ADDENDUM #2
Public Works
95th Resiliency and Reconstruction
BID-009-23

January 31, 2024

The attached addendum supersedes the original Information and Specifications regarding BID-009-23 where it adds to, deletes from, clarifies or otherwise modifies. All other conditions and any previous addendums shall remain unchanged.

PLEASE NOTE:
You must have attended the mandatory meeting to bid on this project.

The Bid Tables that were previously uploaded into Bonfire have been deleted. Two new revised bid tabs are uploaded as Excel Spreadsheets in the public files and are both required to be returned with your submission.

The submittal due date has been extended. Bids are now due by 2:00 p.m. February 14, 2024.

Proposals must be submitted electronically on or before the Close Date at https://bouldercounty.bonfirehub.com/.

NO ZIP FILES OR LINKS TO EXTERNAL SITES WILL BE ACCEPTED. THIS INCLUDES GOOGLE DOCS AND SIMILAR SITES. ALL SUBMITTALS MUST BE RECEIVED AS AN ATTACHMENT (E.G. PDF, WORD, EXCEL).

Electronic submittals must be received at the website above. Submittals sent to any other box will NOT be forwarded or accepted. It is the sole responsibility of the proposer to ensure their documents are received before the deadline specified above. Boulder County does not accept responsibility under any circumstance for delayed or failed submittals. No exceptions will be made.

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

1. Question: Is a field office required on this project by Boulder County? The response in Add. 1, "This is the contractor's responsibility if a field office is desired" makes it seem like it may not be required.

   ANSWER: The contractor shall bid the field office as specified. Permitting of this item shall be the responsibility of the contractor.

2. Question: The quantities on the updated bid form do not reflect "HMA Section C" changing from S mix to SX mix. Do you want us to bid the original quantities?

   ANSWER: Please bid the original quantities.

3. Question: The interior chamfer on the RCBC is a typical for precast box, 45° at 6", curious if the engineer would entertain a more standard CIP square corner, the 45° ones are quite time consuming to form?

   ANSWER: Cast-in-Place Concrete Box shall follow CDOT M&S Drawing M-601-1 to M-601-3. These drawings do not call for an interior chamfer. Therefore, chamfers are not required for cast-in-place construction.

4. Question: Is there any more information on existing conditions that can be provided for the culvert grading at the triple cell boxes? Can you provide elevations of existing wetlands?

   ANSWER: Proposed detailed grading at the culverts are shown on DWGs C-425 and C-425. The existing wetlands with existing contouring are also shown on these drawings.

5. Question: Can you please provide a geotech report if one is available?

   ANSWER: Reports attached.

6. Question: The line item in the bid is for 120 days of Traffic Signal (Temporary). Is this intended as a single trailer each per day (2 trailers for 60 days) or as a pair of trailers for 120 days?

   ANSWER: the quantity is for 120 total days for a single trailer. *Changed the SOQ/Bid Tab to 2 ea.*

7. Question: The Traffic Control Plan states that full depth recon will be performed from stations 178+00 to 244+00 and that temporary traffic signals can be used for this work. Station 244+00 is within 100 ft of the Lookout Rd intersection. There is not enough room between the intersection and the work zone for a traffic signal and storage of waiting vehicles. How does the County anticipate this being handled?

   ANSWER: The portable traffic signal shall be placed a minimum of 500' south of the Lookout Road intersection to allow for the maximum queuing per Section 630. The contractor's MHT shall indicate what traffic control methods the contractor recommends for performing work north of the potable traffic signal. This section of the full depth can be constructed under daytime closures with flaggers. It will be allowable to open traffic to travel on aggregate base course while this section is being constructed. A maximum of 7 calendar days will be allowed for traveling on aggregate base course. Contractor shall maintain the base course and all costs associated with the maintenance shall be inclusive to the Aggregate Base Course bid item.

8. Question: This area (178+00 to 244+00) is 6600 ft long. Even with splitting this up into different sections the driveways and intersections will need to be controlled. This is best handled by a Driveway Assistance Device (DAD), can email spec sheet if need, just can't attach to this webpage. Could a line item be added for these devices if needed?

   ANSWER: This can be presented to the County for consideration during the project and if deemed cost effective they may be added to the project via change order.

9. Question: In the specifications, the Traffic Control Plan states that the "full time one lane closure with temporary traffic signals" has a "60 working day time limit." Is this correct or is this supposed to be calendar days?

   ANSWER: The traffic light should be 2 each.

10. Question: The full depth recon will create a significant drop-off. Will concrete barriers and impact attenuators be needed to protect the drop-off?

    ANSWER: ***YES. Special Provision 630 has been revised. The following bid items are added to the project:***
    630-80370 – Barrier (Temporary) – 1000 LF
    630-85010 - Impact Attenuator (Temporary) – 2 EA

11. Question: Traffic will need to be shifted for the full depth recon work. What is the minimum lane width allowed? Can traffic utilize the shoulder during one lane operations?

    ANSWER: Minimum Lane width is 11'. Shoulders can be used. *Refer to Question/Answer 10.*

12. Question: Can bicycle traffic be detoured for the duration of the project? If not, cyclists will need to merge with vehicular traffic through the work zone which creates timing issues for the temporary signals.

    ANSWER: Bicycles are allowed, plan the MHT accordingly.

13. Question: If we were to start this project in April of 2024, all of phase 1 would need to be completed by late June to early July to meet the 60 Working days given to complete this phase. That would leave a "shut down" period between July through September for the Osprey constraints. Can the contractor complete any other work that could be considered "noncritical path" during this shutdown period and not be charged working days? How does Boulder County want to see this "shutdown period" reflected on the schedule? Does Boulder County have any input on this?

    ANSWER: A shutdown period is allowed and depending on what "non critical path work" is requested can be determined during the project.

14. Question: Can you please provide the list of contractors who were at the pre-bid meeting?

    ANSWER: Attached at the end of this addendum.

15. Question: There is a line item for Uniformed Traffic Control (Vehicle). Will a line item be added for the Uniformed Traffic Control Officer?

    ANSWER: This item Shall include Vehicle and Officer.

16. Question: Can a list of anticipated CTS-A and CTS-B signs be provided?

    ANSWER: This will be per the approved MHTs

17. Question: Will precast concrete box culverts be an acceptable alternate to cast-in-place? Our boxes would meet CDOT spec 603-3. Furthermore, is epoxy reinforcing steel required if Precast concrete box culverts are acceptable? CDOT and ASTM allow for black rebar on precast box culverts.

ANSWER: Precast concrete box culvert is included within the bid-tabs as a bid-alternate. Design shall be per the requirements of CDOT M-603-3.

Project special Amendments:

Subsection 102.03 shall include the following:

- **BID ALTERNATE** has been provided to allow constructing the box culverts with precast box sections in lieu of the cast-in-place option as shown in the plans. The precast option requires cast-in-place work that includes the wingwalls, headwall and concrete apron. These items and quantities have been provided with the bid alternate items. Selection of awarded Contractor will be based on the lowest total cost of the Bid Tab “A” (Cast-in-Place Box Culverts) and Bid Tab “B” (Pre-cast Box Culverts). See Project Special Provision 603 for additional information on the precast option.

Subsection 104.02, Suspensions of work shall include the following:

- The Contractor is required to complete the Contract with sustained work efforts once they begin the project. The Contractor will coordinate work activities with the Engineer to minimize impacts to the water quality of the creek and potential safety hazards to personnel and materials. Work may be temporarily suspended for cold/inclement weather that would impact the quality of the final work, or due to environmental work restrictions such as the Osprey nesting period. No additional payment will be made for remobilization if the project is suspended.

Subsection 630.18 third paragraph shall be revised as follows:

- Traffic channelizing devices consisting of vertical panels, traffic cones, and drums will be measured by the unit. Barrier (Temporary) will be measured by the maximum linear foot set at one time. Impact Attenuator (Temporary) will be measured once. Resetting and removal of temporary barrier and impact attenuators will not be measured or paid and shall be included in the original unit price. Barricade warning lights shall be furnished as a part of this item when required by the Traffic Control Plan (TCP). Advance Warning Flashing or Sequencing Arrow Panels will be measured by the unit according to size.

Project Plan Amendments:

Sheet G-007
Sheet S-501

Bid Tabulations:

Two new Bid tables are associated with this bid. The previous ones have been deleted. Please fill out both. The difference is one is for a cast in place box culvert (s) Tab 'A' and the other is for the installation of a precast box culvert(s), Tab 'B'. Please populate both as bids will be evaluated on the cost difference between the two alternatives.

ITEM NO.	SECTION NUMBER	CONTRACT ITEM	UNIT	PROJECT TOTALS	
				PLAN	AS CONST.
1	201-00000	Clearing & Grubbing	LS	1	
2	202-00000	Removal of Structures and Obstructions	LS	1	
3	202-00010	Removal of Trees (Special)	LS	1	
4	202-00035	Removal of Pipe	LF	120	
5	202-00220	Removal of Asphalt Mat	SY	95,921	
6	202-00240	Removal of Asphalt Mat (Planing) (1" - 2")	SY	2,278	
7	202-01000	Removal of Fence	LF	728	
8	202-01130	Removal of Guardrail (Type 3)	LF	798	
9	202-04002	Clean Culvert	EA	4	
10	203-00010	Unclassified Excavation (Complete in Place)	CY	13,247	
11	203-00050	Unsuitable Material	CY	1,000	
12	203-01597	Potholing	HR	10	
13	206-00000	Structure Excavation	CY	5,620	
14	206-00100	Structure Backfill (Class 1)	CY	1,220	
15	207-00205	Topsoil	CY	4,424	
16	207-00210	Stockpile Topsoil	CY	4,424	
17	208-00002	Erosion Log (12 inch)	LF	1,048	
18	208-00020	Silt Fence	LF	17,337	
19	208-00035	Aggregate Bag	LF	50	
20	208-00046	Pre-fabricated Concrete Washout Structure (Type 1)	EA	4	
21	208-00070	Vehicle Tracking Pad	EA	5	
22	208-00207	Erosion Control Management	DAY	180	
23	210-00010	Reset Mailbox Structure	EA	2	
24	210-00050	Reset Fire Hydrant	EA	1	
25	210-01710	Reset Valve	EA	1	
26	210-04060	Adjust Water Meter	EA	1	
27	211-03005	Dewatering	LS	1	
28	212-00032	Soil Conditioning	AC	4.90	
29	212-00706	Seeding (Floodplain & Upland) Drill	AC	3.30	
30	212-00710	Seeding (Wetland) Hydraulic	AC	1.60	
31	213-00003	Mulching (Weed Free)	AC	4.90	
32	213-00061	Mulch Tackifier	LB	900	
33	214-00000	Landscape Maintenance	LS	1	
34	214-00008	Extended Landscape Preservation	LS	1	
35	214-00908	Perennials (1 Quart Container)	EA	30	
36	214-00910	Perennials (1 Gallon Container)	EA	105	
37	214-00950	Perennials (5 Gallon Container)	EA	9	
38	214-01015	Willow Cuttings	EA	201	
39	216-00201	Soil Retention Blanket (Straw/Coconut) (Biodegradable Class 1)	SY	656	
40	217-00015	Noxious Weed Management	HR	40	
41	240-00000	Wildlife Biologist	HR	40	
42	240-00010	Removal of Nests	HR	40	
43	304-05000	Aggregate Base Course (Class 5)	TON	1,941	
44	304-06000	Aggregate Base Course (Class 6)	TON	12,228	
45	306-01000	Reconditioning	SY	39,183	

ITEM NO.	SECTION NUMBER	CONTRACT ITEM	UNIT	PROJECT TOTALS	
				PLAN	AS CONST.
46	403-00720	Hot Mix Asphalt (Patching)(Asphalt)	TON	100	
47	403-33751	Hot Mix Asphalt (Grading S) (75) (PG 64-22)	TON	11,501	
48	403-34741	Hot Mix Asphalt (Grading SX) (75) (PG 64-22)	TON	4,837	
49	506-00212	Riprap (12 Inch)	CY	176	
50	506-01100	Concrete Block Revetment	SY	4,555	
51	601-03000	Concrete Class D	CY	997	
52	602-00020	Reinforcing Steel (Epoxy Coated)	LB	238,007	
53	603-10600	60 Inch Corrugated Steel Pipe	LF	16	
54	603-30060	60 Inch Steel End Section	EA	1	
55	603-15018	18 Inch Equivalent Corrugated Steel Pipe Arch (20"x14")	LF	14	
56	603-15021	21 Inch Equivalent Corrugated Steel Pipe Arch (28"x18")	LF	20	
57	603-15030	30 Inch Equivalent Corrugated Steel Pipe Arch (32"x24")	LF	62	
58	603-31318	18 Inch Equivalent Arch Steel End Section (20"x14")	EA	2	
59	603-31321	21 Inch Equivalent Arch Steel End Section (28"x18")	EA	1	
60	603-31330	30 Inch Equivalent Arch Steel End Section (32"x24")	EA	1	
61	604-00000	Concrete Collar	EA	5	
62	606-00302	Guardrail Type 3 (31 Inch Midwest Guardrail System)	LF	425	
63	606-02003	End Anchorage (Flared)	EA	6	
64	607-01051	Fence, Wire with Metal Posts (OSMP)	LF	270	
65	607-11455	Fence, Wood	LF	298	
66	607-11525	Fence (Plastic)	LF	1,865	
67	612-00001	Delineator (Type 1)	EA	65	
68	612-00002	Delineator (Type 2)	EA	40	
69	620-00002	Field Office (Class 2)	EA	1	
70	620-00020	Sanitary Facility	EA	3	
71	625-00000	Construction Surveying	LS	1	
72	626-00000	Mobilization	LS	1	
73	627-00005	Epoxy Pavement Marking	GAL	155	
74	627-30405	Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	358	
75	629-01210	Adjust Monument Box	EA	7	
76	630-00000	Flagging	HR	3,500	
77	630-00006	Uniform Traffic Control (Vehicle)	HR	40	
78	630-00007	Traffic Control Inspection	DAY	40	
79	630-00012	Traffic Control Management	DAY	150	
80	630-80335	Barricade (Type 3 M-A) (Temporary)	EA	10	
81	630-80341	Construction Traffic Sign (Panel Size A)	EA	70	
82	630-80342	Construction Traffic Sign (Panel Size B)	EA	25	
~~83~~	~~630-80355~~	~~Portable Message Sign Panel~~	~~EA~~	~~4~~	
84	630-80370	Barrier (Temporary)	LF	1,000	
~~85~~	~~630-80380~~	~~Traffic Cone~~	~~EA~~	~~200~~	
~~86~~	~~630-80360~~	~~Drum Channelizing Device~~	~~EA~~	~~500~~	
87	630-85010	Impact Attenuator (Temporary)	EA	2	
88	630-86802	Traffic Signal (Tempoary)	EA	2	
~~89~~	~~700-70310~~	~~F/A Minor Contract Revisions~~	~~FA~~	~~1~~	
90	700-70380	F/A Erosion Control	FA	1	

1

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J-U-B ENGINEERS, INC.

Sheet Revisions

	Date:	Comments	Init.
1	01/30/24	ADDENDUM #2	KTS

Boulder County

As Constructed

No Revisions:

Revised:

Void:

95TH ST. RECONSTRUCTION DESIGN
SUMMARY OF QUANTITIES

Designer: JTEMPLE
Detailer: KSMITH
Sheet Subset: GENERAL

Structure Numbers

Subset Sheets: 7 of 12

Project No. 101909-30

Drawing Number G-007

Plot Date:1/30/2024 12:16 PM Plotted By: Kevin T. Smith
Date Created:8/15/2023 Path: \\JUB.COM\CENTRAL\CLIENTS\CO\BOULDERCOUNTY\PROJECTS\87-20-008-95TH_ST\DESIGN\CAD\SHEET\87-20-008_G-007.DWG

GENERAL NOTES

1. GENERAL:

A. ALL STRUCTURAL WORK SHALL BE IN ACCORDANCE WITH THE COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS, LATEST EDITION, INCLUDING ALL SUPPLEMENTAL SPECIFICATIONS AND PROJECT SPECIAL PROVISIONS, THE 2019 M&S STANDARDS, AND THE PROJECT CONTRACT BID DOCUMENTS.
B. THESE GENERAL STRUCTURAL NOTES AND SPECIFICATIONS SUPPLEMENT THE PROJECT WRITTEN TECHNICAL SPECIFICATIONS AND THE PROJECT STRUCTURAL DRAWINGS.
C. THE CONTRACTOR IS RESPONSIBLE FOR ALL CONSTRUCTION BRACING, TEMPORARY SHORING, AND OTHER SITE SAFETY CONTROLS REQUIRED DURING CONSTRUCTION IN ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS, TO INSURE THE STABILITY AND SAFETY OF ALL CONSTRUCTION UNTIL IT IS COMPLETED AND SELF-SUPPORTING.
D. THE CONTRACTOR IS RESPONSIBLE FOR ALL WATER, BOTH ABOVE AND BELOW GROUND, RUNOFF AND OTHER ENVIRONMENTAL CONTROLS REQUIRED DURING CONSTRUCTION TO INSURE THE SITE IS MAINTAINED IN COMPLIANCE WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS.
E. PRIOR TO IMPLEMENTING ANY CHANGES TO THESE PLANS, THE ENGINEER AND OWNER SHALL BE NOTIFIED IN WRITING FOR THEIR WRITTEN APPROVAL.
F. THE EXISTING CONDITIONS INDICATED ON THESE DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING EXISTING CONDITIONS AND IS RESPONSIBLE FOR THE FIT OF ALL NEW CONSTRUCTION. ANY DISCREPANCY SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER.
G. HOT WEATHER AND COLD WEATHER CONCRETING OPERATIONS SHALL BE PERFORMED IN ACCORDANCE WITH CDOT STANDARD SPECIFICATIONS, SECTION 601, AND WILL NOT BE PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THE WORK.
H. ALL EXPOSED CONCRETE EDGES SHALL HAVE A ¾" CHAMFER, UNLESS NOTED OTHERWISE ON THE PLANS.
I. ALL CONSTRUCTION JOINTS SHALL BE IN ACCORDANCE WITH CDOT STANDARD SPECIFICATIONS, SECTION 601.12, AND SHALL BE PLACED ONLY AS APPROVED BY THE ENGINEER.
J. ALL REINFORCING STEEL SHALL HAVE 2" OF COVER UNLESS NOTED OTHERWISE ON THE PLANS.
K. EXPANSION JOINT MATERIAL SHALL MEET AASHTO SPECIFICATION M213.
L. THE FINAL FINISH FOR THE INTERIOR BOX SURFACES SHALL BE CLASS 2. ALL OTHER EXPOSED CONCRETE SURFACES SHALL RECEIVE A CLASS 1 FINISH TO ONE FOOT BELOW THE GROUND LINE.
M. ALL REINFORCING STEEL SHALL BE EPOXY COATED UNLESS OTHERWISE NOTED.
N. Ⓝ DENOTES NON COATED REINFORCING STEEL
O. THE FOLLOWING TABLE GIVES THE MINIMUM LAP SPLICE LENGTH FOR EPOXY COATED REINFORCING BARS PLACED IN ACCORDANCE WITH SUBSECTION 602.06. THESE SPLICE LENGTHS SHALL BE INCREASED BY 25% FOR BARS SPACED AT LESS THAN 6" ON CENTER OR LESS THAN 3" OF LATERAL COVER.

BAR SIZE	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH FOR CLASS D CONCRETE	1'-9"	2'-3"	2'-8"	3'-11"	4'-6"	5'-1"	5'-8"	6'-4"

THE ABOVE SPLICE LENGTHS SHALL BE INCREASED BY 20% FOR 3-BAR BUNDLES AND 33% FOR 4-BAR BUNDLES.

P. STATIONS, ELEVATIONS, AND DIMENSIONS CONTAINED IN THESE PLANS ARE CALCULATED FROM A RECENT FIELD SURVEY. THE CONTRACTOR SHALL VERIFY ALL DEPENDENT DIMENSIONS IN THE FIELD BEFORE ORDERING OR FABRICATING ANY MATERIAL.
Q. ALL LONGITUDINAL AND TRANSVERSE DIMENSIONS ARE MEASURED HORIZONTALLY AND INCLUDE NO CORRECTION FOR GRADE.
R. THE INFORMATION SHOWN ON THESE PLANS CONCERNING THE TYPE AND LOCATION OF UNDERGROUND UTILITIES IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE. THE CONTRACTOR IS RESPONSIBLE FOR MAKING HIS/HER OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UNDERGROUND UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. THE CONTRACTOR SHALL CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 (1-800-922-1987) AT LEAST 3 DAYS (2 DAYS NOT INCLUDING THE DAY OF NOTIFICATION) PRIOR TO ANY EXCAVATION OR OTHER EARTHWORK.

2. DESIGN DATA:

A. AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION, AND SUPPLEMENTS
B. LIVE LOADS: HL-93
C. FOR SOIL DESIGN PARAMETERS FOR CONCRETE RETAINING WALLS AND CAST-IN-PLACE CONCRETE TUNNEL UNITS. REFER TO GEOTECHNICAL INVESTIGATION BY TERRACON CONSULTANTS, INC., TITLED "XYZ" DATED XYZ, 2021.

3. CONTRACTOR RESPONSIBILITY FOR COORDINATION:

A. IT IS THE CONTRACTOR'S PRIME RESPONSIBILITY TO COORDINATE THE WORK SHOWN ON ALL OF THE PROJECT DRAWINGS, GENERAL, SPECIAL AND TECHNICAL SPECIFICATIONS.
B. UTILITY LINES SHOWN ON THE PLAN SHEETS ARE PLOTTED FROM THE BEST AVAILABLE INFORMATION. THE CONTRACTOR'S ATTENTION IS DIRECTED TO PARAGRAPH 105.10 OF THE CDOT STANDARD SPECIFICATION CONCERNING UTILITIES.
C. THE CONTRACTOR SHALL CALL 811 FOR UTILITY LOCATION AT LEAST 3 WORKING DAYS PRIOR TO ANY EXCAVATION, NOT INCLUDING THE DAY OF ACTUAL NOTICE.

4. SHOP DRAWINGS:

A. SUBMITTAL REQUIREMENTS SHALL BE PER SECTION 105.02(D) & (C) OF THE CDOT STANDARDS. SUBMIT SHOP DRAWINGS FOR REVIEW PRIOR TO FABRICATION OF THE FOLLOWING ITEMS:
a. REINFORCING STEEL

5. EXCAVATIONS AND EMBANKMENTS:

A. EMBANKMENT SHALL BE IN ACCORDANCE WITH SECTION 203 OF THE CDOT SPECIFICATIONS.
B. STRUCTURE BACKFILL SHALL BE COMPACTED TO A DENSITY NOT LESS THAN 95% OF MAXIMUM DENSITY IN ACCORDANCE WITH AASHTO T-180. REFER TO SECTION 206 OF THE CDOT STANDARDS.
C. BACKFILL BEHIND CONCRETE RETAINING WALLS AND CAST-IN-PLACE BOX CULVERT WALLS SHALL BE STRUCTURE BACKFILL CLASS 1 IN ACCORDANCE WITH CDOT STANDARD SPECIFICATIONS, SECTION 703.08.
D. ALL FILL SHALL BE TESTED AND APPROVED PRIOR TO USE ON THE PROJECT. THE MATERIAL SHALL BE AS SPECIFIED ON THE PLANS OR IN THE CONTRACT DOCUMENTS.
E. DEPTH OF MOISTURE-DENSITY CONTROL SHALL BE FULL DEPTH OF ALL EMBANKMENTS AND 6 INCHES FOR BASES OF CUTS AND FILLS.
F. EXCAVATION REQUIRED FOR COMPACTION OF BASES OF CUTS AND FILLS WILL BE CONSIDERED AS SUBSIDIARY TO THAT OPERATION AND WILL NOT BE PAID FOR SEPARATELY.

6. GROUNDWATER:

A. SHALLOW GROUNDWATER MAY EXIST ON THIS PROJECT (SEE GEOTECHNICAL REPORT). THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING AND FOLLOWING THEIR DEWATERING PLAN. PLEASE REFER TO SPECIAL PROVISIONS. ALL COSTS ASSOCIATED WITH CONSTRUCTING WITHIN THE HIGH GROUND WATER AREA SHALL BE INCLUDED IN BID ITEM 211-03005 – DEWATERING.

7. FOUNDATIONS:

A. LOCAL AREAS OF SOFT AND/OR UNACCEPTABLE MATERIAL ENCOUNTERED AT BOTTOM OF FOOTING ELEVATIONS INDICATED ON THE PLANS MUST BE OVER-EXCAVATED AND BROUGHT UP TO DESIGN GRADE WITH COMPACTED AGGREGATE BASE COURSE CLASS 6, IN ACCORDANCE WITH CDOT STANDARD SPECIFICATIONS, SECTION 206.
B. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH CDOT STANDARD M-206-1. STRUCTURE BACKFILL SHALL BE COMPACTED PER SECTION 206 OF THE CDOT STANDARDS.

8. MATERIALS:

A. CONCRETE: ALL STRUCTURAL CONCRETE CAST ON SITE SHALL BE CLASS D IN ACCORDANCE WITH CDOT STANDARD SPECIFICATIONS, SECTION 601 (f'_c = 4,500 PSI). HOT WEATHER AND COLD WEATHER CONCRETING OPERATIONS SHALL NOT BE PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THE WORK.
B. REINFORCING STEEL: REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 (FY = 60,000 PSI) IN ACCORDANCE WITH CDOT STANDARD SPECIFICATIONS, SECTION 602. ALL STEEL SHALL BE EPOXY COATED.
C. EPOXY SET BOLTS & REBAR: BOLTS AND REINFORCING STEEL BARS NOTED ON THE PLANS AS EPOXY OR CONSTRUCTION ADHESIVE SET BOLTS OR REBAR SHALL BE SET IN PLACE UTILIZING THE SIMPSON SET HIGH STRENGTH EPOXY SYSTEM; SIZE AND EMBEDMENT AS NOTED ON THE DRAWINGS, INSTALLED PER THE MANUFACTURERS RECOMMENDATIONS; OR AN APPROVED EQUAL.

CONTRACT ITEM NO.	CONTRACT ITEM	UNIT	STA. 160+87	STA. 167+06	TOTAL
206-00000	Structure Excavation	CY	5,120	500	5,620
206-00100	Structure Backfill (Class 1)	CY	1,050	170	1,220
304-05000	Aggregate Base Course (Class 5)	TON	1,738	203	1,941
601-03000	Concrete Class D	CY	896	101	997
602-00020	Reinforcing Steel (Epoxy Coated)	LB	213,200	24,807	238,007
625-00000	Construction Surveying	LS			1
626-00000	Mobilization	LS			1

PAY QUANTITY NOTES

1. PAYMENT OF ALL ITEMS SHALL BE AS NOTED IN THE MEASUREMENT AND PAYMENT SECTION OF THE CONTRACT SPECIFICATIONS.
2. LAP SPLICE LENGTHS ARE NOT INCLUDED IN THE QUANTITY FOR REINFORCING STEEL. NO ADDITIONAL PAYMENT WILL BE MADE FOR LAP SPLICE LENGTHS.
3. ALL MATERIALS AND LABOR REQUIRED FOR PLACEMENT OF WATERSTOPS SHALL BE INCLUDED IN THE COST FOR CONCRETE, CLASS D. NO SEPARATE PAYMENT WILL BE MADE FOR WATERSTOPS.
4. CONSTRUCTION SURVEY AND MOBILIZATION SHALL BE INCLUDED IN THE OVERALL PROJECT PAY ITEMS.
5. IN CONFORMANCE WITH CDOT STANDARD BID ITEMS:

6. ITEM 304-AGGREGATE BASE COURSE (CLASS 5) IS INTENDED FOR BOX CULVERT BEDDING MATERIAL. AGGREGATE BASE COURSE (CLASS 6) MAY BE USED AS AN ALTERNATIVE.

7. ITEM 601-CONCRETE CLASS D IS GENERALLY FOR THE WINGWALLS, WINGWALL FOOTINGS, APRON, AND CAST-IN-PLACE BOX CULVERT STRUCTURES.

8. THE USE OF PRE-CAST CONCRETE BOX CULVERTS IS AN ALTERNATE ON THIS PROJECT. DESIGN SHALL MEET THE REQUIREMENTS OF CDOT STANDARD DRAWING M-603-3.

1

BRIDGE DESCRIPTION

1. AT STA. 160+87, TWO 6'x16' TRIPLE-CELL CAST-IN-PLACE REINFORCED CONCRETE BOX CULVERT UNDER 95TH STREET. INDIVIDUAL LENGTH = 72'-0". TOTAL LENGTH = 144'-0".
2. AT STA. 167+06, ONE 4'x10' SINGLE-CELL CAST-IN-PLACE REINFORCED CONCRETE BOX CULVERT UNDER 95TH STREET. BOX LENGTH = 62'-0".

SEISMIC DESIGN CRITERIA

LATITUDE = 40.04948
LONGITUDE = -105.13120

AASHTO SPECTRUM FOR 7% PE IN 75 YEARS (1000YR RETURN PERIOD)

PERIOD (SEC)	SA (G)
0.0	0.060 PGA – SITE CLASS B
0.2	0.125 SS – SITE CLASS B
1.0	0.033 S1 – SITE CLASS B

SPECTRAL RESPONSE ACCELERATIONS:
AS = FPGA*PGA, SDS = FA*SS, AND SD1 = FV*S1
FPGA = 1.60, FA = 1.60, AND FV = 2.40

PERIOD (SEC)	SA (G)
0.0	0.096 AS – SITE CLASS D
0.2	0.200 SDS – SITE CLASS D
1.0	0.079 SD1 – SITE CLASS D

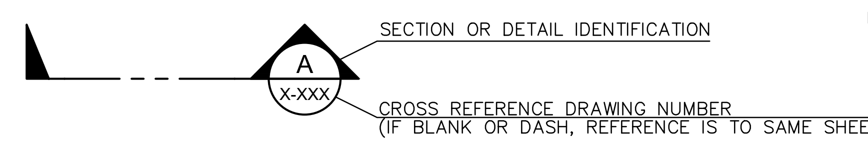
OPERATIONAL CLASS: OTHER

SEISMIC ZONE OR SEISMIC DESIGN CATEGORY:
ZONE = 1 OR CATEGORY = B

INDEX OF STRUCTURAL DRAWINGS

ADVERTISEMENT SET

811
Know what's below. Call before you dig.



Print Date: 1/30/2024	Sheet Revisions				As Constructed	95TH ST. RECONSTRUCTION DESIGN STRUCTURE NOTES & INFORMATION	Project No.
Scale: AS NOTED		Date:	Comments	Init.	No Revisions:		101909-30
J-U-B ENGINEERS, INC. 4745 Boardwalk Drive Building D, Suite 200 Fort Collins, CO 80525 Phone: 970.377.3602	1	01/30/24	ADDENDUM #2	KTS	Revised:	Designer: JTEMPLE; Detailer: KSMITH; Structure Numbers	Drawing Number S-501
					Void:	Sheet Subset: STRUCTURAL; Subset Sheets: 1 of 9	Sheet Number 52 of 119

Boulder County

REVISION OF SECTION 102
PROJECT PLANS AND OTHER DATA

Section 102 of the Standard Specifications is hereby revised for this project as follows:

Subsection 102.03 shall include the following:

BID ALTERNATE has been provided to allow constructing the box culverts with precast box sections in lieu of the cast-in-place option as shown in the plans. The precast option requires cast-in-place work that includes the wingwalls, headwall and concrete apron. These items and quantities have been provided with the bid alternate items. Selection of awarded Contractor will be based on the lowest total cost of the Bid Tab "A" (Cast-in-Place Box Culverts) and Bid Tab "B" (Pre-cast Box Culverts). See Project Special Provision 603 for additional information on the precast option.

Subsection 102.05 shall include the following:

Boulder County will provide electronic PDF files of drawings, the sample contract document, the project technical specifications in PDF format, online at the designated internet bid advertisement site, and they will be considered as the official bid set and record set. No CAD files will be issued during the bid advertisement period.

Upon contract execution, Boulder County will provide one original wet signed and stamped set of plans and specifications. A copy of those original signed and stamped documents will be provided in electronic format as a PDF.

REVISION OF SECTION 104
SCOPE OF WORK

Section 104 of the Standard Specifications is revised for this project as follows:

Subsection 104.02, Suspensions of work shall include the following:

> The Contractor is required to complete the Contract with sustained work efforts once they begin the project. The Contractor will coordinate work activities with the Engineer to minimize impacts to the water quality of the creek and potential safety hazards to personnel and materials. Work may be temporarily suspended for cold/inclement weather that would impact the quality of the final work, or due to environmental work restrictions such as the Osprey nesting period. No additional payment will be made for remobilization if the project is suspended.

REVISION OF SECTION 630
TRAFFIC CONTROL MANAGEMENT

Section 630 of the Standard Specifications is hereby revised as follows:

Subsection 630.01 shall include the following:

Employee vehicle parking is prohibited where it conflicts with safety, access or flow of traffic. The Contractor is responsible for obtaining, coordinating and maintaining acceptable parking and staging areas for the duration of the construction activities. This is considered incidental to the work and payment is included in the Mobilization work item.

The Contractor shall submit to the County Traffic Engineer a method of handling traffic (including bicycles) for approval at least ten working days prior to each construction phase, prior to changes in traffic control, and prior to any construction. The Contractor shall submit an MHT specifically for striping operations for approval by the Engineer.

Delays to road users shall not exceed 15 minutes during the traffic phases that include daily lane closures.

All costs incidental to the foregoing requirements shall be included in the original contract prices for the
project.

Subsection 630.11 shall include the following:

The Contractor's Superintendent and Traffic Control Manager (TCM) shall be equipped with a mobile telephone unit at all times that has a local number for contact with one another, the Project Engineer, or emergency response dispatchers when emergency services are required. The TCM shall make immediate contact with emergency personnel as required to assist accident victims, expedite the removal of broken-down vehicles, and maintain the smooth flow of traffic.

Subsection 630.18 third paragraph shall be revised as follows:

Traffic channelizing devices consisting of vertical panels, traffic cones, and drums will be measured by the unit. Barrier (Temporary) will be measured by the maximum linear foot set at one time. Impact Attenuator (Temporary) will be measured once. Resetting and removal of temporary barrier and impact attenuators will not be measured or paid and shall be included in the original unit price. Barricade warning lights shall be furnished as a part of this item when required by the Traffic Control Plan (TCP). Advance Warning Flashing or Sequencing Arrow Panels will be measured by the unit according to size.

Geotechnical Engineering Report

Culverts for 95th Street Reconstruction
Boulder County, Colorado
January 23, 2023
Terracon Project No. 22215058A

Prepared for:
J-U-B Engineers, Inc.
Fort Collins, Colorado

Prepared by:
Terracon Consultants, Inc.
Longmont, Colorado

January 23, 2023

J-U-B Engineers, Inc.
4745 Boardwalk Drive Building D, Suite 200
Fort Collins, Colorado 80525

Attn: Mr. Jeff Temple, P.E.
P: (970) 377-3602
E: jtemple@jub.com

Re: Geotechnical Engineering Report
Culverts for 95th Street Reconstruction
North 95th Street
Boulder County, Colorado
Terracon Project No. 22215058A

Dear Mr. Temple:

Terracon Consultants, Inc. (Terracon) has performed geotechnical engineering services for the project referenced above. This study was performed in general accordance with Terracon Proposal No. P22215058A (Revised) dated November 2, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of box culvert foundations and associated wing walls 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 pleased 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.

COLORADO REGISTERED PROFESSIONAL ENGINEER ERIC D. BERNHARDT 38829 1/23/2023

Alec N. Strassburg, P.E.
Project Engineer

Eric D. Bernhardt, P.E.
Geotechnical Department Manager

REPORT TOPICS

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

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Overview	A geotechnical exploration was performed for the proposed Culverts for 95th Street Reconstruction project to be constructed along North 95th Street, between Boulder Creek and Liggett Ditch in Boulder County, Colorado. Two, triple-cell reinforced concrete box culverts are planned to be constructed adjacent to each other at the project site. Two borings were performed to depths of approximately 19½ to 24½ feet below existing site grades.
Subsurface Conditions	Subsurface conditions encountered in our exploratory borings generally consisted of about 4 feet of existing fill over about 3 feet of sandy lean clay over sand soils with varying amounts of clay, silt, and gravel. Sandy claystone/siltstone bedrock was encountered below the overburden soils at depths of approximately 15 to 17 feet below existing site grades. Boring logs are presented in the **Exploration Results** section of this report.
Groundwater Conditions	Groundwater was encountered in the test borings at depths of about 7 to 11 feet below existing site grades at the time of drilling. 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 (such as Boulder Creek).
Geotechnical Concerns	The following geotechnical concerns were identified for this project: ■ Existing, undocumented fill was encountered in one of the borings performed on this site to a depth of about 4 feet below existing site grades. The existing fill soils should be removed and replaced with engineered fill within the construction area. ■ Groundwater was measured at depths ranging from about 7 to 11 feet below existing site grades. We understand the new culverts will likely be constructed at or below these groundwater levels. Terracon recommends maintaining a separation of at least 3 feet between the bottom of proposed below-grade foundations and measured groundwater levels during construction. Temporary construction dewatering will likely be needed where excavations extend deeper than the observed groundwater levels. ■ Expansive soils and bedrock are present on this site; however, our experience in the area and the laboratory test results indicated on-site soils and bedrock are generally low swelling or non-expansive. This report provides recommendations to help mitigate the effects of soil movement/heave associated with these materials. The risk can be mitigated by careful design, construction, and maintenance practices; however, it should be recognized these procedures will not eliminate risk. The owner should be aware and understand that on-grade slabs, pavements and, in some instances, foundations may be affected to some degree by the expansive soils and bedrock on this site. ■ Comparatively loose, low relative density sand soils were encountered at depths of approximately 7 to 9.5 feet of one of the borings completed at this site. These materials present a risk for potential settlement of shallow foundations, on-grade

Topic [1]	Overview Statement [2]
	slabs, pavements, and other surficial improvements. These materials can also be susceptible to disturbance and loss of strength under repeated construction traffic loads and unstable conditions could develop. Rework or stabilization of soft/loose soils may be required at some 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).
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 foundations 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 this report be followed to reduce potential movement. As discussed in the **Grading and Drainage** section of this report, surface drainage should be designed, constructed, and maintained to provide rapid removal of surface water runoff away from the existing pavements and proposed culverts. Water should not be allowed to pond adjacent to foundations or on pavements. Excessive wetting of foundation soils and subgrade can cause movement and distress to foundations and pavements.
Foundations	We believe the proposed box culvert wing walls can be supported on a shallow, spread footing foundation system provided the site soils are over-excavated to a depth of at least 12 inches below the bottom of footings and replaced with washed rock (ASTM C33 No. 57 or 67 rock).
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 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 making and 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
Culverts for 95th Street Reconstruction
North 95th Street
Boulder County, Colorado
Terracon Project No. 22215058A
January 23, 2023

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed culverts to be located along North 95th Street, between Boulder Creek and Liggett Ditch in Boulder County, 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
- Demolition considerations
- Excavation considerations
- Foundation design and construction
- Seismic considerations
- Lateral earth pressures

The geotechnical engineering scope of services for this project included the advancement of two test borings (designated as Borings B-1 and B-2) to depths ranging from approximately 19½ to 24½ feet below existing site grades.

Maps showing the site, boring, and bulk sample locations are shown in the **Site Location and Exploration Plans** section of this report. 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.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration.

Item	Description
Parcel Information	The project site is located along N. 95th Street, south of the intersection with Kestrel Lane and Liggett Ditch in Boulder County, Colorado. An approximate latitude and longitude to the center of the site is 40.04948° N / 105.13120° W (see **Site Location**).
Existing Improvements	The site consists of asphalt-surfaced road with aggregate-surfaced shoulders. Access drives to adjacent properties are present near the site. Fence lines delineate the existing right-of-way (ROW).

Item	Description
Surrounding Developments	The is generally surrounded by existing stormwater ponds. Boulder Creek is present to the south of the site and Liggett Ditch is present to the north of the site.
Current Ground Cover	Current ground cover at the site included native grass and weeds on both sides of the existing roadway.
Existing Topography	Based on the provided plan and profile sheets, existing ground surface elevations at the site range from about 5,047 to 5,062 feet AMSL.

PROJECT DESCRIPTION

Our final understanding of the project conditions is as follows:

Item	Description
Information Provided	The project information presented below is based on the following: ■ A Google Earth .KMZ file with proposed boring locations provided by J-U-B ■ Plan and profile design sheets provided by J-U-B and dated March 10, 2021
Project Description	We understand the project includes the construction of two adjacent triple-cell reinforced concrete box culverts oriented east-west beneath North 95th Street. The culverts will be installed about 8 to 12 feet beneath proposed final site grades and will be about 70 feet long. We understand each culvert cell will be approximately 16 feet wide and 6 feet tall. Wing walls are planned at the ends of each culvert. The existing road is planned to be raised approximately 1 to 1½ feet in elevation at the locations of the culverts.
Grading/Slopes	The plan and profile design sheets indicate up to about 10 to 12 feet of cut and fill will be required to develop final grades. We anticipate final slope angles no steeper than 3H:1V (Horizontal: Vertical).
Below-grade Structures	The culverts will be installed with invert elevations of about 5,052 feet AMSL on the west end of the culverts and 5,047 feet AMSL on the east end of the culverts.
Pavements	New asphalt pavements for North 95th Street are anticipated to be constructed after installation of the culverts. However, pavement design was not included in our scope of work. We understand pavement thickness will be determined by others.

If project information or assumptions vary from what is described above or if location of construction changes, we should be contacted as soon as possible to confirm and/or modify our recommendations accordingly.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and wing wall foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs and the GeoModel can be found in the **Exploration Results** section this report.

Model Layer	Layer Name	General Description	Approximate Depth to Bottom of Stratum
1	**Existing Pavement Section**	About 6 inches of asphalt over about 12 inches of aggregate base course.	About 1½ feet below existing site grades in Boring B-2 only.
2	**Existing Fill**	Consisted of poorly graded sand with varying amounts of gravel; tan, brown.	About 4 feet below existing site grades in Boring B-2 only.
3	**Clay**	Stiff sandy lean clay; varies to clayey sand; dark brown, brown.	About 7 feet below existing site grades in Boring B-2 only.
4	**Sand**	Loose to very dense sand with varying amounts of clay, silt, and gravel; dark brown, brown, orange brown, tan, grayish brown, light gray.	About 15 to 17 feet below existing site grades.
5	**Bedrock**	Very hard sandy claystone/siltstone bedrock; gray, dark gray.	Extended to the boring termination depths of about 19½ to 24½ feet below existing site grades.

As noted in **General Comments**, this characterization is based upon widely spaced exploration points across the site and variations are likely.

Groundwater Conditions

The boreholes were observed while drilling and shortly 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 in the following table:

Boring ID	Approx. Depth/Elevation [1] to Groundwater While Drilling, ft.	Approx. Depth/Elevation [1] to Groundwater at Completion of Drilling, ft.
B-1	7½ / ±5,049½	7 / ±5,050
B-2	11 / ±5,048	9 / ±5,050

1. A ground surface elevation at the boring location was estimated by Terracon by interpolation from a site-specific topographic site plan.

These observations represent short-term groundwater conditions at the time of and shortly after the field exploration and may not be indicative of other times or at other locations. Groundwater level fluctuations occur due to seasonal variations in the water levels present in nearby water features (such as Boulder Creek), amount of rainfall, runoff, and other factors not evident at the time the boring was performed. Therefore, groundwater levels during construction or at other times in the life of the structures may be higher or lower than the levels indicated on the boring log. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Laboratory Testing

Representative soil samples were selected for swell-consolidation testing and exhibited 0.7 percent swell when wetted. The site soils are considered to have low expansive potential or to be non-expansive. Samples of site soils selected for plasticity testing exhibited moderate plasticity or were non-plastic with liquid limits ranging from non-plastic to 36 and plasticity indices ranging from 11 to 14. 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 and the owner understands the inherent risks associated with construction on sites underlain by low potential expansive soils and bedrock. We have identified several geotechnical conditions that could impact design, construction and performance of the proposed structures, pavements, and other site improvements. These included existing, undocumented fill, groundwater, expansive soils and bedrock, and potentially loose, low relative density sand soils. 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 undocumented fill was encountered to a depth of about 4 feet in Boring B-2 drilled at the site. Existing fill could exist at other locations on the site and extend to greater depths. We do not possess any information regarding whether the fill was placed under the observation of a geotechnical engineer. Therefore, the fill is considered undocumented. Undocumented fill can present a greater than normal risk of post-construction movement of foundations, slabs, pavements, and other site improvements supported on or above these materials. Consequently, it is our opinion existing fill on the site should not be relied upon for support and should be removed down to native soil from within the construction area and replaced with moisture conditioned, properly compacted engineered fill prior to new fill placement and/or construction.

Groundwater

As previously stated, groundwater was measured at depths ranging from about 7 to 11 feet below existing site grades. We understand the new culverts will likely be constructed at or below these groundwater levels. Terracon recommends maintaining a separation of at least 3 feet between the bottom of proposed below-grade foundations and measured groundwater levels during construction. Temporary construction dewatering will likely be needed where excavations extend deeper than the observed groundwater levels.

Expansive Soils and Bedrock

Expansive soils and bedrock are present on this site; however, our experience in the area and the laboratory test results indicated on-site soils and bedrock are generally low swelling or non-expansive. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the structures, pavements, and flatwork is possible. The severity of cracking and other damage such as uneven pavements and flatwork will probably increase if modification of the site results in excessive wetting or drying of the expansive soils and bedrock. Eliminating the risk of movement and cosmetic distress is generally not feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. It is imperative the recommendations described in section **Grading and Drainage** section of the **Earthwork** section of this report be followed to reduce potential movement.

Low Relative Density Soils

Comparatively loose, low relative density sand soils were encountered at depths of approximately 7 to 9.5 feet of Boring B-1 completed at this site. These materials present a risk for potential settlement of shallow foundations, on-grade slabs, pavements, and other surficial improvements. These materials can also be susceptible to disturbance and loss of strength under repeated construction traffic loads and unstable conditions could develop. Rework or stabilization of soft/loose soils may be required at some 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

Based on the results of the borings and our understanding of the project, we believe the proposed box culvert wing walls can be supported on a shallow, spread footing foundation system provided the site soils are over-excavated to a depth of at least 12 inches below the bottom of footings and replaced with washed rock (ASTM C33 No. 57 or 67 rock).

Design recommendations for foundations for the proposed structures and related structural elements are presented in the following sections of this report.

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 the Geotechnical Engineer. 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, existing pavements, and any other deleterious materials from the proposed construction areas. As previously stated, we also recommend complete removal of existing, undocumented fill within the planned construction area. Existing fill was encountered in Boring B-2 extending to a depth of about 4 feet below existing site grades.

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

Demolition of the existing roadway should include complete removal of all pavements and/or exterior flatwork 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. All materials derived from the demolition of existing pavements or structures (if any) should be removed from the site.

Consideration could be given to re-using existing asphalt and/or concrete as fill 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.

Excavation

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Excavations into the on-site soils will likely encounter loose/weak and/or saturated soil conditions with possible caving conditions.

Cobbles and possible boulders can be locally present within the dense to very dense sand soils in this area of Boulder, Colorado. These conditions can complicate and increase difficulty of excavation and additional effort may be necessary to extract cobble- and/or boulder-sized materials, particularly in deeper narrow excavations, such as utility trenches. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for the project.

Excavation penetrating the bedrock (if any) may require the use of specialized heavy-duty equipment, together with ripping or jack-hammering to advance the excavation and facilitate rock break-up and removal. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for the project.

The soils to be excavated can vary 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 underground facilities such as septic tanks, vaults, 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 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 fill depth below the foundation base elevation. The 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 will likely be encountered in excavations on the site. It is anticipated that pumping from sumps may be utilized to control water within excavations. Well points may be required for significant groundwater flow, or where excavations penetrate groundwater to a significant depth.

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 undocumented existing fill and pavements have been removed from the construction area, and the required excavations and over-excavation have been completed, the top 10 inches of the exposed ground surface should be scarified, moisture conditioned, and compacted to at least 95 percent of the maximum dry unit weight as determined by ASTM D698 (or AASHTO T99) before any new fill, foundation, or pavement is placed or constructed.

In addition, large cobbles or boulder-sized materials may be encountered beneath foundation areas. Such conditions could create point loads on the bottom of foundations, increasing the potential for differential foundation movement. If such conditions are encountered in the foundation excavations, the cobbles and/or boulders should be removed from the upper 6 inches of the subgrade and be replaced with engineered fill prepared as recommended in this report.

Our experience indicates the subgrade materials below existing pavements and other flatwork will likely have relatively high moisture content and will tend to deflect and deform (pump) under construction traffic wheel loads. After removal of pavements, the contractor should expect unstable subgrade materials will need to be reworked or stabilized prior to fill placement and/or construction. Consequently, Terracon recommends a contingency be provided in the construction budget to correct weak/unstable subgrade.

After the bottom of the excavation has been prepared as recommended above, engineered fill can be placed to bring the culvert subgrade and 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 geosynthetics could also be considered as a stabilization technique. Lightweight excavation equipment may also be used to reduce subgrade pumping.

Fill Materials

Fill for this project should consist of engineered fill. Engineered fill is fill that meets the criteria presented in this report and has been properly documented. On-site soils free of deleterious material or approved granular and low plasticity cohesive imported materials may be used as fill material. 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	30-100
No. 200 Sieve	5-60

Soil Properties	Values
Liquid Limit	35 (max.)
Plasticity Index	15 (max.)

Other import fill material 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 [1]	Engineered Fill: at least 95 percent of the maximum dry unit weight as determined by ASTM D698 (or AASHTO T99)
Moisture content cohesive soil (clay) [2]	-1 to +3% of the optimum moisture content
Moisture content cohesionless soil (sand) [3]	-3 to +3% of the optimum moisture content

1. We recommend engineered fill be tested for moisture content and compaction during placement. If 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. 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.
3. Specifically, moisture levels of cohesionless soils should be maintained low enough to allow for satisfactory compaction to be achieved without the fill material pumping when proof rolled.

Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction.

It is imperative that utility trenches be properly backfilled with engineered fill. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill in non-pavement areas to reduce the infiltration and conveyance of surface water through the trench backfill.

It is strongly recommended that a representative of the Geotechnical Engineer provide full-time observation and compaction testing of trench backfill within construction area.

Grading and Drainage

Grades must be adjusted to provide effective drainage away from the proposed structures during construction. Infiltration of water into foundation excavations must be prevented during construction. Water permitted to pond near or adjacent to the perimeter of the structures (either during or post-construction) can result in significantly higher soil movements than those discussed in this report. As a result, any estimations of potential movement described in this report cannot be relied upon if positive drainage is not obtained and maintained, and water is allowed to infiltrate the fill and/or subgrade.

The use of swales, chases and/or area drains may be required to facilitate drainage in unpaved areas around the perimeter of the structures. Backfill against foundations and walls should be properly compacted and free of all construction debris to reduce the possibility of moisture infiltration. After construction of the proposed buildings and prior to project completion, we recommend verification of final grading be performed to document positive drainage, as described above, has been achieved.

Flatwork and pavements will be subject to post-construction movement. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the structures, care should be taken that joints are properly sealed and maintained to prevent the infiltration of surface water.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, 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 the Geotechnical Engineer prior to placement of additional lifts.

In areas of foundation excavations, the bearing subgrade and exposed conditions at the base of the recommended over-excavation should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Spread Footings – Design Recommendations

Description	Values
Bearing material	At least a 12-inch thick layer of washed rock (ASTM C33 No. 57 or 67 rock) over native medium dense to very dense sand soils
Estimated bearing elevation	Below an elevation of approximately 5,050 feet AMSL
Maximum net allowable bearing pressure [1]	2,500 psf
Minimum foundation dimensions	Continuous: 18 inches
Lateral earth pressure coefficients [2]	Lean clay (on-site or imported): Active, K_a = 0.42 Passive, K_p = 2.37 At-rest, K_o = 0.59 Granular soil (on-site or imported): Active, K_a = 0.33 Passive, K_p = 3.00 At-rest, K_o = 0.50
Sliding coefficient [2]	Washed rock: μ = 0.57
Moist soil unit weight	Lean clay (on-site or imported): γ = 120 pcf Granular soil (on-site or imported): γ = 120 pcf
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

Description	Values

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.
4. The estimated movements presented above assume that the maximum footing width is 4.5 feet for continuous footings. Larger foundation footprints will likely require reduced net allowable soil bearing pressures to reduce risk for potential settlement.

Excavations for fill extending below the bottom of foundation elevation should extend laterally beyond all edges of the foundation at least 8 inches per foot of fill depth below the foundation base elevation. The excavation should be backfilled to the foundation base elevation in accordance with the recommendations presented in this report.

Footings should be proportioned to reduce differential foundation movement. As discussed, total movement resulting from the assumed structural loads is estimated to be on the order of about 1 inch. Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction and throughout the life of the structure. Failure to maintain the proper drainage as recommended in the **Grading and Drainage** section of the **Earthwork** section of this report will nullify the movement estimates provided above.

Spread Footings – Construction Considerations

Groundwater water and potentially unstable sand soils could be encountered in foundation excavations. To help provide a relatively stable base for construction and foundation support, we recommend foundations be placed on at least 12 inches of washed rock. Washed rock meeting the specifications of ASTM C33, Size No. 57 or 67 or other approved materials can be used for this application. Washed rock should be placed in maximum 6-inch lifts and densified with a vibratory compactor. More extensive stabilization efforts (such as a greater thickness of washed rock and/or the use of geosynthetics) may be needed if the excavation is not properly dewatered and/or if highly unstable soils are encountered in the excavation.

Spread footing construction should only be considered if the estimated foundation movement can be tolerated. Subgrade soils 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 should be observed by the Geotechnical Engineer 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 the Geotechnical Engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

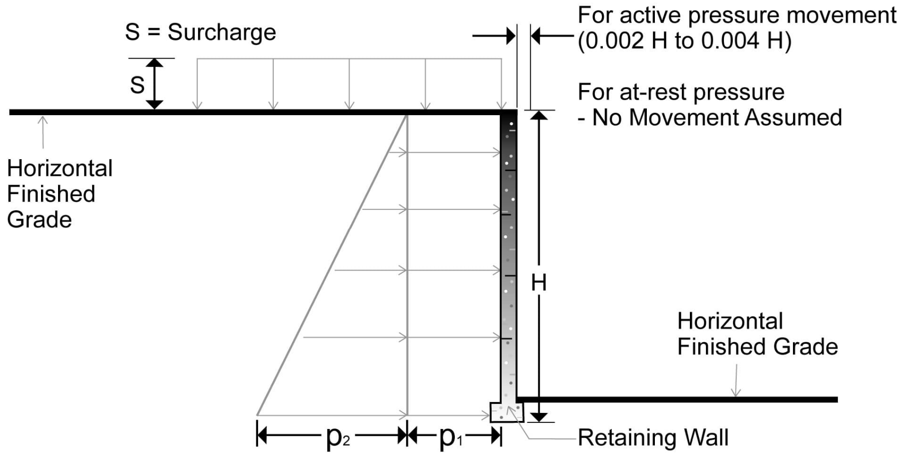
SEISMIC CONSIDERATIONS

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 24½ 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.

BELOW-GRADE STRUCTURES

Lateral Earth Pressures

Below-grade structures or reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Earth Pressure Coefficients

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Granular - 0.33	40	(0.33)S	(40)H
	Lean Clay - 0.42	50	(0.42)S	(50)H
At-Rest (Ko)	Granular - 0.50	60	(0.50)S	(60)H
	Lean Clay - 0.59	70	(0.59)S	(70)H
Passive (Kp)	Granular - 3.0	360	---	---
	Lean Clay - 2.37	285	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted to at least 95 percent of standard Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included
- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.57 should be used as the ultimate coefficient of friction between the footing and the underlying washed rock.

To control hydrostatic pressure behind the walls, we recommend that a drain be installed at the foundation wall with a collection pipe leading to a reliable discharge. If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 85 and 95 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment, or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

CORROSIVITY

Results of water-soluble sulfate testing indicate Exposure Class S0 according to ACI 318 – Building Code Requirements for Structural Concrete. ASTM Type I or II portland cement can be specified for all project concrete on and below grade. Foundation concrete can be designed for low sulfate exposure in accordance with the provisions of the ACI 318, Chapter 4.

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. 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

Contents:

Note: Refer to each individual Attachment for a listing of contents.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

The field exploration program consisted of the following:

Number of Borings	Boring Depth (feet)	Location
2 (B-1 and B-2)	19.3 to 24.3	Planned location of the culverts

Boring Layout and Elevations: Terracon personnel provided the boring layout. Coordinates of the boring locations were obtained with a handheld GPS unit (estimated horizontal accuracy of about +/-20 feet). A ground surface elevation at each boring location was obtained by Terracon by interpolation from a site specific, surveyed topographic map.

Subsurface Exploration Procedures: We advanced the soil borings with a truck-mounted drill rig using continuous-flight, solid-stem augers. Soil sampling was performed using standard split-barrel and modified California 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 log 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. A bulk sample of material from auger cuttings from the upper 4 feet of Boring B-2 was collected for sulfate testing. Bulk samples of material excavated from the upper 3 feet around Boring B-1 and from a location approximate 35 to 40 feet due east from the location of Boring B-2 on the east side of the existing roadway were collected for R-values.

In addition, we observed and recorded groundwater levels during and at the completion of drilling operations.

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 of the subsurface conditions at the boring location based on field data, observation of the samples, and laboratory test results.

We backfilled Boring B-1 with auger cuttings and pea gravel upon completion of drilling. Boring B-2 was backfilled with pea gravel below a depth of about 10 feet and flowable fill above a depth of about 10 feet after completion. Pavement was patched with cold-mix asphalt at the location of Boring B-2. Our services did not include repair of the site beyond backfilling our boreholes and patching existing pavements. Excess auger cuttings were dispersed in the general vicinity of the boreholes at the site.

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. 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 judgement. Testing was performed under the direction of a geotechnical engineer and included the following:

- Visual classification
- Moisture content
- Dry density
- Atterberg limits
- Grain-size analysis
- One-dimensional swell
- R-value
- 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). Bedrock samples obtained were classified using locally accepted practices for engineering purposes.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Culverts for 95th Street Reconstruction ■ Boulder County, Colorado
January 23, 2023 ■ Terracon Project No. 22215058A

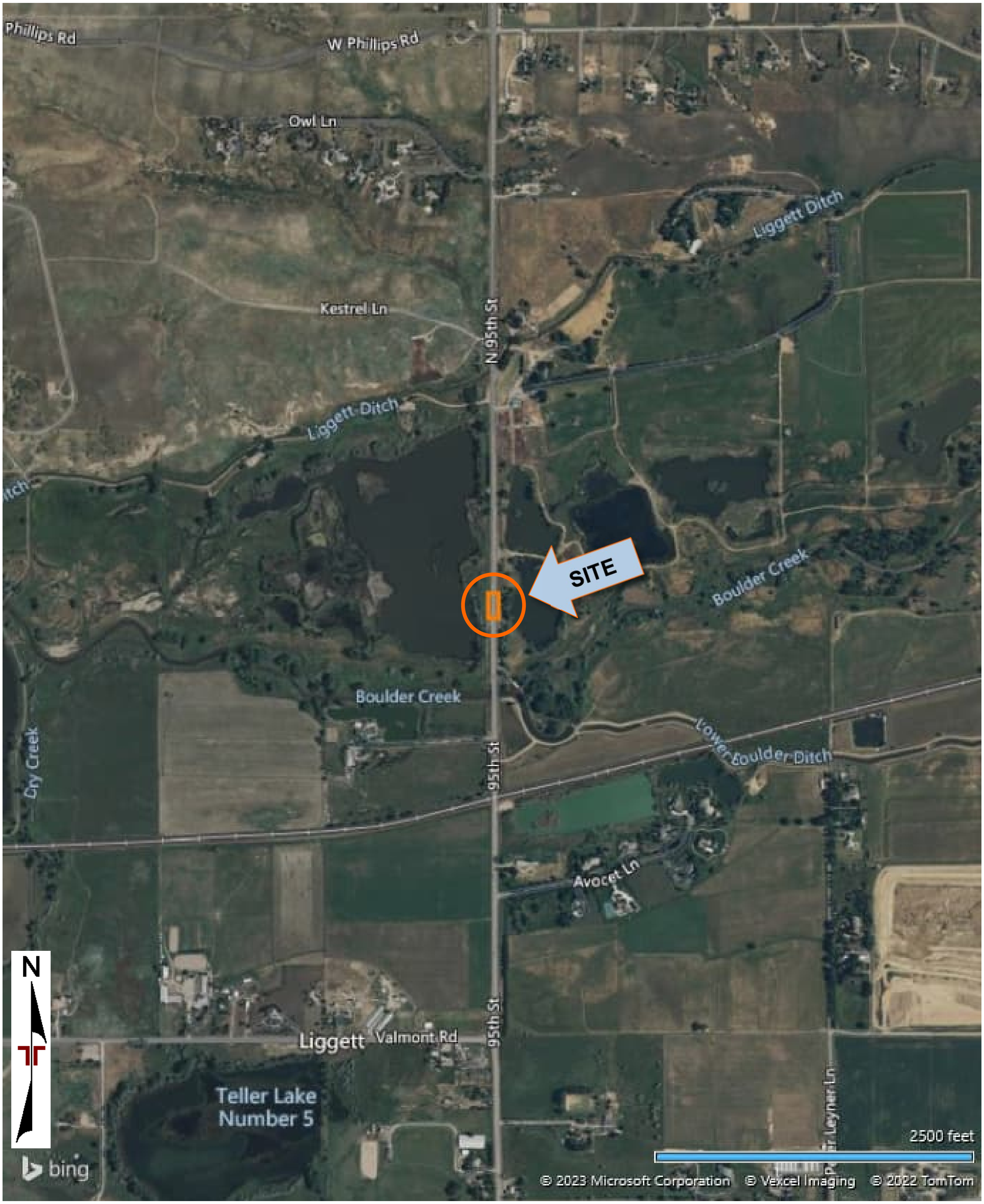


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Culverts for 95th Street Reconstruction ■ Boulder County, Colorado
January 23, 2023 ■ Terracon Project No. 22215058A

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

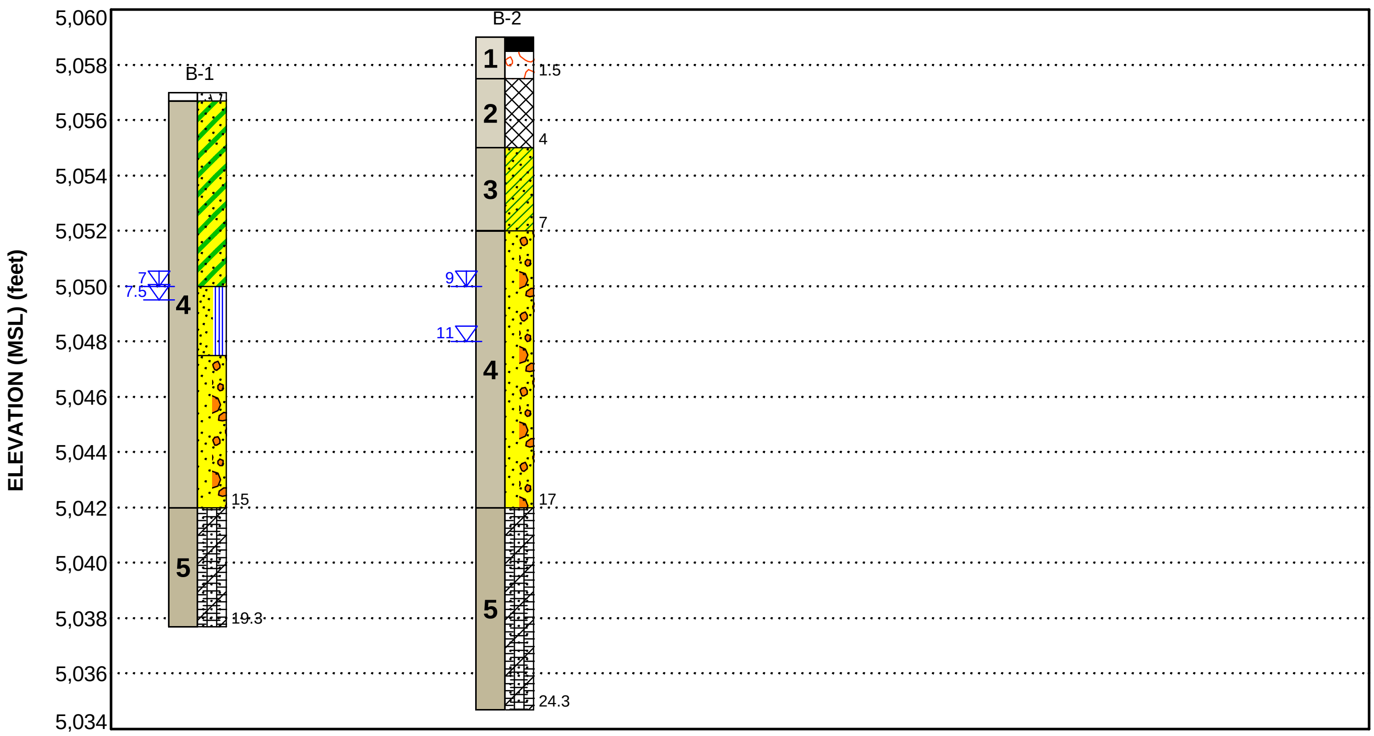
Contents:

Note: All attachments are one page unless noted above.

GEOMODEL

Culverts for 95th Street Reconstruction - Revised Locations ■ Boulder County, Colorado
Terracon Project No. 22215058A

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Pavement Section	About 6 inches of asphalt over about 12 inches of aggregate base course.
2	Existing Fill	Consisted of poorly graded sand with varying amounts of gravel; tan, brown.
3	Clay	Stiff sandy lean clay; varies to clayey sand; dark brown, brown.
4	Sand	Loose to very dense sand with varying amounts of clay, silt, and gravel; dark brown, brown, orange brown, tan, grayish brown, light gray.
5	Bedrock	Very hard sandy claystone/siltstone bedrock; gray, dark gray.

