
Irrigation Facilities	Several including Boulder and Whiterock, Boulder Creek Supply Canal, Star Ditch, Williamson Ditch, and Holland Ditch
Hydrologic Soil Group	A, B, C, and D – Mostly C and D
Topography	Gently sloping terrain with slopes ranging from 0-25% (typically 1-3%). Considerable wetlands and high groundwater.

1.2 Project Description and Intent

The purpose of the CO 119 Bikeway project is constructing a concrete, high-speed bikeway along CO 119 to improve safety and accessibility for bicycles and similar modes of transportation.

In addition to carrying considerable vehicle traffic between Boulder and Longmont, CO 119 and nearby pathways are popular for commuting cyclists and recreational cyclists. Boulder County is proposing the CO 119 Bikeway project to provide an improved alternative for cyclists using the CO 119 corridor. The project will also feature spurs off the main bikeway to connect to existing trails in the area. Specific project improvements include:

- Grading and constructing a bike path along CO 119 from 47th Street in Boulder to Hover Street in Longmont. At-grade crossings, underpasses, and bridges will be designed for the bike path

- Supplementary improvements include:
  - Traffic support for intersections along CO 119 impacted by bike path
  - Structural design of underpasses and bridges
  - Landscaping improvements
  - Lighting for underpasses and other locations
  - Floodplain analysis
  - Irrigation coordination

1.3 Previous Drainage Studies

Muller has received several drainage reports from Boulder County, the City of Longmont, the City of Boulder, and CDOT. The following information summarizes the relevant reports and their impacts on the CO 119 Bikeway project.

The *Hydrology and Hydraulics Report for the Intersections of SH 119 at Jay Road and SH 119 at Niwot Road* report published by Fellsburg, Holt, and Ullevig describes improvements to the intersections of CO 119 at Jay Road and CO 119 at Niwot Road. The report focuses on water quality requirements associated with these two projects. The report states that the majority of drainage facilities were designed for the 2-year event for water quality treatment. The report also describes the Boulder and Whiterock irrigation channel through the intersection at Jay Road which will be impacted by the CO 119 Bikeway project.

The *SH 119 at SH 52 (Mineral Road) Final Drainage Report* published by Muller Engineering Company was intended for an improved intersection of CO 52 with CO 119 which was not constructed. Information regarding how runoff from the IBM Campus and offsite areas is managed and impacts CO 119 was applied to the drainage design for the CO 119 Bikeway project.

The *Final Drainage Report – Front Range Health and Wellness Center* published by Park Engineering Consultants describes a development on the north end of the project area. The report states that no runoff from this development reaches a receiving culvert which will be impacted by the CO 119 Bikeway project.

The *Vojta Farm Final Stormwater Report* published by Drexel, Barrell, and Company describes a residential development at the intersection of 47th Street and Jay Road in the City of Boulder. The development is within an offsite basin which drains to the project area. The report states two detention ponds were constructed to capture and release flow at historic flowrates. The report states that the 10-year event is conveyed to a storm sewer network along 47th Street and the 100-year event overflows into undeveloped land east of 47th Street.

1.4 Floodplain

The CO 119 Bikeway project improvements will cross three Federal Emergency Management Administration (FEMA) regulated floodplains. The three floodplains are Fourmile Canyon Creek,

Dry Creek, and Lefthand Creek. Please refer to the FEMA Flood Insurance Rate Maps (FIRM ette) included in Appendix A. The flood map numbers for Fourmile Canyon Creek and Dry Creek are 08013C0411K and 08013C0404J respectively. The flood map numbers for Lefthand Creek are 08013C04010J, 08013C0407J, and 08013C0269J.

The local regulatory agencies are Mile High Flood District (MHFD) for Fourmile Canyon Creek and Dry Creek and Colorado Water Conservation Board (CWCB) for Lefthand Creek. The floodplain administrators are Boulder County for all three floodplains and Boulder County and the City of Boulder for Fourmile Canyon Creek.

1.4.1 Fourmile Canyon Creek

Fourmile Canyon Creek is in a FEMA designated special flood hazard area Zone AE which is defined as an area that presents a 1% annual chance of flooding and has base elevations provided per hydraulic modeling performed. Muller has received the HEC-RAS model for the "Fourmile Canyon Creek Bikeway – Railroad Underpass Project" which was submitted as a no-rise condition in October 2019.

The railroad underpass project has not been built. Therefore, Boulder County directed Muller to use the effective conditions model completed for the Railroad Underpass project as the existing conditions model for the CO 119 Bikeway project. Boulder County also directed Muller to turn off lateral weir optimization in the HEC-RAS model. Muller will use the hydrology data included in the railroad underpass project HEC-RAS model which is from a FEMA Flood Insurance Study which last revised in August 2019.

1.4.2 Dry Creek

Dry Creek is in a FEMA designated special flood hazard area Zone A which is defined as an area that presents a 1% annual chance of flooding and without base elevations. Muller received a HEC-RAS model from Boulder County that was completed in 2012 by Belt Collins West Ltd. for the purpose of modeling the LOBO Trail: IBM Connection project. Per the "LOBO Trail: IBM Connection Final Hydraulic Design Report", the trail project caused a water surface elevation drop of more than 0.3 feet. Therefore, a LOMR should have been completed for trail project, but according to Boulder County, it was not completed. The project appears to have been constructed around 2017 but no as-built geometry data is available. For purposes of this project, Boulder County has directed Muller to use the 2012 proposed conditions model as the effective model and incorporate survey data to develop an existing conditions model for the proposed bikeway. Muller will use the hydrology data associated with the proposed conditions model.

1.4.3 Lefthand Creek

Lefthand Creek is in a FEMA designated special flood hazard area Zone AE which is defined as an area that presents a 1% annual chance of flooding and has base elevations provided per hydraulic modeling performed. The basis of the floodplain model for Lefthand Creek is the

Colorado Hazard Mapping Program (CHAMP). The primary purpose of CHAMP was to identify flood risks in northeast Colorado following the 2013 flood event.

AECOM, the contractor for CWCB, completed a floodplain model of Lefthand Creek for CHAMP. The model was then used as the existing conditions model for a separate project, the "1901 South Hover Street Development Project". The developer for the project contracted AECOM to prepare a CLOMR for this project. A 2D model was used for the CLOMR application.

Muller has been directed to use the geometry associated with the corrected effective model (versus the proposed conditions geometry) which AECOM developed for the CLOMR. Muller is proceeding with the geometry associated with the corrected effective model. HEC-RAS version 5.0.7 will use 1D capabilities to model the floodplain. Muller will use the hydrology data included in the CLOMR model which is based on the CHAMP study.

Additional cross sections will likely need to be developed by Muller and inserted into the HEC-RAS model to cover Lefthand Creek further upstream beyond the model limits.

1.5 Relationship to CO119 Mobility Improvements Project

The CO 119 Bikeway project is currently on roughly the same design schedule as the CO 119 Safety and Mobility Improvements project. The CO 119 Safety and Mobility Improvements project is a CDOT project being designed in coordination with the Regional Transportation District (RTD). The project improvements include the following:

- Bus Rapid Transit (BRT)/queue jump modifications at five intersections on CO 119
    - Jay Road, 63rd Street, State Highway 52, Niwot Road, and Airport Road
- Major realignment of the CO 119/ CO 52 intersection
- New Regional Transportation District (RTD) Park-and-Ride facilities at two intersections
    - 63rd Street and Niwot Road

The CO 119 Bikeway and CO 119 Safety and Mobility Improvements projects, to date, have been designed and coordinated congruently. The drainage design and analysis of the CO 119 Bikeway project has considered the drainage design and overall design of the CO 119 Safety and Mobility Improvements project and vice-versa.

The drainage design and analysis described in this drainage report is based on the assumption that the CO 119 Mobility Improvements project will be constructed in a similar timeframe as the CO 119 Bikeway project.

Is there any potential that these could be constructed on different schedules? If so, are there drainage/flood control elements of one project that rely on the improvements associated with the other project? Would any temporary facilities be needed if these are constructed on different schedules. This may be unlikely, but if it is a possibility, the implications should be discussed.

2 DRAINAGE BASINS AND SUB BASINS

2.1 Major Basin Description

2.1.1 Project Area

The project area is located within four principal watersheds. The watersheds are Fourmile Canyon Creek, Boulder Creek, Dry Creek, and Lefthand Creek.

At the south end of the project, runoff near and south of 47th Street reaches a relatively small drainageway which then reaches Boulder Creek. From 47th Street to a point south of Jay Road, runoff drains to Fourmile Canyon Creek which is a tributary to Boulder Creek. Runoff from the Jay Road intersection and a small amount of land to the north and south of the intersection drains to an unnamed tributary to Boulder Creek. Runoff north of the Jay Road intersection to Monarch Road drains to Dry Creek. Runoff from Monarch Road to the north limits of the project area drains to Lefthand Creek.

Boulder Creek, Dry Creek, and Lefthand Creek are tributaries to the St. Vrain River.

2.1.2 Offsite Area

Offsite area within the Boulder Creek and Dry Creek watersheds generally flows southeast toward the project area. Offsite area within the Lefthand Creek watershed generally flows north toward to project area.

The proposed bikeway is primarily located within the median of CO 119. The northbound and southbound lanes of CO 119 are typically elevated upon embankments above the surrounding topography such that offsite flow is prevented from reaching the proposed bikeway. Exceptions are at the southern end of the project, near the IBM Campus at the CO 119/ CO 52 intersection, and at the northern end of project.

At the southern end of the project, the proposed bikeway is outside of the median from roughly 47th St to Jay Road. A relatively small (1.9 acre) offsite basin and larger (102 acre) offsite basin reach the proposed bikeway. The larger basin consists of mostly undeveloped land with a portion of residential development. The drainage patterns of the residential development area were briefly described in the *Vojta Farm Final Stormwater Report.*

Near the IBM Campus, the CO 119 Mobility Improvements project would realign the CO 119/ CO 52 intersection such that the proposed bikeway would be within the CO 119 median. If the CO 119 Safety and Mobility Improvements project is not constructed, the proposed bikeway would be outside of the median and subject to offsite flow. The *SH 119 at SH 52 (Mineral Road) Final Drainage Report* describes offsite flow patterns in this area. The report states that runoff from the majority of the IBM Campus is captured by a separate storm drain system and conveyed south. However, runoff from the parking lots on the east side of the IBM Campus and adjacent land (solar panel fields) drains toward CO 119 and therefore is relevant to the project. The drainage

What was the assumed imperviousness or runoff coefficient for the solar area? Please discuss basis for solar runoff parameters.

report states specific 5-year and 100-year flowrates from the IBM Campus reaching a ditch parallel to the existing SB CO 119 lanes and a 24" cross culvert under SB CO 119 and NB CO 119. Runoff from the solar panel fields was determined using the typical basin delineation process outlined below. Runoff from the solar panel fields typically reaches irrigation and/or drainage facilities which cross CO 119.

At the northern end of the project, the proposed bikeway is between SB CO 119 and Dry Creek Drive in Longmont. The proposed bikeway is subject to offsite flow from Dry Creek Drive and the undeveloped infield between Dry Creek Drive and SB CO 119. The contributing basin consists of mostly undeveloped land, its area is approximately 5.2 acres.

2.2 Sub Basin Description

Smaller areas draining to the four major creeks were broken down into sub basins (hereinafter referred to simply as "basins"). The design point (or outlet) of basins is a hydraulic facility such as a roadside ditch, culvert, inlet, water quality pond, or major creek.

Basins were delineated using existing survey contours and topography of existing features provided by CDOT and LiDAR contours referenced from Boulder County. Proposed basins were also delineated using proposed contours and proposed infrastructure.

2.3 Historic Drainage Patterns

The northbound and southbound lanes of CO 119 generally sends roadway runoff flows to the outside of the highway. However, throughout the project length, there are multiple sections where roadway runoff from SB and/or NB CO 119 flows toward the median. In addition, considerable roadway runoff from major intersecting streets (63rd Street, Jay Road, Niwot Road) and minor intersecting streets (such as 55th Street, 83rd Street, etc.) reaches the median.

Runoff within the CO 119 median generally follows a flat (~1.0%) and poorly defined swale. Runoff then typically reaches an open ditch or channel traversing the median. The ditch or channel directs flow to a culvert crossing under either NB CO 119 or SB CO 119. The ditch and culvert systems intended use are for stormwater conveyance, irrigation conveyance, irrigation return flow conveyance, or a combination of these.

Muller has received a record of irrigation facilities from Boulder County and other resources. Muller is working on and will continue to work on coordinating with the irrigation owners to better understand irrigation flow distribution and intended use of existing facilities.

3 DRAINAGE DESIGN CRITERIA

Drainage design for the bikeway is based on historic drainage patterns, the CO 119 Safety and Mobility Improvements project, and the following technical criteria documents:

- Boulder County Storm Drainage Criteria Manual (SDCM), 2016
- Boulder County Multimodal Transportation Standards (MTS), 2012
- CDOT Drainage Design Manual, 2019

3.1 Hydrologic Criteria

The Hydrologic Criteria Table in **Appendix A** provides a full summary and comparison of the hydrologic criteria identified in the technical criteria documents listed above. **Table 2** shows the applied hydrologic criteria for the CO 119 Bikeway project.

Table 2. *Applied Hydrologic Criteria*

Hydrologic Criteria	Applied Criteria
Design Frequency	
Cross Drainage	
Multi-lane Road (Urban)	100-year
Multi-lane Road (Rural)	50-year
Two Lane Road (Urban)	100-year
Two Lane Road (Rural)	25-year
Culvert Outlet Scour Protection	10-year
Pedestrian Walkways and Bikeways	5-year
Parallel Drainage	
Roadway Overtopping & Revetment	*Same as for cross drainage*
Side Drains	10-year
Storm Drains	
Major Storm	100-year
Minor Storm	5-year
Channels	
Capacity	*Depends on roadway classification*
Lining	10-year
Hydrologic Procedure Selection	
Hydrologic Peak Prediction Procedure	
Drainage Area	Rational Method (<200 ac) CUHP and EPA-SWMM (>200 ac)
Time of Concentration (Tc) for Rational Method	
Min. Tc for urban areas	5 min.
Min. Tc for non-urban areas	10 min.
Max. Overland Flow Path Length (urban, rural)	300 ft, 500 ft

Rational method only applies up to 90 acres. Must use CUHP SWMM for > 90 acres, not 200 acres.

Same comment as above. Rational only applies up to 90 acres. If you want to use Rational for > 90 acres instead of CUHP/SWMM, must provide analysis to show that peak flows are comparable or more conservative compared to what you would get using CUHP SWMM.

3.1.1 Hydrologic Methodology

All basins are less than 200 acres; therefore, the Rational Method was used to calculate peak flowrates. See the Existing and Proposed Hydrology Calculation Packets included in **Appendix B** for full procedures and calculations.

Proposed basin delineations considered grading and new impervious areas from the CO 119 Safety and Mobility project. Due to this methodology, the result is that many proposed basins contain new impervious areas (bus lanes, widened portions of CO 119, etc.) associated with the CO 119 Safety and Mobility project.

Rainfall data was taken from NOAA Atlas 2. Per Section 500 of the *Boulder County Storm Drainage Criteria Manual*, Boulder County refers to the rainfall data source selected by Mile High Flood Control District. Per Chapter 5 of the Mile High Flood District *USDCM Volume 1* (2017), Mile High Flood District has adopted NOAA Atlas 14 as its rainfall data source. Therefore, final design hydrology calculations will use rainfall data from NOAA Atlas 14.

3.2 Hydraulic Criteria

The Hydraulic Criteria Table in **Appendix A** provides a full summary and comparison of hydraulic criteria identified in the technical criteria documents listed above. **Table 3** shows the applied criteria for the CO 119 Bikeway project.

3.2.1 Hydraulic Methodology

The proposed drainage improvements include inlets, storm drain, manholes, culverts, and roadside ditches to meet the criteria identified in **Table 3**. Preliminary hydraulic calculations used Bentley FlowMaster, Bentley OpenRoads Designer, and MHFD-Inlet to analyze proposed ditches, inlets, cross culverts, and storm drain systems. See the Proposed Hydraulic Calculation Packet included in **Appendix C** for full procedures and calculations.

Table 3. *Applied Hydraulic Criteria*

Hydraulic Criteria	Applied Criteria
Storm Drain and Culverts	
Min. Pipe Diameter	
Storm Drain Trunk, Median Drain, Side Drain, Irrigation	18 in.
Lateral (Median drain to cross culvert; Curb inlet to trunk line)	15 in.
Cross Culvert (for State Highways)	24 in.
Pipe Velocity	
Minimum	3 ft/s
Maximum	15 ft/s
Manhole Spacing (Max)	
15 in. - 48 in. pipe	300 ft
>48 in. pipe	600 ft
Maximum Allowable Culvert Headwater to Depth Ratio	
D (dia. or ht. or rise) < 36 in.	2.0
36 in. $\leq$ D $\leq$ 60 in.	1.7
60 in. < D < 84 in.	1.5
84 in. $\leq$ D < 120 in.	1.2
120 in. $\leq$ D	1.0
Channels and Roadside Ditches	
Ditch Linings	
Riprap Sizing	Use HY-8 or FHWA software
Channel/Ditch Design	
Side Slope (H:V, max)	3:1
Froude Number (max.)	0.6 (grass), 0.8 (riprap)
Minimum Freeboard	1-foot
Max. Longitudinal Slope	0.6% (grass-lined) 1.0% (riprap-lined) 0.5% (natural) while V>7 fps and Froude # < 0.8 if flow depth exceeds 1 ft
Min. Longitudinal Slope	0.2% (grass-lined and riprap-lined) Match adjacent for natural

4 DRAINAGE DESIGN AND ANALYSIS

4.1 Proposed Drainage Design

The proposed drainage design consists of the following elements:

- Proposed 18" RCP to convey flows under the bikeway at low-points.
- At locations where the bikeway crosses existing ditches, a proposed culvert under the bikeway will be placed to allow flow within ditches to cross bikeway. The proposed culvert sizes will match the existing culvert sizes crossing either NB or SB CO 119.
    - At locations where proposed bikeway grading covers the inlet or outlet end of an existing culvert crossing NB or SB CO 119, the existing culvert will be extended with the same size and material as the existing pipe.
- Type 13 inlets will be located on both sides of underpasses to collect flow. A network of 15" PVC pipes will convey flow to a pump station where flow will be discharged to the ground surface. Further details of pump stations will be completed with final design.
- The only modification to an existing cross culvert or other drainage facility for the CO 119 roadway is approximately 0.25 miles southwest of the CO 119/ Jay Road intersection. At this location, an existing 36" RCP crossing SB CO 119 will need to be replaced along with a Type D inlet in the highway median.
- Ditch grading ditches as needed to convey stormwater to specific locations.

4.2 Hydrologic Analysis

Overall, there are no changes to historic flow patterns. The proposed bikeway does not interfere with existing drainage patterns throughout the CO 119 corridor.

Peak flowrates were calculated at key design points where runoff leaves the project area and other facilities of interest such as existing culvert, inlets and water quality ponds. **Table 4** provides a comparison of the existing and proposed 5-year and 100-year flowrates at these key design points. There are repeated locations in **Table 4** such as the Boulder and Whiterock Irrigation Ditch and the ditch between northbound CO 119 and the BNSF railroad. **Table 4** refers to specific points along the project corridor, therefore runoff to the Boulder and Whiterock Irrigation ditch could decrease in one location and increase in another location. Please refer to the existing basin maps, proposed basin maps, and irrigation crossing inventory map in **Appendix A** for illustration on specific points which Table 4 refers to. Irrigation systems are denoted in the "ID" column in **Table 4**, the ID corresponds with the irrigation crossing inventory map in **Appendix A**. Please note, **Table 4** is not filled out for the CO 119/ CO 52 intersection and areas north and south of this intersection. Ongoing and future coordination with CO 119 Safety and Mobility Improvements project will dictate proposed drainage patterns in these areas.

Table 4. *Existing and Proposed Flowrate Comparison*

Design Point	Description	Contributing Basins		Design Storm Q_5 (cfs)			Major Storm Q_{100} (cfs)			Irrigation ID
		Existing	Proposed	Existing	Proposed	Δ Flow	Existing	Proposed	Δ Flow	
DP1018L	Fourmile Creek	X1016L, X1017L, X1018L, X1021R	P1013R, P1016L, P1017L, P1018L, P1021R, P1021RA	5.3	30.7	25.4	35.4	152.5	117.1	
DP1030R	Ditch between NB SH 119 and BNSF Railroad	X1029R, X1030R, X1032R	P1034R	28.6	0.2	-28.4	144.0	143.9	-0.1	
DP1034R	Boulder and Whiterock Irrigation Ditch	X1034R	P1034R	0.2	0.2	0.1	3.1	1.		
DP1044L	Water Quality Extended Detention Basin North of Jay Road	X1047L	P1043R, P1044L	1.1	0.9	-0.1	12.3	9.		
DP1056L	Boulder and Whiterock Irrigation Ditch	X1054R, X1056L	Mobility Hub Jay Rd Inlet, P1048L, P1053L, P1054R, P1056L, P1057L, P1067L, P1063R, P1069R	4.0	7.7	3.7	16.5	24		
DP1069R	Boulder and Whiterock Irrigation Ditch	X1069R	Mobility Hub Jay Rd Inlet, P1048L, P1053L, P1054R, P1056L, P1057L, P1067L, P1063R, P1069R	0.7	8.5	7.8	11.4	35		
DP1082L	Boulder and Whiterock Irrigation Ditch	X1077R, X1080R, X1083R	P1076L, P1077R, P1080R, P1082L	2.2	2.7	0.5	14.6	7.5	-7.1	ID-13
DP1082R	Ditch between NB SH 119 and BNSF Railroad	X1082R	P1082R	0.0	0.1	0.0	0.7	0.7	0.0	
DP1088R	City of Boulder and Others Irrigation Line	X1088R	P1088R	1.2	1.9	0.7	8.1	9.4	1.3	ID-14
DP2010R	Ditch between NB SH 119 and BNSF Railroad	X2010R	P2010R	1.0	0.7	-0.3	10.0	5.1	-4.8	
DP2022R	Ditch between NB SH 119 and BNSF Railroad	X2022R, X2022RA	P2021L, P2022L, P2022R	0.3	1.3	1.0	3.2	10.8	7.6	
DP2031R	Ditch between NB SH 119 and BNSF Railroad	X2031R	P2030L, P2031R, P2032L	0.6	1.1	0.6	8.0	8.7	0.7	ID-16

I do not see any detention calculations in this report. How will the proposed flows be detained to existing levels? I think the text above says that for increases above 1 cfs, there will be detention (or disconnection at RPA:UIA = 2.0 or more). Please add discussion of this to the report.

Table 4 (continued). *Existing and Proposed Flowrate Comparison*

Design Point	Description	Contributing Basins		Design Storm Q_5 (cfs)			Major Storm Q_{100} (cfs)			Irrigation ID
		Existing	Proposed	Existing	Proposed	Δ Flow	Existing	Proposed	Δ Flow	
DP2059R	Boulder Reservoir Spillway/ Boulder County Irrigation Ditch	X2056R, X2060R	P2049L, P2058L, P2059R, P2062L	3.5	5.0	1.5	19.3	24.4	5.1	ID-17
DP2064R	Ditch between NB SH 119 and BNSF Railroad	X2064R	P2063R, P2064R, P2066R	2.6	4.1	1.5	13.5	17.3	3.8	
DP2079L	City of Boulder and Northern Colorado Water Conservancy District Irrigation Line	X2079R	P2075L, P2077L, P2079L	1.2	1.4	0.2	7.5	7.2	-0.2	ID-19
DP2085R	Ditch between NB SH 119 and BNSF Railroad	X2085R	P2084L, P2085R	1.3	1.8	0.5	8.9	9.7	0.8	
DP2085L	Dry Creek	X2090R, X2099R, X2100R	P2085L, P2092R, P2093R, P2098R, P2100R, P2100L	2.3	3.0	0.8	18.5	19.2	0.7	
DP3049R	Star Irrigation Ditch	X3049R	P3049L, P3049R	2.4	3.4	1.0	10.3	11.9	1.7	ID-30
DP3052R	Ditch between NB SH 119 and BNSF Railroad	X3052L	P3052R	0.7	0.9	0.2	2.8	3.2	0.4	
DP4028R	Water Quality Extended Detention Basin North of Niwot Road	X4019RA, X4021R, X4023R, X4028R	P4021R, P4023R, P4028L, P4028R	4.1	8.7	4.6	21.9	23.2	1.3	
DP4044R	Williamson Irrigation Ditch	X4019RA, X4021R, X4023R, X4028R, X4044R	P4021R, P4023R, P4028L, P4028R, P4040L, P4044R	4.1	7.0	2.9	21.9	26.4	4.5	ID-31
DP4054R	Ditch between NB SH 119 and BNSF Railroad	X4054R	P4053L, P4054R	1.0	1.7	0.7	8.5	10.2	1.7	
DP4065R	Williamson Irrigation Ditch	X4065R	P4060L, P4065R	1.4	1.5	0.2	9.6	8.2	-1.5	ID-32
DP4075L	Ditch outside and adjacent to SB SH 119	X4076LA	P4075L	0.7	0.2	-0.5	8.0	4.2	-3.8	
DP4076L	Ditch outside and adjacent to SB SH 119	X4076L	P4074R, P4076L	0.4	1.7	1.2	1.8	7.0	5.2	ID-37
DP4081L	Ditch outside and adjacent to SB SH 119	X4082L	P4081R, P4081L	0.8	1.6	0.8	6.9	7.7	0.7	
DP4087L	Point outside of SB SH 119, potentially a secondary line of Williamson Irrigation Ditch	X4087L	P4086R, P4087L	1.7	1.8	0.1	9.1	8.7	-0.4	
DP4091L	Point outside of SB SH 119	X4091L	P4091R, P4091L	2.5	2.7	0.2	9.3	9.2	-0.1	

Table 4 (continued). *Existing and Proposed Flowrate Comparison*

Design Point	Description	Contributing Basins		Design Storm Q_5 (cfs)			Major Storm Q_{100} (cfs)			Irrigation ID
		Existing	Proposed	Existing	Proposed	Δ Flow	Existing	Proposed	Δ Flow	
DP4095R	Point outside of SB SH 119	X4096L	P4093L, P4095R	1.2	1.3	0.1	3.8	3.8	0.0	
DP4114L	Point outside of SB SH 119	X4114L	P4108R, P4114L	1.8	2.4	0.6	12.2	13.8	1.6	
DP5001L	Point outside of SB SH 119	None	P4117R, P5001L	0.0	2.2	2.2	0.0	10.6	10.6	
DP5006R	Storm system at existing underpass near Airport Road	X5006R, X5007R	P5006R, P5007R	1.3	1.4	0.2	5.5	5.7	0.2	
DP5011L	Lefthand Creek	X5011L, X5011R	P5011R, P5011L	2.5	2.7	0.2	15.8	15.0	-0.9	
DP5013L	Lefthand Creek	X5013L	P5013L	1.6	1.7	0.2	8.0	8.4	0.5	
DP5023R	Ditch between NB SH 119 and BNSF Railroad	X5023R	P5023L, P5023R	1.3	1.4	0.1	7.4	7.8	0.4	
DP5033R	Lefthand Creek	X5033R	P5030L, P5033R	1.2	1.2	0.0	8.9	6.5	-2.4	
DP5041R	Ditch between NB SH 119 and BNSF Railroad	X5041R	P5040L, P5041R	0.5	0.6	0.1	4.8	2.4	-2.4	
DP5048R	Ditch between NB SH 119 and BNSF Railroad	X5048R	P5048L, P5048R	0.5	1.4	1.0	5.0	4.7	-0.3	
DP5064R	Ditch between NB SH 119 and BNSF Railroad	X5052L, X5064R	P5064R	1.9	2.1	0.2	16.5	12.5	-3.9	
DP5066R	Ditch between NB SH 119 and BNSF Railroad	X5066R	P5066R	0.3	0.5	0.1	6.2	5.0	-1.3	
DP5068R	Holland Ditch	X5068R, X5075R	P5052L, P5066L, P5076R, P5068R, P5084L, P5084R	5.3	9.2	3.9	46.0	56.6	10.6	ID-34

4.3 Hydraulic Analysis

Proposed ditches, inlets, and pipes were analyzed for capacity and meeting criteria. An analysis for every ditch, inlet, and pipe was not performed at the preliminary level. Rather, a typical ditch, inlet, and pipe was compared to peak flowrates to understand the performance of proposed hydraulic facilities at a broad level.

Hydraulic analysis of specific features required for final design.

4.3.1 Ditches

Proposed ditches adjacent to the bikeway were evaluated based on the capacity of a 6", 12", or 18" triangular ditch. Bentley FlowMaster results show a 6" or 12" triangular ditch typically has sufficient capacity to convey the 5-year and 100-year peak flowrates. Please refer to hydraulic calculations in **Appendix C** for more information.

Maximum and minimum longitudinal slope criteria will be subject to proposed grading for the bikeway and existing terrain. A 3:1 (H:V) side slope is anticipated to be feasible in most locations for proposed ditches. A minimum freeboard of 1-ft will not be feasible if a 6" or 12" ditch is selected. Preliminary calculations show a maximum Froude number of 0.6 is feasible for the 5-yr design storm for proposed ditches.

What freeboard is feasible for these smaller ditches? Please justify lesser freeboard if these smaller ditches are used or use larger ditch section that achieves 1 foot of freeboard.

4.3.2 Inlets

CDOT Type C and D area inlets are proposed at roughly [illegible] from the CDOT *Drainage Design Manual* (2019) was used to evaluate the capacity of Type C inlets. Results show a Type C inlet will have sufficient capacity for the 5-yr design storm. Please refer to hydraulic calculations in **Appendix C** for more information.

CDOT Type 13 grate inlets are proposed at the bikeway underpasses. Mile High Flood District MHFD-Inlet results show a single Type 13 inlet has insufficient capacity in the 5-yr design storm. Management of runoff around and to the proposed underpasses will need to be analyzed more closely in the next phase of design to reduce runoff to the underpasses and/or upsized the proposed facilities. Please refer to hydraulic calculations in **Appendix C** for more information.

How will potential for icing be addressed for inlets for underpasses?

4.3.3 Pipes

There are two primary applications for proposed drainage pipes, pipe networks for the pump systems at the underpasses and cross-culverts at the bikeway low points.

Results indicate 15" plastic pipes used for the pipe networks at underpasses have sufficient capacity for the 5-year design storm. The hydraulic grade line elevation exceeds the top of pipe elevation in the 100-year event. The analysis was limited to pipes draining by gravity. Potential pump stations and associated discharge pipes were not evaluated during preliminary design.

Results indicate that an 18" culvert crossing the bikeway typically has sufficient capacity to convey flow under the bikeway. An 18" RCP has been selected [illegible] application.

Does this mean that 5-year is conveyed at 80% of full flow capacity or less to avoid surcharge in the minor event?

4.3.4 Pump Stations

Pump station design was not completed with preliminary design and will be completed in the next phase of design.

4.3.5 Riprap

Riprap is placed at the outfall of proposed pipes which are intended for stormwater. The selected dimensions and size of riprap is based on CDOT M-Standard M-601-12.

4.4 Floodplain Impacts

4.4.1 Fourmile Canyon Creek

A proposed bridge for the bikeway spans Fourmile Canyon Creek adjacent to SB (southbound) CO 119. The proposed bikeway will generally be located above the FEMA Zone AE floodplain. As of the preliminary design stage, the abutments of the proposed bridge have been placed to coincide with the CO 119 SB bridge over the creek to avoid eliciting a rise in water surface elevation. The deck of the proposed bridge does not encroach into the Zone AE floodplain.

4.4.2 Dry Creek

The proposed bikeway will traverse the median of CO 119 and cross Dry Creek. An 12'x8' box culvert crossing under SB CO 119 is used to carry bicyclists, pedestrians, etc. along the "LOBO Reservoir Trail" which is adjacent to Dry Creek. A levee wall separates the LOBO Reservoir Trail from Dry Creek. The proposed bikeway has been designed to traverse up and over the eastern end of an existing box culvert.

A spur connection is proposed from the proposed bikeway to the LOBO trail in the highway median. The spur connection will create an opening in a retaining wall along the existing trail to allow bicyclists and pedestrians to transfer between paths.

Impacts of these improvements to the floodplain are anticipated to be minimal. Ongoing modeling is being performed to confirm the impacts and to determine the need for a no rise certification or Certified Letter of Map Revision (CLOMR).

4.4.3 Lefthand Creek

The floodway and floodplain are very expansive around the Lefthand Creek crossing. The proposed bikeway will be located within the Regulatory Floodway and the Zone AE Floodplain from north of Airport Road to the northern limits of the project per the CHAMP floodplain model .

Two structures are being evaluated to determine if they encroach into the Regulatory Floodway and Zone AE Floodplain. The two structures are a proposed underpass for the bikeway under southbound CO 119 south of Airport Road and a proposed bridge spanning Lefthand Creek north of Airport Road.

The water surface elevation of the Zone AE Floodplain is anticipated to rise more than 0.01 feet due to the bikeway improvements. Therefore, a CLOMR and Letter of Map Revision (LOMR) are anticipated for the improvements.

5 WATER QUALITY

Polluted stormwater runoff is commonly transported via municipal separate storm sewer systems (MS4s) into nearby rivers and streams. Under the 1987 Clean Water Act (CWA) Amendments, the Environmental Protection Agency (EPA) developed Stormwater Phase I and Phase II Regulations which established a MS4 program that manages and regulates stormwater impacts on water quality. The MS4 stormwater management program is intended to improve the Nation's waterways by reducing the quantity of pollutants that stormwater picks up and carries into the storm sewer systems. Among other requirements, the regulations require regulated entities to acquire a National Pollutant Discharge Elimination System (NPDES) Permit for their stormwater discharges.

In Colorado, these regulations are administered by the Colorado Department of Public Health and Environment's (CDPHE) Water Quality Control Commission (WQCC). The Colorado stormwater NPDES permit program is referred to as the Colorado Discharge Permit System (CDPS). The WQCC division regulates sources of pollution from pipes and drains (that do not include runoff from agricultural fields) that flow directly from qualifying municipalities to state waters via two types of permits: individual permits (large entities that need their own permit to cover the work they do) and General Phase II permits.

This project has overlapping MS4 permits, CDOT's individual permit and Boulder County's Statewide General Permit. CDOT is regulated by a Phase I MS4 permit (COS-000005) that covers state and interstate highways and their rights-of-way within urbanized boundaries, as defined by CDPHE. Boulder County is regulated by Statewide standard MS4 General Permit (COR090000). As part of these permits, there are several different programs in place to reduce the amount of pollutants entering Colorado's waterways. Two of the programs that are examined herein are the Permanent Water Quality (PWQ) Program and the Construction Sites Program. Below is a discussion of the project's permanent water quality and construction stormwater management needs as they pertain to these programs.

5.1 Permanent Water Quality

Muller has evaluated the project permanent water quality needs for both CDOT's and Boulder County's MS4 permit. Both permits have a PWQ control measure exemption for trail projects. Therefore, PWQ control measures are not required for the project.

5.2 Construction Stormwater Management

A Stormwater Management Plan (SWMP) and SWMP Site Maps are e
permits for Stormwater Discharges Associated with Construction Activ o
identify BMP/Control Measures, non-structural (i.e., administrative measu d
structural, which will be used throughout each phase of the construct e
erosion and protect water quality. The Stormwater Management Plan (P
Site Maps will be included with the project Final Construction documents

It would be good to note that in areas where the bike path drains to receiving pervious areas, there will be some treatment provided via volume reduction/infiltration even if it is not required.

6 CONCLUSIONS

6.1 Compliance with Standards

The drainage design for CO 119 Bikeway Project is in accordance with the CDOT Drainage Design Criteria Manual, the Boulder County Storm Drainage Criteria Manual, and the Boulder County Multimodal Transportation Standards.

6.2 Drainage Concept

This report presents the drainage analyses and design for the CO 119 Bikeway Project. The overall drainage concept is outlined below:

1. Historic drainage patterns will be maintained.

2. Culverts, inlets, and ditches have been designed to manage runoff.

3. Drainage design assumes the CO 119 Safety and Mobility project is constructed concurrently.

4. Trail projects are exempt from post-construction stormwater quality management per CDOT's and Boulder County's MS4 permits. Therefore, permanent water quality control measures are not required.

7 REFERENCES

AECOM, *Conditional Letter of Map Revision Lefthand Creek 1901 South Hover Street Development Project, Longmont, Boulder County*, 2020

Belt Collins West LTD., *LOBO Trail: IBM Connection Final Hydraulic Design Report*, 2012

Boulder County *Multimodal Transportation Standards (MTS)*, 2012

Boulder County *Storm Drainage Criteria Manual (SDCM)*, 2016

Colorado Department of Transportation (CDOT) *Drainage Design Manual,* 2019

Felsburg, Holt & Ullevig, *Hydrology and Hydraulics Report for the Intersections SH 119 at Jay Rd and SH 119 at Niwot Rd,* May 2012

Muller Engineering Company, *SH 119 at SH 52 (Mineral Road) Final Drainage Report*, November 2005

Drexel , Barrell, and Co., *Vojta Farm Final Stormwater Report*, July 9, 2008

USGS StreamStats, *United States Department of the Interior*, Accessed June 24, 2022

APPENDIX A

Maps and References

Hydrologic Criteria Table

Hydraulic Criteria Table

Existing Basin Map

Proposed Basin Map

Irrigation Crossing Inventory Map

Hydrologic Soils Report (NRCS)

Point Precipitation Data (NOAA Atlas 2)

FEMA Flood Zone Maps

Hydrologic Criteria Table

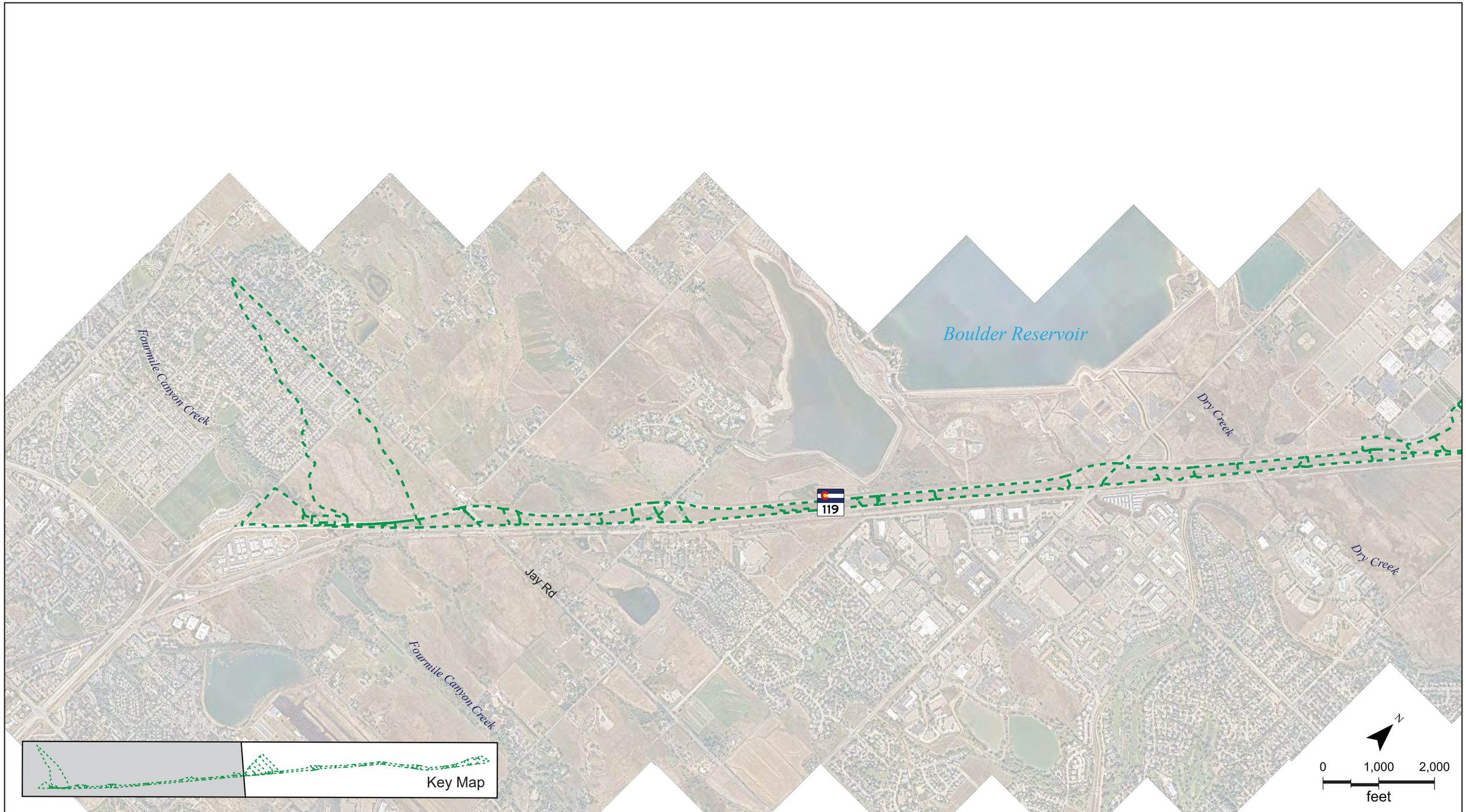
SH 119 Bikeway Hydrologic Design Criteria					
Hydrologic Criteria	CDOT		Boulder County		Applied Criteria
	CDOT Drainage Design Manual (2019)		Multimodal Transportation Standards (MTS) [2012] or Storm Drainage Criteria Manual (SDCM) [2016]		
Design Frequency					
Cross Drainage					
Multi-lane Road (Urban)	100-year	Table 7.2	Minor: 5-year Major: 100-year	Section 3, 304 (SDCM)	100-year
Multi-lane Road (Rural)	50-year				50-year
Two Lane Road (Urban)	100-year				100-year
Two Lane Road (Rural)	25-year (assuming Q<4000 cfs)				25-year
Culvert Outlet Scour Protection	10-year		-		10-year
Pedestrian Walkways and Bikeways	2-year to 5-year		5-year	5.7.4 (MTS)	5-year
Parallel Drainage					
Roadway Overtopping & Revetment	*Same as for cross drainage*	Table 7.2	Minor: 5-year Major: 100-year	Section 3, 304 (SDCM)	*Same as for cross drainage*
Side Drains	2 to 5-year				10-year
Storm Drains					
Major Storm	100-year	Table 7.2	100-year	Section 3, 304 and Section 9 (SDCM)	100-year
Minor Storm	2 to 5-year		5-year		5-year
Channels					
Capacity	*Refer to Parallel or Cross Drainage*	Ch. 8.4	Minor: 5-year Major: 100-year	Section 3, 304 and Section 7 (SDCM)	*Depends on roadway classification*
Lining					10-year
Hydrologic Procedure Selection					
Hydrologic Peak Prediction Procedure					
Drainage Area	Rational Method (<200 ac) CUHP (most desireable), NRCS TR55, Snyder's Unit Hydrograph, SCS Synthetic Unit Hydrograph, others (>200 ac)	Ch. 7.4.1	Rational Method (not to exceed 90 ac)	Section 6, 602 (SDCM)	Rational Method (<200 ac) CUHP and EPA-SWMM (>200 ac)
Time of Concentration (Tc) for Rational Method					
Min. Tc for urban areas	5 min.	Ch. 7.4.5	5 min.	Section 6, 602.2	5 min.
Min. Tc for non-urban areas	10 min.		10 min.		10 min.
Max. Overland Flow Path Length (urban)	300 ft		300 ft	Section 6, Table 600-1	300 ft
Max. Overland Flow Path Length (rural)	500 ft		500 ft		500 ft

See comments above. 90 acres is max for Rational Method.

Hydraulic Criteria Table

SH 119 Bikeway Hydraulic Design Criteria							
Hydraulic Criteria	CDOT		Boulder County		MHFD		Applied Criteria
	CDOT Drainage Design Manual (2019)		Multimodal Transportation Standards (MTS) [2012] or Storm Drainage Criteria Manual (SDCM) [2016]		Urban Storm Drainage Criteria Manual (USDCM)		
Bike Trails							
Minimum Transverse Slope	-	-	2.0%	5.7.3.2 (MTS)	-	-	2.0%
Storm Drain and Culverts							
Min.Pipe Diameter							
Storm Drain Trunk, Median Drain, Side Drain, Irrigation	18 in.	Ch. 13.3.6	18 in.	Section 802.4 (SDCM)	-	-	18 in.
Lateral (Median drain to cross culvert; Curb inlet to trunk line)	15 in.		15 in.				15 in.
Cross Culvert (for State Highways)	24 in.	Table 9.4	18 in. (for any culvert)	Section 1002.2 (SDCM)			24 in.
Pipe Velocity							
Minimum	3 ft/s	Ch. 13.3.6	Not Stated - Refer to MHFD	-	3 ft/s	Ch. 11.4.4.6	3 ft/s
Maximum	Consistent with velocity in downstream channel, energy dissipators required for V>16 fps in channels	Ch. 9.2.2	15 fps	Section 802.6 (SDCM)	-	-	15 ft/s
Manhole Spacing (Max)							
15 in. - 48 in. pipe	300 ft	Table 13.3	Not Stated - Refer to MHFD	-	<400 ft	Ch. 7.4.2	300 ft
>48 in. pipe	600 ft						600 ft
Maximum Allowable Culvert Headwater to Depth Ratio							
D (dia. or ht. or rise) < 36 in.	2.0	Table 9.3	2.0 (100-yr)	Section 1002.4 (SDCM)	-	-	2.0
36 in. ≤ D ≤ 60 in.	1.7		1.5 (100-yr)				1.7
60 in. < D < 84 in.	1.5						1.5
84 in. ≤ D < 120 in.	1.2						1.2
120 in. ≤ D	1.0						1.0
Channels and Roadside Ditches							
Ditch Linings							
Riprap Sizing	Use HY-8 or FHWA software	Ch. 11.5	Not Stated - Refer to MHFD	-	Unit discharge/slope equations by CSU, USDA, or USACE	Ch. 8.1.2	Use HY-8 or FHWA software
Channel/Ditch Design							
Side Slope (H:V, max)	3.0:1 (grass), 2.5:1 (riprap)	Table 8.2	Not Stated - Refer to MHFD	-	Non-cohesive Soils/Poor vegetation: 7 ft/s Cohesive Soils and Vegetation: 5ft/s	Table 8-3	3:1
Froude Number (max.)	0.6 (grass), 0.8 (riprap)		No max if flow depth is less than 1 foot. 0.8 if flow depth > 1 ft.	Table 700-3	-	-	0.6 (grass), 0.8 (riprap)
Minimum Freeboard	1-foot		Not Stated - Refer to MHFD	-	1.5 feet (recommended - not required)	Table 8-2	1-foot
Max. Longitudinal Slope	0.6% (grass-lined) 1.0% (riprap-lined) 0.5% (natural)		Designed such that V> 7 fps and Froude # is less than 0.8 (only if flow depth > 1.0 ft)	Table 700-3	-	-	0.6% (grass-lined) 1.0% (riprap-lined) 0.5% (natural) while V>7 fps and Froude # < 0.8 if flow depth exceeds 1 ft
Min. Longitudinal Slope	0.2% (grass-lined and riprap-lined) Match adjacent for natural		-	-	-	-	0.2% (grass-lined and riprap-lined) Match adjacent for natural
Bridges							
Freeboard							
Low to Moderate Debris Stream	2 ft	Ch. 10.2.2	1 ft above EGL	1004.1	-	-	2 ft
High Debris Stream	4 ft						4 ft

Existing Basin Map



MULLER

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
	Detailer: SR2		
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 1 of 13	Sheet Subset:

MULLER

CDOT

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
	Detailer: SR2		
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 2 of 13	Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X1016L	3.3	27.0
X1017L	1.3	4.0
X1018L	0.6	5.2
X1021R	1.1	2.2
X1029R	28.5	142.5
X1030R	0.1	2.1
X1032R	0.1	1.3
X1034R	0.2	3.1

Fourmile Canyon Creek

X1016L: 10.7 | 0.12 / 0.50

X1017L: 0.70 | 0.42 / 0.67

X1018L: 1.91 | 0.11 / 0.50

X1029R: 101.56 | 0.22 / 0.58

X1030R: 0.94 | 0.05 / 0.49

X1032R: 0.36 | 0.05 / 0.49

X1034R: 1.25 | 0.05 / 0.49

X1021R: 0.28 | 0.86 / 0.90

1000+00 1001+00 1002+00 1003+00 1004+00 1005+00 1006+00 1007+00 1008+00 1009+00 1010+00 1011+00 1012+00 1013+00 1014+00 1015+00 1016+00 1017+00 1018+00 1019+00 1020+00 1021+00 1022+00 1023+00 1024+00 1025+00 1026+00 1027+00 1028+00 1029+00 1030+00 1031+00 1032+00 1033+00 1034+00 1035+00 1036+00 1037+00 1038+00 1039+00 1040+00 1041+00 1042+00 1043+00

MATCH LINE STA. 1044+00

DP 1016L · DP 1017L · DP 1018L · DP 1029R · DP 1030R · DP 1032R · DP 1034R

119

Key Map

0 250 500 feet

Existing Basin · Basin Flowpath · Proposed Bikeway ALG · Existing Pipe · Survey Major Contour · Survey Minor Contour

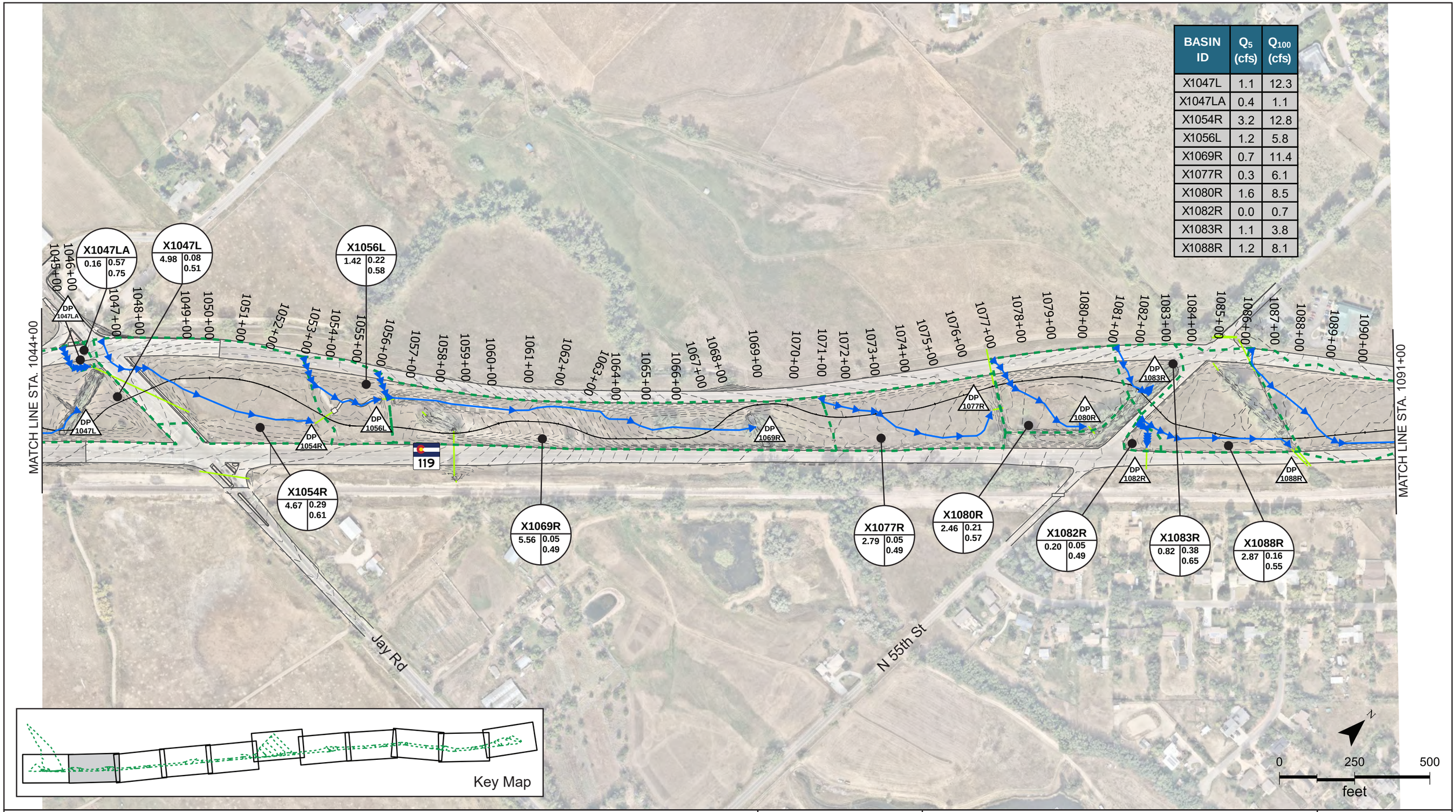
BASIN ID (AREA (AC) | C5 | C100)

DP 123R Design Point

MULLER · CDOT

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 3 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X1047L	1.1	12.3
X1047LA	0.4	1.1
X1054R	3.2	12.8
X1056L	1.2	5.8
X1069R	0.7	11.4
X1077R	0.3	6.1
X1080R	1.6	8.5
X1082R	0.0	0.7
X1083R	1.1	3.8
X1088R	1.2	8.1



MULLER

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Detailer: SR2			Sheet Subset:
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 4 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X2010R	1.0	10.0
X2019R	0.3	6.2
X2022R	0.2	0.7
X2022RA	0.1	2.6
X2031R	0.6	8.0

Sixmile Reservoir

MATCH LINE STA. 1091+00

MATCH LINE STA. 2036+00

1092+00 1093+00 1094+00 1095+00 1096+00 1097+00 1098+00 1099+00 2000+00 2001+00 2002+00 2003+00 2004+00 2005+00 2006+00 2007+00 2008+00 2009+00 2010+00 2011+00 2012+00 2013+00 2014+00 2015+00 2016+00 2017+00 2018+00 2019+00 2020+00 2021+00 2022+00 2023+00 2024+00 2025+00 2026+00 2027+00 2028+00 2029+00 2030+00 2031+00 2032+00 2033+00 2034+00 2035+00

DP 2010R

119

DP 2019R

DP 2022RA

DP 2022R

DP 2031R

X2010R
8.15 | 0.10 | 0.51

X2019R
4.76 | 0.05 | 0.49

X2022RA
1.16 | 0.05 | 0.49

X2022R
0.12 | 0.26 | 0.60

X2031R
3.60 | 0.07 | 0.50

Key Map

N

0 250 500
feet

MULLER

CDOT

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
	Detailer: SR2		
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 5 of 13	Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X2056R	1.2	11.3
X2060R	5.7	19.3
X2064R	2.6	13.5

MATCH LINE STA. 2036+00

2037+00 2038+00 2039+00 2040+00 2041+00 2042+00 2043+00 2044+00 2045+00 2046+00 2047+00 2048+00 2049+00 2050+00 2051+00 2052+00 2053+00 2054+00 2055+00 2056+00 2057+00 2058+00 2059+00 2060+00 2061+00 2062+00 2063+00 2064+00 2065+00 2066+00 2067+00 2068+00 2069+00 2070+00 2071+00 2072+00 2073+00 2074+00 2075+00 2076+00 2077+00

MATCH LINE STA. 2078+00

DP 2056R

DP 2060R

DP 2064R

119

X2056R
9.09 | 0.10 | 0.52

X2060R
5.16 | 0.36 | 0.65

X2064R
5.43 | 0.21 | 0.57

63rd St

Key Map

N

0 250 500
feet

MULLER

CDOT

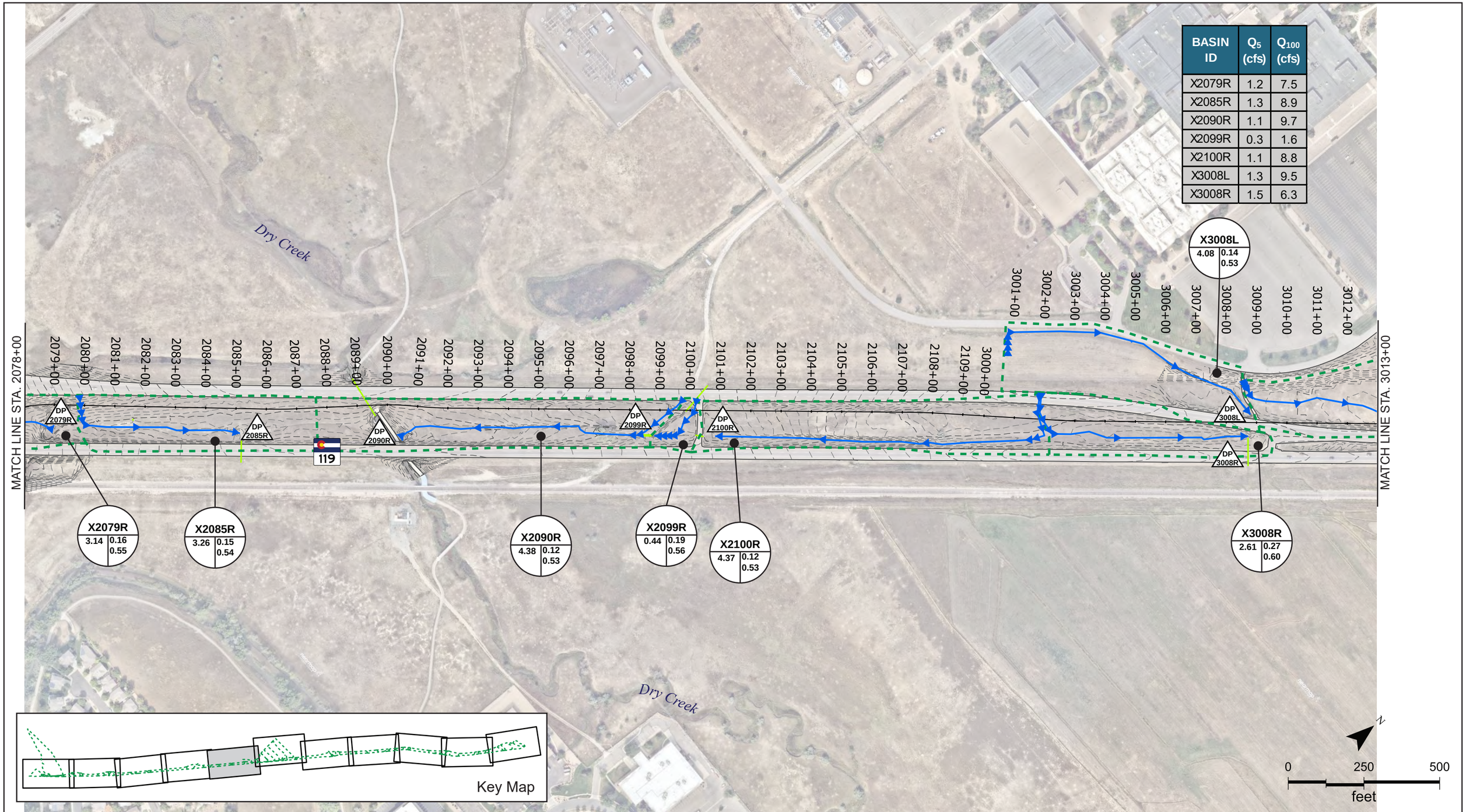
Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 | C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Detailer: SR2			
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 6 of 13	Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X2079R	1.2	7.5
X2085R	1.3	8.9
X2090R	1.1	9.7
X2099R	0.3	1.6
X2100R	1.1	8.8
X3008L	1.3	9.5
X3008R	1.5	6.3



MULLER

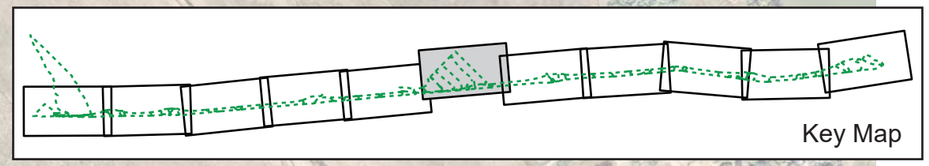
Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY			Project No. / Code
No Revisions:				
Revised:	Designer: ACF	Structure Numbers		
Void:	Detailer: SR2			Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset:	7 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X3013L	1.2	8.3
X3023L	3.7	21.4
X3023R	2.6	5.9
X3029R	4.9	27.0
X3033R	13.6	45.3
X3033RA	1.0	2.6
X3036L	12.0	39.9
X3038R	0.7	3.7
X3042L	0.9	5.3
X3042R	1.4	5.4
X3048L	3.5	31.3
X3049R	2.4	10.3
X3052L	0.7	2.8



N

0 250 500
feet

X3013L 2.81 | 0.15 | 0.54
X3023L 10.96 | 0.18 | 0.56
X3033R 17.48 | 0.37 | 0.65
X3036L 24.91 | 0.37 | 0.65
X3048L 22.96 | 0.11 | 0.52
X3042L 2.30 | 0.19 | 0.56
X3052L 0.61 | 0.31 | 0.62
X3023R 1.18 | 0.68 | 0.80
X3029R 13.74 | 0.19 | 0.56
X3033RA 0.74 | 0.50 | 0.71
X3038R 1.07 | 0.21 | 0.57
X3042R 1.36 | 0.31 | 0.62
X3049R 3.63 | 0.26 | 0.60

DP 3013L, DP 3023L, DP 3029R, DP 3033L, DP 3036L, DP 3038R, DP 3042L, DP 3048L, DP 3052L

3014+00 3015+00 3016+00 3017+00 3018+00 3019+00 3020+00 3021+00 3022+00 3023+00 3024+00 3025+00 3026+00 3027+00 3028+00 3029+00 3030+00 3031+00 3032+00 3033+00 3034+00 3035+00 3036+00 3037+00 3038+00 3039+00 3040+00 3041+00 3042+00 3043+00 3044+00 3045+00 3046+00 3047+00 3048+00 3049+00 3050+00 3051+00 3052+00 3053+00 3054+00 3055+00 3056+00 3057+00 3058+00

MATCH LINE STA.3013+00

MATCH LINE STA. 3059+00

52

119

Monarch Rd

MULLER

CDOT

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 | C100

DP 123R
Design Point

As Constructed	
No Revisions:	
Revised:	
Void:	

EXISTING DRAINAGE BASIN MAPS
CO 119 BIKEWAY

Designer:	ACF	Structure Numbers	
Detailer:	SR2		
Sheet Subset:	DRAINAGE	Sheet Subset:	8 of 13

Project No. / Code

Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X4019R	1.6	15.4
X4019RA	0.6	1.4
X4021R	1.0	2.3
X4023R	3.6	11.2
X4028R	1.9	10.8

MATCH LINE STA.3059+00

3060+00 3061+00 3062+00 3063+00 3064+00 4000+00 4001+00 4002+00 4003+00 4004+00 4005+00 4006+00 4007+00 4008+00 4009+00 4010+00 4011+00 4012+00 4013+00 4014+00 4015+00 4016+00 4017+00 4018+00 4019+00 4020+00 4021+00 4022+00 4023+00 4024+00 4025+00 4026+00 4027+00 4028+00 4029+00 4030+00 4031+00 4032+00 4033+00 4034+00 4035+00 4036+00 4037+00

MATCH LINE STA. 4038+00

119

DP 4019RA
DP 4021R
DP 4023R
DP 4019R
DP 4028R

X4019R
16.48 | 0.10 | 0.52

X4019RA
0.21 | 0.65 | 0.79

X4021R
0.35 | 0.69 | 0.81

X4023R
3.89 | 0.42 | 0.68

X4028R
2.91 | 0.18 | 0.56

Niwot Rd

N

0 250 500
feet

Key Map

MULLER

CDOT

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 9 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X4044R	0.7	9.8
X4054R	1.0	8.5
X4065R	1.4	9.6
X4076LA	0.7	8.0
X4076L	0.4	1.8
X4082L	0.8	6.9

MATCH LINE STA. 4038+00

4039+00 4040+00 4041+00 4042+00 4043+00 4044+00 4045+00 4046+00 4047+00 4048+00 4049+00 4050+00 4051+00 4052+00 4053+00 4054+00 4055+00 4056+00 4057+00 4058+00 4059+00 4060+00 4061+00 4062+00 4063+00 4064+00 4065+00 4066+00 4067+00 4068+00 4069+00 4070+00 4071+00 4072+00 4073+00 4074+00 4075+00 4076+00 4077+00 4078+00 4079+00 4080+00 4081+00 4082+00

MATCH LINE STA. 4084+00

DP 4044R
DP 4054R
DP 4065R
DP 4076LA
DP 4076L
DP 4082L

119

X4044R: 7.65 | 0.07 / 0.50
X4054R: 4.90 | 0.12 / 0.52
X4065R: 4.64 | 0.14 / 0.54
X4076LA: 4.51 | 0.09 / 0.51
X4076L: 0.60 | 0.27 / 0.60
X4082L: 2.95 | 0.12 / 0.53

Key Map

N

0 250 500
feet

MULLER

CDOT

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
	Detailer: SR2		
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 10 of 13	Sheet Subset:

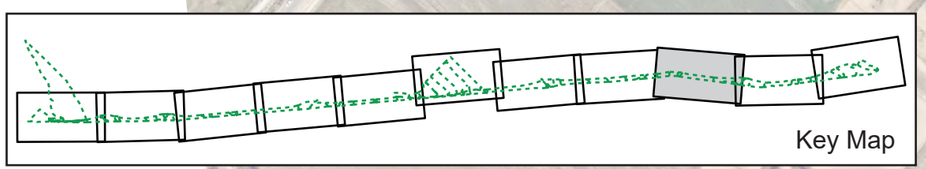
BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X4087L	1.7	9.1
X4091L	2.5	9.3
X4096L	1.2	3.8
X4114L	1.8	12.2
X5006R	1.1	5.1
X5007R	0.2	0.6

Left Hand Creek

X4087L: 3.13 | 0.20 | 0.57
X4091L: 2.40 | 0.32 | 0.63
X4096L: 0.92 | 0.38 | 0.66
X4114L: 8.50 | 0.15 | 0.54
X5006R: 1.44 | 0.25 | 0.59
X5007R: 0.10 | 0.35 | 0.64

DP 4087L
DP 4091L
DP 4096L
DP 4114L

MATCH LINE STA.4083+00
MATCH LINE STA. 5008+00
N 83rd St
119



N
0 250 500
feet

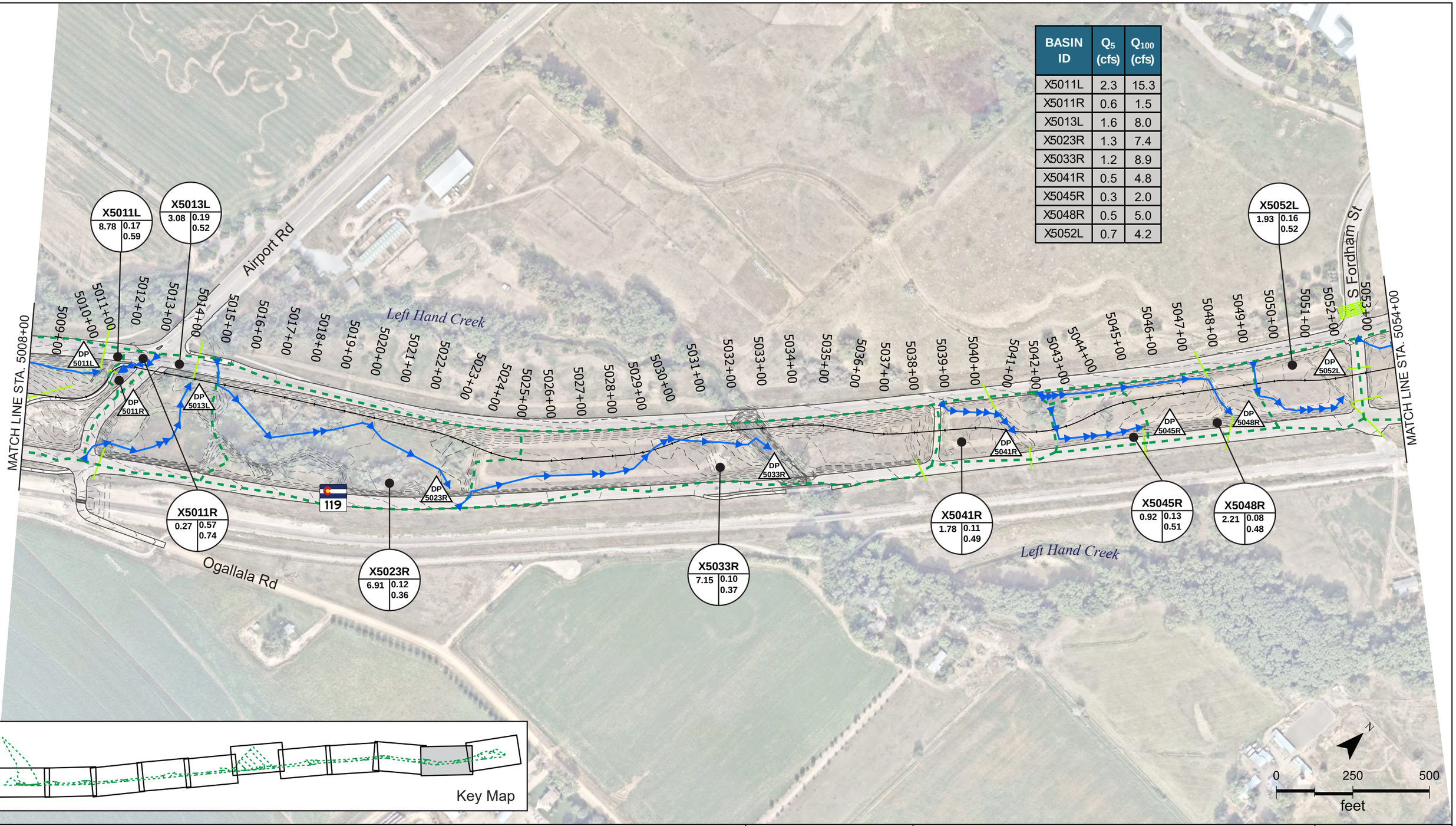
MULLER

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100
Design Point
DP 123R

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 11 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X5011L	2.3	15.3
X5011R	0.6	1.5
X5013L	1.6	8.0
X5023R	1.3	7.4
X5033R	1.2	8.9
X5041R	0.5	4.8
X5045R	0.3	2.0
X5048R	0.5	5.0
X5052L	0.7	4.2



MULLER

Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 12 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
X5064R	1.5	13.6
X5066R	0.3	6.2
X5068R	2.5	24.4
X5075R	2.8	21.6
X5084R	2.5	15.6

S Fordham St

S Hover St

MATCH LINE STA. 5054+00

5055+00 5056+00 5057+00 5058+00 5059+00 5060+00 5061+00 5062+00 5063+00 5064+00 5065+00 5066+00 5067+00 5068+00 5069+00 5070+00 5071+00 5072+00 5073+00 5074+00 5075+00 5076+00 5077+00 5078+00 5079+00 5080+00 5081+00 5082+00 5083+00 5084+00 5085+00 5086+00 5087+00 5088+00

DP 5064R
DP 5066R
DP 5068R
DP 5075R
DP 5084R

119

X5064R
9.61 | 0.10 | 0.49

X5066R
4.10 | 0.05 | 0.46

X5068R
11.18 | 0.10 | 0.50

X5075R
9.68 | 0.13 | 0.53

X5084R
6.80 | 0.17 | 0.55

Key Map

N

0 250 500
feet

MULLER

CDOT

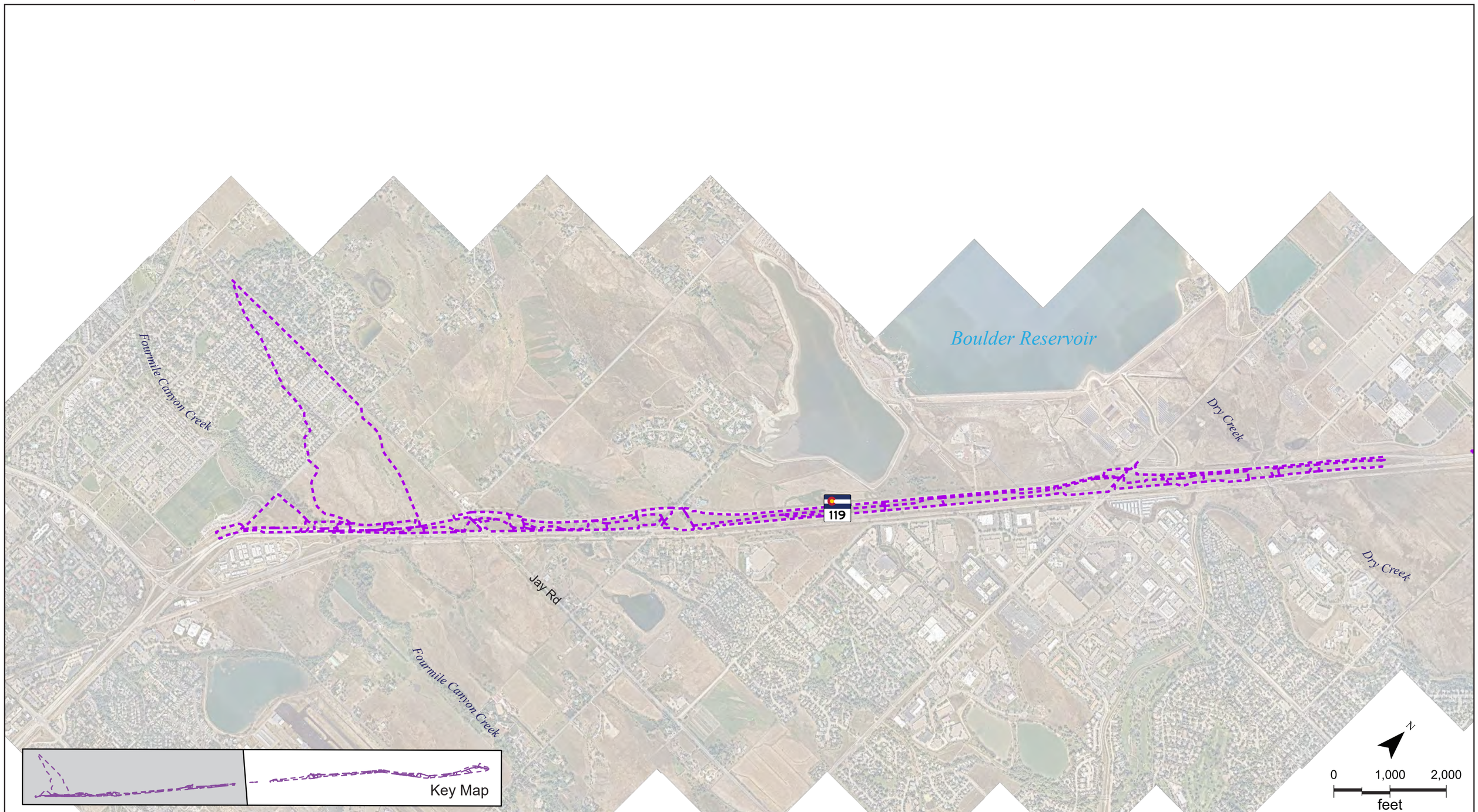
Existing Basin
Basin Flowpath
Proposed Bikeway ALG
Existing Pipe
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	EXISTING DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 13 of 13	

