PROJECT MANUAL

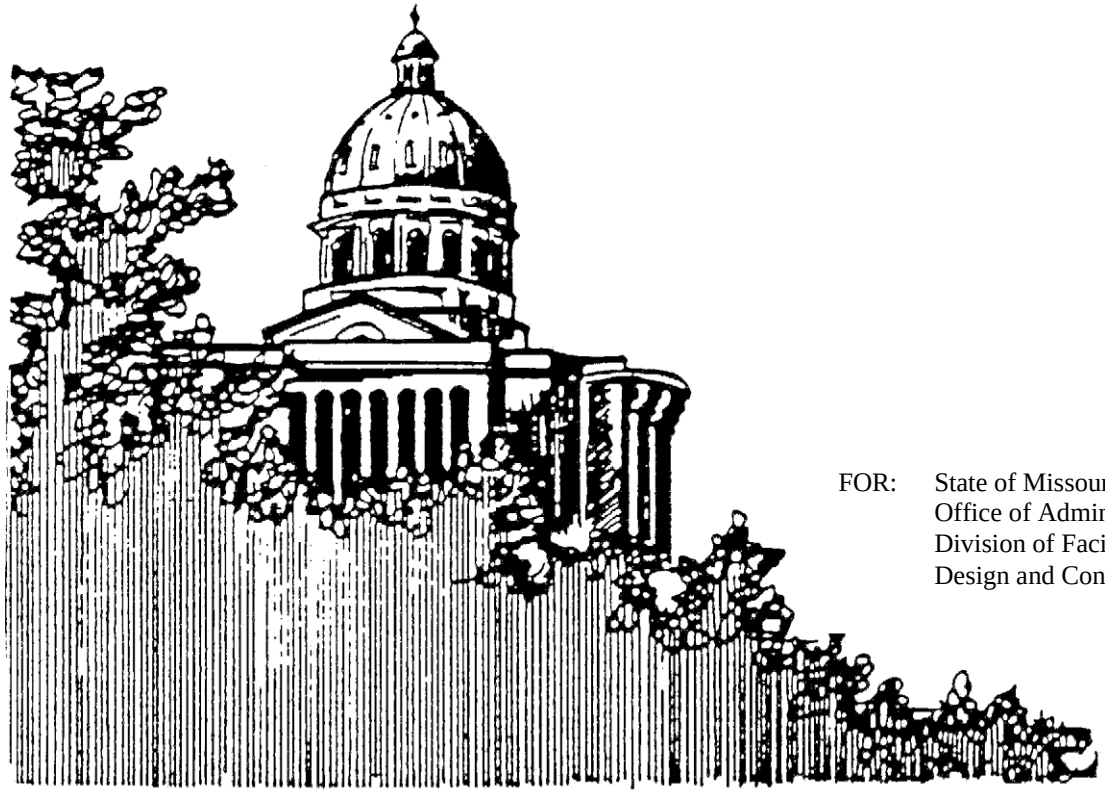
TASMG Readiness Center
AVCRAD Facility
Springfield, Missouri

Volume 4 of 4

DESIGNED BY: Olsson
1301 Burlington St,
Kansas City, MO 64116

DATE ISSUED: 2/26/2020

PROJECT NO.: T1809-01



FOR: State of Missouri
Office of Administration
Division of Facilities Management,
Design and Construction

TABLE OF CONTENTS

SECTION	TITLE	NUMBER OF PAGES
	VOLUME 1	
DIVISION 00 – PROCUREMENT AND CONTRACTING INFORMATION		
000000	**INTRODUCTORY INFORMATION**	
000101	Project Manual Cover	1
000107	Professional Seals and Certifications	5
000110	Table of Contents	5
000115	List of Drawings	5
001116	**INVITATION FOR BID (IFB)** plus Missouri Buys instructions and special notice	3
002113	**INSTRUCTIONS TO BIDDERS (Includes MBE/WBE/SDVE Information)**	8
003132	Geotechnical Data	1
003144	MBE/WBE/SDVE Directory	1
****The following documents may be found on MissouriBUYS at https://missouribuys.mo.gov/****		
004000	**PROCUREMENT FORMS & SUPPLEMENTS**	
004113	Bid Form	*
004336	Proposed Subcontractors Form	*
004337	MBE/WBE/SDVE Compliance Evaluation Form	*
004338	MBE/WBE/SDVE Eligibility Determination Form for Joint Ventures	*
004339	MBE/WBE/SDVE Good Faith Effort (GFE) Determination Forms	*
004340	SDVE Business Form	*
004541	Affidavit of Work Authorization	*
005000	**CONTRACTING FORMS AND SUPPLEMENTS**	
005213	Construction Contract	3
005414	Affidavit for Affirmative Action	1
006113	Performance and Payment Bond	2
006325	Product Substitution Request	2
006519.16	Final Receipt of Payment and Release Form	1
006519.18	MBE/WBE/SDVE Progress Report	1
006519.21	Affidavit of Compliance with Prevailing Wage Law	1
007000	**CONDITIONS OF THE CONTRACT**	
007213	General Conditions	20
007300	Supplementary Conditions	2
007346	Wage Rate	4
DIVISION 01 - GENERAL REQUIREMENTS		
010000	Summary of Work	5
010270	Applications for Payment	4
010350	Modification Procedures	2
010400	Project Coordination	4
010450	Request for Information	1
012100	Allowances	3
	City Utilities Extension Contract for Allowance	3
	City Utilities Cost Memorandum for Allowance	1
	City Utilities Load Sheet	1
012300	Alternates	2
012600	Contract Modification Procedures	2
013100	Coordination	2
013101	Contractor Safety and Special Instructions	5
013200	Construction Progress Documentation	4
013300	Submittal Procedures	10
014000	Quality Control	3
015000	Temporary Facilities and Services	3
016310	Product Substitutions	3
017000	Construction Procedures	12

017400	Warranties and Bonds	3
017419	Construction Waste Management and Disposal	8
017700	Project Close Out	3
017821	Project Record Documents	3
017823	Operation and Maintenance Data	3
018113.14	Sustainable Design Requirements LEEDv4 Bd+C	8
019100	General Commissioning	14

DIVISION 02 - EXISTING CONDITIONS

024119	Selective Demolition	9

DIVISION 03 – CONCRETE

031000	Concrete Forming And Accessories	7
032000	Concrete Reinforcing	4
033000	Cast-In-Place Concrete	23

DIVISION 04 - MASONRY

042000	Unit Masonry	23
047200	Cast Stone Masonry	9

DIVISION 05 - METALS

051200	Structural Steel Framing	9
052100	Steel Joist Framing	5
053100	Steel Decking	6
054000	Cold-Formed Metal Framing	11
055000	Metal Fabrications	12
055113	Metal Pan Stairs	8
057300	Decorative Metal Railings	7

VOLUME 2

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

061053	Miscellaneous Rough Carpentry	8
061600	Sheathing	5
064023	Interior Architectural Woodwork	4
064116	Plastic-Laminate-Faced Architectural Cabinets	9

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

071326	Self-Adhering Sheet Waterproofing	8
072100	Thermal Insulation	5
072119	Foamed-In-Place Insulation	3
072726	Fluid-Applied Membrane Air Barriers	9
074113.19	Batten-Seam Metal Roof Panels	13
074213.13	Formed Metal Wall Panels	10
074213.19	Insulated Metal Wall Panels	10
074217	Insulated-Core Metal Wall Backup Panel System	6
074293	Soffit Panels	9
075419	Polyvinyl-Chloride (Pvc) Roofing	15
076200	Sheet Metal Flashing and Trim	13
077100	Roof Specialties	6
077129	Manufactured Roof Expansion Joints	6
077200	Roof Accessories	8
077210	Rooftop Fall Arrest System	5
077253	Snow Guards	5
078413	Penetration Firestopping	6
078443	Joint Firestopping	6
079100	Preformed Joint Seals	4
079200	Joint Sealants	10
079513.13	Interior Expansion Joint Cover Assemblies	4
079513.16	Exterior Expansion Joint Cover Assemblies	6

DIVISION 08 - OPENINGS

081113	Hollow Metal Doors and Frames	8

081416	Flush Wood Doors	7
083113	Access Doors and Frames	4
083313	Coiling Counter Doors	7
083323	Overhead Coiling Doors	9
083459	Vault Doors and Day Gates	5
084113	Aluminum-Framed Entrances And Storefronts	14
084413	Glazed Aluminum Curtain Walls	13
084523	Fiberglass Sandwich Panel Assemblies	8
087100	Door Hardware	28
088000	Glazing	12
089119	Fixed Louvers	7

DIVISION 09 - FINISHES

092216	Non-Structural Metal Framing	8
092900	Gypsum Board Assemblies	11
095113	Accoustical Panel Ceilings	9
096513	Resilient Base and Accessories	7
096519	Resilient Tile Flooring	6
096723	Resinous Flooring	5
096813	Tile Carpeting	7
098436	Sound-Absorbing Ceiling Units	6
099000	Painting	9

DIVISION 10 - SPECIALTIES

101100	Visual Display Units	6
101423	Panel Signage	6
102113.19	Plastic Toilet Compartments	6
102213	Wire Mesh Partitions	8
102226	Folding Partition Panels	5
102800	Toilet, Bath, and Laundry Accessories	6
104413	Fire Protection Cabinets	4
105113	Metal Lockers	8

DIVISION 11 - EQUIPMENT

114000	Food Service Equipment(N.I.C.) – Furnished Under Separate Contract	NIC

DIVISION 12 - FURNISHINGS

122413	Roller Window Shades	7
123661.16	Solid Surfacing Countertops	5
123661.19	Quartz Agglomerate Countertops	5

DIVISION 14 - CONVEYING EQUIPMENT

142123.16	Machine Room-Less Electric Traction Passenger Elevators	10

VOLUME 3

DIVISION 21-28

211300	Fire Supression System	21
220500	Common Work Results for Plumbing	21
220501	Plumbing Project Coordination and Installation	2
220516	Expansion Fittings and Loops for Plumbing	4
220519	Meters and Gauges for Plumbing Piping	4
220523	Plumbing Valves	3
220529	Plumbing Supports, Anchors, and Seals	4
220548	Plumbing Vibration Isolation	6
220553	Plumbing Identification	4
220719	Plumbing Piping Insulation	4
221116	Domestic Water Piping	10
221119	Domestic Water Piping Specialties	7
221124	Domestic Water Pumps	6

221316	Sanitary Waste And Vent Piping	4
221319	Sanitary Waste Piping Specialties	7
221323	Sanitary Waste Interceptors	3
221413	Storm Drainage Piping	5
221423	Storm Drainage Piping Specialties	5
221429	Sump Pumps	4
223100	Water Softeners	8
223500	Domestic Water Heat Exchangers	6
224000	Plumbing Fixtures And Accessories	5
224500	Emergency Plumbing Fixtures	5
230500	Common Work For Results For HVAC	14
230501	Mechanical Project Coordination And Installation	2
230516	Expansion Fittings And Loops For HVAC Piping	4
230519	Meters and Gauges for HVAC Piping	5
230523	HVAC Valves	3
230529	Hangers and Supports for HVAC Equipment	5
230548	HVAC Vibration Isolation	4
230553	HVAC Identification	4
230593	Testing, Adjusting, and Balancing for HVAC	3
230713	HVAC Duct Insulation	3
230719	HVAC Piping Insulation	5
230923	Direct Digital Control System for HVAC	27
230993	Sequences Of Operation	8
231123	Natural Gas Piping	8
232113	Hydronic Piping	7
232116	Hydronic Specialties	7
232300	Refrigerant Piping	8
232315	Refrigeration Specialties	5
233113	HVAC Ductwork	9
233300	Air Duct Accessories	17
233416	Centrifugal Exhaust Fans	5
233600	Air Terminal Devices	5
233713	HVAC Diffusers, Registers and Grilles	8
233723	HVAC Gravity Ventilators	4
233813	Kitchen Exhaust Systems	10
237313	Modular Indoor Central Station Air Handling Units	8
238220	Fan-Coil Units and Unit Ventilators	8
260500	Common Work Results for Electrical	15
260501	Temporary Electrical Facilities	3
260519	Low-Voltage Electrical Conductors and Cables	5
260526	Grounding and Bonding for Electrical Systems	7
260529	Hangers and Supports for Electrical Systems	4
260533	Raceway and Boxes for Electrical Systems	5
260553	Identification for Electrical Systems	6
260913	Electrical Power Monitoring and Control	10
260923	Lighting Control Devices	7
260926	Network Lighting Controls	15
260936	Modular Dimming Controls	6
262200	Low-Voltage Transformers	5
262213	Low-Voltage Distribution Panelboards	6
262300	Low Voltage Switchgear	21

262413	Integrated Power Center	7
262416	Panelboards	8
262726	Wiring Devices	7
262813	Fuses	3
262816	Enclosed Switches and Circuit Breakers	5
262923	Variable Frequency Drives	9
263213	Engine Generators	16
263600	Transfer Switches	9
264313	Surge Protection Devices (SPD)	9
265100	Interior Lighting	4
265300	Emergency Lighting Fixtures	6
265600	Exterior Lighting	9
270500	Common Work Results for Communications	2
271100	Communications Equipment Room Fittings	2
271500	Communications Horizontal Cabling	4
272500	Cable Tray	5
283100	Fire Alarm System	34

DIVISION 31 – EARTHWORK

311000	Clearing and Grubbing	2
312000	Excavation and Embankment	6
312319	Dewatering	1
312500	Erosion and Sediment Control	6

DIVISION 32 – EXTERIOR IMPROVEMENTS

321123	Crushed Aggregate Base Course	4
321216	Hot-Mix Asphalt Paving	1
321313	Cement Concrete Paving	1
321723	Pavement Markings (Parking Lot)	1
329200	Topsoiling	2
329210	Turf Sodding	6
329220	Turf Seeding	9
329300	Trees Shrubs and Groundcover	11

DIVISION 33 – UTILITIES

331123	Natural Gas Distribution	1
334000	Pipe for Storm Drains and Culverts	4

DIVISION 34 – TRANSPORTATION

344116	Traffic Control	2

VOLUME 4

APPENDIX

Appendix A	2018 Palmerton and Parrish Geotechnical Engineering Report	85
Appendix B	City of Springfield Public Works General Conditions and Technical Specifications	248
Appendix C	City Utilities Technical Specifications	75

END OF TABLE OF CONTENTS

APPENDIX A

2018 Palmerton and Parrish Geotechnical Engineering Report

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... 1, 2 & 3
1.0 INTRODUCTION 4
2.0 PROJECT DESCRIPTION 5
3.0 SITE DESCRIPTION 6
4.0 SITE HISTORY 6
5.0 SUBSURFACE INVESTIGATION 6
5.1 Subsurface Borings 7
5.2 Laboratory Testing 7
5.3 Thermal Testing 8
5.4 Dynamic Cone Penetrometer Testing (DCP) 9
5.5 Resistivity Testing 9
6.0 SITE GEOLOGY 10
7.0 GENERAL SITE & SUBSURFACE CONDITIONS 11
7.1 Limestone Bedrock 13
7.2 Auger Refusal 14
7.3 Groundwater 14
8.0 EARTHWORK 15
8.1 Controlled Fill Material Types 16
8.2 Compaction Requirements 17
8.3 Existing Fill Material 17
8.4 Landscaping and Site Drainage 18
8.5 Earthwork Construction Considerations 19
8.6 Inclement Weather 19
8.7 Excavations 20
8.8 Shallow Bedrock Considerations 20
9.0 FOUNDATIONS 21
9.1 Moderate Foundation Loads up to 400 kips Working Load 21
9.1.1 Uplift 23
9.2 Moderately Heavy Foundation Loads 24
9.2.1 Aggregate Piers 24
9.3 Drilled Piers 25
9.4 Karst Considerations 25
10.0 SEISMIC CONSIDERATIONS 26
11.0 FLOOR SLABS 26
11.1 Modulus of Subgrade Reaction 27
12.0 RETAINING WALLS 28
13.0 PAVEMENT 28
13.1 Flexible Pavement 29
13.2 Rigid Pavement 31
13.3 Pavement Thickness 32
14.0 CONSTRUCTION OBSERVATION & TESTING 32
15.0 REPORT LIMITATIONS 33

TABLE OF CONTENTS (CONTINUED)

FIGURES

FIGURE 1 – BORING LOCATION PLAN
FIGURE 2 – FILL DEPTH CONTOURS (2001)

APPENDICES

APPENDIX I – BORING LOGS & KEY TO SYMBOLS
APPENDIX II – GENERAL NOTES
APPENDIX III – GRAIN SIZE ANALYSIS RESULTS
APPENDIX IV – THERMAL TESTING RESULTS
APPENDIX V – DYNAMIC CONE PENETROMETER (DCP) TESTS
APPENDIX VI – RESISTIVITY TESTING RESULTS
APPENDIX VII – DECLARATION ON UNIFORMITY OF AREA SOIL CONDITIONS
APPENDIX VIII – DECLARATION OF SOIL BEARING CAPACITY
APPENDIX IX – IMPORTANT INFORMATION REGARDING YOUR GEOTECHNICAL REPORT

EXECUTIVE SUMMARY

A Geotechnical Investigation was performed at the site planned for construction of the new MOARNG TASMG 3A / ARC located near the existing AVCRAD Facility in Springfield, Missouri. Based upon the information provided by the Design Team, Phase 3A will consist of constructing a new facility that will be one (1) to two (2) stories in height, consist of steel framing and measure approximately 84,498 sq. ft. in plan view. A future Readiness Center (RC) may be constructed on the north side of Phase 3A and is anticipated to be one (1) to two (2) stories in height, consist of steel framing and measure approximately 26,000 sq. ft. in plan view. All structures are anticipated to have slab-on-grade floor systems and a Finish Floor Elevation (FFE) 1258.5 ft. Preliminary maximum column loads up to 380 kips and wall loads up to 5 kips per lineal ft. are anticipated. Preliminary bottom of footing elevation ranges from 2 to 6 ft. below the FFE. New pavement for parking and access drives is also planned north of the New Addition. Minimal grade changes are anticipated to achieve finish subgrade elevations across the project site.

A total of nineteen (19) sample borings were drilled within the proposed development area. All borings were discontinued in natural overburden soils, existing undocumented fill or limestone bedrock at depths ranging from 6.3 to 22 ft. below the existing ground surface. Based upon the information obtained from the borings and subsequent laboratory testing, the site is suitable for construction of the proposed Phase 3 Addition. Important geotechnical considerations for the project are summarized below. However, users of the information contained in the report must review the entire report for specific details pertinent to geotechnical design considerations.

- Palmerton & Parrish, Inc. (PPI) was retained to provide both Geotechnical Services and Construction Materials Testing for the previous AVCRAD addition Phase 1 and 2 in 2003 and 2010, respectively. After a cursory review of previous Geotechnical Reports and Construction Materials Testing results, PPI has performed compaction testing on controlled fill in 2001 and in 2010 to the north and east of the project site. However, results of Field Density tests documenting fill compaction within the building footprint was not found in these files;

EXECUTIVE SUMMARY (CONTINUED)

- Fill or probable fill material was encountered within Borings 1, 5, 6, 8, 10, 11, 12, 16, 17 and 18 at depths ranging from 2.5 to 6.5 ft. below the existing ground surface and boring completion within Borings 17, 18 and 18B. **The specific origin and method of compaction of this fill material was apparently not documented by PPI and no other records have been provided for review;**

- While the shallow natural soils (CL) were found to be stiff to very stiff as of the date of drilling, shallow natural soils may undergo loss of shear strength upon an increase in soil moisture and when disturbed by heavier construction equipment. **Further, these soils may not be suitable for re-use as Structural Fill if the moisture is several percentage points above optimum**. It is recommended that the Earthwork Contractor manage on-site soils during earthwork procedures so that moisture sensitive lean clay soils are <u>not</u> the only remaining soil type left available to construct the building pad. This practice may result in an unstable building pad subgrade which may not pass a proof-roll, requiring appreciable project schedule and budget to stabilize or remove and replace;

- Shallow to deeper fat (CH) clays were encountered across this site. Based upon the anticipated excavation depths, it is considered possible that CH clays may be exposed at/or near finish subgrade within the proposed development area. Care should be exercised so that CH clays are not allowed to become frozen, desiccated, saturated or disturbed prior to concrete placement to limit the potential for shrink/swell. All affected material should be removed from excavations;

- Limestone bedrock was encountered within Borings 7, 8 and 9 at depths ranging from 6 to 19.5 ft. below the existing ground surface;

EXECUTIVE SUMMARY (CONTINUED)

- In areas where light to moderate foundation loads (400 kips or less) are anticipated, foundation loads may be supported upon shallow foundations bearing in natural soils or controlled fill after complete removal and replacement of all undocumented fill material in accordance with Section 9.1 of this report. However, while PPI has no record of performing compaction testing on the undocumented fill material, based upon the Standard Penetration Test (SPT) N-Values obtained within the widespread borings, the undocumented fill exhibits characteristics of being placed with appreciable compactive effort. In lieu of complete removal and replacement of all existing fill beneath footings, once a final grading plan, foundation loads, foundation type, foundation locations and bottom of footing elevation have been finalized, PPI can be contracted to drill sample borings beneath each footing to determine whether removal and replacement of undocumented fill material is required. If the fill observed within the additional borings exhibits adequate shear strength, it should be permissible to allow new footings to bear in existing fill for some or possibly all new shallow foundations located within this material. In addition, a representative of PPI should be present to observe foundation excavations. These additional services can be provided by PPI upon request and may result in cost savings, as compared to complete removal and replacement below footings;

- Moderately heavy to heavy foundation loads may be supported upon shallow foundations after ground improvement (aggregate piers) or upon deep foundations in the form of drilled piers/micropiles installed at footing locations to increase the allowable bearing pressure and reduce potential settlement;

- The project site classifies as a Site Class C in accordance with Section 1613 of the 2015 International Building Code (IBC); and

- Palmerton & Parrish, Inc. should be retained for construction observation and construction materials testing. Close monitoring of subgrade preparation work is considered critical to achieve adequate foundation and subgrade performance.

GEOTECHNICAL ENGINEERING REPORT

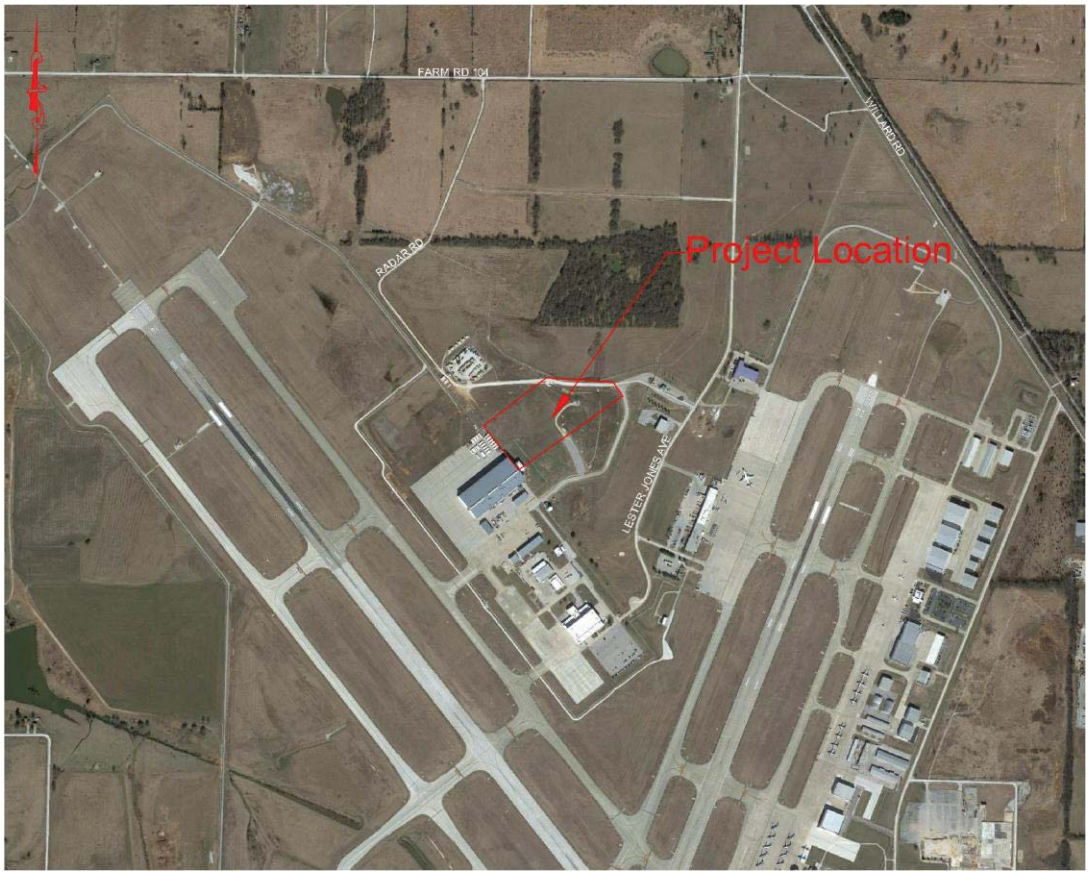
MISSOURI ARMY NATIONAL GUARD (MOARNG)

THEATER AVIATION MAINTENANCE GROUP (TASMG) – ARC

SPRINGFIELD, MISSOURI

1.0 INTRODUCTION

This is the report of the Geotechnical Investigation performed at the site planned for construction of the new MOARNG TASMG ARC located near the existing AVCRAD Facility in Springfield, Missouri. This investigation was authorized by a Subconsultant Agreement between Jacobs and PPI dated December 20, 2017. The approximate site location is shown in the aerial photograph below for reference.



The purpose of the Geotechnical Investigation was to provide information for foundation design and construction planning, and to aid in site development. Palmerton & Parrish Inc.'s (PPI) scope of services included field and laboratory investigation of the subsurface conditions in the vicinity of the proposed project site, engineering analysis of the collected data, development of recommendations for foundation and pavement design and construction planning, and preparation of this engineering report.

2.0 PROJECT DESCRIPTION

Item	Description
Site Layout	See Figure 1: Boring Location Plan.
Phase 3A Addition	• One (1) to two (2) stories in height; • Steel framed; • Utilize a slab-on-grade floor system; and • Measure 84,498 sq. ft. in plan view.
Future Readiness Center (RC)	• One (1) to two (2) stories in height; • Steel framed; • Utilize a slab-on-grade floor system; and • Measure 26,000 sq. ft. in plan view.
Anticipated Finish Floor Elevation (FFE)	1,258.5 ft.
Preliminary Bottom of Footing Elevation	2 to 6 ft. below the FFE.
Anticipated Foundation and Floor Slab Loadings	• Preliminary maximum column loads up to 380 kips and wall loads up to 5 kips per lineal ft.; and • Light to moderate floor slab loadings.
Anticipated Grading	Minimal depths of cut and/or fill are anticipated to achieve subgrade elevation across the project site.
New Pavement	New pavement for parking and access drives are planned north of the new addition.

3.0 SITE DESCRIPTION

Item	Description
Township/Range/Section	29N/23W/1
Latitude/Longitude (± Center of Project Site)	37.252013°N, -93.389237°W
Available Historic Aerial Photography	Based upon available historic aerial photography, the project site has been developed as the existing AVCRAD Facility to the south of the project site since 2010.
Existing Improvements	Existing undocumented or probable fill material was encountered within Borings 1, 5, 6, 8, 10, 11, 12, 16, 17 & 18 at depths ranging from 2.5 to 7.5 ft. below the existing ground surface. This fill was most likely placed during construction of the AVCRAD Facility.
Current Ground Cover	Grass covered lawn area.
Existing Topography	Gently sloping to the northeast.
Drainage Characteristics	Poor to fair.

4.0 SITE HISTORY

As previously mentioned, PPI has performed Geotechnical Services, as well as Construction Materials Testing Services for the New AVCRAD Facility in 2003 and 2010. After a cursory review of previous Geotechnical Reports and Construction Materials Testing results, PPI has performed frequent compaction testing on fill placed in 2001 to the north and east of the project site with fill depths ranging from approximately 2 to 14 ft. and in 2010 also to the north and east of the project site. An overlay of the fill depths from the 2001 fill compaction tests and the site plan is presented in Figure 2: Fill Depth Contours.

In addition, PPI also performed frequent compaction testing on fill placed in 2010 within the building footprint, pavement areas and utility trenches southwest of the project site. However, multiple re-grading of the project site has occurred since 2001. Fill placed in the area of the project site may have been considered nonstructural with compaction testing of this fill not required. File information of benefit for controlled fill placement relevant to the proposed building footprint was not located as of the date of this report;

5.0 SUBSURFACE INVESTIGATION

Subsurface conditions were investigated through completion of nineteen (19) subsurface borings within the New Addition footprint, as well as in anticipated pavement

areas and subsequent laboratory testing. While eighteen (18) borings were originally planned one (1) offset boring was drilled due to early refusal upon concrete.

5.1 Subsurface Borings

Boring locations were selected and staked in the field by the Client. Approximate boring locations are shown on Figure 1: Boring Location Plan. The Missouri One-Call System was notified prior to the investigation to assist in locating buried public utilities.

All borings were discontinued in natural overburden soils, existing undocumented fill or limestone bedrock at depths ranging from 6.3 to 22 ft. below the existing ground surface. Logs of the borings showing descriptions of soil and rock units encountered, as well as results of field and laboratory tests and a "Key to Symbols" are presented in Appendix I. **Surface elevations of the borings were provided by the Client during surveying and staking of the borings in the field and are presented on each boring log attached.**

Borings were drilled January 9 through January 11, 2018, using 4.5-inch O.D. continuous flight augers powered by a CME 55 track-mounted drill-rig. Soil samples were collected at 2.5 to 5-ft. centers during drilling. Soil sample types included split spoon samples collected while performing the Standard Penetration Test (SPT) in general accordance with ASTM D1586 and thin-walled Shelby tubes pushed hydraulically in advance of drilling in accordance with ASTM D1587. Please refer to Appendix II for general notes regarding boring logs and additional soil sampling information.

5.2 Laboratory Testing

Collected samples were sealed and transported to the laboratory for further evaluation and visual examination. Laboratory soil testing included the following:

- Moisture Content (ASTM D2216);
- Unconfined Compressive Strength (ASTM D2166);
- Atterberg Limits (ASTM D4318);

- Grain Size Analysis Results (ASTM D6913M);
- Thermal Conductivity of Soil (ASTM D5334); and
- Pocket Penetrometers.

Laboratory test results are shown on each boring log in Appendix I and are summarized in the following table. Grain size analysis results are presented in Appendix III and are also summarized in the following table.

Boring	Depth (ft.)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Percent Passing #200 Sieve (%)	Moisture Content (%)	USCS Symbol	Cohesion (psf)	Dry Unit Wt. (pcf)
2	6 to 7.2	45	14	31	-	22.8	CL-CH	3340	100.6
3	8 to 9.83	-	-	-	-	53.3	CH	3390	69.7
4	8 to 9.5	48	16	32	-	27.4	CL-CH	3060	96.3
6	3 to 4.5	36	17	19	-	26.4	CL	-	-
6	6 to 8	-	-	-	-	44.9	CH	4140	74.9
8	0 to 1.5	-	-	-	28.8	21.0	GC	-	-
10	8.5 to 10.5	-	-	-	-	44.8	CH	3240	76.4
11	0 to 1.5	-	-	-	36.0	16.8	SC	-	-
11	6 to 7.5	39	16	23	-	20.8	CL	-	-

5.3 Thermal Testing

Samples collected during drilling were sent to GeoTesting Express where the Standard Test Method for Determination of Thermal Conductivity of Soil was performed based upon the ASTM D5334 standard to determine thermal conductivity and thermal resistivity of the soils at the project site. Results of the testing are summarized in the table below and attached in Appendix IV of this report.

Boring	Depth (ft.)	Moisture Content (%)	Dry Unit Wt. (pcf)	Thermal Conductivity (W/m°K)	Thermal Resistivity (°K cm/W)
7	2.5 to 3.7	51.2	62.0	1.14	88
8	3 to 3.7	27.0	85.1	1.11	90

5.4 Dynamic Cone Penetrometer Testing (DCP)

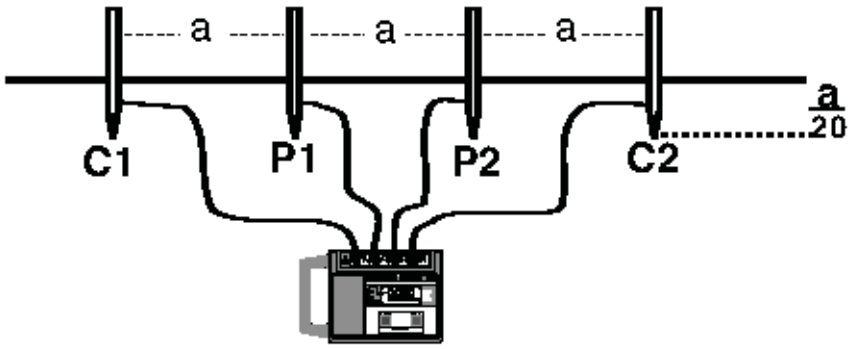
The dual mass dynamic cone penetrometer (DCP) was performed at Borings 11 through 18B prior to drilling. The DCP is used to assess the in-situ strength of undisturbed soil and/or compacted materials. The operator drives the DCP tip into soil and/or compacted materials by lifting the sliding hammer to the handle then releasing it. The total penetration for a given number of blows is measured and recorded, which is then used to estimate the in-situ California Bearing Ratio (CBR) or shear strength from an appropriate correlation chart using equations recommended by the U.S. Army Corps of Engineers. Results of the DCP testing are summarized below and are presented in Appendix V of this report.

Boring	Average Minimum CBR Value
11	8
12	2 – Top 6” >10 – Below 6”
13	5
14	2 – Top 5” >10 – Below 5”
15	2 – Top 5” >10 – Below 5”
16	2 – Top 5” >10 – Below 5”
17	1 – Top 10” >10 – Below 10”
18B	>10

5.5 Resistivity Testing

Soil resistivity measurements were performed using an AEMC 6470-B Digital Earth Tester by PPI on January 11, 2018. Measurements were obtained using the four (4) terminal (Wenner) Method where the probes or electrodes, are arranged in a straight line in the north to south and east to west directions from the center point of the Phase 3A and RC Addition (Boring 6). Soil resistivity measurements for electrode spacing of 2, 3, 5, 10, 25, 50 and 100 ft. were obtained. The Earth Tester is connected to the electrodes as shown in the following figure. Soil conditions at the time of testing were moist. It should be noted that soil resistivity may vary

significantly in very short distances and also changes with soil moisture content and depth below ground surface. Resistivity measurements for the Phase 3A and RC Addition are presented in Appendix VI.



6.0 SITE GEOLOGY

The general site area is underlain at depth by the Mississippian Age Burlington Limestone Formation. This unit characteristically consists of coarse-grained gray limestone, which is nearly pure calcium carbonate. Isolated chert nodules and discontinuous chert layers are present throughout the formation. The upper surface of this limestone unit is generally irregular due to the effects of differential vertical weathering and solution activity. Limestone pinnacles, some of which are 10 to 15 ft. high, are common in the general area. In upland areas, overburden soils are usually composed of red clay and chert and are residual having developed from physical and chemical weathering of the parent limestone. The chert fragments were interbedded with the limestone, but are much more resistant to weathering and retain rock-like properties. The contact between comparatively unweathered bedrock and the residual soils is usually abrupt.

The general site area is located within the Ozarks Physiographic Region of Missouri, which is characterized by rugged to rolling hill terrain, meandering streams and karst topography. Karst topography forms over areas of carbonate bedrock where groundwater has solutionally enlarged openings to form a subsurface drainage system. Springs, caves, losing streams and sinkholes are common in karst areas. Sinkholes are defined as a depression in the landscape with an internal drainage system.

There are two apparent sinkhole depressions adjacent to the project site. A shallow sinkhole is located immediately east of the proposed Phase 3A and RC building with the bottom of the sinkhole at about elevation 1248. A much larger and deeper sinkhole depression exists north of the project site with the bottom of the sinkhole depression at or near 1240.

Based upon readily available digital topographic information, as well as conditions encountered within the widespread borings drilled, no indications of sinkhole activity was observed. However, the Owner and contractor should be aware that it is possible for karst features to be encountered at the project site during construction. **The site vicinity is highly karst and has the potential for collapse of overburden soils due to erosion or piracy of soil particles into deeper bedrock conduits.** An isolated small diameter soil collapse was exposed during excavation of the drainage channel connecting the smaller sinkhole with the radar tower access road prior to 2001. If a karst feature is identified during site grading, PPI should be contacted immediately for evaluation on a case-by-case basis.

7.0 GENERAL SITE & SUBSURFACE CONDITIONS

Based upon subsurface conditions encountered within the borings drilled at the project site, generalized subsurface conditions are summarized in the table below. Soil stratification lines on the boring logs indicate approximate boundary lines between different types of soil and rock units based upon observations made during drilling. In-situ transitions between soil and some rock types are typically gradual. **In addition, the Declaration on Uniformity of Area Soil Conditions is presented in Appendix VII of this report.**

Description	Borings	Approx. Depth to Bottom of Stratum	Material Encountered	Moisture	Consistency/ Density
Stratum 1	All, except Borings 11, 16 through 18B	0.2 to 0.8 ft.	Topsoil	Moist	Soft
Stratum 2	11 & 16 through 18	0.2 to 0.8	Aggregate Baserock	-	-
Stratum 3	1, 5, 6, 8, 10, 11, 12, 16, 17 18 & 18B	Boring Completion – Borings 17, 18 & 18B 2.5 to 6.5 ft. - Remainder	Fill – Lean or Lean to Fat w/ Varying Amounts of Chert, Limestone Boulders, Clayey Gravel w/ Sand or Clayey Sand w/ Gravel	Moist	Stiff to Very Stiff or Dense
Stratum 4	2, 3, 4, 9, 10, 11, 12, 13, 14 & 15	Boring Completion – Borings 11 & 12 3 to 6.5 ft. – Remainder	Lean Clay w/ Varying Amounts of Chert	Moist	Stiff to Very Stiff
Stratum 5	2, 4 & 8	5.5 to 10 ft.	Lean to Fat Clay w/ Chert	Moist	Very Stiff
Stratum 6	All, except Borings 11, 12, 17, 18 & 18B	Boring Completion – All, Except Borings 7, 8 & 9 Top of Limestone – Borings 7, 8 & 9	Fat Clay w/ Varying Amounts of Chert	Moist	Soft to Very Stiff
Stratum 7	7, 8 & 9	Boing Completion	Limestone	-	Medium Hard

As stated in the table above, Stratum 3 & 4 consisting of natural soils or existing fill classified as Lean Clays (CL) with varying amounts of chert was encountered within all borings, except Borings 5 & 7 extending to a depth ranging from 2.5 to 6.5 ft. below the existing ground surface and boring completion within Borings 17, 18 & 18B. This CL Clay complies with project specifications and the Geotechnical Report for this project for use as structural fill, but has inherent properties causing difficulty in obtaining both compaction and stability. **The soil is moisture sensitive.** In other words, compaction and stability can be achieved only within a narrow range of moisture content near optimum. It is also possible to achieve specified density on the wet side of optimum moisture content, but the CL soils may still exhibit deflection under rubber-tired wheel loads. Further, these soils may not be suitable for re-use as Structural Fill if the moisture is several percentage points above optimum. If construction is initiated during or immediately following wetter months, the requirement for undercutting soft surficial

CL soils below normal site stripping should be anticipated and reflected in contract documents. This is further discussed in Section 8.6 of this Report.

7.1 Limestone Bedrock

Limestone was encountered within Borings 7, 8 and 9 at depths ranging from 6 to 19.5 ft. below the existing ground surface. The upper portion of the limestone was weathered allowing penetration with continuous flight augers.

Refer to the table below for additional information regarding depth to limestone encountered within each boring.

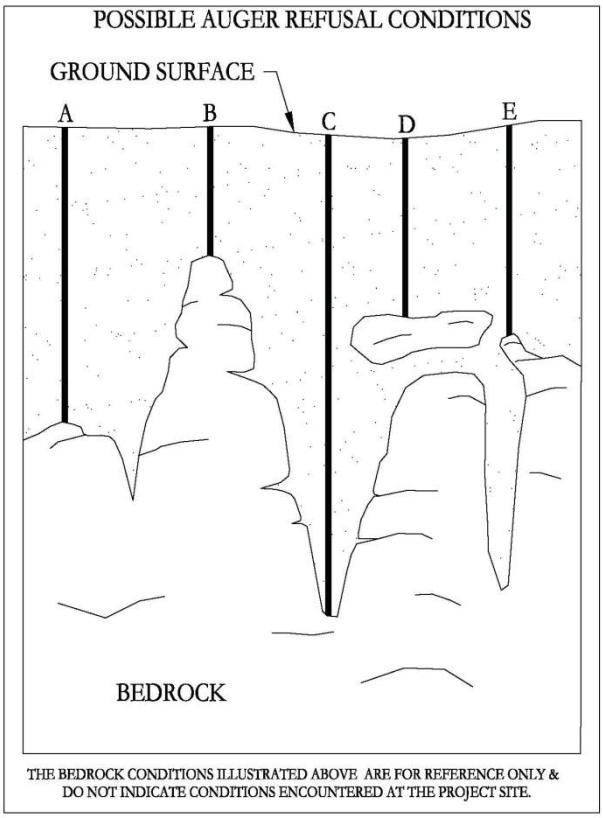
Boring	Surface Elevation	Approx. Depth to Top of Limestone (ft.)	Approx. Correlating Elevation of Top of Limestone	Approx. Depth to Limestone Below FFE (1258.5 ft.)
1	1257.91	>15	<1242.91	>15.58
2	1256.36	>15	<1241.36	>17.14
3	1257.61	>15	<1242.61	>15.89
4	1255.82	>15	<1240.82	>17.68
5	1257.11	>15	<1242.11	>16.39
6	1257.00	>15	<1242.00	>16.5
7	1257.58	6.0	1251.58	6.92
8	1256.47	19.5	1236.97	21.53
9	1257.05	11.5	1245.55	12.95
10	1255.00	>15	<1240.00	>18.5
11	1252.88	>7.5	<1237.88	-
12	1254.12	>7.5	<1239.12	-
13	1253.32	>7.5	<1238.32	-
14	1252.56	>7.5	<1237.56	-
15	1252.66	>7.5	<1237.66	-
16	1252.47	>7.5	<1237.47	-
17	1252.13	>7.5	<1237.13	-
18	1252.51	>3.9	<1237.51	-
18B	1252.51	>7.5	<1237.51	-

Based upon the approximate surface elevations, approximate bottom of footing elevation and depth to limestone within the borings drilled, as well as the minimal depths of cut and fill anticipated at this site, limestone is not anticipated to be encountered within foundation, floor slab or utility trench excavations within the new Phase 3A and RC Addition, except within the area of Boring 7. **However,**

pinnacled bedrock within footing, floor slab and utility trench excavations may be encountered in areas not drilled. If limestone is encountered it is anticipated that it will not be rippable. However, large boulders may be removed using large excavating equipment. Excavations deeper into limestone will most like require pneumatic rock excavation methods or blasting if allowed by local codes. Recommendations for shallow bedrock are presented in Section 8.8 of this report.

7.2 Auger Refusal

Auger refusal is defined as the depth below the ground surface at which a boring can no longer be advanced with the soil drilling technique being used. Auger refusal is subjective and is based upon the type of drilling equipment and types of augers being used, as well as the effort exerted by the driller. Several different auger refusal conditions are possible in the general site area. These conditions are represented graphically in the adjacent figure: (A) on the upper surface of continuous bedrock, (B) on rock "pinnacles", (C) in widened joints that may extend well below the surrounding bedrock surface, (D) slabs of unweathered rock suspended in the residual soil matrix, or "floaters", or (E) on the upper surface of discontinuous bedrock.



7.3 Groundwater

Shallow groundwater was not observed within the borings on the date drilled. However, perched groundwater is typically encountered near the contact between overburden soils and the top of bedrock, resulting in softer in-situ clays just above bedrock. Groundwater levels should be expected to fluctuate with changes in site

grading, precipitation, and regional groundwater levels. Groundwater may be encountered at shallower depths during wetter periods.

8.0 EARTHWORK

While a site-specific grading plan has not been provided as of the date of this report, it is anticipated that minimal depths of cut and/or fill will be required to provide finish subgrade elevations across the project site. The initial phase of site preparation should include:

- Clearing and grubbing of all vegetative matter;
- Topsoil/vegetative matter stripping on the order of 3 to 10-inches should be anticipated within grass-covered lawn areas. Thicker topsoil/vegetative matter zones may be encountered during site development procedures. Topsoil should be stockpiled outside of areas to receive new controlled fill or construction for use in lawn or landscape areas only;
- Removal of aggregate baserock. Aggregate baserock may be incorporated into undocumented fill to be used as controlled fill;
- Undocumented fill material should be removed and replaced in accordance with Section 8.3 of this report; and
- Areas scheduled to receive controlled fill should be proof-rolled and approved in accordance with the following section of this report.

After the initial phase is complete, it is recommended that all building, pavement and undercut bottoms be proof-rolled to assure a stable subgrade. Proof-rolling consists essentially of rolling the ground surface with a loaded tandem axle dump truck or similar heavy rubber-tired construction equipment and noting any areas which rut or deflect during rolling. All soft subgrade areas, if any, identified during proof-rolling should be undercut and replaced with compacted fill as outlined below. Proof-rolling, undercutting and replacement should be monitored by a representative of PPI. The depth and areal extent of undercutting soft subgrade areas will be largely dependent upon the time of year and related soil moisture conditions. **If construction is initiated during or**

immediately following wetter months, the requirement for undercutting soft surficial soils below planned cut depths should be anticipated and reflected in the contract documents. Subgrade improvement may also be accomplished by applying an initial bridge lift of larger size stone (4 to 8-inch top size) compacted using a crawler tractor. The applicability of undercutting versus use of a bridge lift should be evaluated on a case-by-case basis during construction.