LEGEND

- Vegetative Soil
- Poorly-graded Sand with Gravel
- Aggregate Base Course
- Clayey Sand
- Sandy Claystone/Siltstone
- Fill
- Poorly-graded Sand with Silt
- Asphalt
- Sandy Lean Clay

- First Water Observation
- Second Water Observation

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

BORING LOG NO. B-1

PROJECT: Culverts for 95th Street Reconstruction - Revised Locations

CLIENT: J-U-B ENGINEERS, Inc. Fort Collins, Colorado

SITE: 95th Street North of Boulder Creek Boulder County, Colorado

LOCATION See Exploration Plan

Latitude: 40.0496° Longitude: -105.1314°

Approximate Surface Elev.: 5057 (Ft.) +/-

MODEL LAYER	DEPTH	Material Description	ELEVATION (Ft.)	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
4	0.3	**VEGETATIVE SOIL**, dark brown, about 2 to 3 inches thick	5056.7+/-									
		CLAYEY SAND (SC), varies to Sandy Lean Clay, dark brown to brown, with some orange brown, medium dense					8-10 18/12"	+0.7/500	9.9	96	29-18-11	45
				5			5-5-6 N=11		18.0			
	7.0		5050+/-									
		POORLY GRADED SAND WITH SILT, trace gravel, fine grained, brown to dark brown, loose					7-5 12/12"					
							4-3-2 N=5		22.9			
	9.5		5047.5+/-									
		POORLY GRADED SAND, with varying amounts of gravel and clay, fine to coarse grained, tan to brown, and grayish brown, medium dense to very dense		10			7-12-16 N=28		13.8			
		...with larger gravel and possible cobbles below about 14 feet					50/1"		15.0			
	15.0		5042+/-	15								
5		**SANDY CLAYSTONE/SILTSTONE**, gray to dark gray, very hard										
	19.3		5037.7+/-				50/4"		20.9			

Boring Terminated at 19.3 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification of rock estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:
4-inch outside diameter, continuous-flight, solid-stem augers

Abandonment Method:
Boring backfilled with auger cuttings and pea gravel upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

- 7.5 feet while drilling
- 7 feet at completion of drilling
- 7 feet at completion of drilling

Terracon
1831 Lefthand Cir Ste B
Longmont, CO

Boring Started: 12-20-2022	Boring Completed: 12-20-2022
Drill Rig: CME-55 Truck	Driller: Terracon
Project No.: 22215058A	

BORING LOG NO. B-2

PROJECT: Culverts for 95th Street Reconstruction - Revised Locations

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, Colorado

SITE: 95th Street North of Boulder Creek
Boulder County, Colorado

LOCATION See Exploration Plan

Latitude: 40.0494° Longitude: -105.1312°

Approximate Surface Elev.: 5059 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)
1	0.5	**ASPHALT**, about 6 inches thick	5058.5+/-
1	1.5	**AGGREGATE BASE COURSE**, about 12 inches thick	5057.5+/-
2	4.0	**FILL - POORLY GRADED SAND**, trace gravel, tan to brown	5055+/-
3	7.0	**SANDY LEAN CLAY**, varies to Clayey Sand, dark brown to brown, stiff	5052+/-
4	17.0	**POORLY GRADED SAND**, with varying amounts of gravel and clay, fine to coarse grained, brown to orange brown, medium dense to dense ...with light gray below about 9 feet ...very dense below about 14 feet	5042+/-
5	24.3	**SANDY CLAYSTONE/SILTSTONE**, gray to dark gray, very hard	5034.7+/-

Boring Terminated at 24.3 Feet

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
2			14-12 26/12"		3.9			
4			6-8 14/12"		12.9	118		
7			15-17 32/12"		3.6			
9	∇		11-17-22 N=39		8.8			
11	∇							
14			22-25-32 N=57		7.2			
19			50/3"		20.4			
24			50/3"		11.3			

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification of rock estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:
4-inch outside diameter, continuous-flight, solid-stem augers

Abandonment Method:
Boring backfilled with flowable fill above 10'; backfilled with pea gravel below 10'.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

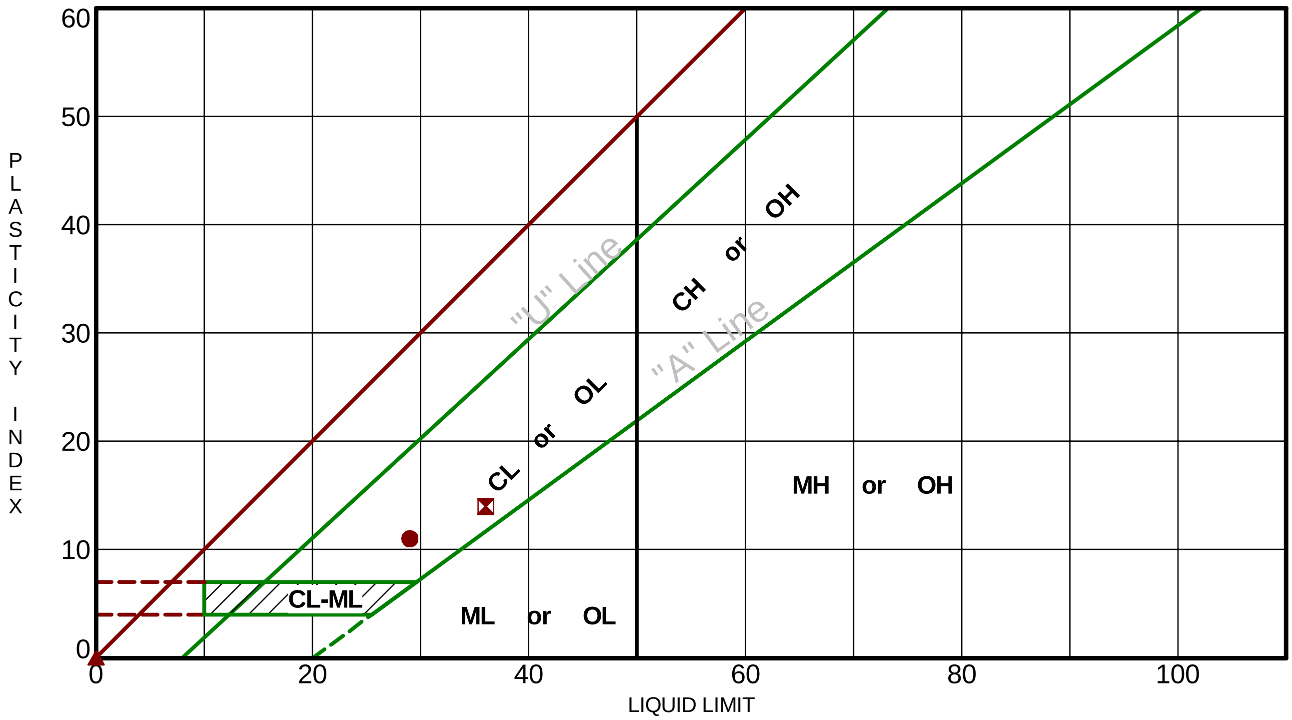
- ∇ *11 feet while drilling*
- ∇ *9 feet at completion of drilling*

Terracon
1831 Lefthand Cir Ste B
Longmont, CO

Boring Started: 12-20-2022	Boring Completed: 12-20-2022
Drill Rig: CME-55 Truck	Driller: Terracon
Project No.: 22215058A	

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
● B-1	2 - 3	29	18	11	44.9	SC	CLAYEY SAND
⊠ B-1 Bulk	0.5 - 2	36	22	14	54.4	CL	SANDY LEAN CLAY
▲ B-2 Bulk	0.5 - 2	NP	NP	NP	19.8	SM	SILTY SAND

PROJECT: Culverts for 95th Street Reconstruction - Revised Locations

SITE: 95th Street North of Boulder Creek Boulder County, Colorado

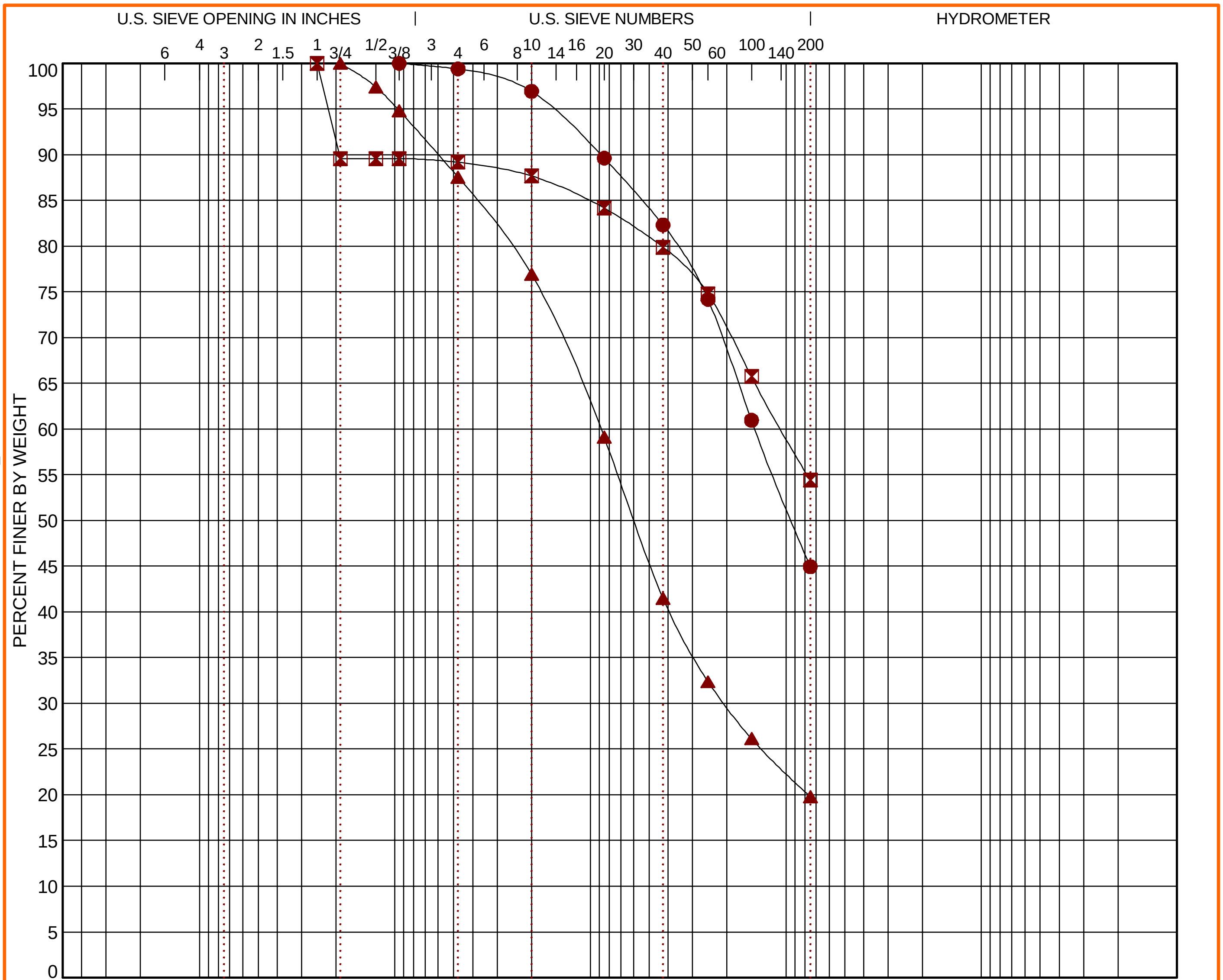
Terracon
1831 Lefthand Cir Ste B
Longmont, CO

PROJECT NUMBER: 22215058A

CLIENT: J-U-B ENGINEERS, Inc. Fort Collins, Colorado

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-1	2 - 3	CLAYEY SAND (SC)	A-6 (2)	9.9	29	18	11		
⊠	B-1 Bulk	0.5 - 2	SANDY LEAN CLAY (CL)	A-6 (5)	13.5	36	22	14		
▲	B-2 Bulk	0.5 - 2	SILTY SAND (SM)	A-1-b (0)	6.6	NP	NP	NP		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-1	2 - 3	9.5	0.144			0.6	54.5		44.9	
⊠	B-1 Bulk	0.5 - 2	25	0.106			10.8	34.8		54.4	
▲	B-2 Bulk	0.5 - 2	19	0.886	0.206		12.4	67.8		19.8	

PROJECT: Culverts for 95th Street
Reconstruction - Revised Locations

SITE: 95th Street North of Boulder Creek
Boulder County, Colorado

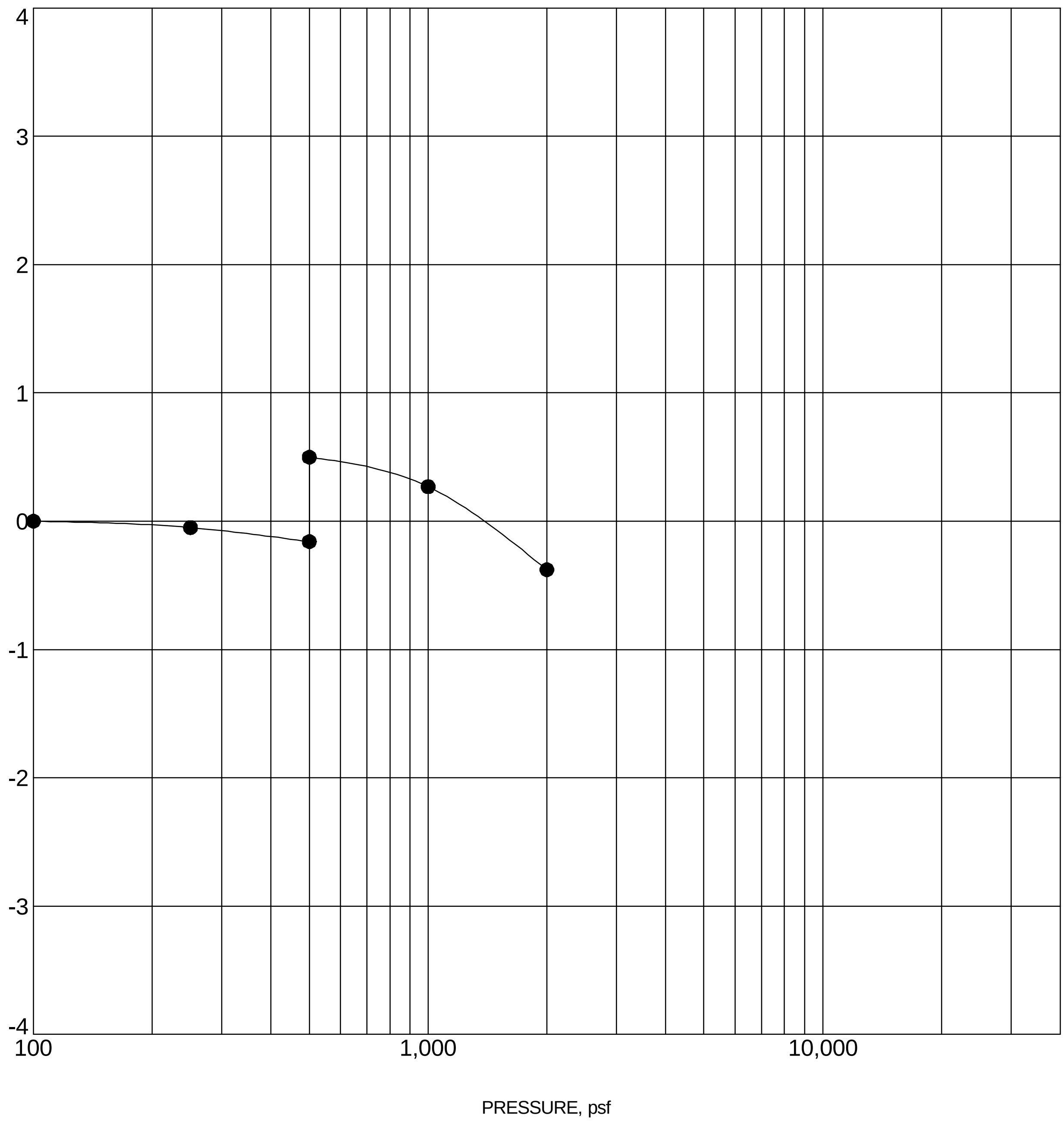
Terracon
1831 Lefthand Cir Ste B
Longmont, CO

PROJECT NUMBER: 22215058A

CLIENT: J-U-B ENGINEERS, Inc.
Fort Collins, Colorado

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS & AASHTO DESC COMBINED 22215058A CULVERTS FOR 95TH.GPJ TERRACON_DATATEMPLATE.GDT 1/6/23

SWELL CONSOLIDATION TEST



Specimen Identification		Classification	γ_d, pcf	WC, %
●	B-1 2 - 3 ft	CLAYEY SAND(SC)	96	9.9

NOTES: Sample exhibited 0.7 percent swell upon wetting under an applied pressure of 500 psf.

PROJECT: Culverts for 95th Street Reconstruction - Revised Locations

SITE: 95th Street North of Boulder Creek Boulder County, Colorado

Terracon
1831 Lefthand Cir Ste B
Longmont, CO

PROJECT NUMBER: 22215058A

CLIENT: J-U-B ENGINEERS, Inc. Fort Collins, Colorado

Terracon

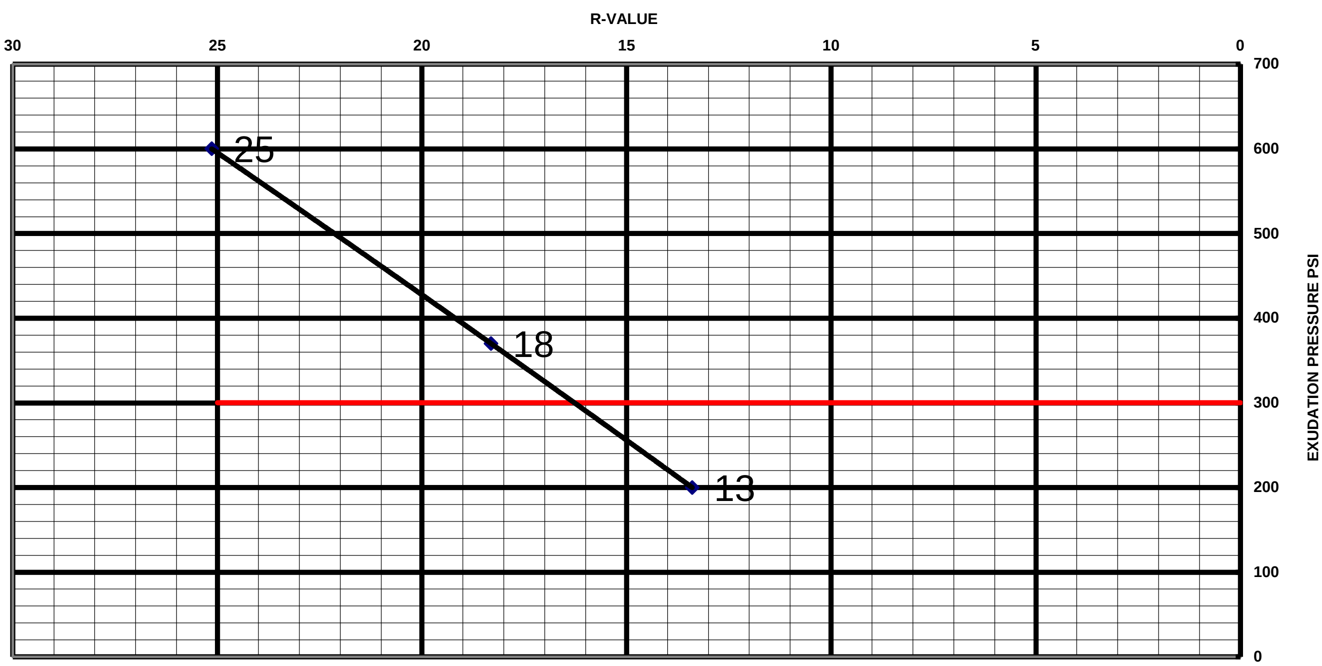
Terracon Project No.: 22215058A
Date. 1/9/2023

RESISTANCE R-VALUE & EXPANSION PRESSURE OF COMPACTED SOIL (ASTM D2844)

CLIENT: J-U-B Engineers, Inc
PROJECT Culverts for 95th Street Reconstruction - Revised Locations
LOCATION: Boulder County, Colorado
R-VALUE # : Bulk 1 @ 0.5' to 3' (Sandy Lean Clay; Bulk sample collected from area around Boring B-1)

	A	B	C	D
COMPACTOR AIR PRESSURE P.S.I.	125	200	275	
INITIAL MOISTURE %	13.9	13.9	13.9	
WATER ADDED, ML	60	50	40	
WATER ADDED %	6.6	5.4	4.2	
MOISTURE AT COMPACTION %	20.5	19.3	18.1	
HEIGHT OF BRIQUETTE	2.55	2.55	2.55	
WET WEIGHT OF BRIQUETTE	1036	1060	1076	
DENSITY LB. PER CU.FT.	102.2	105.6	108.2	
STABILOMETER PH AT 1000 LBS.	52	48	41	
2000 LBS.	127	117	105	
DISPLACEMENT	4.20	4.10	3.90	
R-VALUE	13	18	25	
EXUDATION PRESSURE	200	370	600	
THICK. INDICATED BY STAB.	0.00	0.00	0.00	
EXPANSION PRESSURE	20	31	51	
THICK. INDICATED BY E.P.	0.67	1.03	1.70	

EXUDATION CHART



R-Value: **16**

Terracon

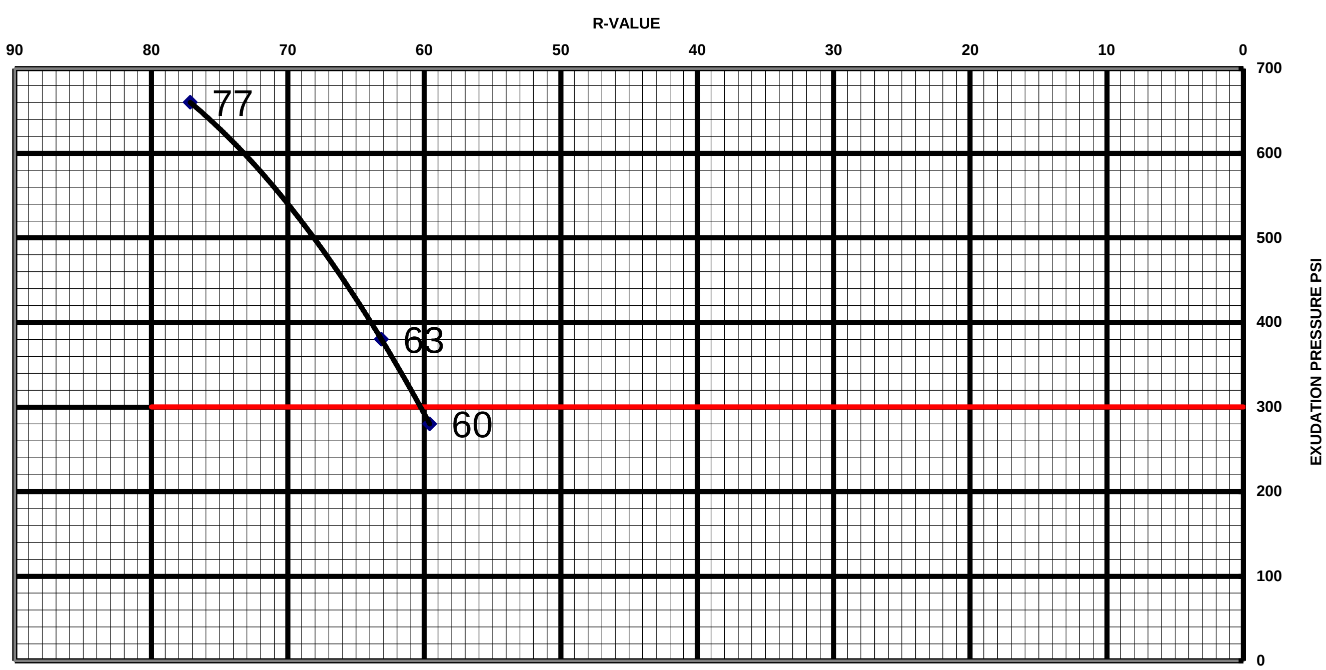
Terracon Project No.: 22215058A
Date: 1/9/2023

RESISTANCE R-VALUE & EXPANSION PRESSURE OF COMPACTED SOIL (ASTM D2844)

CLIENT: J-U-B Engineers, Inc
PROJECT Culverts for 95th Street Reconstruction - Revised Locations
LOCATION: Boulder County, Colorado
R-VALUE # : Bulk 2 @ 0.5' to 3' (Silty Sand; Combined bulk sample from area due east of Boring B-2 about 35 to 40 feet on east side of existing roadway)

	A	B	C	D
COMPACTOR AIR PRESSURE P.S.I.	350	350	350	
INITIAL MOISTURE %	6.0	6.0	6.0	
WATER ADDED, ML	20	15	10	
WATER ADDED %	1.8	1.3	0.9	
MOISTURE AT COMPACTION %	7.8	7.3	6.9	
HEIGHT OF BRIQUETTE	2.50	2.50	2.50	
WET WEIGHT OF BRIQUETTE	1189	1188	1187	
DENSITY LB. PER CU.FT.	133.7	134.1	134.6	
STABILOMETER PH AT 1000 LBS.	25	24	17	
2000 LBS.	46	42	25	
DISPLACEMENT	4.20	4.10	4.00	
R-VALUE	60	63	77	
EXUDATION PRESSURE	280	380	660	
THICK. INDICATED BY STAB.	0.00	0.00	0.00	
EXPANSION PRESSURE	0	3	15	
THICK. INDICATED BY E.P.	0.00	0.10	0.50	

EXUDATION CHART



R-Value: **60**

Client

J-U-B ENGINEERS, Inc.
Fort Collins, CO

Project

Culverts for 95th Street Reconstruction - Revised Locations
22215058A

Date Received: 12/30/2022

Results from Corrosion Testing

Sample Location	B-2
Sample Depth (ft.)	1.5'-4.0'
Water Soluble Sulfate (SO4), ASTM C 1580 (ppm)	12

Analyzed By: ChrisAnne Ross
Field Geologist

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Culverts for 95th Street Reconstruction - Revised Locations ■ Boulder County, Colorado

Terracon Project No. 22215058A

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Auger Cuttings Modified California Ring Sampler Standard Penetration Test	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** **Cave In Encountered** 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.	**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 as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. 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 - 5	Very Soft	less than 500	0 - 1	< 3	< 24	< 20	Soft
Loose	4 - 9	6 - 14	Soft	500 to 1,000	2 - 4	3 - 5	24 - 35	20 - 29	Firm
Medium Dense	10 - 29	15 - 46	Medium Stiff	1,000 to 2,000	4 - 8	6 - 10	36 - 60	30 - 49	Medium Hard
Dense	30 - 50	47 - 79	Stiff	2,000 to 4,000	8 - 15	11 - 18	61 - 96	50 - 79	Hard
Very Dense	> 50	≥ 80	Very Stiff	4,000 to 8,000	15 - 30	19 - 36	> 96	>79	Very Hard
			Hard	> 8,000	> 30	> 36			

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: 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 $[Cc<1$ 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 $[Cc<1$ 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" 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 / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					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 / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					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] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 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 ≥ 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 ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

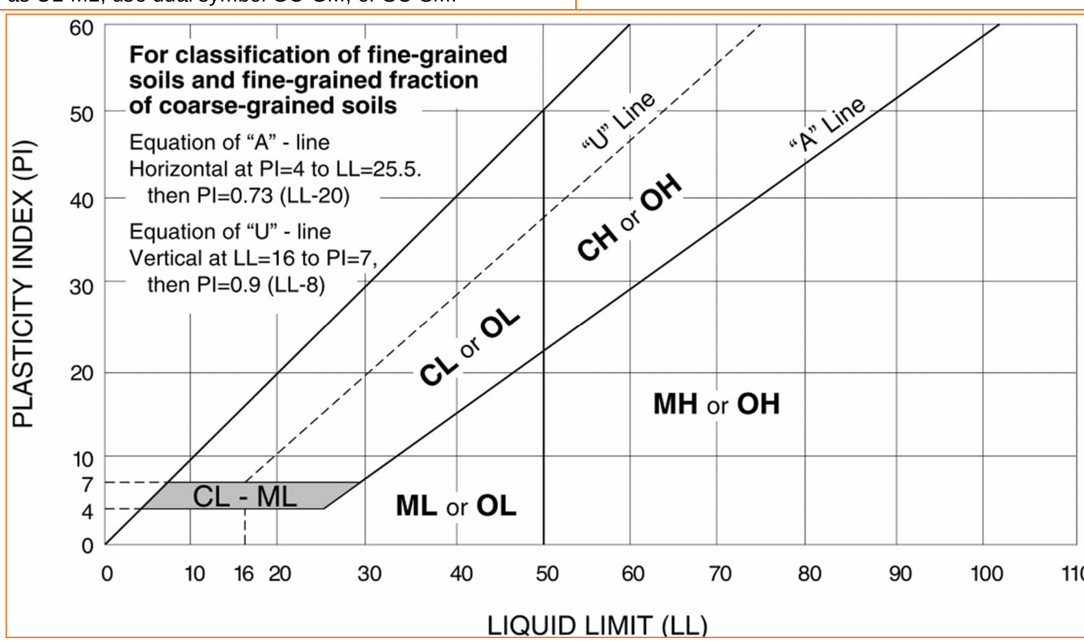
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



AECOM

95th Street Project

Pavement Rehabilitation Study
Boulder County, CO

Project Number: 60492318

January 24, 2017

Quality information

Prepared by	Checked by	Approved by
Jonathan Gould, PE Senior Pavement Engineer		

Revision History

Revision	Revision date	Details	Authorized	Name	Position

Distribution List

# Hard Copies	PDF Required	Association / Company Name

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Table of Contents

Figures

Tables

Executive Summary

AECOM was tasked with providing pavement engineering services to the Boulder County Department of Transportation, CO in order to develop a recommendation for the rehabilitation 95th Street project south of Mineral Road (Highway 52) to the City of Lafayette. The scope of this project was to provide geotechnical investigation, consisting of Ground Penetrating Radar (GPR) survey to collect pavement thickness data, and to progress a pavement study to provide recommendations for the rehabilitation of 95th Street, starting from the northern limits of the City of Lafayette and continuing northerly to the intersection with Mineral Road (Highway 52). The length of this section is approximately 4.2 miles, as shown in Figure A1 (Appendix A), excluding a section of 95th Street from Isabelle Road to Valmont Road, which is designated as a "Project By Others".

The present pavement rehabilitation study references the recently completed report entitled *Geotechnical and Pavement Sections, 95th Street – 2017 Reconstruction Project, Boulder County, CO* dated August 10, 2016, as prepared by Ground Engineering (Appendix B), as well as the letter report entitled RE: *Ground Penetrating Radar, 95th Street, State Highway 52 to Louisville City Limits, Boulder, CO*, dated December 30, 2016, as prepared by Ground Engineering (Appendix E).

The AECOM project team completed an enhanced pavement evaluation of 95th Street, including a visual condition review, evaluation of previously completed geotechnical testing, and analysis of traffic counts, and has developed pavement rehabilitation recommendations for a 20-year design life. In addition, a sensitivity analysis was performed based on variations in pavement design life, and consideration was given to both cost-effective alternatives and sustainability through re-use of and reliance on existing materials in the design process.

The visual condition review and rating of the existing pavement conditions on the 95th Street project was completed based upon identification of distress types and severities in partial conformance to ASTM D6433 - Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys, and the general distresses shown in Table ES1 below were identified. Figure A1 (Appendix A) depicts the grouping of the pavement condition areas listed.

Table ES 1 - Pavement Condition Review

Roadway Area	Distress	Estimated PCI	HMA Coefficient
A	Light Longitudinal & Transverse (L&T) and Block Cracking	80	0.352
B	Minimal Signs of Distress, Pavement in Good Condition	90	0.396
C	Moderate L&T and Block Cracking	65	0.286
D	Moderate L&T, Block Cracking, and Light rutting (SB)	65	0.286
E	Minimal Signs of Distress, Pavement in Good Condition	90	0.396

For purposes of pavement design sectioning, the 95th Street roadway project was segment into four (4) distinct locations based on the existing roadway conditions, as derived from the visual ratings, the traffic distribution, and the geotechnical investigation results. The details of the existing pavement sectioning are depicted in Table ES2, where the assigned stationing starts at 10+00 and runs from north to south (direction). The stationing corresponds to the original Ground Engineering Reconstruction Report and not current design plan stationing.

Table ES 2 - Sectioning of Existing Pavement

Location	STA	Average HMA Thickness (in)	Subgrade AASHTO Classification (Typ.)
1	10+00 to 85+00	6.9	A-7
2	85+00 to 100+00	6.1	A-7
3	100+00 to 175+00	6.6	A-6
4	175+00 to 250+00	6.9	A-6

Based on the sectioning of the 95th Street project pavement alignment, a summary of the results of the DARWin pavement design requirements and recommended sections are depicted in Table ES3.

Table ES 3 - Pavement Design Summary by Segment Location

Location	½" Surface Course (SX) (in)	½" Intermediate Course (SX) (in)	#4 Leveling Course (SF) (in)	Existing HMA (unmilled, in)	Subgrade (in)	Req'd SN	Design SN
1	2.0	2.0	0.75	6.9	12.0	4.16	4.48
2	2.0	3.0	0.75	6.1	12.0	4.16	4.27
3	2.0	2.0	0.75	6.6	12.0	3.74	4.02
4	2.0	2.0	0.75	6.9	12.0	3.74	3.92

Two (2) pavement design alternatives have been developed for the rehabilitation of this roadway, and they include Resurfacing and Full Depth Reconstruction.

A. Resurfacing shall consist of a levelling course, followed by a two-lift structural overlay. The leveling course would correct any existing cross-slope problems and rutted areas, and would provide a fine-grained high-asphalt interlayer to help retard reflective cracking. Any existing crack and joint sealants would be maintained. The two-lift structural overlay would provide the structural support necessary for a 20-year design life.

   Surface preparation utilizing partial depth patching and milling options are also provided.

B. Full Depth Reconstruction shall be completed in areas where existing pavement finished grades cannot be effectively raised from geometric or cost concerns. It is not anticipated that this design option will be economically feasible due to increased project costs and schedule implications, but a pavement design section has been provided.

95th Street is a good candidate for **rehabilitation through resurfacing** which will provide: 1) a restored long-lasting asphalt surface; 2) an improved roadway subbase (in areas of partial depth patching); and 3) improved drainage by increasing the roadway profile.

AECOM recommends that the Boulder County Department of Transportation proceed with the resurfacing option (A) that consists of partial depth patching, transition milling, levelling, and a two-lift structural overlay to provide a 20-year design life.

PROJECT BACKGROUND

The scope of this project was to provide geotechnical investigation, consisting of Ground Penetrating Radar (GPR) survey to collect pavement thickness data, and to perform a pavement study to provide recommendations for the rehabilitation of 95th Street in Boulder County, CO, starting from the the intersection with Mineral Road (Highway 52) and proceeding southerly to the Lafayette city limits. The length of this section is approximately 4.2 miles as shown in Figure A1 (Appendix A). A section of 95th Street from Isabelle Road to Valmont Road, which is designated as a project by others, has been excluded from the study and the aforementioned length.

The segment of 95th Street primarily consists of a two-lane asphalt-surfaced roadway that currently services several residential structures, agricultural land, and vacant undeveloped land. The direction of travel is primarily north-south. There are turn lanes associated with Lookout Road and State Highway 52. The roadway is fairly flat north of Lookout Road, becoming more rolling as it descends south to Boulder Creek with a steep drop in elevation by the Farm in Boulder Valley. A section of roadway has been recently reconstructed at the Boulder Creek Crossing. Visually, the roadway presently exhibits moderate pavement distress with linear block cracking, and longitudinal and transverse cracking observed. Maintenance practices such as crack sealing and preventative maintenance treatments have historically been applied by the County. Underground and overhead utilities were also present within the existing right-of-way.

The present pavement rehabilitation study referenced the recently completed report entitled *Geotechnical and Pavement Sections, 95th Street – 2017 Reconstruction Project, Boulder County, CO* dated August 10, 2016, as prepared by Ground Engineering (Appendix B). That report contained details of the subsurface investigation and geotechnical testing performed in support of pavement reconstruction design recommendations.

AECOM's pavement design analysis has incorporated the results of previous studies and reports in conjunction with updated analysis of previous raw data and updated pavement thickness data through additional ground penetrating radar (GPR) to provide a section-by-section (micro level) analysis in order to optimize the pavement designs and minimize the potential costs to the County.

TRAFFIC ANALYSIS

For purposes of the pavement study, 95th Street was classified as a Minor Arterial Roadway in accordance with the Boulder County Road Map Classification. AECOM relied on traffic count information for 95th Street provided by others. The data was collected over various dates ranging between July 15 and July 28, 2015, and included both single-day as well as weekly counts. Five (5) separate count stations were reviewed. The detailed data for count stations included a 13-vehicle classification count that accounted for the traffic's directional distribution, speed, vehicle classification, and volume. Table 1 provides the distribution of truck traffic in the design direction.

Table 1 - Trucks in Design Direction

Traffic Count Station	% Traveling NB	% Traveling SB
104	49.9	50.1
105	51.0	49.0
237	50.4	49.6
252	51.2	48.8
385	50.5	49.5

The analysis for the traffic count stations showed an Average Daily Traffic (ADT) ranging between 7,972 and 8,843, with and average ADT of 8,313. This average was based upon a combination of three-day mid-week counts and seven day weekly counts. For the weekly counts, the range was 20,876 to 22,144, with a corresponding daily average of 3,072. Refer to Appendix C for the detailed traffic analysis and for the raw data files.

The AASHTO pavement design process uses traffic information in the design calculations by converting traffic data into Equivalent Single Axle Loads (ESALs). This ESAL factor relates various axle load combinations to a standard 80 kN (18,000 lbs) single axle load. AECOM utilized the Colorado Department of Transportation (CDOT) Pavement Design Manual, which assigns a 3-bin vehicle classification system, to determine the equivalency factors for each classification shown in Table 2 below:

Table 2 - Colorado DOT ESAL Equivalency Factors

3-Bin Vehicle Classification	Flexible Pavement
Passenger Cars and Pickup Trucks	0.003
Single Unit Trucks	0.249
Combination Trucks	1.087

Traffic volume and classification are a component to the roadways structural requirements second only to subgrade support. Overestimating the traffic volumes can provide an exponential increase to the roadway's required structural requirements. The three-day averages for the length of the roadway were similar at all five traffic count locations. AECOM thus utilized the weekly count locations to derive the design ADT for the entire project.

When available, weekly traffic volumes are more representative for what the pavement will see over its life taking into consideration Friday-Monday traffic volumes. Tuesday through Thursday counts are more appropriate for traffic congestion and traffic signal simulations due to the high volumes at peak hour on the peak days.

The design two-way ESALs over the 20-year pavement design life were determined to be 673,546.

GEOTECHNICAL INVESTIGATION

Detailed subsurface exploration in support of the design of pavement rehabilitation of 95th Street was previously completed and is referenced in the report entitled *Geotechnical and Pavement Sections, 95th Street – 2017 Reconstruction Project, Boulder County, CO* dated August 10, 2016, as prepared by Ground Engineering (see Appendix B). The subsurface exploration for the project was conducted in December 2011 and July 2016. There were a total of 45 test holes drilled. Twenty-eight (28) were completed in December 2011 within the northern stretch from Highway 52 south to the bridge at Boulder Creek. An additional seventeen (17) test holes were drilled in 2016, south of Boulder Creek to the northern city limits of Lafayette. The test holes extended to depths of approximately 5 to 10 feet below existing grades.

Soil samples were obtained from the site, and examined and visually classified in the laboratory. Laboratory testing of samples included standard property tests, such as natural moisture contents, dry unit weights, grain size analyses, liquid and plastic limits, swell-consolidation testing, soil corrosivity, and water-soluble sulfate contents. Resilient modulus tests were also performed on the composite bulk samples obtained from the auger cuttings. Groundwater was encountered in a few of the test holes at a depth of approximately 7 feet below existing grades. Detailed results from the laboratory-testing program are contained in the report attached to Appendix B.

The subsurface conditions encountered generally consisted of approximately 5 to 7 inches of asphalt underlain by sand and/or clay/silt. Road gravel base, approximately 6 inches thick, was also observed underlying the asphalt in a few of the test holes; however, the presence of ABC base was determined to be inconsistent. The subgrade materials encountered consisted predominantly of fill and sands and clays. For the test holes completed in 2011, the materials were typically classified as A-2-4, A-4, A-6 and A-7-6 soils in accordance with the AASHTO classification system, with Group Index values ranging from 0 to 18. For the test holes completed in 2016, material classifications were typically A-1-b to A-6 soils, with Group Index values from 0 to 13 in the upper 4 feet. Resilient Modulus (MR) testing was performed on representative composite samples of the subgrade materials. According to the test results from 2016, resilient modulus values of 8,644 psi and 10,336 psi were determined for the on-site materials at optimum moisture content. A summary of the subgrade information obtained from the project site is provided in Appendix D.

For pavement design purposes, AECOM used the AASHTO soil classifications as guidance on the CBR converted to Resilient Modulus. These values are more detailed, ranging from 4,500 psi to 15,000 psi. These values bracket the subgrade soil test values from the combined bulk samples and were considered more applicable for use when designing at a section-by-section (micro) level.

Supplemental geotechnical investigation was performed in 2016 in the form of continuous pavement section thickness data collection for the 95th Street project using Ground Penetrating Radar (GPR). The results were presented in a letter RE: *Ground Penetrating Radar, 95th Street, State Highway 52 to Louisville City Limits, Boulder, CO*, dated December 30, 2016, as prepared by Ground Engineering (see Appendix E). Pavement thickness information was provided at 25-foot and 500-foot intervals.

A summary of the pavement thicknesses identified is provided in Table 3 below:

Table 3 - GPR Pavement Thickness Results

Pavement Section	Average Existing AC (in)	Maximum Thickness AC (in)	Minimum Thickness AC (in)	Standard Deviation
NB 95th from Louisville to SH 52	6.81	14.1	2.8	1.13
SB 95th from SH 52 to Louisville	6.77	13.5	3.4	1.10

PAVEMENT CONDITION RATING AND ROADWAY SECTIONING

AECOM performed a visual review and rating of the existing pavement conditions on the 95th Street project, and have identified the general distresses shown in Table 4. The visual condition review and rating of the existing pavement conditions on the 95th Street project was completed based upon identification of distress types and severities in partial conformance to ASTM D6433 - Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys, and the general distresses shown in Table ES1 below were identified.

Figure A1 (Appendix A) depicts the grouping of the pavement condition areas listed.

Table 4 - Pavement Condition Review

Roadway Area	Distress	Estimated PCI	HMA Coefficient
A	Light Longitudinal & Transverse (L&T) and Block Cracking	80	0.352
B	Minimal Signs of Distress, Pavement in Good Condition	90	0.396
C	Moderate L&T and Block Cracking	65	0.286
D	Moderate L&T, Block Cracking, and Light rutting (SB)	65	0.286
E	Minimal Signs of Distress, Pavement in Good Condition	90	0.396

For purposes of pavement design sectioning, the 95th Street roadway project was segment into four distinct locations based on the existing roadway conditions, as derived from the visual ratings, traffic distribution and the geotechnical investigation results. The details of the existing pavement sectioning are depicted in Table 5, where the assigned stationing starts at 10+00 and runs from north to south (direction).

Table 5 - Sectioning of Existing Pavement

Location	STA	Average HMA Thickness (in)	Subgrade AASHTO Classification (Typ.)
1	10+00 to 85+00	6.9	A-7
2	85+00 to 100+00	6.1	A-7
3	100+00 to 175+00	6.6	A-6
4	175+00 to 250+00	6.9	A-6

PAVEMENT DESIGNS

AECOM performed AASHTO 1993 layered-elastic designs through the use of DARWin 3.1 software, based on the traffic and material inputs outlined in previous sections, with a goal of providing a 20-year pavement design life. AASHTO DARWin 3.1 design output files are included with this report in Appendix F.

Design Inputs:

18-kip ESALs Over Initial Performance Period:	673,546[(1)]
Initial Serviceability:	4.2
Terminal Serviceability:	2.5
Reliability Level:	95%
Overall Standard Deviation:	0.44
Roadbed Soil Resilient Modulus:	Varies (see Table 6 below)
Stage Construction:	1

[(1)] Design Lane ESAL – weekly ADT counts.

Design Output:

Calculated Design Structural Number (SN): Varies (see Table 6 below)

Table 6 - Pavement Input and Design Parameters

Location	Subgrade AASHTO Classification	Roadbed Soil Resilient Modulus	Calculated Design SN
1	A-7	4,500	4.16
2	A-7	4,500	4.16
3	A-6	6,000	3.74
4	A-6	6,000	3.74

Table 7 identifies the typical coefficient values assigned to the subgrade soils based on the AASHTO classification system.

Table 7 - Subgrade Conversions

AASHTO Soil Classification	ASTM Soil Classification	Subgrade Coefficient	Drainage Coefficient	Resilient Modulus
A-1-a	SW	0.10	1.2	15,000
A-1-b	SP, SU, SC	0.06	1.0	7,500
A-2-4	SM	0.08	0.8	15,000
A-3	SM-ML	0.06	0.8	15,000
A-4	ML	0.04	0.4	7,500
A-5	CL	0.03	0.4	7,500
A-6	OL	0.02	0.4	6,000
A-7	MH, CH, OH	0.01	0.4	4,500

For the HMA material properties used in the proposed pavement design sections, Table 8 identifies the parameters assigned.

Table 8 - HMA Material Properties

Material Description	Structural Coefficient	Elastic Modulus
½" Surface Course (Grading (SX)	0.44	440,000
½" Intermediate Course (Grading SX)	0.44	440,000
#4 Leveling Course (Grading SF)	0.34	260,000

Table 9 below presents the correlation between the elastic modulus of pavement materials and the structural layer coefficient values, as used in the pavement design inputs.

Table 9 - Elastic Modulus Values

Structural Layer Coefficient	Elastic Modulus (psi)
0.28	180,000
0.30	200,000
0.32	225,000
0.34	260,000
0.36	290,000
0.38	325,000
0.40	365,000

PAVEMENT RECOMMENDATIONS

Based on the sectioning of the 95th Street project pavement alignment, and the constructible layer thicknesses provided in Table 6.6 of the CDOT 2017 Pavement Design manual, a summary of the results of the DARWin pavement design runs is depicted in Table 10.

Table 10 - Pavement Recommendations by Segment Location

Location	½" Surface Course (SX) (in)	½" Intermediate Course (SX) (in)	#4 Leveling Course (SF) (in)	Existing HMA (un-milled, in)	Subgrade (in)	Req'd SN	Design SN
1	2.0	2.0	0.75	6.9	12.0	4.16	4.48
2	2.0	3.0	0.75	6.1	12.0	4.16	4.27
3	2.0	2.0	0.75	6.6	12.0	3.74	4.02
4	2.0	2.0	0.75	6.9	12.0	3.74	3.92

Figure 1 provides a graphical summary of the required HMA overlay thicknesses along the project alignment when considering the following two factors:

1) Minimum required pavement for design life;
2) Minimum layer thicknesses for constructability per Table 6.6 of the CDOT 2017 Pavement Design Manual.

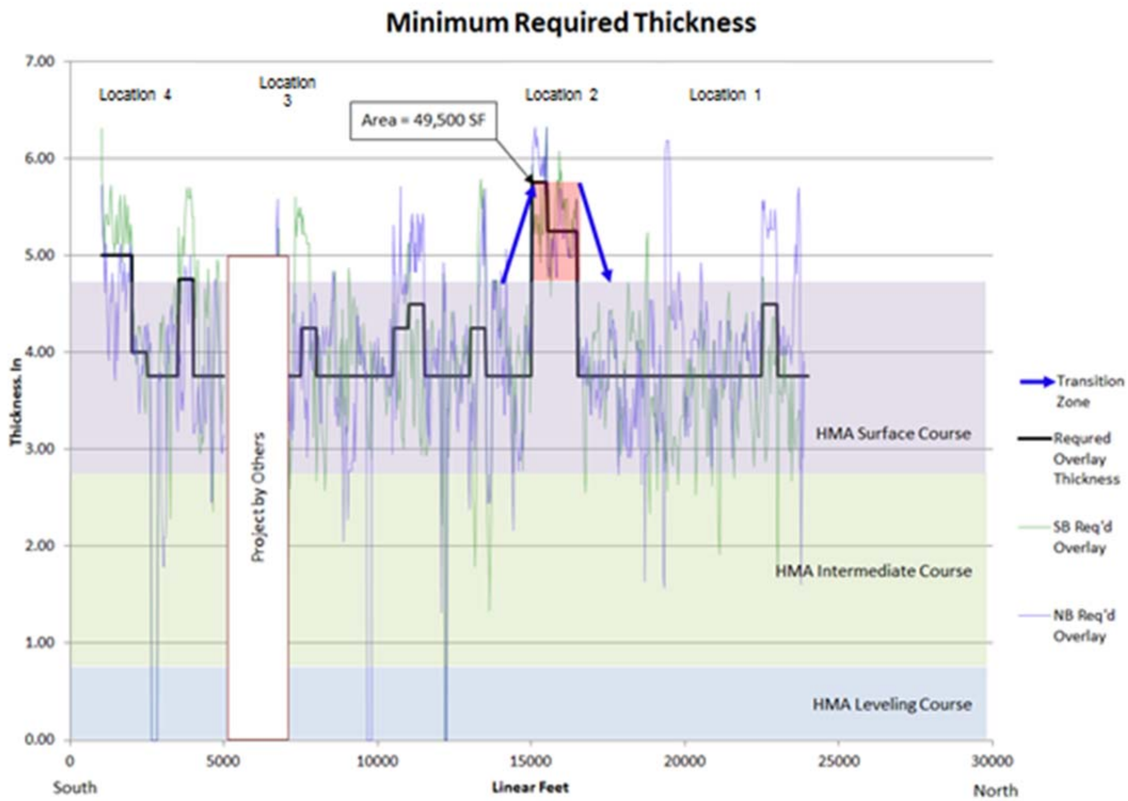

Figure 1. Required HMA Overlay Thickness by Location

A sensitivity analysis was performed on the overlay thickness requirements by varying the pavement design life between 5, 10, 15, and 20 years, and results are provided in Table 11. Essentially, most of the roadway can achieve 15+ years of design life with a 4-inch asphalt overlay, and 20 years with a 4.5-inch overlay. Location (Group) 2, however, would attain less than a 5-year design life with a 4-inch overlay, and between 5 and10 years life with a 4.5-inch overlay.

Table 11 - Minimum Required Overlay Thickness by Design life

Pavement Design Life (Yrs)	Location 1 (in)	Location 2 (in)	Location 3 (in)	Location 4 (in)
5	3.75	4.25	3.75	3.75
10	3.75	5.0	3.75	3.75
15	3.75	5.5	4.0	3.75
20	4.25	5.75	4.5	4.25

In consideration of the existing roadway conditions observed during the geotechnical investigations and field condition survey, AECOM has developed two (2) design approach alternatives for the rehabilitation of 95th Street pavements within the project limits, including the following:

A. Resurfacing:

Resurfacing is recommended for this roadway consisting of a 0.75" of #4 Levelling Course (SF) over the existing roadway pavement surface, followed by a two-lift structural overlay. See Table 10 for the proposed pavement design thicknesses by location.

The leveling course would correct any existing cross-slope problems and rutted areas in the pavement, and would provide a fine-grained high-asphalt interlayer to help retard reflective cracking. Any existing crack and joint sealants would be maintained, and additional sealing of existing cracks and joints may be warranted prior to the placement of the leveling course. This design would restore the roadway cross section and allow for increasing the roadway's grade to improve overall drainage characteristics.

The following surface preparation methods may be performed prior to levelling.

a. **Partial Depth Patching (PDP)** in areas where existing HMA is less than 5 inches thick as shown in Figure 2. The existing asphalt pavement would be sawcut and removed, or removed by milling. A proposed ¾" Superpave Base Course(s) (S) would be placed within the patch area prior to placement of a leveling course and structural overlay. In these areas, the proposed thickness of new HMA would match the existing asphalt thickness and would be placed in one or more lifts consisting of 2.25 to 3.50 inches over existing subbase/subgrade material.

   Removal of aged asphalt and replacement with new asphalt will result in an approximate increase in structural value by 1.5. For example, if the existing pavement thickness is 4 inches, then the new 4-inch layer performs as if it were 6 inches when compared to the adjacent aged pavement.

   This option is recommended in areas where the existing pavement thickness falls below 5 inches.

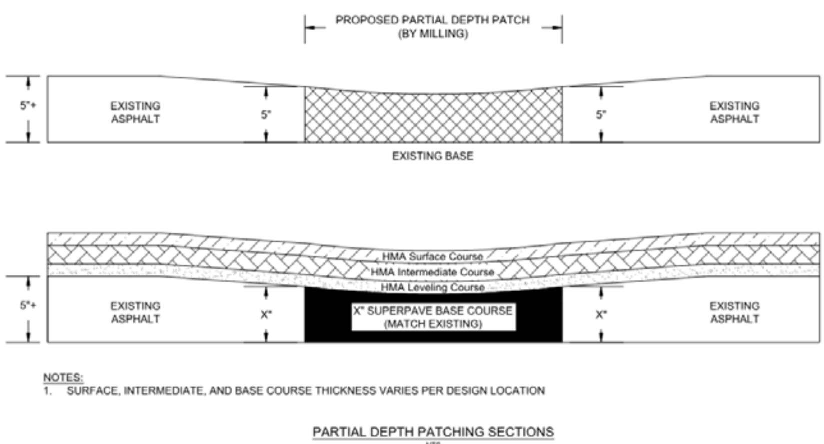

Figure 2. Partial Depth Patching Detail

b. **Milling** may be desired to allow for minimizing the elevation increases as a result of a structural overlay. Milling would remove any existing pavement surface oxidation and raveling of the existing pavement; however, it would also remove the existing crack seal material and increase the required structural overlay.

For every inch of milling performed, approximately 1.5 inches of new asphalt would need to be added to the structural overlay design.

This option is not recommended due to anticipated higher levels of construction effort and increased construction costs associated with milling operations and increased asphalt material costs.

c. **Transition milling** at intersecting roadways which have an existing thicker asphalt sections is recommended. These locations would allow for the levelling and intermediate pavement courses to be keyed into the existing pavement in steps prior to the intersecting roadway and limits of work. Milling of the surface course up to and through the intersection would allow for the new Asphalt surface to continue through the intersecting roadway as illustrated in Figure 3.

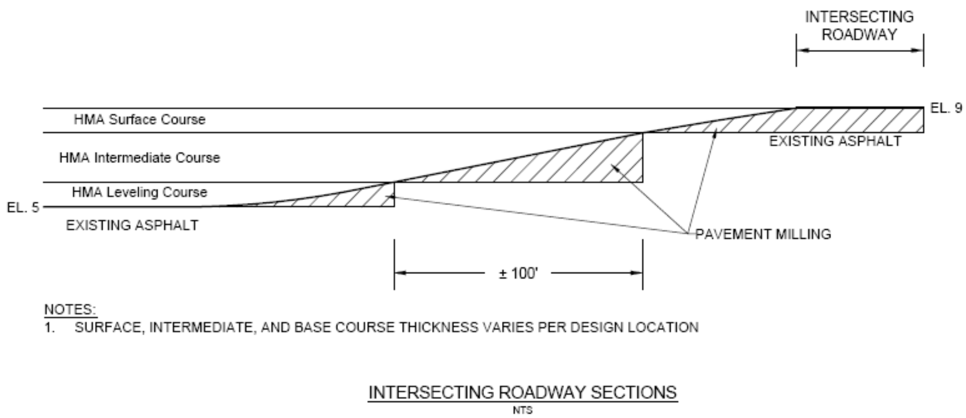

Figure 3. Transition Milling at Intersecting Roadways

B. Full Depth Reconstruction:

Full Depth Reconstruction in areas where existing pavement finished grades cannot be raised. This alternative is recommended when a profile change to the existing roadway is not feasible or unadvised by the County. The design section for Full Depth Reconstruction would consist of 6.0" inches of ABC base course (Class 6) followed by 3.25" of 1" Superpave Base Course (Grading SG), 2.5" of ¾" Superpave Intermediate Course (Grading S), and 2.0" of ½" Superpave Surface Course (Grading SX). The existing subgrade shall be prepared in accordance with CDOT requirements.

95th Street is a suitable candidate for **rehabilitation through resurfacing** which will provide: 1) a restored long-lasting asphalt surface; 2) an improved roadway subbase (in areas of partial depth patching); and 3) improved drainage by increasing the roadway profile. AECOM recommends that the Boulder County Department of Transportation proceed with the aforementioned resurfacing option.

With implementation of the design alternative that is recommended, the following design considerations are noted:

1) An increase in roadway grade of between 4.0 inches and 6.0 inches, so clearance to overhead wires needs to be investigated.

2) Increased transitions lengths at intersecting roadways and driveways (mostly gravel).

3) Many intersections have thicker existing asphalt, which then could allow for a transition to occur and installing just a 2-inch overlay through them (See Figure 3).

4) No pavement rehabilitation work at the Boulder Creek crossing, which contains the limits of previously completed pavement rehabilitation work.

5) 4-inch Gravel added along edges of the existing roadway, for width of 2 feet on either side, to eliminate lane drop off as a result of increased roadway pavement grades.

Appendix A – Project Layout Map

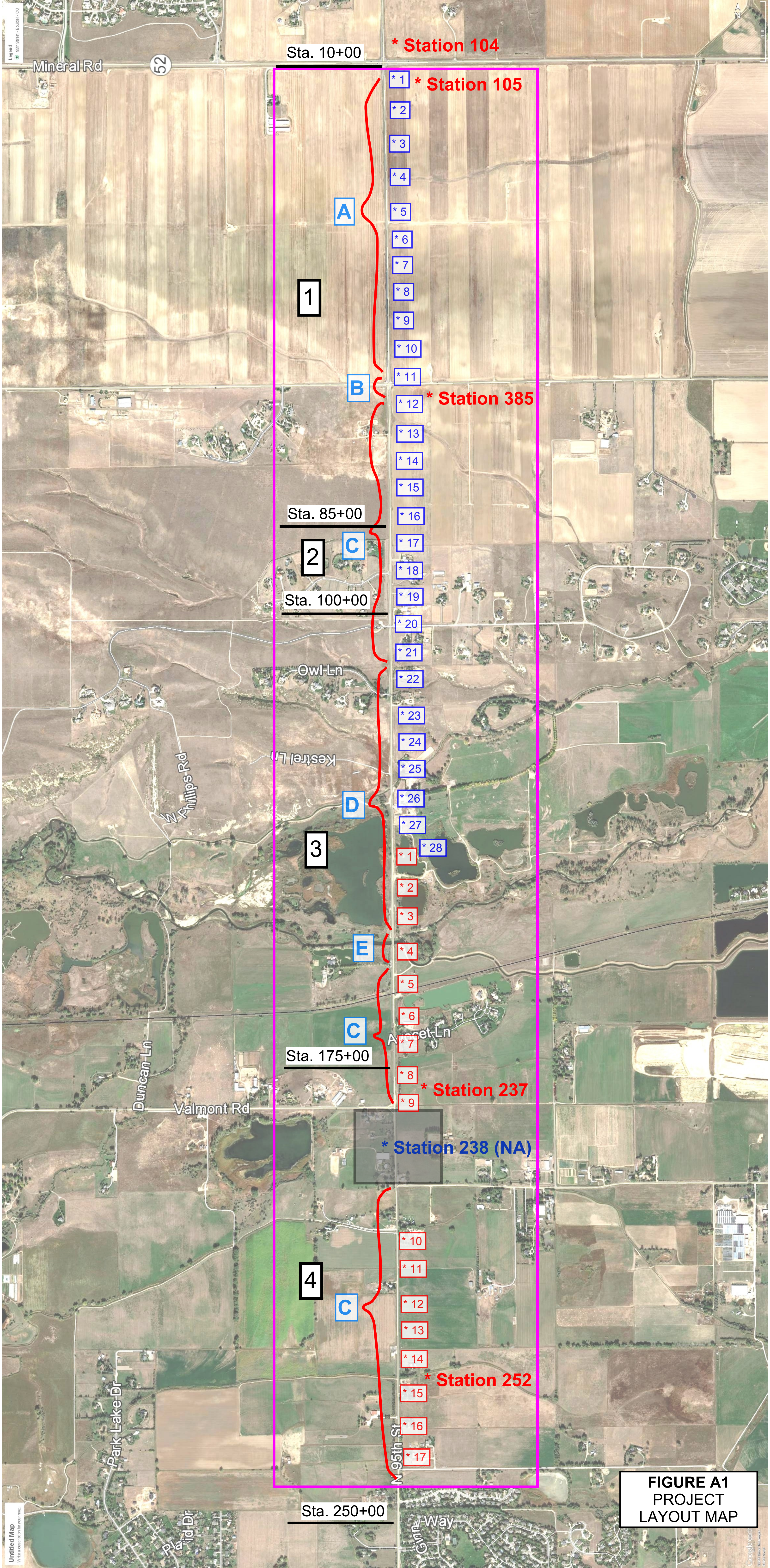

FIGURE A1
PROJECT
LAYOUT MAP

Appendix B – Previous Geotechnical Analysis & Reports

Geotechnical and Pavement Sections, 95th Street- 2017 Reconstruction Project, Boulder County, CO (2016 Report, Ground Engineering)

GROUND ENGINEERING

Geotechnical and Pavement Sections
95th Street – 2017 Reconstruction Project
Job #RD-019-092, Task 1
Boulder County, Colorado
Draft Submittal

Prepared for:
AECOM Transportation
717 17th Street, Suite 2600
Denver, Colorado 80202

Attention: Mr. John C. Sabo, P.E.

Job Number: 16-3619 **August 10, 2016**

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ENGLEWOOD | COMMERCE CITY | LOVELAND | GRANBY | GYPSUM

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a subsurface exploration program performed by Ground Engineering Consultants, Inc. (GROUND), to develop pavement parameters for design and construction of the roadway improvements to portions of 95th Street in Boulder County, Colorado. Our study was conducted in general accordance with the agreement for Sub-consultant services with the Client dated March 23, 2015 and GROUND's Proposal No. 1612-2267 Revised A, dated February 2, 2016.

A field exploration program was conducted to obtain information on subsurface conditions. Material samples obtained during the subsurface exploration were tested in the laboratory to provide data on the classification and engineering characteristics of the on-site soils. The results of the field and laboratory studies are presented herein.

This report has been prepared to summarize the data obtained and to present our conclusions and information based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to the proposed improvements are included.

GROUND previously performed a subsurface exploration program and subsequent report titled, *Geotechnical Subsurface Exploration program, North 95th Street Reconstruction, Boulder County, Colorado*, dated January 30, 2012. The results of this previous study were incorporated herein as applicable, and presented in Appendix B.

PROPOSED CONSTRUCTION

We understand that proposed construction will include roadway reconstruction of 95th Street beginning at the northern city limits of Lafayette and continuing north ending at Highway 52, excluding a section of 95th Street from Isabelle Road to Valmont Road (Valmont Road intersection project by others). Various drainage improvements are also planned for construction. We anticipate that there will be no major grade or profile changes to the existing roadway. If the proposed construction differs significantly from that described above, GROUND should be notified to re-evaluate the information contained herein.

SITE CONDITIONS

At the time of our exploration, the existing alignment of 95th Street existed as a two-lane roadway with turn lanes associated with Lookout Road and State Highway 52. The existing streets currently service several residential structures, agricultural land, and vacant, undeveloped land. The roadway is fairly flat north of Lookout Road with the roadway's grade becoming more rolling as it descends south to Boulder Creek with a steep drop in elevation by the Farm in Boulder Valley. The roadway exhibits moderate to severe pavement distress with linear block cracking and longitudinal cracking observed. Underground and overhead utilities were also present within the existing ROW. Based on our exploration program, the existing pavement section of 95th Street consisted of asphalt ranging from approximately 5 to 7 inches thick underlain by road base in the test holes completed in our 2012 study, ranging from approximately 6 inches to 6 feet thick. Road base was not obviously observed in the test holes recently drilled.

SUBSURFACE EXPLORATION

The subsurface exploration for the project was conducted in December 2011 and on July 8 and 18, 2016. Twenty-eight (28) test holes were drilled in December 2011 within the northern stretch from State Highway 52 south to the bridge at Boulder Creek. On July 8 and 18, 2016, an additional seventeen (17) test holes were drilled south of Boulder Creek to the northern City limits of Lafayette. The test holes were drilled with a truck-mounted, continuous flight power auger rig to evaluate the subsurface conditions as well as to retrieve samples for laboratory testing and analysis. The test holes were drilled within the alignment of the northbound and southbound lanes of 95th Street. The test holes extended to depths of approximately 5 to 10 feet below existing grades. A representative of GROUND directed the subsurface exploration, logged the test holes in the field, and prepared the samples for transport to our laboratory. The test holes were backfill with soil cuttings and patched with non-shrink grout following drilling operations.

Samples of the subsurface materials were taken with 2-inch I.D. California-type liner sampler. The sampler was driven into the substrata with blows from a 140-pound hammer falling 30 inches. This procedure is similar to the Standard Penetration Test described by ASTM Method D1586. Penetration resistance values (blows per distance driven, typically 12 inches), when properly evaluated, indicate the relative density or consistency of soils. A composite disturbed (bulk) sample of the shallow soils was collected from the pavement test hole auger returns. Depths at which the samples were taken, and associated penetration resistance values are shown on the test hole logs.

The approximate locations of the test holes are shown in Figure 1. Logs of the exploratory test holes from the 2016 exploration program are presented in Figures 2 and 3. Explanatory notes and a legend are provided in Figure 4. The logs from the 2011 exploration program are provided in Appendix B. The test hole locations were marked by GROUND utilizing a client-provided site plan. These locations were not surveyed for location and elevation.

LABORATORY TESTING

Samples retrieved from our test holes were examined and visually classified in the laboratory by the project engineer. Laboratory testing of samples obtained from the subject site included standard property tests, such as natural moisture contents, dry unit weights, grain size analyses, liquid and plastic limits, swell-consolidation testing, soil corrosivity, and water-soluble sulfate contents. Resilient modulus tests were also performed on the composite bulk samples obtained from the auger cuttings. Laboratory tests were performed in general accordance with applicable ASTM protocols. Results from the laboratory-testing program are summarized on Table 1. Swell-consolidation test results and gradation test results are presented in Figures 5 through 12. The laboratory test results from our previous study are presented in Appendix B.

SUBSURFACE CONDITIONS

The subsurface conditions encountered generally consisted of a thin veneer of asphalt, approximately 5 to 7 inches thick, or topsoil[1], approximately 6 inches thick, underlain by sand and/or clay/silt. Road base, approximately 6 inches to 6 feet thick, was also observed underlying the asphalt in some the test holes. The test holes extended to depths ranging from approximately 5 to 10 feet below existing grade.

It should be noted that coarse gravel, cobbles and boulders are not well represented in samples obtained from small diameter test holes. At this site, therefore, it should be anticipated that gravel and cobbles, and possibly boulders, may be present in the fill and native soils, as well as comparably sized fragments of construction debris, even where not included in the general descriptions of the site soil types below.

Man-Made Fill was comprised of sands, clays, and gravel, fine to gravel grained, low to moderately plastic, dry to moist, occasionally calcareous, and brown in color.

Delineation of the complete lateral and vertical extents of any fills at the site, or their compositions, however, was beyond our present scope of services. If fill soil volumes and compositions at the site are of significance, they should be further evaluated using test pits.

Sand and/or Clay were interbedded, fine to coarse grained, non-plastic to moderately plastic, medium to hard/loose to medium dense, slightly moist to wet, occasionally calcareous, and brown in color.

Sandstone Bedrock was silty, medium grained, non-plastic to low plastic, medium hard to hard, slightly moist to moist, occasionally iron stained, and brown in color.

Swell-Consolidation Testing indicated a potential for heave/consolidation in the on-site materials tested. Swells up to approximately 0.6 percent and a consolidation of 0.5 percent were measured upon wetting against a 200 psf surcharge pressure.

Groundwater was encountered in Test Holes 1, 10, and 11 at a depth of approximately 7 feet below existing grades. The test holes were backfilled and patched immediately

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[1] "Topsoil" as used herein is defined geotechnically. The materials so described may or may not be suitable for landscaping or as a growth medium for such plantings as may be proposed for the project.

following drilling operations. Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, the nearby ditch, land use, and the development of transient, perched water conditions.

WATER-SOLUBLE SULFATES

The concentrations of water-soluble sulfates measured in selected samples obtained from the test holes ranged from approximately 0.01 to 0.02 percent. Such concentrations of water-soluble sulfates represent a negligible environment for sulfate attack on concrete exposed to these materials. Degrees of attack are based on the scale of 'negligible,' 'moderate,' 'severe' and 'very severe' as described in the "Design and Control of Concrete Mixtures," published by the Portland Cement Association (PCA). The Colorado Department of Transportation (CDOT) utilizes a corresponding scale with 4 classes of severity of sulfate exposure (Class 0 to Class 3) as described in the published table below.

REQUIREMENTS TO PROTECT AGAINST DAMAGE TO CONCRETE BY SULFATE ATTACK FROM EXTERNAL SOURCES OF SULFATE

Severity of Sulfate Exposure	Water-Soluble Sulfate (SO_4) In Dry Soil *(%)*	Sulfate (SO_4) In Water *(ppm)*	Water Cementitious Ratio *(maximum)*	Cementitious Material Requirements
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1500	0.45	Class 1
Class 2	0.21 to 2.00	1501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Based on these data GROUND, makes no suggestion for use of a special, sulfate-resistant cement in project concrete.

SOIL CORROSIVITY

The degree of risk for corrosion of metals in soils commonly is considered to be in two categories: corrosion in undisturbed soils and corrosion in disturbed soils. The potential for corrosion in undisturbed soil is generally low, regardless of soil types and conditions, because it is limited by the amount of oxygen that is available to create an electrolytic cell. In disturbed soils, the potential for corrosion typically is higher, but is strongly affected by soil chemistry and other factors.

A preliminary corrosivity analysis was performed to provide a general assessment of the potential for corrosion of ferrous metals installed in contact with earth materials at the site, based on the conditions existing at the time of GROUND's evaluation. Soil chemistry and physical property data including pH, reduction-oxidation (redox) potential, and sulfides content were obtained. Test results are summarized on Table 2.

pH Where pH is less than 4.0, soil serves as an electrolyte; the pH range of about 6.5 to 7.5 indicates soil conditions that are optimum for sulfate reduction. In the pH range above 8.5, soils are generally high in dissolved salts, yielding a low soil resistivity (AWWA, 2010). Testing indicated pH values of approximately 8.8 to 9.3.

Reduction-Oxidation testing indicated negative potentials: -106 to -137 millivolts. Such low potentials typically create a more corrosive environment.

Sulfide Reactivity testing for the presence of sulfides indicated 'trace' and 'positive' results. The presence of sulfides in the site soils also suggests a more corrosive environment.

Soil Resistivity In order to assess the "worst case" for mitigation planning, samples of materials retrieved from the test holes were tested for resistivity in the in the laboratory, after being saturated with water, rather than in the field. Resistivity also varies inversely with temperature. Therefore, the laboratory measurements were made at a controlled temperature.

Measurements of electrical resistivity indicated values from approximately 2,263 to 10,476 ohm-centimeters in samples of the site earth materials. The following table presents the relationship between soil resistivity and a qualitative corrosivity rating (ASM, 2003) [2].

Corrosivity Ratings Based on Soil Resistivity

Soil Resistivity (ohm-cm)	**Corrosivity Rating**
>20,000	Essentially non-corrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
<1,000	Extremely corrosive

Corrosivity Assessment The American Water Works Association (AWWA, 2010[3]) has developed a point system scale used to predict corrosivity. The scale is intended for protection of ductile iron pipe but is valuable for project steel selection. When the scale equals 10 points or higher, protective measures for ductile iron pipe are suggested. The AWWA scale (Table A.1 Soil-test Evaluation) is presented below. The soil characteristics refer to the conditions at and above pipe installation depth.

[2] ASM International, 2003, *Corrosion: Fundamentals, Testing and Protection,* ASM Handbook, Volume 13A.
[3] American Water Works Association ANSI/AWWA C105/A21.5-05 Standard.

Table A.1 Soil-test Evaluation

Soil Characteristic / Value	Points
Resistivity	
<1,500 ohm-cm	10
1,500 to 1,800 ohm-cm	8
1,800 to 2,100 ohm-cm	5
2,100 to 2,500 ohm-cm	2
2,500 to 3,000 ohm-cm	1
>3,000 ohm-cm	0
pH	
0 to 2.0	5
2.0 to 4.0	3
4.0 to 6.5	0
6.5 to 7.5	0 *
7.5 to 8.5	0
>8.5	3
Redox Potential	
< 0 (negative values)	5
0 to +50 mV	4
+50 to +100 mV	3½
> +100 mV	0
Sulfide Content	
Positive	3½
Trace	2
Negative	0
Moisture	
Poor drainage, continuously wet	2
Fair drainage, generally moist	1
Good drainage, generally dry	0

* If sulfides are present <u>and</u> low or negative redox-potential results (< 50 mV) are obtained, add three points for this range.

The redox potential of a soil is significant, because the most common sulfate-reducing bacteria can only live in anaerobic conditions. A negative redox potential indicates anaerobic conditions in which sulfate reducers thrive. A positive sulfide reaction reveals a potential problem caused by sulfate-reducing bacteria. Anaerobic conditions are regarded as potentially corrosive.

Based on a maximum possible score of 25.5 using the AWWA method, the value of 10 for the use of corrosion protection, and scores of approximately 10 to 13.5 in the on-site soil, the soil appears to comprise a potentially corrosive environment for buried metals.

If additional information are needed regarding soil corrosivity, the American Water Works Association or a Corrosion Engineer should be contacted. It should be noted, however, that changes to the site conditions during construction, such as the import of other soils, or the intended or unintended introduction of off-site water, may significantly alter corrosion potential.

PROJECT EARTHWORK

Prior to earthwork construction, existing vegetation, topsoil, asphalt, and other deleterious materials should be removed and disposed of off-site. Relic underground utilities, if encountered, should be abandoned in accordance with applicable regulations, removed as necessary, and capped at the margins of the property. A materials testing firm should be contracted to test the backfill during placement.

Topsoil should not be incorporated into fill placed on the site. Instead, topsoil should be stockpiled during initial grading operations for placement in areas to be landscaped or for other approved uses.

Existing Fill Soils: Man-made fill was encountered in some of the test holes at the time of drilling. Actual contents and composition of all aspects of the man-made fill materials are not known; therefore, some of the excavated man-made fill materials may not be suitable for replacement as backfill. A Geotechnical Engineer should be retained during site excavations to observe the excavated fill materials and provide guidance for its suitability for reuse.

Use of Existing Native Soils: Overburden soils that are free of trash, organic material, construction debris, and other deleterious materials are suitable, in general, for placement as compacted fill. Organic materials should not be incorporated into project fills.

Fragments of rock, cobbles, and inert construction debris (e.g., concrete or asphalt) larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. In general, such materials should be placed as deeply as possible in the project fills. A Geotechnical Engineer should be consulted regarding appropriate information for usage of such materials on a case-by-case basis when such materials have been identified during earthwork. Standard parameters that likely will be generally applicable can be found in Section 203 of the current CDOT Standard Specifications for Road and Bridge Construction.