Proposed Basin Map



MULLER

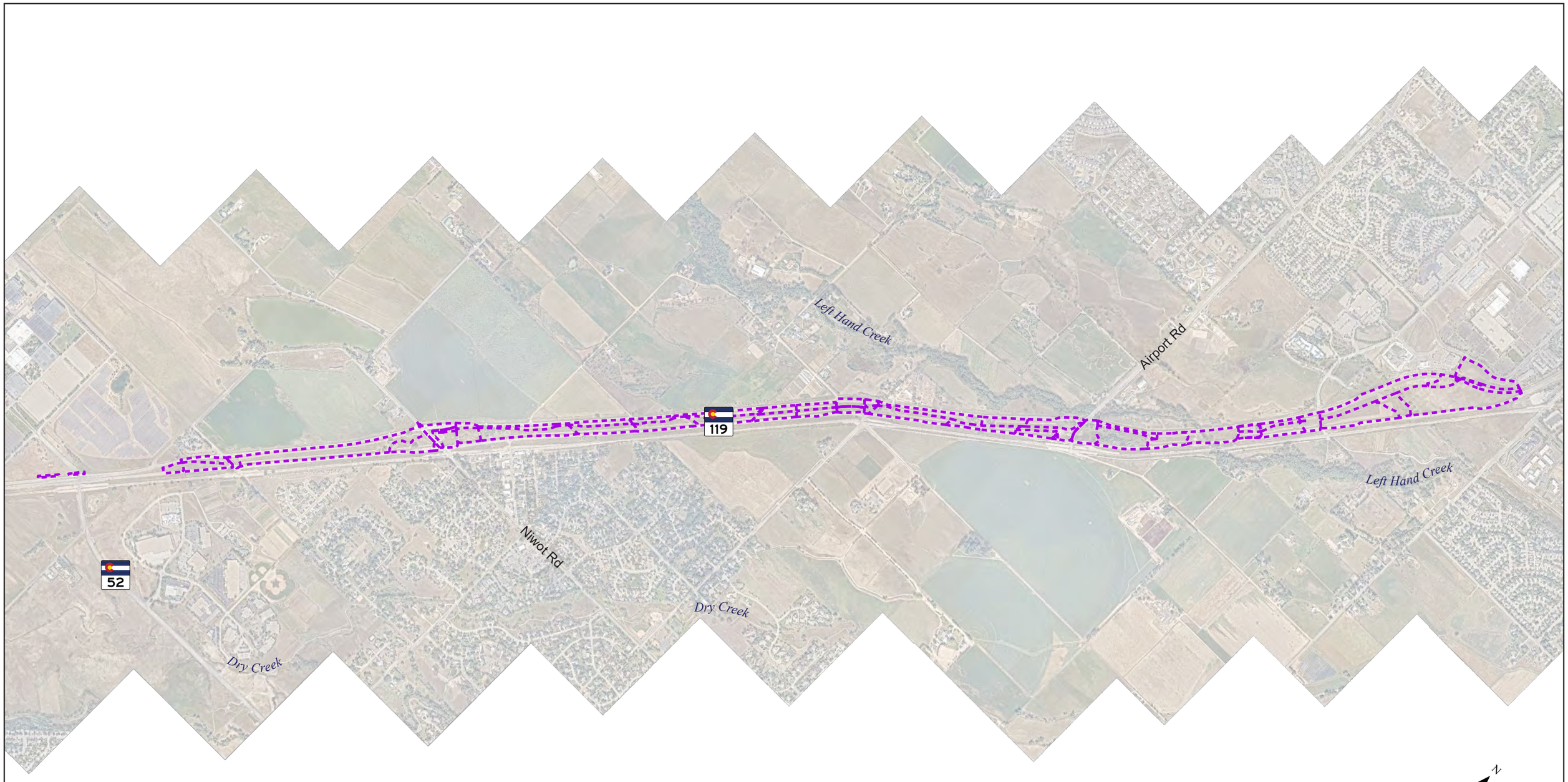
CDOT

- Proposed Basin
- Basin Flowpath
- Proposed Bikeway Layout
- Future Bikeway
- Bikeway Underpass
- Proposed Mobility Layout
- Proposed Bikeway ALG
- Existing Pipe
- Proposed Major Contour
- Proposed Minor Contour
- Survey Major Contour
- Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 1 of 13	



MULLER

CDOT

- Proposed Basin
- Basin Flowpath
- Proposed Bikeway Layout
- Future Bikeway
- Bikeway Underpass
- Proposed Mobility Layout
- Proposed Bikeway ALG
- Existing Pipe
- Proposed Major Contour
- Proposed Minor Contour
- Survey Major Contour
- Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY			Project No. / Code
No Revisions:				
Revised:	Designer: ACF	Structure Numbers		
	Detailer: SR2			
Void:	Sheet Subset: DRAINAGE	Sheet Subset:	2 of 13	Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
P1000R	0.2	2.9
P1013R	1.9	5.5
P1016L	1.3	15.8
P1017L	1.3	4.1
P1018L	0.6	4.3
P1021R	1.0	2.9
P1021RA	1.1	2.2
P1029L	26.5	137.3
P1029R	2.1	5.8
P1030R	0.1	1.7
P1031L	1.6	4.8
P1031R	1.5	4.6
P1032R	0.0	0.9
P1034R	0.2	1.9
P1043R	0.5	3.2

Fourmile Canyon Creek

P1000R 1.41 | 0.07 | 0.47
P1013R 1.54 | 0.46 | 0.69
P1016L 8.85 | 0.08 | 0.48
P1017L 0.71 | 0.42 | 0.67
P1018L 1.27 | 0.14 | 0.53
P1021RA 0.28 | 0.86 | 0.89
P1021R 0.64 | 0.43 | 0.68
X1030R 0.76 | 0.05 | 0.49
P1029R 1.42 | 0.50 | 0.72
P1029L 99.22 | 0.21 | 0.57
P1031R 0.74 | 0.42 | 0.67
P1031L 1.04 | 0.44 | 0.69
P1032R 0.26 | 0.05 | 0.49
P1034R 0.70 | 0.12 | 0.53
P1043R 1.09 | 0.15 | 0.54

DP 1000R, DP 1013R, DP 1016L, DP 1017L, DP 1018L, DP 1021R, DP 1021RA, DP 1029L, DP 1029R, DP 1030R, DP 1031L, DP 1031R, DP 1032R, DP 1034R, DP 1043R

1000+00 1001+00 1002+00 1003+00 1004+00 1005+00 1006+00 1007+00 1008+00 1009+00 1010+00 1011+00 1012+00 1013+00 1014+00 1015+00 1016+00 1017+00 1018+00 1019+00 1020+00 1021+00 1022+00 1023+00 1024+00 1025+00 1026+00 1027+00 1028+00 1029+00 1030+00 1031+00 1032+00 1033+00 1034+00 1035+00 1036+00 1037+00 1038+00 1039+00 1040+00 1041+00 1042+00 1043+00

MATCH LINE STA. 1044+00

119

Key Map

0 250 500 feet

MULLER

Proposed Basin
Basin Flowpath
Proposed Bikeway Layout
Future Bikeway
Bikeway Underpass
Proposed Mobility Layout
Proposed Bikeway ALG
Existing Pipe
Proposed Major Contour
Proposed Minor Contour
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 | C100

DP 123R
Design Point

As Constructed
No Revisions:
Revised:
Void:

PROPOSED DRAINAGE BASIN MAPS
CO 119 BIKEWAY

Designer: ACF
Detailer: SR2
Sheet Subset: DRAINAGE
Structure Numbers
Sheet Subset: 3 of 13

Project No. / Code
Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)	BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
P1044L	0.5	6.7	P1067L	0.9	7.0
MHJRI	1.5	3.1	P1069R	0.5	4.4
P1048L	1.2	6.1	P1076L	0.3	3.1
P1053L	3.5	8.4	P1077R	0.4	4.1
P1054R	1.7	7.2	P1080R	0.5	4.4
P1056L	1.4	5.5	P1082L	2.4	7.2
P1057L	0.2	1.1	P1082R	0.1	0.7
P1063R	0.2	2.2	P1088R	1.9	9.4

MATCH LINE STA. 1044+00

MATCH LINE STA. 1091+00

MHJRI 0.44 | 0.86 | 0.89

P1044L 2.33 | 0.08 | 0.50

P1053L 2.12 | 0.62 | 0.78

P1056L 1.17 | 0.30 | 0.62

P1057L 0.29 | 0.21 | 0.57

P1067L 2.85 | 0.13 | 0.53

P1076L 1.06 | 0.08 | 0.51

P1048L 1.20 | 0.21 | 0.57

P1054R 2.33 | 0.27 | 0.60

P1063R 0.92 | 0.07 | 0.50

P1069R 1.28 | 0.10 | 0.52

P1077R 1.85 | 0.10 | 0.52

P1080R 1.59 | 0.11 | 0.52

P1082R 0.20 | 0.09 | 0.51

P1082L 1.70 | 0.45 | 0.69

P1088R 3.16 | 0.23 | 0.58

DP 1044L, DP 1048L, DP MHJRI, DP 1053L, DP 1054R, DP 1056L, DP 1057L, DP 1063R, DP 1067L, DP 1069R, DP 1076L, DP 1077R, DP 1080R, DP 1082R, DP 1082L, DP 1088R

1045+00 1046+00 1047+00 1048+00 1049+00 1050+00 1051+00 1052+00 1053+00 1054+00 1055+00 1056+00 1057+00 1058+00 1059+00 1060+00 1061+00 1062+00 1063+00 1064+00 1065+00 1066+00 1067+00 1068+00 1069+00 1070+00 1071+00 1072+00 1073+00 1074+00 1075+00 1076+00 1077+00 1078+00 1079+00 1080+00 1081+00 1082+00 1083+00 1084+00 1085+00 1086+00 1087+00 1088+00 1089+00 1090+00

119

Jay Rd

N 55th St

Key Map

0 250 500 feet

MULLER

CDOT

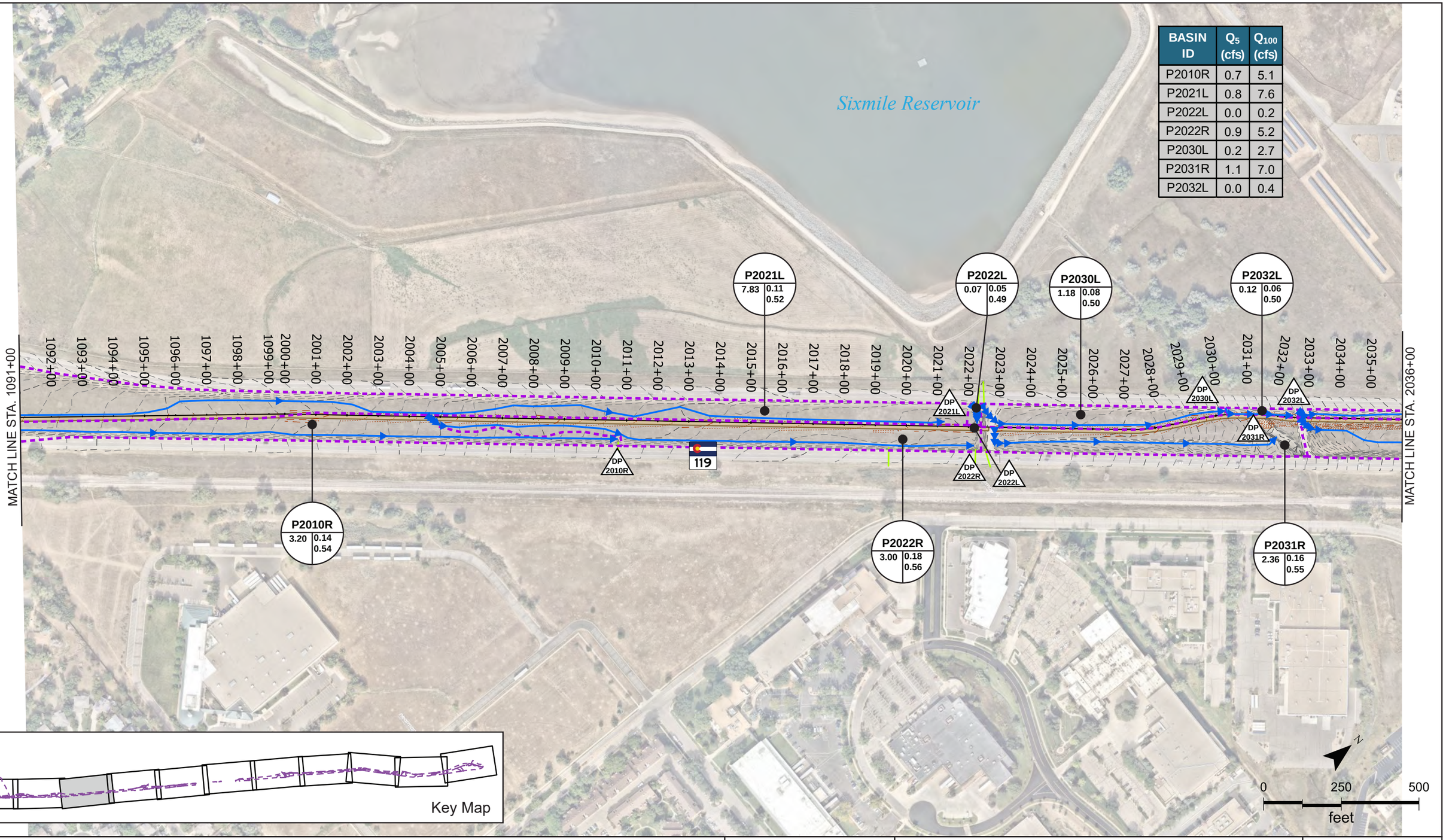
- Proposed Basin
- Basin Flowpath
- Proposed Bikeway Layout
- Future Bikeway
- Bikeway Underpass
- Proposed Mobility Layout
- Proposed Bikeway ALG
- Existing Pipe
- Proposed Major Contour
- Proposed Minor Contour
- Survey Major Contour
- Survey Minor Contour

BASIN ID | AREA (AC) | C5 | C100

DP 123R Design Point

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 4 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
P2010R	0.7	5.1
P2021L	0.8	7.6
P2022L	0.0	0.2
P2022R	0.9	5.2
P2030L	0.2	2.7
P2031R	1.1	7.0
P2032L	0.0	0.4



Proposed Basin
Basin Flowpath
Proposed Bikeway Layout
Future Bikeway
Bikeway Underpass
Proposed Mobility Layout
Proposed Bikeway ALG
Existing Pipe
Proposed Major Contour
Proposed Minor Contour
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY			Project No. / Code
No Revisions:				
Revised:	Designer: ACF	Structure Numbers		
Void:	Detailer: SR2			
	Sheet Subset: DRAINAGE	Sheet Subset:	5 of 13	Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
P2049L	0.2	3.2
P2058L	0.1	1.2
P2059R	3.4	17.7
P2062L	4.2	8.9
P2064R	2.3	9.9
P2066R	1.9	7.9
P2063R	0.5	1.4
P2075L	0.1	1.7
P2077L	0.3	1.5

MATCH LINE STA. 2036+00

2037+00 2038+00 2039+00 2040+00 2041+00 2042+00 2043+00 2044+00 2045+00 2046+00 2047+00 2048+00 2049+00 2050+00 2051+00 2052+00 2053+00 2054+00 2055+00 2056+00 2057+00 2058+00 2059+00 2060+00 2061+00 2062+00 2063+00 2064+00 2065+00 2066+00 2067+00 2068+00 2069+00 2070+00 2071+00 2072+00 2073+00 2074+00 2075+00 2076+00 2077+00

MATCH LINE STA. 2078+00

P2049L 1.75 | 0.06 | 0.50
P2058L 0.53 | 0.05 | 0.49
P2062L 1.13 | 0.78 | 0.86
P2066R 2.26 | 0.27 | 0.60
P2075L 0.58 | 0.08 | 0.50
P2077L 0.37 | 0.19 | 0.56
P2059R 9.82 | 0.21 | 0.57
P2063R 0.23 | 0.43 | 0.68
P2064R 2.43 | 0.27 | 0.60

DP 2049L, DP 2058L, DP 2062L, DP 2059R, DP 2063R, DP 2066R, DP 2064R, DP 2075L, DP 2077L

119

63rd St

0 250 500 feet

Key Map

MULLER

CDOT

- Proposed Basin
- Basin Flowpath
- Proposed Bikeway Layout
- Future Bikeway
- Bikeway Underpass
- Proposed Mobility Layout
- Proposed Bikeway ALG
- Existing Pipe
- Proposed Major Contour
- Proposed Minor Contour
- Survey Major Contour
- Survey Minor Contour

BASIN ID (AREA (AC) | C5 | C100)

DP 123R Design Point

As Constructed

No Revisions:

Revised:

Void:

PROPOSED DRAINAGE BASIN MAPS
CO 119 BIKEWAY

Project No. / Code

Designer: ACF

Detailer: SR2

Structure Numbers

Sheet Subset: DRAINAGE

Sheet Subset: 6 of 13

Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
P2079L	1.1	4.9
P2084L	0.2	2.4
P2085R	1.6	7.6
P2085L	0.9	5.0
P2092R	0.5	1.9
P2093R	0.7	4.3
P2100L	0.3	2.5
P2100R	1.1	7.3
P2098R	0.2	1.4

Dry Creek

MATCH LINE STA. 2078+00

MATCH LINE STA. 3013+00

2079+00 2080+00 2081+00 2082+00 2083+00 2084+00 2085+00 2086+00 2087+00 2088+00 2089+00 2090+00 2091+00 2092+00 2093+00 2094+00 2095+00 2096+00 2097+00 2098+00 2099+00 2100+00 2101+00 2102+00 2103+00 2104+00 2105+00 2106+00 2107+00 2108+00 2109+00 3000+00 3001+00 3002+00 3003+00 3004+00 3005+00 3006+00 3007+00 3008+00 3009+00 3010+00 3011+00 3012+00

DP 2079L
DP 2084L
DP 2085R
DP 2085L
DP 2092R
DP 2093R
DP 2098R
DP 2100L
DP 2100R

119

P2084L: 0.80 | 0.09 / 0.51
P2085L: 2.32 | 0.18 / 0.56
P2100L: 1.09 | 0.10 / 0.52

P2079L: 1.73 | 0.26 / 0.59
P2085R: 2.57 | 0.24 / 0.59
P2092R: 0.39 | 0.32 / 0.63
P2093R: 1.69 | 0.16 / 0.55
P2098R: 0.38 | 0.18 / 0.56
P2100R: 3.11 | 0.17 / 0.55

Dry Creek

Key Map

N

0 250 500
feet

Proposed Basin
Basin Flowpath
Proposed Bikeway Layout
Future Bikeway
Bikeway Underpass
Proposed Mobility Layout

Proposed Bikeway ALG
Existing Pipe
Proposed Major Contour
Proposed Minor Contour
Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100
Design Point

MULLER

CDOT

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 7 of 13	

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
P3021R	0.8	1.6
P3023R	0.7	1.4
P3042R	1.0	4.0
P3049L	1.4	5.1
P3049R	2.0	7.2
P3052R	0.9	3.2

MATCH LINE STA.3013+00

MATCH LINE STA. 3059+00

3014+00 3015+00 3016+00 3017+00 3018+00 3019+00 3020+00 3021+00 3022+00 3023+00 3024+00 3025+00 3026+00 3027+00 3028+00 3029+00 3030+00 3031+00 3032+00 3033+00 3034+00 3035+00 3036+00 3037+00 3038+00 3039+00 3040+00 3041+00 3042+00 3043+00 3044+00 3045+00 3046+00 3047+00 3048+00 3049+00 3050+00 3051+00 3052+00 3053+00 3054+00 3055+00 3056+00 3057+00 3058+00

DP 3021R

DP 3023R

DP 3042R

DP 3049L

DP 3049R

DP 3052R

119

52

Monarch Rd

P3021R
0.20 | 0.86 | 0.89

P3023R
0.17 | 0.86 | 0.89

P3042R
0.97 | 0.30 | 0.62

P3049L
1.47 | 0.34 | 0.64

P3049R
2.24 | 0.35 | 0.64

P3052R
0.61 | 0.36 | 0.65

Key Map

N

0 250 500
feet

MULLER

CDOT

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Bikeway Underpass
Proposed Mobility Layout

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Proposed Minor Contour
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Survey Minor Contour

BASIN ID
AREA (AC) | C5 | C100

DP 123R
Design Point

As Constructed

No Revisions:

Revised:

Void:

PROPOSED DRAINAGE BASIN MAPS
CO 119 BIKEWAY

Designer: ACF
Detailer: SR2
Sheet Subset: DRAINAGE

Structure Numbers

Sheet Subset: 8 of 13

Project No. / Code

Sheet Subset:

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P4019RA	0.7	1.6
P4020R	0.7	1.8
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P4023R	10.4	22.3
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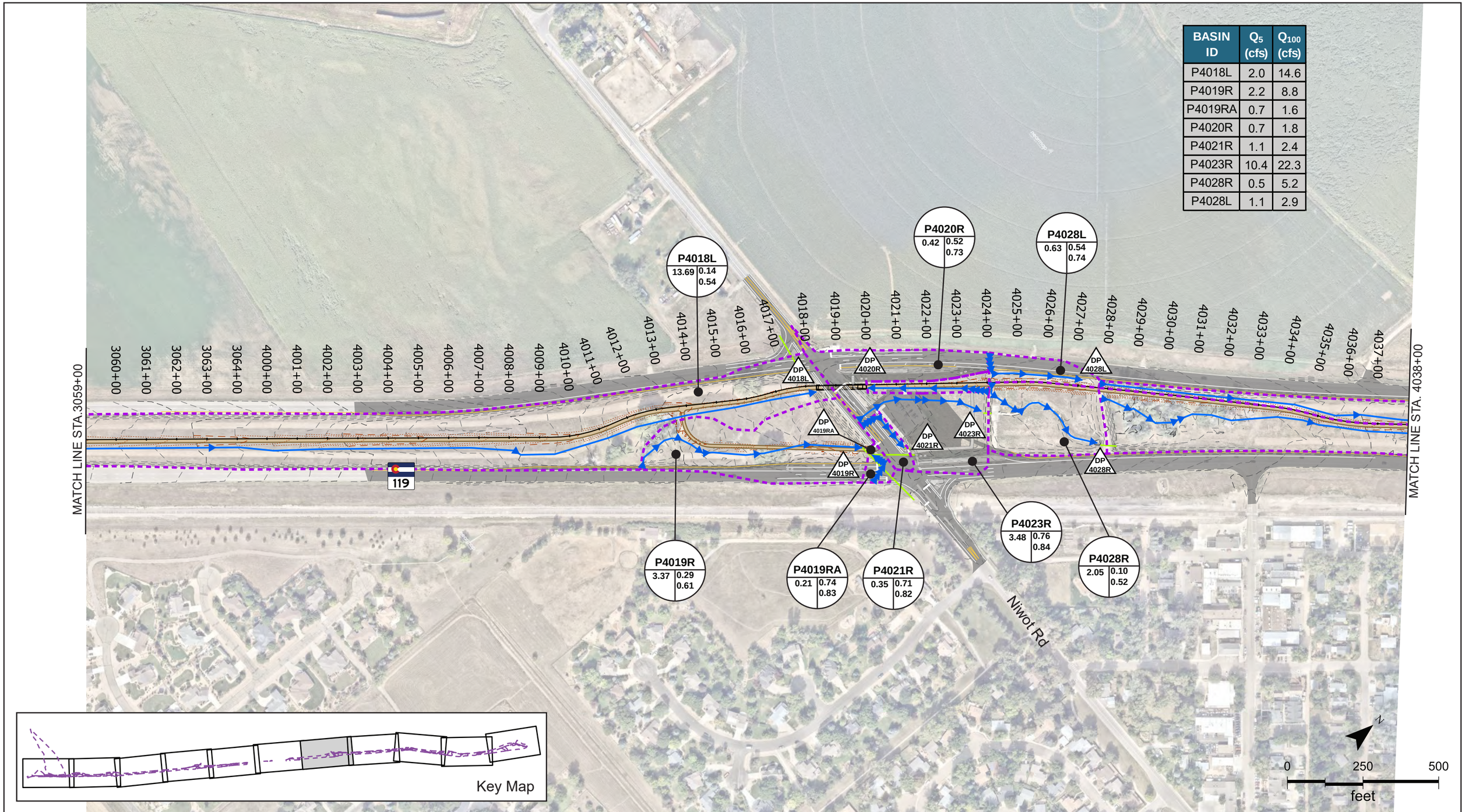

MULLER

CDOT

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BASIN ID
AREA (AC) | C5 | C100

DP 123R
Design Point

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
	Detailer: SR2		
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 9 of 13	Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
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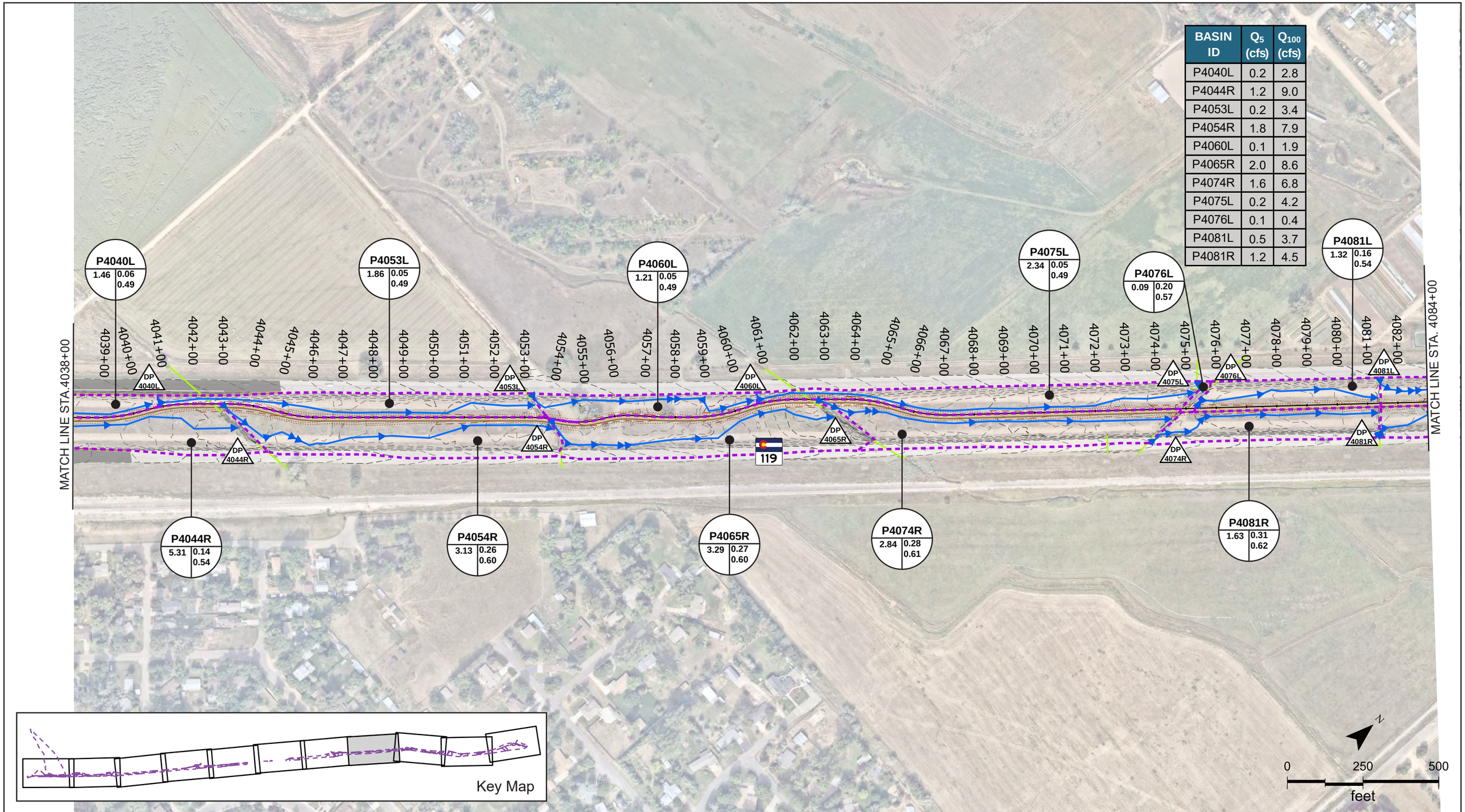
P4044R	1.2	9.0
P4053L	0.2	3.4
P4054R	1.8	7.9
P4060L	0.1	1.9
P4065R	2.0	8.6
P4074R	1.6	6.8
P4075L	0.2	4.2
P4076L	0.1	0.4
P4081L	0.5	3.7
P4081R	1.2	4.5



MULLER

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Basin Flowpath
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Survey Major Contour
Survey Minor Contour

BASIN ID
AREA (AC) | C5 C100
Design Point

As Constructed
No Revisions:
Revised:
Void:

PROPOSED DRAINAGE BASIN MAPS
CO 119 BIKEWAY

Designer: ACF
Detailer: SR2
Sheet Subset: DRAINAGE
Structure Numbers
Sheet Subset: 10 of 13

Project No. / Code
Sheet Subset:

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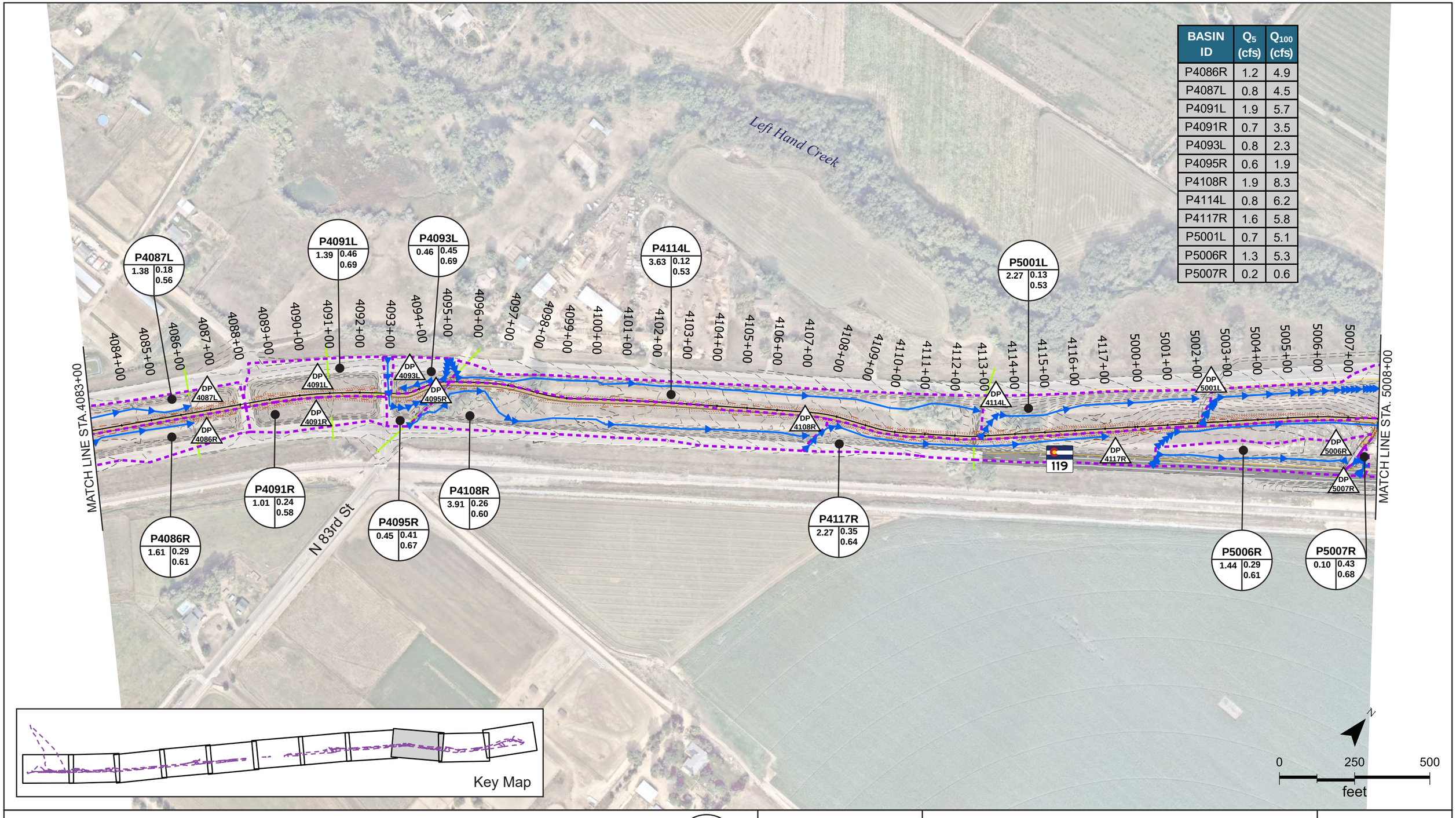
P4087L	0.8	4.5
P4091L	1.9	5.7
P4091R	0.7	3.5
P4093L	0.8	2.3
P4095R	0.6	1.9
P4108R	1.9	8.3
P4114L	0.8	6.2
P4117R	1.6	5.8
P5001L	0.7	5.1
P5006R	1.3	5.3
P5007R	0.2	0.6



Proposed Basin
Basin Flowpath
Proposed Bikeway Layout
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Bikeway Underpass
Proposed Mobility Layout
Proposed Bikeway ALG
Existing Pipe
Proposed Major Contour
Proposed Minor Contour
Survey Major Contour
Survey Minor Contour
BASIN ID / AREA (AC) / C5 C100
DP 123R Design Point

MULLER

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 11 of 13	

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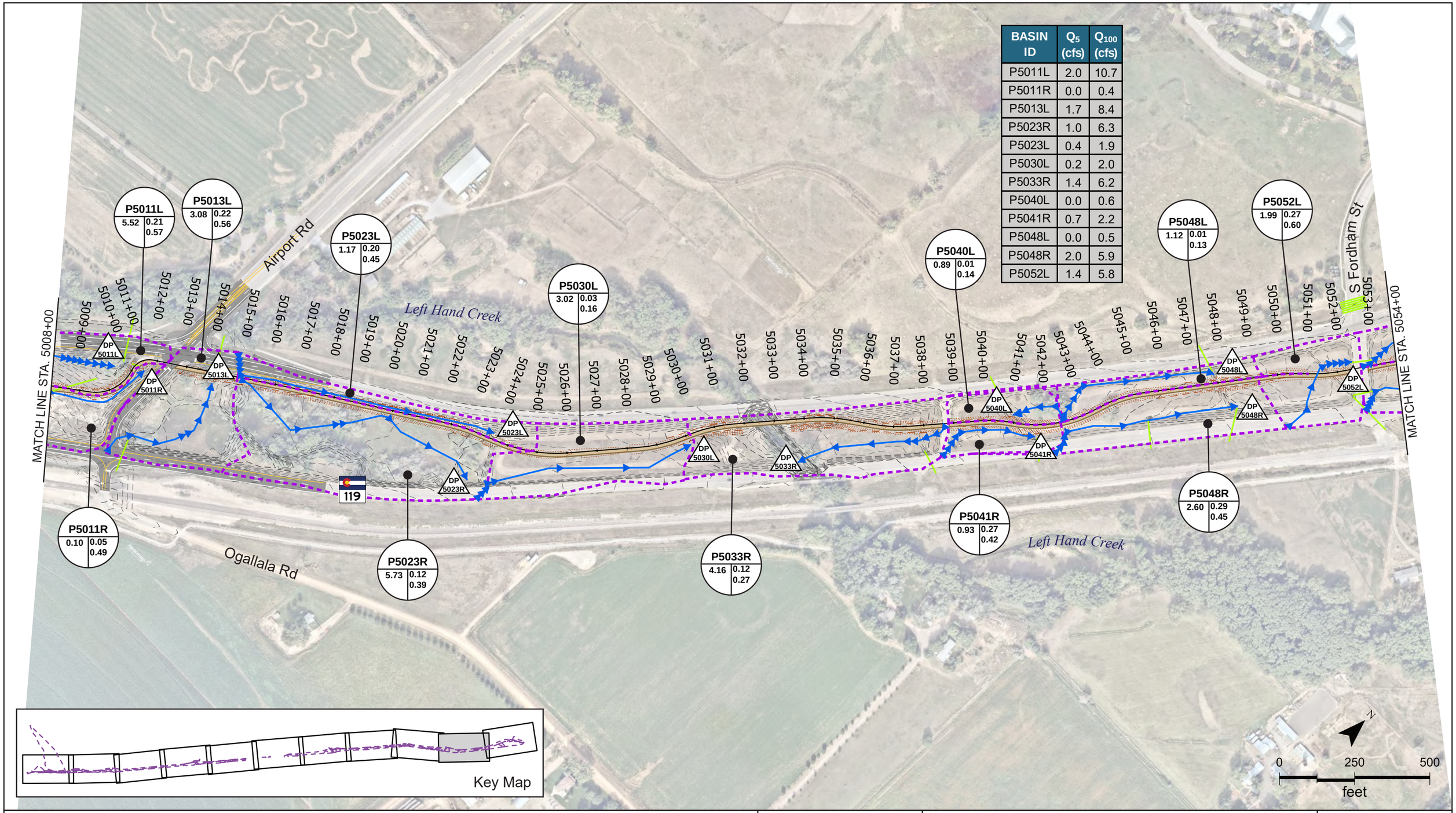
P5011R	0.0	0.4
P5013L	1.7	8.4
P5023R	1.0	6.3
P5023L	0.4	1.9
P5030L	0.2	2.0
P5033R	1.4	6.2
P5040L	0.0	0.6
P5041R	0.7	2.2
P5048L	0.0	0.5
P5048R	2.0	5.9
P5052L	1.4	5.8



MULLER

CDOT

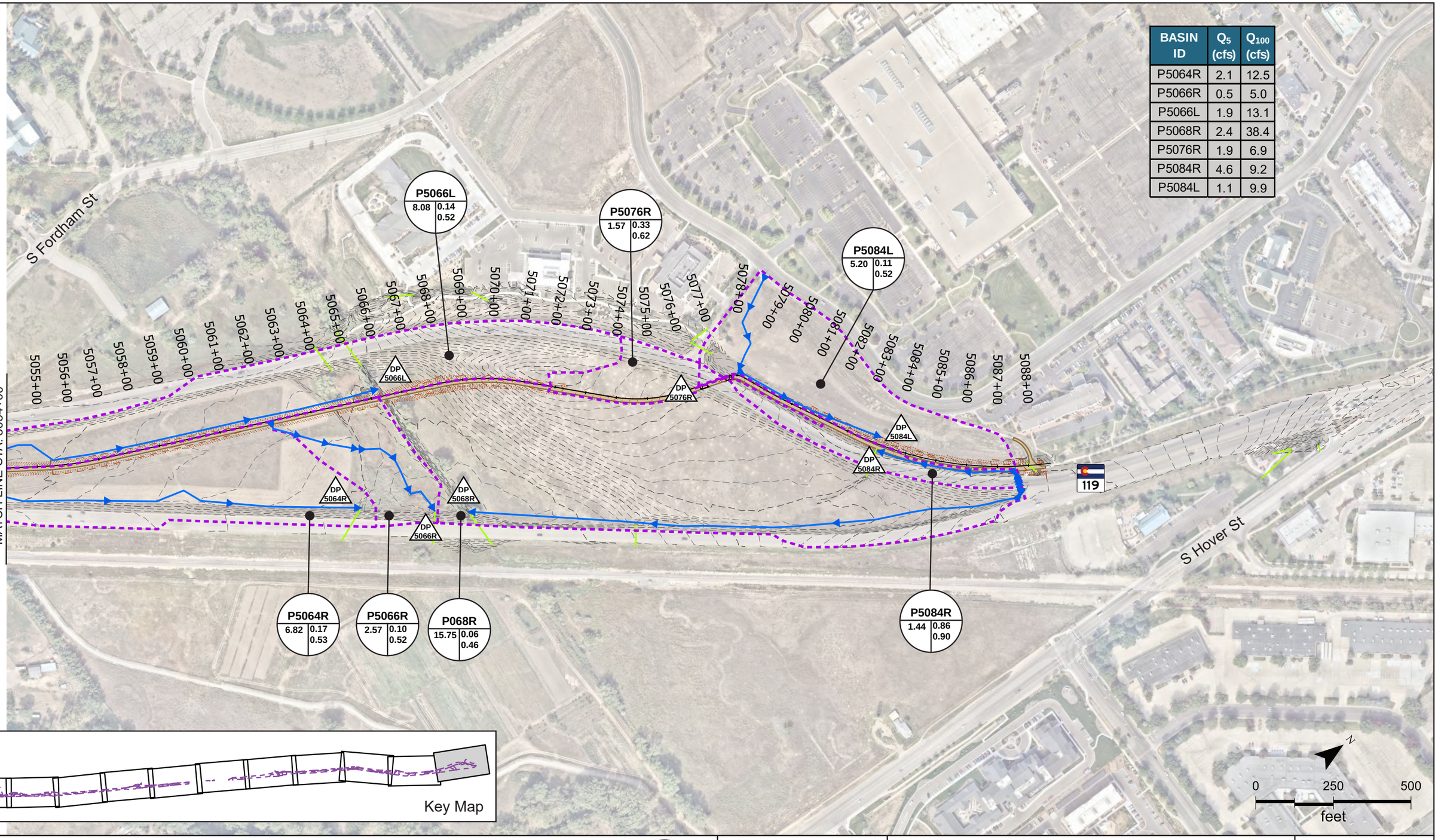
- Proposed Basin
- Basin Flowpath
- Proposed Bikeway Layout
- Future Bikeway
- Bikeway Underpass
- Proposed Mobility Layout
- Proposed Bikeway ALG
- Existing Pipe
- Proposed Major Contour
- Proposed Minor Contour
- Survey Major Contour
- Survey Minor Contour

BASIN ID (AREA (AC) | C5 | C100)

DP 123R Design Point

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
	Detailer: SR2		
Void:	Sheet Subset: DRAINAGE	Sheet Subset: 12 of 13	Sheet Subset:

BASIN ID	Q_5 (cfs)	Q_{100} (cfs)
P5064R	2.1	12.5
P5066R	0.5	5.0
P5066L	1.9	13.1
P5068R	2.4	38.4
P5076R	1.9	6.9
P5084R	4.6	9.2
P5084L	1.1	9.9



MULLER

Proposed Basin
Basin Flowpath
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Bikeway Underpass
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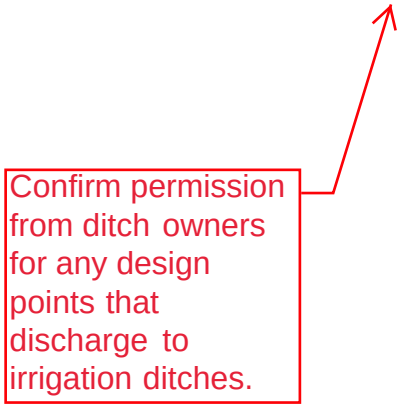
BASIN ID
AREA (AC) | C5 C100

DP 123R
Design Point

As Constructed	PROPOSED DRAINAGE BASIN MAPS CO 119 BIKEWAY		Project No. / Code
No Revisions:			
Revised:	Designer: ACF	Structure Numbers	
Void:	Detailer: SR2		Sheet Subset:
	Sheet Subset: DRAINAGE	Sheet Subset: 13 of 13	

Irrigation Crossing Inventory Map



SH 119 MOBILITY IMPROVEMENTS

Irrigation Crossing Inventory

COLORADO
Department of Transportation

0 500 1000
FEET
scale 1:6,000
1" = 500'

- Parcel Boundary
- SH 119 Right-of-Way (approx.)
- Proposed SH 119 Bikeway
- Proposed SH 119 Design Layout
- Main Ditch
- Lateral Ditch
- Field Lateral
- Tailwater Ditch
- Perennial Stream
- Intermittent Stream

Stream and Ditch data provided by County of Boulder Open Data Catalog

SH 119 MOBILITY IMPROVEMENTS

Irrigation Crossing Inventory

COLORADO
Department of Transportation

0 500 1000
FEET
scale 1:6,000
1" = 500'

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Stream and Ditch data provided by County of Boulder Open Data Catalog

SH 119 MOBILITY IMPROVEMENTS

Irrigation Crossing Inventory

COLORADO
Department of Transportation

0 500 1000
FEET
scale 1:6,000
1" = 500'

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SH 119 MOBILITY IMPROVEMENTS

Irrigation Crossing Inventory

COLORADO
Department of Transportation

0 500 1000
FEET
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1" = 500'

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SH 119 MOBILITY IMPROVEMENTS

Irrigation Crossing Inventory

COLORADO
Department of Transportation

0 500 1000
FEET
scale 1:6,000
1" = 500'

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- Intermittent Stream

Stream and Ditch data provided by County of Boulder Open Data Catalog

SH 119 MOBILITY IMPROVEMENTS

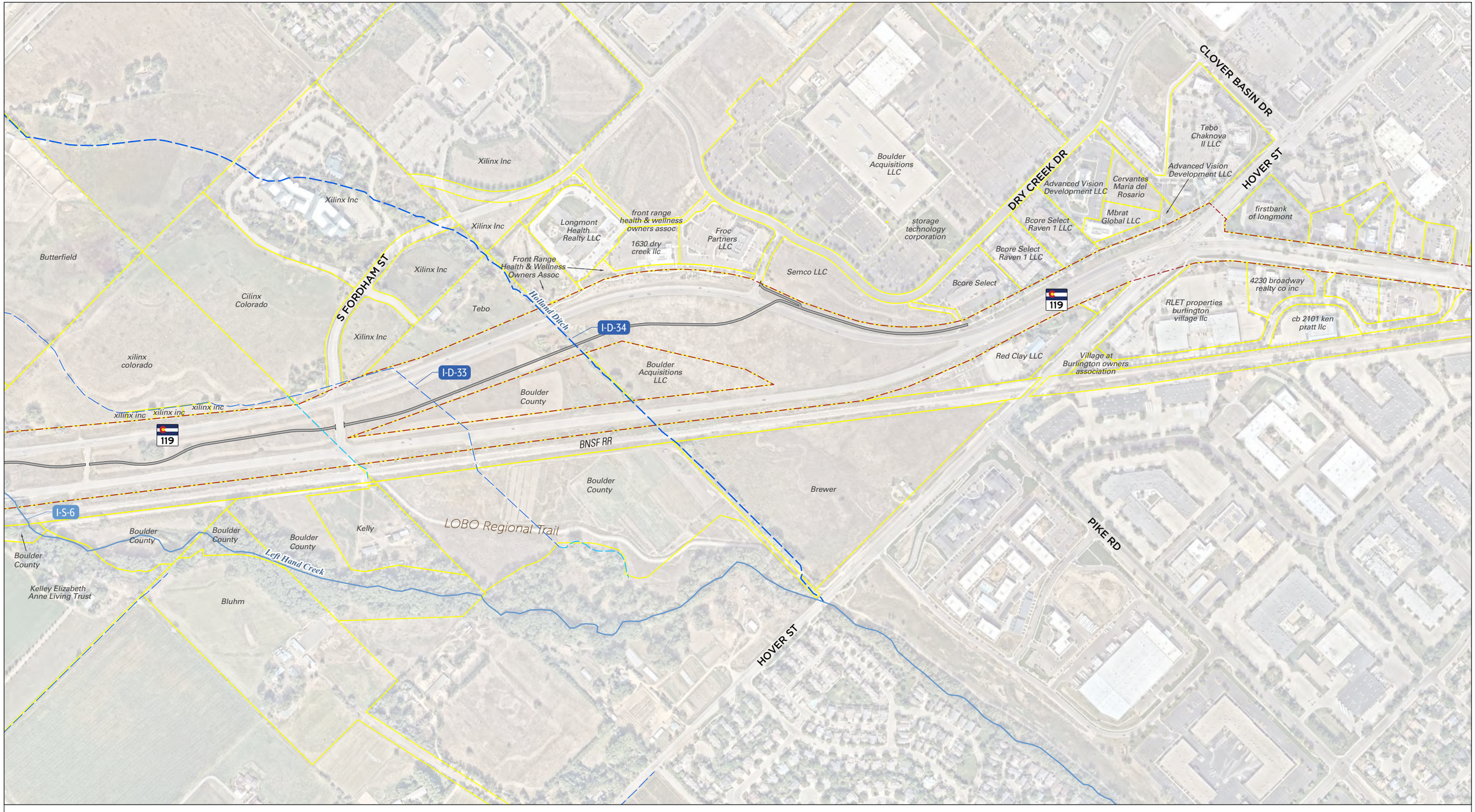
Irrigation Crossing Inventory

COLORADO
Department of Transportation

0 500 1000
FEET
scale 1:6,000
1" = 500'

- Parcel Boundary
- SH 119 Right-of-Way (approx.)
- Proposed SH 119 Bikeway
- Proposed SH 119 Design Layout
- Main Ditch
- Lateral Ditch
- Field Lateral
- Tailwater Ditch
- Perennial Stream
- Intermittent Stream

Stream and Ditch data provided by County of Boulder Open Data Catalog



SH 119 MOBILITY IMPROVEMENTS

Irrigation Crossing Inventory

COLORADO
Department of Transportation

0 500 1000
FEET
scale 1:6,000
1" = 500'

- Parcel Boundary
- SH 119 Right-of-Way (approx.)
- Proposed SH 119 Bikeway
- Proposed SH 119 Design Layout
- Main Ditch
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- Field Lateral
- Tailwater Ditch
- Perennial Stream
- Intermittent Stream

Stream and Ditch data provided by County of Boulder Open Data Catalog

Hydrologic Soils Report (NRCS)

United States Department of Agriculture

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

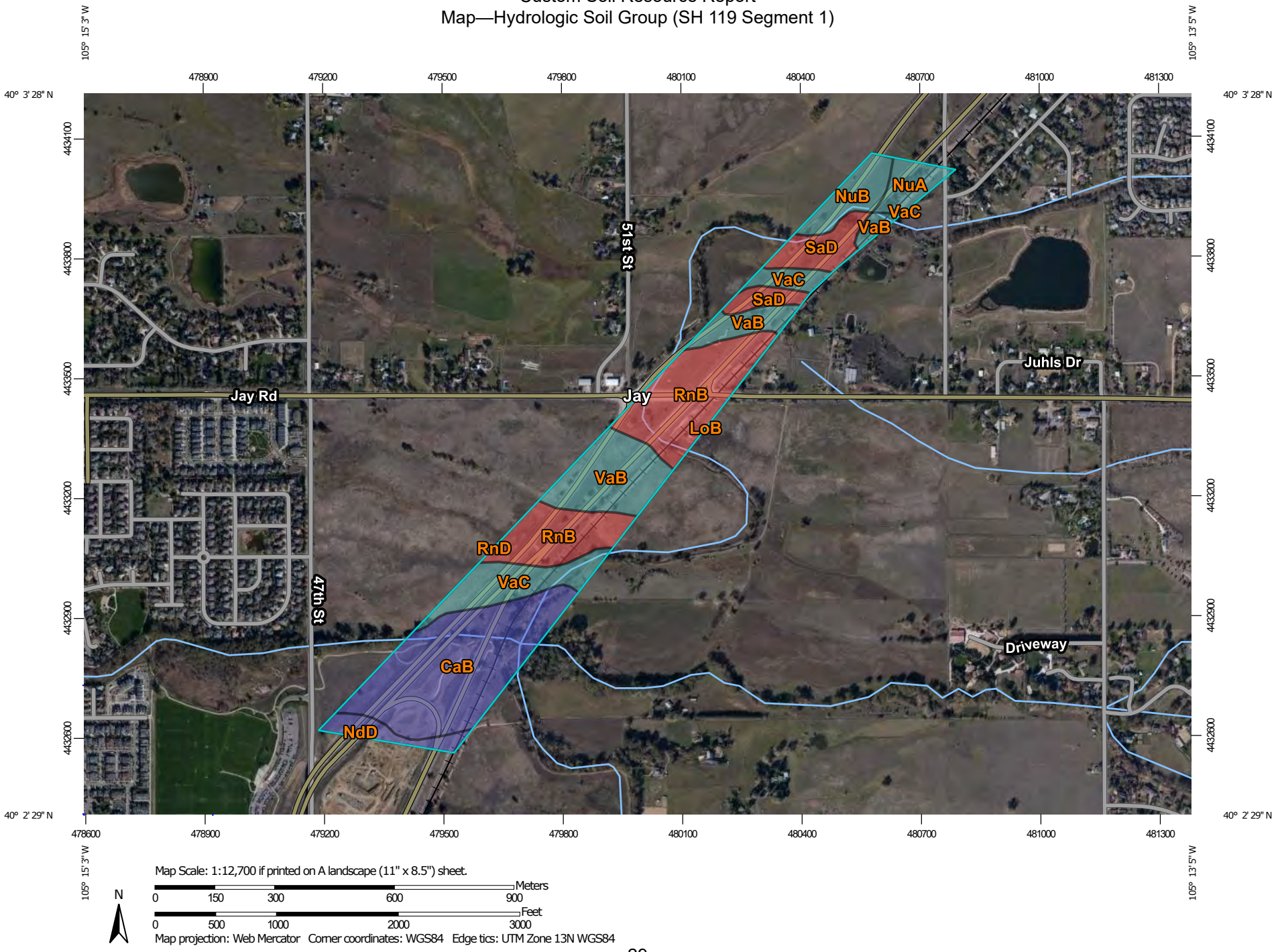
January 27, 2022

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

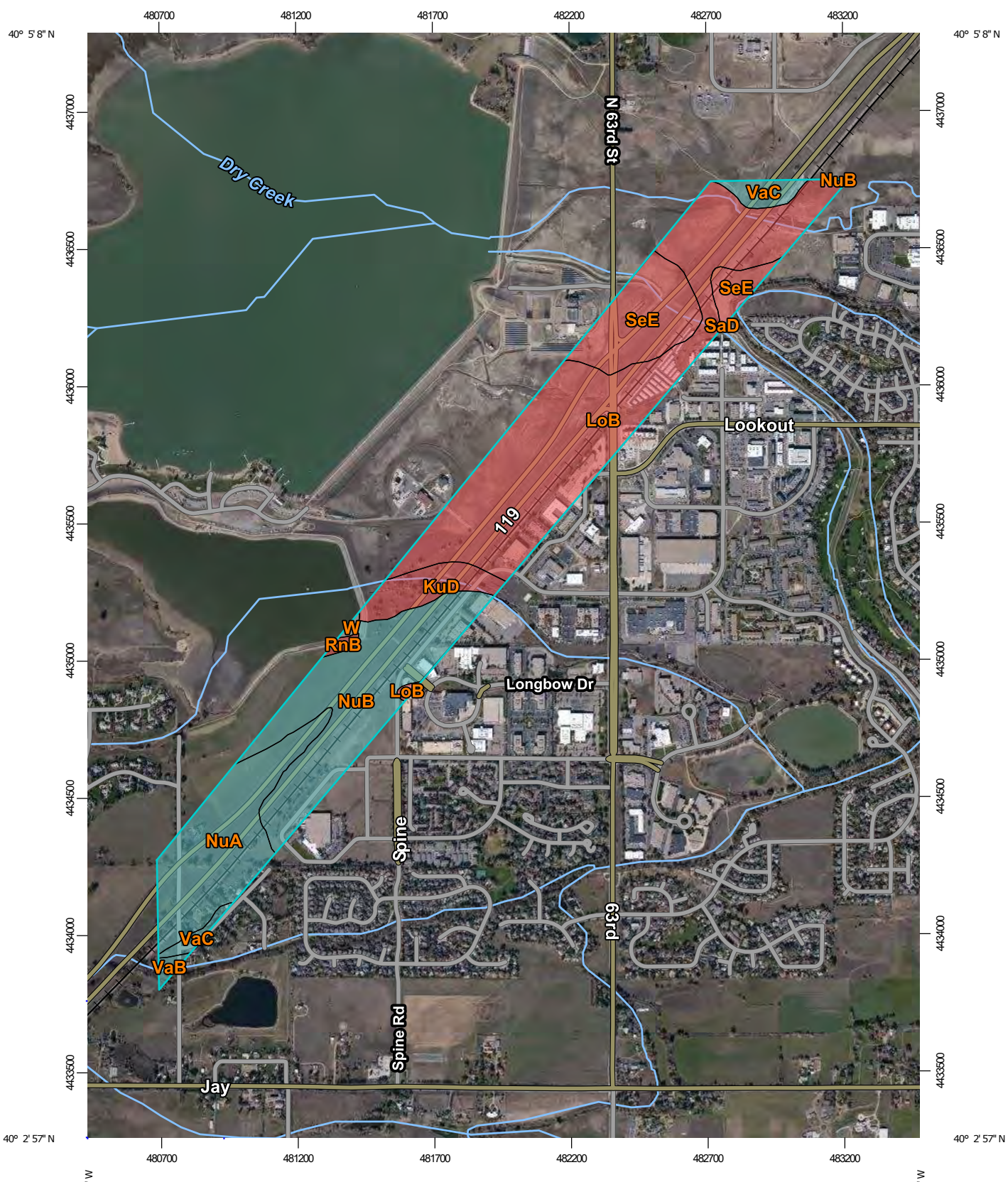
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

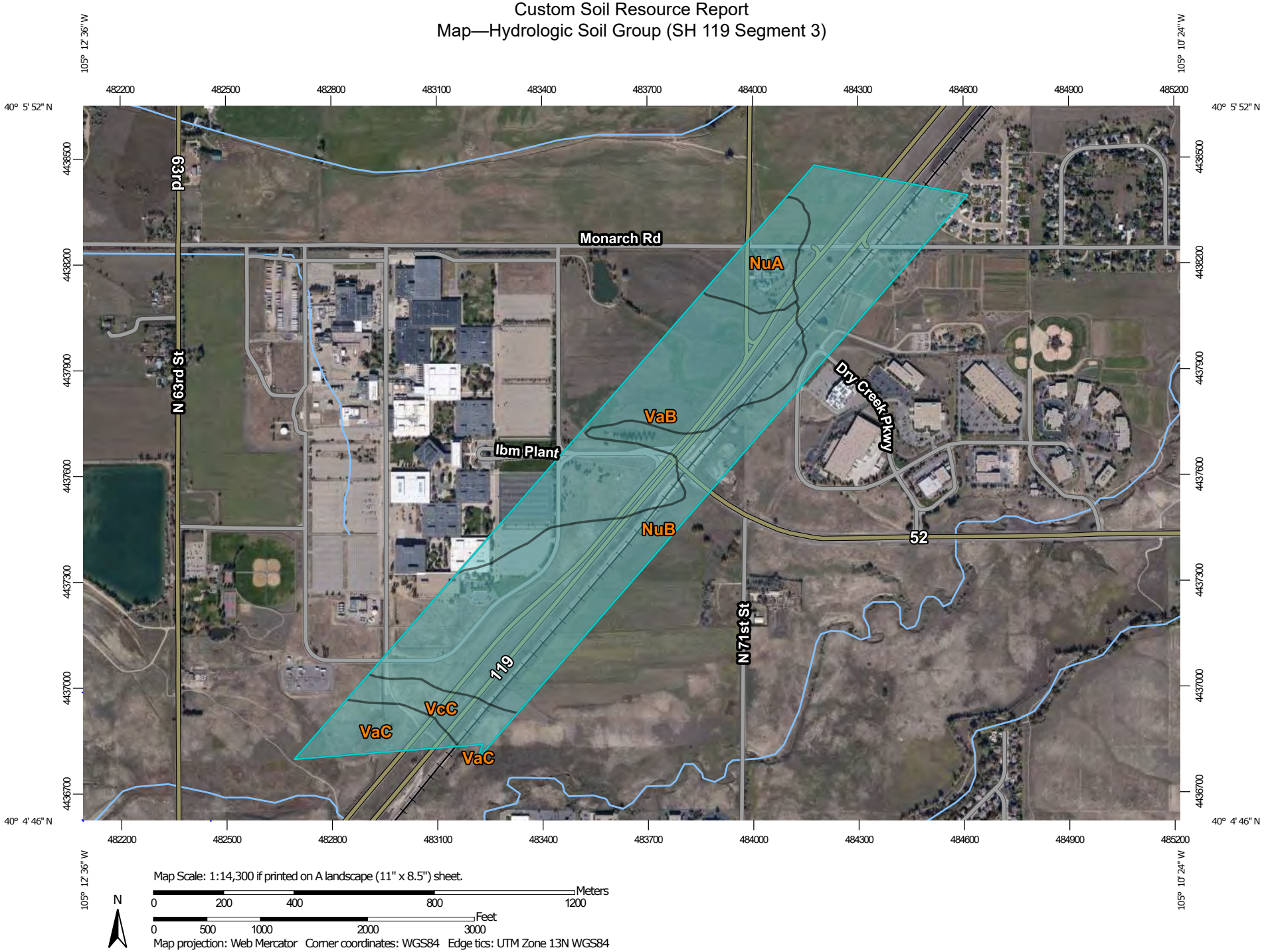
Custom Soil Resource Report
Map—Hydrologic Soil Group (SH 119 Segment 1)



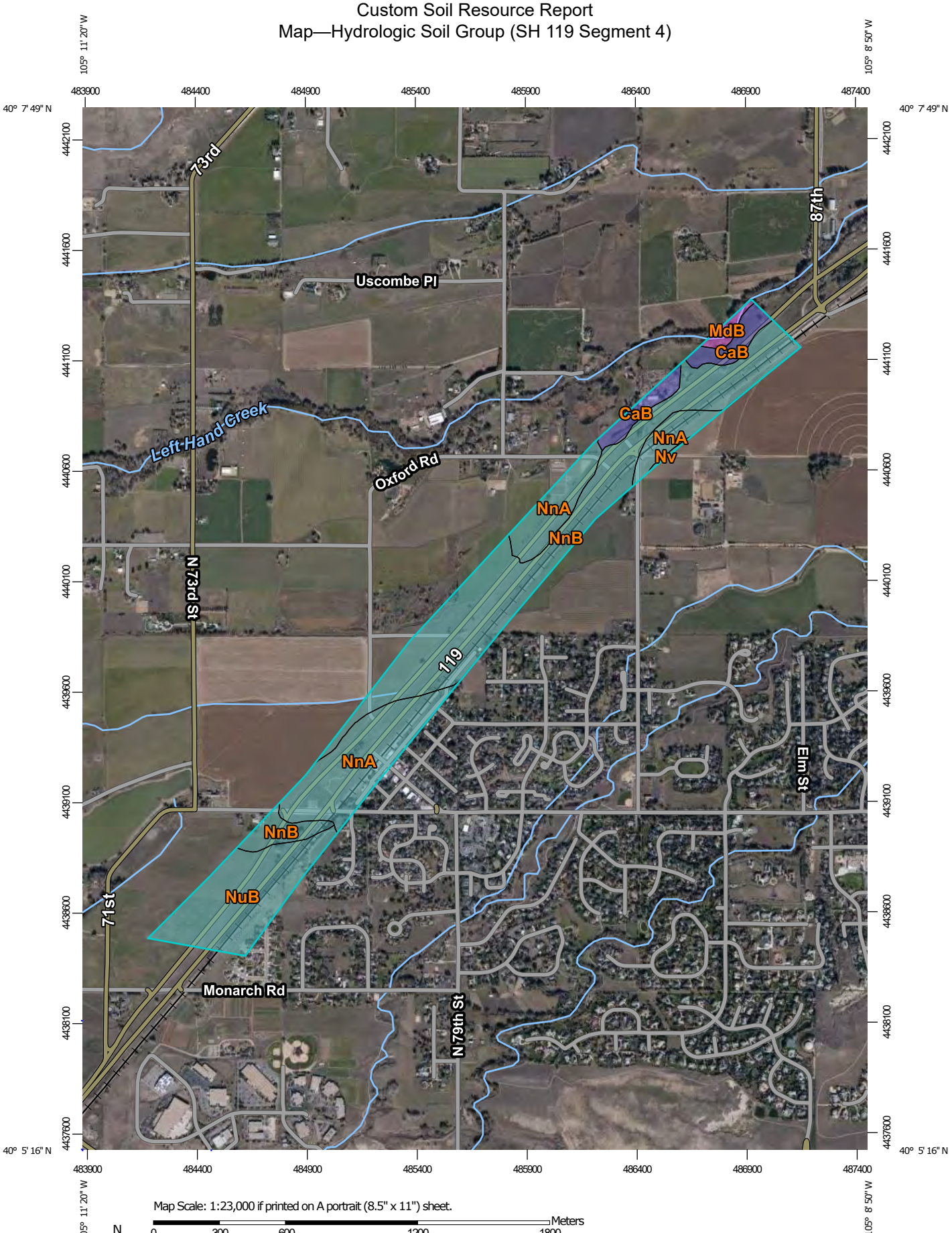
Custom Soil Resource Report
Map—Hydrologic Soil Group (SH 119 Segment 2)



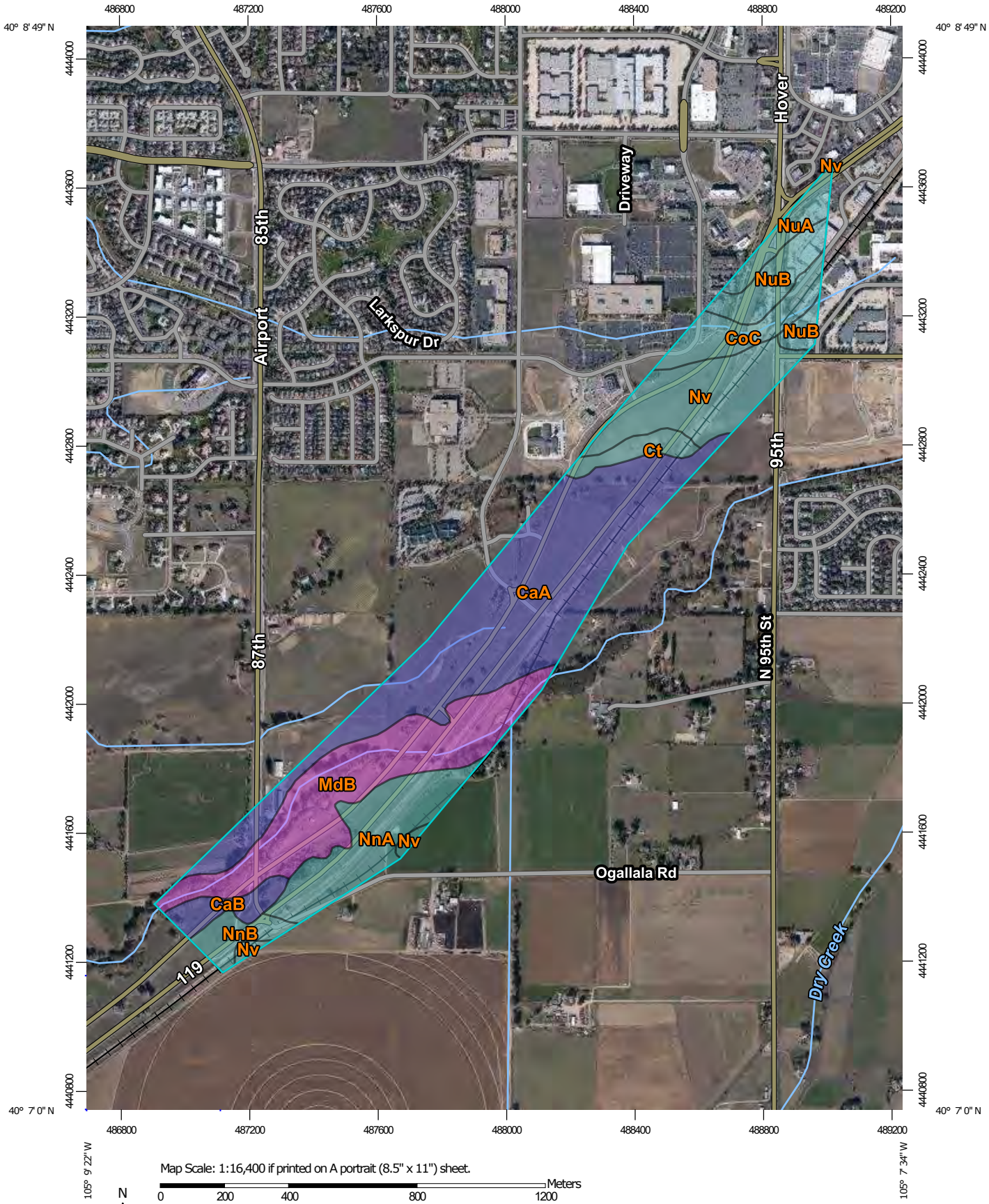
Custom Soil Resource Report
Map—Hydrologic Soil Group (SH 119 Segment 3)



Custom Soil Resource Report
Map—Hydrologic Soil Group (SH 119 Segment 4)



Custom Soil Resource Report
Map—Hydrologic Soil Group (SH 119 Segment 5)



Map Scale: 1:16,400 if printed on A portrait (8.5" x 11") sheet.

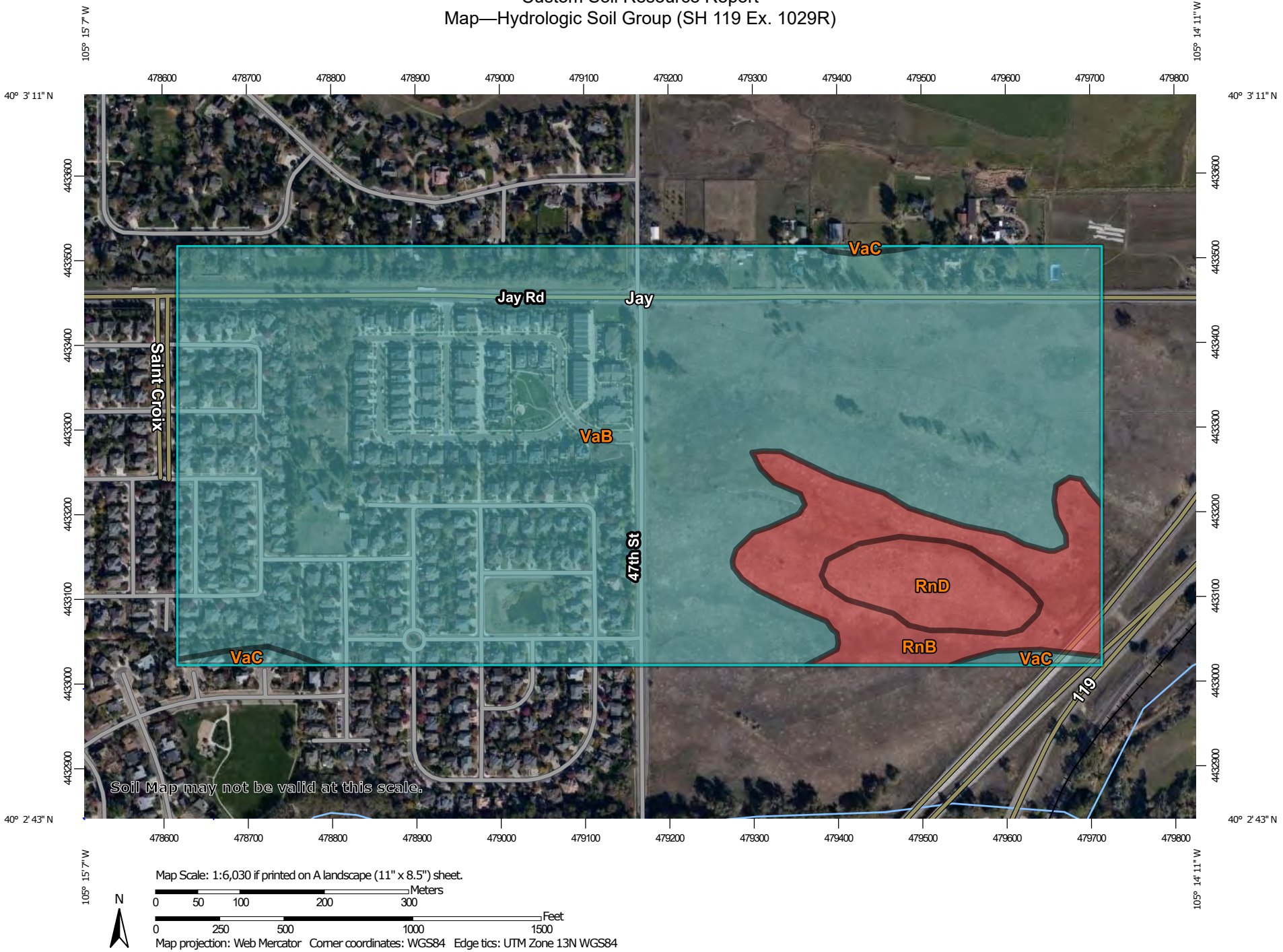
N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

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

Custom Soil Resource Report
Map—Hydrologic Soil Group (SH 119 Ex. 1029R)



Custom Soil Resource Report
Map—Hydrologic Soil Group (SH 52 Intersection (IBM Campus) Offsite)

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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.

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 18, Sep 2, 2021

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

Date(s) aerial images were photographed: Oct 1, 2018—Oct 31, 2018

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.