After evaluation by proof-rolling and approval, the subgrade should be scarified to a depth of at least 8 inches, adjusted to within the optimum moisture content ranges and compacted to specified density, provided below (See Section 8.2). Placement of controlled fill may then proceed.

8.1 Controlled Fill Material Types

Fill Type[1]	USCS Classification	Acceptable Location for Placement
Low Volume Change (LVC) Engineered Fill[2]	CL, GC or SC (LL<50)	All locations and elevations
On-Site Natural Soils	CL, CL-CH or CH	All locations and elevations[3]
Undocumented Fill Material	CL or CL-CH	All locations and elevations
Potential Off-Site Borrow Material	CL, GC, SC, CL-CH or CH	All locations and elevations[3]

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris and contain maximum rock size of 4 to 6 in. Frozen material should not be used and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to its use.
2. Low plasticity cohesive soil or granular soil having at least 15% low plasticity fines.
3. **CH Clays with a Liquid Limit equal to or above 50 are considered suitable for use as controlled fill, only if the percentage of rock fragments exceeds 35% or if placed 2 ft. below shallow foundations, pavements or slab areas.**

8.2 Compaction Requirements

Item	Description
Subgrade Scarification Depth	At least 8 inches
Fill Lift Thickness	8-inches (loose)
Compaction Requirements[1]	• Top 2 ft. of Heavy Duty Paving & Floor Slabs – 98% Standard Proctor Density (ASTM D-698); and • All Other Areas – 95% Standard Proctor Density (ASTM D-698).
Moisture Content	• ±2% optimum moisture for CL soil types; and • 0 to 4% above optimum for CH soil types.
Recommended Testing Frequency	• One (1) Field Density (compaction) test of each 2,500 sq. ft. of fill within building areas; • One (1) Field Density (compaction) test of each 5,000 sq. ft. of fill within pavement areas; and • A minimum of three (3) tests per lift.

1. We recommend that engineered fill (including scarified compacted subgrade) be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

8.3 Existing Fill Material

As previously mentioned, existing undocumented fill material was encountered within Borings 1, 5, 6, 8, 10, 11, 12, 16, 17 and 18 at depths ranging from 2.5 to 6.5 ft. below the existing ground surface and boring completion within Borings 17, 18 & 18B. The undocumented fill material classified as lean or fat clay containing varying amounts of chert. Undocumented fill material present below floor slabs and pavement areas may be left in place, if proof-rolled and approved in accordance with Section 8.0 of this report. Any soft or loose fill identified during proof-rolling should be removed and replaced with controlled fill as outlined above.

All existing fill material below foundations should be removed and replaced in accordance with Section 9.0 of this report. However, if aggregate piers are utilized, the existing fill may be left in-place below pier supported footings. It is anticipated that the undocumented fill material present at the project site may be generally reused as controlled fill provided it is removed and recompacted and adjusted to near optimum moisture content. However, it is possible for zones of

existing fill containing excessive organics or miscellaneous debris to be encountered which will not be suitable for use as controlled fill.

Although PPI has no record of performing compaction testing on the fill material, based upon the SPT N-Values indicating moderate to high shear strength of the existing fill, this material exhibits characteristics of being placed with appreciable compactive effort in the widespread borings drilled. In lieu of complete removal and replacement beneath footings, once the grading plan, foundation loads, foundation type, foundation locations and bottom of footing elevation have been finalized, PPI can be contracted to drill sample borings beneath each footing to determine whether removal and replacement of undocumented fill material is required at each individual location. In addition, a representative of PPI should be present to observe foundation excavations. Depending upon the results of the additional borings, it may be permissible to leave the existing fill in-place beneath the proposed footings in some or all of the proposed footings.

8.4 Landscaping and Site Drainage

Discharge from roof downspouts should be collected and diverted well away from the building perimeter and incorporated into the design plans. Rapid, efficient runoff away from the building should also be provided. In addition, landscaping requiring frequent watering should be prohibited adjacent to building foundations.

In addition, provisions should be implemented to reduce the potential for large fluctuations in moisture within the subgrade soils adjacent to the structure. Ponding of surface water immediately adjacent to the structures and pavements can significantly increase subgrade moisture and may result in undesirable subgrade movement. As previously mentioned, careful consideration should be given to the landscaping and drainage elements to be installed at the project site adjacent to building and pavement areas. **Trees and some large bushes can draw significant moisture from the subgrade soils, resulting in shrinkage and subsequent foundation/pavement movement.**

8.5 Earthwork Construction Considerations

Shallow CH clays are present at this site. These CH clays are known to exhibit primarily low swell potential, if allowed to dry then become saturated. Once grading and filling operations have been completed, the moisture within the subgrade should be maintained and soils not be allowed to dry and desiccate prior to construction of floor slabs, pavement and footings. Grading of the site should be performed in such a manner so that ponding of surface water on prepared subgrade or in excavations is avoided. During construction, if the prepared subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be scarified or removed, moisture conditioned and recompacted prior to slab, pavement, or footing construction.

8.6 Inclement Weather

While the shallow natural lean clay (CL) soils were found to be stiff to very stiff during drilling, if construction is initiated during wetter months, the requirement for undercutting soft surficial soils below normal site stripping should be anticipated and reflected in contract documents. **Undercut depths on the order of 2 or more ft. are considered possible within the new Phase 3A & RC Addition. Based upon past experience of this firm, the shallow lean clay subgrade at the site is known to significantly lose strength when saturated and disturbed by construction equipment. Further, material removed from undercuts may not be suitable for use as compacted fill due to high soil moisture if poor drying conditions (cool temperatures and/or frequent precipitation) occur during site grading. If the construction schedule will not permit delay for better drying conditions, the project budget should include an allowance for subgrade undercut and replacement soil material containing appreciable quantities of chert or sand and gravel from an off-site borrow area that meet the requirements above. As an alternate to select fill, rock fill subbase (4 to 8-inch top size stone) may be placed to improve subgrade stability.**

8.7 Excavations

Based upon the subsurface conditions encountered during this investigation, the on-site natural soils typically classify as Type B in accordance with OSHA regulations. Temporary excavations in soils classifying as Type B with a total height of less than 20 ft. should be cut no steeper than 1H:1V in accordance with OSHA guidelines. However, existing undocumented fill material typically classify as Type C in accordance with OSHA regulations. Temporary excavations in soils classifying as Type C with a total height of less than 20 ft. should be cut no steeper than 1.5H:1V in accordance with OSHA guidelines. Intact limestone may be excavated to near vertical sidewalls, if encountered. **Confirmation of soil classification during construction, as well as construction safety (including shoring, if required), is the responsibility of the contractor.**

8.8 Shallow Bedrock Considerations

In view of the increased potential for differential settlement between foundation units installed upon bearing strata with widely varying compressibility characteristics (incompressible bedrock versus firm clay), one of the following corrective measures should be implemented if bedrock is exposed in footing excavations or immediately below footing bottom elevation:

1. The bedrock be over-excavated sufficient to allow placement of a minimum 12-inch “cushion” below footing bottoms. This “cushion” material may consist of a well-compacted low plasticity earth fill, shot rock fill or compacted baserock. Bedrock heaved by blasting is not considered acceptable as cushion material. Caution should be exercised to limit over-shot of bedrock.

2. Sufficient reinforcing steel added to the footing/foundation wall system in order to allow the footing/foundation wall to span at least 20 ft. each side of the edge of rock. Further, use of building components sensitive to differential settlement (plastic, masonry veneer, glass, etc.) should be prohibited at the edge of rock where there is an abrupt change in support characteristics.

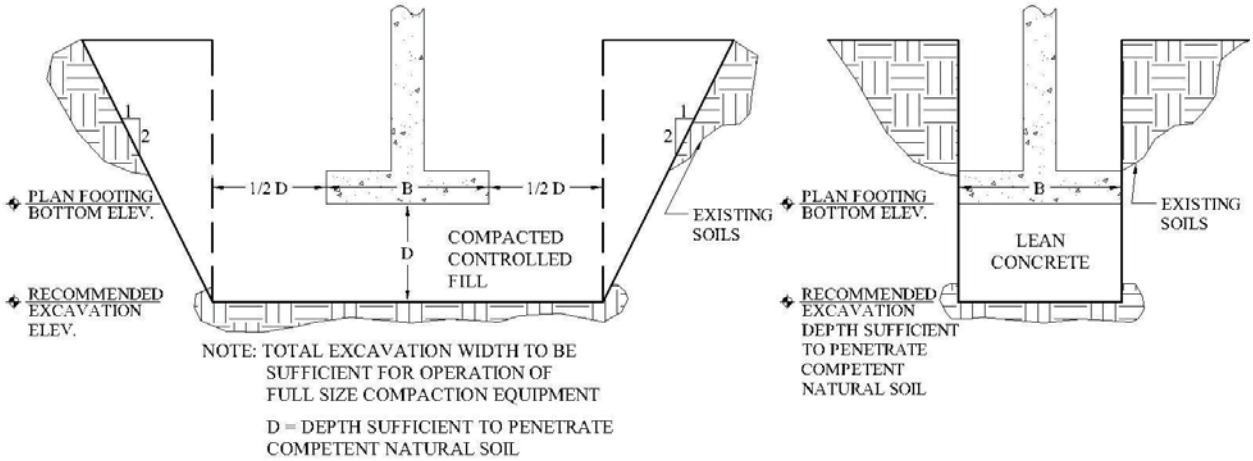
9.0 FOUNDATIONS

Based upon the subsurface conditions encountered in the borings, a FFE of 1258.5 ft. and a preliminary bottom of footing elevation ranging from 2 to 6 ft. below FFE, the new Phase 3A & RC Addition may be supported upon shallow foundations bearing upon medium stiff to stiff natural foundation soils or controlled fill, or upon drilled piers bearing in limestone bedrock. Aggregate piers may also be utilized for ground improvement to increase the allowable bearing capacity for moderately heavy shallow foundation loads.

As previously stated, existing undocumented fill was encountered within Borings 1, 5, 6, 8, 10, 11, 12, 16, 17 and 18 at depths ranging from 2.5 to 7.5 ft. below the existing ground surface and boring completion within Borings 17, 18 & 18B. In addition, the site area is karst impacted with nearby sinkholes and past evidence of collapse features. Recommendations for foundation design are provided below.

9.1 Moderate Foundation Loads up to 400 kips Working Load

For light to moderate foundation loads up to 400 kips, it is believed that the new Phase 3A & RC Addition may be supported upon shallow foundations bearing upon natural foundation soils or controlled fill after complete removal and replacement of all undocumented fill. Removal and replacement of undocumented fill should extend a horizontal distance beyond footing perimeters at least ½ the difference in elevation between bottom of footing and bottom of undercut. Additionally, the excavation should have sufficient width to allow for a large diameter self-propelled vibratory compactor. As an alternative, footing excavations may be deepened to natural soils and replaced with lean concrete backfill. Removal and replacement, as well as lean concrete backfill procedures are illustrated in the following diagrams.



As stated previously, in lieu of complete removal and replacement beneath footings, once the grading plan, foundation loads, foundation type, foundation locations and bottom of footing elevation have been finalized, PPI can be contracted to drill sample borings beneath each individual footing for determination if removal and replacement of undocumented fill material is required. For strip footings, an appropriate boring spacing would be determined based upon width and bearing stress of footing.

With shallow foundations bearing upon controlled fill material or bearing upon natural foundation soils after complete removal and replacement of all undocumented fill material, recommendations for shallow foundation design and construction are provided in the table below**. In addition, the Declaration of Soil Bearing Capacity is presented in Appendix VIII of this report**.

Description	Column (Spread Footing)	Wall (Continuous Footing)
Net allowable bearing pressure[1]	3,000 psf	2,500 psf
Minimum dimensions	2.5 ft.	1.5 ft.
Maximum dimensions (for compressive loads)	11.5 ft.	
Recommended bearing depth[2]	2 ft.	
Minimum embedment below finished grade for frost protection and variation in soil moisture (footings on soil)[3]	2 ft.	
Minimum footing bearing depth for interior footings.	1 ft.	
Allowable passive pressure[4]	600 psf	
Coefficient of sliding friction[5]	0.4 (natural soils/controlled fill)	

1 The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. The recommended pressure considers all unsuitable and/or soft or loose soils, if encountered, are undercut and replaced with tested and approved new engineered fill. Footing excavations should be free of loose and disturbed material, debris, and water when concrete is placed.

2. Footings are recommended to be installed upon medium stiff to stiff natural soils or controlled fill after complete removal and replacement of all undocumented fill material. Foundation soils exposed in footing bottoms should be examined and approved to be consistent with design bearing pressures prior to placement of reinforcing steel or concrete.

3. For perimeter footings and footings beneath unheated areas.

4. Allowable passive pressure value considers a Factor of Safety of about 2. Passive pressure value applies to undisturbed native clay or properly compacted fill. If formed footings are constructed, the space between the formed side of a footing and excavation sidewall should be cleaned of all loose material, debris, and water and backfilled with tested and approved fill compacted to at least 95% of the material's Standard Proctor dry density. Passive resistance should be neglected for the upper 2.5 ft. of the soil below the final adjacent grade due to strength loss from freeze/thaw and shrink/swell.

5. Coefficient of friction value is an ultimate value and does not contain a Factor of Safety.

9.1.1 Uplift

Resistance of shallow spread footings to uplift (U_p) may be based upon the dead weight of the concrete footing structure (W_C) and the weight of soil backfill contained in an inverted cone or pyramid directly above the footings (W_S). The following parameters may be used in design:

Description	Weights
Weight of Concrete (W_c)	150 pcf
Weight of Soil Resistance (W_s)	100 pcf
Weight for on-site soils placed in accordance with Section 8.0	

The base of the cone or pyramid should be the top of the footing and the pyramid or cone sides should form an angle of 30 degrees with the vertical. Allowable uplift capacity (U_p) should be computed as the lesser of the two (2) equations listed below:

$$U_P = (W_S/2.0) + (W_C/1.25) \quad \text{or} \quad U_P = (W_S + W_C)/1.5$$

9.2 Moderately Heavy Foundation Loads

If the new Phase 3A & RC Addition will have moderately heavy column loads (> 400 kips), the use of drilled piers or micropiles is typically preferred for foundations loads exceeding 400 kips to essentially eliminate settlement potential. Use of shallow spread footings may be considered in lieu of drilled piers/micropiles provided the Owner and Design Team are willing to accept the increased settlement potential in return for the savings in cost.

Lighter column loads, less than 400 kips transmitted by this structure may be supported by shallow foundations in accordance with Section 9.1. However, for support of heavier column loads exceeding 400 kips, it is recommended that aggregate piers be installed below heavier loaded footings.

9.2.1 Aggregate Piers

Aggregate piers typically consist of a 20 to 30-inch diameter hole that extends to a competent bearing stratum and is backfilled with compacted granular materials, such as aggregate.

Design of stone column foundation improvement systems are often proprietary and usually part of a foundation contractor's design-build package. Therefore, the subsurface exploration information contained in this report should be provided to the foundation contractors for detailed analysis, and design and cost information.

With this approach, aggregate piers are installed at close spacing to stabilize the existing fill prior to placement of new controlled fill or installation of a shallow foundation system. Aggregate piers may be constructed by the rammed

aggregate method or by vibration methods for aggregate placement. Aggregate piers yield a greater allowable end bearing pressure and reduced settlement than shallow foundations bearing directly upon natural soils. It is recommended that the following companies be contacted to provide design and cost estimates for aggregate piers.

Aggregate Pier Design & Installation Contractors			
Company	**Contact**	**Phone Number**	**Email Address/Web Site**
Hayward Baker, Inc.	Greg Terri	(847) 774-4196	jaterri@haywardbaker.com
Helitech	Tim Distler	(314) 965-4565	tdistler@helitechccd.com
Ground Improvement Engineering	Aaron Gaul	(816) 421-4334	agaul@groundimprovementeng.com
Subsurface Constructors	Lyle Simonton	(317) 421-2460	www.subsurfaceconstructors.com

9.3 Drilled Piers

As stated previously, the use of drilled piers or micropiles is typically preferred for foundations loads exceeding 400 kips to essentially eliminate settlement potential. However, if the moderately heavy foundation loads for the New Phase 3A & RC Addition are supported upon drilled piers bearing in limestone bedrock and the remaining portion is supported upon shallow foundations, all settlement between the shallow and deep foundations will be differential and resulting in cracking of brittle materials such as sheetrock, masonry, etc. It is anticipated that support for the New Phase 3A & RC Addition in the form of shallow foundations is desired. If drilled piers or micropiles are desired, additional geotechnical borings, including rock coring, will be necessary to provide additional recommendations.

9.4 Karst Considerations

As previously described, the site area is karst impacted with nearby sinkholes and past evidence of collapse features. Soil overburden collapse typically occurs when soil particles are eroded into bedrock conduits over geologic time to form a void. A soil arch forms over the void which progresses upward until the soil arch collapses sometimes quite suddenly. These collapse features are also sometimes exposed during site grading when overburden soils are removed. Diameter of these collapse

features typically range from a few feet to 10 to 15 feet and sometimes larger on rare occasions. The Phase 3A and RC buildings as sited in close proximity to existing sinkholes plus there are appreciable differences in depth to limestone across the project site. These conditions are favorable to development of isolated soil collapse.

To essentially eliminate the potential for building settlement due to karst-related soil collapse, support of all building and floor slab loads upon drilled piers bearing upon bedrock would be required. However, this would be a very expensive foundation system and probably not economically justifiable in view of the only moderate risk for isolated soil collapse. As a safeguard to significantly reduce (but not eliminate) the potential for impairment of the building due to overburden collapse the following items may be incorporated into foundation design and construction.

1. Design continuous footings as grade beams capable of spanning a minimum 20 ft. diameter loss of support. This should limit structural damage due to soil overburden collapse plus be more compatible with the use of deep foundation piles or piers for underpinning in the event a collapse occurs;
2. Design closely spaced individual footings as part of a grid system again capable or spanning a 20 ft. diameter loss in support; and
3. In areas of large spans, reduce risk by drilling a probe boring to bedrock at specific column locations or accept the risk of remote potential for karst related collapse of soil overburden and the associated cost for repair and disruption of operations.

10.0 SEISMIC CONSIDERATIONS

Code Used	Site Classification
2012 International Building Code (IBC)[1]	C
1. In general accordance with the *2015 International Building Code*, Section 1613	

11.0 FLOOR SLABS

A slab-on-grade or slab-on-fill floor system is considered appropriate at this site based upon subsurface conditions encountered. Listed below are key considerations for design purposes of the floor slab.

- Prior to placement of controlled fill, exposed in-situ clays should be scarified, moisture content adjusted and recompacted in accordance with Section 8.0 of this report;
- All existing fill should be proof-rolled and approved in accordance with Section 8.0 of this report;
- **Fill placed below floor slabs in the top 2 ft. should be compacted to 98% Standard Proctor Dry Density (ASTM D698);** and
- Prior to slab placement, soil moisture should be adjusted and maintained within the parameters specified in Section 8.0 of this report.

Placement of 4 or more inches of compacted free-draining granular base course below slabs is recommended to limit moisture rise through slabs and to improve slab support, particularly at joints. An impervious moisture barrier consisting of 6-mil plastic sheeting or equivalent should be provided in accordance with the 2015 IBC. Use of a 10-mil vapor barrier is recommended below all slab areas with an intended use sensitive to slab moisture.

11.1 Modulus of Subgrade Reaction

The floor slab and pavement may be designed with the modulus of subgrade reaction presented in the table below.

Bearing Material	Bearing Material Thickness (inches)	Modulus of Subgrade Reaction (pci)
Select Fill Material & Natural Soils	N/A	150
Dense Graded Aggregate Base	6	275
Dense Graded Aggregate Base	12	350
Dense Graded Aggregate Base	18	425

12.0 RETAINING WALLS

It is unknown as of the date of this report whether site retaining walls or foundation stem walls are anticipated at the project site. However, the following information is provided for design of retaining/foundation stem walls.

Wall backfill should consist of either free-draining crushed stone, or lean clay with appreciable (>35%) chert fragments. Lateral earth pressures behind retaining walls may be computed using the equivalent fluid pressures summarized in the table below, for drained backfill conditions. Free-draining crushed stone backfill should be placed within the entire zone commencing 1 ft. out from the base of the wall and projecting 30 degrees from the vertical, in order for the equivalent fluid pressures presented in the table to apply. Equivalent fluid pressures for backslope conditions that vary between level and 2 Horizontal to 1 Vertical (2H:1V) may be interpolated between the values presented in the table. Note that structural design for unrestrained walls should allow wall rotation at the top of the wall equivalent to 1/240th of the wall height.

An impervious moisture barrier should be applied to retaining walls, regardless of the type of backfill material. A geosynthetic drainage mat should also be installed adjacent to the wall if lean clay backfill is utilized to ensure removal of subsurface water. A drain system consisting of perforated PVC pipe should be installed at the base of the wall to collect and remove subsurface water from either the free-draining crushed stone or the geosynthetic drainage mats.

	Equivalent Fluid Pressure (pcf)			
	Level Backfill		Sloped Backfill (2H:1V)	
Backfill Type	Restrained Walls	Unrestrained Walls	Restrained Walls	Unrestrained Walls
Compacted Lean Clay; with >35% Retained on No. 4 Sieve	70	45	80	55
Clean Crushed Stone	50	35	60	45
Rock Fill (Free-Draining)	50	35	60	45

13.0 PAVEMENT

Refer to Section 8.0 regarding subgrade preparation for pavements and Section 11.1 regarding Modulus of Subgrade Reaction. It is anticipated that any new pavements

associated with this project will be constructed of either an asphaltic concrete wearing surface placed over a base or a rigid Portland Cement Concrete pavement over a granular base.

Based upon DCP values obtained in the field, as well as past experience of this firm, the following table provides CBR values to be used in pavement design based upon the subgrade preparation alternate chosen.

Subgrade Preparation Alternate	Design CBR
Medium Stiff to Stiff Natural Soils, Approved After Proof-rolling	2
Select Earth Fill Material Containing at Least 35% Rock Fragments Retained on the No. 4 Sieve	5
Stone Fill (4 to 8-inch top size) min. 18-inch thickness	12

13.1 Flexible Pavement

If asphaltic paving is selected, the aggregate base may be a granular compacted crushed limestone with a gradation and quality conforming to the requirements of the Missouri Department of Transportation, Standard Specification 1007 for either Type 1 or Type 5 aggregates. The maximum lift thickness for the granular base is 4 inches. Granular base thicknesses in excess of 4 inches should be placed in multiple lifts with each lift being of approximate equal thickness. The granular base should be compacted to at least 100% of Standard Proctor Compaction (ASTM D698). The base may also be a bituminous base.

Asphaltic concrete, both base and surface, should conform to the applicable gradational requirements of MoDOT Standard Specification 401 to 403 except that sampling for testing compliance during laydown should be from hot mix samples taken behind the paver. Asphaltic concrete should be compacted to 92 to 96% of Maximum Theoretical Specific Gravity (ASTM D2041). 95% of 50-Blow Marshall compaction is also accepted as a minimum compaction if the void content (Va) is within the specification value range. Substitution of an appropriate Superpave Mix Design (MoDOT Section 403) is permitted. SP-190C or SP-250C can be used in place of the bituminous base. SP-190C or SP-125C may be used for the surface.

All asphalt mixes should comply with the following density, gradation, oil content and volumetric requirements during laydown. However, all Owners, Developers and Contractors should be aware that minor changes in conditions (environmental, materials or mechanical) during production can cause variations in the volumetric properties of an asphalt mix design. Volumetric properties which vary slightly from the requirements below should be reported to the producer to allow plant adjustments. Asphalt mix properties which consistently vary appreciably from the requirements in the following table should be considered deficient. All bituminous mix designs should have been prepared or verified within six (6) months of the date of placement on this project and should recognize the tendency of the mineral aggregate to “fine up” in the mixer.

Asphalt Properties & Recommended Specifications				
Tested Property	**Test Method**	**Testing Frequency**	**Sample Source or Test Location**	**Specification**
Mixture Temperature		As Needed	N/A	For Informational Purposes
Temperature of Base & Air		As Needed	N/A	For Informational Purposes
Max Density (% of Theoretical Maximum Density)	AASHTO T166 or ASTM D2041	1 Test Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	Location selected by testing lab at least 2 ft. from joint	92 to 96%
Gradation	AASHTO T27	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	[1]MoDOT 401.3
Combined Aggregate Asphalt Content	AASHTO T308	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	± 0.3% from Mix Design
VMA @ N_{des} Gyrations (Voids in Mineral Aggregate)	AASHTO 312	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	>13.0% for Base >13.5% for BP-1 >14.0% for BP-2 >15.0% for BP-3
V_a @ N_{des} Gyrations (Air Voids)	AASHTO 312	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	± 1% From Mix Design
Percent Voids Filled	AASHTO 312	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	60 – 80%
Theo. Max SG of the Mixture	AASHTO T209	1 Sample Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	HMAC at Paver	N/A
Thickness	AASHTO T148	1 Test Each 1,000 Tons per Day or Fraction Thereof or as directed by Engineer	As directed by Engineer	Total Asphalt Thickness to be No Less than 0.5" from Specified Thickness

1. See MoDOT 403.3.1 for SP Mixes

13.2 Rigid Pavement

If rigid concrete paving is selected a minimum 4-inch thick granular base compacted to 100% of Standard Proctor should be placed on the prepared subgrade. The Portland Cement Concrete mix should have a minimum 28-day compressive strength of 4000 pounds per square inch (psi). Concrete should be placed at a low slump (1 to 3 inches) and have an entrained air content of 5 to 7%. If an increased

slump is desired, use of Super Plasticizer is recommended. The use of 6x6-inch welded wire mesh is also recommended for reinforcement.

13.3 Pavement Thickness

A pavement thickness would best be computed if traffic frequencies and wheel loadings were provided to us, but a typical pavement design for this type of facility is anticipated to generate a Structural Number of 3.0 to 3.5 within heavy duty areas and 2.4 to 2.6 within light duty areas, depending on the subgrade conditions. The following table presents corresponding typical flexible and rigid pavement thickness using the general Structural Numbers. **The pavement thicknesses provided below are preliminary and should be re-evaluated once a final grading plan, traffic frequencies and wheel loadings are provided.**

Pavement Type	Anticipated Traffic Frequency	Asphaltic Surface (in.)	Asphaltic Base (in.)	Concrete Thickness (in.)	Aggregate Base (in.)
Flexible Pavement	Heavy Duty	3.0	4.0	-	6.0
	Light Duty	2.0	2.0	-	6.0
Rigid Pavement	Heavy Duty	-	-	7.0	4.0
	Light Duty	-	-	5.0	4.0

14.0 CONSTRUCTION OBSERVATION & TESTING

The construction process is an integral design component with respect to the geotechnical aspects of a project. Since geotechnical engineering is influenced by variable depositional and weathering processes and because we sample only a small portion of the soils affecting the performance of the proposed structures, unanticipated or changed conditions can be disclosed during grading. Proper geotechnical observation and testing during construction is imperative to allow the Geotechnical Engineer the opportunity to evaluate assumptions made during the design process. Therefore, we recommend that PPI be kept apprised of design modifications and construction schedule of the proposed project to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study. We recommend that during construction all earthwork be

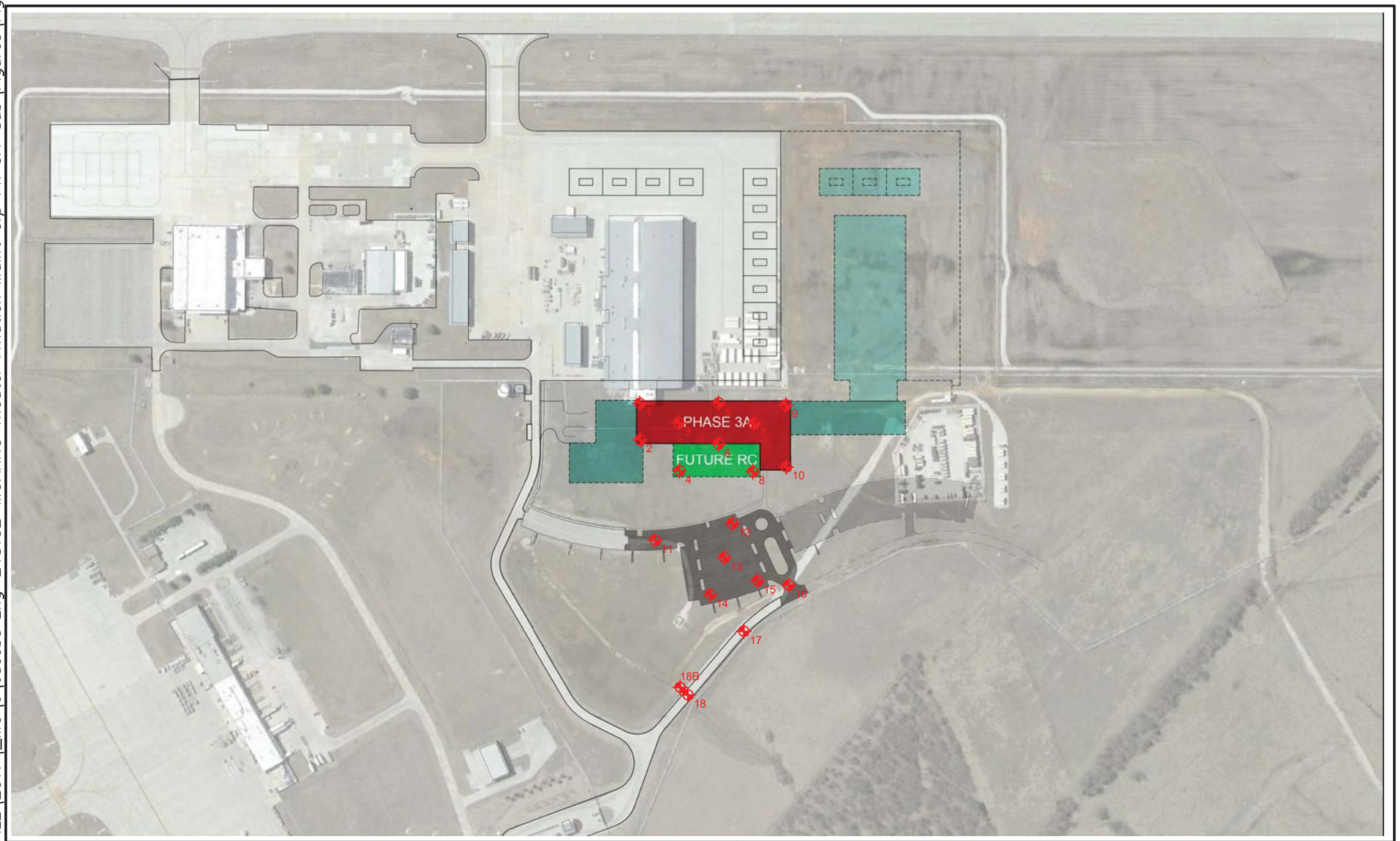
monitored by a representative of PPI, including site preparation, placement of all engineered fill and trench backfill, and all foundation excavations as outlined below.

- An experienced Geotechnical Engineer or Engineering Technician of PPI should observe the subgrade throughout the proposed project site immediately following stripping to evaluate the native clay, identify areas requiring additional undercutting, and evaluate the suitability of the exposed surface for fill placement;
- An experienced Engineering Technician of PPI should monitor and test all fill placed within the building and pavement areas to determine whether the type of material, moisture content, and degree of compaction are within recommended limits;
- An experienced Technician or Engineer of PPI should observe and test all footing excavations. Where unsuitable bearing conditions are observed, remedial procedures can be established in the field to avoid construction delays; and
- The condition of the subgrade should be evaluated immediately prior to construction of the building floor slabs to determine whether the moisture content and relative density of the subgrade soils are as recommended.

15.0 REPORT LIMITATIONS

This report has been prepared in accordance with generally accepted practices of other consultants undertaking similar studies at the same time and in the same geographical area. Palmerton & Parrish, Inc. observed that degree of care and skill generally exercised by other consultants under similar circumstances and conditions. Palmerton & Parrish's findings and conclusions must be considered not as scientific certainties, but as opinions based on our professional judgment concerning the significance of the data gathered during the course of this investigation. Other than this, no warranty is implied or intended.

FIGURE



LEGEND

Boring Location

SCALE
1"=400'

Project: MOARNG Theater Aviation Maintenance Group Phase 3A - Springfield, Missouri
Client: Jacobs Engineering Group

Boring Location Plan

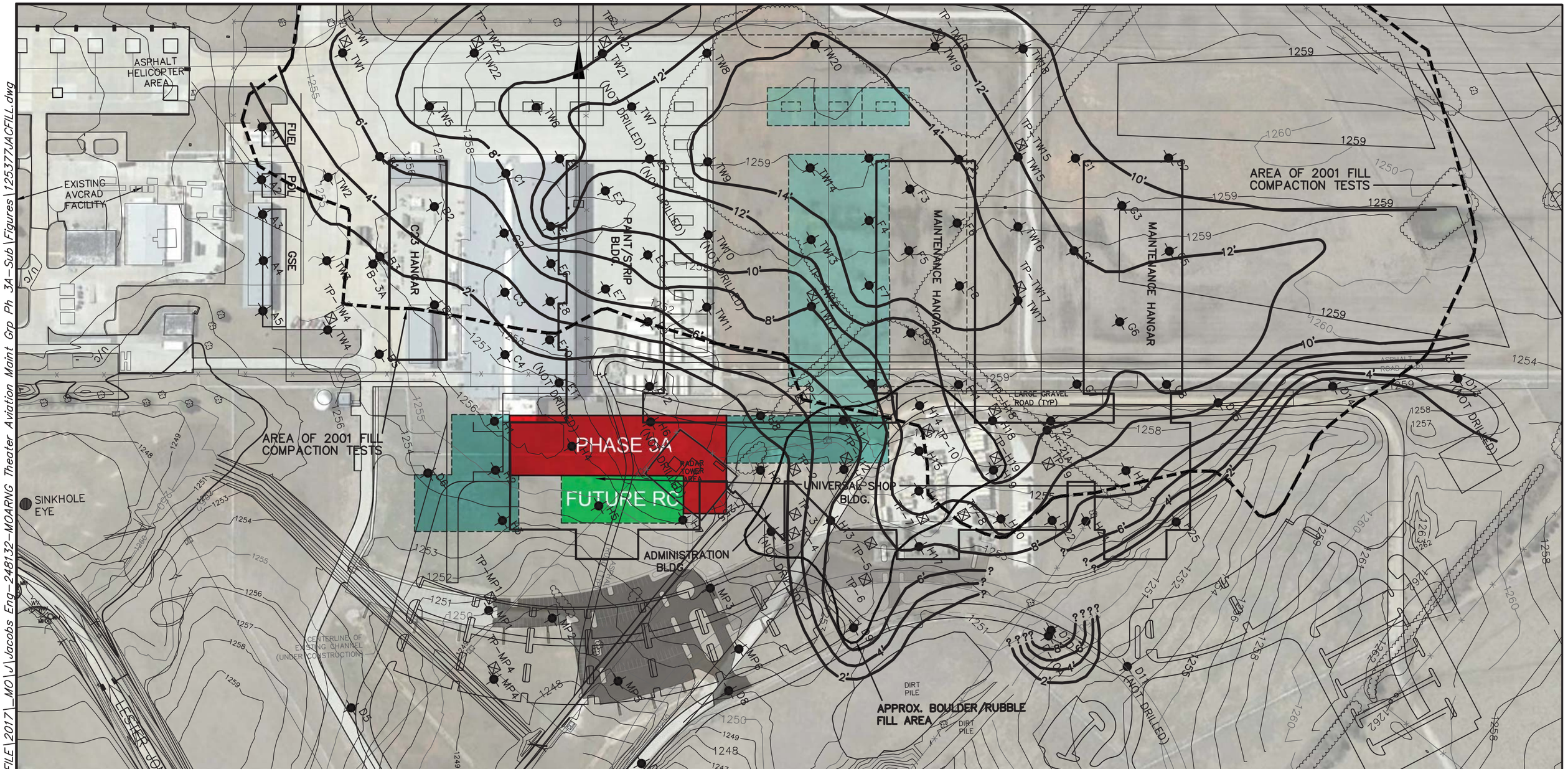
DATE: January 17, 2018

Project Number: 245652

PALMERTON & PARRISH, INC.
GEOTECHNICAL AND MATERIALS ENGINEERS/
MATERIALS TESTING LABORATORIES / ENVIRONMENTAL SERVICES

FIGURE 1

S:_MASTER PROJECT FILE\2017_MO\J\Jacobs Eng-248132-MOARNG Theater Aviation Maint Grp Ph 3A-Sub\Figures\Figures.



LEGEND

SCE CONTOURS — 125X

PREVIOUS CONTOURS — 125X

BORE LOCATION (2003)

TEST PIT LOCATION (2003)

FILL DEPTH CONTOUR — 4'

SCALE
1" = 200'

Project: MOARNG TASMG Phase 3A - Springfield, MO
Client: Jacobs engineering Group

Fill Depth Contours

DATE: February 7, 2018

Project Number: 248132

PALMERTON & PARRISH, INC.
GEOTECHNICAL AND MATERIALS ENGINEERS / MATERIALS TESTING LABORATORIES / ENVIRONMENTAL SERVICES

FIGURE 2

S:_MASTER PROJECT FILE\2017_MO\J\Jacobs Eng-248132-MOARNG Theater Aviation Maint Grp Ph 3A-Sub\Figures\125377JACFILL.dwg

APPENDIX I

BORING LOGS & KEY TO SYMBOLS

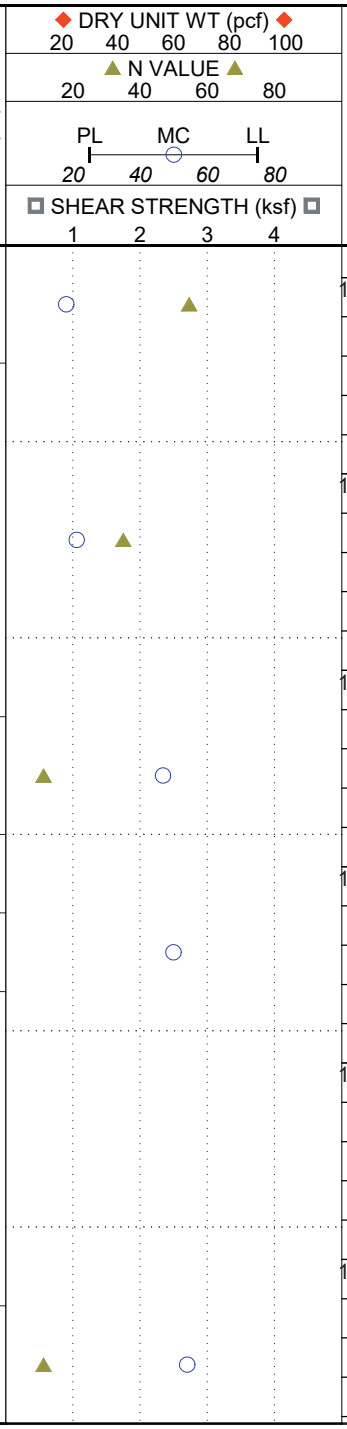
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 1

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/9/18 **COMPLETED** 1/9/18
SURFACE ELEVATION 1257.91 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (3") 0.3 ft					
			FILL - LEAN CLAY, w/ Chert, Brown, Very Stiff, Moist (CL)	SPT 1		36-35-20 (55)	3.5	1257.5
2.5			2.5 ft FILL - LEAN TO FAT CLAY MIX, w/ Chert, Reddish Brown, Very Stiff, Moist (CL-CH)	SPT 2		18-15-20 (35)		1255.0
5.0			5.5 ft FAT CLAY, Trace Chert, Red, Stiff, Moist (CH)	SPT 3		4-6-6 (12)	2.25	1252.5
7.5				ST 4	92		4.5	1250.0
10.0								1247.5
12.5				SPT 5		4-6-6 (12)	1.75	1245.0
			15.0 ft					
15.0			Bottom of borehole at 15.0 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

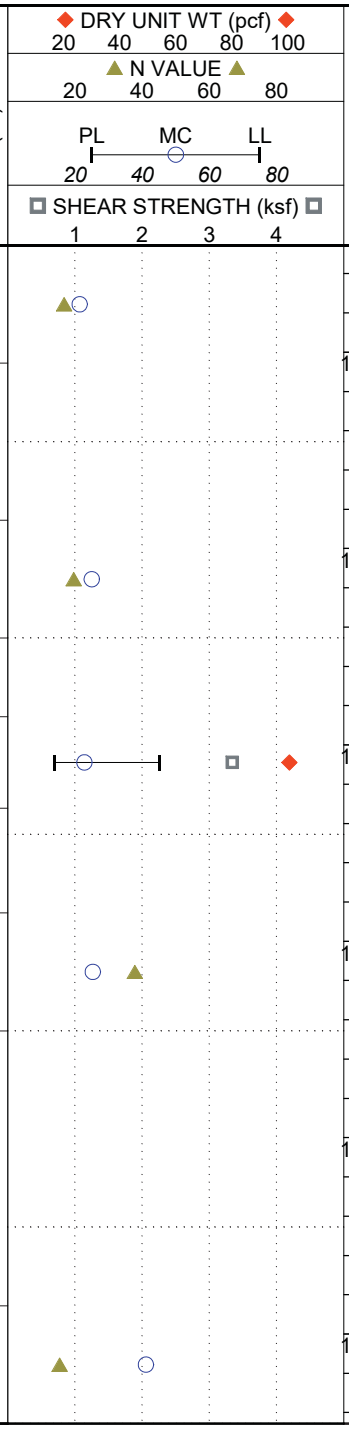
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 2

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/9/18 **COMPLETED** 1/9/18
SURFACE ELEVATION 1256.36 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (3") 0.3 ft					
			LEAN CLAY, Scattered Chert, Reddish Brown, Stiff, Moist (CL)	SPT 1		7-8-8 (16)	1.5	1255.0
2.5								
			4.0 ft					
			LEAN TO FAT CLAY, Trace Chert, Reddish Brown, Very Stiff, Moist (CL-CH)	SPT 2		6-8-11 (19)	4.5	1252.5
5.0								
				ST 3	93		4	1250.0
7.5			8.0 ft					
			FAT CLAY, Scattered Chert, Red, Very Stiff, Moist (CH)	SPT 4		14-14-24 (38)	3.25	1247.5
10.0								1245.0
12.5			- Stiff Below 12.5'					
			15.0 ft	SPT 5		7-8-7 (15)	3	1242.5
15.0			Bottom of borehole at 15.0 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

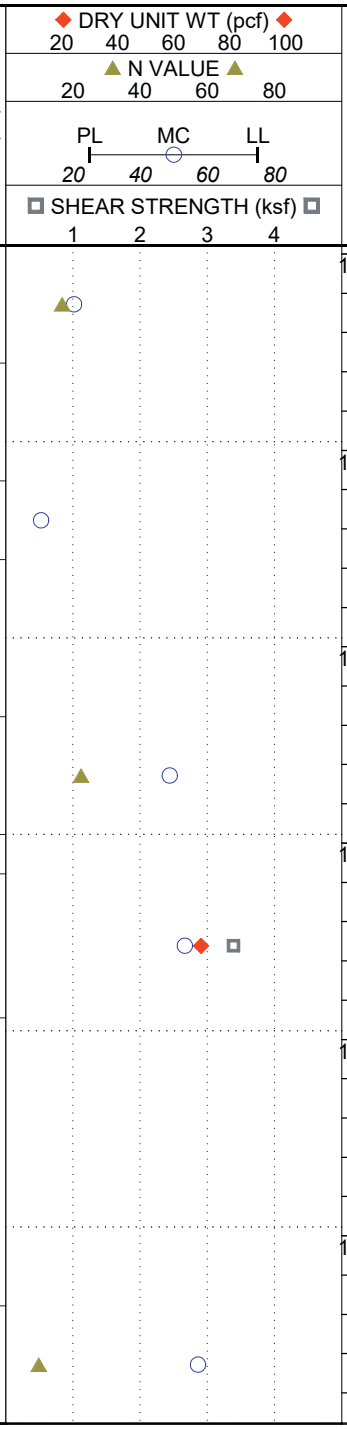
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 3

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/9/18 **COMPLETED** 1/9/18
SURFACE ELEVATION 1257.61 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (2") 0.2 ft					1257.5
			LEAN CLAY, Scattered Chert, Reddish Brown, Very Stiff, Moist (CL)	SPT 1		6-7-10 (17)	3.5	
2.5				ST 2	100		4.5	1255.0
5.0								1252.5
			6.5 ft FAT CLAY, Scattered Chert, Red, Very Stiff, Moist (CH)	SPT 3		6-14-8 (22)	2.25	
7.5				ST 4	41		2.75	1250.0
10.0			10.5 ft FAT CLAY, Trace Chert, Red, Stiff, Moist (CH)					1247.5
12.5								1245.0
			15.0 ft	SPT 5		3-4-6 (10)	2.25	
15.0			Bottom of borehole at 15.0 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

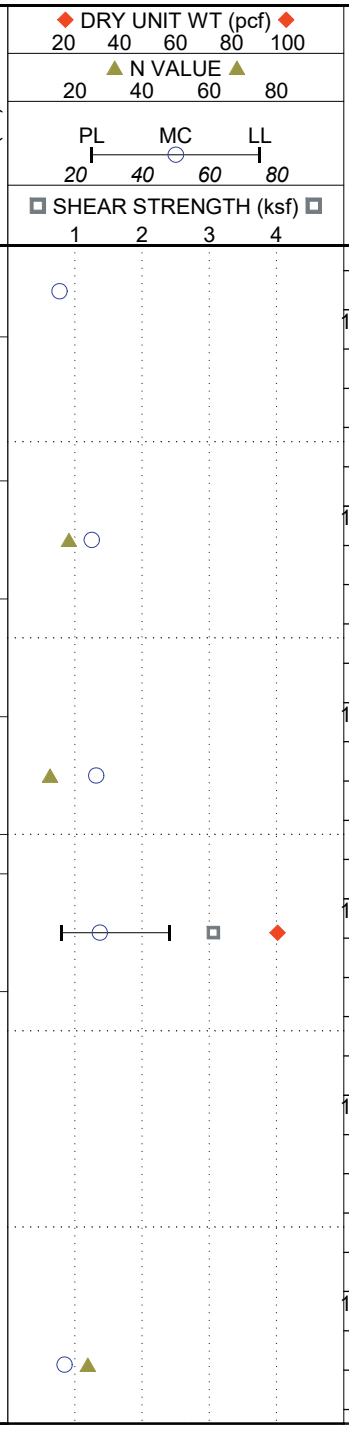
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 4