Fill Platform Preparation: Prior to filling, the top 8 to 12 inches of in-place materials on which fill soils will be placed should be scarified, moisture conditioned and properly compacted in accordance with the parameters below to provide a uniform base for fill placement.

If surfaces to receive fill expose loose, wet, soft or otherwise deleterious material, additional material should be excavated, or other measures taken to establish a firm platform for filling. The surfaces to receive fill must be effectively stable prior to placement of fill.

Fill Placement: Fill materials should be thoroughly mixed to achieve a uniform moisture content, placed in uniform lifts not exceeding 8 inches in loose thickness, and properly compacted.

Soils that classify as A-1 through A-3 should be compacted to 95 percent of the maximum modified Proctor dry density at moisture contents within 2 percent of optimum moisture content as determined by AASHTO T-180.

Soils that classify as A-4 through A-7 should be compacted to 95 percent of the maximum standard Proctor density at moisture contents from 1 percent below to 3 percent above the optimum as determined by AASHTO T-99.

No fill materials should be placed, worked, rolled while they are frozen, thawing, or during poor/inclement weather conditions.

Care should be taken with regard to achieving and maintaining proper moisture contents during placement and compaction. Materials that are not properly moisture conditioned may exhibit significant pumping, rutting, and deflection at moisture contents near optimum and above. The contractor should be prepared to handle soils of this type, including the use of chemical stabilization, if necessary.

Compaction areas should be kept separate, and no lift should be covered by another until relative compaction and moisture content within the suggested ranges are obtained.

FROST HEAVE

Based on the results of the field exploration as well as the laboratory testing, it appears that silty soils requiring special design considerations for the purpose of addressing frost heave are present at the project. According to the US Army Corps of Engineers, the soils on-site classify as F3 materials. Therefore, even if surface drainage is effective, the likelihood of movement of pavements, flatwork and other hardscaping as a result of frost heave is relatively moderate to high.

PAVEMENT SECTIONS

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and traffic loadings. The standard care of practice in pavement design describes the flexible pavement section as a “20-year” and “30-year” design pavement: however, most flexible pavements will not remain in satisfactory condition without routine maintenance and rehabilitation procedures performed throughout the life of the pavement. Pavement sections for the roadway were developed in general accordance with the design guidelines and procedures of Boulder County, which references the American Association of State Highway and Transportation Officials (AASHTO) and CDOT specifications (AASHTO). Since the time of our 2011 report, CDOT has changed to AASHTOWare Pavement M-E design.

Subgrade Materials

Based on the results of our field and laboratory studies, subgrade materials encountered in our test holes within the proposed alignment consisted predominantly of fill and sands and clays. These materials were classified typically as A-1-b to A-6 soils in accordance with the AASHTO classification system, with Group Index values from 0 to 13 in the upper 4 feet.

GROUND collected a composite bulk sample from the test holes. Resilient Modulus (M_R) testing (AASHTO T-307) was performed on a representative composite sample of the subgrade materials encountered along the alignments. Typically, the R-value, unconfined compressive strength, California Bearing Ratio (CBR), or other index properties of subgrade materials have been obtained and the resilient modulus obtained only by correlation. However, due to the variability in the correlations, subjecting representative samples of the subgrade to the actual resilient modulus test is the most accurate way to determine soil support characteristics for use in pavement design.

A dynamic load test, the resilient modulus measures the elastic rebound stiffness of flexible pavement materials, base courses and subgrades under repeated loading. The loading cycles were applied under various confining and deviatoric stresses as specified in AASTHO T-294. The material was compacted to 95 percent of maximum dry density at optimum moisture content, and at 2 percent and 4 percent above the optimum, based on AASHTO T-99 (the “standard Proctor”) for cohesive soils.

The resilient modulus of a material at optimum moisture content (CDOT) typically is used for the pavement design. According to our testing results, resilient modulus values of 8,644 and 10,336 psi were determined for the on-site materials. For this design, a resilient modulus value of 8,644 psi was utilized. Please note that the resilient modulus value performed in our 2011 study was prepared at 2 percent above the optimum moisture content and therefore, is not valid for this design based on the current methodology used.

It is important to note that significant decreases in soil support as quantified by the resilient modulus have been observed as the moisture content increases above the optimum. Therefore, pavements that are not properly drained may experience a loss of the soil support and subsequent reduction in pavement life.

Design Traffic

Traffic volumes were provided as Average Annual Daily Traffic (AADT) in the *Boulder Co Traffic Volume Map 2015* current as of January 1, 2016 from the Boulder County Website (http://www.bouldercounty.org/doc/transportation/bctrafficvol.pdf). Traffic counts for the stretch of 95th Street ranged from approximately 6,700 to 7,100 vehicles per day. For the purpose of this study, a traffic count of 7,100 vehicles per day was utilized. GROUND also utilized traffic information obtained from the CDOT’s On Line Traffic Information System website (OTIS-http://dtdapps.coloradodot.info/Otis/TrafficData) for SH 42 (near the proposed roadway). Based on this information and a truck percentage of 4.3, a design total AADTT (Average Annual Daily Truck Traffic) of 305 trucks was determined. Based on a growth rate of 1.16, a CDOT growth factor rate of 0.7 percent (20-year) was calculated. CDOT level 2 Traffic Cluster 3 was the assumed traffic mix with a 2 lane roadway and an operational speed of 45 mph. Truck traffic information from the CDOT website is presented in below.

	Route	Start	End	Description	AADT	Year	Single Unit	Comb Trucks	% Trucks	20 Year Factor	DHV	DVMT	DD
	042A	0	0.955	ON SH 42, 95TH ST S/O SH 7, ARAPAH...	15,000	2015	570	80	4.3	1.16	11	14,880	52

The assumed traffic loading values should be evaluated by Boulder County and the Project Team to determine that they are acceptable for both current and future traffic on the roadway. Without accurate traffic loading information, the pavement sections indicated herein may be insufficient to support present and future traffic volumes. Premature deterioration of pavement including cracking and other distress may result.

If the traffic loadings utilized above differ significantly from actual values, GROUND should be notified to reevaluate the pavement sections.

Pavement Design

Pavement sections for the reconstruction of 95th Street were based on the CDOT 2016 M-E Pavement Design Manual utilizing the AASHTOWare Pavement M-E design software. The following table presents pavement sections for 95th Street beginning at the northern city limits of Lafayette and continuing north ending at Highway 52, excluding a section of 95th Street from Isabelle Road to Valmont Road (Valmont Road intersection project by others). for a 20-year design life. Details of the 20-year flexible pavement section ME calculations for SH 7 are attached in Appendix A.

Flexible Minimum Pavement Section (20-year design)

Layer Type	Material Type	Thickness (inches)
Flexible	**R6 SX(100) PG 64-28**	**2**
Flexible	**S(100) PG 64-22**	**5**
Aggregate Base Course	**Non-Stabilized Base: CDOT Class 6 ABC**	**6**
Subgrade	**Existing Sand and Clay Material**	**12***

*Properly Moisture-Density Treated

Pavement/Subgrade Properties

Hot Bituminous Asphalt (HBA): The asphalt pavement shall consist of a bituminous plant mix composed of a mixture of high quality aggregate and bituminous material, which meets the requirements of a job-mix formula established by a qualified engineer. The asphalt material used should be based on a SuperPave Gyratory Design Revolution (N_{DES}) of 75 for the lower lift(s) and surface layer, respectively. Grading S is acceptable for the lower lift(s) using PG 64-28 asphalt cement binder and grading S or SX is acceptable for the surface layer using PG 64-22 asphalt cement binder. Note that the recommended pavement binders could be adjusted depending on the market condition at the time of construction. Alternate binding types should be submitted for review and approval prior to construction. Pavement lift thicknesses should be between 2¼ to 3½ inches (S) for the lower lift(s), depending on the material type selected, and 2 to 3 inches for the top lift (SX).

Aggregate Base Course (ABC): The aggregate base material should meet the criteria of CDOT Class 6 aggregate base course. Base course should be placed in uniform lifts not exceeding 8 inches in loose thickness and compacted to at least 95 percent of the maximum dry density a uniform moisture contents within 3 percent of the optimum as determined by ASTM D1557 / AASHTO T-180, the “modified Proctor.” Base course should be extended for a distance of 1 foot behind the back face of the curb.

Subgrade Preparation

The average Plasticity Index value within the upper 4 feet of the tested on-site soils is approximately 7. Therefore, in general accordance with CDOT specifications (*Table 2.6 Treatment of Expansive Soil)*, subgrade materials with an average Plasticity Index below 10 does not require moisture-density treatment to mitigate the soil beneath new pavement areas. Even so, scarification and re-compaction of the subgrade materials to a depth of at **least 12 inches** should be performed prior to placing pavement materials. The subgrade preparation should extend from back of curb to back of curb, in the event curb and gutter is incorporated into the reconstruction or back of sidewalk to back of sidewalk, if applicable. The potential for pavement distress as a result of both heave and settlement still exists after properly following the pavement subgrade preparation provided in this report.

Immediately prior to paving, the subgrade should be proof rolled with a heavily loaded, pneumatic tired vehicle. Areas that show excessive deflection during proof rolling should be excavated and replaced and/or stabilized. Areas allowed to pond with water prior to paving will require significant re-working prior to proof-rolling. The Contractor should be prepared either to dry the subgrade materials or moisten them, as needed, prior to compaction. Areas that remain unstable after moisture-density processing may require additional road base, placement of geotextile/geofabric Mirafi® RS380i, HP 570 Geo fabric, or some combination to achieve stability. All subgrade preparation must ultimately comply with roadway inspection, testing, and construction procedures outlined by CDOT specifications.

The proposed alignment contains existing shallow-buried utilities. The contractor should be aware that additional care should be taken when working in these areas. In the event the subgrade materials are significantly disturbed or require moisture-density treatment, recompaction over/adjacent to these utilities may be very difficult, possibly resulting in the utilization of concrete or flow fill in order to properly prepare the subgrade area for paving.

Pavement subgrade materials should be compacted in accordance with the *Project Earthwork* section of this report. Subgrade preparation should extend the full width of the pavement from back-of-curb to back-of-curb and also extend under the adjacent sidewalks, exterior flatwork, etc.

Additional Observations

The collection and diversion of surface drainage away from paved areas is extremely important to satisfactory performance of the pavements. The subsurface and surface drainage systems should be carefully designed to ensure removal of the water from paved areas and subgrade soils. Allowing surface waters to pond on pavements will cause premature pavement deterioration. Where topography, site constraints or other factors limit or preclude adequate surface drainage, pavements should be provided with edge drains to reduce loss of subgrade support.

GROUND's experience indicates that longitudinal cracking is common in asphalt-pavements generally parallel to the interface between the asphalt and concrete structures such as curbs, gutters or drain pans. Distress of this type is likely to occur even where the subgrade has been prepared properly and the asphalt has been compacted properly.

The standard care of practice in pavement design describes the flexible pavement section as a “20-year” or “30-year” design pavement; however, most pavements will not remain in satisfactory condition without routine, preventive maintenance and rehabilitation procedures performed throughout the life of the pavement. Preventive pavement treatments are surface rehabilitation and operations applied to improve or extend the functional life of a pavement. These treatments preserve, rather than improve, the structural capacity of the pavement structure. In the event the existing pavement is not structurally sound, the preventive maintenance will have no long-lasting effect. Therefore, a routine maintenance program to seal cracks, repair distressed areas, and perform thin overlays throughout the life of the pavement is imperative.

Maintenance programs should follow, at a minimum, CDOT and/or governing municipality guidelines and practices. Traffic volumes that exceed the values utilized by this report will likely necessitate the need of pavement maintenance practices on a schedule of shorter timeframe than that stated above. The greatest benefit of preventive maintenance is achieved by placing the treatments on sound pavements that have little or no distress.

CLOSURE

Geotechnical Review: The author of this report should be retained to review project plans and specifications to evaluate whether they comply with the intent of the information in this report. The review should be requested in writing.

The geotechnical information presented in this report are contingent upon observation and testing of project earthworks by representatives of GROUND. If another geotechnical consultant is selected to provide materials testing, then that consultant must assume all responsibility for the geotechnical aspects of the project by concurring in writing with the information in this report, or by providing alternative parameters.

Materials Testing: The Client should consider retaining a Geotechnical Engineer to perform materials testing during construction. The performance of such testing or lack thereof, in no way alleviates the burden of the contractor or subcontractor from constructing in a manner that conforms to applicable project documents and industry standards. The contractor or pertinent subcontractor is ultimately responsible for managing the quality of their work; furthermore, testing by the geotechnical engineer does not preclude the contractor from obtaining or providing whatever services they deem necessary to complete the project in accordance with applicable documents.

Limitations: This report has been prepared for AECOM as it pertains to the 95th Street improvements as described herein. It may not contain sufficient information for other parties or other purposes. The owner or any prospective buyer relying upon this report must be made aware of and must agree to the terms, conditions, and liability limitations outlined in the proposal.

The geotechnical conclusions and information in this report relied upon subsurface exploration at a limited number of exploration points, as shown in Figure 1, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, the Geotechnical Engineer should be advised at once, so that re-evaluation of the parameters may be made in a timely manner. In addition, a contractor who relies upon this report for development of his scope of work or cost estimates may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor is responsible for obtaining the additional geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes current depths to groundwater, etc.

The materials present on-site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed pavement will depend on implementation of the information in this report and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will exceed estimates provided herein and should therefore be expected by the owner.

ALL DEVELOPMENT CONTAINS INHERENT RISKS. It is important that ALL aspects of this report, as well as the estimated performance (and limitations with any such estimations) of proposed project improvements are understood by the Client, Project Owner (if different), or properly conveyed to any future owner(s). Utilizing these it for planning, design, and/or construction constitutes understanding and acceptance of the information provided herein, potential risks, associated improvement performance, as well as the limitations inherent within such estimations. If any information referred to herein is not well understood, it is imperative for the Client, Owner (if different), or anyone using this report to contact the author or a company principal immediately.

This report was prepared in accordance with generally accepted soil and foundation engineering practice in the project area at the date of preparation. Current applicable codes may contain criteria regarding performance of structures and/or site improvements which may differ from those provided herein. Our office should be contacted regarding any apparent disparity. GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or information contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect.

GROUND appreciates the opportunity to complete this portion of the project and welcomes the opportunity to provide the Owner with a cost proposal for construction observation and materials testing prior to construction commencement.

Sincerely,
GROUND Engineering Consultants, Inc.

Amy Crandall, P.E. Reviewed by Jason A. Smith, REM, P.E.

GOOGLE EARTH AERIAL IMAGE (DATE UNKNOWN)

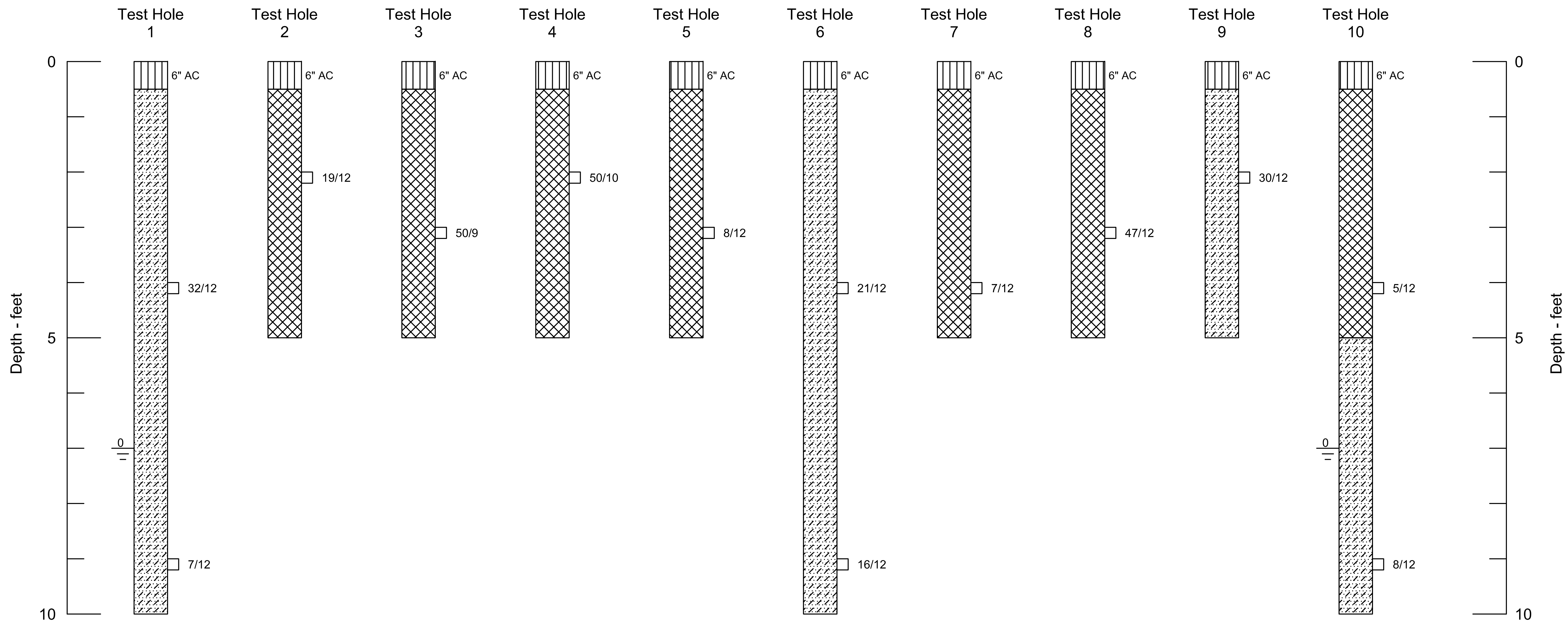
1 Indicates test hole number and approximate location.

(Not to Scale)

GROUND ENGINEERING CONSULTANTS

LOCATION OF TEST HOLES

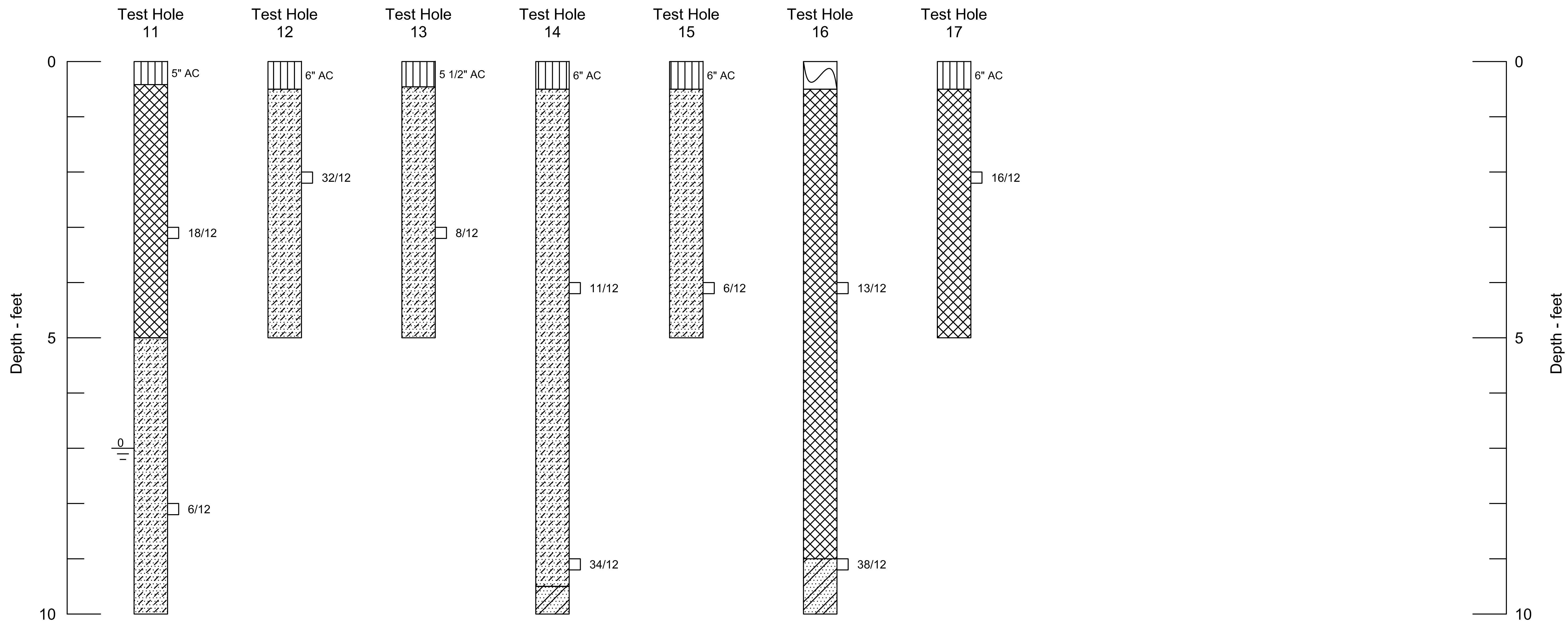
JOB NO.: 16-3619	FIGURE: 1
CADFILE NAME: 3619SITE.DWG	



GROUND ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 16-3619	FIGURE: 2
CADFILE NAME: 3619LOG01.DWG	



GROUND ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 16-3619	FIGURE: 3
CADFILE NAME: 3619LOG02.DWG	

LEGEND:

Topsoil

Asphalt

Fill:

Sand and Clay:

Sandstone Bedrock:

Drive sample, 2-inch I.D. California liner sample

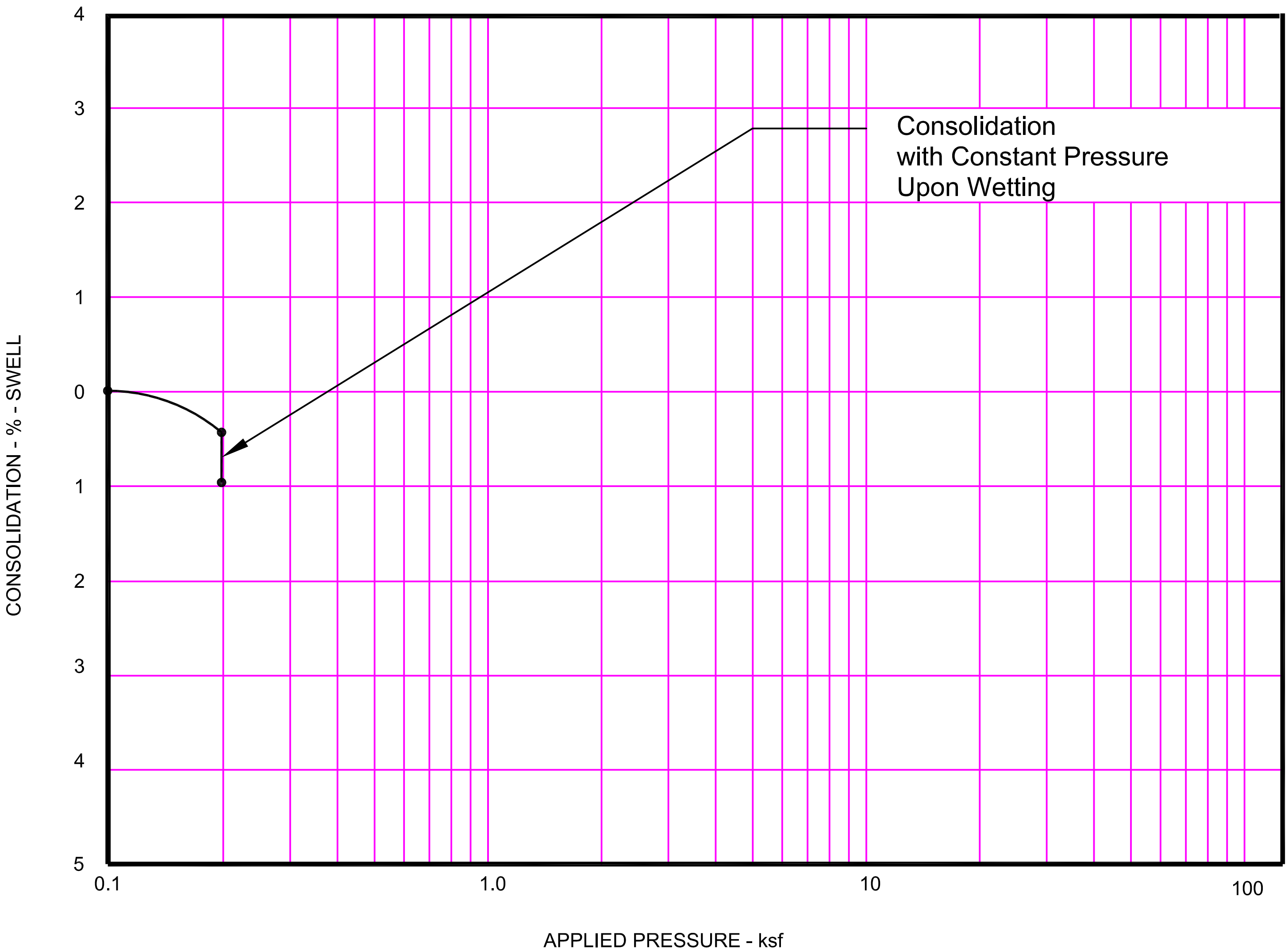
23/12 Drive sample blow count, indicates 23 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

0 Depth to water level and number of days after drilling that measurement was taken.

NOTES:

1) Test holes were drilled on 07/08 and 07/18/2016 with 4-inch diameter continuous flight augers.
2) Locations of the test holes were measured approximately by pacing from features shown on the site plan provided.
3) Elevations of the test holes were not measured and the logs of the test holes are drawn to depth.
4) The test hole locations and elevations should be considered accurate only to the degree implied by the method used.
5) The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.
6) Groundwater level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.
7) The material descriptions on this legend are for general classification purposes only. See the full text of this report for descriptions of the site materials and related information.
8) All test holes were immediately backfilled upon completion of drilling, unless otherwise specified in this report.

GROUND ENGINEERING CONSULTANTS	
LEGEND AND NOTES	
JOB NO.: 16-3619	FIGURE: 4
CADFILE NAME: 3619LEG.DWG	



Moisture Content = 16.4 percent

Dry Unit Weight = 106.1 pcf

Sample of: FILL: SAND with Clay; A-4(0)

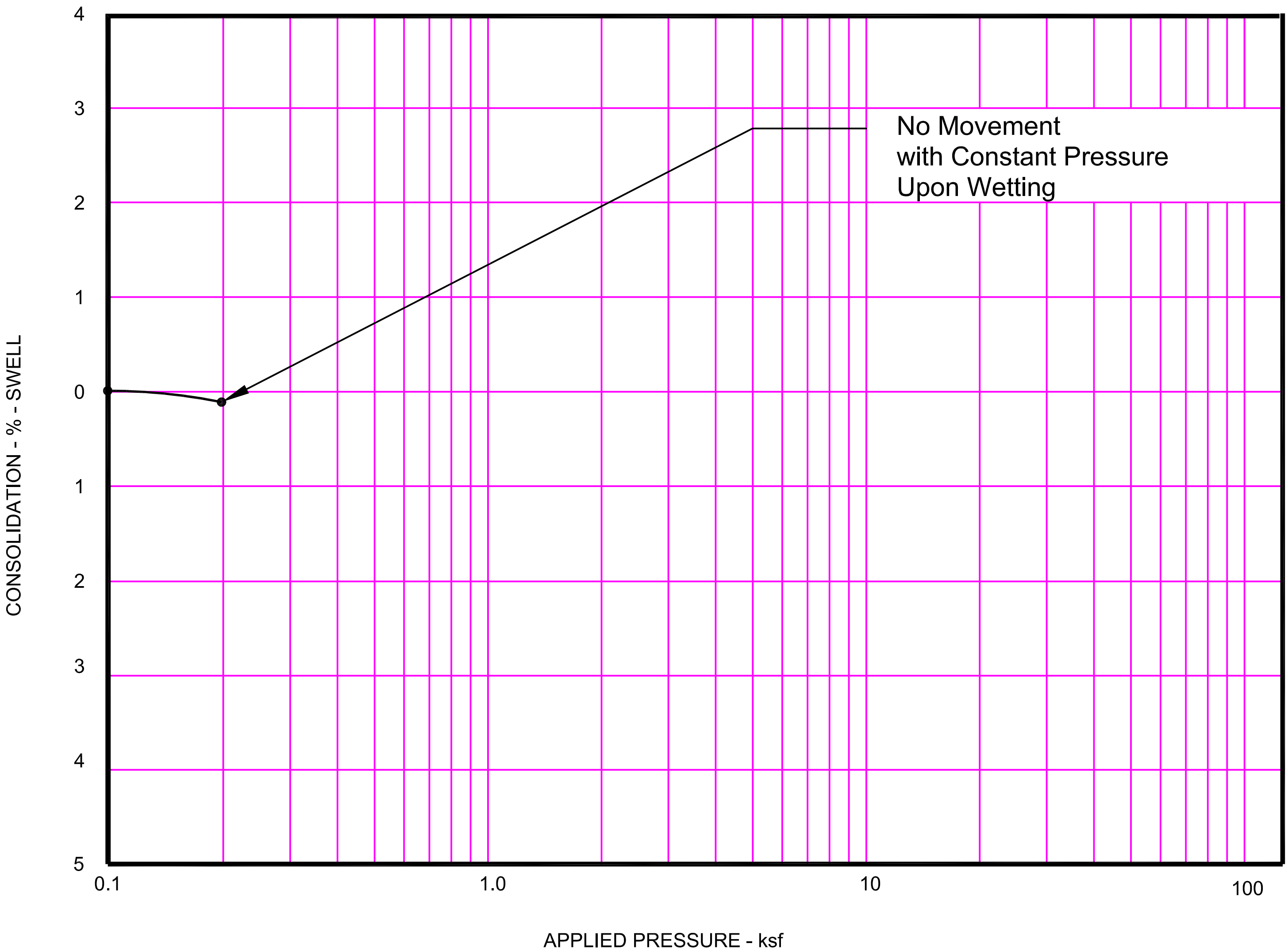
From: Test Hole 5 at 3 ft

GROUND ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION
TEST RESULTS

JOB NO.: 16-3619	FIGURE: 5

CADFILE NAME: 3619SWL01.DWG



Moisture Content = 10.3 percent

Dry Unit Weight = 122.0 pcf

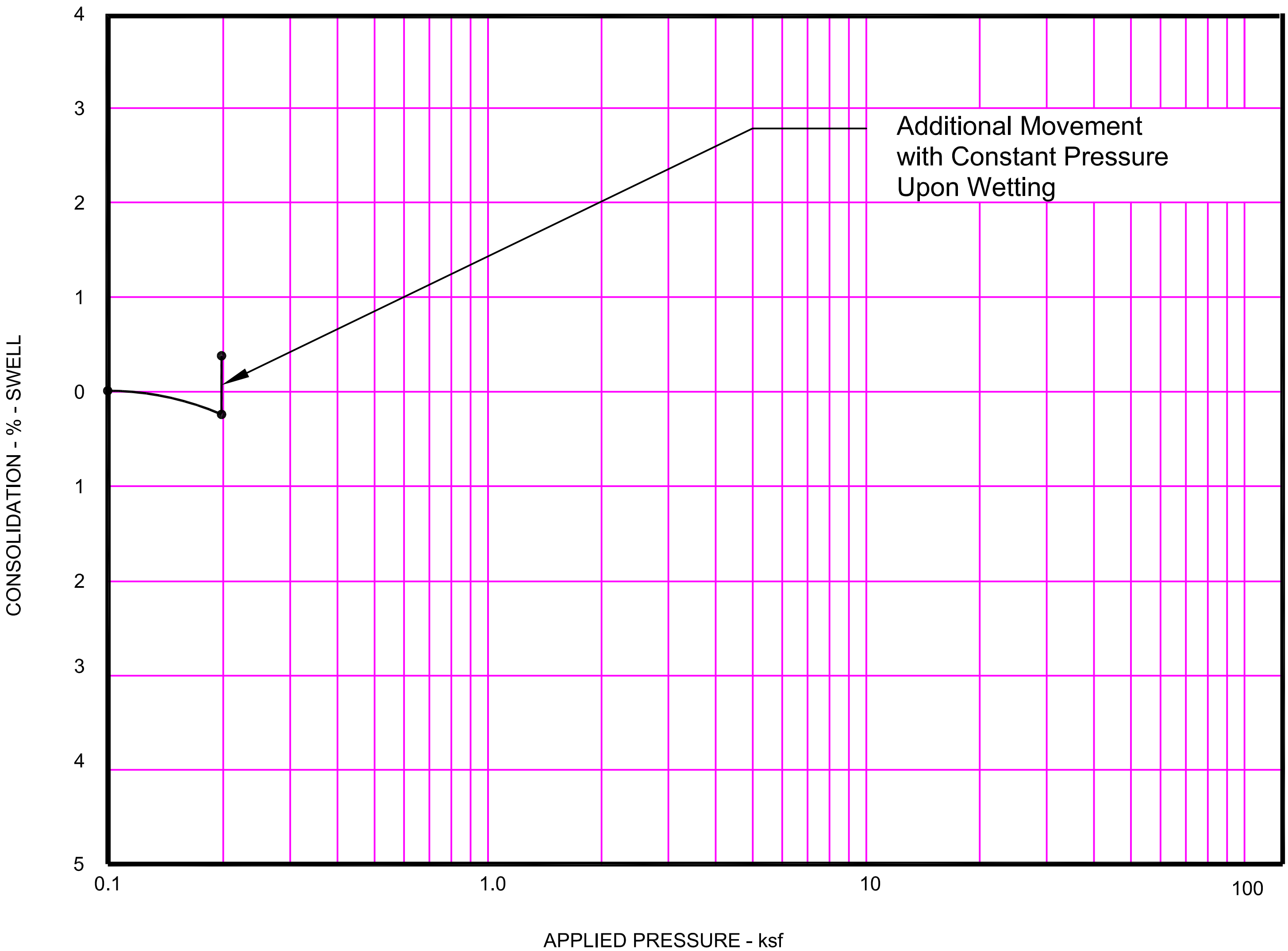
Sample of: Silty, Clayey SAND; A-2-4(0)

From: Test Hole 9 at 2 ft

GROUND ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION TEST RESULTS

JOB NO.: 16-3619	FIGURE: 6
CADFILE NAME: 3619SWL02.DWG	



Moisture Content = 16.4 percent

Dry Unit Weight = 114.8 pcf

Sample of: FILL: Sandy CLAY; A-6(6)

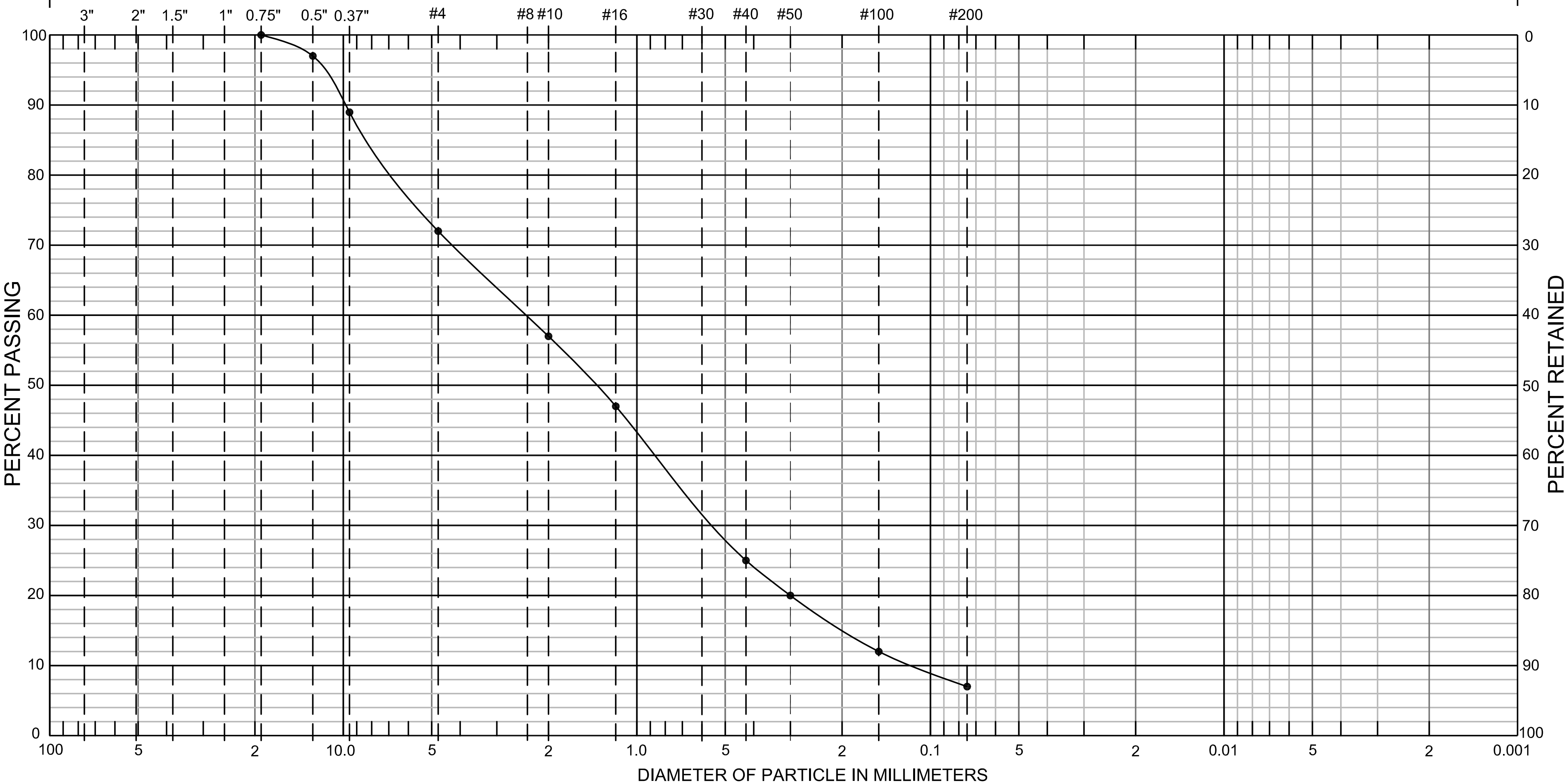
From: Test Hole 11 at 3 ft

GROUND ENGINEERING CONSULTANTS

SWELL-CONSOLIDATION TEST RESULTS

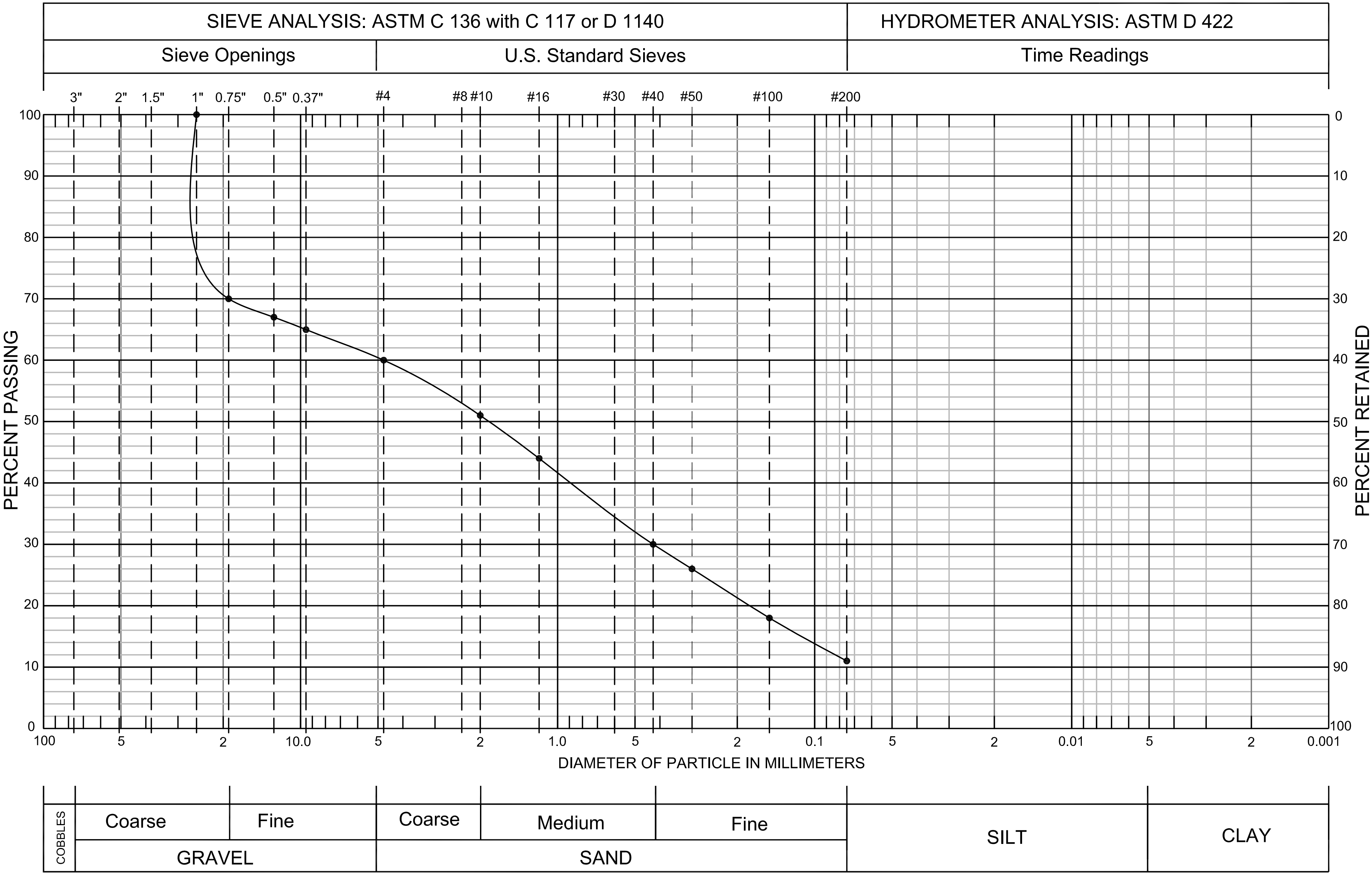
JOB NO.: 16-3619	FIGURE: 7
CADFILE NAME: 3619SWL03.DWG	

SIEVE ANALYSIS: ASTM C 136 with C 117 or D 1140		HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings	U.S. Standard Sieves	Time Readings



COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	Coarse	Medium	Fine		

Sample Location: Test Hole 1 at 4 feet	Gravel: 28 % Sand: 65 % Silt and Clay: 7 %	**GROUND** ENGINEERING CONSULTANTS
Sample Description: SAND with Silt and Gravel; A-1-b(0)	LL = NV PI = NP	GRADATION TEST RESULTS JOB NO.: 16-3619 FIGURE: 8 CADFILE NAME: 3619GRAD01.DWG



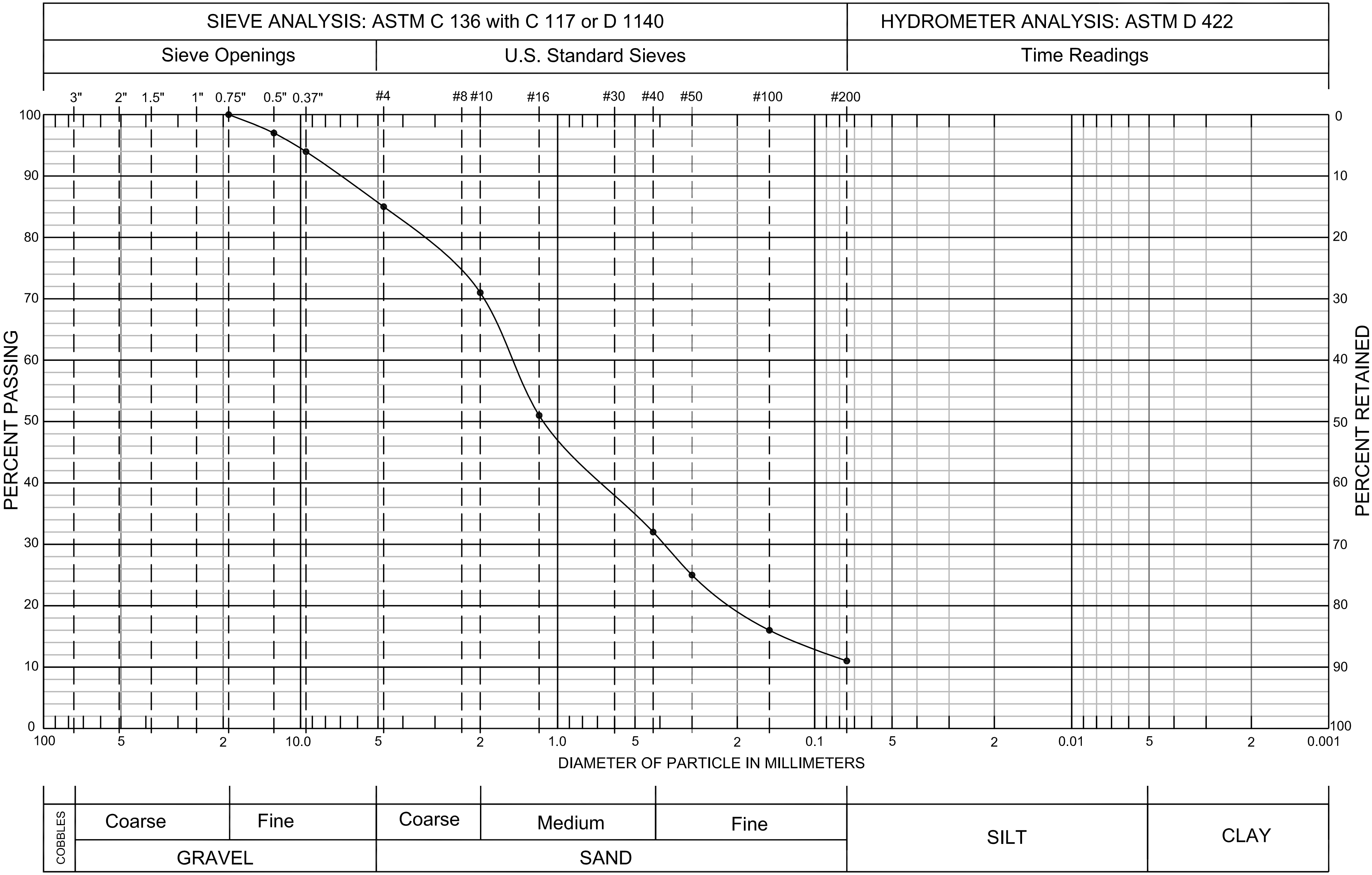
Sample Location: Test Hole 2 at 2 feet	Gravel: 40 %	Sand: 49 %	Silt and Clay: 11 %
Sample Description: FILL: SAND with Clay and Gravel; A-2-4(0)	LL = 17	PI = 9	

GROUND ENGINEERING CONSULTANTS

GRADATION TEST RESULTS

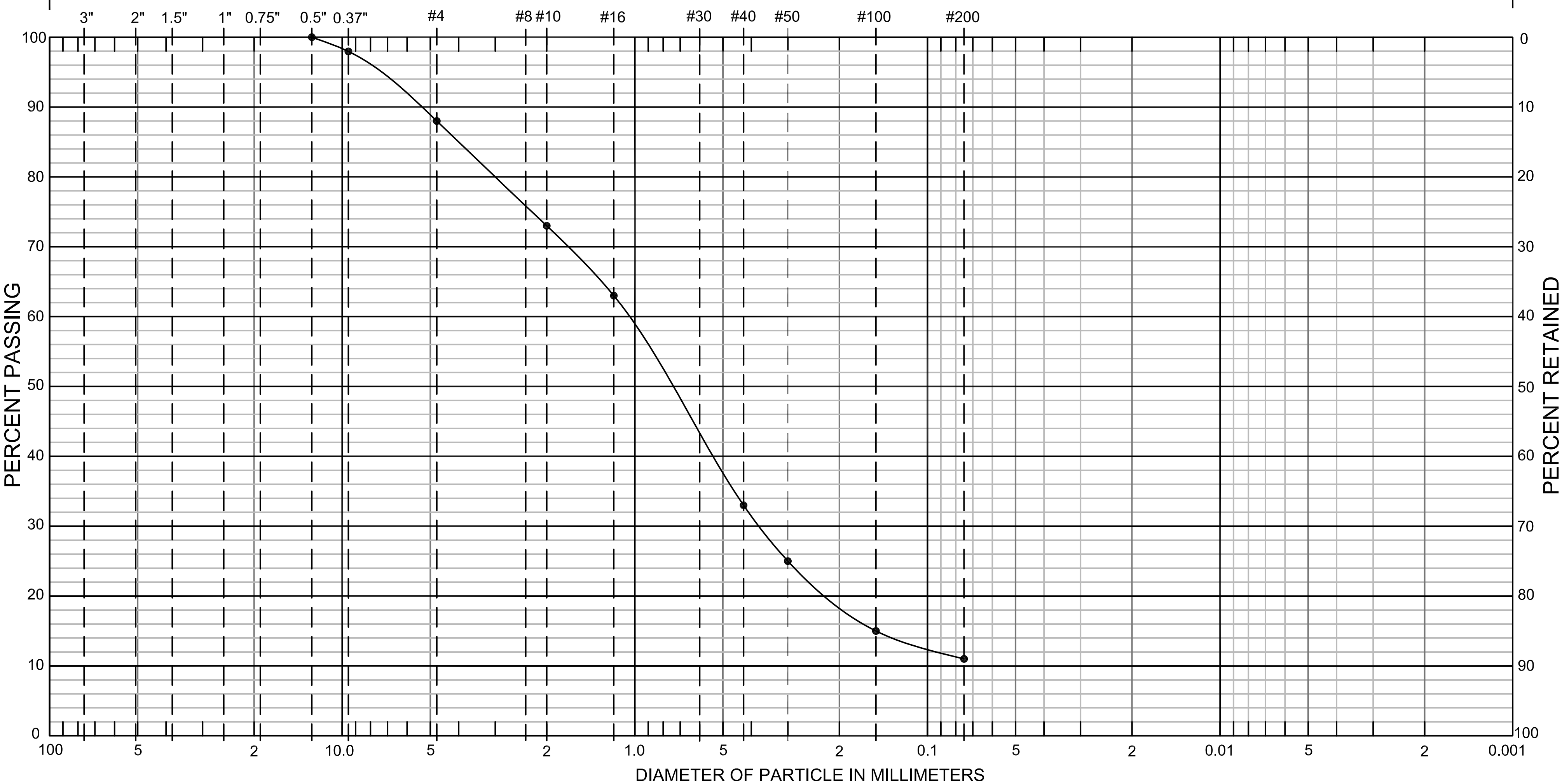
JOB NO.: 16-3619 FIGURE: 9

CADFILE NAME: 3619GRAD02.DWG



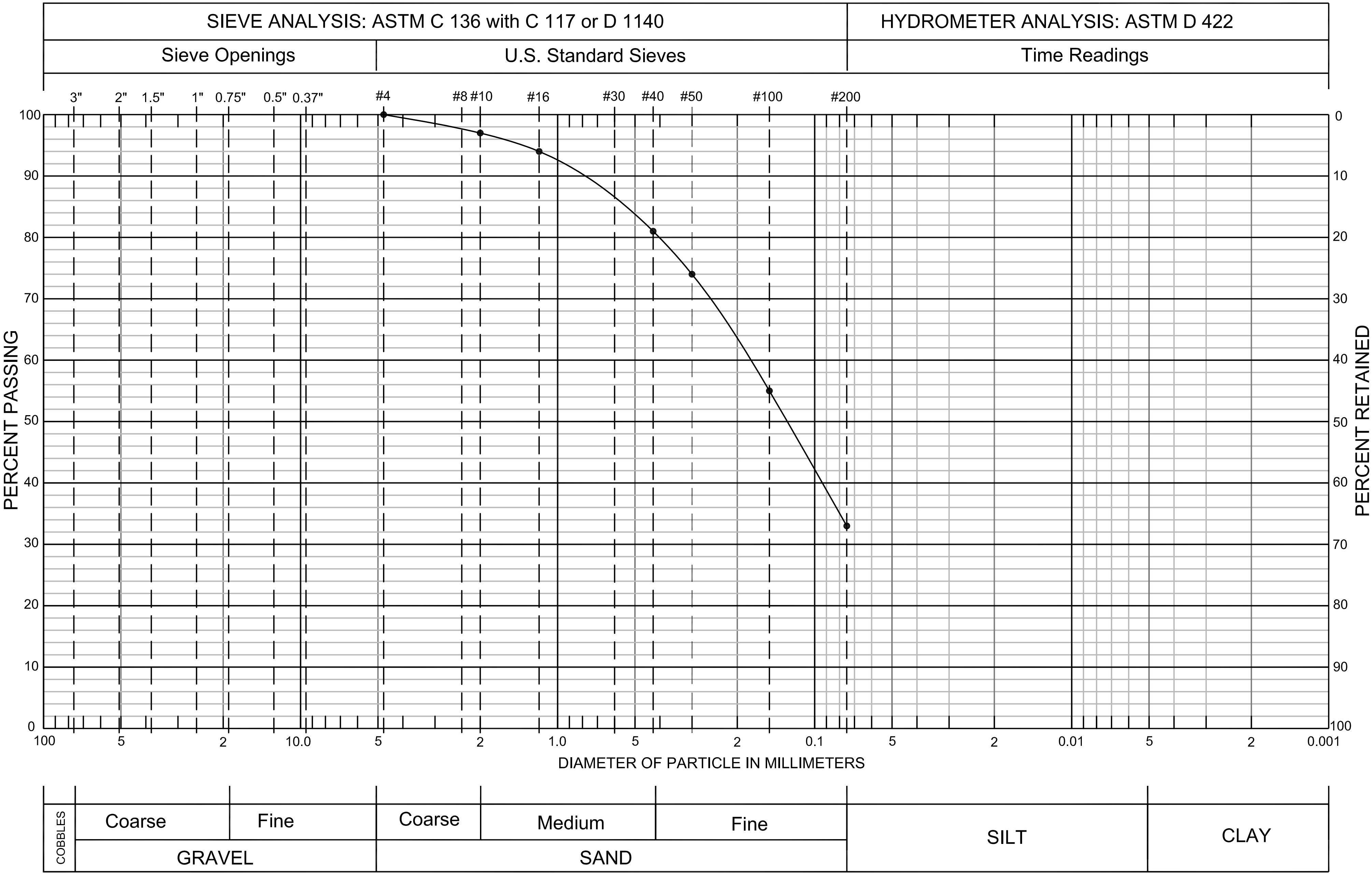
Sample Location: Test Hole 3 at 3 feet	Gravel: 15 % Sand: 74 % Silt and Clay: 11 %	**GROUND** ENGINEERING CONSULTANTS
Sample Description: FILL: SAND with Clay and Gravel; A-2-4(0)	LL = 16 PI = 10	GRADATION TEST RESULTS JOB NO.: 16-3619 FIGURE: 10 CADFILE NAME: 3619GRAD03.DWG

SIEVE ANALYSIS: ASTM C 136 with C 117 or D 1140		HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings	U.S. Standard Sieves	Time Readings



COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	Coarse	Medium	Fine		

Sample Location: Test Hole 4 at 2 feet	Gravel: 12 % Sand: 77 % Silt and Clay: 11 %	**GROUND** ENGINEERING CONSULTANTS
Sample Description: FILL: SAND with Clay; A-2-4(0)	LL = 15 PI = 7	GRADATION TEST RESULTS JOB NO.: 16-3619 FIGURE: 11 CADFILE NAME: 3619GRAD04.DWG



Sample Location: Test Hole 8 at 3 feet	Gravel: 0 % Sand: 67 % Silt and Clay: 33 %	**GROUND** ENGINEERING CONSULTANTS
Sample Description: FILL: Silty, Clayey SAND; A-2-4(0)	LL = 19 PI = 5	GRADATION TEST RESULTS JOB NO.: 16-3619 FIGURE: 12 CADFILE NAME: 3619GRAD05.DWG

GROUND
ENGINEERING CONSULTANTS

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Natural	Natural	Gradation		Percent	Atterberg Limits		Percent	USCS	AASHTO	
Test Hole No.	Depth *(feet)*	Moisture Content *(%)*	Dry Density *(pcf)*	Gravel *(%)*	Sand *(%)*	Passing No. 200 Sieve	Liquid Limit	Plasticity Index	Swell (Surcharge Pressure)	Classifi-cation	Classifi-cation (GI)	Soil or Bedrock Type
1	4	5.7	119.6	28	65	7	NV	NP	-	SW-SM	A-1-b(0)	SAND with Silt and Gravel
2	2	4.2	102.9	40	49	11	17	9	-	SP-SC	A-2-4(0)	Fill: SAND with Clay and Gravel
3	3	5.7	126.1	15	74	11	16	10	-	SW-SC	A-2-4(0)	Fill: SAND with Clay and Gravel
4	2	6.1	125.4	12	77	11	15	7	-	SW-SC	A-2-4(0)	Fill: SAND with Clay
5	3	16.4	106.1	-	-	38	25	9	-0.5 (200)	SC	A-4(0)	Fill: Clayey SAND
6	4	9.7	116.5			8	NV	NP	-	SW-SM	A-1-b(0)	SAND with Silt and Gravel
6	9	25.0	96.1	-	-	81	36	17	-	CL	A-6(13)	CLAY with Sand
7	4	7.6	108.3	-	-	26	18	3	-	SM	A-2-4(0)	Fill: Silty SAND
8	3	8.1	117.3	0	67	33	19	5	-	SC-SM	A-2-4(0)	Fill: Silty, Clayey SAND
9	2	10.3	122.0	-	-	26	21	6	0.0 (200)	SC-SM	A-2-4(0)	Silty, Clayey SAND
10	9	18.0	110.7	-	-	28	22	6	-	SC-SM	A-2-4(0)	Silty, Clayey SAND
11	3	16.4	114.8	-	-	58	33	14	0.6 (200)	CL	A-6(6)	Fill: Sandy CLAY
12	2	11.0	115.9	-	-	25	16	2	-	SM	A-2-4(0)	Silty SAND
13	3	11.5	112.2	-	-	33	21	5	0.1 (200)	SC-SM	A-2-4(0)	Silty, Clayey SAND
14	4	12.6	111.5	-	-	33	20	4	-	SC-SM	A-2-4(0)	Silty, Clayey SAND
15	4	13.6	108.2	-	-	46	23	6	-	SC-SM	A-4(0)	Silty, Clayey SAND
16	4	16.1	109.8	-	-	69	33	14	-	CL	A-6(8)	Fill: Sandy CLAY
17	2	13.3	114.1	-	-	53	28	11	-	CL	A-6(3)	Fill: Sandy CLAY
									Resilient Modulus (psi)			
1-9	1-5	7.8*	130.6	-	-	44	33	15	8,644	CL	A-6(3)	Silty, Clayey SAND
10-17	1-5	7.9*	132.8*	-	-	28	20	5	10,336	SC-SM	A-2-4(0)	Silty, Clayey SAND

* Indicates optimum moisture content and maximum modified Proctor density (ASTM D-1557)
Resilient Modulus performed at optimum moisture content

Job No. 16-3619

GROUND
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TABLE 2
SUMMARY OF SOIL CORROSION TEST RESULTS

Sample Location		Water Soluble Sulfates *(%)*	pH	Redox Potential *(mV)*	Sulfides Content	Resistivity *(ohm-cm)*	USCS Classification	Soil or Bedrock Type
Test Hole No.	Depth *(feet)*							
2	2	<0.01	9.3	-137	Trace	4,609	SP-SC	SAND with Clay and Gravel
8	3	0.01	9.2	-128	Positive	10,476	SC-SM	Silty, Clayey SAND
15	4	0.02	8.9	-115	Positive	2,263	SC-SM	Silty, Clayey SAND
17	2	0.01	8.8	-106	Trace	3,952	CL	Sandy CLAY

Job No. 16-3619

APPENDIX A

Pavement Section Calculations

95th Street Flexible

File Name: C:\Users\engineer\Desktop\95th Street\95th Street Flexible.dgpx

Design Inputs

Design Life:	20 years	Base construction:	April, 2017	Climate Data Sources (Lat/Lon)	39.909, -105.117
Design Type:	Flexible Pavement	Pavement construction:	May, 2017		
		Traffic opening:	September, 2017		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible	R3 SX(100) PG 64-28	2.0
Flexible	S(100) PG 64-22	5.0
NonStabilized	CDOT CLASS 6	6.0
Subgrade	A-6	12.0
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	10.7
Air voids (%)	5.7

Traffic

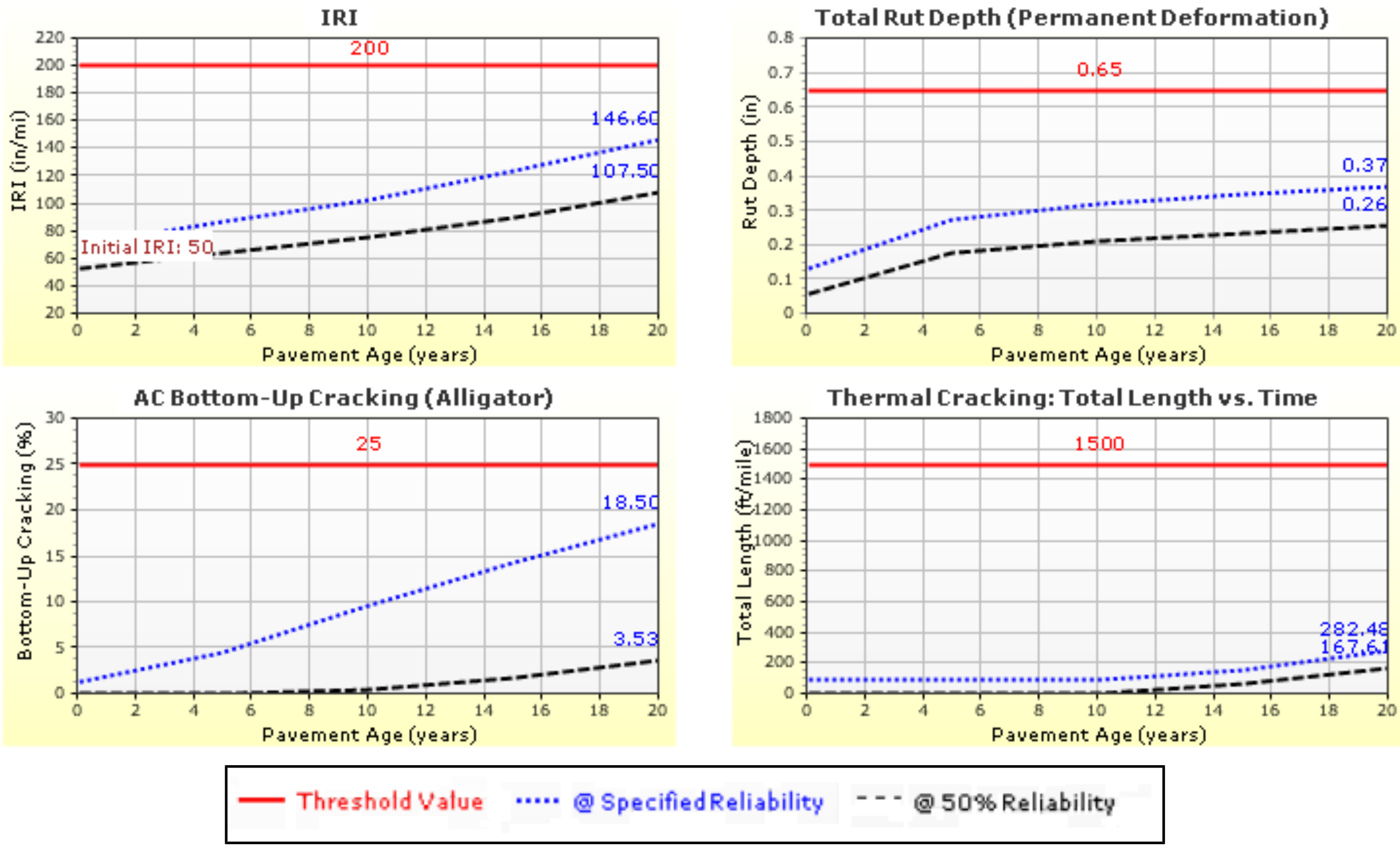
Age (year)	Heavy Trucks (cumulative)
2017 (initial)	305
2027 (10 years)	689,860
2037 (20 years)	1,429,560

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	200.00	146.63	90.00	99.88	Pass
Permanent deformation - total pavement (in)	0.65	0.37	90.00	100.00	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	18.50	90.00	96.69	Pass
AC thermal cracking (ft/mile)	1500.00	282.48	90.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	809.22	90.00	99.93	Pass
Permanent deformation - AC only (in)	0.50	0.24	90.00	100.00	Pass

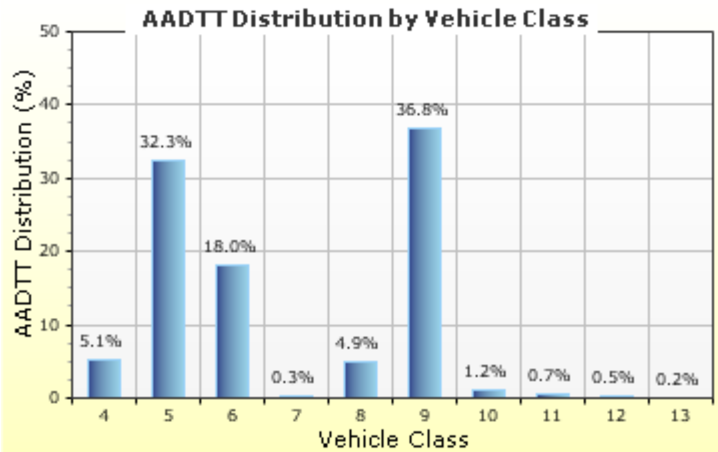
Distress Charts

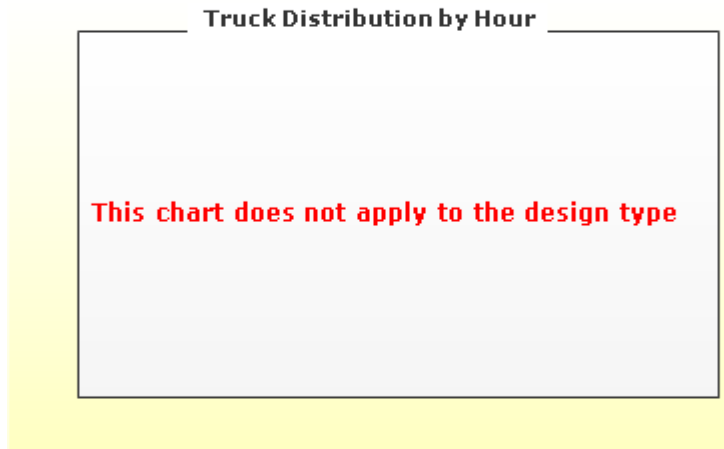


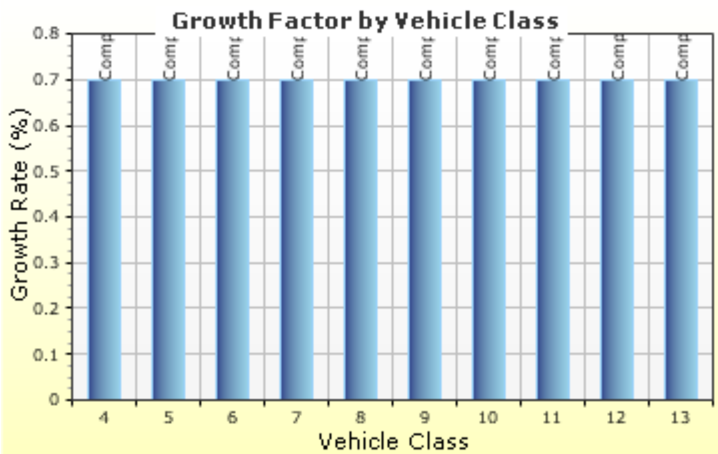
Traffic Inputs

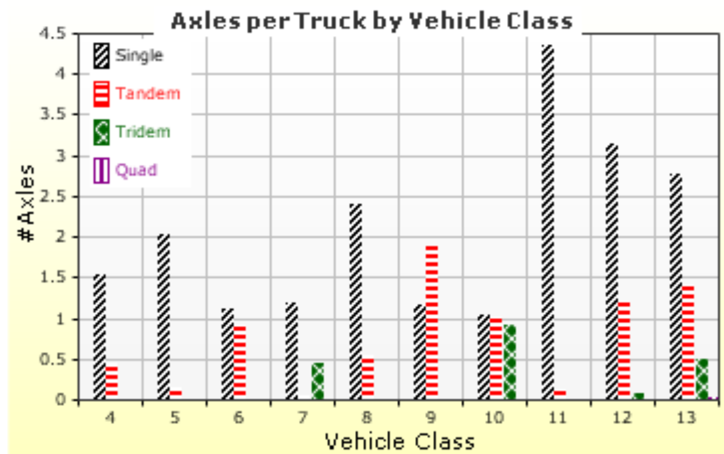
Graphical Representation of Traffic Inputs

Initial two-way AADTT:	305	Percent of trucks in design direction (%):	60.0
Number of lanes in design direction:	1	Percent of trucks in design lane (%):	100.0
		Operational speed (mph)	45.0

