

**CITY OF GREELEY
INVITATION FOR BID**

**20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE –
FA19-05-051**

DUE JUNE 10, 2019 BEFORE 2:00 P.M.



Serving Our
Community
It's A Tradition

*The Office of Purchasing is a service division
established to build effective partnerships through efficient and responsive
procurement processes to obtain high quality
goods and services for the best value.*

SECTION 00110
BID #FA19-05-051
INVITATION FOR BID

The City of Greeley, Colorado is requesting **sealed** bids for 20TH Street Improvements- 83rd to 90th Avenue **before June 10, 2019 before 2:00 p.m.** at the Public Works Building, 1001 9th Avenue, Greeley, Colorado 80631 at which time and place all bids will be publicly opened and read aloud. No late, faxed or electronic bids will be accepted.

The City of Greeley disseminates all bids and requests for proposals through the Rocky Mountain E-Purchasing System site. Go to <http://www.RockyMountainBidSystem.com>, then "Bid Opportunities" and then select "The City of Greeley". Bids submitted to the City of Greeley must include Sections 00120, 00130, 00140 and 00160. Addenda must be acknowledged in Section 00120 of the bidding documents. Bidders failing to acknowledge any and all addenda may be considered non-responsive.

A pre-bid meeting will be held on May 28, 2019 at 1:30 pm at the Public Works Building, 1001 9th Avenue, 2nd Floor Conference Room, Greeley, Colorado. All prospective bidders are encouraged to attend.

Each bid shall be accompanied, in a separate sealed envelope, by a certified check drawn on a bank which is insured by the Federal Deposit Insurance corporation or a bidder's bond executed by a surety company authorized to do business in Colorado, made payable to the City of Greeley, Colorado, in an amount not less than five percent (5%) of the proposal sum as security that the successful bidder will enter into a contract to construct this project in accordance with the plans and specifications, and give bonds in the sum as hereafter provided. Checks accompanying bids not accepted will be returned.

The successful responsive and responsible bidder will be required to furnish a satisfactory performance bond and payment bond in the amount of the contract sum.

No bid shall be withdrawn after the opening on the bids without the consent of the City of Greeley, Colorado, for a period of sixty (60) days after the scheduled time of the receiving the bids.

The City of Greeley retains the right to reject any and all bids and to waive any informality as deemed in the best interest of the city.

Questions pertaining to the project may be directed to Eva Rojas at 970-350-9747.

Adela R. Gain
Greeley Website
May 20, 2019

Section 00120

BID PROPOSAL

PROJECT: 20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051

The Undersigned, having become familiar with the local conditions affecting the cost of the work, plans, drawings, and specifications attached herewith, and with advertisement for bids, the form of bid and proposal, form of bond, all of which are issued and attached and on file in the office of the Project Manager, hereby bid and propose to furnish all the labor, materials, necessary tools, and equipment and all utility and transportation service necessary to perform and complete in a workmanlike manner all of the work required in connection with the construction of the items listed on the bidding schedule in accordance with the plans and specifications as prepared by the City of Greeley, Colorado, for the sums set forth in the Bidding Schedule.

The total bid shall be the basis for establishing the amount of the Performance and Payment Bond for this project. The total bid is based on the quantities shown in the bid proposal form and the dimensions shown on the plans.

The undersigned has carefully checked the Bidding Schedule quantities against the plans and specifications before preparing this proposal and accepts the said quantities as substantially correct, both as to classification and the amounts, and as correctly listing the complete work to be done in accordance with the plans and specifications.

The undersigned, agrees to complete and file a Performance and Payment Bond and further agrees to complete the contract within one-hundred eighty (180) Calendar Days from Notice to Proceed. Official notice to proceed will not be issued until adequate Performance and Payment Bonds and other required documents are on file with the City of Greeley.

NOTE: Bidders should not add any conditions or qualifying statements to this bid as otherwise the bid may be declared irregular as being non responsive to the Invitation for bids. The following numbered Addenda have been received and the bid, as submitted, reflects any changes resulting from those Addenda: _____

ATTEST

DATE

COMPANY NAME

BY

SIGNATURE

TITLE

**20th St from 83rd to 86th
City of Greeley
5/20/2019**

Bid Form

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total Price
	ROADWAY				
1	Clearing and Grubbing	1	LS		\$0
2	Unsuitable Material Excavation	500	CY		\$0
3	Unclassified Excavation (C.I.P.)	22,984	CY		\$0
4	Structure Excavation	725	CY		\$0
5	Structure Backfill (Class 1)	592	CY		\$0
6	Aggregate Pier Soil Improvement Area A	1	LS		\$0
7	Aggregate Pier Soil Improvement Area B	1	LS		\$0
8	Dewatering	1	LS		\$0
9	Removal of Asphalt, Full-Depth	16,728	SY		\$0
10	Removal of Concrete Pavement	475	SY		\$0
11	Remove Sidewalk	2,049	SF		\$0
12	Removal of Curb & Gutter	209	LF		\$0
13	Remove Inlet	1	EA		\$0
14	Remove Type III Barrier	3	EA		\$0
15	Remove of Sign	16	EA		\$0
16	Remove Pipe	732	LF		\$0
17	Remove Flared End Section	3	EA		\$0
18	Remove Pavement Markings	754	LF		\$0
19	Remove Symbols	53	SF		\$0
20	Remove Tree	33	EA		\$0
21	Remove Delineator	18	EA		\$0
22	Remove Headwall	2	EA		\$0
23	Remove Riprap	200	SF		\$0
24	Remove Gravel	2,926	SF		\$0
25	Remove Fence	23	LF		\$0
26	Reset Sign	11	EA		\$0
27	Adjust Water Valve	13	EA		\$0
28	Adjust Manhole Rim	5	EA		\$0
29	Extend Existing Manhole Height	5	EA		\$0
30	Relocate Water Meter	2	EA		\$0
31	Relocate Air Valve Vault and vent pipe	1	EA		\$0
32	Relocate Light (with concrete foundation)	1	EA		\$0
33	Irrigation Modifications	1	LS		\$0
34	Transplant Tree	6	EA		\$0
35	Subgrade Preparation	39,395	SY		\$0
36	Aggregate Base Course (ABC) (Class 6) (4")(Concrete Intersection)	1,432	TON		\$0
37	Aggregate Base Course (ABC) (Class 6) (6") (Asphalt)	8,097	TON		\$0
38	Concrete Pavement, Class P (10") (Intersection)	4,089	SY		\$0
39	Hot Mix Asphalt - Grading S (2.5") (100, PG 64-28)	3,676	TON		\$0
40	Hot Mix Asphalt - Grading SG (3.5") (100, PG 64-22)	5,146	TON		\$0
41	Curb and Gutter (2.5', Vertical Face)	7,441	LF		\$0
42	Drive Over Curb and Gutter	26	LF		\$0

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total Price
43	Curb and Gutter Island (Vertical Face) (Reverse Slope)	1,969	LF		\$0
44	Concrete Apron	3,789	SF		\$0

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total Price
45	Mechanical Reinforcement of Soil	115	CY		\$0
46	Concrete, Class D (Box Culvert, Wingwalls, Apron), includes rebar	146	CY		\$0
47	Structural Concrete Coating	89	SY		\$0
48	Lightweight Concrete Flowfill	82	CY		\$0
49	Safety Grate	1	EA		\$0
50	Concrete Cross Pan	424	SY		\$0
51	Concrete Shared Use Path	5,862	SY		\$0
52	Concrete Curb Ramps	436	SY		\$0
53	Concrete Curb Ramp (without truncated domes)	14	SY		\$0
54	Truncated Domes	160	SF		\$0
55	Pavement Markings (Epoxy)	120	GAL		\$0
56	Pavement Marking (Preformed Plastic & Thermoplastic)	1,315	SF		\$0
57	Sign Panel	662	SF		\$0
58	Steel Sign Post (1 3/4 x 1 3/4 inch tubing)	630	LF		\$0
59	Sign Anchor	90	EA		\$0
60	Type III Barriers	5	EA		\$0
61	Split Rail Fence	205	LF		\$0
62	Type Two Pull Box	16	EA		\$0
63	Fiber Optic 3" Conduit (Orange)	3,600	LF		\$0
64	Fiber Optic 3" Conduit (Red)	3,600	LF		\$0
65	Fiber Optic 3" Conduit (White)	3,600	LF		\$0
66	Fiber Optic 3" Conduit (Blue)	3,600	LF		\$0
67	Electrical Connection to Irrigation Controller	1	LS		\$0
68	Storm Drain Manhole (4' diameter)	2	EA		\$0
69	Storm Drain Manhole (5' diameter)	3	EA		\$0
70	Debris Hood for 5' Manhole	2	EA		\$0
71	Headwall for 24" RCP	1	EA		\$0
72	15 in. Flared End Section	4	EA		\$0
73	18 in. Flared End Section	11	EA		\$0
74	5' Type R Inlet	6	EA		\$0
75	10' Type R Inlet (Modified)	1	EA		\$0
76	10' Type R Inlet	3	EA		\$0
77	8" dia. PVC Pipe	14	LF		\$0
78	15" dia. RCP Pipe (Class III)	55	LF		\$0
79	18" dia. RCP Pipe (Class III)	654	LF		\$0
80	24" dia. RCP Pipe (Class III)	827	LF		\$0
81	23" X 14" Elliptical RCP (Class III)	94	LF		\$0
82	12" dia RCP (Class III)	14	LF		\$0
83	Riprap (D50=9")	16	CY		\$0
84	Riprap (D50=12")	54	CY		\$0
85	Stockpile and Reset Riprap	42	CY		\$0
86	Silt Fence	5,200	LF		\$0
87	Silt Fence, Wire Back	562	LF		\$0
88	Inlet Protection	11	EA		\$0
89	Concrete Washout Structure	2	EA		\$0
90	Wattle	200	LF		\$0

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total Price
91	Vehicle Tracking Pad	10	EA		\$0

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total Price
92	Soil Retention Blanket	14,205	SY		\$0
93	Plastic Construction Fence	657	LF		\$0
94	Rock Sock	200	LF		\$0
95	Outlet Protection	12	EA		\$0
96	Erosion Control Maintenance	1	LS		\$0
97	Maintain Access to Storage Unit	1	LS		\$0
98	Traffic Control Management and Inspection	1	LS		\$0
99	Traffic Control Signs	275	SF		\$0
100	Portable Message Sign Panel (5 EA)	780	DAY		\$0
101	Drum Channelizing Device	100	EA		\$0
102	Traffic Cone	100	EA		\$0
103	M.S.E. Retaining Wall (Complete in Place)	482	SF		\$0
104	Sanitary Facility	2	EA		\$0
105	Construction Survey	1	LS		\$0
106	Utility Pothole	50	Hr		\$0
107	Mobilization	1	LS		\$0
					\$0
108	LANDSCAPE				
109	Shade Trees - Deciduous Tree (2 Inch Caliper)	45	EA		\$ -
110	Ornamental Trees - Deciduous Tree (1.5 Inch Caliper)	85	EA		\$ -
111	Evergreen Tree (6 Foot) (Ball and Burlap)	20	EA		\$ -
112	Shrubs (5 Gal., Includes Deciduous and Evergreen)	85	EA		\$ -
113	Ornamental Grasses	204	EA		\$ -
114	Perennials	185	EA		\$ -
115	Seed Type-1: 'Low Grow Seed Mix	39,550	SF		\$ -
116	Seed Type-2: 'R.O.W. Mix'	248,678	SF		\$ -
117	Seed Repair	1,000	SF		\$ -
118	Top Soil 4" Depth (Seed Areas Only)	3,558	CY		\$ -
119	Landscape Boulde Type 'A'	27	EA		\$ -
120	Landscape Boulde Type 'B'	24	EA		\$ -
121	Landscape Boulde Type 'C'	35	EA		\$ -
122	Cobble mulch Blend 50-30-20 (4115 sf)	38	Ton		\$ -
123	Wood Mulch (3" depth Includes roundabout and trees)	46	CY		\$ -
124	Weed Barrier	3,965	SF		\$ -
125	Steel Edging	490	LF		\$ -
126	Standard Gray Concrete - Medians only (Includes all medians and roundabout apron)	10,992	SF		\$ -
127	Sand Finish Concrete - Medians (Finish - Surface Retardent)	5,114	SF		\$ -
					\$ -
	IRRIGATION				
128	Rain Bird 1806 Spray Sprinkler Assembly	597	EA		
129	Rain Bird 3504 Rotor Sprinkler Assembly	223	EA		
130	Rain Bird Inline Drip Irrigation	4,325	LF		
131	1 1/2" Remote Control Valve Assembly	27	EA		
132	1" Remote Control Valve Assembly	19	EA		
133	1" Remote Control Drip Valve Assembly	18	EA		
134	Irrigation Drip Flush Valve Assembly	29	EA		

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total Price
135	Quick Coupler Assembly	39	EA		
136	Isolation Gate Valve Assembly	14	EA		

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total Price
137	Special Provisions: Irrigation Repair and adjustment	1	LS		
138	6" Class 200 PVC Sleeve	720	LF		
139	4" Class 200 PVC Sleeve	30	LF		
140	3" Class 200 PVC Sleeve	60	LF		
141	2" Class 200 PVC Sleeve	920	LF		
142	3" Class 200 PVC Mainline including Thrust Blocks	6,520	LF		
143	2" Class 200 PVC Lateral	160	LF		
144	1 1/2" Class 200 PVC Lateral	120	LF		
145	1 1/4" Class 200 PVC Lateral	440	LF		
146	1" Class 200 PVC Lateral	15,000	LF		
147	3/4" Polyethylene Drip Lateral UV Resistant	5,800	LF		
148	#14AWG Two-Wire control wire	13,840	LF		
149	Baseline Single Station Decoder	64	EA		
150	Baseline Flow Decoder and CST ISOFLOW	1	EA		
151	Two-Wire Grounding Assembly including Baseline Surge Arrestor	10	EA		
152	Baseline Soil Moisture Sensors	5	EA		
153	Baseline 3200 Irrigation Controller with Cellular Modem	1	EA		
	WATER				
154	3" Irrigation Wet-Tap off 8" Water	1	EA		\$0
155	4" CAP	4	EA		\$0
156	4" Valve Removal	1	EA		\$0
157	6" Gate Valve	1	EA		\$0
158	6" Cap	1	EA		\$0
159	6" 90° BEND	1	EA		\$0
160	8" C900 Pipe	182	LF		\$0
161	8"x6" Reducer	1	EA		\$0
162	8" Solid Sleeve	1	EA		\$0
163	8" Valve Removal	1	EA		\$0
164	8" Cap	1	EA		\$0
165	8" 45° BEND	2	EA		\$0
166	8" 90° BEND	1	EA		\$0
167	8" Lowering	1	EA		\$0
168	8" Cut-in Connection	2	EA		\$0
169	Disconnect Water Service Connection	1	EA		\$0
170	Reestablish Water Service Connection	1	EA		\$0
				SUBTOTAL	\$0
				GRAND TOTAL	\$0

COOPERATIVE PURCHASING STATEMENT

The City of Greeley encourages and participates in cooperative purchasing endeavors undertaken by or on behalf of other governmental jurisdictions. To the extent, other governmental jurisdictions are legally able to participate in cooperative purchasing endeavors; the City of Greeley supports such cooperative activities. Further, it is a specific requirement of this proposal or Request for Proposal that pricing offered herein to the City of Greeley may be offered by the vendor to any other governmental jurisdiction purchasing the same products. The vendor(s) must deal directly with any governmental agency concerning the placement of purchase orders, contractual disputes, invoicing, and payment. The City of Greeley shall not be liable for any costs or damages incurred by any other entity.

SECTION 00140

BID BOND

KNOW ALL MEN BY THESE PRESENT, that we, the undersigned _____ as Principal, and _____ as Surety, are hereby held and firmly bound unto the City of Greeley, Colorado, as Owner, in the penal sum of _____ for the Payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors, and assigns.

THE CONDITION of this obligation is such that whereas the Principal has submitted to the City of Greeley, Colorado, the accompanying bid and hereby made a part hereof to enter into a Contract Agreement for the construction of City of Greeley Project,

20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051

WHEREAS, the Owner, as condition for receiving said bid, requires that the Principal to deposit with the Owner as Bid Guaranty equal to five percent (5%) of the amount of said bid.

NOW, THEREFORE,

(a) If said bid shall be rejected; or in the alternate,

(b) If said bid shall be accepted and the Principal shall execute and deliver a Contract Agreement (properly completed in accordance with said bid) and shall furnish a Performance and Payment Bond upon the forms prescribed by the Owner for the faithful performance of said Agreement; and shall in all other respects perform the agreement created by the acceptance of said bid;

then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals this _____ day of _____, 20_____, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

PRINCIPAL

SURETY

Name: _____

Address: _____

By: _____

Title: _____ Attorney _____

In-Fact: _____
(Seal) (Seal)

NOTE: Surety Companies executing bonds must be authorized to transact business in the State of Colorado and be accepted to the Owner.

SECTION 00160

NOTICE OF PRE-BID CONFERENCE

20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051

A pre-bid conference will be held:

On May 28, 2019 at 1:30 p.m., Public Works Building, 1001 9th Avenue, Greeley, CO 80631. All bidders are highly encouraged to attend.

Representatives of the City of Greeley will be present to answer questions.

Each bidder shall submit the following declaration of attendance, along with the other bid documents.

I have attended the pre-bid conference _____

I have not attended the pre-bid conference _____

Name of Contracting Organization

Authorized Signature

Date

SECTION 00210

NOTICE OF AWARD

DATE:

TO:

Re: **20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051**

Dear Contractor:

The City of Greeley, Colorado (hereinafter called "the Owner") has considered the bids submitted for referenced work in response to its Invitation for Bids. You are hereby notified that your bid has been accepted for items and prices stated in the Bid Schedule in the amount of \$_____. You are required to execute the Contract Agreement, provide the necessary insurance certificates, the Performance and Payment Bonds within ten (10) days from the date of this Notice. If you fail to execute said Contract Agreement and furnish the necessary insurance certificates and bonds within the time allotted from this date, the Owner will be entitled to consider your rights arising out of the Owner's acceptance of your bid as abandoned and to demand payment of bid guaranty as damages. The Owner will be entitled to such other rights as may be granted by law. You are required to return an acknowledged copy of this Notice of Award and enclosures to Purchasing.

CITY OF GREELEY, COLORADO

By: Joel Hemesath

Title: Director of Public Works

ACKNOWLEDGMENT: Receipt of the foregoing Notice of Award accompanied with a Performance and Payment Bond form and a signed copy of the Contract Document is hereby acknowledged this _____ day of _____, 20_____.

Bidder: _____

By: _____

SECTION 00310

CONTRACT

THIS AGREEMENT made and entered into this _____ day of _____, 20____, by and between the City of Greeley, Colorado, and under the laws of the state of Colorado, party of the first part, termed in the Contract Documents as the "Owner" and _____ party of the second part, termed in the Contract Documents as "Contractor."

WITNESSETH: In consideration of monetary compensation to be paid by the Owner to the Contractor at the time and in the manner hereinafter provided, the said Contractor has agreed, and does hereby agree, to furnish all labor, tools, equipment and material and to pay for all such items and to construct in every detail, to wit:

PROJECT: **20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051**

at the price bid on the Proposal Form of \$ _____ all to the satisfaction and under the general supervision of the Project Manager for the City of Greeley, Colorado.

The Contract Documents consist of this Agreement, the Conditions of the Contract (General, Supplementary and other Conditions), the Drawings, the Specifications, all Addenda issued prior to and all Modifications issued after execution of this Agreement. These form the Contract, and all are as fully a part of the Contract as if attached to this Agreement or repeated herein.

The Project Manager named herein shall interpret and construe the Contract Documents, reconciling any apparent or alleged conflicts and inconsistencies therein; and all of the work and all details thereof shall be subject to the approval and determination of the Project Manager as to whether or not the work is in accordance with Contract Documents. Said City Project Manager shall be the final arbiter and shall determine any and all questions that may arise concerning the Contract Documents, the performance of the work, the workmanship, quality of materials and the acceptability of the completed project. The decision of the Project Manager on all questions shall be final, conclusive and binding.

AND FOR SAID CONSIDERATION IT IS FURTHER PARTICULARLY AGREED BETWEEN THE PARTIES TO THIS AGREEMENT.

1. That construction and installation of the above enumerated work for the Owner shall be completed and ready for use in accordance with the time of completion described in the Bid form of this Contract. That the above enumerated work shall begin within ten (10) days of the official "Notice to Proceed". (Contract shall become void if work is not started at specified time.)

2. That said work and materials for the project covered by the Contract Documents shall be completely installed and delivered to the Owner, within the time above stated, clear and free from any and all liens, claims, and demands of any kind.
3. The full compensation to be paid the Contractor by the Owner pursuant to the terms of this Contract shall be payable as provided in the Contract Documents.
4. This Contract consists of the following component parts, all of which are as fully a part of the Contract as herein set out verbatim, or if not attached, as if hereto attached:

Section 00110: Invitation for Bid
Section 00120: Bid Proposal
Section 00130: Bid Schedule
Section 00140: Bid Bond
Section 00160: Pre-bid meeting
Section 00210: Notice of Award
Section 00310: Contract
Section 00320: Performance Bond
Section 00330: Payment Bond
Section 00340: Certificate of Insurance
Section 00350: Lien Waiver Release
Section 00360: Debarment/Suspension Certification Statement
Section 00410: Notice to Proceed
Section 00420: Project Manager Notification
Section 00430: Certificate of Substantial Completion
Section 00440: Final Completion
Section 00510: General Conditions of the Contract
Section 00520: Subcontractors List
Section 00620: Special Provisions

Addenda Number _____ Inclusive

Any modifications, including change orders, duly delivered after execution of this Agreement.

IN WITNESS WHEREOF, the parties have caused this instrument to be executed as of the day and year first above written.

City of Greeley, Colorado

Contractor_____

Approved as to Substance

Authorized Signature

City Manager-Roy Otto

Printed Name

Reviewed as to Legal Form
OFFICE OF THE CITY ATTORNEY

Title

By: _____
City Attorney-Doug Marek

Certification of Contract
Funds Availability

Director of Finance-Renee Wheeler

SECTION 00320

PERFORMANCE BOND

Bond No. _____

KNOWN ALL MEN BY THESE PRESENTS: that

(Firm) _____

(Address) _____

(an Individual), (a Partnership), (a Corporation), hereinafter referred to as "the Principal", and

(Firm) _____

(Address) _____

hereinafter referred to as "the Surety", are held and firmly bound unto the CITY OF GREELEY, 1000 10th Street, Greeley, CO. 80631, a Municipal Corporation, hereinafter referred to as "the Owner" in the penal sum of _____ in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors and assigns, jointly and severally, firmly by these present.

THE CONDITIONS OF THIS OBLIGATION are such that whereas the Principal entered into a certain Contract Agreement with the Owner, dated the _____ day of _____, 20_____, a copy of which is hereto attached and made a part hereof for the performance of City of Greeley Project,

20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions and agreements of said Contract Agreement during the original term thereof, and any extensions thereof which may be granted by the Owner, with or without Notice to the Surety and during the life of the guaranty period, and if he shall satisfy all claims and demands incurred under such Contract Agreement, and shall fully indemnify and save harmless the Owner from all cost and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, and then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract Agreement or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond; and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract Agreement or to the work or to the specifications.

IN WITNESS WHEREOF, this instrument is executed this _____ day of _____, 20____.

PROVIDED, FURTHER, that no final settlement between the Owner and Contractor shall abridge the right of any beneficiary hereunder, whose claims may be unsatisfied.

IN PRESENCE OF:

PRINCIPAL

_____ By: _____

_____ (Corporate Seal) _____ (Address)

IN PRESENCE OF:

OTHER PARTNERS

_____ By: _____

_____ By: _____

By: _____

IN PRESENCE OF:

SURETY

_____ By: _____

(Attorney-in-Fact)

_____ (SURETY SEAL) _____ (Address)

NOTE: Date of Bond must not be prior to date of Contract Agreement. If Contractor is Partnership, all partners should execute bond.

IMPORTANT: Surety Company must be authorized to transact business in the State of Colorado and be acceptable to the Owner.

SECTION 00330

PAYMENT BOND

Bond No. _____

KNOWN ALL MEN BY THESE PRESENT: that

(Firm) _____

(Address) _____

(an Individual), (a Partnership), (a Corporation), hereinafter referred to as "the Principal", and

(Firm) _____

(Address) _____

hereinafter referred to as "the Surety", are held and firmly bound unto the CITY OF GREELEY, 1000 10th Street, Greeley, Co. 80631, a Municipal Corporation, hereinafter referred to as "the Owner", in the penal sum of

_____ in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION are such that whereas the Principal entered into a certain Contract Agreement with the Owner, dated the _____ day of _____, 20_____, a copy of which is hereto attached and made a part hereof for the performance of

20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051

NOW, THEREFORE, if the Principal shall make payment to all persons, firms, subcontractors and corporations furnishing materials for or performing labor in the prosecution of the work provided for in such Contract Agreement, and any equipment and tools, consumed, rented or used in connection with the construction of such work and all insurance premiums on said work, and for all labor, performed in such work whether by subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract Agreement or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond; and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract Agreement or to the work or to the specifications.

IN WITNESS WHEREOF, this instrument is executed this _____ day of _____, 20____.

PROVIDED, FURTHER, that no final settlement between the Owner and Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN PRESENCE OF:

PRINCIPAL

_____ By: _____

(Corporate Seal)

(Address)

IN PRESENCE OF:

OTHER PARTNERS

_____ By: _____

_____ By: _____

_____ By: _____

IN PRESENCE OF:

SURETY

_____ By: _____

(Attorney-in-Fact)

(SURETY SEAL)

(Address)

NOTE: Date of bond must not be prior to date of Contract Agreement. If Contractor is Partnership, all partners should execute Bond.

IMPORTANT: Surety Company must be authorized to transact business in the State of Colorado and be acceptable to the Owner.

ACORD™

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

05/14/2013

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER ABC Insurance Company P. O. Box 1234 Anywhere, USA	CONTACT NAME:		
	PHONE (A/C, No, Ext):	FAX (A/C, No):	
	E-MAIL ADDRESS:		
	PRODUCER CUSTOMER ID #:		
INSURED Sample Certificate	INSURER(S) AFFORDING COVERAGE		NAIC #
	INSURER A : Financial Rating of A		
	INSURER B :		
	INSURER C :		
	INSURER D :		
	INSURER E :		
	INSURER F :		

COVERAGES

CERTIFICATE NUMBER:

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	\$1,000,000
	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	\$100,000
	<input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR						MED EXP (Any one person)	\$5,000
							PERSONAL & ADV INJURY	\$1,000,000
							GENERAL AGGREGATE	\$2,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	\$2,000,000
	<input type="checkbox"/> POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC							\$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	\$ 1,000,000
	<input checked="" type="checkbox"/> ANY AUTO						BODILY INJURY (Per person)	\$
	<input type="checkbox"/> ALL OWNED AUTOS						BODILY INJURY (Per accident)	\$
	<input type="checkbox"/> SCHEDULED AUTOS						PROPERTY DAMAGE (Per accident)	\$
	<input checked="" type="checkbox"/> HIRED AUTOS							\$
	<input checked="" type="checkbox"/> NON-OWNED AUTOS							\$
								\$
	UMBRELLA LIAB						EACH OCCURRENCE	\$
	EXCESS LIAB						AGGREGATE	\$
	DEDUCTIBLE							\$
	RETENTION \$							\$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY						<input checked="" type="checkbox"/> WC STATUTORY LIMITS <input type="checkbox"/> OTHER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH)						E.L. EACH ACCIDENT	\$100,000
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE	\$100,000
							E.L. DISEASE - POLICY LIMIT	\$500,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

City of Greeley is named as Additional Insured on General Liability. Waiver of subrogation is included on Work Compensation. This insurance is primary and noncontributory to insurance policies held by the City.

CERTIFICATE HOLDER

CANCELLATION

City of Greeley 1000 10th St Greeley, CO 80631-3808	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE

SECTION 00350

LIEN WAIVER RELEASE

TO: City of Greeley, Colorado (hereinafter referred to as "the OWNER".)

FROM: (hereinafter referred to as "the CONTRACTOR")

PROJECT: **20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051**

1. The CONTRACTOR does hereby release all Mechanic's Liens Rights, Miller Act Claim (40 USCA 270), Stop Notice, Equitable Liens and Labor and Material Bond Rights resulting from labor and/or materials, subcontract work, equipment or other work, rents, services or supplies heretofore furnished in and for the construction, design, improvement, alteration, additions to or repair of the above described project.
2. This release is given for and in consideration of the sum of \$ and other good and valuable consideration. If no dollar consideration is herein recited, it is acknowledged that other adequate consideration has been received by the CONTRACTOR for this release.
3. In further consideration of the payment made or to be made as above set forth, and to induce the OWNER to make said payment, the CONTRACTOR agrees to defend and hold harmless the OWNER, employees, agents and assigns from any claim or claims hereinafter made by the CONTRACTOR and/or its material suppliers, subcontractors or employees, servants, agents or assigns of such persons against the project. The CONTRACTOR agrees to indemnify or reimburse all persons so relying upon this release for any and all sums, including attorney's fees and costs, which may be incurred as the result of any such claims.
4. It is acknowledged that the designation of the above project constitutes an adequate description of the property and improvements for which the CONTRACTOR has received consideration for this release.
5. It is further warranted and represented that all such claims against the CONTRACTOR or the CONTRACTOR's subcontractors and/or material suppliers have been paid or that arrangements, satisfactory to the OWNER and CONTRACTOR, have been made for such payments.
6. It is acknowledged that this release is for the benefit of and may be relied upon by the OWNER, the CONTRACTOR, and construction lender and the principal and surety on any labor and material bond for the project.

Dated this _____ day of _____, 20____.

By: _____

STATE OF _____)
)ss.
COUNTY OF _____)

The foregoing instrument was acknowledged before me this _____ day of _____,
20___ by _____.

Notary Public

***Strike when not applicable

SECTION 00360
20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051
Debarment/Suspension Certification Statement

The proposer certifies that neither it nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from participation in this transaction by any Federal, State, County, Municipal or any other department or agency thereof. The proposer certifies that it will provide immediate written notice to the City if at any time the proposer learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstance.

DUNS # (Optional) _____

Name of Organization _____

Address _____

Authorized Signature _____

Title _____

Date _____

SECTION 00410

NOTICE TO PROCEED

Month , 20

TO: NAME

PROJECT: **20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051**

To Whom It May Concern:

You are hereby notified to commence work on the above-referenced project in accordance with the Contract Agreement dated Month , 20 .

You are to complete this project by Month , 20

CITY OF GREELEY, COLORADO

By: _____

Title: _____

Signature

SECTION 00420

PROJECT MANAGER NOTIFICATION

_____, 20____

TO:

PROJECT: 20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051

The Owner hereby designates Eva Rojas as its Project Manager and authorizes this individual, under the authority of the Director of Public Works to make all necessary and proper decisions with reference to the project. Contract interpretations, change orders and other requests for clarification or instruction shall be directed to the Project Manager. The Director of Public Works shall be authorized to bind the Owner with respect to any decision made in accordance with the contract document.

SECTION 00430

CERTIFICATE OF SUBSTANTIAL COMPLETION

TO: CONTRACTOR

PROJECT: 20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051

Project or designated portion shall include: Describe Scope.

The work performed under this contract has been reviewed and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above is hereby established as Month , 20 .

The date of commencement of applicable warranties required by the Contract Documents is stipulated in Section 00440 - Certificate of Final Acceptance.

DEFINITION OF DATE OF SUBSTANTIAL COMPLETION

The Date of Substantial Completion of the Work or designated portion thereof is the date certified by the Project Manager when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof for the use for which it is intended, as expressed in the Contract Documents.

A list of items to be completed or corrected, prepared by the Contractor and verified and amended by the Project Manager is attached hereto. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. The date of commencement of warranties for items on the attached list is as stipulated in Section 00440 – Certificate of Final Acceptance.

The Owner shall operate and maintain the Work or portion of the Work described above from the Date of Substantial Completion and be responsible for all costs associated with the completed work excluding cost related to warrantee work.

Certificate of Substantial Completion

Page 2

The Contractor will complete or correct the Work on the list of items attached hereto within
days from the above Date of Substantial Completion.

Contractor

Owner

(Note--Owner's and Contractor's legal and insurance counsel should review and determine insurance requirements and coverage; Contractor shall secure consent of surety company, if any.)

SECTION 00440

CERTIFICATE OF FINAL ACCEPTANCE

TO: **CONTRACTOR**

PROJECT NAME: **20TH STREET IMPROVEMENTS – 83RD TO 90TH AVENUE – FA19-05-051**

The work performed under this contract has been reviewed and found to meet the definition of final acceptance. This Certificate of Final Acceptance applies to the whole of the work.

The Date of Final Acceptance of the Project designated above is hereby established as: Month _____, 20____ at 2:00 pm. This date is also the date of commencement of applicable warranties associated with the Project described above and as required by the Contract Documents.

DEFINITION OF DATE OF FINAL ACCEPTANCE

The Date of Final Acceptance of the Work is the date certified by the City of Greeley's Project Manager when the work is 100% complete, in accordance with the Contract Documents, as amended by change order(s), or as amended below:

Amendment to the Certificate of Final Completion (if any): Describe Amendments.

The Contractor and/or the City Of Greeley shall define any claims or requests for additional compensation above (or as attachments to this document).

Final Acceptance shall not be achieved until the Contractor provides the City Of Greeley with all contract specified Contractor and Sub-contractor close out documents including final lien waivers, releases, insurances, manuals, training, test results, warranties, and other documents required by the Contract Documents, as amended.

Upon issuance of the Certificate of Final Acceptance the Contractor may submit an application for payment requesting final payment for the entire Work. Liquidated damages (if any) will be assessed at this time.

Contractor's acceptance of the final payment shall constitute a waiver by the Contractor of all claims arising out of or relating to the Work; except as noted under 'Amendment to the Certificate of Final Acceptance' above.

Agreed:

_____ Contractor's Representative	_____ DATE	_____ Project Manager (COG)	_____ DATE
--------------------------------------	---------------	--------------------------------	---------------

SECTION 00510

CITY OF GREELEY GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION (REVISED NOVEMBER 2016)

ARTICLE 1 DEFINITIONS

- 1.1 **Bidder:** An architect, engineer, individual, firm, partnership, corporation or combination thereof, submitting a Bid for the Work.
- 1.2 **Change Notice:** A document issued to the Contractor specifying a proposed change to the Contract Documents. Unless otherwise expressly stated on the face of the Change Notice, a Change Notice is a proposal which may result in a Change Order.
- 1.3 **Change Order:** A document issued to the Contractor modifying the Contract.
- 1.4 **Construction Contract:** The Contract Documents, including the Contract for construction (hereinafter "the contract") executed by the Contractor and the Owner covering the performance of the Work including the furnishing of labor, superintendence, materials, tools and equipment as indicated in the Contract Documents.
- 1.5 **Contract Documents:** Documents applicable to and specific to the construction of an individual Project, including the Contract and all other documents executed by the Contractor and Owner covering the performance of the work including but not limited to Specifications, Insurance Requirements, Contract Drawings, Conditions of the Contract (General and Supplementary), Owner-Contractor Agreement, all Addenda, all change orders issued after execution of the Contract, Performance and Payment Bonds, and any other special provisions.
- 1.6 **Contract Drawings(Project Drawings):** Contract drawings, The plans, to include but not limited to plans, profiles, typical cross sections, general cross-sections, elevations, schedules, schematics, notes and details which show locations, character, dimensions, and details of the Work.
- 1.7 **Contractor:** The individual, firm, partnership, or corporation, or combination thereof, private, municipal, or public, including joint ventures, which, as an independent contractor, has entered into a contract with the Owner, who is referred to throughout the Contract Documents by singular number and masculine gender.
- 1.8 **Days:** Unless otherwise designated, days mean calendar days.
- 1.9 **Extra Work:** Work not provided for in the Contract as awarded but found to be essential to the satisfactory completion of the Contract, within its intended scope. Reimbursement for extra work is governed by Article 28, CHANGES, or Article 31, CONTRACTOR PROPOSALS.

- 1.10 **Field Order:** A written order issued to a contractor by the Owner, or Project Manager, effecting a minor change or clarification with instructions to perform work not included in the contract. The work will eventually become a Change Order. A field Order is an expedient process used in an emergency or need situation that in many cases does not involve an adjustment to the contract sum or an extension of the contract sum or an extension of the contract time.
- 1.11 **Final Acceptance:** The formal written acceptance by the Owner of the completed Work.
- 1.12 **Force Account:** A method of payment, other than lump sum or unit price, for Work ordered by Change Order or by written notice from the Owner. Reimbursement for force account work is governed by Article 36, FORCE ACCOUNT WORK.
- 1.13 **Furnishing:** Manufacturing, fabricating and delivering to the site of the Work materials, plant, power, tools, patterns, supplies, appliances, vehicles and conveyances necessary or required for the completion of the Work.
- 1.14 **General Conditions (GC):** A section of the Contract Documents which specifies, in general, the contractual conditions.
- 1.15 **General Terms:** Directed, required, permitted, ordered, designated, selected, prescribed or words of like import shall be understood to mean the direction, requirement, permission, order, designation, selection or prescription of the Project Manager. Approved, satisfactory, equal, necessary or words of like import shall be understood to mean approved by, acceptable to, satisfactory to, equal, necessary in the opinion of the Project Manager.
- 1.16 **Indicated:** A term meaning as shown on the Contract Drawings, or as specified and detailed in the Contract Documents.
- 1.17 **Installation, Install, or Installing:** Completely assembling, erecting and connecting material, parts, components, appliances, supplies and related equipment specified or required for the completion of the Work.
- 1.18 **Limit of Work:** Boundary within which the Work, excepting utility and drainage work in Public Right Of Way and Easements, is to be performed.
- 1.19 **Notice to Proceed:** Written notice from the Owner to the Contractor to proceed with the Work.
- 1.20 **Notice of Termination:** Written notice from the Owner to the Contractor to stop work under the Contract on the date and to the extent specified in the Notice of Termination.
- 1.21 **Owner:** The City of Greeley.
- 1.22 **Permanent Drainage Easement:** Area required to construct and maintain permanent drainage facilities for retention, release, and passage of surface water.
- 1.23 **Permanent Utility Easement:** Area required to construct and maintain utility facilities.

- 1.24 **Project:** That specific portion of the Work indicated in the Contract Documents.
- 1.25 **Project Manager:** The Owner's designated representative. The Project Manager has the authority to delegate portions of his responsibilities to others.
- 1.26 **Provide:** In reference to work to be performed by the Contractor, provide means furnish and install completely in place.
- 1.27 **Punch List:** Work determined to be incomplete or unacceptable at time of inspection for substantial completion.
- 1.28 **Samples:** Physical examples which illustrate materials, equipment, fixtures and workmanship which establish standards by which the Work will be judged.
- 1.29 **Schedule:** Acceptable schedules are BAR or GANTT Chart or CPM schedule.
- 1.30 **Shop Drawings:** Documents furnished by the Contractor to illustrate specific portions of the Work. Shop Drawings include drawings, diagrams, illustrations, schedules, charts, brochures, tables and other data describing fabrication and installation of specific portions of the Work.
- 1.31 **Specifications:** A document applicable to construction contracts containing the Technical Provisions.
- 1.32 **Subcontractor:** Any person, firm or corporation, other than the employees of the Contractor, who contracts with the Contractor to furnish labor, material or labor and materials, under this Contract.
- 1.33 **Special Provisions:** Provisions especially applicable to this Contract which invoke, modify and supplement the General Conditions which are included in the Contract Documents.
- 1.34 **Substantial Completion:** The state in the progress of Work when the Work, or a designated portion thereof, is sufficiently complete in accordance with the Contract Documents, so that Owner may access, occupy, use, and enjoy the Project, or designated portion thereof, for its intended purpose. Substantial Completion shall not occur until a temporary or permanent Certificate of Occupancy is issued and only minor punch list items remain for such Work.
- 1.35 **Technical Provisions:** Those provisions which specify the materials and execution of construction for work entering into the project.
- 1.36 **Work:** The construction, labor, materials, equipment, and contractual requirements as indicated in the Contract Documents, including alterations, amendments, or extensions thereto made by authorized changes.
- 1.37 **Work Site:** The area enclosed by the Limit of Work indicated in the Project Drawings and boundaries of local streets and public easements in which the Contractor is to perform work under the Contract. It shall also include areas obtained by the Contractor for use in connection with the Contract, when contiguous to the Limit of Work.

ARTICLE 2 INTERPRETATION

2.1 The documents comprising the Contract Documents are complementary and indicate the construction and completion of the Work. Anything mentioned in the Contract Specifications and not shown on the Contract Drawings, or shown on the Contract Drawings and not mentioned in the Contract Specifications, shall be of like effect as if shown or mentioned in both.

2.2 Where "as indicated", "as detailed", or words of similar import are used, it shall be understood that the reference is made to the specifications or drawings accompanying this Contract unless stated otherwise.

2.3 References to Articles or Sections include sub articles or subsections under the Article Reference (for example, a reference to Article 2 is also a reference to 2.1 through 2.9, and references to paragraphs similarly include references to subparagraphs).

2.4 Referenced Standards: Material and workmanship specified by the number, symbol, or title of a referenced standard shall comply with the latest edition or revision thereof and amendments and supplements thereto in effect on the date of the Invitation to Bid except where a particular issue is indicated.

2.5 Precedence of Contract Documents: Except as provided by Paragraph 2.1 of this Article, the Construction Contract governs over other Contract Documents, except that a Change Order governs over the Contract and previously issued Change Orders. The Contract Conditions govern over the General Conditions.

2.6 Explanations: Should it appear that the Work to be done or any of the matters relative thereto are not sufficiently detailed or explained in the Contract Documents, the Contractor shall apply to the Owner for such explanation provided as part of the Contract. Disputes over questions of fact which are not settled by agreement shall be decided by Owner. Such decision thereon will be final, subject to remedies under Article 35, DISPUTES.

2.7 Should there be any conflict, detailed instructions govern over general instructions, detail drawings have precedence over small scale drawings, and dimensions have precedence over scale.

2.8 Omissions and Misdescriptions: The Contractor shall carefully study and compare all drawings, specifications, Contract Documents and other instructions; shall verify all dimensions on the Contract Drawings before laying out the Work; shall notify the Project Manager of all errors, inconsistencies or omissions which he may discover; and obtain specific instructions in writing before proceeding with the Work. The Contractor shall not take advantage of apparent errors or omissions which may be found in the Contract Documents, but the Project Manager shall be entitled to make such corrections therein and interpretations thereof as he may deem necessary for the fulfillment of their intent. The Contractor shall be responsible for all errors in construction which could have been avoided by such examination and notification, subject to remedies under Article 35, Disputes.

**ARTICLE 3
ENTITY OF CONTRACTOR**

3.1 If the Contractor hereunder is comprised of more than one legal entity, each such entity shall be jointly and severally liable hereunder.

**ARTICLE 4
LIABILITY AND INDEMNIFICATION**

4.1 It is agreed that the Contractor assumes responsibility and liability for damages, loss or injury of any kind or nature whatever to persons or property caused by or resulting from or in connection with any act, action, neglect, omission, or failure to act when under a duty to act on the part of the Contractor or any of his officers, agents, employees, or subcontractors in his or their performance of the Work. The Contractor shall indemnify and hold harmless the Government, the State, the Owner and the Project Manager and their members, officers, agents, or employees from claims, losses, damages, charges, costs, or expenses, including attorney's fees, whether direct or indirect, to which they or any of them may be put or subjected to by reason of any such loss or injury.

**ARTICLE 5
PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES,
AND IMPROVEMENTS AND LAND SURVEY MONUMENTS**

5.1 A Contractor shall preserve and protect existing vegetation such as trees, shrubs, and grass on or adjacent to the work site which are not indicated to be removed and which do not unreasonably interfere with the construction work and he shall replace in kind any vegetation, shrubs and grass damaged by him at his own expense.

5.2 The Contractor shall protect from damage all utilities, structures, or improvements on or near the site of the Work and shall repair or restore any damage to such utilities, structures, or improvements resulting from failure to comply with the requirements of the Contract or the failure to exercise reasonable care in the performance of the Work. If the Contractor fails or refuses to repair any such damage promptly, the Owner may have the necessary work performed and charge the cost thereof to the Contractor.

5.3 All land survey monuments shall be protected from any damage by any work and/or shall be replaced by a licensed land surveyor licensed in the state of Colorado at the contractor's expense before final acceptance is issued.

**ARTICLE 6
CONTRACTUAL RELATIONSHIPS**

6.1 No contractual relationship will be recognized under the Contract other than the contractual relationship between the Owner and the Contractor.

ARTICLE 7 ASSIGNMENT

7.1 The performance of the Work under the Contract shall not be assigned except upon written consent of the Owner. Consent will not be given to any proposed assignment which would relieve the Contractor or his surety of their responsibilities under the Contract. The Contractor shall not assign any monies due or to become due to him under the Contract without the previous written consent of the Owner.

ARTICLE 8 SUBCONTRACTORS

8.1 Unless otherwise required by the Contract Documents or the Bidding Documents, the Contractor, as soon as practicable after the award of the Contract, not to exceed 3 days, shall furnish to the Owner and the Project Manager, in writing the names of the subcontractors, persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The Project Manager will promptly reply to the Contractor in writing whether or not the Owner or the Project Manager, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Project Manager to reply promptly shall constitute notice of no reasonable objections.

ARTICLE 9 CONDITIONS AFFECTING THE WORK

9.1 The Contractor shall be responsible for taking steps reasonably necessary to ascertain the nature and location of the Work, and the general and local conditions which can affect the Work or the cost thereof. Failure by the Contractor to do so will not relieve him from responsibility for successfully performing work without additional expense to the Owner. The Owner will not be responsible for any understanding or representations concerning conditions, unless such understanding or representations are expressly stated in the Contract.

ARTICLE 10 GRATUITIES AND CONFLICTS OF INTEREST

10.1 The Owner may, by written notice to the Contractor terminate the right of the Contractor to proceed under this Contract if it is found that gratuities (in the form of entertainment, gifts, or otherwise) were offered or given by the Contractor, or any agent or representative of the Contractor or any director, officer or employee of the Owner or its Project Manager with a view toward securing a contract or securing favorable treatment with respect to the awarding or amending, or the making of any determinations with respect to the performance of such contract. The Owner's determination shall be final subject only to judicial review.

10.2 In the event this Contract is terminated for any reason, the Owner shall be entitled to pursue the same remedies against the Contractor as it could pursue in the event of a breach of the Contract by the Contractor.

10.3 No member, officer or employee of the Owner or of a local public body during his tenure or for one year thereafter shall have any interest, direct or indirect, in this Contract or the proceeds thereof. "Local public body" means the State, any political subdivision of the State, or any agency of the State or any political subdivision thereof.

10.4 The rights and remedies of the Owner provided in this article are not exclusive and are in addition to any other rights and remedies provided by law or under the Contract.

ARTICLE 11 WARRANTY OF WORK

11.1 Except where longer periods of warranty are indicated for certain items, the Contractor warrants work under the Contract to be free from faulty materials and workmanship for a period of not less than two years from date of Final Acceptance, which two year period shall be covered by the Performance Bond and Payment Bond as specified in this Contract. The Contractor shall immediately remedy, repair, or replace, without cost to the Owner and to the entire satisfaction of the Owner, defects, damages, or imperfections due to faulty materials or workmanship appearing in said work within said period of not less than two years. Remedied work shall carry the same warranty as the original work starting with the date of acceptance of the replacement or repair. Payment to the Contractor will not relieve him of any obligation under this Contract.

11.2 The Contractor, at no additional expense to the Owner, shall also remedy damage to equipment, the site, or the building or the contents thereof which is the result of any failure or defect in the Work, and restore any work damaged in fulfilling the requirements of the Contract. Should the Contractor fail to remedy any such failure or defect within a reasonable time but no longer than ten (10) days after receipt of notice thereof, the Owner will have the right to replace, repair, or otherwise remedy such failure or defect at the Contractor's expense.

11.3 Subcontractors', manufacturers', and suppliers' warranties and guarantees, expressed or implied, respecting any part of the Work and any material used therein shall be deemed obtained and shall be enforced by the Contractor for the Benefit of the Owner without the necessity of separate transfer or assignment thereof.

11.4 The rights and remedies of the Owner provided in this Article are in addition to and do not limit any rights and remedies afforded by the Contract or by law.

ARTICLE 12 MATERIAL

12.1 Unless otherwise indicated in this Contract, equipment, material and products incorporated in the Work covered by this Contract shall be new and of the grade specified in the Contract for the purpose intended. Unless otherwise specifically indicated, reference to equipment, material, product or patented process by trade names, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor may, at his option, use any equipment, material, article, or process which is equivalent to that named, subject to the requirements of Paragraph 12.2 of this Article.

12.2 Within the scope of his authority, the Project Manager shall be the sole judge of the quality and suitability of proposed alternative equipment, material, article or process. The burden of proving the quality and suitability of the alternative shall be upon the Contractor. Information required by the Project Manager in judging an alternative shall be submitted for approval by the Contractor at the Contractor's expense prior to installation.

12.3 Where use of an alternative material involves redesign of or changes to other parts of the Work, the cost and the time required to affect such redesign or change will be considered in evaluating the suitability of the alternative material. Redesign and changes in other parts of the Work shall be at the Contractor's expense.

12.4 No action relating to the approval of alternative materials will be taken by the Project Manager until the request for substitution is made in writing by the Contractor accompanied by complete data as to the quality and suitability of the materials proposed. Such request shall be made in ample time to permit approval without delaying the Work.

12.5 Disposal of material outside the Work Site: The Contractor shall make his own arrangements for legally disposing of waste and excess materials outside the Work Site and he shall pay costs therefore.

12.6 Property rights in materials: The Contractor shall have no property right in materials after they have been attached or affixed to the Work or the soil, or after payment has been made by the Owner to the Contractor for materials delivered to the site of the Work, or stored subject to or under the control of the Owner as provided in Article 24, PROGRESS PAYMENTS.

ARTICLE 13 WORKMANSHIP AND UNAUTHORIZED WORK

13.1 Work under this Contract shall be performed in a skillful and workmanlike manner. The Project Manager may, in writing, require the Contractor to remove from the work any employee the Project Manager determines incompetent, careless or otherwise objectionable.

13.2 Unauthorized work: Work performed beyond the lines and grades shown on the Contract Drawings, approved Working and Shop Drawings and Extra work done without written authorization, will be considered as unauthorized work, and the Contractor will receive no compensation therefore. If required by the Owner, unauthorized work shall be remedied, removed, or replaced by the Contractor at the Contractor's expense. Upon failure of the Contractor to remedy, remove or replace unauthorized work, the Owner may take courses of action set out in Paragraph 15.3 of Article 15, INSPECTION.

ARTICLE 14 SUPERINTENDENCE BY CONTRACTOR

14.1 The Contractor shall give his personal superintendence to the Work or have a competent foreman or superintendent, hereinafter designated his authorized representative, satisfactory to the Owner, on the Work Site at all times during progress, with authority to act for him. There shall be provided at all times, a reasonable method of communication directly to the Contractor if the Owner experiences any problems or difficulties with the Superintendent.

ARTICLE 15 INSPECTION/TESTING

15.1 Work (which term includes but is not restricted to materials, workmanship and manufacture and fabrication of components) will be subject to inspection and test by the Project Manager at all reasonable times and at all places prior to acceptance. Such inspection and test is for the sole benefit of the Owner and shall not relieve the Contractor of the responsibility of providing quality control measures to assure that the Work strictly complies with the Contract Documents. No inspection or test by the Project Manager shall be construed as constituting or implying acceptance. Inspection or test shall not relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of the Owner after acceptance of the completed Work.

15.2 The Contractor shall, at his own expense, replace any material or correct any workmanship found not to conform to the contract requirements, unless the Owner consents in writing to accept such material or workmanship with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises at his own expense.

15.3 If the Contractor does not promptly replace rejected material or correct the rejected workmanship, the Owner (1) may, by separate contract or otherwise, replace such material or correct such workmanship and charge the cost thereof to the Contractor, or (2) may terminate the Contractor's right to proceed in accordance with Article 38, TERMINATION FOR DEFAULT-- DAMAGES FOR DELAY--TIME EXTENSIONS.

15.4 The Contractor shall give the Project Manager ample notification of inspections and tests, and the Project Manager will perform, except as otherwise specifically provided, said inspections and tests in such manner as not to unnecessarily delay the work. The Owner will have the right to charge to the Contractor any additional cost of inspection or test or when reinspection or retest is necessitated by prior rejection.

15.5 Should it be considered necessary, before acceptance of the entire work, to make an examination of work already completed by removing or tearing out same, the Contractor shall on request promptly furnish all necessary facilities, labor and material therefore. If such work is found to be defective or nonconforming in any material respect, due to the fault of the Contractor or his subcontractors, he shall defray the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, an equitable adjustment will be made in the contract price to compensate the Contractor for the additional services involved in such examination and reconstruction. If completion for the work has been delayed thereby, he will, in addition, be granted an equitable extension of time.

15.6 The Project Manager shall have access to the work during its construction. Work done and materials provided will be subject to the Project Manager's on-site and off-site inspection and approval. When work is to be performed during hours other than during his normal schedule, the Contractor shall so advise the Project Manager not less than 24 hours in advance. The Contractor shall provide access to the work for authorized representatives of the Owner.

15.7 The Project Manager's inspection and approval of work or materials shall not relieve the Contractor of any of his obligations to fulfill the requirements of the Contract Documents. Work and materials not meeting the requirements of the Contract shall not be incorporated in the Work. Unsuitable or substandard work or materials may be rejected by the Project Manager, notwithstanding that such work or materials may have been previously inspected by the Project Manager, or that payment therefore has been included in a progress payment.

ARTICLE 16 PERMITS AND COMPLIANCE WITH LAWS

16.1 The Contractor shall without additional expense to the Owner be responsible for obtaining necessary licenses and permits and for complying with applicable Federal, State, County and Municipal laws, codes and regulations in connection with the commencement of the work. The Contractor is required to supply the Project Manager with complete and final copies of license and permits including final inspection documentation. The Contractor shall be required to obtain permits at his own expense. The Contractor shall protect, indemnify and hold harmless the Owner and the Project Manager and their members, officers, agents and employees against claims and liabilities arising from or based on the violation of requirements of law or permits whether by the Contractor, his employees, agents or subcontractors.

ARTICLE 17 RIGHTS IN LAND IMPROVEMENT

17.1 The Contractor shall make no arrangements with any person to permit occupancy or use of any land, structure or building within the work site for any purpose whatsoever, either with or without compensation, in conflict with any agreement between the Owner and any owner, former owner or tenant of such land, structure or building. The Contractor shall not occupy Owner property outside the work site without obtaining prior written approval from the Owner.

ARTICLE 18 DAMAGE TO THE WORK AND RESPONSIBILITY FOR MATERIALS

18.1 The Contractor shall be responsible for materials delivered and work performed until completion and final acceptance of the entire construction thereof.

18.2 The Contractor shall bear the risk of injury, loss or damage to any and all parts of the work for whatever cause, whether arising from the execution or from the non-execution of work. The Contractor shall rebuild, repair or restore work and materials which have been damaged or destroyed from any cause before completion and acceptance of the work and shall bear the expense thereof. The Contractor shall provide security and drainage and erect temporary structures as necessary to protect the work and materials from damage.

18.3 The Contractor shall be responsible for materials not delivered to the site for which any progress payment has been made to the same extent as if the materials were so delivered.

ARTICLE 19 EMERGENCIES

19.1 In an emergency affecting the safety of life, the work, or adjacent property, the Contractor shall notify the Project Manager as early as possible that an emergency exists. In the meantime, without special instruction from the Project Manager as to the manner of dealing with the emergency, the Contractor shall act at his own discretion to prevent such threatened loss or injury. As emergency work proceeds, the Project Manager may issue instruction, which the Contractor shall follow. The amount of compensation to which Contractor is entitled on account of emergency work will be determined in accordance with Article 28, CHANGES.

ARTICLE 20 NOTICE TO PROCEED

20.1 The Owner will issue a Notice to Proceed to the Contractor within 15 days after the Contractor has executed the Contract and has delivered the specified bonds and Certificates of Insurance as required by the Owner. Except as specifically authorized in writing by the Owner, the Contractor is not authorized to perform work under the Contract until the effective date of the Notice to Proceed. Within 10 days after the effective date of such Notice to Proceed, the Contractor shall commence work and shall diligently prosecute the Work to completion within the time limits specified. These time periods may be modified by mutual written agreement of both the Owner and Contractor.

ARTICLE 21 PROGRESS SCHEDULE AND REQUIREMENTS FOR MAINTAINING PROGRESS

21.1 The Contractor shall, at the pre-construction meeting, prepare and submit to the Project Manager for approval a practicable schedule, showing the order in which the Contractor proposes to carry on the work, the date on which he will start the several salient features (including procurement of materials, plant and equipment) and the contemplated dates for completing the same. The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion at any time. The Contractor shall update the chart with the actual progress monthly or at such intervals as directed by the Project Manager, and shall immediately deliver three copies thereof. If the Contractor fails to submit a progress schedule within the time herein prescribed, the Project Manager may withhold approval of progress payment estimates until such time as the Contractor submits the required progress schedule.

21.2 The Contractor shall prosecute the work in accordance with the latest approved Progress Schedule. In the event, that the progress of items along the critical path is delayed, the Contractor shall revise his planning to include additional forces, equipment, shifts or hours as necessary to meet the time or times of completion specified in this Contract. Additional costs resulting therefrom will be borne by the Contractor. The Contractor shall make such changes when his progress at any check period does not meet at least one of the following two tests:

21.2.1 The percentage of dollar value of completed work with respect to the total amount of the Contract is within ten percentage points of the percentage of the Contract time elapsed, or;

21.2.2 The percentage of dollar value of completed work is within ten percentage points of the dollar value which should have been performed according to the Contractors own network analysis previously approved by the Project Manager.

21.3 Failure of the Contractor to comply with the requirements under this provision will be grounds for determination that the Contractor is not prosecuting the work with such diligence as will ensure completion within the time of completion specified in this Contract. Upon such determination, the Owner may terminate the Contractor's right to proceed with the work, or any separate part thereof, in accordance with Article 38, TERMINATION FOR DEFAULT--DAMAGES FOR DELAY--TIME EXTENSIONS of these General Conditions.

ARTICLE 22 SUSPENSION OF WORK

22.1 The Owner reserves the right to suspend, delay or interrupt execution of the whole or any part of the work for such period of time as he may determine to be appropriate for his convenience.

22.2 If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted by an act of the Owner in the administration of this Contract or by his failure to act within the time specified in this Contract (or if no time is specified, within a reasonable time), an adjustment shall be made for any increase in the cost of performance of this Contract (excluding profit) necessarily caused by such unreasonable suspension, delay, or interruption and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent (1) that performance would have been so suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor or (2) for which an equitable adjustment is provided for or excluded under any other provision of this Contract.

22.3 No claim under this clause shall be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Owner in writing of the act of failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated is asserted in writing as soon as practicable after the termination of such suspension, delay, or interruption, but not later than the date of final payment under the Contract.

ARTICLE 23 FINAL INSPECTION AND ACCEPTANCE

23.1 Final inspection: When the Contractor notifies the Project Manager in writing that the work has been completed, the Owner will make the final inspection for the purpose of ascertaining that the work has been completed in accordance with the requirements of the Contract Documents.

23.2 Acceptance of the work: When the Owner has made the final inspection and has determined that the work has been completed in accordance with the Contract Documents, the Owner will accept the work. Immediately upon and after Final Acceptance, the Contractor will be relieved of the duty of maintaining and protecting the work as a whole. The Contractor will be relieved of his responsibility for injury to persons or property or damage to the work which occurs after Final Acceptance, except that the Contractor will not be relieved of his responsibility for injury to persons or property arising from his duties and obligations under Article 4, LIABILITY AND INDEMNIFICATION.

23.3 Final Acceptance shall be final and conclusive, and no further performance of work shall be required except with regards to latent defects, fraud or such gross mistakes as may amount to fraud, or with regard to the Owner's rights under any warranty or guarantee. All punch list items must be completed and building permits provided to Owner before final acceptance is issued.

23.4 Date of Substantial Completion for all Work shall be within the number of calendar days bid by the Contractor on the Bid proposal.

23.5 Date of Final Completion shall be the date specified on the Certificate of Final Completion.

ARTICLE 24 PROGRESS PAYMENTS

24.1 The Owner will make progress payments monthly as the work proceeds, on estimates approved by the Project Manager. Payment will be made within 15 days after progress estimates are approved by the Project Manager and Department Head. On request of the Project Manager, the Contractor shall furnish a detailed estimate of the total contract price each showing the amount included therein for each principal category of the work, to provide a basis for determining the amount of progress payments. In the preparation of estimates, the Owner, at its sole discretion, may authorize material delivered on the site and preparatory work done to be taken into consideration which is to be submitted at the pre-construction meeting.

24.2 In making such progress payments, five percent of the estimated amount will be retained until Final Acceptance of the Contract work; in addition, the Owner shall retain from all Progress payments an amount equal to all statutory claims filed against the Contractor. Also, whenever the work is substantially complete, the Owner if it considers the amount retained to be in excess of the amount adequate for its protection, may release to the Contractor all or a portion of such excess amount. Substantial completion as used in this Paragraph 24.2 shall mean the following: Substantial completion of the work or a portion thereof shall be when, as determined by both the Project Manager and the Owner, the construction is sufficiently completed in accordance with the Contract Documents and any modification thereto as provided in the Contract to permit the Owner to occupy the work or a portion of the work for the use which it is intended.

24.3 Material and work covered by progress payments shall become the sole property of the Owner. This provision shall not be construed as relieving the Contractor from the sole responsibility for material and work upon which payments have been made, the restoration of damaged work or as waiving the right of the Owner to require the fulfillment of the terms of the Contract.

ARTICLE 25 PAYMENT TO SUBCONTRACTORS

25.1 The Contractor shall pay all subcontractors for and on account of work performed by such subcontractors in accordance with the terms of their respective subcontract. Prior to final payment an unconditional lien waiver release form will be required by the Owner.

ARTICLE 26 PAYMENT OF TAXES

26.1 The price or prices for the work will include full compensation for taxes that the Contractor is or may be required to pay. The Contractor shall bear the risk of any added or increased taxes occurring during the prosecution of the work. A change in taxes shall under no circumstances entitle the Contractor to an adjustment under the Contract.

26.2 The Contractor's attention is directed to the fact that this project is exempt from payment of City of Greeley Sales and Use taxes, and such taxes must not be included in the amount of bid.

26.3 The Contractor shall pay all sales and use taxes required to be paid, shall maintain such records in respect of his work, which shall be separate and distinct from all other records maintained by the Contractor and shall be available for inspection by the Owner at any and all reasonable times, and shall furnish the Owner with such data, as may be necessary to enable the Owner to obtain any refunds of such taxes which may be available to the Owner under the laws, ordinances, rules or regulations applicable to such taxes. The Contractor shall require each of his subcontractors to pay all sales and use taxes required to be paid and to maintain such records and furnish the Contractor with such data as may be necessary to enable the Owner to obtain a refund of the taxes paid by such subcontractors.

ARTICLE 27 FINAL PAYMENT

27.1 After the Work has been accepted by the Owner, subject to the provisions of Article 11, WARRANTY OF WORK and Article 23, FINAL INSPECTION AND ACCEPTANCE of these General Conditions, a final payment due the Contractor under this Contract shall be paid upon the presentation of properly executed voucher and after the Contractor shall have furnished the Owner with a release of all claims against the Owner arising by virtue of this Contract, other than claims in stated amounts as may be specifically excepted by the Contractor from the operation of the release. If the Contractor's claim to amounts payable under the contract has been assigned under the assignment of Claims Act of 1940, as amended (31 U.S.C. 203, 41 U.S.C. 15), a release may also be required of the assignee.

27.2 If any mechanic's or material man's lien or notice of claim of such lien is filed or recorded against the project for labor, materials, supplies or equipment claimed to have been furnished to or incorporated into the Work, or for other alleged contribution thereto, the Owner will have the right to retain from payments otherwise due the Contractor, in addition to other amounts properly withheld under this Article or under other provisions of the Contract, an amount equal to such lien or liens claimed.

27.3 Further, the Owner will have the right to retain from final payment an amount equal to all liquidated damages claimed by the Owner.

27.4 Retainages held by the Owner for any state or federal statutory claim arising out of the project will be held by the Owner in addition to all retainages held under the provisions of the Contract.

ARTICLE 28 CHANGES

28.1 The Owner may, at any time, without notice to the sureties, by written notice or order designated or indicated to be a Change Notice or Change Order, make any change in the work within the general scope of the Contract in accordance with all of the Owner's processes and procedures whether or not set forth herein, including but not limited to changes:

28.1.1 In the Contract (including drawings and designs);

28.1.2 In the method or manner of performance of the work;

28.1.3 In Owner furnished facilities, equipment, materials, services, or site; or

28.1.4 Directing acceleration in performance of the work.

28.2 Any other order (which terms as used in Paragraph 28.2 of this Article shall include direction, instruction, interpretation, or determination) from the Project Manager, which causes any change, shall be treated as a Change Notice under this Article provided that the Contractor gives the Project Manager written notice stating the date, circumstances and source of the order, and that the Contractor regards the order as a Change Notice. The Contractor shall notify the Project Manager when he receives direction, instruction, interpretation or determination from any source which may cause any change in the work. Such notification shall be given to the Project Manager before the Contractor acts on said direction, instruction, interpretation or determination.

28.3 Except as herein provided, no order, statement, or conduct of the Architect/ Project Manager or any other person shall be treated as a change under this Article or entitle the Contractor to an equitable adjustment hereunder.

28.4 If any change under this Article causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the Work under this Contract, whether or not changed by an order, an equitable adjustment will be made and the Contract modified accordingly by a written Change Order; provided, however, that except for claims based on errors in the Contract Documents, no claim for change under Paragraph 28.2 of this Article will be allowed for costs incurred more than 20 days before the Contractor gives written notice as herein required; and provided that in the case of errors in the Contract Documents for which the Owner is responsible, the adjustment will include increased cost, reasonably incurred by the Contractor in attempting to comply with such errors in the Contract Documents. No claim shall be made for the type of errors in the Contract Documents which are set forth in Article 2, INTERPRETATION.

28.5 If the Contractor intends to assert a claim for an equitable adjustment under this Article, he shall, within 30 days after receipt of a written Change Order under Paragraph 28.1 of this Article or the furnishing of a written notice under Paragraph 28.2 of this Article, submit to the Project Manager a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended in writing by the Owner. The statement of claim hereunder may be included in the notice under Paragraph 28.2 of this Article.

28.6 No claim by the Contractor for an equitable adjustment hereunder will be allowed unless asserted as described in Paragraphs 28.4 and 28.5 above.

28.7 Payment will not be made under the provisions of this Article for such work or materials which are so required to be done or furnished in or about or for the performance of the Work and which are not mentioned, specified or indicated or otherwise provided for in this Contract or in the Contract Documents so far as such work or materials may be, in the opinion of the Project Manager, susceptible of classification under or reasonably inferred to be included in the Bid Items of the Bid Form.

