ADDENDUM #1
Community Planning & Permitting
SH 119 Bikeway 100% Design
SOQ # 7173-20

October 7, 2020

The attached addendum supersedes the original Information and Specifications regarding SOQ # 7173-20 where it adds to, deletes from, clarifies or otherwise modifies. All other conditions and any previous addendums shall remain unchanged.

Please see the attached power point from the pre-proposal meeting and the CDOT Geotechnical Reports and Geology Sheets at the end of this document.

Please note: Due to COVID-19, BIDS will only be accepted electronically by emailing purchasing@bouldercounty.org**.**

1. Question: Does a cover page or tabs count towards the 25-page limit?

   ANSWER: A Cover page and section dividers do not county towards the 25-page limit.

2. Question: Will you be posting the meeting attendees?

   ANSWER: No.

3. Question: Will you also post the PowerPoint presentation?

   ANSWER: Yes, it is included as part of this addendum.

4. Question: If we include a cover letter with Contact Information and the required Proposal Checklist will that count against the 25 page limit?

   ANSWER: The required proposal checklist does not count against the 25-page limit. A cover letter does county towards the 25-page limit.

5. Question: Page 21 of the Solicitation of Qualifications states, “Attach brief

professional experience and qualifications...". Will brief bios/summaries within the proposal suffice or should we also include resumes as an appendix. If appendix items, will they count against 25-page limit?

ANSWER: The proposers can determine how they would like to present the biographies of their staff. Any appendix items should fit within the 25-page limit.

6. Question: Page 25 of the SOQ states, "Examples of related work/plans can be included with the proposal". Would these examples be included in the 25-page limit?

   ANSWER: Yes, any examples of work/plans should be included in the 25-page limit.

7. Question: Would the County like a cover letter to be included with the proposal? If yes, will it count towards the 25-page limit for the proposal?

   ANSWER: A cover letter is not required. If included, it will count towards the 25-page limit for the proposal.

8. Question: Will this project require consultant participation as part of the TAC for the SH119 Roadway & Transit Design project with CDOT?

   ANSWER: It is anticipated that regular coordination meetings will be required, however, the exact timing and format of these has not been determined. The selected consultant will determine the best approach for ensuring coordination with CDOT and other project stakeholders.

9. Question: Are deliverable milestones for the bikeway project expected to align with deliverable milestones for the SH 119 Roadway & Transit Design project with CDOT?

   ANSWER: Our primary requirement is that the design for the bikeway must align with and be coordinated with the SH 119 Roadway and Transit Design project. It is not specifically a requirement that the deliverable milestones dates to match. CDOT, Boulder County and the consultant teams will need to work together to determine the best approach to ensuring the designs for each project are aligned.

10. Question: Can Boulder County provide the owners of the ditch companies for following locations:
    Ditch lateral between 55th Street and 63rd Street
    Ditch lateral just west of 55th Street
    Ditch at 63rd Street (West)

    ANSWER: Information on ditches can be found here. Please see the Ditch and Reservoir Directory for owner information.

11. Question: Have any prior geotechnical studies been conducted in the area. Can they be shared?

ANSWER:. Boulder County does not have any geotechnical studies for this area, however CDOT does have some geotechnical information that is included in this addendum. CDOT has additional hard-copy data that can be obtained by going into the CDOT offices.

Questions asked during the optional pre-proposal meeting:

12. Question: How much do you want to explore the general concept of the design before launching into the hard traditional engineering (30, 90, 100% plans). So how much exploration of what the path should be--all the different variables, and what elements could come together. How much of the more planning elements would bring in on connectivity and just exploring the innovation around the project before launching into the hard engineering. Could you describe that?

    ANSWER: Overall, the general alignment overall is fairly certain as we expect to stay within the CDOT ROW. The typical section and other design elements should be confirmed.

    We are also interested in how we can build upon the work that has already been done. Are there other types of ideas, suggestions, and solutions to help us enhance the design we are starting from?

13. Question: Could you explain or describe in a little more detail what Commuting Solutions role might be in the public outreach and coordination along the corridor?

    ANSWER: Commuting Solutions has been helping to coordinate a conversation between the different partners of how we would work together to do outreach, but at this point there is not a formal role or agreement on how that would look.

14. Question: Is there any kind of environmental document or record of finding or anything that constrains the footprint of the bike path? Or is that still open?

    ANSWER: The PEL has some information about the environmental requirements. Items that could pose some constraints include, wetlands, floodplain impacts, tree impacts, and prairie dogs. The PEL has detailed recommendations and estimates of what environmental work may need to be done.

15. Question: Another question related to the CDOT BRT project – I would assume that-obviously things need to be highly integrated between the two projects. Would you want this project to be stand-alone but also integrated with BRT? Or how do you view that as a goal of the project? Do you want it to be able to stand alone without BRT? Or it's a question of how much the project needs to be of independent purpose, separate from the BRT.

    Answer: Our expectation is that they will be integrated because of the design impacts. If we design one not thinking about what's happening with the other, there could be

conflicts. So it needs to be coordinated so that they work together, because our goal is to construct them both.

Submittal Instructions:

Submittals are due at the email box only, listed below, for time and date recording on or before **2:00 p.m. Mountain Time on October 19, 2020.**

Please note that email responses to this solicitation are preferred, but are limited to a maximum of 50MB capacity. NO ZIP FILES OR LINKS TO EXTERNAL SITES WILL BE ACCEPTED. Electronic Submittals must be received in the email box listed below. Submittals sent to any other box will NOT be forwarded or accepted. This email box is only accessed on the due date of your questions or proposals. Please use the Delivery Receipt option to verify receipt of your email. It is the sole responsibility of the proposer to ensure their documents are received before the deadline specified above. Boulder County does not accept responsibility under any circumstance for delayed or failed email or mailed submittals.

Email purchasing@bouldercounty.org; identified as **SOQ # 7173-20** in the subject line.

All proposals must be received and time and date recorded at the purchasing email by the above due date and time. Sole responsibility rests with the Offeror to see that their proposal is received on time at the stated location(s). Any proposal received after due date and time will be returned to the bidder. No exceptions will be made.

The Board of County Commissioners reserve the right to reject any and all proposals, to waive any informalities or irregularities therein, and to accept the proposal that, in the opinion of the Board, is in the best interest of the Board and of the County of Boulder, State of Colorado.

RECEIPT OF LETTER
ACKNOWLEDGMENT

October 7, 2020

Dear Vendor:

This is an acknowledgment of receipt of Addendum #1 for SOQ #7173-20, SH 119 Bikeway 100% Design.

In an effort to keep you informed, we would appreciate your acknowledgment of receipt of the preceding addendum. Please sign this acknowledgment and email it back to purchasing@bouldercounty.org as soon as possible. If you have any questions, or problems with transmittal, please call us at 303-441-3525. This is also an acknowledgement that the vendor understands that due to COVID-19, **BIDS will only be accepted electronically by emailing purchasing@bouldercounty.org.**

Thank you for your cooperation in this matter. This information is time and date sensitive; an immediate response is requested.

Sincerely,

Boulder County Purchasing

Signed by: _____ Date: _____

Name of Company_____

End of Document

State Highway 119 Bikeway

100% Design Pre-Proposal Meeting

September 29, 2020

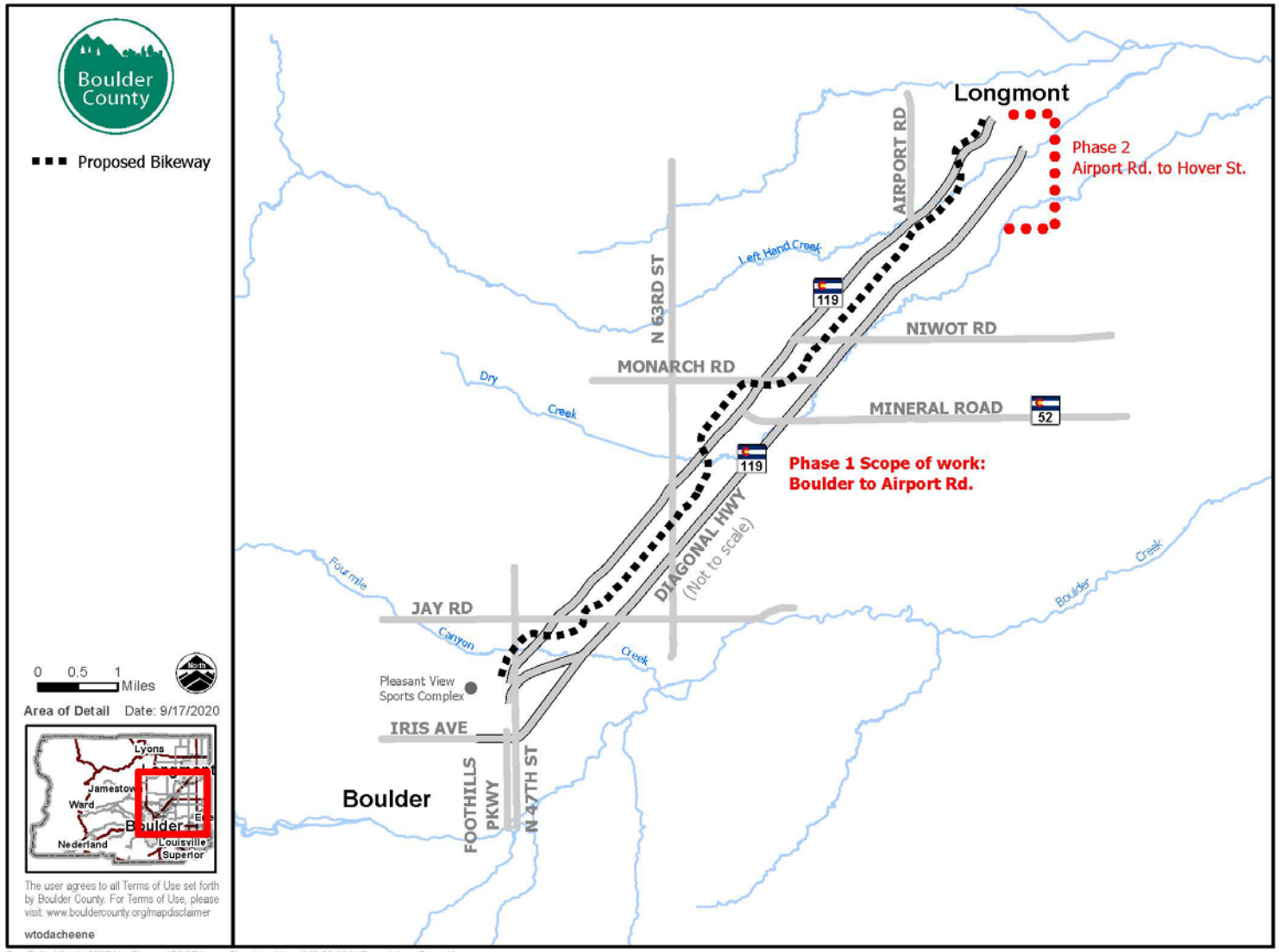
SH 119 Corridor Overview & History

Northwest Area Mobility Study	• Led by RTD • Completed 2014 • Created the vision for the multi-modal corridor including Regional Bus Rapid Transit and a commuter bikeway; modeled on US 36
SH 119 Multi-modal Planning and Environmental Linkages Study	• Led by RTD, approved by FTA and FHWA • Completed 2019 • Selected preferred alternative for managed express lanes with regional BRT • Initial environmental evaluation
Bikeway- Conceptual Design and Basis of Design Memo	• Led by CDOT, completed by Muller • Completed 2019 • Approximately 10% level of design
Bikeway 100% Design	• Boulder County is leading • Funded by DRCOG Transportation Improvement Program (TIP), local match from Regional Trails Fund

SH 119 Corridor Current and Future

- Boulder County: Bikeway 100% Design- Preliminary design starting in 2021
- CDOT
  - Traffic Analysis Study: Complete by the end of 2020
  - Roadway Improvements/Bus Rapid Transit 100% Design- Preliminary design starting in 2021
- Commuting Solutions
  - First and Final Mile Study: Phase one complete early 2021; Phase two starts in 2022
- City of Boulder
  - 28th Street BAT (Business Access Transit) Lanes between Iris and Valmont: Final design complete in early 2021
- City of Longmont
  - SH 119 and Hover Street Multi-Modal Intersection Improvements: Preliminary design starts in 2022 (tentative)
  - Coffman Street Corridor Project: Preliminary design started