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/9/18 **COMPLETED** 1/9/18
SURFACE ELEVATION 1255.82 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Coverd (2") 0.2 ft					
			LEAN CLAY, Scattered Chert, Reddish Brown, Stiff, Moist (CL)	ST 1	86		4.5	1255.0
2.5			3.0 ft					
			LEAN TO FAT CLAY, Trace Chert, Red, Very Stiff, Moist (CL-CH)	SPT 2		7-8-10 (18)	4.25	1252.5
5.0								
				SPT 3		4-6-7 (13)	3.75	1250.0
7.5				ST 4	89		3.5	1247.5
			10.0 ft					
10.0			FAT CLAY, Trace Chert, Red, Very Stiff, Moist (CH)					1245.0
12.5								
			- Scattered Chert Below 13.5'	SPT 5		14-11-13 (24)		1242.5
			15.0 ft					
15.0			Bottom of borehole at 15.0 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

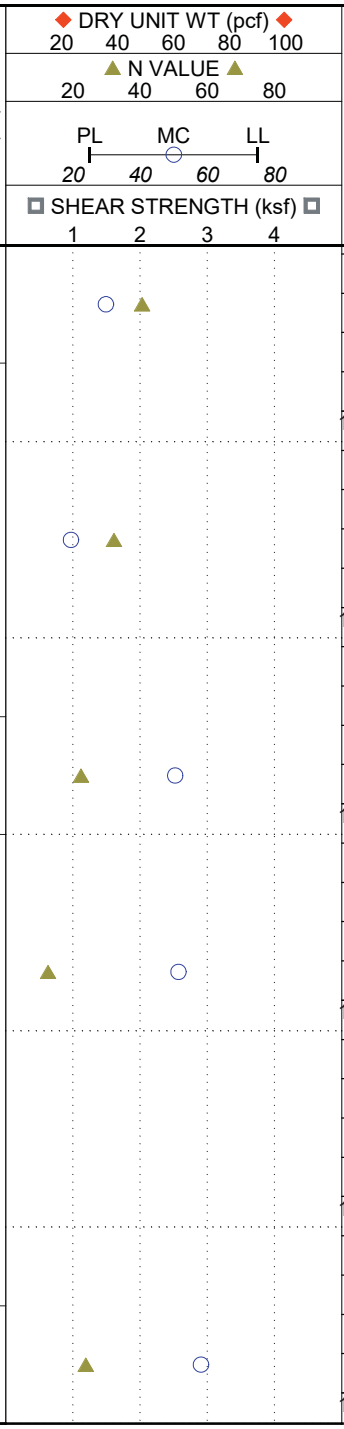
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 5

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1257.11 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (3") 0.3 ft					
			FILL - LEAN TO FAT CLAY MIX, w/ Chert, Reddish Brown, Very Stiff, Moist (CL-CH)	SPT 1		10-17-24 (41)	2.75	
								1255.0
2.5			3.0 ft FAT CLAY, w/ Chert, Red, Very Stiff, Moist (CH)	SPT 2		14-17-15 (32)		
								1252.5
5.0			- Scattered Chert Below 5.5'	SPT 3		6-13-10 (23)	3	
								1250.0
7.5			- Trace & Stiff Below 8'	SPT 4		6-6-7 (13)		
								1247.5
10.0								
								1245.0
12.5				SPT 5		3-14-10 (24)	1.5	
			15.0 ft					1242.5
15.0			Bottom of borehole at 15.0 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

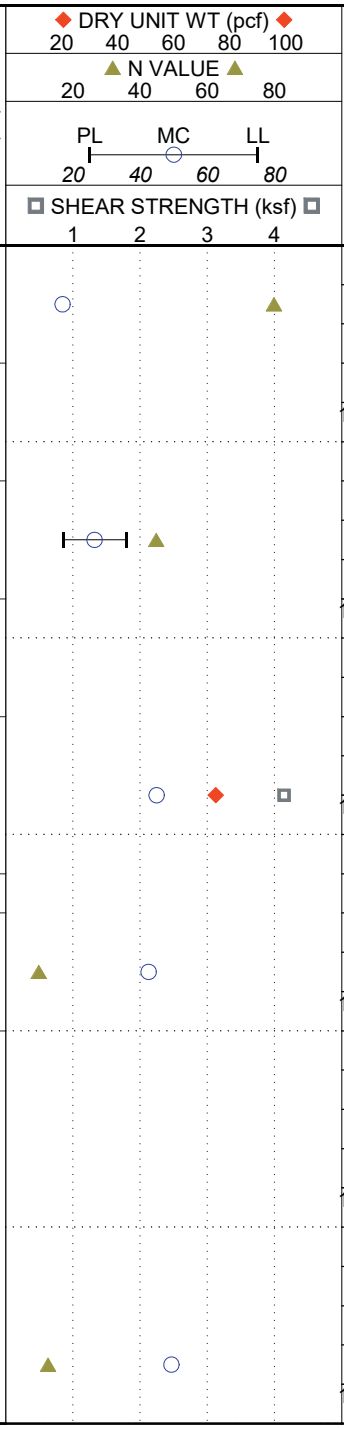
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 6

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/9/18 **COMPLETED** 1/9/18
SURFACE ELEVATION 1257 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (4") 0.3 ft					
			POSSIBLE FILL - LEAN CLAY, w/ Chert, Brown, Very Stiff, Moist (CL)	SPT 1		14-20-60 (80)	4	
								1255.0
2.5			- Reddish Tan Below 3'	SPT 2		15-24-21 (45)	2.25	
								1252.5
5.0			6.5 ft					
			FAT CLAY, Trace Chert, Red, Stiff to Very Stiff, Moist (CH)	ST 3	96		3.5	1250.0
7.5				SPT 4		7-4-6 (10)	2.25	
								1247.5
10.0								
								1245.0
12.5				SPT 5		4-4-8 (12)		
			- Scattered Chert Below 14.5' 15.0 ft					1242.5
15.0			Bottom of borehole at 15.0 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 7

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1257.58 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT (pcf) 20 40 60 80 100 / N VALUE 20 40 60 80 / PL MC LL 20 40 60 80 / SHEAR STRENGTH (ksf) 1 2 3 4	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (5") 0.4 ft						1257.5
			FAT CLAY, Scattered Chert, Red, Stiff to Very Stiff, Moist (CH)	SPT 1		4-14-11 (25)	3		
2.5			- Trace Chert Below 2.5'	ST 2	100				1255.0
5.0			6.0 ft						1252.5
			LIMESTONE, Medium Hard, Weathered 6.3 ft	SPT 3		70/4"			

Refusal at 6.3 feet.
Bottom of borehole at 6.3 feet.

BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

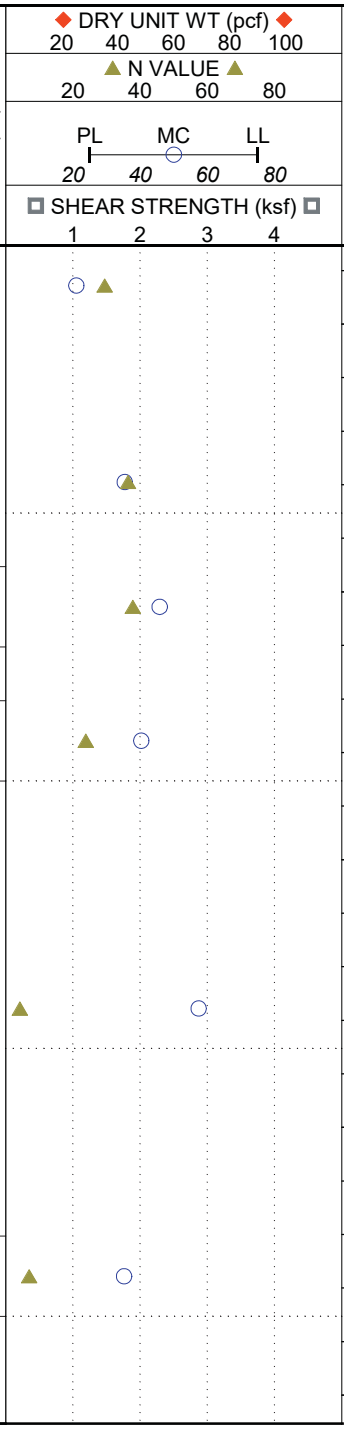
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 8

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1256.47 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (2") 0.2 ft					
			FILL - CLAYEY GRAVEL, w/ Sand, Brown, Dense, Moist (GC)	SPT 1		8-15-14 (29)		1255
			3.0 ft					
			LEAN TO FAT CLAY, w/ Chert, Reddish Brown, Very Stiff, Moist (CL-CH)	ST 2	88			
				SPT 3		18-20-17 (37)		
5			5.5 ft					
			FAT CLAY, w/ Chert, Red, Very Stiff, Moist (CH)	SPT 4		15-17-21 (38)	4	1250
				SPT 5		7-15-8 (23)	2.75	
			10.0 ft					
10			FAT CLAY, Trace Chert, Red, Very Stiff, Moist (CH)					1245
			- Soft Below 13.5'	SPT 6		1-1-3 (4)		
15								1240
			19.5 ft	SPT 7		4-3-4 (7)	1.5	
20			LIMESTONE, Medium Hard, Weathered					
			22.0 ft					1235



Refusal at 22.0 feet.
Bottom of borehole at 22.0 feet.

BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 9

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1257.05 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (3") 0.3 ft					
			LEAN CLAY, Scattered Chert, Brown, Stiff, Moist (CL)	SPT 1		3-6-11 (17)	1.75	
			3.0 ft					1255.0
2.5			FAT CLAY, w/ Chert, Reddish Brown, Very Stiff, Moist (CH)	SPT 2		31-21-18 (39)		
								1252.5
5.0				SPT 3		35-20-24 (44)	3.5	
			6.5 ft					
			FAT CLAY, Scattered Chert, Red, Very Stiff, Moist (CH)					1250.0
7.5			- Trace Chert Below 8.3'	SPT 4		22-11-13 (24)	4	
								1247.5
10.0			11.5 ft					
			LIMESTONE, Pinnacle Medium Hard, Weathered					1245.0
12.5				SPT 5		11-17-70/2"		
			14.7 ft					1242.5

Refusal at 14.7 feet.
Bottom of borehole at 14.7 feet.

BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

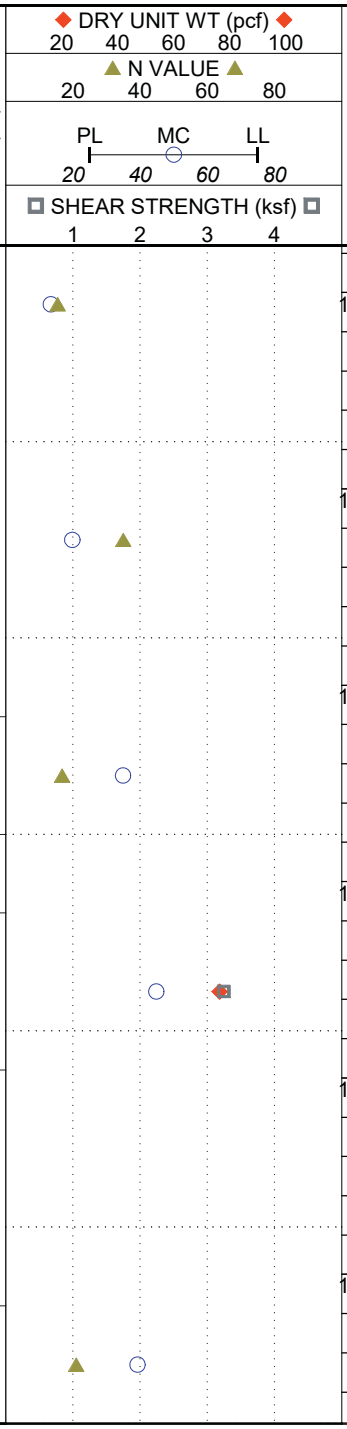
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 10

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1255.6 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Gravelly, Grass Covered (10")					
			0.8 ft POSSIBLE FILL - LEAN CLAY, Scattered Chert & Sand, Brown, Stiff, Moist (CL)	SPT 1		6-7-8 (15)		1255.0
			2.5 ft LEAN CLAY, w/ Chert, Reddish Brown, Very Stiff, Moist (CL)	SPT 2		14-18-17 (35)		1252.5
5.0			5.5 ft FAT CLAY, Trace Chert, Red, Stiff to Very Stiff, Moist (CH)	SPT 3		4-8-8 (16)	3	1250.0
7.5				ST 4	75		3.5	1247.5
10.0								1245.0
12.5			- Scattered Chert Below 12.5'					1242.5
			15.0 ft	SPT 5		4-13-8 (21)	1.5	
15.0			Bottom of borehole at 15.0 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

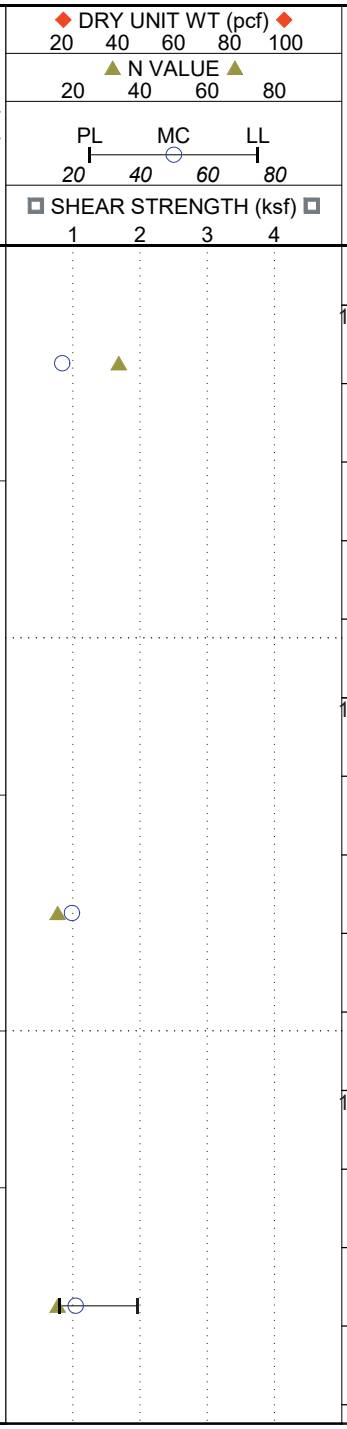
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 11

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1252.88 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		AGGREGATE BASEROCK (2") 0.2 ft FILL - CLAYEY SAND, w/ Gravel, Tan Brown, Dense, Moist (SC)	SPT 1		10-10-24 (34)	4.5	1252.5
2.5			2.5 ft FILL - LEAN CLAY, Scattered Chert, Tan Brown, Stiff, Moist (CL)	SPT 2		11-8-7 (15)	4.5	1250.0
5.0			6.0 ft LEAN CLAY, Trace Chert, Brown, Stiff, Moist (CL)	SPT 3		4-4-11 (15)	3.75	1247.5
7.5			7.5 ft Bottom of borehole at 7.5 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

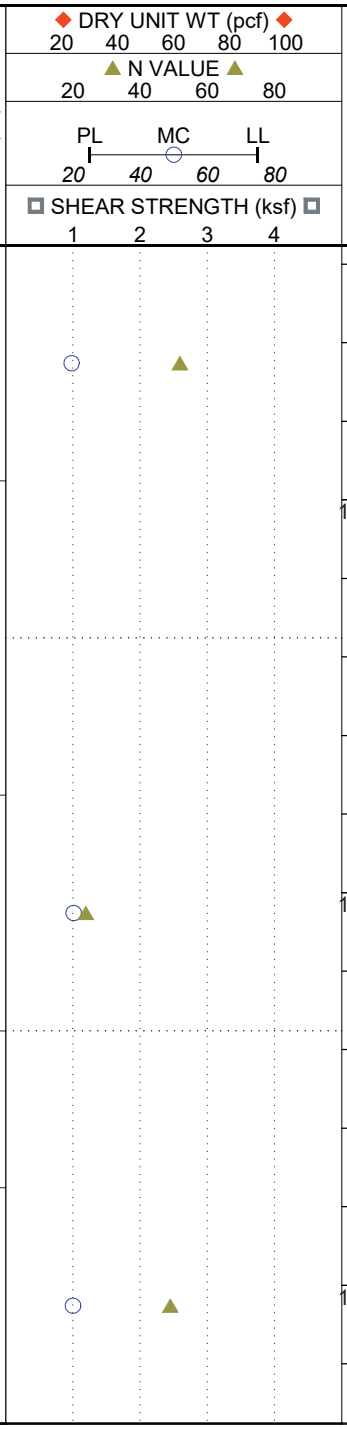
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 12

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1254.12 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (2") 0.2 ft					
			FILL - LEAN CLAY, Scattered Chert, Very Stiff, Moist (CL)	SPT 1		4-14-38 (52)	3.75	
								1252.5
2.5			3.0 ft					
			FILL - LEAN CLAY, Trace Chert & Coal, Brown, Very Stiff, Moist (CL)	SPT 2		10-10-14 (24)	4.5	1250.0
5.0								
			- Chert Layer Below 6' 6.5 ft					
			LEAN CLAY, Scattered Chert, Brown, Very Stiff, Moist (CL) 7.5 ft	SPT 3		29-32-17 (49)	2	1247.5
7.5			Bottom of borehole at 7.5 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

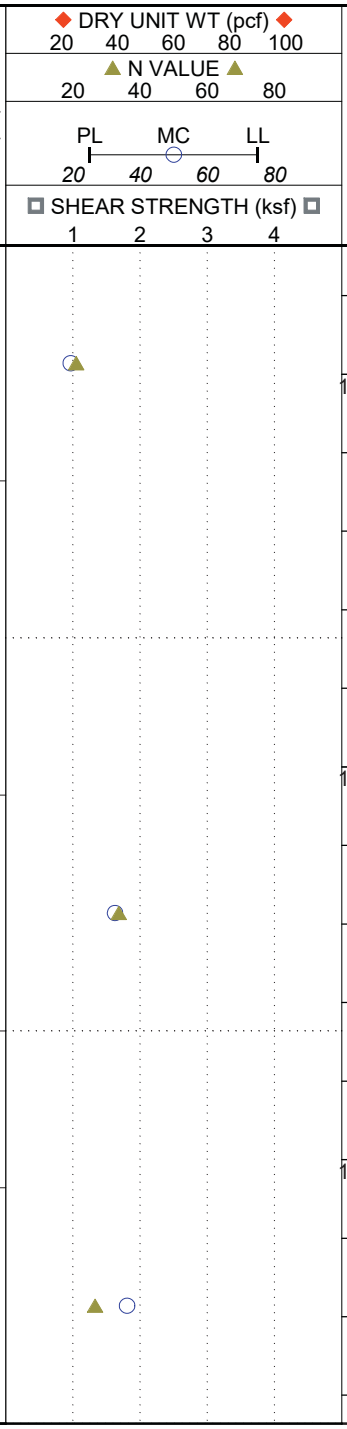
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 13

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1253.32 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (5")					
			0.4 ft					
			LEAN CLAY, Scattered Chert, Brown, Very Stiff, Moist (CL)	SPT 1		4-6-15 (21)	4.5	1252.5
2.5								1250.0
			4.5 ft	SPT 2		15-27-7 (34)	1.25	
			FAT CLAY, Trace Chert, Red, Very Stiff, Moist (CH)					
5.0								1247.5
			7.5 ft	SPT 3		4-7-20 (27)	3	
7.5			Bottom of borehole at 7.5 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

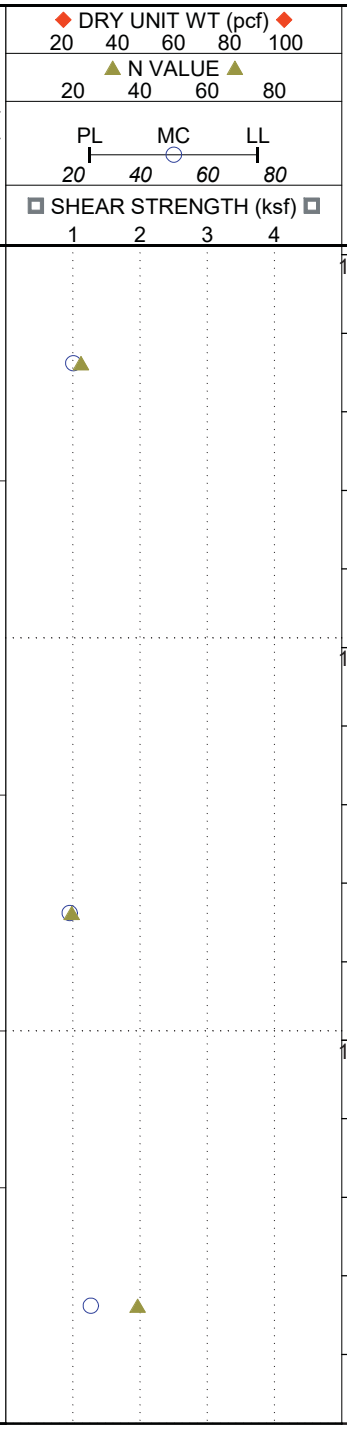
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 14

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1252.56 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (2") 0.2 ft					1252.5
			LEAN CLAY, Scattered Chert, Brown, Very Stiff, Moist (CL)	SPT 1		8-11-11 (22)	2.5	
2.5								1250.0
				SPT 2		11-11-8 (19)	3.5	
5.0								1247.5
			6.2 ft FAT CLAY, w/ Chert, Reddish Brown, Very Stiff, Moist (CH)	SPT 3		17-24-15 (39)	3.75	
			7.5 ft					
7.5			Bottom of borehole at 7.5 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

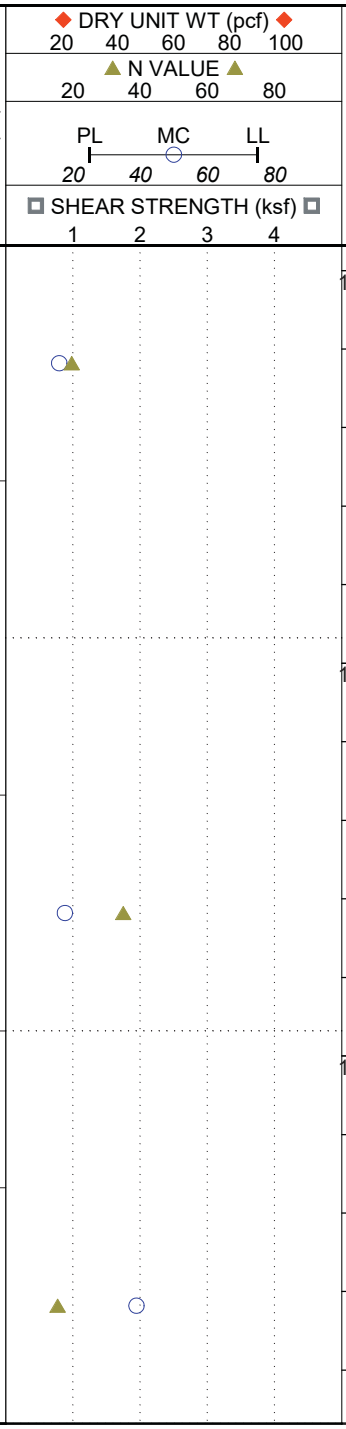
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 15

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/10/18 **COMPLETED** 1/10/18
SURFACE ELEVATION 1252.66 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		TOPSOIL, Grass Covered (5") 0.4 ft					1252.5
			LEAN CLAY, Trace Chert, Reddish Brown, Very Stiff, Moist (CL)	SPT 1		4-8-11 (19)	4	
2.5			3.0 ft					1250.0
			FAT CLAY, w/ Chert, Red, Very Stiff, Moist (CH)	SPT 2		10-15-20 (35)	2.75	
5.0			- Trace Chert Below 5'					1247.5
			7.5 ft	SPT 3		6-6-10 (16)	4.25	
7.5			Bottom of borehole at 7.5 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

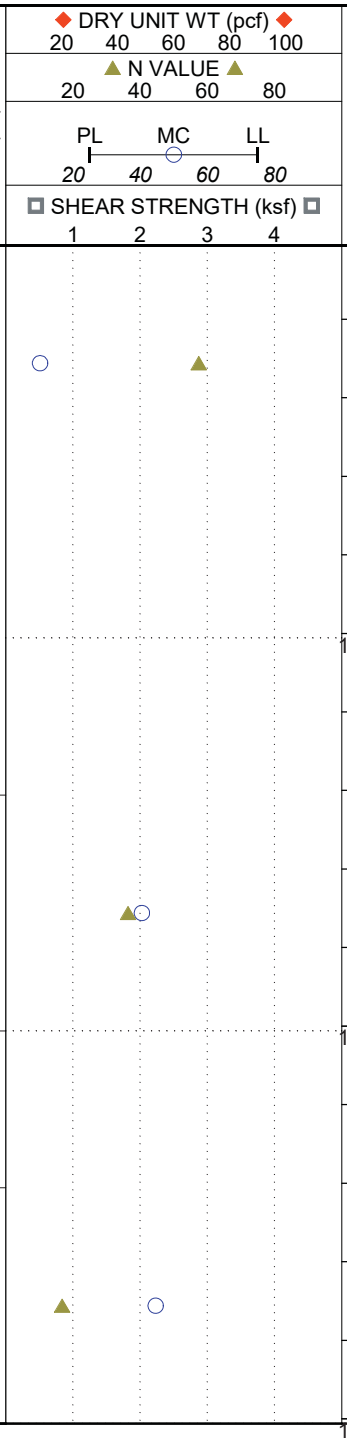
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 16

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/11/18 **COMPLETED** 1/11/18
SURFACE ELEVATION 1252.47 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		AGGREGATE BASEROCK (6") 0.5 ft					
			FILL - GRAVELLY LEAN CLAY, Brown, Very Stiff, Moist (CL) 2.5 ft	SPT 1		17-31-27 (58)		
2.5			FAT CLAY, w/ Chert, Reddish Brown, Very Stiff, Moist (CH)					1250.0
				SPT 2		29-25-11 (36)	4	
5.0			5.5 ft FAT CLAY, Trace Chert, Red, Very Stiff, Moist (CH)					1247.5
				SPT 3		6-7-10 (17)	4.5	
7.5			7.5 ft Bottom of borehole at 7.5 feet.					1245.0



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

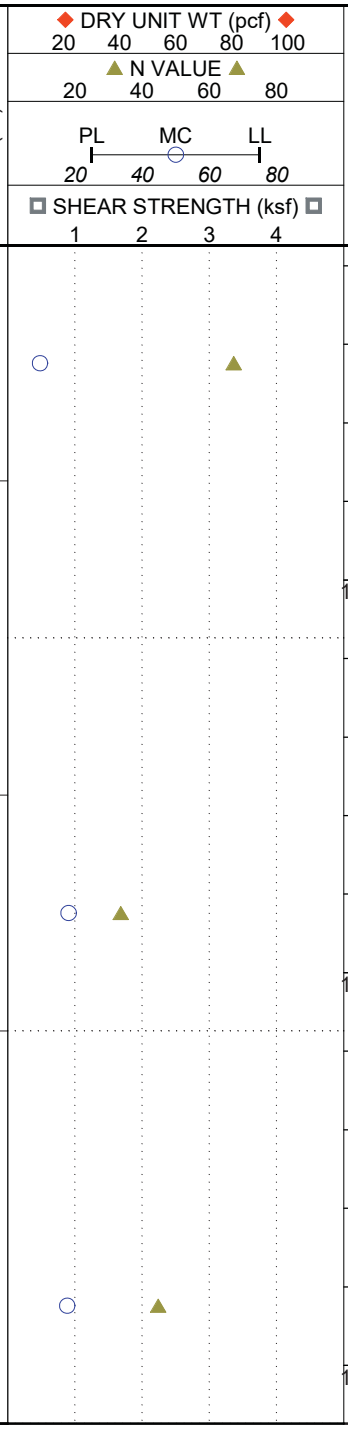
4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 17

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/11/18 **COMPLETED** 1/11/18
SURFACE ELEVATION 1252.13 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		AGGREGATE BASEROCK (6")					
			0.5 ft					
			FILL - GRAVELLY LEAN CLAY, Occational Limestone Boulder, Reddish Brown, Very Stiff, Moist (CL)	SPT 1		21-18-49 (67)	4.5	
								1250.0
2.5								
			3.5 ft					
			FILL - GRAVELLY LEAN CLAY, Brown, Very Stiff, Moist (CL)	SPT 2		14-17-17 (34)	4.5	
								1247.5
5.0								
				SPT 3		11-20-25 (45)		
			7.5 ft					1245.0
7.5			Bottom of borehole at 7.5 feet.					



BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 18

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/11/18 **COMPLETED** 1/11/18
SURFACE ELEVATION 1252.51 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT (pcf) 20 40 60 80 100 / N VALUE 20 40 60 80 / PL MC LL 20 40 60 80 / SHEAR STRENGTH (ksf) 1 2 3 4	ELEVATION (ft)
0	CFA - 4.5" O.D.		AGGREGATE BASEROCK (10")						
			0.8 ft FILL - LEAN CLAY, Scattered Chert, Brown, Very Stiff, Moist (CL)	SPT 1		17-22-25 (47)			1252
1									
									1251
2									
									1250
3									
			3.8 ft	SPT 2		70/4"			1249
			3.9 ft CONCRETE						

Refusal at 3.9 feet.
Bottom of borehole at 3.9 feet.

BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GEOTECHNICAL BORING LOG

BORING NUMBER 18B

CLIENT Jacobs Engineering
PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A
PROJECT NO. 248132
PROJECT LOCATION Springfield, Missouri
DATE STARTED 1/11/18 **COMPLETED** 1/11/18
SURFACE ELEVATION 1252.51 ft **BENCHMARK EL.**
DRILLER JS **DRILL RIG** 2008 CME 55LC
GROUND WATER LEVELS
HAMMER TYPE Auto
AT TIME OF DRILLING None
LOGGED BY SP **CHECKED BY** TA
AT END OF DRILLING
NOTES

DEPTH (ft)	DRILLING METHOD	STRATA SYMBOL	MATERIAL DESCRIPTION (Unified Soil Classification System)	SAMPLE TYPE NUMBER	RECOVERY % (RQD %)	CORRECTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT (pcf) 20 40 60 80 100 / N VALUE 20 40 60 80 / PL MC LL 20 40 60 80 / SHEAR STRENGTH (ksf) 1 2 3 4	ELEVATION (ft)
0.0	CFA - 4.5" O.D.		FILL - LIMESTONE BOULDERS						1252.5
2.5									1250.0
			3.4 ft FILL - LEAN CLAY, w/ Chert, Brown, Very Stiff, Moist (CL)						
5.0									1247.5
				SPT 1		13-11-15 (26)			
			7.5 ft						
7.5			Bottom of borehole at 7.5 feet.						

BORING LOG - PPI - PPI STD TEMPLATE.GDT - 1/31/18 10:15 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

4168 W. Kearney St.
Springfield, Missouri 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

KEY TO SYMBOLS

CLIENT Jacobs Engineering

PROJECT NAME MOARNG Theater Aviation Maint Grp Ph 3A

PROJECT NO. 248132

PROJECT LOCATION Springfield, Missouri

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

- CH: USCS High Plasticity Clay
- CL: USCS Low Plasticity Clay
- CL-CH: USCS Low to High Plasticity Clay
- CONCRETE
- FILL: Fill (made ground)
- LIMESTONE
- TOPSOIL: Topsoil

SAMPLER SYMBOLS

- Standard Penetration Test
- Shelby Tube

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION

- Water Level at Time Drilling, or as Shown
- Water Level at End of Drilling, or as Shown
- Water Level After 24 Hours, or as Shown

KEY TO SYMBOLS - PPI STD TEMPLATE.GDT - 1/31/18 10:16 - S:_MASTER PROJECT FILE\2017_MO\JJACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

APPENDIX II

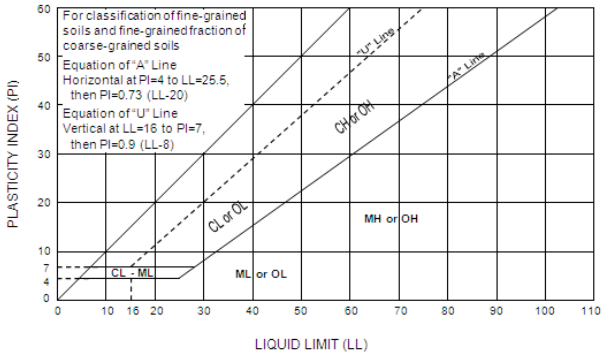
GENERAL NOTES

GENERAL NOTES

SOIL PROPERTIES & DESCRIPTIONS

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (Qu)	Pocket Penetrometer Strength	N-Value
	(psf)	(tsf)	(blows/ft)
Very Soft	<500	<0.25	0-1
Soft	500-1000	0.25-0.50	2-4
Medium Stiff	1001-2000	0.50-1.00	5-8
Stiff	2001-4000	1.00-2.00	9-15
Very Stiff	4001-8000	2.00-4.00	16-30
Hard	>8000	>4.00	31-60
Very Hard			>60



Group Symbol	Group Name
CL –	Lean Clay
ML –	Silt
OL –	Organic Clay or Silt
CH –	Fat Clay
MH –	Elastic Silt
OH –	Organic Clay or Silt
PT –	Peat
CL-CH –	Lean to Fat Clay

Plasticity		Moisture	
Description	Liquid Limit (LL)	Descriptive Term	Guide
Lean	<45%	Dry	No indication of water
Lean to Fat	45-49%	Moist	Indication of water
Fat	≥50%	Wet	Visible water

Fine Grained Soil Subclassification	Percent (by weight) of Total Sample
Terms: SILT, LEAN CLAY, FAT CLAY, ELASTIC SILT	PRIMARY CONSTITUENT
Sandy,gravelly, abundant cobbles, abundant boulders	>30-50]
with sand, with gravel, with cobbles, with boulders	>15-30] – secondary coarse grained constituents
scattered sand, scattered gravel, scattered cobbles, scattered boulders	5-15]
a trace sand, a trace gravel, a few cobbles, a few boulders	<5]
The relationship of clay and silt constituents is based on plasticity and normally determined by performing index tests. Refined classifications are based on Atterberg Limits tests and the Plasticity Chart.	

NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	N-VALUE
Very Loose	0-4
Loose	5-10
Medium Dense	11-24
Dense	25-50
Very Dense	≥51

MOISTURE CONDITION	
Descriptive Term	Guide
Dry	No indication of water
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table.

**GRAIN SIZE IDENTIFICATION		
Name	Size Limits	Familiar Example
Boulder	12 in. or more	Larger than basketball
Cobbles	3 in. to 12 in.	Grapefruit
Coarse Gravel	¾-in. to 3 in.	Orange or lemon
Fine Gravel	No. 4 sieve to ¾-in.	Grape or pea
Coarse Sand	No. 10 sieve to No. 4 sieve	Rock salt
Medium Sand	No. 40 sieve to No. 10 sieve	Sugar, table salt
Fine Sand*	No. 200 sieve to No. 40 sieve	Powdered sugar
Fines	Less than No. 200 sieve	
*Particles finer than fine sand cannot be discerned with the naked eye at a distance of 8 in.		

Coarse Grained Soil Subclassification	Percent (by weight) of Total Sample
Terms: GRAVEL, SAND, COBBLES, BOULDERS	PRIMARY CONSTITUENT
Sandy,gravelly, abundant cobbles, abundant boulders	>30-50]
with gravel, with sand, with cobbles, with boulders	>15-30] – secondary coarse grained constituents
scattered gravel, scattered sand, scattered cobbles, scattered boulders	5-15]
a trace gravel, a trace sand, a few cobbles, a few boulders	<5]
Silty (MH & ML)*, clayey (CL & CH)*	<15]
(with silt, with clay)*	5-15] – secondary fine grained constituents
(trace silt, trace clay)*	<5]
*Index tests and/or plasticity tests are performed to determine whether the term "silt" or "clay" is used.	

*Modified after Ref. ASTM D2487-93 & D2488-93
**Modified after Ref. Oregon DOT 1987 & FHWA 1997
***Modified after Ref. AASHTO 1988, DM 7.1 1982, and Oregon DOT 1987

GENERAL NOTES

BEDROCK PROPERTIES & DESCRIPTIONS

ROCK QUALITY DESIGNATION (RQD)	
Description of Rock Quality	*RQD (%)
Very Poor	< 25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	90-100
*RQD is defined as the total length of sound core pieces 4 in. or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.	

SCALE OF RELATIVE ROCK HARDNESS		
Term	Field Identification	Approx. Unconfined Compressive Strength (tsf)
Extremely Soft	Can be indented by thumbnail	2.6-10
Very Soft	Can be peeled by pocket knife	10-50
Soft	Can be peeled with difficulty by pocket knife	50-260
Medium Hard	Can be grooved 2 mm deep by firm pressure of knife	260-520
Moderately Hard	Requires one hammer blow to fracture	520-1040
Hard	Can be scratched with knife or pick only with difficulty	1040-2610
Very Hard	Cannot be scratched by knife or sharp pick	>2610

DEGREE OF WEATHERING	
Slightly Weathered	Rock generally fresh, joints stained and discoloration extends into rock up to 25mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered	Rock mass is decomposed 50% or less, significant portions of rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

GRAIN SIZE (TYPICALLY FOR SEDIMENTARY ROCKS)		
Description	Diameter (mm)	Field Identification
Very Coarse Grained	>4.76	
Coarse Grained	2.0-4.76	Individual grains can easily be distinguished by eye.
Medium Grained	0.42-2.0	Individual grains can be distinguished by eye.
Fine Grained	0.074-0.42	Individual grains can be distinguished by eye with difficulty.
Very Fine Grained	<0.074	Individual grains cannot be distinguished by unaided eye.

VOIDS	
Pit	Voids barely seen with naked eye to 6mm (¼-in)
Vug	Voids 6 to 50mm (¼ to 2 in) in diameter
Cavity	50 to 6000mm (2 to 24 in) in diameter
Cave	>600mm

BEDDING THICKNESS	
Very Thick Bedded	> 3' thick
Thick Bedded	1' to 3' thick
Medium Bedded	4" to 1' thick
Thin Bedded	1¼" to 4" thick
Very Thin Bedded	½" to 1¼" thick
Thickly Laminated	⅛" to ½" thick
Thinly Laminated	⅛" or less (paper thin)

DRILLING NOTES

Drilling and Sampling Symbols

NQ – Rock Core (2-in. diameter)
HQ – Rock Core (3 in. diameter)
HSA – Hollow Stem Auger
CFA – Continuous Flight (Solid Stem) Auger
SS – Split Spoon Sampler
ST – Shelby Tube
WB – Wash Bore or Mud Rotary
TP – Test-Pit
HA – Hand Auger

Soil Sample Types

Shelby Tube Samples: Relatively undisturbed soil samples were obtained from the borings using thin wall (Shelby) tube samplers pushed hydraulically into the soil in advance of drilling. This sampling, which is considered to be undisturbed, was performed in accordance with the requirements of ASTM D 1587. This type of sample is considered best for the testing of "in-situ" soil properties such as natural density and strength characteristics. The use of this sampling method is basically restricted to soil containing little to no chert fragments and to softer shale deposits.

Split Spoon Samples: The Standard Penetration Test is conducted in conjunction with the split-barrel sampling procedure. The "N" value corresponds to the number of blows required to drive the last 1 foot of an 18-in. long, 2-in. O.D. split-barrel sampler with a 140 lb. hammer falling a distance of 30 in. The Standard Penetration Test is carried out according to ASTM D-1586.

Water Level Measurements

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, shallow groundwater may indicate a perched condition. Caution is merited when interpreting short-term water level readings from open bore holes. Accurate water levels are best determined from piezometers.

Automatic Hammer

Palmerton and Parrish's CME's are equipped with automatic hammers. The conventional method used to obtain disturbed soil samples used a safety hammer operated by company personnel with a cat head and rope. However, use of an automatic hammer allows a greater mechanical efficiency to be achieved in the field while performing a Standard Penetration resistance test based upon automatic hammer efficiencies calibrated using dynamic testing techniques.

*Modified after Ref. ASTM D2487-93 & D2488-93
**Modified after Ref. Oregon DOT 1987 & FHWA 1997
***Modified after Ref. AASHTO 1988, DM 7.1 1982, and Oregon DOT 1987

APPENDIX III

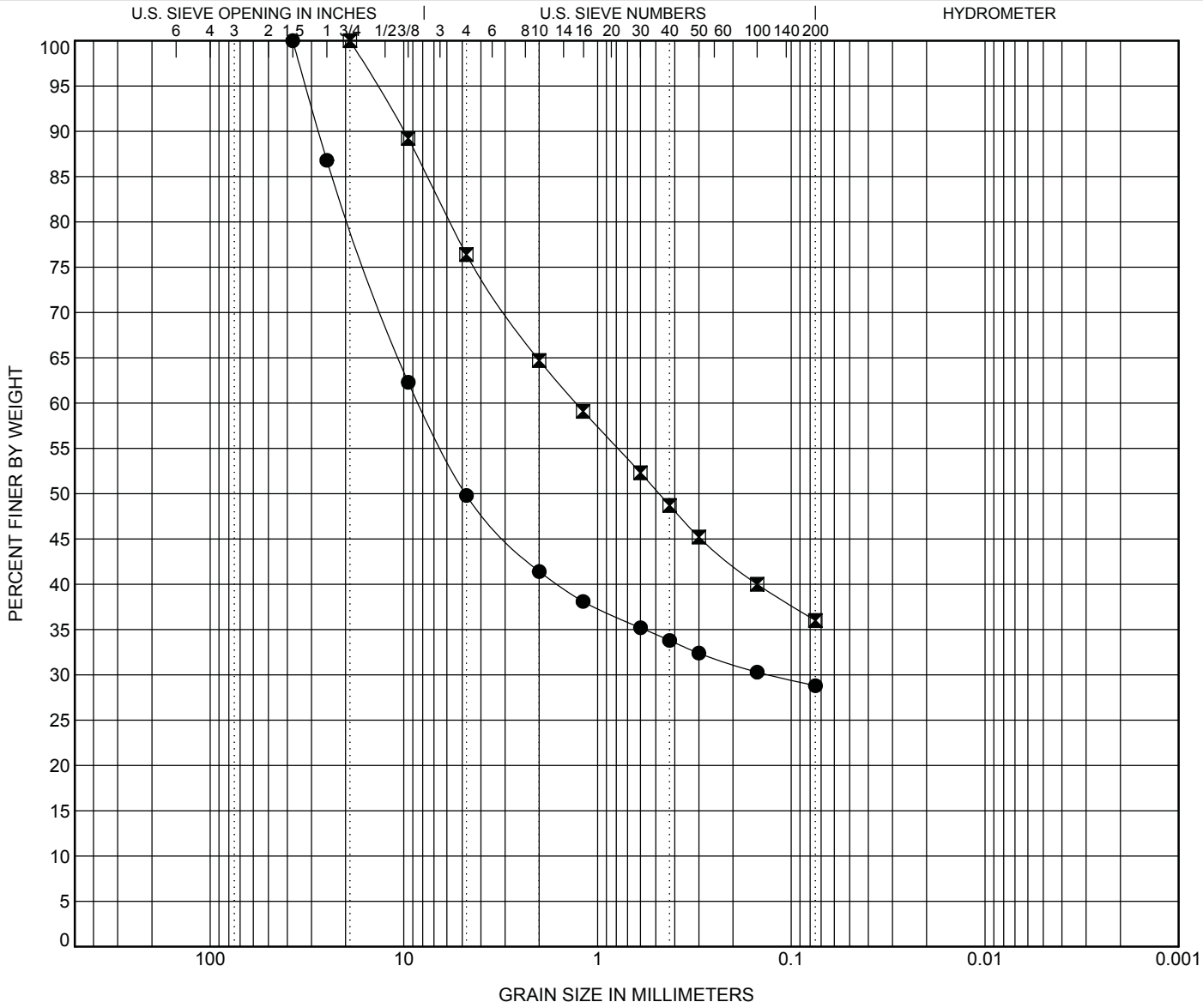
GRAIN SIZE ANALYSIS RESULTS

4168 W. Kearney St.
Springfield, MO 65803
Telephone: (417) 864-6000
Fax: (417) 864-6004

GRAIN SIZE DISTRIBUTION

CLIENT Jacobs Engineering **PROJECT NAME** MOARNG Theater Aviation Maint Grp Ph 3A

PROJECT NO. 248132 **PROJECT LOCATION** Springfield, Missouri



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	8	0.0	**CLAYEY GRAVEL with SAND(GC)**					
⊠	11	0.0	**CLAYEY SAND with GRAVEL(SC)**					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	8	0.0	37.5	8.362	0.131		50.2	21.0	28.8	
⊠	11	0.0	19	1.292			23.6	40.4	36.0	

GRAIN SIZE - PPI STD TEMPLATE.GDT - 1/30/18 12:35 - S:_MASTER PROJECT FILE\2017_MO\JACOBS ENG-248132-MOARNG THEATER AVIATION MAINT GRP PH 3A-SUB\BORING LOGS\BORING LOGS.GPJ

APPENDIX IV

THERMAL TESTING RESULTS

Client:	Palmerton & Parrish, Inc.
Project Name:	MOARNG Theater Aviation
Project Location:	Springfield, MO
GTX #:	307584
Start Date:	01/25/18
End Date:	01/26/18
Tested By:	smd/meo
Checked By:	emm
Preparation:	Test performed at the as-received density and moisture content.