28.8 In case the Contractor is ordered to perform work under this Article for which payments are not determined under Paragraph 28.7 of this Article, which in the opinion of the Owner it is impracticable to have performed by the Contractor's own employees, the Contractor will, subject to the approval of the Owner, be paid the actual cost to him of such work and, in addition thereto, a negotiated amount to cover the Contractor's superintendence, administration and other overhead expenses. The terms and conditions of any subcontract which the Contractor may propose to enter into in connection with work under the provision of this Article shall be subject to the written approval of the Project Manager before such subcontract is made. The contractor shall be responsible for the work of the subcontractors and shall be liable therefore as if he had performed the work directly.

28.9 In cases other than those described in Paragraphs 28.7 and 28.8 above, the Owner and the Contractor (on his own behalf and on behalf of his subcontractors) shall endeavor to negotiate a reasonable contract price and line adjustment in a Change Order on terms appropriate to the changed work. The Contractor will be required to submit a sufficiently detailed price proposal supported with sufficient documentation that (1) the Owner can determine that the proposal reflects all impacts on the Contract from work additions, deletions and modifications shown in the Change Notice being priced, (2) the proposed prices are set out in such a way that their reasonableness can be evaluated against prices based on adequate price competition, bid unit prices, established catalog or market prices of commercial items sold in substantial quantities to the general public, prices set by law or regulation, recognized published price lists and indices, independently developed cost estimates and other appropriate price comparisons, and (3) contract provisions relating to Contract changes costing over \$100,000.00 are complied with. If any prices or other aspects are conditional, such as on firm orders being made by a certain date or the occurrence or nonoccurrence of an event, the Contractor shall identify these aspects in his proposal. A negotiated Change Order shall set out prices, scheduling requirements, time extensions and all costs of any nature arising out of the issuance of a Change Notice except for those cost and time aspects explicitly reserved on the face of the Change Order. Except for these explicit reservations, the execution of a Change Order by both parties will be deemed accord and satisfaction of all claims of any nature arising from the issuance of the Change Notice negotiated.

28.10 In the event the Contractor and the Owner are unable to agree upon the Contractor's entitlement to an equitable adjustment or upon the amount thereof, or in the event that it is in the best interest of the Owner to have the Work proceed pending negotiation of amount of an equitable adjustment, the Owner may direct the Contractor to perform the Work in accordance with the Owner order, direction, instruction, interpretation, or determination, with any Contract price adjustments and progress payments for the Work to be determined on a Force Account basis in accordance with Article 36. The Contractor shall continue diligently to perform the Contract in accordance with the Owner's order, direction, instruction, interpretation, or determination during negotiations with respect to the Contractor's entitlement to an equitable adjustment hereunder or to the amount of any Contract price adjustment or time extension. The Contractor and the Owner may agree on certain aspects of an equitable adjustment and take those aspects out of operation of Force Account provisions. In the

event a mutually agreeable equitable adjustment cannot be made, the Contractor shall continue diligently to perform the orders as he proceeds with his remedies under Article 35, DISPUTES, and shall continue to receive compensation on a Force Account basis.

28.11 For contract changes, the Owner, State and Government or their representative shall have the audit and inspection rights as described below:

28.11.1 Where the agreed payment method for any contract changes is to be by cost reimbursement, time and material, labor hours or any combination thereof, the Contractor shall maintain and the Owner or its representatives shall have the right to examine books, records, documents and other evidence and accounting principles and practices sufficient to reflect properly all direct and indirect costs of whatever nature claimed to have been incurred and anticipated to be incurred for the performance of the contract changes under this sub article.

28.11.2 Contract changes exceeding \$100,000.00 in cost: For submitted cost and pricing data in connection with pricing a contract modification referred to in this sub article, unless such pricing is based on bid unit prices, adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the public, or prices set by law or regulation, the Owner or his representatives and the Comptroller General of the United States and his representatives who are employees of the United States shall have the right to examine all books, records, documents and other data of the Contractor related to the negotiation of or performance under the contract Change Orders for the purpose of evaluating the accuracy, completeness and currency of the cost or pricing data submitted. The right of examination shall extend to all documents necessary to permit adequate evaluation of the cost or pricing data submitted, along with the computations and projections used therein.

28.11.3 Contract changes exceeding \$10,000.00 but not \$100,000.00 in cost: The Owner or his representatives prior to the execution of any contract Change Order in this sub article or for a period of twelve months after execution shall, unless such pricing is based on bid unit prices, adequate price competition, established catalog of market prices or commercial items sold in substantial quantities to the public, or prices set by law or regulation, have the right to examine all books, records, documents, and other data of the Contractor relating to the negotiation and contract Change Order for the purpose of evaluating the accuracy, completeness, and currency of the data is submitted upon which negotiation is or has been based. To the extent the examination reveals inaccurate, incomplete or noncurrent data, the Project Manager may renegotiate the contract Change Order price based on such data.

28.11.4 Contract changes of less than \$10,000.00 in cost: The Owner may require from the Contractor appropriate documentation to support the prices being negotiated for contract changes under this sub article, and may refuse to complete negotiations until satisfactory documentation is submitted.

28.11.5 Availability: The materials described in Paragraphs 28.11.1 and 28.11.2 above shall be available at the office of the Contractor at all reasonable times for inspection, audit or reproduction until three years from the date of final payment under this Contract and for records which relate to Article 35, DISPUTES, or litigations or the settlement of claims arising out of the negotiation or the performance of contract changes over 100,000.00, records shall be made available until such litigations or claims have been resolved.

28.11.6 The Contractor shall insert a clause containing all the provisions in this Paragraph 28.11, including this subparagraph 28.11.6, in all subcontracts hereunder except altered as necessary for proper identification of the contracting parties and Owner.

28.11.7 For the purposes of Paragraph 28.11 of this Article, costs shall include liquidated damages which would be assessed if extension(s) of time were not granted by contract Change Order.

28.11.8 The requirements of this audits and records article are in addition to other audit, inspection and record keeping provisions elsewhere in the Contract Documents.

28.12 Changes involving aggregate increases and decreases in excess of \$100,000.00 shall be subject to the following:

28.12.1 A change involves aggregate increases and decreases in excess of \$100,000.00 if the total value of work affected, without regard to the arithmetic sign, exceeds this amount; for example, a change order adding work in the amount of \$75,000.00 and deleting work in the amount of \$50,000.00 will be considered to involve aggregate increases and decreases of \$125,000.00.

28.12.2 The Contractor shall submit in support of all items not based upon unit prices or lump sum prices contained in the Contract or upon the established prices at which commercial items are sold in substantial quantities to the public, statements by his vendors that the prices charged the Contractor are not greater than the prices charged by the respective vendors to their most favored customers for the same items in similar quantities.

28.12.3 Price reductions for Defective Cost or Pricing Data--Pricing Adjustments: If any price, including profit and fee, negotiated in connection with any price adjustment was increased by any significant sums because:

28.12.3.1 The Contractor furnished cost or pricing data which were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data;

28.12.3.2 A subcontractor, pursuant to Paragraph 28.13 of this Article entitled Subcontractor Cost or Pricing Data--Pricing Adjustments or any subcontract provision therein required, furnished costs or pricing data which were not complete, accurate, and current as certified in the Subcontractor's Certificate of Current Cost or Pricing Data;

28.12.3.3 The subcontractor or his prospective subcontractor furnished cost or pricing data which were required to be complete, accurate, and current and to be submitted to support a subcontract cost estimate furnished by the Contractor but which were not complete, accurate, and current as of the date certified in the Contractor's Certificate of Current Cost or Pricing Data; or

28.12.3.4 The Contractor or a subcontractor or his prospective subcontractor furnished any data, not within subparagraphs 28.12.3.1, 28.12.3.2, or 28.12.3.3 above, which were not complete, accurate, and current as submitted, the price shall be reduced accordingly and the Contract shall be modified in writing as may be necessary to reflect such reduction. Any reduction in the Contract Price due to defective subcontract data of a prospective subcontractor, when the subcontract was not subsequently awarded to such subcontractor, will be limited to the amount (plus applicable overhead

and profit markup) by which the actual subcontract, or actual cost to the Contractor if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor, provided the actual subcontract price was not affected by defective cost or pricing data.

28.13 Subcontract Cost of Pricing Data-- Pricing Adjustment:

28.13.1 When negotiating a change involving increases or decreases in excess of \$100,000.00, the Contractor shall require subcontractors hereunder to submit cost or pricing data under the following circumstances. Prior to award of any cost-reimbursement type, incentive or price redeterminable subcontract;

28.13.1.2 Prior to the award of any subcontract the price of which is expected to exceed \$100,000.00;

28.13.1.3 Prior to the pricing of any subcontract change modifications for which the price is expected to exceed \$100,000.00, except in the case of 28.13.1.2 and 28.13.1.3 where the price is based on adequate price competition, established catalog or market prices, commercial items sold in substantial quantities to the general public, or prices set by law or regulation.

28.13.2 The Contractor shall require subcontractors to certify to the best of their knowledge and belief that the cost and pricing data submitted under subparagraph 28.13.1 of this Article are accurate, complete, and current as of the date of execution, which date shall be as close as possible to the date of agreement on the negotiated price of the contract Change Order.

28.13.3 The Contractor shall insert the substance of Paragraph 28.13 of this Article, including this subparagraph 28.13.3, in each subcontract hereunder which exceeds \$100,000.00.

**ARTICLE 29
PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND**

29.1 The Contractor shall furnish a Performance Bond in the amount equal to one hundred percent (100%) of the Contract Sum as security for the faithful performance of this Contract and also a Labor and Material Payment Bond in an amount not less than one hundred percent (100%) of the Contract Sum or in a penal sum not less than that prescribed by State, or local law, as security for the payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. The Performance Bond and the Labor and Material Payment Bond may be in one or in separate instruments in accordance with local law and shall be delivered to the Owner not later than the date of execution of the Contract.

29.2 Performance Bonds, Labor and Material Payment Bonds and other such sureties shall provide that the surety and the Contractor are both jointly and severally liable and obligated under respective Bond or other surety agreement and shall incorporate acknowledge of applicable provisions of state law into all documents furnished in connection with the project.

**ARTICLE 30
DIFFERING SITE CONDITIONS**

30.1 The Contractor shall within 10 days of actual or constructive notice of a differing site condition, promptly, and before such conditions are disturbed, notify the Project Manager in writing of: (1) subsurface or latent physical conditions at the site differing materially from those indicated in

the Contract Documents, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract. The Project Manager will promptly investigate the conditions, and if such conditions materially differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the work under the Contract, whether or not changed as a result of such conditions, an equitable adjustment may be made subject to Owner's approval and the Contract modified in writing accordingly.

30.2 No claim of the Contractor under this Article will be allowed unless the Contractor has given the notice required in Paragraph 30.1 of this Article.

30.3 No claim by the Contractor for an equitable adjustment hereunder will be allowed if asserted after final payment under this Contract.

ARTICLE 31 CONTRACTOR PROPOSALS

31.1 The Contractor may at any time submit to the Project Manager for his review proposed modifications to the Contract Documents, supported by a cost/price proposal. Upon acceptance of the proposed modifications by the Owner, a Change Order will be issued. Denial of the proposed modification will neither provide the Contractor with any basis for claim for damages nor release the Contractor from contractual responsibilities. An equitable adjustment in the form of a contract price reduction will be made if the change results in a reduction of the cost of performance and the Contractor will not be entitled to share in said savings unless the proposal is made under Paragraph 31.2 of this Article. Except as provided in Paragraph 31.2 of this Article, the Contractor will not be compensated for any direct, incidental or collateral benefits or savings the Owner receives as a result of the proposal.

31.2 Value Engineering Change Proposals: The Contractor may submit to the Project Manager one or more cost reduction proposals for changing the Contract requirements. The Proposals shall be based upon a sound study made by the Contractor indicating that the proposal:

31.2.1 Will result in a net reduction in the Total Contract amount;

31.2.2 Will not impair any essential function or characteristic of the Work such as safety, service life, reliability, economy of operation, ease of maintenance and necessary standardized features.

31.2.3 Will not require an unacceptable extension of the contract completion time; and

31.2.4 Will require a change in the Contract Documents and such change is not already under consideration by the Owner.

31.3 The Owner may accept in whole or in part any proposal submitted pursuant to the previous Paragraph 31.2 by issuing a Change Order which will identify the proposal on which it is based. The Change Order will provide for an equitable adjustment in the Contract Price and will revise any other affected provisions of the Contract Documents. The equitable adjustment in the Contract price will be established by determining the net savings resulting from the accepted change. The net savings resulting from the change will be shared between the Contractor and the Owner on the basis of 50 percent for the Contractor and 50 percent for the Owner and will be limited to this

contract for any one Value Engineering Change Proposal. Net savings will be determined by deducting from the estimated gross savings, the Contractor's costs of developing and implementing the proposal (including any amount attributable to a subcontractor) and the estimated amount of increased costs to the Owner resulting from the change, such as evaluation, implementation, inspection, related items, and the Owner-furnished material. Estimated gross savings will include Contractor's labor, material, equipment, overhead, profit and bond. The Contract price will be reduced by the sum of the Owner's costs and share of the net savings. For the purpose of this Article, the applicable provisions of Article 28, CHANGES, shall be used to determine the equitable adjustment to the Contract price.

31.4 The Owner will not be liable for delay in acting upon, or for failure to act upon, any proposal submitted pursuant to Paragraph 31.2 of this Article. The decision of the Owner as to the Acceptance or rejection of any such proposal under the Contract will be final. The submission of a proposal by the Contractor will not in itself affect the rights or obligations of either party under the Contract.

31.5 The Contractor shall have the right to withdraw part or all of any proposal he may make under Paragraph 31.2 of this Article at any time prior to acceptance by the Owner. Such withdrawal shall be made in writing to the Project Manager. Each such proposal shall remain valid for a period of 60 days from the date submitted. If the Contractor wishes to withdraw the proposal prior to the expiration of the 60-day period, he will be liable for the cost incurred by the Owner in reviewing the proposal.

31.6 The Contractor shall specifically identify any proposals under Paragraph 31.2 of this Article with the heading "Value Engineering Change Proposal", or the proposal will be considered as made under Paragraph 31.1 of this Article.

31.7 The Contractor, in connection with each proposal he makes for a Contract Change Notice under this Article shall furnish the following information:

31.7.1 a description of the difference between the existing Contract requirement and the proposed change, and the comparative advantages and disadvantages of each, justification when a function or characteristic of an item is being altered, and the effect of the change on the performance of the end item;

31.7.2 an analysis and itemization of the requirements of the Contract which must be changed if the Value Engineering Change Proposal is accepted and a recommendation as to how to make each such change (e.g., a suggested specification revision);

31.7.3 a separate detailed cost estimate for both the existing Contract requirement and the proposed change to provide an estimate of the reduction in costs, if any, that will result from acceptance of the Value Engineering Change Proposal taking into account the costs of development and implementation by the Contractor;

31.7.4 a prediction of any effects the proposed change would have on collateral costs to the Owner such Government-furnished property costs, costs of related items, and costs of maintenance and operation;

31.7.5 a statement of the time by which a contract modification accepting the Value Engineering Change Proposal must be issued so as to obtain the maximum cost reduction, noting any effect on the contract completion time or delivery schedule; and

31.7.6 identification of any previous submission of the Value Engineering Change Proposal to the Owner, including the dates submitted, the numbers of contracts involved, and the previous actions by the Owner, if known.

ARTICLE 32 EXTENSION OF TIME

32.1 In addition to the provisions stated in Article 38, the Contractor will be granted an extension of time and will not be assessed liquidated damages for any portion of the delay in completion of the Work, performed under the latest approved progress schedule, arising from acts of God, war, fires, floods, epidemics, quarantine restrictions, freight embargoes, or weather more severe than the norm, provided that the aforesaid causes were not foreseeable and did not result from the fault or negligence of the Contractor, and provided further that the Contractor has taken reasonable precautions to prevent further delays owing to such causes, and has notified the Project Manager in writing of the cause or causes of delay within five days from the beginning of any such delay. Within 15 days after the end of the delay, the Contractor shall furnish the Project Manager with detailed information concerning the circumstances of the delay, the number of days actually delayed, the appropriate Contract Document references, and the measures to be taken to prevent or minimize the delay. Failure to submit such information will be sufficient cause for denying the delay claims. The Owner will ascertain the facts and the extent of the delay, and its findings thereon will be final and conclusive to provisions under Article 35, DISPUTES. The extension of time granted for these reasons shall not be the basis for additional compensation for any costs incurred during the time of delay.

32.1.1 Every effort shall be made by the Contractor to complete the project within the "Contract Time". The "Contract Time" anticipates "Normal" weather and climate. The Contractor's schedule must anticipate normal adverse weather delays on all weather dependent activities. The following specifies the procedure for determining time extensions for unusually severe weather. Listed below are the anticipated numbers of calendar days lost to normal adverse weather for each month.

Monthly Anticipated Calendar Days Lost to Adverse Weather Conditions

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(7)	(4)	(4)	(4)	(6)	(3)	(4)	(2)	(3)	(3)	(2)	(5)

The above schedule of anticipated adverse weather days will constitute the base line for monthly (or portion thereof) weather time evaluations. It is assumed that the work will be carried out Mondays through Fridays (holidays excepted) unless and approved construction schedule or written authorization from the Owner indicates otherwise.

An actual adverse weather day must prevent work for 50 percent or more of the Contractor's workday. When the Contractor anticipates documenting a weather day, he/she shall first notify the Project Manager or his/her designee observing the construction to determine whether or not work can proceed or if work is delayed due to adverse weather or the effects thereof. If in agreement, the Contractor shall formally request a weather day in writing to the Owner's Project Manager or his/her designee. The Contractor shall also notify the Owner's Project Manager in writing or his/her

designee of any disagreement as to whether or not work could have proceeded on a given date within 2 calendar days of that date. The final decision regarding an adverse weather day will be made by the Project Manager or his/her designee.

The number of workdays delayed due to adverse weather or the effects thereof will then be converted to Calendar Days. Weekends and holidays will only count as calendar day delays if a workday delayed due to adverse weather is counted before and after the weekend/holiday. The number of calendar days of delay due to adverse weather or the impact thereof will then be compared to the monthly adverse weather schedule above. The Contract time period will then be increased by change order for the number of calendar days that are in excess of the above schedule and a new Contract Completion day and date will be set.

32.1.2 An extension of time will not be granted for a delay caused by a shortage of materials, except Owner-furnished materials, unless the Contractor furnishes to the Project Manager documentary proof that he has diligently made every effort to obtain such materials from every known source within reasonable reach of the Work. The Contractor shall also submit proof that the inability to obtain such materials when originally planned did in fact cause a delay in final completion of the Work which could not be compensated for by revising the sequence of his operations. Only the physical shortage of material will be considered under these provisions as a cause for extension of time. No consideration will be given to any claim that material could not be obtained at reasonable, practical, or economical costs, unless it is shown to satisfaction of the Project Manager that such material could have been obtained only at exorbitant prices, entirely inconsistent with current rates taking into account the quantities involved and the usual practices in obtaining such quantities.

32.2 A Change Order will be furnished to the Contractor within a reasonable period of time after approval of a request for extension of time, specifying the number of days allowed, if any, and the new date for completion of the Work or specified portions of the Work.

32.3 See also Article 38, TERMINATION FOR DEFAULT--DAMAGES FOR DELAY--TIME EXTENSIONS.

ARTICLE 33 NOTICE OF POTENTIAL CLAIM

33.1 The Contractor will not be entitled to additional compensation otherwise payable for an act or failure to act by the Owner, the happening of any event or occurrence, or any other cause, unless he shall have given the Project Manager a written notice of potential claim therefore as specified in this Article.

33.2 The written notice of potential claim shall set forth the reasons for which the Contractor believes additional compensation will or may be due, the nature of the costs involved, and insofar as possible, the amount of the potential claim. If based on an act or failure to act by the Owner, such notice shall be given to the Project Manager prior to the time that the Contractor has started performance of work giving rise to the potential claim for additional compensation. Notice shall be given within five days after the happening of the event or occurrence giving rise to the potential claim.

33.3 It is the intention of this Article that differences between the parties arising under and by virtue of the contract shall be brought to the attention of the Project Manager at the earliest possible time in order that such matters may be settled, if possible, or other appropriate action promptly taken.

33.4 The notice requirements of this Article are in addition to those required in other Articles of the General Conditions.

ARTICLE 34 SUBMITTAL OF CLAIMS

34.1 Claims filed by the Contractor shall contain sufficient detail to enable the Owner to ascertain the basis and amount of said claims. The Owner will review and evaluate the Contractor's claims. It will be the responsibility of the Contractor to furnish when requested by the Project Manager such further information and details as may be required to determine the facts or contention involved in his claims. Failure to submit such information and details will be sufficient cause for denying the Contractor's claims.

34.2 Each claim the Contractor may make for equitable adjustment on account of delay for any cause shall be accompanied by a progress schedule reflecting the effects of the delay and proposals to minimize these effects. If no progress schedule has been submitted to the Project Manager reflecting conditions prior to the delay for which relief is sought, then a progress schedule so reflecting these conditions shall be prepared and submitted with the claim.

34.3 Depending upon the grounds for relief and the nature of relief sought, additional submittals and conditions upon submitting claims may be required elsewhere in these General Conditions.

34.4 In no event shall claims be made after final payment is made under Article 27, FINAL PAYMENT, of these General Conditions.

34.5 Inasmuch as notice of potential claim requirements of Article 33, NOTICE OF POTENTIAL CLAIM, are intended to enable the Project Manager to investigate while facts are fresh and to take action to minimize or avoid a claim which might be filed thereafter, the Contractor's failure to make the required notice on time is likely to disadvantage the Owner. Therefore no claim for which a notice of potential claim is required will be considered unless the Contractor has complied with the notice of Article 33, NOTICE OF POTENTIAL CLAIM.

ARTICLE 35 DISPUTES

35.1 General: Notwithstanding any other provisions of this Contract, disputes and disagreements by and between the Owner and the Contractor shall be resolved through progressive, sequential process of negotiation, mediation, and in certain cases, arbitration. For contracts which are for \$250,000 or less, amounts in dispute which are less than \$10,000 shall not progress beyond negotiation and shall ultimately be decided by the Owner if not by mutual agreement. For contracts which are for more than \$250,000, amounts in dispute which are less than \$25,000 should not progress beyond negotiation. For all contracts, amounts in dispute greater than those amounts set forth above, but less than \$100,000 shall be resolved through a sequential process of negotiation, mediation, and binding arbitration. Amounts in dispute which are \$100,000 or more shall be resolved through a sequential process of negotiation, mediation, and thence either arbitration or litigation.

35.2 Negotiation: In the event of disputes, unsettled claims, questions or disagreements between the contractor and the City relating to or arising out of the provisions of this Contract, the representatives of those parties shall meet promptly in recognition of mutual interests and in a good

faith effort to resolve the dispute. Either the Contractor or the City shall arrange for this meeting at a time and place within the City of Greeley, mutually acceptable to both parties, within fifteen (15) days of notification of the dispute, unsettled claim, question, or disagreement between the parties. Seven (7) days prior to the meeting, the initiating party shall deliver to the other party, a written and complete summary of the evidence and arguments substantiating its claim. If the parties do not reach a solution within thirty (30) days after said initial meeting, then upon notice of either party to the other, the dispute, claim, question, or difference, may be referred to a mediator pursuant to Section 35.3. The parties can extend the negotiation period by mutual written agreement.

35.3 Mediation: If the dispute, claim, question, or difference is not resolved by negotiation within thirty (30) days after the initial meeting between the parties or within the extended period agreed upon, the parties agree to next request that the American Arbitration Association provide a mediator to assist the Owner and Contractor in resolving the dispute, claim, question, or difference. The rules of mediation shall be the Construction Industry Mediation Rules of the American Arbitration Association. A different mediation/dispute resolution agency may be selected for mediation upon the mutual written agreement between the parties. The dispute resolution agency shall select a qualified mediator who shall have a background in construction. The selected mediator may be rejected by the parties only for bias. The mediator shall have thirty (30) days from the time of appointment to meet with the parties and sixty (60) days from the time of the appointment to resolve the dispute unless the parties mutually consent to an extension of the sixty day deadline. All reasonable fees, costs, and expenses of the mediator, the mediator's association and the mediation agency, shall be borne equally by the parties. Each party shall bear the expense of its own counsel, experts, witnesses, and preparation and presentation of proofs at mediation.

The Contractor shall not cause a delay of work during mediation proceedings except by mutual agreement. All mediation proceedings shall be conducted in the City of Greeley, unless an alternate location is agreed upon in writing by the Owner and the Contractor.

Amounts in dispute which are less than \$10,000 shall not progress beyond mediation.

35.4 Litigation prerequisites: The procedures enumerated in Sections 35.2 and 35.3 shall be a prerequisite to the filing of any litigation between the parties to the Contract. Failure of the Contractor to follow the provisions of Section 35.2 and Section 35.3 shall be a complete defense, and grounds for immediate dismissal of any litigation filed prior to Contractor engaging in negotiation and mediation with the City of Greeley as provided above. Litigation may be filed only if the amount in dispute is \$100,000 or more. In the event litigation is filed by and between the parties after mediation, venue and jurisdiction of any and all suits and causes of action in connection with this Contract shall lie exclusively in Weld County, Colorado.

35.5 Arbitration: After mediation, instead of litigation, any remaining unresolved controversy or claim arising out of or relating to this Contract or the performance or breach thereof, may be settled by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association. For amounts in dispute which are \$100,000 or more, arbitration shall be engaged only upon mutual written agreement by the Owner and the Contractor, and the written agreement shall specify whether the arbitration shall be binding or nonbinding; however, amounts in dispute which are less than \$100,000 shall necessarily be settled by binding arbitration. The sole arbitrator shall be appointed by the Arbitration Association, unless a different arbitrator or dispute resolution agency is mutually agreed upon. The award of the arbitrator shall be accompanied by a reasoned opinion, and shall include findings of fact and conclusions. All fees and expenses of

the arbitration, including the expense of each party's counsel, experts, witnesses, and preparation and presentation of proofs, shall be borne by the party against whom arbitration judgment is made.

35.6 Litigation: Each party shall bear its own litigation fees and expenses, including the expense of its counsel, experts, witnesses, and preparation and presentation of proofs, regardless of the prevailing party.

ARTICLE 36 FORCE ACCOUNT WORK

36.1 This Article shall become operative upon failure of the Contractor and the Owner to arrive at an amount of compensation under Article 28, CHANGES. In the event that no equitable adjustment is arrived at either by mutual agreement or pursuant to the Article 35, DISPUTES, the compensation paid hereunder will be the total compensation.

36.2 Work Performed by or for Contractor: The Contractor will be paid for labor, materials, and equipment as hereinafter provided, except where agreement has been reached to pay in accordance with Paragraph 36.3 of this Article. The following percentages, as full compensation for profit, overhead and small tools, will be added to the totals computed as provided in subparagraphs 36.2.1 through 36.2.3 of this Article.

Labor	25 percent
Materials	20 percent
Equipment	10 percent

Labor, materials, and equipment shall be furnished by the Contractor or by a subcontractor. When work paid on a force account basis is performed by forces other than the Contractor's, the Contractor shall reach agreement with such other forces as to the distribution of the payment made by the Owner for such work and, except as specified herein, no additional payment therefore will be made by the Owner by reason of performance of work by a subcontractor or by others. In addition to the markups, if any, for labor, equipment, and materials, for subcontracted work, the Contractor may add an additional five percent markup. The cost of subcontracted work will be the actual cost to the contractor for work performed by a subcontractor as computed in accordance with this Paragraph 36.2 and its subparagraphs 36.2.1, 36.2.2, and 36.2.3.

36.2.1 Labor: The cost of labor used in performing the work, whether the employer is the Contractor or a subcontractor, will be the sum as determined on the basis of the following three subparagraphs:

36.2.1.1 The gross actual wages, including income tax withholdings but not including employer payments to or on behalf of workmen for health and welfare, pension, vacation, insurance and similar purposes.

36.2.1.2 To the gross actual wages, as defined in the previous subparagraph,

36.2.1.1.1, will be added a percentage based upon current State and Federal laws and applicable labor contracts concerning payments made to or on behalf of workmen other than actual wages, which percentage will constitute full compensation for all payments imposed by State and Federal laws and for all other payments made to or on behalf of the workmen, other than actual wages as defined in the previous subparagraph 36.2.1.1 and the subsistence and travel allowance as specified

in the following subparagraphs 36.2.1.3. The Contractor shall compute a separate percentage for each craft, or a composite percentage for all crafts, if so approved by the Owner. Computed percentages shall be submitted to the Project Manager for approval by the Owner.

36.2.1.3 Subsistence and travel allowance paid to workmen as required by established agreements.

36.2.1.4 The charges for labor shall include all classifications up to but not including foremen, and when authorized by the Owner, shall include foremen engaged in the actual and direct performance of the work. Labor charges shall not include charges for assistant superintendents, office personnel, timekeepers, and maintenance mechanics, unless authorized by the Owner in advance of the start of work.

36.2.2 Materials: The cost of materials required for the accomplishment of the work will be delivered cost to the purchaser, whether contractor or subcontractor, from the supplier thereof, except as the following are applicable:

36.2.2.1 If a cash or trade discount by the actual supplier is offered or available to the Contractor, it shall be credited to the Owner notwithstanding the fact that such discount may not have been taken.

36.2.2.2 If materials are procured by the Contractor by a method which is not a direct purchase from and a direct purchase from and a direct billing by the actual supplier, the cost of such materials will be deemed to be the price paid to the actual supplier, as determined by the Owner. No additional markup for supplier work will be allowed except to the extent of actual cost to the Contractor in handling the material, not to exceed five percent of the price paid to actual supplier.

36.2.2.3 If the materials are obtained from a supply or source owned wholly or in part by the Contractor, payment therefore will not exceed the price paid for similar materials furnished from said source on Contract Items or the current wholesale price for such materials delivered to the work site, whichever price is lower.

36.2.2.4 If the cost of the materials is, in the opinion of Owner, excessive, then the cost of such materials will be deemed to be the lowest current wholesale price at which such materials are available in the quantities concerned, delivered to the job site, less discounts as provided in subparagraph 36.2.2.1 of this Article.

36.2.2.5 If the Contractor does not furnish satisfactory evidence of the cost of such materials from the actual supplier thereof, the cost will be determined in accordance with subparagraph 36.2.2.4 of this Article.

36.2.2.6 The Contractor shall have no claims for costs and profit on Owner-furnished materials.

36.2.3 Equipment: The Contractor will be paid for the use of contractor-owned or rented equipment at the rental rates shown in the Colorado State Department of Highways Construction Equipment Rental Rate Schedule, except as modified below, which edition shall be the latest edition in effect at the time of commencement of the Force Account work. For equipment used in excess of eight hours per day, the rental rate shall be 60 percent of the listed hourly rate. If it is deemed

necessary by the Contractor to use equipment not listed in the C.D.O.H. Construction Equipment Rental Rate Schedule, the Contractor shall furnish the necessary cost data and paid invoices to the Project Manager for his use in establishment of such rental rate.

36.2.3.1 The rates paid as above provided will include the cost of fuel, oil, lubricants, supplies, small tools, necessary attachments, repairs and maintenance, depreciation, storage, insurance and incidentals.

36.2.3.2 Equipment operators will be paid for as stipulated in subparagraph 36.2.1 of this Article.

36.2.3.3 Equipment shall be in good working condition and suitable for the purpose for which the equipment is to be used.

36.2.3.4 Unless otherwise specified, manufacturer-approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer of that equipment.

36.2.3.5 Individual pieces of equipment or tools having a net individual value of \$300 or less, whether or not consumed by use, will be considered to be small tools and no payment will be made therefore.

36.2.3.6 Compensation will not be allowed while equipment is inoperative due to breakdown. Except as specified in paragraph 36.2.3.7 of this Article, time will be computed in half and full hours. In computing the time for use of equipment, less than 30 minutes shall be considered one half hour.

36.2.3.7 Equipment at the Work Site: The time to be paid for use of equipment on the work site will be the time the equipment is in operation on the force account work being performed. The time will include the time required to move the equipment to location of the force account work and return it to the original location or to another location requiring no more time than that required to return it to its original location. Moving time will not be paid for if the equipment is used at the site of the force account work on other than such force account work. Loading and transporting costs will be allowed, in lieu of moving time, when the equipment is moved by means other than its own power. No payment for loading and transporting will be made if the equipment is used at the site of the force account work on other than such force account work.

36.3 Special Items of Work: If the Owner and the Contractor, by agreement, determine that (a) an item of force account work does not represent a significant portion of the total Contract price, and (b) such items of work cannot be performed by the forces of the Contractor or the forces of any of his subcontractors, and (c) it is not in accordance with the established practice of the industry involved to keep the records which the procedure outlined in Paragraph 36.2 of this Article would require, charges for such special force account work items may be made on the basis of invoices for such work without complete itemization of labor, materials, and equipment rental costs. To such invoiced price, less a credit to the Owner for any cash or trade discount offered or available, will be added five percent of the discounted price, in lieu of the percentages provided in Paragraph 36.2 of this Article. In no event will the price paid exceed the current fair market value of such work plus five percent.

36.4 Records: The Contractor shall maintain his records to provide a clear distinction between the direct costs of work paid for on a force account basis and costs of other operations.

36.4.1 The Contractor shall prepare and furnish to the Project Manager, on the following work day, report sheets in duplicate of each day's work paid for on a force account basis. The daily report sheets shall itemize the materials used and shall cover the direct cost of labor and the charges for equipment, whether furnished by the Contractor, subcontractor, or other forces, except for charges described in Paragraph 36.3 of this Article. The daily report sheets shall provide names or identifications and classifications of workmen and the hourly rate of pay and hours worked. In addition, a report of the size, type and identification number of equipment and hours operated shall be furnished to the Project Manager. Daily report sheets shall be signed by the Contractor or his authorized agent.

36.4.2 Material changes shall be substantiated by valid copies of vendor's invoices or conformed copies, certified true by the Contractor. Such invoices shall be submitted with the daily report sheets. Should the vendor's invoices not be submitted within 20 days after the date of delivery of the material or 15 days after acceptance of the work, whichever comes first, the Owner reserves the right to establish the cost of such materials at the lower current wholesale prices at which such materials are available in the quantities concerned delivered to the location of the work, less any discounts provided in subparagraph 36.2.1. of this Article.

36.4.3 The Project Manager will compare his records with the daily report sheets furnished by the Contractor, make any necessary adjustment and compile the costs of work paid for on a force account basis on daily force account work report forms. When these daily reports are agreed upon and signed by the Project Manager, they shall become the basis of payment for the work performed, but shall not preclude subsequent adjustment based on a later audit.

36.4.4 The Contractor's original cost records pertaining to work paid for on a force account basis shall be retained and shall be open to inspection and audit as required by Article 28, CHANGES, and any other provisions of the Contract.

36.5 If, in the Project Manager's opinion, the Contractor or any of his subcontractors, in performing Force Account work, is not making efficient use of labor, material or equipment or is proceeding in a manner which makes Force Account work unnecessarily more expensive to the Owner, the Project Manager may, in whole or part, direct the Contractor in the deployment of labor, material and equipment. By way of illustration, inefficiency may arise in the following ways: (1) the timing of the work, (2) the use of unnecessary labor or equipment, (3) the use of a higher percentage of apprentices than in non-force account work, (4) failure to procure materials at the lowest price, or (5) using materials of quality higher than necessary.

ARTICLE 37

TERMINATION FOR CONVENIENCE OF THE OWNER

37.1 The performance of Work under this contract may be terminated by the Owner in accordance with this Article in whole, or from time to time in part, whenever such termination is in the best interest of the Owner. Such termination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which performance of work under the Contract is terminated, and the date upon which such termination becomes effective.

37.2 After receipt of a Notice of Termination, and except as otherwise directed by the Owner, the Contractor shall:

37.2.1 Stop work under the Contract on the date and to the extent specified in the Notice of Termination.

37.2.2 Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the work under the Contract as is not terminated;

37.2.3 Terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the Notice of Termination;

37.2.4 Assign to the Owner in the manner, at the times, and to the extent directed by it, all of the rights, title and interest of the Contractor under the orders and subcontracts so terminated, in which case the Owner will have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

37.2.5 Settle outstanding liabilities and claims arising out of such termination of orders and subcontracts, with the approval or ratification of the Owner to the extent it may require, which approval or ratification shall be final for the purposes of this Article;

37.2.6 Transfer title and deliver to the Owner in the manner, at the times, and to the extent, if any directed by it, (a) the fabricated or unfabricated parts, work in process, completed work, supplies and other material procured as part of, or acquired in connection with the performance of, the work terminated by the Notice of Termination, and (b) the completed or partially completed plans, drawings, information, and other property, which, if the Contract had been completed, would have been required to be furnished to the Owner;

37.2.7 Use his best efforts to sell, in the manner, at the times, to the extent, and at the price or prices direction or authorized by the Owner, property of the types referred to in (37.2.5) above; provided, however, that the Contractor (a) shall not be required to extend credit to any purchaser and (b) may acquire any such property under the conditions prescribed by and at a price or prices approved by the Owner; provided further that the proceeds of any such transfer or disposition will be applied in reduction of any payments to be made by the Owner to the contractor under this Contract or will otherwise be credited to the price or cost of the work covered by this Contract or paid in such other manner as the Owner may direct;

37.2.8 Complete performance of each part of the work as shall not have been terminated by the Notice of Termination; and

37.2.9 Take such action as may be necessary, or as the Project Manager may direct, for the protection and preservation of the property related to this Contract which is in the possession of the Contractor and in which the Owner has or may acquire an interest.

37.3 After receipt of a Notice of Termination, the Contractor shall submit to the Project Manager his termination claim, in the form and with certification prescribed by the Owner. Such claims shall be submitted promptly but in no event later than the earliest of the following: (1) one year from the effective date of termination or (2) thirty days after the remainder of the project has been accepted by the owner.

37.4 Subject to the provision of Paragraph 37.3, the contractor and the Owner may agree upon the whole or any part of the amount or amounts to be paid to the Contractor by reason of the total or partial termination of work pursuant to this Article, which amount or amounts may include an allowance for profit on work done; provided that such agreed amount or amounts, exclusive of settlement costs, shall not exceed the total contract price as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work terminated. The Contract will be amended accordingly, and the Contractor will be paid the agreed amount.

37.5 In the event of failure of the Contractor and the Owner to agree, as provided in Paragraph 37.4, upon the whole amount to be paid the Contractor by reason of the termination of work pursuant to this Article, the Owner will pay the Contractor the amounts determined by the Owner as follows, but without duplication of any amounts agreed upon in accordance with Paragraph 37.4;

37.5.1 With respect to contract work performed prior to the effective date of the Notice of Termination, the total (without duplication of any items) of:

37.5.1.1 The cost of such work;

37.5.1.2 The cost of settling and paying claims arising out of the termination of work under subcontracts or orders as provided in subparagraph 37.2.5 above, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by the subcontractor prior to the effective date of the Notice of Termination of work under this Contract, which amounts shall be included in the cost on account of which payment is made under 37.5.1 above.

37.5.1.3 A sum, as profit on 37.5.1.1 above, determined by the Owner to be fair and reasonable; provided, however, that if it appears that the Contractor would have sustained a loss on the entire Contract had it been completed, no profit shall be included or allowed under this subparagraph 37.5.1.3 and an appropriate adjustment shall be made by reducing the amount of the settlement to reflect the indicated rate of loss.

37.5.2 The reasonable cost of the preservation and property incurred pursuant to subparagraph 37.2.9 and any other reasonable cost incidental to termination of work under this Contract, including expense incidental to the determination of the amount due to the Contractor as the result of the termination of work under this Contract.

37.5.3 The total sum to be paid to the contractor under paragraph 37.5.1 above will not exceed the total contract price as reduced by the amount of payments otherwise made and as further reduced by the Contract price of the work terminated.

37.6 In arriving at the amount due the Contractor under this Article, there will be deducted (1) any claim which the Owner may have against the Contractor in connection with this Contract, (2) the agreed price for, or the proceeds of sale, of materials, supplies or other things acquired by the contractor or sold, pursuant to the provisions of this Article, and not otherwise recovered by or credited to the Owner and (3) the full amount of any statutory or other claim against the Contractor filed with the Owner.

37.7 Unless otherwise provided for in this Contract, or by applicable statute, the Contractor, from the effective date of termination and for a period of three years after final settlement under this Contract, shall preserve and make available to the Owner at all reasonable times at the office of the Contractor but without direct charge to the Owner, all his books, records, documents, electronic/digital media and other evidence bearing on the costs and expenses of the Contractor under this Contract and related to the work terminated hereunder, or to the extent approved by the Owner, or other authentic reproductions thereof.

37.8 The Contractor shall insert in all subcontracts that the subcontractor shall stop work on the date of and to the extent specified in a Notice of Termination from the Owner and shall require that any tier subcontractors insert the same provision in any tier subcontracts.

37.9 Under no circumstances is the Contractor entitled to anticipatory, unearned profits or consequential damages as a result of a termination or partial termination under this Article.

ARTICLE 38 TERMINATION FOR DEFAULT

38.1 If, in the opinion of the Owner, the Contractor has failed to prosecute work, the Owner will notify the Contractor. The Contractor will then have 5 days to remedy the failure to prosecute work or to obtain the Owner's authorization for the delay or an extension of time as set forth in Article 32.

38.2 If the Contractor refuses or fails after reasonable notice as set forth above to prosecute Work, or any separable part thereof, with such diligence as will insure its completion within the time specified in this Contract, or refuses or fails to complete said Work within such time, the Owner may, by written notice to the Contractor, terminate for default his right to proceed with the Work or such part of the Work as to which there has been unauthorized delay. In such event the Owner may take over the work and prosecute the same to completion, by Contractor or otherwise, and may take possession of and utilize in completing the Work such materials, appliances, and plant as may be on the Work Site and necessary therefore. Whether or not the Contractor's right to proceed with the Work is terminated, he and his sureties shall be liable for any damage to the Owner resulting from his refusal or failure to complete the Work in the specified time.

38.3 If the Owner so terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such time as may be required for final completion of the Work together with any increased costs incurred by the Owner in completing the Work as further set forth in Article 41.

38.4 If, after Notice of Termination of the Contractor's right to proceed under the provisions of this Article, it is determined for any reason that the Contractor was not in default under the provisions of this Article or that the Contractor was entitled to an extension of time under Article 32,

EXTENSION OF TIME, the rights and obligations of the parties shall be the same as if the Notice of Termination had been issued pursuant to Article 37, TERMINATION FOR CONVENIENCE OF THE OWNER.

38.5 The right to terminate for default and any other rights and remedies of the Owner provided in this clause are in addition to any other rights and remedies provided by law or under this Contract.

ARTICLE 39

TERMINATION OF RIGHT TO PROCEED FOR CERTAIN DEFAULTS

39.1 In addition to the Owner's right to terminate for default under other Articles of this Contract, the Owner will have the right to terminate the Contractor's performance of work in whole or in part for default for any of the following reasons:

39.1.1 The Contractor's or subcontractor's performance of work is in violation of the terms of the Contract.

39.1.2 The Contractor or subcontractor has violated an authorized order or requirement of the Owner.

39.1.3 Abandonment of Contract.

39.1.4 Assignment or subcontracting of the Contract or any work under the Contract without approval of the Owner.

39.1.5 Bankruptcy or appointment of a receiver for the Contractor's property.

39.1.6 Performance of the Contractor in bad faith.

39.1.7 Contractor allowing any final judgment to stand against him for a period of 48 hours (excluding weekends and legal holidays).

39.2 If, in the opinion of the Owner, the Contractor is in default of the Contract, the Owner will notify the Contractor. If the Contractor fails to remedy or commence to remedy the default within five days after receipt of such notice, the Owner may terminate the Contractor's right to proceed with the Work or that portion of the Work which the Owner determines is most directly affected by the default.

39.3 If, after Notice of Termination of Contractor's right to proceed under this Article it is determined for any reason Contractor was not in default, the rights and obligations of the parties shall be the same as if the Notice of Termination had been issued pursuant to Article 37, TERMINATION FOR CONVENIENCE OF THE OWNER.

ARTICLE 40

RIGHTS AND OBLIGATIONS OF PARTIES AT TERMINATION FOR DEFAULTS

40.1 This Article shall apply to terminations for defaults covered in Article 15, 38, and 39 of these General Conditions.

- 40.2 On receipt of a Notice of Termination from the Owner, the Contractor shall:
- 40.2.1 Stop all work under the Contract on the date and to the extent specified in the Notice of Termination.
- 40.2.2 Place no further orders or subcontracts for materials, equipment or services except as they relate to the performance of work covered by the Notice of Termination.
- 40.2.3 Cancel or terminate all orders or subcontracts to the extent that they relate to the performance of work covered by the Notice of Termination.
- 40.2.4 Comply with all other requirements of the Owner as may be specified in the Notice of Termination.
- 40.3 Upon the Owner termination of the Contractor's right to proceed with the Work because of the Contractor's default under the Contract, the Owner will have the right to complete the Work by whatever means and method it deems advisable. The Owner shall have the right to take possession of and use any or all the Contractor's materials, plat, tools, equipment and property of any kind provided by or on behalf of the Contractor for the purpose of the Work, or a portion of them, without being responsible to the Contractor for fair wear and tear. The Contractor shall have no rights in such property during their use by the Owner. The Owner will not be required to obtain the lowest prices for completing the Work but shall make such expenditures as, in the Owner's sole judgment, best accomplish such completion.
- 40.4 The expense of completing the Work, together with a reasonable charge for engineering, managerial and administrative services, as certified by the Owner, will be charged to the Contractor and the expense so charged will be deducted by the Owner out of such monies as may be due or may at any time thereafter become due to the Contractor. In case such expense is in excess of the sum which otherwise would have been payable to the Contractor under the Contract, the Contractor or his surety shall promptly pay the amount of such excess to the Owner upon notice from the Owner of the excess so due. The Owner may, in its sole discretion, withhold all or any part of any progress payments otherwise due the Contractor until completion and final settlement of the Work covered by the Notice of Termination of Contractor's right to proceed.
- 40.5 The Contractor shall insert in all subcontracts that the subcontractor will stop work on the date of or to the extent specified in a Notice of Termination from the Owner and shall require the subcontractors to insert the same provision in any tier subcontracts.
- 40.6 The Contractor shall immediately upon receipt communicate any Notice of Termination issued by the Owner to the affected subcontractors and suppliers at any tier.
- 40.7 Rights of Surety: The Surety on the Performance Bond provided for in this Contract shall not be entitled to take over the Contractor's performance of work in case of termination under this Article, except with the consent of the Owner.

ARTICLE 41 LIQUIDATED DAMAGES

41.1 Time is of the essence of the Contract. In the event the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, or fails to meet any other time requirement or the time limit set forth in the Contract, after due allowance for any extension or extensions of time made in accordance with the Contract, the Contractor shall pay to the Owner as fixed, agreed and liquidated damages, pursuant to the clause of the Contract entitled TERMINATION FOR DEFAULT—DAMAGES FOR DELAY—TIME EXTENSIONS, the sum of \$500.00 for each calendar day of delay unless otherwise stated in the Special Provisions. Such liquidated damages shall be assessed for each and every day that the Contractor shall be in default. The Owner shall have the right to deduct said liquidated damages from any amount due or that may become due the Contractor, or to collect such liquidated damages from the Contractor or its surety.

41.2 Liquidated damages in the amount stipulated do not include any sums of money to reimburse the City for actual damages which may be incurred between Substantial Completion and Final Completion because of the Contractor's failure to achieve Final Completion within the Contract Time. For such delay in Final Completion, the Contractor shall reimburse the City, as a mitigation of City damages and not as a penalty, those administrative costs incurred by the City as a result of such failure.

41.3 Liquidated damages in the amounts stipulated do not include any sums of money to reimburse the City for extra costs which the City may become obligated to pay on other contracts which were delayed or extended because of the Contractor's failure to complete the Work within the Contract Time. Should the City incur additional costs because of delays or extensions to other contracts resulting from the Contractor's failure of timely performance, the City will assess these extra costs against the Contractor, and these assessments will be in addition to the stipulated liquidated damages.

41.4 The City reserves all of its rights to actual damages from the Contractor for injury or loss suffered by the City from actions or omissions of the Contractor, including but not limited to any other breach or default of the Contract, outside of the scope of the above sections.

ARTICLE 42 USE AND POSSESSION PRIOR TO COMPLETION

42.1 The Owner shall have the right to take possession of or use any completed or partially completed parts of the Work. Such possession or use will not be deemed an acceptance of Work not completed in accordance with the Contract. While the Owner is in such possession, the Contractor, notwithstanding the provisions of Article 18, DAMAGE TO WORK AND RESPONSIBILITIES FOR MATERIALS, will be relieved of the responsibility for loss or damage to the work other than that resulting from the Contractor's fault or negligence or breach of warranty. If such prior possession or use by the Owner delays the progress of the Work or causes additional expense to the Contractor, an equitable adjustment in the Contract price or the time of completion will be made, and the Contract will be modified in writing accordingly.

ARTICLE 43
RIGHTS IN SHOP DRAWINGS AND WORKING DRAWINGS

43.1 Shop Drawings and Working Drawings, submitted to the Project Manager by the Contractor, subcontractor or any lower tier subcontractor pursuant to the Work, may be duplicated by the Owner and the Owner may use and disclose, in any manner and for any purpose, Shop Drawings and Working Drawings delivered under this Contract.

43.2 This Article, including this Paragraph 43.2, shall be included in all subcontracts hereunder at all tiers.

ARTICLE 44
PATENT AND COPYRIGHT

44.1 The Contractor shall warrant that the materials, equipment or devices used on or incorporated in the Work shall be delivered free of any rightful claim of any third party for infringement of any United States patent or copyright. If notified promptly in writing and given authority, information and assistance, the Contractor shall defend, or may settle, at his expense, any suit or proceeding against the Owner or the Project Manager based on a claimed patent or copyright infringement which would result in a breach of his warranty. The Contractor shall pay all damages and costs awarded therein against the Owner or the Project Manager due to such breach. If any use of materials, equipment or devices is held to constitute an infringement and such use is enjoined, the Contractor shall, at his expense and option, either procure for the Owner the right to continue using said materials, equipment or devices, or replace same with noninfringing materials, equipment or devices, or modify same so it becomes noninfringing. The Contractor shall report to the Owner promptly and in reasonable written detail, each notice or claim of patent or copyright infringement based on the performance of this Contract of which the Contractor has knowledge. In the event of any claim or suit against the Owner on account of any alleged patent or copyright infringement arising out of the performance of this Contract or out of the use of any supplies furnished or work or services performed hereunder, the Contractor shall furnish to the Owner when requested by the Owner, all evidence and information in possession of the Contractor pertaining to such suit or claim. Such evidence and information shall be furnished at the expense of the Owner except where the Contractor has agreed to indemnify the Owner. This clause shall be included in all subcontracts.

ARTICLE 45
HISTORICAL, SCIENTIFIC AND ARCHAEOLOGICAL DISCOVERIES

45.1 All articles of historical, scientific or archaeological interest uncovered by the Contractor during progress of the Work shall be preserved in accordance with applicable law and reported immediately to the Project Manager. Further operations of the Contractor with respect to the find, including disposition of the articles, will be decided by the Owner in accordance with applicable law.

ARTICLE 46
SUBSTITUTIONS

46.1 Where reference is made to one or more proprietary products but restrictive descriptive material of only one manufacturer is used, it is understood that the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the plans and

specifications and are compatible with the intent and purpose of the design, subject to the written approval of the Owner and the Project Manager. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design.

46.2 The Contractor may propose the substitutions of any material as a supplement to his bid with the monetary amount, additive or deductive as may be the case, clearly stated. Manufacturer's information, catalog numbers, and complete descriptive information shall be included with the proposed substitution. This shall be completely apart and separate from the base bid quotation and shall be solely for the information of the Owner, and the use of such proposed substitutions shall be strictly at the decision of the Owner. If substitution is accepted by the Owner, the Contract sum shall be adjusted from the base bid either up or down as indicated on the supplementary list.

ARTICLE 47 INSURANCE

47.1 General

47.1.1 The Contractor shall provide from insurance companies, acceptable to the Owner, the insurance coverage designated hereinafter and pay all costs. The Contractor also indemnifies the Owner as further described in Article 4.

47.1.2 Before commencing work under this Agreement, the Contractor shall furnish the Owner with certificates of insurance specified herein showing the type, amount, class of operations covered, effective dates, and date of expiration of policies. Furthermore, each such certificate shall contain a valid provision or endorsement that the policy may not be cancelled, terminated, changed or modified without first giving ten (10) days written notice to the Owner, which notice must be sent registered mail, return receipt requested, to the Project Manager.

47.1.3 In case of the breach of any provision of this Article, the Owner, at his option, may take out and maintain, at the expense of the Contractor, such insurance as the Owner may deem proper at the Contractor's expense and may deduct the cost of such insurance from any monies which may be due or become due the Contractor under this Agreement.

47.1.4 The Contractor shall either: (1) require each of his subcontractors to procure and maintain during the life of his subcontract, subcontractors' comprehensive General Liability, Automobile Liability and Property Damage Liability Insurance of the type and in the same amounts as specified in this subparagraph, or (2) insure the activity of his subcontractors in his own policy.

47.1.5 Co-Insurance: The Contractor herein agrees to name the Owner as an insured party on all liability insurance policies provided for by this Article 47, INSURANCE.

47.1.6 No insurance shall be cancelled or otherwise voided during the Contract period, without at least 10 days prior written notice to the Owner, nor shall any insurance be invalidated should the insured waive any or all right of recovery against any party.

47.1.7 Liability insurance may be arranged by Comprehensive General Liability and Comprehensive Automobile Liability policies for the full limits required; or by a combination of underlying Comprehensive Liability policies for lesser limits with the remaining limits provided by an Excess or Umbrella Liability policy.

47.1.8 The Owner shall purchase and maintain such boiler and machinery insurance as may be required by the Contract Documents or by law. This insurance shall include the interest of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Work.

47.1.9 Any loss insured under Article 47 is to be adjusted with the Owner and made payable to the Owner as trustee for the insured, as their interests may appear, subject to the requirements of any applicable mortgage clause. The Contractor shall pay each subcontractor a just share of any insurance monies received by the Contractor, and by appropriate share of any insurance monies received by the Contractor, and by appropriate agreement, written where legally required for validity, shall require each subcontractor to make payments to his subcontractors in similar manner.

47.1.10 If the Contractor requests in writing that insurance for risks other than those described in this Article or other special hazards be included in the Owner's property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

47.1.11 The Owner as trustee shall have power to adjust and settle any loss with the insurers.

47.1.12 If the Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion thereof, such occupancy or use shall not commence prior to a time mutually agreed to by the Owner and Contractor and to which the insurance company or companies providing the property insurance have consented by endorsement to the policy or policies. This insurance shall not be cancelled or lapsed on account of such partial occupancy or use. Consent of the Contractor and of the insurance company or companies to such occupancy or use shall not be unreasonably withheld.

47.2 Workmen's Compensation and Employer's Liability Insurance:

47.2.1 The Contractor shall provide coverage and amounts as required by the Workmen's Compensation Act of the State of Colorado.

47.2.2 The Contractor shall provide Employer's Liability Insurance in an amount not less than \$100,000 for each occurrence.

47.2.3 The Contractor shall require any subcontractor to provide Workmen's Compensation and Employer's Liability Insurance in the same amounts for all of the subcontractor's employees to be engaged in work under this Agreement.

47.3 General Liability

47.3.1 General Liability Insurance shall be on a Comprehensive General Liability form and shall provide coverage for the following: Premises and Operations, Owners and Contractors Protective, Elevators, Independent Contractors, Products and Completed Operations, Contractual, Personal Injury, and Broad Form Property Damage; "XCU" exclusions must be deleted.

47.3.2 Minimum requirements for Comprehensive General Liability are: bodily injury, \$1,000,000.00 each person, \$2,000,000.00 each occurrence; property damage, \$1,000,000.00 each occurrence.

47.4 Automobile Liability

47.4.1 Comprehensive Automobile Liability Insurance shall include coverage for all owned motor vehicles and hired and non-owned motor vehicles.

47.4.2 Minimum requirements for Comprehensive Automobile Insurance are: bodily injury, \$1,000,000.00 each person, \$2,000,000.00 each occurrence; property damage, \$1,000,000.00 each occurrence.

47.5 Property Insurance:

47.5.1 The Owner may require the Contractor to purchase and maintain "Builder's Risk" Property Insurance for all work at the site to the full insurable value thereof. The Owner and the Project Manager shall be named as co-insured.

ARTICLE 48 UNCOVERING AND CORRECTION OF WORK

48.1 During construction, whenever materials requiring inspection in place by the Project Manager and the Owner to be permanently covered up, it shall be Contractor's responsibility to notify the Project Manager at least 24 hours in advance of commencement of such covering operation. In the event of failure by Contractor to give such notification, Contractor shall, at his own expense, uncover such portions of work as required by the Project Manager or the Owner, and reinstall such covering after satisfactory inspection and correction of any and all deficiencies.

ARTICLE 49 EQUAL OPPORTUNITY

49.1 The Contractor agrees to comply with the letter and spirit of the Colorado Anti-discrimination Act of 1957, as amended, and other applicable laws respecting discrimination and unfair employment practices (24-34-402, CRS 1973, as amended). The Contractor shall be responsible for any discriminatory or unfair employment practices of his subcontractors. Neither the Contractor nor any subcontractor will discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex, religion, ancestry, mental or physical handicap, or age. Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color, national origin, sex, religion, ancestry, mental or physical handicap, or age. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment, or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

49.2 Contractor and all subcontractors shall, in all solicitations or advertisement for employees placed by them or on their behalf, state that qualified applicants will receive consideration for employment without regard to race, creed, color, national origin, sex, religion, ancestry, mental or physical handicap, or age.

ARTICLE 50 CLAIMS

50.1 The Contractor shall not assert any claim arising out of any act or omission by any officer, agent or employee of the Owner in the execution or performance of this Contract against such officer, agent or employee in his or her individual or official capacities.

50.2 The Contractor shall require each Separate Contract Design Professional or Contractor to agree in his Contract not to make any claim against the Owner, its officers, agents or employees, by reason of such Contract with the contractor.

50.3 Nothing in this Contract shall be construed to give any person other than the Owner and the Contractor any legal or equitable right, remedy or claim under this Contract; and it shall be held to be for the sole and exclusive benefit of the Owner and the Contractor.

ARTICLE 51 NOTICES

51.1 Except as otherwise provided herein, any notice, approval, acceptance, request, bill, demand or statement hereunder from either party to the other shall be in writing and shall be deemed to have been given when either delivered personally or deposited in a U.S. mailbox in a postage-prepaid envelope, addressed to the other party via certified mail. Notices to the Owner shall be addressed to the Project Manager by name. Either party may at any time change such address by delivering or mailing, as aforesaid, to the other party a notice stating the change and the changed address.

ARTICLE 52 LEGAL INSERTIONS, ERRORS, INCONSISTENCIES, OR DISCREPANCIES IN CONTRACT

52.1 It is the intent and understanding of the parties to this Contract that each and every provision of law required to be inserted in this Contract shall be and is inserted herein. Furthermore, it is hereby stipulated that every such provision is deemed to be inserted herein, and if through mistakes or otherwise, any such provision is not inserted in correct form, then this Contract shall upon application of either party, be amended by such insertion so as to comply strictly with the law and without prejudice to the right of either party.

52.2 If this Contract contains any errors, inconsistencies, ambiguities, or discrepancies, including typographical errors, the Contractor shall request a clarification of same by writing to the Project Manager whose decision shall be binding upon the parties.

ARTICLE 53 CAPTIONS OR HEAD NOTES

53.1 The captions or head notes on articles or sections of this Agreement, and marginal notes are intended for convenience and reference purposes only and in no way define, limit or describe the scope or intent hereof, or of this Agreement not in any way affect this Agreement.

ARTICLE 54 EFFECTIVE AND BINDING

54.1 This Contract shall not become effective or binding upon the Owner unless it has been authorized and executed in accordance with the ordinances of the City of Greeley.

ARTICLE 55 CONTRACTOR

55.1 All personnel assigned to the Project by the Contractor shall be required to cooperate fully with personnel of the Owner and if in the sole discretion of the Owner the Contractor's personnel fails so to cooperate, the Contractor shall relieve them of their duties on the Project when required by the Owner.

55.2 Within seven (7) consecutive calendar days after date of written notice to commence work, the Contractor shall designate in writing one person who, on his behalf, shall be responsible for coordinating all of the services to be rendered by the Contractor hereunder. Such designee shall be subject to the approval of the Owner. Any change to the approved designee shall be proposed in writing seven (7) days in advance and subject to Owner approval.

55.3 The Contractor shall engage, at his sole expense, all engineers, architects, cost estimators, lawyers, experts and Contractors as may be required for the proper performance of the Contract. The Contractor shall be responsible for the performance of the work of all architects, engineers, cost estimators, lawyers, experts and Contractors so engaged by him, including maintenance of schedules, correlation of their work and resolution of all difference between them. It is understood that all architects, engineers, cost estimators, lawyers, experts and Contractors are employees of the Contractor and not of the Owner, and the Contractor alone is responsible for their work.

55.4 All drawings, tracings, specifications, digital media/electronic files and other material prepared and furnished under and for this Contract shall become the property of the Owner upon substantial completion and/or their acceptance by the Owner and/or upon termination of the services of the Contractor. Such documents shall be promptly delivered to the Owner upon demand and thereafter may be used by the Owner in whole or in part or in modified form, for those purposes it may deem advisable without further employment of, or payment of additional compensation to, the Contractor.

55.5 The Contractor shall not, without the prior written approval of the Owner, specify for the project, or necessarily imply the required use of any article, product, material, fixture or form of construction, the use of which is covered by a patent, or which is otherwise exclusively controlled by a particular firm or group of firms.

55.6 Should any claim be made or any action brought against the Owner relating to the design and satisfactory operation of the Project herein, the Contractor shall diligently render to the Owner without additional compensation any and all assistance which may be requested by the Owner.

55.7 The Owner's Project Manager's decision shall be final and binding upon the Contractor as to all matters arising in connection with or relating to this Contract. The Project Manager shall determine the amount, quality, acceptability and fitness of the work being performed hereunder and shall determine all matters relative to the fulfillment of this Contract on the part of the Contractor and such determination shall be final and binding on the Contractor. Acceptance by the Owner of any document hereunder and all supporting documents shall not relieve the Contractor of sole responsibility for work performed under this contract, including, but not limited to, the final design of the Project, including the plans, specifications and all supporting documents, except as to any feature thereof which the Owner had specifically directed in writing to be included over the written objection of the Contractor. In case any question shall arise, the decision of the Owner's Project Manager, who is hereby accepted by the Contractor as the arbiter, shall be a condition precedent to the right of the Contractor to receive any money under this Contract.

ARTICLE 56 APPEALS

56.1 Except as otherwise provided in this Contract, any dispute concerning a question of fact arising under this Contract which is not disposed of by Agreement shall be decided by the Project Manager, who shall reduce his decision to writing and mail or otherwise furnish a copy thereof to the Contractor. The decision of the Project Manager shall be final and conclusive unless, within fifteen (15) days from the date of receipt of such copy, the Contractor mails or otherwise furnishes to the Project Manager a written notice of appeal.

56.2 In the event a decision of the Project Manager is the subject of an appeal, such dispute may be settled by appropriate legal proceeding, or, if the parties mutually agree, through arbitration or administrative process. Pending any binding arbitral or administrative decision, appeal, or judgment referred to in this section or the settlement of any dispute arising under this Contract, the Contractor shall proceed diligently with the performance of this Contract.

56.3 Venue and jurisdiction of any suit, right, or cause of action arising under or in connection with this Contract shall lie exclusively in Weld County, Colorado.

ARTICLE 57 PROHIBITED INTEREST

57.1 No member, officer or employee of the City of Greeley shall have any financial or pecuniary interest, direct or indirect, in this Contract or the proceeds thereof.

ARTICLE 58 FINDINGS CONFIDENTIAL

58.1 Any reports, information, data, etc., available to or prepared or assembled by Contractor under this Contract shall not be made available to any individual or organization by Contractor without consent in writing from the Owner subject to applicable law.

ARTICLE 59 GENERAL PROVISIONS

59.1 Services and work performed by Contractor under this Contract shall conform to reasonable and normal professional standards known and accepted within the community.

59.2 No reports, graphics or other material produced directly or indirectly for the Owner under this Contract shall be the subject of an application for copyright or trademark by or on behalf of Contractor.

59.3 The laws of the State of Colorado and applicable Federal, state and local laws, regulations and guidelines shall govern hereunder.

59.4 The headings of the articles, clauses, and paragraphs of this Contract are inserted for reference purposes only and are not restrictive as to content.

59.5 This Contract and any subsequent amendment shall be deemed an original having identical legal effect, and all of which together constitute one and the same instrument.

59.6 Nothing contained herein shall be deemed to give any third party any claim or right of action against the Owner which does not otherwise exist without regard to this Contract.

59.7 Where a number of days is specified in this Contract it shall mean calendar days unless otherwise specified.

59.8 This Contract shall not be assigned, in whole or in part, without the written consent of the Project Manager and Contractor.

59.9 The Owner certifies the following;

A. An amount of money equal to or greater than the Contract amount has been appropriated and budgeted for the Project which this Contract concerns.

B. No Change Order which requires additional compensable work to be performed by the Contractor will be issued by the Owner unless an amount of money has been appropriated and budgeted sufficient to compensate the Contractor for such additional compensable work unless such work is covered under the remedy-granting provisions of this Contract.

C. As used in this paragraph, "remedy granting provision" shall mean any clause of this Contract which permits additional compensation in the event of a specific contingency or event occurs. This term shall include, but not be limited to, change clauses, differing site conditions clauses, variation in quantities clauses, and termination for convenience clauses.

ARTICLE 60 CONTRACTOR ACCEPTANCE

60.1 The acceptance by the Contractor, his successors or assigns of any payment made on the final acceptance of the Project under this Contract or of any final payment due on termination of this Contract, shall constitute a full and complete release of the Owner from any and all claims, demands and causes of action whatsoever which the Contractor, his successors or assigns have or may have against the Owner under the provisions of this Contract.

60.2 No action shall be maintained by the Contractor, its successors or assigns, against the Owner on any claims based upon or arising out of this Contract or out of anything done in connection with this Contract unless such action shall be commenced within 180 days after the date of filing of the voucher for final payment hereunder in the office of the Finance Director, or within 180 days of the termination of this Contract.

ARTICLE 61 SUCCESSORS AND ASSIGNS

61.1 The Contractor binds itself, its partners, successors, assigns and legal representatives to the other party to this Contract and to the partners, successors, assigns and legal representatives of such other party with respect of all covenants of this Agreement. The Contractor shall not transfer, assign, or subcontract any interest in this Agreement.

ARTICLE 62 SEVERABILITY CLAUSE

62.1 If any provision of this Agreement is subsequently declared by legislative or judicial authority to be unlawful, unenforceable, or not in accordance with applicable laws, statutes, and regulations of the United States of America and the State of Colorado, all other provisions of this Agreement shall remain in full force and effect.

ARTICLE 63

63.1 This Agreement represents the entire and integrated Agreement between the Owner and the Contractor and supersedes all prior negotiations, representations or agreements, either written or oral. This Agreement may be amended only by written instrument signed by both Owner and Contractor.

ARTICLE 64

64.1 In accordance with C.R.S. §8-17-101, all parties contracting with the City of Greeley on public works projects shall employ Colorado labor to perform the work to the extent of not less than eighty percent (80%) of each type or class of labor in the several classifications of skilled and common labor employed on this project.