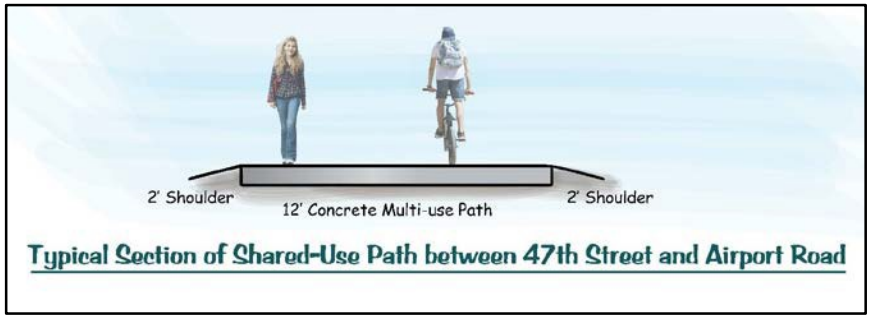
Bikeway Project Map

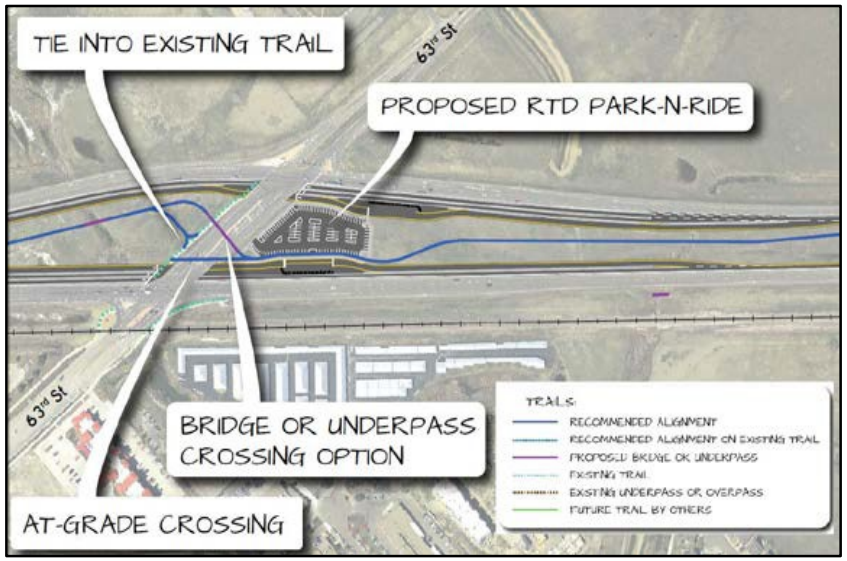


Bikeway Project Details

- 7.6-mile bike/ped connection between Boulder, Longmont, and communities in between
  - DRCOG TIP funding for final design for Boulder to Airport Road
  - Pending funding availability, additional work may be added to the scope of work
- Physically separated hard surface pathway with underpasses and/or protected signals across major intersecting roads
- Provides year-round connection to future Bus Rapid Transit stations
- Within CDOT right-of-way
- Build on/confirm previous work with additional stakeholder input
- Funding for construction not yet identified

Project Goals



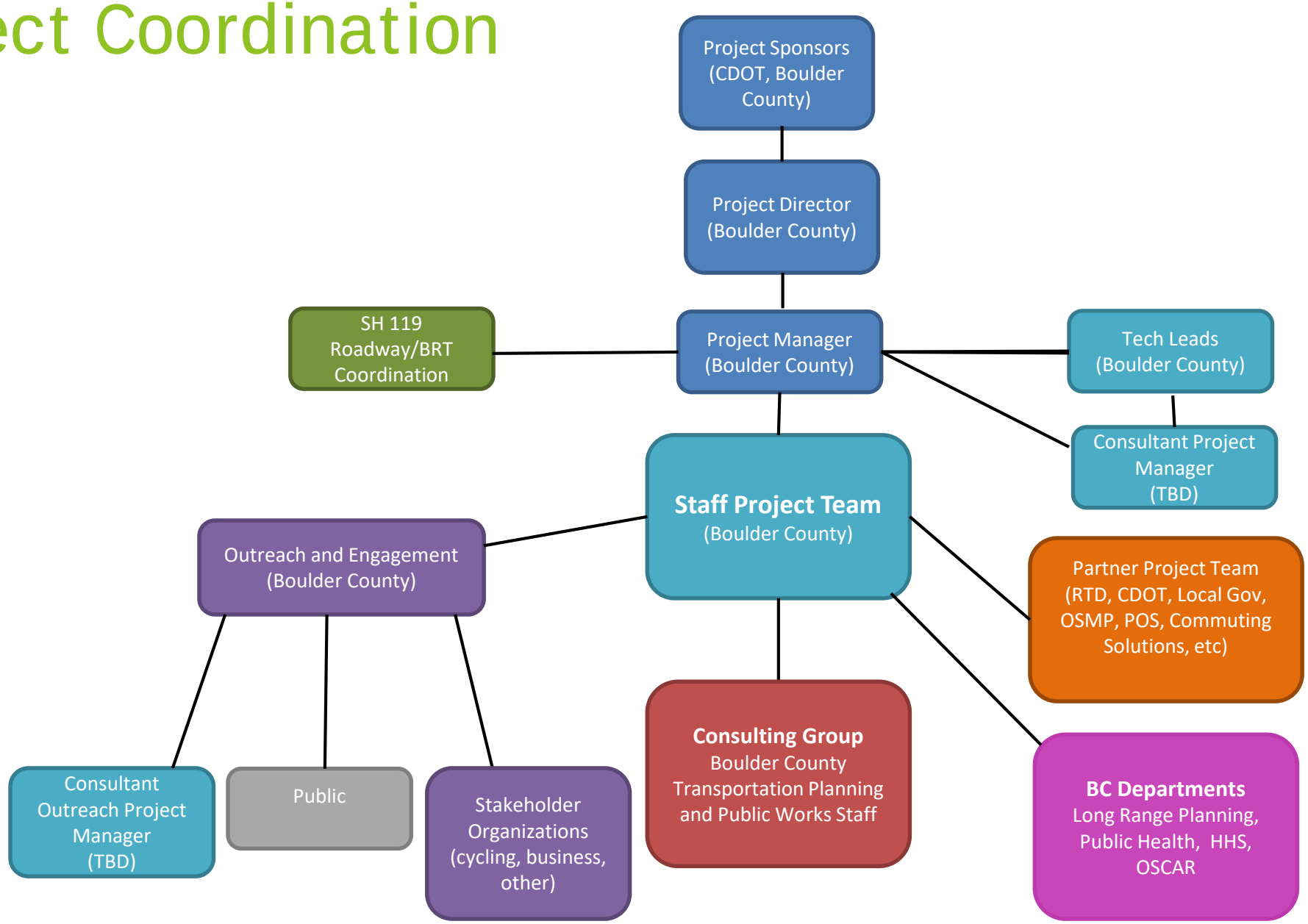


- Compatible with Boulder County's Transportation Master Plan (TMP)
- Provide a direct, low-stress and safe bicycling and walking connection between Longmont and Boulder
- Reduce crashes involving vulnerable road users
- Help to meet the Boulder County Vision Zero goal
- Design for all ages and abilities
- Use national and international best design practices
- Consider potential future technologies
- Design for increased use of electric bicycles
- Increase travel options for all travelers
- Provide a cost-effective transportation option

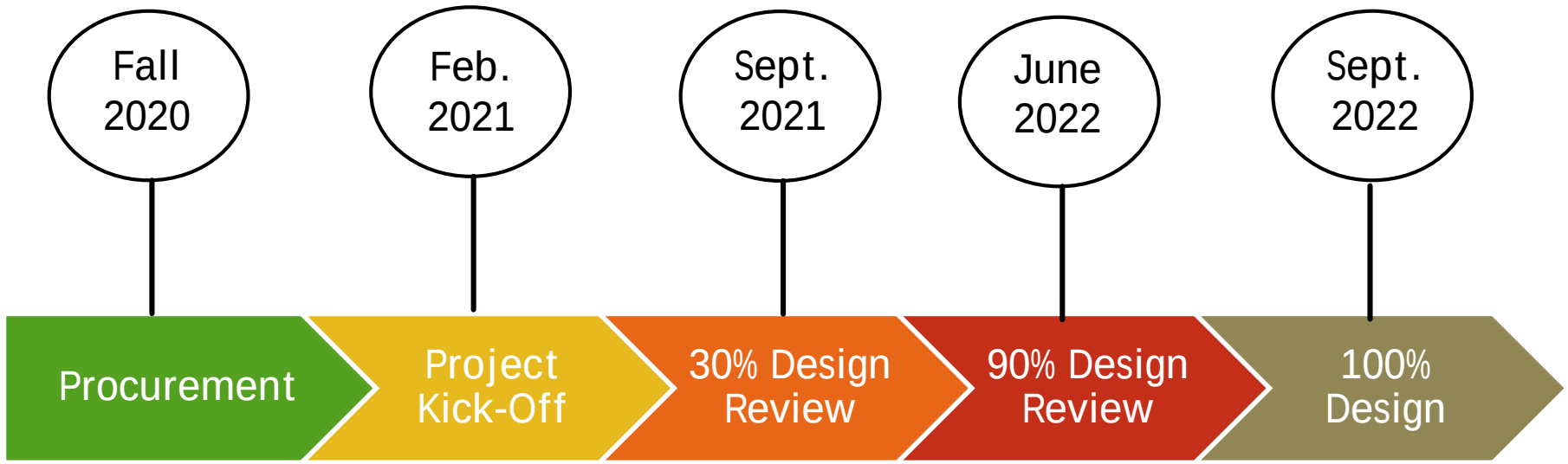
Public Engagement

- Coordinate public engagement with partners for all projects along the corridor
- Some people will be focused only on bikeway or Bus Rapid Transit
- Multiple engagement tools to solicit input from public and other stakeholders
- Consider use of new tools and experimenting with virtual/online engagement

Project Coordination



Tentative Schedule



- **Selected consultant will propose project schedule**
- Project schedule, including public input, will be coordinated with other corridor projects as much as possible

Estimated SOQ Timeline

- Pre-proposal meeting: 2:00 – 3:00 p.m., September 29, 2020
- Questions due to Boulder County: October 1, 2020
- Responses to questions from Boulder County: October 7, 2020
- Last day for submitting proposal: October 19, 2020
- Proposal review by committee: October 20, 2020- November 13, 2020
- Interviews with proposers: November 2, 2020- November 6, 2020
- Recommendation of Award: December 2020
- Execution of Agreement: January 2021

Questions?

COLORADO
Department of Transportation

DOCUMENT SEPARATOR SHEET

Geotechnical Reports and Geology Sheets

To be placed at the beginning of each document.

Row No.

2887

Naming Convention

GT_119B_46.00_20110711

Box No.

19 of 29

For assistance, or to request changes to this form, please email helpdesk@msimaging.com.

MOUNTAIN STATES IMAGING

2887

MEMORANDUM

MATERIALS AND GEOTECHNICAL BRANCH
GEOTECHNICAL PROGRAM
4670 HOLLY STREET, UNIT A, DENVER, COLORADO 80216 303-398-6604 FAX 303-398-6504

C 1191-027
SH-119 & Jay Rd.
SA 16884

TO: Ryan Sorensen, Region 4 South Engineering

FROM: David Thomas, Geotechnical Program

DATE: July 11, 2011

SUBJECT: **GEOTECHNICAL RECOMMENDATIONS FOR MSE WALL AT SH-119 AND JAY RD.**

1.0 INTRODUCTION

This report presents geotechnical exploration observations and recommendations for the proposed construction of a mechanically stabilized earth (MSE) wall along south bound SH-119 north of Jay Rd. The wall is to be located by mile marker (MM) 46 over an existing concrete box culvert (CBC) to widen south bound SH-119 allowing for a bike lane between the ongoing traffic and traffic turning on to west bound Jay Rd. The purpose of the geotechnical exploration is to characterize physical properties of foundation materials at the proposed structure location.

2.0 GEOTECHNICAL INVESTIGATION

Geotechnical field activities were completed on May 10, 2011. Two borings (TH1 and TH2) were advanced using a CME 75 truck mounted drill rig with hollow stem auger techniques. TH1 is located north of the CBC and TH2 is located near the intersection south and adjacent to the CBC. Standard penetration tests using split spoon samplers, California samplers, and thin-walled tube samplers (Shelby tubes) were performed in the borings at select intervals in general accordance with ASTM D-1586, D-3550, and D-1587, respectively. The boring locations were placed along the edge of pavement due to access restrictions from utilities along SH-119.

2.1 GEOLOGY

The geology is similar across the site. The geology consists of medium stiff to very stiff clays and very loose to medium dense clayey, silty sands underlain by hard to very hard claystone bedrock. Claystone was encountered at 5,262 feet above mean sea level (amsl) in boring TH1 and at 5,263 feet amsl in TH2. Groundwater was encountered during drilling at 5,268 feet amsl in both borings; however, groundwater levels may fluctuate with precipitation rates and seasonal changes. The boring logs and geology sheet are presented in Attachments 1 and 2, respectively.

2.2 PHYSICAL PROPERTIES

Clay AASHTO classifications ranged from A-6 (16) to A-6 (22) while sand classifications ranged from A-2-4 (0) to A-6 (2). The bedrock AASHTO classification was A-7-6 (24). Unconfined compressive strengths of the claystone bedrock samples ranged from 2.4 kips per square foot (ksf) to 16.5 ksf. These values are believed to be low since samples were collected

using a California sampler causing disturbance in the sample. Detailed material properties are presented in the laboratory test summary presented on the Engineering Geology sheet in Attachment 2.

2.3 GEOCHEMICAL PROPERTIES

The clayey sand in which the MSE wall will likely be constructed was analyzed for percent sulfate, pH, percent chlorides, and resistivity. Based on the results of water soluble sulfate testing obtained from CP 2103, the potential for sulfate attack on Portland cement concrete in direct contact with the bedrock is classified as a Class 0 exposure per Table 601-2 of the CDOT 2011 *Standard Specifications for Road and Bridge Construction.* Results for pH indicate a mild to no corrosion potential towards metal; however, resistivity results suggest a high corrosion towards metal based on values per Table C.1 of FHWA report FHWAO-IF-3-017, *Geotechnical Engineering Circular No. 7 - Soil Nail Walls.* Detailed material properties are presented in the laboratory test summary presented in Table 1 and on the engineering geology sheet in Attachment 2.

3.0 RECOMMENDATIONS

For MSE retaining walls, it is assumed new fill will consist of Class 1 Structure Backfill. Class 1 Structure Backfill should be compacted to at least 95 percent of the maximum dry density and within 2 percent of optimum moisture content as determined by AASHTO T180 (ASTM D 1557) and as described in Section 206 of the 2011 *CDOT Standard Specification for Road and Bridge Construction.*

Retaining wall parameters for preliminary design are presented in Table 1. Lateral pressures must be reevaluated when sloping backfill or surcharge loads exist. A coefficient of sliding resistance (μ) of 0.35 may be used between concrete or MSE and undisturbed foundation soil. Temporary excavation support may be required where slopes are steeper than 1:1 (H:V). Parameters presented in Table 1 also are suitable for preliminary temporary excavation support design.