Thermal Conductivity of Soil by ASTM D5334

Boring	Sample	Depth, ft	Sample Description	Moisture Content, %	Wet Density, pcf	Dry Density, pcf	Thermal Conductivity, $^{W}/_{m°K}$	Thermal Resistivity, $^{°K\ cm}/_{W}$
7	---	2.5-3.7	Moist, dark red clay	51.2	93.8	62.0	1.14	88
8	---	3-3.7	Moist, red clay	27.0	108.1	85.1	1.11	90

Notes: $^{W}/_{m°K}$ = Watts per Meter °Kelvin
$^{°K\ cm}/_{W}$ = °Kelvin Centimeter per Watt

APPENDIX V

DCP TEST RESULTS

DCP TEST DATA

Client: Jacobs Engineering

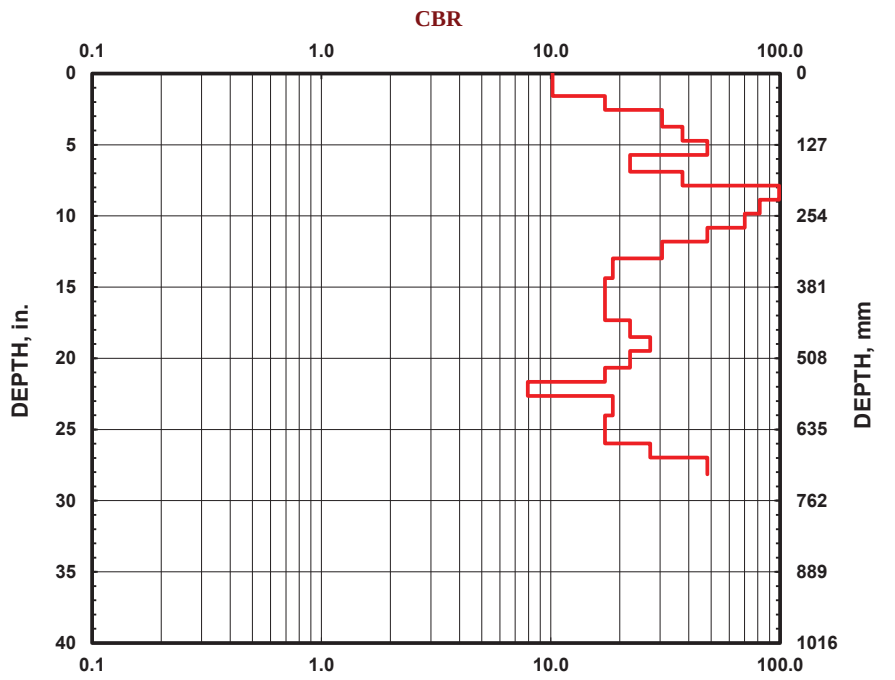
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

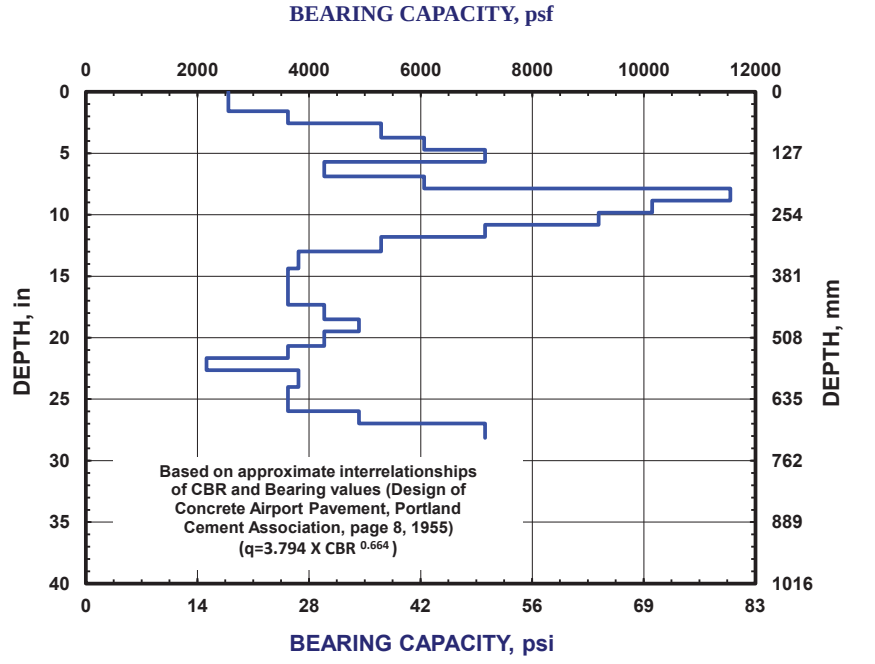
Location: 11 **Soil Type(s):** Clayey Sand w/ Gravel

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	40	1
2	65	1
4	95	1
4	120	1
5	145	1
3	175	1
4	200	1
25	225	1
8	250	1
7	275	1
5	300	1
4	330	1
3	365	1
2	390	1
2	415	1
2	440	1
3	470	1
3	495	1
3	525	1
2	550	1
1	575	1
3	610	1
2	635	1
2	660	1
3	685	1
6	715	1





DCP TEST DATA

Client: Jacobs Engineering

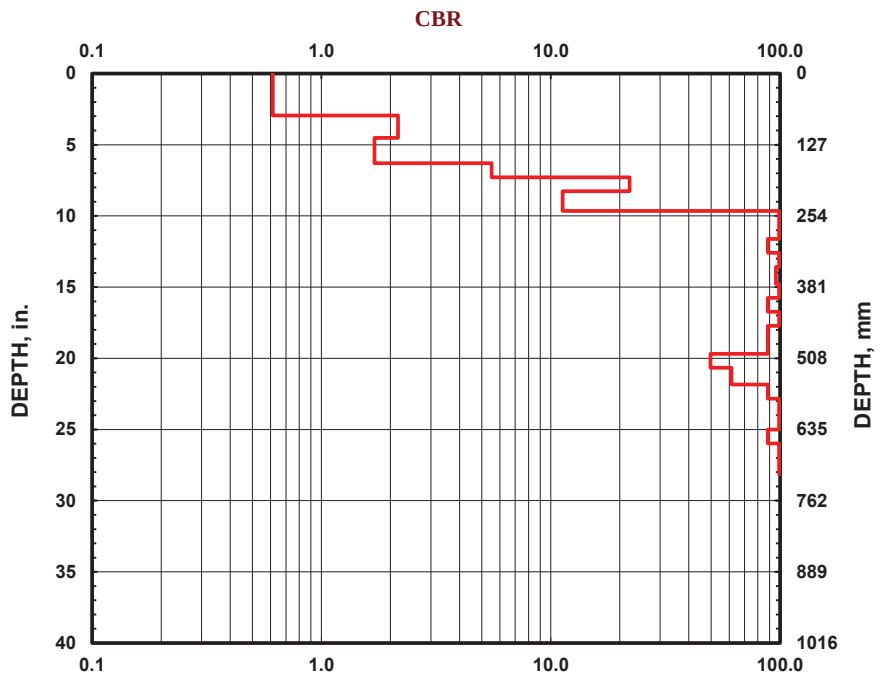
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

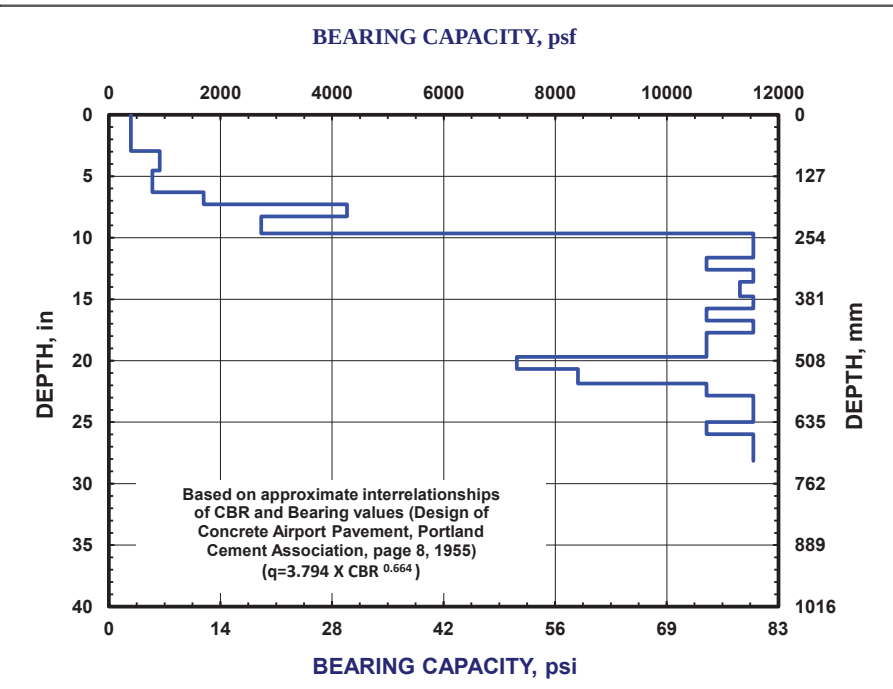
Location: 12 **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ● CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
1	75	1
1	115	1
1	160	1
1	185	1
2	210	1
2	245	1
6	270	1
10	295	1
4	320	1
6	345	1
5	375	1
5	400	1
4	425	1
5	450	1
4	475	1
4	500	1
3	525	1
4	555	1
4	580	1
7	610	1
5	635	1
4	660	1
8	685	1
8	715	1





DCP TEST DATA

Client: Jacobs Engineering

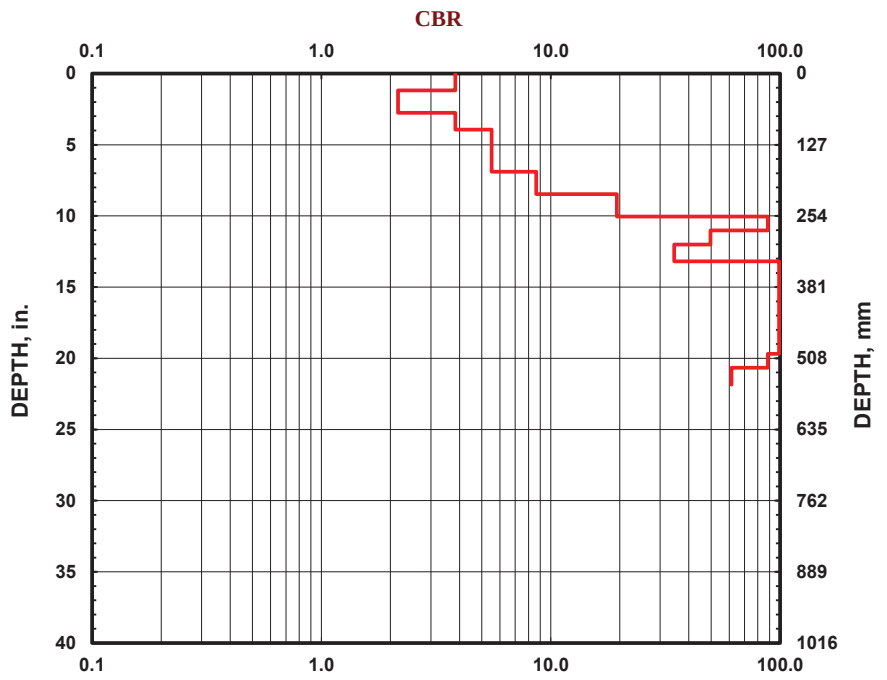
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

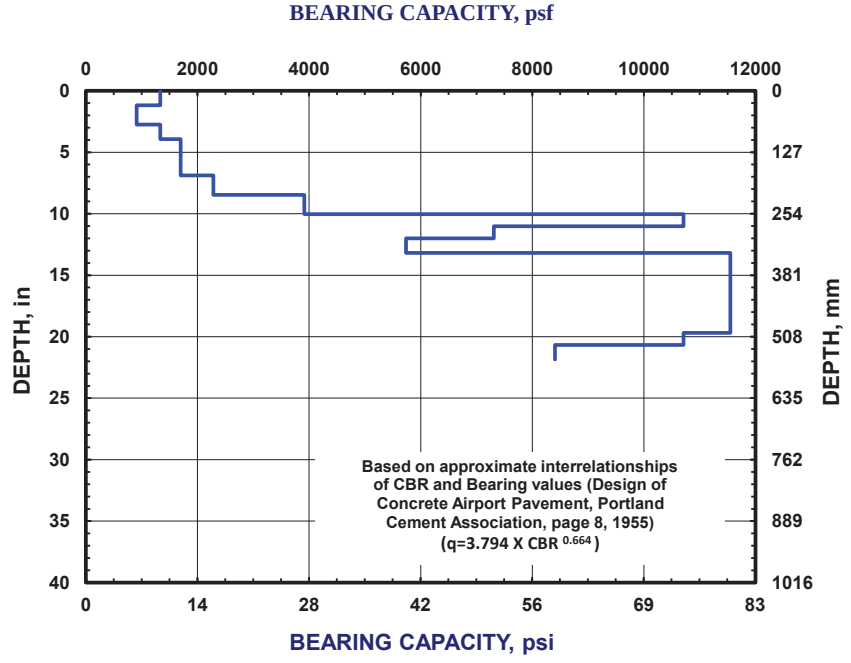
Location: 13 **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ● CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
1	30	1
1	70	1
1	100	1
1	125	1
2	175	1
2	215	1
3	255	1
4	280	1
3	305	1
3	335	1
5	360	1
5	385	1
6	410	1
5	435	1
7	465	1
6	500	1
4	525	1
4	555	1





DCP TEST DATA

Client: Jacobs Engineering

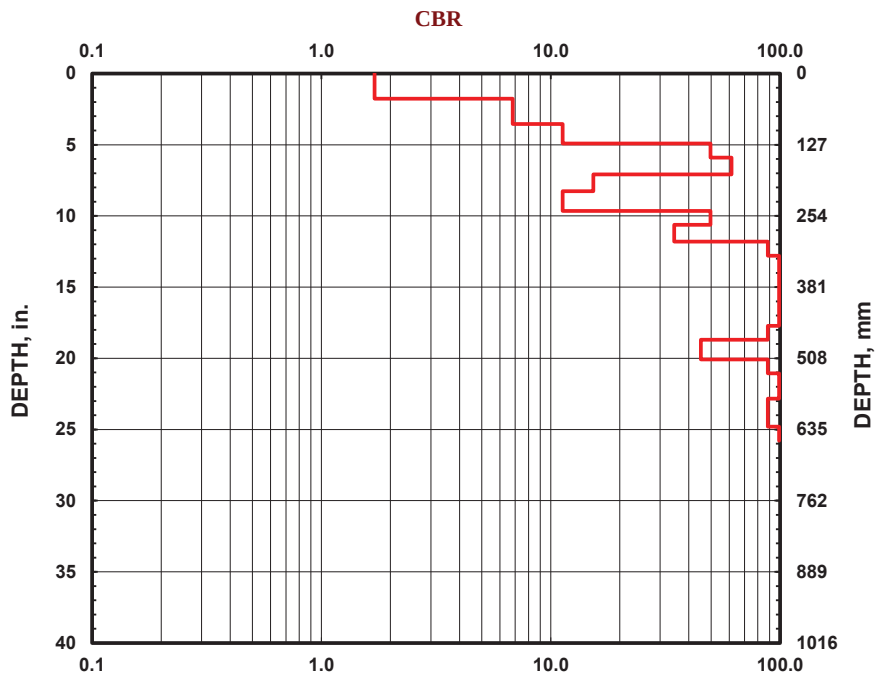
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

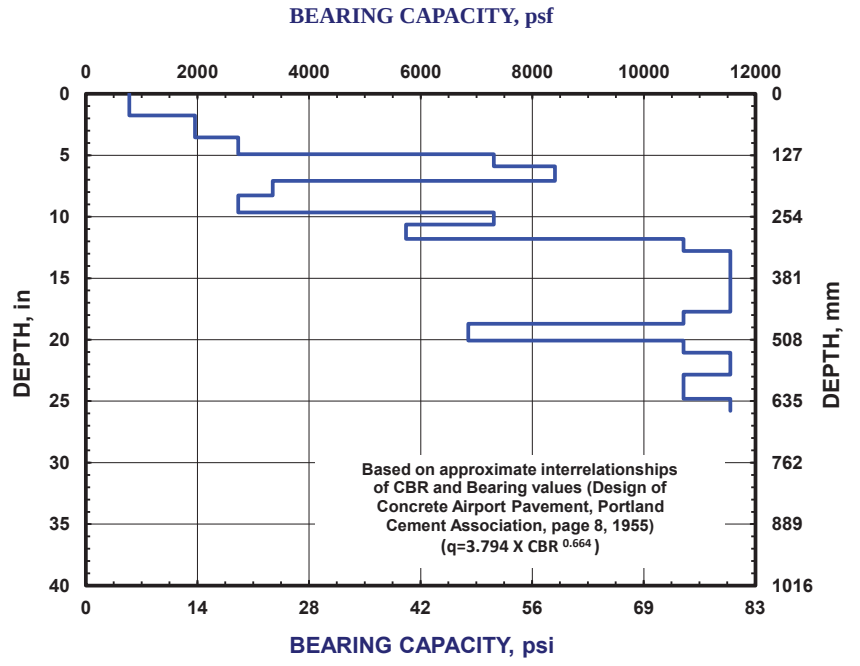
Location: 14 **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ● CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
1	45	1
2	90	1
2	125	1
3	150	1
4	180	1
2	210	1
2	245	1
3	270	1
3	300	1
4	325	1
7	350	1
12	375	1
5	400	1
6	425	1
5	450	1
4	475	1
4	510	1
4	535	1
11	580	1
4	605	1
4	630	1
7	655	1





DCP TEST DATA

Client: Jacobs Engineering

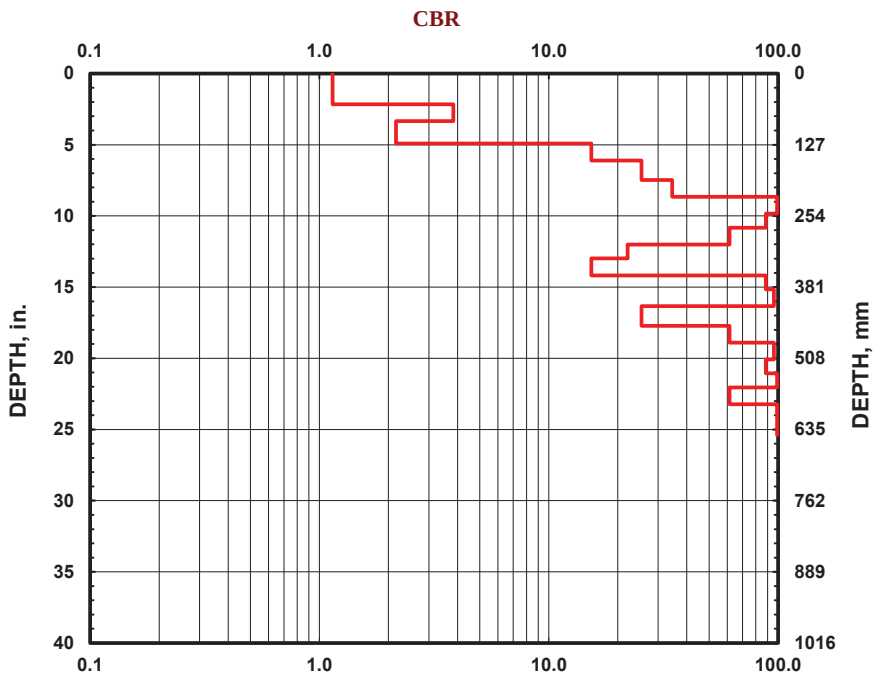
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

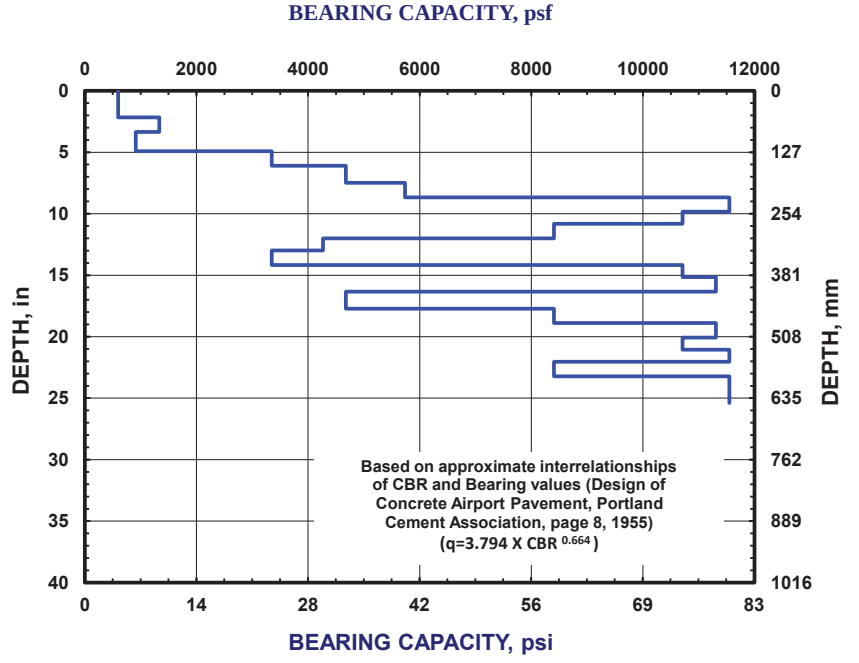
Location: 15 **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ● CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
1	55	1
1	85	1
1	125	1
2	155	1
3	190	1
3	220	1
6	250	1
4	275	1
4	305	1
2	330	1
2	360	1
4	385	1
5	415	1
3	450	1
4	480	1
5	510	1
4	535	1
5	560	1
4	590	1
9	615	1
9	645	1





DCP TEST DATA

Client: Jacobs Engineering

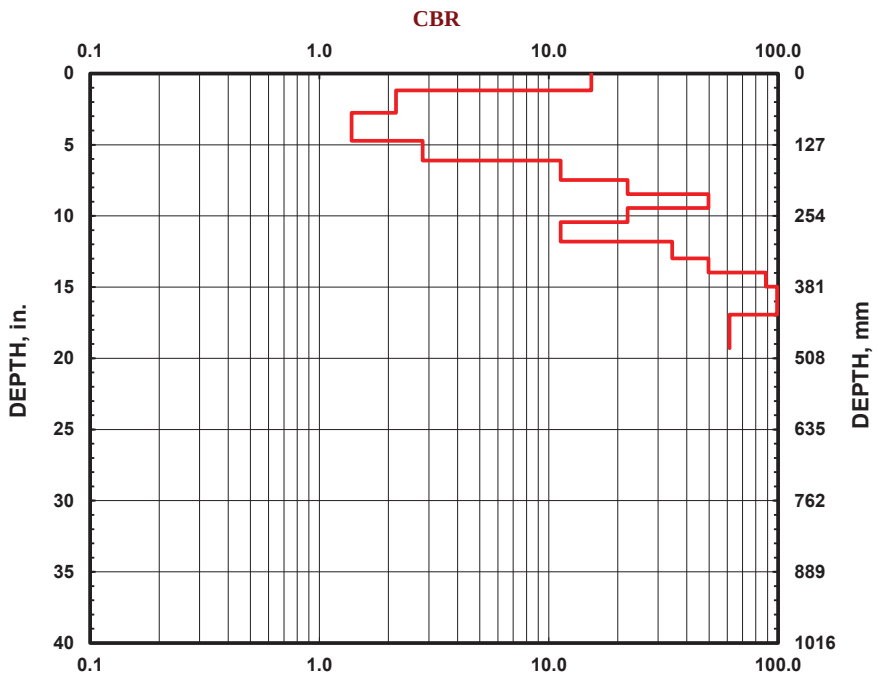
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

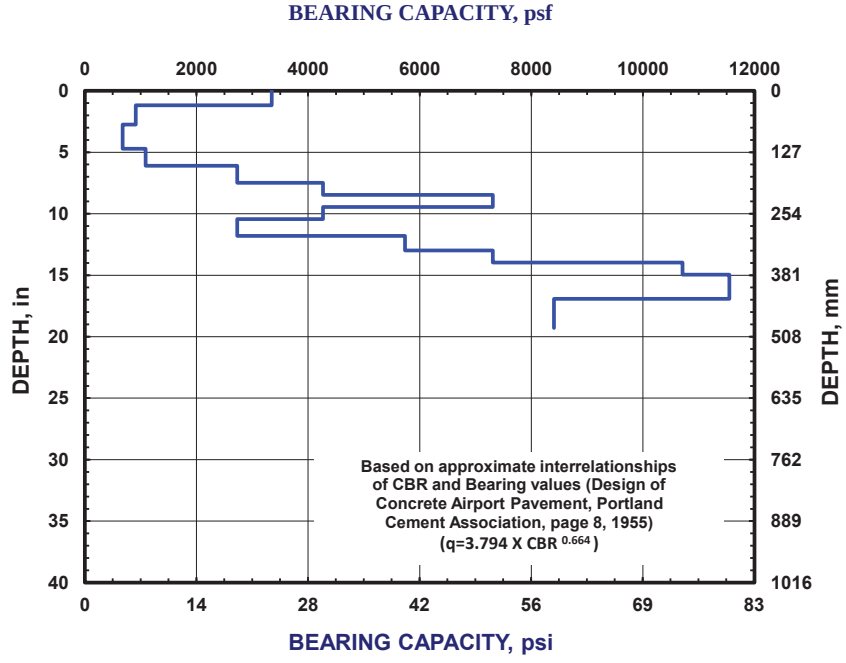
Location: 16 **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ● CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	30	1
1	70	1
1	120	1
1	155	1
2	190	1
2	215	1
3	240	1
2	265	1
2	300	1
3	330	1
3	355	1
4	380	1
8	405	1
11	430	1
4	460	1
4	490	1





DCP TEST DATA

Client: Jacobs Engineering

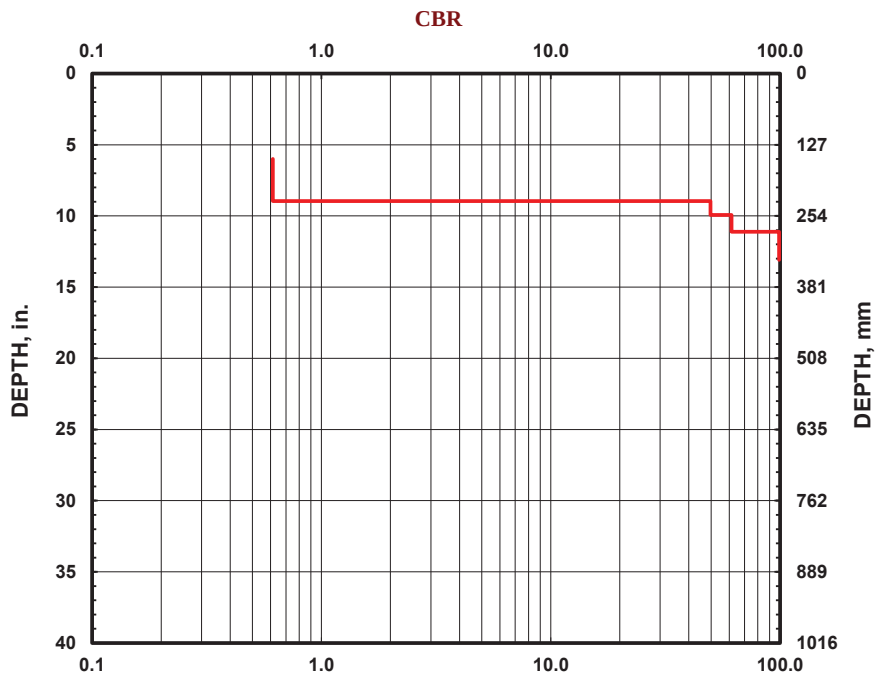
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

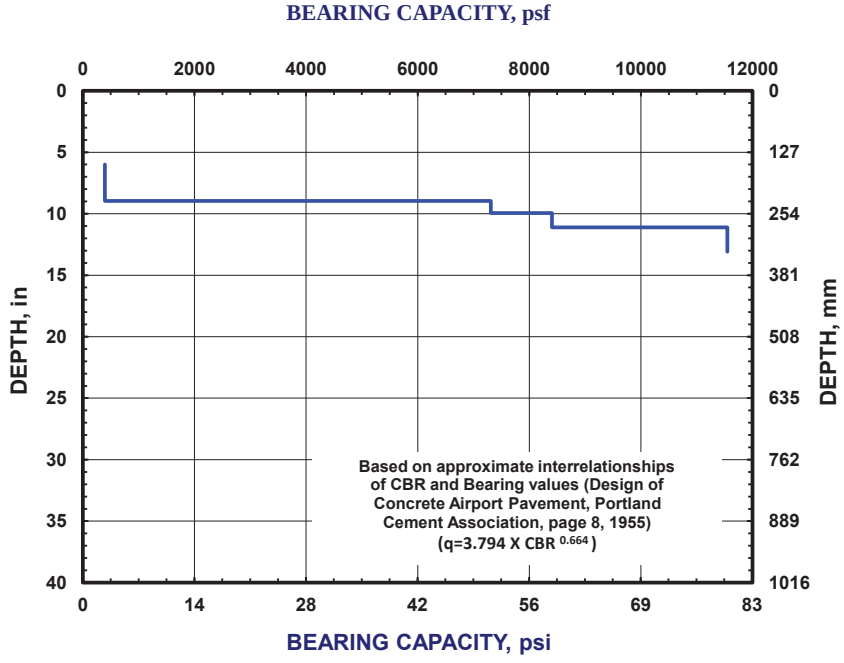
Location: 17 **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ● CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	1
1	227	1
3	252	1
4	282	1
6	307	1
20	332	1





DCP TEST DATA

Client: Jacobs Engineering

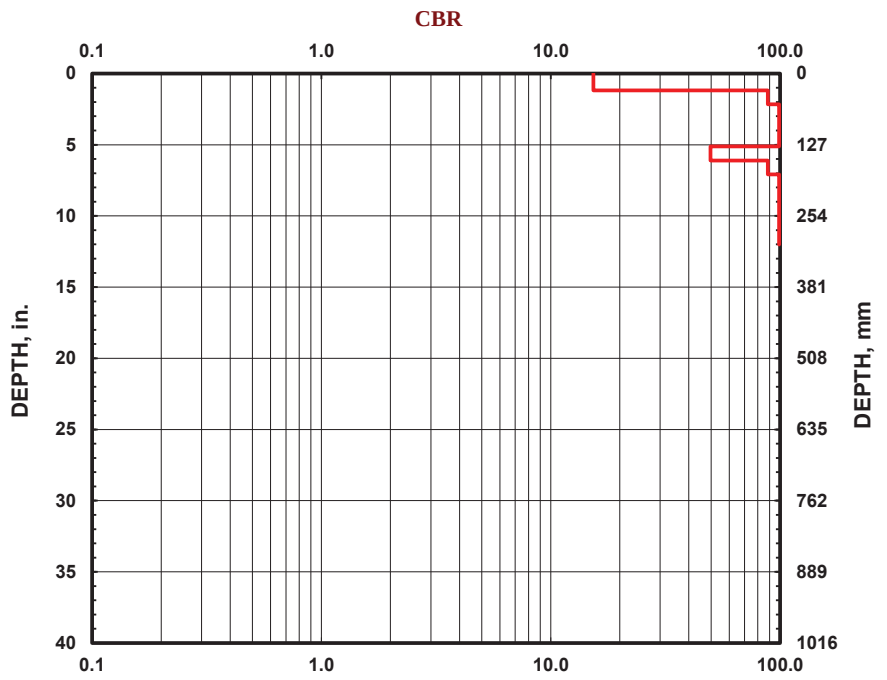
Project: *MOARNG Theater Aviation* **Date:** 9-Jan-18

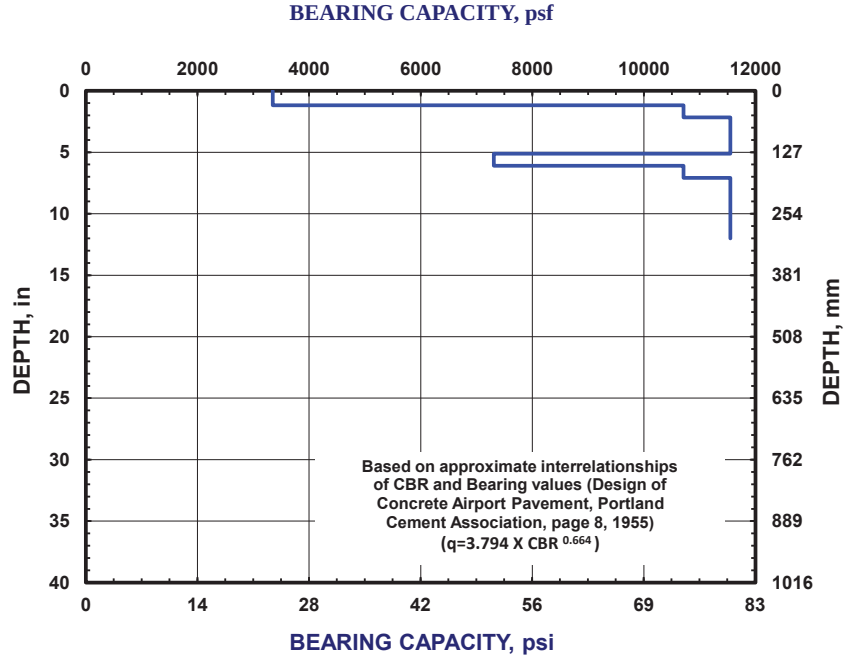
Location: 18B **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ● CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	30	1
4	55	1
10	80	1
8	105	1
5	130	1
3	155	1
4	180	1
20	205	1
14	230	1
7	255	1
5	280	1
14	305	1





APPENDIX VI

RESISTIVITY TESTING RESULTS

PALMERTON & PARRISH, INC.

GEOTECHNICAL & MATERIALS ENGINEERS
MATERIALS TESTING LABORATORIES
ENVIRONMENTAL SERVICES

4168 W. KEARNEY ST.
SPRINGFIELD, MO 65803
Ph: (417) 864-6000
www.ppimo.com

Soil Resistivity Measurements

Client: Jacobs Engineering Test Date: 1/11/2018 Project #: 245652

Project: MOARNG Theater Aviation Maint Grp Ph 3A – Springfield, MO

Electrode Spacing (L) (ft.)	North/ South Alignment	East/ West Alignment	Measured Resistance (R) (Ω)	Calculated Resistivity (ρ) (ohm-cm)
2	X		104	39,832
3	X		71.3	40,962
5	X		24.3	23,267
10	X		7.98	15,282
25	X		3.56	17,044
50	X		2.35	22,501
100	X		2.28	43,662
2		X	91.7	35,121
3		X	67	38,492
5		X	28.4	27,193
10		X	6.67	12,773
25		X	3.76	18,001
50		X	2.75	26,331
100		X	2.04	39,066

Resistivity Equation

$\rho = 191.5 (R) (L)$

Where:
ρ = Resistivity (ohm-cm)
L = Electrode Spacing (feet)
R = Resistance (Ω, ohms)

APPENDIX VII

DECLARATION ON UNIFORMITY OF AREA SOIL CONDITIONS

Appendix G
Soils Declarations

DECLARATION ON

UNIFORMITY OF AREA SOIL CONDITIONS

State: Missouri Date: 02/09/18

Site Location: Springfield-Branson National Airport

Address: Springfield, Missouri Project:

Project: MOARNG TASMG Phase 3A

I hereby declare, on the basis of my knowledge of soil conditions within this area and in conjunction with review of published geological date for this region, that the soil conditions and characteristics existing at the subject site for the proposed project are not peculiar to the site but are, in my judgement, the same type and nature of soils that are prevalent throughout the area within at least a 5-mile radius of the subject site to such an extent that it would not be reasonable to expect that the requirements for special foundation work needed for the proposed facilities at this site could be avoided by relocation of the project to another area within the 5-mile radius.

(Signature of Soils Engineer)

Brandon R. Parrish, P.E.
(Soils Engineer Name)

Vice-President
(Title)

Palmerton & Parrish, Inc. (PPI)
(Firm Name)

NOTE: There are significant depths of existing fill at this site, plus karst considerations. Designers should refer to the PPI Geotechnical Report dated 02/09/18. The natural soils are considered uniform as compared to the surrounding natural soils, but the fill present is specific to the site.

APPENDIX VIII

DECLARATION OF SOIL BEARING CAPACITY

DECLARATION

OF

SOIL BEARING CAPACITY

State: Missouri

Date: 02/09/18

Site Location: Springfield-Branson National Airport

Address: Springfield, Missouri

Project: MOARNG TASMG Phase 3

On the basis of our surface and subsurface investigation, and on generally accepted practices and procedures of the geotechnical engineering profession, I hereby declare to the best of my professional opinion, that the existing soil conditions at the site for this project are of a nature and classification which determine that the undisturbed soils at elevation 1252.5 to 1256.5 feet (elevation of the bottom of the proposed footing) when considered in conjunction with the supporting capability of the underlying soils strata, are rated at an allowable design bearing capacity of not less than 2,500 psf for continuous and 3,000 psf for individual spread footings for a spread footing type of building foundation.

(Signature of Soils Engineer)

Brandon R. Parrish, P.E.

(Soils Engineer Name)

Vice-President

(Title)

Palmerton & Parrish, Inc. (PPI)

(Firm Name)

NOTE: There are significant depths of existing fill at this site, plus karst considerations. Designers should refer to the PPI Geotechnical Reports dated 02/09/18.

APPENDIX IX

IMPORTANT INFORMATION REGARDING YOUR GEOTECHNICAL REPORT

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a.modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

Copyright 2004 by ASFE, Inc. Duplication, reproduction, or copying of this document, in whole or in part, by any means whatsoever, is strictly prohibited, except with ASFE's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of ASFE, and only for purposes of scholarly research or book review. Only members of ASFE may use this document as a complement to or as an element of a geotechnical engineering report. Any other firm, individual, or other entity that so uses this document without being an ASFE member could be commiting negligent or intentional (fraudulent) misrepresentation.

IIGER06075.0MRP

APPENDIX B

City of Springfield, Missouri

General Conditions & Technical Specifications for Public Improvements

Adopted: 03/01/2018

Dan Smith _____
Director of Public Works

TABLE OF CONTENTS
GENERAL CONDITIONS AND TECHNICAL SPECIFICATIONS

CHAPTER 1 – DEFINITIIONS

1.1 DEFINITION OF ABBREVIATIONS……..1-1
1.2 DEFINTIONS AND TERMINOLOGY……..…….. 1-1

CHAPTER 2 – GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY…….…… 2-2
ARTICLE 2 - PRELIMINARY MATTERS……..……. 2-2
ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE……2-4
ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS……..……..... 2-7
ARTICLE 5 - BONDS AND INSURANCE……...…… 2-14
ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES……..……. 2-19
ARTICLE 7 - OTHER WORK AT THE SITE…….…….. 2-35
ARTICLE 8 - OWNER'S RESPONSIBILITIES……..….. 2-37
ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION……...……2-38
ARTICLE 10 - CHANGES IN THE WORK; CLAIMS……...……..2-42
ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK..….2-44
ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES……... 2-48
ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK……..…. 2-51
ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION……..…..2-55
ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION……..… 2-64
ARTICLE 16 - DISPUTE RESOLUTION……..…2-67
ARTICLE 17 – MISCELLANEOUS…….……. 2-67

CHAPTER 3 – EARTHWORK

3.1 CLEARING AND GRUBBING…….……..…… 3-1
3.2 GRADING…….…..…..…… 3-2
3.3 SUBGRADE PREPARATION…….…...……. 3-6
3.4 FILLING EXISTING MANHOLES, CATCH BASINS, INLETS AND MISCELLANEOUS STRUCTURES……3-9
3.5 REMOVAL OF EXISTING STRUCTURES……..…… 3-9
3.6 REMOVAL OF EXISTING PAVEMENT, CURB, COMBINATION CURB AND GUTTER, DRIVEWAY PAVEMENT, AND SIDEWALK ……...… 3-10

CHAPTER 4 – SANITARY SEWERS

4.1 SEWER PIPE…… 4-1
4.2 MANHOLES……. 4-11
4.3 MANHOLE ADJUSTMENTS…….. 4-13
4.4 SEWAGE PUMPING STATIONS……..……. 4-14
4.5 FORCE MAINS…….4-16
4.6 ACCEPTANCE TESTS FOR SEWERS…….…….. 4-16
4.7 ACCEPTANCE TESTS FOR MANHOLES……...……. 4-20
4.8 ADJUSTMENTS OF SANITARY SEWER LATERALS……...…….4-20

CHAPTER 5 – STORM SEWERS

5.1 PIPE…….…….. 5-1
5.2 STRUCTURES…….. 5-8
5.3 FIELD TESTS AND INSPECTIONS……..…….…… 5-13

CHAPTER 6 – PORTLAND CEMENT CONCRETE

6.1 DESCRIPTION…….…… 6-1
6.2 MATERIALS……..…….. 6-1
6.3 PROPORTIONS OF MATERIALS…….……. 6-3
6.4 GENERAL REQUIREMENTS…….…… 6-4
6.5 CONCRETE PROTECTION CURING AND PLACING INTO SERVICE……6-6

CHAPTER 7 – MISCELLANEOUS

7.1 CONCRETE STRUCTURES……..……. 7-1
7.2 ADJUSTMENT OF DOWNSPOUT DRAINS……..…… 7-2
7.3 ADJOINING STREETS AND ALLEYS…….……..…… 7-6
7.4 STONE RIPRAP FACING……..……..7-7
7.5 NOT USED…….……..……7-7
7.6 CONSTRUCTION SURVEYING…….7-7
7.7 TEMPORARY TRAFFIC CONTROL AND WORK ZONE MANAGEMENT…7-10

CHAPTER 8 – PORTLAND CEMENT CONCRETE CURB AND GUTTER

8.1 CURB AND GUTTER…….. 8-1

CHAPTER 9 – PORTLAND CEMENT CONCRETE PAVEMENT AND INTEGRAL CONCRETE CURB

9.1 PORTLAND CEMENT CONCRETE PAVEMENT……..……..9-1
9.2 INTEGRAL CURB……..……. 9-8

CHAPTER 10 – SIDEWALKS AND DRIVEWAYS

10.1 SCOPE OF WORK……..…..…..10-1
10.2 MATERIALS……..……10-1
10.3 CONSTRUCTION METHODS……..…… 10-1
10.4 METHOD OF MEASUREMENT……...……10-4
10.5 BASIC OF PAYMENT……..……. 10-4

CHAPTER 11 – PLANT MIX BITUMINOUS BASE AND PAVEMENT

11.1 GENERAL……...……11-1
11.2 MATERIAL……..……...11-1
11.3 NOT USED…….…….. 11-4
11.4 JOB MIX FORMULA…….…… 11-5
11.5 GRADATION AND DELETERIOUS CONTENT CONTROL…..…….. 11-6
11.6 LABORATORY……...11-7
11.7 CONSTRUCTION REQUIREMENTS ……..……11-8
11.8 QUALITY CONTROL AND TESTING…… …..….. 11-12

CHAPTER 12 – NOT USED

CHAPTER 13 – SEEDING AND SODDING

13.1 SEEDING……...……. 13-1
13.2 NATIVE GRASS AND WILDFLOWERS……..…….…….……13-4
13.3 NOT USED……..……13-7
13.4 SODDING……...…… 13-9

CHAPTER 14 – TRAFFIC SIGNALS

14.1 GENERAL……...……14-1
14.2 EQUIPMENT……..…… 14-4
14.3 INSTALLATION……...……. 14-25

CHAPTER 15 – NOT USED

16 TEMPORARY EROSION AND SEDIMENT CONTROL

16.1 GENERAL……..……..…...16-1
16.2 DEFINITIONS…….16-1
16.3 MATERIALS……...16-1
16.4 PROJECTS DISTURBING 1 ACRE OF GREATER……..16-2
16.5 PROJECTS DISTURBING LESS THAN 1 ACRE…….16-5

16.6 INDEMNITY……...16-6
16.7 ENFORCEMENT……....16-6
16.8 MEASUREMENT AND PAYMENT.……16-6

1 DEFINITIONS

1.1 DEFINITION OF ABBREVIATIONS

1. AASHTO – American Association of State Highway and Transportation Official
2. ACI – American Concrete Institute
3. ANSI – American National Standards Institute
4. ASTM – American Society for Testing and Materials
5. AWWA – American Water Works Association
6. IMSA – International Municipal Signal Association
7. ITE – Institute of Transportation Engineers
8. NEMA – National Electrical Manufacturing Association

1.2 DEFINTIONS AND TERMINOLOGY

1.2.1 Definitions. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. **Addenda**. Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
2. **Agreement.** The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
3. **Application for Payment.** The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
4. **Asbestos.** Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. **Advertisement.** The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

6. **Award.** The action of the City accepting the proposal of the lowest responsible bidder for the work, subject to the execution and approval of a satisfactory contract therefor and bond to secure the performance thereof, and to such other conditions as may be specified or as required by law.

7. **Bid.** The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

8. **Bidder**. The individual or entity who submits a Bid directly to Owner.

9. **Bidding Documents.** The Bidding Requirements and the proposed Contract Documents (including all Addenda).

10. **Bidding Requirements**. The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

11. **Bid Security.** A bid security shall be a bond provided by a surety company authorized to do business in this State, or the equivalent in cash, or otherwise supplied in a form satisfactory to the City in an amount equal to or at least 5% of the amount of the bid.

12. **Change Order.** A document which is signed by Contractor, Engineer of Record, and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

13. **Contract Documents.** Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

14. **Claim**. A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

15. **Contaminated Environmental Media.** Soil, sediment, ground water, or air contaminated with Hazardous Substances.

16. **Contract.** The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

17. **Contract Bond.** The form of security approved by the City to be used by the contractor and his surety or sureties guaranteeing complete performance of the contract and the

payment of all legal debts pertaining to the construction of the project, and conditioned as may be required by the Code of the City of Springfield, Missouri.

18. **Contract Documents.** Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

19. **Contract Price**. The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Chapter 2 Paragraph 11.03 in the case of Unit Price Work).