ARTICLE 65

65.1 The Contract Documents may be executed in two or more counterparts, each of which shall be deemed an original but all of which together shall constitute one and the same document. The Contract Documents, including all component parts set forth above, may be executed and delivered by electronic signature by any of the parties and all parties consent to the use of electronic signatures.



SECTION 520
SUBCONTRACTORS/MATERIALS SUPPLIERS AND RELATED DATA

Firm Name: _____ City Contractors License # _____

Primary Contractor _____

PROJECT: _____ Address: _____

For each Subcontractor and/or Materials Suppliers to be utilized, please provide the following information
(use additional sheets as necessary):

Phone Number: _____ Fax Number: _____

Proposed work and percentage of total work to be assigned _____
Percentage: _____ %

Firm Name: _____ City Contractors License # _____

Address: _____

Phone Number: _____ Fax Number: _____

Proposed work and percentage of total work to be assigned _____
Percentage: _____ %

Firm Name: _____ City Contractors License # _____

Address: _____

Phone Number: _____ Fax Number: _____

Proposed work and percentage of total work to be assigned _____
Percentage: _____ %

Firm Name: _____ City Contractors License # _____

Address: _____

Phone Number: _____ Fax Number: _____

Proposed work and percentage of total work to be assigned _____
Percentage: _____ %

Firm Name: _____ City Contractors License # _____

Address: _____

Phone Number: _____ Fax Number: _____

Proposed work and percentage of total work to be assigned _____
Percentage: _____ %

If the Primary Contractor adds any Subcontractors or Materials Suppliers during the duration of the project, the Primary Contractor will supply the City with an updated form before the Subcontractor or Materials Supplier will be allowed to work on the project.

SPECIAL PROVISIONS FOR CITY OF GREELEY

20TH STREET IMPROVEMENTS PHASE 4 83RD AVENUE to 90TH AVENUE

May 20, 2019

PROJECT DESCRIPTION

This project involves roadway reconstruction, construction of a roundabout, curb & gutter, sidewalk, storm drain facilities, signing, pavement markings, pedestrian ramps. Work will include:

- Erosion and sediment control
- Clearing and grubbing
- Earthwork excavation and embankment with excavated “native” and some import topsoil
- Wetland stabilization to allow roadway embankment and box culvert installation.
- Removal of the existing plant-mix pavement mat
- Removal of existing concrete curb & gutter, sidewalk, and trees within project limits
- Miscellaneous adjustments of valve and manhole covers
- Concrete curb and gutter, curb ramps, and sidewalks
- Concrete roundabout at 20th St and 83rd Ave
- Concrete crosspans
- Storm drain piping, box culvert with wingwalls, manholes, and inlets
- Pavement surface repair including aggregate base course compaction and hot bituminous pavement
- Permanent pavement markings and signs
- Street Trees within sidewalk limits
- Seed (2 types) disturbed areas and between the sidewalk and back of curb, and behind sidewalk
- Irrigation control and supply to landscaping features
- Landscaping
- Construction surveying
- Waterline work

CONSTRUCTION PLANS

The construction plans for this project are dated May 2019 as prepared by J-U-B ENGINEERS, Inc., 4745 Boardwalk Drive, Building D, Suite 200, Fort Collins, Colorado 80525 and include construction plan sheets #1-176 The Landscaping Plans as prepared by BHA Design, Inc., LS-1201 – LS-1211, and the Irrigation Plans as prepared by Hines, IR-1301 - 1311, and lighting plans as prepared by Clanton, L-1401 - 1413, are made a part of these contract documents.

GOVERNING SPECIFICATIONS

This project shall be constructed in accordance with these Special Provisions to the latest edition of the following standard specifications:

- City of Greeley General Conditions to the Construction Contract (“General Conditions”)
- City of Greeley Design Criteria and Construction Specifications – Volume I (Streets), Volume II (Storm Drainage), and Volume III (Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems). A copy of the specification’s manual can be obtained from the City of Greeley, Public Works Department located at 1001 9th Avenue.
- MGPEC Pavement Design Standards and Construction Specifications (MGPEC)
- Manual of Uniform Traffic Control Devices (MUTCD)

- The Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction, the CDOT M & S Standards, CDOT Bridge Plans, CDOT Construction Manual and CDOT Materials Manuals, latest editions.

In case of conflict, documents shall have the following priorities: (1) Special Provisions, (2) General Conditions, (3) Plans, (4) City of Greeley Design and Construction Specifications Volumes I-III, (5) CDOT Standard Special Provisions, (6) CDOT Standard Specifications.

The project is subject to the following additional specifications:

- Section 312514.13 Hydraulically Applied Erosion Control: High Performance Flexible Growth Medium
- Section 034100 Structural Precast Concrete

LICENSE, FEES, AND PERMITS

Conform to GC Section 00510 Article 16. Conform to "Streets Volume I" Section 01010. A pre-construction conference shall be held prior to the issuance of any permits for construction.

A storm water discharge permit from State of Colorado, Department of Public Health & Environment, Water Quality Control Division for temporary storm water runoff from the approximate 14.7 acre construction site, will be obtained by the City. City permit fees will be waived. Any required permits fee from other agencies than the City of Greeley will be at cost from the contractor.

Contractor to provide a copy of necessary permits to the City prior to construction.

A Department of the Army Nationwide Permit (NWP) 14, Corps of Engineers has been obtained for this project. The contractor can receive a copy from the City's project manager.

CERTIFICATE OF INSURANCE:

The Contractor shall provide from the insurance companies, acceptable to the Owner, the insurance coverage designated hereinafter and pay all costs. The Contractor also indemnifies the Owner according to Article 47 of the General Conditions. Insurance agency certificates will not substitute. The Contractor shall name the "City of Greeley" and "J-U-B Engineer Inc." on their General Liability, Automobile Liability and Property Damage Liability policies.

SALES TAX:

The price or prices for the work will include full compensation for taxes that the Contractor is or may be required to pay under Article 26 of the General Conditions.

PRE-CONSTRUCTION MEETING

After Contract Notice of Award, the Contractor shall attend a pre-construction conference with the City prior to commencement of construction. Refer to General Conditions for Pre-construction conference requirements of the Contractor. The Contractor shall submit the following information at the preconstruction meeting:

- Storm water Management Plan
- Traffic Control Plan
- Asphalt Mix Design
- Materials Source submittals
- Materials Suppliers list
- List of Subcontractors
- Insurance Certificates

- Bar graph construction progress schedule in accordance with General Conditions Article 21
- Preliminary means and methods for wetland stabilization

SCALE TICKETS

The Contractor shall provide certified scale tickets for each truck load of material to be paid by unit weight that is delivered to and incorporated in the project. The Contractor shall submit tickets to the designated City project representative at the time material is delivered to the site.

SUBMITTALS - CONSTRUCTION MATERIALS

Contractor shall submit manufacturers' information and materials specifications, testing results, and certifications that the materials proposed for this project meet the specification requirements outlined in the Standard Specifications and these Supplemental Specifications. Refer to individual sections within the Standard Specifications and Supplemental Specifications for specific material submittal requirements.

The Contractor shall submit manufacturers' information and certification that all materials conform to materials specifications for the following items. Receive approval in writing before work commences and before confirmation of order. Deliver two (2) copies of all submittals to the Project Manager within 10 working days from the date of Notice to Proceed. Provide information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed for different components and labeled with the specification section numbered and the name of the component. Submittals must be made for all components on the material list. Indicate which items are being supplied on the catalog cut sheets when multiple items are shown on one sheet. Submittal package must be complete prior to being reviewed by the Project Manager. Incomplete submittals will be returned without review:

- Aggregate Base Course
- Precast Concrete Box Units
- Rebar
- Hot Mix Asphalt Pavement mix design
- Concrete mix designs
- Utility and Electrical components/materials
- Storm Drain

CONTRACTOR USE OF SITE

The Contractor shall, at all times, conduct his work as to insure the least possible inconvenience to the general public and adjacent property owners to the project site, and to ensure safety of persons and property. Fire hydrants on or adjacent to the Work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor to insure the use of access roads / driveways to adjacent properties.

MEASUREMENT AND PAYMENT:

This contract is a unit price contract in which the Contractor will be reimbursed for the actual quantities of work performed and installed in accordance with the contract documents unless otherwise noted. No additional payment for work described in these documents will be allowed, whether a bid item exists or not. The Contractor shall include the costs of all incidentals of construction, labor, equipment, and materials in the appropriate bid item.

CONTRACT TIME, LIQUIDATED DAMAGES, DELAYS

*The Contract Time for completing the contract work is **180-calendar days**.* Phase-1, which includes the roundabout, 83rd Avenue, the east 20th Street roundabout leg and the west roundabout leg to approximate 20th Street stationing 213+00 shall be completed in 90-calendar days. Phase-2, which includes 20th Street west of Phase-1 shall be completed in 90-calendar days. Landscaping and irrigation shall be part of Phase-2. The Contract time commences on the date of the Notice to Proceed. Where a number of days is specified in this Contract it shall mean "Calendar Days" unless otherwise specified according to Article 59 of the General Provisions. There shall not be any "free time".

The project shall be considered substantially complete when, as determined by the Engineer, the Contractor has completed his work. The liquidated damages amount will be in the amount of \$1,000.00 for each calendar day. Liquidated damages are based on additional costs to the City of Greeley for delay of project completion and are not a "late penalty".

Listed below are the anticipated numbers of calendar days lost to normal adverse weather for each month.

Monthly Anticipated Calendar Days Lost to Adverse Weather Conditions												
Month	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Normal Days Lost	7	4	4	4	6	3	4	2	3	3	2	5

PROTECTION OF EXISTING UTILITIES / UTILITY COORDINATION

This set of plans **do not** meet the full requirements of the Colorado Utility Law SB18-167. Since the project was substantially designed prior to the law taking effect, the owner did not perform an individual subsurface utility investigation on this project. The designer has performed a significant amount of utility investigation for this project but cannot guarantee that utilities were located to a quality level "B".

The Contractor shall contact all appropriate utility companies prior to construction to notify of construction, to verify location of utilities in the construction area, and to coordinate utility company relocation, adjustment, or installation work with Contractor's work. Locations of utilities shown on plans are approximate, only based on "field locates" by the affected utility and limited pothole information. The Contractor shall verify prior to construction.

The Contractor shall comply with Article 5 of the General Conditions ("Protection of Existing Vegetation, Structures, Utilities, and Improvements and Land Survey Monuments") when excavation or grading is planned in the area of underground utility facilities. Protection of existing utilities and coordination with utility companies for relocations / manhole lid adjustments shall be in accordance with Streets Volume 1, Section 01010. No additional payment will be made for this coordination.

The Contractor shall notify all affected utilities at least two (2) business days prior to commencing such operations. Contact the Utility Notification Center of Colorado (UNCC) to have locations of UNCC registered lines marked by member companies. Call originating within the Denver metro area use phone no. (303) 534-6700; calls originating outside the Denver metro area use 811. All other underground facilities shall be located by contacting the respective company. Utility service laterals shall also be located prior to beginning excavating or grading.

All cost incidentals to the foregoing requirements will not be paid for separately but shall be included in the work.

The City will not be responsible for any construction down time due to failure on the Contractor's part to notify utility companies of conflicts.

Known utilities within the limits of this project are:

Atmos Energy, Jerry Adams, (970) 304-2075 (gas distribution)
Comcast, Kevin Young, (720) 281-8666 (cable TV)
DCP Midstream, Roger Giesick, (970) 539-3156 (gas distribution)
Poudre Valley Rural Electric Association (PVREA), Ryan Powell, (970) 282-6432 (electric distribution)
CenturyLink, Carson Ortega (970) 392-4837 (communication)
Xcel Energy, Jason Volesky (970) 395-1236 or William Braasch (303) 618-5049 (electric distribution)
Xcel Energy, Gary Shimamoto (970) 566-2546 (gas distribution)
Suncor Energy, Chris La Pole (303) 720-4180 or Dillon Ohrt (303) 549-8002 (crude oil pipeline)
Tallgrass, Kristin O'Neil (970) 397-8001 (gas distribution)
City of Greeley Engineering, Eva Rojas, (970) 350-9747
City of Greeley Water & Sewer, Adam Prior (970) 350-9875 (water/sewer)
City of Greeley, Traffic, Scott Logan (970) 350-9793 (traffic)
City of Greeley Stormwater, Karen Reynolds (970) 336-4031 (Stormwater)

Contractor is responsible for field verifying the location of utilities within the project limits and immediately notifying the City of Greeley of any potential discrepancies or conflicts between the Work and the existing utility.

City of Greeley Water & Sewer: Three (3) waterlines exist East of the 20th St and 83rd Ave intersection within the roadway running parallel to the 20th Street centerline and four (4) waterlines West of the 20th St and 83rd Ave intersection. Starting with the northern most waterline and going south they are a 4 inch diameter, a 24 inch diameter, a 30 inch diameter, and 8 inch diameter pipes. Any City of Greeley water markers will be relocated by the City of Greeley water department. Contractor shall coordinate with the City of Greeley water department.

Work on City of Greeley waterlines include the following:

- At the intersection of 83rd Avenue and 20th Street the contractor shall cap the 4" waterline east, west and north of the 4" tee. The existing 8" waterline west of the intersection shall then be tied to the exiting 6" waterline east of the intersection. There is one residential water service that will need to be relocated. Please refer to the waterline design on drawing UT-209.
- The contractor will need to relocate a water-blow off valve and vent pipe at approximate station 196+75

PVREA shall be responsible for removing the pole, arm, and luminaire for the street light assemblies identified as "Remove light (by others)" on the demolition sheets at approximate Station 216. Contractor shall be responsible for removing the light standard foundation. PVREA will be removing their power poles on the northeast corner of the 20th St and 83rd Ave intersection.

PVRE and Xcel will install streetlights on this project once the roadway construction is far enough along. The contractor shall coordinate with the City and utility companies during this task.

Contractor shall coordinate with CenturyLink for the relocation of the existing fiber optic/communication line (by CenturyLink) around STA 208+50 at the Sheep Draw Tributary to raise the line over the proposed structure. CenturyLink and comcast also have several pedestals that they will need to relocate. These are shown on Drawings UT-200 - UT-208. The storage units also requested that CenturyLink install a fiber optic connection to their facility.

The contractor shall coordinate with all gas companies regarding adjustment of valves and facilities within the project limits. The project has identified 5 gas companies that have facilities within the project limits. Please refer to the utility drawing for additional information.

The contractor is hereby notified that there are several locations within the project limits where existing gas lines are present under 20th Street. It is the responsibility of the contractor to locate these gas lines prior to roadway excavation or subgrade scarification.

The contractor should assume that they will need to perform potholing to visually identify underground utility locations. Potholing is a pay item on this project. The cost of potholing for utility locations shall be incidental to other pay items. The contractor must get approval through the City for all potholing

Abandoned underground utility lines exist within the project limits. Contractor is responsible to coordinate this work and to verify locations of "Active" lines prior to beginning excavating or grading.

There are several existing utility easements within the project limits. These easements are identified within the construction plan set.

RIGHT OF WAY AND EASEMENTS

The City has acquired the permanent right of way and temporary easements for construction of the 20th Street project from 83rd Ave to 90th Ave. Construction of transition areas to match proposed roadway improvements on adjacent properties will be permitted within the limits of construction shown on the contract construction plans.

PROPERTY OWNER NOTIFICATION

The City will provide Contractor with sufficient copies of written notices describing project activity and Contractor's proposed schedule of work. The Contractor shall deliver notices to all property owners and/or business operators located within 500 feet of project limits and to all other homes or businesses abutting or immediately adjacent to the project.

Contractor shall coordinate with property owners prior to initiating removal / construction activities on areas outside of public right of way and shall provide a minimum of 5 days' notice to property owners prior to these activities.

Notice shall also be given 24 hours prior to start of any construction activity that will restrict access to the affected property or when construction will be within 500 feet of that business or residence. Re-notify all property owners if the previously noticed schedule is delayed by 3 or more days.

The contractor shall insure the access to the storage building on the southwest corner of 20th Street and 83rd Avenue is remained opened continuously. Temporary access and driveway must be at least 24' wide and the vertical profile must be able to safely accommodate moving box trucks (SU-40) and trailers without bottoming out.

PROTECTION OF THE PUBLIC

The Contractor shall be responsible for providing fencing, barricades and any necessary safety equipment to keep the site and the public safe at all times.

SOILS INVESTIGATION / REPORT

There are numerous geotechnical engineering report and amendments that were prepared for this project. These reports are as follows:

A geotechnical report has been prepared by Terracon, dated: March 7, 2016, Project Number 21155061, Supplemental Pavement Thickness Design Recommendations dated: August 18, 2017 and February 12, 2019, and Geotechnical Recommendations for Drilled Pier Foundations dated: March 15, 2018. Additional geotechnical engineering reports have been prepared by Terracon titled: 20th St Phase 5, Greeley, Colorado, dated: October 1, 2018, Project Number 21185033 and 20th Street Roundabout, Greeley, Colorado, dated: December 20, 2018 and May 2, 2018, Project Number 21185033. Refer to geotechnical report for any requirements exceeding City standards.

Copies of these reports are available for viewing at the City of Greeley. The contractor may obtain digital copies of these reports from the City. It is the contractor's responsibility to review and become familiar with these reports prior to bidding.

EXCAVATION / EMBANKMENT

Conform to "Streets Volume I" Section 02220 and these special provisions.

Material from the project deemed unusable by the Engineer shall be removed from the project and legally dispose of at no additional cost to City.

Refer to the Bid Form for unit quantities for the respective excavation / embankment items designated within the construction documents.

REMOVALS / RESETS /RELOCATIONS

Saw cutting of existing pavements / concrete shown on the construction plans shall be considered an incidental expense to excavation and no separate payment will be made for this item.

Relocation of existing permanent traffic control signs shall be paid for on a per each basis and shall include all costs for labor, equipment, materials, sign hardware, removal / disposal of existing sign posts and foundations, installation, and all other items of expense required to relocate the existing signs in accordance with City of Greeley standard specifications and MUTCD requirements.

Removal of Bituminous Pavement shall include all labor, materials, excavation, haul, saw cutting, disposal, grading, and other items of expense necessary to the limits shown on the demolition plans and in accordance with "Streets Volume I" specifications. Payment for this item shall be made in accordance with the Bid Form and shall be per square yard of Bituminous Pavement removed.

Refer to the Bid Form for unit quantities for the respective removal / resets / relocations' items designated within the construction documents.

EROSION AND SEDIMENT CONTROL:

Contractor is responsible for control and routing of storm water runoff draining onto and from the construction area to prevent erosion or other damage. Comply with City of Greeley Environmental Municipal Construction Best Management Practices (BMP). City will obtain Colorado Discharge Permit. The Contractor is responsible for all implementation, removals, maintenance, etc. to keep the project in strict compliance with this permit. The City is responsible for inspections and documentation (SWPPP Notebook). Brian Hathaway and Martha Cruse with the City of Greeley will be the City's Erosion Control Supervisors for this project. The Contractor will be required to appoint their own Erosion Control Supervisor and needs to display due diligence towards the maintenance of the sediment and erosion control bid items.

An initial Erosion Control Report/Stormwater Management Plan is included in the bid documents. The Contractor shall submit an updated Stormwater Management Plan (SWMP) with schedule identifying

erosion control methods and timing as well as any construction means and methods items at Preconstruction Meeting.

Not all BMP's shown on Plans are intended for initial installation. BMP's shall be requested/approved by City prior to implementation. Additional BMPs may be required and shall be implemented at the request of the City. Additional BMPs, approved by the City, will be paid per the unit bid price.

GRADING, COMPACTION OF SUB-GRADE

Conform to "Streets Volume I" Section 02225.

CONSTRUCTION TRAFFIC CONTROL

The Contractor shall comply with the requirements of Section 01010, Paragraph 1.3 G of DCCSM. The Contractor shall not perform any construction work in the public right-of-way prior to receiving approval of the Traffic Control Plan from the City of Greeley. The TRAFFIC CONTROL PLAN will include the City's Traffic Control Plan Review Form.

The Contractor will appoint a Traffic Control Supervisor (TCS) to this project. The TCS does not need to be on site but must be available twenty-four (24) hours a day. The name and phone of the TCS will be provided to the City at the Pre-Construction Meeting. The Contractor will also provide the name and phone number of an alternate local traffic control company that will act on the Contractor's behalf in case the designated TCS cannot be reached. If Contractor is unresponsive or otherwise is deemed to not be performing traffic control duties in accordance with submitted plan, the City or its subcontractor may perform traffic control services, at cost to the Contractor.

The Contractor will be notified in writing when the traffic control for any site work is not acceptable. The Contractor will not be allowed to continue work at the location until the problems are corrected. Failure to correct the traffic control deficiencies prior to continuance of the work will result in non-payment for the work performed at the locations in question.

All costs incidental to construction traffic control including inspection and supervision shall be included in the cost of the traffic control bid items (#96-101).

This project will be constructed in two phases. During phase 1 the intersection of 20th Street and 83rd Avenue will be closed to traffic. During phase 2, 20th Street will be closed from east of 92nd Avenue to approximate station 213 +00. Refer to the Traffic Control plans for additional, details. For paving and striping operations, contractor shall coordinate with City of Greeley to determine the appropriate method of handling traffic.

PERMANENT TRAFFIC CONTROL DEVICES

Permanent traffic control signs shall comply with MUTCD. The Contractor shall coordinate with the City of Greeley to provide City of Greeley bike way signs to be installed on new posts and foundations for this project.

EQUIPMENT STAGING/PARKING

The Contractor is responsible for obtaining permission from adjoining property owners for any equipment staging areas. The space north of 20th Street west of 86th Ave (owned by Xcel) may be available for staging and stockpiling of excess material.

DUST CONTROL

The Contractor shall control dust in and around the construction site. If dusty conditions prevail, the site shall be watered at least twice daily. No separate payment will be made for dust control by watering. Merge costs of dust control by watering into bid price of related items.

TESTING

The Contractor shall provide Quality Control Sampling and Testing. The types of tests and minimum test frequencies are described in the City "Streets Volume I" Schedule for Quality Control Sampling and Testing Table in the Appendix. Cost shall be included in the bid price for Mobilization.

Quality Acceptance Testing shall be done by the City of Greeley's Construction Services or their representative. The City will pay for all Quality Assurance Testing. It is important that the Contractor inform the project Inspector or assigned representative as to when they will be ready for tests. A 24-hour advanced notice will be required.

HOT MIX ASPHALT PAVEMENT (HMAP)

Conform to City STREETS Section 02575.

Application:	Bottom lift:	2 1/2" thick, Grading S (100) (PG 64-28)
	Top lift:	3 1/2" thick, Grading SG (100) (PG 64-22)
RAP quantity:	20%	
Design:	See MGPEC Form 9	

CONCRETE

Conform to "Streets" Section 02585 for Portland Cement Concrete Pavement at the roundabout.

Conform to "Streets" Section 03310 for other concrete except as modified herein:

2.1 REFERENCES – delete this section and replace with the following:

"Materials and construction methods shall meet the requirements of MGPEC Item 11 except as noted herein."

2.2 CLASSIFICATION – delete the first 7 lines of this section referring to CDOT concrete classes and replace with the following:

"Use Portland Cement Concrete as specified in MGPEC Item 11.2.7 for sidewalks,

FINAL CLEANUP

The Contractor shall, at completion of construction and prior to submitting request for final payment, clean up the site, removing all related debris. The Contractor shall notify the City when final cleanup is ready for inspection. This task includes any cleanup related to the SWPPP.

PROJECT CHANGES

The City reserves the right to alter the project. Quantities may be added or deleted and adjustment will be made to the contract price according to the unit prices in the Bidding Schedule. However, if quantities are increased or decreased more than 25%, changes and adjustments may be negotiated so that a mutually agreeable adjustment can be made.

PROJECT WARRANTY

The Contractor is responsible for providing a TWO-YEAR warranty to the City of Greeley for all work completed under this contract. The beginning of the TWO-YEAR warranty period will be established with the issuance of the Certificate of Substantial Completion. If the concrete fails, spalls, or deteriorates during the first and second year, the concrete shall be replaced under this warranty. There will be no additional cost to the City or the property owner for material, equipment, labor, and/or traffic control for warranty work.

Warranty work will be completed in accordance with these contract specifications and within 30 days of written notification by the City of Greeley.

BID ITEMS – GENERAL DESCRIPTION OF MEASUREMENT AND PAYMENT

Measurement and payment for bid items listed in the Bid Form shall be on the basis of the description in the applicable standards specifications or as identified in these supplemental specifications and Construction Drawings. Unless the work to be done is specifically called out to be measured and paid for in the Bid Form Unit Price Schedule, payment for such work shall be included in other applicable items, and there shall be no separate measurement and payment for the work.

It is the intention of the contract documents to describe a complete project. Merge the cost of any and all miscellaneous work items (if not separately identified as bid items) shown on the Plans or implied as standard items of work necessary to achieve a complete and operational system in the unit price contained in the Bid for the nearest related bid item.

Merge all costs of labor, materials, supervision, fuel, equipment, and other incidentals necessary to accomplish each work item into the unit price contained in the Bid for that item. Payment will be made at bid unit price for completed items unless otherwise noted. The basis for payment will be the *measured* in-place quantity, or quantity documented by delivery tickets, unless the item unit is Lump Sum (LS), or *plan quantity* is specified below.

Certain bid items may be clarified as follows:

Unit Quantities: Quantities and measurements (with the exception of 'Unclassified Excavation') indicated in Bid Form are for contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment. Actual quantities provided shall determine payment. The estimates of quantities are only approximate (the payment method for 'Unclassified Excavation (C.I.P.)' shall be as described under Bid Item 3 of the next section in these specifications). The City reserves the right to increase or decrease individual items in such amounts as may be in their sole judgment to the City's best interests depending upon conditions encountered or observed during the Project. It shall be the Contractor's responsibility to satisfy himself as to the accuracy of the estimates prior to bid.

Payment shall be made at the contract unit bid price listed in the Bid Form. The price listed therein shall be for unit quantities includes full compensation for required labor, tools, equipment, products, materials, haul, disposal, plant and facilities, transportation, services, erection, application or installation of item of the work; overhead and profit required to construct the respective bid items according to the Contract Documents incidental thereto.

ITEMS WITH ADDITIONAL EXPLANATION ARE AS FOLLOWS:

ROADWAY

Bid Item 1 – CLEARING AND GRUBBING

Clearing and Grubbing shall include tree removal for trees less than 6" in diameter with the trunk being measured 18" above the adjacent ground surface.

Bid Item 2 – UNSUITABLE MATERIALS EXCAVATION

Conform to "Streets Volume I" Section 02220.

Remove and replace areas of unsuitable sub-grade in accordance with Section 02220. Payment for removal / replacement of unstable sub-grade areas shall be made on a per cubic yard basis as measured in the field by the City's construction representative and as outlined in the Bid Form. Payment shall include all labor, equipment, materials, backfill, haul, disposal, compaction, and all other items of expense required to remove and replace unsuitable sub-grade locations. This bid item shall not be used for removing material within the 'Aggregate Pier Soil Improvement' area shown on the plans. Saturated material due to a lack of dewatering does not, in itself, constitute unsuitable material.

Bid Item 3 – UNCLASSIFIED EXCAVATION (C.I.P.)

Conform to "Streets Volume I" Section 02220.

Unit bid price for this item shall include the costs of all labor, supervision, material, and equipment to excavate and place embankment to finish subgrade line and grade as shown on the plans and cross sections and as staked. Plan quantity does not include any allowance for earthen material removed during clearing and grubbing or existing asphalt pavement to be removed; these items are paid for separately. Plan quantity is calculated to the estimated bottom plane of the proposed aggregate base course and proposed topsoil; therefore this item does not include the quantity of the proposed pavement section or the proposed topsoil to be installed. Plan quantity does not include any allowance for shrinkage or swelling.

Payment for the item shall be at the UNCLASSIFIED EXCAVATION (C.I.P.) plan quantity. Engineer will make no separate measurement of cubic yards of embankment.

Cross sections and earthwork volume calculations indicate that there will be a need for additional embankment material on this project (please refer to Drawing G-010). Excess material shall be hauled off site and legally disposed of as part of this item.

Bid Item 4 – STRUCTURE EXCAVATION

Work shall include means, method, labor and materials to excavate the existing materials for the proposed box culvert and wingwalls structure. Contractor shall follow Section 206 of the CDOT Construction Standards (2017) with applicable Standard Special Provisions. Structural excavation performed for the retaining walls will not be measured or paid but shall be part of the retaining wall cost.

Bid Item 5 – STRUCTURE BACKFILL (CLASS 1)

Work shall include means, method, labor and materials to backfill the proposed bridge and box culvert structure. Contractor shall follow Section 206 of the CDOT Construction Standards (2017) with applicable Standard Special Provisions.

Bid Item 6 & 7 – Aggregate Pier Soil Improvement Area A & B

PART 1: GENERAL REQUIREMENTS

1.01 Description

Work shall consist of designing, furnishing and installing Aggregate Pier Soil Improvement System to the lines and grades designated on the project plans and as specified herein. The aggregate piers shall be constructed by either augering a cavity or driving a hollow mandrel to the design depth and vertically compacting lifts of aggregate using the specially designed tamper head and high-energy impact densification equipment to create the compacted aggregate pier. The Aggregate Pier elements shall be in a columnar-type configuration and shall be used to produce an intermediate soil improvement system for support of Box Culvert foundation loads and effected roadway.

1.02 Work Included

- A. Provision of all equipment, material, labor, and supervision to design and install Aggregate Pier Soil Improvement System elements. Design shall rely on subsurface information presented in the project geotechnical report. Layout of Aggregate Pier elements, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is included.
- B. The Aggregate Pier design and installation shall adhere to all methods and standards described in this Specification. The limits of the Aggregate Pier elements are defined in the Contract drawings.
- C. Drawings and General Provisions of the Contract, including General and Supplemental Conditions apply to the work in this specification.

1.03 Approved Installers

- A. Installers of Aggregate Pier Soil Improvement Systems shall have a minimum of 5 years of experience with the installation of Aggregate Pier systems and shall have completed at least 10 projects.

1.04 Reference Standards

- A. Design
 - 1. “Control of Settlement and Uplift of Structures Using Short Aggregate Piers,” by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from *IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.*
 - 2. “Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers,” by Evert C. Lawton and Nathaniel S. Fox. *Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments*, ASCE, 2, 962-974.
 - 3. AASHTO LRFD Bridge Design Specifications 8th Edition, 2017 with Supplements

- B. Modulus Testing
 - 1. ASTM D 1143 - Pile Load Test Procedures
 - 2. ASTM D 1194 - Spread Footing Load Test
- C. Materials and Inspection
 - 1. ASTM D 1241 - Aggregate Quality
 - 2. ASTM D 422 - Gradation of Soils
- D. Where specifications and reference documents conflict, the Aggregate Pier Designer shall make the final determination of the applicable document.

1.05 Certifications and Submittals

- A. Design Calculations - The Installer shall submit detailed design calculations and construction drawings prepared by the Aggregate Pier Designer (the Designer) for review and approval by the Owner or Owner's Engineer. All plans shall be sealed by a Professional Engineer in the State of Colorado.
- B. Modulus Test Reports – A modulus test(s) is performed on a non-production Aggregate Pier element as required by the Aggregate Pier Designer to verify the design assumptions. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer in the State of Colorado.
- C. Daily Aggregate Pier Progress Reports – The Installer shall furnish a complete and accurate record of Aggregate Pier installation to the General Contractor. The record shall indicate the pier location, length, volume of aggregate used or number of lifts, densification forces during installation, and final elevations or depths of the base and top of piers. The record shall also indicate the type and size of the installation equipment used, and the type of aggregate used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Owner.

PART 2: MATERIALS

2.01 Aggregate

- A. Aggregate used by the Aggregate Pier Installer for pier construction shall be pre-approved by the Designer and shall demonstrate suitable performance during modulus testing. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, recycled concrete or other graded aggregate approved by the Designer.
- B. Potable water or other suitable source shall be used to increase aggregate moisture content where required. The General Contractor shall provide such water to the Installer.

PART 3: DESIGN REQUIREMENTS

3.01 Aggregate Pier Soil Improvement System Design

- A. The design of the Aggregate Pier Soil Improvement System shall be based on the service load bearing pressure and the allowable total and differential settlement criteria indicated by the design team for support by the Aggregate Pier system. The Aggregate Pier system shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design life of the structure and roadway shall be 50 years.

- B. The design shall meet the following criteria.

Area A:

Estimated Total Long-Term Settlement for Footings: $\leq 2\text{-inch}$

Area B – (Under Culvert and wingwalls):

Factored Bearing Resistance for
The Box Culvert supported by Aggregate Pier
Reinforced Soils with a resistance factor = 0.5: 2300 psf

Ultimate resistance factor for Strength Load case: 0.5

Ultimate bearing resistance for Strength Load case: 4600 psf

Estimated Total Long-Term Settlement: $\leq 1\text{-inch}$

Demand Pressure for Long Term settlement: 1730 psf

Estimated Long-Term Differential Settlement over
100 ft. length of culvert: $\leq \frac{1}{2}\text{-inch}$

- C. The Aggregate Pier elements shall be designed using an Aggregate Pier stiffness modulus to be verified by the results of the modulus test described in Section 5.02 of these specifications.
- D. Location of existing utilities and the potential effects on them shall be considered during design. It is the responsibility of the designer to coordinate with the utility owners for locations, discuss any issues this system may cause, develop contingent plans during the installation process. Relocation of utilities shall be avoided.

3.02 Design Submittal

The Installer shall submit detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval at least 3 weeks (three weeks) prior to the beginning of construction. A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test program for the Aggregate Pier system, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State of Colorado. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

PART 4: EXECUTION

4.01 Approved Installation Procedures

The following sections provide general criteria for the construction of the Aggregate Pier elements. Unless otherwise approved by the Designer, the installation method used for Aggregate Pier construction shall be that as used in the construction of the successful modulus test.

- A. Augered Aggregate Pier systems –

1. Augered Aggregate Pier system shall be pre-augered using mechanical drilling or excavation equipment.
2. If cave-ins exceeding 10% of the lift volume occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing shall be used to stabilize the cavity, or a displacement Aggregate Pier system may be used.
3. Aggregate shall be placed in the augered cavity in lift thicknesses as determined by the Aggregate Pier Designer.
4. A specially-designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The apparatus shall apply direct **downward** impact energy to each lift of aggregate. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.

B. Displacement Aggregate Pier systems –

1. Displacement Aggregate Pier systems shall be constructed by advancing a specially designed mandrel with a minimum 15 ton static force augmented by dynamic vertical ramming energy to the full design depth. The hollow-shaft mandrel, filled with aggregate, is incrementally raised, permitting the aggregate to be released into the cavity, and then lowered by vertically advancing and/or compacting to densify the aggregate and force it laterally into the adjacent soil. The cycle of raising and lowering the mandrel is repeated to the top of pier elevation. The cycle distance shall be determined by the Aggregate Pier designer.
2. Special high-energy impact densification apparatus shall be employed to vertically densify the Aggregate Pier elements during installation of each constructed lift of aggregate.
3. Densification shall be performed using a mandrel/tamper. The mandrel/tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.
4. Downward crowd pressure shall be applied to the mandrel during installation.

4.02 Plan Location and Elevation of Aggregate Pier Elements

The as-built center of each pier shall be within 6 inches of the locations indicated on the plans. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

4.03 Rejected Aggregate Pier Elements

Aggregate Pier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

PART 5: QUALITY CONTROL

5.01 Control Technician

The Installer shall have a full-time, on-site Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Aggregate Pier Designer, the General Contractor, and to the Testing Agency.

5.02 Aggregate Pier Modulus Test

As required by the Aggregate Pier designer, an Aggregate Pier Modulus Test(s) will be performed at locations agreed upon by the Aggregate Pier Designer and the Testing Agency to verify or modify Aggregate Pier designs. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143 and ASTM D 1194, as outlined in the Aggregate Pier design submittal.

5.03 Bottom Stabilization Testing (BSTs) / Crowd Stabilization Testing (CSTs)

Bottom stabilization testing (BSTs) or Crowd stabilization testing (CSTs) shall be performed by the Control Technician during the installation of the modulus test pier. Additional testing as required by the Aggregate Pier Designer shall be performed on selected production Aggregate Pier elements to compare results with the modulus test pier.

PART 6: QUALITY ASSURANCE

6.01 Independent Engineering Testing Agency (Owner's Quality Assurance)

The Aggregate Pier Installer shall provide full-time Quality Control monitoring of Aggregate Pier construction activities. The Owner is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

6.02 Responsibilities of Independent Engineering Testing Agency

- A. The Testing Agency shall monitor the modulus test pier installation and testing. The Installer shall provide and install all dial indicators and other measuring devices.
- B. The Testing Agency shall monitor the installation of Aggregate Pier elements to verify that the production installation practices are similar to those used during the installation of the modulus test elements.
- C. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.
- D. The Testing Agency shall observe the excavation, compaction and placement of the foundations as described in Part 7. Dynamic Cone Penetration testing may be performed to evaluate the footing bottom condition as determined by the Testing Agency.

PART 7: RESPONSIBILITIES OF THE GENERAL CONTRACTOR

7.01 Site Preparation and Protection

- A. The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Aggregate Pier elements. Underground utilities are existing, and any contingent plans developed by the designer shall be followed.
- B. Site grades for Aggregate Pier installation shall be within 1 foot of the subgrade elevation or finished grade elevation to minimize Aggregate Pier installation depths. Ground elevations and subgrade elevations shall be provided to the Aggregate Pier Installer in sufficient detail to estimate installation depth elevations to within 3 inches.
- C. The General Contractor will provide site access to the Installer, after earthwork in the area has been completed and adequately dewatered. A working surface shall be established and maintained

by the General Contractor to provide a solid platform, wet weather protection of the subgrade and to provide access for efficient operation of the Aggregate Pier installation.

- D. Prior to, during and following Aggregate Pier installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.
- E. If spoils are generated by Aggregate Pier installation, spoil removal from the Aggregate Pier work area in a timely manner to prevent interruption of Aggregate Pier installation is required.

7.02 Aggregate Pier Layout

The location of Aggregate Pier-supported foundations for this project, including layout of individual Aggregate Pier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

7.03 Excavations of Obstructions

- A. Should any obstruction be encountered during Aggregate Pier installation, the General Contractor shall be responsible for promptly removing such obstruction, or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth or shall cause the pier to drift from the required location.
- B. Dense natural rock or weathered rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials.

7.04 Utilities and Utility Excavations

The contractor shall note that there several utilizes going through the soil improvement area. It is the responsibility of the contractor to coordinate with the utility owners. Soil improvements shall not in any way disturb the existing waterlines under the proposed culvert. Location and protections of existing utilities shall be included in the cost of the soil improvement bid items.

The General Contractor shall coordinate all utility excavations made subsequent to Aggregate Pier installations so that utility excavations do not encroach on the piers as shown in the Aggregate Pier construction drawings. Protection of completed Aggregate Pier elements is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Aggregate Pier elements, the General Contractor shall contact the Aggregate Pier Designer immediately to develop construction solutions to minimize impacts on the installed Aggregate Pier elements.

7.05 Box Culvert and Roadway Embankment Subgrade

- A. Excavation and surface compaction of all Box Culvert and roadway embankment subgrade shall be the responsibility of the General Contractor.
- B. Excavations to expose the tops of Aggregate Pier elements shall be made in a workman-like manner, and shall be protected until concrete placement or embankment fill, with procedures and equipment best suited to (1) avoid exposure to water, (2) prevent softening of the matrix soil between and around the Aggregate Pier elements before pouring structural concrete and placing embankment fill, and (3) achieve direct and firm contact between the dense, undisturbed Aggregate Pier elements and the concrete footing and fill.
- C. All excavations supported by Aggregate Pier foundations shall be prepared in the following manner by the General Contractor. Recommended procedures for achieving these goals are to:
 - 1. Limit over-excavation below the bottom of the subgrade to 3-inches (including disturbance from the teeth of the excavation equipment).

2. Compaction of surface soil and top of Aggregate Pier elements shall be prepared using a motorized impact compactor. Sled-type tamping devices shall only be used in granular soils and when approved by the designer. Loose or soft surficial soil over the entire subgrade shall be recompacted or removed, respectively. The surface of the aggregate pier shall be recompacted prior to completing subgrade preparation.
- D. The following criteria shall apply, and a written inspection report sealed by the project Testing Agency shall be furnished to the Installer to confirm:
1. That water (which may soften the unconfined matrix soil between and around the Aggregate Pier elements and may have detrimental effects on the supporting capability of the Aggregate Pier reinforced subgrade) has not been allowed to pond in the footing excavation at any time.
 2. That all Aggregate Pier elements designed have been exposed in the subgrade excavation.
 3. That immediately before box culvert construction and embankment fill, the tops of Aggregate Pier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment.
 4. That no excavations or drilled shafts (elevator, etc) have been made after installation of Aggregate Pier elements within the excavation limits described in the Aggregate Pier construction drawings, without the written approval of the Installer or Designer.
- E. Failure to provide the above inspection and certification by the Testing Agency, which is beyond the responsibility of the Aggregate Pier Installer, may void any written or implied warranty on the performance of the Aggregate Pier Soil Improvement system.

PART 8: PAYMENT

8.01 Method of Measurement

- A. Measurement of the aggregate piers is on a lump sum basis.
- B. Payment shall cover design, supply and installation of the aggregate pier soil improvement system and quality control testing. All construction elements to construct and maintain a work platform for the installer shall be included in this lump sum cost. All responsibilities discussed in Part 7 shall be included as well. Quality Assurance testing shall be coordinated and paid for by the Owner.

8.02 Basis of Payment

- A. The accepted quantities of piers will be paid per approval, in-place aggregate-pier. Payment will be made under:

<u>Pay Item:</u>	<u>Pay Unit:</u>
Aggregate pier soil improvement system (Area A)	Lump Sum
Aggregate pier soil improvement system (Area B)	Lump Sum

PART 9: ALTERNATE SOIL IMPROVEMENT SYSTEMS

9.01 Value Engineering

- A. The Contractor is encouraged to develop and offer alternate soil improvement systems and other innovations to stabilize the wetland area. These proposals will be treated as a Value Engineering Change Proposal and the process and acceptance criteria will be per CDOT specification 104.07. Sufficient review time shall be considered with this proposal. The Owner's Engineer will commit to a 3-week review time frame from the date the proposal submittal is received. No additional contract time will be added for this

review process nor will any additional time be added if proposal is not accepted and delays follow to get an Aggregate Pier Soil Improvement System designed, accepted and installer scheduled.

Bid Item 8 – DEWATERING

This item will use the CDOT Standard Specifications for Road and Bridge Construction Section 107 and is hereby revised for this project as follows:

Subsection 107.25(b)8 shall include the following:

Structure and Riprap Dewatering. The contractor shall be responsible for all dewatering on the project. It is anticipated that dewater will be required on this project, especially will excavating for culverts and storm drains. The dewatering processes shall follow these specifications:

Prior to the preconstruction conference the Contractor shall submit their dewatering plan to the Engineer and Owner to communicate the Contractors intent in regard to dewatering to achieve the required performance contained in these specifications. Submittal of a dewatering plan shall not be interpreted as an acceptance or approval by the Owner or Engineer of the Contractor's dewatering plan. The dewatering plan shall include at a minimum:

1. Major components of the dewatering system including size, location, spacing and details of major dewatering features the Contractor anticipates utilizing.
2. Contingency plans for equipment or power failure.
3. Procedures for verification that water levels have been lowered to the specified levels prior to trench or structure excavation and installation.
4. Location of dewatering disposal or discharge locations and the capacity to accept dewatering discharge. Provide a contingency plan for higher than anticipated flows when capacity of planned discharge and disposal locations may conceivably be exceeded.
5. Location and details of Best Management Practices (BMP's)
6. Agreements with entities accepting discharges
7. All permits obtained by the Contractor including any permit conditions and approvals for the discharge of water generated during the execution of the Work.
8. Other permits required for construction or operation of the dewatering system including the drilling of wells, temporary power drops, etc.

Structure dewatering construction requirements:

1. The construction dewatering permit and water quality shall conform to subsection 107.25(b)7&8 of the CDOT specifications.
2. Dewatering discharge to or across adjacent canals, drains, right-of-way, and private property outside of the designated limits of construction shall not be allowed unless the Contractor has obtained written approval from agency or property owner having jurisdiction. Provide Agreements with dewatering plan submittal as described above
3. Furnish, install and prepare for operation, all necessary machinery, appliances and equipment to maintain all structure excavations free from water during construction.
4. Contractor shall provide temporary power sources for all dewatering equipment that requires a power source.
5. Dewater and dispose of water in such a manner that it does not cause injury to public or private property, or to cause a nuisance or a menace to the general public.
6. The Contractor will be responsible for devising a system to achieve the required level of dewatering. It is anticipated that this system may incorporate wells, well points, interception trenches, sumps, etc. In addition, design and provide dewatering conveyance system to an approved disposal location. The Contractor shall submit details of this plan as described above.

7. Draw and maintain static water level to at least three feet (3') below the bottom of the excavation prior to excavating below the water table to maintain the undisturbed state of the foundation soils and allow placement of bedding material and backfill to the required density.
8. Remove all groundwater, seepage, stormwater and other water that accumulates in the excavation during construction. All structure excavations shall be kept free of water during construction or until otherwise requested by the Contractor and approved by the Engineer.
9. Prevent softening of the bottom of excavations and the formation of "quick" conditions or "boils" during excavation. The occurrence of such conditions will require over-excavation and subsequent backfilling of soils meeting the requirements of the CDOT Specifications at no additional cost to the Owner.
10. Additional cost for trench bottom stabilization resulting from inadequate dewatering and non-compliance with the performance specifications included herein, as determined by the Engineer, will be incidental to the work.
11. Compact native soil at the bottom of the excavation prior to placing bedding in accordance with the CDOT specifications and of these specifications.
12. Maintain static water level at least three feet (3') below the bottom of the excavation until the specified foundation and structure is placed in accordance with these specifications. Maintain water levels at least three feet (3') below the level of backfill during backfilling operations.
13. Control surface runoff to prevent entry or collection of water in excavations.
14. Install and operate a dewatering system so that adjacent structures or property are not endangered by the reduction in the groundwater level.
15. Monitor discharge from dewatering operations for changes in visual or odor components indicating the presence of contaminants including, but not limited to, gasoline and pesticides and other hazardous materials and toxins.
16. Cease dewatering operations and notify Engineer and regulatory agencies immediately upon observation of conditions that may indicate the presence of hazardous contaminants in the dewatering discharge or excavation.

Observation Requirements:

1. Contractor's superintendent shall routinely observe conditions in excavations where dewatering is being performed on a daily basis to verify performance requirements are being met and that conditions in the excavation are in accordance with the Contract Documents.
2. Notify Engineer of any observations that may jeopardize the Work or is not in accordance with the Contract Documents.
3. Prior to advancing the structure excavation below the pre-construction groundwater level, the Contractor shall excavate a test pit or install another form of groundwater measurement. Water levels in the test pit shall be measured and recorded and the information provided to the Engineer. Measured water levels must show that the groundwater has been lowered to the minimum level stated herein. If monitoring shows that the specified level of dewatering has not been achieved, cease construction of the affected work and continue dewatering or modify dewatering activities until the specified level of dewatering is achieved at no additional cost to the Owner.

Dewatering Discharge:

1. Comply with all State & Federal requirements
2. Water quality shall conform to subsection 107.25(b)8 of the CDOT Specification
3. Work required to comply with water quality and permit requirements are considered incidental and additional payment will not be made for this Work.

Termination:

1. Allow groundwater to return to static level after excavations are backfilled as necessary to prevent flotation of constructed improvements.
2. Prevent disturbance of the compacted backfill and prevent flotation or movement of installed structure.
3. Remove or abandon all temporary improvements associated with the dewatering system in accordance with these specifications and any applicable state and federal rules and regulations.
4. Provide surface restoration as required to repair/replace any surface impacted by dewatering activities to a condition as good or better than preconstruction conditions at no additional cost to the Owner. Surface rehabilitation performed as a result of dewatering activities is considered incidental and no additional payment will be made.
5. Comply with any dewatering termination requirements of any State and Federal permits.

Subsection 107.25(c)1 shall be modified as follows:

Delete the first occurrence of the word “dewatering” from the sentence.

Add the following:

Dewatering will not be measured but will be paid as Lump Sum on this project

Bid Items 9 – 12– CONCRETE AND ASPHALT REMOVALS

All removed pavement, curb, sidewalk, and inlet removed shall become the property of the contractor and be disposed of properly. Sawcutting to a clean edge is incidental to the items. Engineer shall determine exact removal limits in the field. If tying into existing curb or sidewalk in poor condition (i.e. heaving), remove to the next expansion joint.

Bid pay item ‘Removal of Concrete Pavement’ includes sidewalk and the Mountain Shadows Storage Unit driveway.

Bid Item 14 & 15 – REMOVAL OF TYPE III BARRIER AND SIGN

Contractor shall remove existing street signs and Type III barrier at the direction of the Engineer and deliver them to a City facility as directed by the Engineer.

Bid Item 18– REMOVAL OF PAVEMENT MARKING

Removal of pavement marking shall be measured and paid per linear foot regardless of stripe width.

Bid Item 22– REMOVE HEADWALLS

Contractor shall remove and dispose of the two concrete pipe headwalls in the area of Station 193 right.

Bid Item 23-24– REMOVE RIPRAP AND GRAVEL

Contractor shall remove and dispose of Riprap at existing drainage outfalls and gravel at driveways. The contractor can reuse the material on site if it fits the specifications.

Bid Item 26 – RESET SIGN

Contractor shall remove existing street signs and store in the contractor’s yard until time of reinstallation. Any damage to the signs caused by the contractor during removal or during the course of the project shall be repaired or replaced at no cost to the project. Permanent signs shall be installed on new posts and sign anchor. Payment for sign posts / sign anchor are included under a separate payment item.

Bid Items 27-28 – WATER VALVE AND MANHOLE RIM ADJUSTMENTS

Refer to “Streets Volume I” Standard Details S-33 and S-34.

Bid Items 29 – EXTEND EXISTING MANHOLE HEIGHT

Refer to “Streets Volume I” Standard Details S-34 and Standard Storm Drain Manhole Detail 6-9..

Manholes that need to be raised 16” or more shall be paid by this bid item. They include:

- a. 190+95 Irrigation - unknown size - assume 6’D or greater - ADD 2.0’
- b. 210+00 Storm - 5’D - ADD 5.8’
- c. 214+50 Storm - 5’D - ADD 3.1’
- d. 215+15 Sewer - 4’D - ADD 2.7’
- e. 420+00 Sewer - 4’D - ADD 4.3’
- f. 216+50 Storm - 5’D - ADD 1.7’

Bid Item 30– RELOCATE WATER METER

Installation of curb stop valves, risers and locking lids shall be all inclusive to this item.

Bid Item 31– RELOCATE AIR VALVE VAULT AND VENT PIPE

Refer to Greeley Water Detail WNP-1

Relocate the water air valve and vent per Greeley details included in the plans. Relocate due south outside of the fill line. The contractor should assume that new vault material will be required.

Bid Item 32– RELOCATE LIGHT

Relocate the HOA streetlight at the northeast corner 90th Avenue and 20th Street. The contractor shall install a new concrete foundation to match the existing street pole and light. Connect conductor and conduit per current electrical code.

Bid Item 33– IRRIGATION MODIFICATIONS

Prior to removal of existing lawn and drip irrigation components adjacent to the Mountain Shadows Subdivision, the contractor shall coordinate with the HOA and determine how the existing irrigation system operates. The contractor shall then make adjustment to the current HOA irrigation system and perform the relocations and adjustment required for the roadway work. Damage to existing HOA vegetation and grass due to lack of water during the project duration shall be replace by the contractor at no additional cost to the City.

Bid Item 34– TRANSPLANT TREES

The contractor shall transplant six trees as called out on the landscape plans. The trees shall be transplanted one time to their final location. This will require the contractor to pre-grade (to final plan grade) the area to receive the trees. Transplanting shall be per the latest revision of CDOT Section 215-Transplanting.

Bid Item 35 – SUBGRADE PREPARATION

Exposed ground surface should be scarified to a depth of 10", moisture conditioned, and re-compacted to at least 95 percent of the maximum dry unit weight at determined by AASHTO T99 before any new fill, curb and gutter, sidewalk, or pavement section is placed. Preparation of finished subgrade for base and pavement after earthwork operation is completed is incidental to the cost of the work. Water necessary for the operation is incidental to the cost of the work. See Geotechnical report.

Bid Item 44 – CONCRETE APRON

Concrete apron shall conform to 'Streets' Section 02585 for Portland Cement Concrete Pavement

Bid Item 45 – MECHANICAL REINFORCEMENT OF SOIL

Shall conform to CDOT Standards and conform to CDOT Bridge Plan B-206-M1 titled 'MECHANICAL STABILIZED BACKFILL'

This pay item shall cover Reinforcement of soil behind the concrete box culvert wingwalls. Material placed behind the modular block walls shall be paid under Item 102 – "M.S.E Retaining Wall".

Bid Item 46– CONCRETE CLASS D (BOX CULVERT, WINGWALLS, APRON) (INCLUDES REBAR)

This item shall include both Concrete and Reinforcing Steel.

Work shall include means, method, labor and materials to construct the cast-in-place concrete elements and the reinforcing steel for the proposed box culvert structure. Contractor shall follow Section 601 and Section 602 of the CDOT Construction Standards (2017) with applicable Standard Special Provisions.

Bid Item 47 – STRUCTURAL CONCRETE COATING

Work shall include means, method, labor and materials to coat the exposed cast-in-place concrete elements for the proposed box culvert structure. Contractor shall follow Section 601 of the CDOT Construction Standards (2017) with applicable Standard Special Provisions.

Bid Item 48– LIGHTWEIGHT CONCRETE FLOWFILL

Work shall include means, method, labor and materials to deliver and place the lightweight concrete flowfill as shown in the Structural Drawings. Material should conform to the following:

Lightweight CLSM (Controlled Low Strength Materials) is a self-leveling cementitious material composed of some combination of cement, fly ash, aggregates, water, chemical admixtures and/or cellular foam for air-entrainment, with the following physical properties and requirements:

It shall have a density of 50pcf to 60pcf, when tested in accordance with ASTM C138. The CLSM shall have a slump of 7 to 11 inches, when tested in accordance with ASTM C143 or a minimum flow consistency of 8 inches when tested in accordance with ASTM D6103. This lightweight CLSM shall have a minimum compressive strength of 100 psi at 28 days, when tested in accordance with ASTM D4832 or D6103. Lightweight CLSM placed in areas that require future excavation, shall have a Removability Modulus (RE) of 1.5 or less.

Removability Modulus, RE, is calculated as follows:

$$RE = W1.5 \times 104 \times C0.5$$

where : W = unit weight (pcf)
C = 28-day compressive strength

Bid Item 49– Safety Grate

Work shall conform to details shown on Drawing S- 613 of the plans.

Work shall include means, method, labor and materials for the fabrication and installation of the safety grate at the inlet of the concrete box culvert.

Bid Items 55-56 PAVEMENT MARKINGS

Refer to “Streets Volume I” Section 02618.

Bid Items 58 – STEEL SIGN POST

Includes mounting new signs and all labor and materials necessary for a sign anchor as shown on the contract documents.

Bid Items 59 – SIGN ANCHOR

Sign shall be installed per detail S-45 and sign shall be set in concrete including a 4” PVC pipe. No separate measurement or payment will be made for concrete or PVC pipe.

Bid Item 61 – SPLIT RAIL FENCE

PART 1: GENERAL

1.01 Description

- A. Work shall consist of furnishing and constructing a split rail cedar fence to the lines and grades as shown on the contract plans and in accordance with the detail shown on the contract plans. Fence shall be installed in accordance with City of Greeley standard specification requirements as applicable.

1.02 Submittals/Certification

- A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the fencing components meet the requirements of this specification.

1.03 Delivery, Storage and Handling

- A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.
- B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2: PRODUCTS

2.01 Materials

- A. Fencing – rough sawn dimensional cedar lumber. Cedar shall be stained with penofin oil to provide a natural cedar color appearance.
- B. Connectors – dark colored Torx wood screws.
- C. Posts – 4" x 6" x 6' Cedar wood posts.
- D. Concrete – Concrete shall meet or exceed the requirements of the latest edition of MGPEC Item 11 – PCCP.

PART 3: EXECUTION

3.01 Construction

- A. The cedar posts shall be set true to line and grade in concrete bases at least two (2) feet in depth. All posts shall be sound and free from all decay, splits, multiple cracks, or any other defect which would weaken the posts or otherwise cause them to be structurally unsuitable for the purpose intended.
- B. The maximum distance between posts in any section shall not exceed ten (10) feet. The top and bottom railings shall be securely fastened to the posts with dark colored Torx screws. Changes in line of 30 degrees or more shall be considered as corners. A minimum of six (6) inches of concrete shall be provided below the bottom of each post. End posts, corner posts, and gate posts shall have a concrete base of at least twelve (12) inches in diameter. Bases for line posts shall also be twelve (12) inches in diameter.
- C. Fence rails shall be placed on the roadway side of posts unless otherwise specified. Rails shall be free from all major decay or defects which would weaken or otherwise cause them to be unsuitable for railing. Fastening to top and bottom railings shall be done with two screws at both the top and bottom rail.

PART 4: MEASUREMENT AND PAYMENT

- A. Measurement and payment for split rail fence shall include all labor, materials, concrete, cedar fencing, braided cable, galvanized steel lag eye bolts, stain, excavation, backfill, drainage, compaction, leveling, and all other items of expense necessary for installation to the lines and grades shown on the contract plans and documents.
- B. Split Rail Fence: By the linear foot of fence length.
- C. Bid Schedule Description: Split Rail Fence...Linear Foot (LF).

Bid Items 62 – TYPE TWO PULL BOX

Work shall conform to City of Greeley Detail S-49 and the Hubble Drawing # PG2436Z83VV3 shown on DWG DT- 1005. The boxes shall measure 24"x36"x18"

Work shall include all means, method, labor and materials for supplying and installation of the boxes.

Bid Items 63-66 – FIBER OPTIC CONDUIT (Color)

Work shall conform to Conduit Detail shown on DWG DT- 1005.

Work shall include all means, method, labor and materials for supplying and installation the conduit as depicted in the detail. Material and construction requirements shall be per CDOT Section 613.

Bid Items 67 – ELECTRICAL CONNECTION TO IRRIGATION CONTROLLER

Work shall conform to the latest National Electrical Code.

Work shall include all means, method, labor and materials for the installation of the main disconnect switch, conduit, conductor and all miscellaneous work required complete the electrical connection from the meter supplied by PVREA to the irrigation controller. Refer to DWG L-1407 and detail on DWG L-1413

Bid Items 70 – DEBRIS HOOD FOR 5' MANHOLE

Work shall conform to the detail on drawing DT-1004

Work shall include all means, method, labor and materials for supplying and installation the Debris Hood.

Bid Items 71 – HEADWALL FOR 24" RCP

Work shall conform to the CDOT Standard Plan M-601-12

Work shall include all means, method, labor and materials installation the pipe headwall to storm line E as shown on DWG DR-506

Bid Items 72-82 – STORM DRAINAGE

Conform to "Storm" Section 6.0 for materials and installation requirements. All storm drain pipe shall be class III reinforced concrete pipe (except Item number 76 - "8' dia PVC Pipe" which shall be Sch 40) Saddles and pipe joint grouting designated on the contract construction plans shall be considered incidental expenses to the installation of the storm drain line. No additional payment will be made for trenching, drainage rock or MIRAFL fabric which shall be considered an incidental expense to the installation of the storm pipes.

Bid Items 83, 84 – RIPRAP

All material, labor, and equipment required to install the riprap per Urban Storm Drainage Criteria Manual shall be included in the unit price. This includes excavation, filter fabric, bedding material, and riprap.

Bid Items 85 – STOCKPILE AND RESET RIPRAP

This pay item shall include all material, labor, and equipment required to excavate and stockpile existing riprap at STA 218+50 LT and to re- install the riprap at the downstream end of the box culvert. This item includes excavation, stockpiling, hauling, filter fabric, and bedding material.

Bid Items 89 – CONCRETE WASHOUT STRUCTURE

No earthen pit wash out areas will be allowed. Washout pans should be placed to coincide with construction phasing. Washout pans must be clearly signed per City detail for washout areas. Recycled concrete is specifically prohibited for use as vehicle tracking pad aggregate.

Bid Item 96– EROSION CONTROL MAINTENANCE

This item shall consist of the on-going maintenance of field erosion control measures in accordance with provisions outlined in the Storm Water Pollution Protection Plan included within these special provisions in addition to State and Federal temporary storm water discharge permits. No separate measurement shall be made for this bid item which shall be paid on a lump sum basis in accordance with the contract bid form.

Contractor shall provide periodic maintenance of the site, particularly during and after storms, to maintain barricades, provide necessary dust control and ensure general maintenance. Disregard of this provision shall cause for suspension of the project. It will be the Contractor responsibility to ensure that existing streets adjacent to the area under construction be kept free of all concrete or other foreign material. All labor, materials, equipment, and other items of expense needed to maintain the erosion control measures required for this project shall be included within this payment item.

Bid Item 97 – MAINTAIN ACCESS TO STORAGE UNIT

This item shall consist of the on-going coordination, construction, and maintenance required to ensure that the storage units on the southwest corner of 20th Street and 83rd Avenue has 24-hour uninterrupted access to their facility. The contractor shall assume that a temporary asphalt access will be required to fulfil these requirements. The driveway to the facility is close to the phase 1/phase 2 boundary shown on the plans and will require a change in grade. It should be assumed that additional coordination will be needed.

Bid Item 98 - 102– TRAFFIC CONTROL ITEMS

Payment shall be per the individual bid items for traffic centriole signs and devices shown on DWG TC-800 to TC-802. Payment for traffic control devices will be paid once for the duration of the project. Maintenance, replacement, and resetting of devices is include in the bid item.

Bid Item 103– M.S.E RETAINING WALL

PART 1: GENERAL

1.01 Description

- A. Work shall consist of designing, furnishing and construction of a concrete segmental block retaining wall system in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.
- B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.
- C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths as recommended by the manufacturer.

1.02 Reference Documents

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C140 Sampling and Testing Concrete Masonry Units
 - 2. ASTM C1372 Specification for Dry-Cast Segmental Retaining Wall Units
 - 3. ASTM D422 Particle-Size Analysis of Soils
 - 4. ASTM D698 Laboratory Compaction Characteristics of Soil –Standard Effort
 - 5. ASTM D1557 Laboratory Compaction Characteristics of Soil –Modified Effort
 - 6. ASTM D3034 Polyvinyl Chloride Pipe (PVC)
 - 7. ASTM D4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
 - 8. ASTM D4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
 - 9. ASTM D4476 Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
 - 10. ASTM D4595 Tensile Properties of Geotextiles - Wide Width Strip
 - 11. ASTM D5262 Unconfined Tension Creep Behavior of Geosynthetics
 - 12. ASTM D5818 Evaluate Installation Damage of Geosynthetics
 - 13. ASTM D6637 Tensile Properties of Geogrids – Single or Multi-Rib
 - 14. ASTM D6638 Connection Strength - Reinforcement/Segmental Units
 - 15. ASTM D6706 Geosynthetic Pullout Resistance in Soil
 - 16. ASTM D6916 Shear Strength Between Segmental Concrete Units
- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M 252 Corrugated Polyethylene Drainage Pipe
- C. Geosynthetic Research Institute (GRI)
 - 1. GRI-GG4 Determination of Long Term Design Strength of Geogrids
 - 2. GRI-GG5 Determination of Geogrid (soil) Pullout
- D. National Concrete Masonry Association (NCMA)
 - 1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW
 - 2. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

1.03 Submittals/Certification

- A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.

1.04 Quality Assurance

- A. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project.
- B. Owner shall/may provide soil testing and quality assurance inspection during earthwork and wall construction operations. Contractor shall provide any quality control testing or inspection not provided by the Owner. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.05 Delivery, Storage and Handling

- A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.
- B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2: PRODUCTS

2.01 Definitions

- A. Segmental Block Concrete Unit - a concrete retaining wall element machine made from Portland cement, water, and aggregates.
- B. Structural Geogrid - a structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.
- C. Unit Drainage Fill - drainage aggregate that is placed within and immediately behind the segmental block concrete units.
- D. Reinforced Backfill - compacted soil that is placed within the reinforced soil volume as outlined on the plans.

2.02 Segmental Block Concrete Retaining Wall Units

- A. Segmental block concrete units shall conform to the following architectural requirements:
 - 1. Face color - concrete gray, unless otherwise specified. The Owner may specify standard manufacturers' color. Contractor to match existing block wall color.
 - 2. Face finish - sculptured rock face in angular tri-planer configuration. Contractor to match existing wall finish. Other face finishes will not be allowed without written approval of Owner.

3. Bond configuration - running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.
 4. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused lighting.
- B. Segmental block concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.
- C. Segmental block concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units:
1. Compressive strength: ≥ 3000 psi (21 MPa);
 2. Absorption: $\leq 8\%$ (6% in northern states) for standard weight aggregates;
 3. Dimensional tolerances: $\pm 1/8"$ (3 mm) from nominal unit dimensions not including rough split face, $\pm 1/16"$ (1.5 mm) unit height - top and bottom planes;
 4. Unit size: 8" (203 mm) (H) x 18" (457 mm)(W) x 18" (457 mm)(D) minimum;
 5. Unit weight: 100-lbs/unit (45 kg/unit) minimum for standard weight aggregates.
- D. Segmental block concrete units shall conform to the following performance testing:
1. Inter-unit shear strength in accordance with ASTM D6916 (NCMA SRWU-2): 1500-plf (21 kN/m) minimum at 2-psi (13 kPa) normal pressure;
 2. Geogrid/unit peak connection strength in accordance with ASTM D6638 (NCMA SRWU-1): 900-plf (13 kN/m) minimum at 2-psi (13 kPa) normal force.
- E. Segmental block concrete units shall conform to the following constructability requirements:
1. Vertical setback: $1/8"$ (3 mm) \pm per course (near vertical) or $1"$ (25 mm) + per course per the design;
 2. Alignment and grid positioning mechanism: fiberglass pins, two per unit minimum;
 3. Horizontal gap between erected units shall be $\leq 1/2$ inch (13 mm).

2.03 Shear Connectors

- A. Shear connectors shall be 1/2-inch (12 mm) diameter thermoset isophthalic polyester resin-pultruded fiberglass reinforcement rods to provide connection between vertically and horizontally adjacent units with the following requirements:
1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum;
 2. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum.
- B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.04 Base Leveling Pad Material

- A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.

2.05 Unit Drainage Fill

- A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch (25 mm)	100
3/4-inch (19 mm)	75-100
No. 4 (4.75 mm)	0 - 10
No. 50 (300um)	0 - 5

- B. Drainage fill shall be placed within the cores of, between, and behind the units as recommended by the block wall manufacturer. Not less than one cubic foot (0.028 m³), of drainage fill shall be used for each square foot (0.093 m²) of wall face unless otherwise specified.

2.06 Reinforced Backfill

- A. Reinforced backfill shall be free of debris and meet the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inch (50 mm)	100
3/4-inch (19 mm)	100-75
No. 40 (425 um)	0-60
No. 200 (75 um)	0-35

Plasticity Index (PI) <15 and Liquid Limit <40 per ASTM D-4318.