It is assumed that the bearing material will be the medium stiff clays and very loose clayey sand at approximately 5,273 feet amsl. The nominal bearing capacity value was calculated to be 3.45 ksf based on a maximum proposed wall height of approximately 8.5 feet, MSE reinforcement lengths of 6 feet, and a 2 feet minimum embedment. The 2 feet embedment is greater than CDOT's standard 1.5 feet based on FHWA Publication FHWA-NHI-10-024 stating a 2 feet minimum and a frost depth of 1.9 feet as calculated using CDOT's 2011 *Pavement Design Manual.* A bearing resistance factor of 0.65 for MSE walls may be applied when using the LRFD method. The global stability of the walls should be verified after final design is completed.

TABLE 1. PRELIMINARY MATERIAL PARAMETERS FOR RETAINING WALLS AND TEMPORARY EXCAVATIONS

Material	Typical Total Unit Weight γ_T (pcf)	Internal Friction Angle ϕ (degrees)	Cohesion C (psf)	Earth Pressure Coefficients		
				Active (Ka)	At Rest (Ko)	Passive (Kp)
New Class 1 Structure Backfill	125	34	0	0.28	0.44	3.5
Native Clay	120	20	100	0.49	0.66	2.0
Native Sand	125	28	0	0.36	0.53	2.8

3.1 SETTLEMENT

Settlement due to consolidation may be of concern. Very loose clayey sands were encountered during the foundation exploration at the proposed MSE location from 5,275 to 5,263 feet amsl in TH2. The loose soils encountered are likely poorly compacted backfill material placed during the installation of the CBC due to its proximity to the CBC. These soils may result in differential settling along the wall. The total settlement of the clayey sand was calculated to be less than 3.5 inches. A majority of the settlement will occur during construction of the embankment. Approximately 90% of total settlement from consolidation of the clayey sand from the MSE wall fill may take up to four months to complete.

To reduce the affect of settling, the very loose soils could be over excavated where encountered and replaced with a geosynthetic separator and Class 1 fill or equivalent and compacted to at least 95 percent of the maximum dry density and within 2 percent of optimum moisture content as determined by AASHTO T180 (ASTM D 1557) and as described in Section 206 of the 2011 *CDOT Standard Specification for Road and Bridge Construction.* Not only would this reduce settlement, but would increase bearing capacity. The CDOT required allowable bearing capacity for a 8.5 feet high MSE wall is 1.69 ksf. Over excavating and placing Class 1 fill or equivalent will increase the bearing capacity and factor of safety as indicated in Table 2. Deep foundations may also be considered because of the shallow depth of bedrock in the area and can be provided on request.

TABLE 2. BEARING CAPACITY AND SAFETY FACTOR BASED ON OVER EXCAVATION DEPTH

Depth of Over Excavation Below Footing (feet)	Nominal Bearing Capacity (ksf)	Factor of Safety
0	3.4	2.0
1	3.6	2.1
2	3.9	2.3
3	4.5	2.7
4	5.1	3.0
5	5.9	3.5

Please contact the Geotechnical Program at 303-398-6604 with questions.

REVIEW: Conroy

COPY: Olson – Region 4 RTD
Gosselin – Region 4 South Program Engineer/Bridge Engineering
Flohr – Region 4 South Engineering RE
DeWitt/Chapman – Region 4 Materials
Phan – Region 4 Hydraulics
Osmun – Staff Bridge
Otegui – Felsburg Holt & Ullevig
Zufall/Kotzer – Branch Materials & Geotech
Liu – Branch Materials & Geotech

ATTACHMENT 1

BORING LOGS

C 1191-027, SH-119 & JAY RD., SA 16884

GEOLOGICAL BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING # 1

PROJECT ID	SA	PROJECT NAME	DATE DRILLED
C 1191-027	18054	SH 119, MSE Wall	5/10/11

ROUTE	COUNTY	STRUCTURE/BENT	LOCATION
SH 119	Boulder	/	SH 119 & Jay Road

TOP HOLE ELEV	TOTAL DEPTH	SURVEY INFO	GEOLOGIST/FOREMAN
5,282.3ft	25.5ft	N: 277,787 E: 122,486	D. Thomas/R. Brown/A. Moreno

ELEV (ft)	DEPTH (ft)	LOG	DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWS	N-VALUE REC%/RQD%
	0.6		**Asphalt**				
		F	**Sandy Gravel Fill**				
5280	2.0		**Sandy Silt,** light brown, soft to medium stiff, fine grained sand				
					4.0	1A 2-2-2	4
	6.0		**Clay,** mottled light gray to light brown, medium stiff, blocky texture				
5275							
	9.0		medium stiff		9.0	1B 2-3-2	5
5270							
	14.0		stiff		14.0	1C 2-5-4	9
5265							
	19.0		very stiff		19.0	1D 9-9	18
	20.0		*drills harder* **Claystone,** light brown, hard, blocky texture				
5260							
					24.0	1E 13-23-39	62
	25.5		Total Boring Depth 25.5ft				
5255							
5250							

SPT DATA: 5 10 20 40 70

WELL DIAGRAM

SPT | CON'T | GRAB | SHELBY | CORE | CALIFORNIA

H_2O DEPTH (ft)	▽ 14.0
DATE	5/10/11
TIME	

NOTES: CME 75, Auger

GEOLOGIC BORING LOG JAY ROAD.GPJ CO_DOT.GDT 7/6/11

GEOLOGICAL BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING # 2

PROJECT ID	SA	PROJECT NAME	DATE DRILLED
C 1191-027	18054	SH 119, MSE Wall	5/10/11

ROUTE	COUNTY	STRUCTURE/BENT	LOCATION
SH 119	Boulder	/	SH 119 & Jay Road

TOP HOLE ELEV	TOTAL DEPTH	SURVEY INFO	GEOLOGIST/FOREMAN
5,283.4ft	30.5ft	N: 277,726 E: 122,435	D. Thomas/R. Brown/A. Moreno

ELEV (ft)	DEPTH (ft)	LOG	DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWS	N-VALUE REC%/RQD%
	0.5		**Asphalt**				
		F	**Silty-Sandy Gravel Fill**				
	2.0		**Silty Sand,** poorly graded, light gray, medium dense, fine grained				
5280					4.0	2A 5-5-6	11
5275	8.0		**Clayey Sand,** light brown, very loose		9.0	2B	
5270	14.0		very locse		14.0	2C 0-0-0	0
5265	19.0		*shelby damaged, no sample*		19.0	2D	
	20.0		**Claystone Bedrock,** light gray, very hard, blocky				
5260					24.0	2E 16-50	66
5255					29.0	2F 10-38-50/5"	88/11"
	30.5		Total Boring Depth 30.5ft				
5250							

SPT DATA

5 10 20 40 70

WELL DIAGRAM

SPT | CON'T | GRAB | SHELBY | CORE | CALIFORNIA

H_2O DEPTH (ft)	▽ 15.0
DATE	5/10/11
TIME	

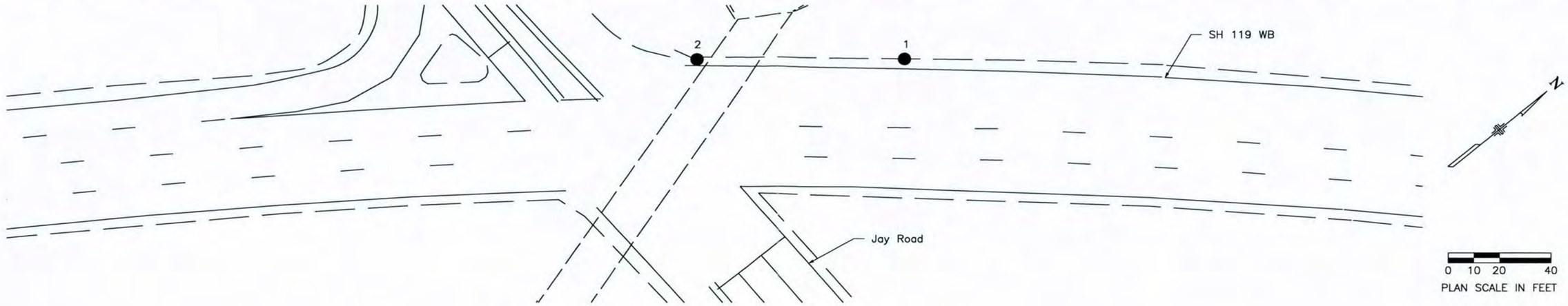
NOTES: CME 75, Auger

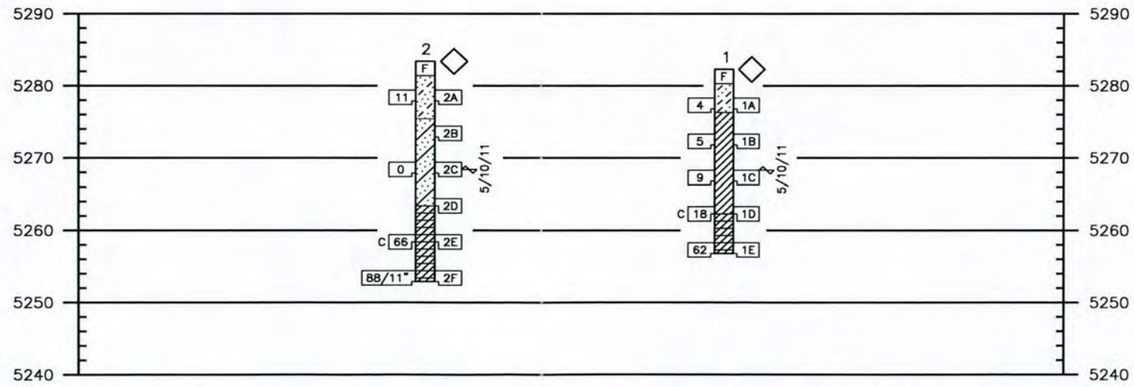
GEOLOGIC BORING LOG JAY ROAD.GPJ CO_DOT.GDT 7/6/11

ATTACHMENT 2

GEOLOGY SHEET

C 1191-027, SH-119 & JAY RD., SA 16884





The boring logs of the above test holes and geotechnical report are on file in the Geotechnical Program Office, Staff Materials and Geotechnical Branch, (303)398–6601

SUMMARY OF TEST RESULTS

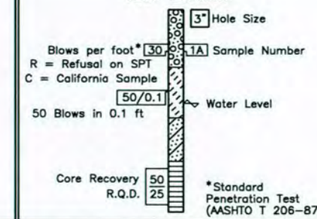
Sample Number	Depth (feet)	Classification			Grading Analysis (AASHTO) Percent				Atterberg Limits			Water Content w %	Dry Density (lb/ft^3)	Uniaxial Compressive Strength (psf)	Chlorides (% mass)	Water Soluble Sulfates (%)	Soil pH ($H_2O/CaCl_2$)	Resistivity ohm–cm Saturated
		Corps of Engrs. or Visual	USCS	AASHTO	Gravel	Coarse Sand	Fine Sand	Silt and Clay	L.L. L_W	P.L. P_W	P.I. I_W							
1B	9	Clay	CL	A–6(16)	4	5	12	79	37	15	22	17.8	–	–	–	–	–	–
1C	14	Clay	CL	A–6(17)	3	1	9	87	36	15	21	17.3	–	–	–	–	–	–
1D	19	Clay	CL	A–6(22)	1	1	3	95	40	18	22	14.7	118.5	2,412	–	–	–	–
2A	4	Silty Sand	SM	A–2–4(0)	9	7	63	21	NV	NP	NP	12.5	–	–	–	–	–	–
2B	9	Clayey Sand	SC	A–6(2)	17	15	27	41	30	15	15	17.3	110.1	–	0.018	0.010	7.60	1,121
2C	14	Clayey Sand	SC	A–2–6(1)	20	16	30	34	28	13	15	14.8	–	–	–	–	–	–
2E	24	Claystone	CL	A–7–6(24)	0	0	4	96	41	17	24	14.0	122.9	16,490	–	–	–	–

TYPE OF MATERIAL

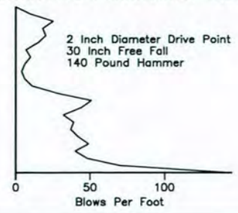
- F Asphalt and Silty/Sandy Gravel Fill
- Clay
- Sandy Silt
- Clayey Sand
- Silty Sand
- Claystone

LEGEND

TEST BORING



CONTINUOUS PENETRATION TEST



- Location of Test Boring
- Location of Continuous Penetration Test
- W 3 Inch Wireline Boring
- Rotary Boring
- Auger Boring

Print Date: 7/6/2011
Drawing File Name: 18054geosheet01.dgn
Horiz. Scale: 1:40 Vert. Scale: As Noted
Staff Geotechnical Program HCL

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
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As Constructed
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Void:

ENGINEERING GEOLOGY

Designer: D. Thomas
Detailer: T. McNulty
Sheet Subset: Geology
Structure Numbers
Subset Sheets: XXX of XXX

Project No./Code
C 1191-027
18054
Sheet Number XXX

COLORADO
Department of Transportation

DOCUMENT SEPARATOR SHEET

Geotechnical Reports and Geology Sheets

To be placed at the beginning of each document.