NOAA Atlas 2 Rainfall Data (from Boulder County Storm Drainage Criteria Manual)

Figure 500-1 Boulder County 5-Year 1-Hour Point Rainfall Depths

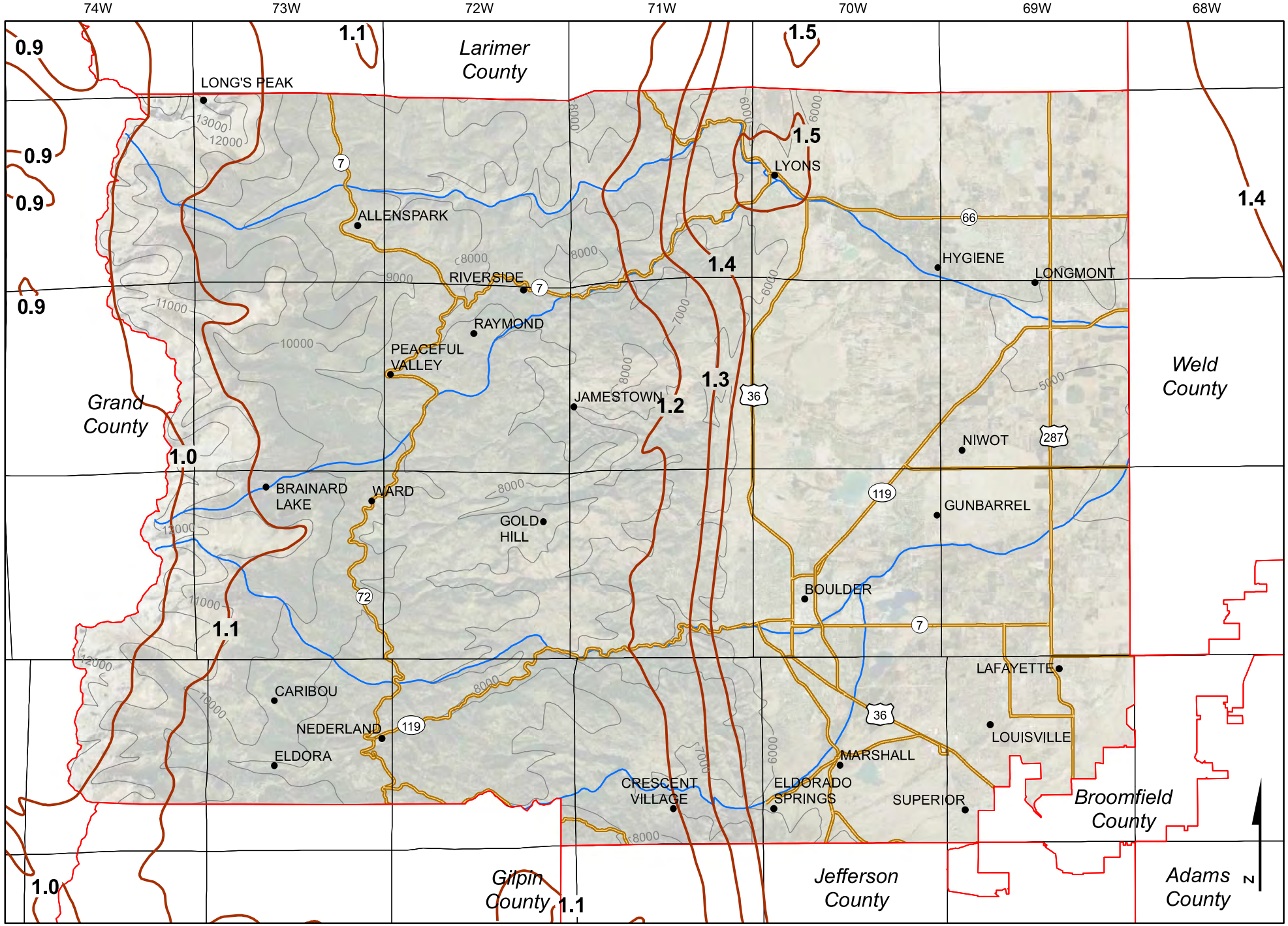


Figure 500-3 Boulder County 100-Year 1-Hour Point Rainfall Depths

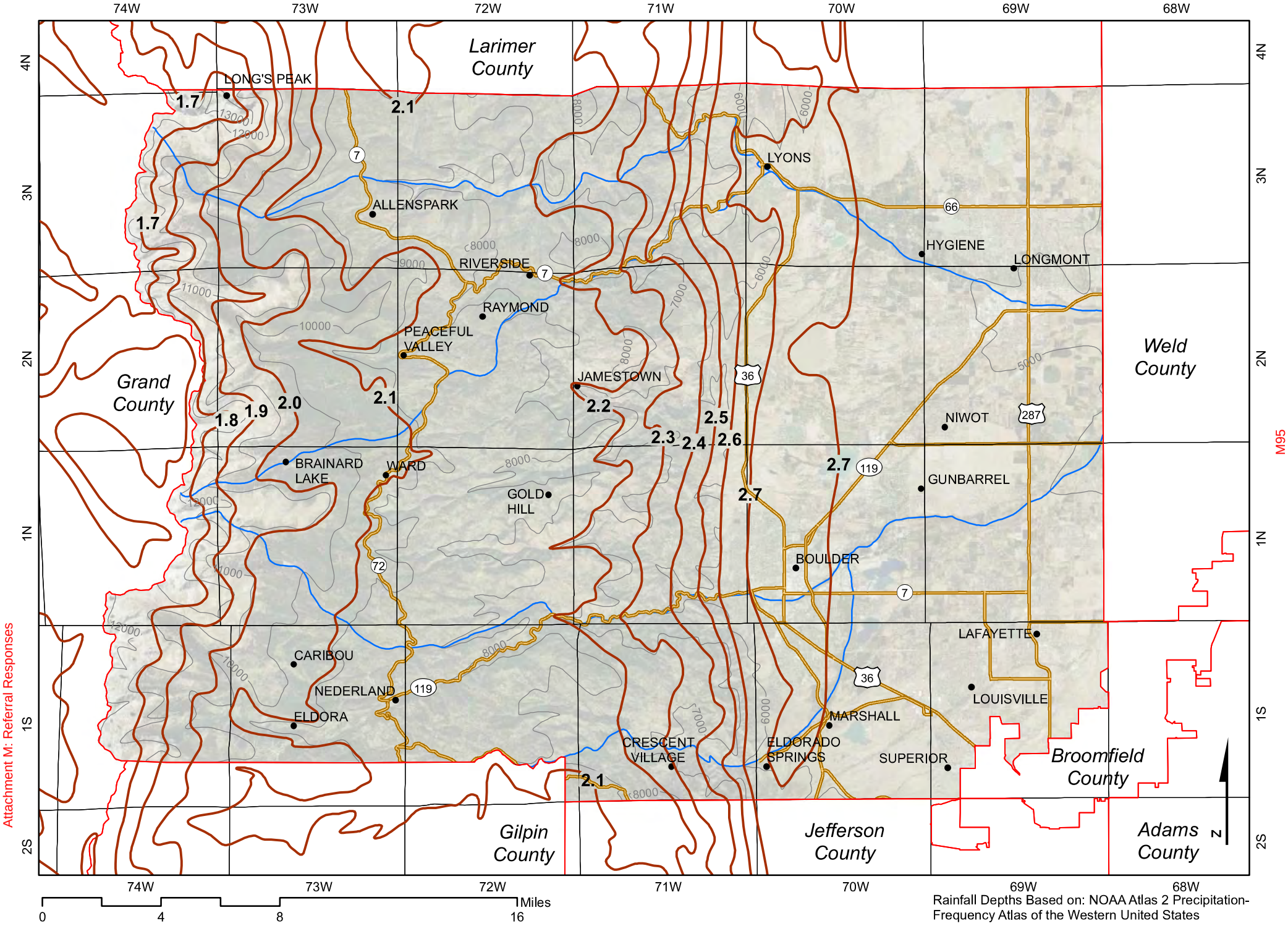
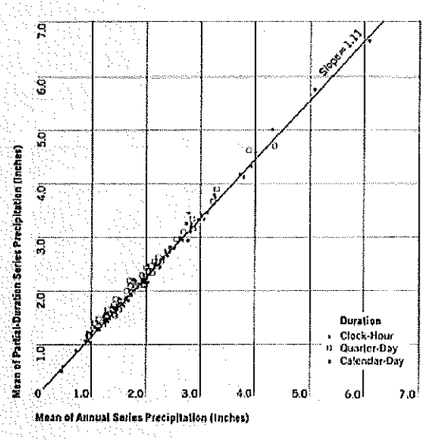


Figure 5. *Relation between annual and partial-duration series.*



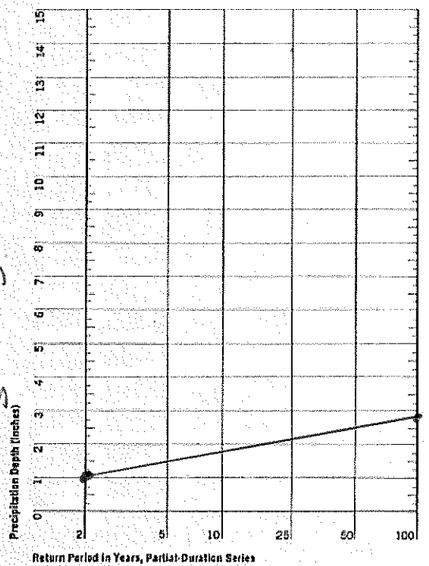


Figure 6. *Precipitation depth versus return period for partial-duration series.*

Figure 7. *Principal paths of moisture inflow in the western United States for storms producing large precipitation amounts. Toned areas are major orographic barriers.*

portant. Next, an examination was made of factors that combined topographic and meteorologic considerations, such as distance and direction to moisture sources. Each factor considered was a measure of some physical reality, and each was understandably related to variation in the precipitation-frequency regime.

Finally, various climatological and meteorological factors that could be indexes of variation of the precipitation-frequency values were considered. The procedure used for developing interpolating equations was a multiple-regression screening technique. This process was done by computer using a least-squares technique. The computer program was capable of accepting a total of 174 independent variables for as many locations as data were available. The number of variables screened for the various relations ranged between 60 and 100. This does not mean that 60 or more completely different factors could be identified. For example, several factors might involve different measures of slope. Moreover, these measures of slope might be over different distances or have different orientations. In each instance, the practice was to permit the computer to select the most critical of the various measures of each factor.

Although the computer program treated each variable as linear during the regression analysis, it was possible through internal computations to use logarithms, powers, roots, reciprocals, or combinations of any or all of the factors. The computer program selected the single variable most highly correlated with the precipitation-frequency value under investigation. The next step was to select the variable that, combined with the variable already selected, would explain the greatest variation in the precipitation-frequency values. The third, fourth, fifth, and further variables were selected in a similar manner. The program continued to select

Table 3. *Statistical parameters for relations used for interstation interpolation of 2-yr 24-hr precipitation values*

Region of applicability[1]	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Gila, Williams, and lower Colorado River Basins (1)	0.84	86	1.86	0.21
Little Colorado, San Juan, and Virgin River Basins, except higher elevations of south-facing slopes (2)[2]	0.81	105	1.36	0.20
Higher elevations of south-facing slopes of Little Colorado, San Juan, and Virgin River Basins (2)[2]	0.93	41	1.31	0.13
Rio Grande Basin north of El Paso, Tex. (3)	0.77	110	1.35	0.18
Crest of Continental Divide and Sangre de Cristo Mountains to generalized 7,000-ft contour from southern Wyoming to southern tip of Sangre de Cristo Mountains (4)	0.83	122	1.43	0.22
Upper Colorado and Gunnison River Basins and Green River Basin below confluence of Green and Yampa Rivers (5)	0.79	69	1.12	0.13
Yampa River Basin, Green River Basin above confluence of Green and Yampa Rivers, and Bear River Basin east of Wasatch Mountains (6)	0.83	29	1.03	0.08
Mountains of central Utah (7)	0.85	86	1.35	0.18
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada Crest (8)[3]	0.71	79	1.03	0.13
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada crest (8)[3]	0.71	55	1.04	0.15
Big Horn River Basin above Saint Xavier and minor portions of North Platte, Powder, Tongue, and Yellowstone River Basins (9)	0.78	55	1.25	0.21
Upper Missouri River Basin above Holter Dam, Mont.; Snake River Basin above Alpine, Wyo.; and upper Yellowstone River Basin above Springdale, Mont. (10)	0.76	57	1.19	0.16
From generalized 4,000-ft contour on east to crests of Crazy and Little Belt Mountains and Lewis Range on west (11)	0.80	52	1.67	0.26
West of Continental Divide, but east of Bitterroot Range and Cabinet and Selkirk Mountains (12)	0.85	44	1.36	0.12
Mountainous region of eastern Washington and Oregon and of Idaho west of Bitterroot Range crest and Continental Divide, and north of southern boundary of Snake River Basin—excluding Snake River Valley below a generalized 5,000-ft contour (13)	0.78	147	1.44	0.24
Orographic region east of crest of Cascade Range and west of Snake River Basin (14)	0.90	115	1.75	0.35
Western slopes of Coast Ranges, Olympic Mountains, and Cascade Range (15)	0.87	125	3.69	0.48
Eel River Basin; southern portion of Klamath River Basin; and Cottonwood, Elder, Thomas, and Gladstone Creeks (16)	0.91	39	4.19	0.50
Russian River, Cache and Putah Creeks, and coastal drainages west of Russian River (17)	0.84	63	5.31	0.78
Santa Cruz Mountains and La Panza, Santa Lucia, and Coast Ranges (18)	0.95	55	4.32	0.45
Diablo, Gabilan, and Temblor Ranges (19)	0.82	58	2.21	0.35
San Rafael, San Bernardino, Santa Monica, and San Gabriel Mountains (20)	0.88	149	3.98	0.59
Santa Ana, Santa Rosa, Coyote, and other extreme southern coastal mountains (21)	0.88	34	2.44	0.33
Northern Sierra Nevada north of Mokelumne River Basin (22)	0.92	84	4.56	0.53
Southern Sierra Nevada south of Consumnes River Basin (23)	0.88	61	3.43	0.53
Southeastern desert region of California (24)	0.89	41	1.07	0.16
Spillover zone east of Sierra Nevada crest (25)	0.94	41	2.05	0.27
Spillover zone east of crest of coastal mountains of southern California (26)	0.97	10	2.08	0.15

[1] Numbers in parentheses refer to geographic regions shown in figure 8.
[2] Two different equations were used in region 2. See text for explanation.
[3] Two different equations were used in region 8. See text for explanation.

FEMA Flood Zone Maps

(Order: Fourmile Canyon Creek, Dry Creek, Lefthand Canyon Creek [3])

National Flood Hazard Layer FIRMette

FEMA

105°14'51"W 40°2'47"N

105°14'13"W 40°2'20"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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National Flood Hazard Layer FIRMette

FEMA

105°12'24"W 40°5'1"N

105°11'46"W 40°4'33"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
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OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
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MAP PANELS
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- Unmapped

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National Flood Hazard Layer FIRMette

FEMA

105°9'11"W 40°7'49"N

105°8'33"W 40°7'21"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
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- With BFE or Depth *Zone AE, AO, AH, VE, AR*
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- Base Flood Elevation Line (BFE)
- Limit of Study
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MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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National Flood Hazard Layer FIRMette

FEMA

105°8'34"W 40°8'16"N

105°7'56"W 40°7'48"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
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- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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APPENDIX B

Hydrology

Existing Hydrology Calculations

Proposed Hydrology Calculations

Existing Hydrology Calculations

CALCULATION COVER SHEET

Project Name:	SH 119 Bikeway	**Project No.**	21015 (Muller)
Design Calculation:	Existing Hydrology	**Version:**	1
Originator	ZDS	**Date:**	February 3, 2022
Checker	ACF	**Date:**	February 17, 2022

Purpose:

Analyze the existing hydrologic conditions and determine peak flowrates for the SH 119 Bikeway project.

References:

Criteria Manuals Used:

Colorado Department of Transportation (CDOT) *Drainage Design Manual,* 2019
Boulder County *Multimodal Transportation Standards (MTS)*, 2012
Boulder County *Storm Drainage Criteria Manual (SDCM)*, 2016

Referenced Data Sources:

CDOT, *Topographic Survey,* Received July 2021
CDOT, *SUE (QL C&D)*, Received December 2021
Boulder County, *LiDAR*, Accessed January 2022
United States Department of Agriculture Natural Resources Conservation Service (NRCS), *Web Soil Service for Hydrologic Soil Group*, Accessed January 2022
National Oceanic and Atmospheric Administration, *Point Frequency Data Server*, Accessed January 2022
Microsoft Corp., *Bing Maps Aerial*, Accessed January 2022
Alphabet Inc., *Google Earth Aerial*, June 2021 Imagery

Previous Reports:

Felsburg, Holt & Ullevig, *Hydrology and Hydraulics Report for the Intersections SH 119 at Jay Rd and SH 119 at Niwot Rd,* May 2012
Muller Engineering Company, *SH 119 at SH 52 (Mineral Road) Final Drainage Report*, November 2005

Refer to the drainage report for the appendices referenced below:

Appendix A
Hydrologic and Hydraulic Criteria Table
Existing Basin Maps

Appendix B
Proposed Hydrology Calculation Packet

Refer to the Drainage Report for full citations of references.

CALCULATION COVER SHEET **SH 119 Bikeway**
March 22, 2022 **Existing Hydrology**

Criteria:

Runoff from existing basins for the proposed project was determined using CDOT and Boulder County drainage manuals. Refer to the Hydrologic Criteria Table in **Appendix A** of the Drainage Report for the complete comparison of analyzed criteria. **Table 1** shows the applied criteria for this calculation packet.

Table 1. *Applied Hydrologic Criteria Table*

Hydrologic Criteria	Applied Criteria
Design Frequency	
Cross Drainage	
Multi-lane Road (Urban)	100-year
Multi-lane Road (Rural)	50-year
Two Lane Road (Urban)	100-year
Two Lane Road (Rural)	25-year
Culvert Outlet Scour Protection	10-year
Pedestrian Walkways and Bikeways	5-year
Parallel Drainage	
Roadway Overtopping & Revetment	*Same as for cross drainage*
Side Drains	10-year
Storm Drains	
Major Storm	100-year
Minor Storm	5-year
Channels	
Capacity	*Depends on roadway classification*
Lining	10-year
Hydrologic Procedure Selection	
Hydrologic Peak Prediction Procedure	
Drainage Area	Rational Method (<200 ac) CUHP and EPA-SWMM (>200 ac)
Time of Concentration (Tc) for Rational Method	
Min. Tc for urban areas	5 min.
Min. Tc for non-urban areas	10 min.
Max. Overland Flow Path Length (urban)	300 ft
Max. Overland Flow Path Length (rural)	500 ft

Background and Rationale:

- The project is located along SH 119 from Boulder, Colorado to Longmont, Colorado.
- Project improvements include:
  - Grading and constructing a bike path along SH 119 from Foothills Parkway in Boulder to Hover Street in Longmont. At-grade crossings, underpasses, and bridges will be designed for the bike path.

  - Supplementary improvements include:
    - Traffic support for intersections along SH 119 impacted by bike path.
    - Structural design of underpasses and bridges.
    - Landscaping improvements.
    - Lighting for underpasses and other locations.
    - Floodplain analysis.
    - Irrigation coordination.
- Drainage generally flows east through the project area, flow directions are not uniform throughout the project length however.
- Design points (DP) for basins are located at the receiving point (stormwater ditches, stormwater pipes and culverts, stormwater area inlets, irrigation ditches, irrigation pipes and culverts, and streams and rivers) and where runoff leaves the project area.
- Basins were delineated using survey contours and topography provided by CDOT and LiDAR contours referenced from Boulder County.
- Basin ID's correspond with centerline stationing for the proposed alignments for the bike path using L and R for left and right designation. Basins with the same station and a greater offset were labeled with increasing alphabetical letters (i.e., the design point for X4019RA has a greater offset distance than X4019R).
- Topographic survey indicates an underground storm drain system at the west side of the SH 119/Airport Road intersection. A drainage report request was submitted on January 27, 2022 to better understand this system.
- Basins were analyzed for peak discharge using rational method, then DPs with multiple contributing areas were routed to determine overall peak discharge leaving the project area.
  - An exception is for Basin X3029R, contributing offsite flow to this basin was taken from the *SH 119 at SH 52 (Mineral Road) Final Drainage Report* and added to the routed flow from X3023L and X3029R.

Assumptions/Givens:

Rational Method Givens

- Hydrologic Soil Group HSG A, B, C, and D
- Rainfall data for 1-hour precipitation values were taken from NOAA Atlas 2 and comp data published in the Boulder County Storm Drainage Criteria Manual
  - NOAA Atlas 2
    - Isopluvial maps were used to interpolate rainfall depths for the 2-yr and 100-yr events with storm durations of 6 hours and 24 hours
    - These rainfall depths were used in the appropriate equations in Table 11 to determine the rainfall depths for the 2-yr and 100-yr events with a 1-hour storm duration.
      - Equations for Region 1 (South Platte watershed) were selected
    - The results for the 2-yr and 100-yr events with a 1 hour storm duration were plotted on Figure 6 to obtain rainfall depths for the 5-yr, 10-yr, 25-yr, and 50-yr events with a 1-hour storm duration

If Rational Method is used, shouldn't the duration of the design storm be the time of concentration? For many design points tc may be less than 1 hour.

        - The results were consistent with the UD-Rain spreadsheet, indicating the regression was correct
    - Boulder County Storm Drainage Criteria Manual
        - Isopluvial maps specific to Boulder County provide the rainfall depth for 5-yr and 100-yr return events with a 1-hour storm duration.
        - These rainfall depths for a 1-hour storm duration match the results taken from NOAA Atlas
        - The equation for rainfall intensity (500.1) matches the equation used for the calculations presented in this calculation packet (please refer to attachments).
- Land use types and percent imperviousness provided in (Table 6-3 of USDCM) used for this project are:
    - Streets: Paved, 100% imperviousness
    - Streets: Gravel (Packed), 40% imperviousness
    - Undeveloped Areas: Greenbelts, Agricultural, 2% imperviousness
    - Business: Suburban Areas, 75% imperviousness
    - Residential: 0.25 Acres or Less, 45% imperviousness
- USDCM Equations 6-3, 6-4, and 6-5 were used to calculate the time of concentration required to calculate intensity.

Rational Method Assumptions

- The following land use types and percent imperviousness values were not taken from USDCM but were assumed:
    - Google Earth imagery indicates that solar panels are currently placed on the IBM property between the main IBM campus and SH 119. A 50% imperviousness was assumed for fields with solar panels.
    - Irrigation ponds were assumed to be 98% impervious.

This answers my question above and seems reasonable to me. You might consider noting this assumption in the main body of the report.

General Assumptions

- Roadside ditches parallel t e embankment of SH 119 prevent offsite flow from reaching the me e, off-site basins were not analyzed with the exception of areas where t outside of the SH 119 median.
    1. Three large waters y Creek, and Lefthand Creek) cross the proposed bike pat alues for these watersheds were provided via floodplain mod . Local areas within the project site contributing to ea ere evaluated.
- Irrigation ownership data from Boulder County was used to aid basin delineations. Irrigation ownership data indicates roughly 35 irrigation systems crossing SH 119 (and subsequently the proposed bike path) within the project area. Irrigation ditches traversing SH 119 have not been assumed to flow full, and thus have capacity to intercept stormwater based on topography.
- There are two culverts as possible design points for Basin X4096L, an 18" CSP crossing SB SH 119 to the north and an 18" CSP crossing N 83rd St to the southwest. The 18" CSP crossing SH 119 to the north was assigned as the design point for Basin X4096L because topographic survey indicates the invert of this pipe is lower. No flow has been assumed to reach the 18" CSP crossing N 83rd Street.

Please provide documentation of permission to discharge to irrigation ditches.

- An irrigation ditch traverses Basin X5052L. This is the only irrigation ditch that has been assumed to flow full and not intercept stormwater runoff due to the shallow depth of the irrigation ditch. The design point for Basin X5052L is an 18" CSP which conveys flow northeast across S Fordham St.

SH 119 and SH 52 Intersection / IBM Campus Offsite Flow Assumptions and Analysis

- Basins X3029R, X3033L, X3036R, X3042L, and X3048L located at the northeast corner of the SH 119/SH 52 intersection adjacent to the IBM campus were delineated with IBM E Loop Road as the western limit for two reasons.
    1. LiDAR contours indicate this road is crowned.
    2. The *SH 119 at SH 52 (Mineral Road) Final Drainage Report* states runoff from the majority of the IBM campus is routed south in an underground storm system and therefore does not reach the project area.
        - The drainage report states the portion of the IBM campus not reaching the storm system is the parking lots on the east side of the IBM campus. Runoff from the parking lots on the east side of the IBM campus flows east towards SH 119 and thus reaches the project area.
        - The 5-year and 100-year flowrates reaching the project area from the IBM campus are 25 cfs and 30 cfs respectively.

CALCULATION COVER SHEET **SH 119 Bikeway**
March 22, 2022 **Existing Hydrology**

Results:

Table 2 summarizes the 5-year and 100-year peak flowrates associated with individual basins.
Table 3 summarizes the 5-year and 100-year flowrates for all design points where runoff leaves the project area.

Table 2. *Peak Discharge Summary of Individual Basins*

BASIN ID	AREA (acre)	Q_5 (cfs)	Q_{100} (cfs)
X1016L	10.65	3.3	27.0
X1017L	0.70	1.3	4.0
X1018L	1.91	0.6	5.2
X1021R	0.28	1.1	2.2
X1029R	101.56	28.5	142.5
X1030R	0.94	0.1	2.1
X1032R	0.36	0.1	1.3
X1034R	1.25	0.2	3.1
X1047L	4.98	1.1	12.3
X1047LA	0.16	0.4	1.1
X1054R	4.67	3.2	12.8
X1056L	1.42	1.2	5.8
X1069R	5.56	0.7	11.4
X1077R	2.79	0.3	6.1
X1080R	2.46	1.6	8.5
X1082R	0.20	0.0	0.7
X1083R	0.82	1.1	3.8
X1088R	2.87	1.2	8.1
X2010R	8.15	1.0	10.0
X2019R	4.76	0.3	6.2
X2022R	0.12	0.2	0.7
X2022RA	1.16	0.1	2.6
X2031R	3.60	0.6	8.0
X2056R	9.09	1.2	11.3
X2060R	5.16	5.7	19.3
X2064R	5.43	2.6	13.5
X2079R	3.14	1.2	7.5
X2085R	3.26	1.3	8.9
X2090R	4.38	1.1	9.7
X2099R	0.44	0.3	1.6

BASIN ID	AREA (acre)	Q_5 (cfs)	Q_{100} (cfs)
X2100R	4.37	1.1	8.8
X3008L	4.08	1.3	9.5
X3008R	2.61	1.5	6.3
X3013L	2.81	1.2	8.3
X3023L	10.96	3.7	21.4
X3023R	1.18	2.6	5.9
X3029R	13.74	4.9	27.0
X3033R	17.48	13.6	45.3
X3033RA	0.74	1.0	2.6
X3036L	24.91	12.0	39.9
X3038R	1.07	0.7	3.7
X3042L	2.30	0.9	5.3
X3042R	1.36	1.4	5.4
X3048L	22.96	3.5	31.3
X3049R	3.63	2.4	10.3
X3052L	0.61	0.7	2.8
X4019R	16.48	1.6	15.4
X4019RA	0.21	0.6	1.4
X4021R	0.35	1.0	2.3
X4023R	3.89	3.6	11.2
X4028R	2.91	1.9	10.8
X4044R	7.65	0.7	9.8
X4054R	4.90	1.0	8.5
X4065R	4.64	1.4	9.6
X4076LA	4.51	0.7	8.0
X4076L	0.60	0.4	1.8
X4028R	2.91	1.9	10.8
X4082L	2.95	0.8	6.9
X4087L	3.13	1.7	9.1
X4091L	2.40	2.5	9.3

Table 2. *Peak Discharge Summary of Individual Basins (continued)*

BASIN ID	AREA (acre)	Q_5 (cfs)	Q_{100} (cfs)
X4096L	0.92	1.2	3.8
X4114L	8.50	1.8	12.2
X5006R	1.44	1.1	5.1
X5007R	0.10	0.2	0.6
X5011L	8.78	2.3	15.3
X5011R	0.27	0.6	1.5
X5013L	3.08	1.6	8.0
X5023R	6.91	1.3	7.4
X5033R	7.15	1.2	8.9
X5041R	1.78	0.5	4.8
X5045R	0.92	0.3	2.0
X5048R	2.21	0.5	5.0
X5052L	1.93	0.7	4.2
X5064R	9.61	1.5	13.6
X5066R	4.10	0.3	6.2
X5068R	11.18	2.5	24.4
X5075R	9.68	2.8	21.6
X5084R	6.80	2.5	15.6

Table 3. *Peak Discharge Summary of Design Points where Flow Leaves Project*

Design Point	Contributing Basins	Description of Runoff Leaving Project Area	Q5 (cfs)	Q100 (cfs)
X1018L	X1016L, X1017L, X1018L, X1021R	Fourmile Creek	5.3	35.4
X1030R	X1029R, X1030R, X1032R	Ditch between NB CO 119 and BNSF Railroad	28.6	144.0
X1034R	X1034R	Poorly defined ditch outside (southeast) of BNSF Railroad	0.2	3.1
X1047L	X1047L	Boulder and Whiterock Irrigation Ditch	1.1	12.3
X1056L	X1054R, X1056L	Water Quality Extended Detention Basin North of Jay Road	4.0	16.5
X1069R	X1069R	Boulder and Whiterock Irrigation Ditch	0.7	11.4
X1082R	X1082R	Ditch between NB CO 119 and BNSF Railroad	0.0	0.7
X1083R	X1077R, X1080R, X1083R	Boulder and Whiterock Irrigation Ditch	2.2	14.6
X1088R	X1088R	City of Boulder and Others Irrigation Ditch	1.2	8.1
X2010R	X2010R	Ditch between NB CO 119 and BNSF Railroad	1.0	10.0
X2019R	X2019R	Ditch between NB CO 119 and BNSF Railroad	0.3	6.2
X2022RA	X2022RA	Ditch between NB CO 119 and BNSF Railroad	0.1	2.6
X2022R	X2022R	Ditch between NB CO 119 and BNSF Railroad	0.2	0.7
X2031R	X2031R	Boulder and Whiterock Irrigation Ditch	0.6	8.0
X2060R	X2056R, X2060R	Boulder Reservoir Spillway/ Boulder County Irrigation Ditch	3.5	19.3
X2064R	X2064R	Ditch between NB CO 119 and BNSF Railroad	2.6	13.5
X2079R	X2079R	City of Boulder and Northern Colorado Water Conservancy District Irrigation Ditch	1.2	7.5
X2085R	X2085R	Ditch between NB CO 119 and BNSF Railroad	1.3	8.9
X0290R	X2090R, X2099R, X2100R	Dry Creek	2.3	18.5
X3008L	X3008L	IBM and Others Irrigation Ditch	1.3	9.5
X3008R	X3008R	Ditch between NB CO 119 and BNSF Railroad	1.5	6.3
X3013L	X3013L	Ditch between NB CO 119 and BNSF Railroad	1.2	8.3
X3023R	X3023R	Inlet at CO 119 and SH 52 Intersection	2.6	5.9
X3029R	X3023L, X3029R, Offsite Flow From IBM Campus	Ditch between NB CO 119 and BNSF Railroad	33.5	78.3
X3033RA	X3033R, X3033RA	Ditch between NB CO 119 and BNSF Railroad	14.4	47.4

Table 3. *Peak Discharge Summary of Design Points where Flow Leaves Project (continued)*

Design Point	Contributing Basins	Description of Runoff Leaving Project Area	Q5 (cfs)	Q100 (cfs)
X3038R	X3036L, X3038R	Ditch between NB CO 119 and BNSF Railroad	12.3	41.4
X3042R	X3042L, X3042R	Ditch between NB CO 119 and BNSF Railroad	1.8	8.7
X3049R	X3048L, X3049R	Ditch between NB CO 119 and BNSF Railroad	4.8	37.0
X3052L	X3052L	Ditch between NB CO 119 and BNSF Railroad	0.7	2.8
X4019R	X4019R	Point between NB CO 119 and BNSF Railroad	1.6	15.4
X4028R	X4019RA, X4021R, X4023R, X4028R	Water Quality Extended Detention Basin North of Niwot Road	4.1	21.9
X4044R	X4044R	Williamson Irrigation Ditch	0.7	9.8
X4054R	X4054R	Ditch between NB CO 119 and BNSF Railroad	1.0	8.5
X4065R	X4065R	Ditch between NB CO 119 and BNSF Railroad	1.4	9.6
X4076LA	X4076LA	Ditch outside and adjacent to SB CO 119	0.7	8.0
X4076L	X4076L	Ditch outside and adjacent to SB CO 119	0.4	1.8
X4082L	X4082L	Ditch outside and adjacent to SB CO 119	0.8	6.9
X4087L	X4087L	Ditch outside and adjacent to SB CO 119	1.7	9.1
X4091L	X4091L	Point outside of SB CO 119	2.5	9.3
X4096L	X4096L	Point outside of SB CO 119	1.2	3.8
X4114L	X4114L	Point outside of SB CO 119 near Lefthand Creek	1.8	12.2
X5006R	X5006R, X5007R	Storm system at existing underpass under NB CO 119 near Airport Road	1.3	5.5
X5011L	X5011L, X5011R	Lefthand Creek	2.5	15.8
X5013L	X5013L	Lefthand Creek	1.6	8.0
X5023R	X5023R	Ditch between NB CO 119 and BNSF Railroad	1.3	7.4
X5033R	X5033R	Lefthand Creek	1.2	8.9
X5041R	X5041R	Ditch between NB CO 119 and BNSF Railroad	0.5	4.8
X5048R	X5048R	Ditch between NB CO 119 and BNSF Railroad	0.5	5.0
X5064R	X5052L, X5064R	Ditch between NB CO 119 and BNSF Railroad	1.9	16.5
X5066R	X5066R	Ditch between NB CO 119 and BNSF Railroad	0.3	6.2
X5075R	X5075R, X5084R	Ditch between NB CO 119 and BNSF Railroad	5.4	37.0

Materials Included in this Calculation Packet:

1. Rational Method Calculations

SH 119 Bikeway
Existing Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
CDOT Project Number: N/A
Muller Project Number: 21015

Originator: ZDS
Date: 2/2/2022
Checker: ACF
Date: 3/1/2022

Land Use Types	Percent Impervious
STREETS: PAVED	100
RESIDENTIAL: 0.25 ACRES OR LESS	45
UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL	2
SOLAR PANEL FIELD	50
STREETS: GRAVEL (PACKED)	40
IRRIGATION POND	98
BUSINESS: SUBURBAN AREAS	75
NO LAND USE DEFINED	0

Land Use Types and Imperviousness Values from USDCM Volume 1 Table 6-3

PERCENT IMPERVIOUS VALUES

BASIN ID	TOTAL AREA		STREETS: PAVED		RESIDENTIAL: 0.25 ACRES OR LESS		UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL		SOLAR PANEL FIELD		STREETS: GRAVEL (PACKED)		IRRIGATION POND		BUSINESS: SUBURBAN AREAS		WEIGHTED PERCENT IMPERVIOUS	WEIGHTED PERCENT PERVIOUS
	(sq ft)	(acre)	(sq ft)	% of Basin ²	(sq ft)	% of Basin ²	(sq ft)	% of Basin ²	(sq ft)	% of Basin ²	(sq ft)	% of Basin ²	(sq ft)	% of Basin ²	(sq ft)	% of Basin ²		
X1016L	463,994	10.65	65,370	14		0	398,624	86		0		0		0		0	16	84
X1017L	30,595	0.70	15,629	51		0	14,966	49		0		0		0		0	52	48
X1018L	83,003	1.91	10,436	13		0	72,567	87		0		0		0		0	14	86
X1021R	12,212	0.28	12,219	100		0		0		0		0		0		0	100	0
X1029R	4,423,755	101.56	61,081	1	1,969,817	45	2,392,857	54		0		0		0		0	23	77
X1030R	41,148	0.94		0		0	41,148	100		0		0		0		0	2	98
X1032R	15,708	0.36		0		0	15,708	100		0		0		0		0	2	98
X1034R	54,497	1.25		0		0	54,497	100		0		0		0		0	2	98
X1047L	217,001	4.98	8,906	4		0	208,095	96		0		0		0		0	6	94
X1047LA	6,874	0.16	4,394	64		0	2,480	36		0		0		0		0	65	35
X1054R	203,467	4.67	61,266	30		0	142,201	70		0		0		0		0	32	68
X1056L	61,720	1.42	13,070	21		0	48,650	79		0		0		0		0	23	77
X1069R	242,034	5.56	682	0		0	240,582	99		0	770	0		0		0	2	98
X1077R	121,454	2.79		0		0	121,454	100		0		0		0		0	2	98
X1080R	107,200	2.46	20,960	20		0	86,240	80		0		0		0		0	21	79
X1082R	8,585	0.20		0		0	8,585	100		0		0		0		0	2	98
X1083R	35,855	0.82	14,489	40		0	21,366	60		0		0		0		0	42	58
X1088R	125,017	2.87	16,864	13		0	108,153	87		0		0		0		0	15	85
X2010R	354,896	8.15	19,778	6		0	335,118	94		0		0		0		0	7	93
X2019R	207,452	4.76		0		0	207,452	100		0		0		0		0	2	98
X2022R	5,417	0.12	1,403	26		0	4,014	74		0		0		0		0	27	73
X2022RA	50,741	1.16		0		0	50,741	100		0		0		0		0	2	98
X2031R	157,010	3.60	3,075	2		0	153,935	98		0		0		0		0	4	96
X2056R	396,021	9.09	24,184	6		0	371,837	94		0		0		0		0	8	92
X2060R	224,901	5.16	87,081	39		0	137,820	61		0		0		0		0	40	60
X2064R	236,468	5.43	47,432	20		0	189,036	80		0		0		0		0	22	78
X2079R	136,934	3.14	19,096	14		0	117,838	86		0		0		0		0	16	84
X2085R	141,925	3.26	17,225	12		0	124,700	88		0		0		0		0	14	86
X2090R	190,821	4.38	15,647	8		0	175,174	92		0		0		0		0	10	90
X2099R	19,351	0.44	3,294	17		0	16,057	83		0		0		0		0	19	81
X2100R	190,162	4.37	17,352	9		0	172,810	91		0		0		0		0	11	89
X3008L	177,783	4.08	18,652	10		0	159,131	90		0		0		0		0	12	88
X3008R	113,528	2.61	31,293	28		0	82,235	72		0		0		0		0	29	71
X3013L	122,487	2.81	14,442	12		0	108,045	88		0		0		0		0	14	86
X3023L	477,443	10.96	77,654	16		0	399,789	84		0		0		0		0	18	82
X3023R	51,358	1.18	39,883	78		0	11,475	22		0		0		0		0	78	22
X3029R	598,300	13.74	87,606	15		0	472,688	79	38,006	6		0		0		0	19	81
X3033R	761,254	17.48	22,582	3		0	163,264	21	575,408	76		0		0		0	41	59
X3033RA	32,407	0.74	18,185	56		0		0		0		0		0		0	56	44
X3036L	1,084,927	24.91	25,038	2		0	243,587	22	791,991	73		0	24,311	2		0	41	59
X3038R	46,539	1.07	10,053	22		0		0		0		0		0		0	22	78
X3042L	100,199	2.30	16,780	17		0	83,419	83		0		0		0		0	18	82
X3042R	59,219	1.36	19,736	33		0		0		0		0		0		0	33	67
X3048L	1,000,057	22.96	72,499	7		0	927,558	93		0		0		0		0	9	91
X3049R	158,167	3.63	43,920	28		0		0		0		0		0		0	28	72
X3052L	26,432	0.61	8,607	33		0	17,825	67		0		0		0		0	34	66
X4019R	717,656	16.48	42,932	6		0	674,724	94		0		0		0		0	8	92
X4019RA	9,066	0.21	6,786	75		0	2,280	25		0		0		0		0	75	25
X4021R	15,055	0.35	11,877	79		0	3,178	21		0		0		0		0	79	21
X4023R	169,237	3.89	77,240	46		0	91,997	54		0		0		0		0	47	53
X4028R	126,600	2.91	20,977	17		0	105,623	83		0		0		0		0	18	82
X4044R	333,447	7.65	5,804	2		0	327,643	98		0		0		0		0	4	96
X4054R	213,546	4.90	17,071	8		0	196,475	92		0		0		0		0	10	90
X4065R	201,942	4.64	23,255	12		0	178,687	88		0		0		0		0	13	87
X4076LA	196,620	4.51	9,681	5		0	186,939	95		0		0		0		0	7	93
X4076L	26,055	0.60	7,128	27		0	18,927	73		0		0		0		0	29	71
X4082L	128,471	2.95	11,315	9		0	117,156	91		0		0		0		0	11	89
X4087L	136,429	3.13	25,554	19		0	110,875	81		0		0		0		0	20	80
X4091L	104,657	2.40	35,538	34		0	69,119	66		0		0		0		0	35	65
X4096L	39,945	0.92	16,462	41		0	23,336	58		0	147	0		0		0	43	57
X4114L	370,089	8.50	47,398	13		0	322,691	87		0		0		0		0	15	85
X5006R	62,921	1.44	15,751	25		0	47,170	75		0		0		0		0	27	73
X5007R	4,569	0.10	1,714	38		0	2,855	62		0		0		0		0	39	61
X5011L	382,365	8.78	50,418	13		0	331,947	87		0		0		0		0	15	85
X5011R	11,635	0.27	7,969	68		0	3,666	32		0		0		0		0	69	31
X5013L	134,100	3.08	32,841	24		0	101,259	76		0		0		0		0	26	74
X5023R	300,782	6.91	42,985	14		0	257,797	86		0		0		0		0	16	84
X5033R	311,264	7.15	34,108	11		0	277,156	89		0		0		0		0	13	87
X5041R	77,498	1.78	9,990	13		0	67,508	87		0		0		0		0	15	85
X5045R	39,903	0.92	6,142	15		0	33,761	85		0		0		0		0	17	83
X5048R	96,384	2.21	9,470	10		0	86,914	90		0		0		0		0	12	88
X5052L	83,929	1.93	16,107	19		0	67,822	81		0		0		0		0	21	79
X5064R	418,822	9.61	51,424	12		0	367,398	88		0		0		0		0	14	86
X5066R	178,669	4.10	9,295	5		0	169,374	95		0		0		0		0	7	93
X5068R	486,810	11.18	43,964	9		0	442,846	91		0		0		0		0	11	89
X5075R	421,518	9.68	43,319	10		0	378,199	90		0		0		0		0	12	88
X5084R	296,113	6.80	44,109	15		0	252,004	85		0		0		0		0	17	83

SH 119 Bikeway
Existing Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
CDOT Project Number: N/A
Muller Project Number: 21015

Originator ZDS
Date: 2/2/2022
Checker: ACF
Date: 3/1/2022

RUNOFF COEFFIECIENTS FOR 2, 5, 10, AND 100 YEAR STORM EVENTS

BASIN ID	NRCS HYDROLOGIC SOIL GROUP[1]																						C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}
	SOIL GROUP (%)[1]			SOIL GROUP A							SOIL GROUP B							SOIL GROUP C/D											
	A	B	C/D	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%						
X1016L		100								0	0.10	0.12	0.19	0.35	0.42	0.50	100							0	0.10	0.12	0.19	0.35	0.42	0.50
X1017L		100								0	0.39	0.42	0.48	0.58	0.62	0.67	100							0	0.39	0.42	0.48	0.58	0.62	0.67
X1018L		90	10							0	0.09	0.10	0.17	0.34	0.41	0.49	90	0.09	0.15	0.24	0.40	0.46	0.54	10	0.09	0.11	0.18	0.35	0.41	0.50
X1021R		80	20							0	0.84	0.86	0.87	0.88	0.89	0.90	80	0.83	0.86	0.87	0.88	0.88	0.89	20	0.84	0.86	0.87	0.88	0.89	0.90
X1029R			100							0							0	0.16	0.22	0.30	0.45	0.50	0.58	100	0.16	0.22	0.30	0.45	0.50	0.58
X1030R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X1032R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X1034R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X1047L			100							0							0	0.04	0.08	0.18	0.35	0.42	0.51	100	0.04	0.08	0.18	0.35	0.42	0.51
X1047LA			100							0							0	0.51	0.57	0.61	0.68	0.71	0.75	100	0.51	0.57	0.61	0.68	0.71	0.75
X1054R			100							0							0	0.23	0.29	0.37	0.50	0.55	0.61	100	0.23	0.29	0.37	0.50	0.55	0.61
X1056L			100							0							0	0.16	0.22	0.30	0.45	0.50	0.58	100	0.16	0.22	0.30	0.45	0.50	0.58
X1069R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X1077R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X1080R			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
X1082R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X1083R			100							0							0	0.31	0.38	0.44	0.55	0.60	0.65	100	0.31	0.38	0.44	0.55	0.60	0.65
X1088R			100							0							0	0.10	0.16	0.24	0.40	0.47	0.55	100	0.10	0.16	0.24	0.40	0.47	0.55
X2010R			100							0							0	0.05	0.10	0.19	0.36	0.43	0.51	100	0.05	0.10	0.19	0.36	0.43	0.51
X2019R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X2022R			100							0							0	0.19	0.26	0.33	0.47	0.53	0.60	100	0.19	0.26	0.33	0.47	0.53	0.60
X2022RA			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
X2031R			100							0							0	0.02	0.07	0.16	0.34	0.41	0.50	100	0.02	0.07	0.16	0.34	0.41	0.50
X2056R			100							0							0	0.05	0.10	0.19	0.36	0.43	0.52	100	0.05	0.10	0.19	0.36	0.43	0.52
X2060R			100							0							0	0.30	0.36	0.43	0.54	0.59	0.65	100	0.30	0.36	0.43	0.54	0.59	0.65
X2064R			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
X2079R			100							0							0	0.10	0.16	0.25	0.41	0.47	0.55	100	0.10	0.16	0.25	0.41	0.47	0.55
X2085R			100							0							0	0.09	0.15	0.23	0.40	0.46	0.54	100	0.09	0.15	0.23	0.40	0.46	0.54
X2090R			100							0							0	0.06	0.12	0.21	0.38	0.44	0.53	100	0.06	0.12	0.21	0.38	0.44	0.53
X2099R			100							0							0	0.13	0.19	0.27	0.42	0.48	0.56	100	0.13	0.19	0.27	0.42	0.48	0.56
X2100R			100							0							0	0.07	0.12	0.21	0.38	0.45	0.53	100	0.07	0.12	0.21	0.38	0.45	0.53
X3008L			100							0							0	0.08	0.14	0.22	0.39	0.45	0.53	100	0.08	0.14	0.22	0.39	0.45	0.53
X3008R			100							0							0	0.21	0.27	0.35	0.48	0.54	0.60	100	0.21	0.27	0.35	0.48	0.54	0.60
X3013L			100							0							0	0.09	0.15	0.23	0.39	0.46	0.54	100	0.09	0.15	0.23	0.39	0.46	0.54
X3023L			100							0							0	0.12	0.18	0.26	0.42	0.48	0.56	100	0.12	0.18	0.26	0.42	0.48	0.56
X3023R			100							0							0	0.63	0.68	0.71	0.76	0.78	0.80	100	0.63	0.68	0.71	0.76	0.78	0.80
X3029R			100							0							0	0.13	0.19	0.28	0.43	0.49	0.56	100	0.13	0.19	0.28	0.43	0.49	0.56
X3033R			100							0							0	0.31	0.37	0.44	0.55	0.59	0.65	100	0.31	0.37	0.44	0.55	0.59	0.65
X3033RA			100							0							0	0.43	0.50	0.55	0.63	0.67	0.71	100	0.43	0.50	0.55	0.63	0.67	0.71
X3036L			100							0							0	0.31	0.37	0.44	0.55	0.60	0.65	100	0.31	0.37	0.44	0.55	0.60	0.65
X3038R			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
X3042L			100							0							0	0.12	0.19	0.27	0.42	0.48	0.56	100	0.12	0.19	0.27	0.42	0.48	0.56
X3042R			100							0							0	0.24	0.31	0.38	0.51	0.56	0.62	100	0.24	0.31	0.38	0.51	0.56	0.62
X3048L			100							0							0	0.06	0.11	0.20	0.37	0.44	0.52	100	0.06	0.11	0.20	0.37	0.44	0.52
X3049R			100							0							0	0.20	0.26	0.34	0.47	0.53	0.60	100	0.20	0.26	0.34	0.47	0.53	0.60
X3052L			100							0							0	0.25	0.31	0.38	0.51	0.56	0.62	100	0.25	0.31	0.38	0.51	0.56	0.62
X4019R			100							0							0	0.05	0.10	0.19	0.36	0.43	0.52	100	0.05	0.10	0.19	0.36	0.43	0.52
X4019RA			100							0							0	0.60	0.65	0.69	0.74	0.76	0.79	100	0.60	0.65	0.69	0.74	0.76	0.79
X4021R			100							0							0	0.64	0.69	0.72	0.76	0.78	0.81	100	0.64	0.69	0.72	0.76	0.78	0.81
X4023R			100							0							0	0.35	0.42	0.48	0.58	0.62	0.68	100	0.35	0.42	0.48	0.58	0.62	0.68
X4028R			100							0							0	0.12	0.18	0.27	0.42	0.48	0.56	100	0.12	0.18	0.27	0.42	0.48	0.56
X4044R			100							0							0	0.02	0.07	0.16	0.34	0.41	0.50	100	0.02	0.07	0.16	0.34	0.41	0.50
X4054R			100							0							0	0.06	0.12	0.20	0.37	0.44	0.52	100	0.06	0.12	0.20	0.37	0.44	0.52
X4065R			100							0							0	0.09	0.14	0.23	0.39	0.46	0.54	100	0.09	0.14	0.23	0.39	0.46	0.54
X4076LA			100							0							0	0.04	0.09	0.18	0.36	0.43	0.51	100	0.04	0.09	0.18	0.36	0.43	0.51
X4076L			100							0							0	0.21	0.27	0.35	0.48	0.53	0.60	100	0.21	0.27	0.35	0.48	0.53	0.60
X4082L			100							0							0	0.07	0.12	0.21	0.38	0.45	0.53	100	0.07	0.12	0.21	0.38	0.45	0.53
X4087L			100							0							0	0.14	0.20	0.28	0.43	0.49	0.57	100	0.14	0.20	0.28	0.43	0.49	0.57
X4091L			100							0							0	0.26	0.32	0.39	0.52	0.57	0.63	100	0.26	0.32	0.39	0.52	0.57	0.63
X4096L			100							0							0	0.32	0.38	0.45	0.56	0.60	0.66	100	0.32	0.38	0.45	0.56	0.60	0.66
X4114L			100							0							0	0.10	0.15	0.24	0.40	0.46	0.54	100	0.10	0.15	0.24	0.40	0.46	0.54
X5006R			100							0							0	0.19	0.25	0.33	0.47	0.52	0.59	100	0.19	0.25	0.33	0.47	0.52	0.59
X5007R			100							0							0	0.29	0.35	0.42	0.54	0.58	0.64	100	0.29	0.35	0.42	0.54	0.58	0.64
X5011L		10	100							0	0.09	0.11	0.18	0.34	0.41	0.50	10	0.10	0.16	0.24	0.40	0.47	0.55	100	0.11	0.17	0.26	0.44	0.51	0.59
X5011R	10	90		0.52	0.54	0.55	0.58	0.61	0.65	10	0.55	0.58	0.62	0.68	0.72	0.75	90							0	0.54	0.57	0.61	0.67	0.70	0.74
X5013L	10	90		0.15	0.15	0.17	0.19	0.25	0.31	10	0.17	0.20	0.27	0.41	0.47	0.55	90							0	0.17	0.19	0.26	0.39	0.45	0.52
X5023R	60		40	0.08	0.08	0.09	0.11	0.16	0.23	60							0	0.11	0.17	0.25	0.41	0.47	0.55	40	0.09	0.12	0.15	0.23	0.29	0.36
X5033R	50	10	40	0.06	0.06	0.07	0.09	0.13	0.21	50	0.08	0.09	0.16	0.33	0.40	0.49	10	0.08	0.14	0.23	0.39	0.46	0.54	40	0.07	0.10	0.14	0.23	0.29	0.37
X5041R		100								0	0.09	0.11	0.18	0.34	0.41	0.49	100							0	0.09	0.11	0.18	0.34	0.41	0.49
X5045R		100								0	0.11	0.13	0.20	0.36	0.42	0.51	100							0	0.11	0.13	0.20	0.36	0.42	0.51
X5048R		100								0	0.07	0.08	0.15	0.32	0.39	0.48	100							0	0.07	0.08	0.15	0.32	0.39	0.48
X5052L		100								0	0.13	0.16	0.23	0.38	0.44	0.52	100							0	0.13	0.16	0.23	0.38	0.44	0.52
X5064R		100								0	0.08	0.10	0.17	0.34	0.41	0.49	100							0	0.08	0.10	0.17	0.34	0.41	0.49
X5066R		100								0	0.04	0.05	0.11	0.29	0.37	0.46	100							0	0.04	0.05	0.11	0.29	0.37	0.46
X5068R		60	40							0	0.06	0.08	0.14	0.32	0.39	0.48	60	0.07	0.12	0.21	0.38	0.45	0.53	40	0.07	0.10	0.17	0.34	0.41	0.50
X5075R			100							0							0	0.08	0.13	0.22	0.39	0.45	0.53	100	0.08	0.13	0.22	0.39	0.45	0.53
X5084R			100							0							0	0.11	0.17	0.25	0.41	0.47	0.55	100	0.11	0.17	0.25	0.41	0.47	0.55

Notes:

[1] Soil Group based on NRCS Soil Classification Map

[2] C Values obtained from USDCM Manual, March 2017, Chpt 6, Sec 2.5.1, Table 6-4

SH 119 Bikeway
Existing Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
CDOT Project Number: N/A
Muller Project Number: 21015

Originator ZDS
Date: 2/2/2022
Checker: ACF
Date: 3/1/2022

TIME OF CONCENTRATION

BASIN DATA				INITIAL/OVERLAND TIME (T_i)					CHANNELIZED (TRAVEL) TIME (T_t)								TOTAL t_c	T_c CHECK (Urbanized Basins)		FINAL t_c
BASIN ID	AREA (acre)	C_5	Basin Type	LENGTH L_i (ft)	ELEV. START (ft)	ELEV. END (ft)	OVERLAND SLOPE (S_i) (ft/ft)	t_i (min)[1]	LENGTH L_t (ft)	ELEV. START (ft)	ELEV. END (ft)	CHANNELIZED SLOPE (S_t) (ft/ft)	CONVEYANCE COEFFICIENT Type	CONVEYANCE COEFFICIENT K	Velocity V_t (ft/sec)	t_t (min)[2]	$t_i + t_t$ (min.)	First Design Point	Maximum t_c (min)[3]	$t_{minimum}$= 5 (Urban) $t_{minimum}$= 10 (Non-Urban)
X1016L	10.65	0.12	Non-Urban	57	5329.8	5306.5	0.409	3.9	1050	5306.5	5287.5	0.018	SP	7	0.9	18.6	22.5	No	N/A	22.5
X1017L	0.70	0.42	Urban	23	5292.0	5291.5	0.022	4.5	171	5291.5	5285.5	0.035	SP	7	1.3	2.2	6.7	No	N/A	6.7
X1018L	1.91	0.11	Non-Urban	73	5294.2	5292.7	0.021	12.1	494	5292.7	5280.5	0.025	SP	7	1.1	7.5	19.5	No	N/A	19.5
X1021R	0.28	0.86	Urban	62	5296.50	5295.80	0.011	3.3	231	5295.80	5294.50	0.006	P	20	1.5	2.6	5.9	No	N/A	5.9
X1029R	101.56	0.22	Non-Urban	500	5373.0	5367.0	0.012	33.5	4814	5367.0	5284.0	0.017	BG	10	1.3	61.1	94.6	Yes	72.5	72.5
X1030R	0.94	0.05	Non-Urban	21	5295.3	5294.3	0.048	5.2	910	5294.3	5285.5	0.010	SP	7	0.7	22.0	27.2	Yes	42.3	27.2
X1032R	0.36	0.05	Non-Urban	33	5287.1	5283.7	0.103	5.0	159	5283.7	5282.5	0.008	SP	7	0.6	4.4	9.4	Yes	28.9	10.0
X1034R	1.25	0.05	Non-Urban	121	5291.8	5284.5	0.060	11.5	341	5284.5	5282.5	0.006	SP	7	0.5	10.6	22.1	No	N/A	22.1
X1047L	4.98	0.08	Non-Urban	127	5291.7	5284.5	0.057	11.7	773	5284.5	5268.0	0.021	SP	7	1.0	12.6	24.3	No	N/A	24.3
X1047LA	0.16	0.57	Urban	77	5285.1	5281.7	0.044	5.2	63	5281.7	5277.5	0.067	SP	7	1.8	0.6	5.8	No	N/A	5.8
X1054R	4.67	0.29	Urban	194	5283.8	5279.0	0.025	15.0	608	5279.0	5271.5	0.012	SP	7	0.8	13.0	28.1	No	N/A	28.1
X1056L	1.42	0.22	Urban	97	5278.2	5274.1	0.042	9.7	252	5274.1	5267.5	0.026	P	20	3.2	1.3	11.0	No	N/A	11.0
X1069R	5.56	0.05	Non-Urban	90	5276.5	5273.5	0.033	12.0	1251	5273.5	5244.5	0.023	SP	7	1.1	19.6	31.6	No	N/A	31.6
X1077R	2.79	0.05	Non-Urban	205	5253.3	5248.0	0.026	19.8	448	5248.0	5241.5	0.015	SP	7	0.8	8.9	28.7	No	N/A	28.7
X1080R	2.46	0.21	Urban	119	5248.0	5241.0	0.059	9.8	290	5241.0	5237.5	0.012	SP	7	0.8	6.3	16.1	No	N/A	16.1
X1082R	0.20	0.05	Non-Urban	52	5241.4	5237.7	0.071	7.1	50	5237.7	5235.5	0.044	SP	7	1.5	0.6	7.7	No	N/A	10.0
X1083R	0.82	0.38	Urban	195	5245.7	5236.0	0.050	10.7	38	5236.0	5235.5	0.013	SP	7	0.8	0.8	11.5	No	N/A	11.5
X1088R	2.87	0.16	Non-Urban	133	5241.1	5237.0	0.031	13.5	399	5237.0	5231.5	0.014	SP	7	0.8	8.1	21.6	No	N/A	21.6
X2010R	8.15	0.10	Non-Urban	449	5241.1	5230.0	0.025	28.5	2109	5230.0	5205.5	0.012	SP	7	0.8	46.6	75.1	No	N/A	75.1
X2019R	4.76	0.05	Non-Urban	500	5220.0	5210.3	0.019	34.0	1191	5210.3	5199.5	0.009	SP	7	0.7	29.8	63.8	No	N/A	63.8
X2022R	0.12	0.26	Urban	32	5201.5	5198.0	0.109	3.9	67	5198.0	5197.5	0.007	SP	7	0.6	1.8	5.7	No	N/A	5.7
X2022RA	1.16	0.05	Non-Urban	213	5202.5	5199.0	0.016	23.5	177	5199.0	5197.5	0.008	SP	7	0.6	4.6	28.0	No	N/A	28.0
X2031R	3.60	0.07	Non-Urban	158	5201.5	5195.6	0.037	15.2	849	5195.6	5175.0	0.024	SP	7	1.1	13.0	28.2	No	N/A	28.2
X2056R	9.09	0.10	Non-Urban	438	5182.0	5164.0	0.041	23.7	2024	5164.0	5145.5	0.009	SP	7	0.7	50.4	74.1	No	N/A	74.1
X2060R	5.16	0.36	Urban	175	5164.8	5156.0	0.050	10.3	433	5156.0	5147.0	0.021	SP	7	1.0	7.2	17.5	No	N/A	17.5
X2064R	5.43	0.21	Urban	269	5169.3	5163.0	0.023	19.8	724	5163.0	5149.0	0.019	SP	7	1.0	12.4	32.2	Yes	29.5	29.5
X2079R	3.14	0.16	Non-Urban	477	5169.2	5156.0	0.028	26.4	323	5156.0	5138.0	0.056	SP	7	1.7	3.3	29.7	No	N/A	29.7
X2085R	3.26	0.15	Non-Urban	97	5151.4	5140.1	0.116	7.5	520	5140.1	5136.5	0.007	SP	7	0.6	14.9	22.4	No	N/A	22.4
X2090R	4.38	0.12	Non-Urban	201	5152.1	5145.7	0.032	17.2	809	5145.7	5130.0	0.019	SP	7	1.0	13.8	31.0	No	N/A	31.0
X2099R	0.44	0.19	Non-Urban	141	5152.5	5148.0	0.032	13.3	76	5148.0	5145.5	0.033	SP	7	1.3	1.0	14.3	No	N/A	14.3
X2100R	4.37	0.12	Non-Urban	182	5170.2	5165.2	0.027	17.0	1048	5165.2	5148.5	0.016	SP	7	0.9	19.8	36.8	No	N/A	36.8
X3008L	4.08	0.14	Non-Urban	78	5175.0	5169.0	0.077	7.8	884	5169.0	5160.5	0.010	SP	7	0.7	21.5	29.3	No	N/A	29.3
X3008R	2.61	0.27	Urban	146	5170.2	5164.8	0.037	11.7	655	5164.8	5161.5	0.005	SP	7	0.5	22.0	33.7	No	N/A	33.7
X3013L	2.81	0.15	Non-Urban	48	5165.1	5162.0	0.065	6.4	507	5162.0	5157.5	0.009	SP	7	0.7	12.8	19.3	No	N/A	19.3
X3023L	10.96	0.18	Non-Urban	408	5165.2	5157.0	0.020	26.6	592	5157.0	5152.0	0.008	SP	7	0.6	15.3	41.9	No	N/A	41.9
X3023R	1.18	0.68	Urban	25	5162.2	5160.0	0.088	1.9	1070	5160.00	5155.2	0.004	P	20	1.3	13.3	15.2	Yes	26.1	15.2
X3029R	13.74	0.19	Non-Urban	346	5161.0	5154.0	0.020	24.1	1199	5154.0	5147.5	0.005	GW	15	1.1	18.1	42.2	No	N/A	42.2
X3033R	17.48	0.37	Urban	300	5161.0	5156.5	0.015	19.9	1301	5156.5	5144.5	0.009	SP	7	0.7	32.3	52.1	Yes	34.3	34.3
X3033RA	0.74	0.50	Urban	22	5155.4	5155.0	0.018	4.2	815	5155.00	5147.0	0.010	SP	7	0.7	19.6	23.8	Yes	24.6	23.8
X3036L	24.91	0.37	Urban	300	5160.5	5154.7	0.019	18.2	1950	5154.7	5140.0	0.008	SP	7	0.6	53.5	71.7	No	N/A	71.7
X3038R	1.07	0.21	Urban	31	5150.6	5148.3	0.074	4.6	511	5148.3	5142.0	0.012	SP	7	0.8	11.0	15.6	No	N/A	15.6
X3042L	2.30	0.19	Non-Urban	356	5148.2	5143.0	0.015	27.5	212	5143.0	5141.0	0.009	SP	7	0.7	5.2	32.7	No	N/A	32.7
X3042R	1.36	0.31	Urban	79	5148.3	5144.8	0.044	7.8	318	5144.80	5140.0	0.015	SP	7	0.9	6.2	13.9	Yes	23.5	13.9
X3048L	22.96	0.11	Non-Urban	488	5160.5	5152.0	0.017	32.9	1518	5152.0	5133.0	0.013	SP	7	0.8	32.3	65.2	No	N/A	65.2
X3049R	3.63	0.26	Urban	100	5144.7	5140.0	0.047	9.1	752	5140.0	5131.0	0.012	SP	7	0.8	16.4	25.4	Yes	30.2	25.4
X3052L	0.61	0.31	Urban	52	5137.5	5136.0	0.029	7.2	178	5136.0	5132.0	0.022	SP	7	1.0	2.8	10.0	No	N/A	10.0
X4019R	16.48	0.10	Non-Urban	304	5135.6	5130.0	0.018	25.7	3150	5130.0	5105.0	0.008	SP	7	0.6	84.2	109.9	No	N/A	109.9
X4019RA	0.21	0.65	Urban	73	5111.5	5110.5	0.014	6.2	53	5110.5	5107.7	0.053	SP	7	1.6	0.5	6.8	No	N/A	6.8
X4021R	0.35	0.69	Urban	62	5110.2	5109.0	0.019	4.7	136	5109.0	5106.5	0.018	SP	7	0.9	2.4	7.1	No	N/A	7.1
X4023R	3.89	0.42	Urban	241	5111.2	5109.0	0.009	19.7	487	5109.0	5103.5	0.011	SP	7	0.7	10.9	30.6	No	N/A	30.6
X4028R	2.91	0.18	Non-Urban	98	5108.5	5104.0	0.046	9.9	415	5104.0	5099.0	0.012	P	20	2.2	3.2	13.0	No	N/A	13.0
X4044R	7.65	0.07	Non-Urban	500	5105.0	5098.8	0.012	38.9	1244	5098.8	5085.0	0.011	SP	7	0.7	28.1	67.0	No	N/A	67.0
X4054R	4.90	0.12	Non-Urban	211	5094.7	5088.0	0.032	17.6	990	5088.0	5081.0	0.007	SP	7	0.6	28.0	45.7	No	N/A	45.7
X4065R	4.64	0.14	Non-Urban	243	5086.2	5082.0	0.017	22.5	727	5082.0	5070.0	0.017	SP	7	0.9	13.5	35.9	No	N/A	35.9
X4076LA	4.51	0.09	Non-Urban	167	5079.5	5073.0	0.039	15.0	1121	5073.0	5062.5	0.009	SP	7	0.7	27.6	42.6	No	N/A	42.6
X4076L	0.60	0.27	Urban	300	5074.8	5067.2	0.025	19.1	186	5067.2	5063.8	0.018	SP	7	0.9	3.3	22.3	No	N/A	22.3
X4082L	2.95	0.12	Non-Urban	119	5072.0	5066.0	0.050	11.3	673	5066.0	5060.0	0.009	SP	7	0.7	17.0	28.3	No	N/A	28.3
X4087L	3.13	0.20	Urban	85	5064.9	5060.5	0.052	8.7	481	5060.5	5057.0	0.007	SP	7	0.6	13.4	22.1	Yes	30.5	22.1
X4091L	2.40	0.32	Urban	123	5064.4	5058.0	0.052	9.0	222	5058.0	5056.5	0.007	SP	7	0.6	6.4	15.4	No	N/A	15.4
X4096L	0.92	0.38	Urban	177	5064.2	5059.0	0.029	12.1	105	5059.0	5058.0	0.010	SP	7	0.7	2.6	14.6	No	N/A	14.6
X4114L	8.50	0.15	Non-Urban	500	5063.2	5056.0	0.014	33.9	1490	5056.0	5036.0	0.013	SP	7	0.8	30.6	64.5	No	N/A	64.5
X5006R	1.44	0.25	Urban	51	5045.7	5041.20	0.088	5.3	644	5041.20	5029.00	0.019	SP	7	1.0	11.1	16.5	Yes	27.6	16.5
X5007R	0.10	0.35	Urban	34	5040.2	5039.2	0.029	5.5	69	5039.20	5034.00	0.075	SP	7	1.9	0.6	6.1	Yes	19.7	6.1
X5011L	8.78	0.17	Non-Urban	468	5048.1	5034.0	0.030	25.3	1223	5034.0	5022.5	0.009	SP	7	0.7	30.0	55.3	No	N/A	55.3
X5011R	0.27	0.57	Urban	120	5030.00	5028.00	0.017	8.8	32	5028.00	5025.50	0.078	SP	7	2.0	0.3	9.1	Yes	14.4	9.1
X5013L	3.08	0.19	Urban	300	5038.0	5024.0	0.047	17.0	224	5024.0	5022.5	0.007	SP	7	0.6	6.5	23.6	No	N/A	23.6

X5023R	6.91	0.12	Non-Urban	500	5029.1	5021.5	0.015	34.6	509	5021.5	5019.5	0.004	SP	7	0.4	19.3	53.9	No	N/A	53.9
X5033R	7.15	0.10	Non-Urban	500	5029.1	5021.3	0.016	35.0	619	5021.3	5005.5	0.026	SP	7	1.1	9.2	44.2	No	N/A	44.2
X5041R	1.78	0.11	Non-Urban	152	5020.2	5017.0	0.021	17.3	133	5017.0	5013.5	0.026	SP	7	1.1	2.0	19.3	No	N/A	19.3
X5045R	0.92	0.13	Non-Urban	212	5017.2	5015.5	0.008	27.5	174	5015.5	5010.0	0.032	SP	7	1.2	2.3	29.9	No	N/A	29.9
X5048R	2.21	0.08	Non-Urban	79	5018.9	5016.0	0.037	10.6	630	5016.0	5009.5	0.010	SP	7	0.7	14.8	25.4	No	N/A	25.4
X5052L	1.93	0.16	Urban	286	5016.0	5012.0	0.014	25.8	139	5012.0	5011.5	0.004	SP	7	0.4	5.5	31.3	No	N/A	31.3
X5064R	9.61	0.10	Non-Urban	386	5014.8	5009.4	0.014	31.7	961	5009.4	5001.5	0.008	SP	7	0.6	25.2	56.9	No	N/A	56.9
X5066R	4.10	0.05	Non-Urban	489	5012.2	5005.0	0.015	37.0	363	5005.0	5001.5	0.010	SP	7	0.7	8.8	45.8	No	N/A	45.8
X5068R	11.18	0.10	Non-Urban	90	5029.5	5023.5	0.067	9.2	1175	5023.5	5000.0	0.020	SP	7	1.0	19.8	29.0	No	N/A	29.0
X5075R	9.68	0.13	Non-Urban	47	5027.0	5025.0	0.043	7.4	1235	5025.0	5006.5	0.015	SP	7	0.9	24.0	31.4	No	N/A	31.4
X5084R	6.80	0.17	Non-Urban	354	5033.0	5020.5	0.035	20.8	507	5020.5	5014.5	0.012	SP	7	0.8	11.1	31.9	No	N/A	31.9

Notes:

[1] $t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$ USDCM Equation 6-3, August 2018

[2] $t_t = \frac{Length}{60 * V_t}$ Where, $V = K * S^{0.5}$ and K = 2.5 (Heavy Meadows), 5 (Tillage / Field), 7 (Short Pasture / Lawns), 10 (Nearly Bare Ground), 15, (Grassed Waterway), 20 (Paved) - USDCM Equation 6-4 August 2018

[3] $t_c = 26 - 17i\,\frac{L_t}{60(14i + 9)\sqrt{S_t}}$ USDCM Equation 6-5 August 2018

SH 119 Bikeway
Existing Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.