- B. The maximum aggregate size shall be limited to 3/4 inch (19 mm) unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.
- C. Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

2.07 Geogrid Soil Reinforcement

- A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high density polyethylene. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 g/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.
- B. Ta, Long Term Allowable Tensile Design Load, of the geogrid material shall be determined as follows:

$$T_a = T_{ult} / (R_{Fcr} \cdot R_{Fd} \cdot R_{Fid} \cdot F_s)$$

T_a shall be evaluated based on a 75-year design life.

1. T_{ult} , Short Term Ultimate Tensile Strength shall be determined in accordance with ASTM D4595 or ASTM D6637.
 T_{ult} is based on the minimum average roll values (MARV).
 2. R_{Fcr} , Reduction Factor for Long Term Tension Creep
 R_{Fcr} shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262. Reduction value = 1.45 minimum.
 3. R_{Fd} , Reduction Factor for Durability
 R_{Fd} shall be determined from polymer specific durability testing covering the range of expected soil environments. R_{Fd} = 1.10 minimum.
 4. R_{Fid} , Reduction Factor for Installation Damage
 R_{Fid} shall be determined from product specific construction damage testing performed in accordance with ASTM D5818 (GRI-GG4). Test results shall be provided for each product to be used with project specific or more severe soil type. R_{Fid} = 1.05 minimum.
 5. F_s , Overall Design Factor of Safety
 F_s shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.
- C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units (NCMA SRWU-1).
- D. Soil Interaction Coefficient, C_i
 C_i values shall be determined per ASTM D6706 (GRI-GG5) at a maximum 0.75-inch (19 mm) displacement.
- E. Manufacturing Quality Control
The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.
The QC testing shall include:
 Tensile Strength Testing
 Melt Flow Index (HDPE)
 Molecular Weight (Polyester)

2.08 Drainage Pipe

- A. If required by the manufacturer, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

2.09 Geotextile Filter Fabric

- A. When required, Geotextile filter fabric shall be 4.0 oz/sy, polypropylene, needlepunched nonwoven fabric.

PART 3: EXECUTION

3.01 Excavation

- A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's representative shall inspect the excavation and approve prior to placement of leveling material or fill soils. Proof roll foundation area as directed to determine if remedial work is required.
- B. Over-excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.02 Base Leveling Pad

- A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the concrete segmental block wall unit.
- B. Soil leveling pad materials shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557.
- C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.03 Concrete Segmental Block Unit Installation

- A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.
- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.
- C. Install shear/connecting devices per manufacturer's recommendations.
- D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.
- E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.04 Structural Geogrid Installation

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.
- B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Manufacturer.

- C. The geogrid shall be laid horizontally on compacted backfill and attached to the concrete segmental units. Place the next course of concrete units over the geogrid. The geogrid shall be pulled taut and anchored prior to backfill placement on the geogrid.
- D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

3.05 Reinforced Backfill Placement

- A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.
- B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches (150 mm) where hand compaction is used, or 8 - 10 inches (200 to 250 mm) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density as required.
- C. Reinforced backfill shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, + 0%, - 3%.
- D. Only lightweight hand-operated equipment shall be allowed within 3 feet (1 m) from the tail of the block wall concrete unit.
- E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.
- F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH (15 KPH). Sudden braking and sharp turning shall be avoided.
- G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 Cap Installation

- A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.

3.07 As-built Construction Tolerances

- A. Vertical alignment: $\pm 1.5"$ (40 mm) over any 10' (3 m) distance.
- B. Wall Batter: within 2 degrees of design batter.
- C. Horizontal alignment: $\pm 1.5"$ (40 mm) over any 10' (3 m) distance.
Corners, bends & curves: ± 1 foot (300 mm) to theoretical location.

- D. Maximum horizontal gap between erected units shall be 1/2 inch (13 mm).

3.08 Field Quality Control

- A. Quality Assurance - The Owner shall/may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction quality control testing.
- B. Quality Assurance should include foundation soil inspection. Verification of geotechnical design parameters, and verification that the contractor's quality control testing is adequate as a minimum. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications.
- C. Quality Control – The Contractor shall engage inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.
- D. Quality Control testing shall include soil and backfill testing to verify soil types and compaction and verification that the retaining wall is being constructed in accordance with the design plans and project specifications.

PART 4: MEASUREMENT AND PAYMENT

- A. Measurement and payment for concrete segmental block retaining wall shall include all labor, materials, concrete block, excavation, geogrid, backfill, drainage, compaction, leveling pad, and all other items of expense necessary for installation to the lines and grades shown on the contract plans and documents.
- B. Concrete Segmental Block Retaining Wall: By the square foot of block wall face area.
- C. Bid Schedule Description: Retaining Wall...Square Foot (SF).

Bid Item 105 - CONSTRUCTION SURVEY

Construction staking shall be provided by the Contractor and shall be performed under the direct supervision of a Professional Land Surveyor licensed in the State of Colorado. Refer to "Streets Volume I" Section 01010.H.

LANDSCAPE

Landscaping shall be per City of Greeley Landscaping Standard Specifications Section 02920 Landscaping Specifications unless revised in the specification

Conform to City of Greeley Landscaping Standard Specifications Section 02920 Landscaping Specifications - Soil Prep and Seeding Specs except as follows:

Part 1, 1.3A

Add: 8. Stake Cap

Part 1, 1.4D

Add:

1. Report suitability of topsoil and subsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory soil mixture.
1. The Contractor shall perform soil test immediately following the award of the Contract and prior to mobilizing for landscape construction.
2. Soil testing shall be provided by Colorado Analytical Laboratory, 240 S. Main Street, Brighton, CO 80601, (303) 659-2313, or an approved testing facility. Soil shall be tested for soluble salts and nutrient levels. Testing facility shall provide interpretation of results and recommendation for soil amendments for each type of planting.
3. Deficient nutrients shall be corrected with the addition of appropriate fertilizer and amendment materials. The Contractor shall submit a Change Order Request for all additional materials that are recommended but are not included in this Specification. Owner will be credited by contractor for any specified materials not used.

Part 1, 1.5H

Add: H. Landscape Areas Acceptance: Initiating work in an area without prior approval from the Owner's Representative will render the Contractor responsible for any and all corrections including, but not limited to, grading corrections, trash removal, debris removal, rock removal and other miscellaneous elements.

Part 2, 2.5A

Add:

2. Topsoil Source: Import topsoil from off-site sources. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4-inches (100 mm) deep; do not obtain from bogs or marshes.
3. Provide the attached Topsoil Letter of Certification found at the end of this section.

Part 2, 2.6C

Add:

1. Provide the attached Soil Amendment Letter of Certification found at the end of this section.

SEEDING MAINTENANCE, GUARANTEE, AND ACCEPTANCE

A. Maintenance Period and Guarantee:

1. The maintenance and warranty period shall begin immediately after each area is seeded until final acceptance of the project. During this time, the contractor shall be responsible for watering, if needed, mowing, spraying, weeding, and all related work and costs as necessary to insure that seeded areas are in a vigorous growing condition until final acceptance. The Landscape Architect will direct the contractor on what seeded areas need to be replaced at the final walk-through.
2. The contractor shall, for a period of one (1) year, monitor his work once every two months to verify that major settlement has not taken place and that no seeded area has become waterlogged in settled swales or other areas. Should settlement occur, the contractor shall repair damage according to these specifications.
3. The contractor shall maintain the seeded areas until all work on the contract has been completed and accepted. Maintenance shall consist of, in addition to watering, mowing, weed control, and protection from vandalism, the repair of areas damaged by erosion protection from vandalism, the repair of areas damaged by erosion or wind. Such areas shall be repaired during the maintenance period at no expense to the Owner to re-establish the condition and grade of the soil prior to application of the mulch and shall be fertilized, reseeded, and mulched as directed. Major repair of areas due to the work or failure of other contractor's systems or work shall be by that contractor who damaged the work, provided that during this maintenance period the lawn contractor notifies the Owner's authorized representative in writing of such damage within ten (10) days of the occurrence. Major damage due to vandalism (major damage is defined as damaged costing over \$5,000.00 in time and materials) in any one incident shall be borne by the Owner, again provided that notification was made within ten (10) days as specified herein. After receiving final acceptance, maintenance shall become the responsibility of the Owner.

The seeded areas shall be accepted on the basis of having a uniform plant growth over the entire seeded area. Two (2) months after seeding, the areas seeded shall be reviewed by the Landscape Architect and the Contractor. Any areas (as determined by the Landscape Architect) where the seed has failed to germinate shall be reseeded and raked to cover the seed. Any area where the seed has failed to grow, reseeded shall be at the Contractor's expense until grass is established and accepted. Acceptable uniform plant growth shall be defined as when the scattered bare spots, not greater than 4 square inches, do not exceed 5% of the seeded area.

Add Section 3.12 – MEASUREMENT AND PAYMENT

A. Payment for Trees listed in bid items 108-111 shall be made on a per each basis in accordance with the contract bid form and these special provisions and to the limits shown on the contract plans. Payment for this item shall include all labor, materials, trees, shrubs, excavation, placement, haul, staking, and all other items of expense necessary for the complete installation of the trees and shrubs in accordance with these contract documents.

B. Top Soil – 4" Depth (Bid Item 117)– Payment for top soil shall be made on a per cubic yard basis for installation to the limits described on the contract drawings and shall include all labor, materials, equipment, placement, fine grading, and all other items of expense required for the complete placement of top soil in accordance with these contract documents.

Bid Item 126– SAND FINISH CONCRETE – MEDIANS – SURFACE RETARDANT

Median paving shall be per the following revisions to the CDOT specification:

REVISION OF SECTION 610 MEDIAN COVER MATERIAL (EXPOSED SAND FINISH)

Section 610 of the Standard Specifications is hereby revised for this project as follows:

Subsection 610.02 shall include the following:

Add: Concrete for Exposed Sand Finish sidewalk / pavement shall meet the requirements of Class B Concrete.

EXPOSED SAND FINISH TEXTURE AND SEALING MATERIALS

Top Cast Surface Retarder. Pre-approved products include:

1. CHI 027 Surface Treatment, by Colorado Hardscapes, 303-750-8200
2. Top-Surface Retarder, by Grace Top-Cast, 1-877-423-6491
3. Top-Cast, by Dayton Superior, 1-888-977-9600
4. OR approved equivalent.

Texture: Provide physical samples of the following textures for review by Owner's Representative.

1. Acid Etch (Grade/Product 03)
2. Sandblast (Grade/Product 05)
3. Owner's Representative will select finish.

Sealer. Exposed sand finish areas shall be sealed with a penetrating sealer in accordance with the Top Cast Surface Retarder Manufacturer's recommendations. The finish surface shall be slip resistant.

Subsection 610.03 shall include the following:

(d) Submittals:

1. Product Data: For each type of manufactured material and product indicated.
2. Top Cast Surface Retarder
3. Sealer
4. Physical sample of each finish specified (12" x 12") showing full range of textures to be expected in finish work.

Exposed Sand Finish Concrete is to be installed by a decorative concrete contractor with a minimum of 5 years of experience installing SandScape® or exposed sand finish Concrete. The contractor shall submit a list of five prior installations, with photos of each for the customer to view in order to evaluate the overall level of quality and expertise demonstrated by the contractor. Contractor will be required to place an 8' x 8' on-site referee sample indicating consistency, isolation joints, control joints and caulking. Said sample shall be retained for the duration of the job and used as the standard for installed work.

Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative cement concrete pavement systems.

1. Pre-qualified Contractors:
 - a. Colorado Hardscape, Denver, Colorado - 303.750.8200
 - b. Naranjo Civil Constructors, Greeley, Colorado – 970.356.7909
 - c. Sipes Concrete, Fort Collins, Colorado – 970.206.1110

Exposed Sand Finish Mockup: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color and standard of workmanship.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Owners Representative.
2. Notify Owners Representative seven (7) days in advance of dates and times when mockups will be constructed.
3. Obtain Owners Representative's approval of mockups before starting construction.
4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
5. Demolish and remove approved mockups from the site when directed by Owner's Representative.

6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

Finishing: Exposed Sand Finish:

1. Roll and float finish per top cast surface retarder manufacturer's instructions.
2. Apply and remove top cast surface retarder per manufacturer's instructions.
3. Apply sealer per manufacturer's instructions.

Subsection 610.05 is revised to include the following:

Pay Item

Median Cover Material (Exposed Sand Finish)

Pay Unit

Square Foot

IRRIGATION

Bid Item 127-152– IRRIGATION ITEMS

Irrigation Bid Items 127-152 as shown on the bid form shall be measured in accordance with their respective bid units and shall include all materials, labor, equipment, piping, excavation, backfill, compaction, concrete footings, assemblies, coordination, and all other items of expense required to install the overall project irrigation system complete as described in these supplemental specifications and as shown in the contract drawings.

IRRIGATION SPECIFICATIONS

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SECTION 02810-IRRIGATION

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PART 4 SUPPLEMENTAL BASELINE SPECIFICATIONS

DIVISION 2-SITE WORK

SECTION 02810 - IRRIGATION

PART 1: GENERAL

1.01 SCOPE:

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

- I. Procurement of all applicable licenses, permits, and fees.
- II. Coordination of Utility Locates ("Utility Notification Center").
- III. Connection of electrical power supply to the irrigation control system.
- IV. Sleeving for irrigation pipe and wire.
- V. Preparation of Record Drawings.
- VI. Spring start-up and winterization.
- VII. Maintenance period.

1.02 WORK NOT INCLUDED:

Items of work specifically excluded or covered under other sections are:

- I. Provision of electrical power supply to the irrigation control system.
- II. Provision for water to the site (water meter).

1.03 SUBMITTALS:

- I. Deliver four (4) copies of all submittals to the Owner's Representative within 10 working days from the date of Notice to Proceed. Provide information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed for different components and labeled with the specification section number and the name of the component. Submittals must be made for all the components on the material list. Indicate which items are being supplied on the catalog cut sheets when multiple items are shown on one sheet. Submittal package must be complete prior to being reviewed by the Owner's Representative. Incomplete submittals will be returned without review.

- II. Materials List: Include sleeving, pipe, fittings, mainline components, sprinkler, drip irrigation components, control system components, shop drawings and all other components shown on the drawings and installation details or described herein. Components such as pipe sealant, wire, wire connectors, ID tags, etc. must be included. Quantities of materials need not be included.
 - III. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
 - IV. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.
 - V. The following items are required to receive Baselines's installation verification and warranty verification: Baseline's Controller and Communications. Prior to final acceptance of the project, the contractor shall be responsible for contacting and coordinating installation verification for any and all of the aforementioned products required by and installed on this project. Prior to starting work on this project, the contractor shall contact the Central Control Distributer, Denver Brass and Copper Greeley Store, and conduct an on-site meeting with a representative of Denver Brass and Copper and a City representative to coordinate all required verification services in a timely manner, to include Radio Site Survey and equipment needs. The contractor shall provide documentation of this meeting to the City of Greeley. Prior to final acceptance of the work, the contractor shall provide proof of installation verification of all required equipment by Denver Brass and Copper to the City of Greeley.
- 1.04 RULES AND REGULATIONS:
- I. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
 - II. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
 - III. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only, it is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.05 QUALITY ASSURANCE:

- I. Engage an experienced Installer who has completed irrigation work similar in material, design, and extent to that indicated for this project and with a record of successful irrigation installations.

Installer's Field Supervision: Field supervision shall be on site, full time during installation. Field supervisor shall have at least 5 years experience in 2 wire installation.

II. 1.06 TESTING:

- I. Notify the Owner's Representative three days in advance of testing.
- II. Pipelines jointed with rubber gaskets or threaded connections may be subjected to a pressure test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.
- III. Subsections of mainline pipe may be tested independently, subject to the review of the Owner's Representative.
- IV. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests. Pressure gauge resolution must be suitable for recording losses less than 5 psi.
- V. All costs, including travel expenses for site visits by the Project Manager, for any reinspection that may be required due to non-compliance with the Construction Documents shall be the sole responsibility of the Contractor.
- VI. Hydrostatic Pressure Test (Solvent Weld Mainline Pipe):
 - A. Subject mainline pipe to a hydrostatic pressure equal to 140 PSI for two hours. Test with mainline components installed.
 - B. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - C. Expose all remote control valves their riser pipe and service tee fittings.
 - D. Purge air from mainline pipe before test. Attach pressure gauge to mainline pipe in test section.
 - E. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
 - F. Visually inspect irrigation pipe for leakage and replace defective pipe, fittings, joint, valve, or appurtenance. Repeat test until pipe passes test.
 - G. Cement or caulking to seal leaks is prohibited.

VII. Volumetric Leakage Test:

- A. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
- B. Purge air from pipeline before test.
- C. Subject mainline pipe to 140 PSI for two hours. Maintain constant pressure.
- D. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
- E. Testing pump must provide a continuous 140-PSI to the mainline. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 140-PSI at end of test.
- F. Water added to mainline pipe must be measured volumetrically to nearest 0.10 gallons.
- G. Use the following table to determine maximum allowable volume lost during test:

Leakage Allowable (Gallons per (100 Joints) / Hour)

Pipe Size (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140
2 ½"	0.39	0.42	0.45	0.48	0.51	0.53	0.56	0.58	0.61
3"	0.48	0.51	0.55	0.58	0.62	0.65	0.68	0.70	0.73
4"	0.62	0.66	0.71	0.75	0.80	0.84	0.87	0.91	0.94
6"	0.90	0.97	1.04	1.11	1.18	1.23	1.29	1.34	1.40

VIII. Operational Test:

- A. Activate each remote control valve in sequence from controller. The Owner's Representative will visually observe operation, water application patterns, and leakage.
- B. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
- C. Replace, adjust, or move water emission devices to correct operational or coverage deficiencies.
- D. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
- E. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

IX. Control System Acceptance Test:

- A. Upon completion of construction, City of Greeley Parks Department Representatives will administer a System Acceptance Test.
- B. Following construction completion and a Review by the Project Manager, an evaluation period will begin. After 30 days of continuous service without major system problems, the system will be accepted and the guarantee/warranty period will begin. If at any time during the 30-day

evaluation period, a major system problem occurs, the source of the problem will be determined and corrected and the 30-day evaluation period will start again. Equipment will not be accepted until such time as the System Acceptance Test is passed.

- C. If successful completion of the System Acceptance Test is not attained within 90 days following commencement of the evaluation period, the Project Manager has the option to request replacement of equipment, terminate the order, or portions thereof, or continue with the System Acceptance Test. These options will remain in effect until such time as a successful completion of the System Acceptance Test.
 - D. Final payment will be made after successful completion of the System Acceptance Test.
- X. Control System Grounding:
- A. Test for proper grounding of control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
 - B. Replace defective wire, grounding rod, or appurtenances. Repeat the test until the manufacturer's guidelines are met.

1.07 CONSTRUCTION REVIEW:

The purpose of on-site reviews by the Owner's Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.

- I. Scheduled reviews such as those for irrigation system layout or testing must be scheduled with the Project Manager as required by these specifications.
- II. Impromptu reviews may occur at any time during the project.
- III. A review will occur at the completion of the irrigation system installation and Project Record Drawing submittal.

1.08 COORDINATION AND SCHEDULING:

- I. The irrigation construction schedule is to be provided at the Pre-Construction meeting depicting the dates the various stages of the project will start and when they will be completed.

1.09 GUARANTEE/WARRANTY AND REPLACEMENT:

The purpose of this guarantee/warranty is to insure that the Owner receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.

- I. For a period of one year from commencement of the formal maintenance period, guarantee/warranty irrigation materials, equipment, and

workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.

- II. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.
- III. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

PART 2: MATERIALS

2.01 QUALITY:

Use materials that are new and without flaws or defects of any type, and which are the best of their class and kind.

2.02 SUBSTITUTIONS:

- I. Alternative equipment must be approved by the Engineer prior to bidding. The Contractor is responsible for making any changes to the design to accommodate alternative equipment.
- II. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

2.03 SLEEVING:

- I. Install a separate sleeve beneath paved areas to route each run of irrigation pipe or wiring bundle.
- II. Sleeving material beneath pedestrian pavements shall be PVC Class 200 pipe with solvent welded joints.
- III. Sleeving beneath drives and streets shall be PVC Class 200 pipe with solvent welded joints.
- IV. Sleeving diameter: equal to twice that of the pipe or wiring bundle.
- V. All sleeving located under concrete, pavement or other hard surfacing shall be notched on both sides to mark the sleeve location.

2.04 PIPE AND FITTINGS:

- I. Mainline Pipe and Fittings:
 - A. Use rigid, un-plasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B,

ASTM Standard D1784, with an integral belled end suitable for solvent welding.

- B. Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters that are not manufactured in Class 200.
- C. Use solvent weld pipe for mainline pipe with a nominal diameter less than 3-inches or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564.

II. Lateral Pipe and Fittings:

- A. Use rigid, un-plasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B. ASTM Standard D1784, with an integral belled end suitable for solvent welding.
- B. Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241.
- C. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of a type approved by the pipe manufacturer.

III. Specialized Pipe and Fittings:

- A. Low Density Polyethylene Hose:
 - a. Use pipe specifically intended for use as a flexible swing joint.
Inside diameter: 0.490_+0.010 inch.
Wall thickness: 0.100+0.010 inch.
Color: Black.
 - b. Use spiral barbed fittings supplied by the same manufacturer as the hose.
- B. Assemblies calling for flanged connections shall utilize stainless steel studs and nuts and rubber gaskets.
- C. Assemblies calling for threaded pipe connections shall utilize PVC Schedule 80 and 40 threaded fittings and Spears pre-manufactured swing-joint assemblies. Use PVC Schedule 80 nipples.
 - D. Joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded connections and approved by the pipe fitting and valve manufacturers. Where directed by valve manufacturers, use thread tape for threaded connections at valves instead of thread paste.
- E. Copper Pipe: Use Type "K" rigid pipe conforming to ASTM

Standard B88. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or treaded joint per installation details or local code. Use a 95-percent tin and 5-percent antimony solder.

F. Pressure Supply Lines (downstream of backflow prevention units) – HDPE, DR11.

IV. Joint Restraint Harness:

- A. Use a joint restraint harnesses wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
- B. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
- C. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are zinc plated or galvanized.
- D. Use on pipe greater than or equal to 3-inch diameter or any diameter rubber gasket pipe.

2.05 MAINLINE COMPONENTS:

- I. Flow Sensor Assembly: As presented in the installation details.
- II. Isolation Gate Valve Assembly: As presented in the installation details. Acceptable manufacturers are American AVK, Clow, Kennedy, Mueller, Matco, Nibco, or Waterous.
- III. Quick Coupling Valve Assembly: As presented in the installation details.
- IV. Air Vacuum Relief Valve Assembly: as presented in the details. Provide a continuous action combination air vacuum relief valve with an operating pressure rating of 150 PSI. Acceptable manufactures are Bermad, Crispin, Fresno, or Waterman.

2.06 SPRINKLER IRRIGATION COMPONENTS:

- I. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: as presented in the installation details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly. Provide PRS-Dial pressure regulators for all spray nozzles when inlet pressure exceeds 15 psi of desired outlet pressure. Install 2-wire decoder on each control valve.
- II. Sprinkler Assembly: As presented in the drawings and installation details.

- III. Sprinkler Pressure Test Kit: Provide Rain Bird PHG assembly, and Rain Bird Pitot Tube (part no. 41017), for use in pressure adjustment for spray and rotors sprinklers.

2.07 DRIP IRRIGATION COMPONENTS:

- I. Remote Control Valve (RCV) /assembly fir Drip Laterals.
 - A. As presented in drawing and installation details.
- II. Inline Drip Tubing:
 - A. Tubing: Use UV resistant polyethylene drip tubing with integral pressure compensating drip emitters. Emitter spacing as noted in drawings and installation details. Use emitters that are pressure compensating from 8 to 70 PSI. Use tubing with O.D. of 0.660", and I.D. of 0.560". Use tubing stakes or landscape fabric staples to hold above-ground pipe in place.
 - B. Blank Drip Tubing: Use UV resistant polyethylene blank tubing for supply and exhaust manifolds with flows less than five (5) GPM, and start connections between manifolds and drip tubing. Use PVC insert line fittings compatible with inline drip tubing. Compression fittings will not be allowed. Use blank tubing from same manufacture as inline drip tubing.
 - C. Flush Valve Assembly: As presented in drawings and installation details.

2.08 CONTROL SYSTEM COMPONENTS:

- A. Automatic Controller (2-Wire) - Size and type shown on Drawings; mounted as detailed.
 - 1. Single Station Decoders (2-Wire) - Size and type shown on Drawings; mounted as detailed.
 - a. Install decoders and wire per manufacture recommendations and requirements.
 - b. Grounding for all decoders and 2-wire cable, to be per manufactures recommendations and requirements. Minimum one grounding assembly per every 600' of wire and at all ends of the wire runs.
- B. Baseline Controller Assembly: All incidental parts which are not specified herein and are necessary to complete the system shall be furnished and installed as though such parts were shown on plans or specified. All systems shall be in satisfactory operation at the time of completion. Contractor is responsible to meet with designated City of Greeley Parks Division staff as well as Denver Brass and Copper Technical Services Staff to determine appropriate communication path from the below options BEFORE PACKAGE SYSTEM IS TO BE

ORDERED. Contractor is also required to provide designated City of Greeley Parks Division Staff with a final Denver Brass and Copper Package System final sales order for approval BEFORE ordering of system occurs. (refer to supplemental Baseline Specification section).

1. Lightning protection: Provide one 4" x 96" x 0.0625" ground plate, one 5/8"x10 foot copper clad UL listed grounding rod, 30 feet of #6 AWG bare copper grounding wire, and one CADWELD connector, and two 6-inch round valve boxes at each satellite controller group. Contractor responsible for adding to the grounding path until test measures 10 ohms or less.
2. Wire markers: Pre-numbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
3. Power Wire:
 - A. Electric wire from the power source to satellite control unit shall be solid or stranded copper, Type UF single conductor cable or multi-conductor with ground cable, UL approved for direct underground burial. Power wires shall be black, white, and green in color. The Contractor is responsible for verifying that the power wire sizes are compatible and adequate for the control system being used.
 - B. Splices: Use 3M 82-A series connectors.
 - C. Conduit: PVC Schedule 40.
 - D. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored yellow, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW"
4. Control Wire:
 - A. Low Voltage:
 1. Electrical Control Wire - UFUL approved No. 12/12 (2-wire Paige #170116RB or as per manufactures requirements) direct burial copper wire to operate system as designed.
 2. If multiple controllers are utilized, refer to wire routing plan for individual wire runs.
 3. Control Wire connections and splices shall be made with 3M DBRy-6 direct bury splice.
 4. Loop five (5) feet minimum of 2-wire cable into all valve boxes.
 5. If multiple controllers are utilized, each controller shall have it's own 2-wire cable run, controllers cannot be connected with same 2-wire run.
 - B. Warning tape: Insert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be

encountered in soils. Three inches wide, colored yellow, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

2.09 OTHER COMPONENTS SUPPLIED BY CONTRACTOR:

- I. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- II. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.
- III.

PART 3: EXECUTION

3.01 INSPECTIONS AND REVIEWS:

- I. Site Inspections:
 - A. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.
 - B. Beginning work of this section implies acceptance of existing conditions.
- II. Utility Locates ("Utility Notification Center of Colorado"):
 - A. Arrange for and coordinate with local authorities the location of all underground utilities.
 - B. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
 - C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the Owner's Representative one week in advance of review. Modifications will be identified by the Owner's Representative at this review.

3.02 LAYOUT OF WORK:

- I. Stake out the irrigation system. Items staked include: back flow device, sprinklers, mainline and lateral pipe, control valves, quick coupling valves, controller, and isolation valves.
- II. Install all mainline pipe and mainline components inside of project property lines.

3.03 EXCAVATION, TRENCHING, AND BACKFILLING:

- I. Excavate to permit the pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.
- II. Minimum cover (distance from top of pipe or control wire to finish grade):
 - A. 24-inches over mainline pipe and over electrical conduit.

- B. 28-inches over control wire.
 - C. 18-inches over lateral pipe to sprinklers.
- III. Maintain at least 15-feet clearance from the centerline of any tree.
 - IV. PVC lateral pipes may be pulled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling. Minimum burial depths equal minimum cover listed above.
 - V. Backfill only after lines have been reviewed and tested.
 - VI. Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects that may damage the pipe.
 - VII. Backfill unsleeved pipe in either of the following manners:
 - A. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
 - B. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting to the density of surrounding soil.
 - VIII. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78. Use of water for compaction around sleeves, "puddling", will not be permitted.
 - XI. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades.
 - XI. Where utilities conflict with irrigation trenching and pipe work, contact the Owner's Representative for trench depth adjustments.
- 3.04 SLEEVING AND BORING:
- I. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
 - II. Extend sleeve ends six inches beyond the edge of the paved surface. Cover pipe ends and mark with stakes.
 - III. Bore for sleeves under obstructions that cannot be removed. Employ equipment and methods designed for horizontal boring. Hand excavating under sidewalks and hardscapes will not be allowed.

3.05 ASSEMBLING PIPE AND FITTINGS:

I. General:

- A. Keep pipe free from dirt and pipe scale Cut pipe ends square and debur. Clean pipe ends.
- B. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
- C. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset will be based on manufactures recommendations. Installer will be required to provide chart of allowable deflection with pipe submittals. No deflection will be allowed at a pipe joint.

II. Mainline Pipe and Fittings:

- A. Use only strap-type friction wrenches for threaded plastic pipe.
- B. PVC Rubber-Gasket Pipe:
 - 1. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
 - 2. Ductile iron fittings shall not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.
- C. PVC Solvent Weld Pipe:
 - 1. Use primer and solvent cement. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.
 - 2. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
 - 3. Snake pipe from side to side within the trench.
- D. Fittings: The use of cross type fittings is not permitted. Do not strike ductile iron fittings with metallic tools. Cushion blows with wood block or similar shock absorber

III. Lateral Pipe and Fittings:

- A. Use only strap-type friction wrenches for threaded plastic pipe.
- B. PVC Solvent Weld Pipe:
 - 1. Use primer and solvent cement. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.
 - 2. Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.
 - 3. Snake pipe from side to side within the trench.
- C. Fittings: The use of cross type fittings is not permitted.

IV. Specialized Pipe and Fittings:

- A. Low Density Polyethylene Hose: Install per manufacturer's recommendations.
- B. Flanged connections: Install stainless steel studs and nuts and rubber

gaskets per manufacturer's recommendations.

C. PVC Threaded Connections:

1. Use only factory-formed threads. Field-cut threads are not permitted.
2. Use only non-hardening, nontoxic thread sealant.
3. When connection is plastic-to-metal, the plastic component shall have male threads and the metal component shall have female threads.

D. Make metal-to-metal, threaded connections with non-hardening, nontoxic pipe sealant applied to the male threads only.

E. Copper Pipe:

1. Use flux and solder. Join pipe in manner recommended by manufacturer and in accordance with local codes and accepted industry practices.
2. Solder so that continuous bead shows around the joint circumference.

3.06 INSTALLATION OF MAINLINE COMPONENTS:

- I. Master Valve Assembly: Install where indicated on the drawings.
- II. Flow Sensor Assembly: Install where indicated on the drawings according to manufactures installation guidelines.
- III. Isolation Gate Valve Assembly:
 - A. Install where indicated on the drawings.
 - B. Locate at least 12-inches from and align with adjacent walls or edges of paved areas.
- IV. Quick Coupling Valve Assembly: Install where indicated on the drawings.

3.07 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS:

I. Remote Control Valve (RCV) Assembly for Sprinkler Laterals:

- A. Flush mainline before installation of RCV assembly.
- B. Install where indicated on the drawings. Connect control wires to remote control valve wires using 3M DBY-6 or DBR-6 waterproof connectors. Install connectors per the manufacturer's recommendations.
- C. Install only one RCV to a valve box. Locate valve box at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Arrange grouped valve boxes in rectangular patterns. Allow at least 12-inches between valve boxes.
- D. Attach ID tag with controller station number to control wiring.
- E. Install 2-wire decoder, per manufacture standards and recommendations.
- F. Brand valve box lid with appropriate station number for each remote control valve. Branding device must create letters a minimum of 3-inches in height and 0.2-inches deep in lid.

II. Sprinkler Assembly:

- A. Flush lateral pipe before installing sprinkler assembly.
- B. Install per the installation details at locations shown on the drawings.
- C. Locate rotary sprinklers 6-inches from adjacent walls, fences, or edges of paved areas.
- D. Locate spray sprinklers 3-inches from adjacent walls, fences, or edges of paved areas.
- E. Install sprinklers perpendicular to the finish grade.
- F. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
- G. Adjust the radius of throw of each sprinkler for best performance.

III. Sprinkler Pressure Test Kit (if applicable):

- A. Use a Pitot tube and pressure gauge at the worst-case rotor sprinkler assembly, from the respective remote control valve. Adjust PRS-Dial at each rotor remote control valve, to provide the design operating pressure at the worst-case rotor sprinkler head. Typically the worst-case sprinkler is the sprinkler furthest from the remote control valve. Complete pressure adjustment for every rotor remote control valve.
- B. Using pressure gauge and necessary fittings, place pressure gauge on worst-case spray sprinkler, from the respective remote control valve. Adjust PRS-Dial at each spray remote control valve to provide an operating pressure of 30 PSI at the worst-case spray sprinkler head. Typically the worst-case sprinkler is the sprinkler furthest from the remote control valve. Complete pressure adjustment for each spray remote control valve.
- C. Turn over Pitot tube and pressure gauge to the City of Greeley at completion of construction.

3.08 INSTALLATION OF DRIP IRRIGATION COMPONENTS:

I. Remote Control Valve (RCV) Assembly for Drip Laterals:

- A. Flush mainline pipe before installing RCV assembly.
- B. Locate as shown on drawings. Connect control wires to remote control valve wires using wire connectors and waterproof sealant. Provide 3M DBRY-6 or DBR-6 connectors and sealant per manufacturer's recommendations.
- C. Install only one RCV per valve box. Locate at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV

- assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12-inches between valve boxes. Brand controller letter and station number on valve box lid in 2-inch high letters.
- D. Arrange grouped valve boxes in rectangular patterns.
- II. Inline Drip Tubing: Install inline drip tubing components in strict accordance with tubing manufacturer's details, guidelines, and recommendations.
- III. Flush Valve Assembly: Provide at end of each dripper line grid as show and directed on drawings and installation details. Install at least 12-inches from and align with adjacent walls or edges of paved areas. Brand "FV" on valve box lid in 2-inch high letters.

3.09 INSTALLATION OF CONTROL SYSTEM COMPONENTS:

- I. Satellite Controller Assemblies:
 - A. The location of the Controller Assemblies as depicted on the drawings is approximate; the Project Manager will determine the exact site location during sprinkler layout review.
 - B. Assemble controller assembly, sensors, and appurtenance controller enclosure per authorized manufacturer representative recommendation and shop drawings. Provide pre-fabrication and testing of controller assembly by authorized Baseline distributor representative prior to installation in field. Provide installation observation and wire connections in field by manufacturer's personnel or trained distributor personnel.
 - C. Provide combination switch/GFCI outlet in accordance with local codes inside satellite controller assembly enclosure.
 - D. Provide electrical service connection for Controller Assemblies under direction and observation of manufactures' personnel or trained distributor personnel. Utilize existing electrical source. Provide primary surge protection arrestors on incoming power lines in accordance with control system manufacturer recommendations.
 - E. Lightning protection: Drive grounding rod into soil its full length. Space rod and grounding plate according to manufactures installation guidelines regarding spacing from controller in order to achieve 10 ohms or less upon testing. Connect #6 AWG copper grounding wire to rod from plate using CADWELD connection. Install 6-inch round valve box over each CADWELD connection and grounding plate connection. Connection of grounding wire to the satellite must be per satellite manufacturer or distributor's recommendations.
 - F. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
 - G. Connect control wires to the corresponding controller terminal.
- II. Power Wire:
 - A. Install with a minimum number of field splices. If a power wire must be

spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 12-inch standard valve box. Coil 2 feet of wire in valve box.

- B. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
- C. Green wire shall be used as the ground wire from power source to all satellites.
- D. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
- E. Unless noted on plans, install wire parallel with mainline pipe. Install wire a minimum of 2-inches below top of PVC mainline pipe.
- F. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.

III. 2- Wire cable:

- A. Install with mainline pipe wrapping with tape spaced at 10-foot intervals.
- B. Provide a 24-inch excess length of 2-wire cable in an 8-inch diameter loop at each 90-degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 5' length of 2-wire cable within each remote control valve box.
- C. If a 2-wire cable must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in a valve box that contains an irrigation valve assembly, or in a separate 12-inch standard valve box. Use same procedure for connection to valves as for in-line splices.
- D. Unless noted on plans, install wire parallel with and below PVC mainline pipe.
- E. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill six inches above the wiring.

3.10 INSTALLATION OF OTHER COMPONENTS:

- I. Tools and Spare Parts: Prior to the Review at completion of construction, supply to the Owner operating keys, servicing tools, spare parts, and any other items indicated in the General Notes on the drawings.
- II. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.11 PROJECT RECORD DRAWINGS:

- I. The Contractor is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built

information is recorded.

- II. Record pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each backflow prevention device, each controller or control unit, each sleeve end, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within a valve box.
 - III. Prior to construction completion, obtain from the Owner's Representative an AutoCAD data file for this project. Using CAD, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing".
Data delivered should conform to the current coordinate system used by the City of Greeley which is HARN NAD83 Stateplane US Survey Feet Northern Colorado projection. Vertical values should be captured in NAVD 88. Reference control point data can be obtained via the City of Greeley's web site within the GIS page or by contacting the GIS division at 970-350-9300.
 - IV. Turn over the "Record Drawings" to the Owner's Representative. Completion of the Record Drawings will be a prerequisite for the Review at the completion of the irrigation system installation.
 - V. Installer will be required to turn over a list of valves and corresponding decoder numbers installed in field.
- 3.12 WINTERIZATION AND SPRING START-UP:
- I. Winterize the irrigation system in the fall after the installation, and start-up the irrigation system the following spring. Repair any damage caused in improper winterization at no additional cost to the Owner. Coordinate the winterization and start-up with the landscape maintenance personnel.
- 3.13 MAINTENANCE:
- I. Upon completion of construction and Review by the Owner's Representative, maintain irrigation system for a duration of 30 calendar days. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.
 - II. Following completion of the Contractor's maintenance period, the Owner will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage after the landscape maintenance operation.
- 3.14 CLEANUP:

- I. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.

CITY OF GREELEY IRRIGATION CONTROLLER SPECIFICATION

Baseline Specification

All irrigation controllers and online web management platform will be as manufactured by Baseline Control Systems. Controllers will be Base Station 3200 painted steel wall mounts and/or stainless-steel pedestals.

BaseManager Online Management System

Real-time internet connectivity that works on any web enabled device. With the ability to run any number of controllers across two controller platforms, using one interface.

Map-based user interface utilizing Bing maps with interactive map icons, giving the user the ability to turn zones on and off with user defined runtime, learn flow on a single station, chart zone activity, view what programs the zone is in and its associated runtime, test electrical circuit providing an AC voltage at the solenoid, amp draw, voltage drop reading along the two-wire path, and custom notes. Ability to geo locate zones, master valves, moisture sensors, flow meters, hydrometers, event switches, temperature sensors, and custom markers on map interface through mobile access. Interactive map icons must be color coded with 11 different colors displaying current status of that device. Colors for zone icon activity status and program status must transcend the entire control platform from controller face plate, to mobile phone access, internet and or self-hosted management platform. System can be configured to send alerts and messages via text message and email.

All sensor status and activity must be available in all access points from controller, to mobile phone, and web platform access. System must be able to interface with a rain switch in a manner that allows for user defined start, stop and pause conditions. Weather Access and weather-based schedules programmed on a by zone basis in watering schedule, with the ability to combine timed runtimes, weather-based runtimes and soil moisture-based runtimes in the same program. Allowing for a combination of weather-based or soil moisture activated runtimes on the same zones, depending on specific needs.

Allow the ability to customize zone names, sensor names, and program names and populate those customized descriptions throughout the entire platform from controller face plate, to mobile phone access, internet and or self-hosted management platform.

Requires the ability to manage controller access between users, giving users access to specific controllers, while other users have access to the same controllers or different controllers.

Basemanager must be available as a cloud-based service provided by Baseline Systems, as a subscription- based access platform or a self-hosted server or virtual machine server-based platform.

Minimum security protocol requirements: AES256-bit encryption along with the TLS1.2 protocol.

Baseline Communication Methods

All controllers must have the capability of utilizing all of the following methods of communication. Cellular (minimum of 4G), Ethernet, 900Mhz Ethernet Radio, Wi-Fi, and Two-Wire as a true two-way communication path. Must have the ability to connect to the online central without the use of a cellular modem device. Also, must be able to utilize 900Mhz Ethernet radio to connect multiple controllers to the internet through a single controller Ethernet and/or Cellular access point. Controller supports up to 8 available addresses for TCP/IP-based connections. These addresses are used to connect the following performance components: Flow station, SubStation, and Munro Pump Station.

Baseline Controller and Two-Wire Specification

Wall mount controllers will be in powder coated steel or 304 grade stainless steel cabinets. Pedestal mount controllers will be in 304 grade stainless steel flip top pedestals mounts. Wall mount controller dimensions are: 15.5" x 12.38" x 6.4", 16-gauge powder coated steel or stainless steel. Pedestal mount enclosure dimensions are: 17.38" x 36.25" x 12.63" 16-gauge stainless steel. Controller display will meet the following minimum requirements: Built in full color display with High contrast 3.5-inch TFT LCD screen, resolution is 320x240 at 65,536 colors, screen brightness of 200 lumens for easy viewing in direct sunlight. Controllers must have a built in Ethernet port and be capable of running two-wire and conventional wire out of the same controller. With a zone count of up to 200 stations per controller in any combination of conventional and decoder stations, not exceeding the 200 stations. Controllers must utilize true two-way communication on the two-wire path. Controller is capable of operating non-irrigation zones with ease. Controller allows for operation of 15 concurrent zones and a up to 99 concurrent zones through the use of SubStations. Allows for the ability to back up and restore all programming and historical data with any USB flash drive. Controller will store all program and history information in its non-volatile memory.

Controller will allow for the establishment of 3 levels of 4-digit PIN password protection: operator, programmer, and administrator.

Programming Features are as follows: All controllers must provide up to 99 automatic programs, with 8 programmable start times, allowing 1-15 concurrent zone to operate in each program, as long as it does not exceed the hydraulic and electrical limitations of the system. Controller will be able to utilize weather-based schedules, moisture sensor-based schedules and traditional runtime-based schedules, and will allow for all three of these methods to be utilized in the same program. Other programming features must include: Water source prioritization, program prioritization, and intelligent water rationing. The controller allows a program to be started by the following options: Start time, moisture percent, temperature value, event switch contacts open or closed, pressure sensor readings.

Each controller must be able to read and manage up to 8 master valves and 8 flow sensors and utilize pressure readings to stabilize flow. Every controller will have the ability to monitor up to 25 soil moisture sensors. Pressure sensors can be used to create start, stop or pause conditions based on a user defined pressure reading. Controller will search for and identify all devices connected to the two-wire path and lists them according to device type and serial number.

Messaging and Alerts: Provides real-time soil moisture measurements and watering feedback to the user, alerts and alarms are self-diagnosed and displayed on the screen. Displays on-screen historical-run-time chart that includes time watered for the last 6 days of program, and a historical water use chart showing actual water used for the last 6 days by flow meter. Displays a 6-day scalable soil moisture history graph with integrated run-time bar chart. Displays high flow alerts, low flow alerts, pause messages and conditions, rain delays, wire faults, and other operating conditions.

Decoders will have built in diagnostic LED indicator lights that tell you at a glance the device is working. Two-wire must utilize true two-way communication on the two-wire path. Requires smart two-way communication allowing you to assign any decoder to a zone or function from the controller after the decoder has been installed in the field. Multi-station decoders can be assigned any station number in any order.

Available devices for two-wire include but are not limited to the following: Single station decoder, two station decoder, four station decoder, master valve decoder, dc latching decoder, event decoder, pump start switching decoder, flow decoder, pause decoder and coach's button, and pressure sensor decoder. Controller must be able to identify every two-wire device connected to the two-wire path and must be able to list them in the controller. Controller is capable of re-addressing any

station decoder to a new station number while leaving it installed in the field, by re-assigning the devices serial number to a new station number.

All decoders will be fully sealed, submersion-proof, and approved for direct bury, and will carry a standard 5-year warranty out of the box.

Acceptable wire and wire connectors for two-wire path: Paige P7072D or Regency 14/2 and 12/2 Maxi Wire, connectors will be DBR/Y-6. Other wire and wire connectors may be approved as an equal but must be submitted to owner prior to installation, and owner makes all final decisions on all specifications.

Controller and Two-Wire Path Grounding and Surge Protection Specification

All installations should conform to manufacturer's instructions and must meet or exceed the American Society of Irrigation Consultants (ASIC) Earth Grounding Electronic Equipment in Irrigation Systems—Guidelines (<http://www.asic.org>).

Grounding Electrodes In all cases where it does not conflict with appropriate grounding grid design for the site in question, grounding electrodes (such as rods or plates) referred to in this specification must conform to the following standards.

Grounding Rods:

- All grounding rods must be bare copper of 5/8" diameter or greater and a minimum of 8' length or longer.
- Grounding rods must be located at a minimum distance to assure that the two-wire path is outside of the electrode sphere of influence for the grounding rod. For an 8' grounding rod, this means that the grounding rod must be connected at least 8' away from the two-wire path, at a right angle to the two-wire path. See the BL-LA01 Surge Arrestor Installation Guide for details on connecting the grounding rod to the device or surge arrestor.
- Install all grounding rods in a 10-inch round valve box to facilitate the use of a clamp-on ground resistance tester. If you use a smaller box, you will not be able to clamp the tester around the ground rod or the conductor.
- Drive grounding rods into the ground to a minimum of 8' in a vertical or oblique position. The angle of the rod relative to the vertical must be no more than 45°.

Grounding Plates:

- All grounding plates must be a minimum of 5 square feet, as outlined in ASIC Earth Grounding Electronic Equipment in Irrigation Systems—Guidelines.
- Grounding plates must be located a distance equal to the diagonal measurement (the distance from one corner of the grounding plate to the

opposite corner) of the grounding plate from the two-wire path. The longest side of the grounding plate must run parallel to the two-wire path.

- Install grounding plates in a horizontal position a minimum of 30" below ground level and below the frost line. Position the plate flat at the bottom of the trench.

Consult the ASIC Earth Grounding Electronic Equipment in Irrigation Systems—Guidelines for correct minimum recommended distances for different grounding rod or grounding plate sizes and grounding grid designs.

Connections to Grounding Rods & Plates:

All connections to grounding rods/plates must conform to ASIC Earth Grounding Electronic Equipment in Irrigation Systems—Guidelines and must consist of either a CADWELD type or screw clamp type of connection. CADWELD or equivalent connections are preferred. All clamps must be suitable for direct burial or exothermic weld. The resistance reading on this connection should be less than 1milliohm.

Any wire extensions required to connect from a grounding rod to a surge arrestor or enclosure ground lug must be 6-gauge bare copper wire and must not have any sharp bends, coils, or kinks. Wire extensions connected to surge arrestors must use a split bolt connector, CADWELD connector, or screw clamp connector where the bare copper ground wire meets the green grounding wire from the surge arrestor.

Never use solder to make connections in the grounding system because it will melt during a lightning discharge.

Grounding Options:

While the best option for grounding irrigation equipment is a direct physical connection to the earth, there are times when this is impossible or impractical. The following options are available for special cases. All other requirements in Baseline's Grounding Specifications apply.

- **Controller Enclosure:** When direct physical connection to the earth is not possible, the irrigation controller's enclosure ground can be connected to the building ground. However, DO NOT connect the two-wire surge arrestor ground to the building ground. The ground on an electrical receptacle (outlet) is not allowed, and is not sufficient.
- **Irrigation System on a Green Roof or Green Wall:** When grounding the irrigation system on a green roof or green wall, the irrigation controller's enclosure ground can be connected to the building ground, and it is acceptable to connect the green wire from each surge arrestor to the building system ground.

Two-wire Grounding with Surge Arrestors:

The surge arrestor is a critical part of the surge protection scheme for the two-wire path. Surge arrestors attach directly to the two-wire path and help dissipate electricity generated by nearby lightning strikes and other electromagnetic events. While two-wire components have optical isolators and other surge arresting features, the surge arrestor provides an extra measure of protection. **IMPORTANT:** Surge arrestors are required for proper operation and for warranty coverage.

Installation of Surge Arrestors:

- Connects directly to the red and black wires
- Attaches to grounding rod via the green wire
- Install in a valve box
- Surge arrestors must be connected to bare copper ground wires using split bolt connectors, CADWELD connectors, or screw clamp connectors suitable for direct burial (no wire nuts of any kind are supported for grounding wires).

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Two-Wire Grounding Installation:

Two-wire supports a large number and variety of wiring configurations. As more wires are connected to a piece of electronic equipment, more lightning energy enters the equipment, and a more substantial grounding grid must be used. Consult the Baseline Two-Wire Specification for more details. The two-wire must have properly installed surge arrestors as outlined in the Baseline Surge Arrestor Install Guide and elsewhere in this document. Surge arrestors must be installed as outlined below:

- The first surge arrestor on the two-wire path must be within 25' of the controller. This grounding point must be separate from the irrigation controller's enclosure grounding point.
- Place a surge arrestor every 600' on the two-wire path. Each surge arrestor protects a 300-foot radius of the two-wire path.
- In lightning prone regions, consider grounding every 300' rather than going out to the maximum distance.
- There must be a surge arrestor at the end of the two-wire that is the maximum distance from the controller or if looped at the point of maximum distance from the controller.
- Any branch of the two-wire that exceeds 50' must have a surge arrestor at the end.
- On an uninterrupted run of more than 600', it is acceptable to have a surge arrestor at each end. Note: On any wire run with no splices, do not cut the wire to install a surge arrestor, just place one at the end.

Controllers in Steel Wall Mount Enclosures:

The following applies to all controllers, controller extensions, add on components, in steel wall mount enclosures. If the controller is on or within an existing building, the unit must be grounded as outlined below: The ground lug, located in the interior in the lower right region of the enclosure, must be connected directly to the building ground using a bare copper wire of 6 AWG or larger, as outlined in article 250 of the National Electric Code (NEC), so that a single point of connection with the building ground is achieved. If the controller is mounted at a remote location more than 25' away from the building or grounded AC power source, the unit must be grounded as outlined below: A bare copper grounding wire of 6 AWG or larger must be connected from the ground lug to an appropriate grounding rod as outlined in the previous sections of this document.

Controllers in Stainless Steel Enclosures:

If the controller is within 25' of an existing building, and is connected to the AC power system within that building, the unit must be grounded as outlined below: The ground lug, located in the interior on the back panel in the lower-left corner under the AC power box in the pedestal enclosure, must be connected directly to the building ground using a bare copper wire of 6 AWG or larger, as outlined in article 250 of the National Electric Code (NEC), so that a single point of connection with the building ground is achieved. If the controller is mounted at a remote location more than 25' away from a building or grounded AC power source, the unit must be grounded as outlined below: A bare copper grounding wire of 6 AWG or larger must be connected from the ground lug to an appropriate grounding rod as outlined in the previous sections, and in conformance with the ASIC Earth Grounding Electronic Equipment in Irrigation Systems– Guidelines. IMPORTANT: All clamps used to connect the 6 AWG wire to the grounding electrode must be suitable for direct burial or exothermic weld.

Baseline Extended Ten Warranty

All Baseline manufacturer specifications must be adhered to including all grounding specifications for the controller and or the two-wire path. Once the controller has been installed the contractor is required to have DBC Technical Service perform the Baseline/DBC Extended Warranty testing. All equipment must meet or exceed the testing standards set forth by Baseline Systems. Controllers must be grounded to 10 ohms or less. After you have installed your grounding system on the two-wire path, Baseline requires that you measure the ground resistance in order to prove that each grounding point meets Baseline's specifications. Resistance readings of 5 to 10 ohms are desirable, and a reading of no more than 25 ohms is required. DBC Technical Service will measure the ground resistance and will perform all other necessary testing, inspections and will submit all paperwork to Baseline for approval.

The Baseline Extended Ten Year Warranty Testing should be specified as follows:
DBC BASELINE EXTENDED WARRANTY CERTIFICATION DBC TO
PERFORM GROUNDING OHMS TEST AT CONTROLLERS AND ALONG TWO-
WIRE PATH GROUNDING RODS. CONTROLLERS MUST BE GROUNDED TO
10 OHMS OR LESS, AND TWO-WIRE GROUNDING RODS (5-10 OHMS
DESIRABLE) MUST BE 25 OHMS OR LESS. INCLUDES ALL
FIELD INSPECTIONS AND SUBMISSION TO BASELINE FOR APPROVAL.

Important: Consult Baseline's Two-Wire Technical Specification and the Surge
Arrestor & Grounding Specification for details on surge protection installation.
Failure to install surge protection hardware to specification will void surge
protection coverage under this warranty.

THIS WARRANTY IS LIMITED SOLELY TO BASELINE EQUIPMENT, AND DOES
NOT WARRANT AGAINST DAMAGE CAUSED BY LIGHTNING OR OTHER
POWER SURGES TO NON-BASELINE EQUIPMENT, WIRING, LANDSCAPE,
OR FACILITIES. THIS WARRANTY DOES NOT COVER ANY EFFECTS TO
LANDSCAPE OR PROPERTY DUE TO BASELINE EQUIPMENT'S OPERATION
OR FAILURE TO OPERATE FOLLOWING A SURGE OR LIGHTNING STRIKE,
NOR DOES IT COVER LABOR COSTS ASSOCIATED WITH
TROUBLESHOOTING OR REPAIRS.

END OF SECTION

Bid Items 153 - 169 – WATERLINE ITEMS

All waterline work shall be per the City of Greeley Design Criteria and Construction Specification.

The individual pay items shall be complete compensation for all means, method, labor and materials for supplying and installation of individual items, including but not limited to excavation, bedding, and backfill.

**Storm Water Management Plan
for
20th Street Improvements
City of Greeley, Colorado**

1. This plan identifies potential sources of pollutants of storm water, presents pollution control measures, and assists in ensuring the implementation and maintenance of the Best Management Practices (BMPs) indicated herein. The intent of this Storm Water Pollution Prevention Plan (SWPPP) is to reduce pollution associated with this project to the maximum extent practicable.
2. In the event of a release of a reportable quantity of a pollutant, the Contractor shall advise the Owner to notify the response center and City of Greeley. If necessary, this pollution prevention plan may be revised to reflect the change in conditions of the construction activity. A reportable quantity is established by 40 Code of Federal Regulations (CFR) 117.3 or 40 CFR 302.4.
3. All contractors and their personnel whose work can contribute to or cause pollution of storm water should be made familiar with this pollution prevention plan. Adequate training for implementation of the measures presented herein shall be provided to the contractors and their personnel.
4. Changes in construction or in conditions which are not covered by this plan should be brought to the attention of the Owner. This pollution prevention plan should be revised to reflect the change in construction or in conditions.
5. All prevention and clean up measures should be conducted in accordance with City of Greeley ordinances, as well as state and federal regulations. Waste materials should be disposed of in a legal manner. All dischargers of storm water must comply with the lawful requirements of City of Greeley, Weld County and other local agencies regarding the discharges of storm water to storm drains and drainage channels.
6. This plan does not cover the removal of hazardous or toxic waste. In the event of a discharge or release of a reportable quantity of toxic waste, work should be stopped until the spill can be assessed and a mitigation report prepared by a qualified environmental consultant, and if necessary, reviewed by Weld County, City of Greeley and any other agency having jurisdiction.
7. Permits: The City of Greeley will obtain a storm water discharge permit from State of Colorado, Department of public Health & Environment, Water Quality Control Division for temporary storm water runoff from the approximate 14.70 acres construction site.
8. Contact Information:

Owner: City of Greeley
Project Manager, Eva Rojas
1001 9th Avenue, Greeley, CO 80631
970-350-9747

Contractor / Discharger: Company Name:
Contact Name:
Company Address:
Contact Phone:

Civil Engineer: J-U-B Engineers, Inc.
Jeff Temple, P.E.
4745 Boardwalk Drive, Building D, Suite 200, Fort Collins, CO 80525
970-377-3602

Regional Environmental Protection Agency
Region VIII EPA, Denver, Colorado
800-759-4372

Federal Environmental Protection Agency
U.S. EPA, Washington, D.C. 20460
202-475-9518

9. Site Description:

- A. The proposed construction activity involves roadway reconstruction and widening along 20th Street from 83rd Ave to 90th Ave. The project site encompasses approximately 14.70 acres in Greeley, Colorado. The project will include excavation, embankment, hot mix asphalt pavement, new concrete curb, gutter, concrete shared use path, storm drainage improvements, and miscellaneous site improvements associated with the new improvements.
- B. The site is generally fairly flat with roadway grades averaging approximately 0.6% - 2.9%. The proposed finish grade of the sidewalk will generally match the roadway grades. A larger embankment fill will occur at the 20th St. and 83rd Ave intersection and to the north to allow positive drainage at the intersection and meet ADA standards. Fill depths are approximately 1'-3' higher than the existing roadway.
- C. The project will include the construction of storm drainage piping improvements that will be stubbed out to the existing Sheep Draw Tributary north of 20th Street.
- D. Potential pollutants during construction are: generation of dust during mass grading, mud and debris being tracked into the streets, pipe primers and solvents for the pressure irrigation system, and fuels and fluids needed to operate and maintain construction equipment.

Best Management Practices (BMP's) to Reduce Pollution

- A. Prohibition on most non-storm water discharges: there is no offsite storm water entering the storm system. Clean, non-chlorinated water from the flushing of fire hydrants, water mains, and storm drains may be discharged to the storm drain if it is not allowed to collect dirt, debris and trash while flowing to a storm drain inlet.
- B. Sources of storm water pollutants: storm water pollutants include soil sediment and nutrients, solvents, and typical vehicle gases, oils and fuels. Sources of storm water pollutants include but are not limited to soil erosion by water and/or wind; clearing of vegetation; grading; paints, solvents and adhesives; and landscaping work.
- C. Erosion and sediment controls:
 - 1. Areas will only be disturbed when needed.
 - 2. Long term stockpile areas (areas where stockpiles will lay dormant for four weeks or more) will be protected using perimeter containment berms or silt fencing.

3. Re-vegetate areas where landscaping has died or not taken hold.
4. Stabilize all construction site entrances to the site with a temporary or permanent material. This is intended to reduce significant amounts of mud-tracking onto the existing streets.
5. Storm water inlets: Provide protection for all storm water inlets as identified on Sediment and Erosion Control Plans of the construction drawings to be clean and free of dirt and debris. Refer to detail sheets for additional inlet protection details and requirements.
6. Provide a sign to identify the concrete washout area to truck drivers. The sign shall read "CONCRETE WASHOUT AREA."

D. Other controls

1. Waste disposal:
 - a. Keep waste disposal containers covered.
 - b. Provide for the disposal of waste containers every other week (or more frequent, if necessary).
 - c. Provide containers at convenient locations around the site.
2. Sweeping of site:
 - a. Provide sweeping by hand or mechanical means every other week to keep the paved areas of the site free of dust, dirt, and debris. Sweeping of streets during stormy periods may be required more frequently.
 - b. Dispose of accumulated dirt in waste containers, or haul it off the site to a landfill.
3. Sanitary sewer:
 - a. Provide and maintain restroom facilities.
4. Spills:
 - a. Store adequate absorbent materials, rags, brooms, shovels, and waste containers on the site to clean-up spills of materials such as fuel, paint, solvents, or cleaners. Clean up minor spills immediately.
 - b. For reportable quantity of hazardous or toxic substance, secure the services of qualified personnel for clean-up and disposal.
5. Landscaping operations
 - a. Use only the minimum amount of landscaping fertilizers, nutrients, and other chemicals that are needed.
 - b. Do not over-water fertilized or treated landscape areas. Minimize runoff of irrigation water from landscaping.

E. Final stabilization and post-construction controls

1. After construction has been completed, the site shall be swept clean, storm water inlets (grates and basins) shall be cleaned, and all waste and leftover materials shall be removed from the site.

2. All landscaping and planting areas should be well maintained to prevent erosion. Avoid over watering of landscaping.
3. All paved and sidewalk areas should be swept either by hand or by mechanical means to keep the site clear of dirt, dust, and debris.
4. Waste materials should be removed from the site and properly disposed of.
5. Storm drain lines should be checked and cleaned annually to keep them clean and clear of debris.
6. All on-site storm water inlets should be clearly marked "storm water only".
7. Temporary BMPs should be removed once the site is stabilized.
8. Permanent BMPs include detention basins, surface drainage across grass areas and re-vegetation.

BMP Inspection (Provided by the City of Greeley)

1. Discharger Responsibility: All dischargers are required to: conduct inspections of the construction site prior to anticipated storm events and after actual storm events, to identify areas contributing to a storm water discharge, to evaluate whether measures to reduce pollutant loadings identified in this SWPPP are adequate, to properly implement in accordance with the terms of the general permit, and to determine whether additional control practices are needed.
2. Frequency: Regular interval inspection to occur at a minimum of every 14 days and also before anticipated storm events and within 24 hours after storm events of ½ inch of moisture or more. Inspections shall continue until the site is stabilized.
3. Documentation: Contractor must keep an inspection log on site at all times until construction is complete. If modifications to this plan are required, the modifications must be made within 7 calendar days of inspected deficiency. Inspection report must be signed and dated by the inspector.
4. Deficiencies: All deficiencies identified in the scheduled report must be corrected by the discharger within 7 calendar days of the notice of deficiency.
5. Retention of Records: The discharger is required to retain records of all monitoring information, copies of all reports required by this general permit, and records of all data used to complete the notice of intent for construction activity for a period of at least three years. This period may be extended by request of the State. With the exception of noncompliance reporting, dischargers are not required to submit the records except upon specific request by the State of Colorado Division of Water Quality.

Maintenance of Controls (Contractor)

1. Maintenance and Repair: All controls and measures indicated on this plan should be maintained in good and effective condition. If any controls or measures are damaged or removed, they should be promptly repaired or restored.
2. Plan Revisions: If construction activity or conditions change from those shown in this plan, then this plan shall be revised to reflect the current conditions. An updated copy of this site

plan shall be kept on site at all times during construction. All revisions shall be noted with a signed acknowledgment of the change at the end of this document.

3. Accumulated Sediment: Sediment that has accumulated inside control structures, pipes, or conveyances must be removed when the capacity of the structure, pipe, or conveyance has been reduced by 50% of the available full capacity.

Completion of Construction Activities and Notice of Termination:

1. Transfer to City: At the completion of construction activities the Contractor shall transfer maintenance responsibilities of ongoing BMP's to the City. This transfer shall include transfer of all operation and maintenance manuals and maintenance instructions.
2. Removal of Temporary BMP's: After the area has been stabilized and a notice of termination has been received, all temporary erosion control measures shall be removed in a manner that minimizes disturbance to the site.

Geotechnical Engineering Report

20th Street Reconstruction
20th Street from 83rd Avenue to 86th Avenue

Greeley, Colorado

March 7, 2016

Terracon Project No. 21155061

Prepared for:

J-U-B Engineers, Inc.
Boise, Idaho

Prepared by:

Terracon Consultants, Inc.
Greeley, Colorado

Offices Nationwide
Employee-Owned

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Geotechnical ■ Environmental ■ Construction Materials ■ Facilities



March 7, 2016

J-U-B Engineers, Inc.
250 South Beechwood Avenue, Suite 201
Boise, Idaho 83709

Attn: Mr. Brian Smith, P.E. – Project Manager / Area Manager
P: (208) 376-7330
E: bsmith@jub.com

Re: Geotechnical Engineering Report
20th Street Reconstruction
20th Street from 83rd Avenue to 86th Avenue
Greeley, Colorado
Terracon Project No. 21155061

Dear Mr. Smith:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the project referenced above. These services were performed in general accordance with our Proposal No. P21150052 dated June 16, 2015. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Bryce C. Reeves, E.I.
Geotechnical Engineer

Eric D. Bernhardt, P.E.
Geotechnical Department Manager

Enclosures

Copies to: Addressee (via e-mail)

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EXECUTIVE SUMMARY

A geotechnical investigation has been performed for the proposed 20th Street Reconstruction from 83rd Avenue to 86th Avenue in Greeley, Colorado. Three (3) borings, presented as Exhibits A-4 through A-6 and designated as Boring No. 1 through Boring No. 3, were performed to depths of approximately 5 to 10 feet below existing site grades. This report specifically addresses the recommendations for the proposed pavements. Borings performed in these areas are for informational purposes and will be utilized by others.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. However, the following geotechnical considerations were identified and will need to be considered:

- Existing fill was encountered in the borings performed on this site to depths ranging from about 2 to 5½ feet below existing pavements. We do not possess any information regarding whether the fill was placed under the observation of a geotechnical engineer. Recommendations for the existing fill materials are presented in this report.
- The existing on-site soils are suitable for use as engineered fill below new pavements, curb and gutter, and median flatwork provided they are moisture conditioned and compacted as presented in the **4.2 Earthwork** section of this report.
- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
20th Street Reconstruction
20th Street from 83rd Avenue to 86th Avenue
Greeley, Colorado
Terracon Project No. 21155061
March 7, 2016

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed 20th Street Reconstruction from 83rd Avenue to 86th Avenue in Greeley, Colorado (Exhibit A-1). The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- grading and drainage
- pavement construction
- earthwork

Our geotechnical engineering scope of work for this project included the initial site visit, the advancement of 3 test borings to depths ranging from approximately 5 to 10 feet below existing site grades, laboratory testing for soil engineering properties and engineering analyses to provide pavement design and construction recommendations.

Logs of the borings along with an Exploration Plan (Exhibit A-2) are included in Appendix A. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B.

Previously, Terracon prepared a Geotechnical Engineering Report (project No. 21145023; report dated October 30, 2014) for the 20th Street project from 71st Avenue to 83rd Avenue. Information from the previous study was used in the evaluation of the current project.

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	Refer to the Exploration Plan (Exhibit A-2 in Appendix A)
Traffic loading	The design equivalent single-axle loads (ESAL's) was selected from Table 2.08.1 in the 2015 City of Greeley Design Criteria and Construction Specifications: 4-Lane Arterial: 1,460,000

2.2 Site Location and Description

Item	Description
Location	The project site is located at 20 th Street from 83 rd Avenue to 86 th Avenue in Greeley, Colorado.
Planned Development	<p>We understand 20th Street will be reconstructed from 83rd Avenue to 86th Avenue in Greeley, Colorado. The reconstruction will likely include widening and the addition of lanes and / or turn lanes along the approximately 1,200 lineal feet of reconstruction.</p> <p>It should be noted that the City of Greeley Design Criteria and Construction Specifications requires a geotechnical investigation following changes in vertical profiles. Accordingly, the pavement design report we provide will be considered “Final” for areas where the vertical alignment does not change, and “Preliminary” for areas where the vertical alignment is adjusted.</p>
Existing site features	The existing alignment is a 2-lane minor arterial as classified by the City of Greeley.
Current ground cover	The existing roadway is paved with asphaltic cement.
Existing topography	The roadway surface is relatively flat.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs included in Appendix A. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Material Description	Approximate Depth to Bottom of Stratum (feet)	Consistency/Density/Hardness
Asphalt pavement	About 3 to 4 inches thick.	--
Aggregate base course	About 10 to 19 inches thick.	--
Silty sand with varying amounts of gravel	About 8 to 10 feet below existing grades.	Loose to medium dense
Sandy silty clay	About 10 feet below existing grade in Boring No. 1 only.	Stiff

3.2 Laboratory Testing

Samples of site soils selected for plasticity testing were non-plastic. Laboratory test results are presented in Appendix B.