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Naming Convention

GT_119B_49.54_20031023

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Memorandum

MATERIALS AND GEOTECHNICAL BRANCH
GEOTECHNICAL PROGRAM
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DEPARTMENT OF TRANSPORTATION

NH 1191-016
SH-119/SH-52 Interchange
Subaccount #13930

TO: Helen Peiker, Region-4 Engineering-South Program

FROM: Roman Jauregui, Geotechnical Program

DATE: October 23, 2003

SUBJECT: **Final Geotechnical Investigation Report, Bridge Structures D-16-DU and D-16-DT and Retaining Wall**

1. INTRODUCTION

This report presents the final geotechnical investigation results and foundation recommendations for the proposed SH-119/SH-52 traffic interchange. The purpose of this final geotechnical investigation was to determine the general geotechnical profile and to characterize the physical properties of the foundation materials at the site. This information was utilized to address design issues and to provide final geotechnical recommendations necessary to finalize the design of two bridge structures and a retaining wall as part of the proposed traffic interchange. This report finalizes information provided in the Initial Site Investigation Report dated January 17, 2003.

2. PROJECT DESCRIPTION

The scope of work for the investigation was based on information provided by Mr. Mark Talvitie of Carter & Burgess and Ms. Helen Peiker of R-4 Engineering. SH-52 currently intersects SH-119 and Burlington Northern Sante Fe Railroad (BNSFRR) at the same grade. It is understood that grade separation will be provided between SH-52 and SH-119 by constructing bridge structure D-16-DU to elevate SH-52 traffic over SH-119. Grade separation will be provided between SH-52 and BNSFRR by constructing bridge structure D-16-DT to elevate SH-52 traffic over BNSFRR. It is also understood that a fill retaining wall is proposed between SH-119 and BNSFRR (i.e., immediately east of SH-119 and west of BNSFRR). The proposed retaining wall is understood to be approximately 1,500 feet long and reach a maximum height of approximately 20 feet.

3. INVESTIGATION

Ten exploratory borings were advanced into bedrock to depths ranging from approximately 19 to 50 feet below the original ground surface (OGS) near the proposed foundations at the locations

shown on the geology sheet. The borings were advanced using CDOT drill rigs utilizing 7 ½-inch hollow stem auger. Standard penetration testing (ASTM D-1586) was performed at 5-foot intervals in each of the borings. One-inch diameter slotted PVC pipe was installed in 9 of the 10 borings to monitor the local groundwater table. Drilling for the geotechnical site investigation was performed in phases beginning on December 12, 2002, and completed on May 8, 2003. Results of the field investigation are attached including logs of the test borings and a geology sheet.

Gradation analysis and Atterberg limits tests were performed for material classification purposes on representative material samples retrieved from the borings. Testing to determine the water-soluble sulfate content of the foundation materials was also performed. Results of the material classification tests are presented on the geology sheet while results of the water-soluble sulfate tests are presented in Table 1.

Table 1. Water-Soluble Sulfate Content

Location	Boring	Depth (feet)	Water-Soluble Sulfate, SO_4 (percent by weight of soil)
Structure D-16-DU	1	3.5-5.0	0.01
	1	8.5-10	BDL*
Structure D-16-DT & Retaining Wall	3	4.0-5.5	BDL*
	3	19.0-19.7	BDL*
	5	3.5-5	BDL*
	5	8.5-10.0	BDL*
	5	18.5-19.3	0.01

* Below Detection Limit

4. SITE CONDITIONS & GEOTECHNICAL PROFILE

Generally, medium dense to dense silty sand and clayey sand with gravel lenses and occasional cobbles were encountered to depths of approximately 13 to 23 feet below the OGS. Medium dense to dense sandy gravel was also encountered overlying bedrock. Hard to very hard siltstone/claystone bedrock was encountered below the sand and gravel to the maximum depth of investigation of approximately 50 feet below the OGS. Elevations of the bedrock surface vary from approximately 5143 to 5132 feet as shown on the boring logs and the geology sheet.

Groundwater was encountered at depths ranging from approximately 10 to 17 feet below OGS and at elevations ranging from approximately 5144 to 5136 feet.

5. DISCUSSION & RECOMMENDATIONS

Bearing capacities for design of the bridge and the retaining wall foundations using allowable stress design (ASD) and load and resistance factor design (LRFD) methods are provided in the following sections. For the LRFD method the ultimate capacities assume a weighted load factor of 1.5 and we recommend a resistance factor of 0.5.

Based on results of the water-soluble sulfate testing presented in Table 1, the potential for sulfate attack on Portland cement concrete in direct contact with the ground is negligible. From the standpoint of sulfate attack, no particular type of cement is specified for concrete foundation components in direct contact with on-site foundation materials.

5.1 Bridges

Driven pile or drilled shaft foundation systems embedded in the hard to very hard siltstone/claystone bedrock encountered at the site are suitable for support of the proposed bridge structures. The recommended geotechnical design parameters are provided in the following sections.

5.1.1. Driven Steel H-Piles

Steel H-piles driven to refusal in the underlying bedrock may be used to support the bridge superstructures. For ASD, a combined skin friction and end bearing allowable capacity of 9 kips per square inch (ksi) times the cross sectional area of the pile should be used. For LRFD, a combined skin friction and end bearing ultimate capacity of 27 ksi times the cross sectional area of the pile should be used. The minimum manufacturer's rated energy for the hammer should be as recommended in Table 502.1E, *CDOT Standard Specifications for Road and Bridge Construction,* 1999.

We anticipate the pile capacities will be achieved with 5 to 10 feet of pile penetration into the hard to very hard siltstone/claystone bedrock. Battered piles not exceeding 1H:4V batter may be used to provide lateral support. It is anticipated that the sand and gravel overlying the bedrock will provide minimal axial or torsional resistance, however, they should be accounted for when calculating the lateral resistance. Material properties presented in Table 3 should be utilized when performing the lateral load analysis of the driven piles using LPILE or similar software

5.1.2. Drilled Shafts

Drilled shafts embedded in the hard to very hard siltstone/claystone bedrock may also be used to support the bridge superstructures. Resistance provided by the bedrock was estimated using methods consistent with local practice. The allowable end bearing capacity, q_a, and the allowable side shear capacity, f_a, required for the ASD method are presented in Table 2. The ultimate end bearing capacity, q_{ult}, and the ultimate side shear capacity, f_{ult}, required for the LRFD method are also presented in Table 2. (Note: Ultimate end bearing capacity, q_{ult}, and the ultimate side shear capacity, f_{ult}, in this document are referred to as nominal bearing resistance, q_{ult}, and nominal unit skin resistance, q_s, respectively, in Section 10 of *AASHTO LRFD Bridge Design Specifications,* 1998.) Embedment of the drilled shafts should be determined based on the required axial and lateral load capacities.

Table 2. Recommended Drilled Shaft Axial Resistance Values

Material	ASD		LRFD	
	q_a (ksf)	f_a (ksf)	q_{ult} (ksf)	f_{ult} (ksf)
Overlying Soils (Sand and Gravel)	0	0	0	0
Bedrock (Siltstone/Claystone)	50	5	150	15

The recommended capacities assume a minimum spacing of three shaft diameters, center-to-center, between adjacent drilled shafts. Drilled shafts spaced more closely than the recommended three diameters should be evaluated on an individual basis to determine the appropriate reduction factor to apply to the axial resistances. The sand and gravel overlying the bedrock should be neglected when calculating the axial or torsional resistance, however, they should be accounted for when calculating the lateral resistance. Material properties presented in Table 3 should be utilized when performing the lateral load analysis of the drilled shafts using LPILE or similar software.

Table 3. Recommended Material Properties for Lateral Load Analysis using LPILE

Material	Internal Friction Angle, ϕ (degrees)	Cohesion, c (lb/ft^2)	Modulus of Horizontal Subgrade Reaction, k_h (lb/in^3)	Strain at ½ the maximum principal stress difference, ε_{50} (in/in)	Total Unit Weight, γ_T (lb/ft^3)	Saturated Unit Weight, γ_{SAT} (lb/ft^3)
Overlying Soils (Sand and Gravel)	32	0	90 ~80 lb/ft^3	---	115	120
Bedrock (Siltstone/Claystone)	0	10,000	2,000 ~1725 lb/ft^3	0.002	135	---

$1\ lb/in^3 \left(\frac{12\ in}{ft}\right)^3 \left(\frac{ton}{2000\ lbs}\right) = 0.86$

Casing or slurry may be required to support the soils overlying the bedrock during excavation of the drilled shafts. Dewatering of the excavation may be required prior to placement of the concrete. Alternatively, the concrete may be placed by tremie or other methods to avoid segregation of the aggregate or voids in the finished shaft.

5.2. Retaining Wall

Cast-in-place (CIP) cantilever walls and mechanically stabilized earth (MSE) walls supported on the native medium dense to dense sand and gravel may be used for the proposed fill retaining walls.

5.2.1. CIP Walls

CIP cantilever walls supported on spread footings founded on the native soils may be used. A maximum allowable bearing pressure of 4 ksf is recommended for the design of the spread footings placed on the native soils using the ASD method. If the LRFD is used, an ultimate bearing capacity of 12 ksf should be used. A coefficient of the base sliding resistance (μ) of 0.5 may be used between the concrete footing and the foundation soils. ASD parameters presented in Table 4 for the Class 1 structural backfill should be used to evaluate the lateral earth pressures on the retaining walls.

5.2.2. MSE Walls

MSE walls supported on the native soils may also be used. An allowable bearing pressure of 5 ksf may be used for design using the ASD method. If the LRFD method is used, an ultimate bearing capacity of 15 ksf may be used. Construction of the MSE walls should utilize Class 1 structural backfill meeting specifications provided in Section 703.08 of *CDOT Standard Specifications for Road and Bridge Construction,* 1999. The parameters recommended for an ASD of the MSE walls are presented in Table 4.

Table 4. Allowable Stress Design Parameters for MSE Walls

Material	Total Unit Weight, γ_T (pcf)	Internal Friction Angle, ϕ (degrees)	Cohesion c (psf)	Coefficient of Active Earth Pressure, K_a
Class 1 Structural Backfill	125	34	---	0.28
Native Soils	115	32	0	0.31

The coefficients of active earth pressure (K_a), presented in Table 4 correspond to approximately 35 pounds per cubic foot (pcf) of equivalent fluid unit weight for the Class 1 structural backfill and the native soils assuming a horizontal backfill slope. K_a must be reevaluated if something other than a horizontal backfill slope is used. A coefficient of the base sliding resistance (μ) of 0.65 may be used between the base of the MSE wall and the native foundation material. This coefficient should be reevaluated if a reinforcement material other than geogrid is utilized. Design of the MSE walls should be in accordance with FHWA guidelines set forth in *Mechanically Stabilized Earth walls and Reinforced Soil Slope Design and Construction Guidelines* (FHWA Demonstration Project 82, Reinforced Soil Structures, MSEW and RSS), Publication No. FHWA-SA-96-071.

Temporary excavation support will be required if slopes steeper than 1H:1V are planned during construction. Parameters presented in Table 4 may be used for design of temporary excavation support.

Please contact this office at 303-757-9275 with any questions regarding the geotechnical site investigation or the foundation recommendations presented herein.

REVIEW: Hsing-Cheng Liu

COPY: Harding / DeWitt
Leonard / Osmun
Davis / Gosselin
Talvitie, Carter-Burgess
Padhiar, Bridge Design Field Pack
Aschenbrener / Kotzer
Liu ✓

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 1

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	12/10/02

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DU /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,154.7ft	29.3ft	N 291,463 E 134,371	H-C.Liu / K.Jiron

ELEV (ft)	DEPTH (ft)	MATERIAL GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5150			**SC/GC: CLAYEY SAND/CLAYEY GRAVEL**, very silty, fine to medium grained, moist, dense to very dense, medium plasticity, light brown. Note: Medium to coarse sand with gravel and small cobbles below 8.5 ft. Reddish-brown below 13.5 ft.		3.5	1A 12-19-40	59
5145					8.5	1B 8-16-16	32
5140	14.7		**CLAYSTONE BEDROCK (CL)**, fractured with iron stains, moist, hard to very hard, medium plasticity, reddish-brown. Note: Silty and very hard below 18.5 ft.		13.5	1C 8-11-7	18
5135					18.5	1D 15-38-50/3"	88/0.8
5130					23.5	1E 31-60/3"	60/0.3
5125	29.3		Stopped HSA at 28'6" SPT Refused at 29'3" Total Boring Depth 29.3ft		28.5	1F 60-65/3"	65/0.3
5120							
5115							

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	13.5	▼ 13.7	▼ 13.7	13.6	▽ 11.1
DATE	12/10/02	12/13/02	12/16/02	12/19/02	5/22/03
TIME	1125 hrs	1428 hrs	1530 hrs	1105 hrs	1130 hrs

NOTES: Boring advanced with CME-75 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring with bottom 20 feet slotted. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 2

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	12/10/02

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DU /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,154.4ft	29.2ft	N 291,379 E 134,443	H-C.Liu / K.Jiron

ELEV (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5150		**SC/GC: CLAYEY SAND/CLAYEY GRAVEL**, very silty, fine to medium grained, moist, dense to very dense, medium plasticity, light brown.		3.5	2A 12-25-28	53
		Note: Medium to coarse sand with gravel and small cobbles below 3.5 ft. Reddish-brown below 8.5 ft.		8.5	2B 6-10-30	40
5145						
5140	13.6	**CLAYSTONE BEDROCK (CL)**, silty, fractured with iron stains, hard to very hard, medium plasticity, light brown.		13.5	2C 5-17-30	47
		Note: Very hard and gray interbedding below 18.5 ft.		18.5	2D 40-50/2"	50/0.2
5135						
5130				23.5	2E 26-50/2"	50/0.2
5125	29.2	Stopped HSA at 28'6" SPT Refused at 29'2" Total Boring Depth 29.2ft		28.5	2F 34-60/2"	60/0.2
5120						
5115						