20. **Contract Times**. The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

21. **Contractor.** The individual or entity with whom Owner has entered into the Agreement.

22. **Cost of the Work.** See Chapter 2 Paragraph 11.01 for definition.

23. **Ditch Line.** A line where the roadway ditch meets the back slope. It is located at the lowest point of a V-bottom ditch or furthest point from the roadway of a flat bottom ditch where the roadway slopes back to the existing ground line.

24. **Duct.** An enclosed tubular casing, or raceway, for protecting wires, lines, or cables that is often flexible or semi-rigid (1-3% diametric deflection). The casing, or raceway, is separate from the cable or conductor that passes through it.

25. **Engineer.** The Director of Public Works, and his designee(s), including the individual whom the Director of Public Works has identified as Project Manager overseeing the Work. Engineer is a representative of Owner.

26. **Engineer of Record.** The Registered Professional Engineer responsible for signing, sealing and dating all submitted contract plans and job special provisions.

27. **Float.** The amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any of the activities in the progress schedule.

28. **Extra Work.** An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract and within the intended scope of the contract, as determined by the Engineer.

29. **Hazardous Environmental Condition.** The presence at the Site of hazardous materials or conditions, including, but not limited to, Contaminated Environmental Media, Asbestos, metal bearing protective coatings, paints, and linings, PCBs, Petroleum,

Hazardous Waste, Radioactive Material, metals such as but not limited to arsenic, cadmium, chrome, cobalt, lead, and mercury, and other Hazardous Substances; in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto or cause them to come under the application of a federal, state, or local regulation.

30. Hazardous Substance. This term shall have the meaning provided in 29 CFR 1910.120 titled "Hazardous Waste Operations and Emergency Response," as amended from time to time.

31. Hazardous Waste. The term Hazardous Waste shall have the meaning provided in 40 CFR 261 titled "Identification and Listing of Hazardous Waste," as amended from time to time.

32. Inspector. The Principal Engineer of Construction Inspection for the Department of Public Works, and his designee(s), employees of Owner, whom Owner has assigned to the Site or any part thereof. Inspector is a representative of Owner.

33. Laws and Regulations; Laws or Regulations. Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

34. Liens. Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

35. Milestone. A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

36. Notice of Award. The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

37. Notice to Contractors. The notification provided prospective bidders, containing a general description of the proposed work, and including information and requirements for the submission of bids.

38. Notice to Proceed. A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

39. Owner. The City of Springfield, Missouri, its agents, employees, and representatives, with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

40. PCBs. Polychlorinated biphenyls.

41. **Petroleum.** Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

42. **Pay Item.** An item of work specifically described and for which a price, either unit or lump sum, is provided. It includes the performance of any and all work and the furnishing of any and all labor, equipment, and materials contemplated or described on the plans or in the text of the specifications included in the contract.

43. **Plans.** That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Plans as so defined.

44. **Progress Schedule.** A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

45. **Project.** The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

46. **Project Manual.** The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

47. **Proposal.** The written offer submitted by the bidder in the required manner on the form of proposal to perform the work contemplated at his bid prices.

48. **Form of Proposal.** The approved form furnished by the Public Works Department on which the bid prices for the work are to be submitted.

49. **Proposal Guaranty.** The security furnished with a proposal to insure that the bidder will enter into the contract if his proposal is accepted.

50. **Radioactive Material.** Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

51. **Responsible Bidder.** Any person, firm, or corporation submitting a bid for the work contemplated who maintains a permanent place of business, has adequate plant equipment to do the work properly and within the time limit that is established, and has adequate financial status to meet his obligations contingent to the work.

52. **Responsive Bidder.** Any person, firm, or corporation submitting a bid for the work contemplated whose Bid Form is complete and regular, free of exclusions or special

conditions and has no alternative bids for any item unless requested in the Technical Specifications, and has submitted all required information with the bid.

53. **Right-of-Way.** Property rights acquired by the City of Springfield for the construction and maintenance of an improvement.

54. **Samples.** Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

55. **Schedule of Submittals.** A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

56. **Schedule of Values.** A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

57. **Shop Drawings.** All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

58. **Site.** Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

59. **Special Provisions.** Directions or requirements, peculiar to the Work and not otherwise thoroughly or satisfactorily detailed or set forth in the General Conditions or Specifications. Special provisions may be included in the specifications or may be included as a note or special detail on the plans. Special Provisions shall prevail over General Conditions, Plans, and Specifications whenever in conflict therewith**.**

60. **Specifications.** That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

61. **Subcontractor.** An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

62. **Substantial Completion.** The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

63. **Successful Bidder.** The Bidder submitting a responsive Bid to whom Owner makes an award.

64. **Supplier.** A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

65. **Surety.** A corporate body duly authorized to do business in the State of Missouri, and which has executed a bid bond with the bidder or a contract bond with the contractor.

66. **Underground Facilities.** All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

67. **Utility**: Privately, publicly or cooperatively owned line, facility or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, storm water not connected with highway drainage or any other similar commodity, including any fire or police signal system or street lighting system which directly or indirectly serves the public and does not include privately owned facilities devoted exclusively to private use. The term utility also means the utility company inclusive of any wholly owned or controlled subsidiary. The term "utility" includes those facilities used solely by the utility that are a part of its operating plant. The term also includes those utility type facilities that are owned or leased by a government agency for its own use or otherwise dedicated solely to governmental use.

68. **Work.** The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

69. **Working Drawings.** Shop drawings, bending diagrams for reinforcing steel, or any other supplementary plans or similar data which the contractor is required to submit to the Engineer for approval.

1.2.2 Terminology. The words and terms discussed in Paragraph 1.2.2.1 through 1.2.2.5 are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

1.2.2.1 Intent of Certain Terms or Adjectives. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize

an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Chapter 2 Paragraph 9.09 of the General Conditions and Technical Specifications or any other provision of the Contract Documents.

1.2.2.2 Day. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight and is any day of the year, no days being excepted.

1.2.2.3 Defective. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents; or

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Owner’s written acceptance of the Work.

1.2.2.4 Furnish, Install, Perform, Provide.

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

1.2.2.5 Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

CITY OF SPRINGFIELD, MO

REVISED November 1, 2017

City of Springfield, Missouri General Conditions.
Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.
Revision: November 1, 2017

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY [Entire section of EJCDC deleted and replaced with Owner-specific requirements, which can be found in Chapter 1 of the City of Springfield's *General Conditions and Technical Specifications*.]

ARTICLE 2 - PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified herein certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor, free of charge, three (3) copies of the Specifications and three (3) sets of the Plans, together with all Addenda. Additional copies of the Project Manual and Plans may be obtained from Owner upon request at the cost of reproduction**.**

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the ninetieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier**,** unless stated otherwise in the Special Provisions.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents.~~;~~

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all**.** In case of discrepancy, calculated dimensions shall prevail over scaled dimensions; Special Provisions shall prevail over Plans; Plans shall prevail over Specifications.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby. Contractor shall take no advantage of any apparent error or omission in the plans or Specifications.

2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by a Change

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

2. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Plans Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer of Record or its consultants, including electronic media editions; or

2. reuse any such Plans, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer or Engineer of Record and specific written verification or adaptation by the entity responsible for those documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Unless otherwise stated, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05. Owner will acquire all easements in the plans unless noted in the Special Provisions.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Special Provisions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Special Provisions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

C. *Cautionary note regarding Karst Features:* The predominant limestone strata in the Springfield area are extensively weathered, resulting in the formation of numerous karst features; caves, springs, sinks, losing streams, cherty clay residuum, etc. In many areas stream erosion has removed the residuum, and rock is at or very close to the surface, whereas in other areas as much as 40 feet of residuum remains. The contact between the bedrock and residual soil is extremely pinnacled. Bedrock pinnacles commonly have 10 to 15 feet of relief and as much as 30 feet. Typically, the limestone pinnacles project vertically upward from narrow bedrock lows or cutters between the pinnacles. Locally, a mass of limestone may be "floating", with clay completely surrounding the large limestone block. Contractor expressly acknowledges that no representations are made in the Plans as to either the presence or absence of karst features and Contractor agrees to be stopped from making any claims regarding such features which may be encountered.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;
then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of obtaining additional exploration or tests with respect thereto, and issue Engineer's findings and conclusions in writing (with a copy to Contractor). ~~of.~~

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer of Record by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Special Provisions:

1. Owner and Engineer of Record shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following shall be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data;

b. locating all Underground Facilities shown or indicated in the Contract Documents;

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated:

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer of Record. Engineer of Record will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, ~~a~~ a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

3. Generally, service connections are not indicated on the Plans. Contractor shall be responsible for discovery of existing underground installations, in advance of excavating or trenching, by contacting all local utilities and by prospecting.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Special Provisions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

reports and drawings are not Contract Documents. Such "technical data" is identified in the Special Provisions . Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Plans or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. Not Used

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site**.** Abatement of Hazardous Environmental Conditions at the Site is covered in the Special Provisions.

ARTICLE 5 - BONDS AND INSURANCE [Entire section of EJCDC deleted and replaced with Owner-specific requirements.]

5.01. *Performance, Payment, and Other Bonds.*

The Contractor shall furnish a Performance Bond and a Labor and Materials Payment Bond with surety approved by Owner and on the forms approved by Owner, each bond shall be in the full amount of contract conditioned upon the full and faithful performance of all major terms and conditions of this contract and payment of all labor and material suppliers. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bond(s) hereto attached for its faithful performance and payment of labor and material suppliers, Owner shall deem the surety or sureties upon such bond(s) to be unsatisfactory, or if, for any reason, such bond(s) ceases to be adequate to cover the performance of the work, the Contractor shall, at its expense, within five (5) days after the receipt of notice from Owner to do so, furnish an additional bond or bonds, in such form and amount, and with such surety or sureties as shall be satisfactory to Owner. In such event no further payment to the Contractor shall be deemed to be due under this contract until such new or additional security for the faithful

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

performance of the work and the payment of labor and material suppliers shall be furnished in a manner and form satisfactory to Owner. The corporate surety on any performance or payment bond must be licensed by the State of Missouri and if the required bond exceeds $25,000.00 must be listed in United States Treasury Circular 570.

5.02. *Licensed Sureties and Insurers*.

A. All Bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required, and shall meet such additional requirements and qualifications as may be provided in the Special Provisions.

B. Without limiting any of the other obligations or liabilities of the Contractor, the Contractor shall secure and maintain at its own cost and expense, throughout the duration of this Contract and until the work is completed and accepted by Owner, and the Board of Utilities, insurance of such types and in such amounts as may be necessary to protect it and the interests of Owner, and the Board of Utilities, against all hazards or risks of loss as hereunder specified or which may arise out of the performance of the Contract Documents. The form and limits of such insurance, together with the underwriter thereof in each case, are subject to approval by the Owner, and the Board of Utilities. Regardless of such approval, it shall be the responsibility of the contractor to maintain adequate insurance coverage at all times during the term of the Contract. Failure of the Contractor to maintain coverage shall not relieve it of any contractual responsibility or obligation or liability in general or under the Contract Documents.

The certificates of insurance, including evidence of the required endorsements hereunder or the policies, shall be filed with Owner within ten (10) days after the date of the receipt of Notice of Award of the Contract to the Contractor and prior to the start of work. All insurance policies shall require that the insurance company in question provide thirty (30) days written notice prior to modification or cancellation of such insurance. Such notices shall be mailed, certified mail, return receipt requested, to:

City of Springfield - Public Works Department, P.O. Box 8368, Springfield, MO 65801-8368; and

Such policies shall name Owner as an additional insured, with limits of liability not less than the sovereign immunity limits for Missouri public entities calculated by the Missouri Department of Insurance as of January 1 each calendar year and published annually in the Missouri Register pursuant to Section 537.610, RSMo.

(See, http://insurance.mo.gov/industry/sovimmunity.php)

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

5.03. *Certificates of Insurance*.

A. Contractor shall deliver to Owner, with copies to each additional insured or loss payee as identified in the Special Provisions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured or loss payee as identified in the Special Provisions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04. *Contractor's Liability Insurance*.

A. The policies of insurance so required by this Paragraph 5.04 to be purchased and maintained shall:

1. Include at least the specific coverages and be written for not less than the limits of liability specified or required by Laws or Regulations, whichever is greater;

2. Include completed operations insurance;

3. Include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.07, 6.11, and 6.20;

4. Contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 shall so provide);

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

5. Remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07;

6. Include completed operations coverage;

a. Such insurance shall remain in effect for two years after final payment.

b. Contractor shall furnish Owner and each other additional insured to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

7. Contain a cross liability or severability of interest clause or endorsement. Insurance covering the specified additional insureds shall be primary insurance, and all other insurance carried by the additional insureds shall be excess insurance; and

8. With respect to workers' compensation and employers' liability, comprehensive automobile liability, commercial general liability, and umbrella liability insurance, and all other liability insurance specified herein to be provided by Contractor, Contractor shall require its insurance carriers to waive all rights of subrogation against Owner, and its officers, employees, and agents.
9. Legislative or Judicial Changes. In the event the scope or extent of Owner's tort liability as a governmental entity as described in Section 537.600 through 537.650 RSMo is broadened or increased during the term of this agreement by legislative or judicial action, Owner may require Contractor, upon 10 days written notice, to execute a contract addendum whereby the Contractor agrees to provide, at a price not exceeding Contractor's actual increased premium cost, additional liability insurance coverage as Owner may require to protect Owner from increased tort liability exposure as the result of such legislative or judicial action. Any such additional insurance coverage shall be evidenced by an appropriate certificate of insurance and shall take effect within the time set forth in the addendum.

10. Subcontracts. In case any or all of this work is sublet, the Contractor shall require the subcontractor to procure and maintain all insurance required in subparagraphs B, C, and D hereof and in like amounts. Contractor shall require any and all subcontractors with whom it enters into a contract to perform work on this project to protect Owner and the Board of Utilities through insurance against applicable hazards or risks and shall, upon request of Owner, provide evidence of such insurance.

B. Workers' Compensation....Statutory coverage per RSMo 287.010 et seq.
Employer's Liability.....$1,000,000.00

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

C. Commercial General Liability Insurance, including coverage for Premises, Operations, Products and Completed Operations, Contractual Liability, Broad Form Property Damage, Independent Contractors, Explosion, Collapse, and Underground Property Damage and endorsed for blasting if blasting required. Such coverage shall apply to bodily injury and property damage on an "Occurrence Form Basis" with limits of at least Two Million Six Hundred Eighteen Thousand Two Hundred Thirty and no/100 Dollars ($2,618,230.00) for all claims arising out of a single accident or occurrence and at least Three Hundred Ninety-Two Thousand Seven Hundred Thirty-Four and no/100 Dollars ($392,734.00) with respect to injuries and/or death of any one person in a single occurrence and an amount not less than at least $1,000,000 for all claims to property arising out of a single occurrence and at least $100,000 to any one owner with respect to damages to property. Contractor agrees that the proceeds of such insurance policy shall first be used to pay any award, damages, costs, and/or attorneys' fees incurred by or assessed against Owner, its employees, officers and agents, before payment of any award, damages, costs or attorney’s fees of Contractor, its employees, officers or agents. Contractor agrees to cause its insurer to name Owner as an additional insured on such insurance policy, including the Owner as an additional insured for coverage under its products-completed operations hazard, and said policy shall be primary and noncontributory.

D. Automobile Liability Insurance covering bodily injury and property damage for owned, non-owned and hired vehicles, with limits of at least Two Million Six Hundred Eighteen Thousand Two Hundred Thirty and no/100 Dollars ($2,618,230.00) for all claims arising out of a single accident or occurrence and at least Three Hundred Ninety-Two Thousand Seven Hundred Thirty-Four and no/100 Dollars ($392,734.00) with respect to injuries and/or death of any one person in a single accident or occurrence.

E. Owner's and Contractor's Protective Liability Insurance to protect the Owner, its agents, servants and employees from claims which may arise from the performance of this Contract, with limits of at least Two Million Six Hundred Eighteen Thousand Two Hundred Thirty and no/100 Dollars ($2,618,230.00) for all claims arising out of a single accident or occurrence and at least Three Hundred Ninety-Two Thousand Seven Hundred Thirty-Four and no/100 Dollars ($392,734.00) with respect to injuries and/or death of any one person in a single accident or occurrence.
Owner's and Contractor's Protective Liability Insurance must:

1. Be a separate policy with the named insured being: Owner and the Board of Utilities;

2. Be with the same insurance company with which the Contractor carries its Commercial General Liability Insurance and Automobile Liability Insurance; and

3. Contain an endorsement that disclaims coverage for any claim barred by the doctrines of sovereign immunity or official immunity, except attorney's fees and other litigation costs incurred in defending a claim. Nothing contained in this policy (or this endorsement thereto) shall constitute any waiver of whatever kind of these

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

defenses or sovereign immunity or official immunity for any monetary amount whatsoever.

5.08. *Acceptance of Bonds and Insurance; Option to Replace.*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 30 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

C. As identified in the contract document, night work (between 5 p.m. and 7 a.m.) may only be undertaken with the permission of Owner; such permission, however, may be revoked at any time by Owner if Contractor fails to maintain adequate equipment and supervision for the proper execution and control of work at night.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

D. Until final completion of the Work is acknowledged by Owner, Contractor shall have responsible charge and care of the Work and of all equipment and materials to be used therein, and shall bear the risk of injury, loss, or damage to any part thereof by action of the elements or from any other cause.

E. Contractor shall rebuild, repair, restore, and make good all injuries, losses, or damage to any portion of the Work or the equipment or materials occasioned by any cause before completion and acceptance of the Work and shall bear the expense therefore. Contractor shall, at no additional cost to Owner, provide suitable drainage and suitable structures as necessary to protect the Work or any portion thereof from damage.

F. Suspension of the Work or the granting of an extension of time for any cause whatever shall not relieve Contractor of his responsibilities for the Work as specified herein.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals "* [Entire section of EJCDC deleted and replaced with Owner-specific requirements, which are modeled on the Missouri Department of Transportation's Standard Specifications For Highway Construction, Section 104.6.]

A. Value Engineering Proposals. A Value Engineering Change Proposal (VECP) shall provide a product of equal or improved quality that will reduce the project cost, improve safety or decrease the time required to complete the project. A Practical Design Value Engineering Change Proposal (PDVECP) may use an existing item in place or underrun contract items. The PDVECP shall not adversely affect safety or function of the final product. The Contractor is encouraged to submit to the Engineer, in writing, VECP's and PDVECP's for modifying the plans, specifications or other requirements of the contract. Proposed modifications shall not impair, in any manner, essential functions or characteristics of the project, including but not limited to, service life, economy of operation, ease of maintenance, desired appearance, design or safety standards, and shall not significantly delay the completion of the project. Proposals shall be submitted to the Engineer in advance of the work to be performed with sufficient time allowed for review. The Owner will not be liable to the Contractor for failure to accept or act upon the proposal nor for any delays to the work attributable to any such proposal.

1. Submitting Proposals. Value engineering proposals shall be submitted on the proper form available from the Public Works Department and shall contain the following information:

a. A description of both the existing contract requirements for performing the work and the proposed changes.

b. A detailed estimate of the cost of performing the work under the existing contract and under the proposed change.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

c. A statement of the time within which the Engineer must make a decision thereon, including the probable effect the proposal will have on the contract completion time.

d. An itemized list of the contract items of Work affected by the proposed changes, including any quantity variation attributable thereto.

e. A description of any previous use or submission of the same proposal by the Contractor, including dates, job numbers, results, and/or outcome of proposal if previously submitted.

B. Conditions. The Engineer will only consider VECP's that meet the following conditions.

1. The Contractor may submit value engineering proposals that propose changes in the basic design of a bridge or a pavement, except for pavement and shoulder type. Value engineering proposals will be considered only when the proposal will not significantly delay the completion of the project.

2. The Contractor shall continue to perform the work in accordance with the requirements of the Contract until a Change Order incorporating the value engineering proposal has been approved, unless otherwise directed by the Engineer. If a Change Order has not been approved by the date upon which the contractor's value engineering proposal specifies that a decision thereon should be made, the proposal shall be deemed rejected, unless the time allowed for a decision has been extended by mutual agreement of both parties.

3. The Owner expressly reserves the right to adopt a value engineering proposal as standard practice for use on other contracts administered by the Owner. If an accepted value engineering proposal is adopted as design policy, only contractors submitting such a proposal will be eligible for compensation pursuant to this section until the proposal is incorporated into design policy, and in that case, only as to those contracts awarded to the contractor prior to submission of the accepted value engineering proposal. Value engineering proposals identical or similar to previously submitted proposals will be eligible for consideration and compensation under the provisions of this Section 6.05 if the identical or similar previously submitted proposals were not adopted as design policy by the City, or included in the present contract. Subject to the provisions contained herein, the Owner will have the right to use all or any part of any submitted value engineering proposal without obligation or compensation of any kind to the Contractor, except as noted in Section 6.05.B.4.

4. The Contractor may request the return of information submitted with a value engineering proposal if the proposal is rejected, provided this request is in writing and submitted with the proposal. If the proposal is accepted, this request will be

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

void, and the Owner may use or disclose in whole or in part any information necessary to utilize the proposal.

5. Prior to approval, it may be necessary for the Engineer to modify a proposal, with the concurrence of the Contractor, to make the proposal acceptable. If any modification increases or decreases the net savings resulting from the proposal, the Contractor's share will be determined on the basis of the proposal as modified.

6. Four copies of the complete proposal shall be submitted to the Engineer for review. The Contractor may submit a conceptual proposal for approval stating the basic proposal and approximate cost savings in order to provide the Contractor with the opportunity to submit an idea without large initial development costs if the proposal is rejected. Approval or disapproval of proposals will be granted within ten days of receipt of the proposal.

7. A proposal will be disqualified if additional information is not provided at the request of the engineer. This will include design computations, field investigations, results, surveys, etc.

8. Reimbursement for modifications to the proposal to adjust field or other conditions will be limited to the total amount of the contract bid prices. Rejection, limitation or reimbursement shall not be a basis for any claim against the Owner.

9. The Contractor will have no claim to additional costs or delays, including development costs, loss of anticipated profits, or increased material or labor costs, if the proposal is rejected.

10. The Engineer will decide whether or not to consider a proposal. The basis for proposal rejections will include excessive review requirements, evaluation or investigation, or if the proposal is inconsistent with project design policies or criteria.

C. Payment. Payment will meet the following conditions:

1. The Engineer will be the sole judge of the acceptability of a value engineering proposal and of the estimated net difference in construction costs from the adoption of all or any part of such a proposal. The Engineer may adjust contract prices if, in the judgment of the Engineer, such prices do not represent a fair measure of the value of work to be performed or to be deleted.

2. If the Contractor's cost reduction is accepted in whole or in part, such acceptance will be by a change order, which will specifically state that the Change Order is executed in accordance with Section 6.05 of the General Conditions. Such Change Orders will incorporate the changes in the Plans and Specifications necessary to permit the value engineering proposal or any part of the proposal that has been

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

accepted, to be put into effect, and will include any conditions upon which the Owner's approval thereof is based, if the approval of the Owner is conditional. The Change Order will also set forth the price for performing those items of work affected by the Change Order and the estimated net savings in the cost of performing the work attributable to the value engineering proposal in the change order, and will further provide that the Contractor will be paid 50 percent for VECP's or 25 percent for PDVECP's of the actual net savings of the construction costs at the completion of the work affected by the Change Order. All reasonable documented engineering costs incurred by the contractor to design and develop a value engineering proposal will be reimbursed and subtracted from the savings of the construction costs. All costs incurred by Engineer to review and implement the VECP will be at the Owner's expense.

3. The amount and time specified in the Change Order will be considered full compensation to the Contractor for the value engineering proposal and for the performance of that work.

4. Only the Contractor may submit proposals and be reimbursed for savings, however the Contractor may submit proposals for any approved subcontractor.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Bidding Documents or the Contract Documents require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Bidding Documents or the Contract Documents, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer, or Inspector to reject defective Work. Particular consideration will be given to the qualifications of each Subcontractor proposed on the List of Subcontractors. The use of Subcontractors proposed by Bidder and accepted

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

by Owner prior to the Notice of Award will be required in the performance of the Work unless otherwise permitted or directed by Owner.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Plans shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Special Provisions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

H. No Subcontractor shall under any circumstances relieve the Contractor or his surety of his liability and obligation under the Contract, and all transactions will be made through the Contractor. Subcontractors shall be recognized and dealt with only as workmen and representatives of the Contractor.

I. If approval is given for subletting Work, the Contractor shall perform with his own organization bid items amounting to not less than forty (40) percent of the total contract cost. The percentage of Work to be performed shall be computed using the bid items as shown on the bid proposal and unit prices as submitted by Contractor. No breakdown of the bid items will be allowed, such as breaking excavation bid item into labor, equipment, fuel, etc. The unit prices used in the computation will be the bid price on the bid proposal, not the price Contractor is to pay Subcontractor. A Subcontractor may not subcontract any portion of his work.

J. The Contractor shall be as fully responsible to the Owner for the acts and omissions of his Subcontractors and material suppliers, and of persons either directly or indirectly employed by them, as he is for acts and omissions of persons directly employed by him. The Contractor shall cause appropriate provisions of the Plans and Specifications to be inserted in all subcontracts, and contracts for the supply of materials relative to the work, to bind Subcontractors to the Contractor by the terms of these Contract Documents insofar as is applicable, and to give the Contractor the same power as regards terminating the subcontract that Owner may exercise over the Contractor under any provision of the Contract Documents. Nothing contained in this Contract shall create any contractual relation between any Subcontractor and Owner, and the Contractor shall defend, indemnify, and save harmless Owner and Engineer of Record from and against any and all liability, suits, claims, damages, costs (including attorney's fees), losses, outlays, and expenses in any manner arising out of or connected with Subcontractor claims and damages arising out of matters covered by terms of these Contract Documents which Contractor either failed to insert in subcontract documents or materially modified, notwithstanding any possible negligence (whether sole, concurrent, or otherwise) on the part of Owner, its agents or employees, and Engineer of Record.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

C. Contractor shall furnish to Owner at the time of initial submittal, satisfactory evidence that Suppliers of proprietary materials, equipment, devices, or processes to be furnished or used in the performance of the Work do indemnify, keep, and save harmless Contractor and Owner from all liabilities, judgments, costs, damages, and expenses which may arise from the use of such proprietary materials, equipment, devices, or processes, furnished to Contractor for incorporation in or use in performance of the Work and their operation by Owner after acceptance of the Work. Such satisfactory evidence shall consist of patent licenses or patent releases covering proprietary materials, equipment, devices, or processes.

6.08 *Permits*

A. Unless otherwise provided in the Special Provisions , Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Plans are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

D. Employment Requirements. Employment requirements shall be as specified herein and in the attachments at the end of the Special Provisions.

E. Work in Confined Spaces. Contractor is hereby notified that manholes and other structures included under the confined-space definition of 29 CFR 1910.146, shall be considered as hazardous locations with hazardous atmospheric conditions. The structures may contain methane, hydrogen sulfide, carbon dioxide, and other gases which are dangerous to life or health. Contractor shall allow its personnel or Subcontractors to enter these confined spaces only through compliance with an entry permit program as specified herein. Contractor shall establish and maintain a confined-space entry program appropriate to the structures and conditions encountered. The program shall meet the requirements of 29 CFR 1910.146 and shall specifically address the provisions of Paragraph (d) therein. Contractor shall enforce the requirements of 29 CFR 1910.146 Paragraphs (e) and (f) therein, shall establish and conduct a training program in accordance with Paragraph (g) therein, and shall comply with all other applicable requirements of the referenced regulation.

F. Labor Standards and Prevailing Wages. Contractor will be required to furnish an affidavit to Owner stating that he has paid the prevailing wages as set forth in the latest annual Wage Order for Greene County issued by the Missouri Division of Labor Standards. All labor utilized in the construction of the aforementioned improvements shall be paid a wage of no less than the "prevailing hourly rate of wages" for work of a similar character in this locality, as established and amended at any time by the Department of Labor and Industrial Relations of the State of Missouri. The Contractor shall submit to the Construction Inspector weekly certified payrolls including any subcontractors. Certified payrolls shall be submitted to the inspector no later than 7 calendar days after the payroll period ends. Failure to comply with timely submittal of payrolls will result in any or all payment being withheld until such time correct certified payrolls are received. At any time the contractor is found to not have paid prevailing wages, the contractor shall forfeit as a penalty to Owner one hundred dollars for each underpaid worker employed, for each calendar day, or portion thereof such worker is paid less than the said stipulated rates for any work done under this contract. Wage interviews of the Contractor's and Subcontractors' work force may be made at random to verify that the prevailing wage rate is being paid. These interviews may be on site examinations or a questionnaire mailed to the individual.

G. Employment of Unauthorized Aliens. Pursuant to Section 285.530, RSMo., Contractor and its subcontractors, shall not knowingly employ, hire for employment, or continue to

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

employ an unauthorized alien to perform work within the State of Missouri, and shall affirm, by "E-Verify", its enrollment and participation in a federal work authorized program with respect to the employees working in connection with contracted services. Further, Contractor shall sign an affidavit affirming that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. In accordance with sections 285.525 to 285.550, RSMo a general contractor or subcontractor of any tier shall not be liable when such a contractor or subcontractor contracts with its direct subcontractor with its direct subcontractor who violates subsection 1 of section 285.520, RSMo if the contract binding the contractor and subcontractor affirmatively states that the direct subcontractor is not knowingly in violation of subsection 1 of section 285.530, RSMo and shall not henceforth be in such violation and the contractor or subcontractor receives a sworn affidavit under the penalty of perjury attesting to the fact that the direct subcontractor's employees are lawfully present in the United States.

H. Missouri Products and Missouri Firms. In accordance with Chapter 71.140, Missouri Revised Statutes, preference shall be given to Missouri products. Pursuant to Section 34.076, RSMo., a preference shall be given to those persons doing business in Missouri firms, corporations, or individuals, or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less. In addition, in order for a nondomicilliary Missouri bidder to be successful, his bid must be that same percentage lower than a domiciliary Missouri bidder's bid, as would be required for a Missouri bidder to successfully bid in the nondomicilliary's state.

6.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

B. Missouri State Sales Tax Law, Section 144.030.1, RSMo. exempts purchases for construction materials associated with the Work from state sales/use tax. Owner will issue Contractor a tax-exempt letter to use as proof of this tax exemption.

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner,-its officers, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner~~,~~, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

E. *Storm Water Management Practices:* Contractor shall take sufficient precautions to prevent pollution of municipal separate storm sewer systmes, streams, lakes, ponds, sinkholes and reservoirs, with fuels, oils, bitumens, calcium chloride, or other harmful materials. Contractor shall schedule and conduct his operations so as to avoid or minimize siltation of streams, lakes, ponds, sinkholes, or reservoirs. In areas particularly subject to erosion, Contractor shall, subject to approval of Engineer, conduct his operations in such a manner to reduce exposure to uncompleted portions of the project.

F. *Vehicle/Equipment Identification:* Each Contractor and Subcontractor working on Owner right-of-way shall have its name or recognizable logo, and the name of the city and state of the principal office of the company on each motor vehicle and motorized piece of equipment being utilized.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Plans Specifications, Addenda, Change Orders~~,~~ and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, and before payment is made, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Special Provisions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Plans or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Change Order will be issued.

6.17 *Shop Drawings and Samples* [Entire section deleted and replaced with Owner-specific requirements.]

A. Requirements for shop drawings, samples, and submittal procedures shall be as specified in the Contract Documents or as required by the Engineer.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others;–

7. any correction of defective Work by Owner; or

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

8. any expiration of a correction period.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, its-employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner ~~or~~, its-employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. It is anticipated that storm, surface, and possible ground or other waters will be encountered at various times and locations during the construction process. Such waters may interfere with Contractor's operation and may cause damage to adjacent or downstream private and/or public property by flooding, lateral erosion, sedimentation, or pollution if not properly controlled by Contractor. Any Contractor working in Owner right-of-way or contracted with the Owner shall be required to follow a sediment and erosion control plan and/or a stormwater pollution prevention plan (SWPPP) as applicable and required to repair any and all damage caused by said waters. Contractor, by working on Owner right-of-way, assumes all said risk, and agrees to hold the Owner harmless.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer of Record will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer of Record.

C. Owner and Engineer of Record shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer of Record have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer of Record's review and acceptance of signed and sealed certifications of performance and design criteria used when designing systems, materials, or equipment and design drawings will be for the purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

F. When professional design services are required by the Contract Documents, Contractor shall provide certification that the design has been performed by a design professional in accordance with the Contact Documents and that the associated construction conforms to the design provided by the design professional.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Special Provisions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Special Provisions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer or Inspector.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint a replacement engineer whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Inspector*

A. Engineer will furnish an Inspector to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Inspector and assistants will be as provided in the Special Provisions and limitations on the responsibilities thereof will be as provided in Paragraph 9.09–

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner, Engineer or Contractor believes that an authorized minor variations in the Work justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

B. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

C. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. The Director of Public Works will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Engineer and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to the Director of Public Works in writing within 30 days of the event giving rise to the question.

B. The Director of Public Works will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of the Director of Public Works' decision shall

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. The Director of Public Works' written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Inspector and assistants, if any.

9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with an authorized minor variation in the Work-; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Director of Public Works for decision. A decision by the Director of Public Works shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to the Director of Public Works the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Director of Public Works ~~and~~ the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to the Director of Public Works and the claimant within 30 days after receipt of the claimant's last submittal (unless the Director of Public Works allows additional time).

C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that the Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *Allowances* [Entire section deleted.]

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease; and

4. The unit price of an item of Unit Price Work shall be subject to reevaluation and adjustment by Change Order if:

a. The variation of the actual quantity of an item of Unit Price Work performed by Contractor differs by more than 50 percent from the estimated quantity of that item indicated in the Bid, <u>and</u>

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

b. The item of Unit Price Work is equal to or greater than ten percent (10%) of the project cost, either before or after the adjustment in quantity.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph
10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that the Contractor will be paid a fee of five percent of the amount paid to the Subcontractor who actually performs the Work;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Director of Public Works and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

C. A claim for an extension of the Contract Times (or Milestones), otherwise allowable under the Contract Documents, shall be granted only to the extent the time lost exceeds the float for the delayed activity at the time of the event giving rise to the claim. Float, whether expressly disclosed or implied in any manner, is jointly owned by the project participants.

D. Contractor shall not use float suppression techniques (including, but not limited to, preferential sequencing caused by late starts of follow-up trades, unreasonably small crews, extended durations, or imposed dates) in information provided to Engineer.

E. Paragraphs C and D of this Section 12.02 shall only apply when critical path scheduling is used for the Work.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract-Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this
Paragraph 12.03.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

F. Nothing in this Article 13 concerning the correction period shall establish a period of limitation with respect to any other obligation which Contractor has under the Contract Documents. The establishment of time periods relates only to the specific obligations of Contractor to correct the Work, and has no relationship to the time within which Contractor's obligations under the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations other than to specifically correct the Work.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Engineerprefers to accept it, Engineer may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Progress Payments*

A. Progress payments on account of Unit Price Work will be based on the estimated number of units completed and approval by the Engineer.

B. *Payment Becomes Due:*

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

1. The contractor will be paid as follows: On the 22nd day of each month, the Owner will measure and compute the amount of work performed during the month and the value thereof at the contract unit price. On or about the 10th day of the month following, the contractor will be paid an amount equal to the estimated value of the work performed less the retained amount as stipulated in the agreement until construction is complete.

C. *Reduction in Payment:*

1. Owner may withhold any and all payment because:

a. The Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. Certifications, testing, or other methods required for acceptance of materials incorporated into the work have not been fully accepted or testing completed;

c. Payrolls were not received in the time frames required. The owner may also withhold payments for incorrectly submitted payrolls that corrections are not being reasonably and promptly pursued by the Contractor. Should payrolls be under investigation by the Department of Labor and/or other governing agencies, the Owner may withhold payment for an estimated amount of penalties and corrected wages as a result of the projected outcome of the said investigation;

d. The Contractor has been negligent in maintaining a job site that is free from reasonably unsafe conditions for both workers and the general public. This includes but is not limited to, maintenance of pedestrian and vehicular traffic and compliance with OSHA regulations and environmental hazards;

e. The Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A ;

f. Claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

g. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

h. There are other items entitling Owner to a set-off against the amount recommended; or

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

i. The Contract Price has been reduced by Change Orders.

14.03 *Contractor's Warranty of Title*

A. The Contractor shall be responsible for the condition of all material and all Work performed as part of this contract and such material and labor shall be guaranteed by the Contractor and his surety against defective workmanship and/or material found to be defective in manufacture or which has been damaged in handling or placement after delivery for a period of 12 months after acceptance by the Owner. Contractor shall repair, replace, or otherwise make good at its own expense any such defect or failure which may become evident within the guarantee period, excepting as may be due to normal use or wear.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use, no further corrections are necessary to the work, and no items of work remain to be completed as shown in the plans or as per executed change orders the Contractor shall notify Engineer in writing that the entire Work is Substantially Complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a Certificate of Substantial Completion.

B. Promptly after Contractor's notification, Contractor~~,~~ and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work Substantially Complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work Substantially Complete, Engineer will deliver to Contractor a Certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a list of exceptions to the project that are still required to be completed or corrected before final payment. Exceptions listed will show a date required for the exceptions to be completed. If the exceptions are not completed by the dates shown and the contractor has not shown reasonable effort to complete the exceptions in the required timeframe, the Engineer may institute liquidated damages in the same manner if the project was not Substantially Complete for the days required to complete the exceptions after the dates shown in the Certificate of Substantial Completion.

D. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the list of exceptions.

14.05 *Partial Utilization*

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Contractor and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be Substantially Complete, Engineer will notify Contractor in writing giving the reasons therefore. If Engineer considers that part of the Work to be Substantially Complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto._

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Engineer will prepare final payment.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

B. Prior to processing final payment, the contractor shall submit the following:

1. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.

2. consent of the surety, if any, to final payment;

3. a list of all Claims against Owner that Contractor believes are unsettled; and

4. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

C. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.B and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

D. After receiving all required documentation, Owner shall release final payment within thirty days less any sum Owner is entitled to including but not limited to liquidated damages.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall , make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer prior to such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

14.10 *Liquidated Damages*

A. Contractor shall furnish all supervision, labor, tools, equipment, materials and supplies as stated in Article 6 necessary to complete the Contract within the Contract Times. All time limits for Substantial Completion, and completion and readiness for final payment are of the essence to the Contract.

B. Contractor shall have all Work Substantially Complete within the Contract Times specified in the Job Special Provisions. All required items and documentation necessary for final payment in accordance with Paragraph 14.07. shall be accepted by Engineer within 45 calendar days after the date of Substantial Completion.

C. Failure or delay in completing work on time as specified or such additional time as may be allowed by the Engineer under the contract shall result in liquidated damages. This amount of liquidated damages is agreed upon by Contractor and Owner, not as a penalty, but as liquidated damages for difficult to quantify losses to the Owner and the public. Permitting the Contractor to continue and finish the work or any part of it after the expiration of the specified time, or after the extension of the time, shall in no way operate as a waiver on the part of the Owner or of any of its rights under the contract.

1. Contractor shall pay Owner liquidated damages in an amount specified in the Contract for each day that expires after the time specified for Substantial Completion until the Work is Substantially Completed.

2. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining close out documents within the Contract Times or any proper extension thereof granted by Owner, Contractor shall pay Owner fifty dollars ($50.00) for each calendar day that expires after the time specified in Paragraph 14.10.B for completion and readiness for final payment until the Work is completed and ready for final payment.

3. Owner shall have the right to deduct the liquidated damages from any money in its hands, otherwise due, or to become due, to Contractor, or initiate applicable dispute resolution procedures and to recover liquidated damages for nonperformance of this Contract within the time stipulated.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and

3. complete the Work as Owner may deem expedient.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Owner fails to act without cause on any Application for Payment within 60 days after it is submitted, or (iii) Owner fails for 60 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner, and provided Owner does not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to the Director of Public Works for a decision under Paragraph 10.05 before such decision becomes final and binding. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Special Provisions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

Legal holidays are:

New Year's Day	January 1
Martin Luther King Day	Third Monday in January
President's Day	Third Monday in February
Memorial Day	Last Monday in May
Independence Day	July 4
Labor Day	First Monday in September
Veteran's Day	November 11
Thanksgiving Day	Fourth Thursday in November
Christmas Day	December 25

When any of the above holidays fall on a Sunday, the holiday will be observed on the following Monday. When any of the above holidays fall on a Saturday, the holiday will be observed on the immediately preceding Friday.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

B. Contractor shall obtain from all Suppliers and manufacturers any and all warranties and guarantees of such Suppliers and manufacturers, whether or not specifically required by the Specifications, and shall assign such warranties and guarantees to Owner. With respect thereto, Contractor shall render reasonable assistance to Owner when requested, in order to enable Owner to enforce such warranties and guarantees. The assignment of any warranties or guarantees shall not affect the correction period or any other provisions of these Contract Documents.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

Adapted from EJCDC C-700 Standard General Conditions of the Construction Contract Copyright © 2007 National Society of Professional Engineers for EJCDC. All rights reserved.

3 EARTHWORK

3.1 CLEARING AND GRUBBING

3.1.1 Scope of Work. This work shall consist of clearing, grubbing, removing, and disposing of vegetation within the limits of right-of-way and easement areas, except such vegetation as is designated to remain or to be selectively treated. Demolition of buildings and structures including foundations and slabs shall be as specified in the Special Provisions or on the plans.

3.1.2 Construction Requirements. The Engineer will establish right-of-way and construction lines and will designate all trees, shrubs, and plants that are to remain. The Contractor shall preserve without damage any trees and shrubs designated to remain. All trees, stumps, brush, and hedge not designated to remain shall be cleared and grubbed as required and shall be disposed of in an acceptable manner.

Stumps and roots in fill and cut areas shall be grubbed to a depth of not less than 12 inches below the existing earth grade. Stump holes shall be back-filled with suitable material and compacted to the approximate density of the adjacent area. Grubbing of borrow areas, channel changes, and inlet and outlet easements will be required only to the extent necessitated by the proposed construction.

Burning of products from clearing and grubbing operations will not be permitted without obtaining a burning permit from the City Fire Department. The burial of stumps and debris will not be permitted on the right-of-way. Products of clearing and grubbing shall be removed from the right-of-way and disposed of out of sight from the roadway provided an acceptable written agreement with the property owner on whose property the products are placed is submitted by the Contractor.

Within the construction limits of the project, the Contractor shall trim any tree which does not provide 9 feet vertical clearance above any sidewalk and 14 feet vertical clearance above any street. Tree trimming shall be done before final payment and the trees shall be shaped at the direction of the Engineer. This tree trimming shall be considered incidental to the contract and no additional compensation shall be allowed.

Contractor shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of the Engineer. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

3.1.3 Method of Measurement. No measurements will be made for clearing and grubbing.

3.1.4 Basis of Payment. The accepted quantities of clearing and grubbing will be paid for at the lump sum contract price. Payment shall include all incidental items necessary to complete the work. When no pay item for clearing and grubbing is included in the contract, clearing and grubbing, including scalping, will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-3.1.4 Clearing & Grubbing -- per lump sum

3.2 GRADING

3.2.1 Scope of Work. This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work required for grading the project in coordination with all previous work performed, at the locations shown on the plans, in accordance with the requirements of applicable sections and as provided for in the Special Provisions.

3.2.2 Materials and Definitions.

3.2.2.1 Grading as used herein shall be construed to mean the performance of all excavation, embankment, and backfill in connection with the construction of all improvements.

3.2.2.2 Excavation is defined as the removal of materials from the construction area to the lines and grades shown on the plans.

3.2.2.2.1 Unclassified Excavation. Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material required to be excavated will be considered as “Unclassified Excavation” unless the contract specifically states otherwise.

3.2.2.2.2 Rock. Rock is defined as being sandstone, limestone, chert, granite, siltstone quartzite, slate, shale occurring in its natural undisturbed state, hard and unweathered, in ledges 6 inches or more in thickness or similar material in masses or boulders, each being more than 1½ cubic yard(s) in volume.

Should rock be encountered in two or more ledges, each ledge being more than 6 inches thick and with interlying strata of earth, clay, shale, or gravel not more than 12 inches thick in each stratum, the entire volume between the top of the upper ledge and bottom of the lower ledge will be classified as rock.

3.2.2.2.3 Earth. All materials not classified as rock shall be classified as earth. Chert (joint flint rock) broken by intermittent clay partings or clay seams or stratified chert cemented with clay seams (hardpans) shall be classified as earth.

3.2.2.3 Embankment is defined as the placing and compacting of suitable material in the construction area to the lines and grades shown on the plans.

3.2.2.4 Material suitable for use as embankment material shall be entirely imperishable and shall be judged acceptable by the Engineer on the site.

3.2.2.4.1 Earth Materials. Material suitable for earth embankment shall be free of waste material, contain less than 40% by volume of rock and gravel, and contain no particles having a maximum dimension greater than 4 inches.

3.2.2.4.2 Rock Materials. Materials suitable for rock embankment shall be free of waste material and contain 60% or more by volume of rock or gravel containing particles with a maximum dimension greater than 3 inches but not greater than 12 inches.

3.2.2.5 Unsuitable or Waste Material. Material not suitable for use as embankment material shall include excess excavation material and waste material including mulch, frozen material, organic material, topsoil, rubbish and rock larger than 12 inches, maximum dimension.

3.2.2.6 Structures. Structures as used herein refers to bridges, culverts, basins, street drainage structures, headwalls, retaining walls, footings, foundation walls and similar construction.

3.2.3 Construction Details. The Contractor shall call Missouri One Call System (1-800-DIG-RITE) and note location of all existing utilities and facilities as shown on the plans, or as confirmed as a result of a pre-construction conference attended by Contractor representatives, public utility organizations, and other interested persons and concerns. The Contractor shall be responsible for the protection and preservations of such utilities and facilities.

Grading, excavation and back-filling for roadways, roadway intersections, sidewalks, shoulders, and parkways shall be made to the lines, grades, and cross-sections shown on the plans. During construction, the area shall be maintained in such condition that it will be well drained at all times.