3.3 Corrosion Protection (Water-Soluble Sulfates)

Results of water-soluble sulfate testing indicate that ASTM Type I or II portland cement should be specified for all project concrete on and below grade. Concrete should be designed for negligible sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

Terracon was requested to perform laboratory testing on soil samples collected from the site to determine the potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials that will be used for project construction. Laboratory test results for select samples tested exhibited the following properties:

Sample Identification	Water-Soluble Sulfate (%)	Redox Potential (mV)	Sulfide (presence)	Water-Soluble Chloride (%)	Electrical Resistivity ¹ (ohm-cm)	pH
Boring No. 1 at 2 feet	0.005	--	--	--	--	--
Boring No. 1 at 9 feet	0.004	338	Negative	0.1370	301	7.1
Boring No. 2 at 2 feet	0.016	--	--	--	--	--
Boring No. 2 at 4 feet	0.016	223	Trace	0.0163	1,245	7.7
Boring No. 3 at 9 feet	0.005	204	Negative	0.0023	2,519	7.8

1. Resistivity determined on saturated samples.

Terracon recommends providing the laboratory test results regarding potential corrosive characteristics of the on-site soils and bedrock materials encountered below this site to a corrosion specialist to interpret the data and incorporate the test results into the design and selection of below grade construction materials.

3.4 Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not observed in the borings while drilling, or for the short duration that the borings were allowed to remain open.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the project may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on subsurface conditions encountered in the borings, the site appears suitable for the proposed construction from a geotechnical point of view provided certain precautions and design and construction recommendations described in this report are followed. We have identified geotechnical conditions that could impact design and construction of the proposed pavements and other site improvements.

4.1.1 Existing Fill

As previously noted, existing fill was encountered to depths up to about 5½ feet in the borings drilled at the site. We do not possess any information regarding whether the fill was placed under the observation of a geotechnical engineer. However, we believe the fill was likely placed during the construction of West 20th Street. We recommend over-excavating the existing fill a minimum depth of 2 feet and replacing with moisture conditioned and compacted engineered fill as presented in the **4.2 Earthwork** section of this report before any new pavements are constructed. On-site soils are suitable for use as engineered fill.

Support of pavements on or above existing fill soils is discussed in this report. There is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by performing additional testing and evaluation.

4.2 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. All earthwork on the project should be observed and evaluated by Terracon on a full-time basis. The evaluation of earthwork should include observation of over-excavation operations, testing of engineered fills, subgrade preparation, subgrade stabilization, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

Prior to placing any fill, strip and remove existing vegetation (if any), existing pavements, and any other deleterious materials from the proposed construction areas.

Stripped organic materials should be wasted from the site or used to re-vegetate landscaped areas or exposed slopes after completion of grading operations. Prior to the placement of fills, the site should be graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath proposed structures.

If fill is placed in areas of the site where existing slopes are steeper than 5:1 (horizontal:vertical), the area should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be wide enough to accommodate compaction and earth moving equipment, and to allow placement of horizontal lifts of fill.

Demolition of the existing pavements should include complete removal of all pavements within the proposed construction area. This should include removal of any utilities to be abandoned along with any loose utility trench backfill or loose backfill found adjacent to existing foundations. Consideration could be given to re-using the asphalt and concrete (if any) provided the materials are processed and uniformly blended with the on-site soils. Asphalt and/or concrete materials should be processed to a maximum size of 2-inches and blended at a ratio of 30 percent asphalt/concrete to 70 percent of on-site soils.

4.2.2 Excavation

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

The soils to be excavated can vary significantly across the site as their classifications are based solely on the materials encountered in widely-spaced exploratory test borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

Although evidence of fills or underground facilities such as septic tanks, vaults, and basements was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Any over-excavation that extends below the bottom of the pavements should extend laterally beyond all edges of the pavements at least 8 inches per foot of over-excavation depth below the pavement base elevation. The over-excavation should be backfilled in accordance with the recommendations presented in this report.

Depending upon depth of excavation and seasonal conditions, surface water infiltration may be encountered in excavations on the site. It is anticipated that pumping from sumps may be utilized to control water within excavations.

The subgrade soil conditions should be evaluated during the excavation process and the stability of the soils determined at that time by the contractors' Competent Person. Slope inclinations flatter than the OSHA maximum values may have to be used. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance from the crest of the slope equal to the slope height. The exposed slope face should be protected against the elements.

4.2.3 Subgrade Preparation

After the recommended depth of over-excavation and any deleterious materials have been removed from the construction areas, the top 8 inches of the exposed ground surface should be scarified, moisture conditioned, and recompacted to at least 95 percent of the maximum dry unit weight as determined by AASHTO T99 before any new fill or pavement is placed.

If pockets of soft, loose, or otherwise unsuitable materials are encountered at the bottom of the foundation excavations and it is inconvenient to lower the foundations, the proposed foundation elevations may be reestablished by over-excavating the unsuitable soils and backfilling with compacted engineered fill.

After the bottom of the excavation has been compacted, engineered fill can be placed to bring the pavement subgrade to the desired grade. Engineered fill should be placed in accordance with the recommendations presented in subsequent sections of this report.

The stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Alternatively, over-excavation of wet zones and replacement with granular materials may be used, or crushed gravel and/or rock can be tracked or "crowded" into the unstable surface soil until a stable working surface is attained. Use of fly ash or geotextiles could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction. Lightweight excavation equipment may also be used to reduce subgrade pumping.

4.2.4 Fill Materials and Placement

The on-site soils or approved granular and low plasticity cohesive imported materials may be used as fill material. The soil removed from this site that is free of organic or objectionable materials, as defined by a Terracon representative who is qualified in soil material identification and compaction procedures, can be re-used as fill for the pavement subgrade. It should be noted that on-site soils will require reworking to adjust the moisture content to meet the compaction criteria.

Imported soils (if required) should meet the following material property requirements:

Gradation	Percent finer by weight (ASTM C136)
4"	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	5-50

Soil Properties	Value
Liquid Limit	30 (max.)
Plastic Limit	15 (max.)
Maximum Expansive Potential (%)	Non-expansive ¹

1. Measured on a sample compacted to approximately 95 percent of the maximum dry unit weight as determined by AASHTO T99 at optimum moisture content. The sample is confined under a 100 psf surcharge and submerged.

The recommendations for placement and compaction criteria presented assume that fill depths will be less than 8 feet. Fills on the order of 8 feet in depth, when placed and compacted as recommended in this report, will experience some settlement, generally 1 inch or less. The amount and rate of settlement will be increased if water is introduced into the fill. It is noted that settlement of the fill material due to self-weight is in addition to settlements due to induced loads. In areas where fill will be placed in thicknesses of 8 feet or more, we recommend increasing the minimum compaction requirements to 98 percent of the maximum dry unit weight as determined by AASHTO T99.

4.2.5 Compaction Requirements

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

Item	Description
Fill lift thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum compaction requirements	Fills less than 8 feet: 95 percent of the maximum dry unit weight as determined by AASHTO T99 Fills 8 feet or more: 98 percent of the maximum dry unit weight as determined by AASHTO T99
Moisture content cohesive soil (clay)	-1 to +3 % of the optimum moisture content
Moisture content cohesionless soil (sand)	-3 to +2 % of the optimum moisture content

1. We recommend engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the fill material pumping when proofrolled.
3. Moisture conditioned clay materials should not be allowed to dry out. A loss of moisture within these materials could result in an increase in the material's expansive potential. Subsequent wetting of these materials could result in undesirable movement.

4.2.6 Grading and Drainage

Positive drainage should be provided away from the pavements during construction and maintained throughout the life of the proposed project. Infiltration of water into utility excavations must be prevented during construction. Landscaped medians and other surface features which could retain water in areas adjacent to the pavements should be irrigated as little as possible to support plant growth. Excessive irrigation of the landscaped medians can result in the softening of the subgrade and aggregate base course and premature pavement distress or failure.

4.3 Pavements

4.3.1 Pavements – Subgrade Preparation

As previously discussed, this report may be used as a Final Pavement Design provided that the grade changes are less than 6 inches, per Section 2.06 of the City of Greeley Design Criteria and Construction Specifications. Should grade changes exceed 6 inches, an additional soil investigation will be required after final grades have been established.

On most project sites, the site grading is accomplished relatively early in the construction phase. Fills are typically placed and compacted in a uniform manner. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, or rainfall/snow melt. As a result, the pavement subgrade may not be suitable for pavement construction and corrective action will be required. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance or instability. We recommend the pavement subgrade be thoroughly proofrolled with a loaded tandem-axle dump truck prior to final grading and paving. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving.

4.3.2 Pavements – Design Recommendations

Design of pavements for the project have been based on the procedures outlined in the 1993 *Guideline for Design of Pavement Structures* prepared by the American Association of State Highway and Transportation Officials (AASHTO) and the City of Greeley Design Criteria and Construction Specifications.

The soils encountered in the upper portions of our borings consisted of silty sand. Therefore, we believe swell-mitigation of the subgrade materials prior to pavement operations will not be required.

We understand this section of 20th Street will likely include widening of the roadway. We have assumed this section of 20th Street will be classified as a 4-lane arterial. The City of Greeley Design Criteria and Construction Specifications Table 2.08.1 specifies the minimum design ESALs of 1,460,000 for a 20-year design period. These assumed traffic design values should be verified by the civil engineer prior to final design and construction. If the actual traffic values vary from the assumed values, the pavement thickness recommendations may not be applicable. When the actual traffic design information is available Terracon should be contacted so that the design recommendations can be reviewed and revised if necessary.

For flexible pavement design, a terminal serviceability index of 2.0 was utilized along with an inherent reliability of 90 percent and a design life of 20 years. Using the correlated design R-value of 15, appropriate ESAL, environmental criteria and other factors, the structural numbers (SN) of the pavement sections were determined on the basis of the 1993 AASHTO design equation.

In addition to the flexible pavement design analyses, a rigid pavement design analysis was completed based upon AASHTO design procedures. Rigid pavement design is based on an evaluation of the Modulus of Subgrade Reaction of the soils (k-value), the Modulus of Rupture of the concrete, and other factors previously outlined. The design k-value of 95 for the subgrade soil was determined by correlation to the laboratory test results. A modulus of rupture of 600 psi (working stress 450 psi) was used for pavement concrete. The rigid pavement thickness for each traffic category was determined on the basis of the AASHTO design equation.

Recommended minimum pavement sections are provided in the table below.

Traffic Area	Alternative	Recommended Pavement Thicknesses (Inches)			
		Asphaltic Concrete Surface	Aggregate Base Course	Portland Cement Concrete	Total
20 th Street	A	6½	12	--	18½
	B	--	4	8½	12½

Aggregate base course (if used on the site) should consist of a blend of sand and gravel which meets strict specifications for quality and gradation. Use of materials meeting Colorado Department of Transportation (CDOT) Class 5 or 6 specifications is recommended for aggregate base course. Aggregate base course should be placed in lifts not exceeding 6 inches and compacted to a minimum of 95 percent of the maximum dry unit weight as determined by AASHTO T99.

Asphaltic concrete should be composed of a mixture of aggregate, filler and additives (if required) and approved bituminous material. The asphalt concrete should conform to approved mix designs stating the Superpave properties, optimum asphalt content, job mix formula and recommended mixing and placing temperatures. Aggregate used in asphalt concrete should meet particular gradations. Material meeting CDOT Grading S specifications or equivalent is recommended for asphalt concrete. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in maximum 3-inch lifts and compacted within a range of 92 to 96 percent of the theoretical maximum (Rice) density (ASTM D2041).

Where rigid pavements are used, the concrete should be produced from an approved mix design with the following minimum properties:

Properties	Value
Compressive strength	4,000 psi
Cement type	Type I or II portland cement
Entrained air content (%)	5 to 8
Concrete aggregate	ASTM C33 and CDOT Section 703

Concrete should be deposited by truck mixers or agitators and placed a maximum of 90 minutes from the time the water is added to the mix. Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation per ACI 325. The location and extent of joints should be based upon the final pavement geometry. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Site grades should slope a minimum of 2 percent away from the pavements;
- The subgrade and the pavement surface have a minimum 2 percent slope to promote proper surface drainage;
- Consider appropriate edge drainage and pavement under drain systems;
- Install pavement drainage surrounding areas anticipated for frequent wetting;
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils; and
- Placing compacted, low permeability backfill against the exterior side of curb and gutter.

4.3.3 Pavements – Construction Considerations

Openings in pavement, such as landscape islands, are sources for water infiltration into surrounding pavements. Water collects in the islands and migrates into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

4.3.4 Pavements – Maintenance

Preventative maintenance should be planned and provided for an ongoing pavement management program in order to enhance future pavement performance. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, pavement construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or

Geotechnical Engineering Report

20th Street Reconstruction ■ Greeley, Colorado

March 7, 2016 ■ Terracon Project No. 21155061



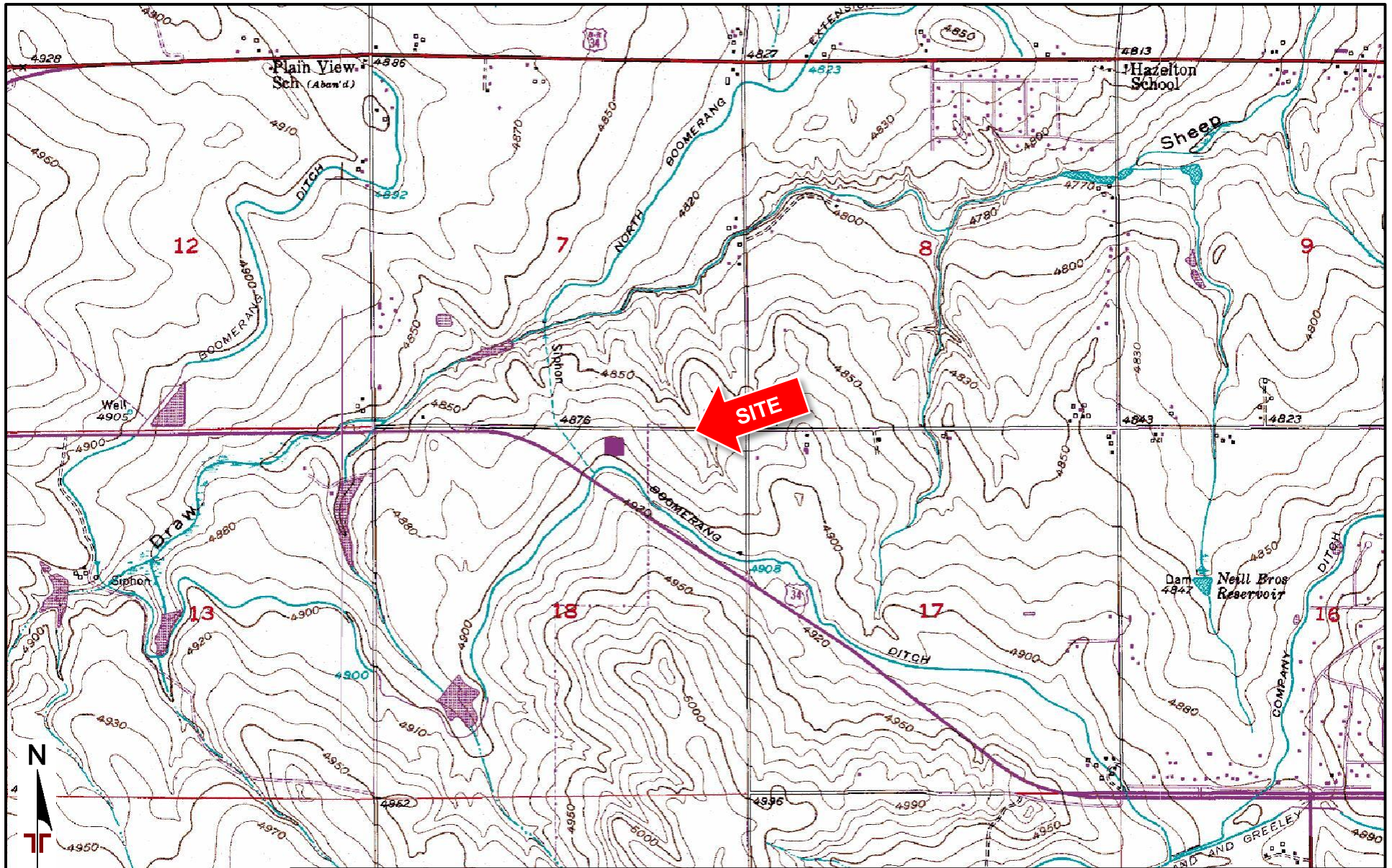
due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, and bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as described in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION



TOPOGRAPHIC MAP IMAGE COURTESY OF
THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: BRACEWELL, CO
(1980).

DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION
PURPOSES

Project Manager:	BCR	Project No.	21155061
Drawn by:	BCR	Scale:	1"=2,000'
Checked by:	EDB	File Name:	
Approved by:	EDB	Date:	3/2/2016

Terracon

1289 1st Ave
Greeley, CO 80631-4275

SITE LOCATION MAP

20th Street Reconstruction
20th Street from 83rd Ave. to 86th Ave.
Greeley, CO

Exhibit

A-1



AERIAL PHOTOGRAPHY PROVIDED BY
MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION
PURPOSES

Project Manager:	BCR	Project No.	21155061
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Checked by:	EDB	File Name:	
Approved by:	EDB	Date:	3/2/2016

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1289 1st Ave
Greeley, CO 80631-4275

EXPLORATION PLAN

20th Street Reconstruction
20th Street from 83rd Ave. to 86th Ave.
Greeley, CO

Exhibit

A-2

Field Exploration Description

The locations of borings were based upon the proposed development. The borings were located in the field using a handheld GPS device accurate to within 15 feet. The ground surface elevation was provided to us by the project surveyor.

The borings were drilled with a CME-45 truck-mounted rotary drill rig with solid-stem augers. During the drilling operations, lithologic logs of the borings were recorded by the field engineer. Disturbed samples were obtained at selected intervals utilizing a 2-inch outside diameter split-spoon sampler. Penetration resistance values were recorded using the standard penetration test (SPT). This test consists of driving the sampler into the ground with a 140-pound hammer free-falling through a distance of 30 inches. The number of blows required to advance the split-spoon samplers 18 inches, final 12 inches are recorded) or the interval indicated, is recorded as a standard penetration resistance value (N-value). The blow count values are indicated on the boring logs at the respective sample depths.

A CME automatic SPT hammer was used to advance the samplers in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The standard penetration test provides a reasonable indication of the in-place density of sandy type materials, but only provides an indication of the relative stiffness of cohesive materials since the blow count in these soils may be affected by the moisture content of the soil. In addition, considerable care should be exercised in interpreting the N-values in gravelly soils, particularly where the size of the gravel particle exceeds the inside diameter of the sampler.

Groundwater measurements were obtained in the borings at the time of site exploration. After completion of drilling, the borings were backfilled with auger cuttings and asphalt patch. Some settlement of the backfill and/or patch may occur and should be repaired as soon as possible.

BORING LOG NO. 1

Page 1 of 1

PROJECT: 20th Street Reconstruction

CLIENT: J-U-B Engineers, Inc.
Boise, Idaho

SITE: 20th Street from 83rd Ave to 86th Ave
Greeley, Colorado

GRAPHIC LOG	LOCATION See Exhibit A-2		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS		PERCENT FINES
	Latitude: 40.406888° Longitude: -104.817794°	Surface Elev.: 4875.4 (Ft.)							LL-PL-PI		
DEPTH	ELEVATION (Ft.)										
	0.3	ASPHALT, 4 inches	4875								
	AGGREGATE BASE COARSE - 20 inches										
	2.0		4873.5								
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, loose										
	8.0		4867.5								
	SANDY SILTY CLAY, brown, stiff										
	10.5		4865								
	Boring Terminated at 10.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1289 First Avenue
Greeley, Colorado

Boring Started: 2/15/2016

Boring Completed: 2/15/2016

Drill Rig: CME-45

Driller: Mike

Project No.: 21155061

Exhibit: A-4



BORING LOG NO. 2

Page 1 of 1

PROJECT: 20th Street Reconstruction

CLIENT: J-U-B Engineers, Inc.
Boise, Idaho

SITE: 20th Street from 83rd Ave to 86th Ave
Greeley, Colorado

GRAPHIC LOG	LOCATION See Exhibit A-2		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
	DEPTH	ELEVATION (Ft.)							LL-PL-PI	
	Latitude: 40.4068° Longitude: -104.815913°									
	Surface Elev.: 4869.7 (Ft.)									
	0.3	4869.5	5							
	<u>ASPHALT</u> , 4 inches									
	<u>AGGREGATE BASE COARSE - 13 inches</u> , 10 inches									
1.1	4868.5									
	<u>FILL - SILTY SAND</u> , brown, medium dense, trace iron oxidation									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1289 First Avenue
Greeley, Colorado

Boring Started: 2/15/2016

Boring Completed: 2/15/2016

Drill Rig: CME-45

Driller: Mike

Project No.: 21155061

Exhibit: A-5


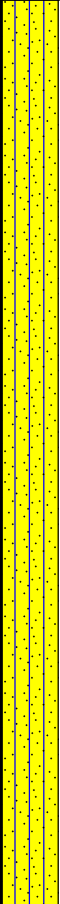
BORING LOG NO. 3

Page 1 of 1

PROJECT: 20th Street Reconstruction

CLIENT: J-U-B Engineers, Inc.
Boise, Idaho

SITE: 20th Street from 83rd Ave to 86th Ave
Greeley, Colorado

GRAPHIC LOG	LOCATION See Exhibit A-2		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS		PERCENT FINES
	DEPTH	ELEVATION (Ft.)							LL-PL-PI		
	0.3	ASPHALT , 3 inches	4875								
		AGGREGATE BASE COARSE - 12 inches , 12 inches									
	1.3		4874								
		SILTY SAND (SM) , fine to medium grained, brown to light brown, loose, trace iron oxidation									
			5								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid stem auger

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1289 First Avenue
Greeley, Colorado

Boring Started: 2/15/2016

Boring Completed: 2/15/2016

Drill Rig: CME-45

Driller: Mike

Project No.: 21155061

Exhibit: A-6

APPENDIX B

LABORATORY TESTING

Geotechnical Engineering Report

20th Street Reconstruction ■ Greeley, Colorado

March 7, 2016 ■ Terracon Project No. 21155061



Laboratory Testing Description

The soil samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer. At that time, the field descriptions were reviewed and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples. The results of these tests are presented on the boring logs and in this appendix. The test results were used for the geotechnical engineering analyses, and the development of pavement and earthwork recommendations. The laboratory tests were performed in general accordance with applicable locally accepted standards. Soil samples were classified in general accordance with the Unified Soil Classification System described in Appendix C. Procedural standards noted in this report are for reference to methodology in general. In some cases variations to methods are applied as a result of local practice or professional judgment.

- | | |
|---------------------------------|--------------------|
| ■ Water content | ■ Plasticity index |
| ■ Grain-size distribution | ■ Dry density |
| ■ Water-soluble sulfate content | ■ Resistivity |
| ■ pH | ■ Sulfide presence |
| ■ Water-soluble chloride | ■ Redox potential |

ASTM D4318

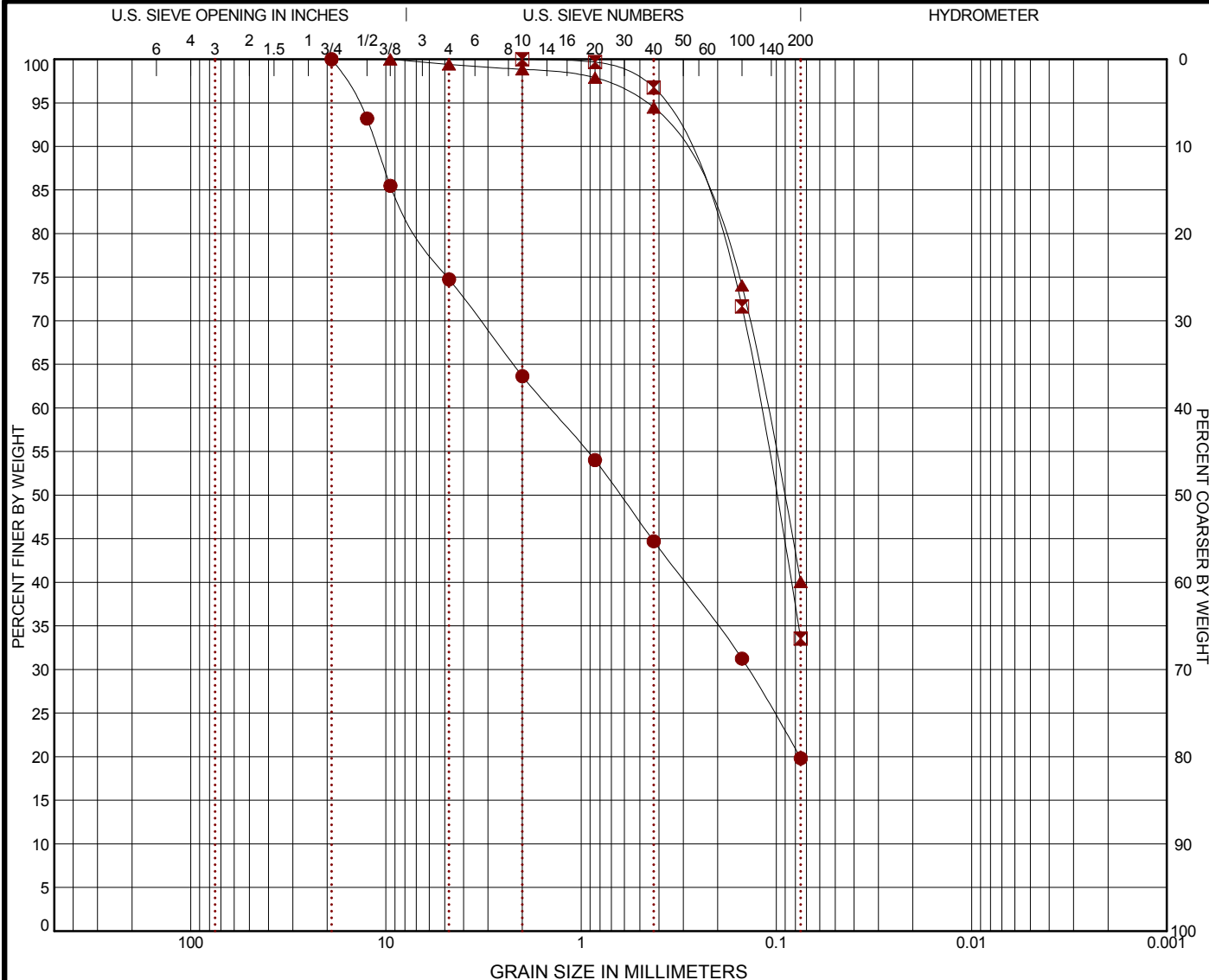


LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 21155061.GPJ TERRACON2015.GDT 2/19/16

EXHIBIT: B-2

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	1	2 - 3.5	0.0	25.2	54.9		19.8		SM
✕	2	2 - 3.5	0.0	0.0	66.5		33.5		SM
▲	3	4 - 5.5	0.0	0.6	59.3		40.1		SM

	GRAIN SIZE		
	●	✕	▲
D ₆₀	1.446	0.121	0.113
D ₃₀	0.139		
D ₁₀			
COEFFICIENTS			
C _c			
C _u			

SIEVE (size)	PERCENT FINER		
	●	✕	▲
1 1/2"			
1"			
3/4"	100.0		
1/2"	93.2		
3/8"	85.49		100.0
#4	74.76		99.41
#10	63.65	100.0	98.84
#20	54.02	99.68	97.89
#40	44.71	96.77	94.47
#60			
#100	31.25	71.64	74.04
#200	19.82	33.54	40.06

SOIL DESCRIPTION
 ● SILTY SAND with GRAVEL (SM)
 ✕ SILTY SAND (SM)
 ▲ SILTY SAND (SM)

REMARKS

●
✕
▲

PROJECT: 20th Street Reconstruction

SITE: 20th Street from 83rd Ave to 86th Ave
Greeley, Colorado

Terracon
 1289 First Avenue
 Greeley, Colorado

PROJECT NUMBER: 21155061

CLIENT: J-U-B Engineers, Inc.
Boise, Idaho

EXHIBIT: B-3

Analytical Results

TASK NO: 160219046

Report To: Mazie R. Ashe

Company: Terracon, Inc. - Greeley
1289 First Avenue
Greeley CO 80631

Bill To: Accounts Payable

Company: Terracon, Inc. - Lenexa
13910 W. 96th Terrace
Lenexa KS 66215

Task No.: 160219046
Client PO:
Client Project: 21155061

Date Received: 2/19/16
Date Reported: 2/26/16
Matrix: Soil - Geotech

Customer Sample ID 1 @ 4 Ft.
Lab Number: 160219046-01

Test	Result	Method
Sulfate - Water Soluble	0.005 %	AASHTO T290-91/ ASTM D4327

Customer Sample ID 2 @ 2 Ft.
Lab Number: 160219046-02

Test	Result	Method
Sulfate - Water Soluble	0.016 %	AASHTO T290-91/ ASTM D4327

Abbreviations/ References:

AASHTO - American Association of State Highway and Transportation Officials.
ASTM - American Society for Testing and Materials.
ASA - American Society of Agronomy.
DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe.



DATA APPROVED FOR RELEASE BY

Analytical Results

TASK NO: 160219047

Report To: Mazie R. Ashe

Company: Terracon, Inc. - Greeley
1289 First Avenue
Greeley CO 80631

Bill To: Accounts Payable

Company: Terracon, Inc. - Lenexa
13910 W. 96th Terrace
Lenexa KS 66215

Task No.: 160219047

Client PO:

Client Project: 21155061

Date Received: 2/19/16

Date Reported: 2/26/16

Matrix: Soil - Geotech

Customer Sample ID 1 @ 9 Ft.

Lab Number: 160219047-01

Test	Result	Method
Chloride - Water Soluble	0.1370 %	AASHTO T291-91/ ASTM D4327
pH	7.1 units	AASHTO T289-91
Redox Potential	338 mv	ASTM D1498
Resistivity	301 ohm.cm	AASHTO T288-91
Sulfate - Water Soluble	0.004 %	AASHTO T290-91/ ASTM D4327
Sulfide	Negative	AWWA C105

Customer Sample ID 2 @ 4 Ft.

Lab Number: 160219047-02

Test	Result	Method
Chloride - Water Soluble	0.0163 %	AASHTO T291-91/ ASTM D4327
pH	7.7 units	AASHTO T289-91
Redox Potential	223 mv	ASTM D1498
Resistivity	1245 ohm.cm	AASHTO T288-91
Sulfate - Water Soluble	0.016 %	AASHTO T290-91/ ASTM D4327
Sulfide	Trace	AWWA C105

Abbreviations/ References:

AASHTO - American Association of State Highway and Transportation Officials.

ASTM - American Society for Testing and Materials.

ASA - American Society of Agronomy.

DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe.



DATA APPROVED FOR RELEASE BY

Analytical Results

TASK NO: 160219047

Report To: Mazie R. Ashe

Company: Terracon, Inc. - Greeley
1289 First Avenue
Greeley CO 80631

Bill To: Accounts Payable

Company: Terracon, Inc. - Lenexa
13910 W. 96th Terrace
Lenexa KS 66215

Task No.: 160219047
Client PO:
Client Project: 21155061

Date Received: 2/19/16
Date Reported: 2/26/16
Matrix: Soil - Geotech

Customer Sample ID 3 @ 9 Ft.
Lab Number: 160219047-03

Test	Result	Method
Chloride - Water Soluble	0.0023 %	AASHTO T291-91/ ASTM D4327
pH	7.8 units	AASHTO T289-91
Redox Potential	204 mv	ASTM D1498
Resistivity	2519 ohm.cm	AASHTO T288-91
Sulfate - Water Soluble	0.005 %	AASHTO T290-91/ ASTM D4327
Sulfide	Negative	AWWA C105

Abbreviations/ References:

AASHTO - American Association of State Highway and Transportation Officials.
ASTM - American Society for Testing and Materials.
ASA - American Society of Agronomy.
DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe.







DATA APPROVED FOR RELEASE BY

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING	 Standard Penetration Test	WATER LEVEL	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time	FIELD TESTS	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS	RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (psf)	Standard Penetration or N-Value Blows/Ft.
	Very Loose	0 - 3	Very Soft	less than 500	0 - 1
	Loose	4 - 9	Soft	500 to 1,000	2 - 4
	Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
	Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
	Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
			Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	Cu ≥ 4 and 1 ≤ Cc ≤ 3 ^E		GW	Well-graded gravel ^F
			Cu < 4 and/or 1 > Cc > 3 ^E		GP	Poorly graded gravel ^F
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH		GM	Silty gravel ^{F,G,H}
			Fines classify as CL or CH		GC	Clayey gravel ^{F,G,H}
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	Cu ≥ 6 and 1 ≤ Cc ≤ 3 ^E		SW	Well-graded sand ^I
			Cu < 6 and/or 1 > Cc > 3 ^E		SP	Poorly graded sand ^I
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH		SM	Silty sand ^{G,H,I}
			Fines classify as CL or CH		SC	Clayey sand ^{G,H,I}
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots on or above “A” line ^J		CL	Lean clay ^{K,L,M}
			PI < 4 or plots below “A” line ^J		ML	Silt ^{K,L,M}
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K,L,M,N}
			Liquid limit - not dried			Organic silt ^{K,L,M,O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line		CH	Fat clay ^{K,L,M}
			PI plots below “A” line		MH	Elastic Silt ^{K,L,M}
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K,L,M,P}
			Liquid limit - not dried			Organic silt ^{K,L,M,Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

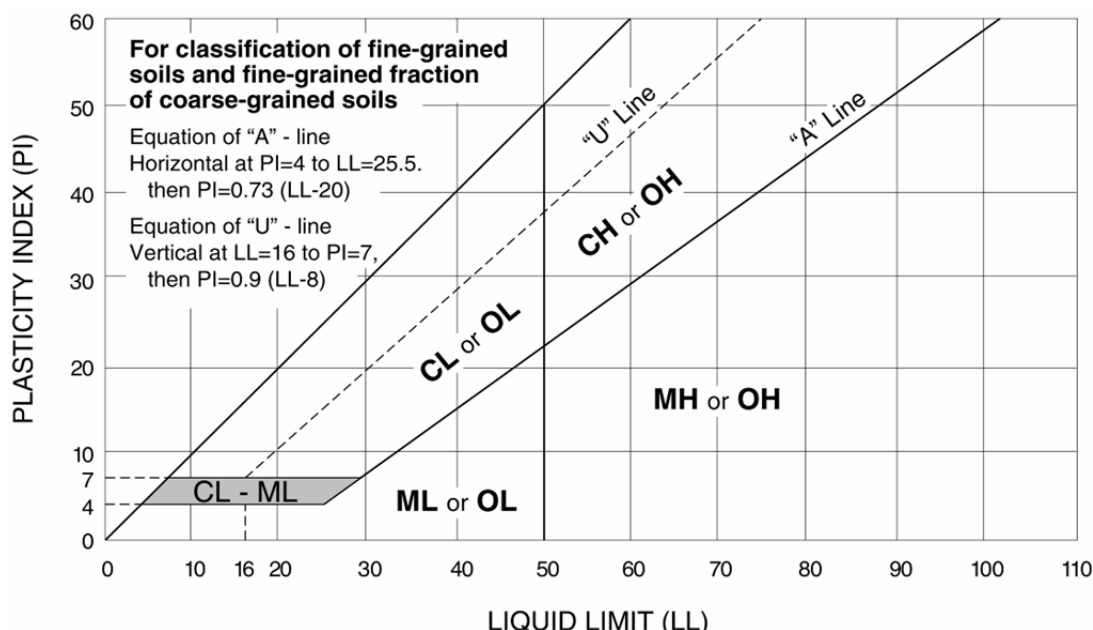
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



**LABORATORY TEST
SIGNIFICANCE AND PURPOSE**

Test	Significance	Purpose
<i>California Bearing Ratio</i>	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	<i>Pavement Thickness Design</i>
<i>Consolidation</i>	Used to develop an estimate of both the rate and amount of both differential and total settlement of a structure.	<i>Foundation Design</i>
<i>Direct Shear</i>	Used to determine the consolidated drained shear strength of soil or rock.	<i>Bearing Capacity, Foundation Design, and Slope Stability</i>
<i>Dry Density</i>	Used to determine the in-place density of natural, inorganic, fine-grained soils.	<i>Index Property Soil Behavior</i>
<i>Expansion</i>	Used to measure the expansive potential of fine-grained soil and to provide a basis for swell potential classification.	<i>Foundation and Slab Design</i>
<i>Gradation</i>	Used for the quantitative determination of the distribution of particle sizes in soil.	<i>Soil Classification</i>
<i>Liquid & Plastic Limit, Plasticity Index</i>	Used as an integral part of engineering classification systems to characterize the fine-grained fraction of soils, and to specify the fine-grained fraction of construction materials.	<i>Soil Classification</i>
<i>Permeability</i>	Used to determine the capacity of soil or rock to conduct a liquid or gas.	<i>Groundwater Flow Analysis</i>
<i>pH</i>	Used to determine the degree of acidity or alkalinity of a soil.	<i>Corrosion Potential</i>
<i>Resistivity</i>	Used to indicate the relative ability of a soil medium to carry electrical currents.	<i>Corrosion Potential</i>
<i>R-Value</i>	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	<i>Pavement Thickness Design</i>
<i>Soluble Sulfate</i>	Used to determine the quantitative amount of soluble sulfates within a soil mass.	<i>Corrosion Potential</i>
<i>Unconfined Compression</i>	To obtain the approximate compressive strength of soils that possess sufficient cohesion to permit testing in the unconfined state.	<i>Bearing Capacity Analysis for Foundations</i>
<i>Water Content</i>	Used to determine the quantitative amount of water in a soil mass.	<i>Index Property Soil Behavior</i>

REPORT TERMINOLOGY (Based on ASTM D653)

<i>Allowable Soil Bearing Capacity</i>	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
<i>Alluvium</i>	Soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.
<i>Aggregate Base Course</i>	A layer of specified material placed on a subgrade or subbase usually beneath slabs or pavements.
<i>Backfill</i>	A specified material placed and compacted in a confined area.
<i>Bedrock</i>	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
<i>Bench</i>	A horizontal surface in a sloped deposit.
<i>Caisson (Drilled Pier or Shaft)</i>	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier or drilled shaft.
<i>Coefficient of Friction</i>	A constant proportionality factor relating normal stress and the corresponding shear stress at which sliding starts between the two surfaces.
<i>Colluvium</i>	Soil, the constituents of which have been deposited chiefly by gravity such as at the foot of a slope or cliff.
<i>Compaction</i>	The densification of a soil by means of mechanical manipulation
<i>Concrete Slab-on-Grade</i>	A concrete surface layer cast directly upon a base, subbase or subgrade, and typically used as a floor system.
<i>Differential Movement</i>	Unequal settlement or heave between, or within foundation elements of structure.
<i>Earth Pressure</i>	The pressure exerted by soil on any boundary such as a foundation wall.
<i>ESAL</i>	Equivalent Single Axle Load, a criteria used to convert traffic to a uniform standard, (18,000 pound axle loads).
<i>Engineered Fill</i>	Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a geotechnical engineer.
<i>Equivalent Fluid</i>	A hypothetical fluid having a unit weight such that it will produce a pressure against a lateral support presumed to be equivalent to that produced by the actual soil. This simplified approach is valid only when deformation conditions are such that the pressure increases linearly with depth and the wall friction is neglected.
<i>Existing Fill (or Man-Made Fill)</i>	Materials deposited throughout the action of man prior to exploration of the site.
<i>Existing Grade</i>	The ground surface at the time of field exploration.

REPORT TERMINOLOGY (Based on ASTM D653)

<i>Expansive Potential</i>	The potential of a soil to expand (increase in volume) due to absorption of moisture.
<i>Finished Grade</i>	The final grade created as a part of the project.
<i>Footing</i>	A portion of the foundation of a structure that transmits loads directly to the soil.
<i>Foundation</i>	The lower part of a structure that transmits the loads to the soil or bedrock.
<i>Frost Depth</i>	The depth at which the ground becomes frozen during the winter season.
<i>Grade Beam</i>	A foundation element or wall, typically constructed of reinforced concrete, used to span between other foundation elements such as drilled piers.
<i>Groundwater</i>	Subsurface water found in the zone of saturation of soils or within fractures in bedrock.
<i>Heave</i>	Upward movement.
<i>Lithologic</i>	The characteristics which describe the composition and texture of soil and rock by observation.
<i>Native Grade</i>	The naturally occurring ground surface.
<i>Native Soil</i>	Naturally occurring on-site soil, sometimes referred to as natural soil.
<i>Optimum Moisture Content</i>	The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
<i>Perched Water</i>	Groundwater, usually of limited area maintained above a normal water elevation by the presence of an intervening relatively impervious continuous stratum.
<i>Scarify</i>	To mechanically loosen soil or break down existing soil structure.
<i>Settlement</i>	Downward movement.
<i>Skin Friction (Side Shear)</i>	The frictional resistance developed between soil and an element of the structure such as a drilled pier.
<i>Soil (Earth)</i>	Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.
<i>Strain</i>	The change in length per unit of length in a given direction.
<i>Stress</i>	The force per unit area acting within a soil mass.
<i>Strip</i>	To remove from present location.
<i>Subbase</i>	A layer of specified material in a pavement system between the subgrade and base course.
<i>Subgrade</i>	The soil prepared and compacted to support a structure, slab or pavement system.



August 18, 2017

J-U-B Engineers, Inc.
4745 East Boardwalk Drive #200
Fort Collins, Colorado 80525

Attn: Ms. Lindsey Jones, P.E.
Project Manager
P: (970) 377-3602
E: ljones@jub.com

Re: Supplemental Pavement Thickness Design Recommendations
20th Street Reconstruction
20th Street from 71st Avenue to 86th Avenue
Greeley, Colorado
Terracon Project No. 21175048

Dear Ms. Jones:

Previously, Terracon Consultants, Inc. (Terracon) provided pavement thickness design recommendations as part of two Geotechnical Engineering Reports (Project No. 21155061; report dated March 7, 2016 and Project No 21145023; report dated October 30, 2014) for the project referenced above. We understand this section of 20th Street will include reconstruction and widening of the roadway. For the section of 20th Street between 71st and 83rd Avenue, we were provided with traffic data from Counter Measures, Inc. and recommended pavement thickness alternatives were calculated and provided accordingly. For the section of 20th Street between 83rd Avenue and 86th Avenue, we have previously assumed this section of 20th Street will be classified as a 4-lane arterial. This supplemental letter presents the pavement design recommendations corresponding to the new information provided to us by J-U-B Engineers, Inc. indicating this section of 20th Street east of 83rd Avenue is a 2-lane arterial.

Design of pavements for the project have been based on the procedures outlined in the 1993 *Guideline for Design of Pavement Structures* prepared by the American Association of State Highway and Transportation Officials (AASHTO) and the City of Greeley Design Criteria and Construction Specifications.

The soils encountered in the upper portions of our borings consisted of silty sand with varying amounts of gravel. Therefore, we believe swell-mitigation of the subgrade materials prior to pavement operations will not be required.

The City of Greeley Design Criteria and Construction Specifications Table 2.08.1 specifies the minimum design ESALs of 730,000 for a 20-year design period for 2-lane arterial roadways. These assumed traffic design values should be verified by the civil engineer prior to final design

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and construction. If the actual traffic values vary from the assumed values, the pavement thickness recommendations may not be applicable. When the actual traffic design information is available Terracon should be contacted so that the design recommendations can be reviewed and revised if necessary.

For flexible pavement design, a terminal serviceability index of 2.5 was utilized along with an inherent reliability of 90 percent and a design life of 20 years. Using the correlated design R-value of 15, appropriate ESAL, environmental criteria and other factors, the structural numbers (SN) of the pavement sections were determined on the basis of the 1993 AASHTO design equation.

In addition to the flexible pavement design analyses, a rigid pavement design analysis was completed based upon AASHTO design procedures. Rigid pavement design is based on an evaluation of the Modulus of Subgrade Reaction of the soils (k-value), the Modulus of Rupture of the concrete, and other factors previously outlined. The design k-value of 95 for the subgrade soil was determined by correlation to the laboratory test results. A modulus of rupture of 600 psi (working stress 450 psi) was used for pavement concrete. The rigid pavement thickness for each traffic category was determined on the basis of the AASHTO design equation.

Recommended minimum pavement sections are provided in the table below.

Traffic Area	Alternative	Recommended Pavement Thicknesses (Inches)			
		Asphaltic Concrete Surface	Aggregate Base Course	Portland Cement Concrete	Total
20 th Street	A	6	11	--	17
	B	--	4	7 ½	11½

Aggregate base course (if used on the site) should consist of a blend of sand and gravel which meets strict specifications for quality and gradation. Use of materials meeting Colorado Department of Transportation (CDOT) Class 5 or 6 specifications is recommended for aggregate base course. Aggregate base course should be placed in lifts not exceeding 6 inches and compacted to a minimum of 95 percent of the maximum dry unit weight as determined by AASHTO T99.

Asphaltic concrete should be composed of a mixture of aggregate, filler and additives (if required) and approved bituminous material. The asphalt concrete should conform to approved mix designs stating the Superpave properties, optimum asphalt content, job mix formula and recommended mixing and placing temperatures. Aggregate used in asphalt concrete should meet particular gradations. Material meeting CDOT Grading S specifications or equivalent is recommended for asphalt concrete. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in maximum 3-inch lifts and compacted within a range of 92 to 96 percent of the theoretical maximum (Rice) density (ASTM D2041).

Where rigid pavements are used, the concrete should be produced from an approved mix design with the following minimum properties:

Properties	Value
Compressive strength	4,000 psi
Cement type	Type I or II portland cement
Entrained air content (%)	5 to 8
Concrete aggregate	ASTM C33 and CDOT Section 703

Concrete should be deposited by truck mixers or agitators and placed a maximum of 90 minutes from the time the water is added to the mix. Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation per ACI 325. The location and extent of joints should be based upon the final pavement geometry. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Site grades should slope a minimum of 2 percent away from the pavements;
- The subgrade and the pavement surface have a minimum 2 percent slope to promote proper surface drainage;
- Consider appropriate edge drainage and pavement under drain systems;
- Install pavement drainage surrounding areas anticipated for frequent wetting;
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils; and
- Placing compacted, low permeability backfill against the exterior side of curb and gutter.

The recommendations presented in this report should be used in conjunction with those presented in our initial Geotechnical Engineering Reports for the project. The General Conditions should be reviewed and understood to apply to those engineering recommendations and opinions presented herein.

Supplemental Pavement Thickness Design Recommendations

20th Street Reconstruction ■ Greeley, Colorado

August 18, 2017 ■ Terracon Project No. 21175048



We appreciate the opportunity to continue to be of service to you on this project. If you have any questions or concerns regarding the content of this report, please feel free to contact us.

Sincerely,

Terracon Consultants, Inc.

A blue ink signature of Richard S. Greeley.

Richard S. Greeley, E.I.

Geotechnical Field Engineer

A blue ink signature of Eric D. Bernhardt.
Eric D. Bernhardt, P.E.
Geotechnical Department Manager

Copies to: Addressee (via e-mail)



March 15, 2018

J-U-B Engineers, Inc.
4745 Boardwalk Drive
Buildig D, Suite 200
Fort Collins, Colorado 80525

Attn: Ms. Lindsey Jones, P.E.
P: (970) 377-3602
E: ljones@jub.com

Re: Geotechnical Recommendations for Drilled Pier Foundations
20th Street Reconstruction
20th Street and 83rd Avenue
Greeley, Colorado
Terracon Project No. 21175048

Dear Ms. Jones:

Previously, Terracon Consultants, Inc. (Terracon) prepared a Geotechnical Engineering Report (Project No. 21175048; report dated September 29, 2018) for the project referenced above. We understand a concrete box culvert (CBC) bridge is to be constructed under 20th Street west of 83rd Avenue. We initially assumed the box culvert would be a precast concrete structure placed directly on prepared subgrade. This supplemental letter presents geotechnical recommendations and design criteria for drilled pier foundations bottomed in bedrock for the CBC bridge.

Only one boring (Boring No. 4) was completed into competent bedrock near the culvert alignment. We have attached Boring No. 4 and Exploration Plan for reference. It should be noted that groundwater and bedrock depths are likely to vary across the alignment and the recommendations in this report are based on only one exploratory boring.

DEEP FOUNDATIONS

Drilled Piers Bottomed in Bedrock - Design Recommendations

Description	Value
Minimum pier length	15 feet
Minimum pier diameter	18 inches
Minimum bedrock embedment ¹	8 feet
Maximum allowable end-bearing pressure	35,000 psf



Description	Value
Allowable skin friction (for portion of pier embedded into bedrock)	2,500 psf
<ol style="list-style-type: none"> 1. Drilled piers should be embedded into competent bedrock materials. Actual structural loads and pier diameters may dictate embedment deeper than the recommended minimum bedrock embedment. 2. Required bedrock embedment should be balanced against uplift forces for the portion of the pier in competent bedrock below a depth of 12 feet to resist axial loads and uplift forces. 	

Site grading details were in a preliminary stage at the time we prepared this report. If significant cuts or fills are planned in the proposed CBC bridge area, longer/shorter drilled pier lengths may be required. Piers should be considered to work in group action if the horizontal spacing is less than three pier diameters. A minimum practical horizontal clear spacing between piers of at least three diameters should be maintained, and adjacent piers should bear at the same elevation. The capacity of individual piers must be reduced when considering the effects of group action. Capacity reduction is a function of pier spacing and the number of piers within a group. If group action analyses are necessary, capacity reduction factors can be provided for the analyses.

To satisfy forces in the horizontal direction using LPILE, piers may be designed for the following lateral load criteria:

Parameters	Sand and Gravel	Claystone Bedrock
LPILE soil type	Sand (Reese)	Stiff clay w/o free water (Reese)
Effective unit weight above groundwater (pcf)	124	132
Effective unit weight below groundwater (pcf)	60	70
Undrained cohesion (psf)	-	8,000
Friction angle, Φ (degrees)	36	-
Coefficient of subgrade reaction above groundwater, k (pci)	225	-
Coefficient of subgrade reaction below groundwater, k (pci)	125	2,000 – Static 800 - Cyclic
Strain factor, ϵ_{50} (%)	-	0.004

Drilled Piers Bottomed in Bedrock - Construction Considerations

Drilling to design depth should be possible with conventional single-flight power augers on the majority of the site; however, specialized drilling equipment may be required for very hard bedrock layers.

Groundwater/caving soil conditions indicate temporary steel casing will be required to properly drill and clean piers prior to concrete placement. Groundwater should be removed from each pier

hole prior to concrete placement. Pier concrete should be placed immediately after completion of drilling and cleaning. If pier concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Free-fall concrete placement in piers will only be acceptable if provisions are taken to avoid striking the concrete on the sides of the hole or reinforcing steel. The use of a bottom-dump hopper, or an elephant's trunk discharging near the bottom of the hole where concrete segregation will be minimized, is recommended. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

Casing should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or caving soils or the creation of voids in pier concrete. Pier concrete should have a relatively high fluidity when placed in cased pier holes or through a tremie. Pier concrete with slump in the range of 5 to 7 inches is recommended.

We recommend the sides of each pier should be mechanically roughened in the claystone bearing strata. This should be accomplished by a roughening tooth placed on the auger. Shaft bearing surfaces must be cleaned prior to concrete placement. A representative of Terracon should observe the bearing surface and shaft configuration.

The recommendations presented in this report should be used in conjunction with those presented in our initial Geotechnical Engineering Report for the project. The General Conditions should be reviewed and understood to apply to those engineering recommendations and opinions presented herein.


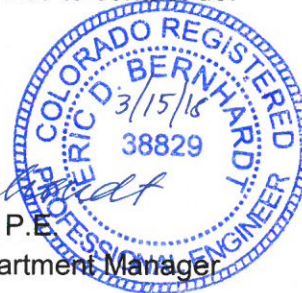
We appreciate the opportunity to continue to be of service to you on this project. If you have any questions or concerns regarding the content of this report, please feel free to contact us.

Sincerely,

Terracon Consultants, Inc.



Rick S. Greeley, E.I.
Field Engineer


Eric D. Bernhardt, P.E.
Geotechnical Department Manager

Attachments: Exploration Plan
Boring Log No. 4

Copies to: Addressee (via e-mail)

EXPLORATION PLAN

20th Street Reconstruction ■ Greeley, CO

March 15, 2018 ■ Terracon Project No. 21175048



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS
NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED
BY MICROSOFT BING MAPS














































































































BORING LOG NO. 4

Page 1 of 1

PROJECT: 20th Street Reconstruction

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SITE: 20th Street and 83rd Avenue
Greeley, CO

GRAPHIC LOG	LOCATION See Exploration Plan		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL-CONSOL /LOAD (%/psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES		
	DEPTH	ELEVATION (Ft.)								LL-PL-PI			
	0.3	4861.5	5										
	TOPSOIL , about 3 inches												
	SILTY SAND , brown, orange brown, dense to very dense												
			10										
			15										
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Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic


Advancement Method:
4-inch solid-stem

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.
Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

 8 feet while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 09-11-2017

Drill Rig: CME-55

Project No.: 21175048

Boring Completed: 09-11-2017

Driller: Drilling Engineers, Inc.

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 21175048 20TH STREET RECON.GPJ TERRACON.DATATEMPLATE.GDT 3/7/18

February 12, 2019

J-U-B Engineers, Inc.
4745 East Boardwalk Drive #200
Fort Collins, Colorado 80525

Attn: Mr. Jeff Temple
P: (970) 377-3602
E: jtemple@jub.com

Re: Supplemental Geotechnical Engineering Report
20th Street Concrete Box Culvert (CBC)
20th Street
Greeley, Colorado
Terracon Project No. 21185033 (supplemental)

Dear Mr. Temple:

Previously, Terracon Consultants, Inc. (Terracon) prepared a Geotechnical Engineering Report (Project No. 21175048; report dated March 15, 2018) for the 20th Street Reconstruction project. We have also prepared a report for 20th Street Phase 5 (Project No. 21185033; report dated October 1, 2018). We submitted an additional letter of recommendations for the concrete box culvert (CBC) bridge to be supported on drilled piers. The project team decided to use AASHTO LRFD design for the CBC bridge. We have since conducted an additional subsurface exploration near the proposed culvert inlet and outlet with pressure meter testing (PMT). This supplemental report presents the results of the additional subsurface exploration and provides foundation design recommendations for the CBC bridge.

PROJECT DESCRIPTION

Site Location

Item	Description
Parcel Information	The project site is located on 20 th Street in Greeley, Colorado. The site is located about 650 feet west of the intersection of 20 th Street and 83 rd Avenue on the south side of 20 th Street. The approximate Latitude/Longitude of the center of the site is 40.40681° N, 104.81578°W (Please refer to Exploration Plan).
Existing Improvements	The site is currently occupied by 20 th Street and surrounding drainage swales. The roadway is paved with asphalt. The culvert is planned in the approximate location of the existing culvert. The inlet and outlet points are in wetlands areas. There are multiple utilities that run east-west under 20 th Street.

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P (970) 351 0460 F (970) 353 8639 terracon.com

Item	Description
Surrounding Developments	20 th Street is generally surrounded by residential housing to the north and vacant land to the south.
Current Ground Cover	Current ground cover is asphalt pavement in the roadway areas and heavily vegetated with native weeds and grasses in the wetlands.
Existing Topography	The site generally slopes down to the wetlands area. 20 th Street is about 10 feet higher in elevation than the adjacent wetlands areas.

Planned Construction

Item	Description
Information Provided	Information was provided via phone and email correspondence with various J-U-B project team members.
Project Description	Previously during Phase 4, a culvert was planned below 20 th Street. A LRFD bridge design is now required for a concrete box culvert (CBC) bridge at the location.
Proposed Construction	The bridge is being designed to span across the existing utilities under 20 th Street. The CBC bridge will be supported by drilled shafts with associated wing wall and aprons.
Grading/Slopes	Based on initial layout plans provided by J-U-B, we understand about 12 feet of cut and 5 feet of fill may be required for the CBC bridge. Due to shallow groundwater concerns, cuts should be limited where possible.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found in **Exploration Results**. A discussion of field sampling and laboratory testing procedures and test results are presented in **Exploration and Testing Procedures**. Based on the results of the borings, subsurface conditions on the project site are generalized in the tables below

CBC bridge borings (Boring Nos. 8 and 9):

Material Description	Approximate Depth to Bottom of Stratum	Consistency/Density/Hardness	Approximate Elevation (feet)
Silty sand and sandy silty clay	About 9 to 20 feet below existing site grades.	Very soft to soft Loose to very dense	4,860 – 4,848
Claystone bedrock	To the maximum depth of exploration of about 50 feet.	Medium hard to very hard	4,848 – maximum depth of exploration

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes are noted on the attached boring logs, and are summarized below:

Boring Number	Depth to groundwater while drilling, ft.	Elevation of groundwater while drilling, ft.
8	6	4,855
9	7	4,850

These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions, and other factors.

Groundwater level fluctuations occur due to seasonal variations in the water levels present in nearby water features, amount of rainfall, runoff and other factors not evident at the time the borings was/were performed. Therefore, groundwater levels during construction or at other times in the life of the pavements and structures may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Laboratory Testing

Samples of clay soils and underlying claystone bedrock exhibited unconfined compressive strengths of approximately 500 to 14,300 pounds per square foot (psf). Samples of site soils and bedrock selected for plasticity testing exhibited low to medium plasticity with liquid limits ranging from non-plastic to 46 and plasticity indices ranging from non-plastic to 29. Laboratory test results are presented in the **Exploration Results** section of this report.

GEOTECHNICAL OVERVIEW

Based on subsurface conditions encountered in the borings, the site appears suitable for the proposed construction from a geotechnical point of view provided certain precautions and design and construction recommendations described in this report are followed. We have identified several geotechnical conditions that could impact design, construction and performance of the proposed structures, pavements, and other site improvements. These included shallow groundwater, and potentially soft and loose, low strength soils. These conditions will require particular attention in project planning, design and during construction and are discussed in greater detail in the following sections.

Shallow Groundwater

As previously stated, groundwater was measured at depths ranging from about 6 to 7 feet below existing site grades. Terracon recommends maintaining a separation of at least 3 feet between the bottom of proposed below-grade shallow foundations and measured groundwater levels. It is also possible and likely that groundwater levels below this site may rise as water levels in the Sheep Draw Tributary rise. Final site grading should be planned and designed to avoid cuts where shallow groundwater is known to exist, and also in areas where such grading would create shallow groundwater conditions.

Low Strength Soils

Very soft lean clay and loose sandy soils were encountered within the upper approximately 7 to 9 feet of the borings completed at this site. These materials can present a risk for potential settlement. These materials can also be susceptible to disturbance and loss of strength under repeated construction traffic loads and unstable conditions could develop. Stabilization of soft soils will very likely be required at most locations to provide adequate support for construction equipment and proposed structures. Terracon should be contacted if these conditions are encountered to observe the conditions exposed and to provide guidance regarding stabilization (if needed).

Foundation Recommendations

After evaluating several alternatives, we understand the design team will be utilizing a drilled shaft foundation system bottomed in bedrock for the CBC bridge.

Very soft clay soils were encountered at anticipated shallow foundation bearing depths. Our analysis indicates up to 2 inches of settlement can be expected for shallow foundations bearing on these materials. We expect the CBC bridge supported on drilled shafts to settle ½ inch or less. There is significant risk for differential settlement if the aprons and wingwalls are supported by shallow foundations on the very soft clay materials encountered.

We recommend the aprons and wingwalls for the proposed CBC bridge be supported by a drilled shaft deep foundation system bottomed in bedrock. As a higher risk alternative, we believe the aprons and wingwalls can be supported on a shallow foundation system with ground modification. Ground modification may include over-excavation and replacement with imported granular fill or rammed aggregate piers (RAP).

Design recommendations for foundations and ground modification for the proposed structure are presented in the following sections.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

The following presents recommendations for site preparation, demolition, excavation, subgrade preparation, fill materials, compaction requirements, utility trench backfill, grading and drainage. Earthwork on the project should be observed and evaluated by Terracon. Evaluation of earthwork should include observation and/or testing of over-excavation, removal of existing fill, subgrade preparation, placement of engineered fills, subgrade stabilization and other geotechnical conditions exposed during the construction of the project.

Site Preparation

Prior to placing any fill, strip and remove existing vegetation, topsoil, and any other deleterious materials from the proposed construction areas.

Stripped organic materials should be wasted from the site or used to re-vegetate landscaped areas or exposed slopes after completion of grading operations. Prior to the placement of fills, the site should be graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath proposed structures.

Demolition

Demolition of the existing roadway and culvert should include complete removal of all pavements and construction debris within the proposed construction area. This should include removal of any utilities to be abandoned along with any loose utility trench backfill or loose backfill found. All materials derived from the demolition of existing pavements should be removed from the site.

Consideration could be given to re-using the asphalt provided the materials are processed and uniformly blended with the on-site soils. Asphalt materials should be processed to a maximum size of 2 inches and blended at a ratio of 30 percent asphalt to 70 percent of on-site soils.

Excavation

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

The soils to be excavated can vary significantly across the site as their classifications are based solely on the materials encountered in widely-spaced exploratory test borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

Supplemental Geotechnical Engineering Report

20th Street Concrete Box Culvert (CBC) ■ Greeley, Colorado
February 12, 2019 ■ Terracon Project No. 21185033 (supplemental)



Although evidence of underground facilities such as grease pits, septic tanks, vaults, basements, and utilities was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Any over-excavation that extends below the bottom of foundation elevation should extend laterally beyond all edges of the foundations at least 8 inches per foot of over-excavation depth below the foundation base elevation. The over-excavation should be backfilled to the foundation base elevation in accordance with the recommendations presented in this report.

Depending upon depth of excavation and seasonal conditions, surface water infiltration and/or groundwater may be encountered in excavations on the site. It is anticipated that pumping from sumps may be utilized to control water within excavations.

The subgrade soil conditions should be evaluated during the excavation process and the stability of the soils determined at that time by the contractors' Competent Person. Slope inclinations flatter than the OSHA maximum values may have to be used. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance from the crest of the slope equal to the slope height. The exposed slope face should be protected against the elements

Subgrade Preparation

After the existing pavements and culvert have been removed from the construction area and over-excavation has been completed (if chosen), the top 10 inches of the exposed ground surface should be scarified, moisture conditioned, and recompact to at least 95 percent of the maximum dry unit weight as determined by ASTM D698 before any new fill or pavement is placed.

If pockets of soft, loose, or otherwise unsuitable materials are encountered at the bottom of the foundation excavations and it is inconvenient to lower the foundations, the proposed foundation elevations may be reestablished by over-excavating the unsuitable soils and backfilling with compacted engineered fill or lean concrete.

After the bottom of the excavation has been compacted, engineered fill can be placed to bring the wing wall, apron and pavement subgrade to the desired grades. Engineered fill should be placed in accordance with the recommendations presented in subsequent sections of this report.

Supplemental Geotechnical Engineering Report

20th Street Concrete Box Culvert (CBC) ■ Greeley, Colorado
February 12, 2019 ■ Terracon Project No. 21185033 (supplemental)



The stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Alternatively, over-excavation of wet zones and replacement with granular materials may be used, or crushed gravel and/or rock can be tracked or “crowded” into the unstable surface soil until a stable working surface is attained. Use of fly ash or geotextiles could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction. Lightweight excavation equipment may also be used to reduce subgrade pumping.

Fill Materials

The on-site soils or approved granular and low plasticity cohesive imported materials may be used as fill material. Bedrock excavated during pier drilling and construction can be reused as fill provided the material is broken down and thoroughly processed to a “soil-like” consistency, with no particles greater than 2 inches in size. The earthwork contractor should expect significant mechanical processing and moisture conditioning of the site soils and/or bedrock will be needed to achieve proper compaction

Imported soils (if required) should meet the following material property requirements:

Gradation	Percent finer by weight (ASTM C136)
4"	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	50 (max.)

Soil Properties	Values
Liquid Limit	35 (max.)
Plasticity Index	15 (max.)

Other import fill materials types may be suitable for use on the site depending upon proposed application and location on the site, and could be tested and approved for use on a case-by-case basis.

Compaction Requirements

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

Item	Description
Fill lift thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum compaction requirements	95 percent of the maximum dry unit weight as determined by ASTM D698
Moisture content cohesive soil (clay)	-1 to +3 % of the optimum moisture content
Moisture content cohesionless soil (sand)	-3 to +3 % of the optimum moisture content

1. We recommend engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the fill material pumping when proofrolled.
3. Moisture conditioned clay materials should not be allowed to dry out. A loss of moisture within these materials could result in an increase in the material's expansive potential. Subsequent wetting of these materials could result in undesirable movement.

Grading and Drainage

Positive drainage should be provided away from the pavements during construction and maintained throughout the life of the proposed project. Infiltration of water into utility excavations must be prevented during construction. Landscaped medians and other surface features which could retain water in areas adjacent to the pavements should be irrigated as little as possible to support plant growth. Excessive irrigation of the landscaped medians can result in the softening of the subgrade and aggregate base course and premature pavement distress or failure.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of Terracon. Monitoring should include documentation of adequate removal of vegetation, topsoil and pavements, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by Terracon prior to placement of additional lifts. In addition to the documentation of the essential parameters necessary for construction, the continuation of Terracon into the construction phase of the project provides the continuity to maintain the Terracon's evaluation of subsurface conditions, including assessing variations and associated design changes.

DEEP FOUNDATIONS

Drilled Shafts Bottomed in Bedrock - Design Recommendations

Shaft and tip resistance were estimated for shaft diameters of 24, 30 and 36 inches. The axial resistances for the compressive load were estimated based on procedures outlined in FHWA Drilled Shafts: Construction Procedures and LRFD Design Methods, Publication No. NHI-10-016, and AASHTO LRFD Bridge Design Specifications 2014.

AASHTO LRFD resistance factors used in design are summarized in the following table.

DRILLED SHAFT RESISTANCE FACTORS		
Layer	Resistance Factors (Φ)	
	Strength Limit 1	
	Tip	Shaft
Sandy silty clay (Soil)	-	0.45
Claystone Bedrock (IGM)	0.55	0.60

Note:

1. AASHTO LRFD Bridge Design Specifications, Table 10.5.5.2.4-1.

Shafts should be terminated at or below elevations corresponding to the estimated tip embedment indicated below. The following table presents depth/elevation and drilled shaft resistance values for the CBC bridge.