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▼ 25.5	14.4	14.4	14.4	▽ 11.7
DATE	12/10/02	12/13/02	12/16/02	12/19/02	5/22/03
TIME	1305 hrs	1430 hrs	1535 hrs	1106 hrs	1131 hrs

NOTES: Boring advanced with CME-75 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring with bottom 20 feet slotted. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 3

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	12/16/02

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	Retaining Wall /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,157.5ft	24.8ft	N 291,009 E 134,441	H-C.Liu / K.Jiron

ELEV (ft)	DEPTH (ft)	MATERIAL GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5155			**SC/CL: CLAYEY SAND/SANDY CLAY**, fine to medium grained, moist, medium dense, medium plasticity, light brown.				
	4.0		**SC-SM: CLAYEY SAND - SILTY SAND**, gravelly, poorly graded, slightly moist, very dense, medium plasticity, light brown to brown.		4.0	3A 34-40-17	57
5150			Note: Reddish-brown and very gravelly below 8 ft. Trace small cobbles below 14 ft.		9.0	3B 3-5-12	17
5145							
	14.5		**SILTY CLAYSTONE BEDROCK (CL)**, iron stains, very hard, moist, medium plasticity, light brown to brown.		14.0	3C 8-32-60/3"	92/0.8
5140			Note: Light brown to gray below 19 ft.		19.0	3D 45-50/2"	50/0.2
5135							
	24.8		Stopped HSA at 24' SPT Refused at 24'9" Total Boring Depth 24.8ft		24.0	3E 17-50/3"	50/0.3
5130							
5125							
5120							

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▼ 19.6	14.2	▽ 14.0	
DATE	12/16/02	12/19/02	5/22/03	
TIME	1300 hrs	1108 hrs	1132 hrs	

NOTES: Boring advanced with CME-850 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring with bottom 20 feet slotted. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 4

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	12/16/02

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DT /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,156.7ft	33.8ft	N 291,280 E 134,681	H-C.Liu / K.Jiron

ELEV (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5155	0	**CL: SILTY CLAY**, considerable fine sand and trace fine gravel, moist, stiff, medium plasticity, dark brown.		3.5	4A 2-5-6	11
5150	7.5	**GP-GC/GP-GM: SANDY GRAVEL**, trace of clay and silt, some small cobbles, poorly graded, moist, dense, medium plasticity, gray to reddish-brown. Note: Wet below approximately 18.5 ft.		8.5	4B 19-25-20	45
5145				13.5	4C 10-15-15	30
5140				18.5	4D 6-17-17	34
5135	22.5	**SILTY CLAYSTONE BEDROCK (CL)**, iron stains, hard to very hard, moist, gray to brown.		23.5	4E 80/5"	Refusal
5130				28.5	N.R. 60/3"	Refusal
5125						
5120	33.8	Stopped HSA at 33'6" SPT Refused at 33'9" Total Boring Depth 33.8ft		33.5	N.R. 100/3"	Refusal

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▼ 33.1	17.5	▽ 15.1
DATE	12/19/02	12/23/02	5/22/03
TIME	1109 hrs	1305 hrs	1133 hrs

NOTES: Boring advanced with CME-850 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring with bottom 20 feet slotted. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 5

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	12/17/02

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	Retaining Wall /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,151.2ft	28.8ft	N 291,617 E 134,968	R.Jauregui / K.Jiron

ELEV (ft)	DEPTH (ft)	MATERIAL GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5150			**SC: CLAYEY SAND**, considerable silt, trace of fine gravel, poorly graded, subangular, very moist, loose/medium stiff, medium plasticity, reddish-brown.		3.5	5A 3-4-4	8
	5.0		**GM/SM: SANDY GRAVEL/GRAVELLY SAND**, some silt, poorly graded, subangular to subrounded, moist, dense, nonplastic, light reddish-brown.		8.5	5B 16-27-23	50
5145			Note: Silty Sand (SM) lense from 10 to 12 ft. Wet below approximately 15 ft.				
5140					13.5	5C 16-22-18	40
5135							
	17.0		**SILTY CLAYSTONE BEDROCK (CL)**, slightly weathered, thickly bedded, very hard (soft rock), olive-gray with rusty staining.		18.5	5D 26-50/3"	50/0.3
5130					23.5	5E 27-50/5"	50/0.4
5125							
	28.8		Stopped HSA at 28'6" SPT Refused at 28'9" Total Boring Depth 28.8ft		28.5	5F 50/3"	Refusal
5120							
5115							

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	14.0	▼ 14.8	▽ 10.5	
DATE	12/17/02	12/19/02	5/22/03	
TIME	1115 hrs	1100 hrs	1134 hrs	

NOTES: Boring advanced with CME-850 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 6

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	5/8/03

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DU /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,158.0ft	49.2ft	N 291,258 E 134,539	A.Khan / D.Novak

ELEV (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
	0.7	**PAVEMENT SURFACE** Approximately 8 inches of asphalt (HBP) at surface.				
5155	3.0	**FILL** **SC: CLAYEY SAND**, some gravel, poorly graded, subangular to subrounded, moist, medium dense, medium plasticity, dark tan to brown.				
		NATIVE **SC: CLAYEY SAND**, considerable gravel, poorly graded, subangular to subrounded, moist, very dense, low plasticity, light brown.		9.0	6A 12-25-35	60
5150	11.0	**GM: SANDY GRAVEL**, some silt, poorly graded, subangular to subrounded, moist to wet, dense, nonplastic, brown.		14.0	6B 8-14-22	36
5145						
5140				19.0	6C 9-15-15	30
5135	23.0	**SILTY CLAYSTONE BEDROCK (CL)**, slightly weathered, thickly bedded, moist, very hard, gray.		24.0	6D 32-50/5"	50/0.4
5130						
5125				34.0	6E 50/4"	Refusal
5120						

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▽ 22.0				
DATE	5/8/03				
TIME	1200 hrs				

NOTES: Boring advanced with CME-55/300 using 7 1/2-inch O.D. HSA. Backfilled hole with cuttings. Pavement patched by R-4 Maintenance.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 10/10/03

BORING LOG

BORING 6

DEPARTMENT OF TRANSPORTATION

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	5/8/03

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DU /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,158.0ft	49.2ft	N 291,258 E 134,539	A.Khan / D.Novak

ELEV (ft)	DEPTH (ft)	MATERIAL GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%	N-VALUE PROFILE (blows per foot) 5 10 20 40 70	WELL DIAGRAM
5115			**SILTY CLAYSTONE BEDROCK (CL),** slightly weathered, thickly bedded, moist, very hard, gray. *(continued)*						
5110									
	49.2		Stopped HSA at 49' SPT Refused at 49'2" Total Boring Depth 49.2ft		49.0	6F 50/2"	Refusal		
5105									
5100									
5095									
5090									
5085									
5080									

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▽ 22.0					NOTES: Boring advanced with CME-55/300 using 7 1/2-inch O.D. HSA. Backfilled hole with cuttings. Pavement patched by R-4 Maintenance.
DATE	5/8/03					
TIME	1200 hrs					

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 10/10/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 7

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	5/7/03

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DT /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,155.0ft	44.2ft	N 291,200 E 134,794	A.Khan / D.Novak

ELEV (ft)	DEPTH (ft)	MATERIAL GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5150			**SC: CLAYEY SAND**, trace gravel, poorly graded, subangular to subrounded, moist, very loose to medium dense, low plasticity, light brown to tan.		4.0	7A 2-2-2	4
5145					9.0	7B 4-5-8	13
	11.0		**GM: SANDY GRAVEL**, some silt, poorly graded, subangular to subrounded, moist to wet, medium dense to dense, nonplastic, light brown to tan/white.		14.0	7C 8-14-21	35
5140					19.0	7D 9-11-12	23
5135							
	23.0		**SILTY CLAYSTONE BEDROCK (CL)**, slightly weathered, thickly bedded, occasional stains in fractures, moist, very hard, gray.		24.0	7E 15-41-50/3"	91/0.8
5130							
5125							
					34.0	N.R. 50/4"	Refusal
5120							
5115							

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▼ 18.5	▽ 16.5			
DATE	5/7/03	5/22/03			
TIME	1530 hrs	1135 hrs			

NOTES: Boring advanced with CME-55/300 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 7

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	5/7/03

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DT /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,155.0ft	44.2ft	N 291,200 E 134,794	A.Khan / D.Novak

ELEV (ft)	DEPTH (ft)	MATERIAL GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%	N-VALUE PROFILE (blows per foot) 5 10 20 40 70	WELL DIAGRAM
5110	44.2		**SILTY CLAYSTONE BEDROCK (CL)**, slightly weathered, thickly bedded, occasional stains in fractures, moist, very hard, gray. *(continued)*						
			Stopped HSA at 44' SPT Refused at 44'2" Total Boring Depth 44.2ft		44.0	N.R. 50/2"	Refusal		
5105									
5100									
5095									
5090									
5085									
5080									
5075									

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▼ 18.5	▽ 16.5			
DATE	5/7/03	5/22/03			
TIME	1530 hrs	1135 hrs			

NOTES: Boring advanced with CME-55/300 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 8

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	5/7/03

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	D-16-DT /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,152.6ft	24.7ft	N 291,140 E 134,835	A.Khan / D.Novak

ELEV (ft)	DEPTH (ft)	MATERIAL GRAPHIC	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5150			**SC: CLAYEY SAND**, trace gravel, poorly graded, subangular to subrounded, moist, loose, low plasticity, tan to light brown.		4.0	8A 5-4-6	10
5145	8.0		**GM: SANDY GRAVEL**, some silt, poorly graded, subangular to subrounded, moist, dense to very dense, nonplastic, light brown to tan.		9.0	8B 7-15-17	32
5140	14.5		**SILTY CLAYSTONE BEDROCK (CL)**, slightly weathered, thickly bedded, some staining, moist to wet, very hard, gray to light brown.		14.0	8C 9-22-50/5"	72/0.9
5135					17.0	8D 40-50/2"	50/0.2
5130							
	24.7		Stopped HSA at 24' SPT Refused at 24'8" Total Boring Depth 24.7ft		24.0	8E 48-50/2"	50/0.2
5125							
5120							
5115							

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▼ 21.0	▼ 14.5			
DATE	5/7/03	5/22/03			
TIME	1300 hrs	1136 hrs			

NOTES: Boring advanced with CME-55/300 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 9

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	5/8/03

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	Retaining Wall /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,155.0ft	19.3ft	N 291,148 E 134,562	A.Khan / D.Novak

ELEV (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5150	0.0	**SC: CLAYEY SAND**, some silt, poorly graded, subangular to subrounded, moist, dense, medium plasticity, brown.		4.0	9A 13-22-27	49
	6.5	**GM: SANDY GRAVEL**, some clay, poorly graded, subangular to subrounded, moist, loose to medium dense, nonplastic to medium plasticity, light brown.		9.0	9B 5-4-5	9
5140	14.5	**SILTY CLAYSTONE BEDROCK (CL)**, slightly weathered, thickly bedded, some staining in fractures, moist, very hard, gray.		14.0	9C 7-13-19	32
5135	19.3	Stopped HSA at 19' SPT Refused at 19'4" Total Boring Depth 19.3ft		19.0	N.R. 50/4"	Refusal
5130						
5125						
5120						
5115						

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▽ 15.2					
DATE	5/22/03					
TIME	1137 hrs					

NOTES: Boring advanced with CME-55/300 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 11913930.GPJ CO_DOT.GDT 9/18/03

BORING LOG

DEPARTMENT OF TRANSPORTATION

BORING 10

PROJECT NUMBER	SA	PROJECT NAME	DATE DRILLED
NH 1191-016	13930	SH-119 at SH-52 Interchange	5/8/03

ROUTE	COUNTY	STRUCTURE / BENT	LOCATION
SH-119	Boulder	Retaining Wall /	Niwot

SURFACE ELEV	TOTAL DEPTH	SURVEY INFORMATION	LOGGED BY / DRILL FOREMAN
5,151.2ft	20.8ft	N 291,408 E 134,796	A.Khan / D.Novak

ELEV (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	DEPTH (ft)	SAMPLE ID BLOWCOUNT	N-VALUE REC%/RQD%
5150	0.0	**SC: CLAYEY SAND**, some silt, poorly graded, subangular to subrounded, moist, medium dense, medium plasticity, dark brown.				
				3.5	10A 4-8-10	18
	4.0	**GM: SANDY GRAVEL**, poorly graded, subangular to subrounded, moist to wet, medium dense, nonplastic, light brown to light yellow.				
5145				8.5	10B 6-8-11	19
5140						
				13.5	10C 4-9-10	19
5135						
	18.0	**SILTY CLAYSTONE BEDROCK (CL)**, slightly weathered, thickly bedded, some staining in fractures, moist, very hard, gray.				
				20.0	10D 35-50/3"	50/0.3
5130	20.8	Stopped HSA at 20' SPT Refused at 20'9" Total Boring Depth 20.8ft				
5125						
5120						
5115						

N-VALUE PROFILE (blows per foot): 5 10 20 40 70

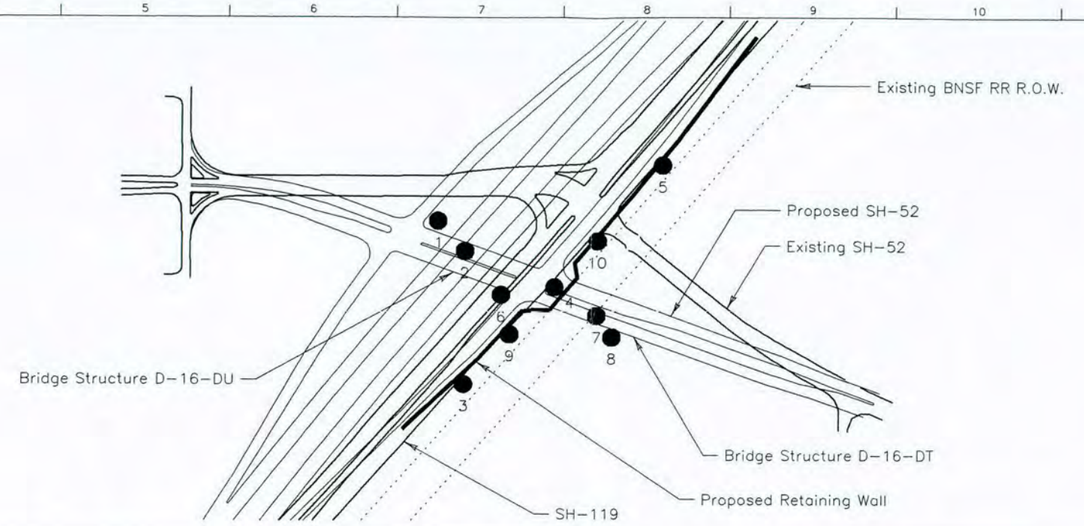
WELL DIAGRAM: Backfilled with drill cuttings; Hand-slotted PVC (1-inch diameter Sch40)

SPT | CON'T | GRAB | SHELBY | CORE (HQ)

H_2O DEPTH	▼ 20.0	▽ 12.3				
DATE	5/8/3	5/22/03				
TIME	1530 hrs	1138 hrs				

NOTES: Boring advanced with CME-55/300 using 7 1/2-inch O.D. HSA. Installed a piezometer (1-inch diameter Sch40 PVC) to the full depth of the boring. Backfilled hole with cuttings.