Waste materials including organic material, trees, stumps, rubbish, and debris shall be removed from the site and disposed of as an incidental part of the grading work. Excess excavation material including muck, topsoil, and rocks larger than 12 inches, maximum dimension, shall be paid for on the basis of the applicable unit bid price for excavation.

It shall be the Contractor’s responsibility to take the necessary precautions to preserve and protect all existing tile drains, sewers and other subsurface drains affected by his operations. All existing subsurface facilities shall be maintained so their use is not interrupted. The Contractor shall repair or replace, at his own expense, any such drainage facility damaged because of negligence on his part.

3.2.4 Excavation. All suitable material removed by excavation shall be used as far as practicable in the formation of embankments as required to complete the work. Any rock encountered within 6 inches of finished subgrade shall be removed. The Contractor shall sort all excavated material and stockpile when necessary, to provide suitable materials for embankments. The cost involved in sorting stockpiling, or wasting of such material shall be included in the cost for excavation or

the cost for embankment, but not both, depending upon which is the basis for bidding as listed in the proposal.

Excavated material in excess of the amount needed to complete the grading shall be considered as waste material and shall be removed from the site. When permitted by the Engineer, a portion of the waste which is suitable for embankment may be disposed of at the site by equitable distribution of the material to specified areas within the project limits. The disposition of all waste material shall be considered as incidental to the performance of grading work.

3.2.4.1 Method of Measurement. No measurements will be made for excavation unless there are appreciable errors in the contract quantity or authorized changes are made to the planned area of excavation. Appreciable errors will only be considered in areas where original ground varies from planned cross sections by more than 1 foot on average. For changes to the quantity as a result of appreciable errors to be considered, the Contractor shall notify the Engineer in writing of the suggested appreciable errors and provide supporting data. The Engineer shall be granted 5 business days to review this data and survey existing conditions on the site before any work shall proceed in the representative area. If the Contractor's notification of appreciable errors are found to be unwarranted, no additional compensation for delays while evaluating the need for consideration of appreciable errors will be granted to the Contractor. Any changes to the plan quantity will be field measured to the nearest cubic yard and added to or subtracted from the original plan quantity. Excavation may be measured by standard volumetric calculations or cross-section end area method of the in-place material prior to excavation.

3.2.4.2 Basis of Payment. The accepted quantities of excavation will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: hauling, dust control, shouldering, rounding slopes, obliterating existing roadbeds, finishing of the excavated area, and disposal of excess material. When no pay item for excavation is included in the contract, excavation will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-3.2.4.2 Excavation -- per cubic yard (plan quantity)

3.2.5 Embankment. The embankments shall be formed with suitable materials, as herein defined, procured from excavations made on the project site, or from a Contractor furnished site as required to complete the grading work.

The existing surface upon which embankment material is to be placed shall be scalped by having all unstable and unsuitable material, such as topsoil, peat, mulch, coal seams, disintegrated shale, rubbish, logs or stumps, and unconfined saturated soils, removed to the depths shown before starting the embankment work.

When embankments 2 feet or less in depth are to be placed on areas covered by existing pavement, the existing pavement shall be removed and the cleared ground surface shall be compacted at optimum moisture to the specified density. Where embankments greater than 2 feet

in depth are to be placed on areas covered by existing pavement, the existing pavement shall be broken into pieces not larger than 12 inches maximum dimension, left in place and the embankment started thereon.

3.2.5.1 Placing Earth Embankment. Earth shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of material shall not exceed 9 inches in thickness (loose state) and shall be compacted to not less than the required density before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading will be required to level the surface and to insure uniform compaction. Embankment construction shall not be performed when material contains frost, is frozen, or a blanket of snow prevents proper compaction.

3.2.5.2 Placing Rock Embankment. Successive horizontal layers of rock embankment not exceeding 24 inches in depth, shall be made by placing the larger stones uniformly over the embankment area, and between which shall be added small stone fragments, sand, earth or gravel to fill all voids. Rocks, boulders, or old rubble walls too large to permit placing in 24 inch layers shall be broken as necessary, or placed so that proper compaction is obtained around them. Each layer shall be thoroughly compacted before the next layer is placed.

The larger rocks shall be withheld from the top 12 inches or more of the embankment and only crushed stone or earth shall be used in this layer as ordered by the Engineer. The crushed stone shall be well graded from 3 inches down to form a dense mass when compacted.

3.2.5.3 Embankment Compaction. Density and moisture requirements for embankment and existing surfaces shall be in relation to the maximum density and optimum moisture as determined by ASTM Designation D-698. Embankment material shall be placed with moisture content within the tolerance of the moisture range for each type of material at the specified percent of maximum density as determined by the moisture density curve.

Earth embankment, except the top 6 inches, and the surface of the existing ground on which embankment is to be placed shall be compacted to at least 90% of the maximum density as determined above. The top 6 inches of the embankment shall be compacted to at least 95% of the maximum density.

All the work involved in either adding moisture to, or removing moisture from embankment materials to within the moisture limits shall be considered incidental to the completion of the grading operation.

During the progress of the work, the in-place density of the embankment will be determined by ASTM Designation D-1556 or D-2167. Unless otherwise stated in the Special Provisions, testing for compaction shall be at the expense of the City.

3.2.5.4 Method of Measurement. No measurements will be made for embankments unless there are appreciable errors in the contract quantity or authorized changes are made to the planned area of embankments. Appreciable errors will only be considered in areas where original ground varies from planned cross sections by more than 1 foot on average. For changes to the quantity as

a result of appreciable errors to be considered, the Contractor shall notify the Engineer in writing of the suggested appreciable errors and provide supporting data. The Engineer shall be granted 5 business days to review this data and survey existing conditions on the site before any work shall proceed in the representative area. If the Contractor's notification of appreciable errors are found to be unwarranted, no additionalcompensation for delays while evaluating the need for consideration of appreciable errors will be granted to the Contractor. Any changes to the plan quantity will be field measured to the nearest cubic yard and added to or subtracted from the original plan quantity. Embankment may be measured by standard volumetric calculations or cross-section end area method of the in-place, compacted material.

3.2.5.5 Basis of Payment. The accepted quantities of embankment will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental work including but not limited to: hauling, dust control, shouldering, rounding slopes, obliterating existing roadbeds, and finishing and grading of the embankment area. When no pay item for embankments is included in the contract, embankments will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-3.2.5.5.1	Earth Embankment -- per cubic yard (plan quantity)
Item COS-3.2.5.5.2	Rock Embankment -- per cubic yard (plan quantity)

3.2.6 Cut Compaction and Undergrading. Where materials are encountered below grade which are deemed unsatisfactory by the Engineer for use in the work, either cut compaction or undergrading shall be preformed, as determined by the Engineer.

3.2.6.1 Cut Compaction. Cut Compaction shall include the temporary removal of material 12 inches below the bottom of the lowest base course for the full width of the road bed. The exposed material, to a depth of 6 inches, shall be manipulated and compacted to not less than the required density. The previously excavated material above this compacted plane shall then be replaced in layers not exceeding 8 inches loose thickness, after being wetted or dried as necessary, and compacted to the specified density. The entire volume so handled and compacted including the 6 inch layer compacted in place, will be considered as Cut Compaction and paid for at the rate specified in the Contract Documents.

3.2.6.1.1 Method of Measurement. No measurements will be made for cut compaction.

3.2.6.1.2 Basis of Payment. No direct payment will be made for cut compaction.

3.2.6.2 Undergrading. Undergrading shall include the removal of earth materials below grade to a maximum depth of 24 inches and to the limits designated by the Engineer. The excavated area shall be back-filled in 12 inch lifts with crushed stone or crushed concrete ranging in size from 2 to 6 inches and free of soil fines. The back-fill material shall be compacted with a minimum of three passes with a vibratory roller with a manufacture's rating of 16 to 20 tons of compacting power. Contractor is to place material until the fill surface is below finished subgrade elevation. The excavation and back-fill will be considered as Undergrading and paid for at the rate

specified in the Contract Documents. All undergrading shall be approved by the Inspector prior to commencing undergrading work.

3.2.6.2.1 Method of Measurement. Measurement of Undergrading will be made for payment to the nearest $^1/_{10}$ cubic yard of in-place material. Undergrading will be measured by standard volumetric calculations. The Inspector shall authorize all undergrading prior to excavation and shall be given the opportunity to measure all areas prior to backfilling after excavation has occurred.

3.2.6.2.2 Basis of Payment. The accepted quantities of undergrading will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.
Payments will be made under:

Item COS-3.2.6.2.2 Undergrading -- per cubic yard

3.2.7 Slides in Grading Work. Slides in the side slopes, after construction to the lines and grades shown on the plans shall be repaired by the Contractor at his own expense before final acceptance by the City.

3.2.8 Finishing. The entire project area shall be left in a finished and neat appearing condition.

The final graded surface shall be made free of rock, concrete, and brick, or fragments thereof, or rubbish, and shall be finished to the lines, grades, and cross-section shown on the plans, including shoulder, berm and sidewalk spaces.

The Contractor shall repair any damaged surface, and shall not use any finishing equipment that will leave a marred surface.

3.2.9 Cleanup. Cleanup shall follow the work progressively and final cleanup shall follow immediately behind the finishing. The Contractor shall remove from the site of the work all equipment, tools, and discarded materials, and other construction items. The entire right-of-way or easement shall be left in a finished and neat condition. Cleanup shall be considered as incidental to the completion of the grading work. If in the opinion of the Engineer a hazardous, unsafe or nuisance condition exists, the Engineer shall order cleanup operations to commence immediately.

3.3 SUBGRADE PREPARATION

3.3.1 Scope of Work. This work shall consist of preparing the subgrade upon which a base course is to be constructed or a surfacing placed.

3.3.2 Preparing the Subgrade for Pavements. The subgrade for pavements shall consist of compacted earth overlaid with a minimum of 4 inches of compacted Type 1, Type 5 or Type 7 aggregate base and shall extend to 12 inches outside back of curb.

Shape the earth subgrade to longitudinal and cross-section grade. Scarify to a depth of at least 8 inches in both cut and fill sections, adjust the moisture content to a range of ± 2% from optimum moisture content for stability. Contractor to verify that compaction is a minimum of 95% Standard Proctor Density (ASTM D-698) before any aggregate is placed. Shaping, scarifying, and compaction are to be done on singularly large areas in one continuous operation. The Contractor is to use compaction equipment of a type and design manufactured to have all the capabilities required to fully meet all the needs of the project.

The aggregate base shall be spread in one lift at a depth greater than the 4 inches required to allow for shaping and compacting. Water shall be applied as necessary to obtain a density of not less than 95% of standard maximum density as determined by ASTM D-698.

3.3.2.1 Type 1 Aggregate. Type 1 aggregate for base shall be essentially limestone or dolomite. The aggregate shall not contain more than 15% deleterious rock and shale. Sand may be added only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. Any sand, silt and clay and any deleterious rock and shale shall be uniformly distributed throughout the material. The fraction passing the No. 40 sieve shall have a maximum plasticity index of 6.

The aggregate shall be in accordance with the following gradation requirements:

Sieve	Percent by Weight
Passing 1 inch	100
Passing ½ inch	60-90
Passing No. 4	35-60
Passing No. 30	10-35

3.3.2.2 Type 5 Aggregate. Type 5 aggregate for base shall consist of crushed stone or sand and gravel. The aggregate shall not contain more than 15% deleterious rock and shale. If crushed stone is used, sand may be added only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. The fraction passing the No. 40 sieve shall have a plasticity index not to exceed 6. Any sand, silt, clay, and any deleterious rock and shale shall be uniformly distributed throughout the material. When sand and gravel aggregate are used, the fraction passing the No. 200 sieve shall be less than one half of that fraction passing the No. 30 sieve.

Type 5 aggregate shall be in accordance with the following gradation requirements:

Sieve	Percent by Weight
Passing 1 inch	100
Passing ½ inch	60-90
Passing No. 4	35-60
Passing No. 30	10-35
Passing No. 200	0-15

3.3.2.3 Type 7 Aggregate. Type 7 aggregate for base shall consist of crushed stone, sand and gravel, or reclaimed asphalt or concrete. The aggregate shall not contain more than 15% deleterious rock and shale. The fraction passing the No. 40 sieve shall have a plasticity index not to exceed 6. Any sand, silt and clay, and any deleterious rock and shale shall be uniformly distributed throughout the material.

Type 7 aggregate shall be in accordance with the following gradation requirements:

Sieve	Percent by Weight
Passing 1½ inch	100
Passing 1 inch	70-100
Passing No. 8	15-50
Passing No. 200	0-12

Shaping and compacting shall be performed until a true, even, and uniform surface of proper grade, cross section and density is obtained.

3.3.3 Compacting the Disturbed Subgrade for Sidewalks. The subgrade for sidewalk pavements shall be tamped or rolled until compacted to 95% density for a depth of at least 6 inches.

3.3.4 Protection and Maintenance of Subgrade. The newly finished subgrade shall be protected or repaired from action of the elements. Any settlement or washing that occurs prior to the acceptance of the work shall be repaired and the specific lines, grades, and cross-section re-established.

The Contractor shall protect all pavements, curbs, curb and gutters and sidewalks from his subgrade operation with an earth cushion, timber planking, or both where tractors, graders, rollers, or other equipment are required to pass or turn around. All resulting damage shall be repaired. Any damaged work, which cannot be repaired to the satisfaction of the Engineer, shall be replaced by the Contractor at his own expense.

3.3.5 Construction Requirements. The subgrade shall be substantially uniform in density throughout its entire width. It shall conform to the lines, grades, and typical cross sections shown on the plans, or as established by the Engineer. Where hauling results in ruts or other objectionable irregularities, the Contractor shall reshape and re-roll the subgrade before the base or surfacing is placed. If any existing roadway comprises any part of the roadbed, the Contractor shall loosen the compacted portions to a depth of at least 6 inches and shall reshape the roadbed.

The subgrade shall be brought to the specified lines, grades, and cross-section by repeatedly adding or removing material and compacting to the specified density with a suitable roller.

The subgrade shall be checked after rolling, and if not at the proper elevation at all points, sufficient material shall be removed or added and compacted to bring all portions of the subgrade to the required elevation and density.

Prior to laying base or setting paving forms on projects, the subgrade shall conform to the density requirements for compaction. Soft spots and unsuitable material shall be removed and back-filled with approved stable material.

3.3.6 Testing. Unless otherwise set out in the Special Provisions, testing as required above shall be at the expense of the City.

After all grading operations have been completed, the subgrade elevations shall be checked by a method approved by the Engineer. Extreme care shall be taken in forming the crown and shaping the subgrade to assure that the specified thickness of pavement will be attained.

The finished subgrade at the time of paving shall be moist, but sufficiently firm to resist rutting or deformation. During prolonged periods of dry weather some clay subgrades will require special treatment to prevent differential expansion of the subgrade and distortion of the pavement.

3.3.7 Method of Measurement. No field measurements will be made for subgrade preparation.

3.3.8 Basis of Payment. No direct payment will be made for subgrade preparation.

3.4 FILLING EXISTING MANHOLES, CATCH BASINS, INLETS AND MISCELLANEOUS STRUCTURES

3.4.1 Scope of Work. This work shall consist of all work necessary to abandon existing manholes, catch basins and inlets and miscellaneous structures in accordance with the specifications, when indicated on the plans or directed by the Engineer.

3.4.2 Method of Construction.

3.4.2.1 Adjustments. Existing manholes, catch basins, and inlets to be abandoned shall be lowered to at least 18 inches below the subgrade of the proposed improvement, the outlet connection shall be securely sealed with concrete or brick masonry, and the structure filled with granular material and thoroughly tamped.

3.4.2.2 Frames and grates of manholes, catch basins, and inlets to be abandoned shall be carefully removed and delivered to the city at a designated location.

3.4.3 Method of Measurement. No measurements will be made for filling existing manholes, catch basins, inlets and miscellaneous structures.

3.4.4 Basis of Payment. No direct payment will be made for filling existing manholes, catch basins, inlets and miscellaneous structures and will be considered incidental to the contract.

3.5 REMOVAL OF EXISTING STRUCTURES

3.5.1 Scope of Work. This work shall consist of the removal and satisfactory disposal of existing structures, except such structures, or portions thereof, as may be required or permitted to be left in place by the plans and specifications or at the direction of the Engineer.

3.5.2 Construction Methods.

3.5.2.1 General. Unless otherwise specified, all portions of existing structures within the right-of-way above the ground surface as it existed before the work was started, that interfere in any way with the new construction shall be removed.

When explosives are used in demolition, the Contractor shall use the utmost care to prevent injury to persons and property, and shall meet all Federal, State, County and City requirements for handling and storing explosives.

Blasting or other operations which might endanger the new work shall be completed prior to the construction of any part of the new structure.

When required by the plans or special provisions, all materials from existing structures which the Engineer deems fit for use elsewhere shall be moved without damage, in sections which may be readily transported and shall be disposed of as directed by the Engineer.

3.5.2.2 Removal of Concrete and Other Structures. Existing structures shall be removed for their entire width and depth unless otherwise noted on the plans. Existing drainage structures shall be removed, or the ends completely and substantially sealed with masonry as required by the Engineer.

If abandoned underground tanks of any kind are encountered, the Contractor shall contact the Project Engineer for further direction. The Project Engineer will discuss with Environmental Services to ensure all Federal, State and local laws and regulations are met.

3.5.2.3 Disposal of Concrete, Asphalt, and Other Materials. All concrete and masonry, drainage pipes, reinforcement steel, structural steel, castings, or timbers not salvable shall be disposed of by the Contractor at his own expense, and to the satisfaction of the Engineer at a location provided by the Contractor outside the limits of the right-of-way. Any of the above materials deposited adjacent to the right-of-way shall be deposited with the written approval of the property owner. The Contractor shall obtain and file with the Engineer the written approval of the property owner.

3.5.2.4 Disposal of Salvaged Material. All materials removed from old structures which are required to be salvaged under the contract and which the Engineer deems fit to re-use shall be stored without damage in a neat and presentable manner at locations designated by the Engineer.

3.5.3 Method of Measurement. Measurement for removal of existing structures will be made for payment per structure removed. No measurement will be made for miscellaneous removals.

3.5.4 Basis of Payment. The accepted quantities for removal of existing structures will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Miscellaneous removals will be paid on a lump sum basis and shall be paid for over the life of the project in proportion to the percentage of work completed. Payment shall include all incidental items necessary to complete the work. When no pay item for removals is included in the contract, removals will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-3.5.4.1	Removal of Existing Structures -- per each
Item COS-3.5.4.2	Miscellaneous Removals -- per lump sum

3.6 REMOVAL OF EXISTING PAVEMENT, CURB, COMBINATION CURB AND GUTTER, DRIVEWAY PAVEMENT, AND SIDEWALK

3.6.1 Scope of Work. This work shall consist of the removal and satisfactory disposal of existing Portland cement concrete pavement and/or base course, curb, curb and gutter, gutter, or sidewalk, floors and similar objects.

3.6.2 Construction Methods.

3.6.2.1 General. Unless otherwise specified, all portions of existing pavement, curb, combination curb and gutter, or sidewalk, floors and similar objects within the right-of-way above the ground surface as it existed before the work was started, that interfere in any way with the new construction shall be removed.

When explosives are used in demolition, the Contractor shall use the utmost care to prevent injury to persons and property, and shall meet all Federal, State, County and City requirements for handling and storing explosives.

Blasting or other operations which might endanger the new work shall be completed prior to the construction of any part of the new structure.

3.6.2.2 Removal of Concrete and Other Structures. Existing structures shall be removed for their entire width and depth unless otherwise noted on the plans.

3.6.2.3 Disposal of Concrete, Asphalt, and Other Materials. All concrete, asphalt, drainage pipes, reinforcement steel, structural steel, etc., shall be disposed of by the Contractor at his own expense, and to the satisfaction of the Engineer at a location provided by the Contractor outside the limits of the right-of-way. Any of the above materials deposited adjacent to the right-of-way shall be deposited with the written approval of the property owner. The Contractor shall obtain and file with the Engineer the written approval of the property owner.

3.6.2.4 Where portions of these objects are to be left in place, they shall be removed to an existing joint or to a new joint sawed to a minimum depth of one (1) inch with a true line and vertical face. Sufficient portions of such objects shall be removed to provide for proper grade and connection to the new work.

3.6.3 Method of Measurement. Measurement of asphalt pavement removal, concrete pavement removal, and sidewalk removal will be made for payment to the nearest $^{1}/_{10}$ square yard of surface area. Measurement of curb removal and combination curb and gutter removal will be made for payment to the nearest lineal foot of curb measured at the back of curb.

3.6.4 Basis of Payment. The accepted quantities of asphalt pavement removal, concrete pavement removal, sidewalk removal, curb removal, and combination curb and gutter removal will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: removal of all underlying base rock, saw cutting, and disposal of material. When no pay item for removal of existing pavement, sidewalk, curb, or curb and gutter is included in the contract, these items will be considered incidental to the work and no direct payment will be made.

When included in the Contract, Payments will be made under:

Item COS-3.6.4.1	Asphalt Pavement Removal -- per square yard
Item COS-3.6.4.2	Concrete Pavement Removal -- per square yard
Item COS-3.6.4.3	Curb Removal -- per linear foot
Item COS-3.6.4.4	Curb & Gutter Removal -- per linear foot
Item COS-3.6.4.5	Sidewalk Removal -- per square yard

4 SANITARY SEWERS

4.1 SEWER PIPE

4.1.1 Scope of Work. The work shall consist of furnishing all materials, equipment, and labor necessary for the construction of sanitary sewer lines and accessories in conformance with the lines and grades shown on the plans or as established by the Engineer, and as specified herein. Items of work or materials not specifically mentioned, but necessary for the completion of the sanitary sewer line construction shall be considered as incidental to other items in the contract.

4.1.2 Materials.

4.1.2.1 Pipe. The type, size, and class of pipe shall be shown on the plans. No discolored or deteriorated pipe shall be used. Type, size, or class of pipe may not be changed during the progress of the work without approval of the Engineer. The pipe, type, and class shall be one of the following:

4.1.2.1.1 Tee Connections shall be an approved molded tee made of the same material as the sanitary sewer. Molded tees shall be used on all new sewer lines. For tap connections into existing pipe, the following connections shall be made:

1. Inserta-tees shall be used on Polyvinyl Chloride (PVC) and large diameter concrete pipe (18 to 60 inch) specified for pipe wall thickness or approved equal.

2. PipeConx (PCX) saddle shall be used on clay, lined pipe, small diameter concrete pipe (8 to 15 inch), or Iron Pipe or approved equal.

4.1.2.1.2 Reinforced Concrete Sewer Pipe shall conform to ASTM designation C76.

4.1.2.1.3 Concrete Sewer Pipe shall conform to ASTM designation C14.

4.1.2.1.4 Cast Pipe and fittings shall conform to United States of America Standards Institute, Specifications A-21, Class 50 with mechanical joints or slip on joints.

General Note: This subsection applies to the requirements for unplasticized PVC plastic for sanitary sewers, house connections, pipe fittings, couplings, and joints. All shall conform to the requirements listed below except as otherwise modified by the Plans or Specifications.

Pipe Size (inches)	ASTM	Wall Thickness Min
4 - 6	D1785	SCH40
8 - 15	D3034	SDR35, SDR 26
18 - 48	F679	SDR 35 (PS46), SDR 26 (PS 115)
8 - 48	D2241	SDR 21
8 - 12	DR1784	DR18 Class 50, C900
12 - 48	(reference in progress)	C905

4.1.2.1.5 PVC Sewer Pipe shall conform to ASTM designate D3034 (SDR 35). Fittings shall conform to ASTM designation D3034 (SDR 35/SDR 26) or as otherwise shown on the Standard Drawings.

4.1.2.1.6 SDR 35 and SDR 26 PVC connections shall be molded tees. Molded tees shall be used on all new sewer lines. Inserta-tees are to be used on existing lines.

4.1.2.1.7 Not Used.

4.1.2.1.8 PS-46 PVC connections shall be molded tees. Molded tees shall be used on all new sewer lines. Compression locking tees are to be used on existing lines, unless saddles are requested by Engineer. An approved long skirted strap-on saddle type connection will be allowed on existing sanitary sewer lines only. (Short skirted strap-on saddle type connections are not acceptable.)

4.1.2.1.9 SDR 21 Class 200 PVC sewer pipe shall conform to ASTM designation D2241. Fittings shall conform to ASTM designation D2241 or as otherwise shown on Standard Drawing.

4.1.2.1.10 SDR 21 Class 200 PVC connections shall be molded tees. Molded tees shall be used on all new sewer lines; Inserta-tees are to be used on existing lines.

All pipe and connections will require a certification, from the supplier, stating that the material supplied meets all applicable specifications. The certification will be required on or before the material is delivered to the job site.

4.1.2.2 Pipe Joints.

4.1.2.2.1 Joints for reinforced concrete sewer pipe shall be flexible watertight, neoprene gaskets of the proper size conforming to the requirements of ASTM designation C-443.

4.1.2.2.2 Joints for cast or ductile iron pipe shall conform to USASI specification A21.11 for mechanical or push-on joints.

4.1.2.2.3 All joints for PVC pipe shall match the pressure rating (PS) for the pipe being used.

4.1.2.3 Couplings. A mechanical device for joining parts shall be Indiana Seal Shear Guard or equal as approved by the Engineer.

4.1.2.4 Bedding and Backfill. All required bedding and backfill material shall be considered incidental and no additional payments will be made for these items.

Bedding Material shall be crushed stone or crushed gravel conforming to the requirements of ASTM Standard C 33 or ASTM D 448 size No. 67, and having a gradation as follows:

Sieve	% Passing
1 inch	100
¾ inch	90-100
⅜ inch	20-55
No. 4	0-10
No. 8	0-5

4.1.2.5 Miscellaneous Materials. Any materials requested by the Contractor for use during construction but not described in this specification will be subject to the approval or rejection of the Engineer.

4.1.3 Construction Methods.

4.1.3.1 Classification of Excavated Materials will be made as follows:

A. Rock is defined as sandstone, limestone, chert, granite, siltstone quartzite, slate, shale occurring in its natural undisturbed state, hard and unweathered, in ledges 6 inches or more in thickness, or similar material in masses or boulders, each being more than 1½ cubic yards in volume.

   Should rock be encountered in 2 or more ledges, each ledge being more than 6 inches thick and with interlying strata of earth, clay, shale, or gravel not more than 12 inches in each stratum, the entire volume between the top of the upper ledge and bottom of the lower ledge will be classified as rock.

B. Earth. All materials not classified as rock shall be classified as earth. Chert (joint flint rock) broken by intermittent clay partings or clay seams or stratified chert cemented with clay seams (hardpans) shall be considered as earth.

C. Unclassified excavation will consist of the excavation of all materials of whatever character encountered in the work. All material required to be excavated will be considered as “Unclassified Excavation” unless the contract specifically states otherwise.

4.1.3.2 Excavation shall consist of the removal of any and all material below ground level necessary in order to carry out the installation and construction required by the plans and specifications and shall include:

1. Additional excavation required for bedding.
2. All sheeting, shoring, bracing, protection of adjacent property and underground conduits or structures and preparation of the sub-grade.

3. The cost of diversion of surface water, pumping, draining or otherwise de-watering of excavation.

4. The subsequent handling and disposal of such material not used in the backfill.

Trench excavation shall not be performed any farther ahead of the bedding and pipe laying operations than is necessary to permit a continuous operation. The elevation of the bottom of the trench shall be continually checked for conformance to the lines and grades shown on the plans. Excavation made below proper sub-grade elevation shall be refilled with bedding material and thoroughly compacted at the Contractor's expense. Sheeting, timbering or bracing shall be placed by the Contractor wherever necessary for the safety of workmen or the public and for the preservation of any excavation, embankment, or structure. Where the excavation is of such an unstable character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the lowest point of the final trench elevation as required for stability. The Contractor shall be held responsible for the determination of the need for sheeting or other types of protection and for the sufficiency of all sheeting and bracing used and for all persons injured or property damaged as the result of improper quality, strength, placing, maintaining, or removing the same. No additional compensation will be made for any sheeting, bracing, or other protective measures whether left in place or not.

The Contractor shall, at his own expense, shore up and protect from damage all buildings, retaining walls, viaduct piers and footings, storm sewers, sanitary sewers, gas lines, water lines, fences, curbs, trees or other property liable to be damaged during the progress of the work, and he will be held responsible for all damage which may occur by reason of prosecution of the work.

The Contractor shall furnish and operate sufficient pumps and equipment, and shall provide all materials, labor, etc., required to prevent interference with the work by water, ice or snow. Damage of any kind resulting from insufficient pumping facilities or similar lack of proper protection of the work shall be repaired or replaced by the Contractor at his own expense.

Where leaks or springs are encountered which, in the opinion of the Engineer, affect the safety, usefulness or satisfactory operation of any of the permanent work, he may direct special precautions to be taken and payment hereof made in accordance with Chapter 2 of these Specifications.

The width of the trench at the bottom of the pipe shall provide at least 6 inches of clear space on each side of the pipe to permit compaction of the bedding material. The minimum trench size for any pipe size shall be 18 inches.

The location of sewers and structures as shown on the plans have been selected to provide the least possible interference with or the crossing of existing utilities and aboveground obstructions. The City reserves the right to make minor variations in the location of the sewers and structures during the construction to adjust for any changed conditions discovered and no additional payment will be allowed the Contractor for shifts in alignment.

Arrangements shall be made by the Contractor with all persons, firms, corporations owning or using any poles, pipes, tracks, or conduits, etc., affected by the construction on this project to maintain and protect such facilities during construction with the cost of any such protection paid by the Contractor and considered as incidental to other items in the contract.

For requirements relating to the use of explosives, refer to Chapter 2 and Chapter 3 of the General Conditions.

Tunneling shall be done only where shown on the plans or by written direction or approval of the Engineer. Tunnels shall be of sufficient size, height, and width to permit proper installation of the pipe, proper bracing of the tunnel section and to permit ample room for the prosecution of the work and safety of the workmen.

Boring installations are made where pipelines must pass under airport runways, highways, railroad tracks, and other locations where conditions prevent the use of “open-cut” excavation. Accuracy in alignment and grade of the casing pipe is very important in maintaining the established invert grade of the carrier pipeline to be inserted. Proper grade of the inserted pipe is a must for satisfactory operation of the gravity flow line. Casing pipe must have a continuous positive grade and straight alignment to be accepted for use (See Standard Drawing SAN-15). It shall be the Contractor's responsibility to provide the Engineer with vertical and horizontal locations of the pilot hole before back reaming process begins. Once reaming is complete and casing is in place, vertical and horizontal positions shall be established by a licensed surveyor. The carrier pipe shall not be installed until the casing location is provided to and approved by the Engineer and the Engineer has inspected casing for straightness. All horizontal locations and flowline elevations will be reported to the Engineer using project datum. All voids around casing shall be filled with flowable fill.

4.1.3.2.1 Method of Measurement.

4.1.3.2.1.1 Bore. Measurement of the bore will be made for payment by the length of per linear foot of steel casing pipe installed.

4.1.3.2.2 Basis of Payment.

4.1.3.2.2.1 Bore. The accepted quantity of bore will be paid for based on field measurements by the Inspector of steel casing installed at the unit bid price for the item stated in the contract. Payment shall include all incidental items necessary to complete the work, including but not limited to: excavation, boring, steel casing, casing spacers, and end seals but will not include the carrier pipe.

Payments will be made under:

Item COS-4.1.3.2.2.1.00 Bore -- per linear foot

*Where 00 represents the steel casing pipe diameter in inches. For example, a 14 inch steel casing pipe would be item COS-4.1.3.5.2.14.

4.1.3.3 Bedding and Laying Pipe. The subgrade of the trench shall be excavated to a depth so as to provide space for at least 4 inches of bedding material between the subgrade and the pipe if the subgrade material is earth, and 6 inches of bedding material between the subgrade and the pipe if the subgrade material is rock. Bedding material shall be placed in the trench and carefully graded and compacted to the proper elevation so that the pipe, when placed, shall be within a half inch of the specified line and grade. The Surveyor will initially provide the Contractor with line and grade stakes set on the natural ground surface. It shall be the Contractor's responsibility to transfer the line and grade to the bottom of the trench. A pipe laser shall be used for the purpose line and grade and shall conform to section 4.1.3.4. The Contractor must verify the trench grade or the grade of the top line and sewer pipe, and will be held responsible for the correct flow of sewers. Any apparent inaccuracy in the grade stakes shall be called to the Engineer's attention immediately upon discovery.

If, in the opinion of the Engineer, subgrade conditions are such that the bedding described above will not adequately support the pipe, he may order the Contractor to install one of the two types of concrete encasement shown on the Standard Drawing SAN-12. Payment for the concrete encasement will be made in accordance with Chapter 2, Article 12 of the General Conditions.

At locations where it is necessary to construct the sewer line across an existing water line and there is less than an 18 inch vertical distance between the top of the lower line and the bottom of the upper line, the sewer line shall be constructed of Class 200 pressure water line pipe and must be air tested at a pressure not less than 4 pounds per square inch for 5 minutes to assure water tightness. A manhole or approved adapter must be located at each end of the pressure pipe; and, the near side of the manholes can be no closer than ten feet from the water main. When the elevation of the sewer cannot be verified to meet the above requirement, the water main or sewer shall be relocated to provide this separation. If a water line is parallel to the sewer line and located within ten feet horizontally and 18 inches vertically, the sewer line shall be constructed as set out above for vertical separation.

Unless approved by the Engineer sanitary sewers shall not be constructed with less than 4 feet of cover over the top of the pipe. If less than 4 feet of cover is allowed and the sewer is under the pavement or the near side of the sewer trench is within 2 feet of the curb, then the pipe must be in a casing consistent with SAN-15. If no portion of the sewer trench is within 2 feet of the curb or under the pavement and less than 4 feet of cover and greater than 3 feet is allowed, then Class 200 (SDR 21) pressure water line pipe will be required. Pipe laid with 3 feet or less of cover will

only be approved by the Director of Environmental Services Engineer on a case by case basis with adequate protection of the pipe.

If more than 12 feet of cover to the top of the sewer pipe is necessary for construction of the sewer line, then Class 200 (SDR 21) pressure water line pipe will be required.

4.1.3.4 Laser. The Contractor shall provide and maintain in good working order, on the site at all times, a laser beam. Each length of pipe shall be laid on an even, firm bed, so that no uneven strain will exist to prevent the pipe from bearing on the sockets. Bell holes for bell and spigot pipe shall be dug at each joint as hereinbefore specified. Each pipe shall be laid in conformity with the line and grade stakes as established by the surveryors. Pipe laying shall commence at the manhole connection at the low point of the project and progress up grade, unless otherwise expressly permitted by the Engineer. The bell-end of the pipe shall be laid up grade. The alignment of all pipelines between adjacent manholes shall be true to line and grade. The pipeline from manhole to manhole shall reflect the full bore of the pipe. The end of each joint pipe shall be truly centered and fully positioned into the abutting pipe. Pipe laid in the trench shall not be covered until approved by the Engineer or Inspector.

The laser beam used to control line and grade for the pipe-laying operation must be verified at the beginning of each day, at least once between manholes, and at any other time the Engineer or Inspector deems necessary to ensure the proper line and grade of the pipe.

4.1.3.5 Tees. On all sewers serving individual lots, one molded tee for lateral sewer or house connection shall be furnished and should be laid to center of every lot where possible, and extending to the property line or edge of permanent easement unless otherwise directed by the Engineer. Additional tees may be required for unplatted areas and large lots, as directed by the Engineer. They shall be 4 inches in diameter unless otherwise shown on the plans or specified by the Engineer and shall be capped or plugged in accordance with manufacturer’s recommendations. No saddle tees will be accepted on new sewers.

The exact location of all tees shall be carefully ascertained by the Engineer or Inspector before concealment by backfilling, by accurate measurement from the center of the manhole downstream in the same line of pipe so that a true and exact record may be preserved for future use. No tees will be permitted to connect to the main opposite each other. The minimum distance permitted between tees shall be 3 feet center to center.

4.1.3.5.1 Method of Measurement. Measurement of tees will be made for payment per tee installed.

4.1.3.5.2 Basis of Payment. The accepted quantities of tees will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-4.1.3.5.2.00.00 PVC Tee -- per each

*Where 00.00 represents the main pipe diameter and the lateral pipe diameter respectively in inches. For example, an 8 inch × 8 inch × 4 inch tee would be item COS-4.1.3.5.2.08.04.

4.1.3.6 Laterals. 4 inch diameter laterals shall have a minimum of ⅛ inch per foot slope and 6 inch laterals shall have a minimum if ⅛ inch per foot slope, unless otherwise approved by the Engineer. On PVC tees and lateral lines, all joints must be glued with an approved adhesive. The plans shall show the stationing of all in-line tees and shall be placed as near as possible to the center of the lot, so as to provide maximum clearance for driveways and utility lines or as shown in the plans. All PVC laterals shall be Schedule 40 pipe.

No more than 700 feet of sewer line shall be constructed prior to commencing construction of laterals. At the option of the Contractor, construction of the sewer lines and laterals may be performed concurrently. If, in the opinion of the Engineer, the lateral construction is not proceeding in a timely manner, the Engineer may order the Contractor to cease work on the sewer line construction until such time as lateral construction has proceeded to a point satisfactory to the Engineer.

If the sewer is being constructed within the street right-of-way, all laterals shall extend to the right-of-way line. All laterals within street right-of-way shall be a minimum of 4 feet deep at the right-of-way line. It will be the responsibility of the Contractor to assure service to each property. If the main sewer line is deep enough, then service shall be provided to basements. If a tee is to be placed but no lateral is required on a main sewer line 8 feet or more in depth, a 4 inch riser shall be placed, bringing the connection to a maximum depth of 7 feet below finished ground level. This riser will be measured and paid for as lateral line.

No lateral can be located within 5 feet of a manhole or connected into a manhole or lamphole without approval of the Engineer. If lateral is to be connected to an existing manhole, the manhole shall be cored and fitted with an insert-a-lock or approved equal.

Any lateral connected to a manhole shall have an approved channeling device. Refer to Standard Drawing San-6 or Chapter 4.2.3, Construction Methods (Inverts).

A Clean-out, as described in Section 4.1.3.6.3 Clean-outs, and Tracer Wire, as described in Section 4.1.3.6.4 Locator Wire, shall be required for each lateral.

Before backfilling, laterals shall be plugged or capped in a manner acceptable to the Inspector.

4.1.3.6.1 Method of Measurement. Measurement of lateral pipe will be made for payment to the nearest linear foot of in-place material. Lateral pipe will be measured by horizontal length of lateral laid from tee or wye to end of lateral.

4.1.3.6.2 Basis of Payment. The accepted quantities of lateral pipe will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: joints, necessary fittings, excavation, backfill, rough grading, and testing.

Payments will be made under:

Item COS-4.1.3.6.2.00 PVC Lateral Pipe -- per linear foot

*Where 00 represents pipe diameter in inches

4.1.3.6.3 Clean-outs. When new lateral sewer lines are installed and connected to an underground facility within the public right-of-way, or if such infrastructure is fully replaced by excavation within the public right-of-way, the Contractor is required to place tracer wire and cleanout for gravity sewer laterals (Standard Drawing Details SAN-24 and SAN-25). All protective enclosures and cleanouts shall be extended to grade and installed so that it is easily accessible. For sewer laterals operating under pressure or vacuum, tracer wire shall be placed within the protective enclosure to provide approximate location of the underground facilities in these areas that are located within a public right-of-way.

4.1.3.6.3.1 Method of Measurement. Measurement of cleanout riser will be made for payment per cleanout riser installed.

4.1.3.6.3.2 Basis of Payment. The accepted quantities of cleanout riser will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: tracer wire and appurtenances for cleanout.

Payments will be made under:

Item COS-4.1.3.6.3.2.00 Cleanout Riser -- per each

*Where 00 represents the lateral diameter in inches.

4.1.3.6.4 Tracer Wire. The tracer wire shall be green No.12 AWG copper clad steel (ccs) wire to allow for grade adjustment, a minimum of 12 inches of excess wire shall be coiled at the cleanout for all wires.

Conductive type pipe tracer wire shall be installed to locate all sewer laterals. The wire shall extend the entire length of the proposed lateral. The wire shall be installed directly on top the

pipe and secured to the lateral by tape at base of riser, sewer main and every 15 feet. Corrosion proof/filled wire connectors shall be used at splice locations. Electrical tape shall be used and no bare wire shall be exposed. Test stations shall be installed inside all cleanout vaults and existing wires shall be connected. Zinc or magnesium anodes shall be attached at the end of the tracer wire as shown on Standard Drawing Detail SAN-25. A typical layout of the tracer wire and cleanout is provided in Standard Drawing Detail SAN-25. Conductivity is to be tested by the City before acceptance. Payment will be incidental to cleanout pay item.

4.1.3.6.4.1 Anodes. The anode shall be ½ lb bare zinc or magnesium. The anodes shall be buried at the same elevation and in close proximity to the sewer lateral. The 1.315 inch diameter anodes shall be connected to the green No.12 AWG copper clad steel (ccs) wire. Payment will be incidental to cleanout pay item.

4.1.3.7 Cleaning. The interior of the sewer line shall be kept clean as the work progresses.

At the end of each workday, the end of the sewer pipe or manhole shall be plugged or capped to prevent the intrusion of water, dirt, gravel, and all other foreign material. At the beginning of each workday, the trench shall be dewatered (by pumping) before opening the end of the sewer pipe. The end of the pipe shall be cleared to prevent the intrusion of foreign material.

Note: If the City Forces are hired to clean and flush lines, a minimum of 4 hours will be charged to the Contractor.

4.1.3.8 Joints. Pipe joints with flexible rubber gaskets shall be made in accordance with manufacturer’s recommendation. Bell and spigot or tongue and groove ends of the pipe shall first be wiped clean before actual jointing operations are started.

Immediately prior to jointing, all surfaces of the joint shall be thoroughly cleaned and lubricated with soapy water or in accordance with manufacturer's recommendations. The tongue end shall be centered on grade into the groove end of the last downstream length of pipe and shoved completely home and properly seated with the application of steady pressure by a lever, winch, or other suitable device. Care shall be used to prevent displacement of the gasket during jointing.

Mechanical joints for cast iron pipe (CIP) or ductile iron pipe (DIP) shall be carefully assembled to assure that the two ends will be centrally located in the joint. The surfaces coming into contact with the rubber gasket shall be thoroughly cleaned with a wire brush just prior to assembly to remove all loose rust or foreign materials, and the gasket brought toward the flange evenly by partially tightening the bottom and top bolts, then the side bolts, and last, the remaining bolts. The cycle should be repeated until all bolts are properly tightened. If effective sealing is not attained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Overstressing on bolts to compensate for improper installation will not be permitted.

4.1.3.9 Backfilling. The backfilling of the trench shall follow closely behind the pipe-laying operation, but not until inspected by the Engineer or Inspector and the location of all connections recorded. In all cases, the pipe shall be backfilled the same day as laying.

The backfill material around the sewer pipe and lateral, to a height of 6 inches above the top of the pipe, and from trench wall to trench wall, shall be aggregate bedding material, as specified in Section 4.1.2.4 Bedding and Backfill, carefully placed and compacted so as not to disturb the pipe location. In any trench where the flowline of the sewer is more than 12 feet below finish grade, then the backfill around the pipe and to a height of 12 inches above the top of the pipe, shall be aggregate bedding material (SAN-12).

The backfill material for sewers and laterals constructed in open cuts crossing or parallel to roadways, driveways, sidewalks, other existing pavements, or having the near side of the trench walls within 2 feet of back/bottom of street curb, and at other locations shown on the plans or specified, all of the backfill shall consist of granular material meeting the requirements for bedding material, specified in Section 4.1.2.4 Bedding and Backfill. This material shall be placed and thoroughly compacted.

Except as specified above, the backfill material may be suitable earth material from the excavation.

4.1.3.9.1 No rocks in the backfill material shall exceed 12 inches diameter in any direction. Care shall be taken to avoid injury to the pipe, structure, or producing unequal pressures thereon. Any rock backfill 12 inches or smaller will need to be mixed with suitable soil material as determined by the Engineer.

4.1.3.9.2 Earth backfill material shall be compacted by thoroughly “mechanical means” (or any other acceptable method) the material.

4.1.3.9.3 The top 4 inches of the backfill shall be made with topsoil and graded as required under Chapter 13.1.2.1 of these specifications.

4.1.3.9.4 Flowable fill must be approved by the Engineer.

4.1.3.9.5 Mechanical Compaction. Any acceptable compaction method used to achieve minimum compaction requirements. At the discretion of the Engineer, any project within the City of Springfield may require testing by an independent testing laboratory at the expense of the Contractor. Minimum compaction shall be 90% standard proctor in accordance with ASTM D698.

4.1.3.9.6 All surplus excavation material not used in the backfill shall be disposed of by the Contractor at his expense. Upon receipt of written notice from the Engineer, any settlement of the backfill below the original ground surface shall be remedied by the Contractor for a period of 1 year after final completion and acceptance.

4.1.3.9.7 Tunnels. The backfill material for all sewers laid in tunnels shall be sand or finely crushed limestone of which 100% shall pass a $^{3}/_{16}$ inch sieve. The backfill shall be thoroughly compacted or blown in.

4.1.3.10 Pavement Replacement.

4.1.3.10.1 Temporary Replacement. If for any reason a roadway must be opened for traffic, after the sewer is in place but before the pavement is replaced, then the Contractor must provide a 1 inch asphalt cap on the trench backfill within 24 hours. This asphalt cap shall be the Contractor's responsibility and no additional compensation will be allowed. Backfill and/or asphalt shall be removed as necessary prior to placement of the permanent pavement.

4.1.3.10.2 Permanent Replacement. All pavement and curbs damaged during construction, in the opinion of the Engineer or Inspector, shall be removed and replaced. In order to determine the amount of damage to the pavement and curbs during construction, all existing cracks in the street or curb should be marked/painted in advance of construction. Permanent pavement replacement shall not occur any later than 30 calendar days after backfilling, unless otherwise approved by the Engineer.