DRILLED SHAFT RESISTANCE						
Shaft Dimensions			Nominal Side Resistance		Nominal Base Resistance	Total Nominal Resistance
Diameter (inches)	Minimum Bedrock Embedment (feet)	Estimated Shaft Length (feet)	ΦR_{SN1} (kips)	ΦR_{SN2} (kips)	ΦR_{BN2} (kips)	Σ (kips)
24	24	36	5.4	131.4	47.5	184.3
30	15	27	6.8	102.6	74.2	183.7
36	8	20	8.2	65.7	106.9	180.8

Site grading details were in a preliminary stage at the time we prepared this report. If significant cuts or fills are planned in the proposed CBC bridge area, longer/shorter drilled shaft lengths may be required. Shafts should be considered to work in group action if the horizontal spacing is less than three pier diameters. A minimum practical horizontal clear spacing between shafts of at least three diameters should be maintained, and adjacent piers should bear at the same elevation. The

capacity of individual piers must be reduced when considering the effects of group action. Capacity reduction is a function of pier spacing and the number of piers within a group. If group action analyses are necessary, capacity reduction factors can be provided for the analyses.

Drilled Shafts Bottomed in Bedrock - Construction Considerations

Drilling to design depth should be possible with conventional single-flight power augers on the majority of the site; however, specialized drilling equipment may be required for very hard bedrock layers.

Groundwater/caving soil conditions indicate temporary steel casing will be required to properly drill and clean shafts prior to concrete placement. Groundwater should be removed from each shaft hole prior to concrete placement. Shaft concrete should be placed immediately after completion of drilling and cleaning. If pier concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Free-fall concrete placement in shafts will only be acceptable if provisions are taken to avoid striking the concrete on the sides of the hole or reinforcing steel. The use of a bottom-dump hopper, or an elephant's trunk discharging near the bottom of the hole where concrete segregation will be minimized, is recommended. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

Casing should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or caving soils or the creation of voids in shaft concrete. Shaft concrete should have a relatively high fluidity when placed in cased shaft holes or through a tremie. Shaft concrete with slump in the range of 5 to 7 inches is recommended.

We recommend the sides of each shaft should be mechanically roughened in the claystone bearing strata. This should be accomplished by a roughening tooth placed on the auger. Shaft bearing surfaces must be cleaned prior to concrete placement. A representative of Terracon should observe the bearing surface and shaft configuration.

GROUND IMPROVEMENT

Very soft to soft clay soils were encountered at anticipated shallow foundation bearing depths. We recommend constructing the proposed aprons and wingwalls on a drilled shaft foundation system bottomed in bedrock. As a higher risk alternative to drilled shaft foundations, consideration could be given to ground modification/improvement techniques to improve strength and compressibility characteristics of the foundation soils. We believe the aprons and wingwalls can be constructed on a shallow foundation system, provided the foundation system bears on improved ground through methods such as over-excavation and replacement with imported granular fill or rammed aggregate piers.

Over-Excavation

One approach to ground modification would include over-excavation. We believe the proposed aprons and wingwalls can be constructed on a shallow foundations system provided the soils are over-excavated to a depth of at least 3 feet below the bottom of aprons and footings and replaced with moisture conditioned, properly compacted imported granular fill.

Rammed Aggregate Piers

Another approach would include rammed aggregate pier foundation elements or stone columns to support shallow foundations. Stone columns and rammed aggregate piers consist of a series of drilled holes filled with highly compacted, well graded aggregate to form very stiff, high-density aggregate piers. The stone column and rammed aggregate piers are generally extended below the low strength soil layer to a layer of higher bearing capacity soils or bedrock. Installation of these elements results in significant strengthening and stiffening of the foundation bearing layer to support footings within typical settlement tolerances. Shallow foundations are then constructed over the piers/columns in a conventional manner. Aggregate pier foundation elements are usually part of the contractor's design-build system. Therefore, the subsurface exploration information contained in this report should be provided to the foundation contractors for detailed analysis and design and cost information.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Ground Modification** and **Earthwork**, the following design parameters are applicable for shallow foundations.

Shallow Foundations - Design Recommendations

Description	Values
Bearing material	At least 3 feet of moisture conditioned, properly compacted, over-excavation backfill or rammed aggregate piers.
Maximum net allowable bearing pressure ¹	2,000 psf
Minimum foundation dimensions	Columns: 30 inches Continues: 18 inches
Lateral earth pressure coefficients ²	Active, $K_a = 0.45$ Passive, $K_p = 2.2$ At-rest, $K_o = 0.63$
Sliding coefficient ²	$\mu = 0.32$
Moist soil unit weight	$\gamma = 125$ pcf

Description	Values
Minimum embedment depth below finished grade ³	30 inches
Estimated total movement ⁴	About 1 inch
Estimated differential movement ⁴	About ½ to ¾ of total movement

1. The recommended maximum net allowable bearing pressure assumes any unsuitable fill or soft/loose soils, if encountered, will be over-excavated and replaced with properly compacted engineered fill. The design bearing pressure applies to a dead load plus design live load condition. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions.
2. The lateral earth pressure coefficients and sliding coefficients are ultimate values and do not include a factor of safety. The foundation designer should include the appropriate factors of safety.
3. For frost protection and to reduce the effects of seasonal moisture variations in the subgrade soils. The minimum embedment depth is for perimeter footings beneath unheated areas and is relative to lowest adjacent finished grade, typically exterior grade. Interior column pads in heated areas should bear at least 12 inches below the adjacent grade (or top of the floor slab) for confinement of the bearing materials and to develop the recommended bearing pressure.
4. The estimated movements presented above are based on the assumption that the maximum footing size is 4 feet for column footings and 1.5 feet for continuous footings. Larger foundation footprints will likely require reduced net allowable soil bearing pressures to reduce risk for potential settlement.

Shallow Footings - Construction Considerations

To reduce the potential of “pumping” and softening of the foundation soils at the foundation bearing level and the requirement for corrective work, we suggest the foundation excavation for the aprons and wingwalls be completed remotely with a track-hoe operating outside of the excavation limits.

Shallow foundation construction should only be considered if the estimated foundation movement can be tolerated. Subgrade soils at the base of the recommended over-excavation beneath footings should be moisture conditioned and compacted as described in the **Earthwork** section of this report. The moisture content and compaction of subgrade soils should be maintained until foundation construction.

Footings and foundation walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement.

Unstable subgrade conditions are anticipated as excavations approach the groundwater surface. Unstable surfaces will need to be stabilized prior to backfilling excavations and/or constructing the building foundation, floor slab and/or project pavements. The use of angular rock, recycled concrete and/or gravel pushed or “crowded” into the yielding subgrade is considered suitable means of stabilizing the subgrade. The use of geogrid materials in conjunction with gravel could also be considered and could be more cost effective.

Unstable subgrade conditions should be observed by Terracon to assess the subgrade and

provide suitable alternatives for stabilization. Stabilized areas should be proof rolled prior to continuing construction to assess the stability of the subgrade.

Foundation excavations should be observed by Terracon. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

APRONS

A slab-on-grade may be utilized for the aprons provided the recommendations in the **Ground Improvement** section have been followed. If the estimated movement cannot be tolerated, a deep foundation system is recommended

Subgrade soils at the base of the recommended over-excavation beneath the aprons should be scarified to a depth of at least 10 inches, moisture conditioned and compacted. The moisture content and compaction of subgrade soils and/or over-excavation backfill should be maintained until slab construction.

Aprons - Design Recommendations

Even when bearing on properly prepared soils, movement of the slab-on-grade aprons is possible should the subgrade soils undergo an increase in moisture content. We estimate movement of about 1 inch is possible. If the owner cannot accept the risk of movement, a deep foundation should be used. If conventional slab-on-grade is utilized, the subgrade soils should be prepared as presented in the **Ground Modification** and **Earthwork** sections of this report.

Additional apron design and construction recommendations are as follows:

- Positive separations and/or isolation joints should be provided between slabs and all foundations, columns, or utility lines to allow independent movement.
- Control joints should be saw-cut in slabs in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended) to control the location and extent of cracking.
- Slabs should not be constructed on frozen subgrade.
- Other design and construction considerations, as outlined in the ACI Design Manual, Section 302.1R are recommended.

Supplemental Geotechnical Engineering Report

20th Street Concrete Box Culvert (CBC) ■ Greeley, Colorado

February 12, 2019 ■ Terracon Project No. 21185033 (supplemental)




The recommendations presented in this report should be used in conjunction with those presented in our initial Geotechnical Engineering Report for the project. The **General Comments** should be reviewed and understood to apply to those engineering recommendations and opinions presented herein.

We appreciate the opportunity to continue to be of service to you on this project. If you have any questions or concerns regarding the content of this report, please feel free to contact us.

Sincerely,

Terracon Consultants, Inc.


For: Rick S. Greeley, E.I.
Field Engineer


Eric D. Bernhardt, P.E.
Geotechnical Department Manager

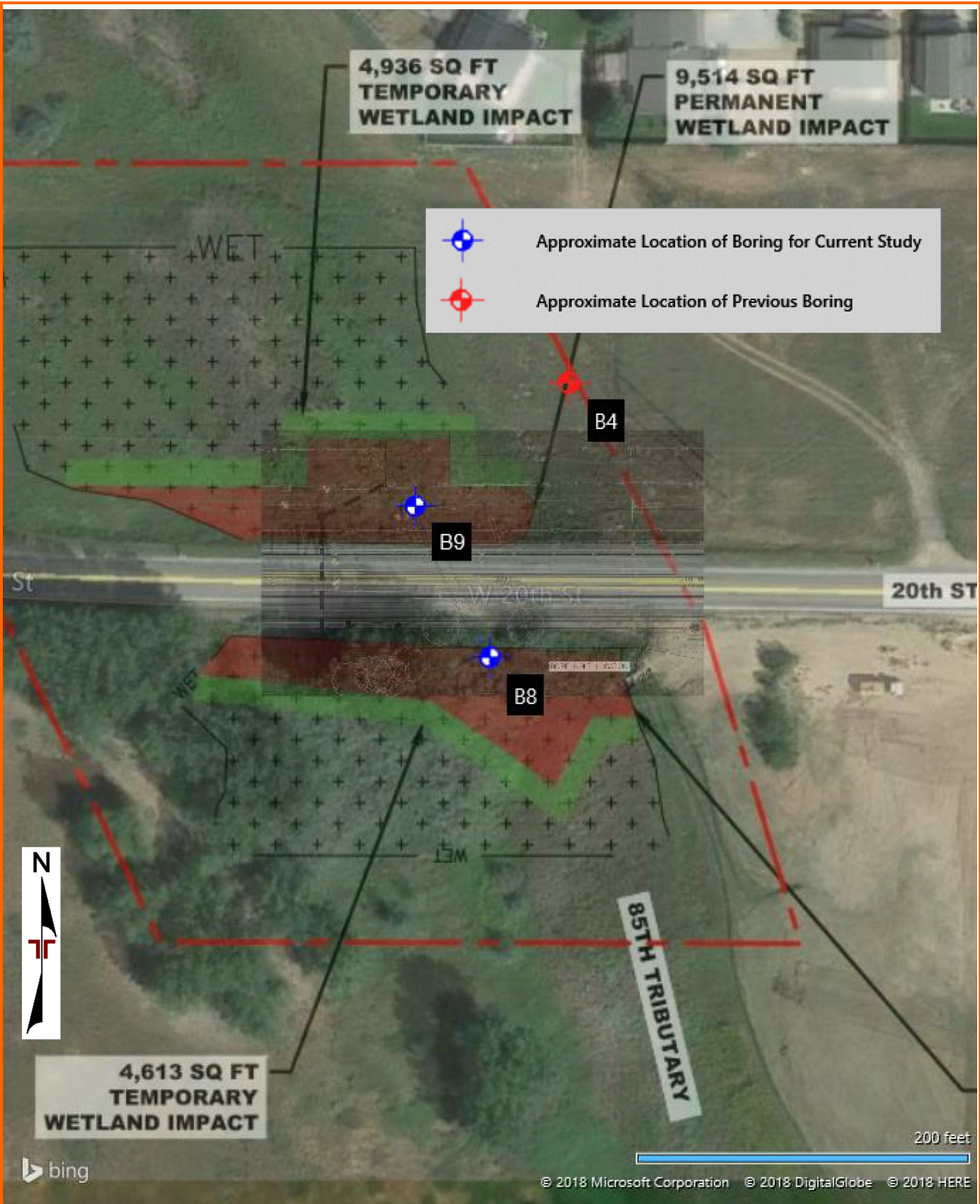
A circular blue ink seal for Eric D. Bernhardt, a Professional Engineer in the State of Colorado. The seal contains the text "COLORADO REGISTERED PROFESSIONAL ENGINEER" around the perimeter. In the center, the name "ERIC D. BERNHARDT" is written, along with the date "2/12/19" and the license number "38829".

Attachments: Exploration Plan
Exploration Results
General Notes

EXHIBIT E - ANTICIPATED EXPLORATION PLAN

20th Street Phase 5 ■ Greeley, Colorado

February 12, 2019 ■ Terracon Proposal No. P21185033



BORING LOG NO. 08

Page 1 of 2

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4067° Longitude: -104.8157° Approximate Surface Elev: 4861 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		DEPTH ELEVATION (Ft.)									
		0.7 VEGETATIVE LAYER , about 8 inches 4860.5+/-									
		SILTY SAND , fine grained, brown to dark brown, loose									
		3.5 4857.5+/-				4-5-3 N=8					
		SANDY SILTY CLAY , light brown to brown, soft				2-3	470	24	103	23-18-5	63
		7.0 4854+/-									
		SILTY SAND , fine grained, light brown to brown to gray, very dense									
						21-26-40 N=66		25		NP	31
						44 - 50/5"		18	113		
		20.0 4841+/-				32-25-27 N=52		20			
		SEDIMENTARY BEDROCK - CLAYSTONE , gray to brown, medium hard to very hard, with interbedded siltstone									
		Iron oxide staining at depths of about 24 feet and below				23-35	14250	20	108	46-17-29	85

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" continuous-flight auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.
Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

6 feet while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 07-27-2018

Drill Rig: CME 55

Project No.: 21185033

Boring Completed: 07-27-2018

Driller: Drilling Engineers, Inc.

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19

BORING LOG NO. 09

Page 1 of 2

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, COSITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4069° Longitude: -104.8159° Approximate Surface Elev: 4857 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.7 VEGETATIVE LAYER , about 8 inches 4856.5+/-									
		SANDY SILTY CLAY , brown, gray, very soft to soft									
						2-3		22	101	25-20-5	69
			5			1-1-1/0"		22			
		9.0 SEDIMENTARY BEDROCK - CLAYSTONE , reddish brown to brown to gray, medium hard to very hard, iron oxide staining 4848+/-	10			3-3-4 N=7		24			
			15			13-26	5060	22	104	41-18-23	84
			20			9 - 24 - 50/4"		23			
			25								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augerAbandonment Method:
Boring backfilled with soil cuttings upon completion.See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

7 feet while drilling

Boring Started: 07-27-2018

Boring Completed: 07-27-2018

Drill Rig: CME 55

Driller: Drilling Engineers, Inc.

Project No.: 21185033

Terracon

1289 1st Ave
Greeley, CO

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19

BORING LOG NO. 09

Page 2 of 2

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, COSITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4069° Longitude: -104.8159° Approximate Surface Elev: 4857 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
										LL-PL-PI	
		SEDIMENTARY BEDROCK - CLAYSTONE , reddish brown to brown to gray, medium hard to very hard, iron oxide staining (continued)	30		X	50/5"					
			35								
			40		X	21-26-33 N=59		20			
			45								
		49.3 4807.5+/- Boring Terminated at 49.3 Feet			X	50/4"		36			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augerAbandonment Method:
Boring backfilled with soil cuttings upon completion.

Notes:

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

WATER LEVEL OBSERVATIONS

7 feet while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 07-27-2018

Boring Completed: 07-27-2018

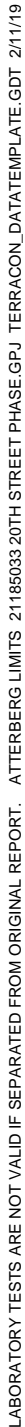
Drill Rig: CME 55

Driller: Drilling Engineers, Inc.

Project No.: 21185033

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19

ASTM D4318



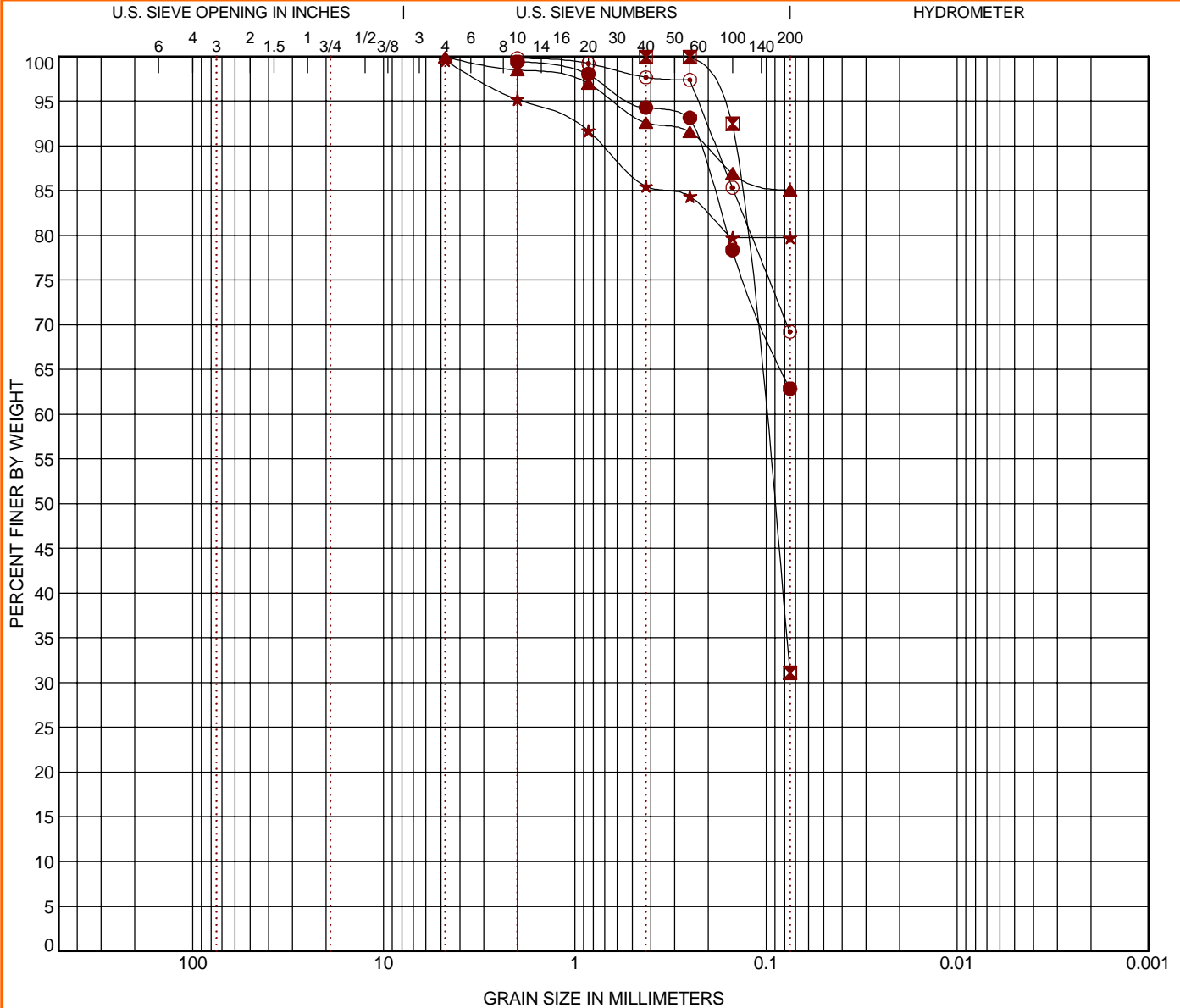
CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification				WC (%)	LL	PL	PI	Cc	Cu
●	08	4 - 5	SANDY SILTY CLAY (CL-ML)				24	23	18	5		
☒	08	9 - 10.5	SILTY SAND (SM)				25	NP	NP	NP		
▲	08	24 - 25	SEDIMENTARY BEDROCK - CLAYSTONE (CL)				20	46	17	29		
★	08	49 - 49.5	SEDIMENTARY BEDROCK - CLAYSTONE (CL)				22	46	20	26		
⊙	09	2 - 3	SANDY SILTY CLAY (CL-ML)				22	25	20	5		
Boring ID		Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Gravel	%Sand	%Silt	%Fines	%Clay	
●	08	4 - 5	2				0.0	36.5		62.9		
☒	08	9 - 10.5	0.425	0.104			0.0	68.8		31.1		
▲	08	24 - 25	4.75				0.0	14.9		85.1		
★	08	49 - 49.5	4.75				0.0	19.8		79.7		
⊙	09	2 - 3	2				0.0	30.6		69.2		

PROJECT: 20th Street Phase 5

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

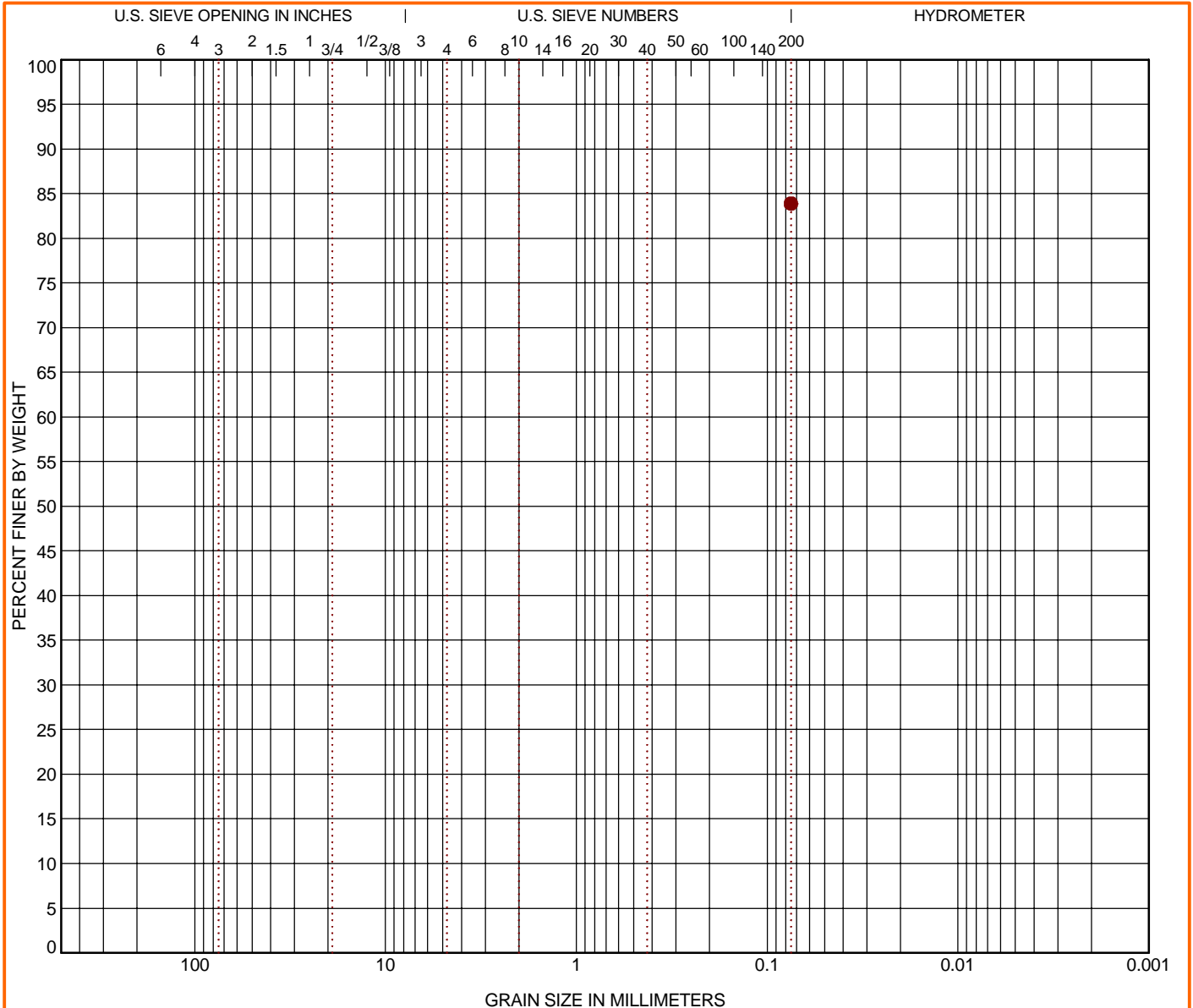
PROJECT NUMBER: 21185033

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

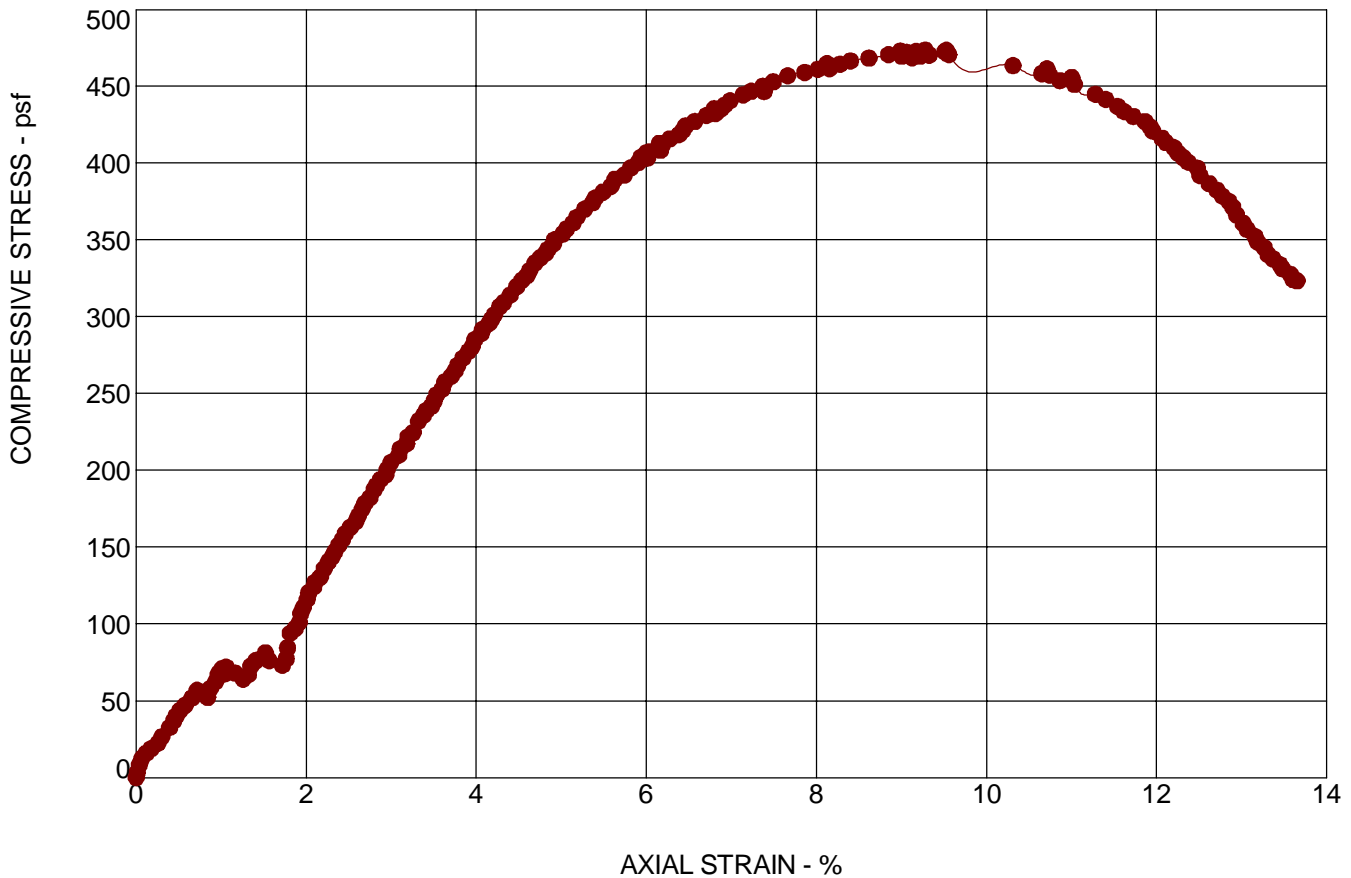
Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
09	14 - 15	SEDIMENTARY BEDROCK - CLAYSTONE (CL)	22	41	18	23		

Boring ID	Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Gravel	%Sand	%Silt	%Fines	%Clay
09	14 - 15	0.075				0.0			83.9	

PROJECT: 20th Street Phase 5	 1289 1st Ave Greeley, CO	PROJECT NUMBER: 21185033
SITE: 20th Street from 86th to 90th Avenue Greeley, CO		CLIENT: J-U-B ENGINEERS, Inc. Fort Collins, CO

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	24
Dry Density:	pcf	103
Diameter:	in.	1.91
Height:	in.	3.83
Height / Diameter Ratio:		2.00
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	9.28
Unconfined Compressive Strength	(psf)	474
Undrained Shear Strength:	(psf)	237
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: 08 @ 4 - 5 feet

DESCRIPTION: SANDY SILTY CLAY(CL-ML)

LL
23

PL
18

PI
5

Percent < #200 Sieve
63

PROJECT: 20th Street Phase 5

PROJECT NUMBER: 21185033

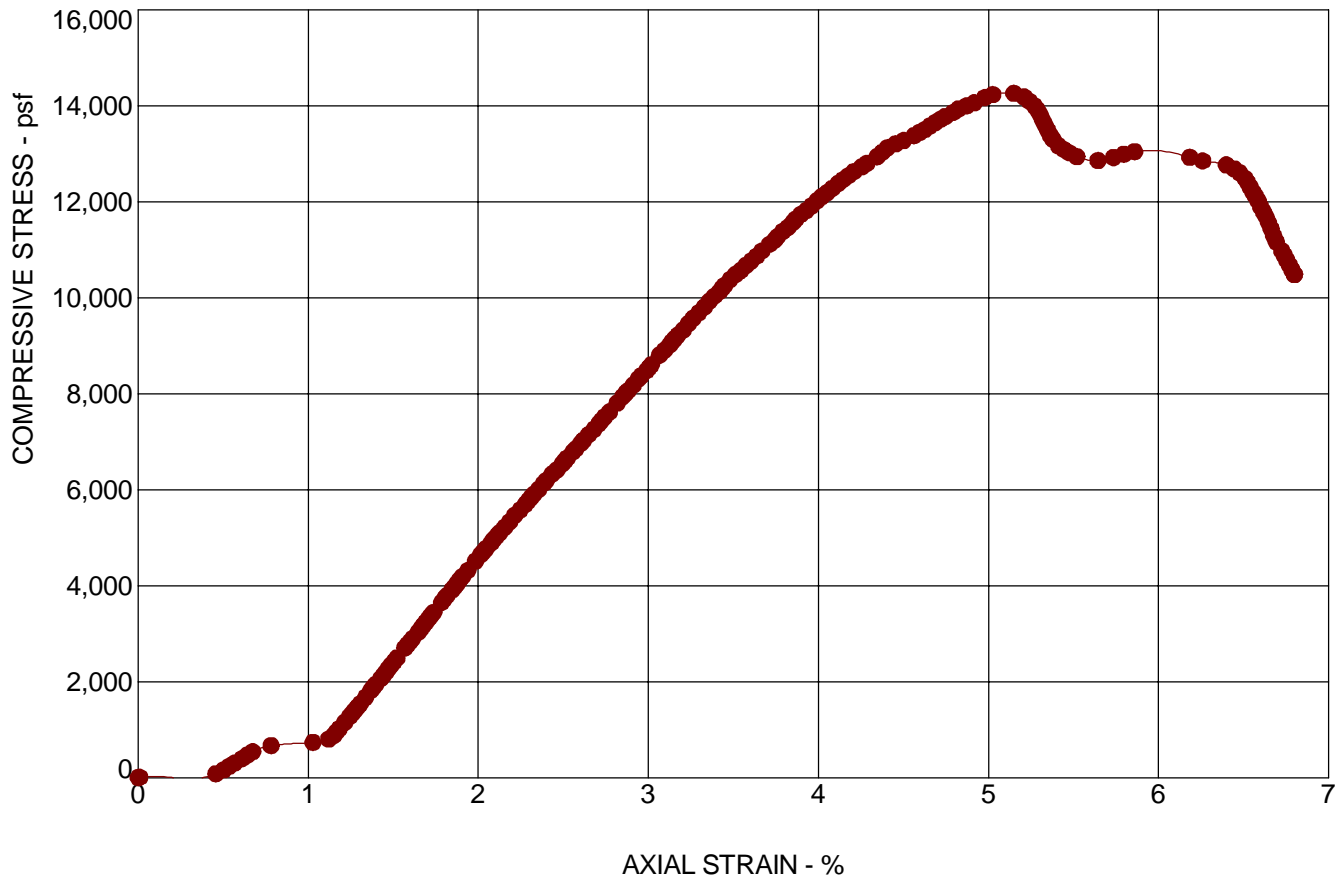
SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	20
Dry Density:	pcf	158
Diameter:	in.	1.60
Height:	in.	3.99
Height / Diameter Ratio:		2.49
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	5.15
Unconfined Compressive Strength	(psf)	14254
Undrained Shear Strength:	(psf)	7127
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: 08 @ 24 - 25 feet

DESCRIPTION: SEDIMENTARY BEDROCK - CLAYSTONE

LL

PL

PI

Percent < #200 Sieve

46

17

29

85

PROJECT: 20th Street Phase 5

PROJECT NUMBER: 21185033

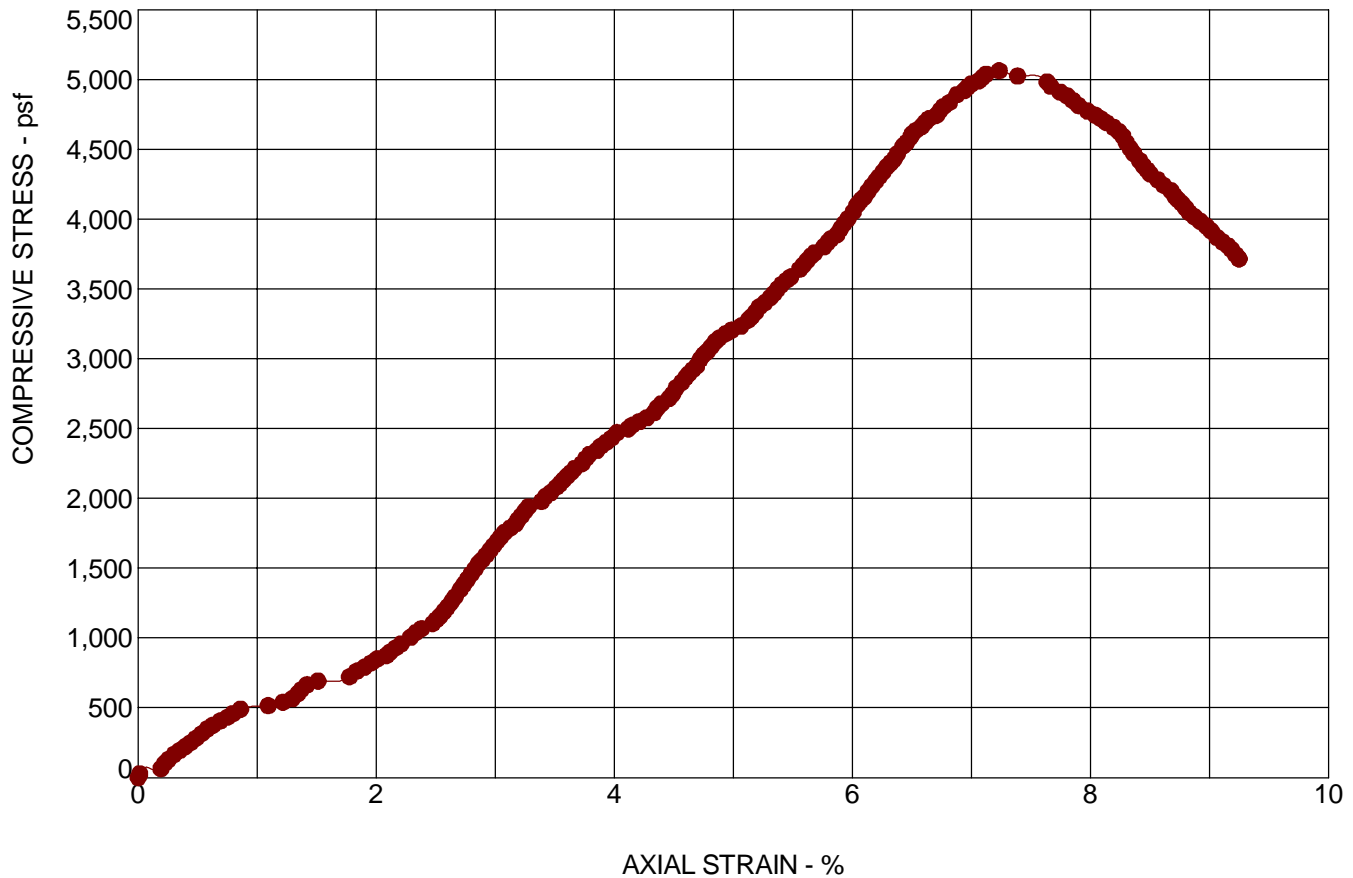
SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	22
Dry Density:	pcf	103
Diameter:	in.	1.94
Height:	in.	3.51
Height / Diameter Ratio:		1.81
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	7.23
Unconfined Compressive Strength	(psf)	5062
Undrained Shear Strength:	(psf)	2531
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: 09 @ 14 - 15 feet

DESCRIPTION: SEDIMENTARY BEDROCK - CLAYSTONE

LL
41

PL
18

PI
23

Percent < #200 Sieve
84

PROJECT: 20th Street Phase 5

PROJECT NUMBER: 21185033

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

PRESSUREMETER TEST DATA

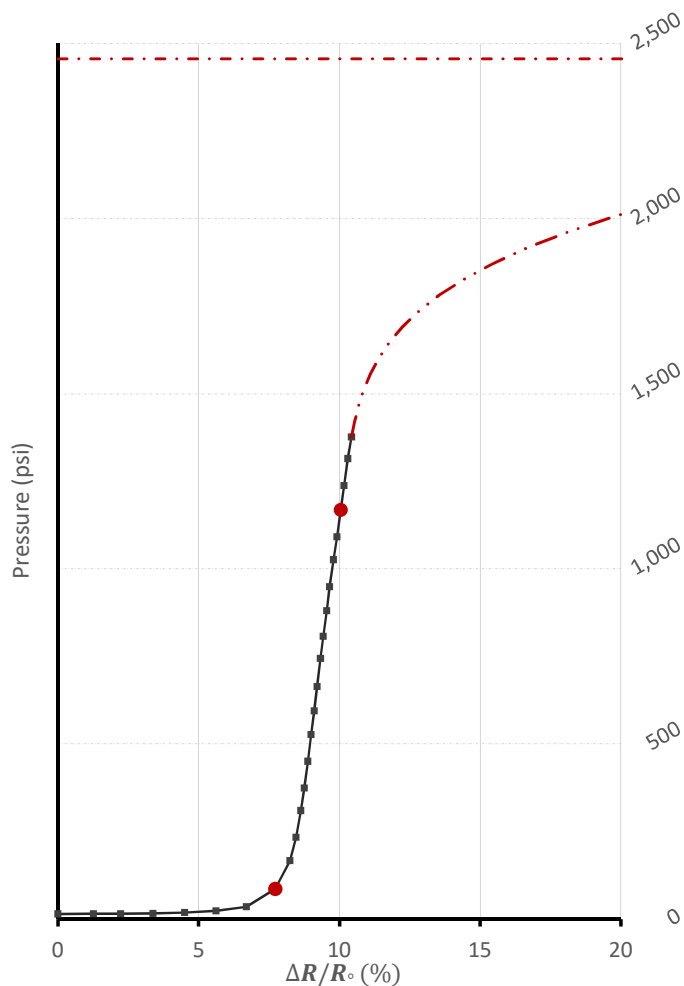
Project:	21185033
Borehole I.D.	B-9
Test date: (mm/dd/yyyy)	07/27/2018
Test number:	2
Probe size:	N
Pressure Calibration Reference:	07/26/2018 - 1
Volume Calibration Reference:	07/26/2018 - 1

Use of a slotted casing:	No	
Test depth:	32.50	ft
Manometer Height Above Ground:	1.64	ft
Poisson's Ratio of Soil or Rock:	0.33	
Fluid Density (g/cc):	1.000	

[illegible]

Remarks

Pressuremeter test zone prepared with 3" drag bit with axial fluid injection.



Test Results

Pressuremeter Modulus E^1 :	67,251	psi
Ultimate Pressure P_L^2 :	2,457	psi
Ratio E / P_L :	27.37	
Yield Pressure P_F :	1,169	psi
Ratio P_L / P_F :	2.10	

¹ The Pressuremeter Modulus was calculated using the straight line (pseudo-elastic) boundaries graphically represented in RED.

² Ultimate Pressure, P_L is estimated using a best fit polynomial curve extrapolated in 20 iterations using the Newton-Raphson method. While graphical extrapolation is considered to be the recommended method for estimating P_L , caution must be exercised in regards to its use, particularly when the maximum radial strain value is low due to the stiffness of the material tested.

PRESSUREMETER TEST DATA

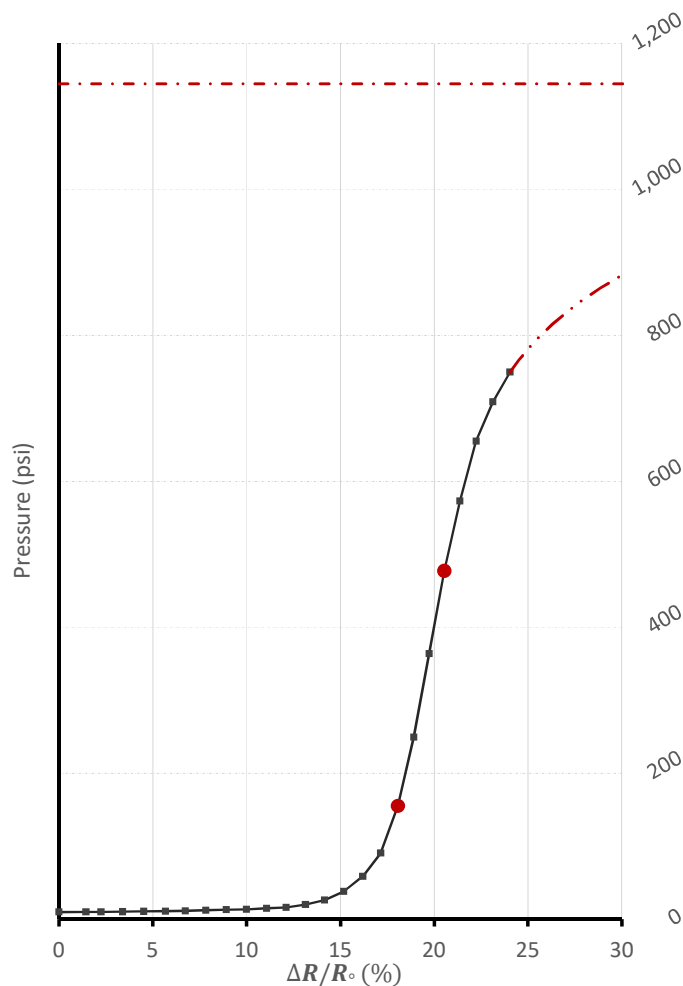
Project:	21185033
Borehole I.D.	B-9
Test date: (mm/dd/yyyy)	07/27/2018
Test number:	1
Probe size:	N
Pressure Calibration Reference:	07/26/2018 - 1
Volume Calibration Reference:	07/26/2018 - 1

Use of a slotted casing:	No	
Test depth:	21.50	ft
Manometer Height Above Ground:	1.64	ft
Poisson's Ratio of Soil or Rock:	0.33	
Fluid Density (g/cc):	1.000	

[illegible]

Remarks

Pressuremeter test zone prepared with 3-1/8" drag bit with axial fluid injection. Test zone was slightly oversized. Accordingly, test was terminated prior to maximum pressuremeter capacity to prevent membrane rupture.



Test Results

Pressuremeter Modulus E^1 :	20,616	psi
Ultimate Pressure P_L^2 :	1,145	psi
Ratio E / P_L :	18.01	
Yield Pressure P_F :	477	psi
Ratio P_L / P_F :	2.40	

¹ The Pressuremeter Modulus was calculated using the straight line (pseudo-elastic) boundaries graphically represented in RED.

² Ultimate Pressure, P_L is estimated using a best fit polynomial curve extrapolated in 20 iterations using the Newton-Raphson method. While graphical extrapolation is considered to be the recommended method for estimating P_L , caution must be exercised in regards to its use, particularly when the maximum radial strain value is low due to the stiffness of the material tested.

PRESSUREMETER TEST DATA

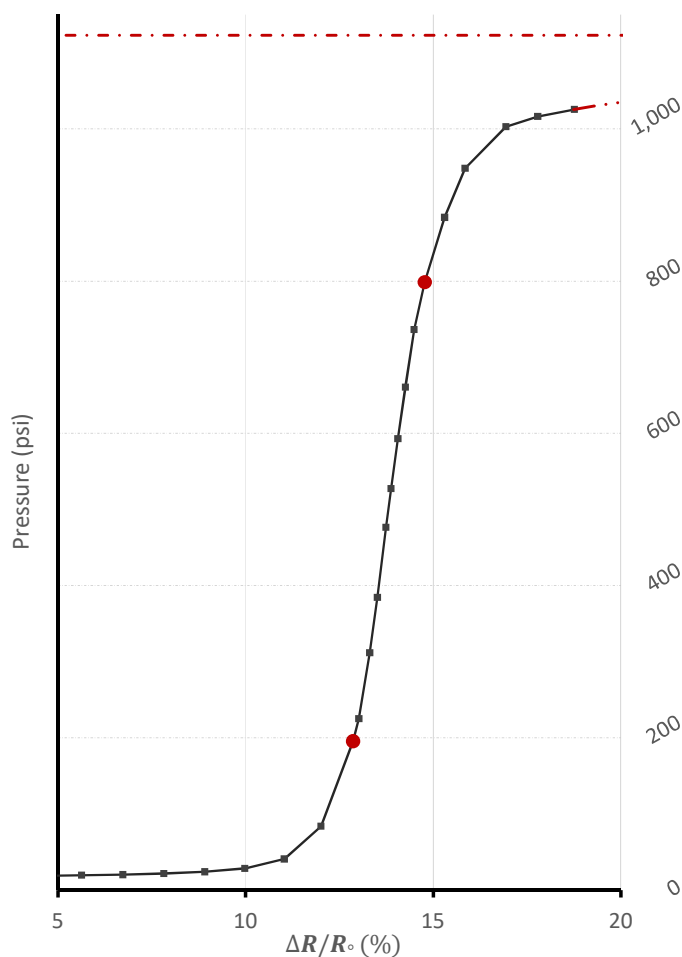
Project:	21185033
Borehole I.D.	B-9
Test date: (mm/dd/yyyy)	07/27/2018
Test number:	3
Probe size:	N
Pressure Calibration Reference:	07/26/2018 - 1
Volume Calibration Reference:	07/26/2018 - 1

Use of a slotted casing:	No	
Test depth:	41.50	ft
Manometer Height Above Ground:	1.64	ft
Poisson's Ratio of Soil or Rock:	0.33	
Fluid Density (g/cc):	1.000	

[illegible]

Remarks

Pressuremeter test zone prepared with 3" drag bit with axial fluid injection.



Test Results

Pressuremeter Modulus E^1 :	47,702	psi
Ultimate Pressure P_L^2 :	1,123	psi
Ratio E / P_L :	42.48	
Yield Pressure P_F :	799	psi
Ratio P_L / P_F :	1.41	

¹ The Pressuremeter Modulus was calculated using the straight line (pseudo-elastic) boundaries graphically represented in RED.







² Ultimate Pressure, P_L is estimated using a best fit polynomial curve extrapolated in 20 iterations using the Newton-Raphson method. While graphical extrapolation is considered to be the recommended method for estimating P_L , caution must be exercised in regards to its use, particularly when the maximum radial strain value is low due to the stiffness of the material tested.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

20th Street Phase 5 ■ Greeley, CO

February 12, 2019 ■ Terracon Project No. 21185033

SAMPLING	WATER LEVEL	FIELD TESTS
 Modified California Ring Sampler  Grab Sample  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	<p>N Standard Penetration Test Resistance (Blows/Ft.)</p> <p>(HP) Hand Penetrometer</p> <p>(T) Torvane</p> <p>(DCP) Dynamic Cone Penetrometer</p> <p>UC Unconfined Compressive Strength</p> <p>(PID) Photo-Ionization Detector</p> <p>(OVA) Organic Vapor Analyzer</p>

DESCRIPTIVE SOIL CLASSIFICATION
<p>Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.</p>
LOCATION AND ELEVATION NOTES
<p>Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.</p>

STRENGTH TERMS									
RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (psf)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Ring Sampler Blows/Ft.	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium Stiff	1,000 to 2,000	4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 8,000	> 30	> 42			

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12
GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	Particle Size	Term	Plasticity Index
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm)	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

May 2, 2018
Revised November 13, 2018



J-U-B Engineers, Inc.
4745 East Boardwalk Drive #200
Fort Collins, Colorado 80525

Attn: Ms. Lindsey Jones, P.E.
P: (970) 377-3602
E: ljones@jub.com

Re: Proposal for Geotechnical Engineering Services
20th Street Phase 5
20th Street from 86th to 90th Avenue
Greeley, Colorado
Terracon Proposal No. P21185033 (revised)

Dear Ms. Jones:


We appreciate the opportunity to submit this proposal to J-U-B Engineers, Inc. (J-U-B) to provide geotechnical engineering services for the project referenced above. We initially submitted a Proposal No. P21185033 on May 2, 2018. We have revised the proposal to separate the fees for each part of the project and to modify boring locations based on the new roundabout site plan provided by J-U-B. The following are exhibits to the attached Agreement for Services.


Exhibit A	Project Understanding
Exhibit B	Scope of Services
Exhibit C	Compensation and Project Schedule
Exhibit D	Site Location and Nearby Geotechnical Data
Exhibit E	Anticipated Exploration Plan

Our base fee to perform the scope of services described in this proposal is \$16,500. See Exhibit C for more details of our fees and consideration of additional services.

Your authorization for Terracon to proceed in accordance with this proposal can be issued by signing and returning a copy of the attached Agreement for Services to our office.

Sincerely,
Terracon Consultants, Inc.


Rick S. Greeley, E.I.
Field Engineer


Eric D. Bernhardt, P.E.
Geotechnical Department Manager

Terracon Consultants, Inc. 1289 First Avenue Greeley, Colorado 80631
P (970) 351 0460 F (970) 353 8639 terracon.com

Environmental

Facilities

Geotechnical

Materials

AGREEMENT FOR SERVICES

This **AGREEMENT** is between J-U-B ENGINEERS, Inc. ("Client") and Terracon Consultants, Inc. ("Consultant") for Services to be provided by Consultant for Client on the 20th Street Phase 5 project ("Project"), as described in Consultant's Proposal dated 11/13/2018 ("Proposal"), including but not limited to the Project Information section, unless the Project is otherwise described in Exhibit A to this Agreement (which section or Exhibit is incorporated into this Agreement).

- 1. Scope of Services.** The scope of Consultant's services is described in the Proposal, including but not limited to the Scope of Services section ("Services"), unless Services are otherwise described in Exhibit B to this Agreement (which section or exhibit is incorporated into this Agreement). Portions of the Services may be subcontracted. Consultant's Services do not include the investigation or detection of, nor do recommendations in Consultant's reports address the presence or prevention of biological pollutants (e.g., mold, fungi, bacteria, viruses, or their byproducts) or occupant safety issues, such as vulnerability to natural disasters, terrorism, or violence. If Services include purchase of software, Client will execute a separate software license agreement. Consultant's findings, opinions, and recommendations are based solely upon data and information obtained by and furnished to Consultant at the time of the Services.
- 2. Acceptance/ Termination.** Client agrees that execution of this Agreement is a material element of the consideration Consultant requires to execute the Services, and if Services are initiated by Consultant prior to execution of this Agreement as an accommodation for Client at Client's request, both parties shall consider that commencement of Services constitutes formal acceptance of all terms and conditions of this Agreement. Additional terms and conditions may be added or changed only by written amendment to this Agreement signed by both parties. In the event Client uses a purchase order or other form to administer this Agreement, the use of such form shall be for convenience purposes only and any additional or conflicting terms it contains are stricken. This Agreement shall not be assigned by either party without prior written consent of the other party. Either party may terminate this Agreement or the Services upon written notice to the other. In such case, Consultant shall be paid costs incurred and fees earned to the date of termination plus reasonable costs of closing the Project.
- 3. Change Orders.** Client may request changes to the scope of Services by altering or adding to the Services to be performed. If Client so requests, Consultant will return to Client a statement (or supplemental proposal) of the change setting forth an adjustment to the Services and fees for the requested changes. Following Client's review, Client shall provide written acceptance. If Client does not follow these procedures, but instead directs, authorizes, or permits Consultant to perform changed or additional work, the Services are changed accordingly and Consultant will be paid for this work according to the fees stated or its current fee schedule. If project conditions change materially from those observed at the site or described to Consultant at the time of proposal, Consultant is entitled to a change order equitably adjusting its Services and fee.
- 4. Compensation and Terms of Payment.** Client shall pay compensation for the Services performed at the fees stated in the Proposal, including but not limited to the Compensation section, unless fees are otherwise stated in Exhibit C to this Agreement (which section or Exhibit is incorporated into this Agreement). If not stated in either, fees will be according to Consultant's current fee schedule. Fee schedules are valid for the calendar year in which they are issued. Fees do not include sales tax. Client will pay applicable sales tax as required by law. Consultant may invoice Client at least monthly and payment is due upon receipt of invoice. Client shall notify Consultant in writing, at the address below, within 15 days of the date of the invoice if Client objects to any portion of the charges on the invoice, and shall promptly pay the undisputed portion. Client shall pay a finance fee of 1.5% per month, but not exceeding the maximum rate allowed by law, for all unpaid amounts 30 days or older. Client agrees to pay all collection-related costs that Consultant incurs, including attorney fees. Consultant may suspend Services for lack of timely payment. It is the responsibility of Client to determine whether federal, state, or local prevailing wage requirements apply and to notify Consultant if prevailing wages apply. If it is later determined that prevailing wages apply, and Consultant was not previously notified by Client, Client agrees to pay the prevailing wage from that point forward, as well as a retroactive payment adjustment to bring previously paid amounts in line with prevailing wages. Client also agrees to defend, indemnify, and hold harmless Consultant from any alleged violations made by any governmental agency regulating prevailing wage activity for failing to pay prevailing wages, including the payment of any fines or penalties.
- 5. Third Party Reliance.** This Agreement and the Services provided are for Consultant and Client's sole benefit and exclusive use with no third party beneficiaries intended. Reliance upon the Services and any work product is limited to Client, and is not intended for third parties other than those who have executed Consultant's reliance agreement, subject to the prior approval of Consultant and Client.
- 6. LIMITATION OF LIABILITY. CLIENT AND CONSULTANT HAVE EVALUATED THE RISKS AND REWARDS ASSOCIATED WITH THIS PROJECT, INCLUDING CONSULTANT'S FEE RELATIVE TO THE RISKS ASSUMED, AND AGREE TO ALLOCATE CERTAIN OF THE ASSOCIATED RISKS. TO THE FULLEST EXTENT PERMITTED BY LAW, THE TOTAL AGGREGATE LIABILITY OF CONSULTANT (AND ITS RELATED CORPORATIONS AND EMPLOYEES) TO CLIENT AND THIRD PARTIES GRANTED RELIANCE IS LIMITED TO THE GREATER OF \$50,000 OR CONSULTANT'S FEE, FOR ANY AND ALL INJURIES, DAMAGES, CLAIMS, LOSSES, OR EXPENSES (INCLUDING ATTORNEY AND EXPERT FEES) ARISING OUT OF CONSULTANT'S SERVICES OR THIS AGREEMENT. PRIOR TO ACCEPTANCE OF THIS AGREEMENT AND UPON WRITTEN REQUEST FROM CLIENT, CONSULTANT MAY NEGOTIATE A HIGHER LIMITATION FOR ADDITIONAL CONSIDERATION IN THE FORM OF A SURCHARGE TO BE ADDED TO THE AMOUNT STATED IN THE COMPENSATION SECTION OF THE PROPOSAL. THIS LIMITATION SHALL APPLY REGARDLESS OF AVAILABLE PROFESSIONAL LIABILITY INSURANCE COVERAGE, CAUSE(S), OR THE THEORY OF LIABILITY, INCLUDING NEGLIGENCE, INDEMNITY, OR OTHER RECOVERY. THIS LIMITATION SHALL NOT APPLY TO THE EXTENT THE DAMAGE IS PAID UNDER CONSULTANT'S COMMERCIAL GENERAL LIABILITY POLICY.**
- 7. Indemnity/Statute of Limitations.** Consultant and Client shall indemnify and hold harmless the other and their respective employees from and against legal liability for claims, losses, damages, and expenses to the extent such claims, losses, damages, or expenses are legally determined to be caused by their negligent acts, errors, or omissions. In the event such claims, losses, damages, or expenses are legally determined to be caused by the joint or concurrent negligence of Consultant and Client, they shall be borne by each party in proportion to its own negligence under comparative fault principles. Neither party shall have a duty to defend the other party, and no duty to defend is hereby created by this indemnity provision and such duty is explicitly waived under this Agreement. Causes of action arising out of Consultant's Services or this Agreement regardless of cause(s) or the theory of liability, including negligence, indemnity or other recovery shall be deemed to have accrued and the applicable statute of limitations shall commence to run not later than the date of Consultant's substantial completion of Services on the project.
- 8. Warranty.** Consultant will perform the Services in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. **EXCEPT FOR THE STANDARD OF CARE PREVIOUSLY STATED, CONSULTANT MAKES NO WARRANTIES OR GUARANTEES, EXPRESS OR IMPLIED, RELATING TO CONSULTANT'S SERVICES AND CONSULTANT DISCLAIMS ANY IMPLIED WARRANTIES OR WARRANTIES IMPOSED BY LAW, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**
- 9. Insurance.** Consultant represents that it now carries, and will continue to carry: (i) workers' compensation insurance in accordance with the laws of the states having jurisdiction over Consultant's employees who are engaged in the Services, and employer's liability insurance (\$1,000,000); (ii)

commercial general liability insurance (\$1,000,000 occ / \$2,000,000 agg); (iii) automobile liability insurance (\$1,000,000 B.I. and P.D. combined single limit); and (iv) professional liability insurance (\$1,000,000 claim / agg). Certificates of insurance will be provided upon request. Client and Consultant shall waive subrogation against the other party on all general liability and property coverage.

- 10. CONSEQUENTIAL DAMAGES.** NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR LOSS OF PROFITS OR REVENUE; LOSS OF USE OR OPPORTUNITY; LOSS OF GOOD WILL; COST OF SUBSTITUTE FACILITIES, GOODS, OR SERVICES; COST OF CAPITAL; OR FOR ANY SPECIAL, CONSEQUENTIAL, INDIRECT, PUNITIVE, OR EXEMPLARY DAMAGES.
- 11. Dispute Resolution.** Client shall not be entitled to assert a Claim against Consultant based on any theory of professional negligence unless and until Client has obtained the written opinion from a registered, independent, and reputable engineer, architect, or geologist that Consultant has violated the standard of care applicable to Consultant's performance of the Services. Client shall provide this opinion to Consultant and the parties shall endeavor to resolve the dispute within 30 days, after which Client may pursue its remedies at law. This Agreement shall be governed by and construed according to Kansas law.
- 12. Subsurface Explorations.** Subsurface conditions throughout the site may vary from those depicted on logs of discrete borings, test pits, or other exploratory services. Client understands Consultant's layout of boring and test locations is approximate and that Consultant may deviate a reasonable distance from those locations. Consultant will take reasonable precautions to reduce damage to the site when performing Services; however, Client accepts that invasive services such as drilling or sampling may damage or alter the site. Site restoration is not provided unless specifically included in the Services.
- 13. Testing and Observations.** Client understands that testing and observation are discrete sampling procedures, and that such procedures indicate conditions only at the depths, locations, and times the procedures were performed. Consultant will provide test results and opinions based on tests and field observations only for the work tested. Client understands that testing and observation are not continuous or exhaustive, and are conducted to reduce - not eliminate - project risk. Client shall cause all tests and inspections of the site, materials, and Services performed by Consultant to be timely and properly scheduled in order for the Services to be performed in accordance with the plans, specifications, contract documents, and Consultant's recommendations. No claims for loss or damage or injury shall be brought against Consultant by Client or any third party unless all tests and inspections have been so performed and Consultant's recommendations have been followed. Unless otherwise stated in the Proposal, Client assumes sole responsibility for determining whether the quantity and the nature of Services ordered by Client is adequate and sufficient for Client's intended purpose. Client is responsible (even if delegated to contractor) for requesting services, and notifying and scheduling Consultant so Consultant can perform these Services. Consultant is not responsible for damages caused by Services not performed due to a failure to request or schedule Consultant's Services. Consultant shall not be responsible for the quality and completeness of Client's contractor's work or their adherence to the project documents, and Consultant's performance of testing and observation services shall not relieve Client's contractor in any way from its responsibility for defects discovered in its work, or create a warranty or guarantee. Consultant will not supervise or direct the work performed by Client's contractor or its subcontractors and is not responsible for their means and methods. The extension of unit prices with quantities to establish a total estimated cost does not guarantee a maximum cost to complete the Services. The quantities, when given, are estimates based on contract documents and schedules made available at the time of the Proposal. Since schedule, performance, production, and charges are directed and/or controlled by others, any quantity extensions must be considered as estimated and not a guarantee of maximum cost.
- 14. Sample Disposition, Affected Materials, and Indemnity.** Samples are consumed in testing or disposed of upon completion of the testing procedures (unless stated otherwise in the Services). Client shall furnish or cause to be furnished to Consultant all documents and information known or available to Client that relate to the identity, location, quantity, nature, or characteristic of any hazardous waste, toxic, radioactive, or contaminated materials ("Affected Materials") at or near the site, and shall immediately transmit new, updated, or revised information as it becomes available. Client agrees that Consultant is not responsible for the disposition of Affected Materials unless specifically provided in the Services, and that Client is responsible for directing such disposition. In no event shall Consultant be required to sign a hazardous waste manifest or take title to any Affected Materials. Client shall have the obligation to make all spill or release notifications to appropriate governmental agencies. The Client agrees that Consultant neither created nor contributed to the creation or existence of any Affected Materials conditions at the site and Consultant shall not be responsible for any claims, losses, or damages allegedly arising out of Consultant's performance of Services hereunder, or for any claims against Consultant as a generator, disposer, or arranger of Affected Materials under federal, state, or local law or ordinance.
- 15. Ownership of Documents.** Work product, such as reports, logs, data, notes, or calculations, prepared by Consultant shall remain Consultant's property. Proprietary concepts, systems, and ideas developed during performance of the Services shall remain the sole property of Consultant. Files shall be maintained in general accordance with Consultant's document retention policies and practices.
- 16. Utilities.** Client shall provide the location and/or arrange for the marking of private utilities and subterranean structures. Consultant shall take reasonable precautions to avoid damage or injury to subterranean structures or utilities. Consultant shall not be responsible for damage to subterranean structures or utilities that are not called to Consultant's attention, are not correctly marked, including by a utility locate service, or are incorrectly shown on the plans furnished to Consultant.
- 17. Site Access and Safety.** Client shall secure all necessary site related approvals, permits, licenses, and consents necessary to commence and complete the Services and will execute any necessary site access agreement. Consultant will be responsible for supervision and site safety measures for its own employees, but shall not be responsible for the supervision or health and safety precautions for any other parties, including Client, Client's contractors, subcontractors, or other parties present at the site.

Consultant: **Terracon Consultants, Inc.**
 By: Eric D. Bernhardt Date: **11/13/2018**
 Name/Title: **Eric D. Bernhardt, P.E. / Geotechnical**
Department Manager
 Address: **1289 1st Ave**
Greeley, CO 80631-4275
 Phone: **(970) 351-0460** Fax: **(970) 353-8639**
 Email: **Eric.Bernhardt@terracon.com**

Client: **J-U-B ENGINEERS, Inc.**
 By: _____ Date: _____
 Name/Title: **Jeff Temple, P.E.**
 Address: **4745 Boardwalk Dr**
Fort Collins, CO 80525-3768
 Phone: **(970) 377-3602** Fax: _____
 Email: **jtemple@jub.com**

EXHIBIT A - PROJECT UNDERSTANDING

Our proposed scope of services is based upon our understanding of the project as described by J-U-B and the expected subsurface conditions as described below. We have not visited the project site since our initial exploration program to confirm the information provided. Aspects of the project, undefined or assumed, are highlighted as shown below. We request the design team verify this information prior to our initiation of field exploration activities.

Site Location

Item	Description
Parcel Information	The project sites are located on 20 th Street in Greeley, Colorado. The Phase 5 pavement widening and improvements are planned for on 20 th Street from 86 th to 90 th Avenue. The LRFD bridge design site is located about 650 feet west of the intersection of 20 th Street and 83 rd Avenue on the south side of 20 th Street. The roundabout site is located at the intersection of 20 th Street and 83 rd Avenue. The approximate Latitude/Longitude of the center of the intersection is 40.40664° N, 104.81515°W (Please refer to Exhibit D).
Existing Improvements	The sites are currently occupied by 20 th Street and surrounding drainage swales. The roadways are paved with asphalt and/or concrete.
Surrounding Developments	20 th Street is generally surrounded by residential housing to the north and vacant land to the south.
Current Ground Cover	Current ground cover is asphalt pavement in the roadway areas and native weeds and grasses in the swales off the roadway.
Existing Topography	The site is generally flat with grades sloping down away from 20 th street.
Site Access	We expect the roadway widening and roundabout site, and associated exploration locations, are accessible with our truck-mounted drilling equipment. We understand the LRFD bridge design site has difficult access and will likely require an all-terrain drill rig.

Planned Construction

Item	Description
Information Provided	Information was provided via phone and email correspondence with Lindsey Jones of J-U-B on April 17, 2018. Additional correspondence with Kirsten Armbruster of J-U-B on February 28, 2017.
Project Description	Phase 5 of 20 th Street includes the widening and general improvements of 20 th Street in Greeley from 86 th Avenue to 83 rd Avenue. Previously during Phase 4, a culvert was planned below 20 th Street. A LRFD bridge design is now required for a concrete box culvert (CBC) bridge at the location. Additionally, the intersection of 20 th Street and 83 rd Avenue is being designed as a roundabout.

Proposal for Geotechnical Engineering Services

20th Street Phase 5 ■ Greeley, Colorado

November 13, 2018 ■ Terracon Proposal No. P21185033 (revised)



Item	Description
Proposed Construction	The project includes construction of new pavements, a CBC bridge and a roundabout.
Grading/Slopes	We anticipate minor cuts and fills on the order of 5 feet or less will be required to achieve proposed grades for the pavements and roundabout. Based on initial layout plans provided by J-U-B, we understand about 12 feet of cut and 5 feet of fill may be required for the CBC bridge.
Pavements	<p>We understand flexible (asphalt) pavement section recommendations are required for the roadway widening from 86th Avenue to 90th Avenue and rigid (concrete) pavement section recommendations are required for the roundabout.</p> <p>Pavement design will be in general accordance with the 2015 City of Greeley Design Criteria and Construction Specifications. We understand 20th Street from 86th Avenue to 90th Avenue will be classified as a two-lane arterial.</p>

EXHIBIT B - SCOPE OF SERVICES

Our proposed scope of services consists of field exploration, laboratory testing, and engineering/project delivery. These services are described in the following sections.