GEOLOGIC BORING LOG 1191930.GPJ CO_DOT.GDT 9/18/03



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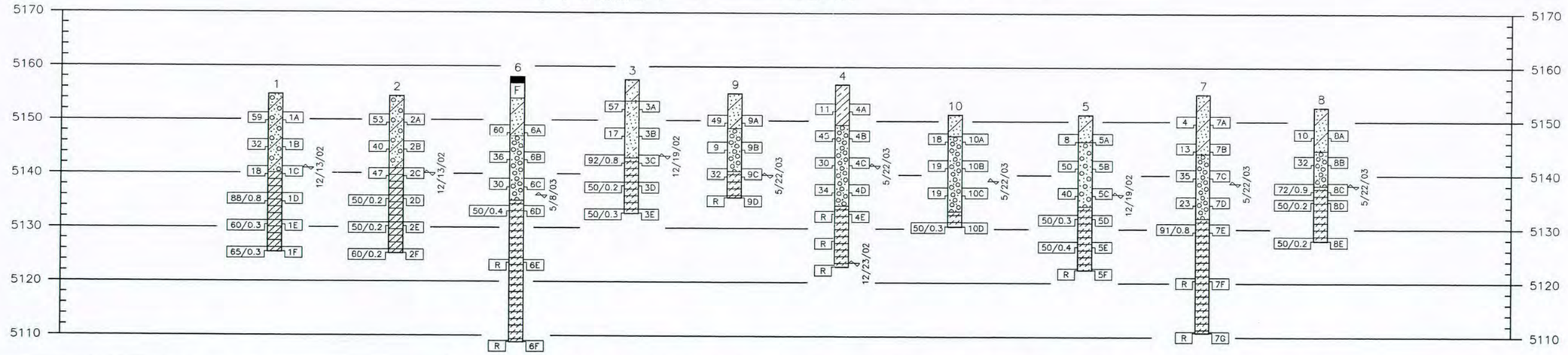
PLAN SCALE IN FEET



SUMMARY OF TEST RESULTS

Sample Number	Depth (feet)	Classification: Corps of Engrs. or Visual	Classification: USCS	Classification: AASHTO	Grading Analysis (AASHTO) Percent: Gravel	Coarse Sand	Fine Sand	Silt and Clay	Atterberg Limits: Liquid Limit L_W	Plastic Limit P_W	Plastic Index I_W	Water Content w %
1A	3.5–5.0	Clayey Gravel / Sand	GC/SC	A–2–6(0)	53.1	16.4	13.7	16.8	28	13	15	3.6
1B	8.5–10.0	Poorly Graded Sand	SP–SC	A–2–6(0)	51.2	27.1	10.3	11.4	29	11	18	2.8
1D	18.5–19.8	Claystone	(CL)	A–7–6(27)	0.9	0.8	1.2	97.1	43	27	16	12.8
2B	8.5–10.0	Clayey Sand	SC	A–2–6(0)	48.1	27.7	11.0	13.2	26	15	11	3.7
2C	13.5–15.0	Claystone	(CL)	A–6(22)	1.0	1.0	5.5	92.5	39	15	24	16.2
3A	4.0–5.5	Clayey / Silty Sand	SC–SM	A–1–b(0)	40.8	22.7	16.7	19.8	23	18	5	3.5
3D	19.0–19.7	Claystone	(CL)	A–6(9)	11.0	2.0	16.8	70.2	31	14	17	8.3
4A	3.5–5.0	Sandy Lean Clay	CL	A–6(8)	4.8	7.6	30.0	57.6	31	11	20	12.1
4C	13.5–15.0	Poorly Graded Gravel	GP–GC/GP–GM	A–1–a(0)	58.2	21.6	10.6	9.6	20	15	5	2.3
5A	3.5–5.0	Clayey Sand	SC	A–6(5)	6.6	26.9	26.0	40.5	39	14	25	12.6
5B	8.5–10.0	Silty Sand	SM	A–1–b(0)	49.3	17.8	17.4	15.5	NV	NP	NP	3.4
5D	18.5–19.3	Claystone	(CL)	A–6(12)	0.0	0.0	33.0	67.0	35	13	22	8.8

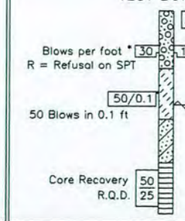
The boring logs of the above test holes are on file in the Geotechnical Program Office, Staff Materials and Geotechnical Branch, (303)757–9274

TYPE OF MATERIAL

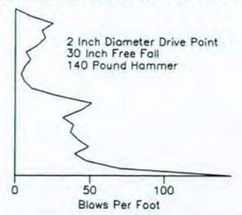
- Pavement Surface
- F Fill – Clayey Sand
- Silty Clay
- Clayey Sand / Sandy Clay
- Clayey Sand
- Clayey Sand / Silty Sand
- Clayey Sand / Clayey Gravel
- Sandy Gravel
- Sandy Gravel / Gravelly Sand
- Claystone Bedrock
- Silty Claystone Bedrock

LEGEND

TEST BORING



CONTINUOUS PENETRATION TEST



- Location of Test Boring
- Location of Continuous Penetration Test
- W 3 Inch Wireline Boring
- Rotary Boring
- Auger Boring

(Preliminary Stage Only)

Revision Dates | Date | Initial | Quantities by | Checked by | Date | Initial | Detailed by | Checked by | Date | Initial | Designed by | Checked by

Computer File Information

Creation Date:	1/15/03	Initials:	TM
Last Modification Date:	10/10/03	Initials:	TM
Full Path:	\\dot\mcnultyt\shared files		
Drawing File Name:	SH119 SH52.dwg		
Acad Ver. 2002	Scale: varies	Units:	english

Sheet Revisions

Colorado Department of Transportation
DEPARTMENT OF TRANSPORTATION
4201 East Arkansas Avenue
Denver, Colorado 80222
Phone: 303–757–9274 FAX: 303–757–9242
Geotechnical Program

As Constructed
No Revisions:
Revised:
Void:

ENGINEERING GEOLOGY
SH–119 at SH–52 Interchange

Designer: R. Jauregui
Detailer: T. McNulty
Sheet Subset: Geology
Structure Numbers:
Subset Sheets:

Project No./Code
NH 1192–016
13930
Sheet Number

Memorandum

MATERIALS AND GEOTECHNICAL BRANCH
GEOTECHNICAL PROGRAM
4201 EAST ARKANSAS AVENUE, DENVER, COLORADO 80222 303-757-9275 FAX 303-757-9242

DEPARTMENT OF TRANSPORTATION

NH 1191-016
SH-119/SH-52 Interchange
Subaccount #13930

TO: Helen Peiker, Region-4 Engineering-South Program

FROM: Roman Jauregui, Geotechnical Program

DATE: November 20, 2003

SUBJECT: **Addendum to Final Geotechnical Investigation Report, Bridge Structures D-16-DU and D-16-DT and Retaining Wall**

As requested by Mr. Dick Osmun of Bridge Design & Management during the F.I.R. of November 20, 2003, the following NAVFAC parameters are provided for lateral design of structural elements related to the referenced project. This addendum is provided to supplement the recommendations provided in Table 3 in the report titled *Final Geotechnical Investigation Report, Bridge Structures D-16-DU and D-16-DT and Retaining Wall*, and dated October 23, 2003.

To estimate the lateral load behavior of piles and caissons using procedures detailed in Naval Facilities Engineering Command (NAVFAC) Design Manual 7.2 (DM-7.2) titled *Foundations and Earth Structures*, and dated May 1982, a coefficient of variation of lateral subgrade reaction, f, of approximately 25 tons per cubic foot (t/ft^3) is recommended for the overlying soils (sand and gravel) referred to in Table 3 of the final report. The modulus of horizontal Subgrade reaction, k_h, should be converted to the proper units resulting in approximately 80 t/ft^3 for the overlying soils. Please contact this office at 303-757-9275 with any questions regarding this addendum.

REVIEW: Hsing-Cheng Liu

COPY: Harding / DeWitt
Leonard / Osmun
Davis / Gosselin
Talvitie, Carter-Burgess
Padhiar, Bridge Design Field Pack
Aschenbrener / Kotzer
Liu

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MOUNTAIN STATES IMAGING

2889

Memorandum

MATERIALS AND GEOTECHNICAL BRANCH
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DEPARTMENT OF TRANSPORTATION

NH 1191-016
SH-119/SH-52 Interchange
Subaccount #13930

TO: Dick Osmun/Andrew Pott, Bridge Design and Management

FROM: Mark Vessely, Geotechnical Program

DATE: June 11, 2004

SUBJECT: **Additional Geotechnical Design Recommendations**

As requested, the following discussion is being provided for the drilled shaft design on Project NH1191-016, SA 13930. Specifically, this memo addresses a reduction factor to be used in the LFRD pier design. The Geotechnical Program issued a Final Geotechnical Investigation Report for the project in a report dated October 23, 2003.

The provided preliminary pier design information suggests a pier diameter of 54 inches in a two-pier group with a center-to-center spacing of 96 inches. This results in a center spacing value of 1.78 B, where B = pier diameter. There also is a possibility of the pier diameter increasing to 60 inches, for a center spacing value of 1.6 B. It is important to note that FHWA Drilled Shaft Publication No. FHWA-IF-99-025 suggests avoiding drilled shaft installation closer than 2 pier diameters with freshly set concrete to reduce the potential for cracking that can result from unbalanced earth pressure along the shaft. Additionally, the FHWA publication indicates drilled shaft construction practices can compromise the support conditions and recommends pier spacing of no less than 2B+0.04D+6in (D = depth of bedrock embedment). In order to achieve this requirement, the shaft diameters would need to be reduced to 40 inches.

If possible, the design should attempt to maintain spacing greater than 2B for a maximum pier diameter of 48 inches. To develop maintain the required pier capacity for smaller piers, the recommended side shear values can be applied for each foot of additional penetration into bedrock, and the end bearing value would remain unchanged with increasing depth. Therefore using 48-inch diameter piers, the reduction factor in the LFRD design would be 0.85. If the indicated larger diameter piers must be used, the reduction factors would be 0.84 for a 54-inch pier and 0.82 for a 60-inch diameter pier. This values were determined based on the site-specific conditions and should not be applied to other pier groups.

The presence of sand and gravel above the bedrock increases the risk for caving to occur between adjacent pier holes during drilling and concrete placement. According to the CDOT Standard Specifications for Road and Bridge Construction Section 503.07, adjacent caissons

shall not be drilled within a clear distance of 3 feet from concrete that has not attained a compressive strength of at least 1500 psi. The minimum concrete strength requirement would apply at this location for the use of a 60-inch diameter pier group, which could affect the construction schedule. In our opinion, any pier holes spaced within 2B, but with greater than 36 inches of clear space, should be inspected after completion to determine if drilling may have weakened the soil along the pier shaft and the Section 503.07 requirement applied.

Alternatively, it may be possible to use a larger diameter single pier in place of the 2-pier group. Pier diameters of 7 to 8 feet have been used in previous CDOT projects and would individually provide a total axial capacity that is greater than the use of two, 4.5-foot diameter piers.

Please contact this office at 303-757-9275 with questions regarding the above recommendations.