CDOT Project Number: N/A

Muller Project Number: 21015

Originator ZDS
Date: 2/2/2022

Checker: ACF

Date: 3/1/2022

INTENSITY VALUES

Storm Event	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
One-Hour Point Rainfall Values (P1) (inches)	1.01	1.44	1.73	2.09	2.42	2.74

Boulder County Storm Drainage Criteria Manual, NOAA Atlas 2 Vol 3 (Region 1, Boulder, CO)

RATIONAL FLOWS

BASIN ID	AREA (acre)	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	I_2 (in/hr)	I_5 (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
X1016L	10.65	0.10	0.12	0.19	0.35	0.42	0.50	1.86	2.66	3.19	3.86	4.47	5.06	1.9	3.3	6.3	14.3	19.8	27.0
X1017L	0.70	0.39	0.42	0.48	0.58	0.62	0.67	3.15	4.49	5.39	6.51	7.54	8.54	0.9	1.3	1.8	2.6	3.3	4.0
X1018L	1.91	0.09	0.11	0.18	0.35	0.41	0.50	2.01	2.87	3.44	4.16	4.82	5.46	0.3	0.6	1.2	2.7	3.8	5.2
X1021R	0.28	0.84	0.86	0.87	0.88	0.89	0.90	3.28	4.68	5.62	6.79	7.86	8.90	0.8	1.1	1.4	1.7	2.0	2.2
X1029R	101.56	0.16	0.22	0.30	0.45	0.50	0.58	0.90	1.28	1.54	1.86	2.15	2.43	14.2	28.5	46.6	83.9	109.9	142.5
X1030R	0.94	0.01	0.05	0.15	0.33	0.40	0.49	1.68	2.39	2.87	3.47	4.02	4.55	0.0	0.1	0.4	1.1	1.5	2.1
X1032R	0.36	0.01	0.05	0.15	0.33	0.40	0.49	2.73	3.90	4.68	5.65	6.55	7.41	0.0	0.1	0.2	0.7	1.0	1.3
X1034R	1.25	0.01	0.05	0.15	0.33	0.40	0.49	1.88	2.69	3.23	3.90	4.51	5.11	0.0	0.2	0.6	1.6	2.3	3.1
X1047L	4.98	0.04	0.08	0.18	0.35	0.42	0.51	1.79	2.55	3.07	3.70	4.29	4.86	0.3	1.1	2.7	6.5	9.0	12.3
X1047LA	0.16	0.51	0.57	0.61	0.68	0.71	0.75	3.29	4.70	5.64	6.81	7.89	8.93	0.3	0.4	0.5	0.7	0.9	1.1
X1054R	4.67	0.23	0.29	0.37	0.50	0.55	0.61	1.65	2.35	2.82	3.41	3.95	4.47	1.7	3.2	4.8	7.9	10.1	12.8
X1056L	1.42	0.16	0.22	0.30	0.45	0.50	0.58	2.63	3.75	4.50	5.44	6.30	7.13	0.6	1.2	1.9	3.4	4.5	5.8
X1069R	5.56	0.01	0.05	0.15	0.33	0.40	0.49	1.54	2.19	2.63	3.18	3.68	4.17	0.1	0.7	2.2	5.9	8.3	11.4
X1077R	2.79	0.01	0.05	0.15	0.33	0.40	0.49	1.63	2.32	2.79	3.37	3.90	4.42	0.0	0.3	1.1	3.1	4.4	6.1
X1080R	2.46	0.15	0.21	0.29	0.44	0.50	0.57	2.22	3.16	3.80	4.59	5.32	6.02	0.8	1.6	2.7	4.9	6.5	8.5
X1082R	0.20	0.01	0.05	0.15	0.33	0.40	0.49	2.73	3.90	4.68	5.65	6.55	7.41	0.0	0.0	0.1	0.4	0.5	0.7
X1083R	0.82	0.31	0.38	0.44	0.55	0.60	0.65	2.58	3.68	4.42	5.33	6.18	6.99	0.7	1.1	1.6	2.4	3.0	3.8
X1088R	2.87	0.10	0.16	0.24	0.40	0.47	0.55	1.91	2.72	3.27	3.95	4.57	5.18	0.5	1.2	2.3	4.6	6.1	8.1
X2010R	8.15	0.05	0.10	0.19	0.36	0.43	0.51	0.88	1.25	1.50	1.81	2.10	2.38	0.3	1.0	2.3	5.3	7.3	10.0
X2019R	4.76	0.01	0.05	0.15	0.33	0.40	0.49	0.98	1.40	1.68	2.03	2.35	2.66	0.0	0.3	1.2	3.2	4.5	6.2
X2022R	0.12	0.19	0.26	0.33	0.47	0.53	0.60	3.30	4.70	5.65	6.82	7.90	8.95	0.1	0.2	0.2	0.4	0.5	0.7
X2022RA	1.16	0.01	0.05	0.15	0.33	0.40	0.49	1.65	2.35	2.82	3.41	3.95	4.47	0.0	0.1	0.5	1.3	1.9	2.6
X2031R	3.60	0.02	0.07	0.16	0.34	0.41	0.50	1.64	2.34	2.82	3.40	3.94	4.46	0.1	0.6	1.6	4.2	5.9	8.0
X2056R	9.09	0.05	0.10	0.19	0.36	0.43	0.52	0.88	1.26	1.51	1.83	2.12	2.40	0.4	1.2	2.6	6.0	8.3	11.3
X2060R	5.16	0.30	0.36	0.43	0.54	0.59	0.65	2.13	3.03	3.65	4.40	5.10	5.77	3.3	5.7	8.0	12.3	15.5	19.3
X2064R	5.43	0.15	0.21	0.29	0.44	0.50	0.57	1.60	2.28	2.74	3.31	3.83	4.34	1.3	2.6	4.3	7.9	10.4	13.5
X2079R	3.14	0.10	0.16	0.25	0.41	0.47	0.55	1.60	2.27	2.73	3.30	3.82	4.33	0.5	1.2	2.1	4.2	5.6	7.5
X2085R	3.26	0.09	0.15	0.23	0.40	0.46	0.54	1.87	2.67	3.20	3.87	4.48	5.07	0.6	1.3	2.5	5.0	6.7	8.9
X2090R	4.38	0.06	0.12	0.21	0.38	0.44	0.53	1.55	2.22	2.66	3.22	3.72	4.22	0.4	1.1	2.4	5.3	7.2	9.7
X2099R	0.44	0.13	0.19	0.27	0.42	0.48	0.56	2.34	3.34	4.01	4.85	5.61	6.36	0.1	0.3	0.5	0.9	1.2	1.6
X2100R	4.37	0.07	0.12	0.21	0.38	0.45	0.53	1.40	2.00	2.40	2.90	3.36	3.80	0.4	1.1	2.2	4.8	6.5	8.8
X3008L	4.08	0.08	0.14	0.22	0.39	0.45	0.53	1.61	2.29	2.75	3.32	3.85	4.36	0.5	1.3	2.5	5.3	7.1	9.5
X3008R	2.61	0.21	0.27	0.35	0.48	0.54	0.60	1.48	2.11	2.53	3.06	3.54	4.01	0.8	1.5	2.3	3.8	4.9	6.3
X3013L	2.81	0.09	0.15	0.23	0.39	0.46	0.54	2.03	2.89	3.47	4.19	4.85	5.50	0.5	1.2	2.3	4.7	6.3	8.3
X3023L	10.96	0.12	0.18	0.26	0.42	0.48	0.56	1.29	1.84	2.21	2.67	3.09	3.50	1.7	3.7	6.4	12.3	16.3	21.4
X3023R	1.18	0.63	0.68	0.71	0.76	0.78	0.80	2.28	3.25	3.91	4.72	5.46	6.18	1.7	2.6	3.3	4.2	5.0	5.9
X3029R	13.74	0.13	0.19	0.28	0.43	0.49	0.56	1.29	1.83	2.20	2.66	3.08	3.49	2.3	4.9	8.3	15.6	20.6	27.0
X3033R	17.48	0.31	0.37	0.44	0.55	0.59	0.65	1.46	2.09	2.51	3.03	3.50	3.97	7.8	13.6	19.1	29.1	36.4	45.3
X3033RA	0.74	0.43	0.50	0.55	0.63	0.67	0.71	1.81	2.58	3.10	3.74	4.34	4.91	0.6	1.0	1.3	1.8	2.2	2.6
X3036L	24.91	0.31	0.37	0.44	0.55	0.60	0.65	0.90	1.29	1.55	1.87	2.17	2.45	7.0	12.0	16.9	25.7	32.2	39.9
X3038R	1.07	0.15	0.21	0.29	0.44	0.50	0.57	2.25	3.21	3.86	4.66	5.40	6.11	0.4	0.7	1.2	2.2	2.9	3.7
X3042L	2.30	0.12	0.19	0.27	0.42	0.48	0.56	1.51	2.15	2.58	3.12	3.61	4.09	0.4	0.9	1.6	3.0	4.0	5.3
X3042R	1.36	0.24	0.31	0.38	0.51	0.56	0.62	2.37	3.38	4.06	4.91	5.68	6.44	0.8	1.4	2.1	3.4	4.3	5.4
X3048L	22.96	0.06	0.11	0.20	0.37	0.44	0.52	0.96	1.38	1.65	2.00	2.31	2.62	1.2	3.5	7.6	17.0	23.2	31.3
X3049R	3.63	0.20	0.26	0.34	0.47	0.53	0.60	1.74	2.48	2.99	3.61	4.18	4.73	1.2	2.4	3.7	6.2	8.0	10.3
X3052L	0.61	0.25	0.31	0.38	0.51	0.56	0.62	2.73	3.89	4.67	5.64	6.53	7.40	0.4	0.7	1.1	1.7	2.2	2.8
X4019R	16.48	0.05	0.10	0.19	0.36	0.43	0.52	0.67	0.95	1.15	1.38	1.60	1.81	0.5	1.6	3.6	8.3	11.4	15.4
X4019RA	0.21	0.60	0.65	0.69	0.74	0.76	0.79	3.14	4.48	5.38	6.50	7.52	8.52	0.4	0.6	0.8	1.0	1.2	1.4

X4021R	0.35	0.64	0.69	0.72	0.76	0.78	0.81	3.09	4.40	5.29	6.39	7.40	8.37	0.7	1.0	1.3	1.7	2.0	2.3
X4023R	3.89	0.35	0.42	0.48	0.58	0.62	0.68	1.57	2.23	2.68	3.24	3.75	4.25	2.2	3.6	5.0	7.3	9.1	11.2
X4028R	2.91	0.12	0.18	0.27	0.42	0.48	0.56	2.44	3.49	4.19	5.06	5.86	6.63	0.9	1.9	3.2	6.2	8.2	10.8
X4044R	7.65	0.02	0.07	0.16	0.34	0.41	0.50	0.95	1.35	1.62	1.96	2.27	2.57	0.1	0.7	2.0	5.1	7.1	9.8
X4054R	4.90	0.06	0.12	0.20	0.37	0.44	0.52	1.22	1.74	2.09	2.53	2.93	3.32	0.4	1.0	2.1	4.6	6.3	8.5
X4065R	4.64	0.09	0.14	0.23	0.39	0.46	0.54	1.42	2.03	2.43	2.94	3.41	3.86	0.6	1.4	2.6	5.4	7.2	9.6
X4076LA	4.51	0.04	0.09	0.18	0.36	0.43	0.51	1.28	1.82	2.19	2.64	3.06	3.47	0.2	0.7	1.8	4.3	5.9	8.0
X4076L	0.60	0.21	0.27	0.35	0.48	0.53	0.60	1.87	2.67	3.21	3.87	4.49	5.08	0.2	0.4	0.7	1.1	1.4	1.8
X4082L	2.95	0.07	0.12	0.21	0.38	0.45	0.53	1.64	2.34	2.81	3.40	3.93	4.45	0.3	0.8	1.7	3.8	5.2	6.9
X4087L	3.13	0.14	0.20	0.28	0.43	0.49	0.57	1.88	2.68	3.23	3.90	4.51	5.11	0.8	1.7	2.9	5.3	7.0	9.1
X4091L	2.40	0.26	0.32	0.39	0.52	0.57	0.63	2.26	3.22	3.87	4.68	5.42	6.13	1.4	2.5	3.7	5.8	7.4	9.3
X4096L	0.92	0.32	0.38	0.45	0.56	0.60	0.66	2.32	3.31	3.98	4.80	5.56	6.30	0.7	1.2	1.6	2.5	3.1	3.8
X4114L	8.50	0.10	0.15	0.24	0.40	0.46	0.54	0.97	1.39	1.67	2.01	2.33	2.64	0.8	1.8	3.4	6.8	9.2	12.2
X5006R	1.44	0.19	0.25	0.33	0.47	0.52	0.59	2.19	3.13	3.76	4.54	5.25	5.95	0.6	1.1	1.8	3.1	4.0	5.1
X5007R	0.10	0.29	0.35	0.42	0.54	0.58	0.64	3.24	4.62	5.55	6.70	7.76	8.79	0.1	0.2	0.2	0.4	0.5	0.6
X5011L	8.78	0.11	0.17	0.26	0.44	0.51	0.59	1.08	1.54	1.85	2.23	2.58	2.92	1.0	2.3	4.2	8.6	11.5	15.3
X5011R	0.27	0.54	0.57	0.61	0.67	0.70	0.74	2.83	4.04	4.85	5.86	6.79	7.69	0.4	0.6	0.8	1.1	1.3	1.5
X5013L	3.08	0.17	0.19	0.26	0.39	0.45	0.52	1.82	2.59	3.12	3.76	4.36	4.94	1.0	1.6	2.5	4.5	6.1	8.0
X5023R	6.91	0.09	0.12	0.15	0.23	0.29	0.36	1.10	1.56	1.88	2.27	2.63	2.97	0.7	1.3	2.0	3.6	5.2	7.4
X5033R	7.15	0.07	0.10	0.14	0.23	0.29	0.37	1.25	1.78	2.14	2.58	2.99	3.38	0.6	1.2	2.2	4.3	6.2	8.9
X5041R	1.78	0.09	0.11	0.18	0.34	0.41	0.49	2.03	2.89	3.47	4.19	4.86	5.50	0.3	0.5	1.1	2.5	3.5	4.8
X5045R	0.92	0.11	0.13	0.20	0.36	0.42	0.51	1.59	2.26	2.72	3.29	3.81	4.31	0.2	0.3	0.5	1.1	1.5	2.0
X5048R	2.21	0.07	0.08	0.15	0.32	0.39	0.48	1.74	2.49	2.99	3.61	4.18	4.73	0.3	0.5	1.0	2.6	3.6	5.0
X5052L	1.93	0.13	0.16	0.23	0.38	0.44	0.52	1.54	2.20	2.65	3.20	3.70	4.19	0.4	0.7	1.1	2.3	3.2	4.2
X5064R	9.61	0.08	0.10	0.17	0.34	0.41	0.49	1.06	1.51	1.81	2.19	2.53	2.87	0.9	1.5	3.0	7.1	9.9	13.6
X5066R	4.10	0.04	0.05	0.11	0.29	0.37	0.46	1.22	1.74	2.09	2.53	2.92	3.31	0.2	0.3	1.0	3.0	4.4	6.2
X5068R	11.18	0.07	0.10	0.17	0.34	0.41	0.50	1.62	2.31	2.77	3.35	3.87	4.39	1.2	2.5	5.3	12.8	17.8	24.4
X5075R	9.68	0.08	0.13	0.22	0.39	0.45	0.53	1.54	2.20	2.64	3.19	3.69	4.18	1.2	2.8	5.7	11.9	16.2	21.6
X5084R	6.80	0.11	0.17	0.25	0.41	0.47	0.55	1.53	2.18	2.62	3.16	3.66	4.14	1.1	2.5	4.5	8.9	11.8	15.6

Notes:

[1] $I = \frac{28.5 * P1}{(10 + T_c)^{0.786}}$ USDCM Equation 5-1, March 2017)

SH 119 Bikeway
Existing Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
CDOT Project Number: N/A
Muller Project Number: 21015

Originator ZDS
Date: 2/2/2022
Checker: ACF
Date: 3/1/2022

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
5-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_5	CA (acres)	T_c (min)	I_5 (in/hr)	Q (cfs)	T_c (min)	Effective CA_5	I_5 (in/hr)	Q (cfs)	
X1018L	X1016L	10.65	0.12	1.23	22.53	2.66	3.3					
	X1017L	0.70	0.42	0.30	6.71	4.49	1.3					
	X1018L	1.91	0.11	0.21	19.54	2.87	0.6					
	X1021R	0.28	0.86	0.24	5.85	4.68	1.1					
								22.5	**1.98**	**2.66**	**5.3**	
X1030R	X1029R	101.56	0.22	22.29	72.47	1.28	28.5					
	X1032R	0.36	0.05	0.02	10.00	3.90	0.1					
	X1030R	0.94	0.05	0.05	27.22	2.39	0.1					
								72.5	**22.36**	**1.28**	**28.6**	
X1056L	X1054R	4.67	0.29	1.37	28.08	2.35	3.2					
	X1056L	1.42	0.22	0.31	11.01	3.75	1.2					
								28.1	**1.68**	**2.35**	**4.0**	
X1083R	X1077R	2.79	0.05	0.14	28.67	2.32	0.3					
	X1080R	2.46	0.21	0.51	16.07	3.16	1.6					
	X1083R	0.82	0.38	0.31	11.54	3.68	1.1					
								28.7	**0.97**	**2.32**	**2.2**	
X2060R	X2056R	9.09	0.10	0.91	74.10	1.26	1.2					
	X2060R	5.16	0.36	1.87	17.49	3.03	5.7					
								74.1	**2.79**	**1.26**	**3.5**	
X2090R	X2090R	4.38	0.12	0.51	30.99	2.22	1.1					
	X2099R	0.44	0.19	0.08	14.33	3.34	0.3					
	X2100R	4.37	0.12	0.54	36.79	2.00	1.1					
								36.8	**1.14**	**2.00**	**2.3**	
X3029R	X3023L	10.96	0.18	2.00	41.92	1.84	3.7					
	X3029R	13.74	0.19	2.67	42.21	1.83	4.9					
								42.2	**4.66**	**1.83**	**8.5**	
X3033RA	X3033R	17.48	0.37	6.51	34.29	2.09	13.6					
	X3033RA	0.74	0.50	0.37	23.79	2.58	1.0					
								34.3	**6.88**	**2.09**	**14.4**	
X3038R	X3036L	24.91	0.37	9.34	71.72	1.29	12.0					
	X3038R	1.07	0.21	0.23	15.56	3.21	0.7					
								71.7	**9.56**	**1.29**	**12.3**	
X3042L	X3042L	2.30	0.19	0.43	32.67	2.15	0.9					
	X3042R	1.36	0.31	0.42	13.94	3.38	1.4					
								32.7	**0.85**	**2.15**	**1.8**	
X3049R	X3048L	22.96	0.11	2.52	65.20	1.38	3.5					
	X3049R	3.63	0.26	0.95	25.44	2.48	2.4					
								65.2	**3.47**	**1.38**	**4.8**	
X4028R	X4019RA	0.21	0.65	0.14	6.77	4.48	0.6					
	X4021R	0.35	0.69	0.24	7.13	4.40	1.0					
	X4023R	3.89	0.42	1.62	30.61	2.23	3.6					
	X4028R	2.91	0.18	0.54	13.05	3.49	1.9					
	X4044R	7.65	0.07	0.50	67.03	1.35	0.7					
								67.0	**3.03**	**1.35**	**4.1**	
X5006R	X5006R	1.44	0.25	0.36	16.47	3.13	1.1					
	X5007R	0.10	0.35	0.04	6.11	4.62	0.2					
								16.5	**0.40**	**3.13**	**1.3**	
X5011L	X5011R	0.27	0.57	0.15	9.10	4.04	0.6					
	X5011L	8.78	0.17	1.48	55.32	1.54	2.3					
								55.3	**1.63**	**1.54**	**2.5**	
X5064R	X5052L	1.93	0.16	0.30	31.33	2.20	0.7					
	X5064R	9.61	0.10	0.98	56.94	1.51	1.5					
								56.9	**1.28**	**1.51**	**1.9**	
X5075R	X5084R	6.80	0.17	1.16	31.91	2.18	2.5					
	X5075R	9.68	0.13	1.30	31.44	2.20	2.8					
								31.9	**2.46**	**2.18**	**5.4**	

Notes:

[1] $I = \frac{28.5 * P1}{(10 * T_c)^{0.786}}$ (UDFCD Equation 5-1, March 2017), Where P1 Values come from NOAA Atlas 2, Volume 8, Version 2

[2] $Q_{tot} = I_{min}\left[\sum_{i=0}^{n}(CA)_i\right]$ Where: I_{min} = Mininmum Intensity and CA = Effective CA

SH 119 Bikeway
Existing Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
CDOT Project Number: N/A
Muller Project Number: 21015

Originator ZDS
Date: 2/2/2022
Checker: ACF
Date: 3/1/2022

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
100-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_{100}	CA (acres)	T_c (min)	I_{100} (in/hr)	Q (cfs)	T_c (min)	Effective CA_{100}	I_{100} (in/hr)	Q (cfs)	
X1018L	X1016L	10.65	0.50	5.33	22.53	5.06	27.0					
	X1017L	0.70	0.67	0.47	6.71	8.54	4.0					
	X1018L	1.91	0.50	0.95	19.54	5.46	5.2					
	X1021R	0.28	0.90	0.25	5.85	8.90	2.2					
								22.5	**7.00**	**5.06**	**35.4**	
X1030R	X1029R	101.56	0.58	58.52	72.47	2.43	142.5					
	X1032R	0.36	0.49	0.18	10.00	7.41	1.3					
	X1030R	0.94	0.49	0.46	27.22	4.55	2.1					
								72.5	**59.16**	**2.43**	**144.0**	
X1056L	X1054R	4.67	0.61	2.86	28.08	4.47	12.8					
	X1056L	1.42	0.58	0.82	11.01	7.13	5.8					
								28.1	**3.68**	**4.47**	**16.5**	
X1083R	X1077R	2.79	0.49	1.37	28.67	4.42	6.1					
	X1080R	2.46	0.57	1.40	16.07	6.02	8.5					
	X1083R	0.82	0.65	0.54	11.54	6.99	3.8					
								28.7	**3.32**	**4.42**	**14.6**	
X2060R	X2056R	9.09	0.52	4.70	74.10	2.40	11.3					
	X2060R	5.16	0.65	3.34	17.49	5.77	19.3					
								74.1	**8.04**	**2.40**	**19.3**	
X2090R	X2090R	4.38	0.53	2.30	30.99	4.22	9.7					
	X2099R	0.44	0.56	0.25	14.33	6.36	1.6					
	X2100R	4.37	0.53	2.31	36.79	3.80	8.8					
								36.8	**4.86**	**3.80**	**18.5**	
X3029R	X3023L	10.96	0.56	6.11	41.92	3.50	21.4					
	X3029R	13.74	0.56	7.74	42.21	3.49	27.0					
								42.2	**13.85**	**3.49**	**48.3**	
X3033RA	X3033R	17.48	0.65	11.41	34.29	3.97	45.3					
	X3033RA	0.74	0.71	0.53	23.79	4.91	2.6					
								34.3	**11.94**	**3.97**	**47.4**	
X3038R	X3036L	24.91	0.65	16.29	71.72	2.45	39.9					
	X3038R	1.07	0.57	0.61	15.56	6.11	3.7					
								71.7	**16.90**	**2.45**	**41.4**	
X3042R	X3042L	2.30	0.56	1.29	32.67	4.09	5.3					
	X3042R	1.36	0.62	0.84	13.94	6.44	5.4					
								32.7	**2.13**	**4.09**	**8.7**	
X3049R	X3048L	22.96	0.52	11.97	65.20	2.62	31.3					
	X3049R	3.63	0.60	2.17	25.44	4.73	10.3					
								65.2	**14.14**	**2.62**	**37.0**	
X4028R	X4019RA	0.21	0.79	0.17	6.77	8.52	1.4					
	X4021R	0.35	0.81	0.28	7.13	8.37	2.3					
	X4023R	3.89	0.68	2.62	30.61	4.25	11.2					
	X4028R	2.91	0.56	1.62	13.05	6.63	10.8					
	X4044R	7.65	0.50	3.82	67.03	2.57	9.8					
								67.0	**8.51**	**2.57**	**21.9**	
X5006R	X5006R	1.44	0.59	0.86	16.47	5.95	5.1					
	X5007R	0.10	0.64	0.07	6.11	8.79	0.6					
								16.5	**0.92**	**5.95**	**5.5**	
X5011L	X5011R	0.27	0.74	0.20	9.10	7.69	1.5					
	X5011L	8.78	0.59	5.22	55.32	2.92	15.3					
								55.3	**5.42**	**2.92**	**15.8**	
X5068R	X5052L	1.93	0.52	1.01	31.33	4.19	4.2					
	X5064R	9.61	0.49	4.73	56.94	2.87	13.6					
								56.9	**5.74**	**2.87**	**16.5**	
X5075R	X5084R	6.80	0.55	3.75	31.91	4.14	15.6					
	X5075R	9.68	0.53	5.16	31.44	4.18	21.6					
								31.9	**8.92**	**4.14**	**37.0**	

Notes:

1 $I = \frac{28.5 * P1}{(10 * T_c)^{0.786}}$ (UDFCD Equation 5-1, March 2017), Where P1 Values come from NOAA Atlas 2, Volume 8, Version 2

2 $Q_{tot} = I_{min}\left[\sum_{i=0}^{n}(CA)_i\right]$ Where: I_{min} = Mininmum Intensity and CA = Effective CA

Proposed Hydrology Calculations

CALCULATION COVER SHEET

Project Name:	CO 119 Bikeway	Project No.	21015 (Muller)
Design Calculation:	Proposed Hydrology	Version:	1
Originator	ZDS	Date:	June 24, 2022
Checker	EGS	Date:	June 28, 2022

Purpose:

Analyze the proposed hydrologic conditions and determine peak flowrates for the CO 119 Bikeway project.

References:

Criteria Manuals Used:

Colorado Department of Transportation (CDOT) *Drainage Design Manual,* 2019
Boulder County *Multimodal Transportation Standards (MTS)*, 2012
Boulder County *Storm Drainage Criteria Manual (SDCM)*, 2016

Referenced Data Sources:
CDOT, *Topographic Survey,* Received July 2021
CDOT, *SUE (QL C&D)*, Received December 2021
Boulder County, *LiDAR*, Accessed January 2022
United States Department of Agriculture Natural Resources Conservation Service (NRCS), *Web Soil Service for Hydrologic Soil Group*, Accessed January 2022
National Oceanic and Atmospheric Administration, *Point Frequency Data Server*, Accessed January 2022
Microsoft Corp., *Bing Maps Aerial*, Accessed January 2022
Alphabet Inc., *Google Earth Aerial*, June 2021 Imagery

Refer to the drainage report for the appendices referenced below:

Appendix A
Roadway Classification Table
Hydrologic and Hydraulic Criteria Table
Existing Basin Maps
Proposed Basin Maps
Hydrologic Soils Report (NRCS)
Point Precipitation Frequency Estimates (NOAA Atlas 14)

Refer to the Drainage Report for full citations of references.

Criteria:

Runoff from existing basins for the proposed project was determined using CDOT and Boulder County drainage manuals. Refer to the Hydrologic Criteria Table in Appendix A of the Drainage Report for the complete comparison of analyzed criteria. Table 1 shows the applied criteria for this calculation packet.

Table 1. Applied Hydrologic Criteria Table

Hydrologic Criteria	Applied Criteria
Design Frequency	
Cross Drainage	
Multi-lane Road (Urban)	100-year
Multi-lane Road (Rural)	50-year
Two Lane Road (Urban)	100-year
Two Lane Road (Rural)	25-year
Culvert Outlet Scour Protection	10-year
Pedestrian Walkways and Bikeways	5-year
Parallel Drainage	
Roadway Overtopping & Revetment	*Same as for cross drainage*
Side Drains	10-year
Storm Drains	
Major Storm	100-year
Minor Storm	5-year
Channels	
Capacity	*Depends on roadway classification*
Lining	10-year
Hydrologic Procedure Selection	
Hydrologic Peak Prediction Procedure	
Drainage Area	Rational Method (<200 ac) CUHP and EPA-SWMM (>200 ac)
Time of Concentration (Tc) for Rational Method	
Min. Tc for urban areas	5 min.
Min. Tc for non-urban areas	10 min.
Max. Overland Flow Path Length (urban)	300 ft
Max. Overland Flow Path Length (rural)	500 ft

90 ac max

Background and Rationale:

- The project is located along CO 119 from Boulder, Colorado to Longmont, Colorado.
- Project improvements include:
  - Grading and constructing a bike path along CO 119 from Foothills Parkway in Boulder to Hover Street in Longmont. At-grade crossings, underpasses, and bridges will be designed for the bike path.

        - Supplementary improvements include:
            - Traffic support for intersections along CO 119 impacted by bike path.
            - Structural design of underpasses and bridges.
            - Landscaping improvements.
            - Lighting for underpasses and other locations.
            - Floodplain analysis.
            - Irrigation coordination.
- Drainage generally flows east through the project area, flow directions are not uniform throughout the project length, however.
- Design points (DP) for basins are located at the receiving point (stormwater ditches, stormwater pipes and culverts, stormwater area inlets, irrigation ditches, irrigation pipes and culverts, and streams and rivers) and where runoff leaves the project area.
- Basins were delineated using survey contours and topography provided by CDOT and LiDAR contours referenced from Boulder County along with the proposed bikeway and improvements associated with the separate CO 119 Mobility Improvements project.
- Basin IDs correspond with centerline stationing for the proposed alignments for the bike path using L and R for left and right designation. Basins with the same station and a greater offset were labeled with increasing alphabetical letters (i.e., the design point for P4019RA has a greater offset distance than P4019R).
- Basins were analyzed for peak discharge using rational method, then DPs with multiple contributing areas were routed to determine overall peak discharge leaving the project area.

Assumptions/Givens:

Rational Method Givens

- Hydrologic Soil Group HSG A, B, C, and D
- Rainfall precipitation values for a 1-hour storm duration for the 5-year event and 100-year event were taken from NOAA Atlas 2 per the Boulder County Storm Drainage Criteria Manual. Rainfall precipitation values for a 1-hour storm duration for the 2-year, 10-year, 25-year, and 50-year events were taken from NOAA Atlas 14 using the NOAA Precipitation Frequency Data Server.
- Land use types and percent imperviousness provided in (Table 6-3 of USDCM) used for this project are:
    - Streets: Paved, 100% imperviousness
    - Streets: Gravel (Packed), 40% imperviousness
    - Undeveloped Areas: Greenbelts, Agricultural, 2% imperviousness
    - Business: Suburban Areas, 75% imperviousness
    - Residential: 0.25 Acres or Less, 45% imperviousness
- USDCM Equations 6-3, 6-4, and 6-5 were used to calculate the time of concentration required to calculate intensity.
- The preliminary CO 119 Mobility Project proposed design was considered during basin delineations, land use inputs, and flow path elevations.
    - The majority of the CO 119 Bikeway project between STA 3000+00 and STA 3064+98 was omitted from basin delineations and subsequent hydrology calculations. The CO 119 Mobility Project includes a major reconstruction of the SH 52/CO 119 intersection

with other impacts to CO 119 through this portion of the project. As a result, the drainage design in this area is primarily influenced by the CO 119 Mobility Project rather than the CO 119 Bikeway Project. The only proposed basins delineated within this stretch of the project are for the bikeway underpass at SH 52.

- The CO 119 Mobility Project involves widening CO 119 to include bus transit lanes and facilities and parking lots. At the time of these preliminary calculations, the drainage design for these elements was not completed. Therefore, proposed basins generally are conservative because they include a larger area than will likely drain to the basin's design point because drainage improvements with the CO 119 Mobility project will likely capture a portion of the large basin area. Refer to Basin P2059R for an example. Additionally, a basin was delineated for the Mobility Hub Jay Road Inlet, which is sometimes referred to by the abbreviated Basin ID "MHJRI".

Rational Method Assumptions

- The following land use types and percent imperviousness values were not taken from USDCM but were assumed:
  - Google Earth imagery indicates that solar panels are currently placed on the IBM property between the main IBM campus and CO 119. A 50% imperviousness was assumed for fields with solar panels.
  - Irrigation ponds were assumed to be 98% impervious.

General Assumptions

- Roadside ditches parallel to CO 119 coupled with the embankment of CO 119 prevent offsite flow from reaching the median of CO 119. Therefore, off-site basins were not analyzed except for areas where the proposed bike path is outside of the CO 119 median.
  - Three large watersheds (Fourmile Creek, Dry Creek, and Lefthand Creek) cross the proposed bike path design. Total flowrate values for these watersheds were provided via floodplain models from Boulder County. Local areas within the project site contributing to each of these watersheds were evaluated.
- Irrigation ownership data from Boulder County was used to aid basin delineations. Irrigation ownership data indicates roughly 35 irrigation systems crossing CO 119 (and subsequently the proposed bike path) within the project area. Irrigation ditches traversing CO 119 have not been assumed to flow full, and thus have capacity to intercept stormwater based on topography.

Results:

Table 2 summarizes the 5-year and 100-year peak flowrates associated with individual basins. Table 3 summarizes the 5-year and 100-year flowrates for all design points where runoff leaves the project area.

Table 2. Peak Discharge Summary of Individual Basins

BASIN ID	AREA (acre)	Q_5 (cfs)	Q_{100} (cfs)
P1000R	1.41	0.2	2.9
P1013R	1.54	1.9	5.5
P1016L	8.85	1.3	15.8
P1017L	0.71	1.3	4.1
P1018L	1.27	0.6	4.3
P1021R	0.64	1.0	2.9
P1021RA	0.28	1.1	2.2
P1029L	99.22	26.5	137.3
P1029R	1.42	2.1	5.8
P1030R	0.76	0.1	1.7
P1031L	1.04	1.6	4.8
P1031R	0.74	1.5	4.6
P1032R	0.26	0.0	0.9
P1034R	0.70	0.2	1.9
P1043R	1.09	0.5	3.2
P1044L	2.33	0.5	6.7
MHJRI	0.44	1.5	3.1
P1048L	1.20	1.2	6.1
P1053L	2.12	3.5	8.4
P1054R	2.33	1.7	7.2
P1056L	1.17	1.4	5.5
P1057L	0.29	0.2	1.1
P1058L	0.05	0.0	0.2
P1063R	0.92	0.2	2.2
P1067L	2.85	0.9	7.0
P1069R	1.28	0.5	4.4
P1076L	1.06	0.3	3.1
P1077R	1.85	0.4	4.1
P1080R	1.59	0.5	4.4
P1082L	1.70	2.4	7.2
P1082R	0.20	0.1	0.7
P1088R	3.16	1.9	9.4
P2010R	3.20	0.7	5.1

BASIN ID	AREA (acre)	Q_5 (cfs)	Q_{100} (cfs)
P2021L	7.83	0.8	7.6
P2022L	0.07	0.0	0.2
P2022R	3.00	0.9	5.2
P2030L	1.18	0.2	2.7
P2031R	2.36	1.1	7.0
P2032L	0.12	0.0	0.4
P2049L	1.75	0.2	3.2
P2058L	0.53	0.1	1.2
P2059R	9.82	3.4	17.7
P2062L	1.13	4.2	8.9
P2063R	0.23	0.5	1.4
P2064R	2.43	2.3	9.9
P2066R	2.26	1.9	7.9
P2075L	0.58	0.1	1.7
P2077L	0.37	0.3	1.5
P2079L	1.73	1.1	4.9
P2084L	0.80	0.2	2.4
P2085L	2.32	0.9	5.0
P2085R	2.57	1.6	7.6
P2092R	0.39	0.5	1.9
P2093R	1.69	0.7	4.3
P2098R	0.38	0.2	1.4
P2100L	1.09	0.3	2.5
P2100R	3.11	1.1	7.3
P3021R	0.20	0.8	1.6
P3023R	0.17	0.7	1.4
P3042R	0.97	1.0	4.0
P3049L	1.47	1.4	5.1
P3049R	2.24	2.0	7.2
P3052R	0.61	0.9	3.2
P4018L	13.69	2.0	14.6
P4019R	3.37	2.2	8.8
P4019RA	0.21	0.7	1.6

Table 2. Peak Discharge Summary of Individual Basins (contd.)

BASIN ID	AREA (acre)	Q_5 (cfs)	Q_{100} (cfs)
P4020R	0.42	0.7	1.8
P4021R	0.35	1.1	2.4
P4023R	3.48	10.4	22.3
P4028L	0.63	1.1	2.9
P4028R	2.05	0.5	5.2
P4040L	1.46	0.2	2.8
P4044R	5.31	1.2	9.0
P4053L	1.86	0.2	3.4
P4054R	3.13	1.8	7.9
P4060L	1.21	0.1	1.9
P4065R	3.29	2.0	8.6
P4074R	2.84	1.6	6.8
P4075L	2.34	0.2	4.2
P4076L	0.09	0.1	0.4
P4081L	1.32	0.5	3.7
P4081R	1.63	1.2	4.5
P4086R	1.61	1.2	4.9
P4087L	1.38	0.8	4.5
P4091L	1.39	1.9	5.7
P4091R	1.01	0.7	3.5
P4093L	0.46	0.8	2.3
P4095R	0.45	0.6	1.9
P4108R	3.91	1.9	8.3
P4114L	3.63	0.8	6.2
P4117R	2.27	1.6	5.8
P5001L	2.27	0.7	5.1
P5006R	1.44	1.3	5.3
P5007R	0.10	0.2	0.6
P5011L	5.52	2.0	10.7
P5011R	2.28	0.9	5.7
P5013L	3.08	1.7	8.4
P5023L	1.17	0.4	1.9
P5023R	5.73	1.0	6.3
P5030L	3.02	0.2	2.0
P5033R	4.16	1.4	6.2
P5040L	0.89	0.0	0.6
P5041R	0.93	0.7	2.2
P5048L	1.12	0.0	0.5
P5048R	2.60	2.0	5.9
P5052L	1.99	1.4	5.8
P5064R	6.82	2.1	12.5
P5066L	8.08	1.9	13.1
P5066R	2.57	0.5	5.0
P5068R	15.75	2.4	38.4
P5076R	1.57	1.9	6.9
P5084L	5.20	1.1	9.9
P5084R	1.44	4.6	9.2

Table 3. Peak Discharge Summary of Design Points where Flow Leaves Project

Design Point	Contributing Basins	Description of Runoff Leaving Project Area	Q5 cfs)	Q100 (cfs)
P1017L	P1013R, P1016L, P1017L	Fourmile Creek	3.3	21.5
P1018L	P1018L, P1021R, P1021RA	Fourmile Creek	2.3	8.6
P1030R	P1029L, P1029R, P1030R, P1031L, P1031R, P1032R	Ditch between NB SH 119 and BNSF Railroad	28.4	143.9
P1034R	P1034R	Poorly defined ditch outside (southeast) of BNSF Railroad	0.2	1.9
P1044L	P1043R, P1044L	Boulder and Whiterock Irrigation Ditch	0.9	9.4
P1056L	Mobility Hub Jay Rd Inlet, P1048L, P1053L, P1054R, P1056L	Water Quality Extended Detention Basin North of Jay Road	7.7	24.6
P1069R	Mobility Hub Jay Rd Inlet, P1048L, P1053L, P1054R, P1056L, P1057L, P1067L, P1063R, P1069R	Boulder and Whiterock Irrigation Ditch	8.5	35.3
P1082L	P1076L, P1077R, P1080R, P1082L	Boulder and Whiterock Irrigation Ditch	2.7	7.5
P1082R	P1082R	Ditch between NB SH 119 and BNSF Railroad	0.1	0.7
P1088R	P1088R	City of Boulder and Others Irrigation Line	1.9	9.4
P2010R	P2010R	Ditch between NB SH 119 and BNSF Railroad	0.7	5.1
P2022R	P2021L, P2022L, P2022R	Ditch between NB SH 119 and BNSF Railroad	1.3	10.8
P2031R	P2030L, P2031R, P2032L	Boulder and Whiterock Irrigation Ditch	1.1	8.7
P2059R	P2049L, P2058L, P2059R, P2062L	Boulder Reservoir Spillway/ Boulder County Irrigation Ditch	5.0	24.4
P2064R	P2063R, P2064R, P2066R	Ditch between NB SH 119 and BNSF Railroad	4.1	17.3
P2079L	P2075L, P2077L, P2079L	City of Boulder and Northern Colorado Water Conservancy District Irrigation Line	1.4	7.2
P2085R	P2084L, P2085R	Ditch between NB SH 119 and BNSF Railroad	1.8	9.7
P2085L	P2085L, P2092R, P2093R, P2098R, P2100R, P2100L	Dry Creek	3.0	19.2
P3049R	P3049L, P3049R	Star Irrigation Ditch	3.4	11.9
P3052R	P3052R	Ditch between NB SH 119 and BNSF Railroad	0.9	3.2

Table 3. Peak Discharge Summary of Design Points where Flow Leaves Project (continued)

Design Point	Contributing Basins	Description of Runoff Leaving Project Area	Q5 (cfs)	Q100 (cfs)
P3052R	P3052R	Ditch between NB SH 119 and BNSF Railroad	0.9	3.2
P4028R	P4021R, P4023R, P4028L, P4028R	Water Quality Extended Detention Basin North of Niwot Road	8.7	23.2
P4044R	P4021R, P4023R, P4028L, P4028R, P4040L, P4044R	Williamson Irrigation Ditch	7.0	26.4
P4054R	P4053L, P4054R	Ditch between NB SH 119 and BNSF Railroad	1.7	10.2
P4065R	P4060L, P4065R	Williamson Irrigation Ditch	1.5	8.2
P4075L	P4075L	Ditch outside and adjacent to SH 119	0.2	4.2
P4076L	P4074R, P4076L	Unkown Irrigation Line, potentially a secondary line of Williamson Irrigation Ditch	1.7	7.0
P4081L	P4081R, P4081L	Ditch outside and adjacent to SH 119	1.6	7.7
P4087L	P4086R, P4087L	Ditch outside and adjacent to SB SH 119	1.6	8.7
P4091L	P4091R, P4091L	Point outside of SB SH 119	2.7	9.2
P4095R	P4093L, P4095R	Point outside of SB SH 119, potentially a secondary line of Williamson Irrigation Ditch	1.3	3.8
P4114L	P4108R, P4114L	Pont outside of SB SH 119	2.4	13.8
P5001L	P4117R, P5001L	Point outside of SB SH 119	2.2	10.6
P5006R	P5006R, P5007R	Storm system at existing underpass near Airport Road	1.4	5.7
P5011L	P5011R, P5011L	Lefthand Creek	2.7	15.0
P5013L	P5013L	Lefthand Creek	1.7	8.4
P5023R	P5023L, P5023R	Ditch between NB SH 119 and BNSF Railroad	1.4	7.8
P5033R	P5030L, P5033R	Lefthand Creek	1.2	6.5
P5041R	P5040L, P5041R	Ditch between NB SH 119 and BNSF Railroad	0.6	2.4
P5048R	P5048L, P5048R	Ditch between NB SH 119 and BNSF Railroad	1.4	4.7
P5064R	P5064R	Ditch between NB SH 119 and BNSF Railroad	2.1	12.5
P5066R	P5066R	Ditch between NB SH 119 and BNSF Railroad	0.5	5.0
P5068R	P5052L, P5066L, P5076R, P5068R, P5084L, P5084R	Holland Ditch	9.2	56.6

Materials Included in this Calculation Packet:

1. Rational Method Calculations

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

Land Use Types	Percent Impervious
STREETS: PAVED	100
RESIDENTIAL: 0.25 ACRES OR LESS	45
UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL	2

Land Use Types and Imperviousness Values from USDCM Volume 1 Table 6-3

PERCENT IMPERVIOUS VALUES

BASIN ID	TOTAL AREA		STREETS: PAVED		RESIDENTIAL: 0.25 ACRES OR LESS		UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL		WEIGHTED PERCENT IMPERVIOUS	WEIGHTED PERCENT PERVIOUS
	(sq ft)	(acre)	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]		
P1000R	61,634	1.41	4,758	8		0	56,876	92	10	90
P1013R	67,164	1.54	37,000	55		0	30,164	45	56	44
P1016L	385,526	8.85	34,879	9		0	350,647	91	11	89
P1017L	30,748	0.71	15,782	51		0	14,966	49	52	48
P1018L	55,282	1.27	7,028	13		0	48,254	87	14	86
P1021R	27,818	0.64	13,126	47		0	14,692	53	48	52
P1021RA	12,175	0.28	12,175	100		0	0	0	100	0
P1029L	4,322,064	99.22	6,784	0	1,969,817	46	2,345,463	54	22	78
P1029R	61,807	1.42	34,743	56		0	27,064	44	57	43
P1030R	33,240	0.76	0	0		0	33,240	100	2	98
P1031L	45,261	1.04	21,989	49		0	23,272	51	50	50
P1031R	32,343	0.74	14,680	45		0	17,663	55	46	54
P1032R	11,285	0.26	0	0		0	11,285	100	2	98
P1034R	30,466	0.70	2,789	9		0	27,677	91	11	89
P1043R	47,432	1.09	5,877	12		0	41,555	88	14	86
P1044L	101,570	2.33	3,148	3		0	98,422	97	5	95
Mobility Hub Jay Road Inlet	19,113	0.44	19,113	100		0	0	0	100	0
P1048L	52,350	1.20	10,230	20		0	42,120	80	21	79
P1053L	92,203	2.12	65,508	71		0	26,695	29	72	28
P1054R	101,448	2.33	27,235	27		0	74,213	73	28	72
P1056L	50,851	1.17	15,696	31		0	35,155	69	32	68
P1057L	12,427	0.29	2,430	20		0	9,997	80	21	79
P1058L	2,104	0.05	0	0		0	2,104	100	2	98
P1063R	39,917	0.92	732	2		0	39,185	98	4	96
P1067L	124,252	2.85	12,017	10		0	112,235	90	11	89
P1069R	55,715	1.28	3,449	6		0	52,266	94	8	92
P1076L	46,204	1.06	1,872	4		0	44,332	96	6	94
P1077R	80,690	1.85	4,881	6		0	75,809	94	8	92
P1080R	69,050	1.59	5,198	8		0	63,852	92	9	91
P1082L	74,084	1.70	36,603	49		0	37,481	51	50	50
P1082R	8,595	0.20	396	5		0	8,199	95	7	93
P1088R	137,450	3.16	30,802	22		0	106,648	78	24	76
P2010R	139,279	3.20	16,199	12	0	0	123,080	88	13	87

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
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Date: 6/28/2022

Land Use Types	Percent Impervious
STREETS: PAVED	100
RESIDENTIAL: 0.25 ACRES OR LESS	45
UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL	2

Land Use Types and Imperviousness Values from USDCM Volume 1 Table 6-3

PERCENT IMPERVIOUS VALUES

BASIN ID	TOTAL AREA		STREETS: PAVED		RESIDENTIAL: 0.25 ACRES OR LESS		UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL		WEIGHTED PERCENT IMPERVIOUS	WEIGHTED PERCENT PERVIOUS
	(sq ft)	(acre)	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]		
P2021L	341,127	7.83	23,196	7	0	0	317,931	93	9	91
P2022L	2,866	0.07	0	0	0	0	2,866	100	2	98
P2022R	130,684	3.00	21,286	16	0	0	109,398	84	18	82
P2030L	51,510	1.18	1,534	3	0	0	49,976	97	5	95
P2031R	102,855	2.36	14,328	14	0	0	88,528	86	16	84
P2032L	5,099	0.12	85	2	0	0	5,014	98	4	96
P2049L	76,390	1.75	803	1	0	0	75,587	99	3	97
P2058L	23,092	0.53	0	0	0	0	23,092	100	2	98
P2059R	427,969	9.82	83,898	20	0	0	344,071	80	21	79
P2062L	49,195	1.13	44,908	91	0	0	4,287	9	91	9
P2064R	105,905	2.43	28,981	27	0	0	76,924	73	29	71
P2066R	98,463	2.26	27,298	28	0	0	71,165	72	29	71
P2063R	10,207	0.23	4,818	47	0	0	5,389	53	48	52
P2075L	25,076	0.58	769	3	0	0	24,307	97	5	95
P2077L	16,160	0.37	2,841	18	0	0	13,319	82	19	81
P2079L	75,318	1.73	19,121	25	0	0	56,197	75	27	73
P2084L	35,033	0.80	1,863	5	0	0	33,170	95	7	93
P2085R	111,797	2.57	26,602	24	0	0	85,195	76	25	75
P2085L	101,216	2.32	16,541	16	0	0	84,675	84	18	82
P2092R	17,184	0.39	5,706	33	0	0	11,478	67	35	65
P2093R	73,728	1.69	9,813	13	0	0	63,915	87	15	85
P2100L	47,275	1.09	3,000	6	0	0	44,275	94	8	92
P2100R	135,561	3.11	19,288	14	0	0	116,273	86	16	84
P2098R	16,426	0.38	2,693	16	0	0	13,733	84	18	82
P3021R	8,688	0.20	8,688	100	0	0	0	0	100	0
P3023R	7,508	0.17	7,508	100	0	0	0	0	100	0
P3042R	42,275	0.97	13,029	31	0	0	29,246	69	32	68
P3049L	64,035	1.47	23,245	36	0	0	40,790	64	38	62
P3049R	97,628	2.24	36,139	37	0	0	61,489	63	38	62
P3052R	26,431	0.61	10,214	39	0	0	16,217	61	40	60
P4018L	596,253	13.69	68,375	11	0	0	527,878	89	13	87
P4019R	146,999	3.37	43,232	29	0	0	103,767	71	31	69
P4019RA	9,066	0.21	7,731	85	0	0	1,334	15	86	14

CO 119 Bikeway
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Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
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Date: 6/28/2022

Land Use Types	Percent Impervious
STREETS: PAVED	100
RESIDENTIAL: 0.25 ACRES OR LESS	45
UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL	2

Land Use Types and Imperviousness Values from USDCM Volume 1 Table 6-3

PERCENT IMPERVIOUS VALUES

BASIN ID	TOTAL AREA		STREETS: PAVED		RESIDENTIAL: 0.25 ACRES OR LESS		UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL		WEIGHTED PERCENT IMPERVIOUS	WEIGHTED PERCENT PERVIOUS
	(sq ft)	(acre)	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]		
P4020R	18,097	0.42	10,505	58	0	0	7,592	42	59	41
P4021R	15,056	0.35	12,326	82	0	0	2,730	18	82	18
P4023R	151,399	3.48	132,698	88	0	0	18,701	12	88	12
P4028R	89,275	2.05	5,789	6	0	0	83,486	94	8	92
P4040L	63,688	1.46	431	1	0	0	63,257	99	3	97
P4044R	231,372	5.31	24,901	11	0	0	206,471	89	13	87
P4053L	80,884	1.86	190	0	0	0	80,694	100	2	98
P4054R	136,299	3.13	35,075	26	0	0	101,224	74	27	73
P4060L	52,733	1.21	94	0	0	0	52,640	100	2	98
P4065R	143,409	3.29	38,307	27	0	0	105,101	73	28	72
P4074R	123,870	2.84	35,609	29	0	0	88,261	71	30	70
P4075L	101,855	2.34	88	0	0	0	101,767	100	2	98
P4076L	3,977	0.09	725	18	0	0	3,253	82	20	80
P4081L	57,379	1.32	7,462	13	0	0	49,916	87	15	85
P4081R	71,026	1.63	23,209	33	0	0	47,817	67	34	66
P4086R	70,230	1.61	20,749	30	0	0	49,481	70	31	69
P4087L	59,967	1.38	9,503	16	0	0	50,465	84	18	82
P4091L	60,677	1.39	30,554	50	0	0	30,123	50	51	49
P4091R	43,938	1.01	10,042	23	0	0	33,896	77	24	76
P4093L	20,171	0.46	9,959	49	0	0	10,212	51	50	50
P4095R	19,774	0.45	8,844	45	0	0	10,930	55	46	54
P4108R	170,192	3.91	43,555	26	0	0	126,637	74	27	73
P4114L	157,955	3.63	14,169	9	0	0	143,785	91	11	89
P4117R	98,714	2.27	36,188	37	0	0	62,525	63	38	62
P5006R	62,881	1.44	18,304	29	0	0	44,577	71	31	69
P5007R	4,569	0.10	2,133	47	0	0	2,437	53	48	52
P5011L	240,492	5.52	47,197	20	0	0	193,295	80	21	79
P5011R	99,149	2.28	14,488	15	0	0	84,661	85	16	84
P5013L	134,100	3.08	36,023	27	0	0	98,077	73	28	72
P5023R	249,731	5.73	43,437	17	0	0	206,294	83	19	81
P5023L	51,051	1.17	13,889	27	0	0	37,161	73	29	71
P5030L	131,456	3.02	6,772	5	0	0	124,683	95	7	93
P5033R	181,335	4.16	35,151	19	0	0	146,184	81	21	79

CO 119 Bikeway
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Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator: ZDS/TPS
Date: 6/24/2022
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Date: 6/28/2022

Land Use Types	Percent Impervious
STREETS: PAVED	100
RESIDENTIAL: 0.25 ACRES OR LESS	45
UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL	2

Land Use Types and Imperviousness Values from USDCM Volume 1 Table 6-3

PERCENT IMPERVIOUS VALUES

BASIN ID	TOTAL AREA		STREETS: PAVED		RESIDENTIAL: 0.25 ACRES OR LESS		UNDEVELOPED AREAS: GREENBELTS, AGRICULTURAL		WEIGHTED PERCENT IMPERVIOUS	WEIGHTED PERCENT PERVIOUS
	(sq ft)	(acre)	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]	(sq ft)	% of Basin [2]		
P5040L	38,574	0.89	687	2	0	0	37,886	98	4	96
P5041R	40,549	0.93	15,690	39	0	0	24,859	61	40	60
P5048L	48,649	1.12	0	0	0	0	48,649	100	2	98
P5048R	113,201	2.60	47,522	42	0	0	65,679	58	43	57
P5052L	86,807	1.99	23,991	28	0	0	62,816	72	29	71
P5064R	297,129	6.82	63,970	22	0	0	233,159	78	23	77
P5066L	351,919	8.08	62,163	18	0	0	289,756	82	19	81
P5068R	685,963	15.75	42,661	6	0	0	643,302	94	8	92
P5076R	68,599	1.57	27,770	40	0	0	40,829	60	42	58
P5084R	62,649	1.44	62,649	100	0	0	0	0	100	0
P5084L	226,563	5.20	16,432	7	0	0	210,131	93	9	91
P5066R	112,112	2.57	6,678	6	0	0	105,434	94	8	92
P5001L	99,055	2.27	9,769	10	0	0	89,287	90	12	88
P4028L	27,547	0.63	16,743	61	0	0	10,804	39	62	38

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RUNOFF COEFFIECIENTS FOR 2, 5, 10, 25, 50, AND 100 YEAR STORM EVENTS

BASIN ID	NRCS HYDROLOGIC SOIL GROUP[1]																								C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}
	SOIL GROUP (%)[1]			SOIL GROUP A							SOIL GROUP B							SOIL GROUP C/D												
	A	B	C/D	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%						
P1000R		100								0	0.05	0.07	0.13	0.31	0.38	0.47	100							0	0.05	0.07	0.13	0.31	0.38	0.47
P1013R		100								0	0.43	0.46	0.51	0.60	0.64	0.69	100							0	0.43	0.46	0.51	0.60	0.64	0.69
P1016L		100								0	0.06	0.08	0.15	0.32	0.39	0.48	100							0	0.06	0.08	0.15	0.32	0.39	0.48
P1017L		100								0	0.39	0.42	0.48	0.58	0.62	0.67	100							0	0.39	0.42	0.48	0.58	0.62	0.67
P1018L		25	75							0	0.09	0.10	0.17	0.34	0.41	0.49	25	0.09	0.15	0.24	0.40	0.46	0.54	75	0.09	0.14	0.22	0.38	0.45	0.53
P1021R			100							0							0	0.37	0.43	0.49	0.59	0.63	0.68	100	0.37	0.43	0.49	0.59	0.63	0.68
P1021RA		25	75							0	0.84	0.86	0.87	0.88	0.89	0.90	25	0.83	0.86	0.87	0.88	0.88	0.89	75	0.83	0.86	0.87	0.88	0.88	0.89
P1029L			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
P1029R			100							0							0	0.44	0.50	0.55	0.64	0.67	0.72	100	0.44	0.50	0.55	0.64	0.67	0.72
P1030R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P1031L			100							0							0	0.38	0.44	0.50	0.60	0.64	0.69	100	0.38	0.44	0.50	0.60	0.64	0.69
P1031R			100							0							0	0.35	0.42	0.48	0.58	0.62	0.67	100	0.35	0.42	0.48	0.58	0.62	0.67
P1032R			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P1034R			100							0							0	0.07	0.12	0.21	0.38	0.45	0.53	100	0.07	0.12	0.21	0.38	0.45	0.53
P1043R			100							0							0	0.09	0.15	0.24	0.40	0.46	0.54	100	0.09	0.15	0.24	0.40	0.46	0.54
P1044L			100							0							0	0.03	0.08	0.17	0.35	0.42	0.50	100	0.03	0.08	0.17	0.35	0.42	0.50
Mobility Hub Jay Road Inlet			100							0							0	0.83	0.86	0.87	0.88	0.88	0.89	100	0.83	0.86	0.87	0.88	0.88	0.89
P1048L			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
P1053L			100							0							0	0.57	0.62	0.66	0.72	0.74	0.78	100	0.57	0.62	0.66	0.72	0.74	0.78
P1054R			100							0							0	0.20	0.27	0.34	0.48	0.53	0.60	100	0.20	0.27	0.34	0.48	0.53	0.60
P1056L			100							0							0	0.23	0.30	0.37	0.50	0.55	0.62	100	0.23	0.30	0.37	0.50	0.55	0.62
P1057L			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
P1058L			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P1063R			100							0							0	0.02	0.07	0.16	0.34	0.41	0.50	100	0.02	0.07	0.16	0.34	0.41	0.50
P1067L			100							0							0	0.07	0.13	0.22	0.38	0.45	0.53	100	0.07	0.13	0.22	0.38	0.45	0.53
P1069R			100							0							0	0.05	0.10	0.19	0.36	0.43	0.52	100	0.05	0.10	0.19	0.36	0.43	0.52
P1076L			100							0							0	0.04	0.08	0.18	0.35	0.42	0.51	100	0.04	0.08	0.18	0.35	0.42	0.51
P1077R			100							0							0	0.05	0.10	0.19	0.36	0.43	0.52	100	0.05	0.10	0.19	0.36	0.43	0.52
P1080R			100							0							0	0.06	0.11	0.20	0.37	0.44	0.52	100	0.06	0.11	0.20	0.37	0.44	0.52
P1082L			100							0							0	0.38	0.45	0.51	0.60	0.64	0.69	100	0.38	0.45	0.51	0.60	0.64	0.69
P1082R			100							0							0	0.04	0.09	0.18	0.36	0.42	0.51	100	0.04	0.09	0.18	0.36	0.42	0.51
P1088R			100							0							0	0.17	0.23	0.31	0.45	0.51	0.58	100	0.17	0.23	0.31	0.45	0.51	0.58
P2010R			100							0							0	0.09	0.14	0.23	0.39	0.46	0.54	100	0.09	0.14	0.23	0.39	0.46	0.54
P2021L			100							0							0	0.05	0.11	0.20	0.37	0.44	0.52	100	0.05	0.11	0.20	0.37	0.44	0.52
P2022L			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P2022R			100							0							0	0.12	0.18	0.26	0.42	0.48	0.56	100	0.12	0.18	0.26	0.42	0.48	0.56
P2030L			100							0							0	0.03	0.08	0.17	0.35	0.42	0.50	100	0.03	0.08	0.17	0.35	0.42	0.50
P2031R			100							0							0	0.10	0.16	0.25	0.41	0.47	0.55	100	0.10	0.16	0.25	0.41	0.47	0.55
P2032L			100							0							0	0.02	0.06	0.16	0.34	0.41	0.50	100	0.02	0.06	0.16	0.34	0.41	0.50
P2049L			100							0							0	0.02	0.06	0.15	0.34	0.41	0.50	100	0.02	0.06	0.15	0.34	0.41	0.50
P2058L			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P2059R			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
P2062L			100							0							0	0.75	0.78	0.81	0.83	0.84	0.86	100	0.75	0.78	0.81	0.83	0.84	0.86
P2064R			100							0							0	0.21	0.27	0.35	0.48	0.53	0.60	100	0.21	0.27	0.35	0.48	0.53	0.60
P2066R			100							0							0	0.21	0.27	0.35	0.48	0.54	0.60	100	0.21	0.27	0.35	0.48	0.54	0.60
P2063R			100							0							0	0.37	0.43	0.49	0.59	0.63	0.68	100	0.37	0.43	0.49	0.59	0.63	0.68
P2075L			100							0							0	0.03	0.08	0.17	0.35	0.42	0.50	100	0.03	0.08	0.17	0.35	0.42	0.50
P2077L			100							0							0	0.13	0.19	0.27	0.43	0.49	0.56	100	0.13	0.19	0.27	0.43	0.49	0.56
P2079L			100							0							0	0.19	0.26	0.33	0.47	0.52	0.59	100	0.19	0.26	0.33	0.47	0.52	0.59
P2084L			100							0							0	0.04	0.09	0.19	0.36	0.43	0.51	100	0.04	0.09	0.19	0.36	0.43	0.51
P2085R			100							0							0	0.18	0.24	0.32	0.46	0.52	0.59	100	0.18	0.24	0.32	0.46	0.52	0.59
P2085L			100							0							0	0.12	0.18	0.27	0.42	0.48	0.56	100	0.12	0.18	0.27	0.42	0.48	0.56
P2092R			100							0							0	0.25	0.32	0.39	0.51	0.56	0.63	100	0.25	0.32	0.39	0.51	0.56	0.63
P2093R			100							0							0	0.10	0.16	0.24	0.40	0.47	0.55	100	0.10	0.16	0.24	0.40	0.47	0.55
P2100L			100							0							0	0.05	0.10	0.19	0.37	0.43	0.52	100	0.05	0.10	0.19	0.37	0.43	0.52
P2100R			100							0							0	0.11	0.17	0.25	0.41	0.47	0.55	100	0.11	0.17	0.25	0.41	0.47	0.55
P2098R			100							0							0	0.12	0.18	0.27	0.42	0.48	0.56	100	0.12	0.18	0.27	0.42	0.48	0.56
P3021R			100							0							0	0.83	0.86	0.87	0.88	0.88	0.89	100	0.83	0.86	0.87	0.88	0.88	0.89
P3023R			100							0							0	0.83	0.86	0.87	0.88	0.88	0.89	100	0.83	0.86	0.87	0.88	0.88	0.89
P3042R			100							0							0	0.23	0.30	0.37	0.50	0.55	0.62	100	0.23	0.30	0.37	0.50	0.55	0.62
P3049L			100							0							0	0.28	0.34	0.41	0.53	0.58	0.64	100	0.28	0.34	0.41	0.53	0.58	0.64
P3049R			100							0							0	0.28	0.35	0.42	0.53	0.58	0.64	100	0.28	0.35	0.42	0.53	0.58	0.64
P3052R			100							0							0	0.30	0.36	0.43	0.54	0.59	0.65	100	0.30	0.36	0.43	0.54	0.59	0.65

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

RUNOFF COEFFIECIENTS FOR 2, 5, 10, 25, 50, AND 100 YEAR STORM EVENTS

BASIN ID	NRCS HYDROLOGIC SOIL GROUP[1]																													
	SOIL GROUP (%)[1]			SOIL GROUP A							SOIL GROUP B							SOIL GROUP C/D							C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}
	A	B	C/D	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	%						
P4018L			100							0							0	0.09	0.14	0.23	0.39	0.46	0.54	100	0.09	0.14	0.23	0.39	0.46	0.54
P4019R			100							0							0	0.22	0.29	0.36	0.49	0.54	0.61	100	0.22	0.29	0.36	0.49	0.54	0.61
P4019RA			100							0							0	0.70	0.74	0.77	0.80	0.81	0.83	100	0.70	0.74	0.77	0.80	0.81	0.83
P4020R			100							0							0	0.46	0.52	0.57	0.65	0.68	0.73	100	0.46	0.52	0.57	0.65	0.68	0.73
P4021R			100							0							0	0.67	0.71	0.74	0.78	0.80	0.82	100	0.67	0.71	0.74	0.78	0.80	0.82
P4023R			100							0							0	0.72	0.76	0.78	0.81	0.82	0.84	100	0.72	0.76	0.78	0.81	0.82	0.84
P4028R			100							0							0	0.05	0.10	0.19	0.37	0.43	0.52	100	0.05	0.10	0.19	0.37	0.43	0.52
P4040L			100							0							0	0.01	0.06	0.15	0.33	0.41	0.49	100	0.01	0.06	0.15	0.33	0.41	0.49
P4044R			100							0							0	0.08	0.14	0.22	0.39	0.45	0.54	100	0.08	0.14	0.22	0.39	0.45	0.54
P4053L			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P4054R			100							0							0	0.19	0.26	0.33	0.47	0.53	0.60	100	0.19	0.26	0.33	0.47	0.53	0.60
P4060L			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P4065R			100							0							0	0.20	0.27	0.34	0.48	0.53	0.60	100	0.20	0.27	0.34	0.48	0.53	0.60
P4074R			100							0							0	0.22	0.28	0.36	0.49	0.54	0.61	100	0.22	0.28	0.36	0.49	0.54	0.61
P4075L			100							0							0	0.01	0.05	0.15	0.33	0.40	0.49	100	0.01	0.05	0.15	0.33	0.40	0.49
P4076L			100							0							0	0.14	0.20	0.28	0.43	0.49	0.57	100	0.14	0.20	0.28	0.43	0.49	0.57
P4081L			100							0							0	0.10	0.16	0.24	0.40	0.47	0.54	100	0.10	0.16	0.24	0.40	0.47	0.54
P4081R			100							0							0	0.25	0.31	0.38	0.51	0.56	0.62	100	0.25	0.31	0.38	0.51	0.56	0.62
P4086R			100							0							0	0.22	0.29	0.36	0.49	0.54	0.61	100	0.22	0.29	0.36	0.49	0.54	0.61
P4087L			100							0							0	0.12	0.18	0.26	0.42	0.48	0.56	100	0.12	0.18	0.26	0.42	0.48	0.56
P4091L			100							0							0	0.39	0.46	0.51	0.61	0.64	0.69	100	0.39	0.46	0.51	0.61	0.64	0.69
P4091R			100							0							0	0.17	0.24	0.31	0.46	0.51	0.58	100	0.17	0.24	0.31	0.46	0.51	0.58
P4093L			100							0							0	0.38	0.45	0.50	0.60	0.64	0.69	100	0.38	0.45	0.50	0.60	0.64	0.69
P4095R			100							0							0	0.35	0.41	0.47	0.58	0.62	0.67	100	0.35	0.41	0.47	0.58	0.62	0.67
P4108R			100							0							0	0.19	0.26	0.33	0.47	0.53	0.60	100	0.19	0.26	0.33	0.47	0.53	0.60
P4114L			100							0							0	0.07	0.12	0.21	0.38	0.45	0.53	100	0.07	0.12	0.21	0.38	0.45	0.53
P4117R			100							0							0	0.28	0.35	0.41	0.53	0.58	0.64	100	0.28	0.35	0.41	0.53	0.58	0.64
P5006R			100							0							0	0.22	0.29	0.36	0.49	0.54	0.61	100	0.22	0.29	0.36	0.49	0.54	0.61
P5007R			100							0							0	0.36	0.43	0.49	0.59	0.63	0.68	100	0.36	0.43	0.49	0.59	0.63	0.68
P5011L			100							0							0	0.15	0.21	0.29	0.44	0.50	0.57	100	0.15	0.21	0.29	0.44	0.50	0.57
P5011R			100							0							0	0.11	0.17	0.25	0.41	0.47	0.55	100	0.11	0.17	0.25	0.41	0.47	0.55
P5013L		100								0	0.19	0.22	0.29	0.43	0.49	0.56	100							0	0.19	0.22	0.29	0.43	0.49	0.56
P5023R	50	50		0.10	0.10	0.11	0.14	0.19	0.26	50	0.12	0.14	0.21	0.37	0.43	0.52	50							0	0.11	0.12	0.16	0.25	0.31	0.39
P5023L	50	50		0.17	0.17	0.19	0.22	0.27	0.33	50	0.19	0.22	0.29	0.43	0.49	0.56	50							0	0.18	0.20	0.24	0.32	0.38	0.45
P5030L	100			0.03	0.03	0.03	0.04	0.08	0.16	100							0							0	0.03	0.03	0.03	0.04	0.08	0.16
P5033R	100			0.11	0.12	0.13	0.15	0.20	0.27	100							0							0	0.11	0.12	0.13	0.15	0.20	0.27
P5040L	100			0.01	0.01	0.02	0.02	0.06	0.14	100							0							0	0.01	0.01	0.02	0.02	0.06	0.14
P5041R	100			0.25	0.27	0.28	0.31	0.36	0.42	100							0							0	0.25	0.27	0.28	0.31	0.36	0.42
P5048L	100			0.01	0.01	0.01	0.01	0.04	0.13	100							0							0	0.01	0.01	0.01	0.01	0.04	0.13
P5048R	100			0.28	0.29	0.31	0.34	0.39	0.45	100							0							0	0.28	0.29	0.31	0.34	0.39	0.45
P5052L			100							0							0	0.21	0.27	0.35	0.48	0.54	0.60	100	0.21	0.27	0.35	0.48	0.54	0.60
P5064R		100								0	0.15	0.17	0.24	0.39	0.46	0.53	100							0	0.15	0.17	0.24	0.39	0.46	0.53
P5066L		100								0	0.12	0.14	0.21	0.37	0.44	0.52	100							0	0.12	0.14	0.21	0.37	0.44	0.52
P5068R		100								0	0.04	0.06	0.12	0.30	0.37	0.46	100							0	0.04	0.06	0.12	0.30	0.37	0.46
P5076R		100								0	0.30	0.33	0.39	0.51	0.56	0.62	100							0	0.30	0.33	0.39	0.51	0.56	0.62
P5084R		100								0	0.84	0.86	0.87	0.88	0.89	0.90	100							0	0.84	0.86	0.87	0.88	0.89	0.90
P5084L			100							0							0	0.06	0.11	0.20	0.37	0.44	0.52	100	0.06	0.11	0.20	0.37	0.44	0.52
P5066R			100							0							0	0.05	0.10	0.19	0.36	0.43	0.52	100	0.05	0.10	0.19	0.36	0.43	0.52
P5001L			100							0							0	0.07	0.13	0.22	0.38	0.45	0.53	100	0.07	0.13	0.22	0.38	0.45	0.53
P4028L			100							0							0	0.48	0.54	0.59	0.66	0.69	0.74	100	0.48	0.54	0.59	0.66	0.69	0.74

[1] Soil Group based on NRCS Soil Classification Map

[2] C Values obtained from USDCM Manual, March 2017, Chpt 6, Sec 2.5.1, Table 6-4

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

TIME OF CONCENTRATION

BASIN DATA				INITIAL/OVERLAND TIME (T_i)					CHANNELIZED (TRAVEL) TIME (T_t)								TOTAL t_c	T_c CHECK (Urbanized Basins)		FINAL t_c
BASIN ID	AREA (acre)	C_5	Basin Type	LENGTH L_i (ft)	ELEV. START (ft)	ELEV. END (ft)	OVERLAND SLOPE (S_i) (ft/ft)	t_i (min)[1]	LENGTH L_t (ft)	ELEV. START (ft)	ELEV. END (ft)	CHANNELIZED SLOPE (S_t) (ft/ft)	CONVEYANCE COEFFICIENT Type	CONVEYANCE COEFFICIENT K	Velocity V_t (ft/sec)	t_t (min)[2]	$t_i + t_t$ (min.)	First Design Point	Maximum t_c (min)[3]	$t_{minimum}$= 5 (Urban) $t_{minimum}$= 10 (Non-Urban)
P1000R	1.41	0.07	Non-Urban	234	5331.40	5308.90	0.096	13.5	276	5308.90	5308.40	0.002	SP	7	0.3	15.4	29.0	No	N/A	29.0
P1013R	1.54	0.46	Urban	79	5308.00	5306.00	0.025	7.6	762	5306.00	5291.70	0.019	SP	7	1.0	13.2	20.8	Yes	22.0	20.8
P1016L	8.85	0.08	Non-Urban	500	5331.50	5296.00	0.071	21.6	705	5296.00	5287.50	0.012	SP	7	0.8	15.3	36.9	No	N/A	36.9
P1017L	0.71	0.42	Urban	23	5292.00	5291.30	0.030	4.0	171	5291.30	5285.80	0.032	SP	7	1.3	2.3	6.3	Yes	18.1	6.3
P1018L	1.27	0.14	Non-Urban	24	5297.20	5296.80	0.017	7.2	500	5296.80	5282.00	0.030	SP	7	1.2	6.9	14.1	No	N/A	14.1
P1021R	0.64	0.43	Urban	73	5294.20	5292.50	0.023	7.8	227	5292.50	5289.00	0.015	SP	7	0.9	4.4	12.2	Yes	19.7	12.2
P1021RA	0.28	0.86	Urban	63	5296.70	5296.00	0.011	3.4	232	5296.00	5294.00	0.009	P	20	1.9	2.1	5.5	Yes	10.8	5.5
P1029L	99.22	0.21	Urban	300	5373.00	5369.00	0.013	25.2	4754	5369.00	5285.00	0.018	BG	10	1.3	59.6	84.8	Yes	71.8	71.8
P1029R	1.42	0.50	Urban	73	5294.00	5292.00	0.027	6.6	533	5292.00	5285.00	0.013	SP	7	0.8	11.1	17.7	Yes	20.9	17.7
P1030R	0.76	0.05	Non-Urban	21	5295.70	5294.10	0.076	4.4	910	5294.10	5285.30	0.010	SP	7	0.7	22.0	26.5	No	N/A	26.5
P1031L	1.04	0.44	Urban	75	5292.50	5290.80	0.023	7.9	395	5290.80	5273.00	0.045	SP	7	1.5	4.4	12.3	Yes	19.5	12.3
P1031R	0.74	0.42	Urban	40	5292.30	5288.00	0.108	3.6	334	5288.00	5272.00	0.048	P	20	4.4	1.3	4.8	Yes	19.7	5.0
P1032R	0.26	0.05	Non-Urban	16	5285.00	5284.00	0.063	4.1	243	5284.00	5282.56	0.006	SP	7	0.5	7.5	11.7	Yes	31.3	11.7
P1034R	0.70	0.12	Non-Urban	110	5291.30	5284.60	0.061	10.2	340	5284.60	5282.80	0.005	SP	7	0.5	11.1	21.3	No	N/A	21.3
P1043R	1.09	0.15	Non-Urban	70	5289.20	5284.80	0.063	7.8	532	5284.80	5278.80	0.011	SP	7	0.7	11.9	19.7	No	N/A	19.7
P1044L	2.33	0.08	Non-Urban	39	5291.20	5289.80	0.036	7.6	733	5289.80	5268.00	0.030	SP	7	1.2	10.1	17.7	No	N/A	17.7
Mobility Hub Jay Road Inlet	0.44	0.86	Urban	71	5285.50	5284.90	0.008	3.9	530	5284.90	5279.50	0.010	P	20	2.0	4.4	8.3	Yes	12.8	8.3
P1048L	1.20	0.21	Urban	19	5282.62	5278.62	0.211	2.6	547	5278.62	5265.12	0.025	P	20	3.1	2.9	5.5	Yes	27.3	5.5
P1053L	2.12	0.62	Urban	245	5284.00	5277.60	0.026	9.8	515	5277.60	5272.10	0.011	SP	7	0.7	11.9	21.7	No	N/A	21.7
P1054R	2.33	0.27	Urban	55	5278.20	5274.00	0.076	5.7	453	5274.00	5271.83	0.005	SP	7	0.5	15.6	21.3	No	N/A	21.3
P1056L	1.17	0.30	Urban	74	5278.00	5274.60	0.046	7.5	278	5274.60	5268.00	0.024	P	20	3.1	1.5	9.0	No	N/A	9.0
P1057L	0.29	0.21	Urban	56	5274.00	5273.00	0.018	9.9	87	5273.00	5271.80	0.014	SP	7	0.8	1.8	11.7	Yes	23.4	11.7
P1058L	0.05	0.05	Non-Urban	26	5276.30	5273.20	0.119	4.3	90	5273.20	5273.00	0.002	SP	7	0.3	4.5	8.8	No	N/A	10.0
P1063R	0.92	0.07	Non-Urban	57	5275.00	5273.60	0.025	10.5	809	5273.60	5255.40	0.022	SP	7	1.0	12.8	23.3	No	N/A	23.3
P1067L	2.85	0.13	Non-Urban	70	5274.60	5268.00	0.094	7.0	1097	5268.00	5246.84	0.019	SP	7	1.0	18.8	25.8	No	N/A	25.8
P1069R	1.28	0.10	Non-Urban	25	5262.00	5259.00	0.120	4.0	567	5259.00	5244.00	0.026	SP	7	1.1	8.3	12.3	No	N/A	12.3
P1076L	1.06	0.08	Non-Urban	8	5254.40	5253.00	0.175	2.0	693	5253.00	5244.50	0.012	SP	7	0.8	14.9	16.9	No	N/A	16.9
P1077R	1.85	0.10	Non-Urban	161	5250.20	5248.00	0.014	20.7	436	5248.00	5241.50	0.015	SP	7	0.9	8.5	29.2	No	N/A	29.2
P1080R	1.59	0.11	Non-Urban	176	5246.20	5239.00	0.041	14.9	176	5239.00	5237.71	0.007	SP	7	0.6	4.9	19.8	No	N/A	19.8
P1082L	1.70	0.45	Urban	89	5248.00	5243.80	0.047	6.7	456	5243.80	5235.70	0.018	SP	7	0.9	8.1	14.8	No	N/A	14.8
P1082R	0.20	0.09	Non-Urban	52	5241.10	5237.80	0.063	7.2	50	5237.80	5235.33	0.049	SP	7	1.6	0.5	7.7	No	N/A	10.0
P1088R	3.16	0.23	Urban	202	5243.80	5236.00	0.039	14.3	347	5236.00	5231.60	0.013	SP	7	0.8	7.3	21.6	No	N/A	21.6
P2010R	3.20	0.14	Non-Urban	20	5235.50	5232.00	0.177	3.0	2245	5232.00	5206.00	0.012	SP	7	0.8	49.7	52.7	No	N/A	52.7
P2021L	7.83	0.11	Non-Urban	375	5241.20	5231.50	0.026	25.4	3243	5231.50	5199.50	0.010	SP	7	0.7	77.7	103.1	No	N/A	103.1
P2022L	0.07	0.05	Non-Urban	25	5202.00	5201.20	0.032	6.5	45	5201.20	5198.00	0.071	SP	7	1.9	0.4	6.9	No	N/A	10.0
P2022R	3.00	0.18	Non-Urban	55	5216.50	5215.00	0.027	8.8	1725	5215.00	5197.00	0.010	SP	7	0.7	40.2	49.0	No	N/A	49.0
P2030L	1.18	0.08	Non-Urban	83	5201.20	5199.70	0.018	13.8	735	5199.70	5187.20	0.017	SP	7	0.9	13.4	27.2	No	N/A	27.2
P2031R	2.36	0.16	Non-Urban	51	5200.82	5196.00	0.094	5.8	887	5196.00	5175.00	0.024	SP	7	1.1	13.7	19.5	No	N/A	19.5
P2032L	0.12	0.06	Non-Urban	20	5189.20	5185.70	0.178	3.2	211	5185.70	5181.00	0.022	SP	7	1.0	3.4	6.6	No	N/A	10.0
P2049L	1.75	0.06	Non-Urban	44	5182.20	5179.20	0.069	6.6	1610	5179.20	5155.00	0.015	SP	7	0.9	31.3	37.8	No	N/A	37.8
P2058L	0.53	0.05	Non-Urban	37	5161.00	5156.20	0.129	5.0	548	5156.20	5154.00	0.004	SP	7	0.4	20.6	25.5	No	N/A	25.5
P2059R	9.82	0.21	Urban	64	5181.50	5172.50	0.141	5.4	2053	5172.50	5147.00	0.012	SP	7	0.8	43.9	49.2	Yes	48.0	48.0
P2062L	1.13	0.78	Urban	63	5164.70	5161.70	0.047	2.7	283	5161.70	5158.50	0.011	P	20	2.1	2.2	4.9	No	N/A	5.0
P2064R	2.43	0.27	Urban	56	5168.20	5164.00	0.075	5.8	845	5164.00	5153.00	0.013	P	20	2.3	6.2	11.9	No	N/A	11.9
P2066R	2.26	0.27	Urban	95	5168.70	5166.00	0.028	10.3	565	5166.00	5143.00	0.041	SP	7	1.4	6.7	17.0	Yes	24.6	17.0
P2063R	0.23	0.43	Urban	20	5154.00	5153.50	0.025	4.0	342	5153.50	5142.00	0.034	P	20	3.7	1.6	5.5	Yes	19.8	5.5
P2075L	0.58	0.08	Non-Urban	82	5170.00	5168.00	0.024	12.5	260	5168.00	5161.30	0.026	SP	7	1.1	3.9	16.4	No	N/A	16.4
P2077L	0.37	0.19	Non-Urban	99	5165.20	5158.00	0.073	8.5	142	5158.00	5153.20	0.034	SP	7	1.3	1.8	10.3	No	N/A	10.3
P2079L	1.73	0.26	Urban	101	5168.50	5168.20	0.003	22.9	561	5168.20	5138.70	0.053	SP	7	1.6	5.8	28.7	Yes	24.6	24.6
P2084L	0.80	0.09	Non-Urban	33	5159.20	5153.20	0.182	4.0	689	5153.20	5141.70	0.017	SP	7	0.9	12.7	16.7	No	N/A	16.7