Field Exploration

The field exploration program consists of the following:

Number of Borings	Planned Boring Depth (feet) ¹	Planned Location
7 (Boring Nos. 10 to 16)	6 to 10	Planned roadway widening area
2 (Boring No. 8 and 9)	50	Planned CBC bridge area
4 (Boring Nos. 17 to 20)	6 to 10	Planned roundabout area

¹. Proposed borings will be completed to the planned depths below existing site grades or practical auger refusal, if shallower.

Boring Layout and Elevations: We use handheld GPS equipment to locate borings with an estimated horizontal accuracy of +/-20 feet. A ground surface elevation at each boring location is obtained by Terracon using an engineer's level, referencing an on-site benchmark. If available, approximate elevations are obtained by interpolation from a site specific, surveyed topographic map.

Subsurface Exploration Procedures: We advance soil borings with a truck-mounted or all-terrain drill rig using continuous-flight augers (solid-stem and/or hollow-stem, as necessary, depending on subsurface conditions). Three samples are obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling is typically performed using thin-wall tube, ring-lined split-barrel, and/or standard split-barrel sampling procedures. For the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample. For the standard split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For the ring-lined split-barrel sampling procedure, a 3-inch outer diameter split-barrel sampling spoon is used for sampling. Ring-lined, split-barrel sampling procedures are similar to standard split-barrel sampling procedures; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. The samples are placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer.

Proposal for Geotechnical Engineering Services

20th Street Phase 5 ■ Greeley, Colorado

November 13, 2018 ■ Terracon Proposal No. P21185033 (revised)



In addition, we will observe and record groundwater levels during drilling observations. No provisions have been made to obtain delayed groundwater measurements.

Our exploration team prepares field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs include visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent the geotechnical engineer's interpretation, and include modifications based on observations and laboratory test results.

Property Disturbance: We backfill borings with auger cuttings after completion. Pavement borings are backfilled with aggregate base coarse and are patched with cold-mix asphalt and/or ready mixed concrete, as appropriate. Our services do not include repair of the site beyond backfilling our boreholes, and cold patching existing pavements. Excess auger cuttings are dispersed in the general vicinity of the boreholes. Because backfill material often settles below the surface after a period, we recommend checking boreholes periodically and backfilling, if necessary. We can provide this service, or grout the boreholes for additional fees, at your request.

Traffic Control: In order to safely complete the exploratory borings proposed within the roadway, we will retain the services of a professional traffic control company to prepare a traffic control plan and provide traffic control services during completion of our field exploration. We will submit the traffic control plan to the appropriate representative for review and approval prior to mobilizing to the site.

Pressure Meter Testing (PMT): Pressure meter testing is an in-situ test method used to develop stress-strain properties of soils and soft rocks. PMT consists of placing a cylindrical probe in a soil or soft rock strata of interest within a predrilled borehole and pressurizing the flexible outer membrane of the probe radially against the soil or soft rock. The pressure applied and the relative increase in cavity radius are recorded, up to 40 data points per set, and an in-situ stress-strain curve of the material is developed. The Pressuremeter test will be repeated at various depths to characterize entire profiles of soil and soft rock. PMT will be performed in general accordance with ASTM D4719-07. We will utilize the PMT results to develop parameters used during LRFD design of the CBC bridge.

Safety

Terracon is currently not aware of environmental concerns at this project site that would create health or safety hazards associated with our exploration program; thus, our scope considers standard OSHA Level D Personal Protection Equipment (PPE) appropriate. Our scope of services does not include environmental site assessment services, but identification of unusual or

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unnatural materials encountered while drilling will be noted on our logs and discussed in our report.

Exploration efforts require borings into the subsurface; therefore, Terracon complies with local regulations to request a utility location service through Colorado 811 (CO811). We consult with the owner/client regarding potential utilities, or other unmarked underground hazards. Based upon the results of this consultation, we consider the need for alternative subsurface exploration methods, as the safety of our field crew is a priority.

Private utilities should be marked by the owner/client prior to commencement of field exploration. Terracon will not be responsible for damage to private utilities that are not made aware to us. If the owner/client is not able to accurately locate private utilities, Terracon can assist the owner/client by coordinating or subcontracting with a private utility locating services. Fees associated with the additional services are not included in our current scope of services and will be forwarded to our client for approval prior to initiating. The detection of underground utilities is dependent upon the composition and construction of the utility line; some utilities are comprised of non-electrically conductive materials and may not be readily detected. The use of a private utility locate service would not relieve the owner of their responsibilities in identifying private underground utilities.

Site Access: Terracon must be granted access to the site by the property owner. By acceptance of this proposal without information to the contrary, we consider this as authorization to access the property for conducting field exploration in accordance with the scope of services. We assume the field work may be completed between 7 a.m. and 7 p.m. on weekdays.

Laboratory Testing

The project engineer reviews field data and assigns various laboratory tests to better understand the engineering properties of various soil and bedrock strata. Exact types and number of tests cannot be defined until completion of field work. Laboratory testing is conducted in general accordance with applicable or other locally recognized standards. Testing is performed under the direction of a geotechnical engineer and may include the following:

- | | |
|----------------------------------|---|
| ■ Visual classification | ■ Moisture content |
| ■ Dry density | ■ Atterberg limits |
| ■ Grain-size analysis | ■ One-dimensional swell |
| ■ Shear strength, as appropriate | ■ Unconfined compressive strength |
| ■ Water-soluble sulfates | ■ Corrosive properties |
| ■ R-value | ■ Laboratory compaction characteristics |

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Our laboratory testing program often includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we describe and classify soil samples in accordance with the Unified Soil Classification System (USCS). Soil and bedrock samples obtained during our field work will be disposed of after laboratory testing is complete unless a specific request is made to temporarily store the samples for a longer period of time.

If bedrock samples are obtained, rock classification is conducted using locally accepted practices for engineering purposes; petrographic analysis (if performed) may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification is determined using the Description of Rock Properties.

Engineering and Project Delivery

Results of our field and laboratory programs are evaluated by a professional engineer. The engineer develops a geotechnical site characterization, performs the engineering calculations necessary to evaluate foundation and pavement alternatives, and develops appropriate geotechnical engineering design criteria for earth-related phases of the project.

Your project is delivered using our [GeoReport](#) system. Upon initiation, we provide you and your design team the necessary link and password to access the website (if not previously registered). Each project includes a calendar to track the schedule, an interactive site map, a listing of team members, access to the project documents as they are uploaded to the site, and a collaboration portal. A typical delivery process includes three basic stages:

- Stage 1: Project Planning
- Stage 2: Site Characterization
- Stage 3: Geotechnical Engineering

When services are complete, we upload a printable version of our completed final geotechnical engineering report, including the professional engineer's seal and signature, which documents our services. Previous submittals, collaboration, and final report are maintained in our system indefinitely. This allows future reference and integration into subsequent aspects of our services, as the project goes through final design and construction.

The final geotechnical engineering report provides the following:

- Site description
- Boring logs with field and laboratory data
- Stratification based on visual soil and/or bedrock classification
- Groundwater levels observed during and after completion drilling
- Site and boring location plans

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- Subsurface exploration procedures
- Description of subsurface conditions
- Laboratory test results
- Pressure meter test results
- LRFD bridge design parameters
- Seismic site classification
- Subgrade preparation/earthwork recommendations
- Recommended pavement options and design parameters

Additional Services

In addition to basic services noted above, the following services are often associated with geotechnical engineering services. Fees for basic services noted above do not include the following:

Review of Plans and Specifications: Our geotechnical report and associated verbal and written communications will be used by others in the design team to develop plans and specifications for construction. Review of the project plans and specifications is a vital part of our geotechnical engineering services. This consists of review of project plans and specifications related to site preparation, foundation, and pavement construction. Our review includes a written statement, which conveys our opinions, related to the plans and specifications' consistency with our geotechnical engineering recommendations.

Observation and Testing of Pertinent Construction Materials: Development of our geotechnical engineering recommendations and report relies on an interpretation of soil conditions. This is based on widely spaced exploration locations, and assuming construction methods will be performed in a manner sufficient to meet our expectations, and is consistent with recommendations made at the time the geotechnical engineering report is issued. We should be retained to conduct construction observations, and perform/document associated materials testing, for site preparation, foundation, and pavement construction. This allows a more comprehensive understanding of subsurface conditions and necessary documentation of construction, to confirm and/or modify (when necessary) the assumptions and recommendations made by our engineers.

Environmental Assessments: Our scope for this project does not include, either specifically or by implication, an environmental assessment of the site intended to identify or quantify potential site contaminants. If the client/owner is concerned about potential for such conditions and/or contamination, an environmental site assessment should be conducted. We can provide a proposal for an environmental assessment, if desired.

EXHIBIT C - COMPENSATION AND PROJECT SCHEDULE

Compensation

Based upon our understanding of the site, the project as summarized in **Exhibit A**, and our planned scope of services described in **Exhibit B**, our base fee is shown in the following table:

Task	Lump Sum Fee
Phase 5 roadway widening – Subsurface Exploration, Laboratory Testing, Geotechnical Consulting & Reporting	\$3,500
CBC bridge with PMT – Subsurface Exploration, Laboratory Testing, Geotechnical Consulting & Reporting	\$7,400
Roundabout – Subsurface Exploration, Laboratory Testing, Geotechnical Consulting & Reporting	\$3,200
Traffic Control (estimated fee) ^{1 2}	\$1800 - \$2,400
Total Estimated Fee ³	\$16,500

1. Traffic control will be invoiced at cost plus 15 percent.

2. Traffic control fee is an estimate and will be impacted by several factors such as access to borings, number of mobilizations and extent of the traffic control program.

3. Total fee including traffic control estimate of \$2,400

Additional services not part of the base fee include the following:

Additional Services (see Exhibit B)	Lump Sum Fee	Initial for Authorization
Private Utility Locate Service ¹	\$125/hour	
Plans and Specifications Review	\$140/hour	
Observation and Testing of Pertinent Construction Materials	TBD	

4. The use of a private locate utilities service does not relieve the owner of their responsibilities in identifying private underground. If the owner/client is unable to accurately locate private utilities, we can subcontract a private utility locating firm and/or utilize geophysical equipment, if necessary. The detection of underground utilities is dependent upon the composition and construction of utility lines. Some utilities are comprised of non-electrically conductive materials and may not be readily detected.

Our scope of services does not include services associated with site clearing, wet ground conditions, tree or shrub clearing, or repair of/damage to existing landscape. If such services are desired by the owner/client, we should be notified so we can adjust our scope of services.

Unless instructed otherwise, we will submit our invoice(s) to the address shown at the beginning of this proposal. If conditions are encountered that require scope of services revisions and/or

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result in higher fees, we will contact you for approval, prior to initiating services. A supplemental proposal stating the modified scope of services as well as its effect on our fee will be prepared. We will not proceed without your authorization, as evidenced by your signature on the appropriate form.

Project Schedule

We developed a schedule to complete the scope of services based upon our existing availability and understanding of your project schedule. However, this does not account for delays in field exploration beyond our control, such as weather conditions, permit delays, or lack of permission to access the boring locations. In the event the schedule provided is inconsistent with your needs, please contact us so we may consider alternatives.

<i>GeoReport</i> Stage	Posting Date from Notice to Proceed ^{1, 2}
Project Planning	5 days
Site Characterization	10 to 15 days
Geotechnical Engineering	20 to 30 days

1. Upon receipt of your notice to proceed, we will activate the schedule component of our *GeoReport* website with specific, anticipated calendar dates for the three delivery points noted above as well as other pertinent events such as field exploration crews on-site, etc.
2. We will maintain a current calendar of activities within our *GeoReport* website. In the event of a need to modify the schedule, the schedule will be updated to maintain a current awareness of our plans for delivery.

Terracon

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MAP PROVIDED BY MICROSOFT BING MAPS

EXHIBIT E - ANTICIPATED EXPLORATION PLAN

20th Street Phase 5 ■ Greeley, Colorado

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Terracon

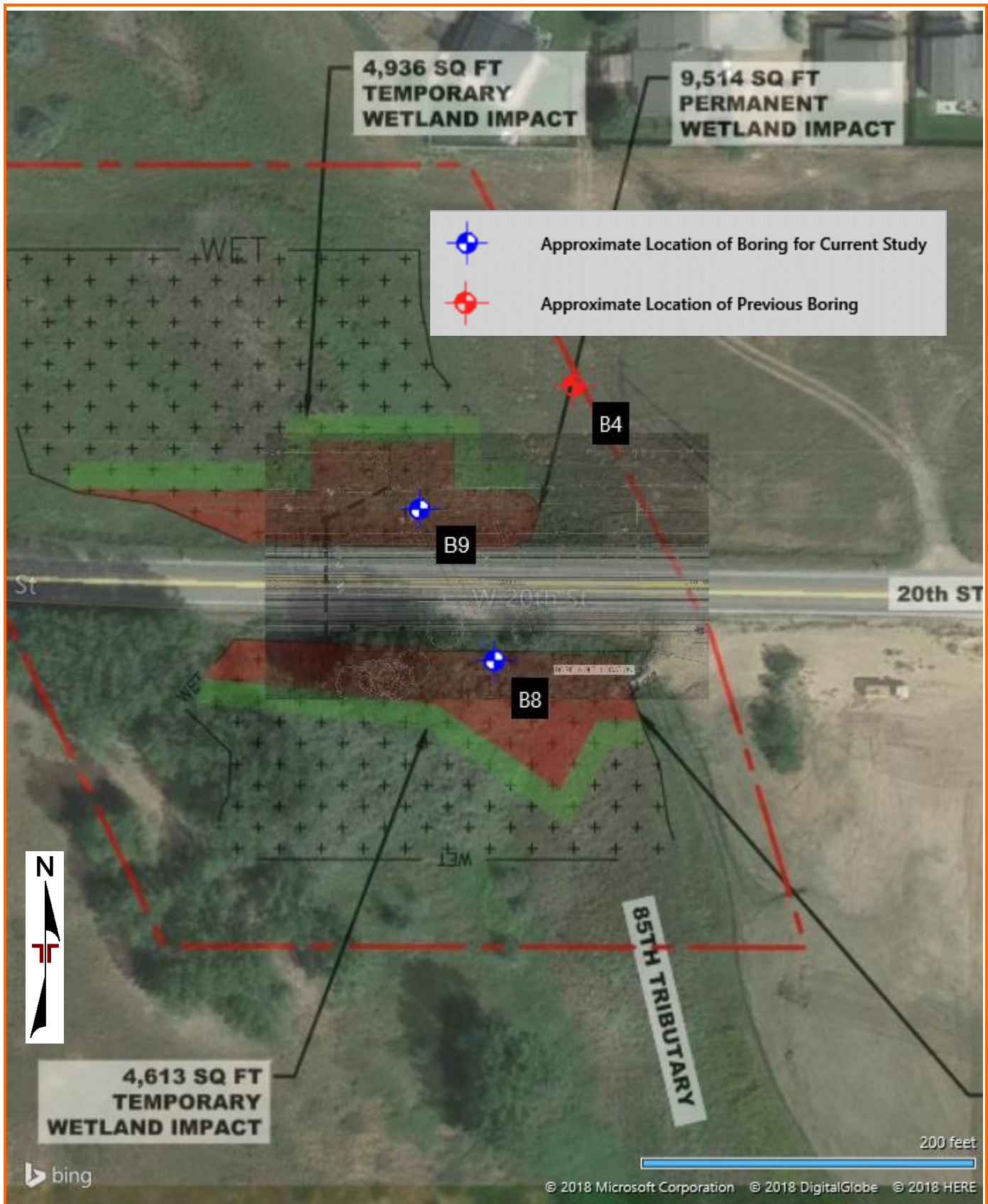


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXHIBIT E - ANTICIPATED EXPLORATION PLAN

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MAP PROVIDED BY MICROSOFT BING MAPS

EXHIBIT E - ANTICIPATED EXPLORATION PLAN

20th Street Phase 5 ■ Greeley, Colorado

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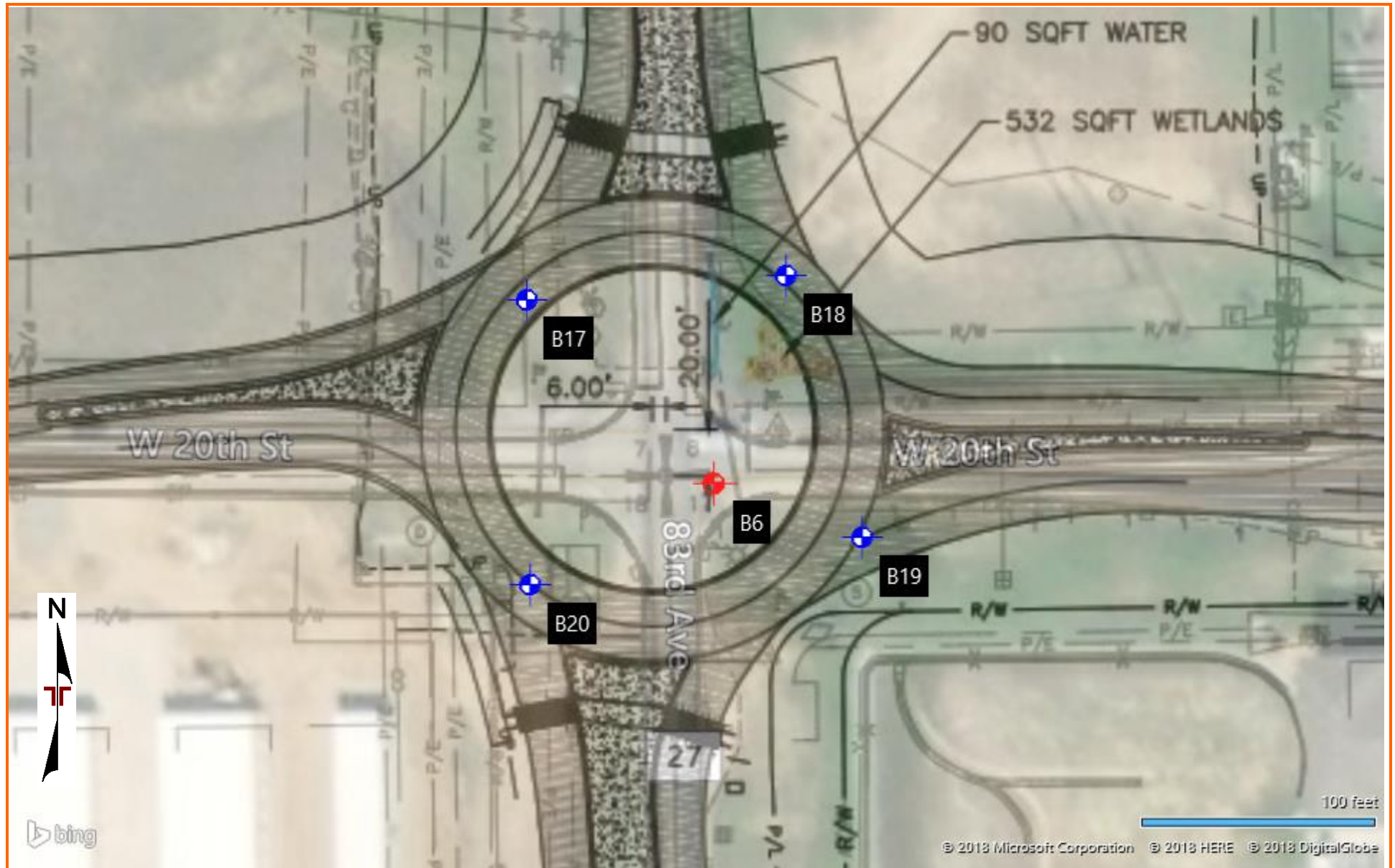


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS



Geotechnical Engineering Report

**20th Street Roundabout
Greeley, Colorado**

December 20, 2018
Terracon Project No. 21185033

Prepared for:

J-U-B Engineers, Inc.
Fort Collins, Colorado

Prepared by:

Terracon Consultants, Inc.
Greeley, Colorado



December 20, 2018

J-U-B Engineers, Inc.
4745 East Boardwalk Drive, Suite 200
Fort Collins, Colorado 80525



Attn: Mr. Jeff Temple
P: (970) 377 3602
E: jtemple@jub.com

Re: Geotechnical Engineering Report
20th Street Roundabout
Intersection of 20th Street and 83rd Avenue
Greeley, Colorado
Terracon Project No. 21185033

Dear Mr. Temple:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the project referenced above. This study was performed in general accordance with Terracon Proposal No. P21185033 (revised) dated November 13, 2018. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. Materials testing and construction observation services are provided by Terracon as well. We would be please to discuss these services with you. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

A handwritten signature in blue ink, appearing to read "Rick S. Greeley".

Rick S. Greeley, E.I.
Field Engineer

A circular blue ink seal for Eric D. Bernhardt, a Professional Engineer in the State of Colorado. The seal includes the text "COLORADO REGISTERED PROFESSIONAL ENGINEER", "ERIC D. BERNHARDT", and the number "38829". The date "12/20/18" is stamped in the center. A handwritten signature "Eric D. Bernhardt" is written across the seal.

Eric D. Bernhardt, P.E.
Geotechnical Department Manager

REPORT TOPICS

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the **GeoReport** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
PHOTOGRAPHY LOG
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic ¹	Overview Statement ²
Project Overview	A geotechnical exploration has been performed for the proposed 20th Street Roundabout to be constructed at the intersection of 20th Street and 83rd Avenue in Greeley, Colorado. Four (4) borings were performed to depths of approximately 10 feet below existing site grades. Previously, we completed a Geotechnical Engineering Report (Project No. 21175048; report dated September 29, 2017) for the proposed reconstruction and roadway widening of 20 th Street. Data from this previous report was used during preparation of our report.
Subsurface Conditions	Subsurface conditions encountered in our exploratory borings generally consisted of about 5 to 10 feet of clay with varying amounts of sand over bedrock. Claystone and siltstone bedrock was encountered below the overburden soils in most of the borings at depths of approximately 5 to 8 feet below existing site grades. Boring logs are presented in the Exploration Results section of this report.
Groundwater Conditions	Groundwater was not encountered during our exploration. Groundwater levels can fluctuate in response to site development and to varying seasonal and weather conditions, irrigation on or adjacent to the site and fluctuations in nearby water features. We do not expect groundwater to significantly impact this project.
Geotechnical Concerns	<ul style="list-style-type: none"> ■ As previously noted, existing fill was encountered to a depth of about 8 feet in Boring No. 6 drilled at the site. We do not possess any information regarding whether the fill was placed under the observation of a geotechnical engineer. However, we believe the fill was likely placed during the construction of 20th Street. The fills encountered have been supporting 20th Street for a long time without any significant settlement below the existing pavements. We believe the existing fills will provide adequate subgrade support for the roundabout. ■ We anticipate embankment fill on the order of 5 to 10 feet in the northwest corner and 3 to 5 feet in all other areas is needed to raise the grades in the drainage swale areas around the existing pavements. Our experience indicates that soft and loose soils are often present in these areas due to excessive wetting of soils. We advanced 4 soil borings in the swale areas and did not encounter significantly soft or loose soils during our exploration. However, soft or loose soils may be present in other areas at this site. Fills placed on soft or loose soils are more susceptible to settlement. We recommend fill materials placed during construction have an R-value greater than or equal to the measured laboratory R-value of 12.
Earthwork	On-site soils typically appear suitable for use as general engineered fill and backfill on the site provided they are placed and compacted as described in this report. Import materials (if needed) should be evaluated and approved by Terracon prior to delivery to the site. Earthwork recommendations are presented in the Earthwork section of this report.
Grading and Drainage	The amount of movement of pavements will be related to the wetting of underlying supporting soils. Therefore, it is imperative the recommendations discussed in the Grading and Drainage section of the Earthwork section of this report be followed to reduce potential movement.
Pavements	Recommended Pavement thicknesses for this project include 8½ inches of asphalt over 12 inches of aggregate base course or 10 inches of concrete over 4 inches of aggregate base course. Additional pavement section discussion is presented in the report.

Geotechnical Engineering Report

20th Street Roundabout ■ Greeley, Colorado

December 20, 2018 ■ Terracon Project No. 21185033



Topic ¹	Overview Statement ²
Seismic Considerations	As presented in the Seismic Considerations section of this report, the International Building Code, which refers to Section 20 of ASCE 7, indicates the seismic site classification for this site is D.
Construction Observation and Testing	Close monitoring of the construction operations and implementing drainage recommendations discussed herein will be critical in achieving the intended foundation, slab and pavement performance. We therefore recommend that Terracon be retained to monitor this portion of the work.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics (bold orange font) above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein.

Geotechnical Engineering Report
20th Street Roundabout
Intersection of 20th Street and 83rd Avenue
Greeley, Colorado
Terracon Project No. 21185033
December 20, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed 2-lane roundabout to be located at the intersection of 20th Street and 83rd Avenue in Greeley, Colorado. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Demolition considerations
- Pavement design and construction

The geotechnical engineering scope of services for this project included the advancement of 4 test borings to depths of approximately 10 feet below existing site grades. We have also attached Boring No. 6 from our previous study.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil and bedrock samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The site is located at the intersection of 20 th Street and 83 rd Avenue. The approximate Latitude/Longitude of the center of the intersection is 40.40664° N, 104.81515°W. See Site Location .
Existing Improvements	The intersection is currently a 4-way stop intersection of two asphalt paved two-lane roads; 20 th Street and 83 rd Avenue.
Current Ground Cover	Current ground cover is asphalt pavement in the roadway areas and native weeds and grasses in the swales off the roadway.

Item	Description
Existing Topography	The road is generally flat with grades sloping down away from the roads into the drainage swales.

PROJECT DESCRIPTION

Item	Description
Information Provided	Information for the roundabout was provided by Jeff Temple with J-U-B on November 12, 2018.
Project Description	A two-lane roundabout is proposed at the intersection of 20 th Street and 83 rd Avenue.
Grading/Slopes	We anticipate minor cuts and fills on the order of 5 feet or less will be required to achieve the proposed grades for the majority of the roundabout. We expect greater fills up to about 10 feet in the northeast corner of the intersection.
Pavements	We understand rigid (concrete) and flexible (asphalt) pavement section recommendations are required for the roundabout. Pavement design is in general accordance with the 2015 City of Greeley Design Criteria and Construction Specifications. We understand 20 th Street is classified as a 2-lane arterial and 83 rd Avenue is classified as a 4-lane arterial.
Estimated Start of Construction	May 1, 2019

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found in **Exploration Results**. A discussion of field sampling and laboratory testing procedures and test results are presented in **Exploration and Testing Procedures**. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Material Description	Approximate Depth to Bottom of Stratum	Consistency/Hardness
Lean and fat clay	About 5 to 10 feet below existing site grades	Medium stiff to very stiff
Siltstone/claystone bedrock	To the maximum depth of exploration of about 10 feet	Weathered to hard

Groundwater Conditions

Groundwater was not encountered during our exploration. Groundwater levels can fluctuate in response to site development and to varying seasonal and weather conditions, irrigation on or adjacent to the site and fluctuations in nearby water features. We do not expect groundwater to significantly impact this project.

Laboratory Testing

Representative soil samples were selected for swell-consolidation testing and exhibited 1.6 to 6.3 percent compression when wetted. Samples of site soils and bedrock selected for plasticity testing exhibited low to high plasticity with liquid limits ranging from 26 to 68 and plasticity indices ranging from 9 to 34. A bulk sample exhibited a measured laboratory R-value of 12. Laboratory test results are presented in the **Exploration Results** section of this report.

GEOTECHNICAL OVERVIEW

Based on subsurface conditions encountered in the borings, the site appears suitable for the proposed construction from a geotechnical point of view provided certain precautions and design and construction recommendations described in this report are followed. We have identified several geotechnical conditions that could impact design, construction and performance of the proposed pavements and other site improvements. These included existing, undocumented fill, and embankment fills. These conditions will require particular attention in project planning, design and during construction and are discussed in greater detail in the following sections.

Existing, Undocumented Fill

As previously noted, existing fill was encountered to a depth of about 8 feet in Boring No. 6 drilled at the site. We do not possess any information regarding whether the fill was placed under the observation of a geotechnical engineer. However, we believe the fill was likely placed during the construction of 20th Street. The fills encountered have been supporting 20th Street for a long time without any significant settlement below the existing pavements. We believe the existing fills will provide adequate subgrade support for the roundabout.

Embankment fills

We anticipate embankment fill on the order of 5 to 10 feet in the northwest corner and 3 to 5 feet in all other areas is needed to raise the grades in the drainage swale areas around the existing pavements. Our experience indicates that soft and loose soils are often present in these areas due to excessive wetting of soils. We advanced 4 soil borings in the swale areas and did not encounter significantly soft or loose soils during our exploration. However, soft or loose soils may be present in other areas at this site. Fills placed on soft or loose soils are more susceptible to

settlement. We recommend fill materials placed during construction have an R-value greater than or equal to the measured laboratory R-value of 12.

EARTHWORK

The following presents recommendations for site preparation, demolition, excavation, subgrade preparation, fill materials, compaction requirements, utility trench backfill (if any), grading and drainage. Earthwork on the project should be observed and evaluated by Terracon. Evaluation of earthwork should include observation and/or testing of over-excavation, removal of existing fill, subgrade preparation, placement of engineered fills, subgrade stabilization and other geotechnical conditions exposed during the construction of the project.

Site Preparation

Prior to placing any fill, strip and remove existing vegetation, topsoil, and any other deleterious materials from the proposed construction areas. As previously stated, we also recommend removing 2 feet of existing, undocumented fill within proposed pavement areas.

Stripped organic materials should be wasted from the site or used to re-vegetate landscaped areas or exposed slopes after completion of grading operations. Prior to the placement of fills, the site should be graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath proposed pavements.

Demolition

Demolition of the existing roadway should include complete removal of all pavement materials within the proposed construction area. This should include removal of any utilities to be abandoned along with any loose utility trench backfill or loose backfill found. All materials derived from the demolition of existing pavements should be removed from the site.

Consideration could be given to re-using the asphalt provided the materials are processed and placed as a subbase in relatively uniform thickness below pavements.

Excavation

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

The soils to be excavated can vary significantly across the site as their classifications are based solely on the materials encountered in widely-spaced exploratory test borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different

subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

Depending upon depth of excavation and seasonal conditions, surface water infiltration and/or groundwater may be encountered in excavations on the site. It is anticipated that pumping from sumps may be utilized to control water within excavations.

The subgrade soil conditions should be evaluated during the excavation process and the stability of the soils determined at that time by the contractors' Competent Person. Slope inclinations flatter than the OSHA maximum values may have to be used. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance from the crest of the slope equal to the slope height. The exposed slope face should be protected against the elements.

Subgrade Preparation

After the existing pavements have been removed from the construction area, the top 10 inches of the exposed ground surface should be scarified, moisture conditioned, and recompact to at least 95 percent of the maximum dry unit weight as determined by AASHTO T99 before any new fill or pavement is placed.

After the bottom of the excavation has been compacted, engineered fill can be placed to bring the pavement subgrade to the desired grade. Engineered fill should be placed in accordance with the recommendations presented in subsequent sections of this report.

The stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Alternatively, over-excavation of wet zones and replacement with granular materials may be used, or crushed gravel and/or rock can be tracked or "crowded" into the unstable surface soil until a stable working surface is attained. Use of fly ash or geotextiles could also be considered as a stabilization technique. Lightweight excavation equipment may also be used to reduce subgrade pumping.

Fill Materials

The on-site soils or approved granular and low plasticity cohesive imported materials may be used as fill material. Bedrock excavated during site development and construction can be reused as

Geotechnical Engineering Report

20th Street Roundabout ■ Greeley, Colorado

December 20, 2018 ■ Terracon Project No. 21185033



fill provided the material is broken down and thoroughly processed to a “soil-like” consistency, with no particles greater than 2 inches in size. The earthwork contractor should expect significant mechanical processing and moisture conditioning of the site soils and/or bedrock will be needed to achieve proper compaction

Imported soils (if required) should meet the following material property requirements:

Gradation	Percent finer by weight (ASTM C136)
4"	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	50 (max.)

Soil Properties	Values
Liquid Limit	35 (max.)
Plasticity	15 (max.)

Other import fill materials types may be suitable for use on the site depending upon proposed application and location on the site and could be tested and approved for use on a case-by-case basis.

Compaction Requirements

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

Item	Description
Fill lift thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used
	4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum compaction requirements	95 percent of the maximum dry unit weight as determined by AASHTO T99
Moisture content cohesive soil (clay)	-1 to +3 % of the optimum moisture content
Moisture content cohesionless soil (sand)	-3 to +3 % of the optimum moisture content

Item	Description
1.	We recommend engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2.	Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the fill material pumping when proofrolled.
3.	Moisture conditioned clay materials should not be allowed to dry out. A loss of moisture within these materials could result in an increase in the material's expansive potential. Subsequent wetting of these materials could result in undesirable movement.

Grading and Drainage

Positive drainage should be provided away from the pavements during construction and maintained throughout the life of the proposed project. Infiltration of water into utility excavations must be prevented during construction. Landscaped medians and other surface features which could retain water in areas adjacent to the pavements should be irrigated as little as possible to support plant growth. Excessive irrigation of the landscaped medians can result in the softening of the subgrade and aggregate base course and premature pavement distress or failure.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of Terracon. Monitoring should include documentation of adequate removal of vegetation, topsoil and pavements, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by Terracon prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In addition to the documentation of the essential parameters necessary for construction, the continuation of Terracon into the construction phase of the project provides the continuity to maintain the Terracon's evaluation of subsurface conditions, including assessing variations and associated design changes.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure.

The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil/bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Subsurface explorations at this site were extended to a maximum depth of 10 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

PAVEMENTS

Pavements – Subgrade Preparation

On most project sites, the site grading is accomplished relatively early in the construction phase. Fills are typically placed and compacted in a uniform manner. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, or rainfall/snow melt. As a result, the pavement subgrade may not be suitable for pavement construction and corrective action will be required. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance or instability. We recommend the pavement subgrade be thoroughly proofrolled with a loaded tandem-axle dump truck prior to final grading and paving. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving.

We anticipate embankment fill on the order of 5 to 10 feet in the northwest corner and 3 to 5 feet in all other areas is needed to raise the grades in the drainage swale areas around the existing pavements. Our experience indicates that soft and loose soils are often present in these areas due to excessive wetting of soils. We advanced 4 soil borings in the swale areas and did not encounter any soft or loose soils during our exploration. However, soft or loose soils may be present in other areas at this site. Fills placed on soft or loose soils are more susceptible to settlement. We recommend fill materials placed during construction have an R-value greater than or equal to the measured laboratory R-value of 12.

Pavements – Design Recommendations

Design of pavements for the project have been based on the procedures outlined in the 1993 *Guideline for Design of Pavement Structures* prepared by the American Association of State Highway and Transportation Officials (AASHTO) and the City of Greeley Design Criteria and Construction Specifications.

Traffic loadings for 20th Street east and west of the intersection were assumed to correspond to typical values for a 2-lane arterial. Traffic loadings for 83rd Avenue north and south of the intersection were assumed to correspond to typical values for a 4-lane arterial. The City of Greeley Design Criteria and Construction Specifications Table 2.08.1 specifies the minimum design ESALs of 730,000 for a 20-year design period for 2-lane arterial roadways and 1,460,000 ESALs for a 20-year design period for a 4-lane arterial. These assumed traffic design values should be verified by the civil engineer prior to final design and construction. If the actual traffic values vary from the assumed values, the pavement thickness recommendations may not be applicable. If the actual traffic design information changes Terracon should be contacted so that the design recommendations can be reviewed and revised if necessary.

For flexible pavement design, a terminal serviceability index of 2.5 was utilized along with an inherent reliability of 90 percent and a design life of 20 years. Using the measured laboratory R-value of 12, appropriate ESAL, environmental criteria and other factors, the structural numbers (SN) of the pavement sections were determined on the basis of the 1993 AASHTO design equation.

In addition to the flexible pavement design analyses, a rigid pavement design analysis was completed based upon AASHTO design procedures. Rigid pavement design is based on an evaluation of the Modulus of Subgrade Reaction of the soils (k-value), the Modulus of Rupture of the concrete, and other factors previously outlined. The design k-value of 90 for the subgrade soil was determined by correlation to the laboratory test results. A modulus of rupture of 600 psi (working stress 450 psi) was used for pavement concrete. The rigid pavement thickness for each traffic category was determined on the basis of the AASHTO design equation.

Recommended minimum pavement sections are provided in the table below.

Traffic Area	Alternative	Recommended Pavement Thicknesses (Inches)			
		Asphaltic Concrete Surface	Aggregate Base Course	Portland Cement Concrete	Total
Roundabout	A	8½	12	-	20½
	B	-	4	10	14

Aggregate base course (if used on the site) should consist of a blend of sand and gravel which meets strict specifications for quality and gradation. Use of materials meeting Colorado Department of Transportation (CDOT) Class 5 or 6 specifications is recommended for aggregate base course. Aggregate base course should be placed in lifts not exceeding 6 inches and compacted to a minimum of 95 percent of the maximum dry unit weight as determined by ASTM D698.

Asphaltic concrete should be composed of a mixture of aggregate, filler and additives (if required) and approved bituminous material. The asphalt concrete should conform to approved mix designs stating the Superpave properties, optimum asphalt content, job mix formula and recommended mixing and placing temperatures. Aggregate used in asphalt concrete should meet particular gradations. Material meeting CDOT Grading S specifications or equivalent is recommended for asphalt concrete. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in maximum 3-inch lifts and compacted within a range of 92 to 96 percent of the theoretical maximum (Rice) density (ASTM D2041).

Where rigid pavements are used, the concrete should be produced from an approved mix design with the following minimum properties:

Properties	Value
Compressive strength	4,000 psi
Cement type	Type I or II portland cement
Entrained air content (%)	5 to 8
Concrete aggregate	ASTM C33 and CDOT section 703

Concrete should be deposited by truck mixers or agitators and placed a maximum of 90 minutes from the time the water is added to the mix. Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation per ACI 325. The location and extent of joints should be based upon the final pavement geometry. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

A minimum 4-inch thick aggregate base course layer is recommended for the PCC pavements to help reduce the potential for slab curl, shrinkage cracking, and subgrade “pumping” through joints. Proper joint spacing will also be required for PCC pavements to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Site grades should slope a minimum of 2 percent away from the pavements;
- The subgrade and the pavement surface have a minimum 2 percent slope to promote proper surface drainage;
- Consider appropriate edge drainage and pavement under drain systems;
- Install pavement drainage surrounding areas anticipated for frequent wetting;
- Install joint sealant and seal cracks immediately;

- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils; and
- Placing compacted, low permeability backfill against the exterior side of curb and gutter.

Pavements – Construction Considerations

Openings in pavement, such as landscape islands, are sources for water infiltration into surrounding pavements. Water collects in the islands and migrates into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavements – Maintenance

Preventative maintenance should be planned and provided for an ongoing pavement management program in order to enhance future pavement performance. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

CORROSIVITY

Results of water-soluble sulfate testing from our previous reports indicate that ASTM Type I or II, portland cement should be specified for all project concrete on and below grade. Foundation concrete should be designed for low sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

At the time this report was prepared, the laboratory testing for water-soluble sulfates had not been completed. We will submit a supplemental section with the testing results and recommendations once the testing has been completed.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction.

Geotechnical Engineering Report

20th Street Roundabout ■ Greeley, Colorado

December 20, 2018 ■ Terracon Project No. 21185033



Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

The field exploration program consisted of the following:

Number of Borings	Approximate Boring Depth (feet)	Location
4	10	Planned roundabout area

Boring Layout and Elevations: We used handheld GPS equipment to locate borings with an estimated horizontal accuracy of +/-20 feet.

Subsurface Exploration Procedures: We advanced soil borings with a truck-mounted drill rig using continuous-flight, solid-stem augers. Three samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was performed using modified California barrel and standard split-barrel sampling procedures. For the standard split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For the modified California barrel sampling procedure, a 2½-inch outer diameter split-barrel sampling spoon is used for sampling. Modified California barrel sampling procedures are similar to standard split-barrel sampling procedures; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observed and recorded groundwater levels during drilling observations.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs included visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent the geotechnical engineer's interpretation, and include modifications based on observations and laboratory test results.

Property Disturbance: We backfilled borings with auger cuttings backfill after completion. Our services did not include repair of the site beyond backfilling our boreholes. Excess auger cuttings were dispersed in the general vicinity of the boreholes. Because backfill material often settles below the surface after a period, we recommend checking boreholes periodically and backfilling, if necessary. We can provide this service for additional fees, at your request.

Geotechnical Engineering Report

20th Street Roundabout ■ Greeley, Colorado

December 20, 2018 ■ Terracon Project No. 21185033



Laboratory Testing

The project engineer reviewed field data and assigned various laboratory tests to better understand the engineering properties of various soil and bedrock strata. Laboratory testing was conducted in general accordance with applicable or other locally recognized standards. Testing was performed under the direction of a geotechnical engineer and included the following:

- Visual classification
- Dry density
- Grain-size analysis
- R-value
- Moisture content
- Atterberg limits
- One-dimensional swell
- Water-soluble sulfates

Our laboratory testing program includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified soil samples in accordance with the Unified Soil Classification System (USCS). Soil and bedrock samples obtained during our field work will be disposed of after laboratory testing is complete unless a specific request is made to temporarily store the samples for a longer period of time.

Bedrock samples obtained had rock classification conducted using locally accepted practices for engineering purposes. Boring log rock classification is determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan

Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

20th Street Roundabout ■ Greeley, Colorado
December 20, 2018 ■ Terracon Project No. 21185033



EXPLORATION PLAN

20th Street Roundabout ■ Greeley, Colorado
December 20, 2018 ■ Terracon Project No. 21185033

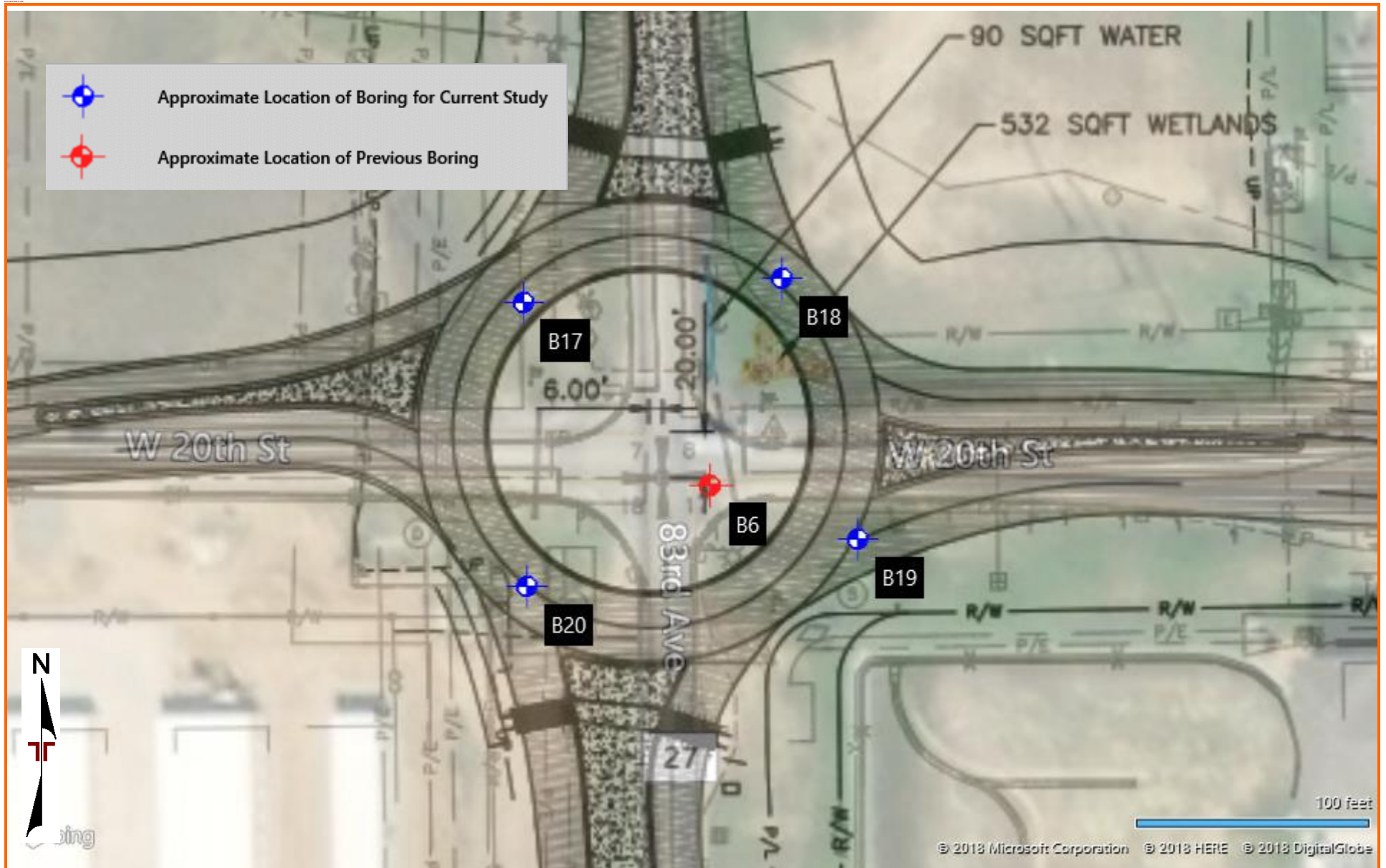


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-6 and B-17 through B-20)

Atterberg Limits

Grain Size Distribution

Consolidation/Swell (2 pages)

R-Value

Note: All attachments are one page unless noted above.

Page 1 of 1

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SITE: 20th Street and 83rd Avenue
Greeley, CO

GRAPHIC LOG	LOCATION	See Exploration Plan	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL-CONSOL /LOAD (%/psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
	Latitude: 40.40673° Longitude: -104.81324°									LL-PL-PI	
DEPTH											
0.4	ASPHALT, about 5 inches										
0.6	AGGREGATE BASE COURSE, about 5 inches										
	FILL - SANDY LEAN CLAY, brown, grayish-brown, stiff										
8.0											
	SEDIMENTARY BEDROCK - CLAYSTONE, gray/orange, brown, medium hard										
10.0											
Boring Terminated at 10 Feet			10								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

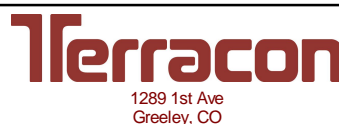
Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See **Supporting Information** for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 08-21-2017

Drill Rig: CME-55

Project No.: 21175048

Boring Completed: 08-21-2017

Driller: Drilling Engineers, Inc.

Page 1 of 1

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

[illegible]

Hammer Type: Automatic

Notes:

Driller: Odell



BORING LOG NO. 18

Page 1 of 1

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.407° Longitude: -104.8131°	DEPTH (Ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL - CONSOL /LOAD (%/PSF)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		DEPTH									
		VEGETATIVE LAYER , about 6 inches	0.5								
		SANDY LEAN CLAY , medium plasticity, brown, very stiff									
1						10-12	-1.6/500	12	109	36-23-13	68
						11-16		15	100		
		CLAYSTONE , olive brown to brown, hard, iron oxide staining	5								
2						20-30-50 N=80		16			
		Boring Terminated at 10.5 Feet	10.5								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" continuous-flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 11-29-2018

Drill Rig: CME 45B

Project No.: 21185033

Boring Completed: 11-29-2018

Driller: Odell



BORING LOG NO. 19

Page 1 of 1

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4067° Longitude: -104.813° DEPTH	DEPTH (Ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL - CONSOL /LOAD (%/PSF)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.5									
		VEGETATIVE LAYER , about 6 inches									
		FAT CLAY , medium plasticity, brown, stiff									
1						6-8		22	99	51-27-24	87
			5			6-9		20	106		
2		7.0									
		WEATHERED SILTSTONE/CLAYSTONE , high plasticity, olive brown to brown, gray, weathered, iron oxide staining									
			10			7-10-12 N=22		23		68-34-34	72
		10.5									
		Boring Terminated at 10.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" continuous-flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 11-29-2018

Drill Rig: CME 45B

Project No.: 21185033

Boring Completed: 11-29-2018

Driller: Odell

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 12/20/18

BORING LOG NO. 20

Page 1 of 1

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4066° Longitude: -104.8135°	DEPTH (Ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL - CONSOL /LOAD (%/PSF)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		DEPTH									
		SANDY LEAN CLAY , low plasticity, light brown to brown, very stiff									
1						11-13	-6.3/500	5	102	31-21-10	60
			5			10-12		6	97		
2		WEATHERED CLAYSTONE , olive brown to brown, weathered, iron oxide staining				8-8-13 N=21		19			
			10								
		Boring Terminated at 10.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" continuous-flight auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 11-29-2018

Drill Rig: CME 45B

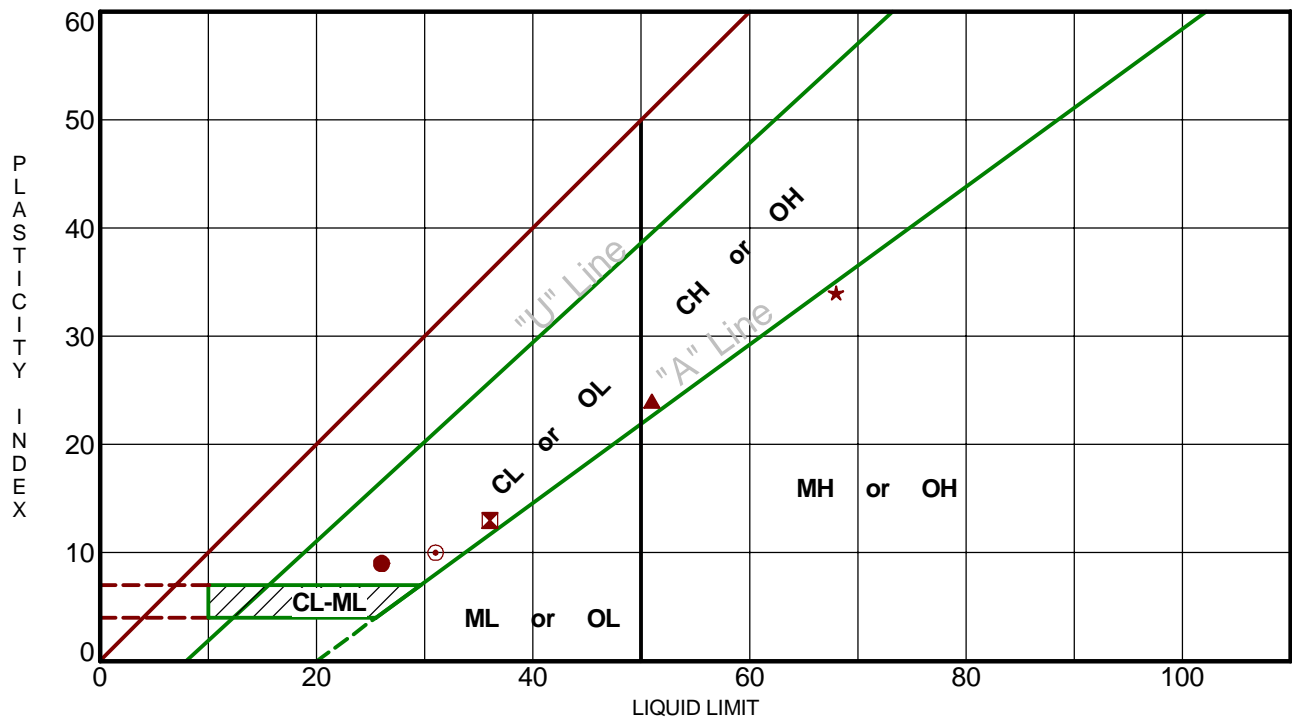
Project No.: 21185033

Boring Completed: 11-29-2018

Driller: Odell

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 12/20/18

ASTM D4318

[illegible]

PROJECT: 20th Street Phase 5

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185033

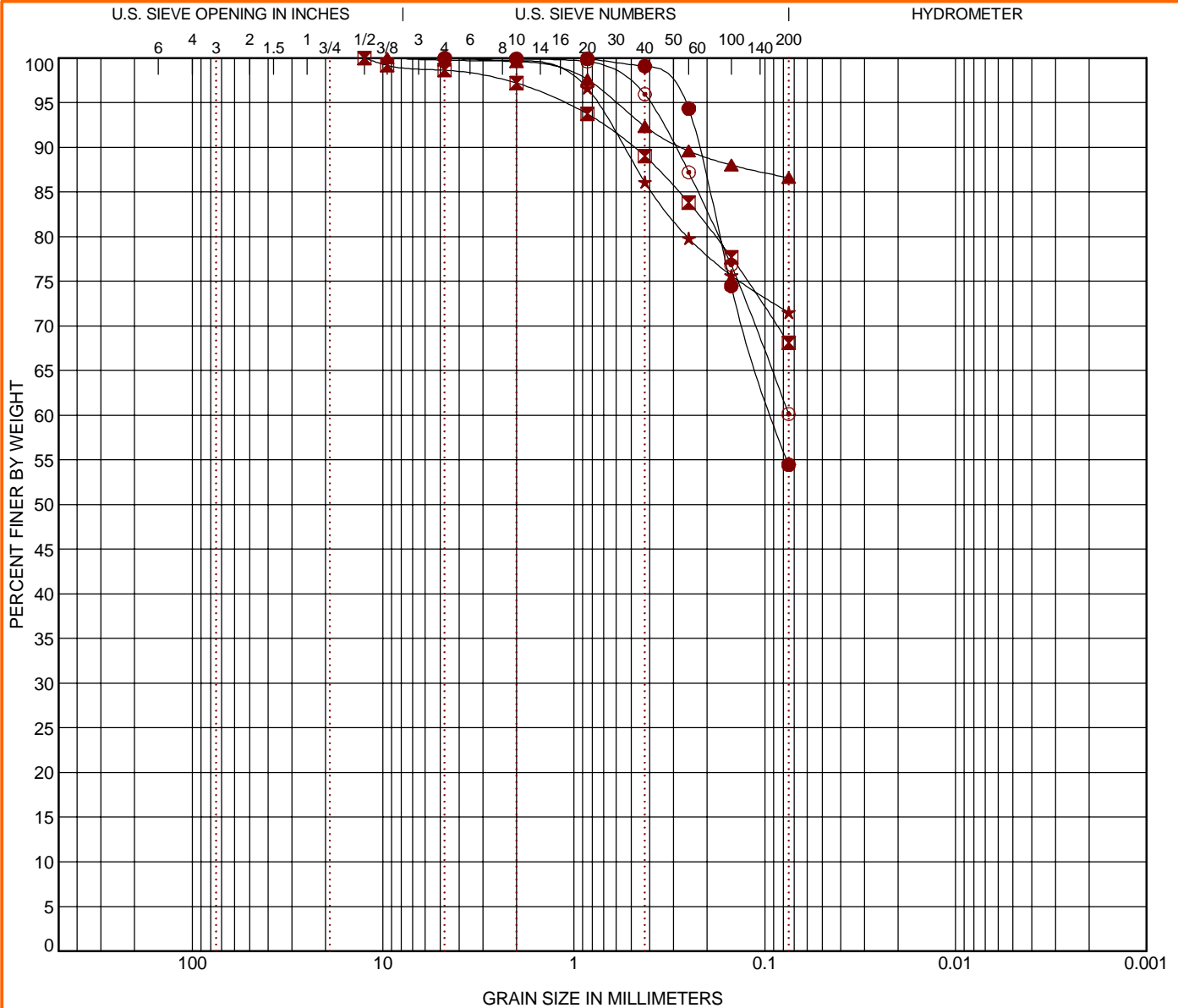
CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 21185033 20TH STREET PHASE.GPJ TERRACON_DATA\TEMPLATE.GDT 12/19/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 12/19/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification				WC (%)	LL	PL	PI	Cc	Cu
●	17	4 - 5	SANDY LEAN CLAY (CL)				19	26	17	9		
⊠	18	2 - 3	SANDY LEAN CLAY (CL)				12	36	23	13		
▲	19	2 - 3	FAT CLAY (CH)				22	51	27	24		
★	19	9 - 10.5	WEATHERED SILTSTONE/CLAYSTONE (MH)				23	68	34	34		
⊙	20	2 - 3	SANDY LEAN CLAY (CL)				5	31	21	10		
Boring ID		Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Gravel	%Sand	%Silt	%Fines	%Clay	
●	17	4 - 5	4.75	0.091			0.0	45.5		54.5		
⊠	18	2 - 3	12.5				1.3	30.6		68.1		
▲	19	2 - 3	9.5				0.2	13.2		86.6		
★	19	9 - 10.5	4.75				0.0	28.5		71.5		
⊙	20	2 - 3	4.75				0.0	39.9		60.1		

PROJECT: 20th Street Phase 5

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

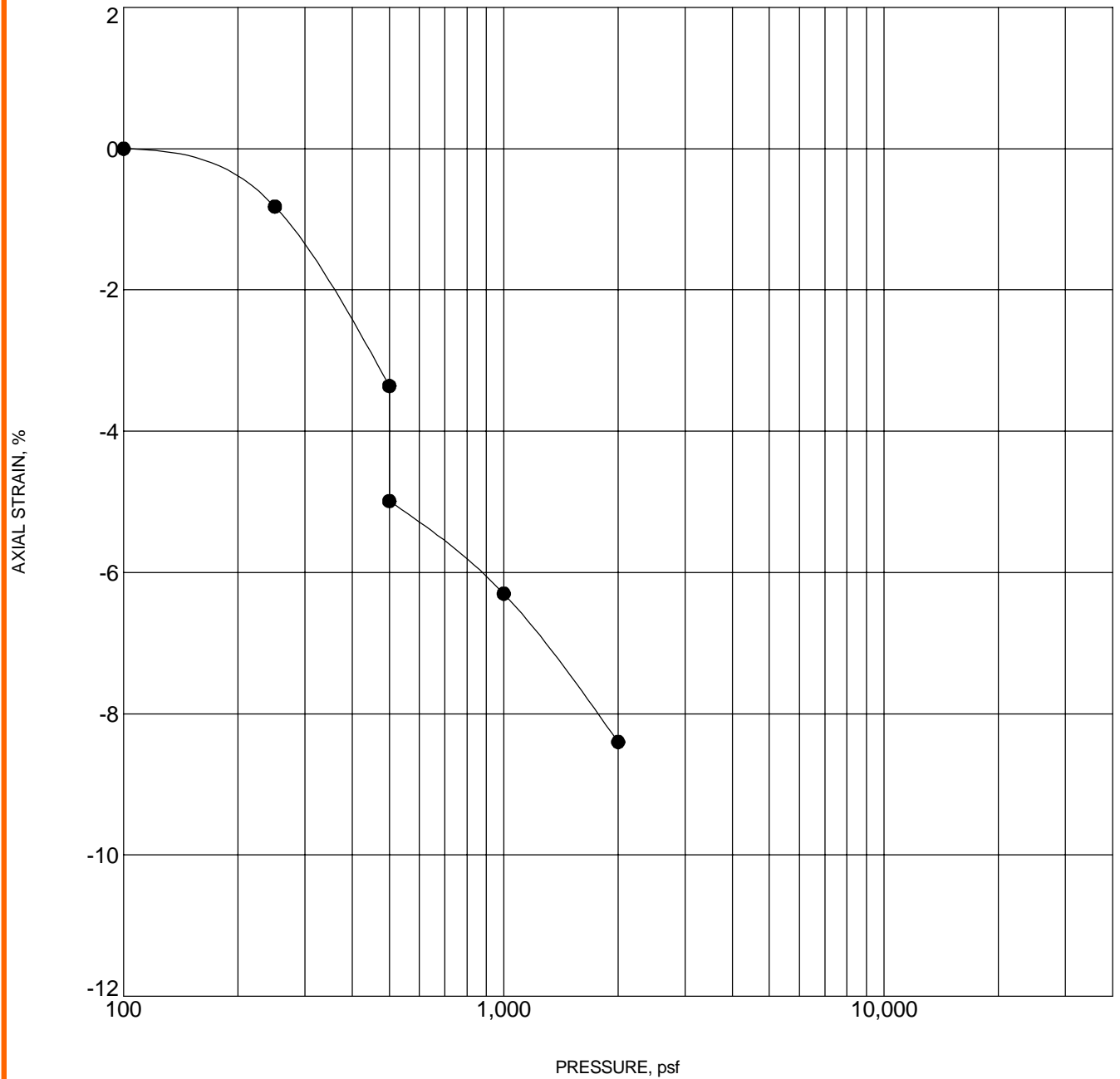


PROJECT NUMBER: 21185033

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d , pcf	WC, %
●	18	2 - 3 ft	SANDY LEAN CLAY(CL)	99	12

NOTES: Sample exhibited 1.6 percent compression upon wetting at an applied pressure of 500 psf.

PROJECT: 20th Street Phase 5

SITE: 20th Street from 86th to 90th
Avenue
Greeley, CO

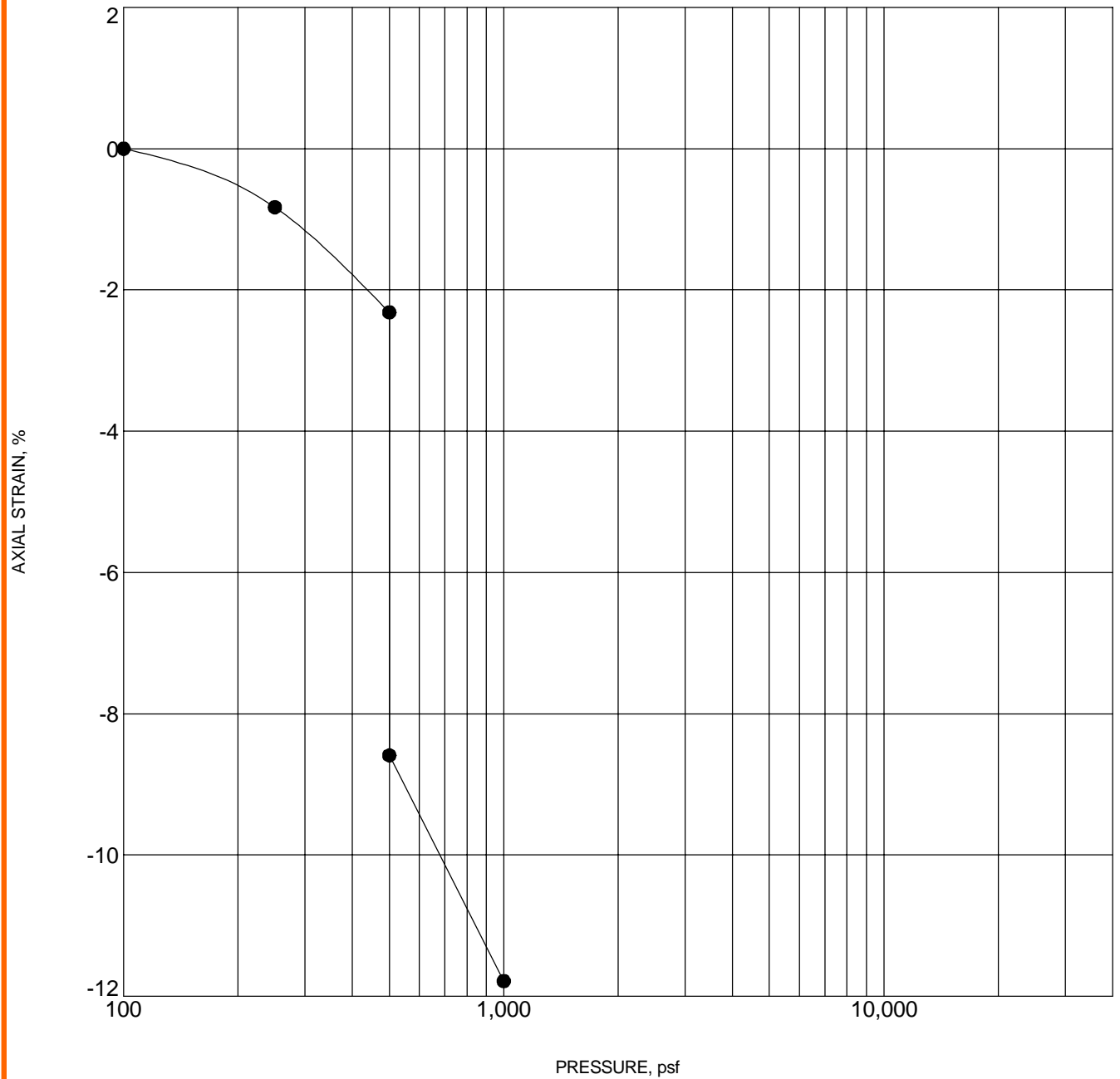
Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185033

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d , pcf	WC, %
●	20	2 - 3 ft	SANDY LEAN CLAY(CL)	98	5

NOTES: Sample exhibited 6.3 percent compression upon wetting at an applied pressure of 500 psf.