Reviewed By: Hsing-Cheng Liu

Copy: Hsing-Cheng Liu

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Transportation

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TO 19 Geology Sheets

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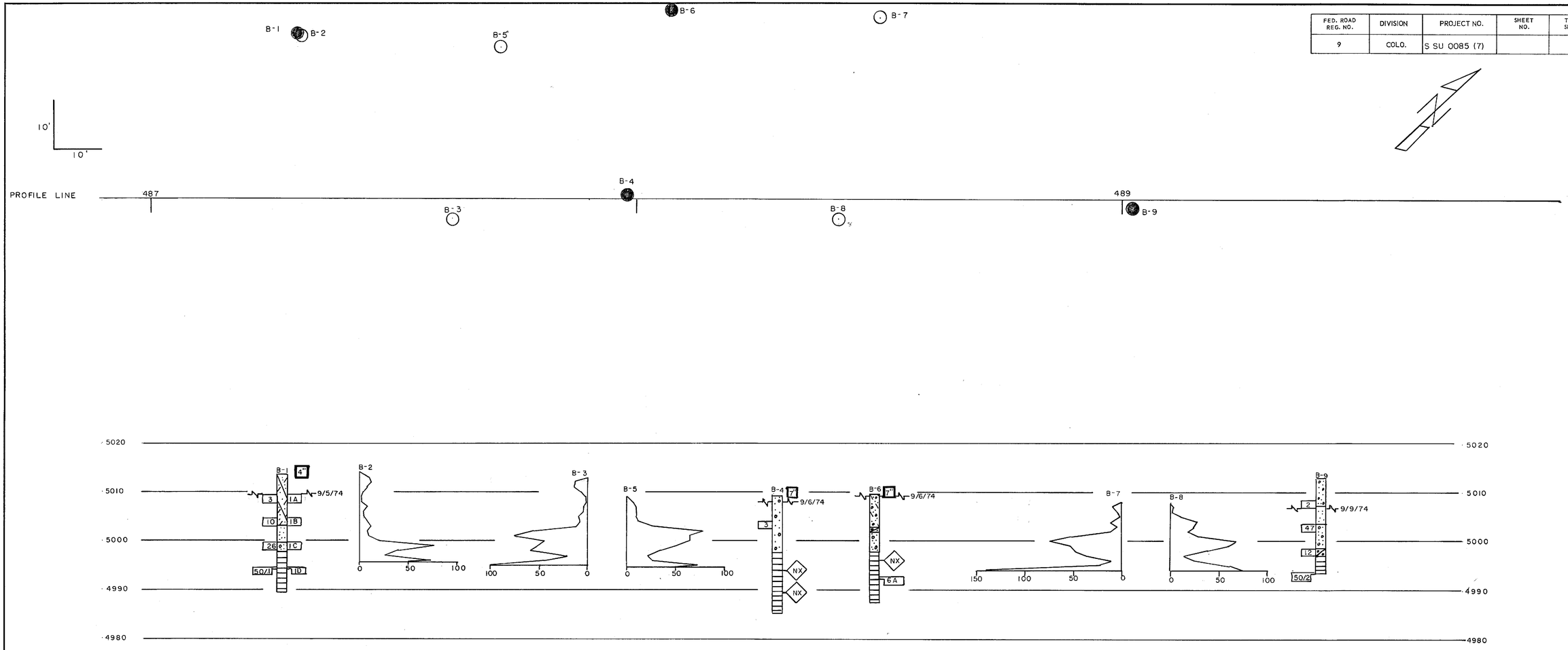
248

DOH FORM NO. 160
REVISED: OCTOBER, 1970

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S SU 0085 (7)		



SUMMARY OF TEST RESULTS

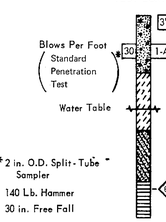
Sample No.	Depth	Classification: Corps of Engrs. or Visual	Classification: AASHO	Grading Analysis: Percent Gravel	Coarse Sand	Fine Sand	Silt and Clay	Atterberg Limits: Liquid Limit L_w	Plastic Limit P_w	Plastic Index I_w	Water Cont. W %	Wet Unit Weight γ P.C.F.	Unconfined Strength Q_u T.S.F.	Triaxial Shear Strength: Unconsolidated ø°	Unconsolidated C T.S.F.	Consolidated ø°	Consolidated C T.S.F.	Consolidated Time hrs.	Consolidated Press P.S.I.	Dia. Of Sample (Inches)
1A	4.3-5.8	SANDY CLAY	A-4(3)	1	15	30	54	35	26	9	31									
1B	9.8-10.8	GRAVELLY SAND	A-1-b(0)	25	56	14	5	NV	NP	NP	15.1									
1C	14.3-15.8	SANDY GRAVEL	A-1-a(0)	60	23	10	7	NV	NP	NP	7.8									
6A	17-17.5	SHALE										147.9	105.34							2040

TYPE OF MATERIAL

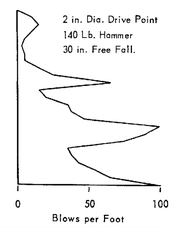
- CLAYEY, SANDY SILT
- SILTY SAND & GRAVEL
- SAND
- SANDY, GRAVELLY CLAY
- SAND & GRAVEL
- GRAVELLY CLAY
- SHALE

LEGEND

TEST BORING



CONTINUOUS PENETRATION TEST



- Location of Test Boring
- Location of Continuous Penetration Test
- Rotary Boring
- Auger Boring
- Core Boring

DIVISION OF HIGHWAYS
STATE OF COLORADO

ENGINEERING GEOLOGY

Across LEFT HAND CREEK
Sta
Near NIWOT Sec. T. R.
Geologist ACE
Made by SMO
Checked by SMO
Approved by Bridge Engineer
Date: Oct. 22 1974

STRUCTURE NO. D-16-AU
DWG. NO. B OF

K&E 10 7153 12-70 42814

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MOUNTAIN STATES IMAGING

2868

S-SU 0085(7)
Niwot North
Left Hand Creek

Bridge Design Division

October 22, 1974

Materials Division

Foundation Investigation for Sta. No. D-16-AU

The proposed structure will carry Colo. 118 traffic over Left Hand Creek approximately 1 mile north of Niwot. Test borings were completed with the Division's CME drilling rig on September 9, 1974.

Geology

The subsurface material consists of 6.0-14.3 feet of loose silt and sand overlying 1.5-5.0 feet of medium to dense gravel, which in turn overlies shale bedrock. The bedrock is weathered to the consistency of stiff clay for approximately 3.0 feet. The water table was encountered between elevations 5006.9 and 5009.6 feet at the time of drilling.

Recommendations

Use steel H-piles at the abutments and drilled caissons or spread footers at the piers. An allowable bearing capacity of 100 tons per pile at the abutments and 30 tons per square foot under the pier foundations will be attained at or near elevation 4994.0 feet for all locations.

B. A. Brakey
Staff Materials Engineer

by Alan C Eastwood
Alan C. Eastwood
Engineer-in-Training II

ACE:jh

cc: Bower-O'Connor
Peterson (2)
FHWA via Bridge Design
Roupp
Gilmore

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 267
Revised: May 1970

Project S-SU 0035(7)
Location Niwot North
Structure Left Hand Creek
Route Colo.119 County Boulder
Date Drilled 9-5-74

FOUNDATION BORING LOG

Top Hole Elev. 5013.3 Geologist Eastwood Station 487+30 34' Lt Boring No. 1

Elev.	Depth	Description of Material	BPF*	Remarks
5013.3	0.0-9.3	Silt, sandy, clayey, brown - black, organic,		4" Augers
		soft		
09.5	4.3-5.8	As Above, moist (1A)	3	
04.5	9.3-10.8	9.3-9.8 - As Above 9.8-10.8 - As Below (1B)	10	
04.0	9.8-14.3	Sand, coarse, clean, wet		
4999.3	14.3-16.0	Gravel, sandy, rusty, wet		
99.5	14.3-15.8	As above (1C)	26	
97.8	16.0-24.3	Shale, hard, black		
94.3	19.3-19.4	As Above	50/.1	
89.3	24.3	BTB		

* Standard Penetration Test (AASHO T 206)

Water level upon completion 4.5' Elev. 5009.3 Date 9-5-74 Time 11:30
Water level (24 hrs.) _____ Elev. _____ Date _____ Time _____

jh 10/22/74

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 334
Prev. Form DOH 267A
August 1969

Project # S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo. 119 County Boulder
Date Drilled 9-5-74

PENETROMETER LOG

Top Hole Elev. 5013.8 Geologist Eastwood Station 487+30.5 33' Lt Boring No. 2

Elev.	Depth	Blows	Elev.	Depth	Blows	Elev.	Depth	Blows	Elev.	Depth	Blows
5012.8	1	10		24			47			70	
11.8	2	12		25			48			71	
10.8	3	8		26			49			72	
09.8	4	4		27			50			73	
08.8	5	2		28			51			74	
07.8	6	3		29			52			75	
06.8	7	8		30			53			76	
05.8	8	4		31			54			77	
04.8	9	4		32			55			78	
03.8	10	7		33			56			79	
02.8	11	12		34			57			80	
01.8	12	8		35			58			81	
00.8	13	9		36			59			82	
4999.8	14	20		37			60			83	
98.8	15	76		38			61			84	
97.8	16	40		39			62			85	
96.8	17	26		40			63			86	
95.8	18	68		41			64			87	
95.5	19	50/.3		42			65			88	
	20			43			66			89	
	21			44			67			90	
	22			45			68			91	
	23			46			69			92	

jh 10/22/74

B. A. Brakey
STAFF MATERIALS ENGINEER

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 334
Prev. Form DOH 267A
August 1969

Project # S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo. 119 County Boulder
Date Drilled 9-5-74

PENETROMETER LOG

Top Hole Elev. 5013.4 Geologist Eastwood Station 487+62 4° Rt. Boring No. 3

Elev.	Depth	Blows	Elev.	Depth	Blows	Elev.	Depth	Blows	Elev.	Depth	Blows
5012.4	1	13		24			47			70	
11.4	2	14		25			48			71	
10.4	3	8		26			49			72	
09.4	4	3		27			50			73	
08.4	5	2		28			51			74	
07.4	6	4		29			52			75	
06.4	7	5		30			53			76	
05.4	8	9		31			54			77	
04.4	9	8		32			55			78	
03.4	10	13		33			56			79	
02.4	11	55		34			57			80	
01.4	12	75		35			58			81	
00.4	13	45		36			59			82	
4999.4	14	52		37			60			83	
98.4	15	39		38			61			84	
97.4	16	21		39			62			85	
96.4	17	43		40			63			86	
95.4	18	100		41			64			87	
	19			42			65			88	
	20			43			66			89	
	21			44			67			90	
	22			45			68			91	
	23			46			69			92	

jh 10/22/74

B. A. Brakey
STAFF MATERIALS ENGINEER

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 267
Revised: May 1970

Project S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo.119 County Boulder
Date Drilled 9-5-74

FOUNDATION BORING LOG

Top Hole Elev. 5009.1 Geologist Eastwood Station 487+98 1' Lt Boring No. 4

Elev.	Depth	Description of Material	BPF*	Remarks
5009.1	0.0-8.0	Sand, med. - coarse, gravelly, wet, some		7" H.F. Augers
		layers of gravel		0-15'
04.1	5.0-8.5	As Above, loose	3	
		(SIM 13)		
01.1	8.0-11.5	Gravel, sandy, wet		
4997.6	11.5-24.0	Bedrock, black shale		Soft - 11.5-14.7' V. hard -at 14.7'
94.1	15.0-19.5	As Above		NX Core
89.6	19.5-24.0	As Above		NX Core

* Standard Penetration Test (AASHO T 206)

Water level upon completion 1.0' Elev. 5008.1 Date 9/6/74 Time 10:00
Water level (24 hrs.) _____ Elev. _____ Date _____ Time _____

jh 10/22/74

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 334
Prev. Form DOH 267A
August 1969

Project # S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo. 119 County Boulder
Date Drilled 9-6-74

PENETROMETER LOG

Top Hole Elev. 5009.0 Geologist Eastwood Station 487+72 31' Lt Boring No. 5

Elev.	Depth	Blows	Elev.	Depth	Blows	Elev.	Depth	Blows	Elev.	Depth	Blows
5008.0	1	6		24			47			70	
07.0	2	10		25			48			71	
06.0	3	10		26			49			72	
05.0	4	10		27			50			73	
04.0	5	11		28			51			74	
03.0	6	26		29			52			75	
02.0	7	77		30			53			76	
01.0	8	65		31			54			77	
00.0	9	65		32			55			78	
4999.0	10	50		33			56			79	
98.0	11	35		34			57			80	
97.0	12	23		35			58			81	
96.0	13	26		36			59			82	
95.0	14	72		37			60			83	
94.8	15	50/.2		38			61			84	
	16			39			62			85	
	17			40			63			86	
	18			41			64			87	
	19			42			65			88	
	20			43			66			89	
	21			44			67			90	
	22			45			68			91	
	23			46			69			92	

jh 10/22/74

B. A. Brakey
STAFF MATERIALS ENGINEER

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 267
Revised: May 1970

Project S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo.119 County Boulder
Date Drilled 9-6-74

FOUNDATION BORING LOG

Top Hole Elev. 5009.8 Geologist Eastwood Station 488+07 39' Lt. Boring No. 6

Elev.	Depth	Description of Material	BPF*	Remarks
5009.8	0.0-6.0	Sand and Gravel, some		7" H.F. Augers
		silt, loose - med. dense, wet		0-13'
03.8	6.0-8.0	Clay, sandy, gravelly, wet		
01.8	8.0-12.0	Gravel, sandy, med. dense		
4997.8	12.0-22.5	Bedrock, black shale		
96.3	13.5-18.0	As Above: 13.5-15.5 - soft, brn; 15.5-18.0 -		NX Core
		hard, black (6A- 17.0-17.5)		
91.8	18.0-22.5	As Above, very hard		NX Core
87.3	22.5	BIS		

* Standard Penetration Test (AASHO T 206)

Water level upon completion 0.2 Elev. 5009.6 Date 9-6-74 Time 3:15
Water level (24 hrs.) _____ Elev. _____ Date _____ Time _____

jh 10/22/74

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 334
Prev. Form DOH 267A
August 1969

Project # S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo. 119 County Boulder
Date Drilled 9-9-74

PENETROMETER LOG

Top Hole Elev. 5008.4 Geologist Eastwood Station 438+50 37' Lt Boring No. 7

Elev.	Depth	Blows
5007.4	1	9
06.4	2	5
05.4	3	3
04.4	4	11
03.4	5	5
02.4	6	12
01.4	7	52
00.4	8	74
4999.4	9	54
98.4	10	48
97.4	11	36
96.4	12	11
95.4	13	24
94.5	14	140/.9
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	