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

TIME OF CONCENTRATION

BASIN DATA				INITIAL/OVERLAND TIME (T_i)					CHANNELIZED (TRAVEL) TIME (T_t)								TOTAL t_c	T_c CHECK (Urbanized Basins)		FINAL t_c
BASIN ID	AREA (acre)	C_5	Basin Type	LENGTH L_i (ft)	ELEV. START (ft)	ELEV. END (ft)	OVERLAND SLOPE (S_i) (ft/ft)	t_i (min)[1]	LENGTH L_t (ft)	ELEV. START (ft)	ELEV. END (ft)	CHANNELIZED SLOPE (S_t) (ft/ft)	CONVEYANCE COEFFICIENT Type	CONVEYANCE COEFFICIENT K	Velocity V_t (ft/sec)	t_t (min)[2]	$t_i + t_t$ (min.)	First Design Point	Maximum t_c (min)[3]	$t_{minimum}$= 5 (Urban) $t_{minimum}$= 10 (Non-Urban)
P2085R	2.57	0.24	Urban	67	5149.20	5140.50	0.129	5.5	540	5140.50	5137.20	0.006	SP	7	0.5	16.5	21.9	Yes	30.9	21.9
P2085L	2.32	0.18	Non-Urban	28	5152.20	5151.00	0.044	5.3	1114	5151.00	5142.00	0.008	SP	7	0.6	29.5	34.8	No	N/A	34.8
P2092R	0.39	0.32	Urban	90	5143.00	5139.00	0.044	8.2	96	5139.00	5134.00	0.052	SP	7	1.6	1.0	9.2	No	N/A	9.2
P2093R	1.69	0.16	Non-Urban	148	5150.50	5146.20	0.029	14.6	519	5146.20	5139.00	0.014	SP	7	0.8	10.5	25.1	No	N/A	25.1
P2100L	1.09	0.10	Non-Urban	37	5169.50	5166.20	0.090	5.3	1148	5166.20	5149.30	0.015	SP	7	0.8	22.5	27.8	No	N/A	27.8
P2100R	3.11	0.17	Non-Urban	55	5167.00	5164.50	0.046	7.6	1085	5164.50	5149.70	0.014	SP	7	0.8	22.1	29.7	No	N/A	29.7
P2098R	0.38	0.18	Non-Urban	92	5151.50	5148.50	0.033	10.8	114	5148.50	5146.50	0.018	SP	7	0.9	2.0	12.8	No	N/A	12.8
P3021R	0.20	0.86	Urban	8	5160.00	5156.00	0.500	0.3	347	5156.00	5143.50	0.036	P	20	3.8	1.5	1.9	Yes	10.3	5.0
P3023R	0.17	0.86	Urban	7	5150.50	5150.00	0.071	0.6	280	5150.00	5142.50	0.027	P	20	3.3	1.4	2.0	Yes	10.2	5.0
P3042R	0.97	0.30	Urban	70	5147.30	5144.00	0.047	7.3	272	5144.00	5140.00	0.015	SP	7	0.8	5.3	12.6	Yes	23.3	12.6
P3049L	1.47	0.34	Urban	48	5146.70	5144.00	0.056	5.4	737	5144.00	5132.00	0.016	SP	7	0.9	13.8	19.1	No	N/A	19.1
P3049R	2.24	0.35	Urban	70	5144.50	5141.00	0.050	6.6	752	5141.00	5131.00	0.013	SP	7	0.8	15.5	22.2	No	N/A	22.2
P3052R	0.61	0.36	Urban	68	5136.50	5133.00	0.051	6.4	45	5133.00	5132.00	0.022	SP	7	1.0	0.7	7.1	No	N/A	7.1
P4018L	13.69	0.14	Non-Urban	133	5135.50	5131.50	0.030	13.8	3046	5131.50	5107.50	0.008	SP	7	0.6	81.7	95.5	No	N/A	95.5
P4019R	3.37	0.29	Urban	266	5116.00	5108.00	0.030	16.6	530	5108.00	5105.00	0.006	SP	7	0.5	16.8	33.4	Yes	29.6	29.6
P4019RA	0.21	0.74	Urban	73	5111.70	5110.50	0.016	4.7	53	5110.50	5108.00	0.047	SP	7	1.5	0.6	5.3	Yes	11.6	5.3
P4020R	0.42	0.52	Urban	70	5105.00	5104.70	0.004	11.6	330	5104.70	5096.50	0.025	SP	7	1.1	5.0	16.6	Yes	18.0	16.6
P4021R	0.35	0.71	Urban	62	5110.50	5109.00	0.024	4.1	136	5109.00	5107.00	0.015	SP	7	0.8	2.7	6.8	Yes	12.9	6.8
P4023R	3.48	0.76	Urban	232	5110.50	5105.00	0.024	7.1	85	5105.00	5104.00	0.012	SP	7	0.8	1.9	9.0	Yes	11.7	9.0
P4028R	2.05	0.10	Non-Urban	149	5106.50	5103.00	0.024	16.5	323	5103.00	5099.00	0.012	SP	7	0.8	6.9	23.4	No	N/A	23.4
P4040L	1.46	0.06	Non-Urban	8	5104.50	5103.20	0.157	2.2	1293	5103.20	5092.00	0.009	SP	7	0.7	33.1	35.2	No	N/A	35.2
P4044R	5.31	0.14	Non-Urban	277	5104.20	5099.00	0.019	23.5	1104	5099.00	5086.00	0.012	SP	7	0.8	24.2	47.7	No	N/A	47.7
P4053L	1.86	0.05	Non-Urban	24	5094.00	5092.00	0.084	4.6	1254	5092.00	5082.00	0.008	SP	7	0.6	33.4	38.0	No	N/A	38.0
P4054R	3.13	0.26	Urban	292	5091.50	5087.50	0.014	23.4	660	5087.50	5081.00	0.010	SP	7	0.7	15.8	39.3	Yes	30.0	30.0
P4060L	1.21	0.05	Non-Urban	497	5087.50	5082.50	0.010	42.1	293	5082.50	5078.00	0.015	SP	7	0.9	5.6	47.7	No	N/A	47.7
P4065R	3.29	0.27	Urban	286	5084.50	5082.00	0.009	26.6	723	5082.00	5070.00	0.017	SP	7	0.9	13.4	40.0	Yes	28.4	28.4
P4074R	2.84	0.28	Urban	193	5076.70	5073.20	0.018	16.9	994	5073.20	5064.20	0.009	SP	7	0.7	24.9	41.7	Yes	34.0	34.0
P4075L	2.34	0.05	Non-Urban	24	5081.00	5078.20	0.118	4.1	1458	5078.20	5063.00	0.010	SP	7	0.7	34.0	38.1	No	N/A	38.1
P4076L	0.09	0.20	Non-Urban	27	5069.20	5064.50	0.174	3.3	19	5064.50	5063.50	0.052	SP	7	1.6	0.2	3.5	No	N/A	10.0
P4081L	1.32	0.16	Non-Urban	27	5066.20	5064.70	0.056	5.0	597	5064.70	5060.20	0.008	SP	7	0.6	16.4	21.4	No	N/A	21.4
P4081R	1.63	0.31	Urban	214	5072.20	5065.00	0.034	13.9	576	5065.00	5060.20	0.008	SP	7	0.6	15.0	29.0	Yes	27.9	27.9
P4086R	1.61	0.29	Urban	141	5064.20	5060.00	0.030	12.2	385	5060.00	5057.00	0.008	SP	7	0.6	10.4	22.5	Yes	26.2	22.5
P4087L	1.38	0.18	Non-Urban	33	5066.70	5062.00	0.141	4.0	505	5062.00	5057.00	0.010	SP	7	0.7	12.1	16.1	No	N/A	16.1
P4091L	1.39	0.46	Urban	119	5064.20	5058.00	0.052	7.4	223	5058.00	5057.20	0.004	SP	7	0.4	8.9	16.2	No	N/A	16.2
P4091R	1.01	0.24	Urban	93	5063.50	5058.00	0.059	8.4	204	5058.00	5057.20	0.004	SP	7	0.4	7.8	16.2	No	N/A	16.2
P4093L	0.46	0.45	Urban	65	5062.80	5061.00	0.028	6.8	160	5061.00	5059.00	0.013	SP	7	0.8	3.4	10.2	Yes	18.9	10.2
P4095R	0.45	0.41	Urban	190	5064.20	5059.00	0.027	12.3	107	5059.00	5058.00	0.009	SP	7	0.7	2.7	14.9	Yes	19.4	14.9
P4108R	3.91	0.26	Non-Urban	443	5063.50	5057.00	0.015	28.2	1391	5057.00	5043.00	0.010	SP	7	0.7	33.0	61.2	Yes	39.5	39.5
P4114L	3.63	0.12	Non-Urban	68	5062.00	5060.00	0.029	10.2	1759	5060.00	5036.00	0.014	SP	7	0.8	35.8	46.0	No	N/A	46.0
P4117R	2.27	0.35	Urban	136	5051.00	5046.00	0.037	10.3	916	5046.00	5040.50	0.006	SP	7	0.5	28.2	38.5	Yes	33.3	33.3
P5006R	1.44	0.29	Urban	46	5045.70	5041.70	0.086	4.9	641	5041.70	5029.00	0.020	SP	7	1.0	10.8	15.7	Yes	26.5	15.7
P5007R	0.10	0.43	Urban	34	5040.50	5039.20	0.038	4.6	68	5039.20	5034.00	0.076	SP	7	1.9	0.6	5.2	Yes	18.1	5.2
P5011L	5.52	0.21	Urban	106	5043.00	5038.00	0.047	9.9	1489	5038.00	5023.00	0.010	SP	7	0.7	35.3	45.2	Yes	43.0	43.0
P5011R	2.28	0.17	Non-Urban	18	5041.50	5041.00	0.028	5.1	1034	5041.00	5027.00	0.014	SP	7	0.8	21.2	26.3	No	N/A	26.3
P5013L	3.08	0.22	Urban	298	5037.70	5024.00	0.046	16.6	197	5024.00	5023.00	0.005	SP	7	0.5	6.6	23.2	Yes	24.7	23.2
P5023R	5.73	0.12	Non-Urban	405	5026.20	5021.50	0.012	33.8	509	5021.50	5020.00	0.003	SP	7	0.4	22.4	56.2	No	N/A	56.2
P5023L	1.17	0.20	Urban	74	5030.00	5025.00	0.067	7.5	873	5025.00	5021.50	0.004	SP	7	0.4	32.8	40.3	Yes	38.8	38.8
P5030L	3.02	0.03	Non-Urban	82	5029.00	5023.00	0.073	9.1	687	5023.00	5020.00	0.004	SP	7	0.5	24.8	33.8	No	N/A	33.8
P5033R	4.16	0.12	Urban	136	5019.50	5013.20	0.046	12.5	385	5013.20	5006.20	0.018	SP	7	0.9	6.8	19.3	Yes	26.4	19.3
P5040L	0.89	0.01	Non-Urban	175	5019.00	5017.00	0.011	24.8	30	5017.00	5014.00	0.098	SP	7	2.2	0.2	25.1	No	N/A	25.1

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

TIME OF CONCENTRATION

BASIN DATA				INITIAL/OVERLAND TIME (T_i)					CHANNELIZED (TRAVEL) TIME (T_t)								TOTAL t_c	T_c CHECK (Urbanized Basins)		FINAL t_c
BASIN ID	AREA (acre)	C_5	Basin Type	LENGTH L_i (ft)	ELEV. START (ft)	ELEV. END (ft)	OVERLAND SLOPE (S_i) (ft/ft)	t_i (min)[1]	LENGTH L_t (ft)	ELEV. START (ft)	ELEV. END (ft)	CHANNELIZED SLOPE (S_t) (ft/ft)	CONVEYANCE COEFFICIENT Type	CONVEYANCE COEFFICIENT K	Velocity V_t (ft/sec)	t_t (min)[2]	$t_i + t_t$ (min.)	First Design Point	Maximum t_c (min)[3]	$t_{minimum}$= 5 (Urban) $t_{minimum}$= 10 (Non-Urban)
P5041R	0.93	0.27	Urban	96	5019.20	5017.50	0.018	12.2	258	5017.50	5014.00	0.014	SP	7	0.8	5.3	17.4	Yes	21.7	17.4
P5048L	1.12	0.01	Non-Urban	120	5016.50	5016.00	0.004	28.8	445	5016.00	5011.00	0.011	SP	7	0.7	10.0	38.8	No	N/A	38.8
P5048R	2.60	0.29	Urban	85	5019.00	5015.50	0.041	8.4	584	5015.50	5009.00	0.011	SP	7	0.7	13.2	21.6	Yes	24.8	21.6
P5052L	1.99	0.27	Urban	84	5016.00	5013.50	0.030	9.6	260	5013.50	5013.00	0.002	SP	7	0.3	14.1	23.7	Yes	28.6	23.7
P5064R	6.82	0.17	Urban	64	5016.00	5011.00	0.078	6.8	1258	5011.00	5002.00	0.007	SP	7	0.6	35.4	42.2	Yes	42.3	42.2
P5066L	8.08	0.14	Non-Urban	93	5016.00	5011.00	0.054	9.5	1286	5011.00	5003.00	0.006	SP	7	0.6	38.8	48.4	No	N/A	48.4
P5068R	15.75	0.06	Non-Urban	31	5027.00	5025.00	0.065	5.7	5000	5025.00	1786.36	0.648	SP	7	5.6	14.8	20.5	No	N/A	20.5
P5076R	1.57	0.33	Urban	81	5026.50	5024.50	0.025	9.2	398	5024.50	5011.00	0.034	P	20	3.7	1.8	11.0	Yes	21.3	11.0
P5084R	1.44	0.86	Urban	51	5027.00	5025.00	0.039	2.0	457	5025.00	5017.50	0.016	SP	7	0.9	8.5	10.5	Yes	11.6	10.5
P5084L	5.20	0.11	Non-Urban	340	5032.00	5021.00	0.032	22.4	510	5021.00	5018.00	0.006	SP	7	0.5	15.8	38.2	No	N/A	38.2
P5066R	2.57	0.10	Non-Urban	308	5009.70	5005.00	0.015	27.6	363	5005.00	5002.00	0.008	SP	7	0.6	9.5	37.1	No	N/A	37.1
P5001L	2.27	0.13	Non-Urban	106	5043.50	5038.00	0.052	10.5	667	5038.00	5033.50	0.007	SP	7	0.6	19.4	29.8	No	N/A	29.8
P4028L	0.63	0.54	Non-Urban	69	5108.70	5105.20	0.051	4.9	301	5105.20	5103.70	0.005	SP	7	0.5	10.1	15.0	No	N/A	15.0

[1] $t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$ USDCM Equation 6-3, August 2018

[2] $t_t = \frac{Length}{60 * V_t}$ Where $V_t = K * S^{0.5}$ and K = 2.5 (Heavy Meadows), 5 (Tillage / Field), 7 (Short Pasture / Lawns), 10 (Nearly Bare Ground), 15, (Grassed Waterway), 20 (Paved) - USDCM Equation 6-4 August 2018

[3] $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)_v}$ USDCM Equation 6-5 August 2018

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

INTENSITY VALUES						
Storm Event	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
One-Hour Point Rainfall Values (P1) (inches)	0.79	1.40	1.35	1.81	2.23	2.70

5-Year: Boulder County Storm Drainage Criteria Manual, NOAA Atlas 2 Vol 3 (Region 1, Boulder, CO)
All other Events: NOAA Atlas 14, Volume 8, Version 2 (Region 1, Boulder, CO)

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

RATIONAL FLOWS

BASIN ID	AREA (acre)	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	I_2 (in/hr)	I_5 (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
P1000R	1.41	0.05	0.07	0.13	0.31	0.38	0.47	1.27	2.24	2.16	2.90	3.57	4.33	0.1	0.2	0.4	1.3	1.9	2.9
P1013R	1.54	0.43	0.46	0.51	0.60	0.64	0.69	1.52	2.70	2.60	3.48	4.29	5.20	1.0	1.9	2.0	3.2	4.2	5.5
P1016L	8.85	0.06	0.08	0.15	0.32	0.39	0.48	1.09	1.94	1.87	2.51	3.09	3.74	0.6	1.3	2.4	7.0	10.6	15.8
P1017L	0.71	0.39	0.42	0.48	0.58	0.62	0.67	2.51	4.44	4.29	5.75	7.08	8.57	0.7	1.3	1.5	2.3	3.1	4.1
P1018L	1.27	0.09	0.14	0.22	0.38	0.45	0.53	1.85	3.27	3.16	4.23	5.21	6.31	0.2	0.6	0.9	2.1	3.0	4.3
P1021R	0.64	0.37	0.43	0.49	0.59	0.63	0.68	1.97	3.49	3.37	4.52	5.56	6.74	0.5	1.0	1.1	1.7	2.2	2.9
P1021RA	0.28	0.83	0.86	0.87	0.88	0.88	0.89	2.62	4.64	4.47	6.00	7.39	8.94	0.6	1.1	1.1	1.5	1.8	2.2
P1029L	99.22	0.15	0.21	0.29	0.44	0.50	0.57	0.71	1.25	1.21	1.62	1.99	2.41	10.5	26.5	35.1	70.8	98.9	137.3
P1029R	1.42	0.44	0.50	0.55	0.64	0.67	0.72	1.66	2.93	2.83	3.79	4.67	5.66	1.0	2.1	2.2	3.4	4.5	5.8
P1030R	0.76	0.01	0.05	0.15	0.33	0.40	0.49	1.33	2.36	2.28	3.05	3.76	4.56	0.0	0.1	0.3	0.8	1.2	1.7
P1031L	1.04	0.38	0.44	0.50	0.60	0.64	0.69	1.97	3.48	3.35	4.50	5.54	6.71	0.8	1.6	1.7	2.8	3.7	4.8
P1031R	0.74	0.35	0.42	0.48	0.58	0.62	0.67	2.68	4.75	4.58	6.14	7.56	9.16	0.7	1.5	1.6	2.6	3.5	4.6
P1032R	0.26	0.01	0.05	0.15	0.33	0.40	0.49	2.01	3.56	3.43	4.60	5.67	6.86	0.0	0.0	0.1	0.4	0.6	0.9
P1034R	0.70	0.07	0.12	0.21	0.38	0.45	0.53	1.51	2.66	2.57	3.44	4.24	5.14	0.1	0.2	0.4	0.9	1.3	1.9
P1043R	1.09	0.09	0.15	0.24	0.40	0.46	0.54	1.57	2.77	2.67	3.58	4.42	5.35	0.2	0.5	0.7	1.6	2.2	3.2
P1044L	2.33	0.03	0.08	0.17	0.35	0.42	0.50	1.66	2.93	2.83	3.79	4.67	5.66	0.1	0.5	1.1	3.1	4.5	6.7
Mobility Hub Jay Road Inlet	0.44	0.83	0.86	0.87	0.88	0.88	0.89	2.29	4.06	3.91	5.25	6.47	7.83	0.8	1.5	1.5	2.0	2.5	3.1
P1048L	1.20	0.15	0.21	0.29	0.44	0.50	0.57	2.62	4.64	4.47	5.99	7.38	8.94	0.5	1.2	1.5	3.2	4.4	6.1
P1053L	2.12	0.57	0.62	0.66	0.72	0.74	0.78	1.49	2.64	2.54	3.41	4.20	5.09	1.8	3.5	3.6	5.2	6.6	8.4
P1054R	2.33	0.20	0.27	0.34	0.48	0.53	0.60	1.51	2.66	2.57	3.44	4.24	5.14	0.7	1.7	2.0	3.8	5.3	7.2
P1056L	1.17	0.23	0.30	0.37	0.50	0.55	0.62	2.23	3.94	3.80	5.09	6.28	7.60	0.6	1.4	1.6	3.0	4.0	5.5
P1057L	0.29	0.15	0.21	0.29	0.44	0.50	0.57	2.01	3.55	3.42	4.59	5.66	6.85	0.1	0.2	0.3	0.6	0.8	1.1
P1058L	0.05	0.01	0.05	0.15	0.33	0.40	0.49	2.14	3.79	3.65	4.90	6.03	7.30	0.0	0.0	0.0	0.1	0.1	0.2
P1063R	0.92	0.02	0.07	0.16	0.34	0.41	0.50	1.43	2.54	2.45	3.28	4.04	4.89	0.0	0.2	0.4	1.0	1.5	2.2
P1067L	2.85	0.07	0.13	0.22	0.38	0.45	0.53	1.35	2.40	2.31	3.10	3.82	4.62	0.3	0.9	1.4	3.4	4.9	7.0
P1069R	1.28	0.05	0.10	0.19	0.36	0.43	0.52	1.97	3.48	3.36	4.50	5.54	6.71	0.1	0.5	0.8	2.1	3.1	4.4
P1076L	1.06	0.04	0.08	0.18	0.35	0.42	0.51	1.69	3.00	2.89	3.88	4.78	5.78	0.1	0.3	0.5	1.4	2.1	3.1
P1077R	1.85	0.05	0.10	0.19	0.36	0.43	0.52	1.26	2.23	2.15	2.89	3.56	4.31	0.1	0.4	0.8	1.9	2.8	4.1
P1080R	1.59	0.06	0.11	0.20	0.37	0.44	0.52	1.57	2.77	2.67	3.58	4.41	5.34	0.1	0.5	0.9	2.1	3.1	4.4
P1082L	1.70	0.38	0.45	0.51	0.60	0.64	0.69	1.81	3.20	3.08	4.14	5.10	6.17	1.2	2.4	2.6	4.2	5.5	7.2
P1082R	0.20	0.04	0.09	0.18	0.36	0.42	0.51	2.14	3.79	3.65	4.90	6.03	7.30	0.0	0.1	0.1	0.3	0.5	0.7
P1088R	3.16	0.17	0.23	0.31	0.45	0.51	0.58	1.49	2.64	2.55	3.42	4.21	5.10	0.8	1.9	2.5	4.9	6.8	9.4
P2010R	3.20	0.09	0.14	0.23	0.39	0.46	0.54	0.87	1.54	1.49	2.00	2.46	2.98	0.2	0.7	1.1	2.5	3.6	5.1
P2021L	7.83	0.05	0.11	0.20	0.37	0.44	0.52	0.55	0.97	0.94	1.25	1.55	1.87	0.2	0.8	1.4	3.6	5.3	7.6
P2022L	0.07	0.01	0.05	0.15	0.33	0.40	0.49	2.14	3.79	3.65	4.90	6.03	7.30	0.0	0.0	0.0	0.1	0.2	0.2
P2022R	3.00	0.12	0.18	0.26	0.42	0.48	0.56	0.91	1.62	1.56	2.09	2.58	3.12	0.3	0.9	1.2	2.6	3.7	5.2
P2030L	1.18	0.03	0.08	0.17	0.35	0.42	0.50	1.31	2.33	2.24	3.01	3.70	4.48	0.0	0.2	0.4	1.2	1.8	2.7
P2031R	2.36	0.10	0.16	0.25	0.41	0.47	0.55	1.58	2.79	2.69	3.61	4.45	5.38	0.4	1.1	1.6	3.5	4.9	7.0
P2032L	0.12	0.02	0.06	0.16	0.34	0.41	0.50	2.14	3.79	3.65	4.90	6.03	7.30	0.0	0.0	0.1	0.2	0.3	0.4
P2049L	1.75	0.02	0.06	0.15	0.34	0.41	0.50	1.08	1.91	1.84	2.47	3.04	3.68	0.0	0.2	0.5	1.5	2.2	3.2
P2058L	0.53	0.01	0.05	0.15	0.33	0.40	0.49	1.36	2.41	2.32	3.12	3.84	4.65	0.0	0.1	0.2	0.5	0.8	1.2

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

INTENSITY VALUES						
Storm Event	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
One-Hour Point Rainfall Values (P1) (inches)	0.79	1.40	1.35	1.81	2.23	2.70

5-Year: Boulder County Storm Drainage Criteria Manual, NOAA Atlas 2 Vol 3 (Region 1, Boulder, CO)
All other Events: NOAA Atlas 14, Volume 8, Version 2 (Region 1, Boulder, CO)

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

RATIONAL FLOWS

BASIN ID	AREA (acre)	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	I_2 (in/hr)	I_5 (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
P2059R	9.82	0.15	0.21	0.29	0.44	0.50	0.57	0.93	1.64	1.58	2.12	2.61	3.16	1.3	3.4	4.5	9.1	12.7	17.7
P2062L	1.13	0.75	0.78	0.81	0.83	0.84	0.86	2.68	4.75	4.58	6.14	7.56	9.16	2.3	4.2	4.2	5.8	7.2	8.9
P2064R	2.43	0.21	0.27	0.35	0.48	0.53	0.60	1.99	3.52	3.40	4.55	5.61	6.79	1.0	2.3	2.9	5.3	7.3	9.9
P2066R	2.26	0.21	0.27	0.35	0.48	0.54	0.60	1.69	2.99	2.89	3.87	4.77	5.78	0.8	1.9	2.3	4.2	5.8	7.9
P2063R	0.23	0.37	0.43	0.49	0.59	0.63	0.68	2.61	4.62	4.46	5.98	7.37	8.92	0.2	0.5	0.5	0.8	1.1	1.4
P2075L	0.58	0.03	0.08	0.17	0.35	0.42	0.50	1.72	3.05	2.94	3.94	4.85	5.88	0.0	0.1	0.3	0.8	1.2	1.7
P2077L	0.37	0.13	0.19	0.27	0.43	0.49	0.56	2.11	3.74	3.61	4.84	5.96	7.21	0.1	0.3	0.4	0.8	1.1	1.5
P2079L	1.73	0.19	0.26	0.33	0.47	0.52	0.59	1.39	2.46	2.37	3.18	3.92	4.75	0.5	1.1	1.4	2.6	3.6	4.9
P2084L	0.80	0.04	0.09	0.19	0.36	0.43	0.51	1.71	3.02	2.91	3.90	4.81	5.82	0.1	0.2	0.4	1.1	1.7	2.4
P2085R	2.57	0.18	0.24	0.32	0.46	0.52	0.59	1.48	2.62	2.53	3.39	4.18	5.06	0.7	1.6	2.1	4.0	5.5	7.6
P2085L	2.32	0.12	0.18	0.27	0.42	0.48	0.56	1.13	2.01	1.94	2.60	3.20	3.87	0.3	0.9	1.2	2.5	3.6	5.0
P2092R	0.39	0.25	0.32	0.39	0.51	0.56	0.63	2.21	3.91	3.77	5.06	6.23	7.55	0.2	0.5	0.6	1.0	1.4	1.9
P2093R	1.69	0.10	0.16	0.24	0.40	0.47	0.55	1.38	2.44	2.35	3.15	3.88	4.70	0.2	0.7	1.0	2.2	3.1	4.3
P2100L	1.09	0.05	0.10	0.19	0.37	0.43	0.52	1.30	2.30	2.21	2.97	3.66	4.43	0.1	0.3	0.5	1.2	1.7	2.5
P2100R	3.11	0.11	0.17	0.25	0.41	0.47	0.55	1.25	2.21	2.13	2.86	3.52	4.26	0.4	1.1	1.7	3.6	5.2	7.3
P2098R	0.38	0.12	0.18	0.27	0.42	0.48	0.56	1.93	3.41	3.29	4.41	5.44	6.59	0.1	0.2	0.3	0.7	1.0	1.4
P3021R	0.20	0.83	0.86	0.87	0.88	0.88	0.89	2.68	4.75	4.58	6.14	7.56	9.16	0.4	0.8	0.8	1.1	1.3	1.6
P3023R	0.17	0.83	0.86	0.87	0.88	0.88	0.89	2.68	4.75	4.58	6.14	7.56	9.16	0.4	0.7	0.7	0.9	1.2	1.4
P3042R	0.97	0.23	0.30	0.37	0.50	0.55	0.62	1.94	3.44	3.32	4.45	5.48	6.64	0.4	1.0	1.2	2.2	2.9	4.0
P3049L	1.47	0.28	0.34	0.41	0.53	0.58	0.64	1.59	2.82	2.72	3.64	4.49	5.44	0.6	1.4	1.6	2.8	3.8	5.1
P3049R	2.24	0.28	0.35	0.42	0.53	0.58	0.64	1.47	2.61	2.51	3.37	4.15	5.03	0.9	2.0	2.3	4.0	5.4	7.2
P3052R	0.61	0.30	0.36	0.43	0.54	0.59	0.65	2.42	4.28	4.13	5.53	6.82	8.25	0.4	0.9	1.1	1.8	2.4	3.2
P4018L	13.69	0.09	0.14	0.23	0.39	0.46	0.54	0.58	1.02	0.99	1.33	1.63	1.98	0.7	2.0	3.1	7.1	10.2	14.6
P4019R	3.37	0.22	0.29	0.36	0.49	0.54	0.61	1.25	2.21	2.14	2.86	3.53	4.27	0.9	2.2	2.6	4.8	6.5	8.8
P4019RA	0.21	0.70	0.74	0.77	0.80	0.81	0.83	2.64	4.67	4.50	6.03	7.44	9.00	0.4	0.7	0.7	1.0	1.3	1.6
P4020R	0.42	0.46	0.52	0.57	0.65	0.68	0.73	1.71	3.03	2.92	3.91	4.82	5.84	0.3	0.7	0.7	1.1	1.4	1.8
P4021R	0.35	0.67	0.71	0.74	0.78	0.80	0.82	2.46	4.35	4.19	5.62	6.92	8.38	0.6	1.1	1.1	1.5	1.9	2.4
P4023R	3.48	0.72	0.76	0.78	0.81	0.82	0.84	2.23	3.94	3.80	5.10	6.28	7.61	5.6	10.4	10.3	14.4	18.0	22.3
P4028R	2.05	0.05	0.10	0.19	0.37	0.43	0.52	1.43	2.53	2.44	3.27	4.03	4.88	0.2	0.5	1.0	2.5	3.6	5.2
P4040L	1.46	0.01	0.06	0.15	0.33	0.41	0.49	1.13	1.99	1.92	2.58	3.18	3.85	0.0	0.2	0.4	1.3	1.9	2.8
P4044R	5.31	0.08	0.14	0.22	0.39	0.45	0.54	0.93	1.65	1.59	2.13	2.62	3.17	0.4	1.2	1.9	4.4	6.3	9.0
P4053L	1.86	0.01	0.05	0.15	0.33	0.40	0.49	1.07	1.90	1.83	2.46	3.03	3.67	0.0	0.2	0.5	1.5	2.3	3.4
P4054R	3.13	0.19	0.26	0.33	0.47	0.53	0.60	1.24	2.20	2.12	2.84	3.50	4.23	0.7	1.8	2.2	4.2	5.8	7.9
P4060L	1.21	0.01	0.05	0.15	0.33	0.40	0.49	0.93	1.65	1.59	2.13	2.62	3.18	0.0	0.1	0.3	0.9	1.3	1.9
P4065R	3.29	0.20	0.27	0.34	0.48	0.53	0.60	1.28	2.27	2.19	2.93	3.61	4.37	0.8	2.0	2.5	4.6	6.3	8.6
P4074R	2.84	0.22	0.28	0.36	0.49	0.54	0.61	1.15	2.04	1.96	2.63	3.24	3.93	0.7	1.6	2.0	3.7	5.0	6.8
P4075L	2.34	0.01	0.05	0.15	0.33	0.40	0.49	1.07	1.90	1.83	2.46	3.03	3.67	0.0	0.2	0.6	1.9	2.9	4.2
P4076L	0.09	0.14	0.20	0.28	0.43	0.49	0.57	2.14	3.79	3.65	4.90	6.03	7.30	0.0	0.1	0.1	0.2	0.3	0.4
P4081L	1.32	0.10	0.16	0.24	0.40	0.47	0.54	1.50	2.66	2.56	3.44	4.24	5.13	0.2	0.5	0.8	1.8	2.6	3.7
P4081R	1.63	0.25	0.31	0.38	0.51	0.56	0.62	1.30	2.29	2.21	2.97	3.65	4.42	0.5	1.2	1.4	2.5	3.3	4.5
P4086R	1.61	0.22	0.29	0.36	0.49	0.54	0.61	1.46	2.58	2.49	3.34	4.12	4.98	0.5	1.2	1.5	2.7	3.6	4.9

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

INTENSITY VALUES						
Storm Event	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
One-Hour Point Rainfall Values (P1) (inches)	0.79	1.40	1.35	1.81	2.23	2.70

5-Year: Boulder County Storm Drainage Criteria Manual, NOAA Atlas 2 Vol 3 (Region 1, Boulder, CO)
All other Events: NOAA Atlas 14, Volume 8, Version 2 (Region 1, Boulder, CO)

Originator ZDS/TPS
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RATIONAL FLOWS

BASIN ID	AREA (acre)	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	I_2 (in/hr)	I_5 (in/hr)	I_{10} (in/hr)	I_{25} (in/hr)	I_{50} (in/hr)	I_{100} (in/hr)	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)
P4087L	1.38	0.12	0.18	0.26	0.42	0.48	0.56	1.74	3.07	2.96	3.97	4.89	5.93	0.3	0.8	1.1	2.3	3.2	4.5
P4091L	1.39	0.39	0.46	0.51	0.61	0.64	0.69	1.73	3.06	2.95	3.96	4.88	5.90	0.9	1.9	2.1	3.3	4.4	5.7
P4091R	1.01	0.17	0.24	0.31	0.46	0.51	0.58	1.73	3.07	2.96	3.97	4.89	5.92	0.3	0.7	0.9	1.8	2.5	3.5
P4093L	0.46	0.38	0.45	0.50	0.60	0.64	0.69	2.12	3.76	3.63	4.86	5.99	7.25	0.4	0.8	0.8	1.4	1.8	2.3
P4095R	0.45	0.35	0.41	0.47	0.58	0.62	0.67	1.80	3.18	3.07	4.12	5.07	6.14	0.3	0.6	0.7	1.1	1.4	1.9
P4108R	3.91	0.19	0.26	0.33	0.47	0.53	0.60	1.05	1.86	1.79	2.40	2.96	3.59	0.8	1.9	2.3	4.4	6.1	8.3
P4114L	3.63	0.07	0.12	0.21	0.38	0.45	0.53	0.95	1.69	1.63	2.18	2.68	3.25	0.2	0.8	1.2	3.0	4.3	6.2
P4117R	2.27	0.28	0.35	0.41	0.53	0.58	0.64	1.17	2.06	1.99	2.67	3.29	3.98	0.7	1.6	1.9	3.2	4.3	5.8
P5006R	1.44	0.22	0.29	0.36	0.49	0.54	0.61	1.75	3.11	2.99	4.01	4.95	5.99	0.6	1.3	1.5	2.8	3.9	5.3
P5007R	0.10	0.36	0.43	0.49	0.59	0.63	0.68	2.66	4.71	4.54	6.09	7.50	9.08	0.1	0.2	0.2	0.4	0.5	0.6
P5011L	5.52	0.15	0.21	0.29	0.44	0.50	0.57	0.99	1.76	1.70	2.27	2.80	3.39	0.8	2.0	2.7	5.5	7.7	10.7
P5011R	2.28	0.11	0.17	0.25	0.41	0.47	0.55	1.34	2.37	2.29	3.07	3.78	4.57	0.3	0.9	1.3	2.9	4.1	5.7
P5013L	3.08	0.19	0.22	0.29	0.43	0.49	0.56	1.44	2.54	2.45	3.29	4.05	4.90	0.8	1.7	2.2	4.3	6.1	8.4
P5023R	5.73	0.11	0.12	0.16	0.25	0.31	0.39	0.84	1.48	1.43	1.91	2.36	2.85	0.5	1.0	1.3	2.8	4.2	6.3
P5023L	1.17	0.18	0.20	0.24	0.32	0.38	0.45	1.06	1.88	1.81	2.43	2.99	3.62	0.2	0.4	0.5	0.9	1.3	1.9
P5030L	3.02	0.03	0.03	0.03	0.04	0.08	0.16	1.16	2.04	1.97	2.64	3.26	3.94	0.1	0.2	0.2	0.4	0.8	2.0
P5033R	4.16	0.11	0.12	0.13	0.15	0.20	0.27	1.59	2.81	2.71	3.63	4.47	5.41	0.7	1.4	1.4	2.3	3.8	6.2
P5040L	0.89	0.01	0.01	0.02	0.02	0.06	0.14	1.38	2.44	2.35	3.15	3.88	4.70	0.0	0.0	0.0	0.1	0.2	0.6
P5041R	0.93	0.25	0.27	0.28	0.31	0.36	0.42	1.67	2.95	2.85	3.82	4.70	5.70	0.4	0.7	0.7	1.1	1.6	2.2
P5048L	1.12	0.01	0.01	0.01	0.01	0.04	0.13	1.06	1.88	1.81	2.43	2.99	3.62	0.0	0.0	0.0	0.0	0.1	0.5
P5048R	2.60	0.28	0.29	0.31	0.34	0.39	0.45	1.50	2.65	2.55	3.42	4.22	5.10	1.1	2.0	2.0	3.0	4.3	5.9
P5052L	1.99	0.21	0.27	0.35	0.48	0.54	0.60	1.42	2.52	2.43	3.25	4.01	4.85	0.6	1.4	1.7	3.1	4.3	5.8
P5064R	6.82	0.15	0.17	0.24	0.39	0.46	0.53	1.01	1.78	1.72	2.30	2.84	3.44	1.0	2.1	2.9	6.2	8.9	12.5
P5066L	8.08	0.12	0.14	0.21	0.37	0.44	0.52	0.92	1.63	1.57	2.11	2.60	3.15	0.9	1.9	2.7	6.3	9.2	13.1
P5068R	15.75	0.04	0.06	0.12	0.30	0.37	0.46	1.54	2.72	2.62	3.52	4.33	5.25	1.1	2.4	5.1	16.6	25.5	38.4
P5076R	1.57	0.30	0.33	0.39	0.51	0.56	0.62	2.06	3.64	3.51	4.71	5.80	7.02	1.0	1.9	2.2	3.8	5.1	6.9
P5084R	1.44	0.84	0.86	0.87	0.88	0.89	0.90	2.10	3.72	3.59	4.81	5.92	7.17	2.5	4.6	4.5	6.1	7.6	9.2
P5084L	5.20	0.06	0.11	0.20	0.37	0.44	0.52	1.07	1.90	1.83	2.45	3.02	3.66	0.3	1.1	1.9	4.7	6.9	9.9
P5066R	2.57	0.05	0.10	0.19	0.36	0.43	0.52	1.09	1.93	1.86	2.50	3.08	3.73	0.1	0.5	0.9	2.3	3.4	5.0
P5001L	2.27	0.07	0.13	0.22	0.38	0.45	0.53	1.25	2.20	2.13	2.85	3.51	4.25	0.2	0.7	1.1	2.5	3.6	5.1
P4028L	0.63	0.48	0.54	0.59	0.66	0.69	0.74	1.79	3.17	3.06	4.10	5.06	6.12	0.5	1.1	1.1	1.7	2.2	2.9

[1] $I = \frac{28.5 * P1}{(10 + T_d)^{0.786}}$ USDCM Equation 5-1, (March 2017) where $T_d = T_c$ USDCM Chapter 6 Section 2.5 (August 2018)

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
5-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_5	CA (acres)	T_c (min)	I_5 (in/hr)	Q (cfs)	T_c (min)	Effective CA_5	I_5 (in/hr)	Q (cfs)	
P1017L	P1013R	1.54	0.46	0.71	20.83	2.70	1.9					
	P1016L	8.85	0.08	0.68	36.92	1.94	1.3					
								36.92	1.39	1.94	2.7	
	P1017L	0.71	0.42	0.30	6.32	4.44	1.3					
								36.9	1.69	1.94	3.3	
P1018L	P1021RA	0.28	0.86	0.24	5.46	4.64	1.1					
	P1021R	0.64	0.43	0.27	12.17	3.49	1.0					
	P1018L	1.27	0.14	0.18	14.08	3.27	0.6					
								14.1	0.69	3.27	2.3	
P1030R	P1029L	99.22	0.21	21.17	71.79	1.25	26.5					
	P1029R	1.42	0.50	0.71	17.68	2.93	2.1					
	P1030R	0.76	0.05	0.04	26.47	2.36	0.1					
	P1031L	1.04	0.44	0.46	12.29	3.48	1.6					
	P1031R	0.74	0.42	0.31	5.00	4.75	1.5					
	P1032R	0.26	0.05	0.01	11.65	3.56	0.0					
								71.8	22.70	1.25	28.4	
P1044L	P1043R	1.09	0.15	0.16	19.74	2.77	0.5					
	P1044L	2.33	0.08	0.18	17.69	2.93	0.5					
								19.7	0.34	2.77	0.9	
P1056L	Mobility Hub Jay Road Inlet	0.44	0.86	0.38	8.32	4.06	1.5					
	P1048L	1.20	0.21	0.25	5.47	4.64	1.2					
	P1053L	2.12	0.62	1.32	21.70	2.64	3.5					
	P1054R	2.33	0.27	0.62	21.29	2.66	1.7					
	P1056L	1.17	0.30	0.35	9.02	3.94	1.4					
								21.7	2.91	2.64	7.7	
P1069R	Mobility Hub Jay Road Inlet	0.44	0.86	0.38	8.32	4.06	1.5					
	P1048L	1.20	0.21	0.25	5.47	4.64	1.2					
	P1053L	2.12	0.62	1.32	21.70	2.64	3.5					
	P1054R	2.33	0.27	0.62	21.29	2.66	1.7					
	P1056L	1.17	0.30	0.35	9.02	3.94	1.4					
	P1057L	0.29	0.21	0.06	11.71	3.55	0.2					
	P1067L	2.85	0.13	0.37	25.80	2.40	0.9					
	P1063R	0.92	0.07	0.06	23.32	2.54	0.2					
	P1069R	1.28	0.10	0.13	12.27	3.48	0.5					
								25.8	3.53	2.40	8.5	
P1082L	P1076L	1.06	0.08	0.09	16.92	3.00	0.3					
	P1077R	1.85	0.10	0.19	29.17	2.23	0.4					
	P1080R	1.59	0.11	0.18	19.76	2.77	0.5					
	P1082L	1.70	0.45	0.76	14.80	3.20	2.4					
								29.2	1.21	2.23	2.7	
P2022R	P2021L	7.83	0.11	0.83	103.10	0.97	0.8					
	P2022L	0.07	0.05	0.00	10.00	3.79	0.0					
	P2022R	3.00	0.18	0.55	48.98	1.62	0.9					
								103.1	1.38	0.97	1.3	
P2031R	P2030L	1.18	0.08	0.09	27.21	2.33	0.2					
	P2031R	2.36	0.16	0.39	19.50	2.79	1.1					
	P2032L	0.12	0.06	0.01	10.00	3.79	0.0					
								27.2	0.48	2.33	1.1	

CO 119 Bikeway
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Originator ZDS/TPS
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Date: 6/28/2022

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
5-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_5	CA (acres)	T_c (min)	I_5 (in/hr)	Q (cfs)	T_c (min)	Effective CA_5	I_5 (in/hr)	Q (cfs)	
P2059R	P2058L	0.53	0.05	0.03	25.54	2.41	0.1					
	P2049L	1.75	0.06	0.10	37.82	1.91	0.2					
	P2059R	9.82	0.21	2.05	48.04	1.64	3.4					
	P2062L	1.13	0.78	0.89	5.00	4.75	4.2					
								48.0	3.07	1.64	5.0	
P2064R	P2063R	0.23	0.43	0.10	5.51	4.62	0.5					
	P2064R	2.43	0.27	0.66	11.93	3.52	2.3					
	P2066R	2.26	0.27	0.62	16.96	2.99	1.9					
								17.0	1.38	2.99	4.1	
P2079L	P2075L	0.58	0.08	0.04	16.39	3.05	0.1					
	P2077L	0.37	0.19	0.07	10.32	3.74	0.3					
	P2079L	1.73	0.26	0.44	24.63	2.46	1.1					
								24.6	0.56	2.46	1.4	
P2085R	P2084L	0.80	0.09	0.08	16.69	3.02	0.2					
	P2085R	2.57	0.24	0.62	21.91	2.62	1.6					
								21.9	0.70	2.62	1.8	
P2085L	P2085L	2.32	0.18	0.42	34.85	2.01	0.9					
	P2092R	0.39	0.32	0.13	9.19	3.91	0.5					
	P2093R	1.69	0.16	0.27	25.05	2.44	0.7					
	P2098R	0.38	0.18	0.07	12.82	3.41	0.2					
	P2100R	3.11	0.17	0.52	29.70	2.21	1.1					
	P2100L	1.09	0.10	0.11	27.81	2.30	0.3					
								34.8	1.51	2.01	3.0	
P3049R	P3049L	1.47	0.34	0.50	19.12	2.82	1.4					
	P3049R	2.24	0.35	0.78	22.17	2.61	2.0					
								22.2	1.29	2.61	3.4	
P4028R	P4021R	0.35	0.71	0.25	6.78	4.35	1.1					
	P4023R	3.48	0.76	2.63	9.00	3.94	10.4					
	P4028L	0.63	0.54	0.34	15.04	3.17	1.1					
	P4028R	2.05	0.10	0.21	23.43	2.53	0.5					
								23.4	3.43	2.53	8.7	
P4044R	P4021R	0.35	0.71	0.25	6.78	4.35	1.1					
	P4023R	3.48	0.76	2.63	9.00	3.94	10.4					
	P4028L	0.63	0.54	0.34	15.04	3.17	1.1					
	P4028R	2.05	0.10	0.21	23.43	2.53	0.5					
	P4040L	1.46	0.06	0.08	35.25	1.99	0.2					
	P4044R	5.31	0.14	0.73	47.74	1.65	1.2					
								47.7	4.24	1.65	7.0	
P4054R	P4053L	1.86	0.05	0.10	38.02	1.90	0.2					
	P4054R	3.13	0.26	0.81	30.03	2.20	1.8					
								38.0	0.91	1.90	1.7	
P4065R	P4060L	1.21	0.05	0.06	47.70	1.65	0.1					
	P4065R	3.29	0.27	0.88	28.44	2.27	2.0					
								47.7	0.94	1.65	1.5	
P4076L	P4074R	2.84	0.28	0.80	34.03	2.04	1.6					
	P4076L	0.09	0.20	0.02	10.00	3.79	0.1					
								34.0	0.82	2.04	1.7	
P4081L	P4081R	1.63	0.31	0.51	27.86	2.29	1.2					
	P4081L	1.32	0.16	0.21	21.36	2.66	0.5					
								27.9	0.72	2.29	1.6	
P4087L	P4086R	1.61	0.29	0.47	22.53	2.58	1.2					
	P4087L	1.38	0.18	0.25	16.10	3.07	0.8					
								22.5	0.71	2.58	1.8	
P4091L	P4091L	1.39	0.46	0.64	16.22	3.06	1.9					
	P4091R	1.01	0.24	0.24	16.15	3.07	0.7					
								16.2	0.87	3.06	2.7	

CO 119 Bikeway
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STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
5-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_5	CA (acres)	T_c (min)	I_5 (in/hr)	Q (cfs)	T_c (min)	Effective CA_5	I_5 (in/hr)	Q (cfs)	
P4095R	P4093L	0.46	0.45	0.21	10.18	3.76	0.8					
	P4095R	0.45	0.41	0.19	14.95	3.18	0.6					
								14.9	0.39	3.18	1.3	
P4114L	P4108R	3.91	0.26	1.00	39.46	1.86	1.9					
	P4114L	3.63	0.12	0.45	46.02	1.69	0.8					
								46.0	1.45	1.69	2.4	
P5001L	P4117R	2.27	0.35	0.78	33.33	2.06	1.6					
	P5001L	2.27	0.13	0.30	29.81	2.20	0.7					
								33.3	1.08	2.06	2.2	
P5006R	P5006R	1.44	0.29	0.41	15.75	3.11	1.3					
	P5007R	0.10	0.43	0.04	5.16	4.71	0.2					
								15.7	0.46	3.11	1.4	
P5011L	P5011R	2.28	0.17	0.38	26.28	2.37	0.9					
	P5011L	5.52	0.21	1.15	43.04	1.76	2.0					
								43.0	1.54	1.76	2.7	
P5023R	P5023L	1.17	0.20	0.23	38.80	1.88	0.4					
	P5023R	5.73	0.12	0.70	56.15	1.48	1.0					
								56.2	0.93	1.48	1.4	
P5033R	P5030L	3.02	0.03	0.09	33.83	2.04	0.2					
	P5033R	4.16	0.12	0.49	19.29	2.81	1.4					
								33.8	0.58	2.04	1.2	
P5041R	P5040L	0.89	0.01	0.01	25.07	2.44	0.0					
	P5041R	0.93	0.27	0.25	17.44	2.95	0.7					
								25.1	0.26	2.44	0.6	
P5048R	P5048L	1.12	0.01	0.01	38.83	1.88	0.0					
	P5048R	2.60	0.29	0.76	21.56	2.65	2.0					
								38.8	0.77	1.88	1.4	
P5068R	P5052L	1.99	0.27	0.55	23.66	2.52	1.4					
	P5066L	8.08	0.14	1.16	48.38	1.63	1.9					
	P5068R	15.75	0.06	0.88	20.46	2.72	2.4					
	P5084R	1.44	0.86	1.24	10.47	3.72	4.6					
	P5084L	5.20	0.11	0.57	38.19	1.90	1.1					
	P5084R	1.44	0.86	1.24	10.47	3.72	4.6					
								48.4	5.63	1.63	9.2	

Notes:

1 $$I = \frac{28.5 * P1}{(10 * T_d)^{0.786}}$$ USDCM Equation 5-1, (March 2017) where P Values come from NOAA Atlas 2, Volume 8, Version 2 and Td = Tc USDCM Chapter 6 Section 2.5 (August 2018)

2 $$Q_{tot} = I_{min}\left[\sum_{i=0}^{n}(CA)_i\right]$$ Where: I_{min} = Minimum Intensity and CA = Effective CA

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STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
10-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_{10}	CA (acres)	T_c (min)	I_{10} (in/hr)	Q (cfs)	T_c (min)	Effective CA_{10}	I_{10} (in/hr)	Q (cfs)	
P1017L	P1013R	1.54	0.51	0.79	20.83	2.60	2.0					
	P1016L	8.85	0.15	1.28	36.92	1.87	2.4					
								36.9	2.07	1.87	3.9	
	P1017L	0.71	0.48	0.34	6.32	4.29	1.5					
								36.9	2.41	1.87	4.5	
P1018L	P1021RA	0.28	0.87	0.24	5.46	4.47	1.1					
	P1021R	0.64	0.49	0.31	12.17	3.37	1.1					
	P1018L	1.27	0.22	0.28	14.08	3.16	0.9					
								14.1	0.59	3.16	1.9	
P1030R	P1029L	99.22	0.29	29.07	71.79	1.21	35.1					
	P1029R	1.42	0.55	0.79	17.68	2.83	2.2					
	P1030R	0.76	0.15	0.11	26.47	2.28	0.3					
	P1031L	1.04	0.50	0.52	12.29	3.35	1.7					
	P1031R	0.74	0.48	0.35	5.00	4.58	1.6					
	P1032R	0.26	0.15	0.04	11.65	3.43	0.1					
								71.8	30.88	1.21	37.3	
P1044R	P1043R	1.09	0.24	0.26	19.74	2.67	0.7					
	P1044L	2.33	0.17	0.39	17.69	2.83	1.1					
								19.7	0.65	2.67	1.7	
P1056L	Mobility Hub Jay Road Inlet	0.44	0.87	0.38	8.32	3.91	1.5					
	P1048L	1.20	0.29	0.35	5.47	4.47	1.5					
	P1053L	2.12	0.66	1.40	21.70	2.54	3.6					
	P1054R	2.33	0.34	0.80	21.29	2.57	2.0					
	P1056L	1.17	0.37	0.43	9.02	3.80	1.6					
								21.7	3.36	2.54	8.5	
P1069R	Mobility Hub Jay Road Inlet	0.44	0.87	0.38	8.32	3.91	1.5					
	P1048L	1.20	0.29	0.35	5.47	4.47	1.5					
	P1053L	2.12	0.66	1.40	21.70	2.54	3.6					
	P1054R	2.33	0.34	0.80	21.29	2.57	2.0					
	P1056L	1.17	0.37	0.43	9.02	3.80	1.6					
	P1057L	0.29	0.29	0.08	11.71	3.42	0.3					
	P1067L	2.85	0.22	0.62	25.80	2.31	1.4					
	P1063R	0.92	0.16	0.15	23.32	2.45	0.4					
	P1069R	1.28	0.19	0.25	12.27	3.36	0.8					
								25.8	4.45	2.31	10.3	
P1082L	P1076L	1.06	0.18	0.19	16.92	2.89	0.5					
	P1077R	1.85	0.19	0.35	29.17	2.15	0.8					
	P1080R	1.59	0.20	0.32	19.76	2.67	0.9					
	P1082L	1.70	0.51	0.86	14.80	3.08	2.6					
								29.2	1.72	2.15	3.7	
P2022R	P2021L	7.83	0.20	1.54	103.10	0.94	1.4					
	P2022L	0.07	0.15	0.01	10.00	3.65	0.0					
	P2022R	3.00	0.26	0.79	48.98	1.56	1.2					
								103.1	2.34	0.94	2.2	
P2031R	P2030L	1.18	0.17	0.20	27.21	2.24	0.4					
	P2031R	2.36	0.25	0.59	19.50	2.69	1.6					
	P2032L	0.12	0.16	0.02	10.00	3.65	0.1					
								27.2	0.80	2.24	1.8	

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STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
10-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_{10}	CA (acres)	T_c (min)	I_{10} (in/hr)	Q (cfs)	T_c (min)	Effective CA_{10}	I_{10} (in/hr)	Q (cfs)	
P2059R	P2058L	0.53	0.15	0.08	25.54	2.32	0.2					
	P2049L	1.75	0.15	0.27	37.82	1.84	0.5					
	P2059R	9.82	0.29	2.84	48.04	1.58	4.5					
	P2062L	1.13	0.81	0.91	5.00	4.58	4.2					
								48.0	4.10	1.58	6.5	
P2064R	P2063R	0.23	0.49	0.11	5.51	4.46	0.5					
	P2064R	2.43	0.35	0.84	11.93	3.40	2.9					
	P2066R	2.26	0.35	0.79	16.96	2.89	2.3					
								17.0	1.74	2.89	5.0	
P2079L	P2075L	0.58	0.17	0.10	16.39	2.94	0.3					
	P2077L	0.37	0.27	0.10	10.32	3.61	0.4					
	P2079L	1.73	0.33	0.57	24.63	2.37	1.4					
								24.6	0.77	2.37	1.8	
P2085R	P2084L	0.80	0.19	0.15	16.69	2.91	0.4					
	P2085R	2.57	0.32	0.82	21.91	2.53	2.1					
								21.9	0.97	2.53	2.5	
P2085L	P2085L	2.32	0.27	0.62	34.85	1.94	1.2					
	P2092R	0.39	0.39	0.15	9.19	3.77	0.6					
	P2093R	1.69	0.24	0.41	25.05	2.35	1.0					
	P2098R	0.38	0.27	0.10	12.82	3.29	0.3					
	P2100R	3.11	0.25	0.78	29.70	2.13	1.7					
	P2100L	1.09	0.19	0.21	27.81	2.21	0.5					
								34.8	2.27	1.94	4.4	
P3049R	P3049L	1.47	0.41	0.60	19.12	2.72	1.6					
	P3049R	2.24	0.42	0.93	22.17	2.51	2.3					
								22.2	1.53	2.51	3.9	
P4028R	P4021R	0.35	0.74	0.26	6.78	4.19	1.1					
	P4023R	3.48	0.78	2.72	9.00	3.80	10.3					
	P4028L	0.63	0.59	0.37	15.04	3.06	1.1					
	P4028R	2.05	0.19	0.40	23.43	2.44	1.0					
								23.4	3.74	2.44	9.1	
P4044R	P4021R	0.35	0.74	0.26	6.78	4.19	1.1					
	P4023R	3.48	0.78	2.72	9.00	3.80	10.3					
	P4028L	0.63	0.59	0.37	15.04	3.06	1.1					
	P4028R	2.05	0.19	0.40	23.43	2.44	1.0					
	P4040L	1.46	0.15	0.22	35.25	1.92	0.4					
	P4044R	5.31	0.22	1.19	47.74	1.59	1.9					
								47.7	5.16	1.59	8.2	
P4054R	P4053L	1.86	0.15	0.28	38.02	1.83	0.5					
	P4054R	3.13	0.33	1.04	30.03	2.12	2.2					
								38.0	1.32	1.83	2.4	
P4065R	P4060L	1.21	0.15	0.18	47.70	1.59	0.3					
	P4065R	3.29	0.34	1.12	28.44	2.19	2.5					
								47.7	1.30	1.59	2.1	
P4076L	P4074R	2.84	0.36	1.01	34.03	1.96	2.0					
	P4076L	0.09	0.28	0.03	10.00	3.65	0.1					
								34.0	1.04	1.96	2.0	
P4081L	P4081R	1.63	0.38	0.63	27.86	2.21	1.4					
	P4081L	1.32	0.24	0.32	21.36	2.56	0.8					
								27.9	0.94	2.21	2.1	
P4087L	P4086R	1.61	0.36	0.58	22.53	2.49	1.5					
	P4087L	1.38	0.26	0.36	16.10	2.96	1.1					
								22.5	0.94	2.49	2.3	
P4091L	P4091L	1.39	0.51	0.71	16.22	2.95	2.1					
	P4091R	1.01	0.31	0.32	16.15	2.96	0.9					
								16.2	1.03	2.95	3.0	

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STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
10-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_{10}	CA (acres)	T_c (min)	I_{10} (in/hr)	Q (cfs)	T_c (min)	Effective CA_{10}	I_{10} (in/hr)	Q (cfs)	
P4095R	P4093L	0.46	0.50	0.23	10.18	3.63	0.8					
	P4095R	0.45	0.47	0.21	14.95	3.07	0.7					
								14.9	0.45	3.07	1.4	
P4114L	P4108R	3.91	0.33	1.30	39.46	1.79	2.3					
	P4114L	3.63	0.21	0.77	46.02	1.63	1.2					
								46.0	2.07	1.63	3.4	
P5001L	P4117R	2.27	0.41	0.94	33.33	1.99	1.9					
	P5001L	2.27	0.22	0.50	29.81	2.13	1.1					
								33.3	1.43	1.99	2.8	
P5006R	P5006R	1.44	0.36	0.52	15.75	2.99	1.5					
	P5007R	0.10	0.49	0.05	5.16	4.54	0.2					
								15.7	0.57	2.99	1.7	
P5011L	P5011R	2.28	0.25	0.58	26.28	2.29	1.3					
	P5011L	5.52	0.29	1.60	43.04	1.70	2.7					
								43.0	2.17	1.70	3.7	
P5023R	P5023L	1.17	0.24	0.28	38.80	1.81	0.5					
	P5023R	5.73	0.16	0.93	56.15	1.43	1.3					
								56.2	1.21	1.43	1.7	
P5033R	P5030L	3.02	0.03	0.10	33.83	1.97	0.2					
	P5033R	4.16	0.13	0.53	19.29	2.71	1.4					
								33.8	0.63	1.97	1.2	
P5041R	P5040L	0.89	0.02	0.01	25.07	2.35	0.0					
	P5041R	0.93	0.28	0.26	17.44	2.85	0.7					
								25.1	0.27	2.35	0.6	
P5048R	P5048L	1.12	0.01	0.01	38.83	1.81	0.0					
	P5048R	2.60	0.31	0.80	21.56	2.55	2.0					
								38.8	0.81	1.81	1.5	
P5068R	P5052L	1.99	0.35	0.69	23.66	2.43	1.7					
	P5066L	8.08	0.21	1.72	48.38	1.57	2.7					
	P5068R	15.75	0.12	1.93	20.46	2.62	5.1					
	P5084R	1.44	0.87	1.25	10.47	3.59	4.5					
	P5084L	5.20	0.20	1.04	38.19	1.83	1.9					
	P5084R	1.44	0.87	1.25	10.47	3.59	4.5					
								48.4	7.88	1.57	12.4	

Notes:

1 $$I = \frac{28.5 * P1}{(10 * T_d)^{0.786}}$$

USDCM Equation 5-1, (March 2017) where P Values come from NOAA Atlas 2, Volume 8, Version 2 and Td = Tc USDCM Chapter 6 Section 2.5 (August 2018)

2 $$Q_{tot} = I_{min}\left[\sum_{i=0}^{n}(CA)_i\right]$$

Where: I_{min} = Minimum Intensity and CA = Effective CA

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STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
100-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_{100}	CA (acres)	T_c (min)	I_{100} (in/hr)	Q (cfs)	T_c (min)	Effective CA_{100}	I_{100} (in/hr)	Q (cfs)	
P1017L	P1013R	1.54	0.69	1.06	20.83	5.20	5.5					
	P1016L	8.85	0.48	4.22	36.92	3.74	15.8					
								36.9	5.28	3.74	19.7	
	P1017L	0.71	0.67	0.47	6.32	8.57	4.1					
								36.9	5.76	3.74	21.5	
P1018L	P1021RA	0.28	0.89	0.25	5.46	8.94	2.2					
	P1021R	0.64	0.68	0.44	12.17	6.74	2.9					
	P1018L	1.27	0.53	0.67	14.08	6.31	4.3					
								14.1	1.36	6.31	8.6	
P1030R	P1029L	99.22	0.57	56.87	71.79	2.41	137.3					
	P1029R	1.42	0.72	1.02	17.68	5.66	5.8					
	P1030R	0.76	0.49	0.38	26.47	4.56	1.7					
	P1031L	1.04	0.69	0.71	12.29	6.71	4.8					
	P1031R	0.74	0.67	0.50	5.00	9.16	4.6					
	P1032R	0.26	0.49	0.13	11.65	6.86	0.9					
								71.8	59.61	2.41	143.9	
P1044R	P1043R	1.09	0.54	0.59	19.74	5.35	3.2					
	P1044L	2.33	0.50	1.18	17.69	5.66	6.7					
								19.7	1.77	5.35	9.4	
P1056L	Mobility Hub Jay Road Inlet	0.44	0.89	0.39	8.32	7.83	3.1					
	P1048L	1.20	0.57	0.69	5.47	8.94	6.1					
	P1053L	2.12	0.78	1.65	21.70	5.09	8.4					
	P1054R	2.33	0.60	1.40	21.29	5.14	7.2					
	P1056L	1.17	0.62	0.72	9.02	7.60	5.5					
								21.7	4.84	5.09	24.6	
P1069R	Mobility Hub Jay Road Inlet	0.44	0.89	0.39	8.32	7.83	3.1					
	P1048L	1.20	0.57	0.69	5.47	8.94	6.1					
	P1053L	2.12	0.78	1.65	21.70	5.09	8.4					
	P1054R	2.33	0.60	1.40	21.29	5.14	7.2					
	P1056L	1.17	0.62	0.72	9.02	7.60	5.5					
	P1057L	0.29	0.57	0.16	11.71	6.85	1.1					
	P1067L	2.85	0.53	1.51	25.80	4.62	7.0					
	P1063R	0.92	0.50	0.46	23.32	4.89	2.2					
	P1069R	1.28	0.52	0.66	12.27	6.71	4.4					
								25.8	7.64	4.62	35.3	
P1082L	P1076L	1.06	0.51	0.54	16.92	2.89	1.6					
	P1077R	1.85	0.52	0.96	29.17	2.15	2.1					
	P1080R	1.59	0.52	0.83	19.76	2.67	2.2					
	P1082L	1.70	0.69	1.17	14.80	3.08	3.6					
								29.2	3.50	2.15	7.5	
P2022R	P2021L	7.83	0.52	4.07	103.10	1.87	7.6					
	P2022L	0.07	0.49	0.03	10.00	7.30	0.2					
	P2022R	3.00	0.56	1.67	48.98	3.12	5.2					
								103.1	5.77	1.87	10.8	
P2031R	P2030L	1.18	0.50	0.60	27.21	4.48	2.7					
	P2031R	2.36	0.55	1.29	19.50	5.38	7.0					
	P2032L	0.12	0.50	0.06	10.00	7.30	0.4					
								27.2	1.95	4.48	8.7	

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STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
100-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_{100}	CA (acres)	T_c (min)	I_{100} (in/hr)	Q (cfs)	T_c (min)	Effective CA_{100}	I_{100} (in/hr)	Q (cfs)	
P2059R	P2058L	0.53	0.49	0.26	25.54	4.65	1.2					
	P2049L	1.75	0.50	0.87	37.82	3.68	3.2					
	P2059R	9.82	0.57	5.61	48.04	3.16	17.7					
	P2062L	1.13	0.86	0.97	5.00	9.16	8.9					
								48.0	7.71	3.16	24.4	
P2064R	P2063R	0.23	0.68	0.16	5.51	8.92	1.4					
	P2064R	2.43	0.60	1.46	11.93	6.79	9.9					
	P2066R	2.26	0.60	1.36	16.96	5.78	7.9					
								17.0	2.99	5.78	17.3	
P2079L	P2075L	0.58	0.50	0.29	16.39	5.88	1.7					
	P2077L	0.37	0.56	0.21	10.32	7.21	1.5					
	P2079L	1.73	0.59	1.03	24.63	4.75	4.9					
								24.6	1.53	4.75	7.2	
P2085R	P2084L	0.80	0.51	0.41	16.69	5.82	2.4					
	P2085R	2.57	0.59	1.51	21.91	5.06	7.6					
								21.9	1.92	5.06	9.7	
P2085L	P2085L	2.32	0.56	1.30	34.85	3.87	5.0					
	P2092R	0.39	0.63	0.25	9.19	7.55	1.9					
	P2093R	1.69	0.55	0.92	25.05	4.70	4.3					
	P2098R	0.38	0.56	0.21	12.82	6.59	1.4					
	P2100R	3.11	0.55	1.71	29.70	4.26	7.3					
	P2100L	1.09	0.52	0.56	27.81	4.43	2.5					
								34.8	4.95	3.87	19.2	
P3049R	P3049L	1.47	0.64	0.94	19.12	5.44	5.1					
	P3049R	2.24	0.64	1.44	22.17	5.03	7.2					
								22.2	2.37	5.03	11.9	
P4028R	P4021R	0.35	0.82	0.28	6.78	8.38	2.4					
	P4023R	3.48	0.84	2.93	9.00	7.61	22.3					
	P4028L	0.63	0.74	0.47	15.04	6.12	2.9					
	P4028R	2.05	0.52	1.06	23.43	4.88	5.2					
								23.4	4.75	4.88	23.2	
P4044R	P4021R	0.35	0.82	0.28	6.78	8.38	2.4					
	P4023R	3.48	0.84	2.93	9.00	7.61	22.3					
	P4028L	0.63	0.74	0.47	15.04	6.12	2.9					
	P4028R	2.05	0.52	1.06	23.43	4.88	5.2					
	P4040L	1.46	0.49	0.72	35.25	3.85	2.8					
	P4044R	5.31	0.54	2.84	47.74	3.17	9.0					
								47.7	8.31	3.17	26.4	
P4054R	P4053L	1.86	0.49	0.92	38.02	3.67	3.4					
	P4054R	3.13	0.60	1.86	30.03	4.23	7.9					
								38.0	2.78	3.67	10.2	
P4065R	P4060L	1.21	0.49	0.60	47.70	3.18	1.9					
	P4065R	3.29	0.60	1.97	28.44	4.37	8.6					
								47.7	2.57	3.18	8.2	
P4076L	P4074R	2.84	0.61	1.73	34.03	3.93	6.8					
	P4076L	0.09	0.57	0.05	10.00	7.30	0.4					
								34.0	1.78	3.93	7.0	
P4081L	P4081R	1.63	0.62	1.02	27.86	4.42	4.5					
	P4081L	1.32	0.54	0.72	21.36	5.13	3.7					
								27.9	1.73	4.42	7.7	
P4087L	P4086R	1.61	0.61	0.98	22.53	4.98	4.9					
	P4087L	1.38	0.56	0.77	16.10	5.93	4.5					
								22.5	1.75	4.98	8.7	
P4091L	P4091R	1.01	0.58	0.59	16.15	5.92	3.5					
	P4091L	1.39	0.69	0.97	16.22	5.90	5.7					
								16.2	1.56	5.90	9.2	

CO 119 Bikeway
Proposed Hydrology Calculations - Rational Method
Muller Engineering Company, Inc.
Muller Project Number: 21015

Originator ZDS/TPS
Date: 6/24/2022
Checker: EGS
Date: 6/28/2022

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)
100-YEAR STORM EVENT

DESIGN POINT	DIRECT RUNOFF FROM BASIN							TOTAL RUNOFF				DESCRIPTION
	BASIN ID	AREA (acres)	C_{100}	CA (acres)	T_c (min)	I_{100} (in/hr)	Q (cfs)	T_c (min)	Effective CA_{100}	I_{100} (in/hr)	Q (cfs)	
P4095R	P4093L	0.46	0.69	0.32	10.18	7.25	2.3					
	P4095R	0.45	0.67	0.31	14.95	6.14	1.9					
								14.9	0.62	6.14	3.8	
P4114L	P4108R	3.91	0.60	2.32	39.46	3.59	8.3					
	P4114L	3.63	0.53	1.92	46.02	3.25	6.2					
								46.0	4.24	3.25	13.8	
P5001L	P4117R	2.27	0.64	1.45	33.33	3.98	5.8					
	P5001L	2.27	0.53	1.21	29.81	4.25	5.1					
								33.3	2.66	3.98	10.6	
P5006R	P5006R	1.44	0.61	0.88	15.75	5.99	5.3					
	P5007R	0.10	0.68	0.07	5.16	9.08	0.6					
								15.7	0.95	5.99	5.7	
P5011L	P5011R	2.28	0.55	1.25	26.28	4.57	5.7					
	P5011L	5.52	0.57	3.15	43.04	3.39	10.7					
								43.0	4.41	3.39	15.0	
P5023R	P5023L	1.17	0.45	0.52	38.80	3.62	1.9					
	P5023R	5.73	0.39	2.22	56.15	2.85	6.3					
								56.2	2.74	2.85	7.8	
P5033R	P5030L	3.02	0.16	0.50	33.83	3.94	2.0					
	P5033R	4.16	0.27	1.14	19.29	5.41	6.2					
								33.8	1.64	3.94	6.5	
P5041R	P5040L	0.89	0.14	0.12	25.07	4.70	0.6					
	P5041R	0.93	0.42	0.39	17.44	5.70	2.2					
								25.1	0.52	4.70	2.4	
P5048R	P5048L	1.12	0.13	0.14	38.83	3.62	0.5					
	P5048R	2.60	0.45	1.16	21.56	5.10	5.9					
								38.8	1.30	3.62	4.7	
P5068R	P5052L	1.99	0.60	1.20	23.66	4.85	5.8					
	P5066L	8.08	0.52	4.17	48.38	3.15	13.1					
	P5068R	15.75	0.46	7.31	20.46	5.25	38.4					
	P5084R	1.44	0.90	1.29	10.47	7.17	9.2					
	P5084L	5.20	0.52	2.71	38.19	3.66	9.9					
	P5084R	1.44	0.90	1.29	10.47	7.17	9.2					
								48.4	17.97	3.15	56.6	

Notes:

1 $I = \frac{28.5 * P1}{(10 * T_d)^{0.786}}$ USDCM Equation 5-1, (March 2017) where P Values come from NOAA Atlas 2, Volume 8, Version 2 and Td = Tc USDCM Chapter 6 Section 2.5 (August 2018)

2 $Q_{tot} = I_{min}\left[\sum_{i=0}^{n}(CA)_i\right]$ Where: I_{min} = Minimum Intensity and CA = Effective CA

APPENDIX C

Hydraulics

Proposed Hydraulics Calculations

CALCULATION COVER SHEET

Project Name:	CO 119 Bikeway	Project No.	21015 (Muller)
Design Calculation:	Proposed Hydraulics	Version:	1
Originator	ZDS	Date:	June 23, 2022
Checker	EGS	Date:	June 24, 2022

Purpose:

Determine if proposed ditches, inlets, and pipes have sufficient capacity and meet criteria for the CO 119 Bikeway project.