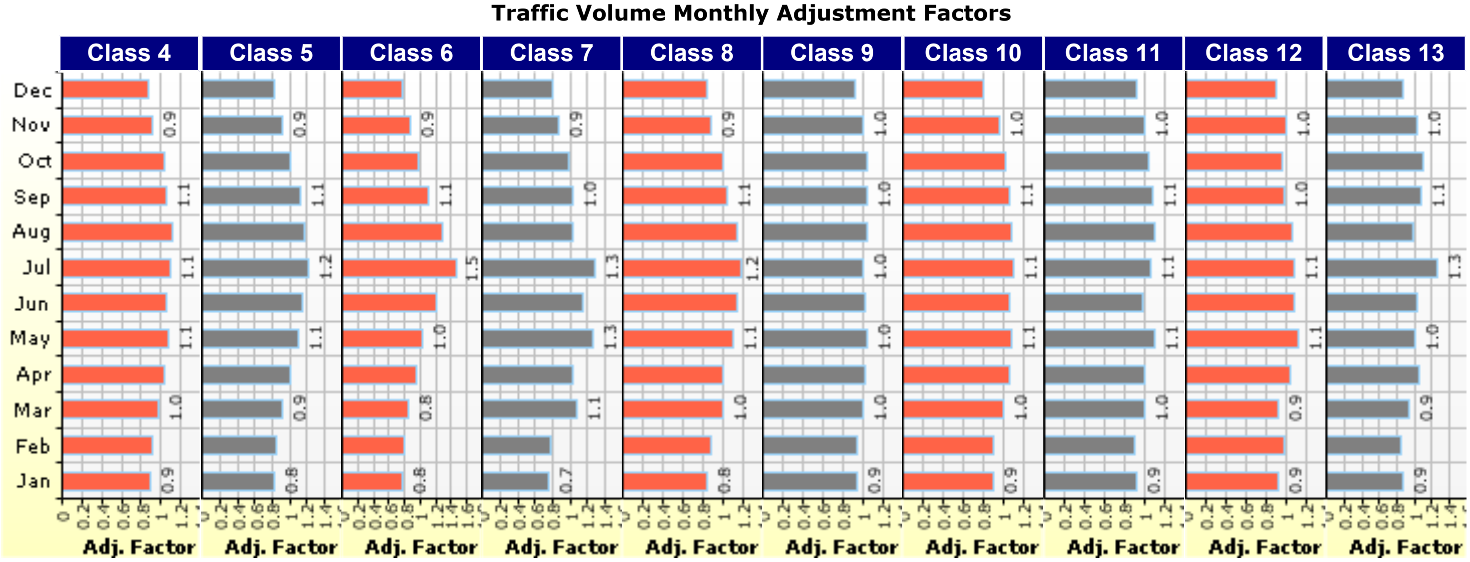








Traffic Volume Monthly Adjustment Factors



Tabular Representation of Traffic Inputs

Volume Monthly Adjustment Factors

Level 3: Default MAF

Month	Vehicle Class									
	4	5	6	7	8	9	10	11	12	13
January	0.9	0.8	0.8	0.7	0.8	0.9	0.9	0.9	0.9	0.9
February	0.9	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	0.8
March	1.0	0.9	0.8	1.1	1.0	1.0	1.0	1.0	0.9	0.9
April	1.0	1.0	0.9	1.0	1.0	1.0	1.1	1.0	1.0	1.1
May	1.1	1.1	1.0	1.3	1.1	1.0	1.1	1.1	1.1	1.0
June	1.1	1.1	1.2	1.1	1.1	1.0	1.1	1.0	1.1	1.0
July	1.1	1.2	1.5	1.3	1.2	1.0	1.1	1.1	1.1	1.3
August	1.1	1.2	1.3	1.0	1.1	1.0	1.1	1.1	1.1	1.0
September	1.1	1.1	1.1	1.0	1.1	1.0	1.1	1.1	1.0	1.1
October	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.1
November	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0
December	0.9	0.8	0.8	0.8	0.8	0.9	0.8	0.9	0.9	0.9

Distributions by Vehicle Class

Vehicle Class	AADTT Distribution (%) (Level 3)	Growth Factor	
		Rate (%)	Function
Class 4	5.1%	0.7%	Compound
Class 5	32.3%	0.7%	Compound
Class 6	18%	0.7%	Compound
Class 7	0.3%	0.7%	Compound
Class 8	4.9%	0.7%	Compound
Class 9	36.8%	0.7%	Compound
Class 10	1.2%	0.7%	Compound
Class 11	0.7%	0.7%	Compound
Class 12	0.5%	0.7%	Compound
Class 13	0.2%	0.7%	Compound

Truck Distribution by Hour does not apply

Axle Configuration

Traffic Wander	
Mean wheel location (in)	18.0
Traffic wander standard deviation (in)	10.0
Design lane width (ft)	12.0

Axle Configuration	
Average axle width (ft)	8.5
Dual tire spacing (in)	12.0
Tire pressure (psi)	120.0

Average Axle Spacing	
Tandem axle spacing (in)	51.6
Tridem axle spacing (in)	49.2
Quad axle spacing (in)	49.2

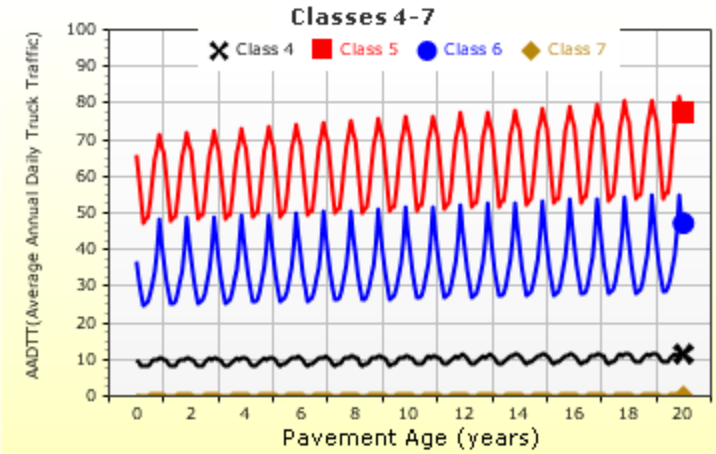
Wheelbase does not apply

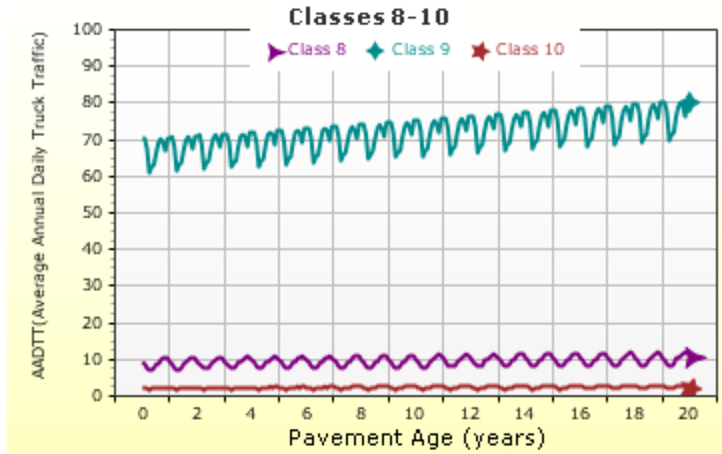
Number of Axles per Truck

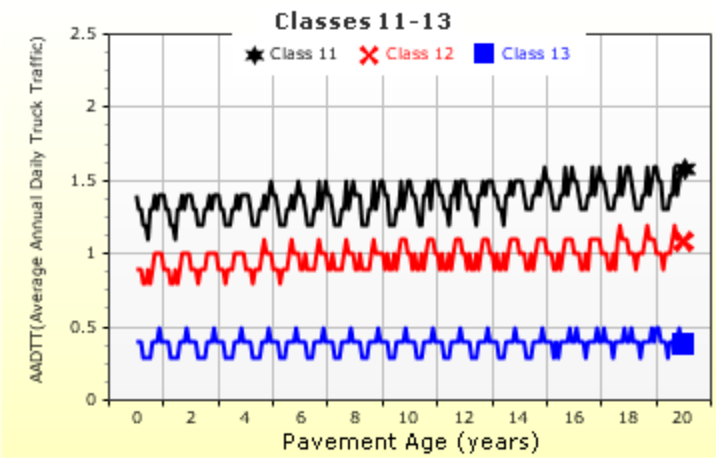
Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.53	0.45	0	0
Class 5	2.02	0.16	0.02	0
Class 6	1.12	0.93	0	0
Class 7	1.19	0.07	0.45	0.02
Class 8	2.41	0.56	0.02	0
Class 9	1.16	1.88	0.01	0
Class 10	1.05	1.01	0.93	0.02
Class 11	4.35	0.13	0	0
Class 12	3.15	1.22	0.09	0
Class 13	2.77	1.4	0.51	0.04

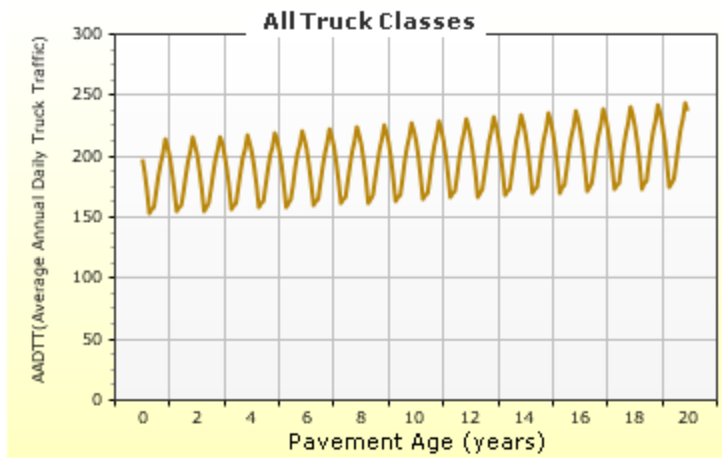
AADTT (Average Annual Daily Truck Traffic) Growth

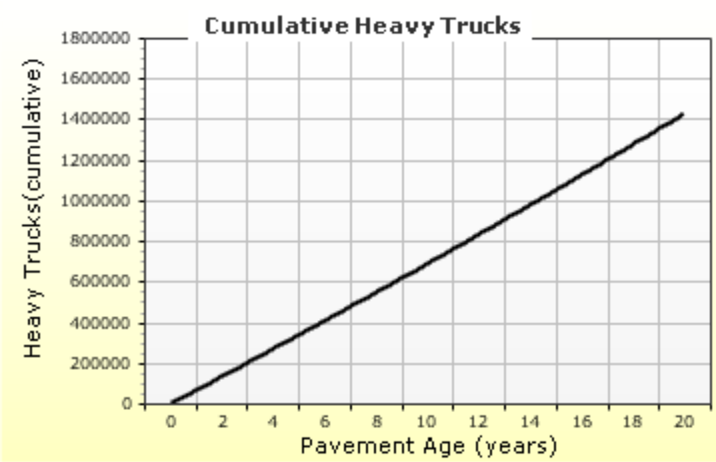
*** Traffic cap is not enforced**







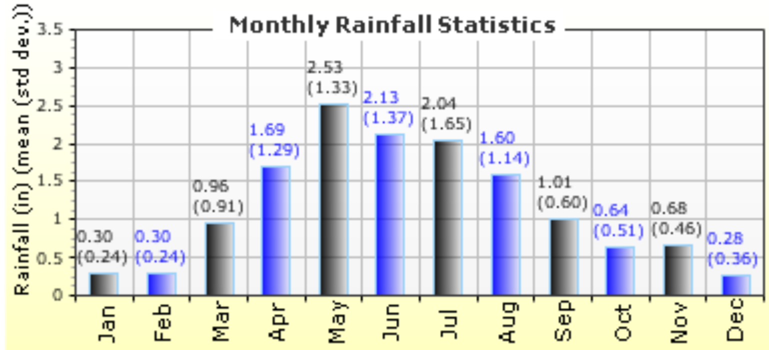




Climate Inputs

Climate Data Sources:

Climate Station Cities:	Location (lat lon elevation(ft))
BROOMFIELD, CO	39.90900 -105.11700 5670

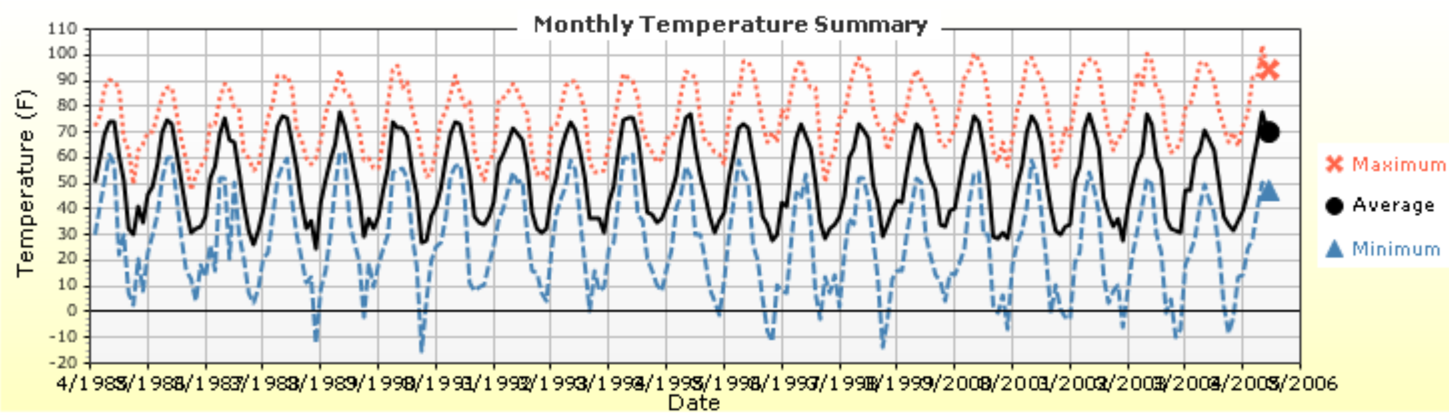


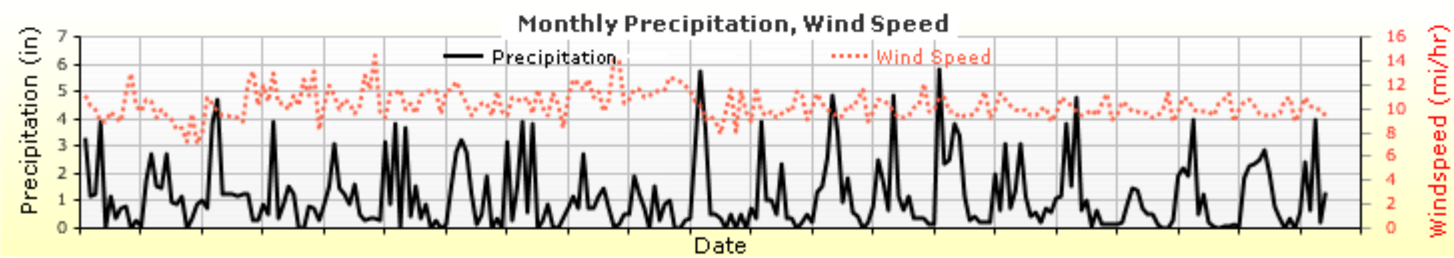
Annual Statistics:

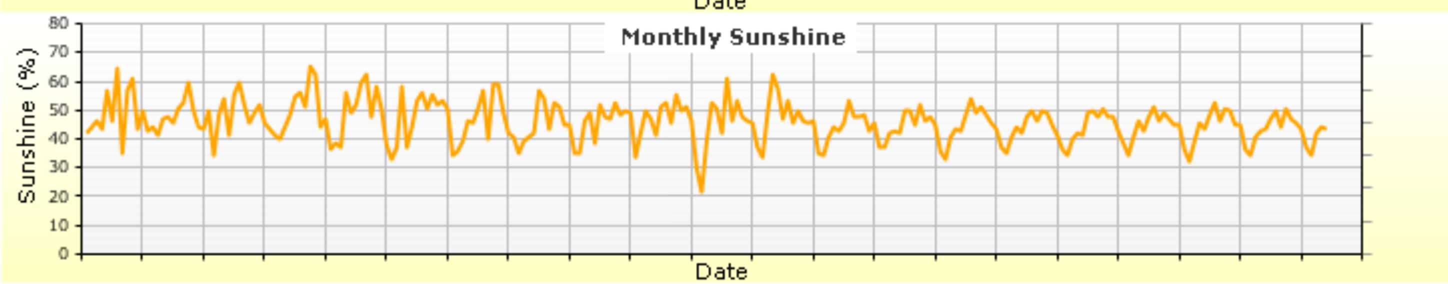
Mean annual air temperature (ºF)	51.55
Mean annual precipitation (in)	14.30
Freezing index (ºF - days)	380.82
Average annual number of freeze/thaw cycles:	96.91

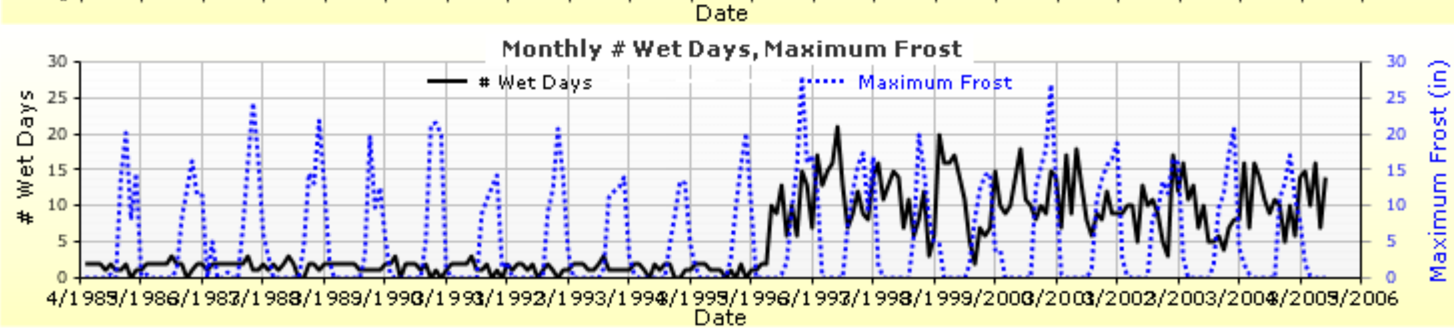
Water table depth (ft)	11.00

Monthly Climate Summary:

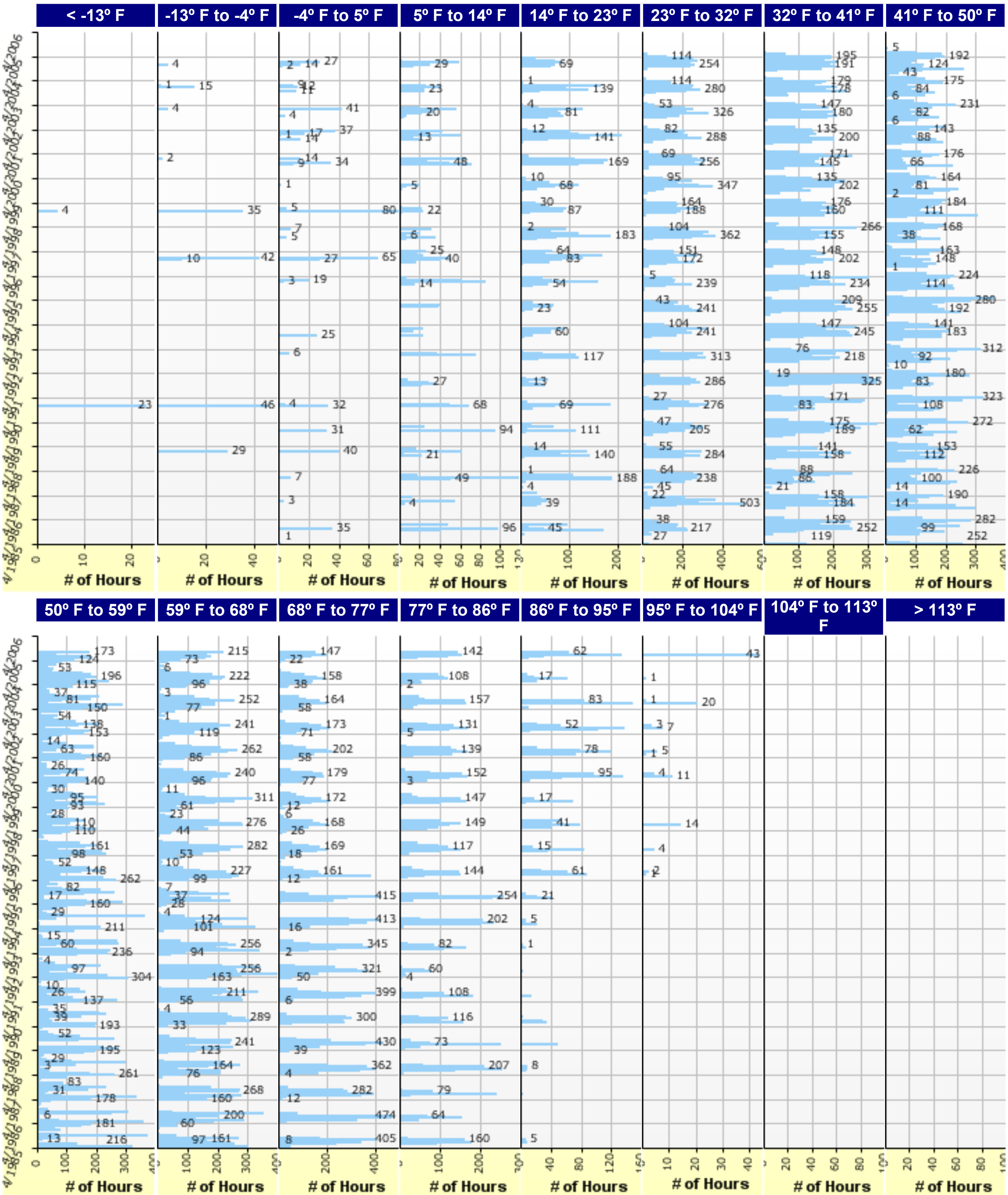








Hourly Air Temperature Distribution by Month:



Design Properties

HMA Design Properties

Use Multilayer Rutting Model	False
Using G* based model (not nationally calibrated)	False
Is NCHRP 1-37A HMA Rutting Model Coefficients	True
Endurance Limit	-
Use Reflective Cracking	True

Structure - ICM Properties	
AC surface shortwave absorptivity	0.85

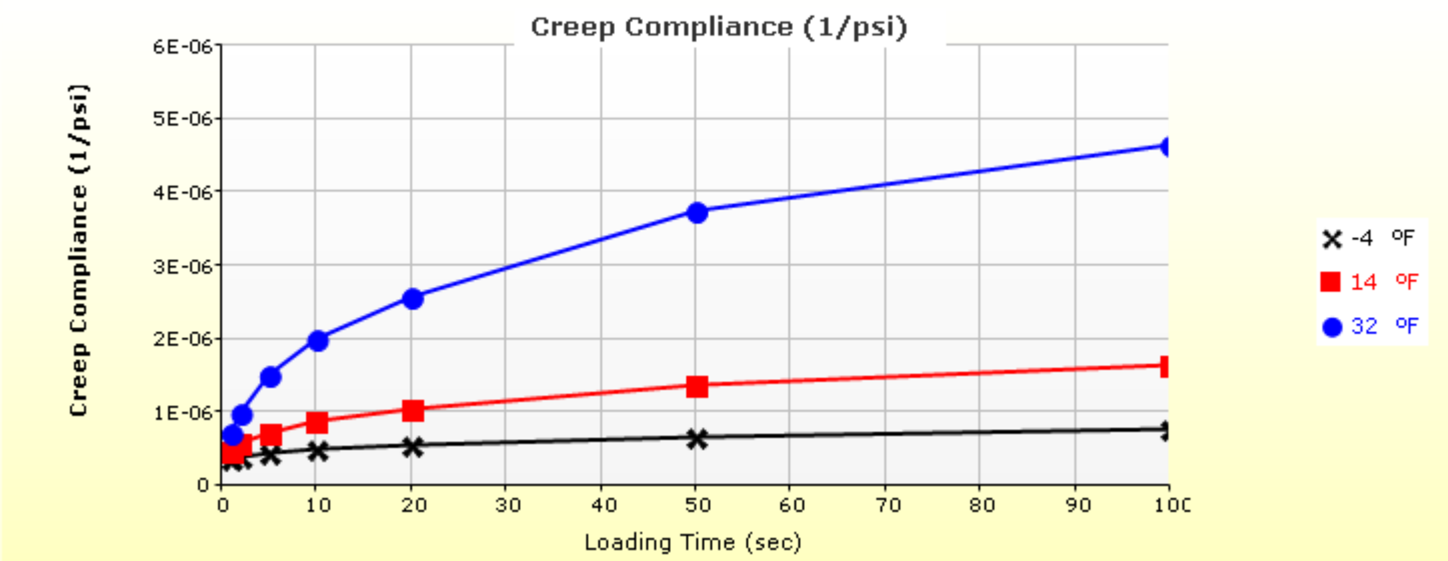
Layer Name	Layer Type	Interface Friction
Layer 1 Flexible : R3 SX(100) PG 64-28	Flexible (1)	1.00
Layer 2 Flexible : S(100) PG 64-22	Flexible (1)	1.00
Layer 3 Non-stabilized Base : CDOT CLASS 6	Non-stabilized Base (4)	1.00
Layer 4 Subgrade : A-6	Subgrade (5)	1.00
Layer 5 Subgrade : A-6	Subgrade (5)	-

Thermal Cracking (Input Level: 1)

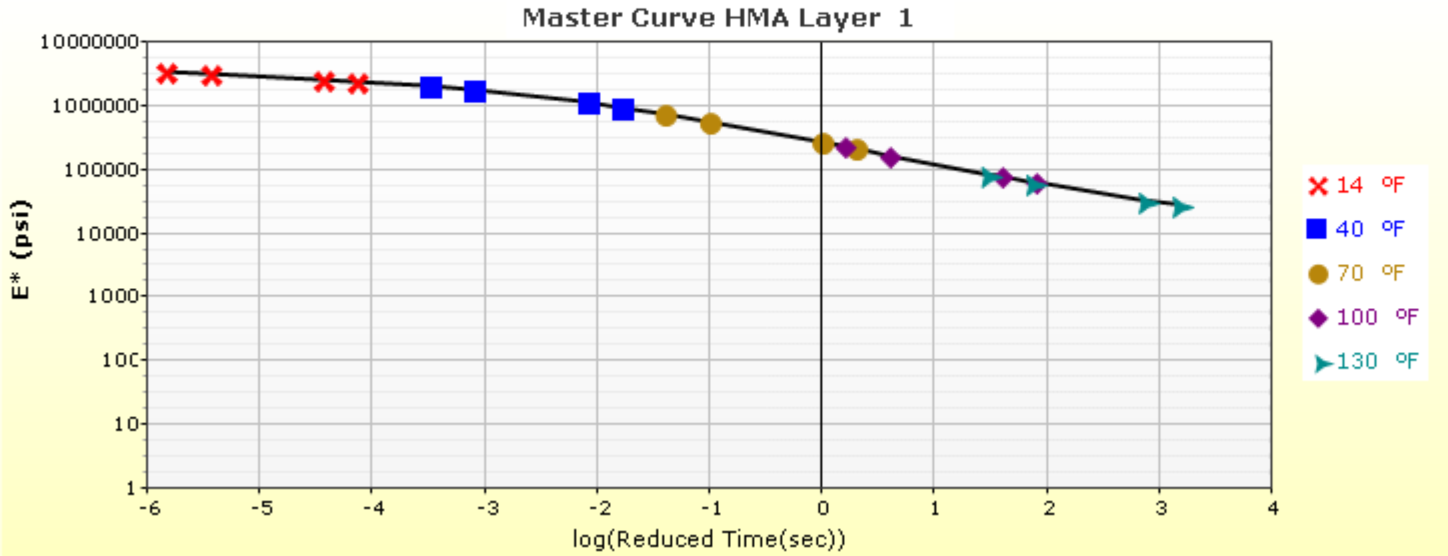
Indirect tensile strength at 14 ºF (psi)	519.00

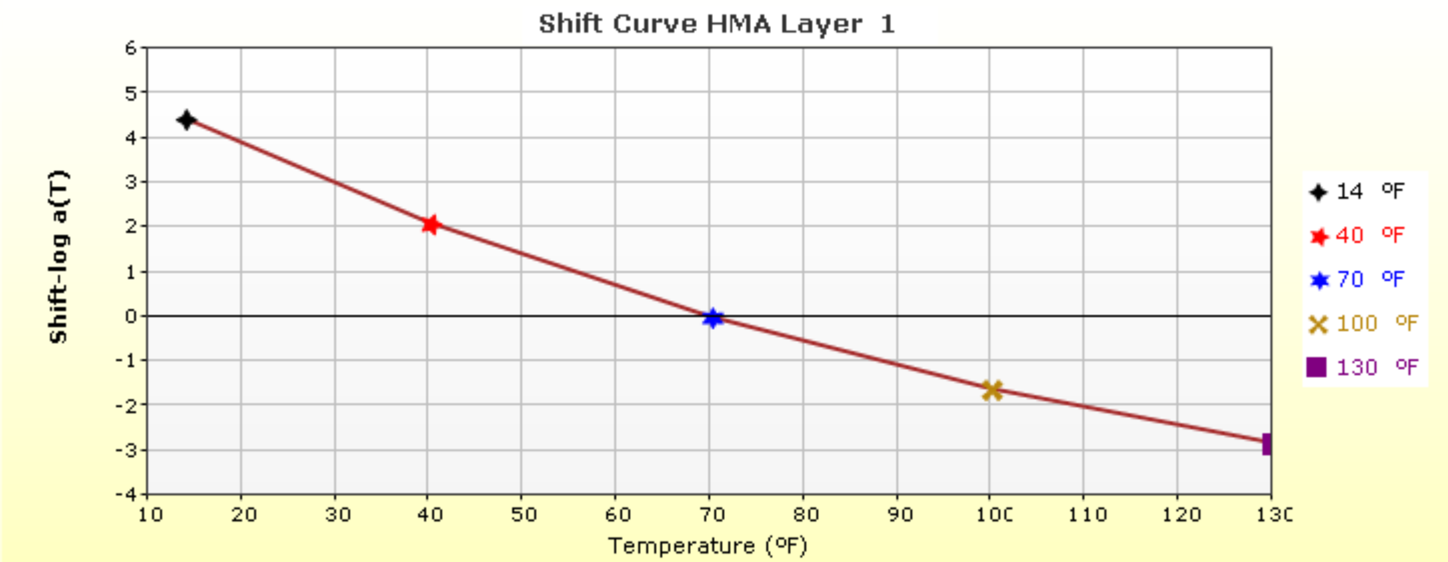
Thermal Contraction	
Is thermal contraction calculated?	True
Mix coefficient of thermal contraction (in/in/ºF)	-
Aggregate coefficient of thermal contraction (in/in/ºF)	5.0e-006
Voids in Mineral Aggregate (%)	16.4

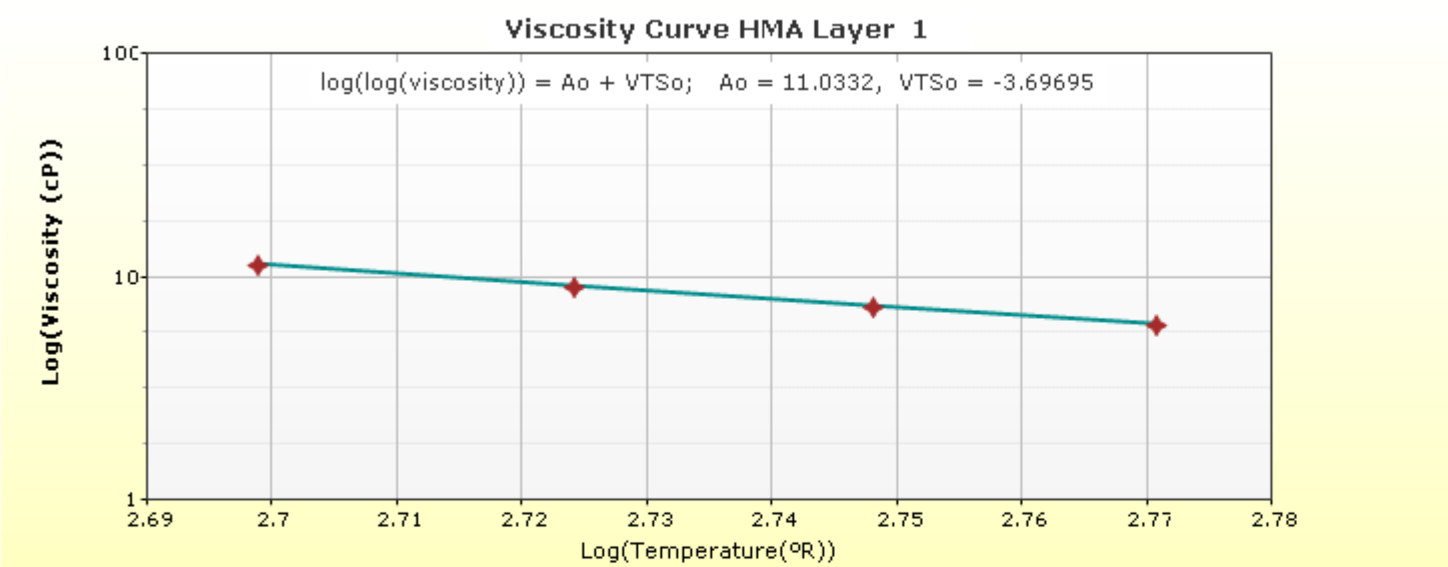
	Creep Compliance (1/psi)		
Loading time (sec)	**-4 ºF**	**14 ºF**	**32 ºF**
1	3.61e-007	4.73e-007	7.12e-007
2	4.04e-007	5.74e-007	9.97e-007
5	4.51e-007	7.35e-007	1.52e-006
10	5.11e-007	8.78e-007	1.99e-006
20	5.67e-007	1.04e-006	2.59e-006
50	6.57e-007	1.37e-006	3.75e-006
100	7.68e-007	1.66e-006	4.66e-006



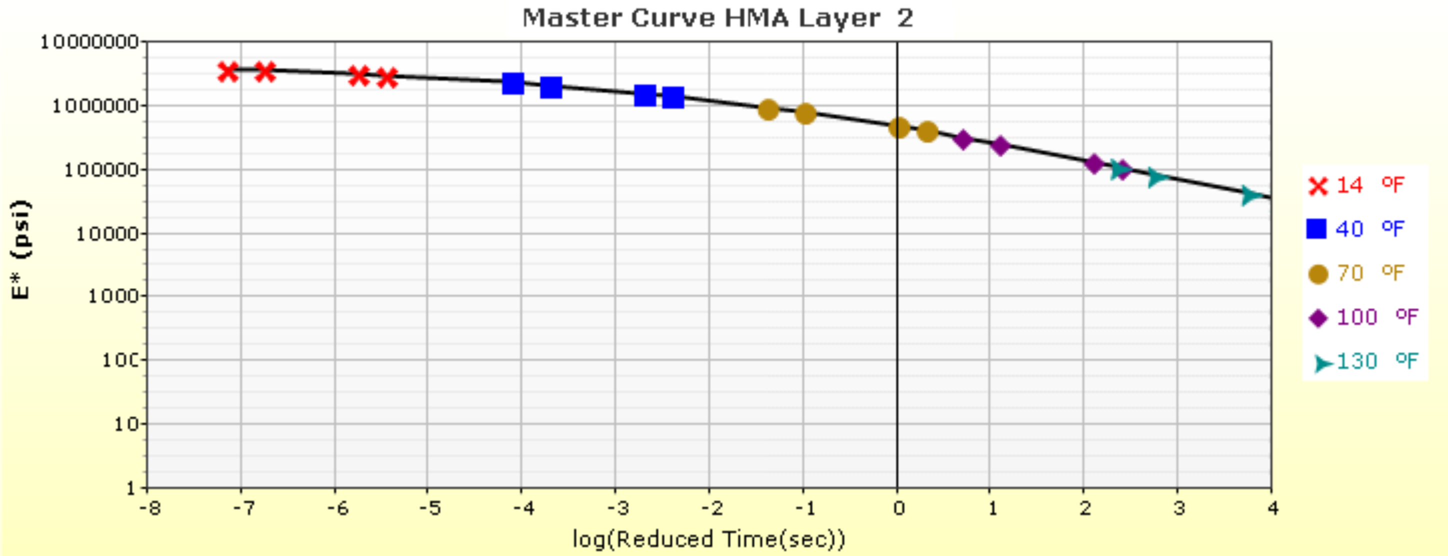
HMA Layer 1: Layer 1 Flexible : R3 SX(100) PG 64-28

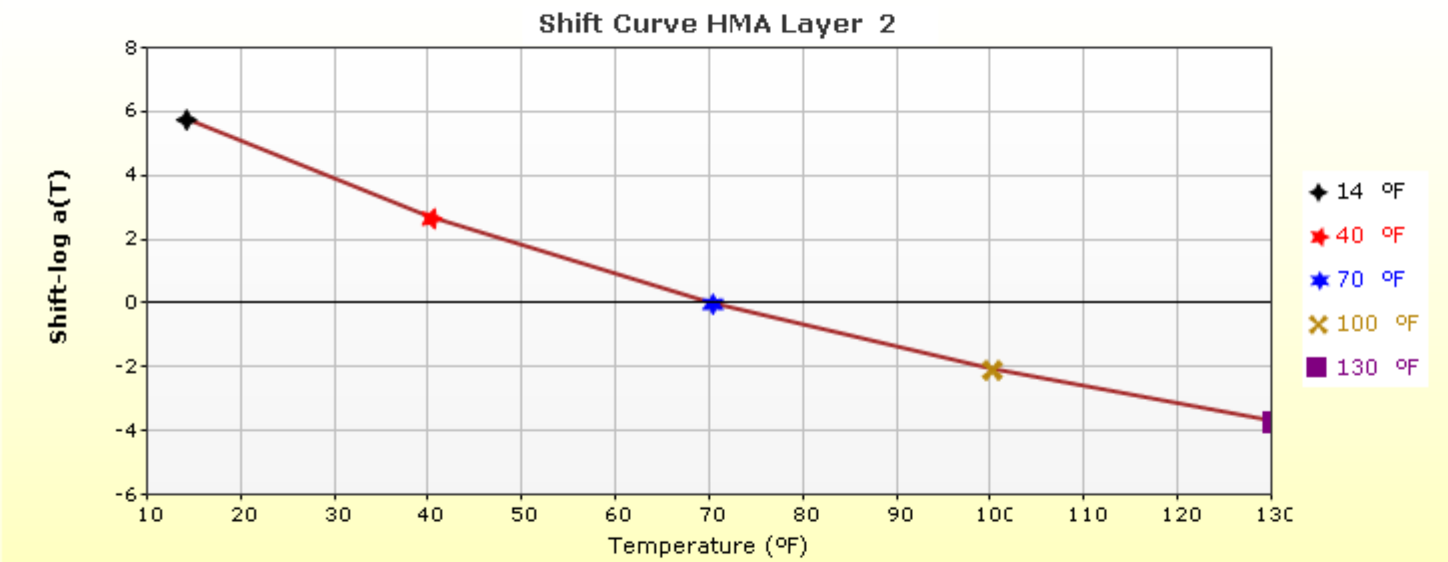


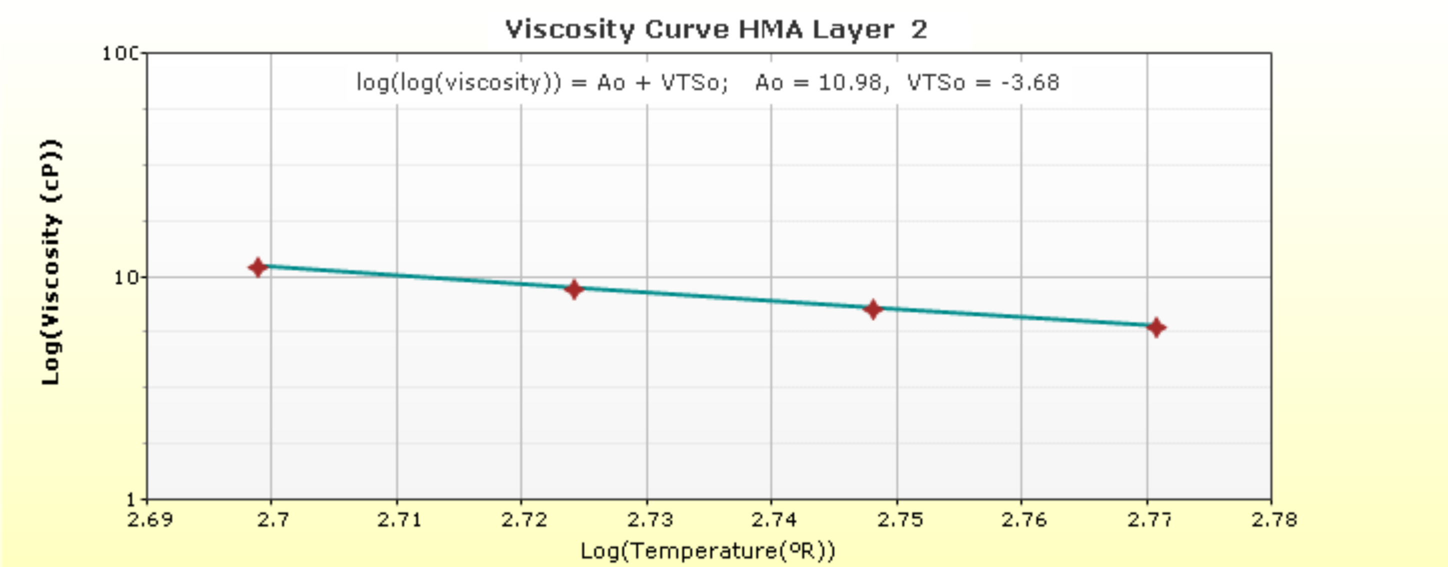




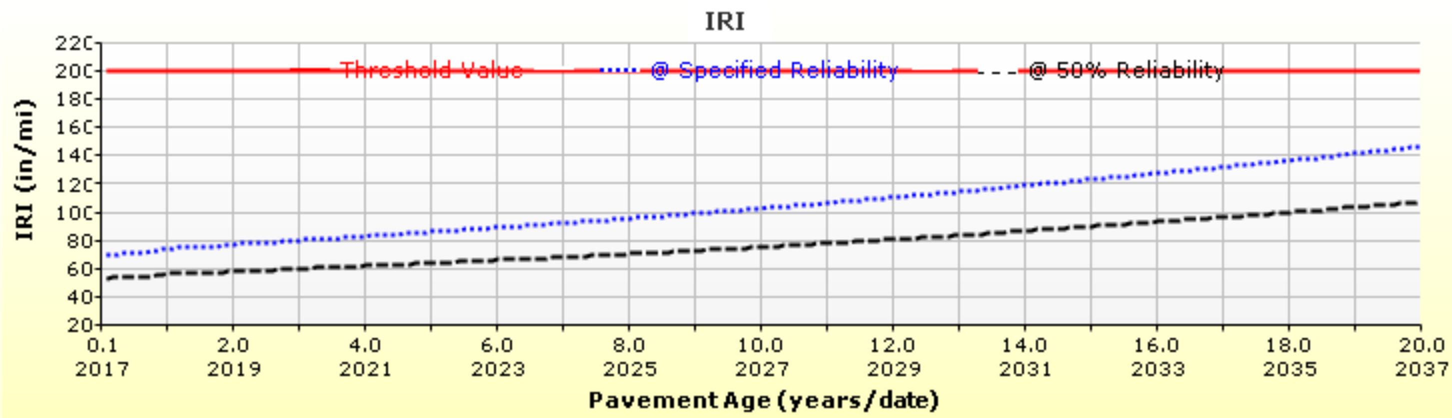
HMA Layer 2: Layer 2 Flexible : S(100) PG 64-22

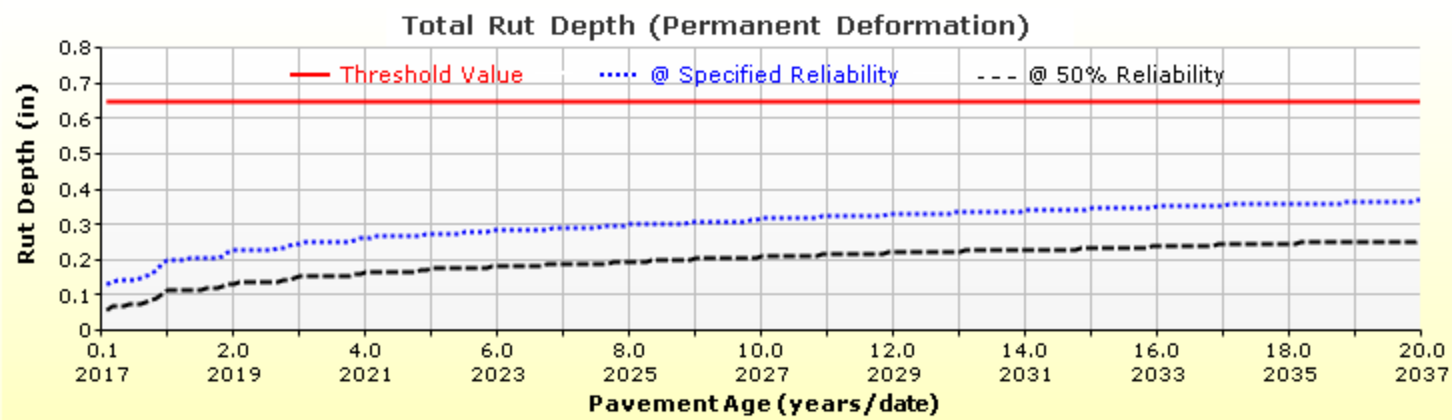


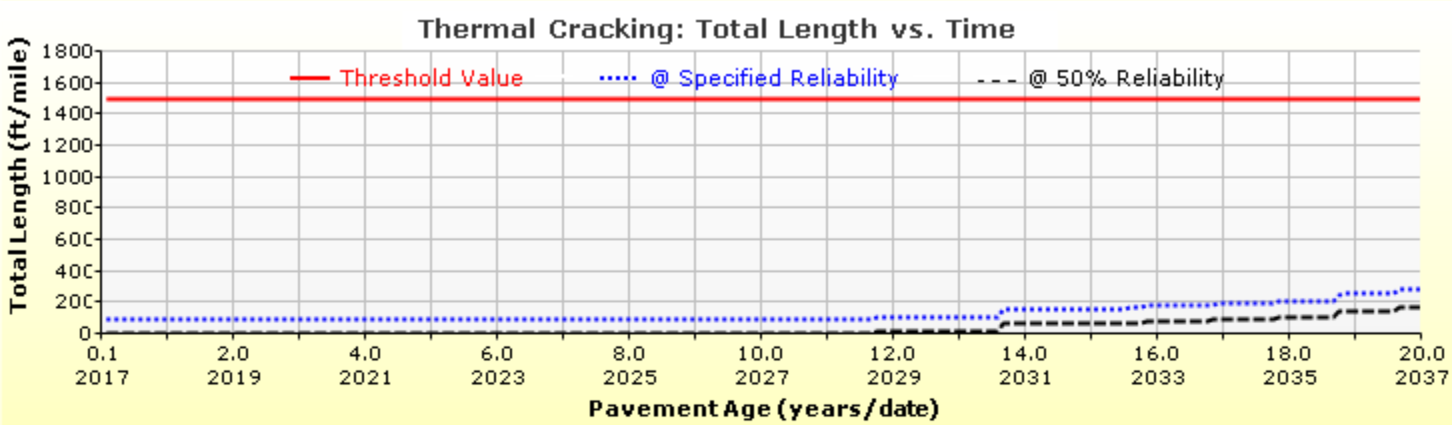


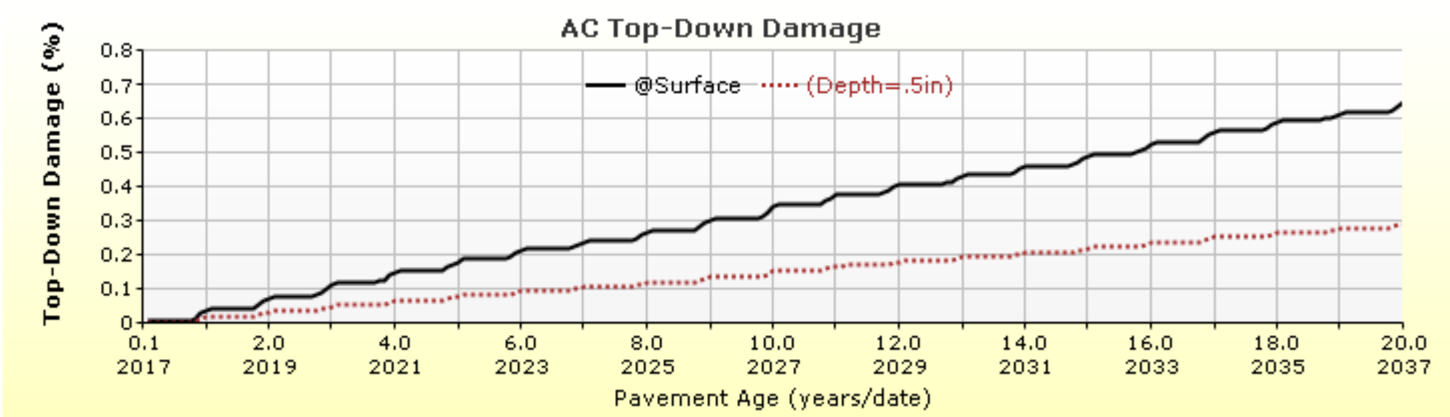


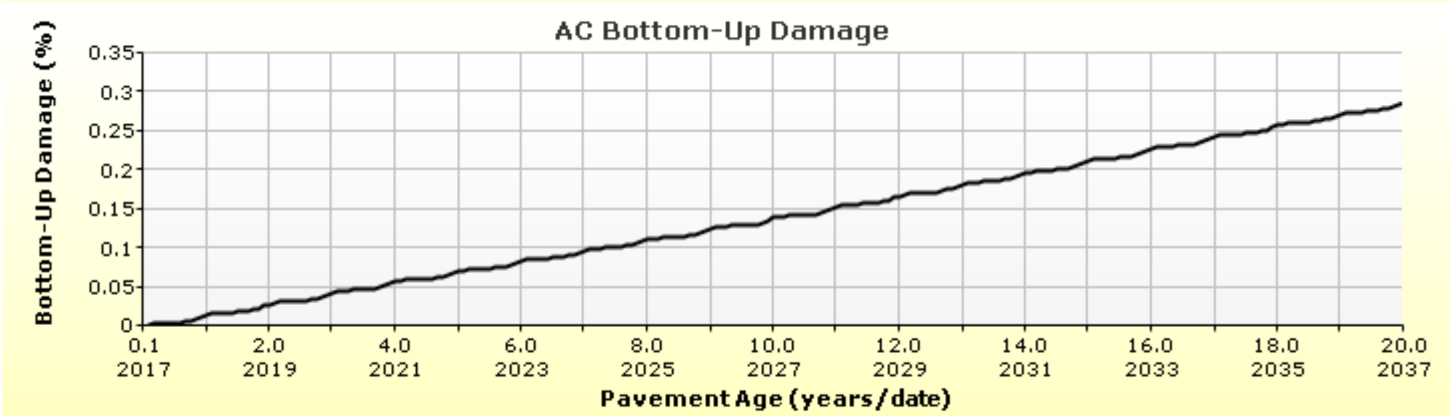
Analysis Output Charts

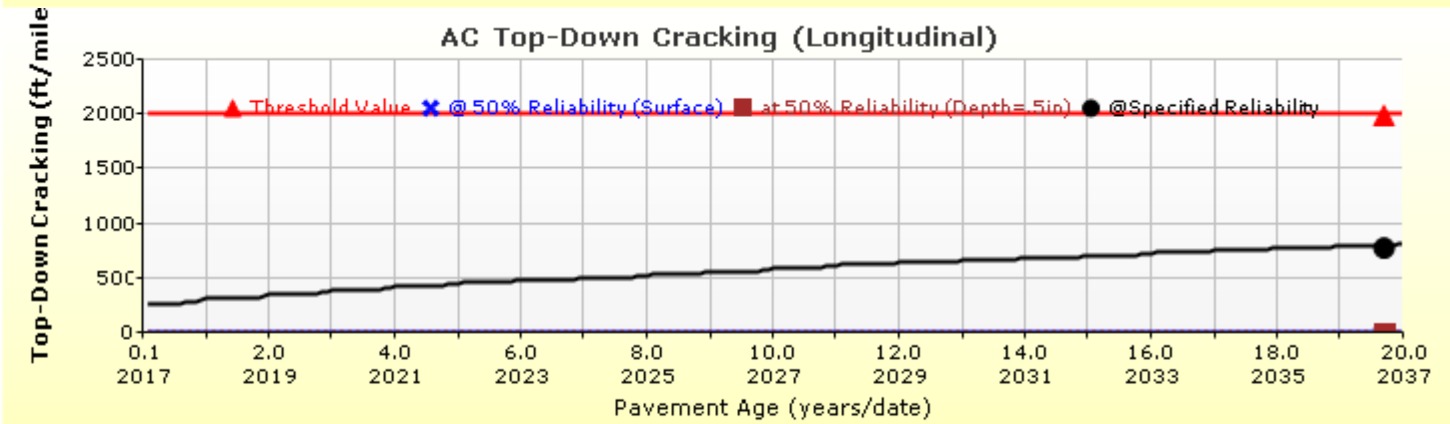


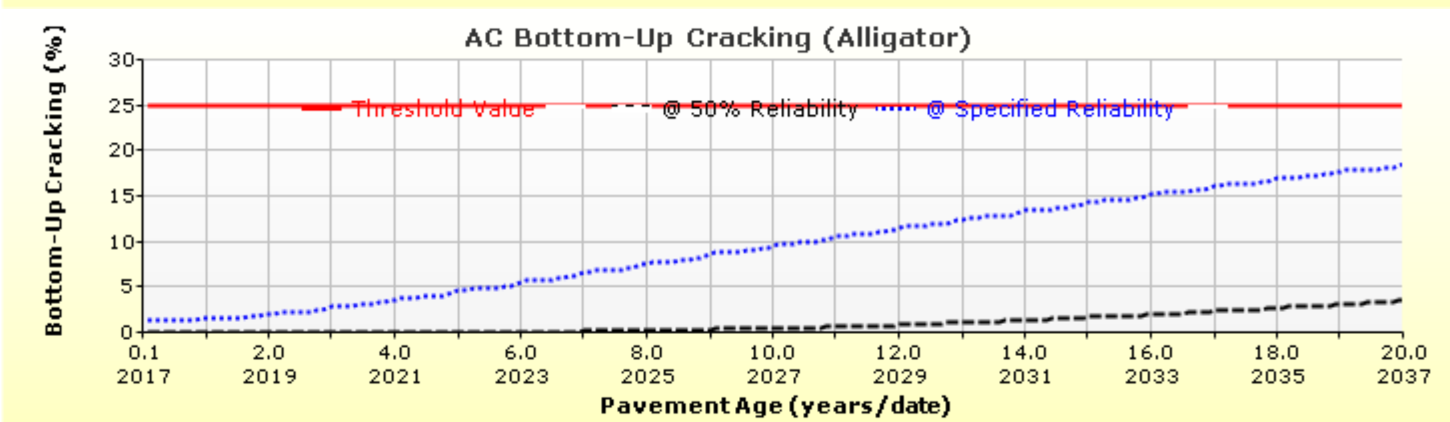


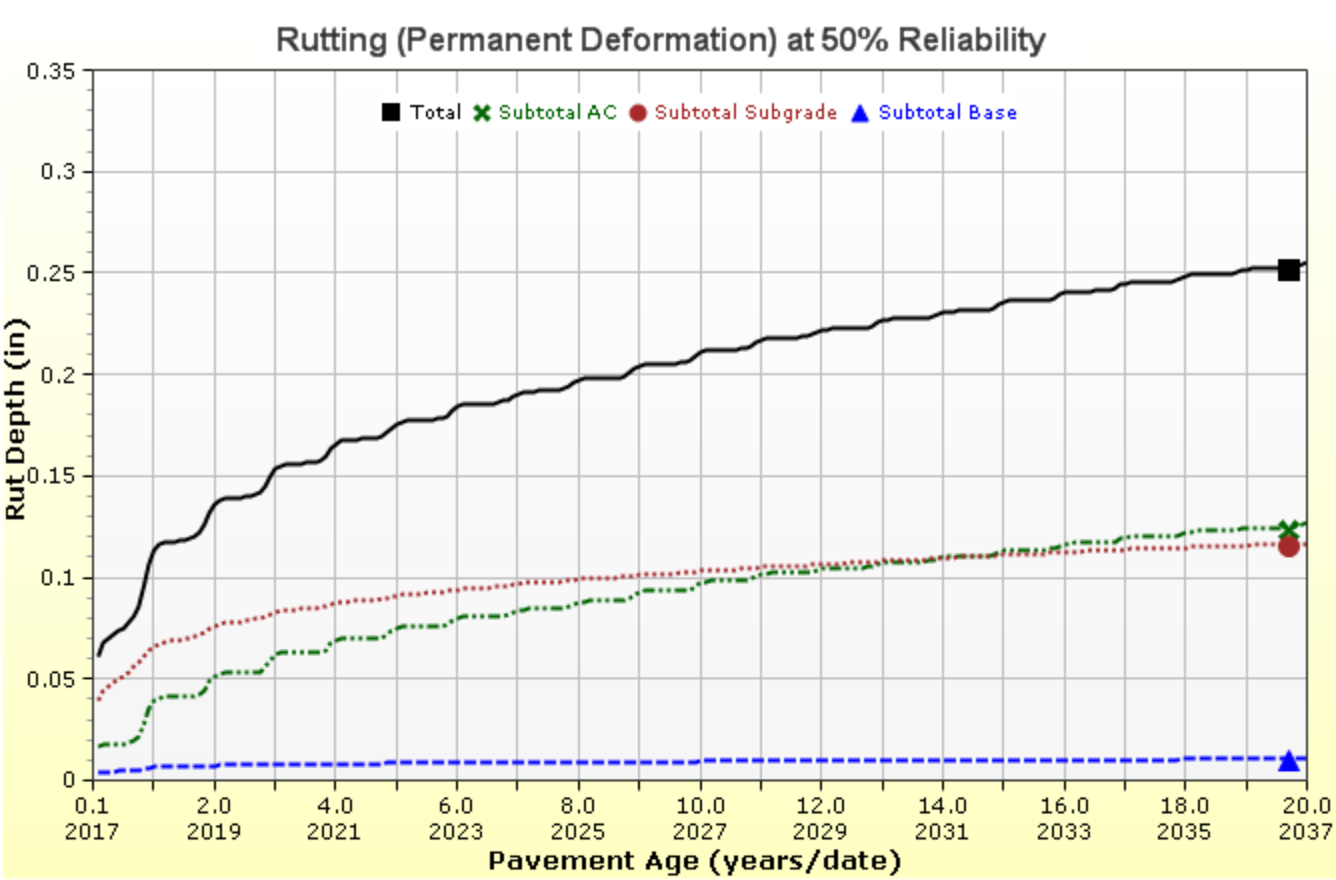


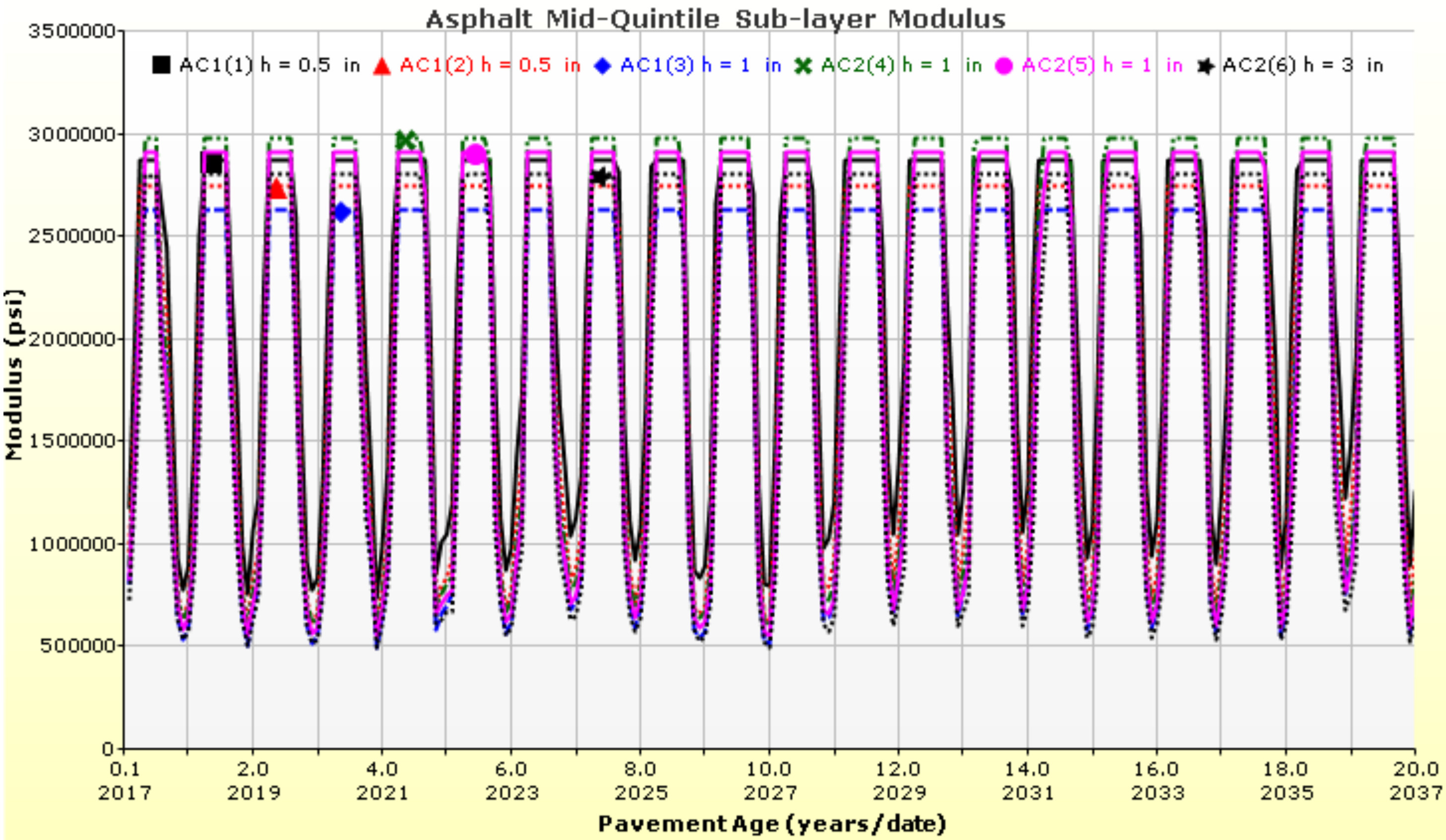

AC Top-Down Damage
@Surface
(Depth=.5in)
Top-Down Damage (%)
Pavement Age (years/date)


AC Bottom-Up Damage
Bottom-Up Damage (%)
Pavement Age (years/date)

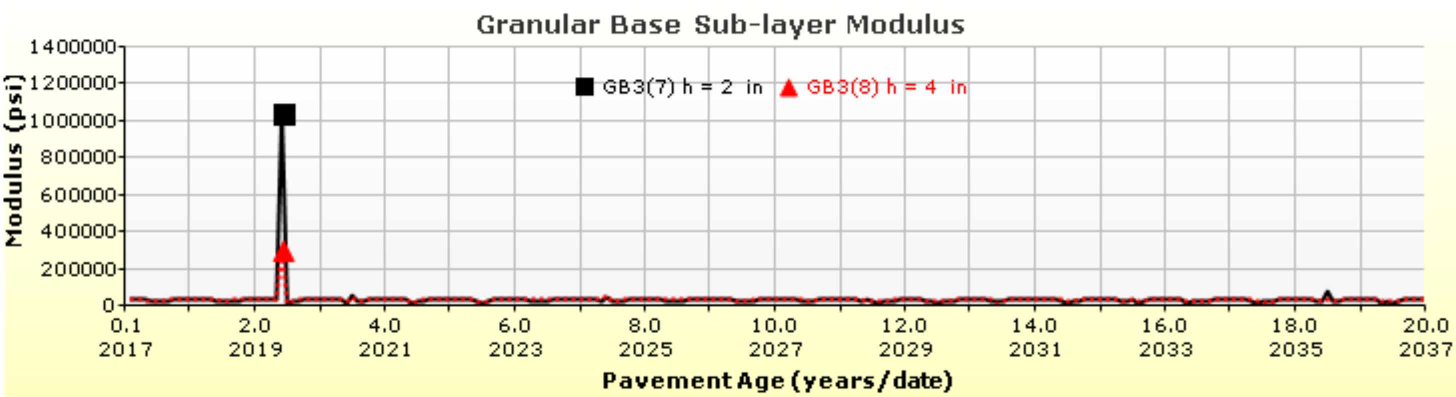

AC Top-Down Cracking (Longitudinal)
Threshold Value
@ 50% Reliability (Surface)
at 50% Reliability (Depth=.5in)
@Specified Reliability
Top-Down Cracking (ft/mile
Pavement Age (years/date)


AC Bottom-Up Cracking (Alligator)
Threshold Value
@ 50% Reliability
@ Specified Reliability
Bottom-Up Cracking (%)
Pavement Age (years/date)

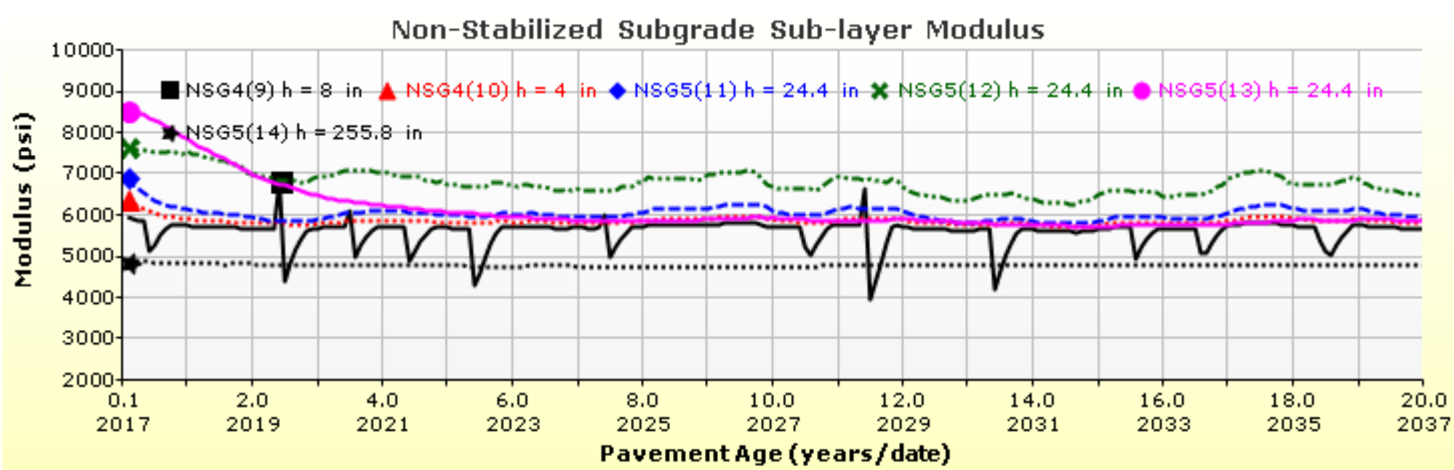

Rutting (Permanent Deformation) at 50% Reliability
Total
Subtotal AC
Subtotal Subgrade
Subtotal Base
Rut Depth (in)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.1 2017
2.0 2019
4.0 2021
6.0 2023
8.0 2025
10.0 2027
12.0 2029
14.0 2031
16.0 2033
18.0 2035
20.0 2037
Pavement Age (years/date)



Asphalt Mid-Quintile Sub-layer Modulus
AC1(1) h = 0.5 in
AC1(2) h = 0.5 in
AC1(3) h = 1 in
AC2(4) h = 1 in
AC2(5) h = 1 in
AC2(6) h = 3 in
Modulus (psi)
Pavement Age (years/date)



Granular Base Sub-layer Modulus
GB3(7) h = 2 in
GB3(8) h = 4 in
Modulus (psi)
Pavement Age (years/date)



Non-Stabilized Subgrade Sub-layer Modulus
NSG4(9) h = 8 in
NSG4(10) h = 4 in
NSG5(11) h = 24.4 in
NSG5(12) h = 24.4 in
NSG5(13) h = 24.4 in
NSG5(14) h = 255.8 in
Modulus (psi)
Pavement Age (years/date)

Layer Information

Layer 1 Flexible : R3 SX(100) PG 64-28

Asphalt		
Thickness (in)	2.0	
Unit weight (pcf)	145.0	
Poisson's ratio	Is Calculated?	False
	Ratio	0.35
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 1)

T (ºF)	0.5 Hz	1 Hz	10 Hz	25 Hz
14	1687360	2134249	2493389	2608869
40	697463	1127680	1612900	1802220
70	173403	334774	616373	765125
100	54259	93163	175106	227742
130	27890	38645	60413	74657

Asphalt Binder

Temperature (ºF)	Binder Gstar (Pa)	Phase angle (deg)
147.2	2442	68
158	1164	70
168.8	587	72

General Info

Name	Value
Reference temperature (ºF)	70
Effective binder content (%)	10.7
Air voids (%)	5.7
Thermal conductivity (BTU/hr-ft-ºF)	0.67
Heat capacity (BTU/lb-ºF)	0.23

Identifiers

Field	Value
Display name/identifier	R3 SX(100) PG 64-28
Description of object	Mix ID # FS1959-8
Author	CDOT
Date Created	4/3/2013 12:00:00 AM
Approver	CDOT
Date approved	4/3/2013 12:00:00 AM
State	Colorado
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Layer 2 Flexible : S(100) PG 64-22

Asphalt		
Thickness (in)	5.0	
Unit weight (pcf)	150.0	
Poisson's ratio	Is Calculated?	False
	Ratio	0.35
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	100
3/8-inch sieve	77
No.4 sieve	60
No.200 sieve	6

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	64-22
A	10.98
VTS	-3.68

General Info

Name	Value
Reference temperature (ºF)	70
Effective binder content (%)	11.6
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-ºF)	0.67
Heat capacity (BTU/lb-ºF)	0.23

Identifiers

Field	Value
Display name/identifier	S(100) PG 64-22
Description of object	
Author	
Date Created	10/29/2010 11:00:00 PM
Approver	
Date approved	10/29/2010 11:00:00 PM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Layer 3 Non-stabilized Base : CDOT CLASS 6

Unbound	
Layer thickness (in)	6.0
Poisson's ratio	0.35
Coefficient of lateral earth pressure (k0)	0.5

Modulus (Input Level: 3)

Analysis Type:	Modify input values by temperature/moisture
Method:	Resilient Modulus (psi)

Resilient Modulus (psi)
24000.0

Use Correction factor for NDT modulus?	-
NDT Correction Factor:	-

Identifiers

Field	Value
Display name/identifier	CDOT CLASS 6
Description of object	
Author	AASHTO
Date Created	1/1/2011 12:00:00 AM
Approver	
Date approved	1/1/2011 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	14.0
Plasticity Index	0.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	127.8
Saturated hydraulic conductivity (ft/hr)	False	1.617e-02
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	6.3

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	5.3215
bf	2.0694
cf	0.6884
hr	100.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	8.0
#100	14.0
#80	
#60	
#50	
#40	24.0
#30	27.0
#20	
#16	34.0
#10	38.0
#8	40.0
#4	48.0
3/8-in.	76.0
1/2-in.	86.0
3/4-in.	100.0
1-in.	
1 1/2-in.	
2-in.	
2 1/2-in.	
3-in.	
3 1/2-in.	