Elev.	Depth	Blows
	24	
	25	
	26	
	27	
	28	
	29	
	30	
	31	
	32	
	33	
	34	
	35	
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	37	
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	43	
	44	
	45	
	46	

Elev.	Depth	Blows
	47	
	48	
	49	
	50	
	51	
	52	
	53	
	54	
	55	
	56	
	57	
	58	
	59	
	60	
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	62	
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	66	
	67	
	68	
	69	

Elev.	Depth	Blows
	70	
	71	
	72	
	73	
	74	
	75	
	76	
	77	
	78	
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jh 10/22/74

B. A. Brakey
STAFF MATERIALS ENGINEER

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 334
Prev. Form DOH 267A
August 1969

Project # S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo. 119 County Boulder
Date Drilled 9-9-74

PENETROMETER LOG

Top Hole Elev. 5008.7 Geologist Eastwood Station 488+41.5 4' Rt. Boring No. 8

Elev.	Depth	Blows
5007.7	1	4
06.7	2	2
05.7	3	11
04.7	4	27
03.7	5	24
02.7	6	18
01.7	7	29
00.7	8	67
4999.7	9	59
98.7	10	38
97.7	11	14
96.7	12	25
95.7	13	53
94.9	14	75/.8
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	

Elev.	Depth	Blows
	24	
	25	
	26	
	27	
	28	
	29	
	30	
	31	
	32	
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	41	
	42	
	43	
	44	
	45	
	46	

Elev.	Depth	Blows
	47	
	48	
	49	
	50	
	51	
	52	
	53	
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	55	
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	66	
	67	
	68	
	69	

Elev.	Depth	Blows
	70	
	71	
	72	
	73	
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	75	
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	92	

jh 10/22/74

B. A. Brakey
STAFF MATERIALS ENGINEER

DIVISION OF HIGHWAYS
STATE OF COLORADO
DOH Form No. 267
Revised: May 1970

Project S-SU 0085(7)
Location Niwot North
Structure Left Hand Creek
Route Colo.119 County Boulder
Date Drilled 9-9-74

FOUNDATION BORING LOG

Top Hole Elev. 5013.1 Geologist Eastwood Station 489+02 2'Rt Boring No. 9

Elev.	Depth	Description of Material	BPF*	Remarks
5013.1	0.0-6.0	Sand, gravelly, med, grained,		4" Augers
		moist		
08.6	4.5-6.0	As Above, loose	2	
07.1	6.0-9.5	Sand, fine grained, wet		
03.6	9.5-14.5	Gravel, sandy, dense, rusty, wet		
03.6	9.5-11.0	As Above (SIM 1C)	47	
4998.6	14.5-17.5	Clay, wxed bedrock, brown, soft, gravelly		
98.6	14.5-16.0	As Above	12	
95.6	17.5-19.7	Bedrock, hard, black		
93.6	19.5-19.7	As Above	50/.2	
93.4	19.7	BIB		

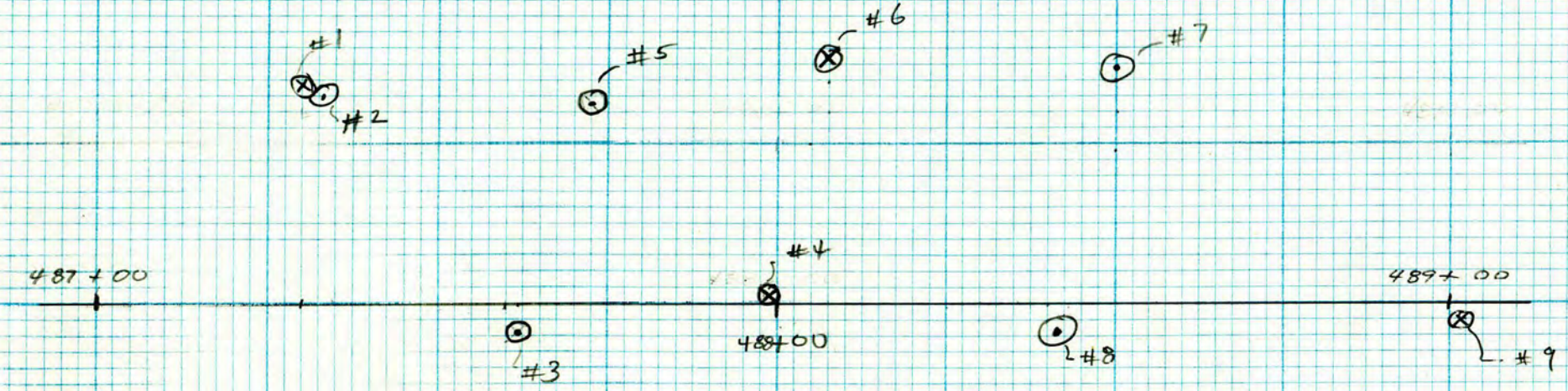
* Standard Penetration Test (AASHO T 206)

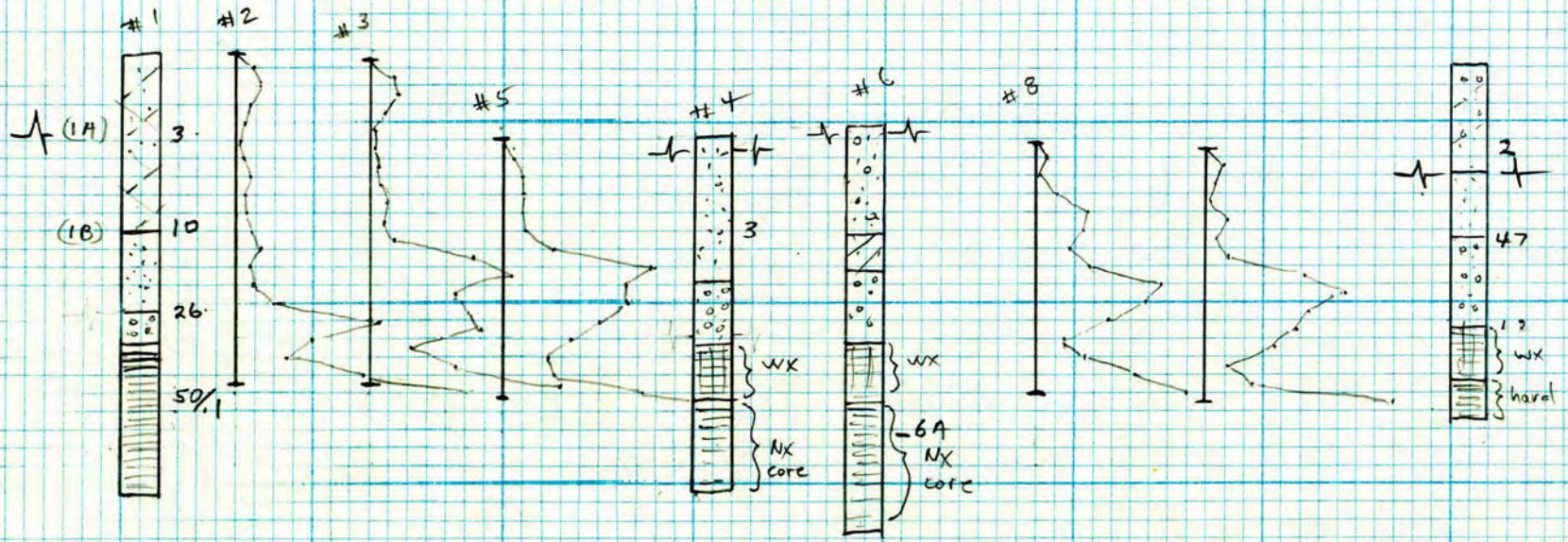
Water level upon completion 6.2' Elev. 5006.9 Date 9/9/74 Time 1:55
Water level (24 hrs.) _____ Elev. _____ Date _____ Time _____

jh 10/22/74

5-SU 6083 (7)
N, west North Left Hand Creek

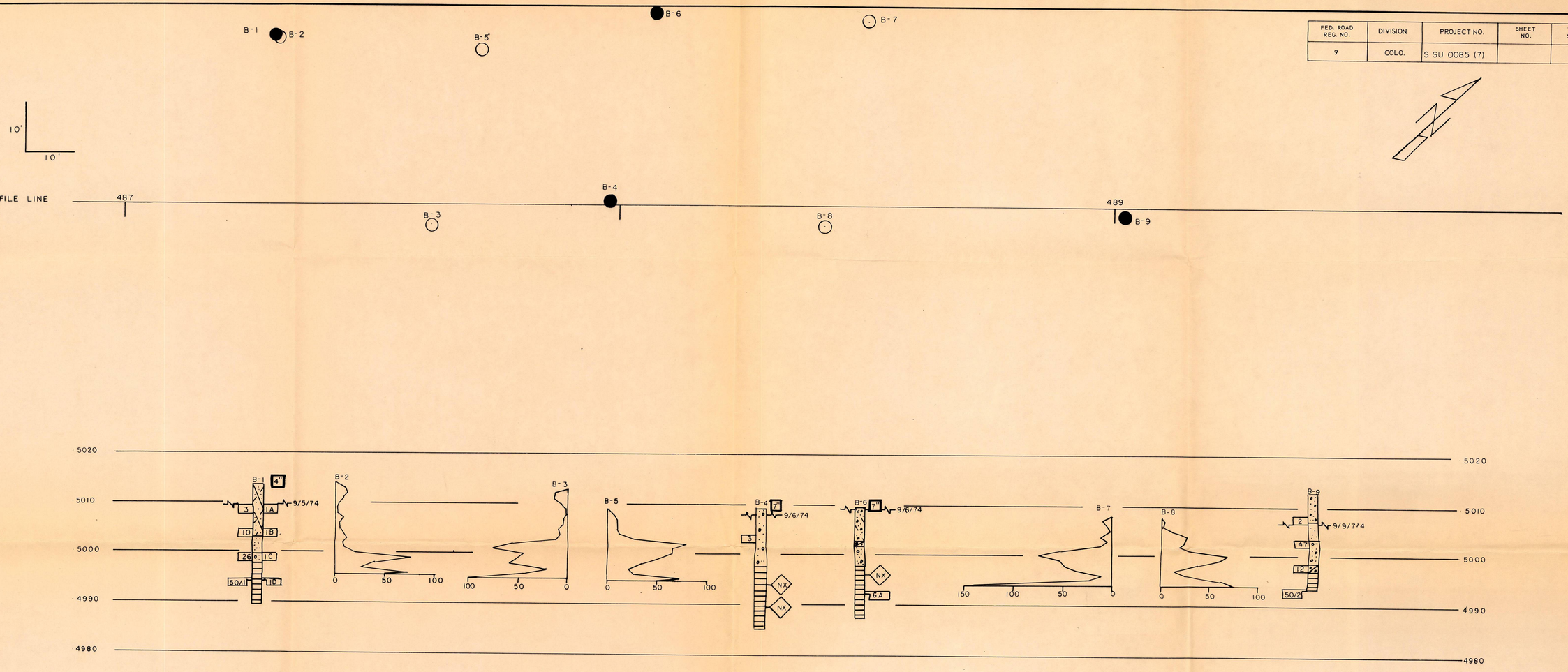
horizontal – 25' = 1"
vertical 10' = 1"





DOH FORM NO. 160
REVISED: OCTOBER, 1970

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S SU 0085 (7)		



SUMMARY OF TEST RESULTS

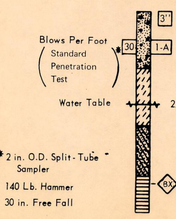
Sample No.	Depth	Classification: Corps of Engrs. or Visual	Classification: AASHO	Grading Analysis: Percent Gravel	Coarse Sand	Fine Sand	Silt and Clay	Atterberg Limits: Liquid Limit L_w	Plastic Limit P_w	Plastic Index I_w	Water Cont. W %	Wet Unit Weight γ P.C.F.	Unconfined Strength Q_u T.S.F.	Triaxial Shear Strength: Unconsolidated ϕ °	C T.S.F.	Consolidated ϕ °	C T.S.F.	Time hrs.	Press P.S.I.	Dia. Of Sample (inches)
1A	4.3-5.8	SANDY CLAY	A-4(3)	1	15	30	54	35	26	9	31									
1B	9.8-10.8	GRAVELLY SAND	A-1-b(0)	25	56	14	5	NV	NP	NP	15.1									
1C	14.3-15.8	SANDY GRAVEL	A-1-a(0)	60	23	10	7	NV	NP	NP	7.8									
6A	17-17.5	SHALE										147.9	105.34							2040

TYPE OF MATERIAL

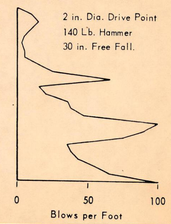
- CLAYEY, SANDY SILT
- SAND
- SAND & GRAVEL
- SHALE
- SILTY SAND & GRAVEL
- SANDY, GRAVELLY CLAY
- GRAVELLY CLAY

LEGEND

TEST BORING



CONTINUOUS PENETRATION TEST



- ● Location of Test Boring
- ○ Location of Continuous Penetration Test
- □ Rotary Boring
- ■ Auger Boring
- ◇ Core Boring

DIVISION OF HIGHWAYS
STATE OF COLORADO

ENGINEERING GEOLOGY

Across LEFT HAND CREEK
Sta
Near NIWOT Sec. T. R.
Geologist ACE
Made by SMO
Checked by SMO
Approved by Bridge Engineer
Date: Oct. 22 1974

STRUCTURE NO. D-16-AU
DWG. NO. B OF

K&E 10 7155 12-70 42914