References:

Criteria Manuals Used:

Colorado Department of Transportation (CDOT) *Drainage Design Manual,* 2019
Boulder County *Multimodal Transportation Standards (MTS)*, 2012
Boulder County *Storm Drainage Criteria Manual (SDCM)*, 2016

Referenced Data Sources:
Proposed OpenRoads Designer Model, Otak Inc.
Proposed OpenRoads Designer Model, Muller Engineering Company
Boulder County, *LiDAR*, Accessed January 2022
Colorado Department of Transportation*, Drainage Design Manual,* 2019

Software Used:
Bentley FlowMaster V8i (SELECTseries 1), *Bentley Systems Inc.*, November 2009
Bentely OpenRoads Designer CE 2021, *Bentley Systems Inc*.
MHFD v5.01, Mile High Flood District. April 2021

Refer to the drainage report for the appendices referenced below:

Appendix A
Hydrologic and Hydraulic Criteria Table
Proposed Basin Maps

Appendix B
Proposed Hydrology Calculation Packet

Criteria:

The ditches for the proposed project have been designed to meet CDOT and Boulder County Criteria. For this project, the 5-year event was used as the design storm for pipes and inlets, the 10-year event was used as the design storm for ditches, and the 100-year event was the major storm. Refer to the Hydrologic and Hydraulic Criteria Tables in Appendix A of the Drainage Report for the complete criteria list.

Background and Rationale:

- Ditches
  - Preliminary stage ditch sizing calculations presented in this calculation packet estimate the required depth of proposed ditches. These calculations use one set of average or representative parameters (longitudinal slope, Manning's roughness coefficient, and ditch geometry) which have been applied to estimate the required depth of all proposed ditches.
    - The longitudinal slope used is 0.01
    - The Manning's roughness coefficient used is 0.035
      - Represents a grass-lined ditch
    - The ditch geometry used is a V-ditch with 3:1 (H:V) side slopes
      - Taken from the proposed bikeway typical section
    - The peak flowrates of basins computed in the *Proposed Hydrology Calculation Packet* were compared to the FlowMaster outputs computed above to estimate the appropriate ditch depth. The average 10-year peak flowrate within a basin is 1.7 cfs. The average 100-year peak basin flowrate is 6.5 cfs.
  - Final stage ditch size calculations will include detailed freeboard, Froude Number, velocity, and capacity calculations on an individual basis for all proposed and existing ditches.
- Inlets
  - Two categories of proposed inlets were analyzed: Type C inlets at upstream end of bikeway crossing pipes and Type 13 inlets located at bikeway underpasses.
    1. Type C inlets at upstream end of bikeway crossing pipes
       a. The capacity of Type C inlets placed at the upstream end of pipes crossing the bikeway were analyzed using nomograph data. Please refer to the attachments for detailed information.
          i. A 1' ponding depth was assumed. Constructing a 1' ponding area appears to be feasible with the bikeway design.
       b. The capacity result was compared to 5-year and 100-year peak flowrate for basins with a Type C inlet at the outlet of the basin to determine if a Type C inlet has sufficient capacity to intercept flow.
       c. Three representative locations were used in the analysis (please refer to the Proposed Hydrology Calculation Packet for more information on basin flowrates):
          i. P1063R, P2049L, P4117R.
             1. Avg. 5-year basin flowrate = 0.5 cfs
             2. Max. 5-year basin flowrate = 1.0 cfs
             3. Avg. 100-year basin flowrate = 3.0 cfs
             4. Max 100-year basin flowrate = 3.7 cfs
    2. Type 13 inlets at bikeway underpasses
       a. Type 13 valley grate inlets are placed at underpasses where the proposed bikeway transects an existing road. Two Type 13 inlets are located in a sump at the lowest point of the underpass and two Type 13 inlets are located on-grade.

b. The inlets at the 63rd St underpass (I2063L, I2063R, I2065L, and I2065R) were analyzed. The 63rd St underpass is relatively representative of all underpasses.
    a. Inlets I2063L and I2063R are in sump condition.
    b. Inlets I2065L and I2065R are on grade.
    c. The 5-year and 100-year flowrates from basin P2066R were assigned to each inlet as appropriate. Please refer to the *Proposed Hydrology Calculation Packet* for more information.
c. The allowable spread width for the minor storm was assigned as the shoulder.
d. The allowable spread width for the major storm was assigned as the shoulder plus bikeway lane.
    i. Per the underpass typical section, there is a 2 ft shoulder and a 12 ft bikeway path.
e. The capacity result was compared to 5-year and 100-year peak flowrate for basins with a Type 13 inlet at the outlet of the basin to determine if a Type 13 inlet has sufficient capacity to intercept flow.

- Pipes
    - Two categories of proposed pipes were analyzed: 1) Pipe networks at bikeway underpasses 2) Single crossing pipes under bikeway.
        1. Pipe networks at bikeway underpasses
            a. Proposed 15" plastic pipes will convey flow from inlets at the bikeway underpasses to a proposed pump station which will return flow to the ground surface.
            b. A complete design and analysis of proposed pump stations will be completed with final design.
            c. At the preliminary stage, the 15" plastic pipes which drain by gravity were analyzed. Pump characteristics are preliminary.
            d. OpenRoads Designer Drainage and Utilities functions were used to analyze proposed pipe networks.
                i. The system at the proposed 63rd Street was analyzed. This underpass is representative of all other underpass locations in terms of receiving flowrate and pipe network design.
                ii. The StormCAD unlimited license was used for computations.
                iii. 5-year and 100-year flowrates to the system were taken from *Proposed Hydrology Calculation Packet* from Basins P2063R and P2066R. Flowrates were applied to inlets I2063L, I2063R, I2065L, and I2065R. Capture efficiency of inlets was ignored as a conservative estimate for pipe calculations. Please refer to the attachments for a schematic showing the layout of the system.
        2. Single crossing pipes under bikeway.
            a. The standard method of conveying flow across the proposed bikeway at a low-point or existing ditch crossing is via an 18" RCP.

b. Bentley FlowMaster was used to evaluate the capacity of an 18" RCP.
c. The capacity result was compared to the 5-year and 100-year peak flowrates of eight representative basins with an 18" RCP at the basin outlet to determine if an 18" RCP is sufficient.
d. The following parameters were used for the Bentley FlowMaster calculation:
    i. Manning's n = 0.013
    ii. Pipe Slope = 1%
e. The following basins were used in the analysis (please refer to the *Proposed Hydrology Calculation Packet* for more information on basin flowrates):
    i. P1043R, P1053L, P2049L, P4040L, P4060L, P4093L, P4108R.
        1. Avg. 5-year basin flowrate = 1.1 cfs
        2. Max. 5-year basin flowrate = 3.5 cfs
        3. Avg. 100-year basin flowrate = 4.6 cfs
        4. Max 100-year basin flowrate = 8.4 cfs

Results:

Ditches

The resulting FlowMaster outputs are:

- A 6" ditch has capacity for 1.2 cfs
- A 12" ditch has capacity for 7.8 cfs
- A 18" ditch has capacity for 22.8 cfs

Please refer to the attachments for detailed FlowMaster calculation reports.

Therefore, a 6" ditch is generally sufficient for conveying the 10-year event for a wide range of basins. A 12" ditch is sufficient for conveying the 10-year and 100-year events for the majority of basins.

Inlets

Type C inlets:

The capacity of a Type C inlet with 1' of ponding depth is 12.5 cfs per the CDOT nomograph. Therefore, a Type C inlet is generally sufficient for capturing the design flowrate.

Type 13 inlets:

MHFD Inlet results show a Type 13 inlet does not have sufficient capture capacity as currently designed. Underpass inlet design will be reevaluated with the final design. Final design will likely include double Type 13 inlets (instead of singles) and trench drains which are not represented in these calculations. Please refer to Table 2 below for results summary.

Table 2. Inlet Results Summary

Inlet ID	Inlet Type	Minor Storm: 5-year					Major Storm: 100-year				
		Design Flow (cfs)	Capture %	Bypass Flow (cfs)	Captured Flow (cfs)	Spread or Depth Criteria Violated?	Design Flow (cfs)	Capture %	Bypass Flow (cfs)	Captured Flow (cfs)	Spread or Depth Criteria Violated?
I2063L and I2063R	Type 13 Valley	1.0	N/A		1.0	Yes, spread = 5.5 ft	4.0	N/A		4.0	No
I2065L and I2065R	Type 13 Valley	1.0	66%	0.3	0.7	Yes	4.0	49%	2.1	1.9	No

Pipes

Underpass storm network:

The 5-year HGL is contained within the system upstream of the pump. The 100-year HGL is not contained within pipe S2065L upstream of the pump. Please refer to the attachments for a profile view of the 5-year and 100-year HGL. The profile view extends from I2065L to the Flared End-Section at the ground surface. Table 3 shows velocity and flow depth results for the 5-year event. Table 4 shows velocity and flow depth results for the 100-year event.

Table 3. 5-Year Underpass Storm Network Results

Label	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
Pr. S2065L 15"	1.0	7.2	5,140.43	5,139.19	0.39	0.76
Pr. S2063L 15"	0.25	2.87	5,139.28	5,139.27	0.19	0.57
Pr. S2063R 15"	0.5	1.23	5,139.26	5,139.19	0.57	0.76
Pr. S2065R 15"	2.5	10.1	5,139.07	5,137.35	0.63	0.34

Table 4. 100-Year Underpass Storm Network Results

Label	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
Pr. S2065L 15"	4	10.74	5,140.85	5,140.08	0.81	1.65
Pr. S2063L 15"	0.7	3.89	5,140.27	5,140.26	1.18	1.57
Pr. S2063R 15"	1.4	1.14	5,140.25	5,140.08	1.56	1.65
Pr. S2065R 15"	9.4	13.78	5,139.60	5,137.80	1.17	0.79

Standard bikeway crossing pipes:

The capacity of an 18" RCP is 10.5 cfs. Please refer to the attachments for a detailed FlowMaster calculation report.

The capacity of 10.5 cfs indicates that an 18" RCP is sufficient for conveying the 5-year and 100-year design flowrates.

Materials Included in this Calculation Packet:

1. Ditches - FlowMaster Ditch Results
2. Inlets - CDOT Nomagraph
3. Inlets - MHFD Inlet Results
4. Pipes – Underpass storm network layout schematic
5. Pipes – OpenRoads Designer HGL Profiles
6. Pipes – FlowMaster 18" RCP Results

FlowMaster Ditch Results

Worksheet for 6 in. V Ditch Check

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Normal Depth	0.50	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)

Results

Discharge	1.22	ft³/s
Flow Area	0.75	ft²
Wetted Perimeter	3.16	ft
Hydraulic Radius	0.24	ft
Top Width	3.00	ft
Critical Depth	0.40	ft
Critical Slope	0.03274	ft/ft
Velocity	1.63	ft/s
Velocity Head	0.04	ft
Specific Energy	0.54	ft
Froude Number	0.57	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.40	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.03274	ft/ft

Worksheet for 12 in. V Ditch Check

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Normal Depth	1.00	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)

Results

Discharge	7.75	ft³/s
Flow Area	3.00	ft²
Wetted Perimeter	6.32	ft
Hydraulic Radius	0.47	ft
Top Width	6.00	ft
Critical Depth	0.84	ft
Critical Slope	0.02559	ft/ft
Velocity	2.58	ft/s
Velocity Head	0.10	ft
Specific Energy	1.10	ft
Froude Number	0.64	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.84	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.02559	ft/ft

Worksheet for 18 in. V Ditch Check

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Normal Depth	1.50	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)

Results

Discharge	22.84	ft³/s
Flow Area	6.75	ft²
Wetted Perimeter	9.49	ft
Hydraulic Radius	0.71	ft
Top Width	9.00	ft
Critical Depth	1.29	ft
Critical Slope	0.02215	ft/ft
Velocity	3.38	ft/s
Velocity Head	0.18	ft
Specific Energy	1.68	ft
Froude Number	0.69	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

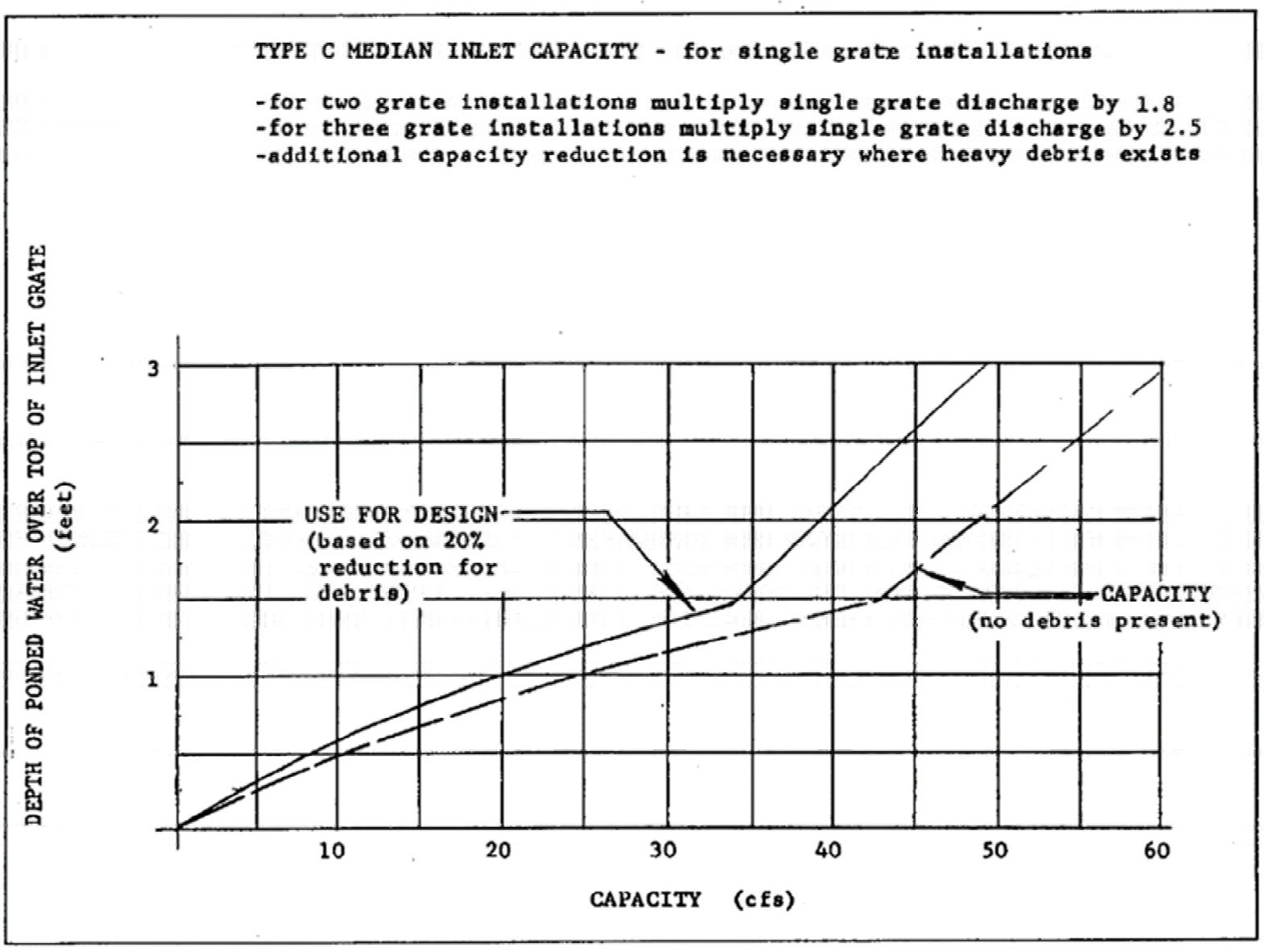
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.29	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.02215	ft/ft

CDOT Nomograph

SH 119 Bikeway			
Type C/D Area Inlet Capacity Calculations		**By:**	**ZDS**
Muller Engineering Company, Inc.		**Date:**	**6/23/2022**
CDOT Project Number:	**None**	**CHECKED BY:**	
Muller Project Number:		**DATE:**	

CDOT Drainage Design Manual (2019) Chapter 13 Appendix A: Design Nomograph 13-16 for Type C/D Area Inlet Capacities



Inlet Type:	Type C
Depth of Ponding:	1.00 ft
Inlet Capacity (no clogging)[1]:	25 cfs
Inlet Multiplication Factor:	1
Clogging Reduction Factor[2]:	0.5
Inlet Design Capacity:	**12.5 cfs**

Notes:
1. Clogging from debris taken into consideration with the clogging reduction factor; therefore, the capacity with no debris present is used.
2. Inlet clogging factor taken from the Urban Drainage and Flood Control District "Hydraulic Capacity of CDOT Type C and D Area Inlets" Report Revised March 5, 2012.

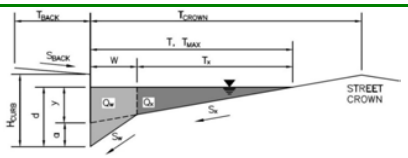
MHFD Inlet

MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SH 119 Bikeway
Inlet ID: I2063R-I2063L



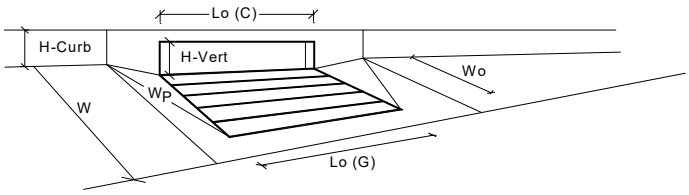
Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	12.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.015	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.167	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	2.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



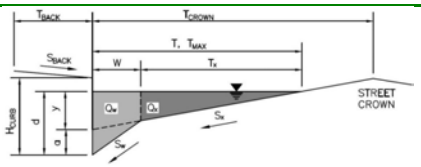
Design Information (Input)	CDOT/Denver 13 Valley Grate	MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.0	6.2	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.7**	**2.3**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor and Major Storms	$Q_{PEAK\ REQUIRED}$ =	1.0	4.0	cfs

MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: SH 119 Bikeway
Inlet ID: I2065L-I2065R



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	12.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.015	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.167	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

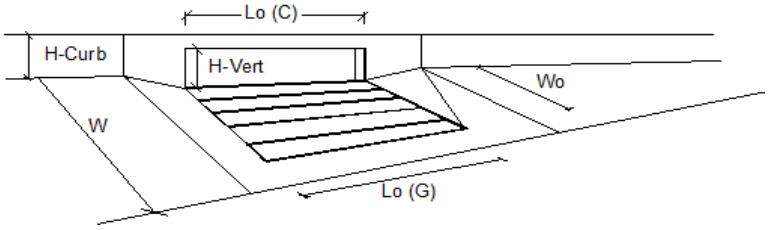
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	2.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**2.0**	**10.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

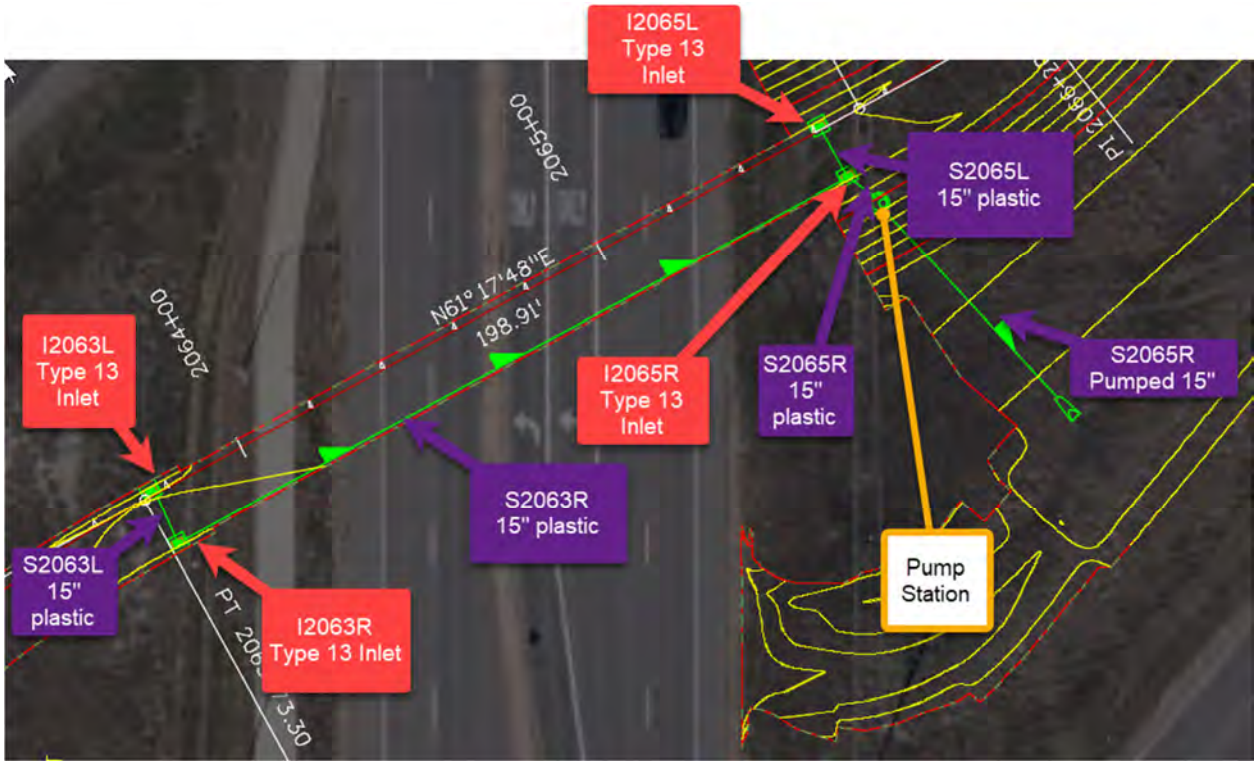


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT/Denver 13 Valley Grate)	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	

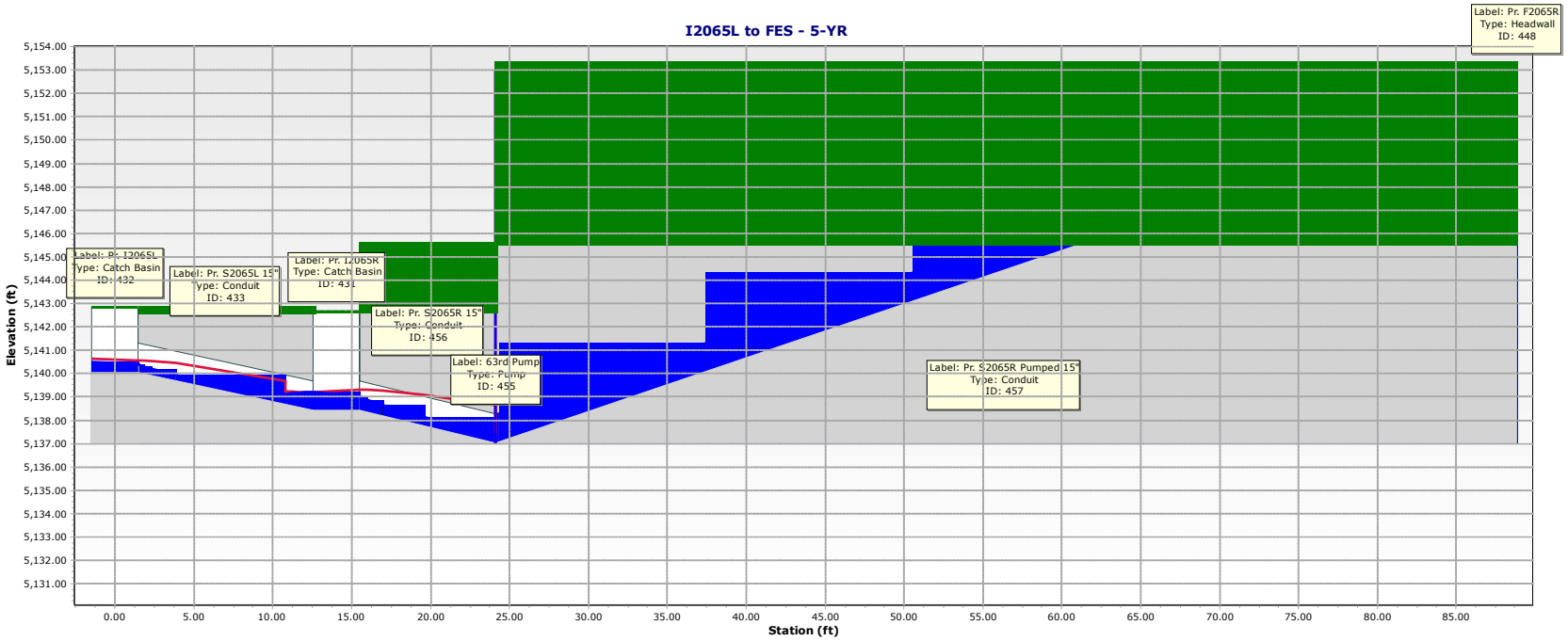
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.0	4.0	cfs
Water Spread Width	T =	1.6	7.5	ft
Water Depth at Flowline (outside of local depression)	d =	3.2	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.010	0.870	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.5	cfs
Discharge within the Gutter Section W	Q_w =	1.0	3.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.19	0.50	sq ft
Velocity within the Gutter Section W	V_W =	5.3	7.0	fps
Water Depth for Design Condition	d_{LOCAL} =	5.2	7.0	inches

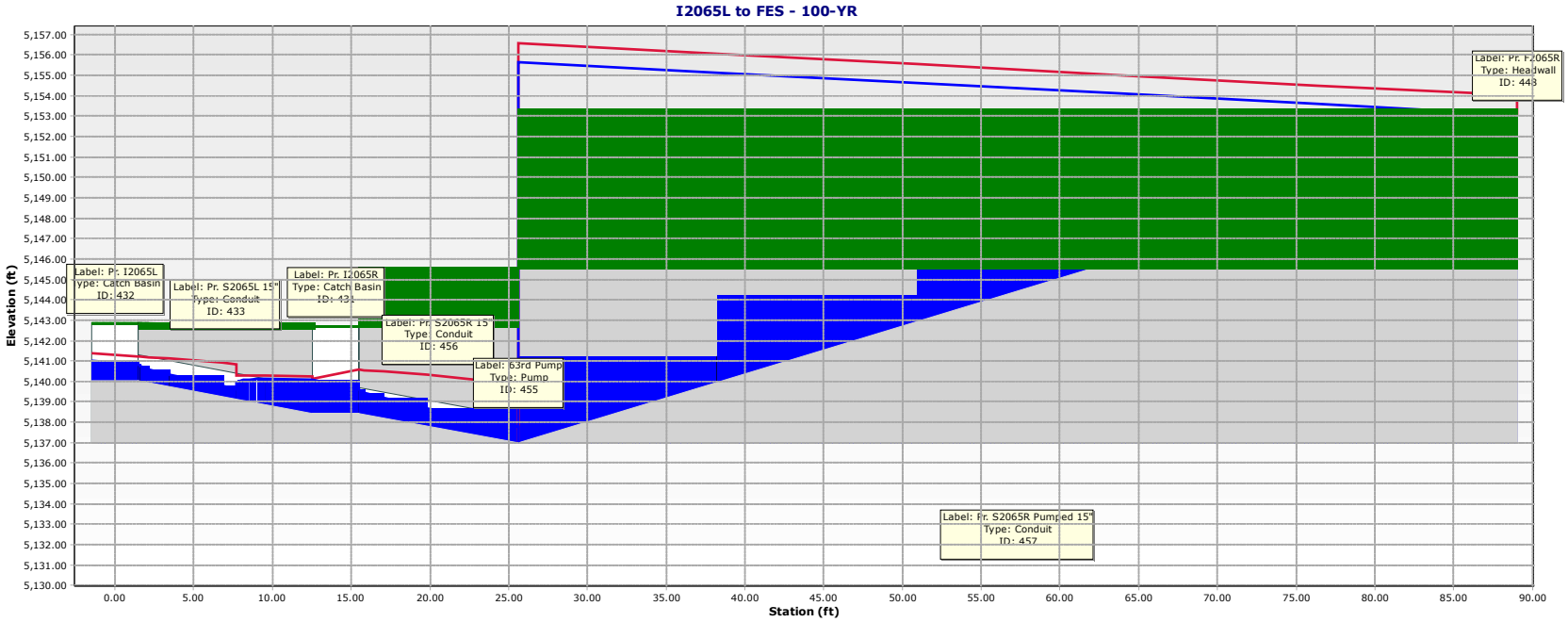
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**2.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**66**	**49**	**%**

Underpass Storm Network Graphic


I2065L
Type 13
Inlet
S2065L
15" plastic
S2065R
Pumped 15"
S2065R
15"
plastic
I2065R
Type 13
Inlet
I2063L
Type 13
Inlet
S2063R
15" plastic
S2063L
15"
plastic
I2063R
Type 13 Inlet
Pump
Station
2065+00
2064+00
N61° 17'48"E
198.91'

OpenRoads Designer Drainage and Utilities HGL Profiles


I2065L to FES - 5-YR
Label: Pr. F2065R
Type: Headwall
ID: 448
Label: Pr. I2065L
Type: Catch Basin
ID: 432
Label: Pr. S2065L 15"
Type: Conduit
ID: 433
Label: Pr. I2065R
Type: Catch Basin
ID: 431
Label: Pr. S2065R 15"
Type: Conduit
ID: 456
Label: 63rd Pump
Type: Pump
ID: 455
Label: Pr. S2065R Pumped 15"
Type: Conduit
ID: 457
Elevation (ft)
5,154.00
5,153.00
5,152.00
5,151.00
5,150.00
5,149.00
5,148.00
5,147.00
5,146.00
5,145.00
5,144.00
5,143.00
5,142.00
5,141.00
5,140.00
5,139.00
5,138.00
5,137.00
5,136.00
5,135.00
5,134.00
5,133.00
5,132.00
5,131.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
70.00
75.00
80.00
85.00
Station (ft)


I2065L to FES - 100-YR
Elevation (ft)
Station (ft)
5,157.00
5,156.00
5,155.00
5,154.00
5,153.00
5,152.00
5,151.00
5,150.00
5,149.00
5,148.00
5,147.00
5,146.00
5,145.00
5,144.00
5,143.00
5,142.00
5,141.00
5,140.00
5,139.00
5,138.00
5,137.00
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5,135.00
5,134.00
5,133.00
5,132.00
5,131.00
5,130.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
70.00
75.00
80.00
85.00
90.00
Label: Pr. I2065L
Type: Catch Basin
ID: 432
Label: Pr. S2065L 15"
Type: Conduit
ID: 433
Label: Pr. I2065R
Type: Catch Basin
ID: 434
Label: Pr. S2065R 15"
Type: Conduit
ID: 456
Label: 63rd Pump
Type: Pump
ID: 455
Label: Pr. S2065R Pumped 15"
Type: Conduit
ID: 457
Label: Pr. I2065R
Type: Headwall
ID: 443

FlowMaster 18” RCP Result

Worksheet for 18" RCP

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft

Results

Discharge	10.50	ft³/s
Flow Area	1.77	ft²
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	1.25	ft
Percent Full	100.0	%
Critical Slope	0.00977	ft/ft
Velocity	5.94	ft/s
Velocity Head	0.55	ft
Specific Energy	2.05	ft
Froude Number	0.00	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.01000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 18" RCP

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.25	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00977	ft/ft

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 •
Tel: 303-441-3930 • www.BoulderCounty.gov

March 7, 2023

TO: Pete L'Orange, Planner II; Community Planning & Permitting, Development Review Team - Zoning

FROM: Anita Riley, Principal Planner; Community Planning & Permitting, Development Review Team – Access & Engineering

SUBJECT: Docket # SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects Addendum

The Development Review Team – Access & Engineering staff has the following additional comments regarding the above referenced docket:

1. A closer review of the traffic analysis, dated December 10, 2021, provided quantitative information that met the objectives of transportation system impact analyses as identified in Section 4.2 of the Boulder County Multimodal Transportation Standards (Standards). Specifically, the analysis addressed the following issues:

    a. The analysis identified the intersection of SH 119/SH 52 as a bottleneck in the corridor. An alternatives analysis concluded that a split intersection would significantly improve delay at the intersection.
    b. The analysis compared 2045 travel times for baseline/no-build conditions to 5 different alternatives (transit slip lanes, 3 general purpose lanes, added toll express lanes (TEL), converting existing lanes/shoulder to toll express lanes, and grade separated tolled express laned.
    c. The 3 general purpose lanes and TEL lane conversion alternatives had negative impacts to travel times for general traffic. The analysis suggests that there could be impacts from induced demand for these options driven by trips diverted from other corridors (e.g. US 36, 63rd Street, etc.). The other alternatives improved travel times.
    d. Transit travel times were improved in all scenarios.
    e. A review of the tables provided in Appendices Q through Z suggest Peak Hour level of service (LOS) for traffic on intersecting county roads appears to be the same, or worse, for all alternatives.
    f. Alternatives which added capacity increased vehicle and person throughput even for those that experienced worse travel times.
    g. Impacts to other modes/safety were assessed qualitatively. The separated path is anticipated to positively impact bicycle exposure but may have slightly negative impacts to pedestrian exposure. This assessment focused primarily on safety.
    h. Separate safety recommendations at the signalized intersections were provided. There were no documented crashes involving a train in the study period and no freight crash pattern was identified.

2. The applicants must install Level 2 or Level 3 electric vehicle charging stations at the park-n-ride facilities located at N. 63rd Street and Niwot Road. The number of stations required is dependent on whether Level 2 or Level 3 charging stations are installed.

    At building permit, the applicant must provide plans that include type, number, and location of electric vehicle charging stations that comply with Section 4-513.D.4.d. of the Boulder County Land Use Code.

3. The park-n-ride facilities must include landscaped areas interior to each lot of at least 5%.

This concludes our comments at this time.

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January 17, 2023

To: Pete L'Orange, Staff Planner
From: Kelly Watson, Principal Floodplain Planner

Subject: Docket SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects
Request: Areas and Activities of State Interest (1041) review for combined projects along Colorado Highway 119 (CO 119) related to safety and mobility improvements and construction of a bikeway from approximately 47th Street/Foothills Parkway in the City of Boulder to milepost 54.2 in the City of Longmont.
Location: Colorado Highway 119 (CO 119) from approximately 47th Street/Foothills Parkway, Boulder, to milepost 54.2, Longmont, in Sections 2, 3, 9, 10, 11, 15, and 16 of T1N, R70W; Sections 25, 35, and 36 of T2N, R70W; and Sections 17, 19, 20, and 30 of T2N, R69W.

The Community Planning & Permitting Department – Floodplain Management Program has reviewed the above referenced docket and has the following comments:

1. Portions of the project intersect the Floodplain Overlay (FO) District at Fourmile Canyon Creek, Dry Creek No. 2, and Lefthand Creek. In accordance with Article 4-400 of the Boulder County Land Use Code, Floodplain Development Permits (FDPs) are required for this project. Separate FDPs will be required for each of the three floodplains in the project area.

2. Each FDP will require one of the following, which must be supported by a hydraulic model and report certified by a Colorado licensed Professional Engineer (P.E) in accordance with Article 4-404.2.E of the Boulder County Land Use Code:
   a. A letter certified by a Colorado Registered Professional Engineer stating that the project will not cause any rise in regulatory 100-year water surface elevations;
   b. An approved Conditional Letter of Map Revision (CLOMR) from FEMA; or
   c. An approved Boulder County Floodway Review.

3. At the time of Building/Grading Permit application submittal, the applicant must submit a Floodplain Development Permit (FDP) application with the Building Permit application. The FDP application must contain the following:
   a. A signed FDP application form;
   b. A site plan showing the proposed development and all staging/storage areas in relation to regulatory floodplain and property boundaries;
   c. Construction design stamped, signed, and dated by a Colorado-licensed Professional Engineer (P.E.); and
   d. A hydraulic model and report demonstrating floodplain impacts, as described above.

4. Construction staging and/or stockpiling areas must be reviewed and approved by the Community Planning & Permitting Department – Floodplain Management Program. All staging and stockpiling areas must avoid the regulatory floodplain unless it is demonstrated that doing so is unavoidable. Construction staging and/or stockpiling in the regulatory floodway will not be permitted without an alternatives evaluation and an emergency evacuation plan approved by the Community Planning & Permitting Department – Floodplain Management Program.

5. The proposed development around Lefthand Creek is within a known fluvial hazard zone, which is the area a stream has occupied in recent history, could occupy, or could physically influence as it stores and transports water, sediment and debris. Parts of the project that are outside the regulatory FO District are still within the fluvial hazard zone and may be subject to excessive erosion, sedimentation, and/or wholesale changes in the location of the stream channel. The Floodplain Management Program strongly encourages the applicant to consider flood protection measures above and beyond the minimum requirements of the Land Use Code. Such measures may include additional scour protection or capacity for hydraulic structures.

Please contact Kelly Watson, Principal Floodplain Planner, at 720-564-2652 or kwatson@bouldercounty.org to discuss this referral.

This concludes our comments at this time.

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.bouldercounty.org**

MEMO TO: Agencies and adjacent property owners
FROM: Pete L'Orange, Staff Planner
DATE: January 12, 2023
RE: **Docket SI-22-0002**

Docket SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

Request:	Areas and Activities of State Interest (1041) review for combined projects along Colorado Highway 119 (CO 119) related to safety and mobility improvements and construction of a bikeway from approximately 47th Street/Foothills Parkway in the City of Boulder to milepost 54.2 in the City of Longmont.
Location:	Colorado Highway 119 (CO 119) from approximately 47th Street/Foothills Parkway, Boulder, to milepost 54.2, Longmont, in Sections 2, 3, 9, 10, 11, 15, and 16 of T1N, R70W; Sections 25, 35, and 36 of T2N, R70W; and Sections 17, 19, 20, and 30 of T2N, R69W.
Zoning:	Agricultural, Rural Residential, Commercial, Light Industrial, Niwot Rural Community Districts I and II
Applicants:	Colorado Department of Transportation c/o Adnana Murtic and Boulder County Community Planning & Permitting c/o Stacy Proctor, and Regional Transportation District c/o Ali Imansepahi

This process includes public hearings before the Board of County Commissioners and may include a public hearing before the Boulder County Planning Commission. Adjacent property owners and holders of liens, mortgages, easements or other rights in the subject property are notified of these hearings.

The Community Planning & Permitting staff, Planning Commission, and County Commissioners value comments from individuals and referral agencies. Please check the appropriate response below or send a letter to the Community Planning & Permitting Department at P.O. Box 471, Boulder, Colorado 80306 or via email to **plorange@bouldercounty.org.** All comments will be made part of the public record and given to the applicant.

You may view or download the application materials at **www.boco.org/docket-si-22-0002.**

You are welcome to call the Community Planning & Permitting Department at 303-441-3930 to request more information. If you have any questions regarding this application, please contact the Community Planning & Permitting office at **303-441-1418** or via email at **plorange@bouldercounty.org**.

As required per article 8-508(C)1.a, referral responses must be returned within 14 days or **January 26, 2023**.
*As noted in section 8-508(C)1.b, an extension may be expressly granted by the Director.

_____ We have reviewed the proposal and have no conflicts.
_____ Letter is enclosed.
Signed _____ PRINTED Name Jessica Fasick
Agency or Address CP&P Historic Review
Date 1/19/23

**Coordination with Boulder County historic preservation staff will be completed prior to construction and may require review by the Historic Preservation Advisory Board.

Parks & Open Space
5201 St. Vrain Road • Longmont, CO 80503
303-678-6200 • POSinfo@bouldercounty.org
www.BoulderCountyOpenSpace.org

TO: Pete L'Orange, Community Planning & Permitting Department
FROM: Ron West, Natural Resource Planner
DATE: February 20, 2023
SUBJECT: Docket SI-22-0002, CO 119 Safety and Bikeway Project

Site Conditions

The existing conditions of the corridor are well-described in the application and will not be repeated here. In summary, nearly all of the project components are within the state highway right-of-way, and most are in the wide median between the north and southbound lanes. The project spans the length of the Diagonal Highway, between incorporated Boulder and Longmont. Although the highway passes through the relatively large incorporated area of Gunbarrel, the corridor is not annexed into the City of Boulder through this passage.

County Comprehensive Plan Designations

The parcels have the following designations in the Boulder County Comprehensive Plan, or from other resource inventories:

- Significant Agricultural Lands of National or State Importance – almost all of route, except for Gunbarrel area
- Proximate to Bald Eagle Nest
- Prairie Dog Habitat
- Possible *Spiranthes diluvialis* habitat -- Ute Ladies' Tresses
- Wetlands – scattered along the corridor
- Riparian Areas – scattered along the corridor
- Riparian Habitat Connector – on Lefthand Creek
- Significant Natural Community – localized, near Jay Road; on OSMP lands
- View Protection Corridor – associated with the state highway
- Adjacent to Critical Wildlife Habitat – on Lefthand Creek
- Adjacent to Public Lands – numerous county and city open space properties

Discussion

From a natural resource perspective, this is one of the most well-written 1041 applications that staff has reviewed. It closely follows the requirements of Article 8 of the Land Use Code. Overall, staff does not foresee significant natural resource impacts from the rather extensive project. However, there are numerous questions and clarifications that need to be addressed, organized below by page number of the application text.

3.2 Environmental Impact Analysis

Page 22, 3.2.1.2 Detail the Agricultural Productivity Capability of the Land Affected by the Proposal

Staff disagrees with the conclusion that the project, "…will not impact any agricultural land." However, this might be more of an issue of interpretation than anything else. This paragraph continues… "While there is significant agricultural land of national [and] statewide…importance adjacent to portions of the CO 119 corridor, there is no agricultural productivity capability with the Project limits (Figure 5)."

Yet Figure 5 correctly shows that the Comprehensive Plan designates most of the median itself as agricultural land of either national or statewide importance. With the exception of the City's Gunbarrel area, nearly all of the corridor's median is so-designated.

The Comprehensive Plan classifies agricultural lands primarily by the quality/productivity of their soils. Lands of national and statewide importance all have the "best" or most productive soils in the county. Indeed, nationally significant lands are the same as the federal designation of "prime farmland." The difference between the two – national and statewide – is the ability or potential to get irrigation water to the areas.

While it is true that there currently isn't agricultural production in any of the CDOT median, it is theoretically possible to do so. Staff could even argue that these lands might be particularly useful as micro-farms, or "agrivoltaic" farms in the not-so-distant future. CDOT may not have presently entertained this idea, but the possibility is real. Many small-plot producers are looking for agricultural land with good soils, and it seems that the median is a "viable" location for agriculture.

As an example, some of the fields at the produce farm at Oxford and CO 119 are immediately adjacent to the state ROW, while their irrigation pond is 20 feet from the ROW fenceline. Unutilized Prime Farmland soils are hard to find, and perhaps a trial "Diagonal Median Farm" could be considered by the state.

Regardless, staff's point is that these state and nationally important soils *are* designated in the Comprehensive Plan, and the question for the 1041 review is if the project would significantly impact them. Staff's opinion is that they would be impacted, but the "significance" of this impact would be relative and minor.

The grading area for the bikeway would be comparatively small compared to the width of the median. As an example, at Oxford Road, the median is about 165 feet in width, while the bikeway would be 16 feet (with vegetated shoulders), or about 10 percent of the width.

Between Oxford and Niwot roads, the median's acreage is about 38 acres in total, while the bikeway would require about 2.5 acres of this. Given that the state ROW's purpose is specifically for transportation, and *not* farming, this loss of "potential" agricultural lands is probably both appropriate and relatively small.

Page 25, 3.2.2.3 – "The preliminary design proposed two full spectrum detention ponds to

address concentrated runoff impacts from the two new park-n-ride facilities." Where would these be located (they are not shown on the (30%) drawings), and how much area/acreage would be required?

Page 27 – Referenced here is Section 212 of *CDOT Standard Specifications for Road and Bridge Construction*, Seeding, Fertilizer, Soil Conditioner, and Sodding. Staff notes that fertilizer, soil conditioners, and sodding will likely not be part of the Revegetation Plan. This should be further discussed.

Page 30, 3.2.2.5, Wetland and Riparian Areas – Staff notes that the state noxious weeds Canada thistle, Fuller's teasel, and Russian-olive are listed as "common" Finding other noxious weed species in the project area is very likely. According to the county's Noxious Weed Management Plan, Canada thistle and teasel must be contained and suppressed. In general, weed management is not fully addressed in the application. Staff does note, however, that a full Integrated Noxious Weed Management Plan will be completed (see p. 37). This should be reviewed.

The details of weed management – pre-construction, during, and post-construction – need to be submitted. Specific weed species to be targeted, and the proposed control techniques for each, must be stated. Staff particularly notes a large population of teasel in the ROW near Sixmile Reservoir. Additionally, it is strongly recommended that all Russian-olive trees – also a state-listed noxious weed -- be cut down and the stumps immediately treated with a systemic herbicide to prevent re-sprouting. The county has been eradicating Russian-olives from all of its properties, over many years.

Staff notes that wetland jurisdictional determinations have been completed and that the applicants are consulting with the Corps of Engineers relative to Section 404 of the Clean Water Act.

In total, the two projects are expected to temporarily impact 0.67 acres of *non-jurisdictional* wetlands, and permanently impact 0.38 acres of non-jurisdictional wetlands. For jurisdictional wetlands, less than 0.02 acres are estimated to be impacted, and this impact is likely to be approved with a federal Nationwide Permit – a common occurrence for such a small amount. Permanent non-jurisdictional impacts are to be mitigated at a 1:1 ratio (in accordance with Federal Highway Administration requirements).

Page 32 -- Impacts to Riparian Areas are similarly minor, and state projects are mandated by state law to comply with Senate Bill 40, and its consultation requirement with the Division of Parks and Wildlife, to minimize impacts.

Page 36, 3.2.3.1 – The applicant is consulting with the US Fish and Wildlife Service for possible impacts to threatened species, in accordance with the Endangered Species Act. Any resulting Biological Assessment and Biological Opinion will be submitted to the county. It appears that Ute Ladies' Tresses, *Spiranthes diluvialis*, is probably the only federally-listed species in the area, and its likelihood to be found is small. Surveys must be completed during its blooming season. Page 58 states that, "The Project will consult with USFWS to determine potential survey requirements."

Staff is not concerned about impacts to "potential" Preble's Meadow Jumping Mouse

(PMJM) habitat. There is possibly potential habitat, yet no populations are known from Lefthand Creek. Standard mitigation for any riparian impacts is adequate, without regard to PMJM needs.

Raptors and Other Migratory Birds – "No active raptor nests were identified in the Project Area (CPW 2022c)." This is confusing since there is a relatively new bald eagle nest within one-half mile of the highway, as is shown on Figure 9. (Perhaps the nest was outside of the defined Project buffers.) At its closest, the nest is about 1500 linear feet from the highway ROW. According to the Division of Parks and Wildlife's 2020 guidelines, no human encroachment should occur within one-half mile (2640 feet) of an active nest, year-round, and no human occupancy should occur within one-quarter mile (1320 ft) during mating season.

This pair of eagles, however, began nesting at this location in 2019, and the chosen tree is only 200 feet from a well-used county road, and only 350 feet from an existing residence. A nearby tree on which they regularly roost is only 180 feet from the county road. Also, the chosen nest tree was/is only 1500 feet from the very busy highway itself. This pair of eagles has been repeatedly successful in fledging young.

Therefore, staff has very limited concerns that the proposed construction project would significantly impact this nesting pair. The closest bus lane construction would be about 1700 feet distant, and the closest Park-n-Ride expansion work would be 3400 feet distant. Bikeway construction, at its closest, would be about 1600 feet distant. All of these distances are beyond the one-quarter mile buffer and one is beyond the half-mile buffer.

With the possible exception of requiring no construction under lights, i.e. night-work, staff concludes that construction restrictions are not necessary, relative to the bald eagle nest. It is assumed that no night-work might be part of the contract regardless, but this should be further examined.

Page 40, Table 5 – This information is well done, and staff agrees with nearly all of the information. Staff notes that of the species listed in the table, bald eagle, burrowing owl, and prairie dog are those most likely to be impacted, and the application and this memo address these species.

Page 51, Prairie Dog and Burrowing Owl – Staff suggests that "moving" prairie dogs from construction areas to *other* properties is not necessary. As noted, it is unlikely that a property owner would accept them. (Particularly for a possible relocation to Pueblo; by state law, county commissioners of the receiving county must specifically approve of any relocations.)

Instead, prairie dogs can be passively relocated ("pushed," as noted in the application). This would move them out of the way during construction, and then allow their return. All of this could occur *within* the state ROW, so other properties are not necessary.

This technique is known as "Reverse Dispersal Translocation," and has been successfully used in the county. City of Boulder OSMP has experience with this technique. This would also supersede and remove the need for the 7-stage prairie dog guidelines, as shown on page 51. The details/methods would be necessary to review, but if this technique is adopted staff would have no concerns with impacts to prairie dogs.

It is understood that a survey for burrowing owls would occur just prior to construction, and subsequent actions/restrictions adopted as necessary (see p. 54 for standard BMPs).

Page 52, 3.2.3.2 – Staff does not expect significant impacts to the Critical Wildlife Habitat (CWH) near Milepost 52.3. This is known as the Lefthand Creek Cottonwood Groves (and associated wetlands). The only construction activity that would occur in this vicinity would be for the bikeway, with minimal grading and construction necessary. "Off-site" impacts into the CWH should not be significant.

Lefthand Creek, as the "center" of this CWH, is about 400 feet distant from the bikeway location. The creek is about 180 feet from the existing ROW edge and the southbound highway lanes. These existing lanes are already closer to Lefthand Creek than the narrow bikeway would be. (Note that the creek here is only paralleling the highway; there is no crossing. The crossing occurs further northeast, and only on Airport Road, not the highway.)

Page 57 – The fourth bullet is a duplicate and can be removed. In the third bullet, "important spawning areas" is mentioned. There are no such areas in the vicinity, and the project would not impact Lefthand Creek itself.

Page 66, Table 7 – The existing highway, and thus the project, passes next to numerous city and county open space properties. The latter including Dodd Farm, Chandler, Fitzgerald, the LOBO Trail, Bielins-Hock, and Peck, among others. However, staff has no significant concerns with impacts from the project to any of these holdings. Most are in agriculture, and the character of the existing highway will not change as a result of this project. Staff defers to OSMP for concerns with their properties.

The following resources, from the Comprehensive Plan Designations above, should not be significantly impacted: Riparian Habitat Connector, Significant Natural Communities, and the Archeologically Sensitive Travel Route.

Page 72, "Visual Aesthetics," etc. -- Staff has no concerns with impacts to the View Protection Corridor associated with the highway, with the possible exception of the new/expanded Park-n-Rides. It may be necessary to incorporate vegetative screening/plantings at these lots, but such details will not be considered until further into project planning.

<u>Recommendations</u>

- All items discussed above must be addressed, and questions resolved.
- 90 percent drawings must be reviewed and approved by the county. This should include details of the Park-n-Rides, concerning the possible need for vegetative screening.
- Staging areas must be shown on the final plans. What re-fueling BMP's would be used? All BMP's must be in the construction specifications.
- Prior to transporting equipment to the site, all machinery must be cleaned to remove soil/mud and attendant weed seeds.

- Prior to transporting equipment to the site, *all* machinery that would come in contact with water features must be cleaned to remove aquatic nuisance species (ANS) in accordance with State of Colorado ANS regulations. This involves either steam (heat) or chemical cleaning, not just power washing. The application states that only "equipment that has been used earlier in riparian projects" needs to be cleaned in this manner. *Regardless of the history* of use of the equipment, any equipment that is to contact water must be cleaned in this manner.
- As called for in the county's 2016 Storm Drainage Criteria Manual, biodegradable hydraulic fluids must be used in equipment and machinery used in the water.
- A Revegetation Plan is required that includes a list of all native grass and forb species (with scientific names) to be used, as well as any container plantings, an explanation of how topsoils will be stockpiled and reused, mapped delineation of all disturbance areas (this includes construction staging areas), locations of silt fence or erosion control logs down slope of disturbed areas, and matting requirements where necessary. This must be reviewed and approved before any grading occurs. Irrigation for establishment, particularly for plantings, must be included in the Plan, as well as replacement protocols if plantings die. Plantings should be tended for three years after planting. (The application notes that irrigation *may* be needed, which is not sufficient – see p. 57.)
- Construction should possibly be limited to daytime-only – no construction under lights – due to the proximity of the bald eagle nest; this needs further discussion.
- Page 4 – An easement will be necessary for "a small section within unincorporated Boulder County." Where is this located?
- Any trees to be cut should be removed between September 1 and March 31, the non-nesting season for migratory birds, based on the federal Migratory Bird Treaty Act. As noted in the application, trees removed shall be replaced in a 1:1 ratio.
- Weed management needs to be better incorporated into the project. Specific weed species to be targeted, and the proposed control techniques for each, must be stated.
- All straw mulch or straw bales must be certified weed-free.
- Final US Fish & Wildlife Service clearance needs to be obtained prior to initiation of construction; the USFWS letter shall be submitted to Community Planning and Permitting.
- Hydroseeding should not be used; it is often unsuccessful in our climate. Grass seed can be either broadcast or drilled, but rates doubled if broadcast. Hydromulching, after seeding, is encouraged.
- The project corridor must be surveyed for raptor and other bird nests (including burrowing owls) by a qualified biologist just prior to commencement of construction, and subsequent actions/restrictions adopted as necessary.
- It is strongly recommended that all Russian-olive trees -- a state-listed noxious weed -- be cut down and the stumps immediately treated with a systemic herbicide to prevent re-sprouting.
- Who is responsible for seeing that the conditions of approval, and commitments of record, are incorporated into the construction specifications for the project?

From:	Keyes, Jennifer
To:	Alejandra C. Ferrufino
Cc:	Proctor, Stacey; Karl E. Buchholz; Michelle M. Morgan; Emily P. Tyler; Karen S. Fuhr; Steven D. Humphrey; Thomas, Mike; Phillips, Alexandra; Kelly, Allison
Subject:	RE: 21497 CO 119- Boulder County
Date:	Friday, March 3, 2023 10:31:00 AM
Attachments:	image001.png

Alejandra and Emily - Thanks for meeting with me earlier today to discuss the table that the City of Boulder, Longmont, and Boulder County would like to be developed pertaining to the amount of excluded impervious area outside CDOT ROW for our MS4 programs. When the three municipalities met on this topic, we thought that it would be easiest to add this table to the drainage report; however, given the timing of the 1041 process and the percent design drawings, we do not believe that the table needs to be added at this time. Boulder County can add the table to our jurisdictional letter agreements with the cities. Please remove this requirement from the 1041 process and we will add it to the Stormwater Quality Permit Process which just needs to be completed prior to construction. Please let me know if you have any questions. Thanks, Jenn

Jennifer Keyes (she/her/hers)

Stormwater Quality Coordinator
Boulder County Public Works
2525 13th St., Boulder CO 80304
Mailing address: PO Box 471 Boulder CO 80306
Cell: 720-225-7228
jkeyes@bouldercounty.org

Boulder County has a new website: BoulderCounty.gov! Bookmark it today. Email addresses will transition at a later date.

BC Logo

From: Dean Rogers
To: L"Orange, Pete
Subject: [EXTERNAL] SI-22-0002
Date: Saturday, January 14, 2023 9:41:08 AM

Pete,
Boulder has the following recommendations regarding SI-22-0002, the CO 119 Safety and Mobility and Bikeway Projects. Due to the speed and volume of traffic there are several sketchy areas that are of concern as a cyclist. These are:

1. Reduce the speed limit to 55 mph for this entire length.
2. Increase the enforcement of the speed limit.
3. Cyclists not exiting 119 (if they intend to go either straight or left), at any intersection, can face a challenge in attempting to get into the proper lane. I think this is especially so at 119 and 63rd, either Longmont or Boulder bound.
4. The underpass at Airport (Longmont and Boulder bound) made exiting/entering 119 so much easier and safer. To do this at all intersections would be very expensive, but it may save a life.
5. The bridge that crosses Left Hand Creek made riding Longmont bound much safer as it gives additional room to cars and cyclists.

Thanks,

Dean Rogers, Engineer
Boulder Rural Fire Rescue
6230 Lookout Road, Boulder, CO 80301
Office: 303-530-9575 | Cell: 720-498-0019
drogers@brfr.org | www.brfr.org

CITY OF BOULDER

Referral Docket SI-22-0002
CO 119 Safety and Mobility and Bikeway Projects
February 15, 2023

City of Boulder Planning Department Comments:

Chris Ranglos, City Senior Planner (Land Use), ranglosc@bouldercolorado.gov (303) 441-4124

Thank you for the opportunity to comment on the CO 119 Safety and Mobility Improvements Mobility and Bikeway Project(s). The following comments address the City of Boulder land use perspective and alignment with the Boulder Valley Comprehensive Plan.

Land Use
Colorado Highway 119 (CO 119) from approximately 47th Street/Foothills Parkway to Jay Road (southern project limit) is located within the Planning Area for the Boulder Valley Comprehensive Plan (BVCP), a jointly adopted plan by the city and county.
This section of CO 119 is within city limits and is adjacent to Area III – Rural Preservation to the east - and is designated Open Space, Acquired (OS-A) on the Land Use Map. Various land use designations exist to the west of the southern project limit stretch, including: Park, Urban and Other (PK-U/O); Open Space, Other (OS-O); Low Density Residential (LR), and Medium Density Residential (MR).

Boulder Valley Comprehensive Plan
The Boulder Valley Comprehensive Plan (BVCP) establishes a vision to create and maintain a safe, complete and efficient transportation system that provides travel choices and reduces single-occupant automobile trips and vehicle miles traveled. The BVCP also recognizes the role of providing transportation options as a form to create climate stabilization. Staff believes this project adequately meets the established vision within the BVCP and is well aligned with the following policies:

4.01 Climate Action: Reduce Greenhouse Gas Emissions
To mitigate climate change, the city and county will continue to take action to reduce the burning of fossil fuels for energy and encourage such change throughout the Boulder Valley. The city and county will identify and implement innovative as well as cost-effective actions to dramatically reduce the entire community's and visitor's contributions to total global GHG emissions and power a vibrant future.

4.05 Clean Mobility
To reduce GHG emissions, the city and county will support the retirement of fossil-fuel based transportation.

6.01 All-mode Transportation System & Complete Streets
The Boulder Valley will be served by an integrated all-mode transportation system, developed cooperatively by the city and county. The city and county transportation system focuses on moving people, and is based on complete streets reflecting the unique contexts or urban, suburban, and rural areas. These streets include completed networks for each mode, making safe and convenient connections between modes, providing seamless connections between the city and county systems and promoting access and placemaking for the adjacent land uses and activities.
Improvements to urban travel corridors will recognize pedestrian travel as the primary mode of transportation and preserve or improve the safety of all modes of transportation. For more suburban and rural parts of the Boulder Valley, the transportation system is focused on sustainable mobility through development of a safe, multimodal system, creating the complete trip and investing in key regional transportation corridors.

6.02 Equitable Transportation
The city and county will equitably distribute transportation investments and benefits in service of all community members, particularly vulnerable populations, ensuring that all people benefit from expanded mobility options. Providing more transportation options – like walking, biking, transit and shared options – in areas where people are more reliant on various modes will have a greater benefit to overall mobility.

6.05 Reduction of Single Occupancy Auto Trips
The city and county will support and promote the greater use of multimodal travel options to reduce vehicle miles traveled (VMT) and single-occupancy automobile travel.

6.04 Transportation System Optimization
The transportation system serves people using all modes, and maintaining its efficient and safe operation benefits all users.

6.06 Accessibility and Mobility for All
The city and county will continue development of a complete all-mode transportation system accommodating all users, including people with mobility impairments, youth, older adults, non-English speakers and low-income persons

6.07 Transportation Safety
The city and county recognize safety for people of all ages using any mode within the transportation system (i.e., walking, bicycling, transit riding and driving) as a fundamental goal.

6.08 Regional Travel Coordination
The city and county will work to develop regional consensus for multimodal improvements to regional corridors

6.22 Improving Air Quality & Reducing Greenhouse Gas Emissions
Both the city and county are committed to reductions in GHG emissions, with the city committing to an 80 percent reduction from 2005 levels by 2050 and the county committing to a 45% reduction by 2030 and a 90% reduction by 2050. The city and county will design the transportation system to minimize air

pollution and reduce GHG emissions by promoting the use of active transportation (e.g., walking and bicycling) and low-emission transportation modes and infrastructure to support them.

City of Boulder Open Space and Mountain Parks (OSMP) Comments:

Thank you for the opportunity to review the application referenced above. The project runs adjacent to City of Boulder Open Space and Mountain Parks (OSMP) land and temporarily impacts a portion of OSMP land. Please consider the following comments regarding this development application:

Wetlands

Portions of the projects propose to impact wetlands or wetland buffers located outside the right-of-way and within the Boulder city limits. Applicant will be required to consult with the City's wetland administrator to determine permit requirements. More information can be found at https://bouldercolorado.gov/services/wetland-permits.

The Applicant's Jurisdictional Determination shows a wetland area (3-E-1 and 3-E-2) that is not within the plan set/project area. OSMP and City staff would like to know what project-related activities are proposed at this location.

Grading and Construction on City of Boulder – OSMP Land

The Applicants proposes some temporary disturbance/grading of city-owned land outside the right-of-way north of Fourmile Canyon Creek. This area will be used and restored consistent with a Temporary Access and Construction Agreement. No permanent rights or uses of any city-owned land is proposed or anticipated for the project.

Irrigation Ditches and Laterals

The plans include numerous crossings of, and culvert installation/improvements to, irrigation laterals and ditches that the City of Boulder – OSMP owns or holds interests in. OSMP staff have been working with the applicants to understand the proposed impacts to these structures and will require one or more formal crossing agreements that address maintenance, replacement and access. OSMP staff requests executed agreements be a condition of approval.

Applicants have also agreed to work with BNSF railroad to clear culverts of debris in the area of the Hwys 119 and 52 intersection during construction so that proper flows can be restored and requested lateral adjustments can be permitted.

Please feel free to contact me if you have any questions or comments about this response.

Jake Cassidy, Property Agent, City of Boulder OSMP

Cassidyj@bouldercolorado.gov

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.bouldercounty.org**

MEMO TO: Agencies and adjacent property owners
FROM: Pete L'Orange, Staff Planner
DATE: January 12, 2023
RE: **Docket SI-22-0002**

Docket SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

Request: Areas and Activities of State Interest (1041) review for combined projects along Colorado Highway 119 (CO 119) related to safety and mobility improvements and construction of a bikeway from approximately 47th Street/Foothills Parkway in the City of Boulder to milepost 54.2 in the City of Longmont.

Location: Colorado Highway 119 (CO 119) from approximately 47th Street/Foothills Parkway, Boulder, to milepost 54.2, Longmont, in Sections 2, 3, 9, 10, 11, 15, and 16 of T1N, R70W; Sections 25, 35, and 36 of T2N, R70W; and Sections 17, 19, 20, and 30 of T2N, R69W.

Zoning: Agricultural, Rural Residential, Commercial, Light Industrial, Niwot Rural Community Districts I and II

Applicants: Colorado Department of Transportation c/o Adnana Murtic and Boulder County Community Planning & Permitting c/o Stacy Proctor, and Regional Transportation District c/o Ali Imansepahi

This process includes public hearings before the Board of County Commissioners and may include a public hearing before the Boulder County Planning Commission. Adjacent property owners and holders of liens, mortgages, easements or other rights in the subject property are notified of these hearings.

The Community Planning & Permitting staff, Planning Commission, and County Commissioners value comments from individuals and referral agencies. Please check the appropriate response below or send a letter to the Community Planning & Permitting Department at P.O. Box 471, Boulder, Colorado 80306 or via email to **plorange@bouldercounty.org.** All comments will be made part of the public record and given to the applicant.

You may view or download the application materials at **www.boco.org/docket-si-22-0002.**

You are welcome to call the Community Planning & Permitting Department at 303-441-3930 to request more information. If you have any questions regarding this application, please contact the Community Planning & Permitting office at **303-441-1418** or via email at **plorange@bouldercounty.org**.

As required per article 8-508(C)1.a, referral responses must be returned within 14 days or **January 26, 2023**.
*As noted in section 8-508(C)1.b, an extension may be expressly granted by the Director.

_____ We have reviewed the proposal and have no conflicts.
_✓_ Letter is enclosed.
Signed _____ PRINTED Name Ayanna Reed
Agency or Address City of Longmont
Date 2/9/2023

CITY OF LONGMONT COLORADO

REFERRAL RESPONSE TO: Boulder County Community Planning and Permitting

FROM: Ayanna Reed, Associate Planner

DATE: February 9, 2023

RE: Docket SI-22-0002

Staff Comments

Hannah Chin, Civil Engineer II – Public Works Natural Resources

- Our plats show the Connector Road shown on sheet 43 of the trail plans as Business Center Way (see attached).
- Was any consideration given to tie the bikeway in with the existing sidewalk southwest of the development located south of Dry Creek Drive and east of Fordham Street? It seems like there could be some potential cost savings if the existing 8' trail was used for this roughly 1000 ft stretch, but there may be other variables at play. If the project leaves the bikeway alignment as is, what would be the best plan for connecting this development's sidewalk with the bikeway?
- I have attached some plats for the developments located north of CO 119 in Longmont. They may be helpful to reference if you consider shifting any more of the trail to the north side of the highway. Xiling Filing 2 has been quiet for quite some time now, so although the area is platted, development may still be a long way away (relevant plats are attached).

940

Subdivision Plat

LONGMONT BUSINESS CENTER
FINAL PLAT

A PORTION OF THE EAST 1/2 OF SECTION 17,
TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M.
CITY OF LONGMONT, BOULDER COUNTY, COLORADO
144.3 ACRES, MORE OR LESS

SHEET 1 OF 2

BASIS OF BEARING

THE BEARINGS ARE BASED ON THE ASSUMPTION THAT THE EAST LINE OF THE SOUTHEAST QUARTER OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST, OF THE 6TH PM. AS BEARING NORTH 00° 39' 50" EAST.

TOTAL ACREAGE OF THIS PLAT

144.3 ACRES MORE OR LESS

FLOODPLAIN STATEMENT

A PORTION OF THE SUBJECT PROPERTY IS LOCATED IN ZONES X AND AE, ACCORDING TO THE FEMA FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 269, MAP NO. 08013C0269 F, EFFECTIVE DATE, JUNE 2, 1995.

MAYORS CERTIFICATE:

THIS IS TO CERTIFY THAT A PLAT OF THE ABOVE DESCRIBED PROPERTY WAS APPROVED BY THE CITY OF LONGMONT AND THAT THE MAYOR OF THE CITY OF LONGMONT, COLORADO, ACCEPTS ALL PUBLIC STREETS, EASEMENTS, RIGHTS-OF-WAY AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USE FOR ALL PURPOSES INDICATED HEREON.

MAYOR ATTEST:

EASEMENT APPROVAL:

UTILITY EASEMENTS ARE ADEQUATE AS SHOWN AND ARE HEREBY APPROVED:

U.S. WEST COMMUNICATIONS

PUBLIC SERVICE COMPANY OF COLORADO

UTILITIES APPROVAL:

THE REQUIRED WATER RIGHTS AND/OR NECESSARY CASH PAYMENTS HAVE BEEN TRANSFERRED TO THE CITY OF LONGMONT AND THE FINAL UTILITY PLANS HAVE BEEN APPROVED. UTILITY EASEMENTS ARE ADEQUATE AS SHOWN.

WATER/SEWER UTILITIES

ELECTRIC UTILITIES

PUBLIC WORKS APPROVAL:

THE FINAL STREET PLANS AND PROFILES AND DRAINAGE PLANS HAVE BEEN APPROVED AND ARE SUBSTANTIATED BY AN EXECUTED MEMORANDUM OF AGREEMENT FOR PUBLIC IMPROVEMENTS.

PUBLIC WORKS DIVISION

PLANNING DIRECTOR:

APPROVED THIS 17TH DAY OF FEBRUARY, A.D. 2000

PLANNING DIRECTOR

NOTES:

1. DUE TO THE PROXIMITY OF THE PROPERTY TO THE VANCE BRAND AIRPORT, THERE WILL BE AIRCRAFT PASSING ABOVE THE PROPERTY. AIRCRAFT PASSAGE MAY RESULT IN NOISE AND OTHER IMPACTS ON THE PROPERTY. AIRCRAFT MAY CROSS ABOVE THE PROPERTY AT LOW ALTITUDE IN ACCORDANCE WITH FAA REGULATIONS. THE FREQUENCY OF AIRCRAFT PASSING OF THE PROPERTY MAY INCREASE IN THE FUTURE. THE OWNERS, THEIR HEIRS, SUCCESSORS AND ASSIGNS, SPECIFICALLY ACKNOWLEDGE THE RIGHT OF PASSAGE OVER THE PROPERTY FOR AIRCRAFT AND AGREE TO HOLD HARMLESS THE CITY OF LONGMONT FOR AIRCRAFT OPERATIONS WHICH MAY CREATE NOISE, VIBRATION, DUST, FUEL PARTICLES, AND ALL OTHER EFFECTS THAT MAY BE CAUSED BY THE OPERATION OF AIRCRAFT LANDING AT OR TAKING OFF FROM, OR OPERATION AT OR ON SAID VANCE BRAND AIRPORT IN ACCORDANCE WITH FAA REGULATIONS.

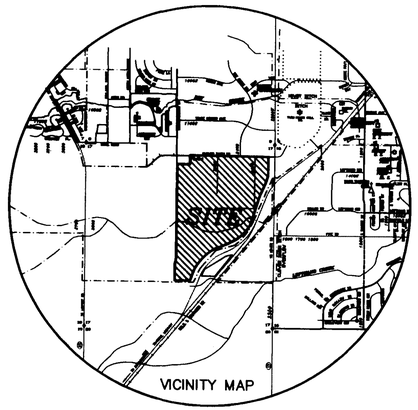
2. ACCESS ONTO CLOVER BASIN DRIVE WILL NOT BE PERMITTED FOR INDIVIDUAL LOTS, WITH THE EXCEPTION OF THE EXISTING ACCESS.

3. A FINAL LANDSCAPE PLAN HAS BEEN APPROVED AS PART OF THIS FINAL PLAT.

4. THIS PLAT CONSIDERS TWO (2) PHASES. PHASE 1 INCLUDES LOTS 1,2,3,4,5 AND 14. PHASE 2 INCLUDES LOTS 6,7,8,9,10,11,12 AND 13.

5. NO BUILDING PERMITS WILL BE ISSUED FOR LOTS IN PHASE 2 UNTIL ALL PHASE 2 PUBLIC IMPROVEMENTS (AS IDENTIFIED BY THE MOAPI DATED SEPTEMBER, 28, 1999) ARE COMPLETED.

6. A PRAIRIE DOG RELOCATION/PRESERVATION PLAN HAS BEEN APPROVED AS PART OF THIS FINAL PLAT.



VICINITY MAP

SURVEYOR'S CERTIFICATE

I, CHARLES R. MELVIN, DO HEREBY CERTIFY THIS PLAT ACCURATELY REPRESENTS THE RESULTS OF A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION AND DONE IN ACCORDANCE WITH APPLICABLE STATE OF COLORADO LAWS.

CHARLES R. MELVIN, COLORADO REGISTERED PROFESSIONAL LAND SURVEYOR NO. 22576 DATE 2/16/2000

CLERK AND RECORDER'S CERTIFICATE

STATE OF COLORADO)
)SS
COUNTY OF BOULDER)

I, HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED IN MY OFFICE AT 9:32 O'CLOCK A.M., THIS 18TH DAY OF February A.D. 2000 AND IS RECORDED IN PLAN FILE ____, FILM ____, RECEPTION NO. 2022489 P-50 F-2 #27 & 28

DEPUTY Charlotte Houerton RECORDER

$ 20.00
FEES

DEDICATION:

KNOW ALL MEN BY THESE PRESENTS, THAT K/B FUND IV, A DELAWARE GENERAL PARTNERSHIP, BY K/B OPPORTUNITY FUND IV, L.P., A DELAWARE LIMITED PARTNERSHIP, ITS MANAGING PARTNER, BY K/B OPPORTUNITY INVESTORS, A CALIFORNIA GENERAL PARTNERSHIP, ITS GENERAL PARTNER, BY KOLL INVESTMENT MANAGEMENT, INC., A CALIFORNIA CORPORATION, ITS GENERAL PARTNER. BEING THE SOLE OWNER OF THE LAND DESCRIBED HEREIN, HAS CAUSED SAID LAND TO BE PLATTED UNDER THE NAME OF "LONGMONT BUSINESS CENTER", AND DO HEREBY DEDICATE TO THE PUBLIC FOREVER ALL PUBLIC STREETS AND RIGHT-OF-WAYS, EASEMENTS AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USES. ALL CONDITIONS, TERMS AND SPECIFICATIONS DESIGNATED OR DESCRIBED HEREIN SHALL BE BINDING ON THE OWNER, HIS HEIRS, SUCCESSORS AND ASSIGNS.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND SEAL THIS 14TH DAY OF Feb, 20.00.