The existing pavement necessary to be removed for construction shall follow the Pavement Repair Standard Drawing Detail ST-13. The existing pavement shall be sawed in a neat line and removed prior to excavation. The width of this removal shall not exceed the width specified on the plans or approved by the Engineer.

4.1.3.10.2.1 Method of Measurement. Measurement of permanent pavement replacement will be made for payment to the nearest $^{1}/_{10}$ square yard. Permanent pavement replacement will be measured based on the area of the final driving surface with a maximum trench width of 6 feet for the total pavement crossing, unless specified by the Engineer.

4.1.3.10.2.2 Basis of Payment. The accepted quantities of permanent pavement replacement will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, sawcutting, compaction, aggregate base, dowels, concrete, finishing, and curing. When no pay item for permanent pavement replacement is included in the contract, permanent pavement replacement will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-4.1.3.10.2.2	Permanent Pavement Replacement-SAN (ST-13) -- per square yard

4.1.4 Method of Measurement.

4.1.4.1 Sewer Pipe. Measurement of sewer pipe will be made for payment to the nearest linear foot of in-place material. Sewer pipe will be measured by horizontal length of sewer laid from inside edge of manhole or structure to inside edge of manhole or structure.

4.1.4.2 Encasement. Measurement of encasement will be made for payment to the nearest linear foot of in-place material. Encasement will be measured by horizontal length.

4.1.5 Basis of Payment.

4.1.5.1 Sewer Pipe. The accepted quantities of sewer pipe in place will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: joints, tee branches, necessary fittings, excavation, backfill, rough grading, and testing.

Payments will be made under:

Item COS-4.1.5.1.1.00	PVC Pipe -- per linear foot
Item COS-4.1.5.1.2.00	Class 200 Pipe -- per linear foot

*Where 00 represents pipe diameter in inches

4.1.5.2 Encasement. The accepted quantities of encasement will be paid for based on the field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: concrete, rebar, spacers, and material fill. When no pay item for encasement is included in the contract, encasement will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-4.1.5.2	Concrete Encasement (SAN-12) -- per linear foot

4.1.5.3 Rock Excavation. Rock excavation, if specified and shown in the contract bid items, will be calculated at the width of 3 feet for pipe up to and including 24 inches in diameter. For pipe having a diameter greater than 24 inches, the trench width to be paid for will be calculated as the pipe width plus 6 inches on each side of the pipe.

4.2 MANHOLES

4.2.1 Scope of Work. The work shall consist of furnishing all materials, equipment, and labor necessary for the construction of manholes and accessories at the location and in accordance with the details of the plans and as specified herein. Manholes shall be of the precast-concrete or poured-in-place concrete type. Items not specifically mentioned, but necessary for completion of the work shall be considered as incidental to other items in the contract.

4.2.2 Materials.

4.2.2.1 Concrete for manhole bases or pipe encasement shall conform to the requirements of Chapter 6 of these specifications except that the slump shall be 4 inches plus or minus 1 inch.

4.2.2.2 Cast iron fittings and piping with mechanical joints shall be in accordance with USASI Specification A21, Class 50 and the plan details.

4.2.2.3 Cast iron frames and covers shall conform to the requirements of the Standard Drawing San-1.

4.2.2.4 Precast concrete manholes shall receive an application of asphaltic waterproofing paint on the exterior at the plant site.

4.2.3 Construction Methods.

4.2.3.1 If manholes are constructed of precast sections, each precast section shall be set in a preformed, bitumastic gasket material. A minimum of 6 inches bedding material shall be used under manhole base.

4.2.3.2 Inverts shall be precast or constructed with cement mortar after all precast sections are in place. Inverts shall be smoothly finished to assure smooth flow through the manhole with a minimum of $^{2}/_{10}$ of an foot fall across the manhole and in accordance with the plans.

4.2.3.3 The elevation of manhole cover shall be adjusted to the required grade by shimming using HDPE ring or Cretex Pro-Ring for an adjustment of 4 inches or less. A concrete ring shall be used for manhole adjustments greater than 4 inches and laid in with a bitumastic material in accordance with Section 4.3. Type “A” frame and covers shall be used in all areas unless otherwise directed on the plans or by the Engineer.

4.2.3.4 Manholes shall be waterproofed on the exterior. Inlet and outlet pipes shall be joined to the manhole with an A-Lok gasket to allow for a flexible, watertight connection with the manhole allowing for differential settlement of the pipe and manhole wall to take place. The bottom ⅓ of the pipe diameter must be grouted between the pipe gasket (A-Lok or Z-Loc) and the end of the pipe to provide a smooth transition with the manhole flowline.

4.2.3.5 Cold Weather Requirements. Whenever the temperature of the surrounding air is below 40°F, or when the possibility exists that the temperature will fall below 40°F within the 24 hour period after concrete operations, concrete placed in the forms shall have a temperature between 80°F and 100°F. All concrete shall be maintained at a temperature of not less than 50°F for at least 72 hours, and shall be protected from freezing for at least an additional 72 hours or for as much time as is necessary to ensure proper curing of the concrete. The housing, covering, or other protection used in connection with curing shall remain in place and intact for at least 24 hours after the artificial heating isdiscontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Contractor will be held responsible for any damage to concrete as a result of cold weather operations.

4.2.3.6 Finishing. The top surfaces of structures shall be struck off with a straight edge and finished with a wood float. Forms will be removed between 12 and 24 hours, and all exterior form ties shall be removed to a depth of 1 inch below the surface. All fins caused by forms, joints, and other projections shall be removed, and all pockets cleaned and filled with mortar. All exposed surfaces shall then be wetted and hand rubbed with a rubber float using a sand and cement mixture to obtain a smooth and uniform texture as directed by the Engineer.

4.2.3.7 Curing. As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surfaces shall either be covered with plastic sheet, or covered with earth and/or burlap, or when not required to be painted, sprayed with liquid conforming with ASTM designation C309.

4.2.3.8 Backfilling. Manholes, which lie within an area to be paved, shall be backfilled with granular material meeting the requirements for bedding materials specifiedin Section 4.1.2.4 Bedding and Backfill. This material shall be placed and thoroughly compacted. All other manholes shall be placed in the same manner as for sewer lines, specified in Section 4.1.3.9.1 to Section 4.1.3.9.5.

4.2.3.9 Removal of Forms. Forms shall remain in place until, in the opinion of the Engineer, it is safe to remove them. In determining the time for removal of forms, consideration shall be given to the location and character of the structure, the weather, and other conditions influencing the setting of the concrete, and the requirements for curing and finishing.

4.2.4 Method of Measurement. Measurement of manholes up to 6 feet in depth will be made for payment per manhole. Measurement of manholes exceeding 6 feet in depth will be made for payment to the nearest $^{1}/_{10}$ linear foot of in-place material. Manholes exceeding 6 feet in depth will be measured by vertical length of the portion exceeding 6 feet.

4.2.5 Basis of Payment. The accepted quantities of manholes will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Measured linear feet of manholes will be added to the original per manhole price. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, concrete base, cone, rings, cover, fittings and appurtenances, acceptance testing and sidewalls.

Payments will be made under:

Item COS-4.2.5.1.00	Standard (I.D.) Manhole -- per each
Item COS-4.2.5.2.00	Dog House Manhole -- per each
Item COS-4.2.5.3.00	Inside Drop Manhole -- per each
Item COS-4.2.5.4.00	Manhole Depth Exceeding 6 feet -- per vertical foot

*Where 00 represents the manhole diameter in inches

4.3 MANHOLE ADJUSTMENTS

4.3.1 Scope of Work. The work shall consist of the adjustment of sanitary sewer manhole frames and structures within the construction area to the lines and grades shown on the plans or as established by the Engineer.

4.3.2 Materials. On Sanitary Sewer manhole grade adjustments 4 inches and smaller, high density polyethylene (HDPE) adjustment rings or Cretex Pro-Rings shall be used or approved equal. The following may be used in adjusting the grade of the manhole tops:

4.3.2.1 Precast Reinforced Concrete, HDPE Adjustment Rings or Cretex Pro-Rings meeting HS-20 loading

4.3.2.2 Manhole sections per ASTM designation C478

4.3.2.3 Preformed Flexible Joint Material per AASHTO designation M-198.

4.3.2.4 High Density Polyethylene(HDPE) adjustment rings.

A. The adjustment rings shall be manufactured from polyethylene plastic as identified in ASTM Designation D-1248 (Standard Specification for Polyethylene Plastic Molding and Extrusion Materials).
B. The plastic rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers).
C. The adjustment rings shall be tested to assure compliance with impact and loading requirements per the ASSHTO Standard Specification for Highway Bridges.
D. The annular space between the rings and cone basin, the rings, and the rings and cover frame shall be sealed utilizing an approved butyl sealant.
E. Installation shall be per manufacturer’s recommendations only.

4.3.2.5 Cretex Pro-Ring shall be installed per manufacturers specifications.

4.3.3 Construction Methods. The grade of a manhole may be raised a maximum of 12 inches by removing the frame and building up with precast concrete or HDPE adjustment rings as prescribed above. The frame shall be reset in preformed flexible joint material. Where required to raise the grade of a manhole more than 12 inches, the Contractor shall be required to remove the cone section of the manhole, add a barrel section approximately the height of the grade and replace the cone section and necessary adjustment rings, etc. as directed by the Engineer.

Where it is required to lower the grade, unless there is a sufficient height of precast concrete or HDPE adjustment rings in place above the cone section which can be removed the cone section and a sufficient number of barrel sections shall be removed and the cone section replaced or changed as directed by the Engineer.

The existing manhole ring and lid shall be removed and placed in a location designated by the Inspector and become the property of the City. A standard Type A ring and lid shall be installed on the manhole as a part of the adjustment.

4.3.4 Method of Measurement. Measurement of manhole adjustments will be made for payment per manhole adjusted.

4.3.5 Basis of Payment. The accepted quantities of manhole adjustments will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: new ring, lid, and excavation. When no pay item for manhole adjustments is included in the contract, manhole adjustments will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-4.3.5 Manhole Adjustment -- per each

4.4 SEWAGE PUMPING STATIONS

4.4.1 Scope of Work. The work shall consist of the furnishings of all labor, equipment, tools, and materials to install sewage pumping stations as required by the Plans, Special Provisions, and these Specifications.

4.4.2 Pumps. Pumps must be designed so that it is not necessary to disconnect piping, valves, electrical circuits, and other appurtenances in the wet well when the pumps are replaced.

4.4.3 Wet and Dry Well Access. Suitable and safe means of access shall be provided to dry wells and wet wells of pump stations. Stairways should be installed in dry wells with rest landings not to exceed 10 foot vertical intervals. All wet wells shall be given an application of asphaltic waterproofing paint.

4.4.4 Electrical Equipment. Electrical equipment in enclosed places where gas may accumulate shall comply with the National Board of Fire Underwriters specifications for hazardous conditions (NEMA Type 7).

4.4.5 Alarm Systems. Alarm systems shall be provided for all pumping stations. The alarm shall be activated in cases of power failure, pump failure, or any cause of pump station malfunction. The alarm system shall be capable of transmitting over phone lines an audio-visual signal to the Southwest Wastewater Treatment Plant. The system shall also have a remote station at the pump station, which will give the same audio-visual signal as at the Treatment Plant.

4.4.6 Emergency Power Supply. Provision of an emergency power supply for pumping stations shall be made, and may be accomplished by connection of the station to at least two independent public utility sources, or by provision of in-place internal combustion engine equipment which

will generate electrical or mechanical energy unless a fail safe gravity relief system can be incorporated into the wet well.

4.4.7 Instructions and Equipment. A complete set of operational instructions for pump station and emergency power generation equipment, including emergency procedures, maintenance schedules, tools, and such spare parts as may be necessary, must be provided.

4.4.8 Fencing. A fence surrounding the station site shall be provided. The fence shall be a minimum of 8 feet high with a 12 foot wide, double-leaf gate. The fence may be either galvanized chain link or wooden privacy type. Supporting posts for all types of fences shall not be more than 8 feet apart and be concrete encased below grade. Minimum bury depth to be 2½ feet. Wooden fences shall be constructed of pressure treated or other approved weather resistant wood. Wooden support posts shall be a minimum of 4 inches × 4 inches. The gate is to be located so that entranceway does not go over manholes. Pump station and generator unit to be easily accessible for maintenance from entranceway. Gate to be set back 25 feet from edge of road.

4.4.9 Outside Lighting. An outside weatherproof pole-mounted light, with enough illuminating power to adequately light the pump station site at night, shall be provided. The light is to be an LED system with electric eye for dusk-to-dawn operation.

4.4.10 Enclosure. Enclosure shall be of sufficient area to provide a 20 foot × 12 foot parking area and enclose all pump station buildings and equipment. A 2 inch × 4 inch wooden header will be placed around the enclosure, inside the fence, and a 4 mm polyethylene sheeting shall be placed on the entire enclosed area and covered with at least 4 inches crushed rock or gravel.

4.4.11 Accessibility to Site. The pump station site must be accessible by an acceptable all-weather, hard surface road. Junction of pump station road and public street shall have a 16 foot long culvert of acceptable diameter in ditch if necessary.

4.4.12 Locks. Locks shall be provided on all wet wells, dry wells, and gates. Two keys for each lock shall be furnished to the Engineer at the time of final inspection.

4.4.13 Painting. All metal, except galvanized and stainless steel items which are not painted at the factory, shall receive a prime and finish coat of paint that is recommended for use in the environment in which the item is installed. Color to be determined by the Engineer.

4.4.14 Surfacing of Lift Station Area. The area inside the fence must be constructed of 4 inches of Type I aggregate on a 4 mm polyethylene sheeting placed over the entire enclosed area with three 1 inch holes per square yard. Prior to placing the sheeting, the soil to be covered is to be treated with a soil sterilant Diuron (Karmer by DuPont), or equal, and applied as directed by the manufacturer.

4.4.15 Method of Measurement. Measurement of sewage pumping stations will be made for payment per sewage pumping station.

4.4.16 Basis of Payment. The accepted quantities of sewage pumping stations will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-4.4.16 Sewage Pumping Station -- per each

4.5 FORCE MAINS

4.5.1 Scope of Work. The work shall consist of the furnishing of all labor, equipment, tools, and materials to install force mains as required by the Plans, Special Provisions, and these Specifications.

4.5.2 Materials. Materials for pressure sewage force mains shall conform to the following standard:

4.5.2.1 Polyvinyl Chloride (PVC) pressure pipe shall meet the requirements of AWWA C-900.

4.5.3 Air Release Valve. An APCO Sewage Air Release Valve Model 401, or approved equal, shall be placed at high points in the force main to prevent air locking. A standard 4 foot diameter manhole with standard frame and cover to be installed around force main and relief valve for maintenance access to valve.

4.5.4 Termination. Force mains should enter the gravity sewer system at a point not more than 2 feet above the flow line of the receiving manhole.

4.5.5 Bedding. Bedding shall be in accordance with required bedding specified for sewer pipe, Section 4.1.2.4 Bedding and Backfill.

4.5.6 Method of Measurement. Measurement of force main will be made for payment to the nearest linear foot of in-place material. Force main will be measured by horizontal length.

4.5.7 Basis of Payment. The accepted quantities of force main will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: air relief valves, excavation, and bedding.

Payments will be made under:

Item COS-4.5.8 Force Main -- per linear foot

4.6 ACCEPTANCE TESTS FOR SEWERS

4.6.1 Scope of Work. The work shall consist of the furnishing of all labor, equipment, tools, and materials, and the performance of any or all acceptance tests as required by the Plans, Special Provisions, and these Specifications.

4.6.2 General Requirements.

4.6.2.1 The Contractor shall furnish the Engineer or Inspector with every reasonable facility for ascertaining whether or not the work performed was in accordance with the requirements and intent of the plans and specifications. Any work done (except excavation) or material used without suitable supervision or inspection by the Engineer or Inspector may be ordered removed and replaced at the Contractor's expense.

4.6.2.2 After substantial completion of the work, which includes compaction, backfilling, and rough cleanup, from time to time as the work progresses, the Contractor shall, under the direction of the Engineer, make such test of the entire work or any part thereof as may be required to demonstrate the efficiency of the sewer and accessories. If required, the Contractor shall make such openings as the Engineer may direct and shall restore the part of the work so disturbed to the satisfaction of the Engineer. Should any part of the work be found faulty in any respect, the Contractor shall repair such defects or replace them with new work as may be directed by the Engineer.

4.6.2.3 The Contractor shall provide facilities to the Engineer to make a visual observation test of the proper alignment of each section of sewer between two adjacent manholes.

4.6.3 Acceptance Tests for Gravity Sewers.

4.6.3.1 Visual Inspection.

4.6.3.1.1 Contractor shall clean pipe of excess mortar, joint sealant, and other dirt and debris prior to acceptance.

4.6.3.1.2 The Contractor will be required during construction to install a line throughout the entire length of the sewer district. This line will be used for running a mandrel through the sewer lines. The ends of the line will be secured in a manner satisfactory to the Engineer or Inspector to ensure that the line will not be removed from the sewer before inspection. The line to be installed shall be ¼ inch nylon or polypropylene yellow or white rope.

4.6.3.1.3 A mandrel will be furnished by the City for the Contractor to use to mandrel all sewer lines in checking for the presence of any misaligned, displaced, or broken pipe, and the presence of visible infiltration, debris, or other defects. Mandrelling of installed pipe sections will occur after approved compaction of the backfill. Exceptions are when granular backfill is used, soil is compacted to 90% proctor or approved flowable fill is used. All mandrelling must be done in the presence of the Engineer or Inspector.

4.6.3.1.4 The Contractor shall correct all defects found during mandrelling operations prior to conducting leakage tests.

4.6.3.2 Air Leakage Testing. An air leakage test shall be performed on the full length of all sewer lines and lateral lines prior to acceptance.

4.6.3.2.1 Contractor must perform air tests on all pipes.

4.6.3.2.2 The Contractor must furnish all facilities required, including necessary piping connections, test pumping equipment, pressure gauges, bulkheads, regulator to avoid over-pressurization, and all miscellaneous items required.

4.6.3.2.3 The pipe plug for introducing air to the sewer line shall be equipped with two taps. One tap will be used to introduce air into the line being tested, through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valves and fittings to accept a pressure test gauge readable from ground level indicating internal pressure in the sewer pipe. An additional valve and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer line.

4.6.3.2.4 The pressure test gauge shall meet the following minimum specifications:

Size (diameter)	4 - 4.5 inches
Pressure Range	0 - 30 P.S.I.
Figure Intervals	.5 P.S.I. Increments
Pressure Tube	Bourdon Tube or diaphragm
Accuracy	+/- 0.25% of maximum scale reading
Dial	White coated aluminum with black lettering, 270°F arc
Pipe Connection	Low male .5 inch N.P.T.

Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are performed. The test gauges shall be calibrated at least every 6 months.

4.6.3.2.5 The Contractor shall test each reach of sewer pipe between manholes after completion of installation of all utilities.

4.6.3.2.6 The Contractor shall plug ends of line and cap or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment. After connecting air control equipment to the air hose, monitor air pressure so that internal pressure does not exceed 5.0 psig. After reaching 4.0 psig, throttle the air supply to maintain between 4.0 and 3.5 psig for at least 2 minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off

air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressure is allowed to decrease to 3.5 psig. At 3.5 psig, begin timing to determine the time required for pressure to drop to 2.5 psig. If the time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown in the table below, the pipe shall be presumed free of defects.

Pipe Size (inches)	Required Time Per 100 LF	Minimum Required Time
8	1 min. 10 sec.	3 min. 47 sec.
10	1 min. 50 sec.	4 min. 43 sec.
12	2 min. 38 sec.	5 min. 40 sec.
15	4 min. 08 sec.	7 min. 05 sec.
18	5 min. 56 sec.	8 min. 30 sec.
21	8 min. 05 sec.	9 min. 55 sec.
24	10 min. 34 sec.	11 min. 20 sec.
27	12 min. 45 sec.	12 min. 45 sec.
30	14 min. 11 sec.	14 min. 11 sec.
33	16 min. 35 sec.	16 min. 35 sec.

If the air test fails to meet the above requirements, repeat test as necessary after all leaks and defects have been repaired. Prior to acceptance all constructed sewer lines shall satisfactorily pass the low-pressure air test.

4.6.3.2.7 In areas where groundwater is known to exist, the Contractor shall install a ½ inch diameter capped pipe nipple, approximately 10 inches long, through manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed.

Immediately prior to the performance of the acceptance test, groundwater level shall be determined by removing pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.

4.6.3.3 Closed Circuit Television (CCTV) Inspection. CCTV inspection will be performed on the full length of all sewer lines and lateral connections after successful completion of visual inspection, mandrel and air leakage testing prior to acceptance.

4.6.3.3.1 The Contractor is to provide clean lines prior to CCTV inspection. If flushing is required due to debris accumulation, the city will flush the lines at the Contractor's expense.

4.6.3.3.2 The City will perform the CCTV inspection of the lines.

4.6.3.3.3 Upon successful completion of visual inspection, mandrel test and air leakage testing the Contractor will contact Sewer Maintenance at (417) 864-1923 a minimum of 72 hours in advance to schedule the inspection.

4.6.3.3.4 The Contractor will be responsible for providing clear and acceptable access prior to final grading for the City Inspection vehicles to access the manholes for inspection.

4.6.4 Acceptance Tests for Force Mains. All force main piping shall be subject to a hydrostatic and leakage test.

4.6.4.1 Hydrostatic Tests. The hydrostatic test shall be conducted in accordance with Section 4 of AWWA C-600, at a test pressure determined by the following formula (if no head pressure is specified on the plans, then use pipe pressure rating in psi):

Test Pressure = Total design head pressure × 0.433 × 1.5. The test pressure must be maintained for at least 2 hours duration.

4.6.4.2 Leakage Test. The leakage test shall be conducted concurrently with the hydrostatic test. Leakage shall be considered as the volume of water added to maintain the test pressure determined by the formula above. The leakage test shall be conducted in accordance with Section 4 of the AWWA specifications. Allowable leakage must not exceed the volumes specified below for each 1,000 feet of the specific diameter of pipe being tested:

Pipe Diameter (inches)	Allowable Leakage/1000 L.F.
2	0.19 gallons/hr.
4	0.37 gallons/hr.
6	0.55 gallons/hr.
8	0.74 gallons/hr.
12	0.92 gallons/hr.

If testing results in leakage greater than the allowed maximum, the defective pipe and joint(s) shall be located and repaired. When repair work is complete, tests shall be performed again to determine that leakage is within the allowable limit.

4.6.5 Method of Measurement. No field measurements will be made for acceptance tests for sewers.

4.6.6 Basis of Payment. No direct payment will be made for acceptance tests for sewers. It is incidental to force main pipe payment.

4.7 ACCEPTANCE TESTS FOR MANHOLES

4.7.1 Scope of Work. The work shall consist of the furnishing of all labor, equipment, tools, and materials, in the performance of any acceptance test.

4.7.1.1 All manholes must be tested to assure water tightness.

4.7.1.2 After the manhole is in place and backfilled to finish grade, then the Contractor shall plug the inlet and outlet sewer feeds in a watertight manner. The manhole shall be tested using a vacuum test.

4.7.2 Vacuum Testing Manholes. The Contractor will furnish all facilities required, including necessary piping connections, test pumping equipment, pressure gauges, bulkheads, regulator, avoid over pressurization, and all miscellaneous items required. Calibration data will be supplied with all pressure test gauges. Certification of vacuum test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are performed. Test each manhole and accessories after the complete installation. Stabilize the vacuum at 10 inch Hg (mercury). After temperature has stabilized, the gauge is allowed a maximum of 1 inch Hg drop during the test period. The required test period is 2 minutes (minimum) for all sizes and manholes depths. If the vacuum test fails to meet the above requirement, repeat test as necessary after all leaks and defects have been repaired.

4.8 ADJUSTMENTS OF SANITARY SEWER LATERALS

4.8.1 Scope of Work. At many locations, the house connections to the main sanitary sewer located within the present pavement area consist of a riser from the sewer to the point close to the existing pavement subgrade, from this point the connection runs nearly horizontally to the house connection. Experience has indicated that in many instances the house connections are above the elevation of the proposed subgrade, making it necessary to relay house connections at a lower grade. This work shall include all equipment, materials, and labor for the adjustment of sewers to accommodate the paving project.

This work shall consist of all work necessary for the lowering of the riser and adjustment in grade to coincide with proposed elevations.

4.8.2 Materials. Sanitary sewer pipe shall meet the requirements specified in Chapter 4 of these specifications.

4.8.3 Construction Methods. Extra riser pipe shall be removed to the elevation indicated by the Engineer. Construction methods for riser pipe shall meet the requirements for sewer pipe specified in Chapter 4 of these specifications.

All existing sanitary sewer pipe removed because of necessary grade adjustments shall be disposed of by the Contractor and replaced with new pipe of the diameter required, meeting the specifications as set forth above.

4.8.4 Method of Measurement. Measurement of pipe for sanitary sewer lateral adjustments will be made for payment to the nearest linear foot of in-place material. Sanitary sewer lateral adjustments will be measured by horizontal length.

4.8.5 Basis of Payment. The accepted quantities of pipe for sanitary sewer lateral adjustments will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to couplings to complete the removal and replacement of the sanitary sewer house connections.

Payments will be made under:

Item COS-4.8.5.00 Lateral Adjustments -- per linear foot

*Where 00 represents the lateral diameter in inches.

5 STORM SEWERS

5.1 PIPE

5.1.1 Scope of Work. The work shall consist of furnishing all labor, materials, and equipment for the complete installation of storm sewer pipe, and appurtenances, in conformance with the lines and grades shown on the plans or as established by the Engineer and as specified herein. Items of work or materials not specifically mentioned, but necessary for the completion of storm sewer line construction shall be considered as incidental to other items in the contract.

5.1.2 Materials.

5.1.2.1 Pipe. Storm sewer pipe shall be Reinforced Concrete, Polypropylene, or Corrugated Metal pipe, as specified below.

5.1.2.1.1 Reinforced Concrete Culvert Pipe. Reinforced concrete pipe shall conform to the requirements of the Specifications for Reinforced Concrete Culvert Pipe, A.S.T.M. Designation C76. Unless otherwise shown on the plans or stated in the Special Provisions, installations shall be made with circular pipe conforming to the requirements for Class III, Wall B of this A.S.T.M. specification. When reinforced concrete elliptical pipe is to be used, installation shall be made with pipe conforming to the requirements of A.S.T.M. Designation C507, Class HE-111.

5.1.2.1.2 Dual Wall and Triple Wall Polypropylene Pipe. Dual wall pipe and fittings 12 inch through 30 inch diameter pipe shall conform to ASTM F2736 and triple wall pipe 30 inch through 60 inch shall conform to ASTM F2764. Dual wall polypropylene pipe shall have a smooth interior and annular exterior corrugation. Triple wall polypropylene pipe shall have a smooth interior and exterior with annular inner corrugations. Pipe shall have a minimum pipe stiffness of 46 pii when tested in accordance with ASTM D2412. Pipe shall be joined with an integral bell and spigot joint on all sizes. The joints shall be watertight in accordance with ASTM D3212. The spigot shall have two gaskets meeting the requirements of ASTM F477. The gaskets shall be installed by the pipe manufacturer and shall be covered with a removable, protective wrap to ensure the gaskets are free from debris. Pipe shall have a reinforced bell with a polymer composite band installed by the manufacturer. A joint lubricant shall be used on the gasket and pipe bell during assembly.

Each individual section of pipe shall be marked in accordance with ASTM F 2736 or ASTM F 2764, and shall have “ASTM F 2736” or ASTM F 2764” and the manufacture’s name marked on the pipe.

5.1.2.1.3 Corrugated Metal Pipe. Aluminum coated steel pipe, polymer coated steel pipe and aluminum alloy pipe may be used in the construction of storm sewer applications. All metal coated steel pipes shall be Type I, Type IA or Type IR in compliance with AASHTO M 36 unless otherwise specified. Sheet steel must be certifiable in accordance with AASHTO M 274. All pipes will be subject to inspection of the Engineer at the source of manufacture, at an

intermediate shipping terminal or at destination. The Engineer shall be allowed unlimited access to all facilities and records, as required, to conduct inspection and sampling.

The interior roughness coefficient (Manning's 'n' value) of Corrugated Metal Pipe shall be equal to or less than 0.013.

The thickness of the coated steel shall be a minimum thickness as follows:

Pipe Diameter in inches	Minimum Gauge of Steel Pipe	
	2 ⅔ × ½	3 × 1
	¾ × ¾ × 7 ½	5 × 1
< 42	14	14
42 < 60	12	12
60 < 78	10	12
78 < 108	N/A	12
108 and above	N/A	10

5.1.2.2 Concrete Pipe Joints. Joints for concrete pipe shall be any of the following:

5.1.2.2.1 Neoprene Gaskets. Flexible Neoprene Gaskets of the proper size conforming to the requirements of A.S.T.M. Designation C443.

5.1.2.2.2 Bituminous Mastic Joint Compound. This compound shall be a homogeneous blend of bituminous material, inert filler, and suitable solvents or plasticizing compounds thoroughly mixed at the factory to a uniform consistency.

5.1.2.3 Dual Wall and Triple Wall Polypropylene Joints. Field joints shall provide circumferential and longitudinal strength to maintain the pipe alignment, prevent separation of pipe and prevent infiltration of fill material. Coupling bands, if used, shall be of the same base material as the pipe. Prior to use, the design of coupling bands and fastening devices shall be submitted to and approved by the Engineer. Final acceptance of coupling bands and fastening devices will be based on field performance.

5.1.2.4 Corregated Metal Pipe Joints. Field joints shall provide circumferential and longitudinal strength to maintain the pipe alignment, prevent separation of pipe and prevent infiltration of fill material. Corrugated Metal Coupling bands shall conform to AASHTO M36 standard joining systems.

5.1.2.5 Bedding Material. Material for bedding shall be crushed stone, crushed gravel, or crushed concrete conforming to the requirements of ASTM Standard C 33 or ASTM D 448 size No.67, and having a gradation as follows:

Sieve	% Passing
1 inch	100
¾ inch	90 - 100
⅜ inch	20 - 55
No.4	0 - 10
No.8	0 - 5

5.1.2.6 Miscellaneous Materials. Any materials requested for use by the Contractor during construction but not described in this specification will be subject to the approval or rejection of the Engineer.

5.1.3 Construction Methods.

5.1.3.1 Classification of Excavated Materials. Classification of excavated materials will be made as defined in Section 3.2.2 Materials and Definitions.

5.1.3.2 Excavation. Excavation shall consist of the removal of any and all material below ground level necessary in order to carry out the installation and construction required by the plans and specifications and shall include:

1. Additional excavation required for bedding.
2. All sheeting, shoring, bracing, protection of adjacent property, and underground conduits, or structures, and preparation of the subgrade.
3. The cost of diversion of surface water, pumping, draining, or otherwise dewatering of excavation.
4. The subsequent handling and disposal of such material not used in the backfill.

Trench excavation shall not be performed any farther ahead of the bedding and pipe laying operations than is necessary to permit a continuous operation. The elevation of the bottom of the trench shall be continually checked for conformance to the lines and grades shown on the plans. Excavation made below proper subgrade elevation shall be backfilled with bedding material and thoroughly compacted at the Contractor’s expense. Sheeting, timbering, and bracing shall be placed by the Contractor whenever necessary for the safety of workmen or the public, and for the preservation of any excavation, embankment, or structure. When the excavation is of such an unstable character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the lowest point of the final trench elevation as required for stability. The Contractor shall be held responsible for the determination of the need for sheeting or other types of protection and for the sufficiency of all sheeting and bracing used and for all persons injured or property damaged as the result of improper quality, strength, placing, maintaining, or removing the same. No additional compensation will be made for any sheeting, bracing, or other protective measures whether left in place or not.

The Contractor shall at his own expense, shore up, protect, and ensure from damage all buildings, retaining walls, viaduct piers and footings, storm sewers, sanitary sewers, gas lines, water lines, fences, curbs, trees, or other property liable to be injured during the progress of the

work, and he will be held responsible for all damage which may occur by reason of prosecution of the work.

The Contractor shall furnish and operate sufficient pumps and equipment and shall provide all materials, labor, etc., required to prevent interference with the work by water, ice, or snow. Damage of any kind resulting from insufficient pumping facilities or similar lack of protection of the work shall be repaired or replaced by the Contractor at his own expense. No water shall be allowed to run into or over any concrete work unless by special permission in writing by the Engineer.

Where leaks or springs are encountered which, in the opinion of the Engineer, affect the safety, usefulness, or satisfactory operation of any of the permanent work, he may direct special precautions to be taken and payment herefor made in accordance with the General Conditions, Chapter 2.

The width of the trench at the bottom of the pipe shall provide at least 6 inches of clear space on each side of the pipe to permit compaction of the bedding material.

The location of storm sewers and structures as shown on the plans have been selected to provide the least possible interference with or the crossing of existing utilities and above-ground obstructions. The City reserves the right to make minor variations in the location of the sewers and structures during the construction to adjust for any changed conditions discovered, and no additional payment will be allowed the Contractor for shifts in alignment.

Arrangements shall be made by the Contractor with all persons, firms, corporations owning or using any poles, pipes, tracks, or conduits, etc., affected by the construction on this project to maintain and protect such facilities during construction with the cost of any such protection paid by the Contractor, and is considered as incidental to other items in the contract.

For requirements relating to the use of explosives, refer to Chapter 3.

Tunneling shall be done only where shown on the plans or by written direction or approval of the Engineer.

Tunnels shall be of sufficient size, height, and width to permit proper installation of the pipe, proper bracing of the tunnel section, and to permit ample room for the prosecution of the work and safety of the workmen.

5.1.3.3 Bedding and Pipe Laying. The subgrade of the trench shall be excavated to a depth as to provide space for at least 4 inches of bedding material between the subgrade and the pipe if the subgrade material is earth and 6 inches of bedding material between the subgrade and the pipe if the subgrade material is rock. Bedding material shall be placed in the trench and carefully graded and compacted to the proper elevation so that the pipe, when placed, shall conform to the specified line and grade. The Contractor shall be responsible for establishing the horizontal and vertical alignment of all storm sewers. The Contractor must verify the trench grade or the grade of the top line and storm sewer pipe, and will be held responsible for the correct flow of storm

sewers. Any apparent inaccuracy in the grade stakes shall be called to the Engineer's attention immediately upon discovery.

If, in the opinion of the Engineer, subgrade conditions are such that the bedding described above will not adequately support the pipe, he may order the Contractor to install one of the two types of concrete cradle shown on the Drawing SAN-12.

5.1.3.4 Laser. A laser beam shall be used and maintained in good working order, on the site, at all times to control line and grade for the pipe laying operation. The laser must be checked at the beginning of each day and at any other time the Engineer deems necessary to ensure the proper line and grade of the pipe. Each length of pipe shall be laid on an even, firm bed, so that no uneven strain will exist to prevent the pipe from bearing on the sockets. Bell holes for bell and spigot pipe shall be dug at each joint as hereinbefore specified. Each pipe shall be laid in conformity with the line and grade established by the Contractor. Pipe laying shall commence at the low point of the project and progress upgrade, unless otherwise expressly permitted by the Engineer. The bell-end of the pipe shall be laid upgrade. The alignment of all pipelines shall be true to line and grade. The end of each joint of pipe shall be truly centered and fully positioned into the abutting pipe. Pipe laid in the trench shall not be covered until approved by the Engineer.

5.1.3.5 Cleaning. The interior of the storm sewer line shall, as the work progresses, be cleaned of all dirt, excess jointing material, and superfluous materials of every description.

5.1.3.6 Joints. Joints for reinforced concrete pipe with neoprene rubber gaskets shall be made in accordance with manufacturer's recommendations. Bell and spigot, or tongue and groove ends of the pipe shall first be wiped clean before actual jointing operations are started.

Immediately prior to jointing, all surfaces of the joint shall be thoroughly cleaned and lubricated in accordance with manufacturer's recommendations. The tongue end shall be centered on grade into the groove end of the last downstream length of pipe and shoved completely home and properly seated with the application of steady pressure by a lever, winch, or other suitable device. Care shall be used to prevent displacement of the gasket during jointing.

In sealing concrete pipe with bituminous mastic joint compound, trowel grade compound shall be applied to the mating surfaces of both the tongue and groove, or to the entire interior surface o the bell and the upper portion of the spigot. Two 1 inch pieces of rope or tape-type plastic compound shall be applied in accordance with the manufacturer's recommendations. The joints shall be forced together with excess compound extruding both inside and outside the joint. Excess compound shall be removed from the interior surface where accessible. The joint between the bell and spigot shall be uniform for the full circumference and care shall be taken to prevent the bell from supporting the spigot.

5.1.3.7 Backfilling. The backfilling of the trench shall follow closely behind the pipe-laying operation, but not until inspected by the Engineer. In all cases the pipe shall be backfilled the same day as laying.

The backfill material for all storm sewer pipe laid in tunnels shall be sand or finely crushed limestone of which 100% shall pass a $^{3}/_{16}$ inch sieve. It shall be thoroughly compacted.

5.1.3.7.1 Backfill Material Under Pavements. This includes all backfill material for storm sewers constructed in open cuts crossing or parallel to roadways, parking lots, driveways, sidewalks, and other existing pavements, or having the trench wall within 2 feet of the back of street curb or edge of surface. Backfill shall consist of granular material meeting the requirements for bedding material, specified hereinbefore. In addition, granular backfill material shall be placed between pipes on all parallel storm sewer pipes located closer than two times the largest pipe diameter. This material shall be placed and thoroughly compacted.

5.1.3.7.1.1 Reinforced Concrete Culvert Pipe. Backfill shall consist of thoroughly compacted granular material meeting the requirements for bedding material, specified hereinbefore. Minimum depth for storm sewers on improved streets shall be 12 inches plus the pipe depth, and the minimum depth under unimproved streets shall be 24 inches plus the pipe depth.

5.1.3.7.1.2 Dual Wall, Triple Wall Polypropylene and Corrugated Metal Pipe. Backfill shall consist of thoroughly compacted granular material meeting the requirements for bedding material, specified hereinbefore. Minimum cover for 12 inch – 48 inch diameter pipe shall be 12 inches from the top of rigid pavement or to the bottom of flexible pavement. If 60 inch diameter pipe is used, minimum cover shall be 24 inches from the top of rigid pavement or to the bottom of flexible pavement. A minimum cover of 12 inches to the top of ground surface is required when outside of pavement.

5.1.3.7.2 Backfill material <u>not</u> under pavements. This includes all backfill material for storm sewers not placed under pavements or within 2 feet of the back of street curb shall be compacted granular material placed to the midpoint on all storm sewer pipe. Sutable embankment material as described in Chapter 3 (Earthwork) shall be placed from the mid point of the pipe to 12 inches above the pipe. Compaction of the select material shall be performed with hand-held tampers to a minimum distance of 12 inches above the pipe and 6 inches beyond the sides of the pipe. The backfill material shall be placed in lifts not to exceed twelve inches in thickness. The backfill shall be placed and compacted on both sides of the pipe simultaneously. Heavier compaction equipment may not be used until the backfill has been placed in a minimum of 12 inches above the top of pipe, or as directed by the Engineer.

No frozen material shall be used in the backfill. Care shall be taken to avoid injury to the pipe or structures or producing unequal pressures thereon. Earth backfill shall be thoroughly compacted to a density of at least 90% of the maximum density for the material used as determined by ASTM designation D-698. The top 4 inches of the backfill shall be made with topsoil and graded as required under Chapter 8 (Portland Cement Concrete Curb and Gutter) of these specifications. All surplus excavation material not used in backfilling shall be disposed of by the Contractor. Upon receipt of written notice from the Engineer, any settlement of the backfill below the original ground surface shall be remedied by the Contractor for a period of 1 year after final completion and acceptance.

5.1.3.8 Pavement Replacement.

5.1.3.8.1 Temporary Replacement. If for any reason a roadway must be opened for traffic after the storm sewer is in place but before the pavement is replaced, then the Contractor must provide a 1 inch asphalt cap on the trench backfill. This asphalt cap shall be the Contractor's responsibility, and no additional compensation will be allowed. Permanent pavement replacement shall not occur any later than 30 calendar days after backfilling unless otherwise approved by the Engineer. Backfill and/or asphalt shall be removed as necessary prior to placement of the permanent pavement.

5.1.3.8.2 Permanent Replacement. All pavement and curbs damaged during construction, in the opinion of the Engineer, shall be removed and replaced. In order to determine the amount of damage to the pavement and curbs during construction, all existing cracks in the street or curb should be marked in advance of construction. Pavement replacement (whether temporary or permanent) shall closely follow backfilling operation.

The existing pavement necessary to be removed for construction shall follow the Pavement Repair Standard Drawing Detail ST-13. The existing pavement shall be sawed in a neat line and removed prior to excavation. The width of this removal shall not exceed the width specified on the plans or approved by the Engineer.

5.1.3.8.2.1 Method of Measurement. Measurement of permanent pavement replacement will be made for payment to the nearest $^{1}/_{10}$ square yard. Permanent pavement replacement will be measured based on the area of the final driving surface.

5.1.3.8.2.2 Basis of Payment. The accepted quantities of permanent pavement replacement will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: sawcutting, compaction, aggregate base, dowels, concrete, finishing, and curing. When no pay item for permanent pavement replacement is included in the contract, permanent pavement replacement will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-5.1.3.8.2 Permanent Pavement Replacement-SS (ST-13) -- per square yard

5.1.4 Method of Measurement.

5.1.4.1 Pipe. Final measurement of all pipe will be to the nearest foot.

5.1.4.2 Encasement. Final measurement of all encasements will be to the nearest foot.

5.1.4.3 Rock Excavation. Final measurement of rock excavation, if specified, will be to the nearest $^{1}/_{10}$ cubic yard.

5.1.5 Basis of Payment. The accepted quantities of storm sewer pipe and encasement will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, bedding, pipe, concrete, reinforcing, forms, backfill, joints, fittings, connections, mitering, and haul off of excess material.

Payments will be made under:

Item COS-5.1.5.1.00	Circular Storm Pipe -- per linear foot
Item COS-5.1.5.2.00.00	Elliptical Storm Pipe -- per linear foot
Item COS-5.1.5.3.00	Storm Pipe Encasement -- per linear foot
Item COS-5.1.5.4.00.00	Box Culvert -- per linear foot

*Where 00 represents pipe diameter in inches and where 00.00 represents the inside width and height dimensions respectively in inches for a non-circular section. For example, a 36 inch Storm Pipe would be item COS-5.1.5.1.36 and a 5 foot wide by 3 foot high box culvert would be item COS-5.1.5.4.60.36.

5.2 STUCTURES

5.2.1 Scope of Work. The work shall consist of furnishing all labor, materials, and equipment necessary to perform all operations in connection with the construction of junction boxes, inlets, and catch basins required for the project in accordance with the specifications and drawings. Items not specifically mentioned, but necessary for completion of the work shall be considered as incidental to other items in the contract.

5.2.2 Materials.

5.2.2.1 Concrete shall be Class “A” Portland Cement Concrete in accordance with the requirements of Chapter 6 (Portland Cement Concrete) of these specifications.

5.2.2.2 Reinforcing steel shall consist of deformed bars of grade 60 steel conforming to the requirements of A.S.T.M. designation A615 or of wire fabric conforming to A.S.T.M. designation A185.

5.2.2.3 Expansion Joint Fillers shall be of a non-extruding type conforming to A.S.T.M. designation D1751 and cut to the dimensions shown on the plans.

5.2.2.4 Precast units may be substituted provided they meet plan intent.

5.2.3 Construction Methods.

5.2.3.1 Forms. Forms shall be of wood, plywood, or any other suitable material, designed, constructed, braced, and maintained so that the finished concrete will be true to line and elevation and will conform to the required dimensions. They shall be designed to withstand the pressure of the concrete; the effect of vibration as the concrete is placed in all other loads incidental to the construction operations without distortion or displacement. They shall be mortar tight. Oiling both inside and outside surfaces will be required to prevent warping, shrinkage, or swelling.

Forms shall be constructed and designed so that their removal can be effected without injury to the concrete, and so that portions where surface finishing is required may be removed without disturbing forms that are to remain. Dirt, chips, sawdust, nails, and other foreign matter shall be removed before any concrete is deposited therein.

Tie rods, belts, and anchorages within the forms shall be constructed so as to permit their removal to a depth of at least 1½ inches from the face without injury to the concrete. In case wire ties are used, upon removal of the forms, all projecting wire shall be cut back at least ½ inch from the face of all surfaces that will be exposed to view after completion of the work and flush with the face of all concrete surfaces that will not be exposed to view. All fittings for metal ties shall be of such design that, upon their removal, the cavities, which are left, will be of the smallest practical size.

5.2.3.2 Inlet and Outlet Pipe. Pipe or tile placed in the concrete for inlet or outlet connections shall extend through the concrete walls beyond the outside surfaces of the walls a sufficient distance to allow for connections. The pipe or tile shall be placed through the forms and poured in place.

The ends of the pipe shall be flush with the inside wall of the structure. Inlet pipe(s) shall be placed so that the minimum invert elevation is $^{2}/_{10}$ feet higher than the outlet pipe, unless otherwise authorized by the Engineer.

5.2.3.3 Bedding. The subgrade for the structure shall be excavated a sufficient depth so as to provide space for at least 4 inches of bedding material between the subgrade and the structure. Bedding material shall be placed and compacted to the proper elevation. If rock is encountered within 6 inches of the bottom of the structure, then excavate down a minimum of 6 inches and backfill with bedding material.

5.2.3.4 Reinforcement.

5.2.3.4.1 Placement. Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position in accordance with Concrete Reinforcing Steel Institute "Recommended Practice for Placing Reinforcing Bars," and by using concrete or metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to

resist crushing under full load. Metal chairs which extend to the surface of the concrete (except where shown on the plans) and wooden supports, shall not be used. Placing bars in layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing in the forms, all reinforcing steel shall be cleaned thoroughly of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

5.2.3.4.2 Splicing. Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced, they shall be lapped at least 48 diameters, unless otherwise shown on the plans.