Layer 4 Subgrade : A-6

Unbound	
Layer thickness (in)	12.0
Poisson's ratio	0.35
Coefficient of lateral earth pressure (k0)	0.5

Modulus (Input Level: 3)

Analysis Type:	Modify input values by temperature/moisture
Method:	Resilient Modulus (psi)

Resilient Modulus (psi)
8644.0

Use Correction factor for NDT modulus?	-
NDT Correction Factor:	-

Identifiers

Field	Value
Display name/identifier	A-6
Description of object	Default material
Author	AASHTO
Date Created	1/1/2011 12:00:00 AM
Approver	
Date approved	1/1/2011 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	35.0
Plasticity Index	16.0
Is layer compacted?	True

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	109.2
Saturated hydraulic conductivity (ft/hr)	False	1.509e-05
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	16.8

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	106.7030
bf	0.6914
cf	0.2273
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	60.0
#100	
#80	75.0
#60	
#50	
#40	80.0
#30	
#20	
#16	
#10	90.2
#8	
#4	93.5
3/8-in.	96.4
1/2-in.	97.4
3/4-in.	98.4
1-in.	99.0
1 1/2-in.	99.5
2-in.	99.8
2 1/2-in.	
3-in.	
3 1/2-in.	100.0

Layer 5 Subgrade : A-6

Unbound	
Layer thickness (in)	Semi-infinite
Poisson's ratio	0.35
Coefficient of lateral earth pressure (k0)	0.5

Modulus (Input Level: 3)

Analysis Type:	Modify input values by temperature/moisture
Method:	Resilient Modulus (psi)

Resilient Modulus (psi)
8644.0

Use Correction factor for NDT modulus?	-
NDT Correction Factor:	-

Identifiers

Field	Value
Display name/identifier	A-6
Description of object	Default material
Author	AASHTO
Date Created	1/1/2011 12:00:00 AM
Approver	
Date approved	1/1/2011 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 2	
User defined field 3	
Revision Number	0

Sieve

Liquid Limit	35.0
Plasticity Index	16.0
Is layer compacted?	False

	Is User Defined?	Value
Maximum dry unit weight (pcf)	False	108.4
Saturated hydraulic conductivity (ft/hr)	False	1.584e-05
Specific gravity of solids	False	2.7
Optimum gravimetric water content (%)	False	16.8

User-defined Soil Water Characteristic Curve (SWCC)	
Is User Defined?	False
af	106.7030
bf	0.6914
cf	0.2273
hr	500.0000

Sieve Size	% Passing
0.001mm	
0.002mm	
0.020mm	
#200	60.0
#100	
#80	75.0
#60	
#50	
#40	80.0
#30	
#20	
#16	
#10	90.2
#8	
#4	93.5
3/8-in.	96.4
1/2-in.	97.4
3/4-in.	98.4
1-in.	99.0
1 1/2-in.	99.5
2-in.	99.8
2 1/2-in.	
3-in.	
3 1/2-in.	100.0

Calibration Coefficients

AC Fatigue

$$N_f = 0.00432 * C * \beta_{f1} k_1 \left(\frac{1}{\varepsilon_1}\right)^{k_2 \beta_{f2}} \left(\frac{1}{E}\right)^{k_3 \beta_{f3}}$$

$$C = 10^M$$

$$M = 4.84\left(\frac{V_b}{V_a + V_b} - 0.69\right)$$

k1: 0.007566	k2: 3.9492
k3: 1.281	Bf1: 130.3674
Bf2: 1	Bf3: 1.217799

AC Rutting

$$\frac{\varepsilon_p}{\varepsilon_r} = k_z \beta_{r1} 10^{k_1} T^{k_2 \beta_{r2}} N^{k_3 \beta_{r3}}$$

$$k_z = (C_1 + C_2 * depth) * 0.328196^{depth}$$

$$C_1 = -0.1039 * H_\alpha^2 + 2.4868 * H_\alpha - 17.342$$

$$C_2 = 0.0172 * H_\alpha^2 - 1.7331 * H_\alpha + 27.428$$

Where:

H_{ac} = total AC thickness(in)

ε_p = plastic strain(in/in)
ε_r = resilient strain(in/in)
T = layer temperature(°F)
N = number of load repetitions

AC Rutting Standard Deviation	0.1414 * Pow(RUT,0.25) + 0.001	
AC Layer	K1:-3.35412 K2:1.5606 K3:0.3791	Br1:4.3 Br2:1 Br3:1

Thermal Fracture

$$C_f = 400 * N\left(\frac{\log C / h_{ac}}{\sigma}\right)$$

$$\Delta C = (k * \beta t)^{n+1} * A * \Delta K^n$$

$$A = 10^{(4.389 - 2.52 * \log(E * \sigma_m * n))}$$

C_f = observed amount of thermal cracking(ft/500ft)
k = refression coefficient determined through field calibration
$N()$ = standard normal distribution evaluated at()
σ = standard deviation of the log of the depth of cracks in the pavments
C = crack depth(in)
h_{ac} = thickness of asphalt layer(in)
ΔC = Change in the crack depth due to a cooling cycle
ΔK = Change in the stress intensity factor due to a cooling cycle
A, n = Fracture parameters for the asphalt mixture
E = mixture stiffness
σ_M = Undamaged mixture tensile strength
β_t = Calibration parameter

Level 1 K: 6.3	Level 1 Standard Deviation: 0.1468 * THERMAL + 65.027
Level 2 K: 0.5	Level 2 Standard Deviation: 0.2841 * THERMAL + 55.462
Level 3 K: 6.3	Level 3 Standard Deviation: 0.3972 * THERMAL + 20.422

CSM Fatigue

$$N_f = 10^{\left(\frac{k_1 \beta_{c1} \left(\frac{\sigma_s}{M_r}\right)}{k_2 \beta_{c2}}\right)}$$

N_f = number of repetitions to fatigue cracking
σ_s = Tensile stress(psi)
M_r = modulus of rupture(psi)

k1: 1	k2: 1	Bc1: 0.75	Bc2:1.1

Subgrade Rutting

$$\delta_a(N) = \beta_{s_1} k_1 \varepsilon_v h \left(\frac{\varepsilon_0}{\varepsilon_r}\right) \left| e^{-\left(\frac{\rho}{N}\right)^\beta} \right|$$

δ_a = permanent deformation for the layer
N = number of repetitions
ε_v = average veritcal strain(in/in)
$\varepsilon_0, \beta, \rho$ = material properties
ε_r = resilient strain(in/in)

Granular		Fine	
k1: 2.03	Bs1: 0.22	k1: 1.35	Bs1: 0.37
Standard Deviation (BASERUT) 0.0104* Pow(BASERUT,0.67) + 0.001		Standard Deviation (BASERUT) 0.0663 * Pow(SUBRUT,0.5) + 0.001	

AC Cracking

AC Top Down Cracking

$$FC_{top} = \left(\frac{C_4}{1 + e^{\left(C_1 - C_2 * log_{10}(Damage)\right)}}\right) * 10.56$$

AC Bottom Up Cracking

$$FC = \left(\frac{6000}{1 + e^{\left(C_1 * C_1' + C_2 * C_2' log_{10}(D * 100)\right)}}\right) * \left(\frac{1}{60}\right)$$

$$C_2' = -2.40874 - 39.748 * (1 + h_{ac})^{-2.856}$$

$$C_1' = -2 * C_2'$$

AC Top Down Cracking				AC Bottom Up Cracking		
c1: 7	c2: 3.5	c3: 0	c4: 1000	c1: 0.021	c2: 2.35	c3: 6000
AC Cracking Top Standard Deviation				**AC Cracking Bottom Standard Deviation**		
200 + 2300/(1+exp(1.072-2.1654*LOG10 (TOP+0.0001)))				1 + 15/(1+exp(-3.1472-4.1349*LOG10 (BOTTOM+0.0001)))		

CSM Cracking

$$FC_{ctb} = C_1 + \frac{C_2}{1 + e^{C_3 - C_4(Damage)}}$$

C1: 0	C2: 75	C3: 5	C4: 3

CSM Standard Deviation

CTB*1

IRI Flexible Pavements

C1 - Rutting
C2 - Fatigue Crack
C3 - Transverse Crack
C4 - Site Factors

C1: 50	C2: 0.55	C3: 0.0111	C4: 0.02

APPENDIX B

GROUND Report Job No. 11-3089
January 30, 2012

Geotechnical Subsurface Exploration Program
North 95th Street Reconstruction
Boulder County, Colorado

Prepared for:

Matrix Design Group
1601 Blake Street, Suite 200
Denver, Colorado 80202

Attention: Mr. Mace Pemberton

Job Number 11-3089 **January 30, 2012**

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a subsurface exploration program performed by GROUND Engineering Consultants, Inc. (GROUND) to provide geotechnical recommendations for the proposed reconstruction of North 95th Street in Boulder County, Colorado. This includes the reach of North 95th Street from State Highway 52, extending south for approximately 2.5 miles, ending at the north end of the road bridge over Boulder Creek. Our study was conducted in general accordance with GROUND's Proposal No. 1109-1507, dated September 29, 2011.

Field and office studies provided information regarding surface and subsurface conditions. Material samples retrieved during the subsurface exploration were tested in our laboratory to assess the relevant engineering characteristics of the site earth materials, and assist in the development of our geotechnical recommendations. Results of the field, office, and laboratory studies are presented below.

This report has been prepared to summarize the data obtained and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of engineering considerations related to construction of the proposed roadway paving are included herein.

PROPOSED CONSTRUCTION

We understand that the project will involve reconstruction of approximately 13,950 linear feet of County roadway. The subject road will be reconstructed as a Minor Arterial Roadway in accordance with the Boulder County Road Map Classification and will be paved with flexible asphalt pavement. It is anticipated there will be no major grade or profile changes to the existing roadway.

If proposed construction, including the anticipated alignment grades, changes subsequent to the latest provided information, GROUND should be notified to re-evaluate our recommendations in this report.

ALIGNMENT CONDITIONS

The current roadway runs north-south from the City of Longmont to the City of Louisville. The subject reach begins at State Highway 52 and extends south to the bridge at Boulder Creek. The roadway is in moderate to poor condition with linear block cracking evident. Maintenance practices such as crack sealing and chip seal coating have been applied by the County. The roadway is fairly flat in the northern portion (north of Lookout Road). South of Lookout Road, the roadway's grade becomes more rolling as it descends south to Boulder Creek with a steep drop in elevation by the Farm in Boulder Valley. The current roadway is asphalt surfaced pavement with one lane running in either direction.

SUBSURFACE EXPLORATION

The subsurface exploration for the project was conducted on December, 2011. Twenty eight (28) test holes were drilled with a truck-mounted, 4-inch diameter, continuous flight, power auger rig to evaluate the subsurface conditions as well as to retrieve soil samples for laboratory testing and analysis. The test holes were drilled to depths of about 5 to 10 feet within the proposed roadway alignment at approximately 500-foot spacing. A GROUND engineer directed the subsurface exploration, logged the test holes in the field, and prepared the soil samples for transport to our laboratory. The approximate locations of our test holes are shown in Figure 1. Logs of the exploratory test holes are presented in Figure 2 & 7. Explanatory notes and a legend are provided in Figure 4.

Samples of the subsurface materials were retrieved with a 2-inch I.D. California liner sampler. The sampler was driven into the substrata with blows from a 140-pound hammer falling 30 inches. This procedure is similar to the Standard Penetration Test described by ASTM Method D1586. Penetration resistance values, when properly evaluated, indicate the relative density or consistency of soils and bedrock. Depths at which the samples were obtained and associated penetration resistance values are shown on the test hole logs. A composite bulk sample also was collected from the auger returns.

LABORATORY TESTING

Samples obtained from the exploratory holes were examined and classified in the laboratory by the project engineer. Laboratory testing of soil and bedrock samples obtained from the subject site included standard property tests, such as natural moisture contents, dry unit weights, grain size analyses and liquid and plastic limits. Swell-consolidation tests were performed on selected samples of the on-site soils, as well.

Laboratory tests were performed in general accordance with applicable AASHTO protocols. Data from the laboratory-testing program are summarized on Table 1. Gradation test results are presented in Figure 9, 10, 11, 12, 13 and 14. Compaction test results are provided in Figure 15.

SUBGRADE CONDITIONS

The existing asphalt section ranged from approximately 5 to 7 inches in thickness. Actual thicknesses are recorded in Table 2. The subsurface conditions encountered in the majority of test holes generally consisted of overburden sandy clays and clayey sands, either in their native condition or as placed fill that extended to the test hole termination depths of approximately 5 to 10 feet below the existing grades in the majority of test holes. In Test Holes 2, 3, 5, 7, 9, 11, 13, 15, 21, and 24, a layer of gravel was noted immediately below the asphalt that was generally 6 inches in thickness but up to 6 feet thick in Test Holes 13 and 15. The subsurface conditions in Test Hole 24 consisted of sandstone bedrock.

Delineating the complete vertical and lateral extents and composition of all fills that may be present was beyond our present scope of services. Because of the history of construction and grading operations, the contractor should anticipate encountering fill soil of varying depths throughout the alignments.

Fill consisted of sandy clays and clayey sands with scattered gravel. They were low to moderately plastic, the sand fractions were fine to medium grained, stiff to very stiff, dry to moist, and light brown in color.

Sand and Clay soils encountered consisted of sandy clays with local clayey sands. They were low to moderately plastic, the sand fractions were fine to medium grained, stiff to very stiff, dry to moist, and light brown in color.

Sandstone Bedrock was medium grained, non-plastic, very dense, slightly moist and local iron staining in the upper few feet.

Swell-Consolidation Testing indicated low to moderate potential for post-construction movement in the tested on-site materials. A swell of 0.3 percent and consolidations of 0.1 to 3.9 percent were measured upon wetting under a 200-psf surcharge load. (See Table 1).

Groundwater was not encountered in the test holes at the time of subsurface exploration to the depths explored. Groundwater levels should be anticipated to fluctuate, however, in response to annual and longer-term cycles of precipitation, applied irrigation, drainage and other factors.

PAVEMENT SECTION RECOMMENDATIONS

A pavement section is a layered system constructed to distribute concentrated traffic loads to the subgrade. Pavement sections for North 95th Street were developed in general accordance with Boulder County Multimodal Transportation Standards. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and traffic loadings. The standard of practice for development of pavement sections describes the recommended flexible pavement section as a “20-year design-life” pavement. However, most flexible pavements will not remain in satisfactory condition without routine maintenance and rehabilitation procedures performed throughout the life of the pavement.

Subgrade Materials Based on the results of our field and laboratory studies, subgrade materials in the proposed pavement area consisted predominantly of sandy clays. These materials typically classified as A-2-4, A-4, A-6 and A-7-6 soils in accordance with the AASHTO classification system, with Group Index values ranging from 0 to 18.

Resilient Modulus (M_R) testing (AASHTO T-307) was performed on a representative composite sample of the subgrade materials encountered at the site. Typically, the R-value, unconfined compressive strength, California Bearing Ratio (CBR), or other index properties of subgrade materials have been obtained and the resilient modulus obtained only by correlation. However, due to the variability in the correlations, subjecting representative samples of the subgrade to the actual resilient modulus testing is the most accurate way to determine soil support characteristics for use in pavement design.

A dynamic load test, the resilient modulus measures the elastic rebound stiffness of flexible pavement materials, base courses and subgrades under repeated loading. The loading cycles were applied under various confining and deviatoric stresses as specified in AASTHO T-294. The material was compacted to 95 percent of maximum dry density at optimum moisture content, and at 2 percent and 4 percent above the optimum, based on AASHTO T-99 (the “standard Proctor”) for cohesive soils, or AASHTO T-180 (the “modified Proctor”) for granular soils.

The resilient modulus of a material at 2 percent above optimum moisture content typically is used for the pavement design for fine-grained soils that classify as A-4, A-6, or A-7. The resilient modulus at the optimum moisture content is typically used for granular soils that classify as A-1 or A-2. For the clayey shallow site soils, the resilient modulus at 2 percent above the optimum moisture content was taken as representative of the subgrade materials. Therefore, a resilient modulus 4,202 psi was used for pavement design obtained at 2 percent above the optimum moisture content.

It is important to note that significant decreases in soil support as quantified by the resilient modulus have been observed as the moisture content increases above the optimum. Therefore, pavements that are not properly drained may experience a loss of the soil support and subsequent reduction in pavement life.

Anticipated Traffic Specific traffic loadings were provided by Matrix Design for the approximate 24-hour period of October 11, 2011 at 9.55 am through Wednesday October 12, 2011 at 10.21 am. The average daily traffic (ADT) traffic loading was converted to an equivalent 18-kip single axle load (ESAL) value of 1,205,187 for a 20-year design life utilizing table 1.2 of the Colorado Department of Transportation Pavement Design Manual. A growth factor of 2 percent was then applied over the 20 year period with the median traffic count at 10 years utilized for the pavement design section. If the development of pavement design thickness based on the full 20 year design is preferred, an additional ½inch of asphalt thickness should be added to the design sections given in the table below.

If street classification or the design traffic loadings differ significantly from these estimated values, GROUND should be notified to re-evaluate the recommended minimum pavement sections provided below.

Pavement Design The soil resilient modulus and the design ESAL values were used to determine the required design structural number for the project pavements. The required structural number was then used to develop recommended pavement sections. Pavement designs were based on the DARWin™ computer program that solves the 1993 AASHTO pavement design equation. Pavement design parameters and calculations are summarized in Appendix A. A Reliability Level of 95 percent was utilized for design of the pavement sections. Structural coefficients of 0.44 and 0.12 were used for hot bituminous asphalt and high quality aggregate base course, respectively.

GROUND recommends the following flexible asphalt pavement section be placed for the project.

Recommended Minimum Pavement Sections

Location	***Full Depth Asphalt*** *(inches Asphalt)*	***Composite Section*** *(inches Asphalt / inches Aggregate Base)*
North 95th Street	10.5**	7** / 13

(** Asphalt thickness design based on traffic growth at 10 years. Add ½-inch thickness asphalt if the 20 year traffic growth value is preferred for thickness calculations.)

Asphalt pavement should consist of a bituminous plant mix composed of a mixture of aggregate and bituminous material. Asphalt mixture(s) should meet the requirements of a job-mix formula established by a qualified engineer as well as applicable design requirements of Boulder County.

The aggregate base material placed under the composite asphalt pavements and concrete roadway pavements should meet the criteria of CDOT Class 6 aggregate base course. Base course should be placed in uniform lifts not exceeding 8 inches in loose thickness and compacted to at least 95 percent of the maximum dry density a uniform moisture contents within 3 percent of the optimum as determined by ASTM D1557 / AASHTO T-180, the “modified Proctor.”

Subgrade Preparation Due to the plastic nature of the site soils as well as the potential for vertical movement, some post-construction movements of the pavements should be anticipated. Shortly before placement of pavement, the exposed subgrade soils (including existing aggregate base) along the alignment should be excavated to a depth of 24 inches, mixed to achieve a uniform moisture content and then re-compacted. Subgrade preparation should extend the full width of the pavement from edge of shoulder to edge of shoulder. A greater depth of excavation and replacement will result in improved pavement performance over its design life. Recommendations in this regard can be provided upon request.

Subgrade soil should be moisture conditioned and compacted in accordance with the *Project Earthwork* section of this report.

The Contractor should be prepared either to dry the subgrade materials or moisten them, as needed, prior to compaction. It may be difficult for the contractor to achieve and maintain compaction in some silty sand soils encountered along the alignment without careful control of water contents. Some site soils will “pump” or deflect during compaction if moisture levels are not carefully controlled. The contractor should be prepared to process and compact such soils to establish a stable platform for paving, including use of chemical stabilization, if necessary.

Immediately prior to paving, the subgrade should be proof rolled with a heavily loaded, pneumatic tired vehicle. Areas that show excessive deflection during proof rolling should be excavated and replaced and/or stabilized. Areas allowed to pond prior to paving will require significant re-working prior to proof-rolling. All subgrade preparation must ultimately comply with roadway inspection, testing, and construction procedures outlined by Boulder County.

Additional Observations The collection and diversion of surface drainage away from paved areas is extremely important to satisfactory performance of the pavements. The subsurface and surface drainage systems should be carefully designed to ensure removal of the water from paved areas and subgrade soils. Allowing surface waters to pond on pavements will cause premature pavement deterioration. Where topography, site constraints or other factors limit or preclude adequate surface drainage, pavements should be provided with edge drains to reduce loss of subgrade support.

GROUND's experience indicates that longitudinal cracking is common in asphalt-pavements generally parallel to the interface between the asphalt and concrete structures such as curbs, gutters or drain pans. Distress of this type is likely to occur even where the subgrade has been prepared properly and the asphalt has been compacted properly.

The design traffic loading does not include excess loading conditions imposed by heavy construction vehicles. Consequently, heavily loaded construction material trucks can have a detrimental effect on the pavement. GROUND recommends that an effective program of regular maintenance be developed and implemented to seal cracks, repair distressed areas, and perform thin overlays throughout the life of the pavements.

As noted above, the standard of practice in pavement design describes the recommended flexible pavement section as a "20-year" design pavement; however, most pavements will not remain in satisfactory condition without routine, preventive maintenance and rehabilitation procedures performed throughout the life of the pavement. Preventive measures include surface rehabilitation and operations applied to improve or extend the functional life of a pavement. These treatments preserve, rather than improve, the structural capacity of the pavement structure. In the event the existing pavement is not structurally sound, the preventive maintenance will have no long-lasting effect. Therefore, a routine maintenance program to seal cracks, repair distressed areas, and perform thin overlays throughout the life of the pavement is recommended.

A crack sealing and fog seal/chip seal program should be performed on the roadway alignments every 3 to 4 years. After approximately 8 to 10 years, patching, additional crack sealing, and asphalt overlay may be required. Prior to future overlays, it is important that all transverse and longitudinal cracks be sealed with a flexible, rubberized crack sealant in order to reduce the potential for propagation of the crack through the overlay. Traffic volumes that exceed the values utilized by this report will likely necessitate the need of pavement maintenance practices on a schedule of shorter timeframe than that stated above. “The greatest benefit of preventive maintenance is achieved by placing the treatments on sound pavements that have little or no distress.”

SURFACE DRAINAGE

The following drainage precautions should be observed during construction and maintained at all times after the proposed alignment has been constructed.

1) Wetting or drying of the pavement subgrade should be avoided during construction.

2) Positive surface drainage measures should be provided and maintained to reduce water infiltration into subgrade soils. In no case should water be allowed to pond near or adjacent to pavement elements. Ponding will lead to increased infiltration and post-construction movements.

   Drainage measures also should be included in project design to direct water away from sidewalks and other hardscaping as well as utility trench alignments which are likely to be adversely affected by moisture-volume changes in the underlying soils or flow of infiltrating water. Routine maintenance of site drainage should be undertaken throughout the design life of the project.

   In GROUND’s experience, it is common during construction that in areas of partially completed paving or hardscaping, bare soil behind curbs and gutters, and utility trenches, water is allowed to pond after rain or snow-melt events. Wetting of the subgrade can result in loss of support and increased settlements or heave. By the time final grading has been completed, significant volumes of water can already have entered the subgrade, leading to subsequent distress and failures. The contractor should maintain effective site drainage throughout construction so that water is directed into appropriate drainage structures.

3) The ground surface near pavement elements should be able to convey water away readily. Ground coverings that direct water downward rather than away from the pavements should not be used to cover the ground surface near the pavements or other improvements sensitive to post-construction soil movements.

Cobbles or other materials that tend to act as baffles and restrict surface flow should not be used.

Correspondingly, near other project improvements such as hardscaping, where the ground surface does not convey water away readily additional post-construction movements and distress should be anticipated.

4) Landscaping which requires watering should be located 10 or more feet from the pavements. Irrigation sprinkler heads should be deployed so that applied water is not introduced into pavement subgrade soils. Landscape irrigation should be limited to the minimum quantities necessary to sustain healthy plant growth.

   Use of drip irrigation systems can be beneficial for reducing over-spray beyond planters. Drip irrigation also can be beneficial for reducing the amounts of water introduced to subgrade soils, but only if the total volumes of applied water are controlled with regard to limiting that introduction. Controlling rates of moisture increase beneath the pavements should take higher priority than minimizing landscape plant losses.

   Where plantings are desired within 10 feet of the pavements, GROUND recommends that the plants be placed in water-tight planters, constructed either in-ground or above-grade, to reduce moisture infiltration in the surrounding subgrade soils. Planters should be provided with positive conveyance well away from the subgrade soils or off-site for collected waters.

5) We do not recommend the use of plastic membranes to cover the ground surface near the pavements without careful consideration of other components of project drainage. Plastic membranes can be beneficial to directing surface waters away from the pavements and toward drainage structures. However, they effectively preclude evaporation or transpiration of shallow soil moisture. Therefore, soil moisture tends to increase beneath a continuous membrane. Where plastic membranes are used, additional shallow, subsurface drains should be installed. Perforated “weed barrier” membranes, which allow ready evaporation from the underlying soils may be used.

6) Edge drains should be provided if nearby slopes direct water towards streets or if other means of removing water are not provided.

PROJECT EARTHWORK

General Considerations We do not anticipate that more than minor grading operations will be required to prepare the alignment for paving. Grading of the alignment and adjacent areas should be planned carefully to provide positive surface drainage away from all pavements and utility alignments. Surface diversion features should be provided around paved areas to prevent surface runoff from flowing across the paved surfaces.

Use of On-Site Materials as Fill The subgrade soils encountered along the project alignment, free of trash or other deleterious materials are suitable, in general, for placement as fill. Fragments of rock, cobbles, and inert construction debris (e.g., concrete or asphalt) larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. In general, such materials should be placed as deeply as possible in the project fills. A geotechnical engineer should be consulted regarding appropriate recommendations for usage of such materials on a case-by-case basis when such materials have been identified during earthwork. Standard recommendations that likely will be generally applicable can be found in Section 203 of the current CDOT Standard Specifications for Road and Bridge Construction.

Imported Fill Materials If it is necessary to import material to the site, the imported soils should be similar to the native sands and clays and should be free of organic material, claystone, and other deleterious materials. Imported material should consist of relatively impervious soils that have less than 60 percent passing the No. 200 Sieve and should have a plasticity index of less than 12. In addition, any imported soil placed within 24 inches of finished subgrade should have a minimum R-Value of 15. All materials proposed for import should be tested and approved by a geotechnical engineer based on their intended use, prior to transport to the site. The geotechnical engineer should be provided with samples of the proposed materials at least 1 week prior to importing.

Fill Platform Preparation Prior to filling, the top 8 to 12 inches of in-place materials on which fill soils will be placed should be scarified, moisture conditioned and properly compacted in accordance with the recommendations below to provide a uniform base for fill placement.

If surfaces to receive fill expose loose, wet, soft or otherwise deleterious material, additional material should be excavated, or other measures taken, to establish a firm platform for filling. The surfaces to receive fill must be effectively stable prior to placement of fill.

Fill Placement Fill materials should be thoroughly mixed to achieve a uniform moisture content, placed in uniform lifts not exceeding 8 inches in loose thickness, and properly compacted. Soils that classify as A-1 through A-5, in accordance with AASHTO, should be compacted to 95 or more percent of the maximum Proctor dry density at moisture contents within 2 percent of optimum moisture content as determined by AASHTO T180, the “modified Proctor.” Soils that classify as A-6 and A-7 should be compacted to 95 percent of the maximum Proctor density at moisture contents from optimum to 2 percent above the optimum moisture content as determined by AASHTO T99, the “standard Proctor.”

No fill materials should be placed, worked, or rolled while they are frozen, thawing, or during poor/inclement weather conditions.

Care should be taken with regard to achieving and maintaining proper moisture contents during placement and compaction. We anticipate that some on-site soils may exhibit significant pumping, rutting, and deflection at moisture contents near optimum and above. In our experience, achieving and maintaining compaction in such soils can be very difficult, particularly if water contents are not monitored closely. The Contractor should be prepared to handle soils of this type, including the use of chemical stabilization, if necessary.

Compaction areas should be kept separate, and no lift should be covered by another until relative compaction and moisture content within the recommended ranges are obtained.

Settlements Settlements will occur in filled ground, typically on the order of 1 to 2 percent of the fill depth. If fill placement is performed properly and is tightly controlled, in GROUND’s experience the majority (on the order of 60 to 80 percent) of that settlement will typically take place during earthwork construction, provided the contractor achieves the compaction levels recommended herein. The remaining potential settlements likely will take several months or longer to be realized, and may be exacerbated if these fills are subjected to changes in moisture content.

Cut and Filled Slopes Permanent site slopes supported by on-site soils up to 3 feet in height may be constructed no steeper than 2½:1 (horizontal : vertical). Minor raveling or surficial sloughing should be anticipated on slopes cut at this angle until vegetation is well re-established. Surface drainage should be designed to direct water away from slope faces.

Frost and Ice Based on the results of the field exploration as well as the laboratory testing, it does not appear that the subsurface conditions require special design considerations for the purpose of addressing unusual frost heave potential at the project site. Proper drainage incorporated into design of the pavements should reduce the potential for heave associated with the formation of ice.

Nearly all soils other than relatively coarse, clean, granular materials are susceptible to loss of density if allowed to become saturated and exposed to freezing temperatures and repeated freeze – thaw cycling. The infiltration of surface waters and formation of ice in the underlying soils can result in heaving of pavements, flatwork and other hardscaping ("ice jacking") in sustained cold weather up to 2 inches or more. This heaving can develop relatively rapidly. A portion of this movement typically is recovered when the soils thaw, but due to loss of soil density, some degree of displacement will remain. This can result even where the subgrade soils were prepared properly.

Where hardscape movements are a design concern replacement of the subgrade soils with 3 or more feet of clean, coarse sand or gravel should be considered. Detailed recommendations in this regard can be provided upon request. It should be noted that where such open graded granular soils are placed, water can infiltrate and accumulate in the subsurface relatively easily, which can lead to increased settlement or heave from factors unrelated to ice formation. The relative risks from these soil conditions should be taken into consideration where ice jacking is a concern. GROUND will be available to discuss these concerns upon request.

CLOSURE

Geotechnical Review The author of this report should be retained to review project plans and specifications to evaluate whether they comply with the intent of the recommendations in this report. The review should be requested in writing.

The geotechnical recommendations presented in this report are contingent upon observation and testing of project earthworks by representatives of GROUND. If another geotechnical consultant is selected to provide materials testing, then that consultant must assume all responsibility for the geotechnical aspects of the project by concurring in writing with the recommendations in this report, or by providing alternative recommendations.

Materials Testing Boulder County and Matrix Design should consider retaining a geotechnical engineer to perform materials testing during construction including observation of drilled piers. The performance of such testing or lack thereof, in no way alleviates the burden of the contractor or subcontractor from constructing in a manner that conforms to applicable project documents and industry standards. The contractor or pertinent subcontractor is ultimately responsible for managing the quality of their work; furthermore, testing by a geotechnical engineer does not preclude the contractor from obtaining or providing whatever services they deem necessary to complete the project in accordance with applicable documents.

Limitations This report has been prepared for Boulder County and Matrix Design as it pertains to design and construction of the residential building as described herein. It may not contain sufficient information for other parties or other purposes.

In addition, GROUND has assumed that project construction will commence by Winter, 2012. Any changes in project plans or schedule should be brought to the attention of a geotechnical engineer, in order that the geotechnical recommendations may be re-evaluated and, as necessary, modified.

The geotechnical conclusions and recommendations in this report relied upon subsurface exploration at a limited number of exploration points, as shown on Figure 1, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, a geotechnical engineer should be advised at once, so that re-evaluation of the recommendations may be made in a timely manner. In addition, a contractor who relies upon this report for development of his scope of work or cost estimates may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor is responsible for obtaining the additional geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes current depths to groundwater, etc.

The materials present on-site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed structure will depend on implementation of the recommendations in this report and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will exceed estimates provided herein and should therefore be expected by the owner.

This report was prepared in accordance with generally accepted soil and foundation engineering practice in the Boulder County area at the date of preparation. GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or recommendations contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect. This report together with the concepts and recommendations herein, as an instrument of service was intended only for the specific purpose and client for whom it was prepared. Re-use of and/or unauthorized reliance on this report without written authorization from GROUND shall be without liability to GROUND Engineering Consultants, Inc.

GROUND appreciates the opportunity to complete this portion of the project and welcomes the opportunity to provide Boulder County and Matrix Design with a cost proposal for construction observation and materials testing prior to construction commencement.

Sincerely,

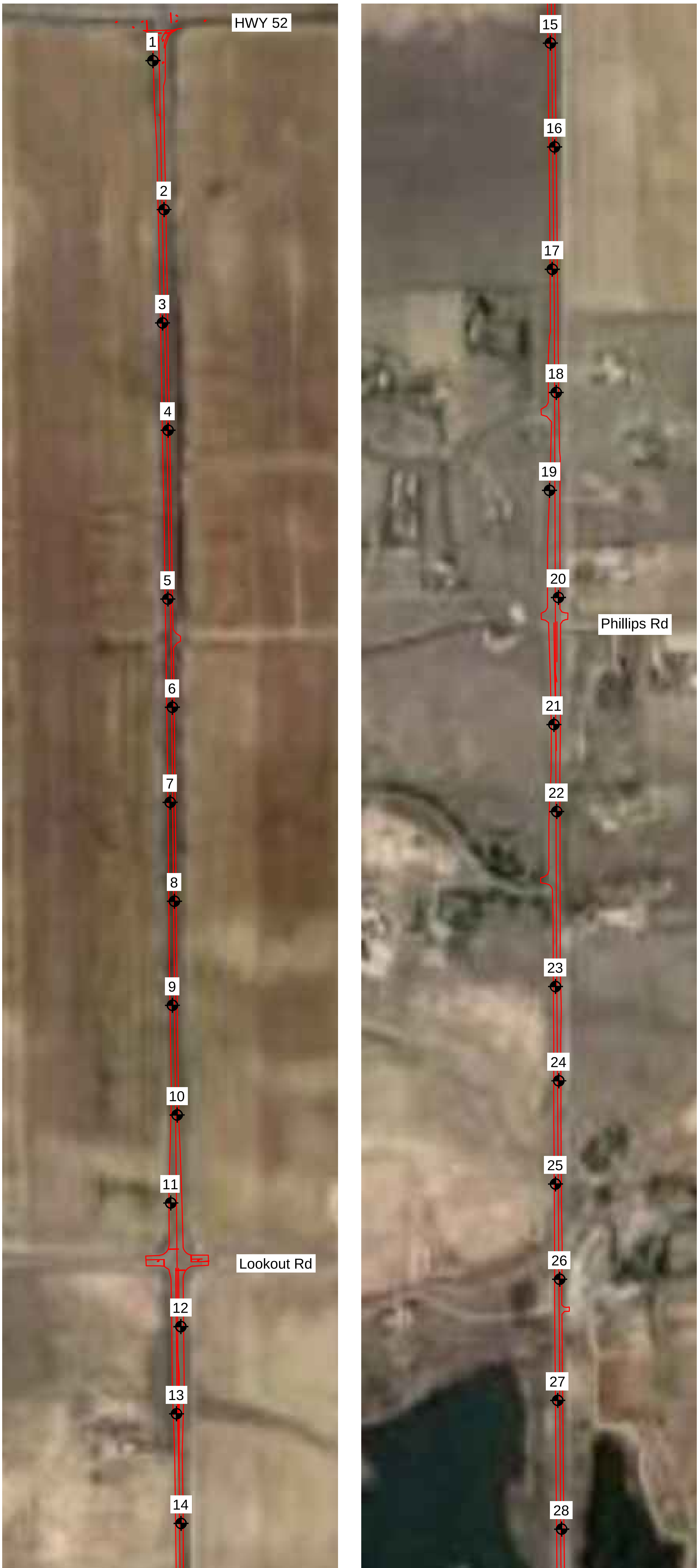
GROUND Engineering Consultants, Inc.

Timothy C. Luscombe

COLORADO REGISTERED PROFESSIONAL ENGINEER JAMES B. KOWALSKY 27680

4/30/12

Reviewed by James B. Kowalsky, P.E.



95th Street Pavement Potholes locations			
TH#	Station	Offset	Lt/Rt
1	13+70	4.3	Rt
2	19+20	8.6	Lt
3	24+38	3.4	Rt
4	28+46	11.4	Lt
5	32+87	5.8	Rt
6	36+90	5.3	Lt
7	44+39	3.6	Rt
8	48+11	7.3	Lt
9	53+54	13.6	Rt
10	58+12	23.1	Lt
11	62+31	7.1	Rt
12	67+58	7.1	Lt
13	72+81	8.1	Rt
14	77+25	5.6	Lt
15	81+35	6.1	Rt
16	86+04	8.8	Lt
17	89+77	13.6	Rt
18	95+08	24.5	Lt
19	98+82	6.3	Rt
20	103+52	9.3	Lt
21	107+97	3.5	Rt
22	112+20	10.8	Lt
23	116+27	2.5	Rt
24	120+90	10.3	Lt
25	128+12	5.6	Rt
26	132+71	8.9	Lt
27	137+56	7.9	Lt
28	144+94	26.6	Lt

1 ⊕ Indicates test hole number and approximate location.

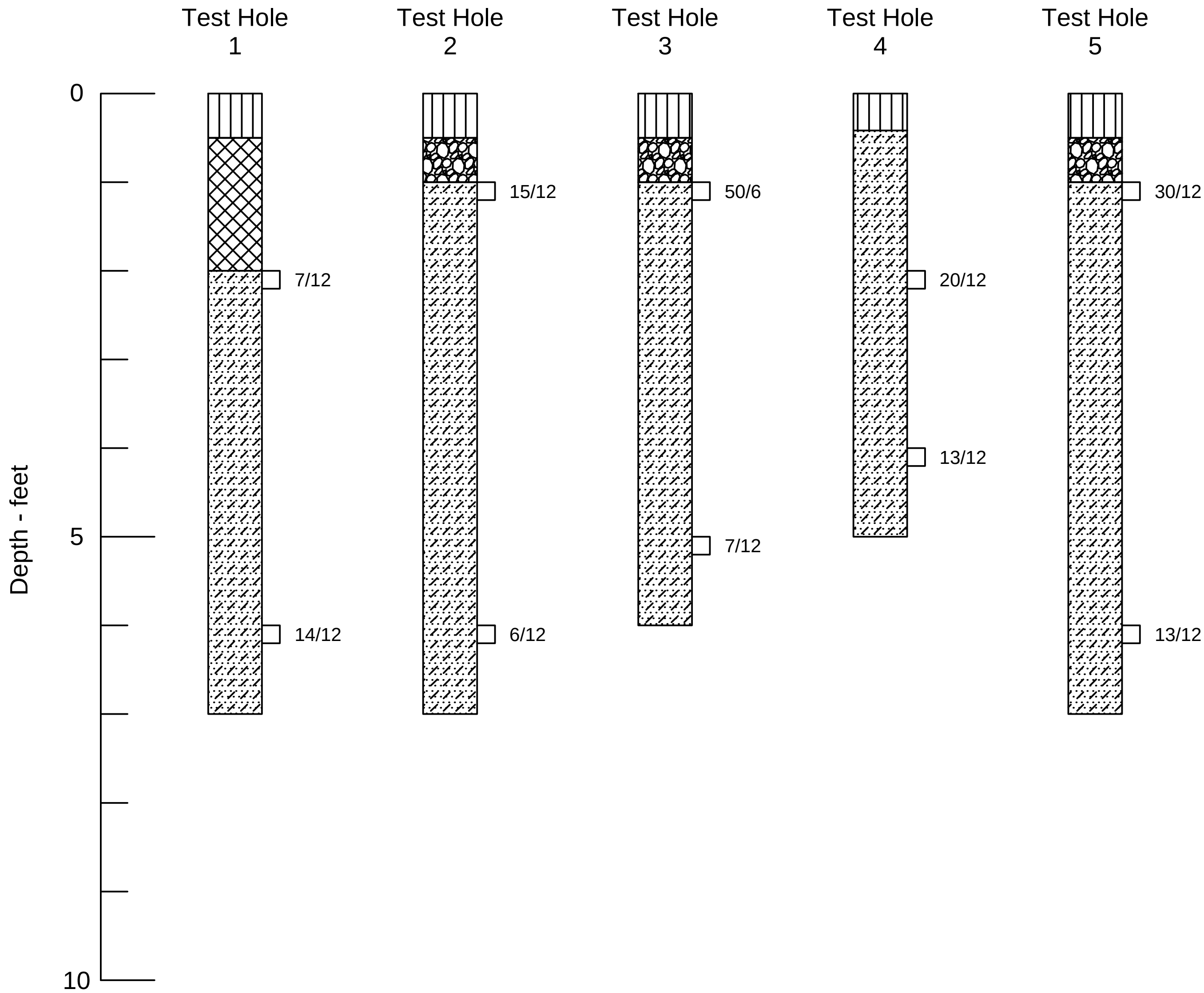
(Not to Scale)

GROUND ENGINEERING CONSULTANTS

LOCATION OF TEST HOLES

JOB NO.: 11-3089 FIGURE: 1

CADFILE NAME: 3089SITE.DWG

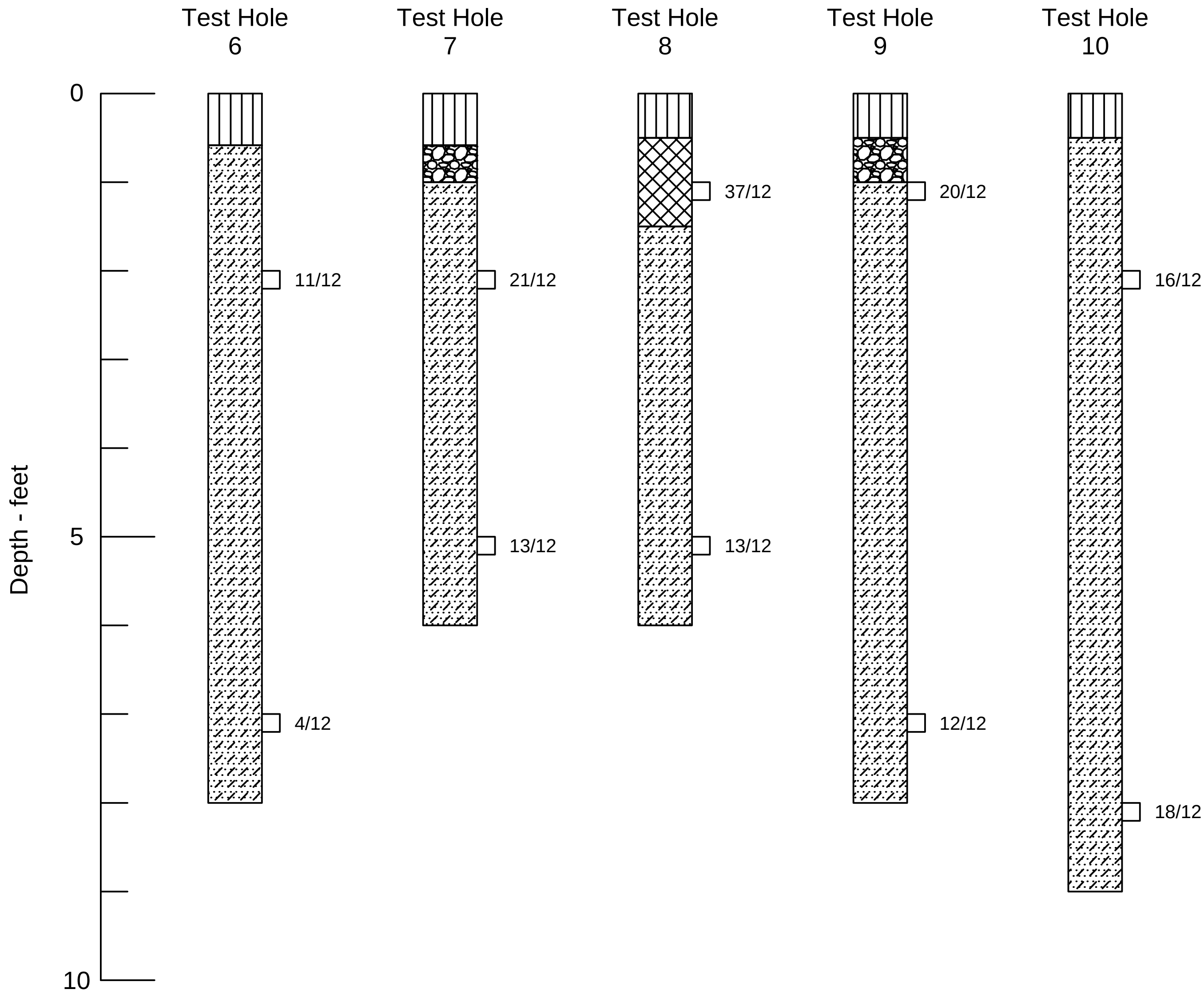


GROUND ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-3089	FIGURE: 2

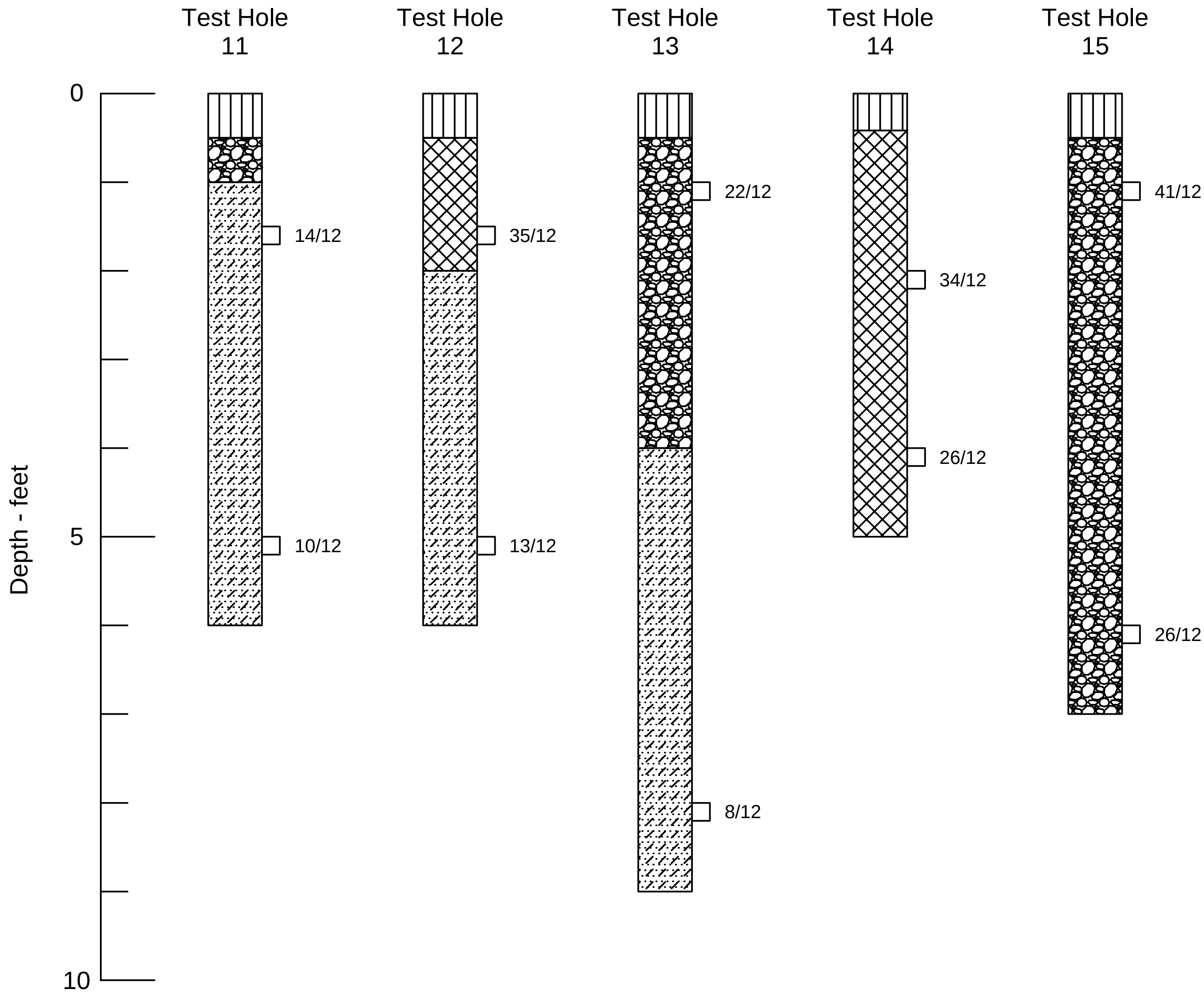
CADFILE NAME: 3089LOG01.DWG



GROUND ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

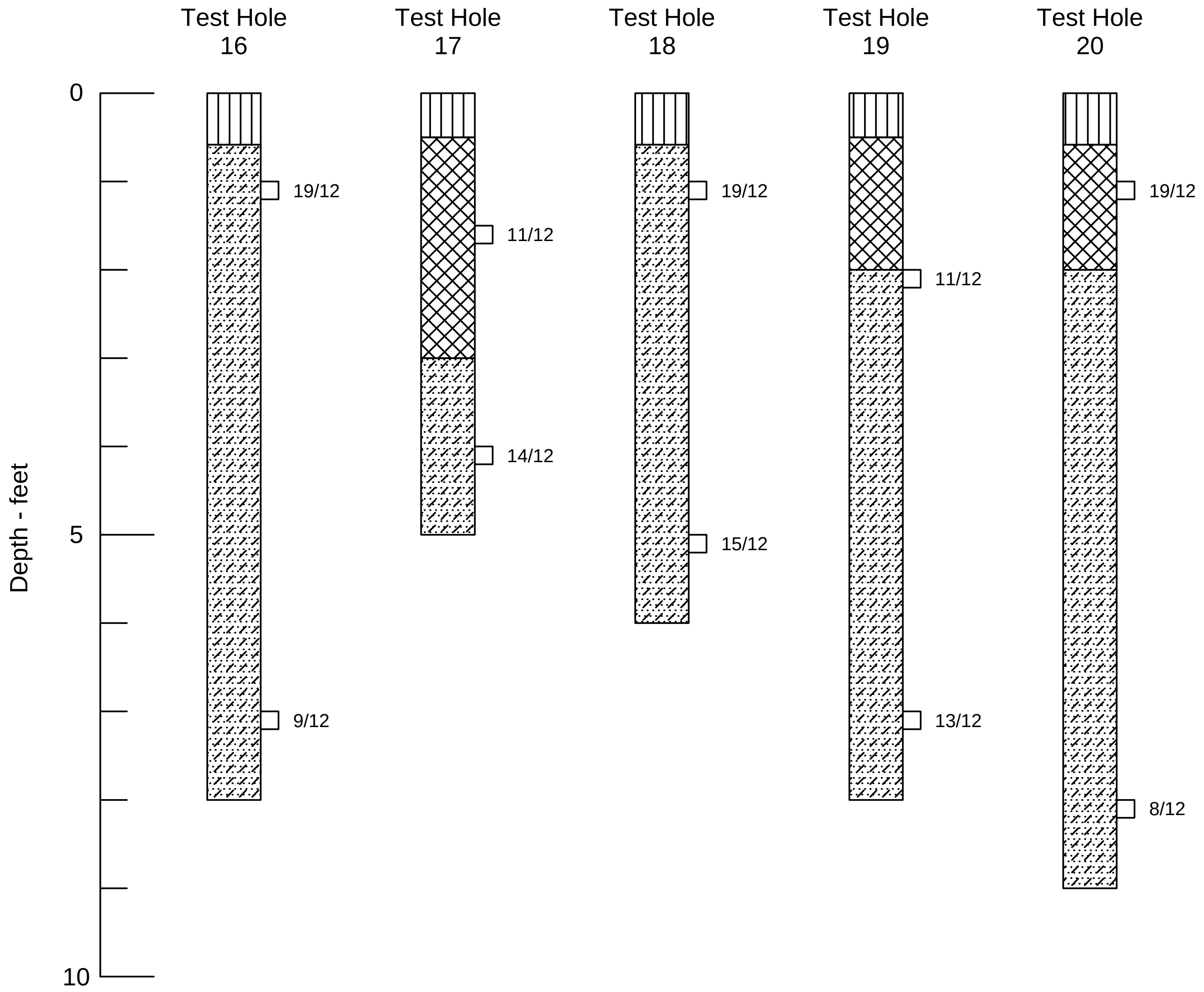
JOB NO.: 11-3089	FIGURE: 3
CADFILE NAME: 3089LOG02.DWG	



GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-3089	FIGURE: 4
CADFILE NAME: 3089LOG03.DWG	

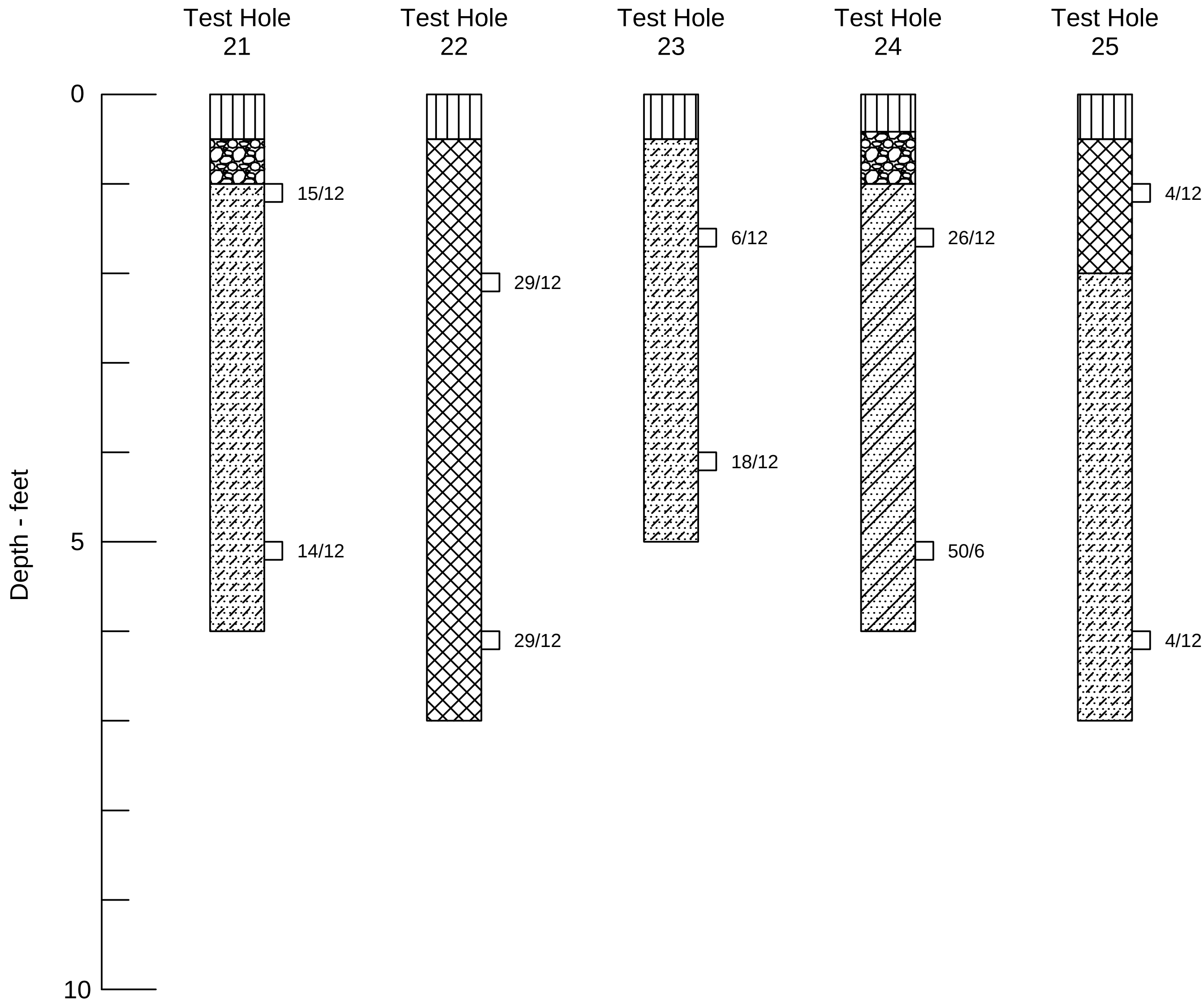


GROUND ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-3089	FIGURE: 5

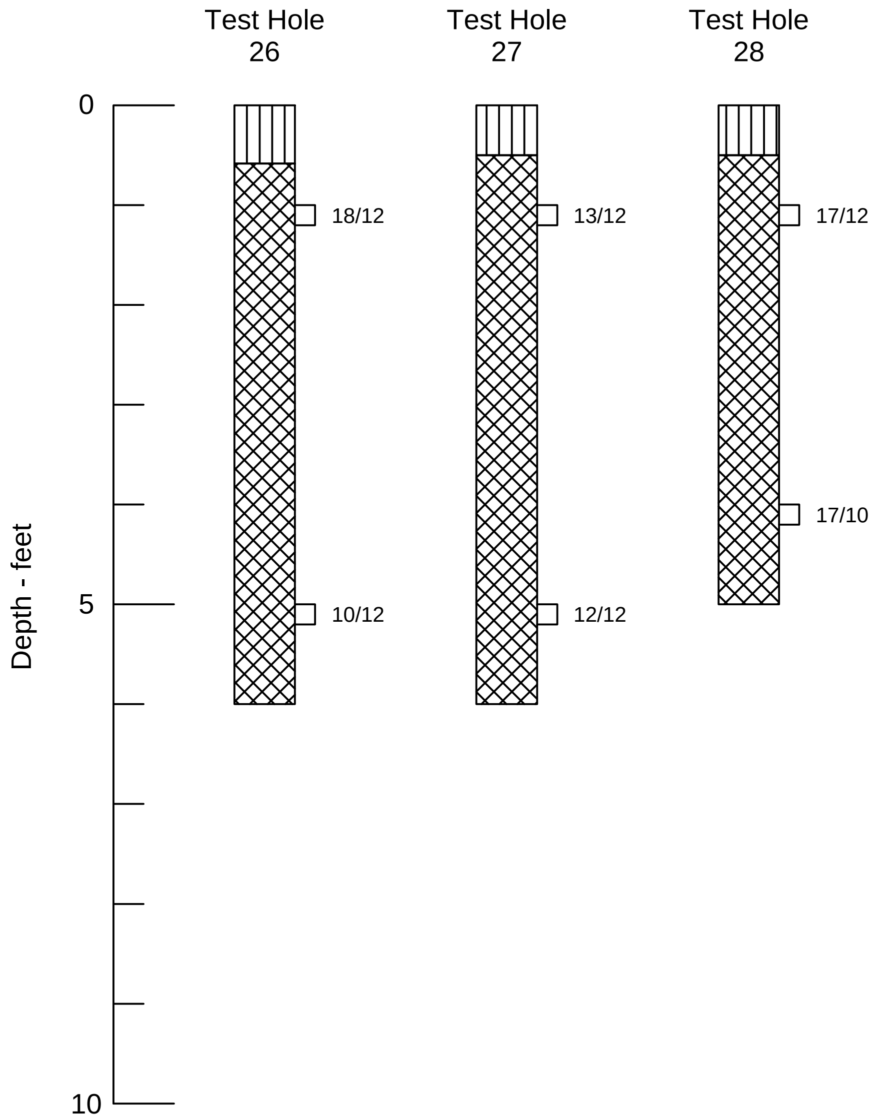
CADFILE NAME: 3089LOG04.DWG



GROUND ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-3089	FIGURE: 6
CADFILE NAME: 3089LOG05.DWG	



GROUND ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 11-3089	FIGURE: 7
CADFILE NAME: 3089LOG06.DWG	

LEGEND:

Asphalt

Base Course

Fill: Consisted of sandy clays and clayey sands with scattered gravel. They were low to moderately plastic, the sand fractions were fine to medium grained, stiff to very stiff, dry to moist, and light brown in color.

Sand and Clay: Soils encountered consisted of sandy clays with local clayey sands. They were low to moderately plastic, the sand fractions were fine to medium grained, stiff to very stiff, dry to moist, and light brown in color.

Sandstone Bedrock: Medium grained, non-plastic, very dense, slightly moist and local iron staining in the upper few feet.

Drive sample, 2-inch I.D. California liner sample

23/12 Drive sample blow count, indicates 23 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

NOTES:

1) Test holes were drilled on 12/21/2011 with 4-inch diameter continuous flight power augers.

2) Locations of the test holes were measured approximately by pacing from features shown on the site plan provided.

3) Elevations of the test holes were not measured and the logs of the test holes are drawn to depth.

4) The test hole locations and elevations should be considered accurate only to the degree implied by the method used.

5) The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.

6) Groundwater was not encountered during drilling. Groundwater levels can fluctuate seasonally and in response to landscape irrigation.

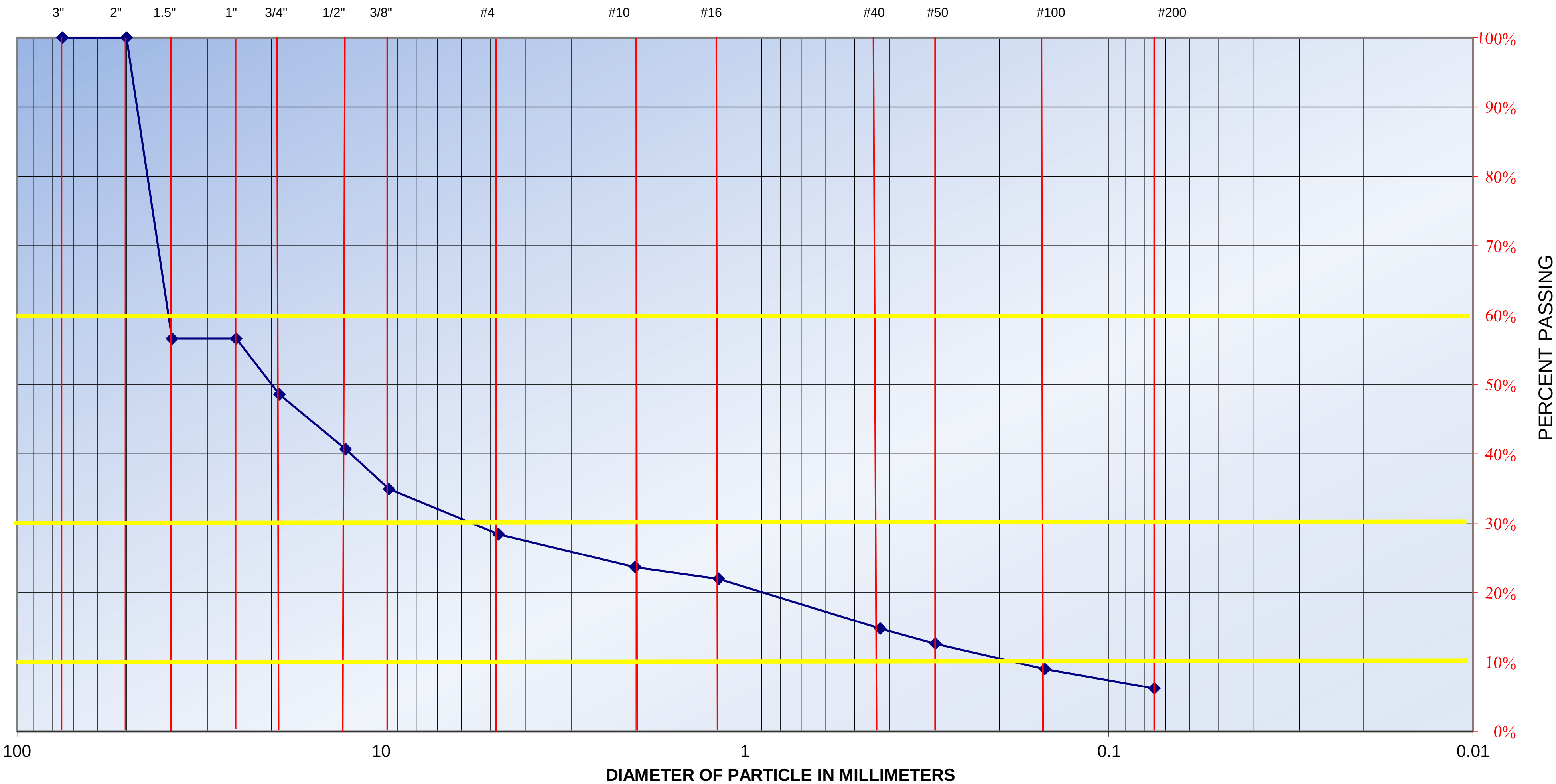
7) The material descriptions on this legend are for general classification purposes only. See the full text of this report for descriptions of the site materials and related recommendations.