CHARLES J. SCHREIBER, JR.
CHIEF EXECUTIVE OFFICER

NOTARIAL CERTIFICATE:

STATE OF COLORADO)
)SS
COUNTY OF BOULDER)

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 14th DAY OF February A.D. 2000

BY Charles J. Schreiber, Jr

MY COMMISSION EXPIRES 3/11/2001

NOTARY PUBLIC

2346 Clover Basin Dr.
ADDRESS

Longmont, CO 80503

DESCRIPTION

A PLAT OF A PARCEL OF LAND IN THE CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO, LOCATED IN THE EAST 1/2 OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M. AND MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHEAST CORNER OF SAID SECTION 17, THENCE SOUTH 00°39'50" WEST ALONG EAST LINE OF SAID SECTION 17, 750.05 FEET TO A POINT; THENCE SOUTH 17°45'07" WEST, 204.31 FEET TO A POINT ON THE NORTHWESTERLY RIGHT-OF-WAY LINE OF STATE HIGHWAY 119, THE POINT OF BEGINNING; THENCE ALONG SAID RIGHT-OF-WAY LINE THE FOLLOWING TEN (10) COURSES;

1. SOUTH 17°45'07" WEST, 248.59 FEET;
2. THENCE SOUTH 24°08'19" WEST, 402.55 FEET;
3. THENCE SOUTH 17°45'07" WEST, 828.22 FEET;
4. THENCE ALONG THE ARC OF A 1183.30 FOOT RADIUS CURVE TO THE RIGHT, 603.37 FEET, SAID CURVE BEING SUBTENDED BY A CHORD BEARING SOUTH 44°36'54" WEST, 596.85 FEET;
5. THENCE SOUTH 63°49'10" WEST, 288.99 FEET;
6. THENCE SOUTH 64°12'14" WEST, 14.12 FEET;
7. THENCE SOUTH 69°28'42" WEST, 312.72 FEET;
8. THENCE ALONG THE ARC OF A 1552.50 FOOT RADIUS CURVE TO THE LEFT 812.88 FEET, SAID CURVE BEING SUBTENDED BY A CHORD BEARING SOUTH 44°58'23" WEST, 803.62 FEET;
9. THENCE SOUTH 20°22'36" WEST, 312.75 FEET;
10. THENCE SOUTH 23°56'36" WEST, 59.86 FEET, TO A POINT ON THE SOUTH LINE OF THE NORTH 1/2 OF THE SOUTHEAST 1/4 OF SAID SECTION 17;

THENCE DEPARTING SAID RIGHT-OF-WAY LINE OF STATE HIGHWAY 119 NORTH 89°31'24" WEST, ALONG SAID SOUTH LINE OF THE NORTH 1/2 OF THE SOUTHEAST 1/4 OF SAID SECTION 17, 431.31 FEET TO THE SOUTHWEST CORNER OF SAID NORTH 1/2 OF THE SOUTHEAST 1/4;
THENCE NORTH 00°17'22" EAST, ALONG THE WEST LINE OF SAID NORTH 1/2 OF THE SOUTHEAST 1/4, 486.97 FEET TO A POINT ON THE EAST LINE OF THE SOUTH FORDHAM STREET RIGHT-OF-WAY;
THENCE ALONG SAID EAST LINE OF THE SOUTH FORDHAM STREET RIGHT-OF-WAY THE FOLLOWING TWO (2) COURSES:

1. ALONG THE ARC OF A 630.00 FOOT RADIUS CURVE TO THE LEFT 195.20 FEET, SAID CURVE BEING SUBTENDED BY A CHORD BEARING NORTH 09°09'57" EAST, 194.42 FEET;
2. THENCE NORTH 00°17'22" EAST, 2601.74 FEET;

THENCE DEPARTING SAID EAST LINE OF THE SOUTH FORDHAM RIGHT-OF-WAY NORTH 89°19'41" EAST, 357.50 FEET;
THENCE NORTH 00°17'22" EAST, 250.00 FEET TO A POINT ON THE SOUTH LINE OF THE CLOVER BASIN DRIVE RIGHT-OF-WAY;
THENCE ALONG SAID SOUTH LINE OF THE CLOVER BASIN DRIVE RIGHT-OF-WAY THE FOLLOWING TWO (2) COURSES:

1. SOUTH 89°19'41" EAST, 1835.37 FEET;
2. SOUTH 89°12'25" EAST, 375.09 FEET TO A POINT ON THE WEST LINE OF THE SOUTH HOVER ROAD RIGHT-OF-WAY;

THENCE SOUTH 00°39'50" WEST, 525.89 FEET ALONG THE WEST LINE OF SAID SOUTH HOVER ROAD RIGHT-OF-WAY TO THE POINT OF BEGINNING.

DESCRIBED PARCEL CONTAINS 144.3 ACRES MORE OR LESS.
COUNTY OF BOULDER.
STATE OF COLORADO.

MELVIN SURVEYING
4755 SHOUP PLACE
BOULDER, COLORADO 80303
1-303-499-2175

LONGMONT BUSINESS CENTER
FINAL PLAT 940

JOB NO	DATE	CAD NO	SHEET NO
229-1	02/03/00	2291FP02	1 OF 2

C:\DWG\2291595\dwg\2291FP02.dwg Mon Feb 07 11:18:26 2000

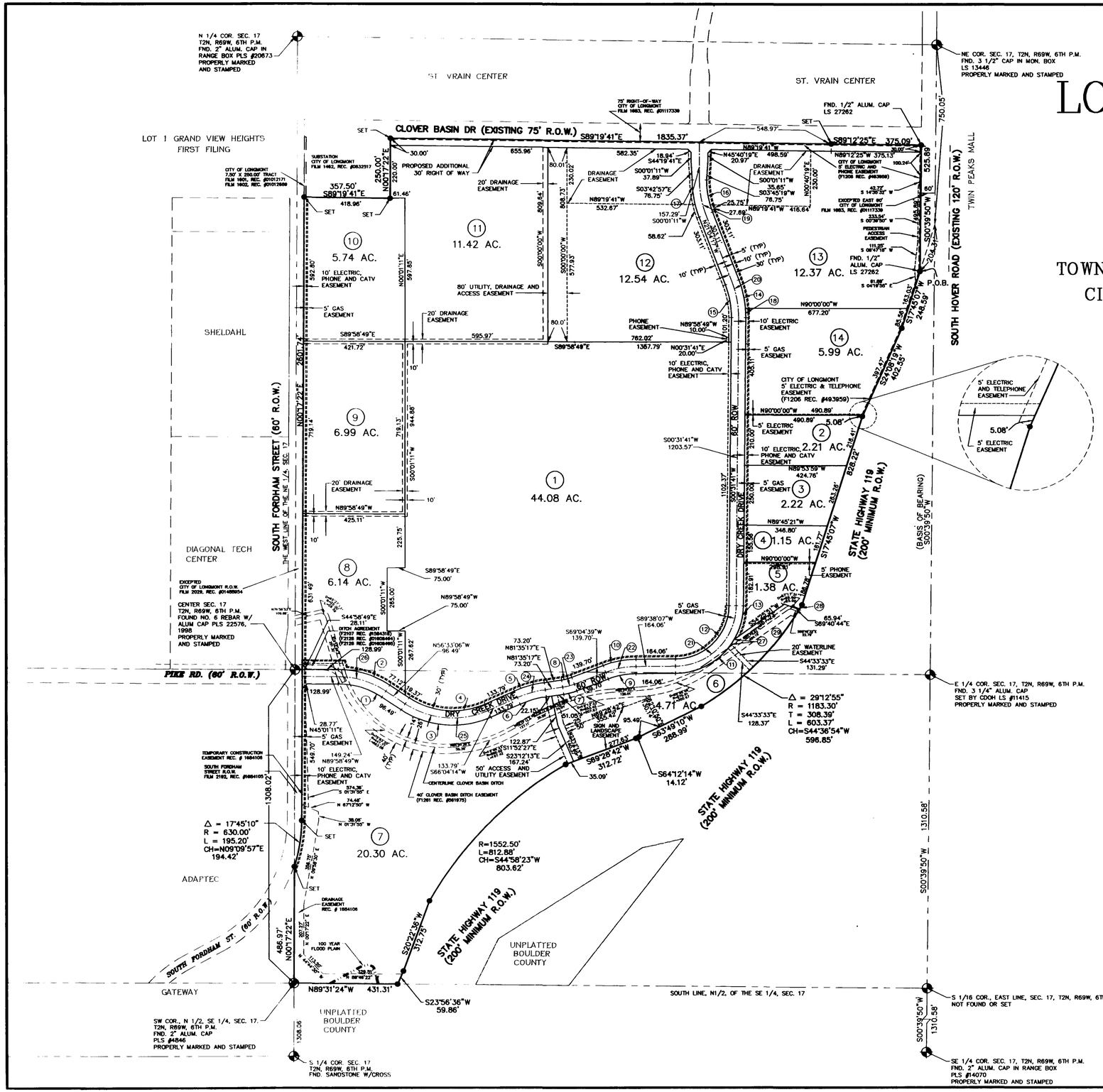
940

Subdivision Plat

LONGMONT BUSINESS CENTER
FINAL PLAT

A PORTION OF THE EAST 1/2 OF SECTION 17,
TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M.
CITY OF LONGMONT, BOULDER COUNTY, COLORADO
144.3 ACRES, MORE OR LESS

SHEET 2 OF 2



CURVE	RADIUS	LENGTH	TANGENT	CHORD	BEARING	DELTA
1	330.00'	192.54'	99.09'	189.82'	N73°15'57"W	33°25'43"
2	390.00'	227.54'	117.11'	224.33'	N73°15'57"W	33°25'43"
3	390.00'	390.56'	213.42'	374.44'	S85°14'26"E	57°22'41"
4	330.00'	330.47'	180.59'	316.84'	N85°14'26"W	57°22'41"
5	480.00'	130.00'	65.40'	129.60'	N73°49'45"E	15°31'03"
6	420.00'	113.75'	57.22'	113.40'	N73°49'45"E	15°31'03"
7	260.00'	56.77'	28.50'	56.66'	S75°19'58"W	12°30'38"
8	200.00'	43.67'	21.92'	43.58'	S75°19'58"W	12°30'38"
9	330.00'	118.40'	59.85'	117.77'	N79°21'23"E	20°33'28"
10	390.00'	139.93'	70.73'	139.18'	N79°21'23"E	20°33'28"
11	285.00'	294.63'	162.01'	281.68'	S60°01'10"W	59°13'55"
12	225.00'	349.92'	221.52'	315.71'	N45°04'54"E	89°06'26"
13	285.00'	148.61'	76.03'	146.93'	S15°27'56"W	29°52'32"
14	430.00'	122.95'	61.90'	122.53'	N12°52'48"W	16°22'57"
15	370.00'	139.48'	70.58'	138.66'	S10°16'18"E	21°35'57"
16	370.00'	136.03'	68.79'	135.27'	N10°32'19"W	21°03'55"
17	430.00'	158.12'	79.96'	157.23'	N10°32'13"W	21°04'07"
18	430.00'	39.15'	19.59'	39.14'	S02°04'49"E	05°13'00"
19	400.00'	147.24'	74.46'	146.41'	N10°31'33"W	21°05'28"
20	400.00'	150.79'	76.30'	149.90'	S10°16'18"E	21°35'57"
21	255.00'	396.58'	251.06'	357.80'	N45°04'54"E	89°06'26"
22	360.00'	129.17'	65.29'	128.48'	N79°21'23"E	20°33'28"
23	230.00'	50.22'	25.21'	50.12'	N75°19'58"E	12°30'38"
24	450.00'	121.87'	61.31'	121.50'	S73°49'45"W	15°31'03"
25	360.00'	360.52'	197.00'	345.64'	N85°14'26"W	57°22'41"
26	360.00'	210.04'	108.10'	207.07'	N73°15'57"W	33°25'43"
27	264.87'	23.42'	11.72'	23.41'	N32°45'26"E	04°32'37"
28	1183.30'	23.11'	11.55'	23.11'	N30°34'01"E	01°07'08"
29	1183.30'	580.26'	296.09'	574.46'	S45°10'28"W	28°05'47"

- INDICATES 1" PLASTIC CAP ON #5 REBAR P.L.S. 4846
- INDICATES #5 REBAR W/PLASTIC CAP P.L.S. 22576 WHEN DENOTED "SET"

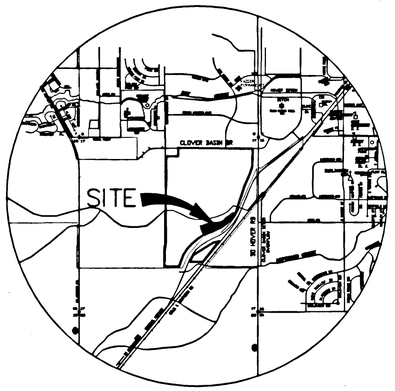
MELVIN SURVEYING
4755 SHOUP PLACE
BOULDER, COLORADO 80303
1-303-499-2175

LONGMONT BUSINESS CENTER
FINAL PLAT 940

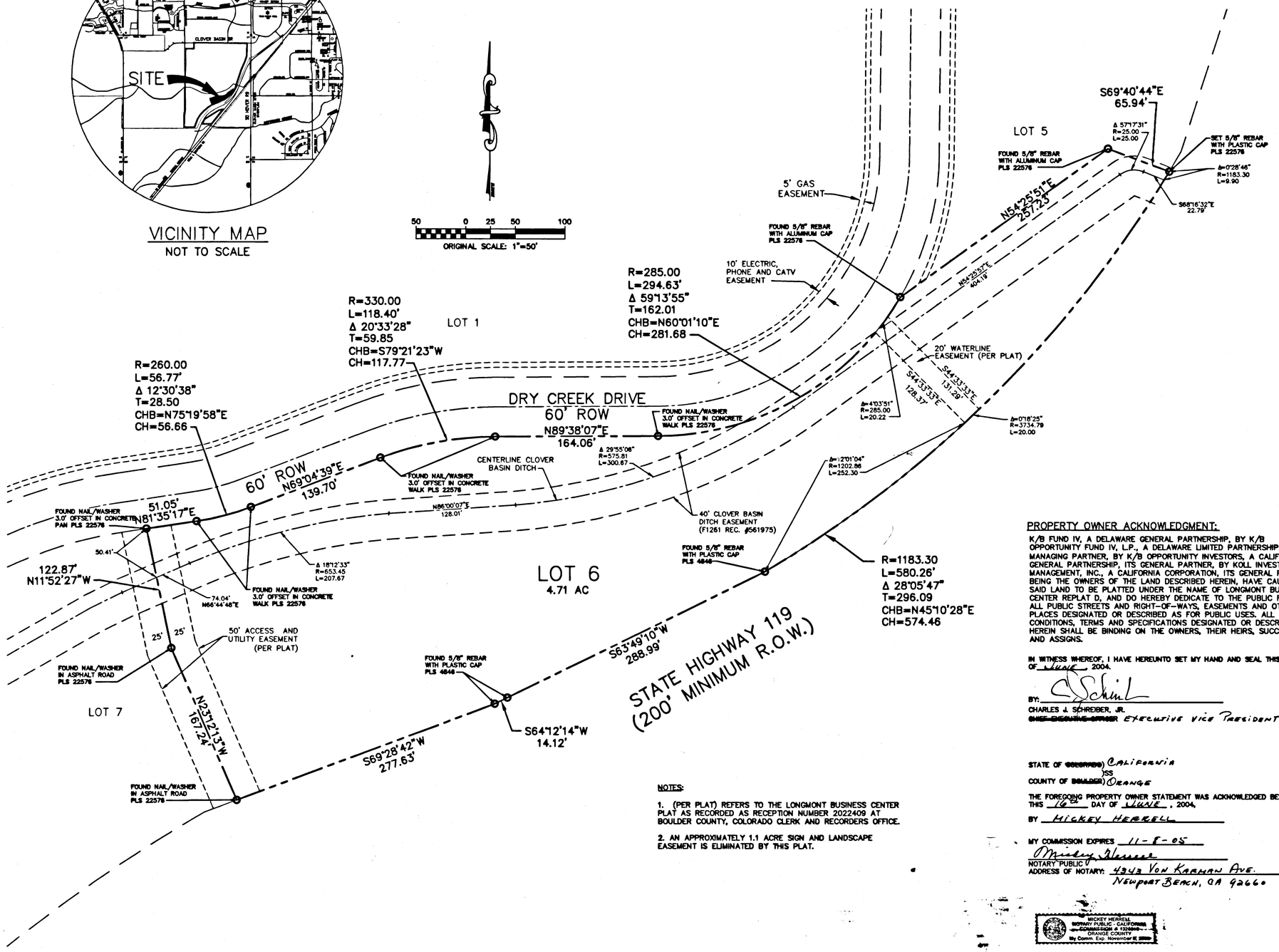
JOB NO	DATE	CAD NO	SHEET NO
229-1	02/03/00	2291FP01	2 OF 2

LONGMONT BUSINESS CENTER REPLAT D

A REPLAT OF LOT 6 LONGMONT BUSINESS CENTER
LOCATED IN THE EAST 1/2 OF SECTION 17,
TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH
P.M. CITY OF LONGMONT, COUNTY OF BOULDER,
STATE OF COLORADO, 4.71 ACRES, MORE OR LESS
SHEET 1 OF 1



VICINITY MAP
NOT TO SCALE



NOTES:

1. (PER PLAT) REFERS TO THE LONGMONT BUSINESS CENTER PLAT AS RECORDED AS RECEPTION NUMBER 2022409 AT BOULDER COUNTY, COLORADO CLERK AND RECORDERS OFFICE.

2. AN APPROXIMATELY 1.1 ACRE SIGN AND LANDSCAPE EASEMENT IS ELIMINATED BY THIS PLAT.

PROPERTY DESCRIPTION:

LOT 6 LONGMONT BUSINESS CENTER, CITY OF LONGMONT COUNTY OF BOULDER, STATE OF COLORADO DESCRIBED PARCEL CONTAINING 4.71 ACRES MORE OR LESS. THE RECEPTION NUMBER FOR THE LONGMONT BUSINESS CENTER IS 2022409, RECORDED FEB 18, 2000.

BASIS OF BEARING

THE BEARINGS ARE BASED ON THE RECORDED PLAT OF LONGMONT BUSINESS CENTER.

FLOODPLAIN STATEMENT

LONGMONT BUSINESS CENTER LOT 6 REPLAT A IS NOT LOCATED IN A FLOODPLAIN ACCORDING TO THE FEMA FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 269, MAP NO. 08013C0269 F, EFFECTIVE DATE, JUNE 2, 1995.

EASEMENT APPROVAL:

UTILITY EASEMENTS ARE ADEQUATE AS SHOWN AND ARE HEREBY APPROVED:

QWEST COMMUNICATIONS

PUBLIC SERVICE COMPANY OF COLORADO

UTILITIES APPROVAL:

THIS PLAT IS IN COMPLIANCE WITH THE CITY OF LONGMONT RAW WATER POLICY AND THE FINAL UTILITY PLANS HAVE BEEN APPROVED. UTILITY EASEMENTS FOR WATER, SANITARY SEWER AND ELECTRIC FACILITIES ARE ADEQUATE AS SHOWN

6/21/04
WATER WASTEWATER DEPARTMENT

LONGMONT POWER AND COMMUNICATIONS

PLANNING DIRECTOR'S CERTIFICATE:

APPROVED THIS 23rd DAY OF June 2004.

PLANNING DIRECTOR

PUBLIC WORKS APPROVAL:

THE FINAL STREET PLANS AND PROFILES AND DRAINAGE PLANS HAVE BEEN APPROVED AND ARE SUBSTANTIATED BY AN EXECUTED MEMORANDUM OF AGREEMENT FOR PUBLIC IMPROVEMENTS.

PUBLIC WORKS DIVISION

MAYORS CERTIFICATE:

THIS IS TO CERTIFY THAT A PLAT OF THE ABOVE DESCRIBED PROPERTY WAS APPROVED BY THE CITY OF LONGMONT AND THAT THE MAYOR OF THE CITY OF LONGMONT, COLORADO, ACCEPTS ALL PUBLIC STREETS, EASEMENTS, RIGHTS-OF-WAY AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USE FOR ALL PURPOSES INDICATED HEREON.

MAYOR

ATTEST:

CITY OF LONGMONT COLORADO

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARY INFORMATION DEPICTED HEREON ACCURATELY REPRESENTS THE RESULTS OF A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION AND DONE IN ACCORDANCE WITH STATE OF COLORADO REQUIREMENTS.

22576

CHARLES R. MELVIN, L.S. #22576

6/8/04

ZONING:

EXISTING ZONING - BLI

PROPERTY OWNER ACKNOWLEDGMENT:

K/B FUND IV, A DELAWARE GENERAL PARTNERSHIP, BY K/B OPPORTUNITY FUND IV, L.P., A DELAWARE LIMITED PARTNERSHIP, ITS MANAGING PARTNER, BY K/B OPPORTUNITY INVESTORS, A CALIFORNIA GENERAL PARTNERSHIP, ITS GENERAL PARTNER, BY KOLL INVESTMENT MANAGEMENT, INC., A CALIFORNIA CORPORATION, ITS GENERAL PARTNER BEING THE OWNERS OF THE LAND DESCRIBED HEREIN, HAVE CAUSED SAID LAND TO BE PLATTED UNDER THE NAME OF LONGMONT BUSINESS CENTER REPLAT D, AND DO HEREBY DEDICATE TO THE PUBLIC FOREVER ALL PUBLIC STREETS AND RIGHT-OF-WAYS, EASEMENTS AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USES. ALL CONDITIONS, TERMS AND SPECIFICATIONS DESIGNATED OR DESCRIBED HEREIN SHALL BE BINDING ON THE OWNERS, THEIR HEIRS, SUCCESSORS AND ASSIGNS.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND SEAL THIS 16th DAY OF June, 2004.

BY:

CHARLES J. SCHREIBER, JR.

~~CHIEF EXECUTIVE OFFICER~~ Executive Vice President

STATE OF ~~COLORADO~~ California
)SS
COUNTY OF ~~BOULDER~~ Orange

THE FOREGOING PROPERTY OWNER STATEMENT WAS ACKNOWLEDGED BEFORE ME ON THIS 16th DAY OF June, 2004,

BY MICKEY HERRELL

MY COMMISSION EXPIRES 11-8-05

NOTARY PUBLIC

ADDRESS OF NOTARY: 4343 Von Karman Ave. Newport Beach, CA 92660

MICKEY HERRELL NOTARY PUBLIC - CALIFORNIA COMMISSION # 1320600 ORANGE COUNTY My Comm. Exp. November 8, 2005

CLERK AND RECORDER'S CERTIFICATE:

STATE OF COLORADO)
)SS
COUNTY OF BOULDER)

I HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED IN MY OFFICE AT 3:19 O'CLOCK P M., THIS 13th DAY OF July A.D. 2004, AND IS RECORDED IN PLAN FILE 20:228, FILM N/A, RECEPTION NO. 2607002

DEPUTY

RECORDER

$11.00
FEES

MELVIN SURVEYING			
1202 FALL RIVER CIRCLE LONGMONT, COLORADO 80501 1-303-702-0868			
LONGMONT BUSINESS CENTER REPLAT D			
JOB NO	DATE	CAD NO	SHEET NO
379-1	6/07/04	2291replatD	1 OF 1

1049

LONGMONT BUSINESS CENTER - REPLAT H

FINAL PLAT

A REPLAT OF LOT 7 OF LONGMONT BUSINESS CENTER, LYING WITHIN THE SOUTHEAST QUARTER (SE 1/4) OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE SIXTH PRINCIPAL MERIDIAN, CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO

LEGAL DESCRIPTION

A PLAT OF A PARCEL OF LAND LOCATED IN THE CITY OF LONGMONT, COLORADO, LYING WITHIN THE SOUTHEAST QUARTER (SE 1/4) OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE SIXTH PRINCIPAL MERIDIAN, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

ALL OF LOT 7 OF LONGMONT BUSINESS CENTER AS RECORDED FEBRUARY 18, 2000 AT RECEPTION No. 2022409, IN THE OFFICE OF THE CLERK AND RECORDER OF THE COUNTY OF BOULDER, STATE OF COLORADO.

CONTAINING ±883,987 SQUARE FEET OR ±20.293 ACRES OF LAND, MORE OR LESS.

PROPERTY OWNERS' DEDICATION AND ACKNOWLEDGMENT

TRIUMPH INVESTMENTS LLC, A COLORADO LIMITED LIABILITY COMPANY, AND SEMCO, LLC, A COLORADO LIMITED LIABILITY COMPANY, BEING THE OWNERS OF THE LAND DESCRIBED HEREIN HAVE CAUSED SAID LAND TO BE PLATTED UNDER THE NAME OF LONGMONT BUSINESS CENTER – REPLAT H, AND DEDICATE TO THE PUBLIC FOREVER ALL PUBLIC STREETS AND RIGHT-OF-WAYS, EASEMENTS, AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USES ON THIS PLAT. ALL CONDITIONS, TERMS, AND SPECIFICATIONS DESIGNATED OR DESCRIBED ON THIS DOCUMENT SHALL BE BINDING ON THE OWNERS, THEIR HEIRS, SUCCESSORS AND ASSIGNS.

IN WITNESS WHEREOF, WE HAVE HEREUNTO SET OUR HANDS AND SEALS THIS 6TH DAY OF JUNE, 20 16

FOR: TRIUMPH INVESTMENTS LLC, A COLORADO LIMITED LIABILITY COMPANY, OWNER

BY: _____
DON MACY, MANAGER

FOR: SEMCO, LLC, A COLORADO LIMITED LIABILITY COMPANY, OWNER

BY: _____
DON MACY, MANAGER

NOTARY CERTIFICATE

STATE OF Colo)
) SS.
COUNTY OF Boulder)

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 6th DAY OF June, 2016, BY DON MACY AS MANAGER OF TRIUMPH INVESTMENTS LLC.

MY COMMISSION EXPIRES: 12/2/17

_____
NOTARY PUBLIC

PAMELA S ANGEL
Notary Public
State of Colorado
Notary ID 19934018313
My Commission Expires Dec 2 2017

ADDRESS OF NOTARY: Longmont, CO

NOTARY CERTIFICATE

STATE OF Colo)
) SS.
COUNTY OF Boulder)

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 6th DAY OF June, 2016, BY DON MACY AS MANAGER OF SEMCO, LLC.

MY COMMISSION EXPIRES: 12/2/17

_____
NOTARY PUBLIC

PAMELA S ANGEL
Notary Public
State of Colorado
Notary ID 19934018313
My Commission Expires Dec 2 2017

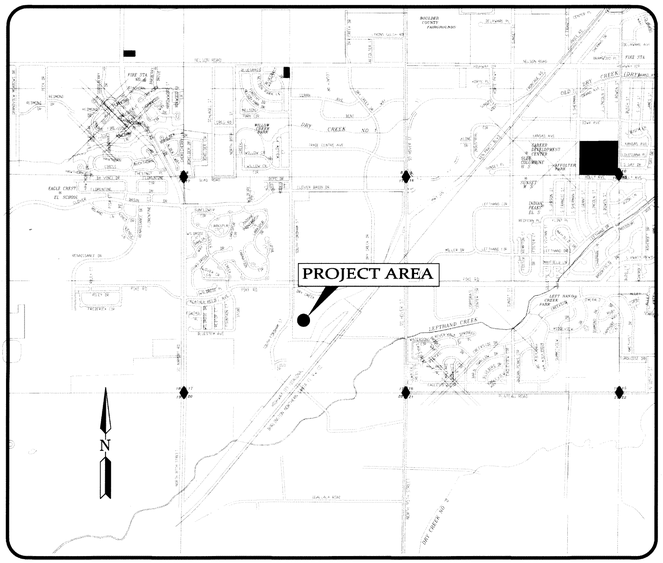
ADDRESS OF NOTARY: Longmont, CO

COMPLIANCE STATEMENT

THE OWNER OF THIS PROPERTY SHALL COMPLY WITH THE APPLICABLE DEVELOPMENT CODE REQUIREMENTS AS SET FORTH IN THE CITY OF LONGMONT MUNICIPAL CODE.

FLOODPLAIN STATEMENT

THE SUBJECT PROPERTY LIES WITHIN ZONE X (AREAS DETERMINED TO BE OUTSIDE THE 0.2% PERCENT ANNUAL CHANCE FLOODPLAIN), SHADED ZONE X (AREAS OF 0.2% ANNUAL CHANCE FLOOD) AND ZONE AE (BASE FLOOD ELEVATIONS DETERMINED), AS SHOWN ON F.I.R.M. PANEL #08013 C 0269J, WITH AN EFFECTIVE DATE OF DECEMBER 18, 2012.



VICINITY MAP
Not to scale

PUBLIC WORKS APPROVAL

THE FINAL CONSTRUCTION PLANS, INCLUDING STREET PLANS AND PROFILES AND DRAINAGE PLANS, HAVE BEEN APPROVED AND ARE SUBSTANTIATED BY AN EXECUTED PUBLIC IMPROVEMENT AGREEMENT.

_____
PUBLIC WORKS

FIRE APPROVAL

THIS PLAT HAS BEEN APPROVED

_____
FIRE

RAW WATER POLICY, UTILITY PLAN AND EASEMENT APPROVAL

THIS PLAT IS IN COMPLIANCE WITH THE CITY OF LONGMONT RAW WATER POLICY AND THE FINAL UTILITY PLANS HAVE BEEN APPROVED. UTILITY EASEMENTS FOR WATER, SANITARY SEWER AND ELECTRIC FACILITIES ARE ADEQUATE AS SHOWN.

_____ _____
WATER / UTILITIES LONGMONT POWER AND COMMUNICATIONS

PLANNING DIRECTOR APPROVAL

APPROVED THIS 7th DAY OF June, 20 16

_____
PLANNING DIRECTOR

OWNERSHIP AND MAINTENANCE TABLE

I.D.	AREA (acres)	USE(S)	OWNERSHIP	MAINTENANCE
OUTLOT A	0.64 ACRES	PEDESTRIAN, LANDSCAPE, SIGNAGE	TRIUMPH INVESTMENTS LLC	FRH&W HOA
OUTLOT B	0.48 ACRES	PEDESTRIAN, LANDSCAPE, SIGNAGE, XCEL EASEMENT	TRIUMPH INVESTMENTS LLC	FRH&W HOA
OUTLOT P	2.59 ACRES	STORM SEWER, DRAINAGE, LANDSCAPE, XCEL EASEMENT	TRIUMPH INVESTMENTS LLC	FRH&W HOA
OUTLOT R	0.76 ACRES	EMERGENCY ACCESS, PEDESTRIAN, UTILITIES, STORM SEWER AND DRAINAGE, XCEL EASEMENT	TRIUMPH INVESTMENTS LLC	FRH&W HOA
OUTLOT S	0.87 ACRES	PEDESTRIAN, LANDSCAPE, STORM SEWER, UTILITIES	TRIUMPH INVESTMENTS LLC	FRH&W HOA

GENERAL NOTES

1. NOTICE: ANY PERSON WHO KNOWINGLY REMOVES, ALTERS OR DEFACES ANY PUBLIC LAND SURVEY MONUMENT, OR LAND BOUNDARY MONUMENT OR ACCESSORY, COMMITS A CLASS 2 MISDEMEANOR PURSUANT TO STATE STATUTE 18-4-508 C.R.S.

2. NOTICE: ACCORDING TO COLORADO LAW YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT IN THIS SURVEY BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.

3. THE LINEAR UNIT OF MEASUREMENT FOR THIS SUBDIVISION PLAT IS THE U.S. SURVEY FOOT.

4. ZONING: THE SUBJECT PROPERTY IS CURRENTLY ZONED "BL-I" (BUSINESS LIGHT-INDUSTRIAL), AS DEFINED BY THE CITY OF LONGMONT LAND DEVELOPMENT CODE.

5. THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY POWER SURVEYING, INC. FOR INFORMATION REGARDING BOUNDARY, EASEMENTS AND TITLE, POWER SURVEYING, INC. RELIED UPON THE FOLLOWING TITLE COMMITMENT ISSUED BY COMMONWEALTH LAND TITLE INSURANCE COMPANY:

COMMITMENT No. A451-H0407019-266-NCS, WITH AN EFFECTIVE DATE OF JULY 21, 2015 AT 7:00 A.M.

6. LONGMONT POWER & COMMUNICATIONS (LPC) EASEMENTS WILL BE CREATED BY SEPARATE DOCUMENT.

7. THE PROPERTY OWNERS' ASSOCIATION IS RESPONSIBLE FOR MAINTAINING ALL LANDSCAPING ON ADJACENT RIGHTS-OF-WAY AS SHOWN ON THE APPROVED LANDSCAPE PLAN.

8. PROPERTY OWNER AGREES TO INDEMNIFY AND HOLD HARMLESS THE CITY AND ITS OFFICERS AND EMPLOYEES FROM ANY AND ALL SUITS, CLAIMS, DAMAGES, LIABILITY OR COURT AWARDS, INCLUDING COSTS AND ATTORNEY FEES THAT ARE OR MAY BE AWARDED AS A RESULT OF ANY LOSS, INJURY OR DAMAGE SUSTAINED OR CLAIMED TO HAVE BEEN SUSTAINED BY ANYONE INCLUDING BUT NOT LIMITED TO ANY PERSON, FIRM, PARTNERSHIP OR CORPORATION IN CONNECTION WITH OR ARISING FROM PROPERTY OWNER'S RELEASE OF STORM DRAINAGE FROM THE SITE.

BASIS OF BEARINGS

SOUTH 89°33'43" EAST, BEING THE BEARING OF THE NORTH LINE OF THE SOUTHEAST QUARTER (SE 1/4) OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE SIXTH PRINCIPAL MERIDIAN, AS DEFINED AND MEASURED BETWEEN THE MONUMENTS FOUND AND SHOWN HEREON.

NOTE: THE GRID BEARING OF THE NORTH LINE OF SAID SOUTHEAST QUARTER (SE 1/4), AS BASED ON STATE PLANE COORDINATES, COLORADO NORTH ZONE 0501, IS SOUTH 89°49'34" EAST, WITH A PUBLISHED GRID INVERSE DISTANCE OF 2642.58'.

SURVEYOR'S CERTIFICATE

"I CERTIFY THIS PLAT ACCURATELY REPRESENTS THE RESULTS OF A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION AND COMPLETED ACCORDING TO APPLICABLE STATE OF COLORADO REQUIREMENTS."

_____
RICHARD B. GABRIEL
L.S. COLORADO REG. NO. 37929

COLORADO LICENSED 37929 PROFESSIONAL LAND SURVEYOR

6.6.16

MAYOR'S CERTIFICATE

THIS IS TO CERTIFY THAT THIS FINAL PLAT OF THE ABOVE DESCRIBED PROPERTY WAS APPROVED BY THE CITY OF LONGMONT AND THAT THE MAYOR OF THE CITY OF LONGMONT, COLORADO, ACCEPTS ALL PUBLIC STREETS, EASEMENTS, RIGHTS-OF-WAY AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USE FOR ALL PURPOSES INDICATED ON THIS PLAT.

_____ _____ (SEAL)
MAYOR ATTEST:

CITY OF LONGMONT COLORADO

CLERK & RECORDER'S CERTIFICATE

STATE OF COLORADO)
) SS.
COUNTY OF BOULDER)

I HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED IN MY OFFICE AT 8:14:15 O'CLOCK A.M., THIS 9th DAY OF June A.D., 2016, AND IS RECORDED IN PLAN FILE _____, RECEPTION No. 03523012.

_____ _____
DEPUTY RECORDER

$31.00
FEES

POWER Surveying Company, Inc.
Established 1948
150 W. 84TH AVENUE
THORNTON, COLORADO 80260
PH. 303-702-1617
FAX. 303-702-1486
WWW.POWERSURVEYING.COM

TYPE OF SUBMITTAL:	FINAL PLAT
PREPARATION DATE:	NOV 2015
REVISION DATE:	JAN 2016
REVISION DATE:	FEB 25, 2016
REVISION DATE:	MAY 11, 2016
JOB NO. 501-15-070	DWG: 501-15-070.dwg

Sheet 1 of 3

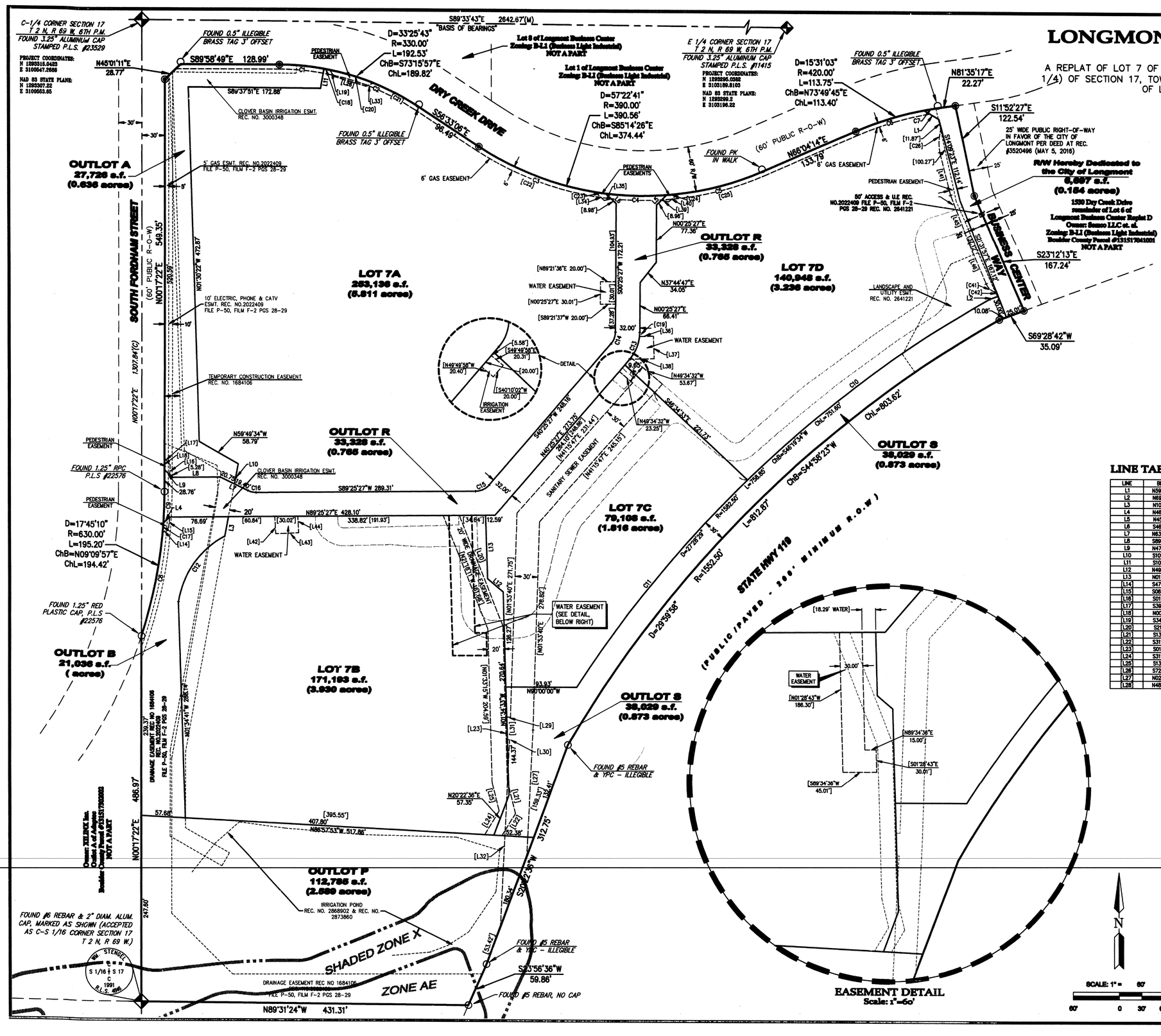
1238

LONGMONT BUSINESS CENTER - REPLAT H

FINAL PLAT

A REPLAT OF LOT 7 OF LONGMONT BUSINESS CENTER, LYING WITHIN THE SOUTHEAST QUARTER (SE 1/4) OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE SIXTH PRINCIPAL MERIDIAN, CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO

SHEET 2 OF 3



CURVE	RADIUS	DELTA	LENGTH	CHORD BRG	CHORD LENGTH
C1	330.00'	10°14'06"	58.95'	N84°51'46"W	58.87'
C2	330.00'	23°11'37"	133.59'	N68°08'55"W	132.68'
C3	390.00'	26°21'03"	179.35'	S69°43'57"E	177.79'
C4	390.00'	11°44'46"	79.95'	S88°46'31"E	79.81'
C5	390.00'	19°16'53"	131.24'	N75°42'39"E	130.63'
C6	420.00'	12°55'29"	94.74'	S72°31'59"W	94.54'
C7	420.00'	2°35'34"	19.01'	S80°17'30"W	19.00'
C8	630.00'	13°56'12"	153.24'	N11°04'28"E	152.86'
C9	630.00'	3°48'56"	41.98'	N02°11'51"E	41.95'
C10	1582.50'	14°32'28"	401.62'	S52°47'35"W	400.55'
C11	1582.50'	12°56'01"	357.22'	S39°03'20"W	356.47'
C12	118.73'	53°27'30"	110.78'	S35°01'32"W	106.80'
C13	56.00'	40°00'00"	39.10'	N20°25'27"E	38.31'
C14	24.00'	40°00'00"	16.76'	N20°25'27"E	16.42'
C15	24.00'	49°00'00"	20.53'	N64°55'27"E	19.91'
C16	24.00'	27°00'00"	11.31'	S77°04'33"E	11.21'
C17	630.00'	1°13'25"	13.45'	N04°43'02"E	13.45'
C18	330.00'	1°17'08"	7.40'	N78°05'09"W	7.40'
C19	56.00'	5°34'35"	5.45'	N03°12'45"E	5.45'
C20	330.00'	10°21'59"	59.71'	N73°16'36"W	59.62'
C21	330.67'	12°03'31"	69.59'	N82°03'51"W	69.46'
C22	390.00'	24°20'42"	165.71'	S88°43'27"E	164.47'
C23	390.00'	2°06'21"	13.85'	S81°53'58"E	13.85'
C24	389.95'	2°11'27"	14.91'	N84°19'23"E	14.91'
C25	390.00'	17°05'28"	116.33'	N74°36'58"E	115.90'
C26	75.68'	25°04'08"	33.11'	S02°55'49"W	32.85'
C27	17.00'	89°58'46"	26.70'	S46°33'57"E	24.04'
C28	34.40'	58°58'54"	35.41'	N53°07'40"E	33.87'
C29	44.00'	28°20'17"	20.23'	S27°14'58"W	20.05'
C30	13.00'	69°55'00"	15.86'	S84°31'57"E	14.90'
C31	13.00'	58°56'58"	13.36'	N14°21'30"E	12.79'
C32	39.55'	68°13'02"	47.09'	S20°54'25"W	44.36'
C33	6.00'	87°23'42"	9.15'	S26°34'52"W	8.28'
C34	35.00'	64°08'40"	39.18'	N16°57'21"E	37.17'
C35	36.37'	79°38'04"	50.76'	S86°59'18"E	46.74'
C36	13.00'	90°00'00"	20.42'	S85°25'27"W	18.38'
C37	50.49'	71°15'02"	62.79'	N53°27'20"E	58.82'
C38	40.88'	90°19'40"	64.44'	S46°33'57"E	57.97'
C39	44.32'	56°10'45"	43.33'	S52°52'57"E	41.62'
C40	8.00'	90°00'00"	12.57'	S46°34'33"E	11.31'
C41	21.10'	45°19'53"	16.69'	S46°17'24"E	16.28'
C42	27.57'	5°49'45"	2.80'	N61°45'59"W	2.80'

LINE TABLE

LINE	BEARING	LENGTH
L1	N59°09'23"W	22.92'
L2	N69°28'42"E	12.03'
L3	N10°24'03"E	26.05'
L4	N46°44'39"E	11.55'
L5	N45°11'59"E	18.75'
L6	S46°27'34"E	19.11'
L7	N63°34'33"W	40.16'
L8	S89°25'27"W	61.91'
L9	N47°50'17"W	14.63'
L10	S10°24'03"W	27.37'
L11	S10°15'22"W	28.40'
L12	N49°34'33"W	27.01'
L13	N01°34'33"W	84.34'
L14	S47°03'50"W	10.86'
L15	S08°24'25"W	14.01'
L16	S01°43'31"W	13.14'
L17	S39°35'58"E	11.36'
L18	N00°17'22"E	15.62'
L19	S34°51'09"E	10.65'
L20	S21°18'11"E	157.59'
L21	S13°14'59"E	45.38'
L22	S31°14'36"W	34.36'
L23	S01°33'15"E	206.03'
L24	S31°14'36"W	36.91'
L25	S13°14'59"E	36.25'
L26	S72°33'00"E	43.26'
L27	N02°55'09"E	169.33'
L28	N48°44'13"W	30.00'
L29	S87°04'51"E	5.00'
L30	S87°04'51"E	2.92'
L31	S01°34'33"E	30.09'
L32	N02°55'09"E	249.99'
L33	N64°57'37"E	10.78'
L34	S46°56'13"E	16.26'
L35	N76°15'26"E	9.24'
L36	S88°26'14"W	18.09'
L37	N01°33'46"W	30.00'
L38	N88°26'14"E	31.90'
L39	S76°45'58"E	9.73'
L40	N49°12'15"E	16.26'
L41	S13°33'24"E	58.67'
L42	S02°51'25"E	23.08'
L43	N87°08'35"E	30.00'
L44	N02°51'25"W	21.89'
L45	S20°34'16"E	69.16'
L46	S22°55'08"E	58.30'
L47	N89°24'28"E	95.58'
L48	N88°04'10"E	38.94'
L52	S89°26'40"W	33.55'
L53	S17°29'22"W	49.23'
L54	S12°02'35"W	13.51'
L55	S14°36'15"W	44.53'
L56	S40°25'15"W	34.82'
L57	S49°34'33"E	70.87'
L58	N49°34'33"W	43.16'
L59	N49°34'27"W	76.69'
L60	N49°34'27"W	3.62'
L61	N49°34'27"W	37.00'
L62	N49°34'27"W	8.43'
L63	S49°42'56"W	4.01'
L64	S80°05'11"W	23.92'
L65	S53°07'56"W	54.73'
L66	S53°06'02"W	53.39'
L67	S15°06'53"E	57.96'
L68	S72°16'43"W	24.53'
L69	S88°25'27"W	23.02'
L70	S88°26'19"W	25.69'
L71	S72°16'43"W	21.58'
L72	S15°06'52"E	51.88'
L73	S15°06'59"E	4.46'
L74	S55°49'44"W	62.87'
L75	S52°06'19"W	13.56'
L76	S48°34'37"W	43.34'
L77	N49°34'19"W	53.94'
L78	N49°34'33"W	4.81'
L79	S40°25'27"W	12.71'
L80	S40°25'27"W	77.46'
L81	S28°32'36"W	8.89'
L82	S88°24'59"W	30.75'
L83	N01°34'21"W	5.78'
L84	S88°26'37"W	50.93'
L85	N85°48'06"W	40.84'
L86	S88°25'43"W	65.28'
L87	N00°34'33"W	14.04'
L88	S01°34'33"E	8.02'

LEGEND OF SYMBOLS & ABBREVIATIONS

- ○ MONUMENT FOUND, AS NOTED
- ◉ SET REBAR & 1-1/2" DIAMETER YELLOW PLASTIC CAP, PLS 37929, TYPICAL UNLESS NOTED OTHERWISE
- (C) CALCULATED
- (M) MEASURED
- LOT 7 LOT NUMBER
- (R) RECORD
- EXISTING RECORD EASEMENT LINE
- NEW EASEMENT GRANTED PER THIS PLAT (DIMENSIONED IN [ ] BRACKETS)
- NEW LOT LINE PER THIS PLAT
- ADJOINING PARCEL OR LOT LINE
- CENTER LINE
- PUBLIC LANDS SURVEY SECTION LINE
- PLAT BOUNDARY LIMITS

POWER™ Surveying Company, Inc.
Established 1948
120 W. 84TH AVENUE
THORNTON, COLORADO 80260
PH. 303-703-1017
FAX. 303-703-1486
WWW.POWERSURVEYING.COM

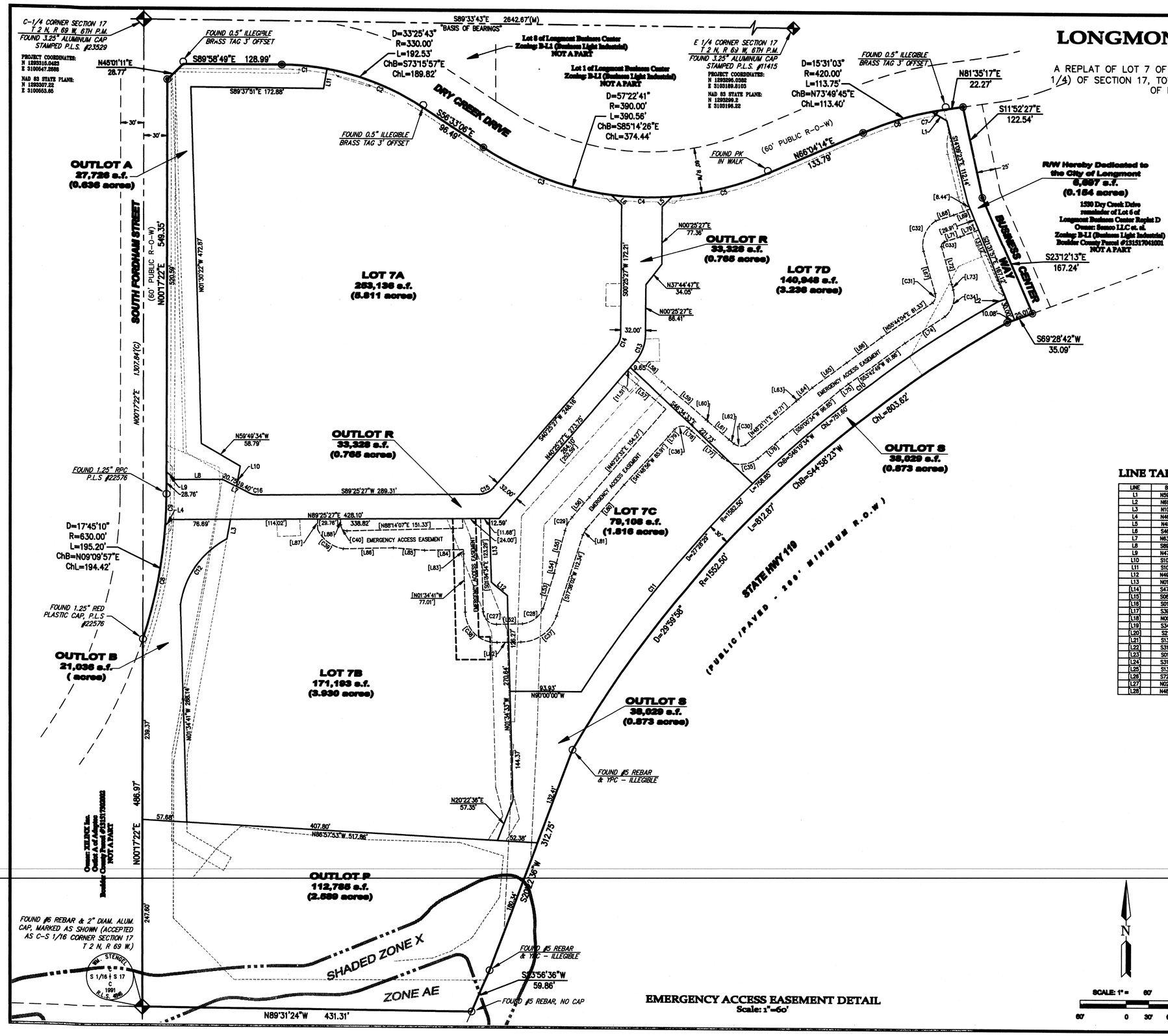
TYPE OF SUBMITTAL:	FINAL PLAT
PREPARATION DATE:	NOV 2015
REVISION DATE:	JAN 2016
REVISION DATE:	FEB 25, 2016
REVISION DATE:	MAY 11, 2016
JOB NO. 501-15-070	DWG: 501-15-070

LONGMONT BUSINESS CENTER - REPLAT H

FINAL PLAT

A REPLAT OF LOT 7 OF LONGMONT BUSINESS CENTER, LYING WITHIN THE SOUTHEAST QUARTER (SE 1/4) OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE SIXTH PRINCIPAL MERIDIAN, CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO

SHEET 3 OF 3



LINE TABLE

LINE	BEARING	LENGTH
L1	N59°09'23"W	22.92'
L2	N69°26'42"E	12.03'
L3	N10°24'03"E	26.05'
L4	N46°44'39"E	11.55'
L5	N45°11'56"E	18.75'
L6	S46°27'34"E	19.11'
L7	N63°34'33"W	40.16'
L8	S89°25'27"W	61.91'
L9	N47°50'17"W	14.63'
L10	S10°24'03"W	27.37'
L11	S10°15'22"W	26.40'
L12	N49°34'33"W	27.01'
L13	N01°34'33"W	84.34'
L14	S47°03'50"W	10.86'
L15	S06°24'25"W	14.01'
L16	S01°43'31"W	13.14'
L17	S39°35'56"E	11.36'
L18	N00°17'22"E	15.62'
L19	S34°31'09"E	10.65'
L20	S21°15'11"E	157.59'
L21	S13°14'59"E	45.38'
L22	S31°14'36"W	34.36'
L23	S01°33'15"E	206.03'
L24	S31°14'36"W	36.91'
L25	S13°14'59"E	36.25'
L26	S72°33'00"E	43.28'
L27	N02°55'09"E	169.33'
L28	N48°44'13"W	30.00'

LINE	BEARING	LENGTH
L29	S87°04'51"E	5.00'
L30	S87°04'51"E	2.92'
L31	S01°34'33"E	30.09'
L32	N02°55'09"E	249.99'
L33	N64°57'37"E	10.76'
L34	S46°56'13"E	16.28'
L35	N76°15'28"E	9.24'
L36	S88°26'14"W	18.09'
L37	N01°33'46"W	30.00'
L38	N88°26'14"E	31.90'
L39	S76°45'56"E	9.73'
L40	N49°12'15"E	16.26'
L41	S13°33'24"E	58.67'
L42	S02°51'25"E	23.08'
L43	N87°06'35"E	30.00'
L44	N02°51'25"W	21.89'
L45	S20°34'16"E	69.16'
L46	S22°55'08"E	58.30'
L47	N89°24'28"E	95.56'
L48	N86°04'10"E	38.94'
L49	S88°25'40"W	33.55'
L53	S17°29'22"W	49.23'
L54	S12°02'35"W	13.51'
L55	S14°36'15"W	44.53'
L56	S40°23'15"W	34.82'
L57	S49°34'33"E	70.67'
L58	N49°34'33"W	43.16'
L59	N49°34'27"W	76.69'

LINE	BEARING	LENGTH
L60	N49°34'27"W	3.62'
L61	N49°34'27"W	37.00'
L62	N49°34'27"W	8.43'
L63	S49°42'56"W	4.01'
L64	S50°03'11"W	23.92'
L65	S53°07'56"W	54.73'
L66	S53°09'02"W	53.39'
L67	S15°06'53"E	57.96'
L68	S72°16'43"W	24.53'
L69	S88°25'27"W	23.02'
L70	S66°26'19"W	25.69'
L71	S72°16'43"W	21.58'
L72	S15°06'52"E	51.88'
L73	S15°06'59"E	4.48'
L74	S55°49'44"W	62.87'
L75	S52°08'19"W	13.56'
L76	S48°34'37"W	43.34'
L77	N49°34'19"W	53.94'
L78	N49°34'33"W	4.81'
L79	S40°25'27"W	12.71'
L80	S40°25'27"W	77.48'
L81	S28°32'38"W	8.89'
L82	S88°24'59"W	30.75'
L83	N01°34'21"W	5.78'
L84	S88°26'37"W	50.93'
L85	N85°48'08"W	40.84'
L86	S86°25'43"W	65.28'
L87	N00°34'33"W	14.04'
L88	S01°34'33"E	8.02'

CURVE	RADIUS	DELTA	LENGTH	CHORD BRG	CHORD LENGTH
C1	330.00'	10°14'06"	58.95'	N84°51'48"W	58.87'
C2	330.00'	23°11'37"	133.59'	N68°08'25"W	132.68'
C3	390.00'	26°21'03"	179.38'	S89°43'37"E	177.79'
C4	390.00'	11°44'46"	79.95'	S86°46'31"E	79.81'
C5	390.00'	19°18'53"	131.24'	N75°42'39"E	130.63'
C6	420.00'	12°30'29"	94.74'	S72°31'59"W	94.54'
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C8	630.00'	13°56'12"	153.24'	N11°04'28"E	152.88'
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C11	1582.50'	12°58'01"	357.22'	S39°03'20"W	356.47'
C12	118.73'	53°27'30"	110.78'	S35°01'32"W	106.80'
C13	56.00'	40°00'00"	39.10'	N20°25'27"E	38.31'
C14	24.00'	40°00'00"	16.76'	N20°25'27"E	16.42'
C15	24.00'	49°00'00"	20.53'	N84°55'27"E	19.91'
C16	24.00'	27°00'00"	11.31'	S77°04'33"E	11.21'
C17	630.00'	1°13'25"	13.45'	N04°43'02"E	13.45'
C18	330.00'	1°17'08"	7.40'	N79°06'08"W	7.40'
C19	56.00'	5°34'35"	5.45'	N03°12'45"E	5.45'
C20	330.00'	10°21'59"	59.71'	N73°16'38"W	59.62'
C21	330.00'	12°03'31"	69.59'	N82°03'51"W	69.46'
C22	390.00'	24°20'42"	165.71'	S68°43'27"E	164.47'
C23	390.00'	2°00'21"	13.65'	S81°53'58"E	13.65'
C24	389.95'	2°11'27"	14.91'	N84°15'23"E	14.91'
C25	390.00'	17°00'28"	116.33'	N74°36'58"E	115.90'
C26	75.68'	25°04'06"	33.11'	S02°55'49"W	32.85'
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C28	34.40'	58°56'54"	35.41'	N53°07'40"E	33.87'
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C31	13.00'	58°56'58"	13.38'	N14°21'30"E	12.79'
C32	39.55'	68°13'02"	47.09'	S20°54'25"W	44.36'
C33	6.00'	87°23'42"	9.15'	S28°34'52"W	8.29'
C34	35.00'	64°08'40"	39.18'	N16°57'21"E	37.17'
C35	36.37'	79°58'04"	50.76'	S86°59'18"E	46.74'
C36	13.00'	90°00'00"	20.42'	S85°25'27"E	18.38'
C37	50.49'	71°15'02"	62.79'	N53°27'20"E	58.82'
C38	40.88'	90°19'40"	64.44'	S46°33'57"E	57.97'
C39	44.32'	56°00'45"	43.33'	S52°52'57"E	41.62'
C40	8.00'	90°00'00"	12.57'	S46°34'33"E	11.31'
C41	21.10'	45°19'53"	16.69'	S46°17'24"E	16.26'
C42	27.57'	5°49'45"	2.80'	N61°45'59"W	2.80'

LEGEND OF SYMBOLS & ABBREVIATIONS

- ○ — MONUMENT FOUND, AS NOTED
- ◉ — SET REBAR & 1-1/2" DIAMETER YELLOW PLASTIC CAP, PLS 37929, TYPICAL UNLESS NOTED OTHERWISE
- (C) — CALCULATED
- (M) — MEASURED
- LOT 7 — LOT NUMBER
- (R) — RECORD
- ---------- — EXISTING RECORD EASEMENT LINE
- — — — — — NEW EASEMENT GRANTED PER THIS PLAT (DIMENSIONED IN [ ] BRACKETS)
- ———— NEW LOT LINE PER THIS PLAT
- — — — — ADJOINING PARCEL OR LOT LINE
- ——— — ——— CENTER LINE
- ——— — — ——— PUBLIC LANDS SURVEY SECTION LINE
- ———— PLAT BOUNDARY LIMITS

N

SCALE: 1" = 60'

60' 0 30' 60'

EMERGENCY ACCESS EASEMENT DETAIL
Scale: 1"=60'

POWER Surveying Company, Inc.
Established 1948
100 W. 84TH AVENUE
THORNTON, COLORADO 80260
PH. 303-703-1077
FAX. 303-703-1088
WWW.POWERSURVEYING.COM

TYPE OF SUBMITTAL:	FINAL PLAT
PREPARATION DATE:	NOV 2015
REVISION DATE:	JAN 2016
REVISION DATE:	FEB 25, 2016
REVISION DATE:	MAY 11, 2016
JOB NO. 501-15-070	DWG: 501-15-070

Sheet 3 of 3

1238

945

Subdivision Plat

FINAL PLAT

XILINX, FIRST FILING

A PART OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 17,
TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M.,
CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO,
CONTAINS 25.82 ACRES MORE OR LESS.

SHEET 1 OF 2

MAYORS CERTIFICATE:

THIS IS TO CERTIFY THAT A PLAT OF THE ABOVE DESCRIBED PROPERTY WAS APPROVED BY THE CITY OF LONGMONT AND THAT THE MAYOR OF THE CITY OF LONGMONT, COLORADO, ACCEPTS ALL PUBLIC STREETS, EASEMENTS, RIGHTS-OF-WAY AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USE FOR ALL PURPOSES INDICATED HEREON.

MAYOR ATTEST: (SEAL)

EASEMENT APPROVAL:

UTILITY EASEMENTS ARE ADEQUATE AS SHOWN AND ARE HEREBY APPROVED:

U.S. WEST COMMUNICATIONS

PUBLIC SERVICE COMPANY OF COLORADO

UTILITIES APPROVAL:

THE REQUIRED WATER RIGHTS AND/OR NECESSARY CASH PAYMENT HAVE BEEN TRANSFERRED TO THE CITY OF LONGMONT AND THE FINAL UTILITY PLANS HAVE BEEN APPROVED. UTILITY EASEMENTS ARE ADEQUATE AS SHOWN.

WATER/SEWER UTILITIES

ELECTRIC UTILITIES

PUBLIC WORKS APPROVAL:

THE FINAL STREET PLANS AND PROFILES AND DRAINAGE PLANS HAVE BEEN APPROVED AND ARE SUBSTANTIATED BY AN EXECUTED MEMORANDUM OF AGREEMENT FOR PUBLIC IMPROVEMENTS.

PUBLIC WORKS DIVISION

PLANNING DIRECTOR:

APPROVED THIS 24TH DAY OF MAY, 2000.

PLANNING DIRECTOR

OUTLOT DESCRIPTION

OUTLOT A – PRIVATE OPEN SPACE TO BE OWNED AND MAINTAINED BY THE OWNERS ASSOCIATION

SURVEYOR'S CERTIFICATE

I, JAMES PECK, DO HEREBY CERTIFY THIS PLAT ACCURATELY REPRESENTS THE RESULTS OF A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION AND DONE IN ACCORDANCE WITH APPLICABLE STATE OF COLORADO LAWS.

JAMES M. PECK, COLORADO REGISTERED
PROFESSIONAL LAND SURVEYOR NO. 29425

4/12/00
DATE

PLAT NOTES:

1) BASIS OF BEARINGS IS THE SOUTH LINE OF THE SOUTHEAST 1/4 OF THE SOUTHWEST 1/4 OF SECTION 17 BEARS N 89°53'26" W BETWEEN THE FOUND MONUMENTS SHOWN AND DESCRIBED HEREON.

2) ACCORDING TO COLORADO LAW YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.

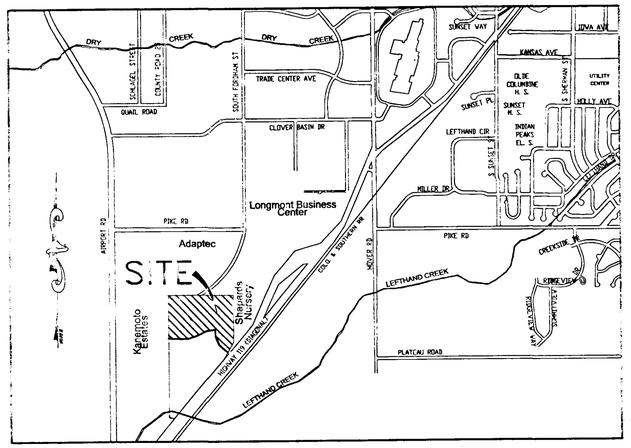
3) THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY EASTLAKE SURVEYING COMPANY TO DETERMINE OWNERSHIP OR TO VERIFY THE DESCRIPTION SHOWN HEREON, OR THE COMPATIBILITY OF THIS DESCRIPTION WITH THAT OF ADJACENT TRACTS, OR EASEMENTS OF RECORD.

4) THERE WILL BE NO INDIVIDUAL LOT ACCESS TO STATE HIGHWAY 119.

5) ALL STREETS AND DRAINAGE IMPROVEMENTS NOT IN THE PUBLIC RIGHT-OF-WAY ARE TO BE MAINTAINED BY THE PROPERTY OWNER.

FLOODPLAIN STATEMENT

A PORTION OF THE SITE LIES WITHIN THE LEFT HAND CREEK'S FLOOD PLAIN. LIMITS AS SHOWN HEREON TAKEN FROM ALTA SURVEY PREPARED BY OTHERS AND IS NOT A PART OF THE SURVEYOR'S CERTIFICATE HEREON.



VICINITY MAP

PROPERTY DESCRIPTION

A TRACT OF LAND LOCATED IN THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 17, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M., CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT A FOUND STONE MONUMENT MARKING THE SOUTHEAST CORNER OF SAID SOUTHWEST QUARTER OF SECTION 17; THENCE N 89°53'26" W ALONG THE SOUTH LINE OF THE SOUTHEAST QUARTER OF SAID SOUTHWEST QUARTER SECTION 17, 195.90 FEET TO A FOUND NO. 4 REBAR WITH 1 INCH PLASTIC CAP LS 17485 MARKING A POINT ON THE NORTHWESTERLY RIGHT OF WAY LINE OF STATE HIGHWAY NO. 19 AS ESTABLISHED IN FEBRUARY 1974 AND AS EVIDENCED BY EXISTING FENCE LINES;
THENCE NORTHEASTERLY ALONG SAID NORTHWESTERLY RIGHT OF WAY LINE ALONG THE ARC OF A CURVE TO THE LEFT HAVING A RADIUS OF 5534.58 FEET, A CENTRAL ANGLE OF 02°09'55", A DISTANCE OF 209.17 FEET, THE LONG CHORD OF WHICH BEARS N 30°28'50" E, 209.15 FEET TO THE POINT OF BEGINNING;

THENCE DEPARTING SAID RIGHT-OF-WAY LINE N 49°19'13" W, 190.97 FEET;
THENCE N 41°31'40" W, 70.06 FEET;
THENCE N 24°47'18" W 90.35 FEET;
THENCE ALONG THE ARC OF A CURVE TO THE RIGHT HAVING A RADIUS OF 410.00 FEET, A CENTRAL ANGLE OF 18°00'27", A DISTANCE OF 128.86 FEET, THE LONG CHORD OF WHICH BEARS N 15°47'05" W, 128.33 FEET;
THENCE N 06°46'51" W, 104.90 FEET;
THENCE S 78°18'43" W, 156.82 FEET;
THENCE S 64°09'09" W, 278.11 FEET;
THENCE S 70°22'39" W, 156.49 FEET;
THENCE N 89°56'15" W, 410.29 FEET TO A POINT ON THE WEST LINE OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SAID SECTION 17;
THENCE N 00°21'07" E ALONG SAID WEST LINE, 852.58 FEET TO A FOUND NO. 6 REBAR WITH 2-1/2 INCH ALUMINUM CAP LS 19588 MARKING THE NORTHWEST CORNER OF THE SOUTHEAST QUARTER OF SAID SOUTHWEST QUARTER OF SECTION 17;
THENCE S 89°42'39" E ALONG THE NORTH LINE OF THE SOUTHEAST QUARTER OF SAID SOUTHWEST QUARTER OF SECTION 17, 1330.59 FEET TO A FOUND NO. 5 REBAR WITH 2-1/2 INCH ALUMINUM CAP LS 4846 MARKING THE NORTHEAST CORNER OF THE SOUTHEAST QUARTER OF SAID SOUTHWEST 1/4 SECTION 17;
THENCE S 00°21'00" W ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SOUTHWEST QUARTER SECTION 17, 857.26 FEET TO A FOUND NO. 4 REBAR WITH 1 INCH PLASTIC CAP LS 17485 MARKING A POINT ON THE NORTHWESTERLY RIGHT OF WAY LINE OF STATE HIGHWAY NO. 119 AS ESTABLISHED IN FEBRUARY 1974 AND AS EVIDENCED BY EXISTING FENCE LINES;
THENCE SOUTHWESTERLY ALONG SAID RIGHT OF WAY LINE ALONG THE ARC OF A CURVE TO THE RIGHT, NON-TANGENT TO THE LAST DESCRIBED COURSE, HAVING A RADIUS OF 5534.58 FEET, A CENTRAL ANGLE OF 02°00'06", A DISTANCE OF 193.36 FEET, THE LONG CHORD OF WHICH BEARS S 28°23'49" W, 193.35 FEET TO THE POINT OF BEGINNING;
CONTAINING 25.82 ACRES, MORE OR LESS.

TOTAL ACREAGE OF THIS PLAT:

25.82 ACRES MORE OR LESS.

CLERK AND RECORDER'S CERTIFICATE:

STATE OF COLORADO)
) SS
COUNTY OF BOULDER)

I, HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED IN MY OFFICE AT 9:14 O'CLOCK A.M., THIS 6TH DAY OF JUNE A.D. 2000, AND IS RECORDED IN PLAN FILE —, FILM —, RECEPTION NO. 2051212. P-51 F-1 #34 #35

Catherine Connell
DEPUTY

Charlotte Houston
RECORDER

$10.00
FEES

DEDICATION:

KNOW ALL MEN BY THESE PRESENTS, THAT XILINX, INC. BEING THE SOLE OWNER OF THE LAND DESCRIBED HEREIN, HAS CAUSED SAID LAND TO BE PLATTED UNDER THE NAME OF "XILINX FIRST FILING", AND DO HEREBY DEDICATE TO THE PUBLIC FOREVER ALL PUBLIC STREETS AND RIGHT-OF-WAYS, EASEMENTS AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USES. ALL CONDITIONS, TERMS AND SPECIFICATIONS DESIGNATED OR DESCRIBED HEREIN SHALL BE BINDING ON THE OWNER, HIS HEIRS, SUCCESSORS AND ASSIGNS.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND SEAL THIS 13 DAY OF April, 2000.

XILINX, INC.

NOTARIAL CERTIFICATE:

STATE OF COLORADO)
) SS
COUNTY OF BOULDER)

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 13TH DAY OF April, 2000.

MY COMMISSION EXPIRES 10-06-01

NOTARY PUBLIC

4300 Baseline Rd E104
ADDRESS
Boulder, CO 80303

2051212
PAM
06/06/2000 14:
03.00 D 0.00

Boulder County Clerk, CO

P-51 F-1 #34 (1 OF 2)

XILINX, FIRST FILING
A PART OF THE SE1/4 SW1/4 SECTION 17, T2N, R69W 6TH P.M.,
COUNTY OF BOULDER, STATE OF COLORADO.

eastlake surveying company
PO BOX 1143 12520 FIRST STREET EASTLAKE, CO 80614 303-252-8881

SCALE:	1" = 100'
FILE NO.	2041FP01
DATE:	4/4/00

945

M200

945

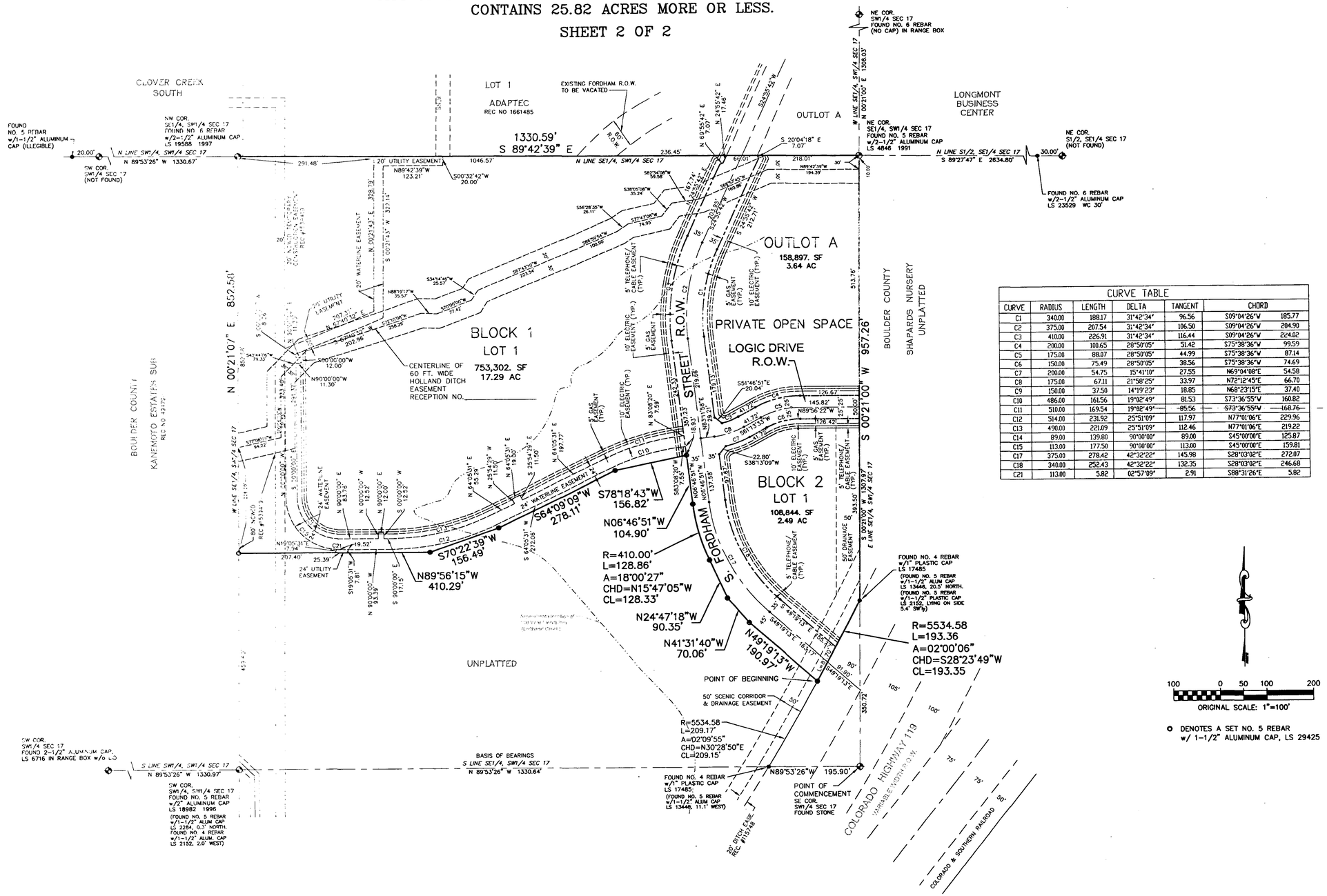
Subdivision Plat

FINAL PLAT

XILINX, FIRST FILING

A PART OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 17,
TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M.,
CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO,
CONTAINS 25.82 ACRES MORE OR LESS.