PROJECT: 20th Street Phase 5

SITE: 20th Street from 86th to 90th
Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

PROJECT NUMBER: 21185033

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO



1901 Sharp Point Drive, Suite C
Fort Collins, Colorado 80525
(970) 484-0359

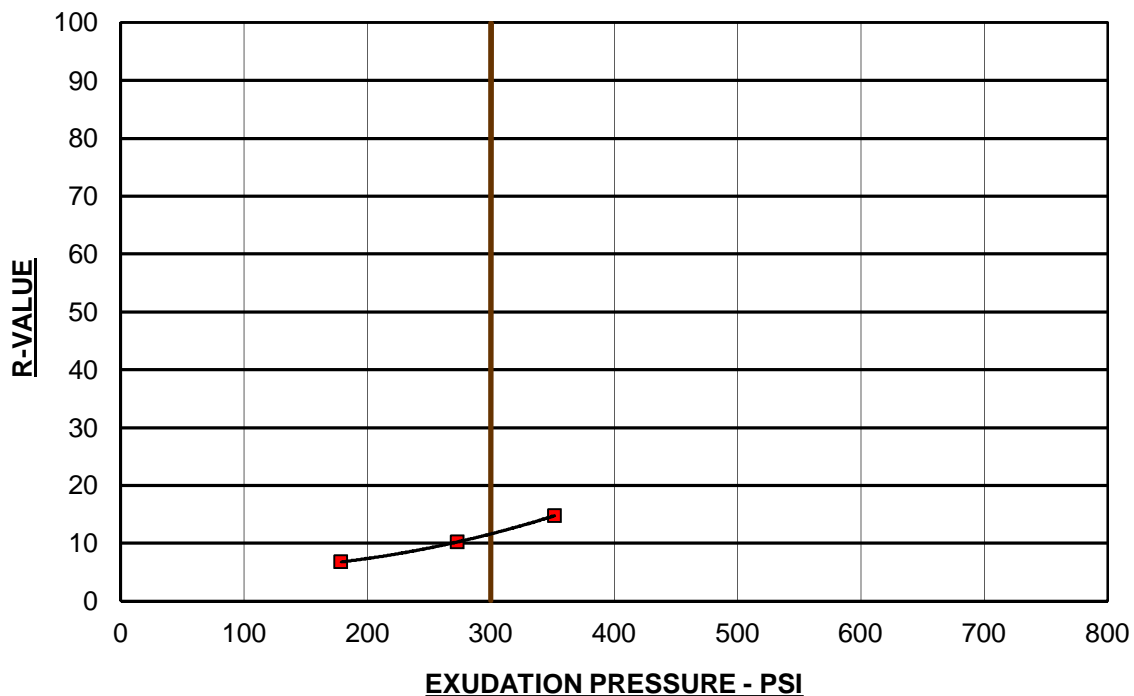
RESISTANCE R-VALUE & EXPANSION PRESSURE OF COMPACTED SOIL AASHTO T190

CLIENT:	J-U-B Engineers, Inc.	DATE OF TEST:	12/17/2018
PROJECT:	20th Street Roundabout		
LOCATION:	Boring No. 17 at 0'-5'		
TERRACON NO.	21185033	CLASSIFICATION:	Sandy lean clay

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
COMPACTION PRESSURE (PSI)	60	100	160
DENSITY (PCF)	110.5	112.6	115.6
MOISTURE CONTENT (%)	19.4	17.7	16.5
EXPANSION PRESSURE (PSI)	-2.23	-1.24	-1.55
HORIZONTAL PRESSURE @ 160 PSI	147	145	138
SAMPLE HEIGHT (INCHES)	2.70	2.60	2.47
EXUDATION PRESSURE (PSI)	178.6	272.9	351.6
CORRECTED R-VALUE	6.8	10.2	14.8
UNCORRECTED R-VALUE	6.3	9.8	14.8

R-VALUE @ 300 PSI EXUDATION PRESSURE = 12



SUPPORTING INFORMATION

Contents:

General Notes

Unified Soil Classification System

Description of Rock Properties







Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

20th Street Phase 5 ■ Greeley, CO

December 19, 2018 ■ Terracon Project No. 21185033

SAMPLING	WATER LEVEL	FIELD TESTS
 Modified California Ring Sampler  Grab Sample  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	<p>N Standard Penetration Test Resistance (Blows/Ft.)</p> <p>(HP) Hand Penetrometer</p> <p>(T) Torvane</p> <p>(DCP) Dynamic Cone Penetrometer</p> <p>UC Unconfined Compressive Strength</p> <p>(PID) Photo-Ionization Detector</p> <p>(OVA) Organic Vapor Analyzer</p>

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (psf)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Ring Sampler Blows/Ft.	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium Stiff	1,000 to 2,000	4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 8,000	> 30	> 42			

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15
With	15-29
Modifier	>30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<5
With	5-12
Modifier	>12

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above “A”	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below “A” line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried		Organic silt ^{K, L, M, O}	
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line	CH	Fat clay ^{K, L, M}	
			PI plots below “A” line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried		Organic silt ^{K, L, M, Q}	
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

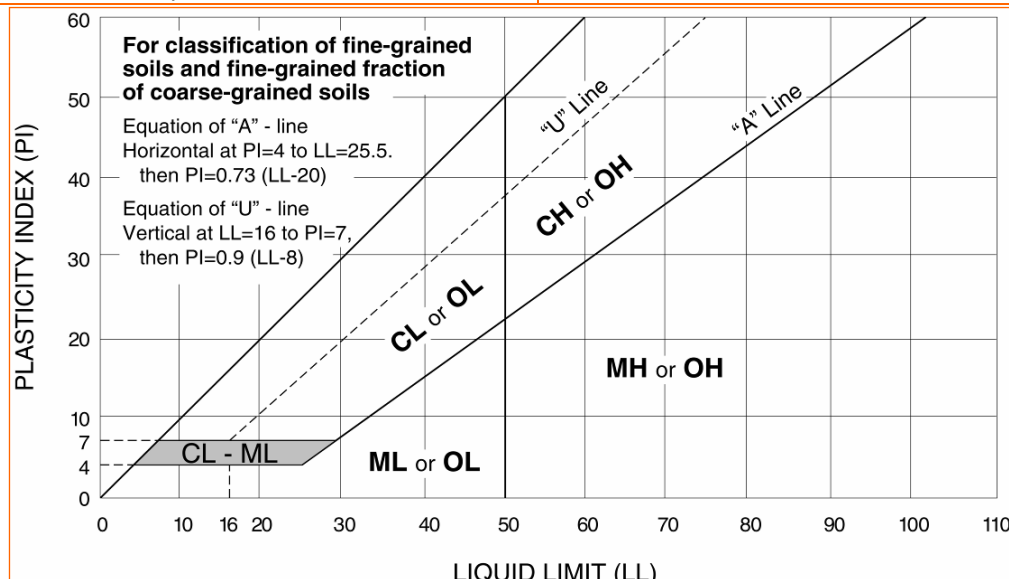
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



ROCK VERSION 1

WEATHERING	
Term	Description
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	Field Identification	Uniaxial Compressive Strength, psi (MPa)
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		Bedding Spacing (May Include Foliation or Banding)	
Description	Spacing	Description	Spacing
Extremely close	< ¾ in (<19 mm)	Laminated	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	Very thin	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	Thin	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	Medium	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	Thick	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	Massive	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) ¹	
Description	RQD Value (%)
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

February 12, 2019

J-U-B Engineers, Inc.
4745 East Boardwalk Drive #200
Fort Collins, Colorado 80525

Attn: Mr. Jeff Temple
P: (970) 377-3602
E: jtemple@jub.com

Re: Supplemental Geotechnical Engineering Report
20th Street Concrete Box Culvert (CBC)
20th Street
Greeley, Colorado
Terracon Project No. 21185033 (supplemental)

Dear Mr. Temple:

Previously, Terracon Consultants, Inc. (Terracon) prepared a Geotechnical Engineering Report (Project No. 21175048; report dated March 15, 2018) for the 20th Street Reconstruction project. We have also prepared a report for 20th Street Phase 5 (Project No. 21185033; report dated October 1, 2018). We submitted an additional letter of recommendations for the concrete box culvert (CBC) bridge to be supported on drilled piers. The project team decided to use AASHTO LRFD design for the CBC bridge. We have since conducted an additional subsurface exploration near the proposed culvert inlet and outlet with pressure meter testing (PMT). This supplemental report presents the results of the additional subsurface exploration and provides foundation design recommendations for the CBC bridge.

PROJECT DESCRIPTION

Site Location

Item	Description
Parcel Information	The project site is located on 20 th Street in Greeley, Colorado. The site is located about 650 feet west of the intersection of 20 th Street and 83 rd Avenue on the south side of 20 th Street. The approximate Latitude/Longitude of the center of the site is 40.40681° N, 104.81578°W (Please refer to Exploration Plan).
Existing Improvements	The site is currently occupied by 20 th Street and surrounding drainage swales. The roadway is paved with asphalt. The culvert is planned in the approximate location of the existing culvert. The inlet and outlet points are in wetlands areas. There are multiple utilities that run east-west under 20 th Street.

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Item	Description
Surrounding Developments	20 th Street is generally surrounded by residential housing to the north and vacant land to the south.
Current Ground Cover	Current ground cover is asphalt pavement in the roadway areas and heavily vegetated with native weeds and grasses in the wetlands.
Existing Topography	The site generally slopes down to the wetlands area. 20 th Street is about 10 feet higher in elevation than the adjacent wetlands areas.

Planned Construction

Item	Description
Information Provided	Information was provided via phone and email correspondence with various J-U-B project team members.
Project Description	Previously during Phase 4, a culvert was planned below 20 th Street. A LRFD bridge design is now required for a concrete box culvert (CBC) bridge at the location.
Proposed Construction	The bridge is being designed to span across the existing utilities under 20 th Street. The CBC bridge will be supported by drilled shafts with associated wing wall and aprons.
Grading/Slopes	Based on initial layout plans provided by J-U-B, we understand about 12 feet of cut and 5 feet of fill may be required for the CBC bridge. Due to shallow groundwater concerns, cuts should be limited where possible.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found in **Exploration Results**. A discussion of field sampling and laboratory testing procedures and test results are presented in **Exploration and Testing Procedures**. Based on the results of the borings, subsurface conditions on the project site are generalized in the tables below

CBC bridge borings (Boring Nos. 8 and 9):

Material Description	Approximate Depth to Bottom of Stratum	Consistency/Density/Hardness	Approximate Elevation (feet)
Silty sand and sandy silty clay	About 9 to 20 feet below existing site grades.	Very soft to soft Loose to very dense	4,860 – 4,848
Claystone bedrock	To the maximum depth of exploration of about 50 feet.	Medium hard to very hard	4,848 – maximum depth of exploration

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes are noted on the attached boring logs, and are summarized below:

Boring Number	Depth to groundwater while drilling, ft.	Elevation of groundwater while drilling, ft.
8	6	4,855
9	7	4,850

These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions, and other factors.

Groundwater level fluctuations occur due to seasonal variations in the water levels present in nearby water features, amount of rainfall, runoff and other factors not evident at the time the borings was/were performed. Therefore, groundwater levels during construction or at other times in the life of the pavements and structures may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Laboratory Testing

Samples of clay soils and underlying claystone bedrock exhibited unconfined compressive strengths of approximately 500 to 14,300 pounds per square foot (psf). Samples of site soils and bedrock selected for plasticity testing exhibited low to medium plasticity with liquid limits ranging from non-plastic to 46 and plasticity indices ranging from non-plastic to 29. Laboratory test results are presented in the **Exploration Results** section of this report.

GEOTECHNICAL OVERVIEW

Based on subsurface conditions encountered in the borings, the site appears suitable for the proposed construction from a geotechnical point of view provided certain precautions and design and construction recommendations described in this report are followed. We have identified several geotechnical conditions that could impact design, construction and performance of the proposed structures, pavements, and other site improvements. These included shallow groundwater, and potentially soft and loose, low strength soils. These conditions will require particular attention in project planning, design and during construction and are discussed in greater detail in the following sections.

Shallow Groundwater

As previously stated, groundwater was measured at depths ranging from about 6 to 7 feet below existing site grades. Terracon recommends maintaining a separation of at least 3 feet between the bottom of proposed below-grade shallow foundations and measured groundwater levels. It is also possible and likely that groundwater levels below this site may rise as water levels in the Sheep Draw Tributary rise. Final site grading should be planned and designed to avoid cuts where shallow groundwater is known to exist, and also in areas where such grading would create shallow groundwater conditions.

Low Strength Soils

Very soft lean clay and loose sandy soils were encountered within the upper approximately 7 to 9 feet of the borings completed at this site. These materials can present a risk for potential settlement. These materials can also be susceptible to disturbance and loss of strength under repeated construction traffic loads and unstable conditions could develop. Stabilization of soft soils will very likely be required at most locations to provide adequate support for construction equipment and proposed structures. Terracon should be contacted if these conditions are encountered to observe the conditions exposed and to provide guidance regarding stabilization (if needed).

Foundation Recommendations

After evaluating several alternatives, we understand the design team will be utilizing a drilled shaft foundation system bottomed in bedrock for the CBC bridge.

Very soft clay soils were encountered at anticipated shallow foundation bearing depths. Our analysis indicates up to 2 inches of settlement can be expected for shallow foundations bearing on these materials. We expect the CBC bridge supported on drilled shafts to settle ½ inch or less. There is significant risk for differential settlement if the aprons and wingwalls are supported by shallow foundations on the very soft clay materials encountered.

We recommend the aprons and wingwalls for the proposed CBC bridge be supported by a drilled shaft deep foundation system bottomed in bedrock. As a higher risk alternative, we believe the aprons and wingwalls can be supported on a shallow foundation system with ground modification. Ground modification may include over-excavation and replacement with imported granular fill or rammed aggregate piers (RAP).

Design recommendations for foundations and ground modification for the proposed structure are presented in the following sections.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

The following presents recommendations for site preparation, demolition, excavation, subgrade preparation, fill materials, compaction requirements, utility trench backfill, grading and drainage. Earthwork on the project should be observed and evaluated by Terracon. Evaluation of earthwork should include observation and/or testing of over-excavation, removal of existing fill, subgrade preparation, placement of engineered fills, subgrade stabilization and other geotechnical conditions exposed during the construction of the project.

Site Preparation

Prior to placing any fill, strip and remove existing vegetation, topsoil, and any other deleterious materials from the proposed construction areas.

Stripped organic materials should be wasted from the site or used to re-vegetate landscaped areas or exposed slopes after completion of grading operations. Prior to the placement of fills, the site should be graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath proposed structures.

Demolition

Demolition of the existing roadway and culvert should include complete removal of all pavements and construction debris within the proposed construction area. This should include removal of any utilities to be abandoned along with any loose utility trench backfill or loose backfill found. All materials derived from the demolition of existing pavements should be removed from the site.

Consideration could be given to re-using the asphalt provided the materials are processed and uniformly blended with the on-site soils. Asphalt materials should be processed to a maximum size of 2 inches and blended at a ratio of 30 percent asphalt to 70 percent of on-site soils.

Excavation

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

The soils to be excavated can vary significantly across the site as their classifications are based solely on the materials encountered in widely-spaced exploratory test borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

Supplemental Geotechnical Engineering Report

20th Street Concrete Box Culvert (CBC) ■ Greeley, Colorado
February 12, 2019 ■ Terracon Project No. 21185033 (supplemental)



Although evidence of underground facilities such as grease pits, septic tanks, vaults, basements, and utilities was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Any over-excavation that extends below the bottom of foundation elevation should extend laterally beyond all edges of the foundations at least 8 inches per foot of over-excavation depth below the foundation base elevation. The over-excavation should be backfilled to the foundation base elevation in accordance with the recommendations presented in this report.

Depending upon depth of excavation and seasonal conditions, surface water infiltration and/or groundwater may be encountered in excavations on the site. It is anticipated that pumping from sumps may be utilized to control water within excavations.

The subgrade soil conditions should be evaluated during the excavation process and the stability of the soils determined at that time by the contractors' Competent Person. Slope inclinations flatter than the OSHA maximum values may have to be used. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance from the crest of the slope equal to the slope height. The exposed slope face should be protected against the elements

Subgrade Preparation

After the existing pavements and culvert have been removed from the construction area and over-excavation has been completed (if chosen), the top 10 inches of the exposed ground surface should be scarified, moisture conditioned, and recompact to at least 95 percent of the maximum dry unit weight as determined by ASTM D698 before any new fill or pavement is placed.

If pockets of soft, loose, or otherwise unsuitable materials are encountered at the bottom of the foundation excavations and it is inconvenient to lower the foundations, the proposed foundation elevations may be reestablished by over-excavating the unsuitable soils and backfilling with compacted engineered fill or lean concrete.

After the bottom of the excavation has been compacted, engineered fill can be placed to bring the wing wall, apron and pavement subgrade to the desired grades. Engineered fill should be placed in accordance with the recommendations presented in subsequent sections of this report.

Supplemental Geotechnical Engineering Report

20th Street Concrete Box Culvert (CBC) ■ Greeley, Colorado
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The stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Alternatively, over-excavation of wet zones and replacement with granular materials may be used, or crushed gravel and/or rock can be tracked or “crowded” into the unstable surface soil until a stable working surface is attained. Use of fly ash or geotextiles could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction. Lightweight excavation equipment may also be used to reduce subgrade pumping.

Fill Materials

The on-site soils or approved granular and low plasticity cohesive imported materials may be used as fill material. Bedrock excavated during pier drilling and construction can be reused as fill provided the material is broken down and thoroughly processed to a “soil-like” consistency, with no particles greater than 2 inches in size. The earthwork contractor should expect significant mechanical processing and moisture conditioning of the site soils and/or bedrock will be needed to achieve proper compaction

Imported soils (if required) should meet the following material property requirements:

Gradation	Percent finer by weight (ASTM C136)
4"	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	50 (max.)

Soil Properties	Values
Liquid Limit	35 (max.)
Plasticity Index	15 (max.)

Other import fill materials types may be suitable for use on the site depending upon proposed application and location on the site, and could be tested and approved for use on a case-by-case basis.

Compaction Requirements

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

Item	Description
Fill lift thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum compaction requirements	95 percent of the maximum dry unit weight as determined by ASTM D698
Moisture content cohesive soil (clay)	-1 to +3 % of the optimum moisture content
Moisture content cohesionless soil (sand)	-3 to +3 % of the optimum moisture content

1. We recommend engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the fill material pumping when proofrolled.
3. Moisture conditioned clay materials should not be allowed to dry out. A loss of moisture within these materials could result in an increase in the material's expansive potential. Subsequent wetting of these materials could result in undesirable movement.

Grading and Drainage

Positive drainage should be provided away from the pavements during construction and maintained throughout the life of the proposed project. Infiltration of water into utility excavations must be prevented during construction. Landscaped medians and other surface features which could retain water in areas adjacent to the pavements should be irrigated as little as possible to support plant growth. Excessive irrigation of the landscaped medians can result in the softening of the subgrade and aggregate base course and premature pavement distress or failure.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of Terracon. Monitoring should include documentation of adequate removal of vegetation, topsoil and pavements, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by Terracon prior to placement of additional lifts. In addition to the documentation of the essential parameters necessary for construction, the continuation of Terracon into the construction phase of the project provides the continuity to maintain the Terracon's evaluation of subsurface conditions, including assessing variations and associated design changes.

DEEP FOUNDATIONS

Drilled Shafts Bottomed in Bedrock - Design Recommendations

Shaft and tip resistance were estimated for shaft diameters of 24, 30 and 36 inches. The axial resistances for the compressive load were estimated based on procedures outlined in FHWA Drilled Shafts: Construction Procedures and LRFD Design Methods, Publication No. NHI-10-016, and AASHTO LRFD Bridge Design Specifications 2014.

AASHTO LRFD resistance factors used in design are summarized in the following table.

DRILLED SHAFT RESISTANCE FACTORS		
Layer	Resistance Factors (Φ)	
	Strength Limit 1	
	Tip	Shaft
Sandy silty clay (Soil)	-	0.45
Claystone Bedrock (IGM)	0.55	0.60

Note:

1. AASHTO LRFD Bridge Design Specifications, Table 10.5.5.2.4-1.

Shafts should be terminated at or below elevations corresponding to the estimated tip embedment indicated below. The following table presents depth/elevation and drilled shaft resistance values for the CBC bridge.

DRILLED SHAFT RESISTANCE						
Shaft Dimensions			Nominal Side Resistance		Nominal Base Resistance	Total Nominal Resistance
Diameter (inches)	Minimum Bedrock Embedment (feet)	Estimated Shaft Length (feet)	ΦR_{SN1} (kips)	ΦR_{SN2} (kips)	ΦR_{BN2} (kips)	Σ (kips)
24	24	36	5.4	131.4	47.5	184.3
30	15	27	6.8	102.6	74.2	183.7
36	8	20	8.2	65.7	106.9	180.8

Site grading details were in a preliminary stage at the time we prepared this report. If significant cuts or fills are planned in the proposed CBC bridge area, longer/shorter drilled shaft lengths may be required. Shafts should be considered to work in group action if the horizontal spacing is less than three pier diameters. A minimum practical horizontal clear spacing between shafts of at least three diameters should be maintained, and adjacent piers should bear at the same elevation. The

capacity of individual piers must be reduced when considering the effects of group action. Capacity reduction is a function of pier spacing and the number of piers within a group. If group action analyses are necessary, capacity reduction factors can be provided for the analyses.

Drilled Shafts Bottomed in Bedrock - Construction Considerations

Drilling to design depth should be possible with conventional single-flight power augers on the majority of the site; however, specialized drilling equipment may be required for very hard bedrock layers.

Groundwater/caving soil conditions indicate temporary steel casing will be required to properly drill and clean shafts prior to concrete placement. Groundwater should be removed from each shaft hole prior to concrete placement. Shaft concrete should be placed immediately after completion of drilling and cleaning. If pier concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Free-fall concrete placement in shafts will only be acceptable if provisions are taken to avoid striking the concrete on the sides of the hole or reinforcing steel. The use of a bottom-dump hopper, or an elephant's trunk discharging near the bottom of the hole where concrete segregation will be minimized, is recommended. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

Casing should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or caving soils or the creation of voids in shaft concrete. Shaft concrete should have a relatively high fluidity when placed in cased shaft holes or through a tremie. Shaft concrete with slump in the range of 5 to 7 inches is recommended.

We recommend the sides of each shaft should be mechanically roughened in the claystone bearing strata. This should be accomplished by a roughening tooth placed on the auger. Shaft bearing surfaces must be cleaned prior to concrete placement. A representative of Terracon should observe the bearing surface and shaft configuration.

GROUND IMPROVEMENT

Very soft to soft clay soils were encountered at anticipated shallow foundation bearing depths. We recommend constructing the proposed aprons and wingwalls on a drilled shaft foundation system bottomed in bedrock. As a higher risk alternative to drilled shaft foundations, consideration could be given to ground modification/improvement techniques to improve strength and compressibility characteristics of the foundation soils. We believe the aprons and wingwalls can be constructed on a shallow foundation system, provided the foundation system bears on improved ground through methods such as over-excavation and replacement with imported granular fill or rammed aggregate piers.

Over-Excavation

One approach to ground modification would include over-excavation. We believe the proposed aprons and wingwalls can be constructed on a shallow foundations system provided the soils are over-excavated to a depth of at least 3 feet below the bottom of aprons and footings and replaced with moisture conditioned, properly compacted imported granular fill.

Rammed Aggregate Piers

Another approach would include rammed aggregate pier foundation elements or stone columns to support shallow foundations. Stone columns and rammed aggregate piers consist of a series of drilled holes filled with highly compacted, well graded aggregate to form very stiff, high-density aggregate piers. The stone column and rammed aggregate piers are generally extended below the low strength soil layer to a layer of higher bearing capacity soils or bedrock. Installation of these elements results in significant strengthening and stiffening of the foundation bearing layer to support footings within typical settlement tolerances. Shallow foundations are then constructed over the piers/columns in a conventional manner. Aggregate pier foundation elements are usually part of the contractor's design-build system. Therefore, the subsurface exploration information contained in this report should be provided to the foundation contractors for detailed analysis and design and cost information.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Ground Modification** and **Earthwork**, the following design parameters are applicable for shallow foundations.

Shallow Foundations - Design Recommendations

Description	Values
Bearing material	At least 3 feet of moisture conditioned, properly compacted, over-excavation backfill or rammed aggregate piers.
Maximum net allowable bearing pressure ¹	2,000 psf
Minimum foundation dimensions	Columns: 30 inches Continues: 18 inches
Lateral earth pressure coefficients ²	Active, $K_a = 0.45$ Passive, $K_p = 2.2$ At-rest, $K_o = 0.63$
Sliding coefficient ²	$\mu = 0.32$
Moist soil unit weight	$\gamma = 125$ pcf

Description	Values
Minimum embedment depth below finished grade ³	30 inches
Estimated total movement ⁴	About 1 inch
Estimated differential movement ⁴	About ½ to ¾ of total movement

1. The recommended maximum net allowable bearing pressure assumes any unsuitable fill or soft/loose soils, if encountered, will be over-excavated and replaced with properly compacted engineered fill. The design bearing pressure applies to a dead load plus design live load condition. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions.
2. The lateral earth pressure coefficients and sliding coefficients are ultimate values and do not include a factor of safety. The foundation designer should include the appropriate factors of safety.
3. For frost protection and to reduce the effects of seasonal moisture variations in the subgrade soils. The minimum embedment depth is for perimeter footings beneath unheated areas and is relative to lowest adjacent finished grade, typically exterior grade. Interior column pads in heated areas should bear at least 12 inches below the adjacent grade (or top of the floor slab) for confinement of the bearing materials and to develop the recommended bearing pressure.
4. The estimated movements presented above are based on the assumption that the maximum footing size is 4 feet for column footings and 1.5 feet for continuous footings. Larger foundation footprints will likely require reduced net allowable soil bearing pressures to reduce risk for potential settlement.

Shallow Footings - Construction Considerations

To reduce the potential of “pumping” and softening of the foundation soils at the foundation bearing level and the requirement for corrective work, we suggest the foundation excavation for the aprons and wingwalls be completed remotely with a track-hoe operating outside of the excavation limits.

Shallow foundation construction should only be considered if the estimated foundation movement can be tolerated. Subgrade soils at the base of the recommended over-excavation beneath footings should be moisture conditioned and compacted as described in the **Earthwork** section of this report. The moisture content and compaction of subgrade soils should be maintained until foundation construction.

Footings and foundation walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement.

Unstable subgrade conditions are anticipated as excavations approach the groundwater surface. Unstable surfaces will need to be stabilized prior to backfilling excavations and/or constructing the building foundation, floor slab and/or project pavements. The use of angular rock, recycled concrete and/or gravel pushed or “crowded” into the yielding subgrade is considered suitable means of stabilizing the subgrade. The use of geogrid materials in conjunction with gravel could also be considered and could be more cost effective.

Unstable subgrade conditions should be observed by Terracon to assess the subgrade and

provide suitable alternatives for stabilization. Stabilized areas should be proof rolled prior to continuing construction to assess the stability of the subgrade.

Foundation excavations should be observed by Terracon. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

APRONS

A slab-on-grade may be utilized for the aprons provided the recommendations in the **Ground Improvement** section have been followed. If the estimated movement cannot be tolerated, a deep foundation system is recommended

Subgrade soils at the base of the recommended over-excavation beneath the aprons should be scarified to a depth of at least 10 inches, moisture conditioned and compacted. The moisture content and compaction of subgrade soils and/or over-excavation backfill should be maintained until slab construction.

Aprons - Design Recommendations

Even when bearing on properly prepared soils, movement of the slab-on-grade aprons is possible should the subgrade soils undergo an increase in moisture content. We estimate movement of about 1 inch is possible. If the owner cannot accept the risk of movement, a deep foundation should be used. If conventional slab-on-grade is utilized, the subgrade soils should be prepared as presented in the **Ground Modification** and **Earthwork** sections of this report.

Additional apron design and construction recommendations are as follows:

- Positive separations and/or isolation joints should be provided between slabs and all foundations, columns, or utility lines to allow independent movement.
- Control joints should be saw-cut in slabs in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended) to control the location and extent of cracking.
- Slabs should not be constructed on frozen subgrade.
- Other design and construction considerations, as outlined in the ACI Design Manual, Section 302.1R are recommended.

Supplemental Geotechnical Engineering Report

20th Street Concrete Box Culvert (CBC) ■ Greeley, Colorado

February 12, 2019 ■ Terracon Project No. 21185033 (supplemental)




The recommendations presented in this report should be used in conjunction with those presented in our initial Geotechnical Engineering Report for the project. The **General Comments** should be reviewed and understood to apply to those engineering recommendations and opinions presented herein.

We appreciate the opportunity to continue to be of service to you on this project. If you have any questions or concerns regarding the content of this report, please feel free to contact us.

Sincerely,

Terracon Consultants, Inc.


For: Rick S. Greeley, E.I.
Field Engineer


Eric D. Bernhardt, P.E.
Geotechnical Department Manager

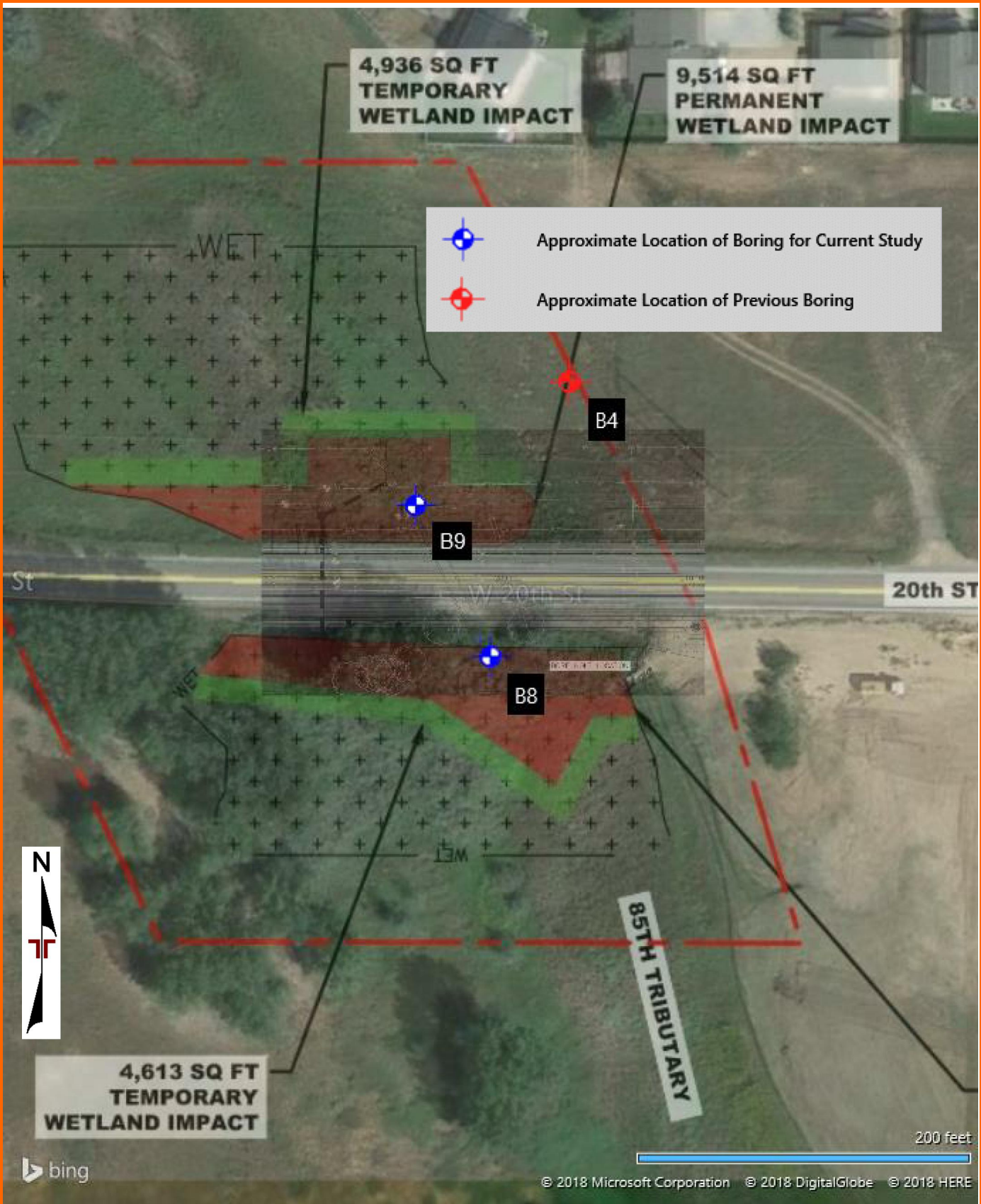
A circular blue ink seal for Eric D. Bernhardt, a Professional Engineer in the State of Colorado. The seal contains the text "COLORADO REGISTERED PROFESSIONAL ENGINEER" around the perimeter. In the center, the name "ERIC D. BERNHARDT" is written, along with the date "2/12/19" and the number "38829".

Attachments: Exploration Plan
Exploration Results
General Notes

EXHIBIT E - ANTICIPATED EXPLORATION PLAN

20th Street Phase 5 ■ Greeley, Colorado

February 12, 2019 ■ Terracon Proposal No. P21185033



BORING LOG NO. 08

Page 1 of 2

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4067° Longitude: -104.8157° Approximate Surface Elev: 4861 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		DEPTH ELEVATION (Ft.)									
		0.7 VEGETATIVE LAYER , about 8 inches 4860.5+/-									
		SILTY SAND , fine grained, brown to dark brown, loose									
		3.5 4857.5+/-				4-5-3 N=8					
		SANDY SILTY CLAY , light brown to brown, soft				2-3	470	24	103	23-18-5	63
		7.0 4854+/-									
		SILTY SAND , fine grained, light brown to brown to gray, very dense									
						21-26-40 N=66		25		NP	31
						44 - 50/5"		18	113		
		20.0 4841+/-				32-25-27 N=52		20			
		SEDIMENTARY BEDROCK - CLAYSTONE , gray to brown, medium hard to very hard, with interbedded siltstone									
		Iron oxide staining at depths of about 24 feet and below				23-35	14250	20	108	46-17-29	85

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" continuous-flight auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.
Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

6 feet while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 07-27-2018

Drill Rig: CME 55

Project No.: 21185033

Boring Completed: 07-27-2018

Driller: Drilling Engineers, Inc.

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19

BORING LOG NO. 09

Page 1 of 2

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, COSITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4069° Longitude: -104.8159° Approximate Surface Elev: 4857 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSION STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.7 VEGETATIVE LAYER , about 8 inches 4856.5+/-									
		SANDY SILTY CLAY , brown, gray, very soft to soft									
						2-3		22	101	25-20-5	69
			5			1-1-1/0"		22			
		9.0 SEDIMENTARY BEDROCK - CLAYSTONE , reddish brown to brown to gray, medium hard to very hard, iron oxide staining 4848+/-	10			3-3-4 N=7		24			
			15			13-26	5060	22	104	41-18-23	84
			20			9 - 24 - 50/4"		23			
		Black manganese lens at a depth of about 20 feet									
			25								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augerAbandonment Method:
Boring backfilled with soil cuttings upon completion.See [Supporting Information](#) for explanation of
symbols and abbreviations.Elevations were interpolated from a topographic site
plan.

Notes:

WATER LEVEL OBSERVATIONS

7 feet while drilling

Boring Started: 07-27-2018

Boring Completed: 07-27-2018

Drill Rig: CME 55

Driller: Drilling Engineers, Inc.

Project No.: 21185033

Terracon

1289 1st Ave
Greeley, CO

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19

BORING LOG NO. 09

Page 2 of 2

PROJECT: 20th Street Phase 5

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, COSITE: 20th Street from 86th to 90th Avenue
Greeley, CO

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 40.4069° Longitude: -104.8159° Approximate Surface Elev: 4857 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
										LL-PL-PI	
		SEDIMENTARY BEDROCK - CLAYSTONE , reddish brown to brown to gray, medium hard to very hard, iron oxide staining (continued)	30		50/5"						
			35								
			40		21-26-33 N=59			20			
			45								
		49.3 4807.5+/- Boring Terminated at 49.3 Feet			50/4"			36			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augerAbandonment Method:
Boring backfilled with soil cuttings upon completion.

Notes:

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

WATER LEVEL OBSERVATIONS

7 feet while drilling

Terracon
1289 1st Ave
Greeley, CO

Boring Started: 07-27-2018

Boring Completed: 07-27-2018

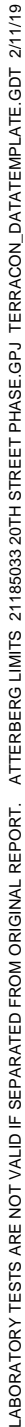
Drill Rig: CME 55

Driller: Drilling Engineers, Inc.

Project No.: 21185033

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19

ASTM D4318

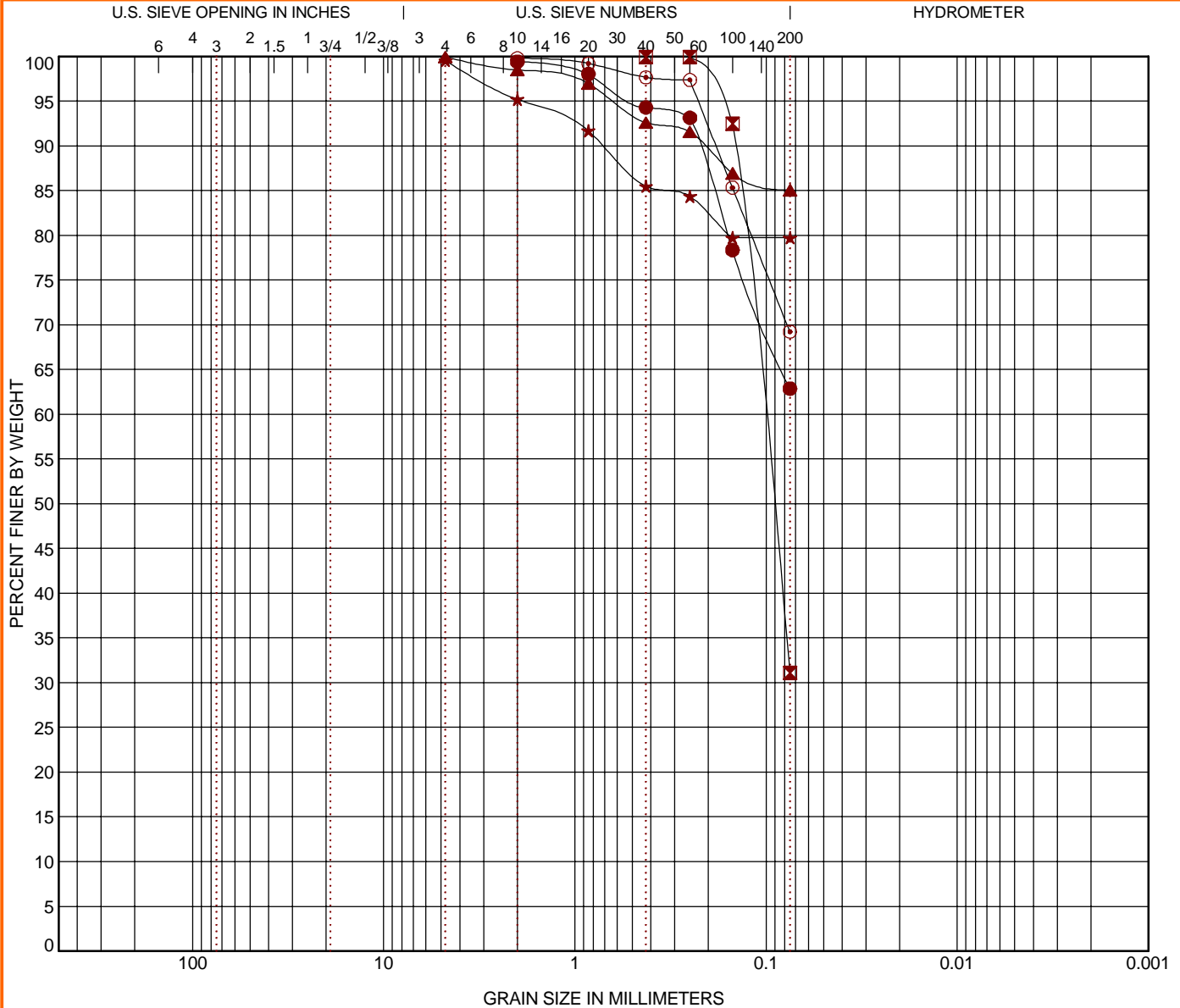


CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification				WC (%)	LL	PL	PI	Cc	Cu
●	08	4 - 5	SANDY SILTY CLAY (CL-ML)				24	23	18	5		
☒	08	9 - 10.5	SILTY SAND (SM)				25	NP	NP	NP		
▲	08	24 - 25	SEDIMENTARY BEDROCK - CLAYSTONE (CL)				20	46	17	29		
★	08	49 - 49.5	SEDIMENTARY BEDROCK - CLAYSTONE (CL)				22	46	20	26		
⊙	09	2 - 3	SANDY SILTY CLAY (CL-ML)				22	25	20	5		
Boring ID		Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Gravel	%Sand	%Silt	%Fines	%Clay	
●	08	4 - 5	2				0.0	36.5		62.9		
☒	08	9 - 10.5	0.425	0.104			0.0	68.8		31.1		
▲	08	24 - 25	4.75				0.0	14.9		85.1		
★	08	49 - 49.5	4.75				0.0	19.8		79.7		
⊙	09	2 - 3	2				0.0	30.6		69.2		

PROJECT: 20th Street Phase 5

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

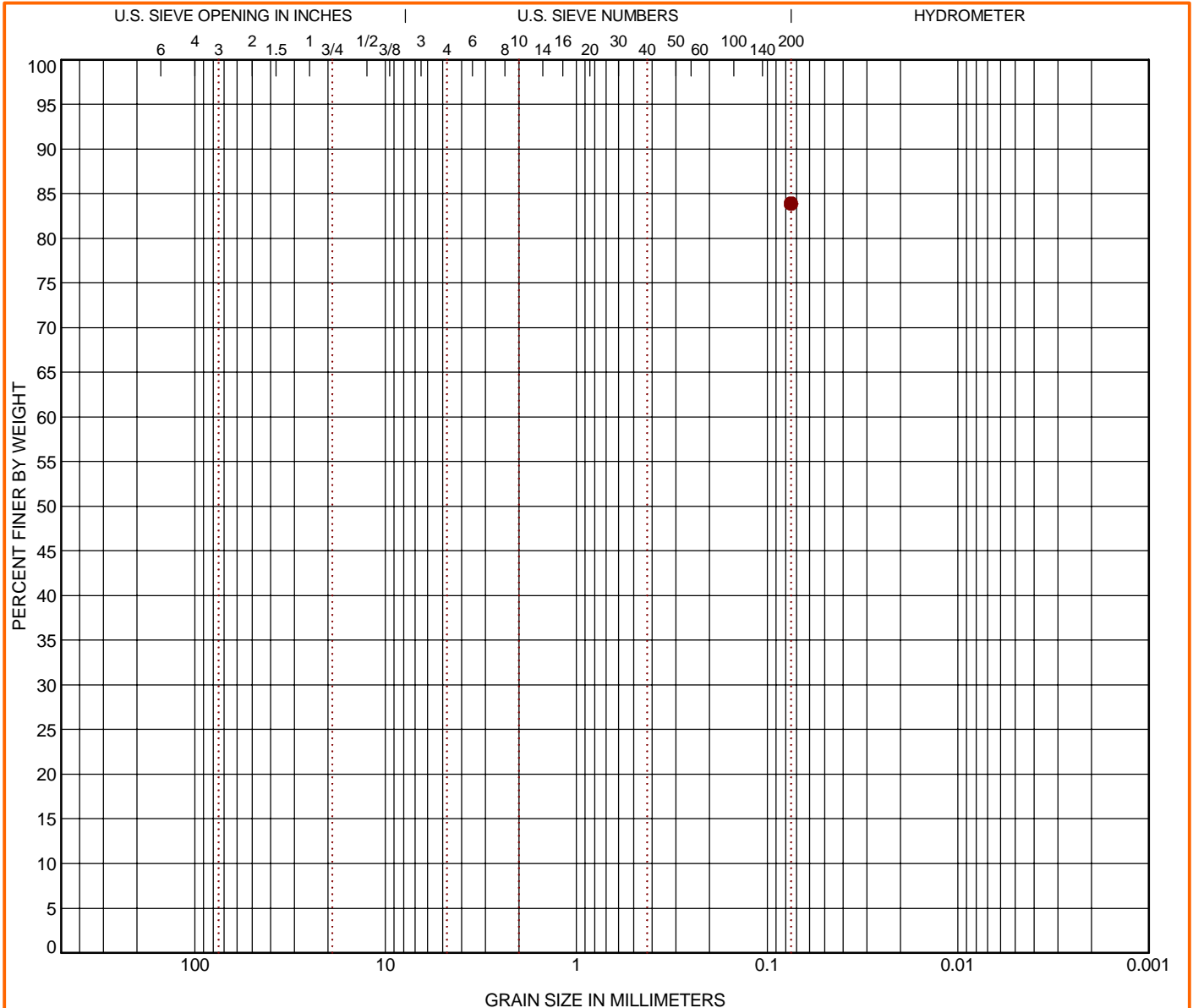
PROJECT NUMBER: 21185033

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 21185033 20TH STREET PHASE.GPJ TERRACON_DATATEMPLATE.GDT 2/11/19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

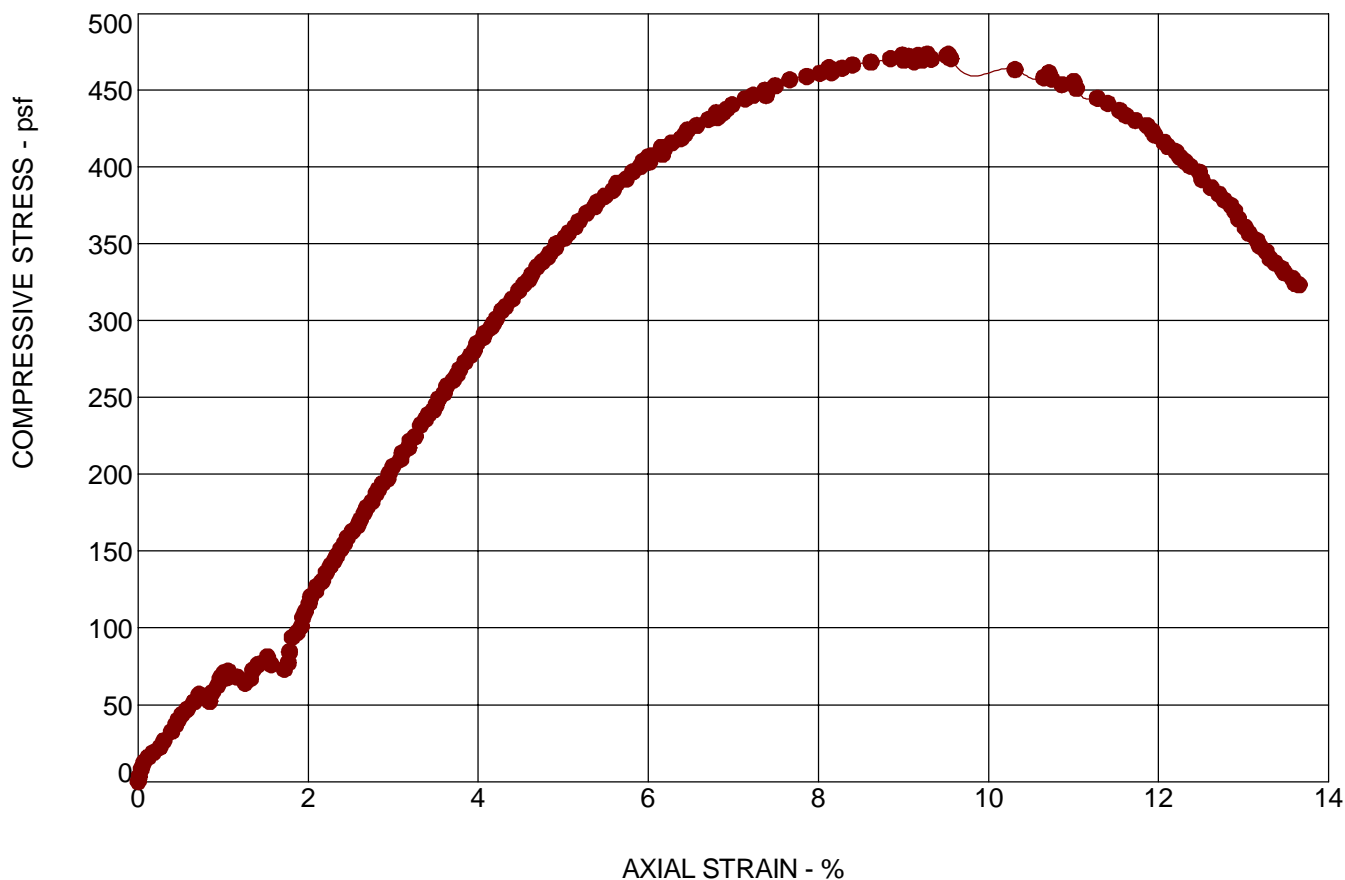
Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
09	14 - 15	SEDIMENTARY BEDROCK - CLAYSTONE (CL)	22	41	18	23		

Boring ID	Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Gravel	%Sand	%Silt	%Fines	%Clay
09	14 - 15	0.075				0.0			83.9	

PROJECT: 20th Street Phase 5	<p>1289 1st Ave Greeley, CO</p>	PROJECT NUMBER: 21185033
SITE: 20th Street from 86th to 90th Avenue Greeley, CO		CLIENT: J-U-B ENGINEERS, Inc. Fort Collins, CO

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	24
Dry Density:	pcf	103
Diameter:	in.	1.91
Height:	in.	3.83
Height / Diameter Ratio:		2.00
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	9.28
Unconfined Compressive Strength	(psf)	474
Undrained Shear Strength:	(psf)	237
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: 08 @ 4 - 5 feet

DESCRIPTION: SANDY SILTY CLAY(CL-ML)

LL
23

PL
18

PI
5

Percent < #200 Sieve
63

PROJECT: 20th Street Phase 5

PROJECT NUMBER: 21185033

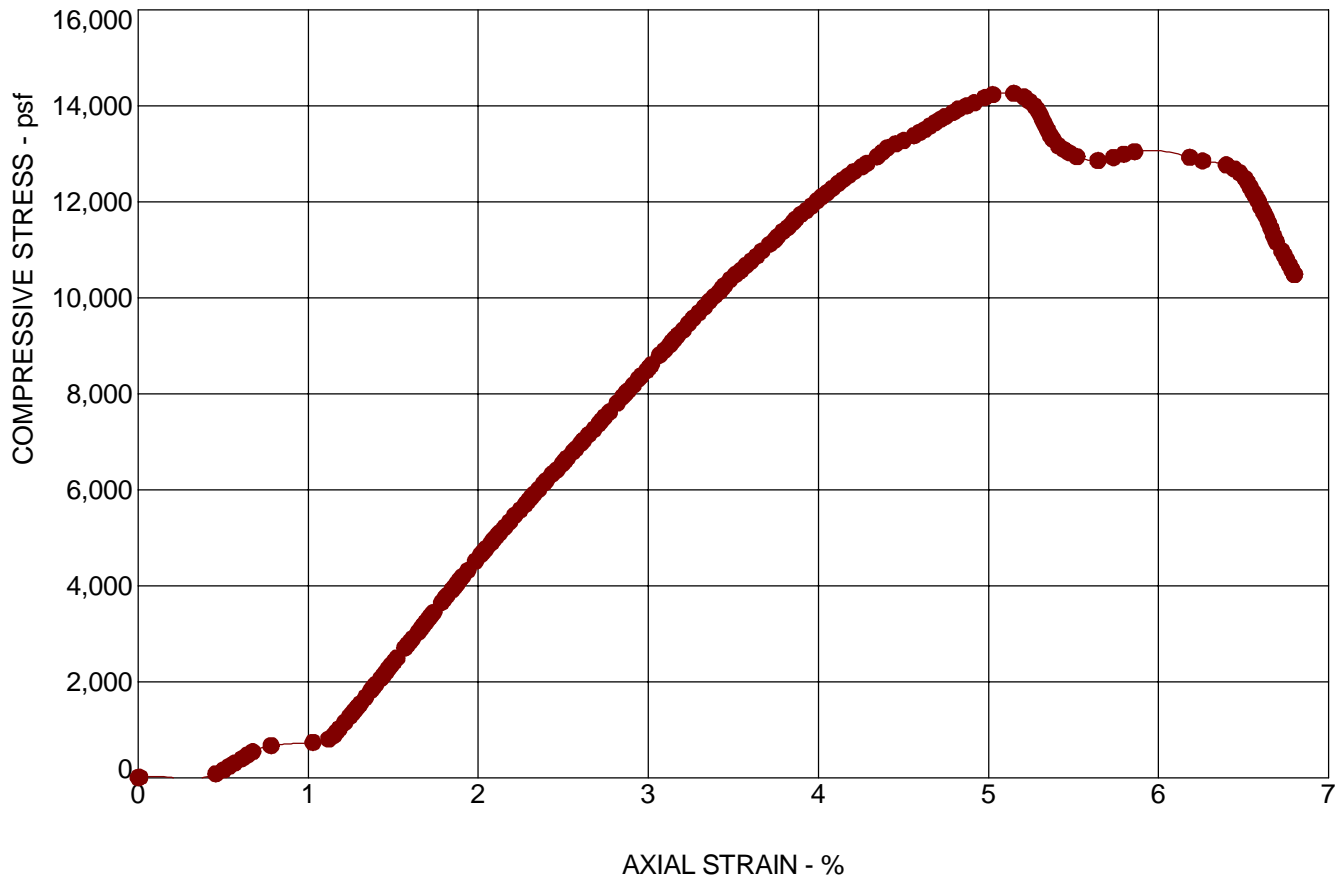
SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	20
Dry Density:	pcf	158
Diameter:	in.	1.60
Height:	in.	3.99
Height / Diameter Ratio:		2.49
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	5.15
Unconfined Compressive Strength	(psf)	14254
Undrained Shear Strength:	(psf)	7127
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: 08 @ 24 - 25 feet

DESCRIPTION: SEDIMENTARY BEDROCK - CLAYSTONE

LL
46

PL
17

PI
29

Percent < #200 Sieve
85

PROJECT: 20th Street Phase 5

PROJECT NUMBER: 21185033

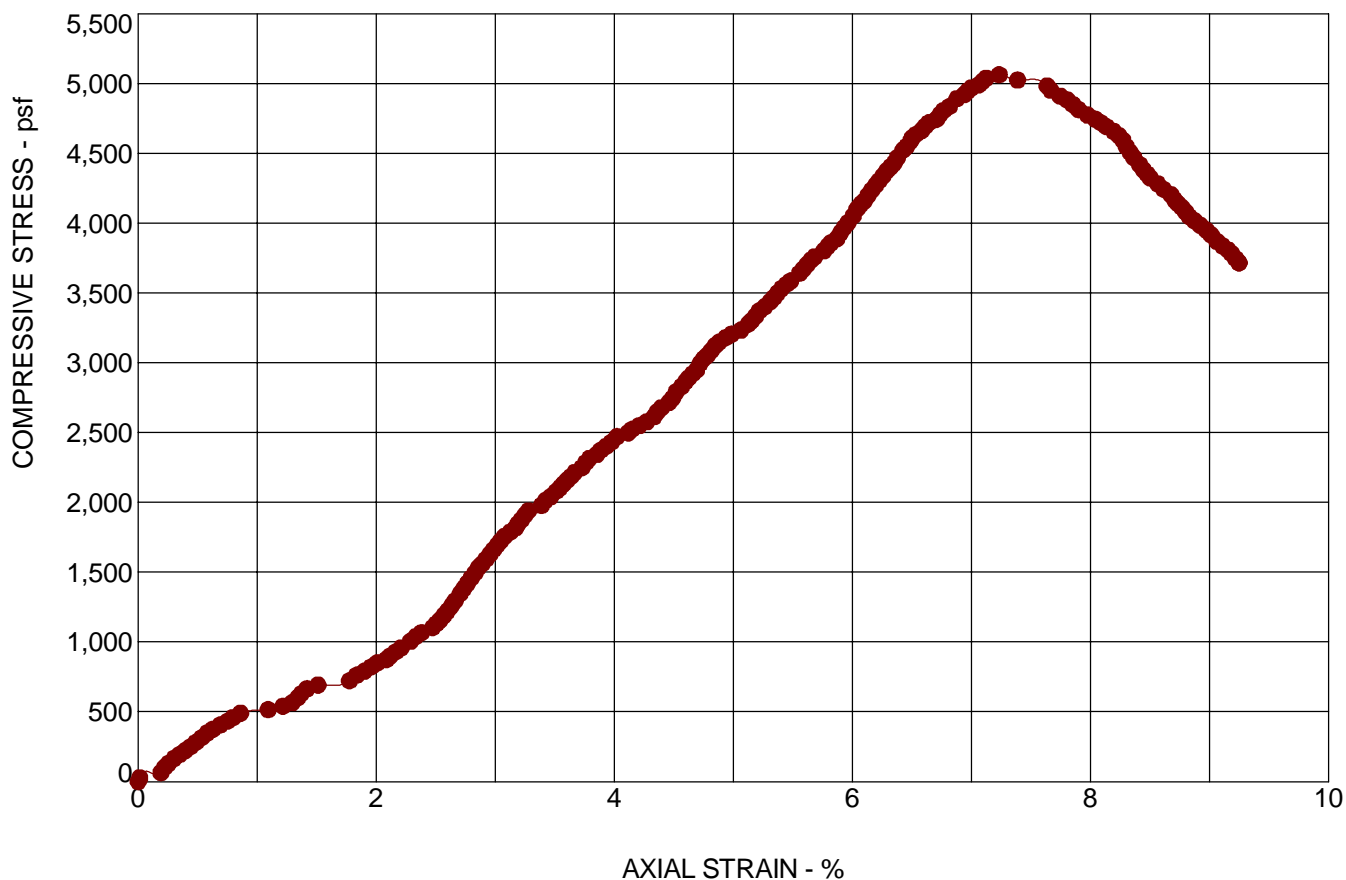
SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH



SPECIMEN TEST DATA

Moisture Content:	%	22
Dry Density:	pcf	103
Diameter:	in.	1.94
Height:	in.	3.51
Height / Diameter Ratio:		1.81
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	7.23
Unconfined Compressive Strength	(psf)	5062
Undrained Shear Strength:	(psf)	2531
Strain Rate:	in/min	
Remarks:		

SAMPLE TYPE: CA RING SAMPLER

SAMPLE LOCATION: 09 @ 14 - 15 feet

DESCRIPTION: SEDIMENTARY BEDROCK - CLAYSTONE

LL

PL

PI

Percent < #200 Sieve

41

18

23

84

PROJECT: 20th Street Phase 5

PROJECT NUMBER: 21185033

SITE: 20th Street from 86th to 90th Avenue
Greeley, CO

Terracon
1289 1st Ave
Greeley, CO

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, CO

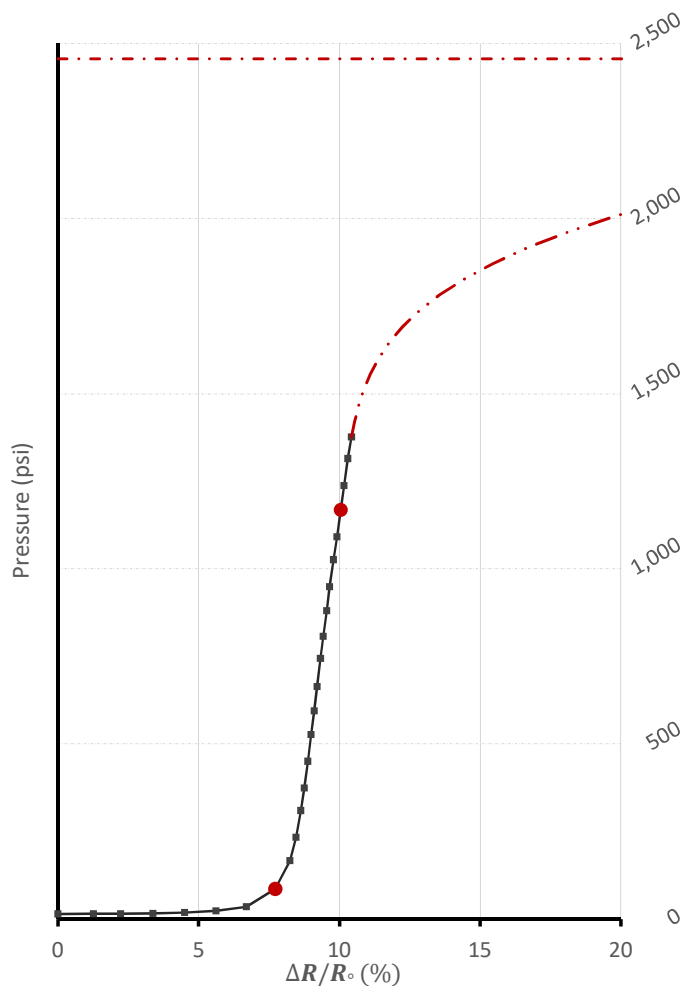
PRESSUREMETER TEST DATA

Use of a slotted casing:	No	
Test depth:	32.50	ft
Manometer Height Above Ground:	1.64	ft
Poisson's Ratio of Soil or Rock:	0.33	
Fluid Density (g/cc):	1.000	

[illegible]

Remarks

Pressuremeter test zone prepared with 3" drag bit with axial fluid injection.



Test Results

Pressuremeter Modulus E^1 :	67,251	psi
Ultimate Pressure P_L^2 :	2,457	psi
Ratio E / P_L :	27.37	
Yield Pressure P_F :	1,169	psi
Ratio P_L / P_F :	2.10	

¹ The Pressuremeter Modulus was calculated using the straight line (pseudo-elastic) boundaries graphically represented in RED.

² Ultimate Pressure, P_L is estimated using a best fit polynomial curve extrapolated in 20 iterations using the Newton-Raphson method. While graphical extrapolation is considered to be the recommended method for estimating P_L , caution must be exercised in regards to its use, particularly when the maximum radial strain value is low due to the stiffness of the material tested.

PRESSUREMETER TEST DATA

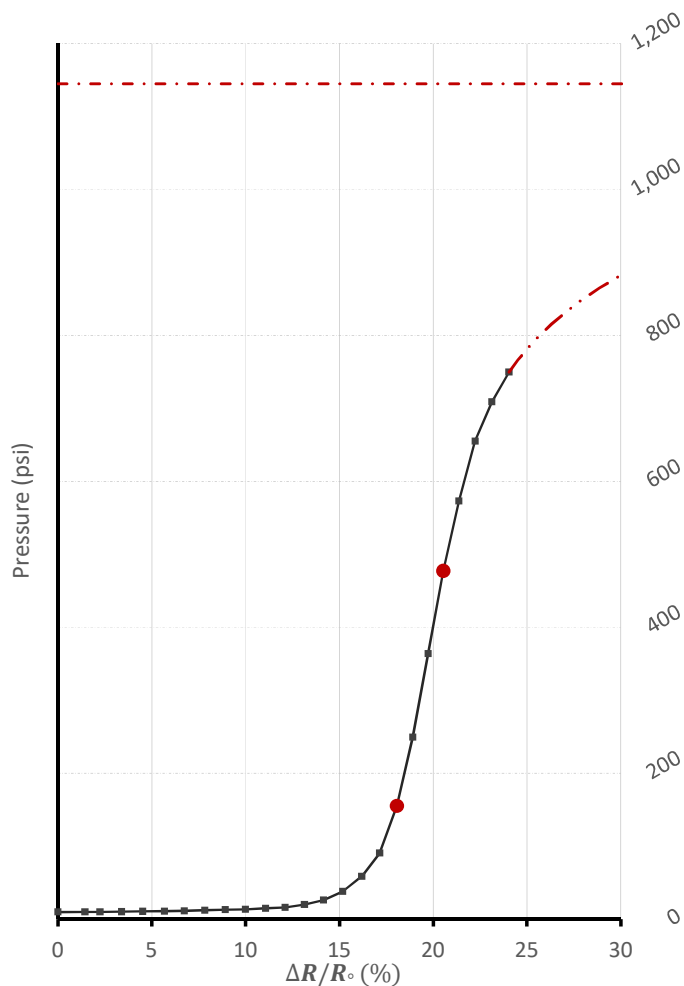
Project:	21185033
Borehole I.D.	B-9
Test date: (mm/dd/yyyy)	07/27/2018
Test number:	1
Probe size:	N
Pressure Calibration Reference:	07/26/2018 - 1
Volume Calibration Reference:	07/26/2018 - 1

Use of a slotted casing:	No	
Test depth:	21.50	ft
Manometer Height Above Ground:	1.64	ft
Poisson's Ratio of Soil or Rock:	0.33	
Fluid Density (g/cc):	1.000	

[illegible]

Remarks

Pressuremeter test zone prepared with 3-1/8" drag bit with axial fluid injection. Test zone was slightly oversized. Accordingly, test was terminated prior to maximum pressuremeter capacity to prevent membrane rupture.



Test Results

Pressuremeter Modulus E^1 :	20,616	psi
Ultimate Pressure P_L^2 :	1,145	psi
Ratio E / P_L :	18.01	
Yield Pressure P_F :	477	psi
Ratio P_L / P_F :	2.40	

¹ The Pressuremeter Modulus was calculated using the straight line (pseudo-elastic) boundaries graphically represented in RED.

² Ultimate Pressure, P_L is estimated using a best fit polynomial curve extrapolated in 20 iterations using the Newton-Raphson method. While graphical extrapolation is considered to be the recommended method for estimating P_L , caution must be exercised in regards to its use, particularly when the maximum radial strain value is low due to the stiffness of the material tested.

PRESSUREMETER TEST DATA

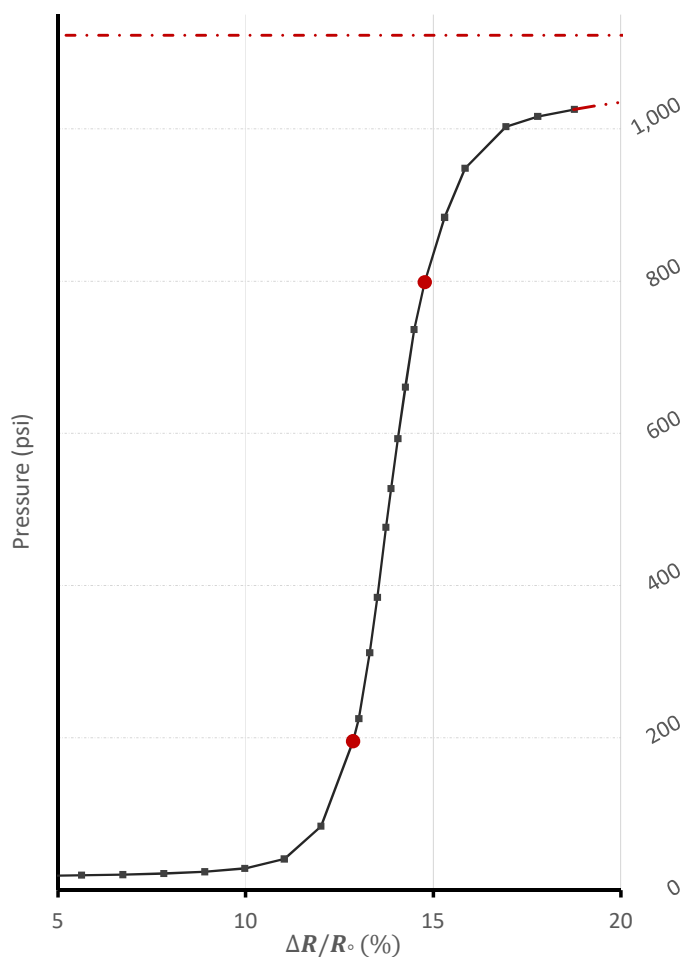
Project:	21185033
Borehole I.D.	B-9
Test date: (mm/dd/yyyy)	07/27/2018
Test number:	3
Probe size:	N
Pressure Calibration Reference:	07/26/2018 - 1
Volume Calibration Reference:	07/26/2018 - 1

Use of a slotted casing:	No	
Test depth:	41.50	ft
Manometer Height Above Ground:	1.64	ft
Poisson's Ratio of Soil or Rock:	0.33	
Fluid Density (g/cc):	1.000	

[illegible]

Remarks

Pressuremeter test zone prepared with 3" drag bit with axial fluid injection.



Test Results

Pressuremeter Modulus E^1 :	47,702	psi
Ultimate Pressure P_L^2 :	1,123	psi
Ratio E / P_L :	42.48	
Yield Pressure P_F :	799	psi
Ratio P_L / P_F :	1.41	

¹ The Pressuremeter Modulus was calculated using the straight line (pseudo-elastic) boundaries graphically represented in RED.







² Ultimate Pressure, P_L is estimated using a best fit polynomial curve extrapolated in 20 iterations using the Newton-Raphson method. While graphical extrapolation is considered to be the recommended method for estimating P_L , caution must be exercised in regards to its use, particularly when the maximum radial strain value is low due to the stiffness of the material tested.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

20th Street Phase 5 ■ Greeley, CO

February 12, 2019 ■ Terracon Project No. 21185033

SAMPLING	WATER LEVEL	FIELD TESTS
 Modified California Ring Sampler  Grab Sample  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (psf)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Ring Sampler Blows/Ft.	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium Stiff	1,000 to 2,000	4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 8,000	> 30	> 42			

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15
With	15-29
Modifier	>30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<5
With	5-12
Modifier	>12

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30