GROUND ENGINEERING CONSULTANTS

LEGEND AND NOTES

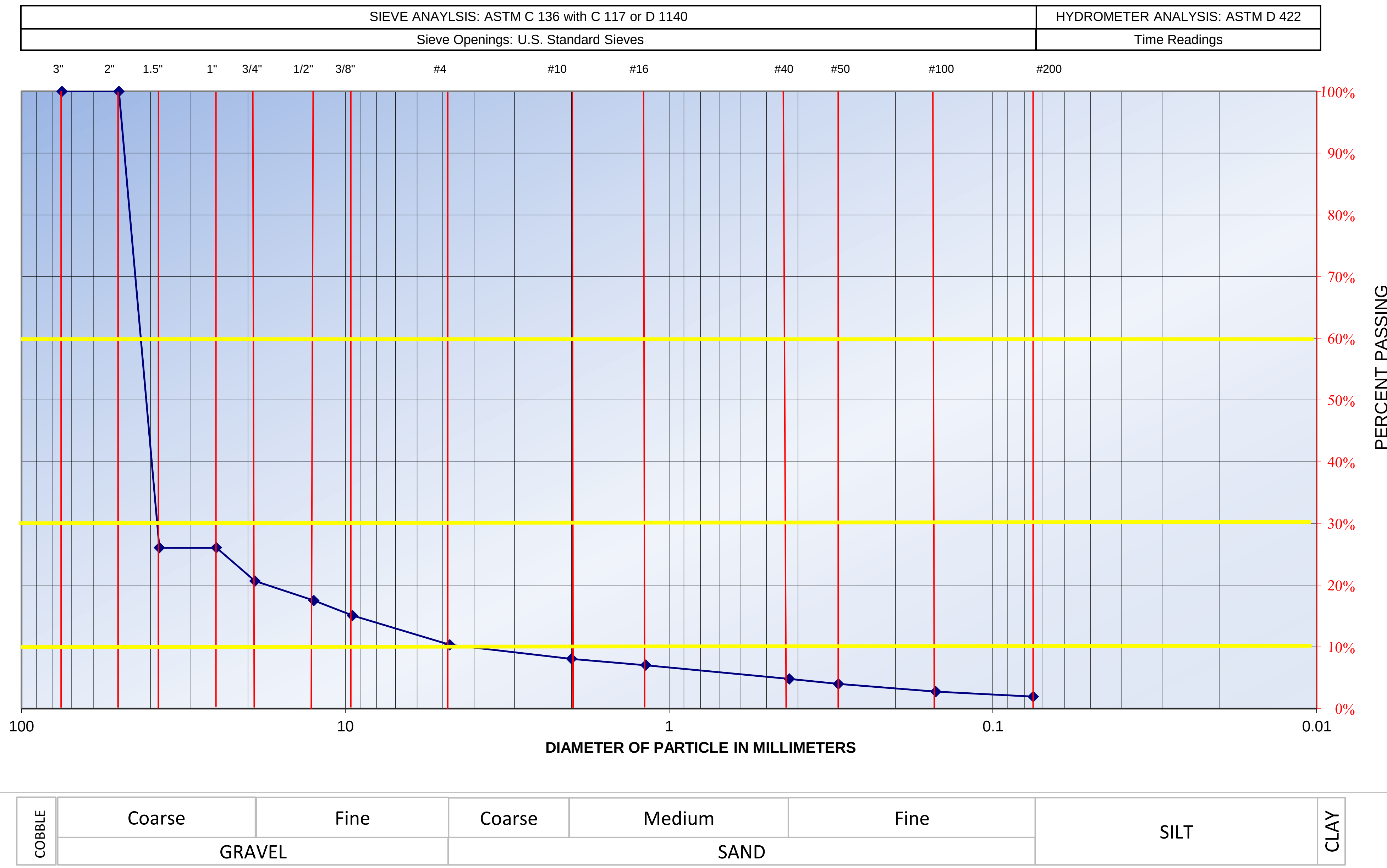
JOB NO.: 11-3089	FIGURE: 8
CADFILE NAME: 3089LEG.DWG	

SIEVE ANAYLSIS: ASTM C 136 with C 117 or D 1140	HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings: U.S. Standard Sieves	Time Readings



COBBLE	Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY
	GRAVEL		SAND				

Sample of: Poorly Graded GRAVEL with Silty Clay	Gravel	72%	Sand	22%	Silt and Clay	6%	GROUND ENGINEERING CONSULTANTS
From: Test Hole 8 at 1' Below Grade	Liquid Limit	22	Plastic Limit	6			GRADATION TEST RESULTS JOB NO.: 11-3089 FIGURE: 9



Sample of: Poorly Graded GRAVEL	Gravel	90%	Sand	8%	Silt and Clay	2%
From: Test Hole 12 at 1.5' Below Grade	Liquid Limit	NV	Plastic Limit	NP		

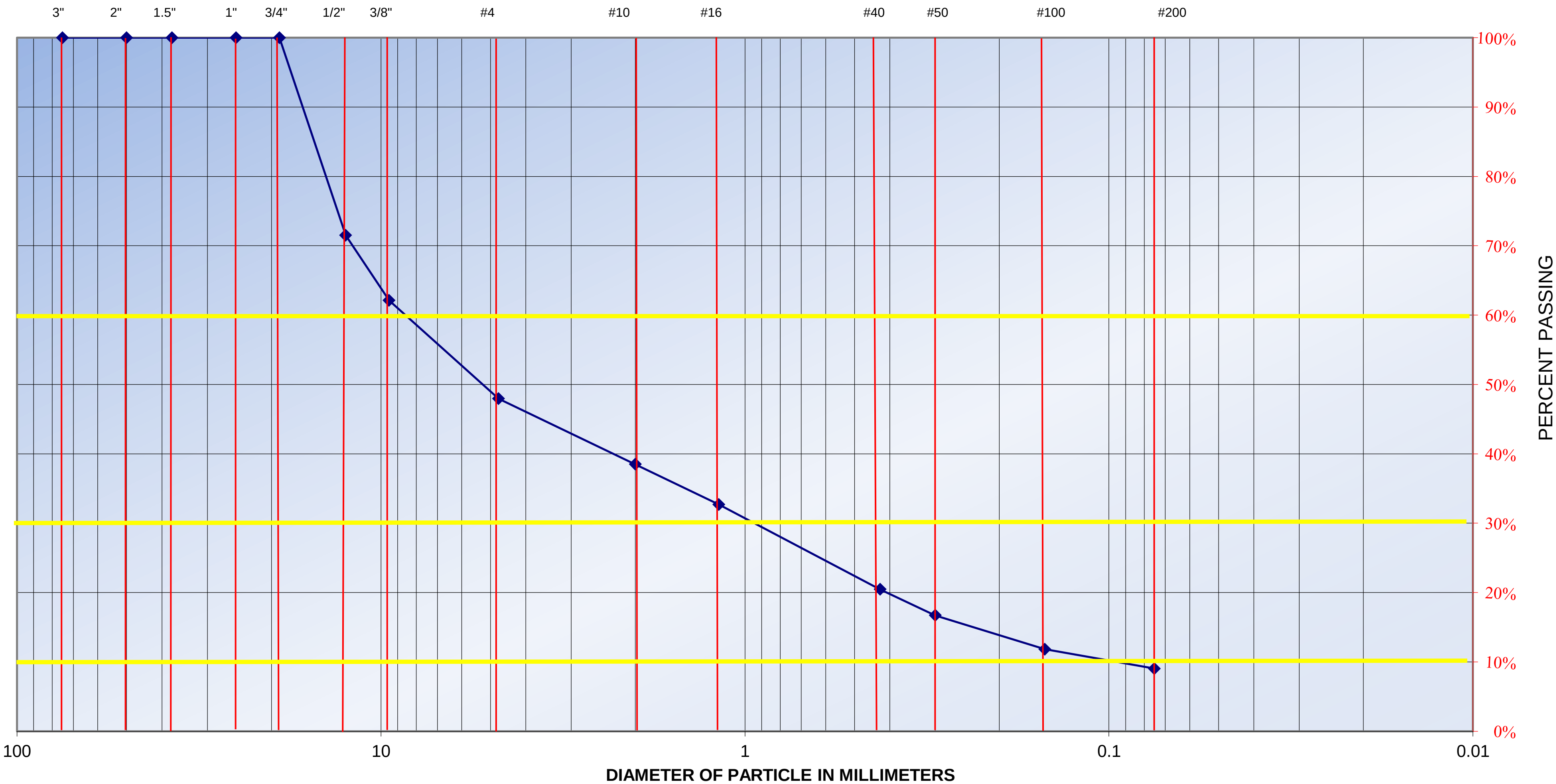
GROUND
ENGINEERING CONSULTANTS

GRADATION TEST RESULTS

JOB NO.: 11-3089

FIGURE: 10

SIEVE ANAYLSIS: ASTM C 136 with C 117 or D 1140	HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings: U.S. Standard Sieves	Time Readings



COBBLE	Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY
	GRAVEL		SAND				

Sample of: Poorly Graded GRAVEL with Silty Clay	Gravel 52%	Sand 39%	Silt and Clay 9%
From: Test Hole 14 at 2' Below Grade	Liquid Limit 22	Plastic Limit 7	

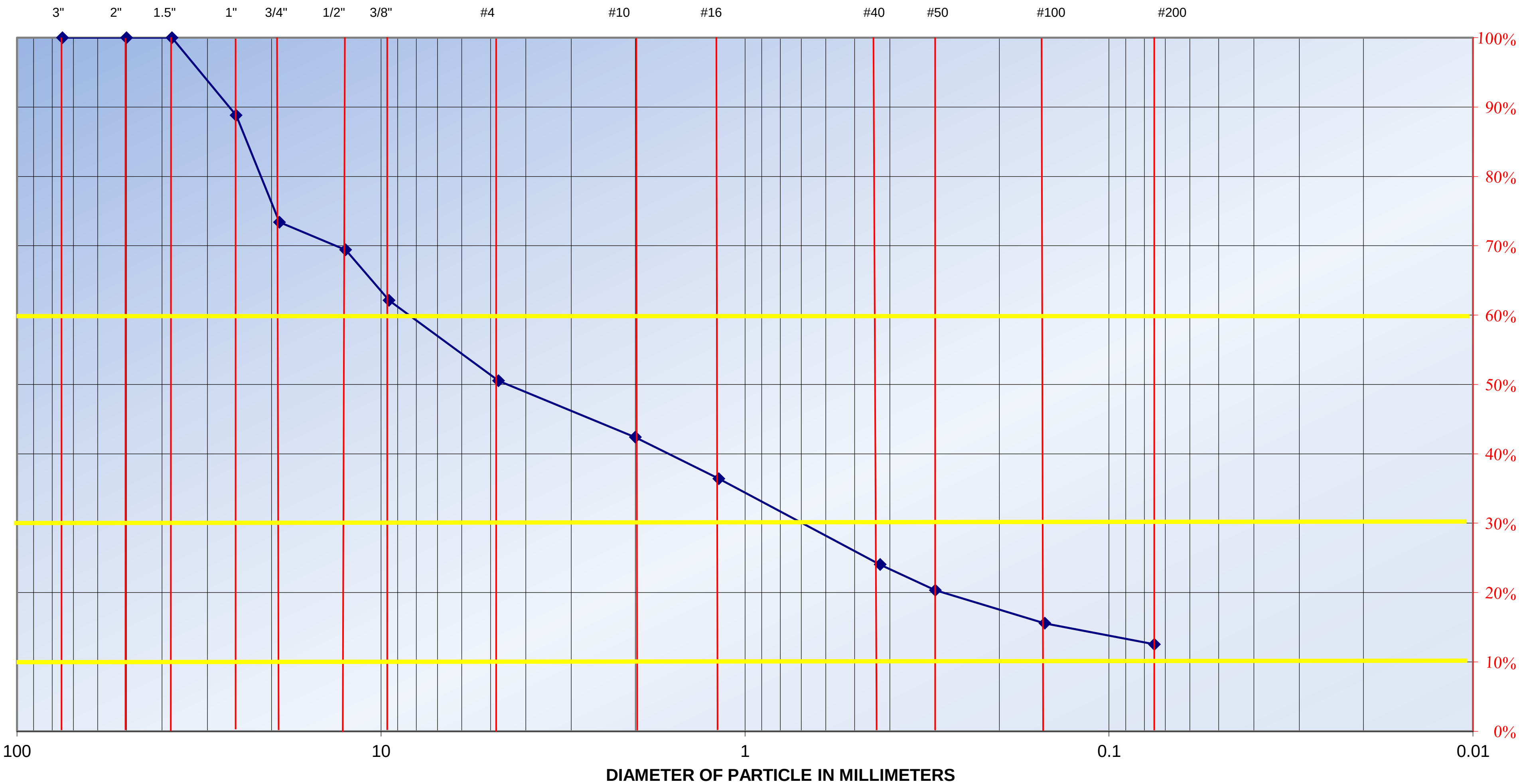
GROUND
ENGINEERING CONSULTANTS

GRADATION TEST RESULTS

JOB NO.: 11-3089

FIGURE: 11

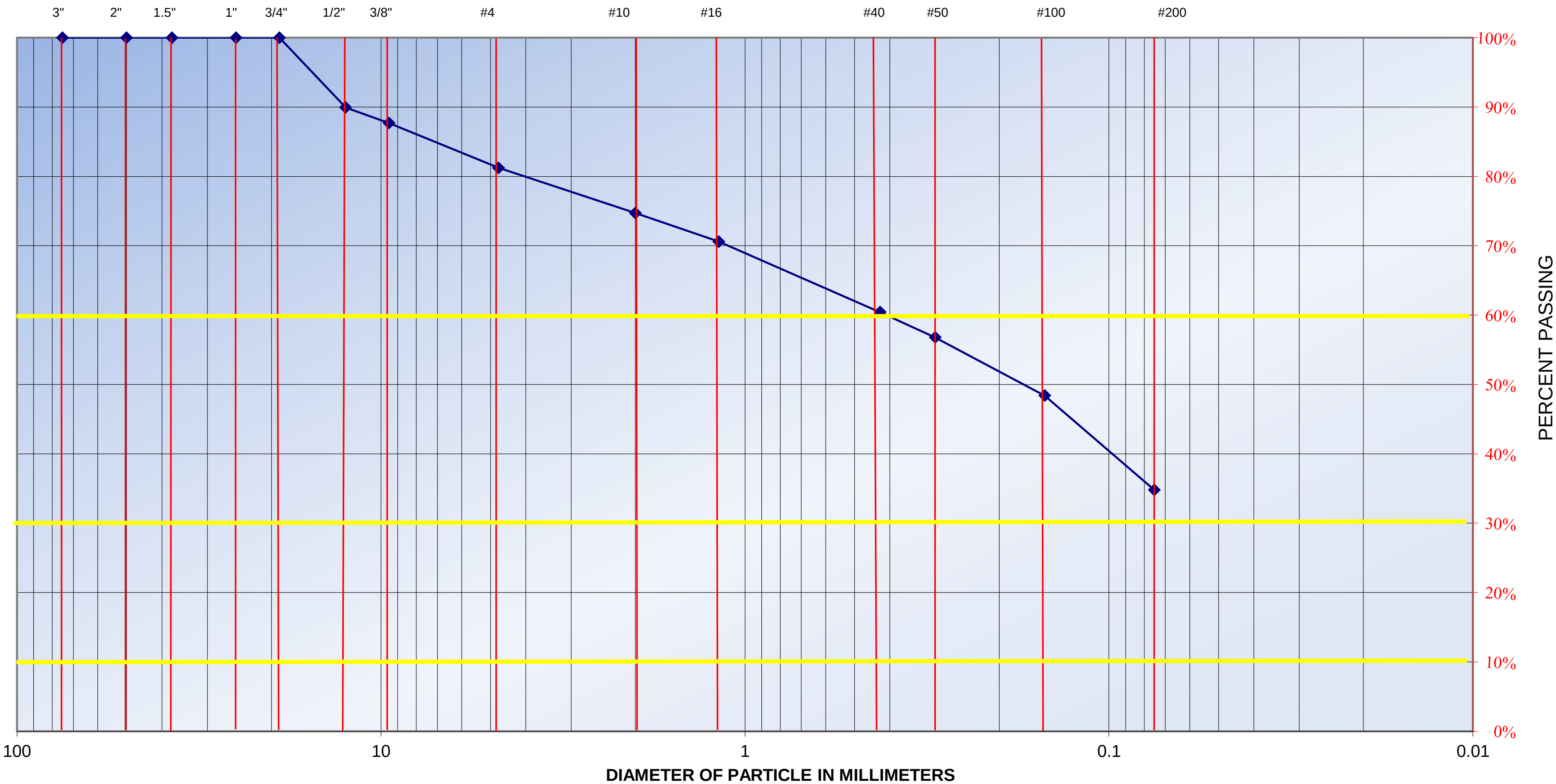
SIEVE ANAYLSIS: ASTM C 136 with C 117 or D 1140	HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings: U.S. Standard Sieves	Time Readings



COBBLE	Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY
	GRAVEL		SAND				

Sample of: Silty Clayey GRAVEL with Sand	Gravel	49%	Sand	38%	Silt and Clay	13%	GROUND ENGINEERING CONSULTANTS
From: Test Hole 15 at 1' Below Grade	Liquid Limit	23	Plastic Limit	9			GRADATION TEST RESULTS
							JOB NO.: 11-3089
							FIGURE: 12

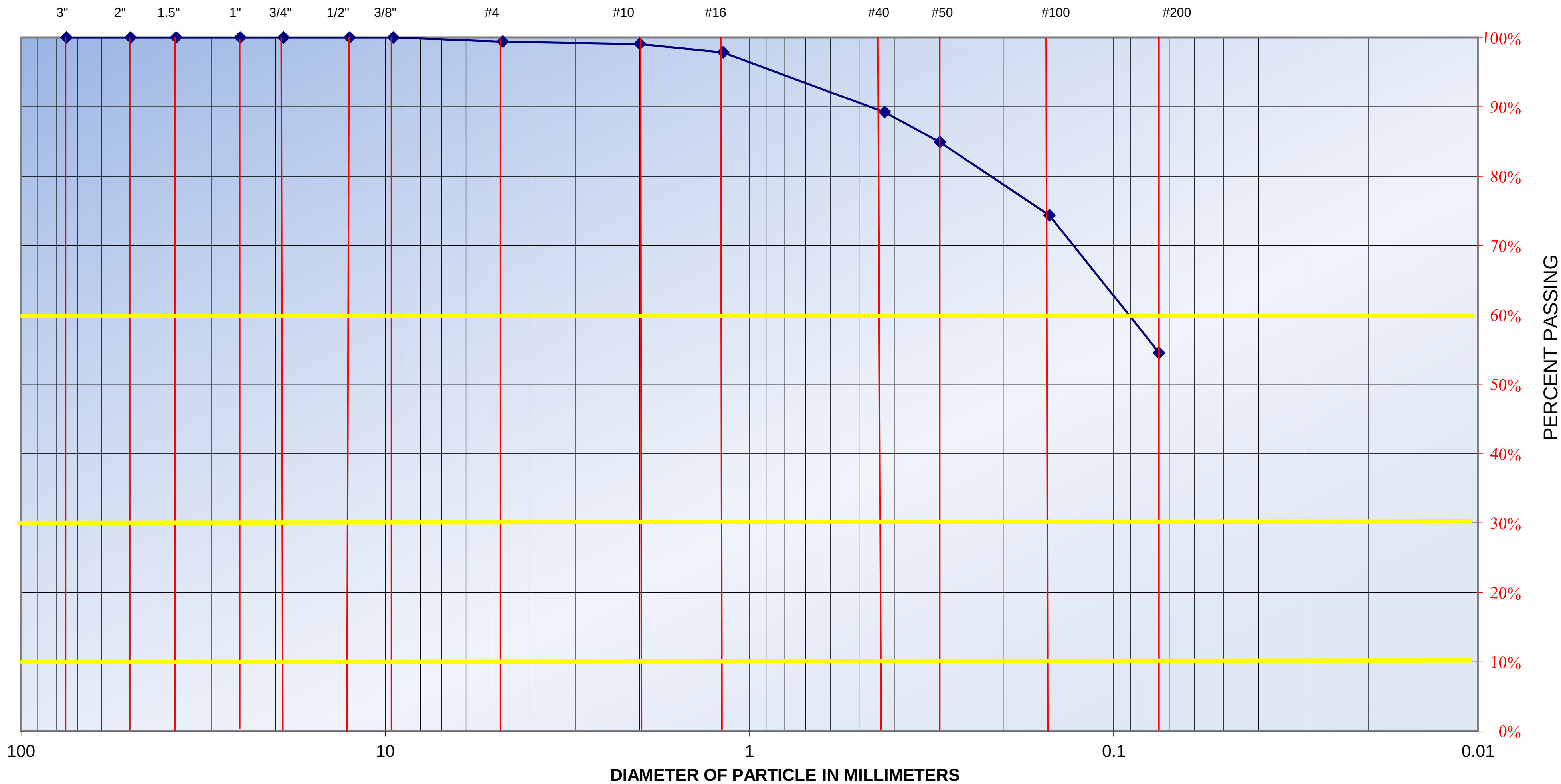
SIEVE ANAYLSIS: ASTM C 136 with C 117 or D 1140	HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings: U.S. Standard Sieves	Time Readings



COBBLE	Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY
	GRAVEL		SAND				

Sample of: Clayey SAND with Gravel	Gravel 19%		Sand 46%		Silt and Clay 35%	GROUND ENGINEERING CONSULTANTS
From: Test Hole 22 at 2' Below Grade	Liquid Limit 23		Plastic Limit 9			GRADATION TEST RESULTS
						JOB NO.: 11-3089
						FIGURE: 13

SIEVE ANAYLSIS: ASTM C 136 with C 117 or D 1140	HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings: U.S. Standard Sieves	Time Readings



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY
	GRAVEL		SAND				

Sample of: Sandy Clay	Gravel	1%	Sand	45%	Silt and Clay	55%
From: Test Hole 27 at 1' Below Grade	Liquid Limit	30	Plastic Limit	14		

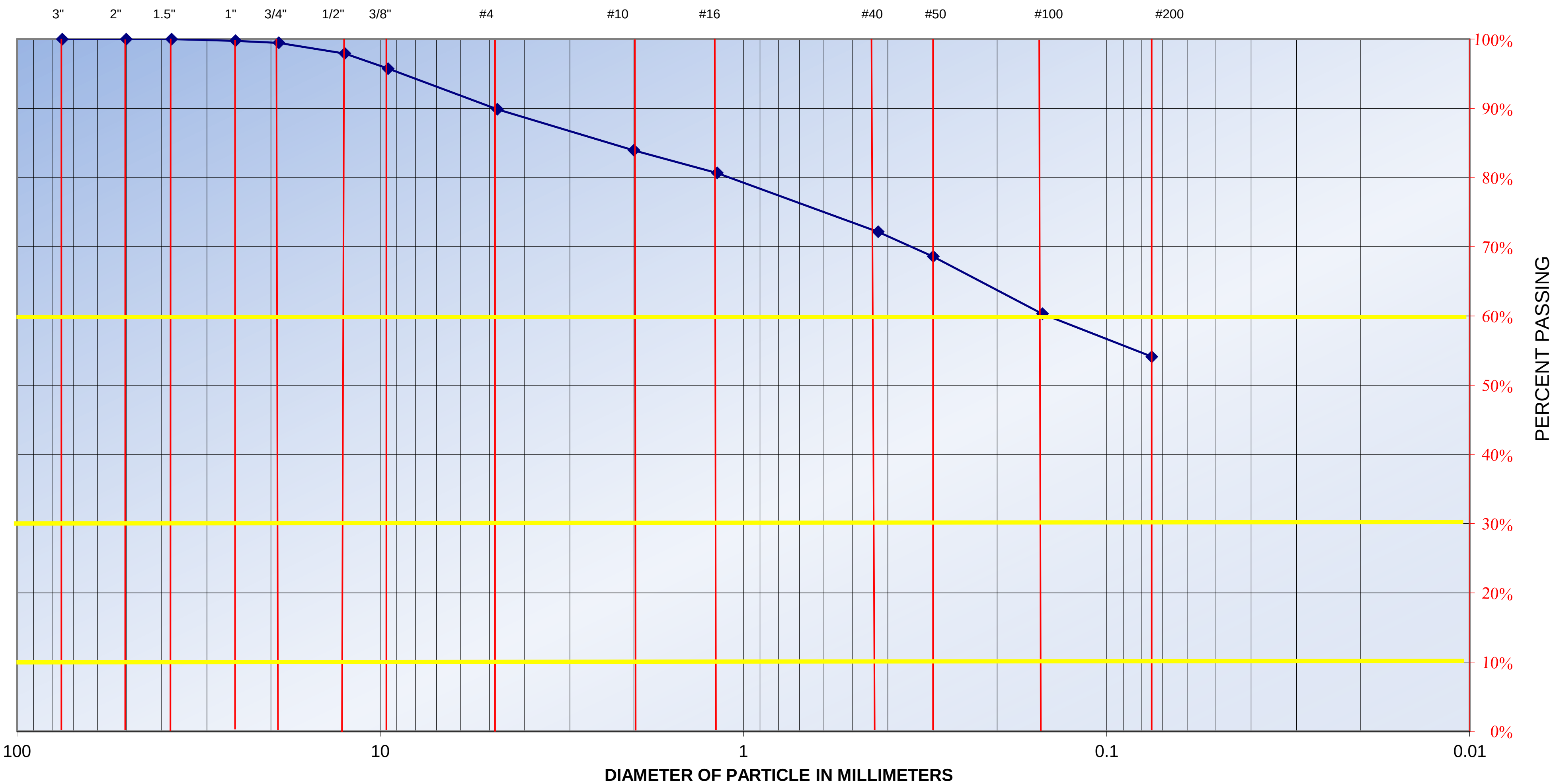
GROUND
ENGINEERING CONSULTANTS

GRADATION TEST RESULTS

JOB NO.: 11-3089

FIGURE: 14

SIEVE ANAYLSIS: ASTM C 136 with C 117 or D 1140	HYDROMETER ANALYSIS: ASTM D 422
Sieve Openings: U.S. Standard Sieves	Time Readings



COBBLE	Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY
	GRAVEL		SAND				

Sample of: Sandy Clay	Gravel 10%		Sand 36%	Silt and Clay 54%		GROUND ENGINEERING CONSULTANTS
From: Bulk Composite Sample from Test Holes	Liquid Limit 21		Plastic Limit 8			GRADATION TEST RESULTS
						JOB NO.: 11-3089
						FIGURE: 15

GROUND
ENGINEERING CONSULTANTS

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Sample Location Test Hole No.	Sample Location Depth *(feet)*	Natural Moisture Content *(%)*	Natural Dry Density *(pcf)*	Gradation Gravel *(%)*	Gradation Sand *(%)*	Percent Passing No. 200 Sieve	Atterberg Limits Liquid Limit *(%)*	Atterberg Limits Plasticity Index *(%)*	Percent Swell (200 psf Surcharge)	USCS Classifi-cation	AASHTO Classifi-cation (GI)	Soil or Bedrock Type
1	2	22.6	100.3			63	40	16	-3.9	s(CL)	A-6(8)	Sandy CLAY
2	1	21.3	104.3			73	48	22	-0.4	(CL)s	A-7-6(16)	CLAY with Sand
3	5	19.0	108.2			79	48	22	-0.7	(CL)s	A-7-6(18)	CLAY with Sand
4	2	13.1	112.8			47	26	7	-0.2	SC-SM	A-4(1)	Silty Clayey SAND
5	1	6.9	121.3			22	24	5		SC-SM	A-2-4(0)	Silty Clayey SAND
6	2	19.8	103.9			76	39	19		(CL)s	A-6(13)	CLAY with Sand
7	2	11.8	103.5			31	19	2		SM	A-2-4(0)	Silty SAND
8	1	2.9	SD	72	22	6	22	6		(GP-GC)s	A-1-a	Poorly Graded GRAVEL with Silty Clay
9	1	10.4	113.0			36	19	4		SC-SM	A-4(0)	Silty Clayey SAND
10	2	17.6	104.8			75	44	21	0.3	(CL)s	A-7-6(15)	CLAY with Sand
11	1.5	15.1	110.4			62	34	14		s(CL)	A-6(6)	Sandy CLAY
12	1.5	0.8	SD	90	8	2	NV	NP		GP	A-1-a	Poorly Graded GRAVEL
13	1	4.5	SD			10	24	7		SC-SM	A-2-4(0)	Silty Clayey SAND
14	2	4.0	SD	52	39	9	22	7		(GP-GC)s	A-1-a	Poorly Graded GRAVEL with Silty Clay
15	1	3.6	SD	49	38	13	23	9		(GC-GM)s	A-1-a	Silty Clayey GRAVEL
16	1	13.2	120.1			50	28	11	-0.8	s(CL)	A-6(2)	Sandy CLAY
17	1.5	16.7	111.1			59	33	14	-0.1	s(CL)	A-6(6)	Sandy CLAY
18	1	15.0	115.0			54	29	13		s(CL)	A-6(4)	Sandy CLAY
19	2	25.6	96.3			87	51	23	-0.3	CH	A-7-6(23)	Fat CLAY
20	1	9.5	126.0			30	25	10		SC	A-2-4(0)	Clayey SAND
21	1	13.0	109.5			37	24	10		SC	A-4(0)	Clayey SAND
22	2	8.0	SD	19	46	35	23	9		(SC)g	A-4(0)	Clayey SAND with Gravel
23	1.5	13.8	112.2			62	39	30	-3.0	s(CL)	A-6(15)	Sandy CLAY
24	1.5	14.3	104.5			27	NV	NP		SM	A-2-4(0)	Silty SAND
25	1	13.8	112.3			40	21	6		SC-SM	A-4(0)	Silty Clayey SAND
26	1	5.0	129.4			14	26	10		SC	A-2-4(0)	Clayey SAND
27	1	13.7	116.6	1	45	55	30	14		s(CL)	A-6(5)	Sandy CLAY
28	2	10.6	118.0			52	20	14		s(CL)	A-6(4)	Sandy CLAY
Bulk Sample				10	36	54	21	8		s(CL)	A-4(1)	Sandy CLAY

Job No. 11-3089

GROUND
ENGINEERING CONSULTANTS

TABLE 2

SUMMARY OF LABORATORY TEST RESULTS

95th Street Pavement Pothole Locations

Test Hole	Pt. #	Station	Offset	Lt/Rt	Thickness Asphalt *(inches)*
1	450027	13+70	4.3	Rt	6
2	450026	19+20	8.6	Lt	6
3	450025	24+38	3.4	Rt	6
4	450024	28+46	11.4	Lt	5
5	450023	32+87	5.8	Rt	6
6	450022	36+90	5.3	Lt	7
7	450021	44+39	3.6	Rt	7
8	450020	48+11	7.3	Lt	6
9	450019	53+54	13.6	Rt	6
10	450018	58+12	23.1	Lt	6
11	450017	62+31	7.1	Rt	6
12	450016	67+58	7.1	Lt	6
13	450015	72+81	8.1	Rt	6
14	450014	77+25	5.6	Lt	5
15	450013	81+35	6.1	Rt	6
16	450012	86+04	8.8	Lt	7
17	450011	89+77	13.6	Rt	6
18	450010	95+08	24.5	Lt	7
19	450009	98+82	6.3	Rt	6
20	450008	103+52	9.3	Lt	7
21	450007	107+97	3.5	Rt	6
22	450006	112+20	10.8	Lt	6
23	450005	116+27	2.5	Rt	6
24	450004	120+90	10.3	Lt	5
25	450003	128+12	5.6	Rt	6
26	450002	132+71	8.9	Lt	7
27	450001	137+56	7.9	Lt	6
28	450000	144+94	26.6	Lt	6

Appendix A

Pavement Section Calculations

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Network Administrator

Flexible Structural Design Module

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,469,116
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,202 psi
Stage Construction	1
Calculated Design Structural Number	4.59 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt	0.44	1	10.5	-	4.62
Total	-	-	-	10.50	-	4.62

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Network Administrator

Flexible Structural Design Module

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,469,116
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,202 psi
Stage Construction	1
Calculated Design Structural Number	4.59 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt	0.44	1	7	-	3.08
2	Class 6 Base Course	0.12	1	13	-	1.56
Total	-	-	-	20.00	-	4.64

Appendix C – AECOM Traffic Data & Analysis

PAVEMENT DESIGN TRAFFIC ANALYSIS (20-YEAR)

Station	ADT (7/2015)					
	DAY	OTHER	END	WEEKLY TOTAL	YEARLY BY DAY	YEARLY BY WEEK
104	7,972	-	-	-	2,909,780	-
105	8,380	-	-	-	3,058,700	-
237	8,295	7,682	4,899	20,876	3,027,797	1,085,543
252	8,843	7,698	5,603	22,144	3,227,573	1,151,471
385	8,074	-	-	-	2,947,010	-
Average	**8,313**	7,690	5,251	21,510	**3,034,172**	**1,118,507**

Note: Day = Tuesday, Wednesday, Thursday; Other = Monday, Friday; End = Saturday, Sunday
STA 104, 105, 385 = Single Day Counts; STA 237, 252 = Weekly Counts

Directional Split		
Station	NB	SB
104	49.9	50.1
105	51.0	49.0
237	50.4	49.6
238	50.5	49.5
252	51.2	48.8
385	50.5	49.5
Average	**51**	49

20 Year Analysis			
Method		ESALs	Difference
FHWA	By Day	5,606,787	-
CDOT	By Day	3,457,815	-
FHWA	By Week	2,095,319	37.4%
CDOT	By Week	1,254,772	36.3%

Station	Total ADT	% ADT BY DAY ANALYSIS													
		CLASS													
		0.1	1	2	3	4	5	6	7	8	9	10	11	12	13
		Bicycle	MC	SV	SVT	TB2	TB3	T4	ART3	ART4	ART5	ART6	BD	DRT	-
104	7,972	0.4%	1.0%	79.9%	0.2%	15.9%	0.5%	0.1%	0.6%	1.0%	0.3%	0.1%	0.01%	0.01%	
105	8,380	0.3%	1.1%	79.4%	0.4%	16.0%	0.4%	0.04%	0.5%	1.1%	0.8%	0.1%		0.02%	
237	8,295	1.0%	1.0%	79.9%	0.4%	14.4%	0.6%	0.1%	0.5%	1.0%	0.9%	0.1%	0.02%	0.04%	
252	8,843	0.6%	0.5%	90.8%	0.2%	6.8%	0.2%	0.004%	0.2%	0.5%	0.1%	0.0%		0.00%	
385	8,074	0.6%	1.3%	78.7%	0.3%	15.4%	0.8%	0.1%	0.6%	1.2%	0.8%	0.1%	0.01%		
Average	**8,313**	**0.6%**	**1.0%**	**81.7%**	**0.3%**	**13.7%**	**0.5%**	**0.04%**	**0.5%**	**1.0%**	**0.6%**	**0.1%**	**0.01%**	**0.02%**	
FHWA ESAL Factors	**ESAL Factor**	0.000	0.000	0.000	0.000	0.570	0.260	0.420	0.420	0.300	1.200	0.930	0.820	1.060	1.390
	Yearly ESALs	0	0	0	0	237,031	3,867	520	6,420	8,723	20,730	2,314	244	491	0
	Average by Bin	**84%**				**15%**				**2%**					
	ESAL Factor (Weighted)	0.000				0.554				0.655					
	Yearly ESALs	0				247,837				32,503					
	Total Yearly ESALs	**280,339**													
CDOT ESAL Factors	**Average by Bin**	**84%**				**15%**				**2%**					
	ESAL Factor	0.003				0.249				1.087					
	Yearly ESALs	7,612				111,362				53,917					
	Total Yearly ESALs	**172,891**													

Station	Total ADT	% ADT BY WEEK ANALYSIS													
		CLASS													
		0.1	1	2	3	4	5	6	7	8	9	10	11	12	13
		Bicycle	MC	SV	SVT	TB2	TB3	T4	ART3	ART4	ART5	ART6	BD	DRT	-
104															
105															
237	20,876	1.4%	1.3%	80.1%	0.5%	14.1%	0.4%	0.04%	0.5%	0.9%	0.6%	0.1%	0.01%	0.02%	
252	22,144	0.9%	1.4%	80.4%	0.4%	14.6%	0.4%	0.03%	0.5%	1.0%	0.2%	0.0%	0.00%	0.01%	
385															
Average	**21,510**	**1.2%**	**1.4%**	**80.3%**	**0.4%**	**14.4%**	**0.4%**	**0.03%**	**0.5%**	**0.9%**	**0.4%**	**0.1%**	**0.01%**	**0.01%**	
FHWA ESAL Factors	**ESAL Factor**	0.000	0.000	0.000	0.000	0.570	0.260	0.420	0.420	0.300	1.200	0.930	0.820	1.060	1.390
	Yearly ESALs	0	0	0	0	91,545	1,205	160	2,547	3,151	5,335	580	65	177	0
	Average by Bin	**83.2%**				**15.3%**				**1.4%**					
	ESAL Factor (Weighted)	0.000				0.556				0.588					
	Yearly ESALs	0				95,458				9,308					
	Total Yearly ESALs	**104,766**													
CDOT ESAL Factors	**Average by Bin**	**83.2%**				**15.3%**				**1.4%**					
	ESAL Factor	0.003				0.249				1.087					
	Yearly ESALs	2,793				42,750				17,195					
	Total Yearly ESALs	**62,739**													

General Notes: Counts were taken between 7/20/2015 and 7/29/2015 (BY OTHERS).

Appendix D – AECOM Summary of Geotechnical Investigation Results

500’ INTERVAL
25’INTERVAL
PARTIAL DEPTH LOCATIONS

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)
245+00	4	500	7.7	5.5	6.2	C	0.29	1.78						3,073	673,546	
240+00	4	1,000	5.6	5.4	7.1	C	0.29	2.03						3,073	673,546	
235+00	4	1,500	5.7	6.6	6.1	C	0.29	1.76	CL	A-6	0.02	0.24	2.00	3,073	673,546	5.00
230+00	4	2,000	6.0	6.4	6.1	C	0.29	1.75	CL	A-6	0.02	0.24	1.99	3,073	673,546	5.00
225+00	4	2,500	6.4	6.2	6.3	C	0.29	1.79	SC-SM	A-4	0.04	0.48	2.27	3,073	673,546	4.00
220+00	4	3,000	6.0	8.2	6.6	C	0.29	1.87	SC-SM	A-2-4	0.08	0.96	2.83	3,073	673,546	3.75
215+00	4	3,500	5.9	7.1	6.5	C	0.29	1.87	SM	A-2-4	0.08	0.96	2.83	3,073	673,546	3.75
210+00	4	4,000	5.7	7.8	6.3	C	0.29	1.81	CL	A-6	0.02	0.24	2.05	3,073	673,546	4.75
205+00	4	4,500	6.5	7.1	7.6	C	0.29	2.18	SC-SM	A-2-4	0.08	0.96	3.14	3,073	673,546	3.75
200+00	4	5,000	7.5	8.0	7.4	C	0.29	2.12	SC-SM	A-2-4	0.08	0.96	3.08	3,073	673,546	3.75
195+00	N/A	5,500	3.6"	5.8	8.1	C	0.29	2.31	PROJECT BY OTHERS					3,073	673,546	
190+00	N/A	6,000	8.2	10.5	7.3	C	0.29	2.09	PROJECT BY OTHERS					3,073	673,546	
185+00	N/A	6,500	7.7	9.1	8.2	C	0.29	2.35	PROJECT BY OTHERS					3,073	673,546	
180+00	4	7,000	10.0	9.8	9.1	C	0.29	2.61	SC-SM	A-2-4	0.08	0.96	3.57	3,073	673,546	3.75
175+00	4	7,500	5.9	7.5	7.6	E	0.40	3.03	SM	A-2-4	0.08	0.96	3.99	3,073	673,546	3.75
170+00	3	8,000	8.1	6.6	6.9	D	0.29	1.96	CL	A-6	0.02	0.24	2.20	3,073	673,546	4.25
165+00	3	8,500	6.4	6.5	6.8	D	0.29	1.95	SC	A-4	0.04	0.48	2.43	3,073	673,546	3.75
160+00	3	9,000	6.7	7.6	7.1	D	0.29	2.03	SW-SC	A-2-4	0.08	0.96	2.99	3,073	673,546	3.75
155+00	3	9,500	5.8	5.9	6.1	D	0.29	1.75	SW-SC	A-2-4	0.08	0.96	2.71	3,073	673,546	3.75
150+00	3	10,000	5.8	5.8	6.1	D	0.29	1.73	SP-SC	A-2-4	0.08	0.96	2.69	3,073	673,546	3.75
145+00	3	10,500	6.1	5.8	6.0	D	0.29	1.72	SW-SM	A-1-b	0.06	0.72	2.44	3,073	673,546	3.75
140+00	3	11,000	6.2	6.6	7.1	D	0.29	2.02	s(CL)	A-6	0.02	0.24	2.26	3,073	673,546	4.25
135+00	3	11,500	7.6	6.0	6.8	D	0.29	1.95	s(CL)	A-6	0.02	0.24	2.19	3,073	673,546	4.50
130+00	3	12,000	6.2	5.8	6.3	D	0.29	1.80	SC	A-2-4	0.08	0.96	2.76	3,073	673,546	3.75
125+00	3	12,500	6.3	6.0	6.7	D	0.29	1.91	SC-SM	A-4	0.04	0.48	2.39	3,073	673,546	3.75
120+00	3	13,000	6.3	7.6	6.2	C	0.29	1.78	SM	A-2-4	0.08	0.96	2.74	3,073	673,546	3.75
115+00	3	13,500	6.2	5.5	6.9	C	0.29	1.98	s(CL)	A-6	0.02	0.24	2.22	3,073	673,546	4.25
110+00	3	14,000	6.4	5.9	7.0	C	0.29	2.00	(SC)g	A-4	0.04	0.48	2.48	3,073	673,546	3.75
105+00	3	14,500	7.1	6.8	6.6	C	0.29	1.89	SC-SM	A-4	0.04	0.48	2.37	3,073	673,546	3.75
100+00	3	15,000	6.1	6.4	6.7	C	0.29	1.92	SC-SM	A-2-4	0.08	0.96	2.88	3,073	673,546	3.75
95+00	2	15,500	6.0	6.0	6.6	C	0.29	1.88	s(CL)	A-6	0.015	0.18	2.06	3,073	673,546	5.75
90+00	2	16,000	5.7	6.0	5.9	C	0.29	1.69	s(CL)	A-6	0.02	0.24	1.93	3,073	673,546	5.25
85+00	2	16,500	5.5	5.4	5.7	C	0.29	1.64	s(CL)	A-6	0.02	0.24	1.88	3,073	673,546	5.25
80+00	1	17,000	5.5	5.9	5.9	C	0.29	1.69	(GC-GM)s	A-1-a	0.1	1.2	2.89	3,073	673,546	3.75
75+00	1	17,500	6.0	6.0	5.9	C	0.29	1.68	(GP-GC)s	A-1-a	0.1	1.2	2.88	3,073	673,546	3.75
70+00	1	18,000	7.1	7.4	6.7	B	0.40	2.65	SC-SM	A-2-4	0.08	0.96	3.61	3,073	673,546	3.75
65+00	1	18,500	7.2	7.8	7.5	A	0.35	2.63	GP	A-1-a	0.1	1.2	3.83	3,073	673,546	3.75
60+00	1	19,000	8.4	7.5	8.0	A	0.35	2.81	s(CL)	A-6	0.02	0.24	3.05	3,073	673,546	3.75
55+00	1	19,500	7.1	5.7	7.8	A	0.35	2.76	(CL)s	A-7	0.01	0.12	2.88	3,073	673,546	3.75
50+00	1	20,000	6.8	7.1	6.5	A	0.35	2.28	SC-SM	A-4	0.04	0.48	2.76	3,073	673,546	3.75
45+00	1	20,500	6.0	5.8	6.5	A	0.35	2.28	(GP-GC)s	A-1-a	0.1	1.2	3.48	3,073	673,546	3.75
40+00	1	21,000	7.3	7.4	6.9	A	0.35	2.42	SM	A-2-4	0.08	0.96	3.38	3,073	673,546	3.75
35+00	1	21,500	6.6	7.3	7.1	A	0.35	2.49	(CL)s	A-6	0.02	0.24	2.73	3,073	673,546	3.75
30+00	1	22,000	5.8	6.0	6.5	A	0.35	2.27	SC-SM	A-2-4	0.08	0.96	3.23	3,073	673,546	3.75
25+00	1	22,500	6.1	5.8	6.2	A	0.35	2.17	SC-SM	A-4	0.04	0.48	2.65	3,073	673,546	3.75
20+00	1	23,000	9.2	6.8	6.8	A	0.35	2.38	(CL)s	A-7	0.01	0.12	2.50	3,073	673,546	4.50
15+00	1	23,500	8.1	7.2	7.5	A	0.35	2.65	(CL)s	A-7	0.01	0.12	2.77	3,073	673,546	3.75
10+00	1	24,000	-	-	7.9	A	0.35	2.76	s(CL)	A-6	0.02	0.24	3.00	3,073	673,546	3.75

Note:

- HMA Thickness Data for NB direction was modified to remove 4 locations throughout the run to maintain an accurate GPS LAT Difference from NB to SB.

- NB Direction chainage started approximately 75' North of the SB end chainage.

- LF 24000 is at STA 10+00

- SN = Structural Number

- HMA Thickness Color Scheme:

Green = Maximum Thickness

Red = Minimum Thickness

Pink = Proposed Partial Depth Patching

- SN Color Scheme:

Green = Maximum SN

Red = Minimum SN

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
249+75	4	25	6.6	-													
249+50	4	50	6.4	-													
249+25	4	75	6.7	-													
249+00	4	100	6.4	5.9													
248+75	4	125	6.0	5.8													
248+50	4	150	6.3	5.8													
248+25	4	175	6.4	6.0													
248+00	4	200	6.1	6.0													
247+75	4	225	5.9	5.7													
247+50	4	250	7.1	6.0	6.2	C	0.29	1.78						3,073	673,546		
247+25	4	275	5.8	5.8													
247+00	4	300	5.9	5.2"													
246+75	4	325	6.3	4.8"													NB ≤5.0" Partial Depth Patching
246+50	4	350	6.4	5"													NB ≤5.0" Partial Depth Patching
246+25	4	375	6.5	4.4"													NB ≤5.0" Partial Depth Patching
246+00	4	400	7.5	5"													NB ≤5.0" Partial Depth Patching
245+75	4	425	7.7	5.3"													
245+50	4	450	7.5	5.3"													
245+25	4	475	8.0	5.7													
245+00	4	500	7.7	5.5													
244+75	4	525	7.0	6.0													
244+50	4	550	7.1	6.0													
244+25	4	575	7.1	8.0													
244+00	4	600	7.1	8.4													
243+75	4	625	7.0	9.1													
243+50	4	650	6.9	8.3													
243+25	4	675	6.8	8.2													
243+00	4	700	7.0	8.1													
242+75	4	725	7.0	8.1													
242+50	4	750	7.0	8.5	7.1	C	0.29	2.03						3,073	673,546		
242+25	4	775	7.2	8.5													
242+00	4	800	6.9	8.3													
241+75	4	825	6.6	7.4													
241+50	4	850	6.9	7.5													
241+25	4	875	7.2	8.2													
241+00	4	900	6.9	7.6													
240+75	4	925	6.0	6.5													
240+50	4	950	5.9	5.7													
240+25	4	975	6.0	5.4													
240+00	4	1,000	5.6	5.4													
239+75	4	1,025	4.8"	5.4												5.00	SB ≤5.0" Partial Depth Patching
239+50	4	1,050	5.3	5.6												5.00	
239+25	4	1,075	5.4	5.9												5.00	
239+00	4	1,100	5.9	6.0												5.00	
238+75	4	1,125	6.1	6.5												5.00	
238+50	4	1,150	5.8	6.5												5.00	
238+25	4	1,175	5.7	6.0												5.00	
238+00	4	1,200	5.7	6.7					CL	A-6						5.00	
237+75	4	1,225	5.8	6.9												5.00	
237+50	4	1,250	5.8	7.1	6.1	C	0.29	1.76			0.02	0.24	2.00	3,073	673,546	5.00	
237+25	4	1,275	5.8	7.2												5.00	
237+00	4	1,300	5.5	6.6												5.00	
236+75	4	1,325	5.4	6.5												5.00	
236+50	4	1,350	5.4	6.6												5.00	
236+25	4	1,375	5.7	6.3												5.00	
236+00	4	1,400	6.0	6.5												5.00	
235+75	4	1,425	6.0	7.1												5.00	
235+50	4	1,450	6.1	7.3												5.00	
235+25	4	1,475	6.0	7.4												5.00	
235+00	4	1,500	5.7	6.6					CL	A-6						5.00	
234+75	4	1,525	5.9	6.8												5.00	
234+50	4	1,550	6.0	7.2												5.00	
234+25	4	1,575	6.0	6.7												5.00	
234+00	4	1,600	5.7	6.2												5.00	
233+75	4	1,625	5.6	6.1												5.00	
233+50	4	1,650	5.5	6.0												5.00	
233+25	4	1,675	5.9	6.3					CL	A-6						5.00	
233+00	4	1,700	6.0	6.3												5.00	
232+75	4	1,725	6.2	6.5												5.00	
232+50	4	1,750	5.8	6.4	6.1	C	0.29	1.75			0.02	0.24	1.99	3,073	673,546	5.00	
232+25	4	1,775	5.5	6.2												5.00	
232+00	4	1,800	5.8	6.5												5.00	
231+75	4	1,825	6.0	6.7												5.00	
231+50	4	1,850	5.8	6.5												5.00	
231+25	4	1,875	5.6	6.3												5.00	
231+00	4	1,900	6.0	6.3												5.00	
230+75	4	1,925	5.8	6.4												5.00	
230+50	4	1,950	6.0	6.0												5.00	
230+25	4	1,975	5.8	6.1												5.00	
230+00	4	2,000	6.0	6.4					CL	A-6						5.00	
229+75	4	2,025	5.7	6.2												4.00	
229+50	4	2,050	5.8	6.3												4.00	
229+25	4	2,075	5.9	6.1												4.00	
229+00	4	2,100	6.0	6.3												4.00	
228+75	4	2,125	6.3	6.3												4.00	
228+50	4	2,150	6.4	6.1												4.00	
228+25	4	2,175	6.3	6.2					SC-SM	A-4						4.00	
228+00	4	2,200	6.1	6.2												4.00	
227+75	4	2,225	6.0	6.5												4.00	
227+50	4	2,250	6.0	6.9	6.3	C	0.29	1.79			0.04	0.48	2.27	3,073	673,546	4.00	
227+25	4	2,275	6.1	6.6												4.00	
227+00	4	2,300	6.0	6.5												4.00	
226+75	4	2,325	6.2	6.5												4.00	
226+50	4	2,350	6.2	6.4												4.00	
226+25	4	2,375	6.4	6.5												4.00	
226+00	4	2,400	6.6	6.2												4.00	
225+75	4	2,425	6.8	6.0												4.00	
225+50	4	2,450	6.9	6.0												4.00	
225+25	4	2,475	6.4	6.3												4.00	
225+00	4	2,500	6.4	6.2					SC-SM	A-4						4.00	
224+75	4	2,525	6.3	6.0												3.75	
224+50	4	2,550	6.2	6.2												3.75	
224+25	4	2,575	6.5	6.1												3.75	
224+00	4	2,600	6.9	6.3												3.75	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
223+75	4	2,625	7.2	6.2												3.75	
223+50	4	2,650	7.8"	7.1"					SC-SM	A-2-4						3.75	Intersection >7" | Preclude from Analysis
223+25	4	2,675	9.0"	9.2"												3.75	Intersection >9" | Preclude from Analysis
223+00	4	2,700	11.0"	11.1"												3.75	Intersection >9" | Preclude from Analysis
222+75	4	2,725	13.3"	12.5"												3.75	Intersection >9" | Preclude from Analysis
222+50	4	2,750	13.3"	11.7"	6.6	C	0.29	1.87			0.08	0.96	2.83	3,073	673,546	3.75	Intersection >9" | Preclude from Analysis
222+25	4	2,775	10.3"	9.8"												3.75	Intersection >9" | Preclude from Analysis
222+00	4	2,800	7.9"	7.8"												3.75	Intersection >7" | Preclude from Analysis
221+75	4	2,825	7.3"	7.3"												3.75	Intersection >7" | Preclude from Analysis
221+50	4	2,850	7.2	6.6												3.75	
221+25	4	2,875	6.6	6.6												3.75	
221+00	4	2,900	6.5	6.5												3.75	
220+75	4	2,925	6.0	6.6												3.75	
220+50	4	2,950	6.0	6.5												3.75	
220+25	4	2,975	6.3	7.7												3.75	
220+00	4	3,000	6.0	8.2					SC-SM	A-2-4						3.75	
219+75	4	3,025	5.9	8.5												3.75	
219+50	4	3,050	6.1	8.5												3.75	
219+25	4	3,075	6.4	8.2												3.75	
219+00	4	3,100	6.4	8.2					SC-SM	A-2-4						3.75	
218+75	4	3,125	6.8	8.0												3.75	
218+50	4	3,150	7.3	6.1												3.75	
218+25	4	3,175	6.7	6.0												3.75	
218+00	4	3,200	6.3	6.4												3.75	
217+75	4	3,225	6.2	6.0												3.75	
217+50	4	3,250	7.4	6.1	6.5	C	0.29	1.87			0.08	0.96	2.83	3,073	673,546	3.75	
217+25	4	3,275	8.0	5.9												3.75	
217+00	4	3,300	6.5	5.8												3.75	
216+75	4	3,325	6.2	6.0												3.75	
216+50	4	3,350	5.9	6.2												3.75	
216+25	4	3,375	5.7	6.0												3.75	
216+00	4	3,400	5.6	6.0												3.75	
215+75	4	3,425	5.7	6.1												3.75	
215+50	4	3,450	6.0	6.5												3.75	
215+25	4	3,475	5.9	6.9												3.75	
215+00	4	3,500	5.9	7.1					SM	A-2-4						3.75	
214+75	4	3,525	5.8	7.0												4.75	
214+50	4	3,550	5.9	7.1												4.75	
214+25	4	3,575	6.3	7.2												4.75	
214+00	4	3,600	6.3	7.1												4.75	
213+75	4	3,625	6.6	7.7												4.75	
213+50	4	3,650	6.2	7.5												4.75	
213+25	4	3,675	5.9	7.7												4.75	
213+00	4	3,700	6.1	7.4												4.75	
212+75	4	3,725	6.0	6.5												4.75	
212+50	4	3,750	5.7	6.2	6.3	C	0.29	1.81			0.02	0.24	2.05	3,073	673,546	4.75	
212+25	4	3,775	5.5	6.3												4.75	
212+00	4	3,800	5.4	6.4												4.75	
211+75	4	3,825	5.4	6.5												4.75	
211+50	4	3,850	5.5	6.8												4.75	
211+25	4	3,875	5.5	6.5												4.75	
211+00	4	3,900	5.5	6.1												4.75	
210+75	4	3,925	5.4	6.3												4.75	
210+50	4	3,950	5.5	6.5												4.75	
210+25	4	3,975	5.7	7.3												4.75	
210+00	4	4,000	5.7	7.8					CL	A-6						4.75	
209+75	4	4,025	6.2	8.2												3.75	
209+50	4	4,050	6.7	8.2												3.75	
209+25	4	4,075	7.0	8.1												3.75	
209+00	4	4,100	6.9	8.1												3.75	
208+75	4	4,125	6.7	8.1												3.75	
208+50	4	4,150	6.4	7.8												3.75	
208+25	4	4,175	7.2	7.7												3.75	
208+00	4	4,200	8.2	7.9												3.75	
207+75	4	4,225	8.4	8.0												3.75	
207+50	4	4,250	8.4	8.2	7.6	C	0.29	2.18			0.08	0.96	3.14	3,073	673,546	3.75	
207+25	4	4,275	8.2	8.2												3.75	
207+00	4	4,300	8.2	7.9												3.75	
206+75	4	4,325	8.3	7.5												3.75	
206+50	4	4,350	8.2	7.9												3.75	
206+25	4	4,375	7.5	8.0												3.75	
206+00	4	4,400	6.7	8.0												3.75	
205+75	4	4,425	6.9	8.1												3.75	
205+50	4	4,450	7.0	7.7					SC-SM	A-2-4						3.75	
205+25	4	4,475	6.6	7.5												3.75	
205+00	4	4,500	6.5	7.1					SC-SM	A-2-4						3.75	
204+75	4	4,525	6.6	7.3												3.75	
204+50	4	4,550	7.1	7.8												3.75	
204+25	4	4,575	7.5	8.3												3.75	
204+00	4	4,600	8.0	8.7												3.75	
203+75	4	4,625	8.6	8.7												3.75	
203+50	4	4,650	8.8	7.9												3.75	
203+25	4	4,675	7.7	7.0												3.75	
203+00	4	4,700	7.2	6.5												3.75	
202+75	4	4,725	7.1	6.4												3.75	
202+50	4	4,750	6.7	6.5	7.4	C	0.29	2.12			0.08	0.96	3.08	3,073	673,546	3.75	
202+25	4	4,775	6.4	6.5												3.75	
202+00	4	4,800	6.2	6.7												3.75	
201+75	4	4,825	6.3	7.0												3.75	
201+50	4	4,850	6.6	7.2												3.75	
201+25	4	4,875	7.0	7.5												3.75	
201+00	4	4,900	7.4	7.9												3.75	
200+75	4	4,925	7.7	8.2												3.75	
200+50	4	4,950	7.9	8.2												3.75	
200+25	4	4,975	7.6	8.1												3.75	
200+00	4	5,000	7.5	8.0					SC-SM	A-2-4						3.75	
199+75	N/A	5,025	7.9	8.7													
199+50	N/A	5,050	9.1	10.3													
199+25	N/A	5,075	7.8	12.6													
199+00	N/A	5,100	6.6	14.1													
198+75	N/A	5,125	10.1	12.4													
198+50	N/A	5,150	8.6	11.5													
198+25	N/A	5,175	7.7	9.9													
198+00	N/A	5,200	6.8	8.4													