SHEET 2 OF 2



CURVE TABLE						
CURVE	RADIUS	LENGTH	DELTA	TANGENT	CHORD	
C1	340.00	188.17	31°42'34"	96.56	S09°04'26"W	185.77
C2	375.00	207.54	31°42'34"	106.50	S09°04'26"W	204.90
C3	410.00	226.91	31°42'34"	116.44	S09°04'26"W	224.02
C4	200.00	100.65	28°50'05"	51.42	S75°38'36"W	99.59
C5	175.00	88.07	28°50'05"	44.99	S75°38'36"W	87.14
C6	150.00	75.49	28°50'05"	38.56	S75°38'36"W	74.69
C7	200.00	54.75	15°41'10"	27.55	N69°04'08"E	54.58
C8	175.00	67.11	21°58'25"	33.97	N72°12'45"E	66.70
C9	150.00	37.50	14°19'23"	18.85	N68°23'15"E	37.40
C10	486.00	161.56	19°02'49"	81.53	S73°36'55"W	160.82
C11	510.00	169.54	19°02'49"	-85.56	S73°36'55"W	-168.76
C12	514.00	231.92	25°51'09"	117.97	N77°01'06"E	229.96
C13	490.00	221.09	25°51'09"	112.46	N77°01'06"E	219.22
C14	89.00	139.80	90°00'00"	89.00	S45°00'00"E	125.87
C15	113.00	177.50	90°00'00"	113.00	S45°00'00"E	159.81
C17	375.00	278.42	42°32'22"	145.98	S28°03'02"E	272.07
C18	340.00	252.43	42°32'22"	132.35	S28°03'02"E	246.68
C21	113.00	5.82	02°57'09"	2.91	S88°31'26"E	5.82

P-51 F-1 #35 (2 OF 2)

XILINX, FIRST FILING
A PART OF THE SE1/4 SW1/4 SECTION 17, T2N, R69W 6TH P.M., COUNTY OF BOULDER, STATE OF COLORADO.

eastlake surveying company
PO BOX 1143 12520 FIRST STREET EASTLAKE, CO 80614 303-252-8881

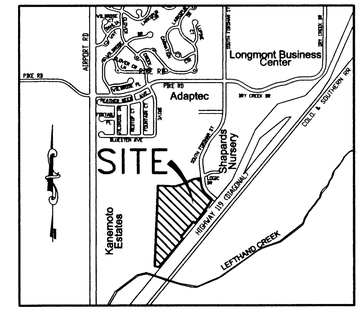
SCALE:	1" = 100'
FILE NO.	2041FP01
DATE:	4/4/00

945

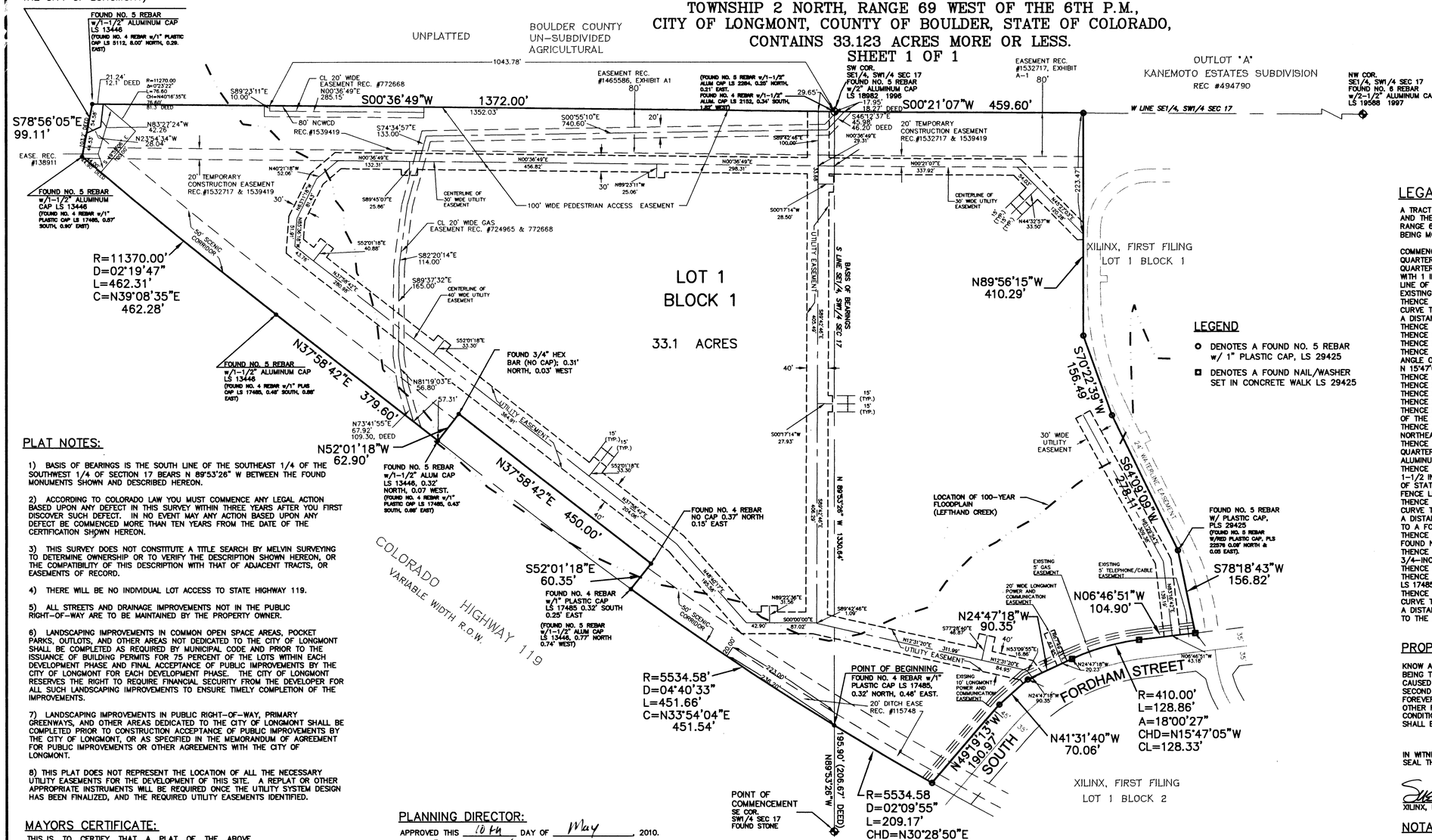
FINAL PLAT
XILINX, SECOND FILING

A PART OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 17, AND THE NORTHEAST QUARTER OF THE NORTHWEST QUARTER OF SECTION 20, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M., CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO, CONTAINS 33.123 ACRES MORE OR LESS.

SHEET 1 OF 1



VICINITY MAP



PLAT NOTES:

1) BASIS OF BEARINGS IS THE SOUTH LINE OF THE SOUTHEAST 1/4 OF THE SOUTHWEST 1/4 OF SECTION 17 BEARS N 89°53'26" W BETWEEN THE FOUND MONUMENTS SHOWN AND DESCRIBED HEREON.

2) ACCORDING TO COLORADO LAW YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.

3) THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY MELVIN SURVEYING TO DETERMINE OWNERSHIP OR TO VERIFY THE DESCRIPTION SHOWN HEREON, OR THE COMPATIBILITY OF THIS DESCRIPTION WITH THAT OF ADJACENT TRACTS, OR EASEMENTS OF RECORD.

4) THERE WILL BE NO INDIVIDUAL LOT ACCESS TO STATE HIGHWAY 119.

5) ALL STREETS AND DRAINAGE IMPROVEMENTS NOT IN THE PUBLIC RIGHT-OF-WAY ARE TO BE MAINTAINED BY THE PROPERTY OWNER.

6) LANDSCAPING IMPROVEMENTS IN COMMON OPEN SPACE AREAS, POCKET PARKS, OUTLOTS, AND OTHER AREAS NOT DEDICATED TO THE CITY OF LONGMONT SHALL BE COMPLETED AS REQUIRED BY MUNICIPAL CODE AND PRIOR TO THE ISSUANCE OF BUILDING PERMITS FOR 75 PERCENT OF THE LOTS WITHIN EACH DEVELOPMENT PHASE AND FINAL ACCEPTANCE OF PUBLIC IMPROVEMENTS BY THE CITY OF LONGMONT FOR EACH DEVELOPMENT PHASE. THE CITY OF LONGMONT RESERVES THE RIGHT TO REQUIRE FINANCIAL SECURITY FROM THE DEVELOPER FOR ALL SUCH LANDSCAPING IMPROVEMENTS TO ENSURE TIMELY COMPLETION OF THE IMPROVEMENTS.

7) LANDSCAPING IMPROVEMENTS IN PUBLIC RIGHT-OF-WAY, PRIMARY GREENWAYS, AND OTHER AREAS DEDICATED TO THE CITY OF LONGMONT SHALL BE COMPLETED PRIOR TO CONSTRUCTION ACCEPTANCE OF PUBLIC IMPROVEMENTS BY THE CITY OF LONGMONT, OR AS SPECIFIED IN THE MEMORANDUM OF AGREEMENT FOR PUBLIC IMPROVEMENTS OR OTHER AGREEMENTS WITH THE CITY OF LONGMONT.

8) THIS PLAT DOES NOT REPRESENT THE LOCATION OF ALL THE NECESSARY UTILITY EASEMENTS FOR THE DEVELOPMENT OF THIS SITE. A REPLAT OR OTHER APPROPRIATE INSTRUMENTS WILL BE REQUIRED ONCE THE UTILITY SYSTEM DESIGN HAS BEEN FINALIZED, AND THE REQUIRED UTILITY EASEMENTS IDENTIFIED.

MAYORS CERTIFICATE:

THIS IS TO CERTIFY THAT A PLAT OF THE ABOVE DESCRIBED PROPERTY WAS APPROVED BY THE CITY OF LONGMONT AND THAT THE MAYOR OF THE CITY OF LONGMONT, COLORADO, ACCEPTS ALL PUBLIC STREETS, EASEMENTS, RIGHTS-OF-WAY AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USE FOR ALL PURPOSES INDICATED HEREON.

MAYOR ATTEST: (SEAL)

COMMUNICATION AND GAS EASEMENT APPROVAL:

UTILITY EASEMENTS ARE ADEQUATE AS SHOWN AND ARE HEREBY APPROVED:

U.S. WEST COMMUNICATIONS

PUBLIC SERVICE COMPANY OF COLORADO

UTILITIES APPROVAL:

THIS PLAT IS IN COMPLIANCE WITH THE CITY OF LONGMONT RAW WATER POLICY AND THE FINAL UTILITY PLANS HAVE BEEN APPROVED. (REFER TO NOTE 8 ON THIS SHEET IN REGARDS TO THE LOCATION OF UTILITY EASEMENTS ON THE PLAT).

WATER/SEWER UTILITIES

LONGMONT POWER AND COMMUNICATIONS 5-3-10

PLANNING DIRECTOR:

APPROVED THIS 10th DAY OF May, 2010.

PLANNING DIRECTOR

PUBLIC WORKS APPROVAL:

THE FINAL STREET PLANS AND PROFILES AND DRAINAGE PLANS HAVE BEEN APPROVED AND ARE SUBSTANTIATED BY AN EXECUTED MEMORANDUM OF AGREEMENT FOR PUBLIC IMPROVEMENTS.

PUBLIC WORKS DIVISION

SURVEYOR'S CERTIFICATE

I, KIM A. ALBERS, DO HEREBY CERTIFY THIS PLAT ACCURATELY REPRESENTS THE RESULTS OF A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION AND DONE IN ACCORDANCE WITH APPLICABLE STATE OF COLORADO LAWS.

KIM A. ALBERS, COLORADO REGISTERED PROFESSIONAL LAND SURVEYOR NO. 25614

4/1/2010 DATE

OUTLOT DESCRIPTION

A THE PORTION OF LEFT HAND CREEK PRIMARY GREENWAY REQUIRED FOR DEDICATION TO THE CITY OF LONGMONT (OUTLOT A) IS RESERVED. THIS AREA WILL BE DEDICATED TO THE CITY OF LONGMONT UPON THE DEVELOPMENT OF THE ADJACENT PROPERTIES TO THE WEST AND SOUTH OF THE GREENWAY OR WHEN THE CITY REQUESTS DEDICATION, WHICHEVER IS PREFERRED BY THE CITY.

FLOODPLAIN STATEMENT

THIS PROPERTY IS PARTIALLY WITHN THE 100 YEAR FLOODPLAIN AS PER FIRM FLOOD INSURANCE RATE MAP No. 08013C0269 F, EFFECTIVE DATE JUNE 2, 1995, REVISED TO REFLECT LOMR DATED MAY 14 1999. THE BASE FLOOD ELEVATION IN THIS REGION IS APPROXIMATELY 5010 AND 5016.

THE LOWEST OCCUPIED FLOOR ELEVATION FOR THIS PROJECT IS 5022. GARAGE ELEVATIONS ARE PROPOSED AT 5008 AND 5011, BUT WILL NOT BE SUBJECT TO INUNDATION BY THE AFOREMENTIONED FLOODPLAIN. ADDITIONALLY, THESE GARAGE LEVELS WILL CONTAIN NO OCCUPIED SPACE.

CLERK AND RECORDER'S CERTIFICATE:

STATE OF COLORADO) SS
COUNTY OF BOULDER)

I, HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED IN MY OFFICE AT ____ O'CLOCK __M., THIS 31st DAY OF May A.D. 2010., AND IS RECORDED IN PLAN FILE ____, FILM ____, RECEPTION NO. 3076110 Fee: $ 11.00

Copy DEPUTY

Copy RECORDER

$11.00 FEES

LEGAL DESCRIPTION:

A TRACT OF LAND LOCATED IN THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 17 AND THE NORTHEAST QUARTER OF THE NORTHWEST QUARTER OF SECTION 20, TOWNSHIP 2 NORTH, RANGE 69 WEST OF THE 6TH P.M., CITY OF LONGMONT, COUNTY OF BOULDER, STATE OF COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT A FOUND STONE MONUMENT MARKING THE SOUTHEAST CORNER OF SAID SOUTHWEST QUARTER OF SECTION 17; THENCE N 89°53'26" W ALONG THE SOUTH LINE OF THE SOUTHEAST QUARTER OF SAID SOUTHWEST QUARTER OF SECTION 17, 195.90 FEET TO A FOUND NO. 4 REBAR WITH 1 INCH PLASTIC CAP LS 17485 MARKING A POINT ON THE NORTHWESTERLY RIGHT OF WAY LINE OF STATE HIGHWAY NO. 119 AS ESTABLISHED IN FEBRUARY 1974 AND AS EVIDENCED BY EXISTING FENCE LINES, THE POINT OF BEGINNING;
THENCE NORTHEASTERLY ALONG SAID NORTHWESTERLY RIGHT OF WAY LINE ALONG THE ARC OF A CURVE TO THE LEFT HAVING A RADIUS OF 5534.58 FEET, A CENTRAL ANGLE OF 02°09'55", A DISTANCE OF 209.17 FEET, THE LONG CHORD OF WHICH BEARS N 30°28'50" E, 209.15 FEET;
THENCE DEPARTING SAID RIGHT-OF-WAY LINE N 49°19'13" W, 190.97 FEET;
THENCE N 41°31'40" W, 70.06 FEET;
THENCE N 24°47'18" W 90.35 FEET;
THENCE ALONG THE ARC OF A CURVE TO THE RIGHT HAVING A RADIUS OF 410.00 FEET, A CENTRAL ANGLE OF 18°00'27", A DISTANCE OF 128.86 FEET, THE LONG CHORD OF WHICH BEARS N 15°47'05" W, 128.33 FEET;
THENCE N 06°46'51" W, 104.90 FEET;
THENCE S 78°18'43" W, 156.82 FEET;
THENCE S 64°09'09" W, 278.11 FEET;
THENCE S 70°22'39" W, 156.49 FEET;
THENCE N 89°56'15" W, 410.29 FEET TO A POINT ON THE WEST LINE OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SAID SECTION 17;
THENCE ALONG SAID WEST LINE S 00°21'07" W, 459.60 FEET TO THE NORTHWEST CORNER OF THE NORTHEAST QUARTER OF THE NORTHWEST QUARTER OF SECTION 20;
THENCE S 00°36'49" W ALONG THE WEST LINE OF SAID NORTHWEST QUARTER OF THE NORTHEAST QUARTER OF SECTION 20, 1372.00 FEET TO A FOUND NO. 5 REBAR WITH 1-1/2 INCH ALUMINUM CAP LS 13446;
THENCE DEPARTING SAID WEST LINE S 78°56'05" E, 99.11 FEET TO A FOUND NO. 5 REBAR WITH 1-1/2 INCH ALUMINUM CAP LS 13446 MARKING A POINT ON THE NORTHWESTERLY RIGHT OF WAY LINE OF STATE HIGHWAY NO. 119 AS ESTABLISHED IN FEBRUARY 1974 AND AS EVIDENCED BY EXISTING FENCE LINES;
THENCE NORTHEASTERLY ALONG SAID NORTHWESTERLY RIGHT OF WAY LINE ALONG THE ARC OF A CURVE TO THE LEFT HAVING A RADIUS OF 11370.00 FEET, A CENTRAL ANGLE OF 02°19'47", A DISTANCE OF 462.31 FEET, THE LONG CHORD OF WHICH BEARS N 39°08'35" E, 462.28 FEET TO A FOUND NO. 5 REBAR WITH 1-1/2 INCH ALUMINUM CAP LS 13446;
THENCE CONTINUING ALONG SAID RIGHT-OF-WAY LINE N 37°58'42" E, 379.60 FEET TO A FOUND NO. 4 REBAR WITH 1 INCH PLASTIC CAP LS 17485;
THENCE DEPARTING SAID RIGHT-OF-WAY LINE N 52°01'18" W, 62.90 FEET TO A FOUND 3/4-INCH HEX BAR;
THENCE N 37°58'42" E, 450.00 FEET TO A FOUND NO. 5 REBAR;
THENCE S 52°01'18" E, 60.35 FEET TO A FOUND NO. 4 REBAR WITH 1 INCH PLASTIC CAP LS 17485 MARKING A POINT ON SAID NORTHWESTERLY RIGHT OF WAY LINE OF STATE HIGHWAY NO. 119;
THENCE NORTHEASTERLY ALONG SAID NORTHWESTERLY RIGHT OF WAY LINE ALONG THE ARC OF A CURVE TO THE LEFT HAVING A RADIUS OF 5534.58 FEET, A CENTRAL ANGLE OF 04°40'33", A DISTANCE OF 451.66 FEET, THE LONG CHORD OF WHICH BEARS N 33°54'04" E, 451.54 FEET TO THE POINT OF BEGINNING; CONTAINING 33.123 ACRES, MORE OR LESS.

PROPERTY OWNER DEDICATION AND ACKNOWLEDGEMENT:

KNOW ALL MEN BY THESE PRESENTS, THAT XILINX, INC, BEING THE SOLE OWNER OF THE LAND DESCRIBED HEREIN, HAS CAUSED SAID LAND TO BE PLATTED UNDER THE NAME OF "XILINX SECOND FILING", AND DO HEREBY DEDICATE TO THE PUBLIC FOREVER ALL PUBLIC STREETS AND RIGHT-OF-WAYS, EASEMENTS AND OTHER PLACES DESIGNATED OR DESCRIBED AS FOR PUBLIC USES. ALL CONDITIONS, TERMS AND SPECIFICATIONS DESIGNATED OR DESCRIBED HEREIN SHALL BE BINDING ON THE OWNER, HIS HEIRS, SUCCESSORS AND ASSIGNS.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND SEAL THIS 9 DAY OF April, 2010.

Susan Mesch
XILINX, INC.

NOTARIAL CERTIFICATE:

STATE OF COLORADO) SS
COUNTY OF BOULDER)

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 9 DAY OF April 2010

MY COMMISSION EXPIRES 8/27/2012

Kathi Commodore
NOTARY PUBLIC
1157 Spruce Ave
ADDRESS
Boulder, CO 80304

SCALE
100 0 50 100 200
ORIGINAL SCALE: 1"=100'

TRUE POSITION LAND SURVEYING			
1202 FALL RIVER CIRCLE LONGMONT, COLORADO 80501 1-303-702-0868			
FINAL PLAT XILINX, SECOND FILING			
JOB NO 204-1	DATE 04/1/08	CAD NO 2041FP02	SHEET NO 1 OF 1

115

From: Salamack, Kristin A
To: L"Orange, Pete
Subject: [EXTERNAL] Referral Memo for Docket SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects
Date: Monday, January 23, 2023 3:20:33 PM
Attachments: image001.png

Hello Pete L'Orange,

I have the following comments after reviewing the 1041 application on behalf of the Colorado Field Office, Ecological Services, for the U.S. Fish and Wildlife Service:

1. Western prairie-fringed orchid is included on Table 5 (p. 49) as "moderate" potential to occur in the project area. I wanted to clarify that there are no populations or individuals of this plant species within Colorado; the reason it appears on IPaC for the USFWS is due to the fact that this species occurs downstream along the South Platte River and any depletions to this river could result in adverse effects to the species downstream in Nebraska.
2. Figure 9 (p. 50) shows Preble's "habitat" and I think it would be helpful if the Figure indicated where that habitat layer comes from. I think it's Boulder County's habitat layer and just wanted to make the point that this is not all-encompassing and there is potentially suitable Preble's habitat in other areas of Boulder County not shown on that map.

Please let me know if there are any questions, thanks!

Kristin Salamack **(she/her/hers)**
CDOT/USFWS Liaison
Colorado Ecological Services Field Office
134 Union Blvd, Lakewood, CO 80228
Office: 303/236-4748 II Mobile: 518/441-2827

COLORADO
Department of Transportation
Division of Transportation Development

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.bouldercounty.org**

MEMO TO: Agencies and adjacent property owners
FROM: Pete L'Orange, Staff Planner
DATE: January 12, 2023
RE: **Docket SI-22-0002**

Docket SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

Request: Areas and Activities of State Interest (1041) review for combined projects along Colorado Highway 119 (CO 119) related to safety and mobility improvements and construction of a bikeway from approximately 47th Street/Foothills Parkway in the City of Boulder to milepost 54.2 in the City of Longmont.

Location: Colorado Highway 119 (CO 119) from approximately 47th Street/Foothills Parkway, Boulder, to milepost 54.2, Longmont, in Sections 2, 3, 9, 10, 11, 15, and 16 of T1N, R70W; Sections 25, 35, and 36 of T2N, R70W; and Sections 17, 19, 20, and 30 of T2N, R69W.

Zoning: Agricultural, Rural Residential, Commercial, Light Industrial, Niwot Rural Community Districts I and II

Applicants: Colorado Department of Transportation c/o Adnana Murtic and Boulder County Community Planning & Permitting c/o Stacy Proctor, and Regional Transportation District c/o Ali Imansepahi

This process includes public hearings before the Board of County Commissioners and may include a public hearing before the Boulder County Planning Commission. Adjacent property owners and holders of liens, mortgages, easements or other rights in the subject property are notified of these hearings.

The Community Planning & Permitting staff, Planning Commission, and County Commissioners value comments from individuals and referral agencies. Please check the appropriate response below or send a letter to the Community Planning & Permitting Department at P.O. Box 471, Boulder, Colorado 80306 or via email to **plorange@bouldercounty.org.** All comments will be made part of the public record and given to the applicant.

You may view or download the application materials at **www.boco.org/docket-si-22-0002.**

You are welcome to call the Community Planning & Permitting Department at 303-441-3930 to request more information. If you have any questions regarding this application, please contact the Community Planning & Permitting office at **303-441-1418** or via email at **plorange@bouldercounty.org**.

As required per article 8-508(C)1.a, referral responses must be returned within 14 days or **January 26, 2023**.
*As noted in section 8-508(C)1.b, an extension may be expressly granted by the Director.

_____ We have reviewed the proposal and have no conflicts.
__x__ Letter is enclosed.
Signed Martin Harders PRINTED Name Martin Harders
Agency or Address Left Hand Water District
Date 1/20/2023

Left Hand Water District

January 20, 2023

Pete L'Orange
Community Planning and Permitting
P.O. Box 471
Boulder, CO 80306
RE: SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

Mr. L'Orange:

Left Hand Water District owns and maintains multiple waterlines within the limits of construction for this project. These lines feed hundreds of our customers and include multiple critical transmission lines. We ask that the designer and the County show the depth of our lines on the profile drawings, explain how our customers will be kept in service during the project, and show any reconfigurations needed to maintain adequate coverage/separation. Any outage or reconfiguration of our existing lines will require our prior approval.

Please contact me with any questions or concerns.

Sincerely,

Martin Harders

Martin Harders
Civil Engineer II
Left Hand Water District
(303) 530-4200

From: Hester, Renee
To: Milner, Anna; L"Orange, Pete
Subject: [EXTERNAL] RE: Referral Memo for Docket SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects
Date: Monday, January 23, 2023 12:52:07 PM
Attachments: image001.png
HWY 119 BIKE PATH LUMEN FACILITIES PT 1.pptx

Anna and Pete,

Please see the attached Powerpoint of Lumen/Century Link facilities which are in conflict with the Bikeway Paving project.

I am sending in 2 parts as the file is large.

Lumen/Century Link also recommends that locates are done for all facilities for your project to ensure safety and protection of all facilities.

Thanks…
Renee Hester
Network Implementation Engineer
5325 Zunit St.
Denver, CO 80221
Tel: 720-738-2778
renee.hester@lumen.com

From: Milner, Anna <amilner@bouldercounty.org>
Sent: Thursday, January 12, 2023 7:15 AM
To: crossbill@boulderaudubon.org; info@niwot.com; landuse@niwot.org; bwarren@niwotlaw.com; kathyboco@gmail.com; info@niwothistoricalsociety.org; pmurphy@niwotrealty.com; Steve Buckbee <sbuckbee@lefthandwater.org>; chrissmith@lefthandwater.org; LPC@longmontcolorado.gov; morgan@pvrea.com; jstruble@northernwater.org; bflockhart@northernwater.org; BDRCO@xcelenergy.com; Donna.L.George@xcelenergy.com; Hester, Renee <Renee.Hester@lumen.com>; theboss@cushmancattle.com; lscriptercpa@gmail.com; bouldergeoservices@gmail.com; niwotfarms@aol.com; djhindman1229@msn.com; tlongseth@msn.com; Alexander, Robert <ralexander@bouldercounty.org>; theboss@cushmancattle.com; vtfarms@skybeam.com; angie@dangrantbookkeeping.com; Bill.boulderwhiterock@gmail.com; Peeples_cody@hotmail.com; RanglosC@bouldercolorado.gov; bonnellj@bouldercolorado.gov; CollinsB@bouldercolorado.gov; CassidyJ@bouldercolorado.gov; ayanna.reed@longmontcolorado.gov; don.burchett@longmontcolorado.gov; glen.segrue@bvsd.org; toillion_scott@svvsd.org; Vanessa McCracken <bldrvalleyandlongmontcds@gmail.com>; joe.padia@state.co.us; dora_puc_website@state.co.us; submittals@udfcd.org; timothy.bilobran@state.co.us; #AssessorReferral <AssessorReferral@bouldercounty.org>; hc_filesearch@state.co.us; kiel.g.downing@usace.army.mil; BMA@bouldercolorado.gov; coloradoes@fws.gov; Amber.Stoffels@BNSF.com; Andy.Williams@BNSF.com; prevention@mvfpd.org; drogers@brfr.org; Lowrey, D <lowreyd@bouldercolorado.gov>; Calderazzo, Mike <calderazzom@bouldercolorado.gov>; Michele.goldman@longmontcolorado.gov; willis2729@hotmail.com; TrioProperty@comcast.net; Hippely, Hannah <hhippely@bouldercounty.org>; Abner, Ethan <eabner@bouldercounty.org>; Vaughn, Andrea

<avaughn@bouldercounty.org>; Sheehan, Jack <jsheehan@bouldercounty.org>; Historic <historic@bouldercounty.org>; #CodeCompliance <codecompliance@bouldercounty.org>; Floodplain Admin <floodplainadmin@bouldercounty.org>; #CAreferral <CAreferral@bouldercounty.org>; #CEreferral <CEreferral@bouldercounty.org>; Johnson, Curtis <cjohnson@bouldercounty.org>; Allshouse, Alycia <aallshouse@bouldercounty.org>; Kiepe, Bob <bkiepe@bouldercounty.org>; Stadele, Lee <leestadele@bouldercounty.org>; Stadele, Lee <leestadele@flagstaffsurveying.com>; Moline, Jeffrey <jmoline@bouldercounty.org>; Strenge, Ernst <estrenge@bouldercounty.org>; Cavaleri, Keli <kcavaleri@bouldercounty.org>; Flax, Ron <rflax@bouldercounty.org>; Goldstein, Andrew <agoldstein@bouldercounty.org>; HealthWaterQuality-EnvironmentalBP LU <HealthWQ-EnvironBPLU@bouldercounty.org>; Huebner, Michelle <mhuebner@bouldercounty.org>; Transportation Development Review <TransDevReview@bouldercounty.org>; West, Ron <rowest@bouldercounty.org>
Cc: L'Orange, Pete <plorange@bouldercounty.org>; Sanchez, Kimberly <ksanchez@bouldercounty.org>; Case, Dale <dcase@bouldercounty.org>; Frederick, Summer <sfrederick@bouldercounty.org>
Subject: Referral Memo for Docket SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects

Please find attached the electronic referral memo for ***SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects***.

Please visit **www.boco.org/docket-si-22-0002** to access the complete application materials.

Please return responses and direct any questions to ***Pete L'Orange*** by ***January 26, 2023.*** (Boulder County internal departments and agencies: Please attach the referral comments in Accela.)

Best Regards,
Anna

Anna Milner | **Admin. Lead Tech.**
Boulder County Community Planning & Permitting
Pronouns: she/her/hers
Physical address: 2045 13th St., Boulder CO 80302
Mailing address: PO Box 471, Boulder, CO 80306
(720) 564-2638 (Direct)
amilner@bouldercounty.org
Service hours are 8 a.m.-4:30 p.m. Monday, Wednesday, Thursday, Friday, and 10 a.m.-4:30 p.m. Tuesday
*My core working hours are 7am-5:30pm Tues - Fri

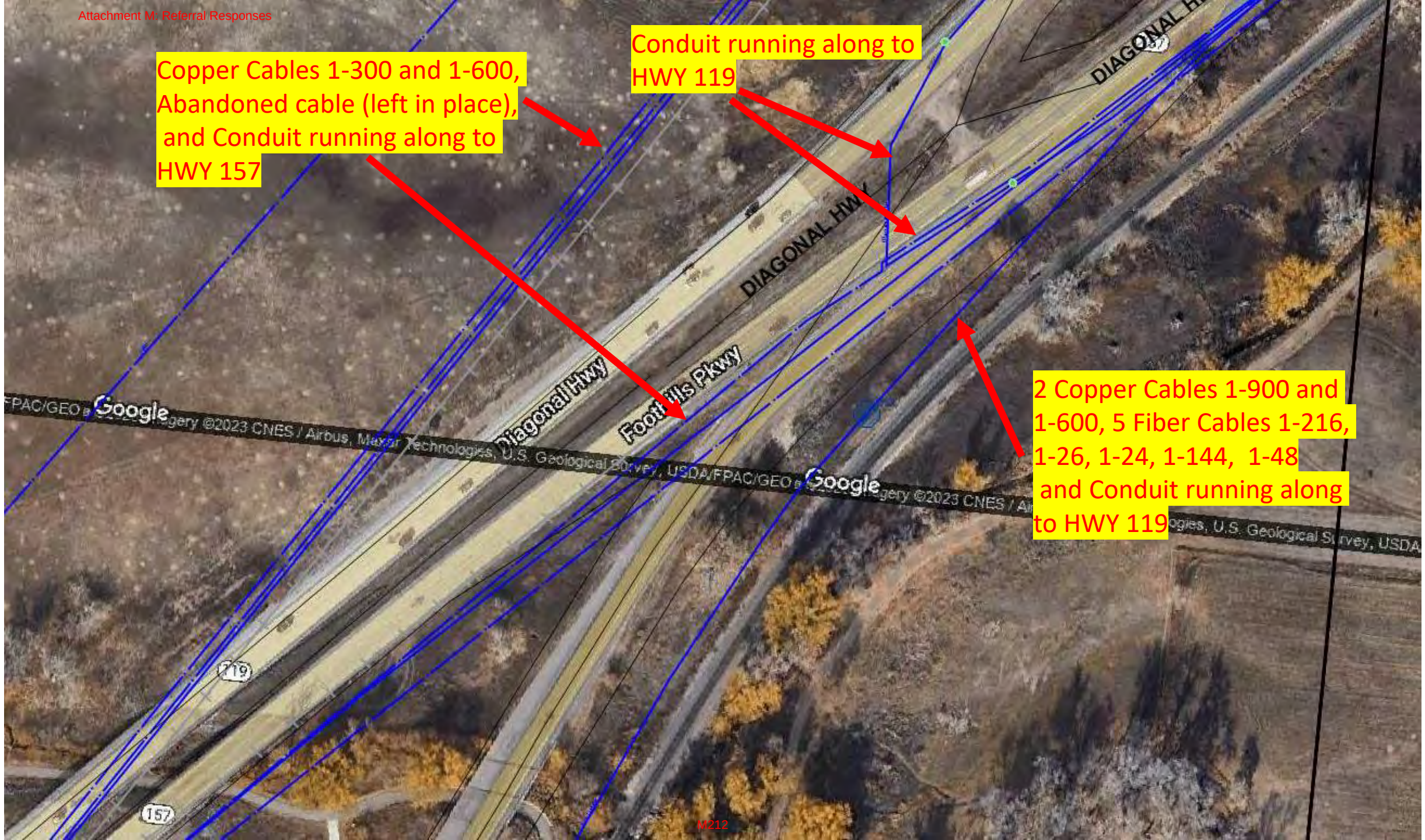
New: Boulder County has a new website: BoulderCounty.gov! Bookmark it today. Email addresses will transition at a later date.

www.bouldercounty.gov

Fiber on the West & Copper on the East are in the area – along with Splice Points


Copper Cable 1-1
Crossing adjacent
to HWY 157
Copper Cables 1-300 and 1-600,
Abandoned cable (left in place),
and Conduit crossing and running along
to HWY 157
157
Foothills Pkwy
DIAGONAL HWY
HWY 119
157
©2023 CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO
Google
©2023 CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO
Google


Copper Cables 1-300 and 1-600, Abandoned cable (left in place), and Conduit running along to HWY 157
719
157
Foothills Pkwy
DIAGONAL HWY
Google

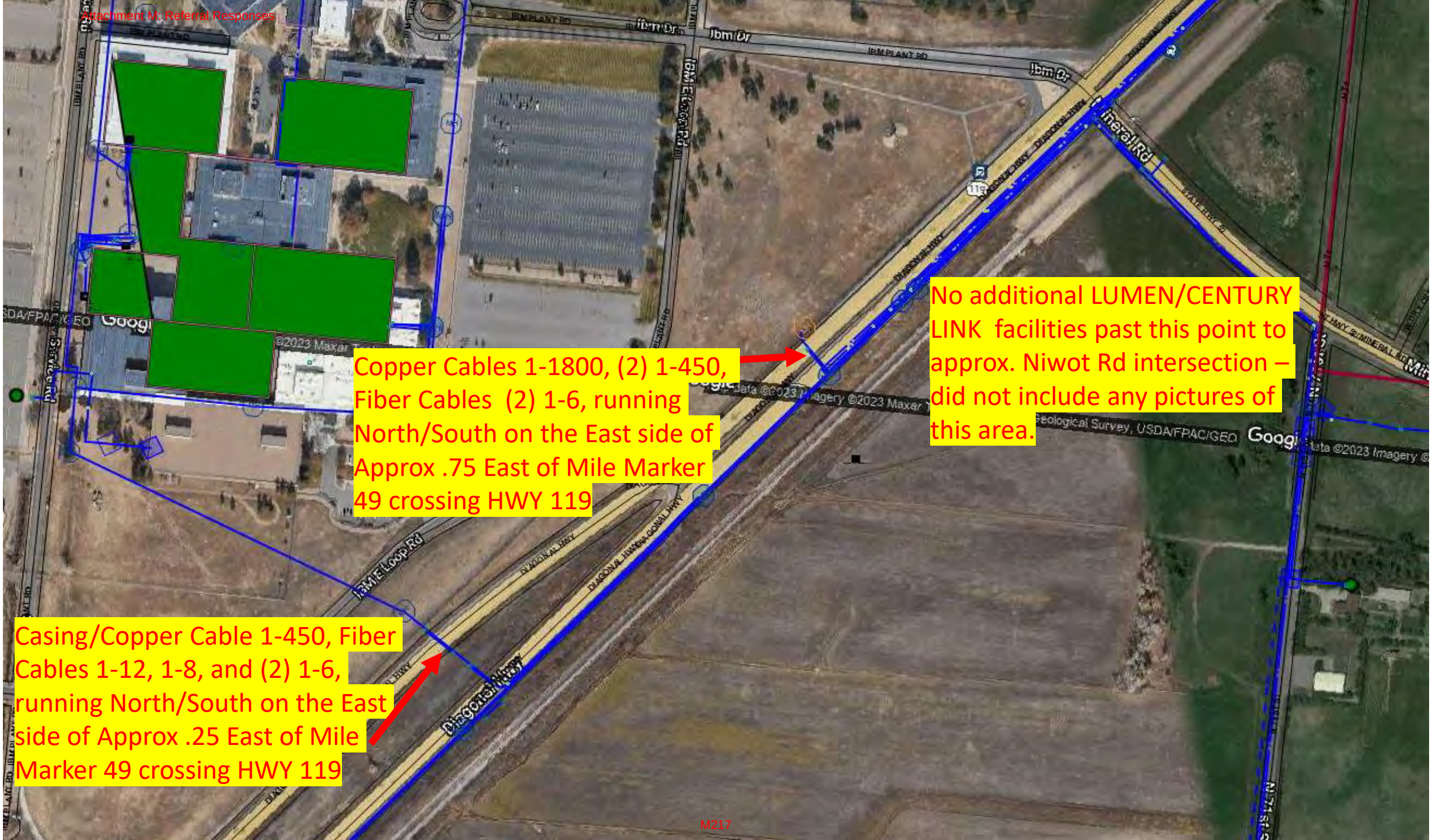

Copper Cables 1-300 and 1-600, Abandoned cable (left in place), and Conduit running along to HWY 157
Conduit running along to HWY 119
2 Copper Cables 1-900 and 1-600, 5 Fiber Cables 1-216, 1-26, 1-24, 1-144, 1-48 and Conduit running along to HWY 119
DIAGONAL HWY
Diagonal Hwy
Foothills Pkwy
Google
Imagery ©2023 CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO
219
157

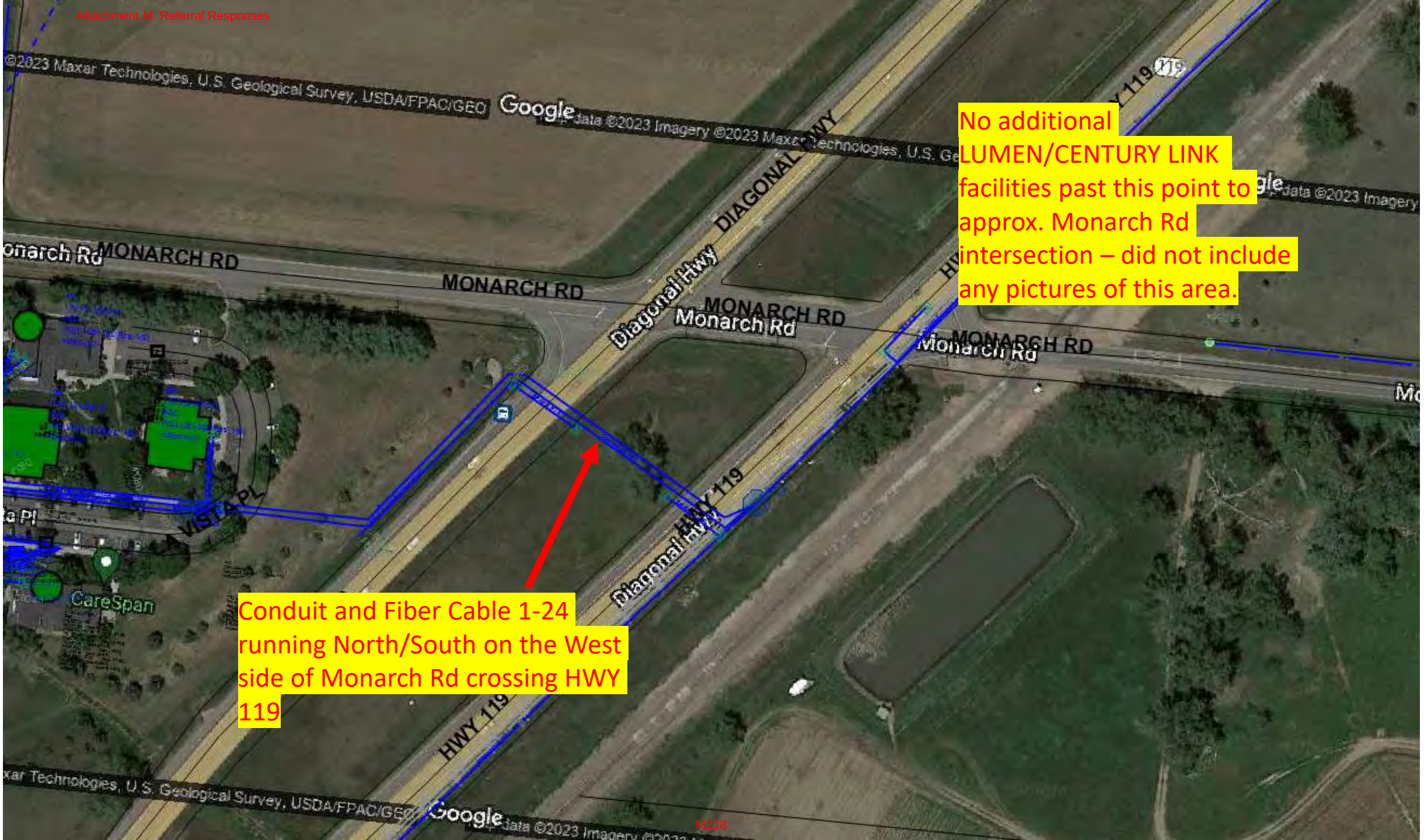

DIAGONAL HWY
DIAGONAL HWY
Foothills Pkwy
Google
Image ©2023 CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO
Google
Image ©2023 CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO
No additional LUMEN/CENTURY LINK facilities past this point to the N. 55th St intersection – did not include any pictures of this area.
Conduit running along to HWY 119


Copper Cable 1-600 North/South on the West side of N 55th St crossing HWY 119
No additional LUMEN/CENTURY LINK facilities past this point to the N. 63rd St intersection – did not include any pictures of this area.
DIAGONAL HWY
N 55
55th St
119
Google
Data ©2023 Imagery ©2023 Maxar Technologies
U.S. Geological Survey, USDA/FPAC/GEO
63rd St


Copper Cable 1-600 running North/South on the East side of N 63rd St crossing HWY 119
No additional LUMEN/CENTURY LINK facilities past this point to approx. 49.25 mile marker intersection – did not include any pictures of this area.
Conduit running North/South on the East side of N 63rd St crossing HWY 119
DIAGONAL HWY
N 63rd St
119
Odell Pl
U.S. Geological Survey, USDA/FPAC/GEO
Google
Data ©2023 Imagery ©2023 Maxar Technologies


No additional LUMEN/CENTURY LINK facilities past this point to approx. 49.25 mile marker intersection – did not include any pictures of this area.
Copper Cable 1-450, Fiber 1-12, Fiber 1-8, and (2) Fibers 1-6, running North/South on the East side of Approx .25 East of Mile Marker 49 crossing HWY 119
Casing running North/South on the East side of Approx .25 East of Mile Marker 49 crossing HWY 119
Service Rd
IBM PLANT RD
DIAGONAL HWY
Google
Data ©2023 Imagery ©2023 Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO


Copper Cables 1-1800, (2) 1-450, Fiber Cables (2) 1-6, running North/South on the East side of Approx .75 East of Mile Marker 49 crossing HWY 119
No additional LUMEN/CENTURY LINK facilities past this point to approx. Niwot Rd intersection – did not include any pictures of this area.
Casing/Copper Cable 1-450, Fiber Cables 1-12, 1-8, and (2) 1-6, running North/South on the East side of Approx .25 East of Mile Marker 49 crossing HWY 119
IBM Dr
IBM PLANT RD
IBM E Loop Rd
Diagonal Hwy
Imperial Rd
©2023 Maxar
USDA/FPAC/GEO


©2023 Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO
Google
Data ©2023 Imagery ©2023 Maxar Technologies, U.S. Ge
MONARCH RD
MONARCH RD
MONARCH RD
MONARCH RD
Monarch Rd
Monarch Rd
Diagonal Hwy
DIAGONAL HWY
HWY 119
Diagonal Hwy
HWY 119
VISTA PL
CareSpan
No additional LUMEN/CENTURY LINK facilities past this point to approx. Monarch Rd intersection – did not include any pictures of this area.
Conduit and Fiber Cable 1-24 running North/South on the West side of Monarch Rd crossing HWY 119


No additional LUMEN/CENTURY LINK facilities past this point to Oxford Rd intersection – did not include any pictures of this area.
Copper Cable 1-100 and East/West the North side of Niwot Rd crossing HWY 119
NIWOT RD
DIAGONAL HWY
HWY 119
ROCK RD
PEPPER TREE DR
NO NAME ST
Google
Data ©2023 Imagery ©2023 Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO


No additional LUMEN/CENTURY LINK facilities past this point to Airport Rd intersection – did not include any pictures of this area
Conduit and Abandoned Copper Cable running East/West the South side of N 83rd St crossing HWY 119
Conduit and Copper Cable 1-200 and East/West on the the North side of Oxford Rd crossing HWY 119
OXFORD RD
HWY 119
Diagonal Hwy
N 83rd St
N 83
Longmont-to-Boulder (LOB
©2023 Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO
Google


Abandoned Copper Cable running North/South on the East side of Airport Rd approx. .25 miles crossing HWY 119
Conduit and Hand Hole running North/South on the East side of Airport Rd crossing HWY 119
No additional LUMEN/CENTURY LINK facilities past this point to S Fordham Rd intersection – did not include any pictures of this area
Left Hand Creek
91 ST
119
Airport Rd
Diagonal Hwy
HWY 119
OGALLALA RD
Google
Imagery ©2023 Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO


No additional LUMEN/CENTURY LINK facilities past this point to S Fordham Rd intersection – did not include any pictures of this area
Fiber Cable 1-48 running North/South on the West side of S Fordham Rd crossing HWY 119
S FORDHAM RD
S Fordham St
Diagonal Hwy
STATE HWY 119
Diagonal Hwy
Longmont-to-Boulder (LOBO) P
Google
Data ©2023 Imagery ©2023 Maxar Technologies, U.S. Geological Survey, USDA/FP
M222


END
No additional LUMEN/CENTURY LINK facilities in this area
STATE HWY 119
Diagonal Hwy
PIKE RD
Google

Community Organizations of Niwot
% Eric Bergeson;
President, Niwot Business Association
PO Box 92
Niwot, CO 80544-0092
ericb@niwotwheelworks.com

15 February 2023

Boulder County Commissioners
Boulder County Planning Commission

Re: Docket SI-22-0002: CO 119 Mobility and Bikeway Projects

Dear Commissioners:

We, the several Niwot community organizations undersigned, wish to express serious concerns relating to the proposed CO 119 mobility and bikeway projects currently under review. We have taken the various opportunities presented to us to understand the current design; and we believe the intersection at Niwot Road and CO 119 will become even more dangerous and even less convenient for a large number of residents in Boulder County unless changes to the design are made.

The intersection at Niwot Road and CO 119 is dangerous and getting more so as evidenced by several high speed accidents resulting in multiple fatalities and serious injuries during the past year. The Niwot community has been rocked by these accidents - those killed and injured at the intersection in the past year include Niwot residents and business owners. Sadly, we have recently learned that a Boulder County sheriff's deputy has been criminally charged as a result of a serious accident at the intersection during the performance of his duties. It is in this context that we express our frustration with the apparent lack of concern for our community when reviewing the proposed redesign of the intersection. The current redesign of the intersection dramatically increases the complexity of the intersection while adding very little in terms of enhanced safety - particularly for those traveling in and out of Niwot including cyclists and pedestrians.

Furthermore, the design as currently proposed offers no ingress or egress improvements for cars, bicycles or pedestrians traveling either west or east after exiting CO 119 at the intersection. It is difficult for those of us who live, work, play and raise families in Niwot to understand why safer pedestrian and bicycle crossings at CO 119 (tunnels near Boulder Reservoir and Airport Road) are such a priority over access to Niwot that they have long since been completed. Yet even now with this opportunity and the proposed addition of a bus station, nothing like that is being incorporated for the intersection at Niwot Road where the need is clearly greater based on traffic.

We believe the immediate proximity of a thriving business district and a highly active population require that this intersection be designed to slow traffic on CO 119 and better accommodate Niwot Rd traffic, particularly pedestrians and cyclists. It appears that all emphasis in the current version of the redesign for CO 119 and Niwot Road is on moving traffic between Boulder and Longmont with little consideration for folks that live and work in between, including most specifically the 5,000 residents of Niwot. It is as if it were designed to discourage pedestrian and bicycling traffic at the intersection. We are asking that this rare opportunity be taken to design the intersection in accordance with the Boulder County Comprehensive Plan - relative elements of which we have attached to this letter, including the following:

> ***XV. Transportation Element***
>
> ***Goal 1****. Provide a Multimodal Transportation System. Plan, design, construct, manage, and maintain the Boulder County transportation system to be efficient, safe, convenient, and appealing for pedestrians, bicyclists, transit riders, motorists, and other users. Provide convenient and affordable mobility options for all users irrespective of ability, income, or personal vehicle ownership.*
>
> ***TR 4.04*** *Facilitate Active Living. Create a transportation system that enables active and healthy lifestyles by providing safe and attractive opportunities to walk and bike as part of everyday living.*
>
> We understand there are financial opportunities and constraints that impact design; but we believe that such circumstances always exist, and that is precisely why Goal 6 is included in the comprehensive plan:
>
> ***Goal 6.*** *Provide Safe & Environmentally Compatible Transportation Improvements. Require all transportation improvements to uphold the goals of the Comprehensive Plan.*

We respectfully request that our concerns be addressed to ensure that people who live in and visit our community can do so as safely as possible. Various leaders in the Niwot community have engaged in several forums on this issue and we will continue to do so. We stand ready to work together with planners and policy makers in Boulder County, RTD and CDOT to improve the safety and ease of multi-modal traffic in and out of Niwot as part of the CO 119 mobility and bikeway projects.

Respectfully submitted,

Niwot Business Association
Niwot Community Association
Niwot Cultural Arts Association
Niwot Future League

Elements of the Boulder County Comprehensive Plan that we believe are not getting due consideration in the current design of the intersection at CO119 and Niwot Road:

III. - Niwot, Lefthand, Boulder Creek Subregion:
"NIW 2.08 Pedestrian and Bicycle Network. The county shall encourage the development of a network of pedestrian and bicycle pathways that are protected from vehicular encroachment and that serve the residents' needs to safely and efficiently move between activity areas and living areas within the Niwot Community Area."

*Almost every element of the Transportation Element of the Boulder County Comprehensive Plan applies to our request, most notably (**emphasis added**) :*

XV. Transportation Element

***Goal 1**. Provide a Multimodal Transportation System. Plan, design, construct, manage, and maintain the Boulder County transportation system to be **efficient, safe, convenient, and appealing for pedestrians, bicyclists, transit riders,** motorists, and other users. Provide **convenient and affordable mobility options** for all users irrespective of ability, income, or personal vehicle ownership.*

*TR 1.02 Design **Complete** Corridors. Develop county transportation standards that assign specific design treatments for transit, pedestrian, bicycle, and motor vehicle facilities for each transportation corridor classification. Develop standards for new transportation technologies as they become available and anticipated for common use.*

*TR 1.03 Enhance the Bicycle and Pedestrian Network. Expand the bikeway and pedestrian network to provide **safe, appealing, and convenient connections** throughout the county for travel and recreation.*

*TR 1.04 Develop a Regional Trails Network. Implement a countywide Regional Trails Plan to provide **offroad travel and recreational opportunities for pedestrian, bicycle**, equestrian, and other nonmotorized uses, where each is warranted.*

*TR 1.05 **Establish Connections to Development. Provide transit, pedestrian, bicycle, trail, and motor vehicle connections in developments to link residential and employment areas, commercial centers, recreational and open space areas, and educational facilities.***

*TR 3.02 Prioritize Operations Over Construction. Implement operational improvements to improve mobility in a corridor before initiating construction based solutions. **Reduce the need for new capital improvements through investments in operations, demand management strategies, and system management activities that improve the efficiency of the current system.***

TR 4.04 Facilitate Active Living. Create a transportation system that enables active and healthy lifestyles by ***providing safe and attractive opportunities to walk and bike*** *as part of everyday living.*

Goal 6. *Provide Safe & Environmentally Compatible Transportation Improvements.* ***Require all transportation improvements to uphold the goals of the Comprehensive Plan.***

TR 6.04 Promote Public Safety. Promote the ***safety of transportation system users*** *and the public as a core parameter when designing, constructing, or approving transportation facilities.*

TR 8.01 Context Sensitive Design. Consider the surrounding natural environment, ***local community,*** *scenic vistas, and landscape features, through aesthetic treatments and the* ***context-sensitive design of transportation facilities****.*

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
DENVER REGULATORY OFFICE, 9307 SOUTH WADSWORTH BOULEVARD
LITTLETON, COLORADO 80128-6901

SUBJECT: Section 404 of the Clean Water Act Initial Comments

To whom it concerns:

In accordance with Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers reviews and authorizes any work associated with the discharge of dredged or fill material, and any excavation associated with a dredge or fill project, either temporary or permanent, in waters of the United States. Waters of the United States may include ephemeral, intermittent and perennial streams, wetlands, lakes, ponds, drainage ditches and irrigation ditches. Please note that the discharge of dredged or fill material into upland areas or aquatic resources which are not waters of the United States does not require authorization from this office.

Jurisdictional Determinations identify the locations and amounts of aquatic resources within a specified area to determine if they are or are not waters of the United States. Prior to submitting a request for a Jurisdictional Determination, we recommend a wetland delineation be conducted in the field by a qualified environmental consultant. A wetland delineation identifies the boundaries of aquatic resources located within your project area and must be conducted using the methods outlined in the Corps of Engineers Wetlands Delineation Manual and applicable regional supplements.

Nationwide Permits authorize common types of dredge and fill activities in waters of the United States that will result in a minimal adverse effect to the environment. Some fill activities require a pre-construction notification (PCN) to the Corps prior to any work and possibly coordination with other local or state agencies. Descriptions of the current nationwide permits and their general conditions can be found at:

https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/

Regional General Permits authorize specific types of dredge and fill activities in waters of the United States that will result in a minimal adverse effect to the environment. These fill activities require a pre-construction notification to the Corps prior to starting work, and possibly coordination with other local or state agencies. Please note several of the RGP's are applicant and location specific. Descriptions of the current regional general permit activities and their general conditions can be found at:

https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/Regional-General-Permits/

Standard Individual Permits authorize dredge and fill activities that do not qualify for Nationwide or Regional General Permits. We recommend contacting the Denver Regulatory Office to arrange for a pre-application consultation prior to applying for a

Standard Individual Permit. Standard Individual Permits include public interest review procedures, including public notice, notification of adjacent property owners and review of public and agency comments. Standard Individual Permits require an evaluation of effects for a range of alternatives. The Corps will evaluate practicable (cost, logistics, and technology) alternatives that meet the overall project purpose for environmental effects. Alternatives can include off-site alternatives and alternative designs. When evaluating Standard Individual Permit applications, the Corps can only issue a permit for the least environmentally damaging practicable alternative (LEDPA). In some cases, the LEDPA may not be the applicant's preferred alternative. The Standard Individual Permit application form and instructions can be found at:

https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/Obtain-a-Permit/

A federal action occurs when a discharge of dredged or fill material into waters of the United State requires a Clean Water Act Section 404 permit. For the Corps to make a permit decision, the applicant must provide enough information to demonstrate compliance with Section 106 of the National Historic Preservation Act (NHPA) and Section 7 of the Endangered Species Act (ESA).

Dredge and fill activities in waters of the United States must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to the maximum extent practicable at the project site. Mitigation, including avoiding, minimizing, rectifying, reducing, or compensating for resource losses, will be required to the extent necessary to ensure that the adverse effects to the aquatic site are minimal. Any loss of function at an aquatic site may require mitigation. Mitigation requirements will be determined during the Clean Water Act Section 404 review process.

If the activity you described would impact waters of the United States, the Denver Regulatory Office should be notified. Please include a map identifying dimensions of work in each aquatic site, the county, Township, Range and Section and the latitude and longitude of the activity in decimal degrees, along with a description of your request, to the Denver Regulatory Office mailbox located at DenverRegulatoryMailbox@usace.army.mil or contact the Denver Regulatory Office at 303-979-4120.

Sincerely,

Kiel Downing
Chief, Denver Regulatory Office

Right of Way & Permits

1123 West 3rd Avenue
Denver, Colorado 80223
Telephone: **303.571.3306**
Facsimile: 303. 571. 3284
donna.l.george@xcelenergy.com

January 26, 2023

Boulder County Community Planning and Permitting
PO Box 471
Boulder, CO 80306

Attn: Pete L'Orange

Re: CO 119 Safety and Mobility and Bikeway Projects, Case # SI-22-0002

Public Service Company of Colorado's (PSCo) Right of Way & Permits Referral Desk has reviewed the documentation for **CO 119 Safety and Mobility and Bikeway Projects**. Please be aware PSCo owns and operates existing natural gas and electric *distribution* and *transmission* facilities in these areas of the project:

- natural gas and overhead/underground electric *distribution* along and crossing in various areas
- intermediate pressure natural gas *distribution* pipeline crossing north-south near Spine and Lookout Roads
- underground electric *transmission* crossing east-west near the IBM plant
- high pressure natural gas *transmission* pipeline crossing north-south at 87th Street/Airport Road along

Does this go as far as Ken Pratt Boulevard? If so, there are a variety of facilities in that intersection.

Bear in mind that per the National Electric Safety Code, a minimum 10-foot radial clearance must be maintained at all times from all overhead electric facilities including, but not limited to, construction activities and permanent structures.

Note that proper clearances must be maintained including ground cover that should not be modified from original depths. Contact Colorado 811 before excavating. Use caution and hand dig when excavating within 18-inches of each side of the marked facilities. Please be aware that all risk and responsibility for this request are unilaterally that of the Applicant/Requestor.

For any new natural gas or electric service or modification to existing facilities, the property owner/ developer/contractor must complete the application process via xcelenergy.com/InstallAndConnect.

Donna George
Right of Way and Permits
Public Service Company of Colorado dba Xcel Energy
Office: 303-571-3306 – Email: donna.l.george@xcelenergy.com

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.bouldercounty.org**

MEMO TO: Agencies and adjacent property owners
FROM: Pete L'Orange, Staff Planner
DATE: January 12, 2023
RE: **Docket SI-22-0002**

Docket SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

Request:	Areas and Activities of State Interest (1041) review for combined projects along Colorado Highway 119 (CO 119) related to safety and mobility improvements and construction of a bikeway from approximately 47th Street/Foothills Parkway in the City of Boulder to milepost 54.2 in the City of Longmont.
Location:	Colorado Highway 119 (CO 119) from approximately 47th Street/Foothills Parkway, Boulder, to milepost 54.2, Longmont, in Sections 2, 3, 9, 10, 11, 15, and 16 of T1N, R70W; Sections 25, 35, and 36 of T2N, R70W; and Sections 17, 19, 20, and 30 of T2N, R69W.
Zoning:	Agricultural, Rural Residential, Commercial, Light Industrial, Niwot Rural Community Districts I and II
Applicants:	Colorado Department of Transportation c/o Adnana Murtic and Boulder County Community Planning & Permitting c/o Stacy Proctor, and Regional Transportation District c/o Ali Imansepahi

This process includes public hearings before the Board of County Commissioners and may include a public hearing before the Boulder County Planning Commission. Adjacent property owners and holders of liens, mortgages, easements or other rights in the subject property are notified of these hearings.

The Community Planning & Permitting staff, Planning Commission, and County Commissioners value comments from individuals and referral agencies. Please check the appropriate response below or send a letter to the Community Planning & Permitting Department at P.O. Box 471, Boulder, Colorado 80306 or via email to **plorange@bouldercounty.org.** All comments will be made part of the public record and given to the applicant.

You may view or download the application materials at **www.boco.org/docket-si-22-0002.**

You are welcome to call the Community Planning & Permitting Department at 303-441-3930 to request more information. If you have any questions regarding this application, please contact the Community Planning & Permitting office at **303-441-1418** or via email at **plorange@bouldercounty.org**.

As required per article 8-508(C)1.a, referral responses must be returned within 14 days or **January 26, 2023**.
*As noted in section 8-508(C)1.b, an extension may be expressly granted by the Director.

_x_ We have reviewed the proposal and have no conflicts.
_____ Letter is enclosed.
Signed Liz Northrup PRINTED Name Liz Northrup
Agency or Address Conservation Easement Program at Boulder County Parks & Open Space
Date 1/23/2023

From: Glen Segrue
To: L"Orange, Pete
Subject: [EXTERNAL] CO 119 Poject
Date: Thursday, January 12, 2023 1:32:17 PM

Thanks for the referral Pete - looks like a great project and a huge improvement (I bike to work myself on this route at times). As far as BVSD goes, we have no schools directly impacted by the proposal and see no impacts.

-Glen

--
Glen Segrue, AICP
Senior Planner
Boulder Valley School District
720-561-5794

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.bouldercounty.org**

MEMO TO: Agencies and adjacent property owners
FROM: Pete L'Orange, Staff Planner
DATE: January 12, 2023
RE: **Docket SI-22-0002**

Docket SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

Request: Areas and Activities of State Interest (1041) review for combined projects along Colorado Highway 119 (CO 119) related to safety and mobility improvements and construction of a bikeway from approximately 47th Street/Foothills Parkway in the City of Boulder to milepost 54.2 in the City of Longmont.

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*As noted in section 8-508(C)1.b, an extension may be expressly granted by the Director.

__X__ We have reviewed the proposal and have no conflicts.
_____ Letter is enclosed.
Signed David Lowrey PRINTED Name David Lowrey
Agency or Address Boulder Fire Rescue
Date 1/17/2023

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.bouldercounty.org**

MEMO TO: Agencies and adjacent property owners
FROM: Pete L'Orange, Staff Planner
DATE: January 12, 2023
RE: **Docket SI-22-0002**

Docket SI-22-0002: CO 119 Safety and Mobility and Bikeway Projects

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*As noted in section 8-508(C)1.b, an extension may be expressly granted by the Director.

X We have reviewed the proposal and have no conflicts.
____ Letter is enclosed.
Signed Michele A Goldman PRINTED Name Michele Goldman
Agency or Address Longmont Fire, Fire Marshal
Date 1/25/2023
I lend full support to comments made by City of Longmont Transportation, Streets, and Engineering
MG

Claire Levy *County Commissioner* **Marta Loachamin** *County Commissioner* **Ashley Stolzmann** *County Commissioner*

From:	Ryan Tigera
To:	L"Orange, Pete
Cc:	Milner, Anna
Subject:	[EXTERNAL] RE: Question on CO 119 Mobility and Safety Project (Docket-SI-22-002)
Date:	Thursday, February 16, 2023 7:30:57 AM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png

Good morning Pete,

My apologies for sending this over a day late. MHFD does not have any comments on this referral at this time however we would like to be included in future referrals as the design progresses.

Please let me know if you have any other questions.

Thanks,

Ryan

Ryan Tigera, P.E.
MILE HIGH FLOOD DISTRICT

From: Ryan Tigera
Sent: Monday, January 23, 2023 10:34 AM
To: L'Orange, Pete <plorange@bouldercounty.org>
Cc: Milner, Anna <amilner@bouldercounty.org>; Kurt Bauer <kbauer@mhfd.org>
Subject: RE: Question on CO 119 Mobility and Safety Project (Docket-SI-22-002)

Thanks Pete. I appreciate your quick response to this one. I was able to download it and MHFD will provide you with comments by the due date.

Thanks,

Ryan

From: L'Orange, Pete <plorange@bouldercounty.org>
Sent: Friday, January 20, 2023 4:46 PM
To: Ryan Tigera <rtigera@mhfd.org>
Cc: Milner, Anna <amilner@bouldercounty.org>; Kurt Bauer <kbauer@mhfd.org>
Subject: RE: Question on CO 119 Mobility and Safety Project (Docket-SI-22-002)

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Hi Ryan,

It appears that one didn't get uploaded initially – thanks for the heads up! I have gotten up now. It's "Appendix 1G".

Pete L'Orange | Planner II
Boulder County Community Planning & Permitting

From: Ryan Tigera <rtigera@mhfd.org>
Sent: Friday, January 20, 2023 4:23 PM
To: L'Orange, Pete <plorange@bouldercounty.org>
Cc: Milner, Anna <amilner@bouldercounty.org>; Kurt Bauer <kbauer@mhfd.org>
Subject: [EXTERNAL] Question on CO 119 Mobility and Safety Project (Docket-SI-22-0002)

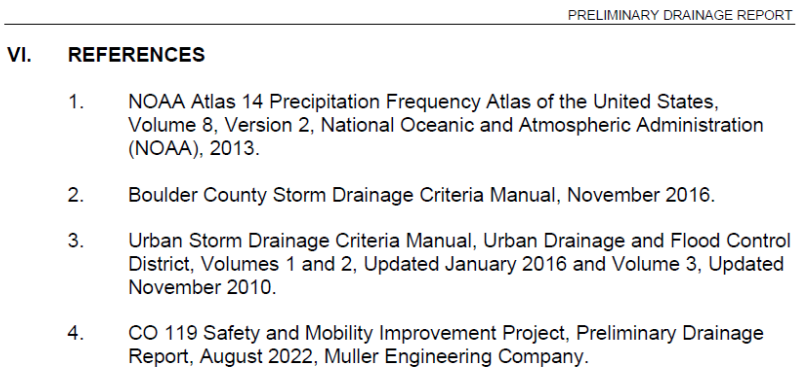
Hi Pete and Ana,

Hope you are both doing well and had a good holiday.

I am reviewing the CO 119 Safety and Mobility project for MHFD and had a question on the drainage reports. In the link provided in your referral email (**www.boco.org/docket-si-22-0002**), I noticed two drainage reports:

- Appendix 1C RTD Preliminary Drainage Report
- Appendix 1F CO 119 Preliminary Drainage Report for the Bikeway

The RTD report references a drainage report from Muller Engineering as Reference 4, which does not match the title and date for the Muller report in Appendix 1F. See screenshot below:



PRELIMINARY DRAINAGE REPORT

VI. REFERENCES

1. NOAA Atlas 14 Precipitation Frequency Atlas of the United States, Volume 8, Version 2, National Oceanic and Atmospheric Administration (NOAA), 2013.
2. Boulder County Storm Drainage Criteria Manual, November 2016.
3. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Volumes 1 and 2, Updated January 2016 and Volume 3, Updated November 2010.
4. CO 119 Safety and Mobility Improvement Project, Preliminary Drainage Report, August 2022, Muller Engineering Company.

When you have a moment, can you confirm whether an additional drainage report should be included in this referral?

Thanks for your help.

Ryan

Ryan Tigera, P.E.
Project Engineer
MILE HIGH FLOOD DISTRICT
2480 W. 26th Ave. Suite 156-B | Denver, CO 80211
Office: 303-455-6277 | **Direct:** 303-749-5420 | www.mhfd.org

Protecting People, Property, and our Environment

MILE HIGH FLOOD DISTRICT

From:	Kragerud, Ryan
To:	Brendan Willits; L"Orange, Pete; Heidi Feula
Subject:	[EXTERNAL] Fwd: [external] Referral Memo for Docket SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects
Date:	Wednesday, January 25, 2023 8:43:56 AM
Attachments:	image001.png si-22-0002-referral-memo.pdf

Thank you for the opportunity to respond. The SVVSD has no comment on this referral.

Ryan Kragerud, GIS/Planner, AICP, LCI
SVVSD
395 S. Pratt Parkway
Longmont CO 80501

303-682-7317

---------- Forwarded message ---------
From: **Toillion, Scott** <toillion_scott@svvsd.org>
Date: Thu, Jan 12, 2023 at 7:25 AM
Subject: Fwd: [external] Referral Memo for Docket SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects
To: Brendan Willits <willits_brendan@svvsd.org>, Feula, Heidi <feula_heidi@svvsd.org>, Ryan Kragerud <kragerud_ryan@svvsd.org>

FYI

---------- Forwarded message ---------
From: **Milner, Anna** <amilner@bouldercounty.org>
Date: Thu, Jan 12, 2023 at 7:15 AM
Subject: [external] Referral Memo for Docket SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects
To: crossbill@boulderaudubon.org <crossbill@boulderaudubon.org>, info@niwot.com <info@niwot.com>, landuse@niwot.org <landuse@niwot.org>, bwarren@niwotlaw.com <bwarren@niwotlaw.com>, kathyboco@gmail.com <kathyboco@gmail.com>, info@niwothistoricalsociety.org <info@niwothistoricalsociety.org>, pmurphy@niwotrealty.com <pmurphy@niwotrealty.com>, Steve Buckbee <sbuckbee@lefthandwater.org>, chrissmith@lefthandwater.org <chrissmith@lefthandwater.org>, LPC@longmontcolorado.gov <LPC@longmontcolorado.gov>, morgan@pvrea.com <morgan@pvrea.com>, jstruble@northernwater.org <jstruble@northernwater.org>, bflockhart@northernwater.org <bflockhart@northernwater.org>, BDRCO@xcelenergy.com <BDRCO@xcelenergy.com>, Donna.L.George@xcelenergy.com <Donna.L.George@xcelenergy.com>, Renee.Hester@lumen.com <Renee.Hester@lumen.com>, theboss@cushmancattle.com <theboss@cushmancattle.com>, lscriptercpa@gmail.com <lscriptercpa@gmail.com>, bouldergeoservices@gmail.com <bouldergeoservices@gmail.com>, niwotfarms@aol.com <niwotfarms@aol.com>, djhindman1229@msn.com <djhindman1229@msn.com>, tlongseth@msn.com <tlongseth@msn.com>, Alexander, Robert <ralexander@bouldercounty.org>, vtfarms@skybeam.com <vtfarms@skybeam.com>,

angie@dangrantbookkeeping.com <angie@dangrantbookkeeping.com>, Bill.boulderwhiterock@gmail.com <Bill.boulderwhiterock@gmail.com>, Peeples_cody@hotmail.com <Peeples_cody@hotmail.com>, RanglosC@bouldercolorado.gov <RanglosC@bouldercolorado.gov>, bonnellj@bouldercolorado.gov <bonnellj@bouldercolorado.gov>, CollinsB@bouldercolorado.gov <CollinsB@bouldercolorado.gov>, CassidyJ@bouldercolorado.gov <CassidyJ@bouldercolorado.gov>, ayanna.reed@longmontcolorado.gov <ayanna.reed@longmontcolorado.gov>, don.burchett@longmontcolorado.gov <don.burchett@longmontcolorado.gov>, glen.segrue@bvsd.org <glen.segrue@bvsd.org>, toillion_scott@svvsd.org <toillion_scott@svvsd.org>, Vanessa McCracken <bldrvalleyandlongmontcds@gmail.com>, joe.padia@state.co.us <joe.padia@state.co.us>, dora_puc_website@state.co.us <dora_puc_website@state.co.us>, submittals@udfcd.org <submittals@udfcd.org>, timothy.bilobran@state.co.us <timothy.bilobran@state.co.us>, #AssessorReferral <AssessorReferral@bouldercounty.org>, hc_filesearch@state.co.us <hc_filesearch@state.co.us>, kiel.g.downing@usace.army.mil <kiel.g.downing@usace.army.mil>, BMA@bouldercolorado.gov <BMA@bouldercolorado.gov>, coloradoes@fws.gov <coloradoes@fws.gov>, Amber.Stoffels@BNSF.com <Amber.Stoffels@bnsf.com>, Andy.Williams@BNSF.com <Andy.Williams@bnsf.com>, prevention@mvfpd.org <prevention@mvfpd.org>, drogers@brfr.org <drogers@brfr.org>, Lowrey, D <lowreyd@bouldercolorado.gov>, Calderazzo, Mike <calderazzom@bouldercolorado.gov>, Michele.goldman@longmontcolorado.gov <Michele.goldman@longmontcolorado.gov>, willis2729@hotmail.com <willis2729@hotmail.com>, TrioProperty@comcast.net <TrioProperty@comcast.net>, Hippely, Hannah <hhippely@bouldercounty.org>, Abner, Ethan <eabner@bouldercounty.org>, Vaughn, Andrea <avaughn@bouldercounty.org>, Sheehan, Jack <jsheehan@bouldercounty.org>, Historic <historic@bouldercounty.org>, #CodeCompliance <codecompliance@bouldercounty.org>, Floodplain Admin <floodplainadmin@bouldercounty.org>, #CAreferral <CAreferral@bouldercounty.org>, #CEreferral <CEreferral@bouldercounty.org>, Johnson, Curtis <cjohnson@bouldercounty.org>, Allshouse, Alycia <aallshouse@bouldercounty.org>, Kiepe, Bob <bkiepe@bouldercounty.org>, Stadele, Lee <leestadele@bouldercounty.org>, Stadele, Lee <leestadele@flagstaffsurveying.com>, Moline, Jeffrey <jmoline@bouldercounty.org>, Strenge, Ernst <estrenge@bouldercounty.org>, Cavaleri, Keli <kcavaleri@bouldercounty.org>, Flax, Ron <rflax@bouldercounty.org>, Goldstein, Andrew <agoldstein@bouldercounty.org>, HealthWaterQuality-EnvironmentalBP LU <HealthWQ-EnvironBPLU@bouldercounty.org>, Huebner, Michelle <mhuebner@bouldercounty.org>, Transportation Development Review <TransDevReview@bouldercounty.org>, West, Ron <rowest@bouldercounty.org>
CC: L'Orange, Pete <plorange@bouldercounty.org>, Sanchez, Kimberly <ksanchez@bouldercounty.org>, Case, Dale <dcase@bouldercounty.org>, Frederick, Summer <sfrederick@bouldercounty.org>

Please find attached the electronic referral memo for ***SI-22-0002, CO 119 Safety and Mobility and Bikeway Projects***.

Please visit **www.boco.org/docket-si-22-0002** to access the complete application materials.

Please return responses and direct any questions to ***Pete L'Orange*** by ***January 26, 2023.*** (Boulder County internal departments and agencies: Please attach the referral comments in Accela.)

Best Regards,

Anna

Anna Milner | Admin. Lead Tech.

Boulder County Community Planning & Permitting

Pronouns: she/her/hers

Physical address: 2045 13th St., Boulder CO 80302

Mailing address: PO Box 471, Boulder, CO 80306

(720) 564-2638 (Direct)

amilner@bouldercounty.org

Service hours are 8 a.m.-4:30 p.m. Monday, Wednesday, Thursday, Friday, and 10 a.m.-4:30 p.m. Tuesday

*My core working hours are 7am-5:30pm Tues - Fri

New: Boulder County has a new website: BoulderCounty.gov! Bookmark it today. Email addresses will transition at a later date.

www.bouldercounty.gov

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Scott Toillion, AICP
Planning Director
St. Vrain Valley School District
http://www.svvsd.org/about/departments/planning