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
197+75	N/A	5,225	5.7	7.8													
197+50	N/A	5,250	4.8"	7.1													
197+25	N/A	5,275	4.4"	7.1	8.1	C	0.29	2.31	PROJECT BY OTHERS					3,073	673,546		
197+00	N/A	5,300	4.3"	7.0													
196+75	N/A	5,325	4.1"	6.5													
196+50	N/A	5,350	3.9"	6.8													
196+25	N/A	5,375	3.9"	6.5													
196+00	N/A	5,400	3.9"	6.5													
195+75	N/A	5,425	3.7"	6.0													
195+50	N/A	5,450	3.4"	5.9													
195+25	N/A	5,475	3.6"	5.9													
195+00	N/A	5,500	3.6"	5.8													
194+75	N/A	5,525	3.4"	5.9													
194+50	N/A	5,550	3.1"	5.5													
194+25	N/A	5,575	3.1"	6.0													
194+00	N/A	5,600	6.6"	6.0													
193+75	N/A	5,625	7.3"	6.0													
193+50	N/A	5,650	3.9"	6.0													
193+25	N/A	5,675	5"	6.2													
193+00	N/A	5,700	5.7	6.4													
192+75	N/A	5,725	6.5	6.5													
192+50	N/A	5,750	5.5	7.0	7.3	C	0.29	2.09	PROJECT BY OTHERS					3,073	673,546		
192+25	N/A	5,775	7.1	7.7													
192+00	N/A	5,800	7.7	6.9													
191+75	N/A	5,825	7.9	8.6													
191+50	N/A	5,850	6.6	9.2													
191+25	N/A	5,875	6.8	8.3													
191+00	N/A	5,900	7.4	9.6													
190+75	N/A	5,925	7.7	8.6													
190+50	N/A	5,950	7.9	8.8													
190+25	N/A	5,975	8.2	8.8													
190+00	N/A	6,000	8.2	10.5													
189+75	N/A	6,025	7.4	10.0													
189+50	N/A	6,050	7.8	9.5													
189+25	N/A	6,075	7.9	9.1													
189+00	N/A	6,100	7.7	9.3													
188+75	N/A	6,125	7.7	8.5													
188+50	N/A	6,150	7.6	8.2													
188+25	N/A	6,175	7.7	9.1													
188+00	N/A	6,200	7.7	8.4													
187+75	N/A	6,225	7.6	8.5													
187+50	N/A	6,250	7.6	7.9	8.2	C	0.29	2.35	PROJECT BY OTHERS					3,073	673,546		
187+25	N/A	6,275	8.0	8.1													
187+00	N/A	6,300	7.9	8.1													
186+75	N/A	6,325	7.9	8.8													
186+50	N/A	6,350	7.6	8.8													
186+25	N/A	6,375	7.6	9.5													
186+00	N/A	6,400	7.7	9.3													
185+75	N/A	6,425	7.5	8.9													
185+50	N/A	6,450	7.7	8.1													
185+25	N/A	6,475	7.6	8.2													
185+00	N/A	6,500	7.7	9.1													
184+75	4	6,525	8.5	10.1												3.75	
184+50	4	6,550	8.8	8.9												3.75	
184+25	4	6,575	8.4	8.2												3.75	
184+00	4	6,600	9.4	8.5												3.75	
183+75	4	6,625	9.5	8.7					SC-SM	A-2-4						3.75	
183+50	4	6,650	9.0	8.0												3.75	
183+25	4	6,675	8.3	9.9												3.75	
183+00	4	6,700	8.8	8.7												3.75	
182+75	4	6,725	8.6	7.6												3.75	
182+50	4	6,750	9.4	7.3	9.1	C	0.29	2.61			0.08	0.96	3.57	3,073	673,546	3.75	
182+25	4	6,775	9.5	8.8												3.75	
182+00	4	6,800	7.6	9.4												3.75	
181+75	4	6,825	8.2	8.3												3.75	
181+50	4	6,850	7.9	9.1												3.75	
181+25	4	6,875	9.5	9.8												3.75	
181+00	4	6,900	10.2	9.9												3.75	
180+75	4	6,925	10.6	10.2												3.75	
180+50	4	6,950	10.4	10.7												3.75	
180+25	4	6,975	10.7	9.9												3.75	
180+00	4	7,000	10.0	9.8					SC-SM	A-2-4						3.75	
179+75	4	7,025	9.9	8.9					SC-SM	A-2-4						3.75	
179+50	4	7,050	9.5	9.0												3.75	
179+25	4	7,075	10.0	8.6												3.75	
179+00	4	7,100	9.7	8.1												3.75	
178+75	4	7,125	8.3	8.1												3.75	
178+50	4	7,150	8.8	7.6					SC-SM	A-2-4						3.75	
178+25	4	7,175	8.7	8.2												3.75	
178+00	4	7,200	8.4	8.3												3.75	
177+75	4	7,225	7.6	7.7												3.75	
177+50	4	7,250	7.0	7.8	7.6	E	0.40	3.03			0.08	0.96	3.99	3,073	673,546	3.75	
177+25	4	7,275	7.1	8.2												3.75	
177+00	4	7,300	6.7	7.5												3.75	
176+75	4	7,325	5.8	6.8												3.75	
176+50	4	7,350	6.0	7.1												3.75	
176+25	4	7,375	6.2	7.6												3.75	
176+00	4	7,400	6.0	7.6												3.75	
175+75	4	7,425	5.9	7.4												3.75	
175+50	4	7,450	6.0	7.3												3.75	
175+25	4	7,475	6.0	7.1												3.75	
175+00	4	7,500	5.9	7.5					SM	A-2-4						3.75	
174+75	3	7,525	5.9	7.5												4.25	
174+50	3	7,550	5.8	7.0												4.25	
174+25	3	7,575	5.7	6.7												4.25	
174+00	3	7,600	5.9	7.1												4.25	
173+75	3	7,625	5.9	7.5												4.25	
173+50	3	7,650	5.9	7.8												4.25	
173+25	3	7,675	5.9	7.6												4.25	
173+00	3	7,700	6.0	7.7												4.25	
172+75	3	7,725	6.0	8.2												4.25	
172+50	3	7,750	6.0	7.8	6.9	D	0.29	1.96			0.02	0.24	2.20	3,073	673,546	4.25	
172+25	3	7,775	6.0	7.1												4.25	
172+00	3	7,800	6.7	6.8												4.25	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
171+75	3	7,825	7.2	6.6												4.25	
171+50	3	7,850	7.1	7.1												4.25	
171+25	3	7,875	7.0	7.3												4.25	
171+00	3	7,900	7.5	7.3												4.25	
170+75	3	7,925	8.0	6.6												4.25	
170+50	3	7,950	7.3	6.5					CL	A-6						4.25	
170+25	3	7,975	7.4	6.6												4.25	
170+00	3	8,000	8.1	6.6					CL	A-6						4.25	
169+75	3	8,025	7.9	6.6												3.75	
169+50	3	8,050	7.5	6.6												3.75	
169+25	3	8,075	6.9	6.4												3.75	
169+00	3	8,100	6.4	6.5												3.75	
168+75	3	8,125	6.4	6.9												3.75	
168+50	3	8,150	6.7	7.3												3.75	
168+25	3	8,175	7.1	7.3												3.75	
168+00	3	8,200	7.3	6.8												3.75	
167+75	3	8,225	7.5	6.3												3.75	
167+50	3	8,250	7.6	6.4	6.8	D	0.29	1.95			0.04	0.48	2.43	3,073	673,546	3.75	
167+25	3	8,275	7.8	6.6												3.75	
167+00	3	8,300	8.0	6.5												3.75	
166+75	3	8,325	7.8	6.4												3.75	
166+50	3	8,350	7.1	6.3												3.75	
166+25	3	8,375	6.5	6.5												3.75	
166+00	3	8,400	6.6	6.5					SC	A-4						3.75	
165+75	3	8,425	6.6	6.5												3.75	
165+50	3	8,450	6.9	6.4												3.75	
165+25	3	8,475	6.2	6.3												3.75	
165+00	3	8,500	6.4	6.5					SC	A-4						3.75	
164+75	3	8,525	6.3	6.3												3.75	
164+50	3	8,550	6.3	6.0												3.75	
164+25	3	8,575	6.3	6.1												3.75	
164+00	3	8,600	6.1	6.3												3.75	
163+75	3	8,625	6.0	7.5												3.75	
163+50	3	8,650	6.7	7.3												3.75	
163+25	3	8,675	7.0	7.5												3.75	
163+00	3	8,700	7.2	7.6												3.75	
162+75	3	8,725	7.4	7.5												3.75	
162+50	3	8,750	7.4	7.4	7.1	D	0.29	2.03			0.08	0.96	2.99	3,073	673,546	3.75	
162+25	3	8,775	7.6	7.3												3.75	
162+00	3	8,800	6.8	7.0												3.75	
161+75	3	8,825	6.7	7.4												3.75	
161+50	3	8,850	7.9	7.7												3.75	
161+25	3	8,875	6.4	7.8												3.75	
161+00	3	8,900	7.3	8.8												3.75	
160+75	3	8,925	7.5	8.1					SW-SC	A-2-4						3.75	
160+50	3	8,950	7.1	7.3												3.75	
160+25	3	8,975	6.8	7.7												3.75	
160+00	3	9,000	6.7	7.6					SW-SC	A-2-4						3.75	
159+75	3	9,025	6.7	7.6												3.75	
159+50	3	9,050	6.4	7.3												3.75	
159+25	3	9,075	5.0	7.1												3.75	SB ≤5.0"
159+00	3	9,100	5.2	7.1												3.75	
158+75	3	9,125	5.6	7.1												3.75	
158+50	3	9,150	6.0	7.1												3.75	
158+25	3	9,175	5.8	7.0												3.75	
158+00	3	9,200	5.4	7.0												3.75	
157+75	3	9,225	5.3	6.6												3.75	
157+50	3	9,250	5.3	6.4	6.1	D	0.29	1.75			0.08	0.96	2.71	3,073	673,546	3.75	
157+25	3	9,275	5.6	7.0												3.75	
157+00	3	9,300	6.1	6.5												3.75	
156+75	3	9,325	5.8	5.8												3.75	
156+50	3	9,350	5.4	5.5												3.75	
156+25	3	9,375	5.8	5.5												3.75	
156+00	3	9,400	6.0	5.9					SW-SC	A-2-4						3.75	
155+75	3	9,425	6.0	5.6												3.75	
155+50	3	9,450	6.0	6.0												3.75	
155+25	3	9,475	6.0	5.8												3.75	
155+00	3	9,500	5.8	5.9					SW-SC	A-2-4						3.75	
154+75	3	9,525	5.6	5.9												3.75	
154+50	3	9,550	5.5	6.0												3.75	
154+25	3	9,575	5.7	5.8												3.75	
154+00	3	9,600	5.9	6.1												3.75	
153+75	3	9,625	6.2	6.0												3.75	
153+50	3	9,650	6.4	6.5												3.75	
153+25	3	9,675	6.6	3"												3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
153+00	3	9,700	6.8	3"												3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+75	3	9,725	6.8	3.1"												3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+50	3	9,750	6.8	3.1"	6.1	D	0.29	1.73			0.08	0.96	2.69	3,073	673,546	3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+25	3	9,775	5.7	3.1"												3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+00	3	9,800	5.9	3.1"												3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
151+75	3	9,825	6.9	6.3												3.75	
151+50	3	9,850	5.9	6.0												3.75	
151+25	3	9,875	5.8	5.8												3.75	
151+00	3	9,900	5.9	5.7					SP-SC	A-2-4						3.75	
150+75	3	9,925	6.0	5.9												3.75	
150+50	3	9,950	6.0	6.0												3.75	
150+25	3	9,975	6.1	6.1												3.75	
150+00	3	10,000	5.8	5.8					SP-SC	A-2-4						3.75	
149+75	3	10,025	5.7	5.6												3.75	
149+50	3	10,050	6.0	6.0												3.75	
149+25	3	10,075	6.0	6.0												3.75	
149+00	3	10,100	6.0	6.0												3.75	
148+75	3	10,125	6.0	6.0												3.75	
148+50	3	10,150	5.8	5.8												3.75	
148+25	3	10,175	5.8	6.0												3.75	
148+00	3	10,200	6.0	6.0												3.75	
147+75	3	10,225	6.0	5.9												3.75	
147+50	3	10,250	6.2	5.9	6.0	D	0.29	1.72			0.06	0.72	2.44	3,073	673,546	3.75	
147+25	3	10,275	6.3	6.0												3.75	
147+00	3	10,300	6.4	6.0												3.75	
146+75	3	10,325	6.3	6.2												3.75	
146+50	3	10,350	6.2	6.0												3.75	
146+25	3	10,375	6.2	6.0					SW-SM	A-1-b						3.75	
146+00	3	10,400	6.1	5.6												3.75	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
145+75	3	10,425	6.2	5.4												3.75	
145+50	3	10,450	6.0	5.7												3.75	
145+25	3	10,475	6.0	6.8												3.75	
145+00	3	10,500	6.1	5.8					SW-SM	A-1-b						3.75	
144+75	3	10,525	6.8	6.0					s(CL)	A-6						4.25	
144+50	3	10,550	7.3	6.5												4.25	
144+25	3	10,575	7.7	6.5												4.25	
144+00	3	10,600	7.7	8.0												4.25	
143+75	3	10,625	7.7	7.5												4.25	
143+50	3	10,650	7.9	6.9												4.25	
143+25	3	10,675	7.5	6.7												4.25	
143+00	3	10,700	7.6	6.8												4.25	
142+75	3	10,725	7.8	6.3												4.25	
142+50	3	10,750	7.3	5.6	7.1	D	0.29	2.02			0.02	0.24	2.26	3,073	673,546	4.25	
142+25	3	10,775	7.7	6.2												4.25	
142+00	3	10,800	8.2	6.7												4.25	
141+75	3	10,825	8.2	6.7												4.25	
141+50	3	10,850	8.3	6.6												4.25	
141+25	3	10,875	8.1	6.8												4.25	
141+00	3	10,900	7.7	6.5												4.25	
140+75	3	10,925	6.9	6.7												4.25	
140+50	3	10,950	6.5	6.6												4.25	
140+25	3	10,975	6.3	6.7												4.25	
140+00	3	11,000	6.2	6.6					s(CL)	A-6						4.25	
139+75	3	11,025	6.2	6.4												4.50	
139+50	3	11,050	6.5	6.1												4.50	
139+25	3	11,075	7.2	6.5												4.50	
139+00	3	11,100	7.6	6.0												4.50	
138+75	3	11,125	7.1	5.9												4.50	
138+50	3	11,150	7.4	6.3												4.50	
138+25	3	11,175	8.0	6.0												4.50	
138+00	3	11,200	8.1	6.5												4.50	
137+75	3	11,225	7.7	6.2												4.50	
137+50	3	11,250	7.2	6.5	6.8	D	0.29	1.95	s(CL)	A-6	0.02	0.24	2.19	3,073	673,546	4.50	
137+25	3	11,275	7.0	6.5												4.50	
137+00	3	11,300	7.0	5.9												4.50	
136+75	3	11,325	7.0	6.0												4.50	
136+50	3	11,350	7.3	6.3												4.50	
136+25	3	11,375	8.1	6.4												4.50	
136+00	3	11,400	8.3	6.0												4.50	
135+75	3	11,425	8.2	6.3												4.50	
135+50	3	11,450	8.4	6.1												4.50	
135+25	3	11,475	7.6	5.9												4.50	
135+00	3	11,500	7.6	6.0					s(CL)	A-6						4.50	
134+75	3	11,525	6.8	6.4												3.75	
134+50	3	11,550	6.9	6.3												3.75	
134+25	3	11,575	7.1	6.0												3.75	
134+00	3	11,600	7.1	6.7												3.75	
133+75	3	11,625	6.9	6.9												3.75	
133+50	3	11,650	6.5	5.8												3.75	
133+25	3	11,675	6.5	6.8												3.75	
133+00	3	11,700	6.3	7.0												3.75	
132+75	3	11,725	6.2	6.6					SC	A-2-4						3.75	
132+50	3	11,750	5.8	6.4	6.3	D	0.29	1.80			0.08	0.96	2.76	3,073	673,546	3.75	
132+25	3	11,775	5.7	6.1												3.75	
132+00	3	11,800	5.8	6.1												3.75	
131+75	3	11,825	5.9	6.0												3.75	
131+50	3	11,850	6.0	6.1												3.75	
131+25	3	11,875	6.0	6.2												3.75	
131+00	3	11,900	6.0	6.0												3.75	
130+75	3	11,925	6.0	6.3												3.75	
130+50	3	11,950	6.0	6.2												3.75	
130+25	3	11,975	6.0	5.9												3.75	
130+00	3	12,000	6.2	5.8					SC	A-2-4						3.75	
129+75	3	12,025	6.7	6.6												3.75	
129+50	3	12,050	6.8	7.1												3.75	
129+25	3	12,075	7.9	9.1												3.75	
129+00	3	12,100	8.2	7.2												3.75	
128+75	3	12,125	6.5	6.4												3.75	
128+50	3	12,150	5.6	5.5												3.75	
128+25	3	12,175	5.2"	6.0												3.75	
128+00	3	12,200	4.9"	5.7					SC-SM	A-4						3.75	SB ≤5.0" Partial Depth Patching
127+75	3	12,225	4.9"	5.3"												3.75	SB ≤5.0" Partial Depth Patching
127+50	3	12,250	5"	5.3"	6.7	D	0.29	1.91			0.04	0.48	2.39	3,073	673,546	3.75	SB ≤5.0" Partial Depth Patching
127+25	3	12,275	6.5	7.0												3.75	
127+00	3	12,300	7.4	7.1												3.75	
126+75	3	12,325	7.5	7.0												3.75	
126+50	3	12,350	7.1	6.7												3.75	
126+25	3	12,375	6.5	6.3												3.75	
126+00	3	12,400	6.1	6.4												3.75	
125+75	3	12,425	6.0	6.3												3.75	
125+50	3	12,450	6.1	6.4												3.75	
125+25	3	12,475	6.2	6.5												3.75	
125+00	3	12,500	6.3	6.0					SC-SM	A-4						3.75	
124+75	3	12,525	6.4	6.0												3.75	
124+50	3	12,550	6.3	6.3												3.75	
124+25	3	12,575	5.9	6.4												3.75	
124+00	3	12,600	6.0	6.7												3.75	
123+75	3	12,625	6.1	6.8												3.75	
123+50	3	12,650	6.2	6.4												3.75	
123+25	3	12,675	6.3	6.2												3.75	
123+00	3	12,700	6.5	6.1												3.75	
122+75	3	12,725	6.2	6.2												3.75	
122+50	3	12,750	6.0	6.5	6.2	C	0.29	1.78			0.08	0.96	2.74	3,073	673,546	3.75	
122+25	3	12,775	5.8	6.1												3.75	
122+00	3	12,800	5.8	6.0												3.75	
121+75	3	12,825	6.0	6.0												3.75	
121+50	3	12,850	6.1	6.0												3.75	
121+25	3	12,875	6.0	5.8												3.75	
121+00	3	12,900	5.9	5.7					SM	A-2-4						3.75	
120+75	3	12,925	6.0	6.1												3.75	
120+50	3	12,950	6.2	6.6												3.75	
120+25	3	12,975	6.3	7.3												3.75	
120+00	3	13,000	6.3	7.6					SM	A-2-4						3.75	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
119+75	3	13,025	6.7	7.7												4.25	
119+50	3	13,050	7.3	7.8												4.25	
119+25	3	13,075	7.9	8.1												4.25	
119+00	3	13,100	8.7	7.6												4.25	
118+75	3	13,125	8.8	7.5												4.25	
118+50	3	13,150	9.3	8.0												4.25	
118+25	3	13,175	9.4	8.2												4.25	
118+00	3	13,200	9.0	7.7												4.25	
117+75	3	13,225	7.7	7.4												4.25	
117+50	3	13,250	6.6	7.2	6.9	C	0.29	1.98			0.02	0.24	2.22	3,073	673,546	4.25	
117+25	3	13,275	6.0	7.1												4.25	
117+00	3	13,300	5.8	6.5												4.25	
116+75	3	13,325	5.6	6.5												4.25	
116+50	3	13,350	5.5	6.3												4.25	
116+25	3	13,375	5.4	6.0					s(CL)	A-6						4.25	
116+00	3	13,400	5.7	5.9												4.25	
115+75	3	13,425	5.5	5.6												4.25	
115+50	3	13,450	5.5	6.3												4.25	
115+25	3	13,475	5.9	6.1												4.25	
115+00	3	13,500	6.2	5.5					s(CL)	A-6						4.25	
114+75	3	13,525	6.6	6.2												3.75	
114+50	3	13,550	7.4	7.5												3.75	
114+25	3	13,575	8.4	8.3												3.75	
114+00	3	13,600	8.8	8.3												3.75	
113+75	3	13,625	9.1	8.0												3.75	
113+50	3	13,650	9.4	8.2												3.75	
113+25	3	13,675	8.8	8.3												3.75	
113+00	3	13,700	8.3	7.7												3.75	
112+75	3	13,725	6.9	6.2												3.75	
112+50	3	13,750	6.1	6.0	7.0	C	0.29	2.00			0.04	0.48	2.48	3,073	673,546	3.75	
112+25	3	13,775	6.0	6.3					(SC)g	A-4						3.75	
112+00	3	13,800	6.0	6.0												3.75	
111+75	3	13,825	6.1	6.3												3.75	
111+50	3	13,850	6.1	6.0												3.75	
111+25	3	13,875	6.0	6.1												3.75	
111+00	3	13,900	6.0	7.1												3.75	
110+75	3	13,925	6.2	6.5												3.75	
110+50	3	13,950	6.5	6.5												3.75	
110+25	3	13,975	6.5	6.6												3.75	
110+00	3	14,000	6.4	5.9					(SC)g	A-4						3.75	
109+75	3	14,025	6.3	5.9												3.75	
109+50	3	14,050	6.1	6.7												3.75	
109+25	3	14,075	6.0	6.5												3.75	
109+00	3	14,100	5.9	6.4												3.75	
108+75	3	14,125	5.9	7.0												3.75	
108+50	3	14,150	6.2	7.0												3.75	
108+25	3	14,175	6.4	5.3												3.75	
108+00	3	14,200	6.3	6.0					SC-SM	A-4						3.75	
107+75	3	14,225	6.6	6.2												3.75	
107+50	3	14,250	6.8	6.4	6.6	C	0.29	1.89			0.04	0.48	2.37	3,073	673,546	3.75	
107+25	3	14,275	6.5	6.8												3.75	
107+00	3	14,300	6.1	6.3												3.75	
106+75	3	14,325	6.1	6.5												3.75	
106+50	3	14,350	6.7	7.2												3.75	
106+25	3	14,375	6.5	7.5												3.75	
106+00	3	14,400	7.1	7.7												3.75	
105+75	3	14,425	7.6	8.2												3.75	
105+50	3	14,450	6.6	7.2												3.75	
105+25	3	14,475	7.2	6.8												3.75	
105+00	3	14,500	7.1	6.8					SC-SM	A-4						3.75	
104+75	3	14,525	6.6	7.1												3.75	
104+50	3	14,550	6.5	7.4												3.75	
104+25	3	14,575	6.3	7.7												3.75	
104+00	3	14,600	6.4	7.5												3.75	
103+75	3	14,625	6.5	7.6												3.75	
103+50	3	14,650	6.5	7.6					SC-SM	A-2-4						3.75	
103+25	3	14,675	6.6	7.3												3.75	
103+00	3	14,700	7.1	7.4												3.75	
102+75	3	14,725	7.7	7.5												3.75	
102+50	3	14,750	6.8	7.1	6.7	C	0.29	1.92			0.08	0.96	2.88	3,073	673,546	3.75	
102+25	3	14,775	6.1	6.6												3.75	
102+00	3	14,800	6.3	6.3												3.75	
101+75	3	14,825	6.7	6.2												3.75	
101+50	3	14,850	6.4	6.3												3.75	
101+25	3	14,875	6.0	6.3												3.75	
101+00	3	14,900	6.4	6.5												3.75	
100+75	3	14,925	6.5	6.4												3.75	
100+50	3	14,950	6.7	6.2												3.75	
100+25	3	14,975	7.1	6.5												3.75	
100+00	3	15,000	6.1	6.4					SC-SM	A-2-4						3.75	
99+75	2	15,025	6.4	6.4												5.75	
99+50	2	15,050	6.5	6.4												5.75	
99+25	2	15,075	6.9	6.2												5.75	
99+00	2	15,100	7.1	6.1												5.75	
98+75	2	15,125	6.9	6.0					CH	A-7						5.75	
98+50	2	15,150	6.9	6.2												5.75	
98+25	2	15,175	7.0	6.2												5.75	
98+00	2	15,200	7.1	6.1												5.75	
97+75	2	15,225	6.9	6.3												5.75	
97+50	2	15,250	7.2	6.3	6.6	C	0.29	1.88			0.015	0.18	2.06	3,073	673,546	5.75	
97+25	2	15,275	7.0	6.4												5.75	
97+00	2	15,300	7.4	6.5												5.75	
96+75	2	15,325	6.6	6.4												5.75	
96+50	2	15,350	6.7	6.5												5.75	
96+25	2	15,375	7.1	6.3												5.75	
96+00	2	15,400	7.1	6.5												5.75	
95+75	2	15,425	7.0	6.3												5.75	
95+50	2	15,450	6.5	6.7												5.75	
95+25	2	15,475	6.3	6.4												5.75	
95+00	2	15,500	6.0	6.0					s(CL)	A-6						5.75	
94+75	2	15,525	6.4	6.2												5.25	
94+50	2	15,550	6.1	6.3												5.25	
94+25	2	15,575	5.5	6.3												5.25	
94+00	2	15,600	6.0	6.4												5.25	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
93+75	2	15,625	6.6	6.2												5.25	
93+50	2	15,650	6.5	6.2												5.25	
93+25	2	15,675	6.3	6.0												5.25	
93+00	2	15,700	6.0	6.2												5.25	
92+75	2	15,725	5.9	5.9												5.25	
92+50	2	15,750	6.0	6.0	5.9	C	0.29	1.69			0.02	0.24	1.93	3,073	673,546	5.25	
92+25	2	15,775	5.9	6.1												5.25	
92+00	2	15,800	5.6	6.4												5.25	
91+75	2	15,825	5.4	6.4												5.25	
91+50	2	15,850	5.4	6.0												5.25	
91+25	2	15,875	5.4	5.9												5.25	
91+00	2	15,900	5.7	5.8												5.25	
90+75	2	15,925	5.1	5.5												5.25	
90+50	2	15,950	5.4	5.5												5.25	
90+25	2	15,975	5.3	5.5												5.25	
90+00	2	16,000	5.7	6.0					s(CL)	A-6						5.25	
89+75	2	16,025	5.4	5.8					s(CL)	A-6						5.25	
89+50	2	16,050	5.5	5.8												5.25	
89+25	2	16,075	5.4	5.8												5.25	
89+00	2	16,100	5.7	5.7												5.25	
88+75	2	16,125	5.4	5.7												5.25	
88+50	2	16,150	5.4	5.8												5.25	
88+25	2	16,175	5.4	5.9												5.25	
88+00	2	16,200	5.8	6.0												5.25	
87+75	2	16,225	5.8	5.9												5.25	
87+50	2	16,250	6.0	6.0	5.7	C	0.29	1.64			0.02	0.24	1.88	3,073	673,546	5.25	
87+25	2	16,275	6.0	6.0												5.25	
87+00	2	16,300	5.9	6.0												5.25	
86+75	2	16,325	5.6	6.0												5.25	
86+50	2	16,350	5.7	6.0												5.25	
86+25	2	16,375	5.8	6.0												5.25	
86+00	2	16,400	5.5	5.7					s(CL)	A-6						5.25	
85+75	2	16,425	5.6	5.7												5.25	
85+50	2	16,450	5.4	5.8												5.25	
85+25	2	16,475	5.5	5.8												5.25	
85+00	2	16,500	5.5	5.4					s(CL)	A-6						5.25	
84+75	1	16,525	5.5	5.6												3.75	
84+50	1	16,550	5.5	5.6												3.75	
84+25	1	16,575	5.5	5.7												3.75	
84+00	1	16,600	5.6	5.9												3.75	
83+75	1	16,625	5.7	5.8												3.75	
83+50	1	16,650	5.7	5.7												3.75	
83+25	1	16,675	5.8	6.0												3.75	
83+00	1	16,700	6.1	5.6												3.75	
82+75	1	16,725	6.8	5.7												3.75	
82+50	1	16,750	7.1	5.9	5.9	C	0.29	1.69			0.1	1.2	2.89	3,073	673,546	3.75	
82+25	1	16,775	6.9	6.0												3.75	
82+00	1	16,800	6.2	5.5												3.75	
81+75	1	16,825	5.8	5.6												3.75	
81+50	1	16,850	6.0	5.7												3.75	
81+25	1	16,875	6.0	5.8					(GC-GM)s	A-1-a						3.75	
81+00	1	16,900	5.7	5.9												3.75	
80+75	1	16,925	6.0	6.3												3.75	
80+50	1	16,950	6.2	6.3												3.75	
80+25	1	16,975	6.1	6.0												3.75	
80+00	1	17,000	5.5	5.9					(GC-GM)s	A-1-a						3.75	
79+75	1	17,025	5.4	5.9												3.75	
79+50	1	17,050	5.5	5.7												3.75	
79+25	1	17,075	5.5	6.0												3.75	
79+00	1	17,100	5.4	6.2												3.75	
78+75	1	17,125	5.4	6.0												3.75	
78+50	1	17,150	5.4	6.1												3.75	
78+25	1	17,175	5.4	5.8												3.75	
78+00	1	17,200	5.1	5.7												3.75	
77+75	1	17,225	5.7	6.3												3.75	
77+50	1	17,250	5.8	6.1	5.9	C	0.29	1.68			0.1	1.2	2.88	3,073	673,546	3.75	
77+25	1	17,275	6.0	6.2					(GP-GC)s	A-1-a						3.75	
77+00	1	17,300	5.9	6.0												3.75	
76+75	1	17,325	6.1	5.7												3.75	
76+50	1	17,350	6.1	5.7												3.75	
76+25	1	17,375	6.1	5.8												3.75	
76+00	1	17,400	6.4	6.0												3.75	
75+75	1	17,425	6.2	6.1												3.75	
75+50	1	17,450	6.1	6.0												3.75	
75+25	1	17,475	5.9	6.0												3.75	
75+00	1	17,500	6.0	6.0					(GP-GC)s	A-1-a						3.75	
74+75	1	17,525	6.1	6.0												3.75	
74+50	1	17,550	6.1	6.2												3.75	
74+25	1	17,575	6.0	6.2												3.75	
74+00	1	17,600	6.0	6.3												3.75	
73+75	1	17,625	6.0	6.1												3.75	
73+50	1	17,650	6.3	6.1												3.75	
73+25	1	17,675	6.4	6.1												3.75	
73+00	1	17,700	6.5	6.2												3.75	
72+75	1	17,725	6.5	6.5					SC-SM	A-2-4						3.75	
72+50	1	17,750	6.4	6.2	6.7	B	0.40	2.65			0.08	0.96	3.61	3,073	673,546	3.75	
72+25	1	17,775	6.5	6.5												3.75	
72+00	1	17,800	6.9	7.3												3.75	
71+75	1	17,825	7.6	7.7												3.75	
71+50	1	17,850	7.5	7.7												3.75	
71+25	1	17,875	6.8	6.8												3.75	
71+00	1	17,900	7.1	7.0												3.75	
70+75	1	17,925	7.5	7.1												3.75	
70+50	1	17,950	7.4	7.1												3.75	
70+25	1	17,975	7.0	7.2												3.75	
70+00	1	18,000	7.1	7.4					SC-SM	A-2-4						3.75	
69+75	1	18,025	7.3	7.7												3.75	
69+50	1	18,050	7.5	7.4												3.75	
69+25	1	18,075	7.3	8.2												3.75	
69+00	1	18,100	7.1	7.7												3.75	
68+75	1	18,125	6.9	8.2												3.75	
68+50	1	18,150	6.5	8.3												3.75	
68+25	1	18,175	6.6	8.3												3.75	
68+00	1	18,200	7.0	7.9												3.75	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
67+75	1	18,225	7.1	7.8												3.75	
67+50	1	18,250	7.1	8.3	7.5	A	0.35	2.63	GP	A-1-a	0.1	1.2	3.83	3,073	673,546	3.75	
67+25	1	18,275	6.9	8.1												3.75	
67+00	1	18,300	6.8	7.9												3.75	
66+75	1	18,325	7.0	7.6												3.75	
66+50	1	18,350	7.0	8.0												3.75	
66+25	1	18,375	7.0	7.9												3.75	
66+00	1	18,400	7.2	7.5												3.75	
65+75	1	18,425	7.1	8.0												3.75	
65+50	1	18,450	7.2	7.1												3.75	
65+25	1	18,475	7.1	8.2												3.75	
65+00	1	18,500	7.2	7.8					GP	A-1-a						3.75	
64+75	1	18,525	7.3	7.7												3.75	
64+50	1	18,550	7.5	7.7												3.75	
64+25	1	18,575	8.1	9.1												3.75	
64+00	1	18,600	7.6	7.9												3.75	
63+75	1	18,625	7.6	8.2												3.75	
63+50	1	18,650	7.7	8.0												3.75	
63+25	1	18,675	8.4	8.1												3.75	
63+00	1	18,700	7.5	10.1												3.75	Intersection w/ Lookout Rd
62+75	1	18,725	7.0	8.8												3.75	
62+50	1	18,750	6.6	8.8	8.0	A	0.35	2.81			0.02	0.24	3.05	3,073	673,546	3.75	
62+25	1	18,775	6.5	8.8					s(CL)	A-6						3.75	
62+00	1	18,800	8.7	8.0												3.75	
61+75	1	18,825	9.1	7.5												3.75	
61+50	1	18,850	9.4	7.2												3.75	
61+25	1	18,875	8.2	7.2												3.75	
61+00	1	18,900	8.4	7.3												3.75	
60+75	1	18,925	8.2	7.7												3.75	
60+50	1	18,950	8.2	7.9												3.75	
60+25	1	18,975	8.3	7.2												3.75	
60+00	1	19,000	8.4	7.5					s(CL)	A-6						3.75	
59+75	1	19,025	8.2	8.1												3.75	
59+50	1	19,050	8.6	8.4												3.75	
59+25	1	19,075	7.9	8.3												3.75	
59+00	1	19,100	9.0	8.4												3.75	
58+75	1	19,125	8.4	8.5												3.75	
58+50	1	19,150	8.2	7.7												3.75	
58+25	1	19,175	8.1	7.8												3.75	
58+00	1	19,200	8.0	7.5					(CL)s	A-7						3.75	
57+75	1	19,225	7.8	8.4												3.75	
57+50	1	19,250	7.8	8.3	7.8	A	0.35	2.76			0.01	0.12	2.88	3,073	673,546	3.75	
57+25	1	19,275	8.1	8.2												3.75	
57+00	1	19,300	8.2	9.9												3.75	
56+75	1	19,325	8.8	10.0												3.75	
56+50	1	19,350	8.3	7.5												3.75	
56+25	1	19,375	8.7	5.5												3.75	
56+00	1	19,400	8.6	5.4												3.75	
55+75	1	19,425	9.0	5.4												3.75	
55+50	1	19,450	7.4	5.4												3.75	
55+25	1	19,475	7.1	5.4												3.75	
55+00	1	19,500	7.1	5.7					(CL)s	A-7						3.75	
54+75	1	19,525	6.8	5.7												3.75	
54+50	1	19,550	7.1	5.8												3.75	
54+25	1	19,575	7.3	5.9												3.75	
54+00	1	19,600	7.4	5.9												3.75	
53+75	1	19,625	7.1	5.6												3.75	
53+50	1	19,650	7.1	5.7					SC-SM	A-4						3.75	
53+25	1	19,675	7.1	6.0												3.75	
53+00	1	19,700	7.2	6.0												3.75	
52+75	1	19,725	7.2	5.8												3.75	
52+50	1	19,750	7.2	5.7	6.5	A	0.35	2.28			0.04	0.48	2.76	3,073	673,546	3.75	
52+25	1	19,775	7.6	5.6												3.75	
52+00	1	19,800	7.3	5.4												3.75	
51+75	1	19,825	7.1	5.6												3.75	
51+50	1	19,850	7.0	5.9												3.75	
51+25	1	19,875	6.9	5.7												3.75	
51+00	1	19,900	6.9	5.9												3.75	
50+75	1	19,925	6.9	6.0												3.75	
50+50	1	19,950	6.7	6.1												3.75	
50+25	1	19,975	6.6	6.6												3.75	
50+00	1	20,000	6.8	7.1					SC-SM	A-4						3.75	
49+75	1	20,025	7.1	7.1												3.75	
49+50	1	20,050	6.8	6.7												3.75	
49+25	1	20,075	6.3	6.7												3.75	
49+00	1	20,100	6.9	7.1												3.75	
48+75	1	20,125	6.5	7.0												3.75	
48+50	1	20,150	6.3	7.0												3.75	
48+25	1	20,175	6.5	7.0												3.75	
48+00	1	20,200	6.3	6.5					(GP-GC)s	A-1-a						3.75	
47+75	1	20,225	6.7	6.1												3.75	
47+50	1	20,250	6.6	6.1	6.5	A	0.35	2.28			0.1	1.2	3.48	3,073	673,546	3.75	
47+25	1	20,275	6.4	6.1												3.75	
47+00	1	20,300	6.4	6.0												3.75	
46+75	1	20,325	6.6	6.0												3.75	
46+50	1	20,350	7.7	6.1												3.75	
46+25	1	20,375	7.4	6.1												3.75	
46+00	1	20,400	6.5	6.1												3.75	
45+75	1	20,425	6.5	6.1												3.75	
45+50	1	20,450	6.2	6.2												3.75	
45+25	1	20,475	5.9	6.0												3.75	
45+00	1	20,500	6.0	5.8					(GP-GC)s	A-1-a						3.75	
44+75	1	20,525	6.2	5.7												3.75	
44+50	1	20,550	6.7	5.9												3.75	
44+25	1	20,575	7.1	6.5					SM	A-2-4						3.75	
44+00	1	20,600	7.2	6.6												3.75	
43+75	1	20,625	6.4	6.5												3.75	
43+50	1	20,650	6.4	6.3												3.75	
43+25	1	20,675	6.7	6.3												3.75	
43+00	1	20,700	7.1	6.1												3.75	
42+75	1	20,725	7.7	6.2												3.75	
42+50	1	20,750	7.7	6.5	6.9	A	0.35	2.42			0.08	0.96	3.38	3,073	673,546	3.75	
42+25	1	20,775	7.0	6.8												3.75	
42+00	1	20,800	7.1	6.9												3.75	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
41+75	1	20,825	7.4	6.8												3.75	
41+50	1	20,850	7.7	7.8												3.75	
41+25	1	20,875	8.0	7.6												3.75	
41+00	1	20,900	7.1	7.4												3.75	
40+75	1	20,925	6.5	7.1												3.75	
40+50	1	20,950	6.5	6.5												3.75	
40+25	1	20,975	7.3	6.9												3.75	
40+00	1	21,000	7.3	7.4					SM	A-2-4						3.75	
39+75	1	21,025	7.2	7.5												3.75	
39+50	1	21,050	7.4	7.4												3.75	
39+25	1	21,075	7.9	7.0												3.75	
39+00	1	21,100	8.7	6.7												3.75	
38+75	1	21,125	8.9	6.5												3.75	
38+50	1	21,150	8.2	6.5												3.75	
38+25	1	21,175	7.1	6.7												3.75	
38+00	1	21,200	7.1	7.1												3.75	
37+75	1	21,225	7.3	7.1												3.75	
37+50	1	21,250	7.2	7.1	7.1	A	0.35	2.49			0.02	0.24	2.73	3,073	673,546	3.75	
37+25	1	21,275	6.8	7.2												3.75	
37+00	1	21,300	6.8	7.2					(CL)s	A-6						3.75	
36+75	1	21,325	7.1	7.1												3.75	
36+50	1	21,350	6.8	6.9												3.75	
36+25	1	21,375	6.5	6.8												3.75	
36+00	1	21,400	6.3	6.5												3.75	
35+75	1	21,425	6.2	6.5												3.75	
35+50	1	21,450	6.5	7.2												3.75	
35+25	1	21,475	6.7	7.3												3.75	
35+00	1	21,500	6.6	7.3					(CL)s	A-6						3.75	
34+75	1	21,525	7.0	7.3												3.75	
34+50	1	21,550	6.8	7.1												3.75	
34+25	1	21,575	7.1	6.8												3.75	
34+00	1	21,600	7.5	6.5												3.75	
33+75	1	21,625	6.7	6.3												3.75	
33+50	1	21,650	6.5	6.2												3.75	
33+25	1	21,675	6.9	6.0												3.75	
33+00	1	21,700	7.0	6.2												3.75	
32+75	1	21,725	7.1	6.5					SC-SM	A-2-4						3.75	
32+50	1	21,750	6.6	6.8	6.5	A	0.35	2.27			0.08	0.96	3.23	3,073	673,546	3.75	
32+25	1	21,775	6.3	6.6												3.75	
32+00	1	21,800	6.4	6.5												3.75	
31+75	1	21,825	6.7	6.4												3.75	
31+50	1	21,850	6.3	6.2												3.75	
31+25	1	21,875	6.1	6.0												3.75	
31+00	1	21,900	6.0	6.1												3.75	
30+75	1	21,925	6.1	6.0												3.75	
30+50	1	21,950	6.0	6.0												3.75	
30+25	1	21,975	5.9	5.9												3.75	
30+00	1	22,000	5.8	6.0					SC-SM	A-2-4						3.75	
29+75	1	22,025	6.0	6.0												3.75	
29+50	1	22,050	6.0	5.9												3.75	
29+25	1	22,075	6.0	6.0												3.75	
29+00	1	22,100	6.0	5.9												3.75	
28+75	1	22,125	6.3	6.0												3.75	
28+50	1	22,150	6.5	6.1												3.75	
28+25	1	22,175	6.7	6.2												3.75	
28+00	1	22,200	6.8	6.1												3.75	
27+75	1	22,225	6.9	5.5												3.75	
27+50	1	22,250	7.1	5.9	6.2	A	0.35	2.17			0.04	0.48	2.65	3,073	673,546	3.75	
27+25	1	22,275	6.7	6.1												3.75	
27+00	1	22,300	6.3	6.4												3.75	
26+75	1	22,325	6.2	5.7												3.75	
26+50	1	22,350	6.6	5.7												3.75	
26+25	1	22,375	6.8	5.6												3.75	
26+00	1	22,400	6.8	5.6												3.75	
25+75	1	22,425	6.6	5.7												3.75	
25+50	1	22,450	6.5	6.0												3.75	
25+25	1	22,475	6.0	5.7					SC-SM	A-4						3.75	
25+00	1	22,500	6.1	5.8					SC-SM	A-4						3.75	
24+75	1	22,525	6.5	5.7												4.50	
24+50	1	22,550	6.5	5.8												4.50	
24+25	1	22,575	7.1	5.7					(CL)s	A-7						4.50	
24+00	1	22,600	8.2	5.8												4.50	
23+75	1	22,625	8.4	5.9												4.50	
23+50	1	22,650	8.3	6.0												4.50	
23+25	1	22,675	8.2	6.0												4.50	
23+00	1	22,700	7.7	6.1												4.50	
22+75	1	22,725	7.2	6.0												4.50	
22+50	1	22,750	7.3	6.0	6.8	A	0.35	2.38			0.01	0.12	2.50	3,073	673,546	4.50	
22+25	1	22,775	7.6	5.8												4.50	
22+00	1	22,800	7.7	6.0												4.50	
21+75	1	22,825	7.1	6.0												4.50	
21+50	1	22,850	6.9	6.0												4.50	
21+25	1	22,875	6.9	6.0												4.50	
21+00	1	22,900	7.4	6.0												4.50	
20+75	1	22,925	7.4	5.8												4.50	
20+50	1	22,950	7.3	6.0												4.50	
20+25	1	22,975	8.1	6.4												4.50	
20+00	1	23,000	9.2	6.8					(CL)s	A-7						4.50	
19+75	1	23,025	9.6	6.9												3.75	
19+50	1	23,050	7.4	7.0												3.75	
19+25	1	23,075	7.6	7.2					(CL)s	A-7						3.75	
19+00	1	23,100	7.7	7.1												3.75	
18+75	1	23,125	7.7	7.3												3.75	
18+50	1	23,150	7.7	7.3												3.75	
18+25	1	23,175	7.8	7.2												3.75	
18+00	1	23,200	7.2	7.0												3.75	
17+75	1	23,225	7.7	7.1												3.75	
17+50	1	23,250	7.2	7.3	7.5	A	0.35	2.65			0.01	0.12	2.77	3,073	673,546	3.75	
17+25	1	23,275	7.5	7.2												3.75	
17+00	1	23,300	7.6	7.3												3.75	
16+75	1	23,325	7.7	7.2												3.75	
16+50	1	23,350	7.8	7.1												3.75	
16+25	1	23,375	8.2	7.2												3.75	
16+00	1	23,400	8.3	7.2												3.75	

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
15+75	1	23,425	7.5	7.3												3.75	
15+50	1	23,450	8.2	7.4												3.75	
15+25	1	23,475	8.6	7.2												3.75	
15+00	1	23,500	8.1	7.2					(CL)s	A-7						3.75	
14+75	1	23,525	8.2	7.1												3.75	
14+50	1	23,550	8.3	7.0												3.75	
14+25	1	23,575	8.5	6.8												3.75	
14+00	1	23,600	8.6	6.5												3.75	
13+75	1	23,625	8.4	6.8					s(CL)	A-6						3.75	
13+50	1	23,650	8.3	6.5												3.75	
13+25	1	23,675	8.3	6.0												3.75	
13+00	1	23,700	8.2	5.9												3.75	
12+75	1	23,725	8.2	6.3												3.75	
12+50	1	23,750	8.8	7.5	7.9	A	0.35	2.76			0.02	0.24	3.00	3,073	673,546	3.75	
12+25	1	23,775	8.8	10.0												3.75	
12+00	1	23,800	-	8.9												3.75	
11+75	1	23,825	-	7.6												3.75	
11+50	1	23,850	-	8.7												3.75	
11+25	1	23,875	-	7.7												3.75	
11+00	1	23,900	-	-												3.75	
10+75	1	23,925	-	-												3.75	
10+50	1	23,950	-	-												3.75	
10+25	1	23,975	-	-												3.75	
10+00	1	24,000	-	-					s(CL)	A-6						3.75	

Note:

- HMA Thickness Data for NB direction was modified to remove 4 locations throughout the run to maintain an accurate GPS LAT Difference from NB to SB.
- NB Direction chainage started approximately 75' North of the SB end chainage.
- LF 24000 is at STA 10+00
- SN = Structural Number

- HMA Thickness Color Scheme:
Green = Maximum Thickness
Red = Minimum Thickness
Pink = Proposed Partial Depth Patching
- SN Color Scheme:
Green = Maximum SN
Red = Minimum SN

STA	Group	LF	SB HMA Thickness (in.)	NB HMA Thickness (in.)	Avg Thickness (in.)	Pavement Condition	HMA Coefficient	HMA SN	USCS Classification	AASHTO Classification	Avg Subgrade Coefficient	Subgrade SN (12" SG)	Assumed SN (12" SG)	ADT	ESALs	Min Req'd Overlay (incl leveling)	HMA Thickness Comments
246+75	4	325	6.3	4.8"	6.2	C	0.29	1.78						3,073	673,546		NB ≤5.0" Partial Depth Patching
246+50	4	350	6.4	5"		C	0.29	1.78									NB ≤5.0" Partial Depth Patching
246+25	4	375	6.5	4.4"		C	0.29	1.78									NB ≤5.0" Partial Depth Patching
246+00	4	400	7.5	5"		C	0.29	1.78									NB ≤5.0" Partial Depth Patching
239+75	4	1,025	4.8"	5.4	6.1	C	0.29	1.76			0.02	0.24	2.00	3,073	673,546	5.00	SB ≤5.0" Partial Depth Patching
159+25	3	9,075	5.0	7.1	6.1	D	0.29	1.75			0.08	0.96	2.71	3,073	673,546	3.75	SB ≤5.0" Partial Depth Patching
153+25	3	9,675	6.6	3"	6.1	D	0.29	1.73			0.08	0.96	2.69	3,073	673,546	3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
153+00	3	9,700	6.8	3"		D	0.29	1.73			0.08					3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+75	3	9,725	6.8	3.1"		D	0.29	1.73			0.08					3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+50	3	9,750	6.8	3.1"		D	0.29	1.73			0.08					3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+25	3	9,775	5.7	3.1"		D	0.29	1.73			0.08					3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
152+00	3	9,800	5.9	3.1"		D	0.29	1.73			0.08					3.75	NB ≤3.5" - Assumed Bridge Deck (Aerial)
128+00	3	12,200	4.9"	5.7	6.7	D	0.29	1.91	SC-SM	A-4	0.04	0.48	2.39	3,073	673,549	3.75	SB ≤5.0" Partial Depth Patching
127+75	3	12,225	4.9"	5.3"		D	0.29	1.91			0.04			3,073	673,546	3.75	SB ≤5.0" Partial Depth Patching
127+50	3	12,250	5"	5.3"		D	0.29	1.91			0.04			3,073	673,546	3.75	SB ≤5.0" Partial Depth Patching

Appendix E – Additional Geotechnical Data Collection

GROUND PENETRATING RADAR, 95TH STREET, STATE HIGHWAY 52 TO LOUISVILLE CITY LIMITS, BOULDER, CO (2016 REPORT, GROUND ENGINEERING)

December 30, 2016

Subject: Ground Penetrating Radar, 95th Street, State Highway 52 to Louisville City Limits, Boulder, Colorado

Mr. Patrick McNamara, P.E. & P.L.S.
AECOM
6200 South Quebec Street
Denver, Colorado 80111

Dear Mr. McNamara,

This letter presents the results of the Ground Penetrating Radar (GPR) data collection and analysis for 95th Street from State Highway 52 to the Louisville City Limits in Boulder County, Colorado. Our study was conducted in general accordance with GROUND's reduced scope proposal 1611-2317 dated December 6, 2016 for GPR only.

This report has been prepared to summarize the data obtained and to present the results of the analysis. The information provided in this letter is supplemental to the original report prepared for GROUND Job Number 16-3619 dated July 27, 2016. Any information from the report noted above not specifically superseded by this letter is still valid.

GROUND PENETRATING RADAR

GROUND utilized a MALA RoadCart GPR unit, which is designed for high-speed road measurements. Data was collected with the use of the 2.3GHz and 800MHz antennas. For the purpose of this project only the high frequency 2.3GHz (shallow depth) antenna data was used. A Hemisphere A325 GNSS Receiver was used to collect GPS data to within +/- 1-meter of accuracy, of which was combined with the GPR results to provide a continuous stream/profile of the obtained pavement thicknesses.

The 2.3GHz antenna penetrates to depths up to 18-24-inches depending on material types and underlying subgrade whereas the 800MHz antenna produces readings at much greater depths depending on the underlying subgrade materials.

The GPR uses electromagnetic wave reflection from the material or object beneath the antennas to obtain a trace and it is the collection of these multiple traces that create a 2-D image called a scan. These scans produce high-resolution images of underlying subsurface materials and structures. Lower frequency GPR can be used to locate utilities, storage tanks, water table and geotechnical site characteristics. Higher frequency GPR can be used to locate and size reinforcing steel and determine thicknesses of pavement structures.

GPR thickness data was analyzed using a software package that filters, amplifies, and creates pavement thickness models to identify the various pavement layers and thicknesses.

Generally filtered GPR thickness data was adjusted based on the correlation to the actual thickness of cores taken from within the profile which provides an average epsilon ( ) value (wavelength of the electromagnetic wave and velocity of the electromagnetic wave) for the purpose of this study an epsilon value of 9 was used for asphalt sections.

It should be noted that the epsilon values may differ between mediums and differing material densities such as asphalt, poorly compacted asphalt (high voids), and Portland cement concrete. In addition, the epsilon values may differ within these mediums at locations exhibiting increased or decreased moisture contents. As a result, the calibrated depth of pavement was interpolated at locations where amplitudes were not adequately definable. If actual pavement thicknesses very significantly from those provided additional cores can be obtained and additional analysis can be completed for additional fees. Results of the GPR in the form of a Google Earth Map with pavement thickness overlays can be found in Figures 1 to 5. Pavement thickness spreadsheets are also provided with 25 foot and 500 foot intervals.

Table 1 - Results

Pavement Section	Average Existing AC (in.)	Max Thickness AC, (in.)	Min Thickness AC, (in.)	Standard Deviation
NB 95th from Louisville to SH 52	6.81	14.1	2.8	1.13
SB 95th from SH 52 to Louisville	6.77	13.5	3.4	1.10

Please contact our office if you have any questions regarding the information presented herein.

Sincerely,

Mark D. Guikema, P.E., Project Manager

GOOGLE EARTH AERIAL IMAGE (DATE UNKNOWN)

(Not to Scale)

GROUND ENGINEERING CONSULTANTS

GPR PAVEMENT THICKNESS

JOB NO.: 16-3619	FIGURE: 1
CADFILE NAME: 16-3619PAVEMENTSITE.DWG	

GOOGLE EARTH AERIAL IMAGE (DATE UNKNOWN)

(Not to Scale)

GROUND
ENGINEERING CONSULTANTS

GPR PAVEMENT THICKNESS

JOB NO.: 16-3619	FIGURE: 2
CADFILE NAME: 16-3619PAVEMENTSITE.DWG	

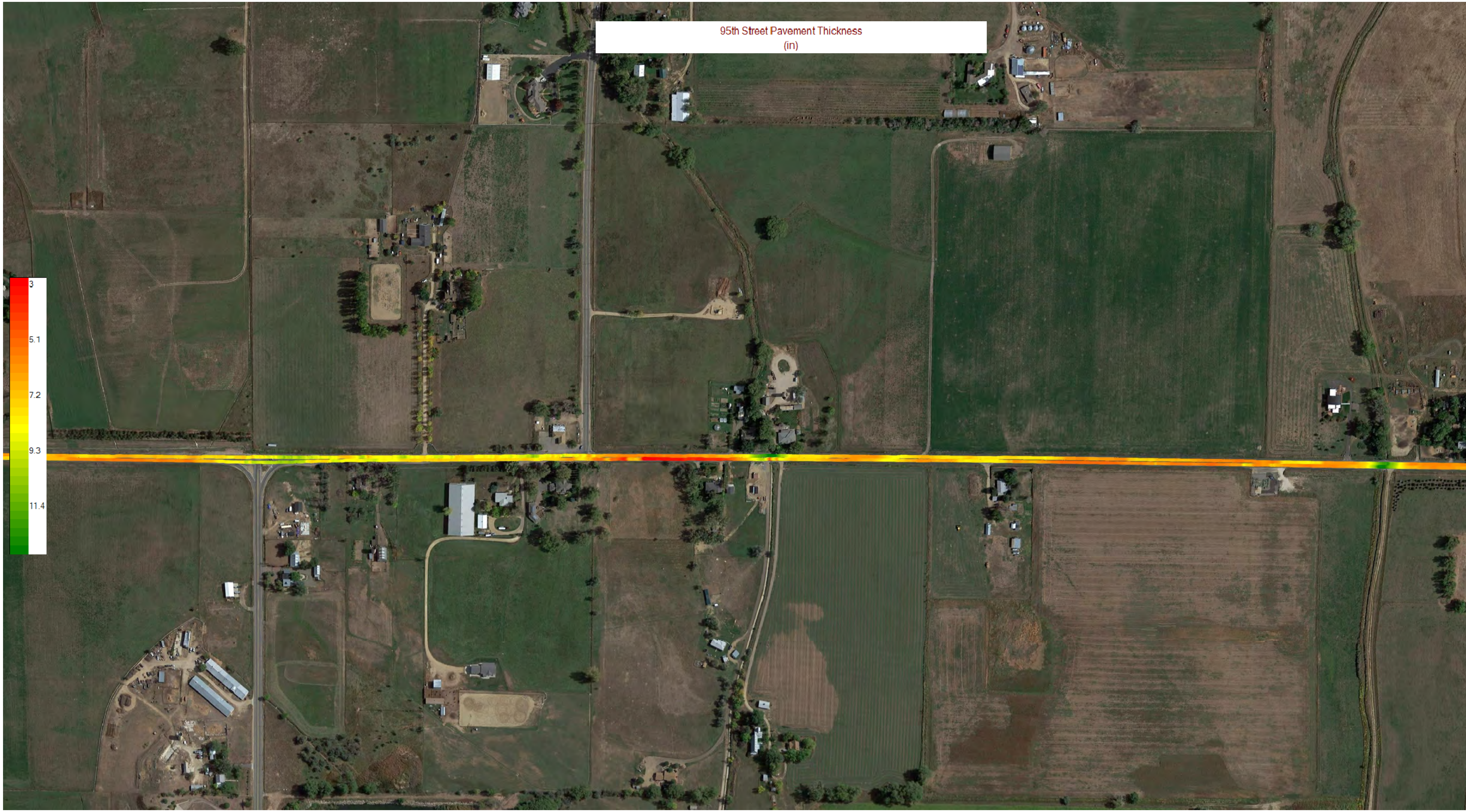
GOOGLE EARTH AERIAL IMAGE (DATE UNKNOWN)

(Not to Scale)

GROUND ENGINEERING CONSULTANTS

GPR PAVEMENT THICKNESS

JOB NO.: 16-3619	FIGURE: 3
CADFILE NAME: 16-3619PAVEMENTSITE.DWG	



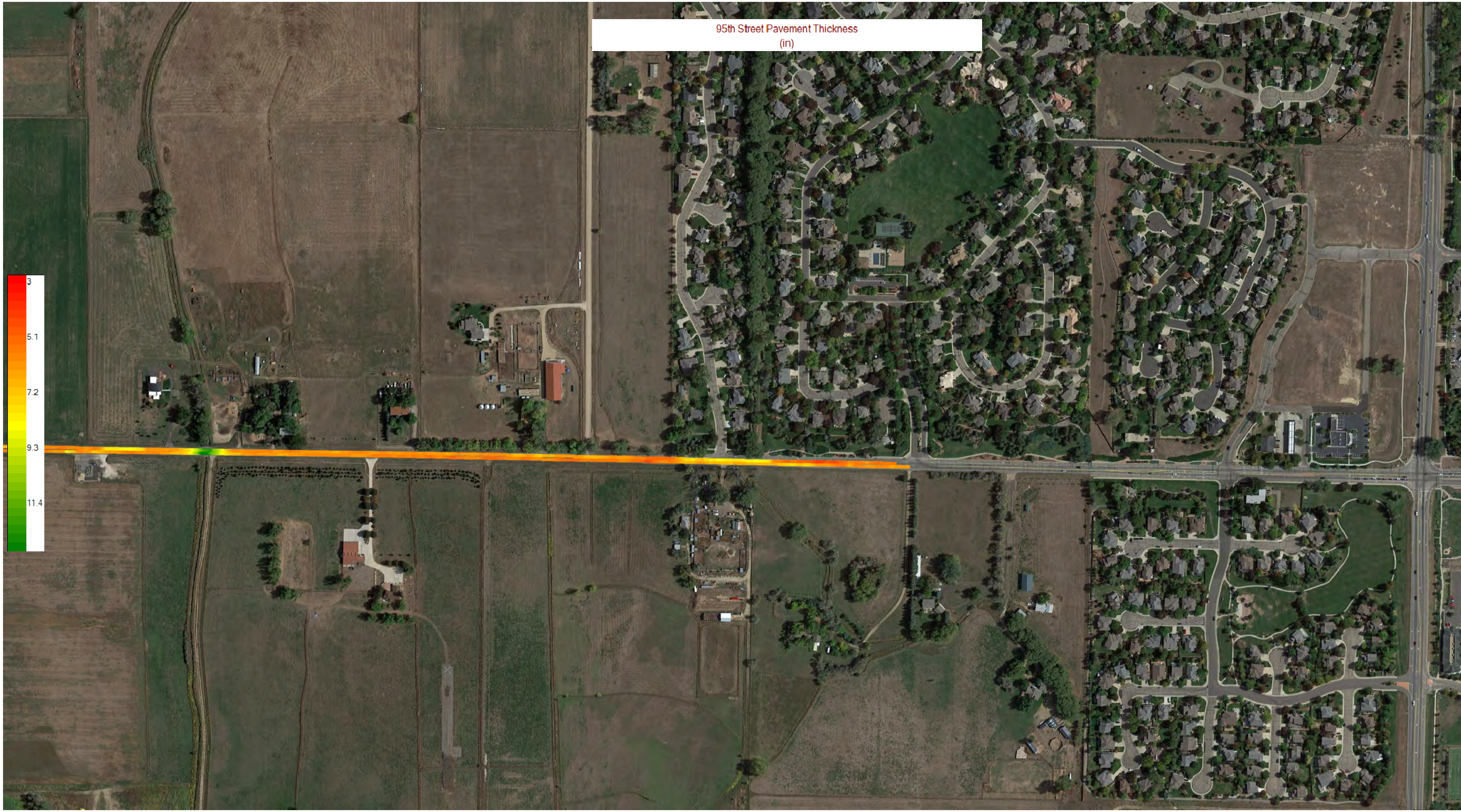
GOOGLE EARTH AERIAL IMAGE (DATE UNKNOWN)

(Not to Scale)

GROUND
ENGINEERING CONSULTANTS

GPR PAVEMENT THICKNESS

JOB NO.: 16-3619	FIGURE: 4
CADFILE NAME: 16-3619PAVEMENTSITE.DWG	



GOOGLE EARTH AERIAL IMAGE (DATE UNKNOWN)

(Not to Scale)

GROUND
ENGINEERING CONSULTANTS

GPR PAVEMENT THICKNESS

JOB NO.: 16-3619 | FIGURE: 5

CADFILE NAME: 16-3619PAVEMENTSITE.DWG

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
25	40.020491	-105.131035	5.9
50	40.020563	-105.131027	5.8
75	40.02063	-105.131027	5.8
100	40.0207	-105.131027	6.0
125	40.020775	-105.131027	6.0
150	40.020836	-105.131027	5.7
175	40.020907	-105.131027	6.0
200	40.020973	-105.131027	5.8
225	40.021047	-105.131027	5.2
250	40.021114	-105.131027	4.8
275	40.021182	-105.131027	5.0
300	40.021256	-105.131027	4.4
325	40.021314	-105.131027	5.0
350	40.021393	-105.131027	5.3
375	40.021463	-105.131027	5.3
400	40.021527	-105.131027	5.7
425	40.021601	-105.131027	5.5
450	40.021669	-105.131027	6.0
475	40.021743	-105.131027	6.0
500	40.021808	-105.131027	8.0
525	40.021871	-105.131027	8.4
550	40.021947	-105.131027	9.1
575	40.022015	-105.131027	8.3
600	40.022084	-105.13102	8.2
625	40.022161	-105.13102	8.1
650	40.022228	-105.13102	8.1
675	40.022305	-105.13102	8.5
700	40.022372	-105.13102	8.5
725	40.022432	-105.13102	8.3
750	40.022509	-105.13102	7.4
775	40.022579	-105.13102	7.5
800	40.022643	-105.13102	8.2
825	40.02272	-105.131014	7.6
850	40.022791	-105.131012	6.5
875	40.022849	-105.131012	5.7
900	40.02293	-105.131012	5.4
925	40.022996	-105.131012	5.4
950	40.023061	-105.131012	5.4
975	40.023132	-105.131012	5.6
1000	40.023209	-105.131012	5.9
1025	40.02327	-105.131007	6.0
1050	40.023348	-105.131004	6.5
1075	40.02342	-105.131004	6.5
1100	40.023485	-105.131004	6.0
1125	40.023556	-105.131004	6.7
1150	40.023629	-105.131004	6.9
1175	40.023694	-105.131004	7.1
1200	40.02376	-105.131004	7.2
1225	40.023841	-105.131004	6.6

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
1250	40.023907	-105.131004	6.5
1275	40.023971	-105.130997	6.6
1300	40.024051	-105.130997	6.3
1325	40.024112	-105.130997	6.5
1350	40.024177	-105.130997	7.1
1375	40.024267	-105.130997	7.3
1400	40.024328	-105.130997	7.4
1425	40.024391	-105.130997	6.6
1450	40.02446	-105.130997	6.8
1475	40.024539	-105.130997	7.2
1500	40.024601	-105.130997	6.7
1525	40.024669	-105.130989	6.2
1550	40.024749	-105.130989	6.1
1575	40.024814	-105.130989	6.0
1600	40.02488	-105.130989	6.3
1625	40.024963	-105.130989	6.3
1650	40.025022	-105.130989	6.5
1675	40.025085	-105.130989	6.4
1700	40.025164	-105.130989	6.2
1725	40.025237	-105.130989	6.5
1750	40.0253	-105.130989	6.7
1775	40.025373	-105.130989	6.5
1800	40.025444	-105.130989	6.3
1825	40.025512	-105.130989	6.3
1850	40.025588	-105.130989	6.4
1875	40.025669	-105.130989	6.0
1900	40.025726	-105.130989	6.1
1925	40.025792	-105.130989	6.4
1950	40.025867	-105.130989	6.2
1975	40.02594	-105.130989	6.3
2000	40.026004	-105.130989	6.1
2025	40.026072	-105.130989	6.3
2050	40.026156	-105.130989	6.3
2075	40.026218	-105.130989	6.1
2100	40.026283	-105.130989	6.2
2125	40.026363	-105.130989	6.2
2150	40.026431	-105.130989	6.5
2175	40.026493	-105.130989	6.9
2200	40.026569	-105.130989	6.6
2225	40.026641	-105.130989	6.5
2250	40.026709	-105.130989	6.5
2275	40.026771	-105.130989	6.4
2300	40.026852	-105.130989	6.5
2325	40.026919	-105.130989	6.2
2350	40.026982	-105.130989	6.0
2375	40.027064	-105.130989	6.0
2400	40.027132	-105.130989	6.3
2425	40.027199	-105.130989	6.2
2450	40.02726	-105.130989	6.0

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
2475	40.027345	-105.130989	6.0
2500	40.027409	-105.130989	6.2
2525	40.027471	-105.130989	6.1
2550	40.027547	-105.130989	6.3
2575	40.027623	-105.130989	6.2
2600	40.027685	-105.130989	7.1
2625	40.027756	-105.130989	9.2
2650	40.027837	-105.130989	11.1
2675	40.0279	-105.130989	12.5
2700	40.02797	-105.130989	11.7
2725	40.02803	-105.130989	9.8
2750	40.028116	-105.130989	7.8
2775	40.028179	-105.130989	7.3
2800	40.028243	-105.130989	6.6
2825	40.028328	-105.130989	6.6
2850	40.028395	-105.130989	6.5
2875	40.028457	-105.130989	6.6
2900	40.028532	-105.130989	6.5
2925	40.028612	-105.130989	7.7
2950	40.028673	-105.130989	8.2
2975	40.028736	-105.130989	8.5
3000	40.02881	-105.130989	8.5
3025	40.028888	-105.130989	8.2
3050	40.028956	-105.130989	8.2
3075	40.029021	-105.130989	8.0
3100	40.029101	-105.130989	6.1
3125	40.029169	-105.130989	6.0
3150	40.029234	-105.130989	6.4
3175	40.02931	-105.130985	6.0
3200	40.029385	-105.130981	6.1
3225	40.029449	-105.130981	5.9
3250	40.029512	-105.130981	5.8
3275	40.029584	-105.130981	6.0
3300	40.029663	-105.130981	6.2
3325	40.029726	-105.130981	6.0
3350	40.029795	-105.130981	6.0
3375	40.029881	-105.130981	6.1
3400	40.029943	-105.130981	6.5
3425	40.030005	-105.130981	6.9
3450	40.030085	-105.130981	7.1
3475	40.030153	-105.130981	7.0
3500	40.030222	-105.130981	7.1
3525	40.030286	-105.130981	7.2
3550	40.030364	-105.130981	7.1
3575	40.030437	-105.130981	7.7
3600	40.030501	-105.130981	7.5
3625	40.030567	-105.130981	7.7
3650	40.030652	-105.130981	7.4
3675	40.030717	-105.130981	6.5

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
3700	40.030781	-105.130981	6.2
3725	40.030866	-105.130981	6.3
3750	40.030933	-105.130981	6.4
3775	40.030993	-105.130981	6.5
3800	40.031052	-105.130981	6.8
3825	40.031146	-105.130981	6.5
3850	40.031207	-105.130981	6.1
3875	40.031271	-105.130981	6.3
3900	40.031348	-105.130981	6.5
3925	40.031418	-105.130981	7.3
3950	40.031487	-105.130981	7.8
3975	40.031556	-105.130981	8.2
4000	40.031637	-105.130981	8.2
4025	40.031698	-105.130981	8.1
4050	40.031764	-105.130981	8.1
4075	40.031833	-105.130981	8.1
4100	40.031915	-105.130981	7.8
4125	40.031982	-105.130981	7.7
4150	40.032046	-105.130981	7.9
4175	40.032131	-105.130989	8.0
4200	40.032195	-105.130989	8.2
4225	40.032261	-105.130989	8.2
4250	40.032338	-105.130989	7.9
4275	40.032409	-105.130989	7.5
4300	40.032475	-105.130989	7.9
4325	40.032537	-105.130989	8.0
4350	40.032622	-105.130989	8.0
4375	40.032689	-105.130989	8.1
4400	40.032754	-105.130989	7.7
4425	40.032827	-105.130989	7.5
4450	40.0329	-105.130989	7.1
4475	40.032968	-105.130989	7.3
4500	40.033033	-105.130989	7.8
4525	40.033114	-105.130989	8.3
4550	40.033179	-105.130994	8.7
4575	40.033241	-105.130997	8.7
4600	40.033324	-105.130997	7.9
4625	40.033392	-105.130997	7.0
4650	40.033455	-105.130997	6.5
4675	40.033533	-105.130997	6.4
4700	40.033599	-105.130997	6.5
4725	40.033666	-105.130997	6.5
4750	40.033737	-105.130997	6.7
4775	40.033817	-105.130997	7.0
4800	40.033884	-105.130997	7.2
4825	40.033942	-105.131004	7.5
4850	40.034024	-105.131004	7.9
4875	40.034088	-105.131004	8.2
4900	40.034153	-105.131004	8.2

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
4925	40.034231	-105.131004	8.1
4950	40.034307	-105.131004	8.0
4975	40.034372	-105.131004	8.7
5000	40.03444	-105.131004	10.3
5025	40.034515	-105.131004	12.6
5050	40.03458	-105.131004	14.1
5075	40.034642	-105.131005	12.4
5100	40.034724	-105.131012	11.5
5125	40.034793	-105.131012	9.9
5150	40.034859	-105.131012	8.4
5175	40.03494	-105.131012	7.8
5200	40.035004	-105.131015	7.1
5225	40.035068	-105.13102	7.1
5250	40.03515	-105.13102	7.0
5275	40.035212	-105.13102	6.5
5300	40.035279	-105.13102	6.8
5325	40.035357	-105.13102	6.5
5350	40.035424	-105.13102	6.5
5375	40.035491	-105.131026	6.0
5400	40.035566	-105.131027	5.9
5425	40.035637	-105.131027	5.9
5450	40.035708	-105.131027	5.8
5475	40.035769	-105.131027	5.9
5500	40.035855	-105.131027	5.5
5525	40.035918	-105.131027	6.0
5550	40.03598	-105.131027	6.0
5575	40.036064	-105.131035	6.0
5600	40.036128	-105.131035	6.0
5625	40.036194	-105.131035	6.2
5650	40.036274	-105.131035	6.4
5675	40.036337	-105.131035	6.5
5700	40.036409	-105.131042	7.0
5725	40.036482	-105.131042	7.7
5750	40.036551	-105.131042	6.9
5775	40.03661	-105.131042	8.6
5800	40.036696	-105.131042	9.2
5825	40.036764	-105.131042	8.3
5850	40.036826	-105.131047	9.6
5875	40.036907	-105.13105	8.6
5900	40.036968	-105.13105	8.8
5925	40.037039	-105.131057	8.8
5950	40.037118	-105.131058	10.5
5975	40.037181	-105.131058	10.0
6000	40.037244	-105.131065	9.5
6025	40.037324	-105.131065	9.1
6050	40.037389	-105.131065	9.3
6075	40.037458	-105.131066	8.5
6100	40.03754	-105.131073	8.2
6125	40.037604	-105.131073	9.1

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
6150	40.037669	-105.131073	8.4
6175	40.03773	-105.131073	8.5
6200	40.037815	-105.131081	7.9
6225	40.037879	-105.131081	8.1
6250	40.037945	-105.131081	8.1
6275	40.038024	-105.131088	8.8
6300	40.038092	-105.131088	8.8
6325	40.038155	-105.131088	9.5
6350	40.038235	-105.131088	9.3
6375	40.038299	-105.131092	8.9
6400	40.038367	-105.131096	8.1
6425	40.038445	-105.131096	8.2
6450	40.038508	-105.131096	9.1
6475	40.038575	-105.131096	10.1
6500	40.038653	-105.131097	8.9
6525	40.038723	-105.131104	8.2
6550	40.038785	-105.131104	8.5
6575	40.038866	-105.131104	8.7
6600	40.038933	-105.131104	8.0
6625	40.039001	-105.131105	9.9
6650	40.039082	-105.131111	8.7
6675	40.039143	-105.131111	7.6
6700	40.039209	-105.131111	7.3
6725	40.039291	-105.131119	8.8
6750	40.039355	-105.131119	9.4
6775	40.039416	-105.131119	8.3
6800	40.039496	-105.131119	9.1
6825	40.039566	-105.131123	9.8
6850	40.039631	-105.131126	9.9
6875	40.039714	-105.131126	10.2
6900	40.039778	-105.131126	10.7
6925	40.039841	-105.131126	9.9
6950	40.039923	-105.131126	9.8
6975	40.039987	-105.131126	8.9
7000	40.040047	-105.131126	9.0
7025	40.040133	-105.131126	8.6
7050	40.040194	-105.131129	8.1
7075	40.040265	-105.131134	8.1
7100	40.04034	-105.131134	7.6
7125	40.040403	-105.131134	8.2
7150	40.040466	-105.131134	8.3
7175	40.040546	-105.131134	7.7
7200	40.040615	-105.131134	7.8
7225	40.04068	-105.131134	8.2
7250	40.040759	-105.131142	7.5
7275	40.040825	-105.131142	6.8
7300	40.040887	-105.131142	7.1
7325	40.040957	-105.131142	7.6
7350	40.041034	-105.131142	7.6

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
7375	40.041101	-105.131142	7.4
7400	40.041174	-105.131142	7.3
7425	40.041249	-105.131142	7.1
7450	40.041312	-105.131142	7.3
7475	40.041386	-105.131142	7.5
7500	40.041459	-105.131142	7.5
7525	40.04152	-105.131142	7.0
7550	40.041587	-105.131142	6.7
7575	40.04167	-105.131145	7.1
7600	40.041735	-105.131149	7.5
7625	40.041796	-105.131149	7.8
7650	40.041882	-105.131149	7.6
7675	40.041942	-105.131149	7.7
7700	40.042005	-105.131149	8.2
7725	40.042086	-105.131149	7.8
7750	40.042155	-105.131149	7.1
7775	40.04222	-105.131149	6.8
7800	40.042301	-105.131149	6.6
7825	40.042366	-105.131149	7.1
7850	40.04243	-105.131149	7.3
7875	40.042517	-105.131149	7.3
7900	40.042578	-105.131149	6.6
7925	40.042643	-105.131149	6.5
7950	40.042723	-105.131149	6.6
7975	40.042791	-105.131149	6.6
8000	40.042855	-105.131149	6.6
8025	40.042927	-105.131149	6.6
8050	40.043004	-105.131149	6.4
8075	40.043064	-105.131149	6.5
8100	40.043133	-105.131149	6.9
8125	40.043211	-105.131149	7.3
8150	40.043277	-105.131149	7.3
8175	40.043346	-105.131149	6.8
8200	40.043425	-105.131149	6.3
8225	40.043488	-105.131149	6.4
8250	40.043553	-105.131149	6.6
8275	40.043633	-105.131149	6.5
8300	40.043701	-105.131149	6.4
8325	40.043767	-105.131149	6.3
8350	40.04385	-105.131149	6.5
8375	40.043911	-105.131149	6.5
8400	40.043973	-105.131149	6.5
8425	40.044055	-105.131149	6.4
8450	40.044125	-105.131149	6.3
8475	40.044191	-105.131149	6.5
8500	40.044252	-105.131149	6.3
8525	40.044336	-105.131149	6.0
8550	40.044399	-105.131149	6.1
8575	40.044463	-105.131149	6.3

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
8600	40.044549	-105.131149	7.5
8625	40.04461	-105.131149	7.3
8650	40.044673	-105.131149	7.5
8675	40.044759	-105.131149	7.6
8700	40.044826	-105.131149	7.5
8725	40.044886	-105.131149	7.4
8750	40.044968	-105.131149	7.3
8775	40.045033	-105.131149	7.0
8800	40.045099	-105.131149	7.4
8825	40.045174	-105.131149	7.7
8850	40.045249	-105.131149	7.8
8875	40.04531	-105.131149	8.8
8900	40.045383	-105.131157	8.1
8925	40.045458	-105.131157	7.3
8950	40.045523	-105.131157	7.7
8975	40.045587	-105.131157	7.6
9000	40.045667	-105.131157	7.6
9025	40.045734	-105.131157	7.3
9050	40.045798	-105.131157	7.1
9075	40.045881	-105.131157	7.1
9100	40.045949	-105.131157	7.1
9125	40.04601	-105.131157	7.1
9150	40.046094	-105.131157	7.0
9175	40.04616	-105.131157	7.0
9200	40.046226	-105.131157	6.6
9225	40.046294	-105.131165	6.4
9250	40.04637	-105.131159	7.0
9275	40.046437	-105.131157	6.5
9300	40.046505	-105.131157	5.8
9325	40.046584	-105.131157	5.5
9350	40.046649	-105.131157	5.5
9375	40.046711	-105.131157	5.9
9400	40.046795	-105.131165	5.6
9425	40.046859	-105.131165	6.0
9450	40.046923	-105.131165	5.8
9475	40.047001	-105.131165	5.9
9500	40.047071	-105.131165	5.9
9525	40.047136	-105.131165	6.0
9550	40.047218	-105.131165	5.8
9575	40.047283	-105.131165	6.1
9600	40.047346	-105.131165	6.0
9625	40.047432	-105.131165	6.5
9650	40.047492	-105.131172	3.0
9675	40.047559	-105.131172	3.0
9700	40.047619	-105.131172	3.1
9725	40.047702	-105.131172	3.1
9750	40.04777	-105.131172	3.1
9775	40.04784	-105.131172	3.1
9800	40.047918	-105.131172	6.3

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
9825	40.047979	-105.131172	6.0
9850	40.04805	-105.131172	5.8
9875	40.048127	-105.131172	5.7
9900	40.048193	-105.131172	5.9
9925	40.04826	-105.131172	6.0
9950	40.048339	-105.13118	6.1
9975	40.048404	-105.13118	5.8
10000	40.048464	-105.13118	5.6
10025	40.048547	-105.13118	6.0
10050	40.048618	-105.13118	6.0
10075	40.048678	-105.13118	6.0
10100	40.048761	-105.13118	6.0
10125	40.048821	-105.13118	5.8
10150	40.04889	-105.13118	6.0
10175	40.048959	-105.13118	6.0
10200	40.049039	-105.13118	5.9
10225	40.049102	-105.13118	5.9
10250	40.049164	-105.13118	6.0
10275	40.049247	-105.13118	6.0
10300	40.049313	-105.13118	6.2
10325	40.049378	-105.13118	6.0
10350	40.049459	-105.13118	6.0
10375	40.049526	-105.13118	5.6
10400	40.049586	-105.13118	5.4
10425	40.049674	-105.13118	5.7
10450	40.049743	-105.13118	6.8
10475	40.049803	-105.13118	5.8
10500	40.049881	-105.13118	6.0
10525	40.049953	-105.13118	6.5
10550	40.050018	-105.13118	6.5
10575	40.050094	-105.13118	8.0
10600	40.050165	-105.13118	7.5
10625	40.050227	-105.13118	6.9
10650	40.050291	-105.13118	6.7
10675	40.050376	-105.13118	6.8
10700	40.050441	-105.13118	6.3
10725	40.050507	-105.13118	5.6
10750	40.050594	-105.13118	6.2
10775	40.050655	-105.13118	6.7
10800	40.050718	-105.13118	6.7
10825	40.0508	-105.13118	6.6
10850	40.050863	-105.131187	6.8
10875	40.050926	-105.131187	6.5
10900	40.050993	-105.131187	6.7
10925	40.051079	-105.131187	6.6
10950	40.051143	-105.131187	6.7
10975	40.051207	-105.131187	6.6
11000	40.051285	-105.131187	6.4
11025	40.051351	-105.131187	6.1

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
11050	40.051416	-105.131187	6.5
11075	40.051493	-105.131187	6.0
11100	40.05157	-105.131187	5.9
11125	40.051632	-105.131187	6.3
11150	40.051696	-105.131195	6.0
11175	40.05178	-105.131195	6.5
11200	40.051844	-105.131195	6.2
11225	40.051904	-105.131195	6.5
11250	40.051986	-105.131195	6.5
11275	40.052055	-105.131195	5.9
11300	40.05212	-105.131195	6.0
11325	40.052194	-105.131195	6.3
11350	40.052274	-105.131195	6.4
11375	40.052336	-105.131195	6.0
11400	40.052401	-105.131195	6.3
11425	40.052475	-105.131195	6.1
11450	40.052545	-105.131195	5.9
11475	40.052611	-105.131195	6.0
11500	40.052682	-105.131195	6.4
11525	40.052756	-105.131195	6.3
11550	40.052828	-105.131195	6.0
11575	40.052895	-105.131195	6.7
11600	40.052976	-105.131195	6.9
11625	40.05304	-105.131195	5.8
11650	40.053104	-105.131195	6.8
11675	40.053177	-105.131198	7.0
11700	40.053249	-105.131203	6.6
11725	40.053311	-105.131203	6.4
11750	40.053399	-105.131203	6.1
11775	40.053466	-105.131203	6.1
11800	40.053527	-105.131203	6.0
11825	40.053605	-105.131203	6.1
11850	40.053677	-105.131203	6.2
11875	40.053736	-105.131203	6.0
11900	40.053805	-105.131203	6.3
11925	40.053884	-105.131203	6.2
11950	40.053953	-105.131203	5.9
11975	40.054013	-105.131203	5.8
12000	40.0541	-105.131203	6.4
12025	40.054159	-105.131203	6.6
12050	40.054227	-105.131203	7.1
12075	40.054307	-105.131203	9.1
12100	40.054375	-105.131203	7.2
12125	40.054438	-105.131203	6.4
12150	40.054508	-105.131203	5.5
12175	40.054586	-105.131203	6.0
12200	40.054649	-105.131203	5.7
12225	40.054719	-105.131203	5.3
12250	40.054793	-105.131203	5.3

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
12275	40.054863	-105.131203	7.0
12300	40.054925	-105.131203	7.1
12325	40.05501	-105.131203	7.0
12350	40.055075	-105.131203	6.7
12375	40.055135	-105.131203	6.3
12400	40.05522	-105.131203	6.4
12425	40.055282	-105.131203	6.3
12450	40.055347	-105.131203	6.4
12475	40.055421	-105.131203	6.5
12500	40.055498	-105.131203	6.0
12525	40.055565	-105.131203	6.0
12550	40.05563	-105.131203	6.3
12575	40.05571	-105.131203	6.4
12600	40.055777	-105.131203	6.7
12625	40.055838	-105.131203	6.8
12650	40.05591	-105.131203	6.4
12675	40.05599	-105.131203	6.2
12700	40.056051	-105.131203	6.1
12725	40.056126	-105.131203	6.2
12750	40.056197	-105.131203	6.5
12775	40.056262	-105.131203	6.1
12800	40.056337	-105.131203	6.0
12825	40.056412	-105.131203	6.0
12850	40.056475	-105.131203	6.0
12875	40.056541	-105.131203	5.8
12900	40.056621	-105.131203	5.7
12925	40.056693	-105.131203	6.1
12950	40.056753	-105.131203	6.6
12975	40.056829	-105.131203	7.3
13000	40.056903	-105.131203	7.6
13025	40.056967	-105.131203	7.7
13050	40.057037	-105.131203	7.8
13075	40.057114	-105.131203	8.1
13100	40.057179	-105.131203	7.6
13125	40.057243	-105.131203	7.5
13150	40.057321	-105.131203	8.0
13175	40.057393	-105.131203	8.2
13200	40.057455	-105.131203	7.7
13225	40.057527	-105.131203	7.4
13250	40.0576	-105.131203	7.2
13275	40.057664	-105.131203	7.1
13300	40.057739	-105.131203	6.5
13325	40.057816	-105.131203	6.5
13350	40.057878	-105.131203	6.3
13375	40.057949	-105.131203	6.0
13400	40.058028	-105.131203	5.9
13425	40.058095	-105.131203	5.6
13450	40.058155	-105.131203	6.3
13475	40.058229	-105.131203	6.1

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
13500	40.058304	-105.131203	5.5
13525	40.058367	-105.131203	6.2
13550	40.058443	-105.131203	7.5
13575	40.058518	-105.131203	8.3
13600	40.058581	-105.131203	8.3
13625	40.058643	-105.131203	8.0
13650	40.058731	-105.131203	8.2
13675	40.058794	-105.131203	8.3
13700	40.05886	-105.13121	7.7
13725	40.058938	-105.13121	6.2
13750	40.05901	-105.13121	6.0
13775	40.05907	-105.13121	6.3
13800	40.059152	-105.13121	6.0
13825	40.059219	-105.13121	6.3
13850	40.059284	-105.13121	6.0
13875	40.059361	-105.13121	6.1
13900	40.059427	-105.131203	7.1
13925	40.059496	-105.131203	6.5
13950	40.059558	-105.131203	6.5
13975	40.059643	-105.131203	6.6
14000	40.059708	-105.131203	5.9
14025	40.059773	-105.131203	5.9
14050	40.059855	-105.131203	6.7
14075	40.059915	-105.131203	6.5
14100	40.059982	-105.131203	6.4
14125	40.060055	-105.131203	7.0
14150	40.060136	-105.131202	7.0
14175	40.060198	-105.131195	5.3
14200	40.060274	-105.131195	6.0
14225	40.060344	-105.131195	6.2
14250	40.060403	-105.131195	6.4
14275	40.060476	-105.131195	6.8
14300	40.060555	-105.131187	6.3
14325	40.06062	-105.131187	6.5
14350	40.060689	-105.131187	7.2
14375	40.060765	-105.131187	7.5
14400	40.060828	-105.131187	7.7
14425	40.06089	-105.131187	8.2
14450	40.060973	-105.131187	7.2
14475	40.06104	-105.131187	6.8
14500	40.0611	-105.131187	6.8
14525	40.061183	-105.131187	7.1
14550	40.061249	-105.131187	7.4
14575	40.061316	-105.131187	7.7
14600	40.061398	-105.131187	7.5
14625	40.06146	-105.131187	7.6
14650	40.061524	-105.131187	7.6
14675	40.061606	-105.131187	7.3
14700	40.06167	-105.131187	7.4

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
14725	40.061734	-105.131187	7.5
14750	40.061818	-105.131187	7.1
14775	40.061879	-105.131187	6.6
14800	40.061943	-105.131187	6.3
14825	40.062023	-105.131187	6.2
14850	40.06209	-105.131187	6.3
14875	40.062157	-105.131187	6.3
14900	40.062219	-105.131187	6.5
14925	40.062307	-105.131187	6.4
14950	40.062367	-105.131187	6.2
14975	40.062434	-105.131187	6.5
15000	40.06252	-105.131187	6.4
15025	40.06258	-105.131187	6.4
15050	40.062646	-105.131187	6.4
15075	40.062714	-105.131187	6.4
15100	40.062797	-105.131187	6.2
15125	40.062859	-105.131187	6.1
15150	40.062921	-105.131187	6.0
15175	40.063007	-105.131187	6.2
15200	40.063072	-105.131187	6.2
15225	40.063138	-105.131187	6.1
15250	40.063221	-105.131187	6.3
15275	40.063288	-105.131187	6.3
15300	40.063352	-105.131187	6.4
15325	40.06343	-105.131187	6.5
15350	40.063501	-105.131187	6.4
15375	40.06356	-105.131187	6.5
15400	40.063628	-105.131187	6.3
15425	40.063715	-105.131187	6.5
15450	40.063772	-105.131187	6.3
15475	40.063844	-105.131187	6.7
15500	40.063927	-105.131187	6.4
15525	40.063991	-105.131187	6.0
15550	40.064055	-105.13119	6.2
15575	40.064117	-105.131195	6.3
15600	40.064203	-105.131195	6.3
15625	40.064266	-105.131195	6.4
15650	40.064336	-105.131195	6.2
15675	40.064418	-105.131195	6.2
15700	40.06448	-105.131195	6.0
15725	40.064544	-105.131195	6.2
15750	40.064629	-105.131195	5.9
15775	40.064692	-105.131195	6.0
15800	40.064756	-105.131195	6.1
15825	40.064829	-105.131203	6.4
15850	40.064909	-105.131203	6.4
15875	40.064968	-105.131203	6.0
15900	40.065034	-105.131203	5.9
15925	40.065113	-105.131203	5.8

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
15950	40.065182	-105.131203	5.5
15975	40.06525	-105.131203	5.5
16000	40.065313	-105.131203	5.5
16025	40.065394	-105.131203	6.0
16050	40.065459	-105.131203	5.8
16075	40.065525	-105.131203	5.8
16100	40.065605	-105.131203	5.8
16125	40.065672	-105.131203	5.7
16150	40.065739	-105.131203	5.7
16175	40.065816	-105.131203	5.8
16200	40.065888	-105.131203	5.9
16225	40.065954	-105.131203	6.0
16250	40.066015	-105.131203	5.9
16275	40.066094	-105.131203	6.0
16300	40.066161	-105.131203	6.0
16325	40.066229	-105.131203	6.0
16350	40.066308	-105.131203	6.0
16375	40.066377	-105.131203	6.0
16400	40.066441	-105.131203	6.0
16425	40.066509	-105.131203	5.7
16450	40.066589	-105.131203	5.7
16475	40.06666	-105.131206	5.8
16500	40.066722	-105.13121	5.8
16525	40.066807	-105.13121	5.4
16550	40.066874	-105.13121	5.6
16575	40.066933	-105.13121	5.6
16600	40.067002	-105.13121	5.7
16625	40.067088	-105.13121	5.9
16650	40.067147	-105.13121	5.8
16675	40.06721	-105.13121	5.7
16700	40.0673	-105.13121	6.0
16725	40.067363	-105.13121	5.6
16750	40.067429	-105.13121	5.7
16775	40.067509	-105.13121	5.9
16800	40.067575	-105.13121	6.0
16825	40.067638	-105.13121	5.5
16850	40.067704	-105.131218	5.6
16875	40.06779	-105.131218	5.7
16900	40.067853	-105.131218	5.8
16925	40.067918	-105.131218	5.9
16950	40.067995	-105.131218	6.3
16975	40.068067	-105.131218	6.3
17000	40.068142	-105.131218	6.0
17025	40.068204	-105.131218	5.9
17050	40.068285	-105.131218	5.9
17075	40.068347	-105.131218	5.7
17100	40.06841	-105.131218	6.0
17125	40.068487	-105.131218	6.2
17150	40.068562	-105.131226	6.0

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
17175	40.068624	-105.131226	6.1
17200	40.068688	-105.131226	5.8
17225	40.068776	-105.131226	5.7
17250	40.068837	-105.131226	6.3
17275	40.068899	-105.131226	6.1
17300	40.068989	-105.131226	6.2
17325	40.069052	-105.131226	6.0
17350	40.069115	-105.131226	5.7
17375	40.069194	-105.131226	5.7
17400	40.069262	-105.131226	5.8
17425	40.069326	-105.131226	6.0
17450	40.069393	-105.131226	6.1
17475	40.069472	-105.131226	6.0
17500	40.069544	-105.131226	6.0
17525	40.069608	-105.131226	6.0
17550	40.069689	-105.131233	6.0
17575	40.069754	-105.131233	6.2
17600	40.069821	-105.131233	6.2
17625	40.069885	-105.131233	6.3
17650	40.069969	-105.131233	6.1
17675	40.070033	-105.131233	6.1
17700	40.070099	-105.131233	6.1
17725	40.070178	-105.131233	6.2
17750	40.070246	-105.131233	6.5
17775	40.070313	-105.131233	6.2
17800	40.070394	-105.131233	6.5
17825	40.070458	-105.131233	7.3
17850	40.070526	-105.131233	7.7
17875	40.070603	-105.131233	7.7
17900	40.070671	-105.131233	6.8
17925	40.070734	-105.131233	7.0
17950	40.07081	-105.131233	7.1
17975	40.07088	-105.131233	7.1
18000	40.070947	-105.131226	7.2
18025	40.071019	-105.131226	7.4
18050	40.071092	-105.131226	7.7
18075	40.071157	-105.131226	7.4
18100	40.071229	-105.131226	8.2
18125	40.071308	-105.131226	7.7
18150	40.071369	-105.131226	8.2
18175	40.07144	-105.131226	8.3
18200	40.071511	-105.131226	8.3
18225	40.071586	-105.131226	7.9
18250	40.071651	-105.131226	7.8
18275	40.071722	-105.131226	8.3
18300	40.071797	-105.131226	8.1
18325	40.071861	-105.131226	7.9
18350	40.071924	-105.131226	7.6
18375	40.072006	-105.131226	8.0

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
18400	40.072074	-105.131226	7.9
18425	40.072138	-105.131226	7.5
18450	40.072223	-105.131226	8.0
18475	40.07229	-105.131226	7.1
18500	40.072357	-105.131226	8.2
18525	40.072432	-105.131226	7.8
18550	40.072498	-105.131226	7.7
18575	40.072576	-105.131226	7.7
18600	40.072637	-105.131226	9.1
18625	40.072701	-105.131226	7.9
18650	40.072771	-105.131226	8.2
18675	40.07284	-105.131228	8.0
18700	40.072911	-105.131233	8.1
18725	40.072976	-105.131233	10.1
18750	40.07305	-105.131233	8.8
18775	40.073111	-105.131233	8.8
18800	40.07319	-105.131233	8.8
18825	40.07325	-105.131233	8.0
18850	40.073331	-105.13124	7.5
18875	40.073392	-105.131241	7.2
18900	40.073462	-105.131241	7.2
18925	40.073533	-105.131241	7.3
18950	40.073593	-105.131247	7.7
18975	40.073672	-105.131248	7.9
19000	40.073736	-105.131248	7.2
19025	40.073818	-105.131248	7.5
19050	40.073881	-105.131251	8.1
19075	40.073945	-105.131256	8.4
19100	40.074024	-105.131256	8.3
19125	40.074085	-105.131256	8.4
19150	40.074154	-105.131257	8.5
19175	40.074229	-105.131264	7.7
19200	40.074295	-105.131264	7.8
19225	40.074374	-105.131264	7.5
19250	40.074441	-105.131264	8.4
19275	40.074509	-105.131266	8.3
19300	40.07457	-105.131271	8.2
19325	40.074648	-105.131271	9.9
19350	40.074716	-105.131271	10.0
19375	40.074784	-105.131271	7.5
19400	40.074866	-105.131271	5.5
19425	40.074932	-105.131271	5.4
19450	40.075001	-105.131274	5.4
19475	40.075076	-105.131279	5.4
19500	40.075139	-105.131279	5.4
19525	40.075204	-105.131279	5.7
19550	40.07528	-105.131279	5.7
19575	40.075349	-105.131279	5.8
19600	40.075414	-105.131281	5.9

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
19625	40.075497	-105.131287	5.9
19650	40.075562	-105.131287	5.6
19675	40.075622	-105.131287	5.7
19700	40.075695	-105.131287	6.0
19725	40.075773	-105.131287	6.0
19750	40.07584	-105.131287	5.8
19775	40.075902	-105.131287	5.7
19800	40.075981	-105.131287	5.6
19825	40.076051	-105.131287	5.4
19850	40.076119	-105.131287	5.6
19875	40.076189	-105.131287	5.9
19900	40.076265	-105.131288	5.7
19925	40.076331	-105.131294	5.9
19950	40.076405	-105.131294	6.0
19975	40.076476	-105.131294	6.1
20000	40.076543	-105.131294	6.6
20025	40.076605	-105.131294	7.1
20050	40.076677	-105.131294	7.1
20075	40.076756	-105.131294	6.7
20100	40.076821	-105.131294	6.7
20125	40.0769	-105.131294	7.1
20150	40.07697	-105.131294	7.0
20175	40.077037	-105.131294	7.0
20200	40.077104	-105.131294	7.0
20225	40.077186	-105.131299	6.5
20250	40.077246	-105.131302	6.1
20275	40.077312	-105.131302	6.1
20300	40.077382	-105.131302	6.1
20325	40.077464	-105.131302	6.0
20350	40.077529	-105.131302	6.0
20375	40.07759	-105.131302	6.1
20400	40.077672	-105.131302	6.1
20425	40.077737	-105.131302	6.1
20450	40.077804	-105.131302	6.1
20475	40.077893	-105.131302	6.2
20500	40.077953	-105.131302	6.0
20525	40.07802	-105.131302	5.8
20550	40.078083	-105.131302	5.7
20575	40.078167	-105.131302	5.9
20600	40.078233	-105.131308	6.5
20625	40.078303	-105.13131	6.6
20650	40.078383	-105.13131	6.5
20675	40.078446	-105.13131	6.3
20700	40.07851	-105.13131	6.3
20725	40.078578	-105.13131	6.1
20750	40.078657	-105.13131	6.2
20775	40.078721	-105.13131	6.5
20800	40.07879	-105.13131	6.8
20825	40.078865	-105.13131	6.9

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
20850	40.078934	-105.13131	6.8
20875	40.079001	-105.13131	7.8
20900	40.079073	-105.131317	7.6
20925	40.079156	-105.131317	7.4
20950	40.079216	-105.131317	7.1
20975	40.079281	-105.131317	6.5
21000	40.079365	-105.131317	6.9
21025	40.079428	-105.131317	7.4
21050	40.079492	-105.131317	7.5
21075	40.079563	-105.131317	7.4
21100	40.07964	-105.131317	7.0
21125	40.079703	-105.131317	6.7
21150	40.079773	-105.131317	6.5
21175	40.079854	-105.131324	6.5
21200	40.079916	-105.131325	6.7
21225	40.079975	-105.131325	7.1
21250	40.080062	-105.131325	7.1
21275	40.080127	-105.131325	7.1
21300	40.080198	-105.131325	7.2
21325	40.080272	-105.131332	7.2
21350	40.080347	-105.131332	7.1
21375	40.080412	-105.131332	6.9
21400	40.080484	-105.131332	6.8
21425	40.080559	-105.131332	6.5
21450	40.080624	-105.131337	6.5
21475	40.080681	-105.13134	7.2
21500	40.080768	-105.13134	7.3
21525	40.080831	-105.13134	7.3
21550	40.0809	-105.13134	7.3
21575	40.080969	-105.13134	7.1
21600	40.081043	-105.13134	6.8
21625	40.081113	-105.13134	6.5
21650	40.081187	-105.131343	6.3
21675	40.081259	-105.131348	6.2
21700	40.081324	-105.131348	6.0
21725	40.08139	-105.131348	6.2
21750	40.08147	-105.131348	6.5
21775	40.081534	-105.131348	6.8
21800	40.081599	-105.131348	6.6
21825	40.081674	-105.131348	6.5
21850	40.081755	-105.131355	6.4
21875	40.081818	-105.131355	6.2
21900	40.081886	-105.131355	6.0
21925	40.081964	-105.131355	6.1
21950	40.082027	-105.131355	6.0
21975	40.082089	-105.131355	6.0
22000	40.082173	-105.131355	5.9
22025	40.082241	-105.131355	6.0
22050	40.082306	-105.13136	6.0

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
22075	40.082376	-105.131363	5.9
22100	40.082452	-105.131363	6.0
22125	40.082515	-105.131363	5.9
22150	40.082585	-105.131363	6.0
22175	40.082664	-105.131363	6.1
22200	40.082729	-105.131363	6.2
22225	40.082796	-105.131363	6.1
22250	40.082876	-105.131371	5.5
22275	40.08294	-105.131371	5.9
22300	40.083008	-105.131371	6.1
22325	40.083073	-105.131371	6.4
22350	40.083158	-105.131371	5.7
22375	40.083221	-105.131378	5.7
22400	40.083284	-105.131378	5.6
22425	40.08337	-105.131378	5.6
22450	40.083432	-105.131378	5.7
22475	40.083494	-105.131378	6.0
22500	40.08358	-105.131386	5.7
22525	40.083647	-105.131386	5.8
22550	40.083708	-105.131386	5.7
22575	40.083781	-105.131386	5.8
22600	40.083864	-105.131386	5.7
22625	40.083923	-105.13139	5.8
22650	40.083993	-105.131393	5.9
22675	40.084077	-105.131393	6.0
22700	40.084137	-105.131393	6.0
22725	40.084206	-105.131393	6.1
22750	40.084286	-105.131393	6.0
22775	40.084349	-105.131397	6.0
22800	40.084413	-105.131401	5.8
22825	40.084495	-105.131401	6.0
22850	40.08456	-105.131401	6.0
22875	40.084619	-105.131401	6.0
22900	40.084699	-105.131401	6.0
22925	40.084777	-105.131409	6.0
22950	40.084842	-105.131409	5.8
22975	40.084919	-105.131409	6.0
23000	40.084985	-105.131409	6.4
23025	40.085048	-105.131409	6.8
23050	40.085116	-105.131409	6.9
23075	40.085198	-105.131409	7.0
23100	40.085262	-105.131409	7.2
23125	40.085338	-105.131416	7.1
23150	40.085408	-105.131416	7.3
23175	40.08547	-105.131416	7.3
23200	40.085538	-105.131416	7.2
23225	40.085617	-105.131416	7.0
23250	40.085682	-105.131422	7.1
23275	40.085747	-105.131424	7.3

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
23300	40.08583	-105.131424	7.2
23325	40.085897	-105.131424	7.3
23350	40.085954	-105.131424	7.2
23375	40.08604	-105.13143	7.1
23400	40.086101	-105.131432	7.2
23425	40.086176	-105.131432	7.2
23450	40.086252	-105.131432	7.3
23475	40.086312	-105.131432	7.4
23500	40.086391	-105.131439	7.2
23525	40.086456	-105.131439	7.2
23550	40.086532	-105.131439	7.1
23575	40.086597	-105.131439	7.0
23600	40.086672	-105.131439	6.8
23625	40.08674	-105.131439	6.5
23650	40.086809	-105.131447	6.8
23675	40.086874	-105.131447	6.5
23700	40.086952	-105.131447	6.0
23725	40.087013	-105.131447	5.9
23750	40.087088	-105.131447	6.3
23775	40.087154	-105.131447	7.5
23800	40.087223	-105.131454	10.0
23825	40.087297	-105.131454	8.9
23850	40.087367	-105.131454	7.6
23875	40.087434	-105.131454	8.7
23900	40.087505	-105.131462	7.7

95th St - NB - Louisville City Limits to SH 52

LF	Latitude	Longitude	Pavement Thickness, in
500	40.021808	-105.131027	8.0
1000	40.023209	-105.131012	5.9
1500	40.024601	-105.130997	6.7
2000	40.026004	-105.130989	6.1
2500	40.027409	-105.130989	6.2
3000	40.02881	-105.130989	8.5
3500	40.030222	-105.130981	7.1
4000	40.031637	-105.130981	8.2
4500	40.033033	-105.130989	7.8
5000	40.03444	-105.131004	10.3
5500	40.035855	-105.131027	5.5
6000	40.037244	-105.131065	9.5
6500	40.038653	-105.131097	8.9
7000	40.040047	-105.131126	9.0
7500	40.041459	-105.131142	7.5
8000	40.042855	-105.131149	6.6
8500	40.044252	-105.131149	6.3
9000	40.045667	-105.131157	7.6
9500	40.047071	-105.131165	5.9
10000	40.048464	-105.13118	5.6
10500	40.049881	-105.13118	6.0
11000	40.051285	-105.131187	6.4
11500	40.052682	-105.131195	6.4
12000	40.0541	-105.131203	6.4
12500	40.055498	-105.131203	6.0
13000	40.056903	-105.131203	7.6
13500	40.058304	-105.131203	5.5
14000	40.059708	-105.131203	5.9
14500	40.0611	-105.131187	6.8
15000	40.06252	-105.131187	6.4
15500	40.063927	-105.131187	6.4
16000	40.065313	-105.131203	5.5
16500	40.066722	-105.13121	5.8
17000	40.068142	-105.131218	6.0
17500	40.069544	-105.131226	6.0
18000	40.070947	-105.131226	7.2
18500	40.072357	-105.131226	8.2
19000	40.073736	-105.131248	7.2
19500	40.075139	-105.131279	5.4
20000	40.076543	-105.131294	6.6
20500	40.077953	-105.131302	6.0
21000	40.079365	-105.131317	6.9
21500	40.080768	-105.13134	7.3
22000	40.082173	-105.131355	5.9
22500	40.08358	-105.131386	5.7
23000	40.084985	-105.131409	6.4
23500	40.086391	-105.131439	7.2

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
25	40.087219	-105.131531	8.8
50	40.087157	-105.131531	8.8
75	40.087082	-105.131529	8.2
100	40.087014	-105.131523	8.2
125	40.086936	-105.131523	8.3
150	40.08687	-105.131523	8.3
175	40.086809	-105.131523	8.4
200	40.086728	-105.131523	8.6
225	40.086665	-105.131516	8.5
250	40.086586	-105.131516	8.3
275	40.086525	-105.131516	8.2
300	40.086459	-105.131516	8.1
325	40.086381	-105.131509	8.6
350	40.086317	-105.131508	8.2
375	40.086252	-105.131508	7.5
400	40.086171	-105.131508	8.3
425	40.086105	-105.1315	8.2
450	40.086038	-105.1315	7.8
475	40.085962	-105.131496	7.7
500	40.085897	-105.131493	7.6
525	40.085819	-105.131493	7.5
550	40.085754	-105.131491	7.2
575	40.085688	-105.131485	7.7
600	40.085613	-105.131485	7.2
625	40.085546	-105.131478	7.8
650	40.085478	-105.131477	7.7
675	40.085399	-105.13147	7.7
700	40.085337	-105.13147	7.7
725	40.085264	-105.131467	7.6
750	40.085187	-105.131462	7.4
775	40.085124	-105.131462	9.6
800	40.085057	-105.131454	9.2
825	40.084984	-105.131454	8.1
850	40.084917	-105.131454	7.3
875	40.084843	-105.131454	7.4
900	40.084772	-105.131454	7.4
925	40.084713	-105.131447	6.9
950	40.08463	-105.131447	6.9
975	40.084562	-105.131447	7.1
1000	40.084495	-105.131447	7.7
1025	40.084423	-105.131447	7.6
1050	40.084352	-105.131439	7.3
1075	40.084287	-105.131439	7.2
1100	40.084207	-105.131439	7.7
1125	40.084146	-105.131439	8.2
1150	40.084078	-105.131439	8.3
1175	40.083997	-105.131439	8.4
1200	40.083935	-105.131439	8.2
1225	40.08387	-105.131432	7.1

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
1250	40.083791	-105.131432	6.5
1275	40.083723	-105.131432	6.5
1300	40.083663	-105.131432	6.1
1325	40.083577	-105.131432	6.0
1350	40.083514	-105.131432	6.5
1375	40.083448	-105.131427	6.6
1400	40.083366	-105.131424	6.8
1425	40.083305	-105.131424	6.8
1450	40.08324	-105.131424	6.6
1475	40.083158	-105.131424	6.2
1500	40.08309	-105.131424	6.3
1525	40.083027	-105.131416	6.7
1550	40.082947	-105.131416	7.1
1575	40.082882	-105.131416	6.9
1600	40.082821	-105.131416	6.8
1625	40.082734	-105.131416	6.7
1650	40.082671	-105.131416	6.5
1675	40.082606	-105.131409	6.3
1700	40.082528	-105.131409	6.0
1725	40.082457	-105.131409	6.0
1750	40.0824	-105.131409	6.0
1775	40.082314	-105.131409	6.0
1800	40.082247	-105.131409	5.8
1825	40.082182	-105.131401	5.9
1850	40.082102	-105.131401	6.0
1875	40.082029	-105.131401	6.1
1900	40.08197	-105.131401	6.0
1925	40.081906	-105.131401	6.1
1950	40.081823	-105.131401	6.3
1975	40.081753	-105.131401	6.7
2000	40.081689	-105.131401	6.4
2025	40.081609	-105.131393	6.3
2050	40.08154	-105.131393	6.6
2075	40.081479	-105.131393	7.1
2100	40.081396	-105.131393	7.0
2125	40.081335	-105.131393	6.9
2150	40.081262	-105.131393	6.5
2175	40.081202	-105.131386	6.7
2200	40.081116	-105.131386	7.5
2225	40.081054	-105.131386	7.1
2250	40.080978	-105.131386	6.8
2275	40.080909	-105.131386	7.0
2300	40.080841	-105.131386	6.6
2325	40.080781	-105.131386	6.7
2350	40.080698	-105.131378	6.5
2375	40.080629	-105.131378	6.2
2400	40.080566	-105.131378	6.3
2425	40.080482	-105.131378	6.5
2450	40.08042	-105.131378	6.8

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
2475	40.080355	-105.131378	7.1
2500	40.080273	-105.131378	6.8
2525	40.080203	-105.131378	6.8
2550	40.080139	-105.131371	7.2
2575	40.080078	-105.131371	7.3
2600	40.079994	-105.131371	7.1
2625	40.079927	-105.131371	7.1
2650	40.079867	-105.131371	8.2
2675	40.079781	-105.131371	8.9
2700	40.079716	-105.131371	8.7
2725	40.079636	-105.131364	7.9
2750	40.079575	-105.131363	7.4
2775	40.079507	-105.131363	7.2
2800	40.079442	-105.131363	7.3
2825	40.079357	-105.131363	7.3
2850	40.079294	-105.131363	6.5
2875	40.079227	-105.131363	6.5
2900	40.079142	-105.131363	7.1
2925	40.079085	-105.131363	8.0
2950	40.079014	-105.131355	7.7
2975	40.078937	-105.131355	7.4
3000	40.078869	-105.131355	7.1
3025	40.078808	-105.131355	7.0
3050	40.07873	-105.131355	7.7
3075	40.078655	-105.131355	7.7
3100	40.078593	-105.131355	7.1
3125	40.078524	-105.131355	6.7
3150	40.078444	-105.131355	6.4
3175	40.078376	-105.131355	6.4
3200	40.078309	-105.131355	7.2
3225	40.078231	-105.131355	7.1
3250	40.078167	-105.131353	6.7
3275	40.078106	-105.131348	6.2
3300	40.078028	-105.131348	6.0
3325	40.077953	-105.131348	5.9
3350	40.07789	-105.131348	6.2
3375	40.077819	-105.131348	6.5
3400	40.077734	-105.131348	6.5
3425	40.077674	-105.131348	7.4
3450	40.077609	-105.131348	7.7
3475	40.077526	-105.131348	6.6
3500	40.077465	-105.131348	6.4
3525	40.0774	-105.131348	6.4
3550	40.077322	-105.13134	6.6
3575	40.077249	-105.13134	6.7
3600	40.077186	-105.13134	6.3
3625	40.077111	-105.13134	6.5
3650	40.077033	-105.13134	6.3
3675	40.076973	-105.13134	6.5

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
3700	40.076905	-105.13134	6.9
3725	40.076824	-105.13134	6.3
3750	40.076754	-105.13134	6.8
3775	40.076689	-105.13134	7.1
3800	40.076616	-105.13134	6.8
3825	40.076539	-105.13134	6.6
3850	40.076481	-105.13134	6.7
3875	40.076408	-105.13134	6.9
3900	40.076327	-105.13134	6.9
3925	40.076262	-105.13134	6.9
3950	40.076195	-105.13134	7.0
3975	40.076112	-105.13134	7.1
4000	40.076049	-105.131332	7.3
4025	40.075985	-105.131332	7.6
4050	40.075909	-105.131332	7.2
4075	40.075838	-105.131332	7.2
4100	40.075773	-105.131332	7.2
4125	40.075704	-105.131332	7.1
4150	40.075619	-105.131332	7.1
4175	40.075563	-105.131332	7.1
4200	40.075488	-105.131332	7.4
4225	40.075411	-105.131332	7.3
4250	40.075348	-105.131325	7.1
4275	40.07528	-105.131325	6.8
4300	40.075196	-105.131325	7.1
4325	40.075134	-105.131325	7.1
4350	40.075069	-105.131325	7.4
4375	40.07499	-105.131324	9.0
4400	40.074922	-105.131317	8.6
4425	40.074857	-105.131317	8.7
4450	40.074773	-105.131317	8.3
4475	40.074712	-105.131317	8.8
4500	40.074642	-105.131317	8.2
4525	40.074563	-105.131317	8.1
4550	40.074502	-105.131317	7.8
4575	40.074433	-105.131317	7.8
4600	40.074351	-105.131317	8.0
4625	40.07429	-105.131317	8.1
4650	40.074219	-105.131317	8.2
4675	40.074144	-105.131317	8.4
4700	40.074079	-105.131317	9.0
4725	40.074001	-105.131317	7.9
4750	40.073932	-105.131317	8.6
4775	40.073866	-105.131321	8.2
4800	40.073795	-105.131325	8.4
4825	40.073727	-105.131321	8.3
4850	40.073654	-105.131317	8.2
4875	40.073589	-105.131317	8.2
4900	40.073519	-105.131317	8.4

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LF	Latitude	Longitude	Pavement Thickness, in
4925	40.073442	-105.131317	8.2
4950	40.073378	-105.131317	9.4
4975	40.073307	-105.131317	9.1
5000	40.073241	-105.131317	8.7
5025	40.07317	-105.131317	6.5
5050	40.073101	-105.131317	6.6
5075	40.073032	-105.131317	7.0
5100	40.072961	-105.131317	7.5
5125	40.072896	-105.131317	8.4
5150	40.072826	-105.131317	7.7
5175	40.072757	-105.131317	7.6
5200	40.072691	-105.131317	7.6
5225	40.072617	-105.131317	8.1
5250	40.072556	-105.131317	7.5
5275	40.072478	-105.131317	7.3
5300	40.072417	-105.131317	7.2
5325	40.072339	-105.131317	7.1
5350	40.072276	-105.13131	7.2
5375	40.072199	-105.13131	7.1
5400	40.072133	-105.13131	7.2
5425	40.072074	-105.13131	7.0
5450	40.071995	-105.13131	7.0
5475	40.071927	-105.13131	7.0
5500	40.071846	-105.13131	6.8
5525	40.071782	-105.13131	6.9
5550	40.071711	-105.13131	7.1
5575	40.071642	-105.131304	7.1
5600	40.071581	-105.131302	7.0
5625	40.0715	-105.131302	6.6
5650	40.071435	-105.131302	6.5
5675	40.071368	-105.131302	6.9
5700	40.071293	-105.131302	7.1
5725	40.071226	-105.131302	7.3
5750	40.071154	-105.131302	7.5
5775	40.071084	-105.131302	7.3
5800	40.071021	-105.131298	7.1
5825	40.07094	-105.131294	7.0
5850	40.070875	-105.131294	7.4
5875	40.070807	-105.131294	7.5
5900	40.070729	-105.131293	7.1
5925	40.070663	-105.131287	6.8
5950	40.070601	-105.131287	7.5
5975	40.07052	-105.131287	7.6
6000	40.070457	-105.131287	6.9
6025	40.070389	-105.131287	6.5
6050	40.07031	-105.131284	6.4
6075	40.070247	-105.131279	6.5
6100	40.070171	-105.131279	6.5
6125	40.070103	-105.131279	6.4

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LF	Latitude	Longitude	Pavement Thickness, in
6150	40.070037	-105.131279	6.3
6175	40.069972	-105.131279	6.0
6200	40.069889	-105.131279	6.0
6225	40.069831	-105.131279	6.0
6250	40.069757	-105.131279	6.1
6275	40.069677	-105.131279	6.1
6300	40.069613	-105.131279	6.0
6325	40.069542	-105.131279	5.9
6350	40.069471	-105.131279	6.1
6375	40.069404	-105.131279	6.2
6400	40.06934	-105.131279	6.4
6425	40.069258	-105.131275	6.1
6450	40.069194	-105.131271	6.1
6475	40.069133	-105.131271	6.1
6500	40.069044	-105.131271	5.9
6525	40.068981	-105.131271	6.0
6550	40.068919	-105.131271	5.8
6575	40.068836	-105.131271	5.7
6600	40.068771	-105.131271	5.1
6625	40.068707	-105.131271	5.4
6650	40.068629	-105.131271	5.4
6675	40.068558	-105.131271	5.4
6700	40.068489	-105.131271	5.4
6725	40.068418	-105.131271	5.5
6750	40.068341	-105.131271	5.5
6775	40.06828	-105.131271	5.4
6800	40.068201	-105.131267	5.5
6825	40.068126	-105.131264	6.1
6850	40.068068	-105.131264	6.2
6875	40.067997	-105.131264	6.0
6900	40.06792	-105.131264	5.7
6925	40.067854	-105.131264	6.0
6950	40.067789	-105.131264	6.0
6975	40.067699	-105.131264	5.8
7000	40.067639	-105.131264	6.2
7025	40.067571	-105.131264	6.9
7050	40.06749	-105.131257	7.1
7075	40.067424	-105.131256	6.8
7100	40.067361	-105.131256	6.1
7125	40.067291	-105.131256	5.8
7150	40.067211	-105.131256	5.7
7175	40.067144	-105.131256	5.7
7200	40.067081	-105.131256	5.6
7225	40.067	-105.131256	5.5
7250	40.066933	-105.131256	5.5
7275	40.066868	-105.131256	5.5
7300	40.066784	-105.131256	5.5
7325	40.066716	-105.131256	5.5
7350	40.066659	-105.131256	5.4

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LF	Latitude	Longitude	Pavement Thickness, in
7375	40.066584	-105.131256	5.6
7400	40.066501	-105.131256	5.5
7425	40.066437	-105.131256	5.8
7450	40.066371	-105.131256	5.7
7475	40.066287	-105.131256	5.6
7500	40.066226	-105.131251	5.9
7525	40.066159	-105.131248	6.0
7550	40.066085	-105.131248	6.0
7575	40.066014	-105.131248	5.8
7600	40.065948	-105.131248	5.8
7625	40.065883	-105.131248	5.4
7650	40.065799	-105.131248	5.4
7675	40.065733	-105.131248	5.4
7700	40.065665	-105.131248	5.7
7725	40.06558	-105.131248	5.4
7750	40.065517	-105.131248	5.5
7775	40.065455	-105.131248	5.4
7800	40.065375	-105.131248	5.7
7825	40.065308	-105.131248	5.3
7850	40.065242	-105.131248	5.4
7875	40.065173	-105.131248	5.1
7900	40.065088	-105.131248	5.7
7925	40.065023	-105.131248	5.4
7950	40.064961	-105.131248	5.4
7975	40.064874	-105.131248	5.4
8000	40.064808	-105.131248	5.6
8025	40.064741	-105.131248	5.9
8050	40.064659	-105.131248	6.0
8075	40.064596	-105.131245	5.9
8100	40.064534	-105.131241	6.0
8125	40.064466	-105.131241	6.3
8150	40.064381	-105.131241	6.5
8175	40.064313	-105.131241	6.6
8200	40.06425	-105.131241	6.0
8225	40.064168	-105.131241	5.5
8250	40.064102	-105.131241	6.1
8275	40.064039	-105.131241	6.4
8300	40.063957	-105.131241	6.0
8325	40.063885	-105.131241	6.3
8350	40.063825	-105.131241	6.5
8375	40.063755	-105.131243	7.0
8400	40.063675	-105.131248	7.1
8425	40.063607	-105.131248	7.1
8450	40.063539	-105.131256	6.7
8475	40.063461	-105.131256	6.6
8500	40.0634	-105.131256	7.4
8525	40.063328	-105.131264	7.0
8550	40.063253	-105.131264	7.2
8575	40.063186	-105.131264	6.9

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LF	Latitude	Longitude	Pavement Thickness, in
8600	40.06312	-105.131264	7.1
8625	40.063034	-105.131264	7.0
8650	40.06297	-105.131264	6.9
8675	40.062901	-105.131264	6.9
8700	40.062824	-105.131271	7.1
8725	40.06276	-105.131271	6.9
8750	40.062693	-105.131271	6.5
8775	40.062607	-105.131271	6.4
8800	40.062539	-105.131271	6.1
8825	40.062479	-105.131271	7.1
8850	40.062412	-105.131271	6.7
8875	40.062332	-105.131271	6.5
8900	40.062266	-105.131271	6.4
8925	40.062204	-105.131271	6.0
8950	40.062115	-105.131271	6.4
8975	40.062051	-105.131271	6.7
9000	40.061988	-105.131271	6.3
9025	40.061903	-105.131267	6.1
9050	40.061839	-105.131264	6.8
9075	40.061776	-105.131264	7.7
9100	40.061701	-105.131264	7.1
9125	40.061626	-105.131264	6.6
9150	40.06156	-105.131264	6.5
9175	40.06148	-105.131264	6.5
9200	40.061408	-105.131264	6.4
9225	40.061342	-105.131264	6.3
9250	40.061261	-105.131264	6.5
9275	40.061196	-105.131264	6.6
9300	40.061131	-105.131264	7.1
9325	40.061069	-105.131264	7.2
9350	40.060987	-105.131264	6.6
9375	40.060921	-105.131264	7.6
9400	40.060855	-105.131256	7.1
9425	40.06077	-105.131256	6.5
9450	40.060708	-105.131256	6.7
9475	40.06064	-105.131256	6.1
9500	40.060553	-105.131255	6.1
9525	40.060495	-105.131248	6.5
9550	40.060429	-105.131248	6.8
9575	40.06036	-105.131248	6.6
9600	40.060276	-105.131248	6.3
9625	40.060212	-105.131248	6.4
9650	40.060147	-105.131248	6.2
9675	40.060062	-105.131248	5.9
9700	40.059999	-105.131248	5.9
9725	40.059933	-105.131248	6.0
9750	40.059848	-105.131248	6.1
9775	40.059785	-105.131248	6.3
9800	40.059716	-105.131256	6.4

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LF	Latitude	Longitude	Pavement Thickness, in
9825	40.05965	-105.131256	6.5
9850	40.059568	-105.131256	6.5
9875	40.059511	-105.131256	6.2
9900	40.059444	-105.131256	6.0
9925	40.059359	-105.131256	6.0
9950	40.059292	-105.131256	6.1
9975	40.059231	-105.131256	6.1
10000	40.059141	-105.131256	6.0
10025	40.059079	-105.131256	6.0
10050	40.059016	-105.131255	6.1
10075	40.05893	-105.131248	6.9
10100	40.058865	-105.131248	8.3
10125	40.058794	-105.131248	8.8
10150	40.058719	-105.131248	9.4
10175	40.058651	-105.131248	9.1
10200	40.058586	-105.131248	8.8
10225	40.058501	-105.131248	8.4
10250	40.058442	-105.131248	7.4
10275	40.058378	-105.131248	6.6
10300	40.05831	-105.131248	6.2
10325	40.05823	-105.131248	5.9
10350	40.058157	-105.131248	5.5
10375	40.058085	-105.131248	5.5
10400	40.058008	-105.131248	5.7
10425	40.057945	-105.131248	5.4
10450	40.057879	-105.131248	5.5
10475	40.057803	-105.131248	5.6
10500	40.057734	-105.131248	5.8
10525	40.057669	-105.131248	6.0
10550	40.05759	-105.131248	6.6
10575	40.057522	-105.131248	7.7
10600	40.057455	-105.131248	9.0
10625	40.057371	-105.131248	9.4
10650	40.057307	-105.131248	9.3
10675	40.057245	-105.131248	8.8
10700	40.057162	-105.131248	8.7
10725	40.057091	-105.131248	7.9
10750	40.05703	-105.131248	7.3
10775	40.056952	-105.131248	6.7
10800	40.05688	-105.131248	6.3
10825	40.056819	-105.131248	6.3
10850	40.056749	-105.131248	6.2
10875	40.056669	-105.131248	6.0
10900	40.056607	-105.131248	5.9
10925	40.056528	-105.131248	6.0
10950	40.056455	-105.131248	6.1
10975	40.056395	-105.131248	6.0
11000	40.05633	-105.131248	5.8
11025	40.056249	-105.131248	5.8

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LF	Latitude	Longitude	Pavement Thickness, in
11050	40.056175	-105.131248	6.0
11075	40.056119	-105.131248	6.2
11100	40.05603	-105.131248	6.5
11125	40.055965	-105.131248	6.3
11150	40.055901	-105.131248	6.2
11175	40.055817	-105.131248	6.1
11200	40.055752	-105.131248	6.0
11225	40.055689	-105.131248	5.9
11250	40.055626	-105.131248	6.3
11275	40.05554	-105.131248	6.4
11300	40.055477	-105.131248	6.3
11325	40.055412	-105.131248	6.2
11350	40.055326	-105.131248	6.1
11375	40.055261	-105.131248	6.0
11400	40.055194	-105.131248	6.1
11425	40.055109	-105.131248	6.5
11450	40.055046	-105.131248	7.1
11475	40.054985	-105.131248	7.5
11500	40.054918	-105.131248	7.4
11525	40.054832	-105.131248	6.5
11550	40.054768	-105.131248	5.0
11575	40.054702	-105.131248	4.9
11600	40.054615	-105.131248	4.9
11625	40.05455	-105.131248	5.2
11650	40.054488	-105.131248	5.6
11675	40.054401	-105.131248	6.5
11700	40.054339	-105.131248	8.2
11725	40.054273	-105.131248	7.9
11750	40.054204	-105.131248	6.8
11775	40.054123	-105.131248	6.7
11800	40.054057	-105.131248	6.2
11825	40.053992	-105.131248	6.0
11850	40.053911	-105.131248	6.0
11875	40.053846	-105.131248	6.0
11900	40.053782	-105.131248	6.0
11925	40.053695	-105.131248	6.0
11950	40.053631	-105.131248	6.0
11975	40.053565	-105.131248	5.9
12000	40.053501	-105.131248	5.8
12025	40.053419	-105.131248	5.7
12050	40.05335	-105.131248	5.8
12075	40.053291	-105.131248	6.2
12100	40.053208	-105.131241	6.3
12125	40.053143	-105.131241	6.5
12150	40.053076	-105.131241	6.5
12175	40.052991	-105.131241	6.9
12200	40.052923	-105.131241	7.1
12225	40.052862	-105.131241	7.1
12250	40.052793	-105.131241	6.9

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LF	Latitude	Longitude	Pavement Thickness, in
12275	40.052712	-105.131241	6.8
12300	40.052649	-105.131241	7.6
12325	40.052576	-105.131241	7.6
12350	40.052499	-105.131241	8.4
12375	40.052439	-105.131241	8.2
12400	40.052366	-105.131241	8.3
12425	40.052285	-105.131241	8.1
12450	40.052222	-105.131241	7.3
12475	40.052158	-105.131241	7.0
12500	40.052074	-105.131241	7.0
12525	40.052013	-105.131241	7.0
12550	40.051941	-105.131241	7.2
12575	40.051868	-105.131241	7.7
12600	40.051795	-105.131241	8.1
12625	40.051732	-105.131241	8.0
12650	40.051655	-105.131241	7.4
12675	40.051583	-105.131241	7.1
12700	40.051517	-105.131241	7.6
12725	40.051454	-105.131236	7.2
12750	40.05137	-105.131233	6.5
12775	40.051307	-105.131233	6.2
12800	40.051241	-105.131233	6.2
12825	40.051157	-105.131233	6.3
12850	40.051093	-105.131233	6.5
12875	40.051029	-105.131233	6.9
12900	40.05094	-105.131233	7.7
12925	40.050879	-105.131233	8.1
12950	40.050815	-105.131233	8.3
12975	40.050749	-105.131233	8.2
13000	40.050667	-105.131233	8.2
13025	40.050597	-105.131233	7.7
13050	40.050535	-105.131233	7.3
13075	40.050453	-105.131226	7.8
13100	40.050388	-105.131226	7.6
13125	40.050325	-105.131226	7.5
13150	40.050241	-105.131226	7.9
13175	40.050172	-105.131226	7.7
13200	40.050112	-105.131226	7.7
13225	40.050028	-105.131226	7.7
13250	40.049969	-105.131226	7.3
13275	40.049905	-105.131226	6.8
13300	40.049817	-105.131226	6.1
13325	40.049753	-105.131226	6.0
13350	40.049689	-105.131226	6.0
13375	40.049616	-105.131226	6.2
13400	40.049538	-105.131226	6.1
13425	40.049476	-105.131226	6.2
13450	40.049397	-105.131226	6.2
13475	40.049324	-105.131226	6.3

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LF	Latitude	Longitude	Pavement Thickness, in
13500	40.049263	-105.131226	6.4
13525	40.049186	-105.13122	6.3
13550	40.049115	-105.131218	6.2
13575	40.049051	-105.131218	6.0
13600	40.048987	-105.131218	6.0
13625	40.048903	-105.131218	5.8
13650	40.048837	-105.131218	5.8
13675	40.048768	-105.131218	6.0
13700	40.048691	-105.131218	6.0
13725	40.048626	-105.131218	6.0
13750	40.048557	-105.131218	6.0
13775	40.048481	-105.131218	5.7
13800	40.048416	-105.131218	5.8
13825	40.048352	-105.131218	6.1
13850	40.048267	-105.131218	6.0
13875	40.048203	-105.13121	6.0
13900	40.048138	-105.13121	5.9
13925	40.048059	-105.13121	5.8
13950	40.047993	-105.13121	5.9
13975	40.047909	-105.13121	6.9
14000	40.047843	-105.13121	5.9
14025	40.047778	-105.13121	5.7
14050	40.047714	-105.13121	6.8
14075	40.047631	-105.13121	6.8
14100	40.047558	-105.13121	6.8
14125	40.047495	-105.13121	6.6
14150	40.047421	-105.13121	6.4
14175	40.047356	-105.13121	6.2
14200	40.047276	-105.13121	5.9
14225	40.047204	-105.13121	5.7
14250	40.047143	-105.13121	5.5
14275	40.047073	-105.13121	5.6
14300	40.046995	-105.13121	5.8
14325	40.046934	-105.131203	6.0
14350	40.046866	-105.131203	6.0
14375	40.046782	-105.131203	6.0
14400	40.046719	-105.131203	6.0
14425	40.046654	-105.131203	5.8
14450	40.04657	-105.131203	5.4
14475	40.046506	-105.131203	5.8
14500	40.046443	-105.131203	6.1
14525	40.046367	-105.131203	5.6
14550	40.046291	-105.131203	5.3
14575	40.046219	-105.131203	5.3
14600	40.046152	-105.131203	5.4
14625	40.046078	-105.131203	5.8
14650	40.046014	-105.131203	6.0
14675	40.045938	-105.131203	5.6
14700	40.045869	-105.131203	5.2

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
14725	40.045799	-105.131203	5.0
14750	40.045738	-105.131203	6.4
14775	40.045657	-105.131203	6.7
14800	40.045585	-105.131203	6.7
14825	40.045524	-105.131203	6.8
14850	40.045442	-105.131203	7.1
14875	40.045376	-105.131203	7.5
14900	40.045314	-105.131203	7.3
14925	40.045229	-105.131203	6.4
14950	40.045166	-105.131203	7.9
14975	40.045099	-105.131203	6.7
15000	40.045029	-105.131203	6.8
15025	40.044949	-105.131203	7.6
15050	40.04488	-105.131203	7.4
15075	40.044814	-105.131195	7.4
15100	40.04474	-105.131195	7.2
15125	40.044675	-105.131195	7.0
15150	40.044601	-105.131195	6.7
15175	40.044526	-105.131195	6.0
15200	40.044458	-105.131195	6.1
15225	40.044394	-105.131195	6.3
15250	40.044315	-105.131195	6.3
15275	40.044246	-105.131195	6.3
15300	40.044179	-105.131195	6.4
15325	40.0441	-105.131195	6.2
15350	40.04403	-105.131195	6.9
15375	40.043964	-105.131195	6.6
15400	40.043886	-105.131195	6.6
15425	40.043818	-105.131195	6.5
15450	40.043757	-105.131195	7.1
15475	40.043691	-105.131195	7.8
15500	40.04361	-105.131195	8.0
15525	40.043542	-105.131195	7.8
15550	40.043473	-105.131195	7.6
15575	40.043393	-105.131195	7.5
15600	40.043327	-105.131195	7.3
15625	40.043265	-105.131195	7.1
15650	40.043179	-105.131195	6.7
15675	40.043113	-105.131195	6.4
15700	40.043049	-105.131195	6.4
15725	40.042987	-105.131195	6.9
15750	40.042904	-105.131195	7.5
15775	40.042836	-105.131195	7.9
15800	40.042772	-105.131195	8.1
15825	40.042688	-105.131195	7.4
15850	40.042624	-105.131195	7.3
15875	40.042564	-105.131195	8.0
15900	40.042479	-105.131195	7.5
15925	40.04241	-105.131195	7.0

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LF	Latitude	Longitude	Pavement Thickness, in
15950	40.042347	-105.131195	7.1
15975	40.042272	-105.131195	7.2
16000	40.042196	-105.131195	6.7
16025	40.042126	-105.131195	6.0
16050	40.042065	-105.131195	6.0
16075	40.041987	-105.131195	6.0
16100	40.041923	-105.131195	6.0
16125	40.041854	-105.131195	5.9
16150	40.041779	-105.131195	5.9
16175	40.041708	-105.131195	5.9
16200	40.041648	-105.131195	5.9
16225	40.041559	-105.131195	5.7
16250	40.041495	-105.131195	5.8
16275	40.041433	-105.131195	5.9
16300	40.041349	-105.131195	5.9
16325	40.041288	-105.131195	6.0
16350	40.041222	-105.131195	6.0
16375	40.041136	-105.131195	5.9
16400	40.041074	-105.131195	6.0
16425	40.041008	-105.131195	6.2
16450	40.040927	-105.131195	6.0
16475	40.04086	-105.131195	5.8
16500	40.040792	-105.131195	6.7
16525	40.040717	-105.131195	7.1
16550	40.040647	-105.131195	7.0
16575	40.040588	-105.131195	7.6
16600	40.040504	-105.131195	8.4
16625	40.04044	-105.131203	8.7
16650	40.040376	-105.131203	8.8
16675	40.040291	-105.131203	8.3
16700	40.040232	-105.131203	9.7
16725	40.040164	-105.131203	10.0
16750	40.040085	-105.131203	9.5
16775	40.040021	-105.131203	9.9
16800	40.039936	-105.131203	10.0
16825	40.039874	-105.131195	10.7
16850	40.039809	-105.131195	10.4
16875	40.039736	-105.131191	10.6
16900	40.039664	-105.131187	10.2
16925	40.039597	-105.13118	9.5
16950	40.03952	-105.13118	7.9
16975	40.039451	-105.131172	8.2
17000	40.039392	-105.131172	7.6
17025	40.039305	-105.131165	9.5
17050	40.03924	-105.131165	9.4
17075	40.039178	-105.131157	8.6
17100	40.039102	-105.131157	8.8
17125	40.039033	-105.131157	8.3
17150	40.038969	-105.131155	9.0

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LF	Latitude	Longitude	Pavement Thickness, in
17175	40.038884	-105.131149	9.5
17200	40.038824	-105.131149	9.4
17225	40.038754	-105.131149	8.4
17250	40.038667	-105.131142	8.8
17275	40.038607	-105.131142	8.5
17300	40.038542	-105.131142	7.7
17325	40.038471	-105.131142	7.6
17350	40.038395	-105.131142	7.7
17375	40.038327	-105.131134	7.5
17400	40.038251	-105.131134	7.7
17425	40.038188	-105.131134	7.6
17450	40.038121	-105.131134	7.6
17475	40.038037	-105.131127	7.9
17500	40.037971	-105.131126	7.9
17525	40.037906	-105.131126	8.0
17550	40.037846	-105.131126	7.6
17575	40.03776	-105.131119	7.6
17600	40.037697	-105.131119	7.7
17625	40.037636	-105.131119	7.7
17650	40.037551	-105.131113	7.6
17675	40.037479	-105.131111	7.7
17700	40.037411	-105.131111	7.7
17725	40.037332	-105.131111	7.9
17750	40.037267	-105.131104	7.8
17775	40.037202	-105.131104	7.4
17800	40.037123	-105.131104	8.2
17825	40.037056	-105.1311	8.2
17850	40.036981	-105.131096	7.9
17875	40.036914	-105.131096	7.7
17900	40.036843	-105.131096	7.4
17925	40.03678	-105.131096	6.8
17950	40.036703	-105.131091	6.6
17975	40.03663	-105.131088	7.9
18000	40.036564	-105.131088	7.7
18025	40.036501	-105.131088	7.1
18050	40.036416	-105.131088	5.5
18075	40.03635	-105.131088	6.5
18100	40.036285	-105.131088	5.7
18125	40.036205	-105.131081	5.0
18150	40.036137	-105.131081	3.9
18175	40.036073	-105.131081	7.3
18200	40.035988	-105.131078	6.6
18225	40.035929	-105.131073	3.1
18250	40.035863	-105.131073	3.1
18275	40.035786	-105.131073	3.4
18300	40.03571	-105.131073	3.6
18325	40.035642	-105.131073	3.6
18350	40.035581	-105.131073	3.4
18375	40.035505	-105.131073	3.7

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LF	Latitude	Longitude	Pavement Thickness, in
18400	40.035439	-105.131065	3.9
18425	40.035372	-105.131065	3.9
18450	40.035291	-105.131065	3.9
18475	40.035224	-105.131065	4.1
18500	40.035157	-105.131065	4.3
18525	40.035072	-105.131058	4.4
18550	40.035015	-105.131058	4.8
18575	40.034944	-105.131058	5.7
18600	40.034865	-105.131058	6.8
18625	40.034798	-105.131058	7.7
18650	40.03473	-105.131058	8.6
18675	40.034651	-105.131058	10.1
18700	40.034582	-105.13105	6.6
18725	40.034517	-105.13105	7.8
18750	40.034456	-105.13105	9.1
18775	40.034372	-105.13105	7.9
18800	40.034306	-105.13105	7.5
18825	40.03424	-105.13105	7.6
18850	40.034156	-105.13105	7.9
18875	40.034091	-105.13105	7.7
18900	40.034027	-105.13105	7.4
18925	40.033942	-105.13105	7.0
18950	40.033874	-105.13105	6.6
18975	40.033813	-105.13105	6.3
19000	40.033755	-105.13105	6.2
19025	40.033667	-105.131042	6.4
19050	40.0336	-105.131042	6.7
19075	40.033536	-105.131042	7.1
19100	40.03345	-105.131042	7.2
19125	40.033382	-105.131042	7.7
19150	40.033321	-105.131042	8.8
19175	40.033236	-105.131042	8.6
19200	40.033174	-105.131042	8.0
19225	40.033105	-105.131042	7.5
19250	40.033047	-105.131042	7.1
19275	40.032958	-105.131042	6.6
19300	40.032892	-105.131042	6.5
19325	40.03283	-105.131036	6.6
19350	40.032745	-105.131035	7.0
19375	40.032684	-105.131035	6.9
19400	40.032619	-105.131035	6.7
19425	40.032534	-105.131035	7.5
19450	40.032462	-105.131035	8.2
19475	40.032401	-105.131035	8.3
19500	40.032342	-105.131035	8.2
19525	40.032254	-105.131035	8.2
19550	40.032193	-105.131035	8.4
19575	40.032124	-105.131035	8.4
19600	40.032041	-105.131035	8.2

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LF	Latitude	Longitude	Pavement Thickness, in
19625	40.031974	-105.131035	7.2
19650	40.031912	-105.131035	6.4
19675	40.031823	-105.131035	6.7
19700	40.031761	-105.131035	6.9
19725	40.031695	-105.131035	7.0
19750	40.031632	-105.131035	6.7
19775	40.031554	-105.131035	6.2
19800	40.031483	-105.131035	5.7
19825	40.031417	-105.131035	5.7
19850	40.031332	-105.131035	5.5
19875	40.031269	-105.131035	5.4
19900	40.031206	-105.131035	5.5
19925	40.031121	-105.131035	5.5
19950	40.031051	-105.131035	5.5
19975	40.030991	-105.131035	5.4
20000	40.030925	-105.131035	5.4
20025	40.030841	-105.131035	5.5
20050	40.03078	-105.131035	5.7
20075	40.030715	-105.131035	6.0
20100	40.030632	-105.131035	6.1
20125	40.03056	-105.131035	5.9
20150	40.030496	-105.131035	6.2
20175	40.030417	-105.131035	6.6
20200	40.030346	-105.131035	6.3
20225	40.030285	-105.131035	6.3
20250	40.030219	-105.131035	5.9
20275	40.030135	-105.131035	5.8
20300	40.03007	-105.131035	5.9
20325	40.030001	-105.131035	5.9
20350	40.029925	-105.131035	6.0
20375	40.02986	-105.131035	5.7
20400	40.029794	-105.131035	5.6
20425	40.029714	-105.131035	5.7
20450	40.02964	-105.131035	5.9
20475	40.029575	-105.131035	6.2
20500	40.029514	-105.131035	6.5
20525	40.029428	-105.131035	8.0
20550	40.029362	-105.131035	7.4
20575	40.029298	-105.131035	6.2
20600	40.029213	-105.131035	6.3
20625	40.02915	-105.131035	6.7
20650	40.029083	-105.131035	7.3
20675	40.029011	-105.131035	6.8
20700	40.028937	-105.131035	6.4
20725	40.028872	-105.131035	6.4
20750	40.028807	-105.131035	6.1
20775	40.028725	-105.131035	5.9
20800	40.028655	-105.131035	6.0
20825	40.028584	-105.131035	6.3

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LF	Latitude	Longitude	Pavement Thickness, in
20850	40.028521	-105.131035	6.0
20875	40.028443	-105.131035	6.0
20900	40.02838	-105.131035	6.5
20925	40.028309	-105.131035	6.6
20950	40.028229	-105.131035	7.2
20975	40.028161	-105.131035	7.3
21000	40.028099	-105.131035	7.9
21025	40.028019	-105.131035	10.3
21050	40.027952	-105.131035	13.3
21075	40.027887	-105.131035	13.3
21100	40.027813	-105.131035	11.0
21125	40.027738	-105.131035	9.0
21150	40.027671	-105.131035	7.8
21175	40.027598	-105.131035	7.2
21200	40.027522	-105.131035	6.9
21225	40.027456	-105.131035	6.5
21250	40.027392	-105.131035	6.2
21275	40.027318	-105.131035	6.3
21300	40.027244	-105.131035	6.4
21325	40.027172	-105.131035	6.4
21350	40.027096	-105.131035	6.9
21375	40.027033	-105.131035	6.8
21400	40.026967	-105.131035	6.6
21425	40.02689	-105.131035	6.4
21450	40.026821	-105.131035	6.2
21475	40.026752	-105.131035	6.2
21500	40.026687	-105.131035	6.0
21525	40.0266	-105.131035	6.1
21550	40.026537	-105.131035	6.0
21575	40.026473	-105.131035	6.0
21600	40.02639	-105.131035	6.1
21625	40.02632	-105.131035	6.3
21650	40.026263	-105.131035	6.4
21675	40.026183	-105.131035	6.3
21700	40.026109	-105.131035	6.0
21725	40.026046	-105.131035	5.9
21750	40.02598	-105.131035	5.8
21775	40.025898	-105.131035	5.7
21800	40.025835	-105.131035	6.0
21825	40.025761	-105.131035	5.8
21850	40.025688	-105.131035	6.0
21875	40.025616	-105.131035	5.8
21900	40.025551	-105.131035	6.0
21925	40.025475	-105.131035	5.6
21950	40.025404	-105.131035	5.8
21975	40.025339	-105.131035	6.0
22000	40.025277	-105.131037	5.8
22025	40.025188	-105.131042	5.5
22050	40.025124	-105.131042	5.8

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
22075	40.025059	-105.131042	6.2
22100	40.024984	-105.131042	6.0
22125	40.024909	-105.131042	5.9
22150	40.024846	-105.131042	5.5
22175	40.024765	-105.131042	5.6
22200	40.024695	-105.131042	5.7
22225	40.024636	-105.131042	6.0
22250	40.024573	-105.131042	6.0
22275	40.024488	-105.131042	5.9
22300	40.024419	-105.131042	5.7
22325	40.024351	-105.131042	6.0
22350	40.024276	-105.131042	6.1
22375	40.024213	-105.13105	6.0
22400	40.024133	-105.13105	6.0
22425	40.024062	-105.13105	5.7
22450	40.023999	-105.13105	5.4
22475	40.023933	-105.13105	5.4
22500	40.023848	-105.13105	5.5
22525	40.023786	-105.13105	5.8
22550	40.023708	-105.13105	5.8
22575	40.023637	-105.13105	5.8
22600	40.023576	-105.13105	5.7
22625	40.023492	-105.13105	5.7
22650	40.023429	-105.13105	5.8
22675	40.023361	-105.13105	6.1
22700	40.023293	-105.13105	5.9
22725	40.023219	-105.13105	5.4
22750	40.023146	-105.13105	5.3
22775	40.023072	-105.131057	4.8
22800	40.023007	-105.131058	5.6
22825	40.022942	-105.131058	6.0
22850	40.022862	-105.131058	5.9
22875	40.022797	-105.131058	6.0
22900	40.022732	-105.131058	6.9
22925	40.022659	-105.131058	7.2
22950	40.022593	-105.131058	6.9
22975	40.022513	-105.131058	6.6
23000	40.022449	-105.131058	6.9
23025	40.022383	-105.131058	7.2
23050	40.022298	-105.131065	7.0
23075	40.022234	-105.131065	7.0
23100	40.022168	-105.131065	7.0
23125	40.022093	-105.131065	6.8
23150	40.022028	-105.131065	6.9
23175	40.021965	-105.131065	7.0
23200	40.021881	-105.131065	7.1
23225	40.021819	-105.131065	7.1
23250	40.021742	-105.131065	7.1
23275	40.021673	-105.131073	7.0

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
23300	40.021604	-105.131073	7.7
23325	40.021524	-105.131073	8.0
23350	40.021462	-105.131073	7.5
23375	40.0214	-105.131073	7.7
23400	40.021323	-105.131073	7.5
23425	40.021253	-105.131073	6.5
23450	40.021193	-105.131073	6.4
23475	40.021106	-105.131073	6.3
23500	40.021043	-105.131073	5.9
23525	40.020976	-105.131073	5.8
23550	40.020897	-105.131073	7.1
23575	40.020834	-105.131074	5.9
23600	40.020752	-105.131081	6.1
23625	40.020692	-105.131081	6.4
23650	40.020624	-105.131081	6.3
23675	40.020546	-105.131081	6.0
23700	40.020475	-105.131081	6.4
23725	40.020412	-105.131081	6.7
23750	40.02033	-105.131081	6.4
23775	40.020269	-105.131081	6.6

95th St - SB - SH 52 to Louisville City Limits

LF	Latitude	Longitude	Pavement Thickness, in
500	40.085897	-105.131493	7.6
1000	40.084495	-105.131447	7.7
1500	40.08309	-105.131424	6.3
2000	40.081689	-105.131401	6.4
2500	40.080273	-105.131378	6.8
3000	40.078869	-105.131355	7.1
3500	40.077465	-105.131348	6.4
4000	40.076049	-105.131332	7.3
4500	40.074642	-105.131317	8.2
5000	40.073241	-105.131317	8.7
5500	40.071846	-105.13131	6.8
6000	40.070457	-105.131287	6.9
6500	40.069044	-105.131271	5.9
7000	40.067639	-105.131264	6.2
7500	40.066226	-105.131251	5.9
8000	40.064808	-105.131248	5.6
8500	40.0634	-105.131256	7.4
9000	40.061988	-105.131271	6.3
9500	40.060553	-105.131255	6.1
10000	40.059141	-105.131256	6.0
10500	40.057734	-105.131248	5.8
11000	40.05633	-105.131248	5.8
11500	40.054918	-105.131248	7.4
12000	40.053501	-105.131248	5.8
12500	40.052074	-105.131241	7.0
13000	40.050667	-105.131233	8.2
13500	40.049263	-105.131226	6.4
14000	40.047843	-105.13121	5.9
14500	40.046443	-105.131203	6.1
15000	40.045029	-105.131203	6.8
15500	40.04361	-105.131195	8.0
16000	40.042196	-105.131195	6.7
16500	40.040792	-105.131195	6.7
17000	40.039392	-105.131172	7.6
17500	40.037971	-105.131126	7.9
18000	40.036564	-105.131088	7.7
18500	40.035157	-105.131065	4.3
19000	40.033755	-105.13105	6.2
19500	40.032342	-105.131035	8.2
20000	40.030925	-105.131035	5.4
20500	40.029514	-105.131035	6.5
21000	40.028099	-105.131035	7.9
21500	40.026687	-105.131035	6.0
22000	40.025277	-105.131037	5.8
22500	40.023848	-105.13105	5.5
23000	40.022449	-105.131058	6.9
23500	40.021043	-105.131073	5.9

Appendix F – DARWin Pavement Designs

PROPOSED RESURFACING:
LOCATION 1
LOCATION 2
LOCATION 3
LOCATION 4
AVERAGE

PROPOSED RECONSTRUCTION:
LOCATION 1
LOCATION 2
LOCATION 3
LOCATION 4
AVERAGE

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
HWY 52 to N of Gunbarrel Rd (STA 10+00 to 85+00)
PROPOSED RESURFACING - LOCATION 1

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,500 psi
Stage Construction	1
Calculated Design Structural Number	4.16 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surface Course (...	0.44	1	2	-	440,000	-	2.00	0.88
2	1/2-in Intermediate Co...	0.44	1	2	-	440,000	-	2.00	0.88
3	#4 Leveling Course (SF)	0.34	1	0.75	-	260,000	-	0.75	0.26
4	Existing HMA (unmill...	0.35	1	6.9	-	275,000	-	6.90	2.42
5	Fat Clay (A-7)	0.01	0.4	12	-	4,500	-	12.00	0.05
6	Fat Clay (A-7)	0.01	0.4	-	-	4,500	-	0.00	0.00
Total	-	-	-	-	-	-	-	23.65	4.48

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
N. of Gunbarrel Rd to N. of Phillips Rd (STA 85+00 to 100+00)
PROPOSED RESURFACING - LOCATION 2

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,500 psi
Stage Construction	1
Calculated Design Structural Number	4.16 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surface Course (...	0.44	1	2	-	440,000	-	2.00	0.88
2	1/2-in Intermediate Co...	0.44	1	3	-	440,000	-	3.00	1.32
3	#4 Leveling Course (SF)	0.34	1	0.75	-	260,000	-	0.75	0.26
4	Existing HMA (unmill...	0.29	1	6.1	-	190,000	-	6.10	1.77
5	Fat Clay (A-7)	0.01	0.4	12	-	4,500	-	12.00	0.05
6	Fat Clay (A-7)	0.01	0.4	-	-	4,500	-	0.00	0.00
Total	-	-	-	-	-	-	-	23.85	4.27

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
N. of Phillips Rd to S. of Avocet Ln (STA 100+00 to 175+00)
PROPOSED RESURFACING - LOCATION 3

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	6,000 psi
Stage Construction	1
Calculated Design Structural Number	3.74 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surface Course (...	0.44	1	2	-	440,000	-	2.00	0.88
2	1/2-in Intermediate Co...	0.44	1	2	-	440,000	-	2.00	0.88
3	#4 Leveling Course (SF)	0.34	1	0.75	-	260,000	-	0.75	0.26
4	Existing HMA (unmill...	0.29	1	6.6	-	190,000	-	6.60	1.91
5	Organic Silt (A-6)	0.02	0.4	12	-	6,000	-	12.00	0.10
6	organic Silt (A-6)	0.02	0.4	-	-	6,000	-	0.00	0.00
Total	-	-	-	-	-	-	-	23.35	4.02

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
S.of Avocet Ln to Blue Heron Way (STA 175+00 to 250+00)
PROPOSED RESURFACING - LOCATION 4

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	6,000 psi
Stage Construction	1
Calculated Design Structural Number	3.74 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	9.5mm Surface Course	0.44	1	1.5	-	440,000	-	1.50	0.66
2	12.5mm Intermediate ...	0.44	1	2.25	-	440,000	-	2.25	0.99
3	HMA Leveling Course	0.34	1	0.5	-	260,000	-	0.50	0.17
4	Existing HMA (unmill...	0.29	1	6.9	-	190,000	-	6.90	2.00
5	Organic Silt (A-6)	0.02	0.4	12	-	6,000	-	12.00	0.10
6	Organic Silt (A-6)	0.02	0.4	-	-	6,000	-	0.00	0.00
Total	-	-	-	-	-	-	-	23.15	3.92

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
All Sections (Averaging)
PROPOSED RESURFACING

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,500 psi
Stage Construction	1
Calculated Design Structural Number	4.16 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Superpave Surfa...	0.44	1	2	-	440,000	-	2.00	0.88
2	3/4-in Superpave Inter...	0.44	1	2.5	-	440,000	-	2.50	1.10
3	1-in Superpave Base C...	0.44	1	3.25	-	440,000	-	3.25	1.43
4	ABC Base Material	0.14	1	6	-	200,000	-	6.00	0.84
5	Fat Clay (A-7)	0.01	0.4	12	-	4,500	-	12.00	0.05
6	Fat Clay (A-7)	0.01	0.4	-	-	4,500	-	0.00	0.00
Total	-	-	-	-	-	-	-	25.75	4.30

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
HWY 52 to N of Gunbarrel Rd (STA 10+00 to 85+00)
PROPOSED RECONSTRUCTION - LOCATION 1

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,500 psi
Stage Construction	1
Calculated Design Structural Number	4.16 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surfsce Course (...	0.44	1	2	-	440,000	-	2.00	0.88
2	3/4-in Intermediate Co...	0.44	1	2.5	-	440,000	-	2.50	1.10
3	1-in Base Course (SX)	0.44	1	3	-	440,000	-	3.00	1.32
4	ABC Base Material (C...	0.15	1	6	-	32,883	-	6.00	0.90
5	Fat Clay (A-7)	0.01	0.4	12	-	4,500	-	12.00	0.05
6	Fat Clay (A-7)	0.01	0.4	-	-	4,500	-	0.00	0.00
Total	-	-	-	-	-	-	-	25.50	4.25

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Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
N. of Gunbarrel Rd to N. of Phillips Rd (STA 85+00 to 100+00)
PROPOSED RECONSTRUCTION - LOCATION 2

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,500 psi
Stage Construction	1
Calculated Design Structural Number	4.16 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surface Course (...	0.44	1	2	-	440,000	-	2.00	0.88
2	3/4-in Intermediate Co...	0.44	1	2.5	-	440,000	-	2.50	1.10
3	1-in Base Course (SX)	0.44	1	3	-	440,000	-	3.00	1.32
4	ABC Base Material (C...	0.15	1	6	-	32,883	-	6.00	0.90
5	Fat Clay (A-7)	0.01	0.4	12	-	4,500	-	12.00	0.05
6	Fat Clay (A-7)	0.01	0.4	-	-	4,500	-	0.00	0.00
Total	-	-	-	-	-	-	-	25.50	4.25

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Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
N. of Phillips Rd to S. of Avocet Ln (STA 100+00 to 175+00)
PROPOSED RECONSTRUCTION - LOCATION 3

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	6,000 psi
Stage Construction	1
Calculated Design Structural Number	3.74 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surface Course (...	0.44	1	2	-	440,000	-	2.00	0.88
2	3/4-in Intermediate Co...	0.44	1	2.25	-	440,000	-	2.25	0.99
3	1-in Base COurse (SX)	0.44	1	3	-	440,000	-	3.00	1.32
4	ABC Base Material (C...	0.15	1	6	-	32,883	-	6.00	0.90
5	Organic Silt (A-6)	0.02	0.4	12	-	6,000	-	12.00	0.10
6	organic Silt (A-6)	0.02	0.4	-	-	6,000	-	0.00	0.00
Total	-	-	-	-	-	-	-	25.25	4.19

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DARWin Pavement Design and Analysis System

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Computer Software Product

Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
S.of Avocet Ln to Blue Heron Way (STA 175+00 to 250+00)
PROPOSED RECONSTRUCTION - LOCATION 4

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	6,000 psi
Stage Construction	1
Calculated Design Structural Number	3.74 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surface Course (...	0.44	1	2	-	440,000	-	2.00	0.88
2	3/4-in Intermediate Co...	0.44	1	2.25	-	440,000	-	2.25	0.99
3	1-in Base Course (SX)	0.44	1	3	-	440,000	-	3.00	1.32
4	ABC Base Material (C...	0.15	1	6	-	32,883	-	6.00	0.90
5	Organic Silt (A-6)	0.02	0.4	12	-	6,000	-	12.00	0.10
6	Organic Silt (A-6)	0.02	0.4	-	-	6,000	-	0.00	0.00
Total	-	-	-	-	-	-	-	25.25	4.19

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Computer Software Product

Flexible Structural Design Module

95th Street - Boulder, CO
Pavement Rehabilitation
All Sections (Averaging)
PROPOSED RECONSTRUCTION

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	673,546
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,500 psi
Stage Construction	1
Calculated Design Structural Number	4.16 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	3,072
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	51 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	2.6	0.5	0.003	0	936
2	80.25	0.5	0.003	0	28,902
3	0.4	0.5	0.003	0	144
4	14.4	0.5	0.249	0	430,458
5	0.4	0.5	0.249	0	11,957
6	0.03	0.5	0.249	0	897
7	0.5	0.5	0.249	0	14,946
8	0.9	0.5	1.087	0	117,447
9	0.4	0.5	1.087	0	52,199
10	0.1	0.5	1.087	0	13,050
11	0.01	0.5	1.087	0	1,305
12	0.01	0.5	1.087	0	1,305
13	0	0.5	1.39	0	0
Total	100	-	-	-	673,546

Growth	Compound

Total Calculated Cumulative ESALs 673,546

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	1/2-in Surface Course (...	0.44	1	1.5	-	440,000	-	1.50	0.66
2	1/2-in Surface Course (...	0.38	1	1.75	-	440,000	-	1.75	0.67
3	#4 Leveling Course (SF)	0.34	1	2	-	260,000	-	2.00	0.68
4	Existing HMA (unmill...	0.32	1	6.8	-	225,000	-	6.80	2.18
5	Fat Clay (A-7)	0.01	0.4	12	-	4,500	-	12.00	0.05
6	Fat Clay (A-7)	0.01	0.4	-	-	4,500	-	0.00	0.00
Total	-	-	-	-	-	-	-	24.05	4.23

PUBLIC WORKS - ENGINEERING
MEETING SIGN-IN SHEET

MEETING TYPE: ☐ FIR ☐ FOR ☐ GENERAL ☒ PRE-BID ☐ PRE-CONSTRUCTION

Project Title: 95th St Resiliency and Reconstruction	Project No. RD -19-150 (BID # 009-23)
Federal Project? ☐ Yes ☒ No / Federal Project No. N/A	Federal Code N/A
Date, Time: January 4, 2024, 10:00 AM	Location: 2525 13th Street 2nd floor

[Pre-bid] SIGN-IN SHEET		PROJECT: 95th Reconstruction	
NAME/SIGNATURE	COMPANY	PHONE NUMBER	EMAIL ADDRESS
Connor Nolan	Brannon Sand and Gravel	303-356-3295	cnolan@brannan1.com
Jake Goss	Preform	973-879-7258	jakeg@preform.us
Paiton Carr	EZ Excavating	720-698-2986	pcarr@ezexcavation.com
Sarah Gray	FNF Construction, Inc.	480-784-2910	Sgray@fnfinc.com
Josh Duran	Duran Excavating, Inc.	970-539-1420	joshd@duranexcavating.com
Naresh Surigala	JHL Constructors, Inc.	682.216.9101	nsurigala@jhlconstructors.com
Jason Creach	FNF Construction, Inc	480-929-6704	jcreach@fnfinc.com

[Pre-bid] SIGN-IN SHEET		PROJECT: 95th Reconstruction	
NAME/SIGNATURE	**COMPANY**	**PHONE NUMBER**	**EMAIL ADDRESS**
Stevie Moran	AWP Safety		stevie.moran@awpsafety.com estimatingco@awpsafety.com
Alyssa Barlow	Timber Wolf Excavating, LLC.	(918) 986-0286	Alyssa@twolfx.com
Karyl Smith	Coal Creek Excavation Inc.		karyl@coalcreekexcavation.com
Bill Sisko	Coal Creek Excavation Inc.	303.859.9513	bill@coalcreekexcavation.com wyatt@coalcreekexcavation.com
Brandon Shafer	APC Construction	303-996-7227	bshafer@apc.us.com
John Grubesic	American Civil Constructors MW	303-419-7079	john.grubesic@accbuilt.com
			Duranjosh19@ou.edu cneibauer@trustawc.com Lee.f.tfwconstruction@comcast.net