Splicing shall be accomplished by placing the bars in contact with each other and wiring them together.

Welding of reinforcing steel or cutting with a cutting torch will not be permitted unless specifically authorized by the Engineer.

5.2.3.4.3 Bending Reinforcement. Bends and hooks in bars shall be made in the manner prescribed in the “Manual of Standard Practice” of the American Concrete Institute.

Bars shall not be bent or straightened in a manner, which will injure the material. Bars with kinks or unspecified bends shall not be used.

5.2.3.4.4 Welded Wire Fabric. Welded wire fabric shall be spliced not less than two meshes. It shall be lifted carefully into its specified position after the concrete is placed but still plastic.

5.2.3.4.5 Placing Concrete. Concrete shall be conveyed, deposited, and consolidated by any method which will preclude the segregation or loss of ingredients.

Chutes used in conveying concrete shall be sloped to permit concrete of the consistency required to flow without segregation. Where necessary to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

Where a sequence for placing concrete is shown on the plans, no deviation will be permitted unless approved in writing by the Engineer.

Where concrete is to be deposited against hardened concrete at horizontal construction joints, placing operations shall begin by conveying a grout mixture through the placing system and equipment, and depositing the mixture on a joint. The grout mixture shall consist of a modification of the concrete specified to reduce the quantity of coarse aggregate in the mix larger than pea-gravel size to ½ the quantity specified.

To avoid segregation, concrete shall be deposited as near to its final position as is practicable. The use of vibrators for extensive shifting of the mass of concrete will not be permitted.

Concrete that has partially hardened or is contaminated by foreign materials shall not be deposited in the structure.

Concrete shall be placed in horizontal layers insofar as practical. Placing shall start at the low point and precede upgrade unless otherwise permitted by the Engineer. Concrete shall be placed in a continuous operation between construction joints and shall be terminated with square ends and level tops unless otherwise shown on the plans.

Concrete shall not be permitted to fall more than 6 feet without the use of pipes or tremies. Pipes or tremies shall be at least 6 inches in diameter, or the equivalent cross sectional area for rectangular sections. Concrete shall not be placed in horizontal members or sections until the concrete in the supporting vertical members or sections has been consolidated and a 2 hour period has elapsed to permit shrinkage to occur.

Concrete shall be thoroughly vibrated in a manner that will encase the reinforcement and inserts, fill the forms, and produce a surface or even texture free of rock pockets and excessive voids.

Structural concrete, except slope paving steeper than 1 inch per foot, such as spillway aprons and channel lining, and concrete placed under water, shall be consolidated by means of high-frequency, internal vibrators of a type, size, and number approved by the Engineer. The location, manner, and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without separation of the mortar and course aggregate, and without causing water or cement paste to flush to the surface. Internal vibrators shall not be held against the forms or reinforcing steel.

The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it has been deposited in the forms. At least 2 vibrators in good operating condition shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed.

5.2.3.4.6 Joints. The work shall be so prosecuted that construction joints will occur at designated places shown on the plans unless otherwise authorized by the Engineer. The Contractor shall construct, in one continuous concrete placing operation, all work comprised between such joints. Joints shall be kept moist until adjacent concrete is placed.

All construction joints having a keyed, stepped, or roughened surface shall be cleaned prior to placement of the adjacent concrete as directed by the Engineer.

Expansion and contraction joints in concrete structures shall be formed where shown on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans.

No direct payment will be made for furnishing and placing asphaltic paint, premolded asphaltic filler, or other types of joint separators. The cost therefore shall be included in the price bid for the item of work of which they are a part.

5.2.3.4.7 Cold Weather Requirements. Whenever the temperature of the surrounding air is below 40°F or when the possibility exists that the temperature will fall below 40°F, within the 24 hour period after concrete operations, concrete placed in the forms shall have a temperature of between 80°F and 100°F. All concrete shall be maintained at a temperature of not less than 50°F for at least 72 hours or for as much time as is necessary to ensure proper curing of the concrete. The housing, covering, or other protection used in connection with curing, shall remain in place and intact at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Contractor will be held responsible for any damage to concrete as a result of cold weather operations.

5.2.3.4.8 Finishing. The top surfaces of structures shall be struck off with a straight edge and finished with a wood float. As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surfaces shall either be covered with burlap or sprayed with white pigmented membrane curing compound conforming with A.S.T.M. designation C309, Type 2. Forms shall be removed between 12 and 24 hours after concrete placement and all exterior form ties shall be removed to a depth of 1 inch below the surface, all fins caused by forms, joints, and other projections, shall be removed, and all pockets cleaned and filled with mortar. All exposed surfaces shall then be wetted and hand rubbed with a rubber float using a sand and cement mixture to obtain a smooth and uniform texture as directed by the Engineer.

5.2.3.4.9 Inverts. Inverts for inlet boxes, junction boxes, and other drainage structures shall be constructed with cement mortar after other concrete work has been done. Inverts shall be smoothly finished in accordance with the plans and to ensure a smooth flow of water through the structure.

5.2.3.4.10 Backfilling. Structures which lie within the area to be paved, or within 2 feet of the back of curb, such as curb inlets or junction boxes, shall be backfilled with granular material meeting the requirements of bedding material specified hereinbefore. Backfill not within 2 feet of the paving area may be sutable embankment material. Bedding material shall be placed and thoroughly compacted. Earth backfill shall be placed in accordance with the requirements specified hereinbefore for pipe backfilling.

5.2.3.4.11 Removal of Forms. Forms shall remain in place until, in the opinion of the Engineer, it is safe to remove them. In determining the time for removal of forms, consideration shall be given to the location and character of the structure, the weather, and other conditions influencing the setting of the concrete and the requirements for curing and finishing.

5.2.3.4.12 Exposed Metal. All exposed metal shall be painted and primed in accordance with the Standard Drawings.

5.2.4 Method of Measurement. Measurement of all junction boxes, manholes, curb inlets, area inlets, and flared end sections will be per each structure.

5.2.5 Basis of Payment. The accepted quantities of , junction boxes, manholes, curb inlets, area inlets, and flared end sections will be paid for based on field measurements completed by the

Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, bedding, backfill, forms, reinforcement, concrete, metal casting, joints, connections, curb and gutter within the limits of the structure, concrete toe wall, and haul off of excess material.

Payments will be made under:

Item COS-5.2.5.1.00.00	SS-1 Junction Box -- per each
Item COS-5.2.5.2.00	SS-2 Storm Sewer Manhole -- per each
Item COS-5.2.5.3.00.00	SS-3 Curb Inlet -- per each
Item COS-5.2.5.4	Not Used
Item COS-5.2.5.5.00.00	SS-5 Area Inlet -- per each
Item COS-5.2.5.6.00.00	SS-6 Curb Inlet -- per each
Item COS-5.2.5.7.00	Flared End Section -- per each

*Where 00 represents the inside diameter in inches and where 00.00 represents the inside length and width dimensions respectively in inches for a non-circular section. For example, a 7 foot × 3 foot SS-6 Curb Inlet would be item COS-5.2.5.6.84.36 and a 24 inch Flared End Section would be item COS-5.2.5.7.24.

5.3 FIELD TESTS AND INSPECTIONS

The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work performed is in accordance with the requirements and intent of the plans and specifications. Any work done (except excavation) or material used without suitable supervision or inspection by the Engineer may be ordered removed and replaced at the Contractor’s expense.

6 PORTLAND CEMENT CONCRETE

6.1 DESCRIPTION. The concrete described herein shall consist of a mixture of Portland cement, fine aggregate, coarse aggregate, an air-entraining agent and water combined in the proportions specified for the various classes of concrete used in construction work and as set forth in these specifications. Admixtures may be added as specifically permitted. Unless specified, Class A and Class X Concrete are interchangeable. All concrete mix deigns shall have a minimum 28vday compressive strength of 4,000 psi with the specification listed herein.

6.2 MATERIALS

6.2.1 Cement. Cement shall conform to the ASTM Designation C-150. Type I, and II cement shall be used unless specified in special provisions. Different brands or different types of cement from the same mill or the same brand or type from different mills shall not be mixed or used alternately in the same item of construction unless authorized by the Engineer. The Contractor shall not store cement at the site of the work without prior approval of the Engineer. The right is reserved by the Engineer to sample the cement either at the origin of the shipment or after delivery at the site of the work or the ready-mix concrete plant. Provisional acceptance by the Engineer prior to the completion of tests shall in no way act as a waiver of the right to reject cement which has been shipped and unused, if upon completion of the tests, it fails to meet the requirements of the specifications.

6.2.1.1 Supplementary Cementitious Materials (Mineral Admixtures)

6.2.1.1.1 Fly Ash. Fly Ash shall conform to ASTM Designation C-618 Class C or Class F.

6.2.1.1.2 Ground Granulated Blast Surface Slag (GGBFS). GGBFS shall conform to ASTM C 989 and meet the activity performance in Table 1 Grade 100 or grade 120.

6.2.2 Water. Water shall comply with requirements of ASTM C 1602.

6.2.2.1 Recycled Water. Recycled water from production and stormwater runoff meeting the requirements of ASTM C 1602 and other non-potable water sources shall be tested daily, or at intervals directed by the Engineer, and shall meet the requirements of ASTM 1602 Table 2. The concrete chloride ion content shall be in accordance with of ACI 318.

6.2.3 Fine Aggregate. Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof that is free from cemented or conglomerated lumps. Fine aggregate shall conform to the requirements of ASTM Designation C-33 Table 1 with respect to deleterious substances, soundness, and abrasion resistance.

6.2.3.1 The gradation requirements of fine aggregate shall be as follows:

ASTM C-33 Sand	
Sieve	% Passing
⅜ inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 - 30
No. 100	0 - 10

The fine aggregate shall not have more than 45% passing any sieve and its fineness modulus shall be between 2.3 and 3.10.

6.2.4 Coarse Aggregate. The coarse aggregate shall consist of crushed stone or crushed gravel. Coarse aggregates shall be of uniform quality and conform to the requirements of ASTM Designation C-33 Table 3 Class Designation 4S with respect to deleterious substances (excluding deleterious rock), soundness, lightweight chert (specific gravity less than 2.4), lignite, and abrasion resistance.

6.2.4.1 Testing for hard and soft chert, and deleterious aggregate shall be performed in accordance with MoDOT TM-71 Deleterious Content of Aggregate and shall meet the requirements as follows:

Chert and Deleterious Material in Aggregate	
Total of all Deleterious Rock	6.0
Total Shale	1.0
Total Hard and Soft Chert	4.0
Total Other Foreign Material	0.5

6.2.4.2 Coarse aggregates for Class “A” and Class “X” concrete shall meet the gradation requirements as follows:**Coarse Aggregate Gradation Requirements**

U. S. Standard Sieve Size	Percent Passing by Weight			
	Class A		Class X	
	ASTM C 33 No. 467	ASTM C 33 No. 57	ASTM C 33 No. 67	ASTM C 33 No. 89
2 inch	100	--	--	--
1½ inch	95-100	100	--	--
1 inch	--	95-100	100	--
¾ inch	35-70	--	90-100	--
½ inch	--	25-60	--	100
⅜ inch	10-30	--	20-55	90-100
No. 4	0 - 5	0-10	0 - 10	20-55
No. 8	--	0-5	0-5	5-30
No. 16	--	--	--	0-10
No. 50	--	--	--	0-5
No. 200	2.5 max.	2.5 max.	2.5 max.	2.5 max.

6.2.5 Admixtures

6.2.5.1 Air Entrainment. Air entraining admixtures shall conform to the requirements of ASTM C 260.

6.2.5.2 All other Admixtures except air entrainment for concrete shall conform to the requirements of ASTM C 494. All admixtures to be used in concrete shall be shown on the approved mix design in proportions anticipated to be used. Any admixtures other than air entrainment must be approved for use by the Engineer or shown on the mix design.

6.2.5.3 Only Non-Chloride Accelerators meeting requirements of ASTM C494 shall be used in Concrete for purposes of accelerating the set time of mixtures. No Calcium Chloride accelerator shall be used in any concrete mixtures.

6.3 PROPORTIONS OF MATERIALS

6.3.1 Cement Content. Class "A" concrete and Class "X" concrete shall contain not less than 564 pounds of cement per cubic yard. Cement content includes weight of pozzolan.

6.3.2 Water Content. The water to cementitious ratio, including free surface moisture on the aggregate, shall not exceed 0.45.
6.3.3 Air Content. Portland cement concrete shall have an air content of 6.0% ± 1.5% of the volume of the concrete when tested in accordance with ASTM Designation C-173 or ASTM C 231.

6.3.4 Fly Ash Content. The Portland cement concrete can contain up to a maximum of 25% by weight of fly ash per cubic yard. Fly ash may not be used in Portland cement concrete when the desired property is high early strength gain.

6.3.5 Slump. The slump, when tested in accordance with ASTM Designation C-143, shall not exceed 4.0 inches. If a water reducing admixture (WRA) is used, then the slump shall not exceed 5.0 inches. If a high range water reducing admixture (HRWR) is used, then the slump may not exceed 8.0 inches.

6.4 GENERAL REQUIREMENTS

6.4.1 Weather Limitations. Additional precautions must be taken when placing concrete during hot and cold weather to insure it will have the strength and durability to function properly. The Contractor shall assume all risks when performing work under the conditions identified below, regardless of the precautions taken or approved by the Engineer. All costs associated with hot and cold weather concreting shall be incidental to the work being performed.

6.4.1.1 Cold Weather Concreting. Cold weather concreting conditions exist when the ambient air temperature has fallen to, or is expected to fall below 40°F during the placement and/or

curing period of concrete. Concrete shall not be placed unless the ambient air temperature is 35°F and rising without prior approval from the Engineer as described herein.

Contractor shall submit in writing to the Engineer detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather conditions. The submittal shall include procedures to be implemented upon abrupt changes in weather conditions or equipment failures. The Contractor shall not begin cold weather concreting until these procedures have been reviewed and accepted by the Engineer.

Contractor shall maintain cold weather protection for a minimum of 3 days at a curing temperature of 50°F, or until the minimum strength has been obtained. Contractor shall also furnish temperature monitoring equipment and shall bear the responsibility to demonstrate to the Engineer the concrete has been protected from freezing throughout the protection period.

6.4.1.2 Hot Weather Concreting. Hot weather concreting conditions exist when the ambient air temperature has risen to, or is expected to rise above 90°F during the placement and/or curing period of the concrete.

Contractor shall submit in writing to the Engineer, detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot weather conditions. The submittal shall include procedures to be implemented upon abrupt changes in weather conditions or equipment failures. The Contractor shall not begin hot weather concreting until these procedures have been reviewed and accepted by the Engineer.

6.4.2 Ready-Mix Concrete Plants and Delivery Mixers shall meet the requirements of ASTM C 94 Standard Specification for Ready-Mix Concrete. The manufacturer shall afford the Engineer all reasonable access, without charge, for making necessary checks of the production facility and for securing necessary samples to determine if the concrete is being produced in accordance with this Specification and the Job Special Provisions.

6.4.2.1 Calibration and Certification of Plants and Delivery Mixers shall be certified by the National Ready Mixed Concrete Association (NRMCA). The manufacturer shall have an independent scale company calibrate all scales and measuring devices for batching, cement, water, and aggregates every 12 months. Admixture measuring devices shall be calibrated and certified by the admixture supplier. Anytime a repair is made on plant equipment which can affect the calibration of the measuring devices, a new calibration is required. Blades and drums of the mixers shall be in good condition and be in compliance with the mixer manufacturers' requirements. When excessive buildup is observed in a drum, the truck shall not be used until the buildup is removed.

6.4.2.2 Plant Calibration. Plant scales and watering devices shall be calibrated and certified by an approved commercial scale service. A copy of the calibration and certification shall be provided to the Engineer upon request. Plants are to calibrated and certified annually and when found to be out of tolerance during verification.

6.4.3 Delivery Tickets. The concrete manufacturer shall furnish a delivery ticket for each batched load to the Construction Inspector with weight or volumetric batch information containing the quantities of each ingredient at the proportions used to batch that load of concrete. The information included on delivery tickets shall be in accordance with ASTM C 94 which includes, but is not limited to, the following information:

- The mix design batch weights for one cubic yard of concrete submitted for the project, and the batched weights of all materials shall be printed on the delivery ticket.
- The saturated surface-dry batch weights of the aggregates and the free water moisture content of the aggregates shall be printed on the delivery ticket.
- Batch Time, which starts at the time all ingredients have been charged into the delivery vehicle.
- All information that is necessary to calculate the total mixing water. The amount of water that can be added on the job site without exceeding the specified water to cement ratio.
- The amount of water that can be added on the job site without exceeding the specified water to cement ratio.

6.4.4 Delivery. The concrete shall be delivered to the jobsite in trucks so designed and operated that the concrete will be thoroughly mixed during the time it is in transit. The concrete shall be discharged at the site within a period of 90 minutes from batch time. In hot weather conditions, as defined in 6.4.1, the discharge time shall be reduced to 60 minutes. When concrete is placed at the job site, it shall have the proper consistency and slump for satisfactory workability and shall not exhibit signs of mix segregation. The temperature of the concrete shall not be less than 55°F or greater than 85°F for structural items and not greater than 90°F for non-structural items at the time of placement, unless approved by the Engineer.

6.4.5 Testing. Quality assurance testing will be conducted at intervals determined by the Engineer.

6.5 CONCRETE PROTECTION CURING AND PLACING INTO SERVICE

6.5.1 Concrete Protection and Curing. All concrete will be cured with a curing compound meeting the requirements of ASTM C 309. Follow the requirements of section 6.4.1.1 for Hot Weather Protection and Curing or section 6.4.1.2 for Cold Weather Protection and Curing, and as directed by the Engineer.

6.5.1.1 Application. Immediately after the finishing operation has been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured by spraying with a uniform application of a curing compound. Follow the curing compound manufacturer’s requirements for application rates. If rain falls on the newly coated surface before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the Contractor will be required to apply additional curing material to the affected portions.

6.5.1.2 Acceptance. If the spraying pattern does not appear to give uniform coverage or the spayed pattern produces a finish aesthetically unacceptable to the Engineer, the Contractor may be required to remove or replace the structure.

6.5.2 Concrete Curing Compounds. Water retention properties for all curing compounds shall be determined by ASTM Test Method C 156. The vehicle class of all curing compounds shall be Class A.

6.5.2.1 Type 1-D Curing Compounds. Type 1-D liquid membrane-forming curing compounds shall be in accordance with ASTM C 309 for Type 1-D, clear or translucent with fugitive dye.

6.5.3 Removing Protection and Placing the Concrete Component into Service. The minimum compressive strength Formwork Concrete or Falsework Concrete must attain prior to being placed into service and removal of protection requirements in accordance with Chapter 6.

6.5.3.1 Formwork Concrete. Is defined as machine or hand formed concrete work, forms are used to contain poured concrete and mold it into required dimensions and support until the concrete has set. The compressive strength must attain a minimum of 75% of the 28th day strength of the concrete mix design prior to removing protection and placing in service.

6.5.3.2 Falsework Concrete. Is defined as a temporary structure, which maintains load bearing support for the cast in place concrete structure during curing and protection until it has attained enough compressive strength to support itself and the expected loads placed upon it during service. The minimum compressive strength requirement will be directed by the Engineer.

6.6 MEASUREMENT AND PAYMENT

6.6.1 Method of Measurement. No measurement will be made for placing Portland cement concrete.

6.6.2. Basis of Payment. No direct payment will be made for placing Portland cement concrete and it will be considered incidental to the item being constructed e.g. concrete curb and gutter.

7 MISCELLANEOUS

7.1 CONCRETE STRUCTURES

7.1.1 Scope of Work. The work shall consist of furnishing all labor, materials, and equipment to perform all operations in connection with the construction cast in place of retaining walls, traffic islands, concrete culverts and headwalls, and any other miscellaneous concrete structures, except those covered elsewhere in these specifications, required for the project in accordance with the specifications and drawings.

7.1.2 Materials.

7.1.2.1 Concrete. Concrete shall be Class "A" Portland Cement Concrete in accordance with the requirements of Chapter 6 of these specifications.

7.1.2.2 Reinforcing Steel. Reinforcing steel shall consist of deformed bars of grade 60 steel conforming to the requirements of ASTM designation A615 or of wire fabric conforming to ASTM designation A185.

7.1.2.3 Expansion Joint Fillers. Expansion joint fillers shall be of a non-extruding type conforming to ASTM designation D1751 and cut to the dimensions shown on the plans.

7.1.2.4 Bedding Material. Material for bedding shall be crushed stone or crushed gravel conforming to the requirements of ASTM Standard C33, and having a gradation as follows:

Sieve	% Passing
Passing ½ inch	100
Passing ⅜ inch	30-100
Passing No. 4	0-5

7.1.3 Construction Methods.

7.1.3.1 Forms. Forms shall be of wood, plywood, or any other suitable material, designed, constructed, braced, and maintained so that the finished concrete will be true to line, and elevation will conform to the required dimensions. They shall be designed to withstand the pressure of the concrete, the effect of vibration as the concrete is placed, and all other loads incidental to the construction operations, without distortion or displacement. They shall be mortar tight. Oiling both inside and outside surfaces will be required to prevent warping, shrinkage, or swelling.

Forms shall be constructed and designed so that their removal can be effected without injury to the concrete and so that portions where surface finishing is required may be removed without disturbing forms that are to remain. ¾ inch chamfer strips shall be placed on all edges to be

exposed. Dirt, chips, sawdust, nails, and other foreign matter shall be removed before any concrete is deposited therein.

Tie rods, belts, and anchorages within the forms shall be constructed so as to permit their removal to a depth of at least 1½ inches from the face without injury to the concrete. In case wire ties are used, upon removal of the forms, all projecting wire shall be cut back at least ½ inch from the face of all surfaces that will be exposed to view after the completion of the work and flush with the face of all concrete surfaces that will not be exposed to view. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest practical size.

7.1.3.2 Inlet and Outlet Pipe. Pipe or tile placed in the concrete for inlet or outlet connections shall extend through the concrete walls beyond the outside surfaces of the walls a sufficient distance to allow for connections. The pipe or tile shall be placed through the forms and poured in place.

7.1.3.3 Reinforcement.

7.1.3.3.1 Placement. Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position in accordance with Concrete Reinforcing Steel Institute's (CRSI) "Recommended Practice for Placing Reinforcing Bars," and by using concrete or metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under full load. Metal chairs which extend to the top surface of the concrete (except where shown on the plans) and wooden supports, shall not be used.

Placing bars on layers of fresh concrete as the work progresses, and adjusting bars during the placing of concrete will not be permitted. Before placing in the forms, all reinforcing steel shall be cleaned thoroughly of mortar, oil, dirt, loose mill scale, loose or thick rusts, and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved by the Engineer.

7.1.3.3.2 Splicing. Splicing of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced, they shall be lapped at least 30 diameters, unless otherwise shown on the plans.

Splicing space shall be accomplished by placing the bars in contact with each other and wiring them together.

Welding of reinforcing steel or cutting with a cutting torch will not be permitted unless specifically authorized by the Engineer.

7.1.3.3.3 Bending Reinforcement. Bends and hooks in bars shall be made in the manner prescribed in the "Manual of Standard Practice" of the American Concrete Institute.

Bars shall not be bent or straightened in a manner which will injure the material. Bars with kinks or unspecified bends shall not be used.

7.1.3.3.4 Welded Wire Fabric. Welded wire fabric shall be spliced no less than 2 meshes. It shall be lifted carefully into its specified position after the concrete is placed but still plastic.

7.1.3.4 Bedding. The subgrade for the structure shall be excavated a sufficient depth so as to provide space for at least 4 inches of bedding material between the subgrade and the structure. Bedding material shall be placed and compacted to the proper elevation.

7.1.3.5 Placing Concrete. Concrete shall be conveyed, deposited, and consolidated by any method which will preclude the segregation or loss of ingredients.

Chutes used in conveying concrete shall be sloped to permit concrete of the consistency required to flow without segregation. Where necessary to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

Where a sequence for placing concrete is shown on the plans, no deviation will be permitted unless approved in writing by the Engineer.

Where concrete is to be placed against hardened concrete, the hardened concrete shall be wetted immediately before placing the fresh concrete, and then vibrated sufficiently to ensure no voids.

To avoid segregation, concrete shall be deposited as near to its final position as is practicable. The use of vibrators for extensive shifting of the mass of concrete will not be permitted. Concrete that has partially hardened or is contaminated by foreign materials shall not be deposited in the structure.

Concrete shall be placed in horizontal layers insofar as practical. Placing shall start at the low point and precede upgrade unless otherwise permitted by the Engineer. Concrete shall be placed in a continuous operation between construction joints and shall be terminated with square ends and level tops unless otherwise shown on the plans.

Concrete shall not be permitted to fall more than 6 feet without the use of pipes or tremies. Pipes or tremies shall be at least 6 inches in diameter, or the equivalent cross sectional area for rectangular sections. Concrete shall not be placed in horizontal members or sections until the concrete in the supporting vertical members or sections has been consolidated and a 2 hour period has elapsed to permit shrinkage to occur.

Concrete shall be thoroughly vibrated in a manner that will encase the reinforcement and inserts, fill the forms, and produce a surface or even texture free of rock pockets and excessive voids.

Structural concrete, except slope paving steeper than 1 inch per foot, such as spillway aprons and channel lining, and concrete placed under water, shall be consolidated by means of high frequency internal vibrators of a type, size, and number approved by the Engineer. The location, manner, and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without separation of the mortar and coarse aggregate, and without

causing water or cement paste to flush to the surface. Internal vibrators shall not be held against the forms or reinforcing steel.

The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it has been deposited in the forms. At least 2 vibrators in good operating condition shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed.

7.1.3.6 Joints. The work shall be so prosecuted that construction joints will occur at designated places shown on the plans unless otherwise authorized by the Engineer. The contractor shall construct, in one continuous concrete placing operation, all work compromised between such joints. Joints shall be kept moist until adjacent concrete is placed.

All construction joints having a keyed, stepped, or roughened surface shall be cleaned prior to placement of the adjacent concrete as directed by the Engineer.

¾ inch expansion and contraction joints for cast-in-place concrete structures shall be constructed at a minimum distance between joints of 50 feet, and in no case shall exceed 75 feet. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans.

No direct payment will be made for furnishing and placing asphaltic paint, pre-molded asphaltic filler, or other types of joint separators. The cost, therefore, shall be included in the price bid for the item of work of which they are a part.

7.1.3.7 Cold Weather Requirements. Whenever the temperature of the surrounding air is below 40°F within the 24 hour period after concrete operations, concrete placed in the forms shall have a temperature of between 50°F and 90°F. All concrete shall be maintained at a temperature of no less than 50°F for at least 72 hours or for as much time as is necessary to ensure proper curing of the concrete. The housing, covering, or other protection used in connection with curing, shall remain in place and intact at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Contractor will be held responsible for any damage to concrete as a result of cold weather operations. No concrete will be placed on a bridge superstructure when the air temperature is less than 40°F.

7.1.3.8 Finishing. The top surfaces of structures shall be struck off with a straight edge and finished with a wood or aluminum float. As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surfaces shall either be covered with burlap or sprayed with curing compound conforming to Chapter 6. Forms shall be removed between 4 and 12 hours after concrete placement and all exterior form ties shall be removed to a depth of 1 inch below the surface, all fins caused by forms, joints, and other projections shall be removed, and all pockets cleaned and filled with mortar. All exposed surfaces shall then be wetted and hand rubbed with a rubber float using a sand and cement mixture to obtain a smooth and uniform texture as directed by the Engineer.

7.1.3.9 Backfilling. Structures which lie within the area to be paved, or within 2 feet of the back of curb shall be backfilled with granular material meeting the requirements of bedding material specified hereinbefore. Backfill not within 2 feet of the paving area may be clean earth. Bedding material shall be placed and thoroughly compacted. Earth backfill shall be placed in accordance with the requirements specified in Chapter 5 of these specifications for pipe backfilling.

7.1.3.10 Removal of Forms. Forms shall remain in place until, in the opinion of the Engineer, it is safe to remove them. On structures such as box culverts, forms shall not be removed until the concrete has attained a strength of 3,000 psi. In determining the time for removal of forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the requirements for curing and finishing.

7.1.4. Method of Measurement.

7.1.4.1 Cast-In-Place Concrete Retaining Wall. Measurement of Cast-In-Place Concrete Retaining Wall will be made for payment to the nearest square foot of surface area of face of wall complete, in place, and accepted. Surface area will be based on the area from the top of wall to the top of the footing. Contract quantities will be used for final payment except for authorized changes during construction or where appreciable errors are found in the contract quantities. The revision or correction will be computed and added or deducted from the contract quantities.

7.1.4.2 Cast-In-Place Concrete Headwall and Wingwalls. No measurements will be made for Cast-In-Place Concrete Headwall and Wingwalls.

7.1.4.3 Cast-In-Place Concrete Traffic Islands. Measurement of Cast-In-Place Concrete Traffic Islands will be made by the Inspector for payment to the nearest square foot of surface area of concrete complete, in place, and accepted.

7.1.5 Basis of Payment. The accepted quantities of concrete structures specified herein will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, bedding, backfill, concrete, reinforcing, forms, joints, footings, and haul off of excess material.

Payments will be made under:

Item COS-7.1.5.1	Cast-In-Place Concrete Retaining Wall – per square foot
Item COS-7.1.5.2	Cast-In-Place Concrete Headwall and Wingwalls – per lump sum
Item COS-7.1.5.3	Cast-In-Place Concrete Traffic Islands – per square foot

7.2 ADJUSTMENT OF DOWNSPOUT DRAINS

7.2.1 Scope of Work. The work shall consist of reconnecting existing downspout drains now located in the existing curb into and through the proposed curb or curb and gutter.

7.2.2 Material. In general, the relocated drains shall be of the same diameter as the existing drains. Wherever practical, existing drains shall be re-laid.

7.2.3 Construction Methods. Existing drains are indicated on the plans. The contractor shall exercise care while removing existing curb and excavating between existing curb and new curb or curb and gutter not to damage existing drains. The Engineer in the field shall determine the location of the removal to ensure proper drainage. Usable drain pipe removed shall be cleaned. Existing concrete drains with steel covers shall be removed to the locations indicated by the Engineer and all material disposed of outside of the right-of-way.

Specification for relaying exiting or new drains shall conform to specifications included in Chapter 5 of these specifications. Drain tile shall be poured in place in proposed curb or curb and gutter at locations indicated by the Engineer.

7.2.4 Method of Measurement. No measurements will be made for adjustment of downspout drains.

7.2.5 Basis of Payment. No direct payment will be made for adjustment of downspout drains and it will be considered incidental to the work..

7.3 ADJOINING STREETS AND ALLEYS

All roadways adjacent to the new construction shall be graded for a satisfactory connection with slopes not greater than 1 foot vertical to 15 feet horizontal, unless otherwise authorized by the Engineer. All approaches or connections shall be smoothly finished and present a good appearance and provide for proper drainage.

7.4 STONE RIPRAP FACING

Stone riprap facing shall be of such shape as to form a stable protection of the required section.

Stone shall be sound, durable, hard, resistant to abrasion, and free from laminations, weak cleavage planes, and the undesirable effects of weathering. It shall be of such character that it will not disintegrate from the action of air, water, or the conditions to be met in handling and placing. All materials shall be clean and free from deleterious impurities, including alkali, earth, clay, refuse, and adherent coatings.

Each piece of facing stone shall have its greatest dimension not greater than 3 times its least dimension and shall have an apparent specific gravity not less than 2.2 according to ASTM C127.

Each load of stone shall be reasonably well graded from the smallest to the maximum size specified. Control of grading shall be by visual inspection. Stones must be placed by hand to achieve proper placement and distribution.

The larger stones shall be well distributed, and the entire mass of stones shall be roughly graded to conform to the approximate distribution specified. The finished stonework shall be free from objectionable pockets of small stones and clusters of larger stones.

Rocks shall be placed with the longitudinal axis normal to the alignment of the embankment face, and each rock should have a three-point bearing. No rock shall be dependent upon an overlying rock to hold it in place nor shall any rock be dependent upon chinking with smaller rocks to hold it in a temporary stable position.

Unless otherwise indicated in the plans or specifications, the stone shall be shot rock with a maximum size of 24 inches, chinked rock shall be no smaller than 4 inches in diameter and the maximum depression in any face will be 6 inches. The stone shall be even graded between 6 inches and 24 inches.

7.4.1 Method of Measurement. Measurement of Riprap Facing will be made for payment to the nearest square yard of surface area of Riprap Facing complete, in place, and accepted.

7.4.2 Basis of Payment. The accepted quantities of Riprap Facing will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, aggregate bedding, filter fabric, and riprap.

Payments will be made under:

Item COS-7.4.2.1 Riprap Facing -- per square foot

7.5 NOT USED

7.6 CONSTRUCTION SURVEYING

7.6.1 Scope of Work. All construction surveying shall be under the direct supervision of a Registered Land Surveyor licensed in the State of Missouri. All surveying work performed by the Contractor shall be sufficient and accurate to construct the work in accordance with the contract documents. Any delays or additional cost to the project which result from insufficient or inaccurate staking or time lost for corrective actions will be considered as a non-excusable and non-compensable delay.

7.6.2 Existing Markers. The location of any reference points, which may have been established by the Department of Public Works and any control data, which the Department of Public Works may have will be made available to the Contractor upon request. If benchmarks, right-of-way monuments, control points, or any other reference marks are disturbed during construction, the Contractor shall immediately notify the Inspector or Engineer. Cost of replacement shall be the Contractor's responsibility and completed under the supervision of a Registered Land Surveyor licensed in the State of Missouri.

7.6.3 Minimum Requirements. Any deviations to the following requirements shall be approved by the Inspector, prior to beginning construction staking. Staking shall be done in accordance with the generally accepted surveying practices as necessary for field installations so that it can be checked with normal equipment such as string lines, tapes, and auto levels. The Contractor will be required to be set to a vertical and horizontal tolerance for all points, not to exceed 0.04 of a foot from the point's true position. All stakes shall have stationing, grades, and offset distances clearly displayed on the front of the stake. Elevations shall be clearly displayed on the backside of all stakes. Roadway markings shall be maintained to the full satisfaction of the Inspector. The Contractor is responsible for field verification of existing features before construction begins.

7.6.3.1 Streets and Approaches. Streets and approaches shall be staked with offsets to the centerline or backs of curbs. Standard offset distance for streets and approaches is 10 feet or less from the back of curb. Field conditions that require offsets greater than 10 feet shall be approved by the Inspector. Streets shall be staked at a maximum of 50 feet on straight runs, and 25 feet on curves. Curves shall also be staked at the radius point, point of curvature, point of tangency, and midpoint.

7.6.3.2 Sanitary Sewer Lines. Sanitary sewer lines shall be staked with offsets and elevations to the flow line. Standard offset distance is 10 feet, but shall not exceed 20 feet for deep trenches. Spacing shall not exceed 100 feet along the centerline.

7.6.3.3 Sanitary Sewer Laterals. When lateral locations are shown on the plans, tees shall be staked with an offset from the flowline. Standard offset is 10 feet, but shall not exceed 20 feet for deep connection. Also, the intersection of the proposed lateral and right-of-way line/edge-of-easement shall be staked at two locations, at least 5 feet apart, with offsets not exceeding 15 feet, or 25 feet for deep connections. When laterals are not located on plans, at least two stakes must be placed at the right-of-way line or edge of easement, near the expected lateral location. The Contractor is responsible for verifying lateral locations before construction surveying begins.

7.6.3.4 Storm Sewer Lines. Storm sewer lines shall be staked with offsets and elevations to the flow line. Standard offset distance is 10 feet, but shall not exceed 20 feet for deep trenches. Spacing shall not exceed 100 feet along the centerline. Storm sewer lines shall also be staked at the end of each line. For flared end sections, the beginning and end of line shall include the full length of the flared end sections.

7.6.3.5 Large Box Structures. Box structures such as inlet boxes, junction boxes, curb inlets, etc. shall be staked to the corners of the structure. At least two corners of each structure shall be staked with elevations and offsets not exceeding 10 feet, or 20 feet for deep structures. For all curb inlets, the top of the structure must be graded with the slope of the road.

7.6.3.6 Large Cylindrical Structures. Cylindrical structures such as sanitary sewer manholes, storm sewer manholes, etc. shall be staked to the center of the structure. Two stakes, at least 5 feet apart, shall be placed for each structure. Standard offset distance is 10 feet, but shall not exceed 25 feet for deep structures. Elevations shall be determined for top of the structure, flow lines in and out, and cuts and fills to these respective locations placed on the stakes.

7.6.3.7 Bridges and Box Culverts. Bridges and Box Culverts shall be staked with horizontal and vertical control with tolerances not to exceed 0.02 of a foot. The centerline of the structure, bent lines, and fill faces, and/or other major alignments as deemed necessary by the Engineer shall be staked prior to beginning any construction on the structure.

After completing the staking of any bridge, box culvert or retaining wall, the contractor shall furnish to the Engineer structural layout plan sheets which show the location of all points that have been staked. At the time of furnishing the marked layout sheets, the Contractor shall meet with the Engineer or Inspector to review the layout a minimum of two working days before construction begins.

7.6.4 Field Verification, Changes, and Adjustments. The Contractor shall field verify the elevations and alignment/locations of all existing features. Adjustments necessary to provide accurate staking to match the improvements to existing features, design errors, or omissions shall be immediately brought to the attention of the Inspector. The Engineer will determine the nature of the discrepancy and will make revisions as necessary. The Contractor shall perform any re-staking required by such revisions. Minor corrections or adjustments of staking shall be considered incidental to construction staking and no change to the contract price will be made. Any reimbursement due to the Contractor for additional staking due to design errors or omissions shall have a change order issued prior to execution of the work.

7.6.5 Method of Measurement. If a bid item for construction staking is included in the contract, the work provided will not be measured for payment, but will be considered a lump sum unit.

7.6.6 Basis of Payment. Construction surveying shall be considered incidental to the project, unless a bid item is listed in the contract. When a bid item for construction surveying/staking is listed in the contract, contractor furnished surveying and staking will be paid for at the lump sum price as work progresses based on invoices for surveying work and will be considered full compensation for the following:

a) Performing this work.
b) All material, labor, equipment and incidentals necessary to complete the work.
c) For all effects, impacts, cumulative impacts, incidental and consequential costs, loss or damage arising from, relating to, or produced by error or discrepancies in surveys or

staking; and plans based on such surveys or staking, and any cost, including time effects, to correct the errors or discrepancies.

When a bid item for construction surveying/staking is listed in the contract, a percentage of the lump sum price will be paid based on the amount of work completed as determined by the Engineer.

When a bid item is listed in the Contract, payments will be made under:

Item COS-7.6.6	Construction Surveying -- per lump sum

7.7 TEMPORARY TRAFFIC CONTROL AND WORK ZONE MANAGEMENT

7.7.1 Scope of Work. This work shall consist of furnishing, installing, operating, maintaining, cleaning, relocating and removing temporary traffic control devices and equipment, and the removal and relocation or covering and uncovering of existing signs and other traffic control devices. Contractor or entity performing work that affects the normal pedestrian or vehicular traffic patterns in any fashion shall provide traffic control means and methods to provide for reasonably safe operations in strict compliance with the latest revision of the Manual on Uniform Traffic Control Devices (MUTCD) as published by the Federal Highway Administration, any applicable Contract Documents, and/or Permits. This includes work directly on City Right of Way or work adjacent to the City Right of Way that affects traffic, pedestrians, or public safety. Items requiring traffic control include but are not limited to: sidewalk closures, lane closure, lane width restriction, equipment crossing, flagging operations, and mobile and/or temporary operations. The Contractor shall also comply with all OSHA requirements as applicable when working on City Right of Way.

7.7.2 Construction Requirements.

7.7.2.1 General Requirements. The Contractor shall be responsible for providing and maintaining all traffic control devices, flaggers, and incidental items as necessary to protect the work area and provide reasonably safe traffic flow, access, and detours as required. Signs, barricades, and all traffic control devices shall be properly maintained by the Contractor for the life of the Project. The Contractor shall monitor traffic flow through the project and verify that all traffic control devices are in place and functioning properly during both daytime and nighttime conditions, as applicable. If the Contractor determines, or is notified, that a deficiency in any traffic control device exists, the Contractor shall take corrective action. All traffic control devices shall remain in place only as long as they are needed and shall be removed immediately thereafter. Traffic Control devices that do not apply to existing conditions shall be removed, covered, or turned away from traffic.

7.7.2.2 Traffic Control Devices. All devices shall be clean, plumb, maintain all reflective requirements, and be in strict compliance with all requirements of the MUTCD and/or Section 616.3.2 of the Missouri Department of Transportation Standard Specifications for Highway Construction. In the event that a traffic control device is deemed unacceptable in condition or

installed incorrectly, the Contractor shall be responsible to replace or repair the device as necessary to be in conformance.

7.7.3 Notifications and Traffic Control Plans.

7.7.3.1 Work Zone Notifications. The Contractor shall notify the City of any operations that will result in any lane, shoulder, street, or sidewalk closures including lane width restrictions, as shown in the Contract Documents or Permits. If no time frame for notification or contact info is given in the Contract Documents or Permits, the Contractor shall contact the City of Springfield Public Works Construction Department at least 5 business days prior to any operations occurring that require any lane or sidewalk closures for approval.

7.7.3.1 Traffic Control Plan Approvals. Unless otherwise noted in any Contract Documents, a traffic control plan will be required to be submitted and approved by the Department of Public Works before any work may occur affecting traffic. Traffic control plans shall at a minimum, clearly show the area of work, any detours, location and description of all traffic control devices to be installed, time frame and dates the work will occur, and responsible contact person. The City reserves the right to require all traffic control plans to be signed and sealed by a Professional Engineer licensed in the State of Missouri. The costs associated with developing and implementing a traffic control plan shall be the Contractor's responsibility. Any messages placed on changeable message boards shall be approved by the City prior to display.

7.7.3.2 Notifications of Accidents. The Contractor shall provide written notice to the Department of Public Works of any pedestrian or vehicular accident when physical evidence or other information suggests an accident has occurred in the work zone or work area. The Contractor shall obtain and provide to the City copies of law enforcement accident reports for any accidents in the work zone or work area.

7.7.4 Non-Compliance and Corrections. The Contractor shall be in strict compliance with this Section of the Specifications, MUTCD, Plans, and Specifications as required. Non-compliance may result in withholding of any and all pay or order by the City to cease all operations per Section 2 of the General Conditions and Specifications. Also, non-compliance may result in penalties, fines, or non-issuance of permits as per all City Codes and applicable laws. If any of the Contractor's staff is deemed to be unfit to properly implement and perform Traffic Control to maintain public safety, the City reserves the right to request any individual to be removed from implementation of traffic control and/or project safety. If the Contractor's operations result in chronic non-compliance with traffic control or an immediate traffic control or work zone safety issue, the City may order the Contractor to cease all operations.

7.7.5 Method of Measurement. No measurement will be made for temporary traffic control.

7.7.6 Basis of Payment. Temporary traffic control will be paid for at the lump sum contract price. Contractor shall be paid at the rate of 50% of the lump sum on the first monthly pay estimate. An additional 25% of the lump sum shall be paid to the Contractor on the second pay estimate with the balance of the lump sum paid upon completion of the project. Payment shall include all incidental items necessary to complete the work. Upon failure of the Contractor to

comply with any order of the Engineer to correct a deficiency in traffic control and/or work zones, the Engineer shall have the authority to cause said conditions to be corrected and to deduct the cost from any payment due or to become due to the Contractor. When no pay item for temporary traffic control is included in the contract, temporary traffic control will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-7.7.6	Temporary Traffic Control -- per lump sum

8 PORTLAND CEMENT CONCRETE CURB AND GUTTER

8.1 CURB AND GUTTER

8.1.1 Scope of Work. Furnish all labor, materials, and equipment to perform all operations in connection with construction of concrete curb and gutter, in accordance with the specifications and drawings, subject to the terms and conditions of the contract.

8.1.2 Materials.

8.1.2.1 Class "A" concrete shall be Portland Cement Concrete in accordance with Chapter 6 of these specifications. Admixtures shall meet the requirements of Chapter 6 of these specifications. Calcium Chloride shall not be used unless specifically approved by the Engineer.

8.1.2.2 Expansion joints shall be made with preformed expansion joint filler of a non-extruding type conforming to ASTM Designation D1751. Configuration of the curb and gutter is indicated in Standard Drawing ST-2 included in these specifications.

8.1.2.3 Joint sealing compound for contraction joints shall be one of the following:

1. Cold pour polymer fortified crack fill material generally conforming with ASTM D-1190, approved by the Engineer; or

2. Hot pour polymer rubber asphalt sealer meeting the requirements of ASTM D-3405. A certification will be required from the Contractor certifying that the joint sealer meets this specification.

8.1.2.4 Concrete curing compound shall conform to Chapter 6.5 of these specifications.

8.1.3 Method of Construction.

8.1.3.1 Forms shall be made of metal and shall have a depth equal to or greater than the prescribed edge thickness of the pavement slab. The minimum length of each section of form used shall be 10 feet. Each section or form shall be uniform and free from undesirable bends or warps.

The maximum deviation of the top surface of any section shall not exceed ⅛ inch, or the inside face not more than ¼ inch from planned alignment. The method of connection between sections shall be such that the joint thus formed shall be free from movement in any direction. Forms shall be of such cross-section and strength and so secured as to resist the pressure of the concrete when planed, the impact where planed, and the impact and vibration of any equipment which they support, without springing or settling.

Every 10 foot length of form shall have at least three form braces and pin sockets which shall be spaced at intervals of not more than 5 feet, having the end brace and socket not more than 6 inches from the end of the form. Approved flexible forms shall be used for construction where the radius is 150 feet or less.

The subgrade under the forms shall be compacted and cut to grade so that the form when set will be uniformly supported for its entire length at the specified elevation. Forms shall be joined neatly and in such a manner that the joints are free from play or movement in any direction. The supply of forms shall be sufficient to permit their remaining in place for at least 12 hours after the concrete has been placed. All forms shall be cleaned and oiled prior to use.

The alignment and grade elevations of the forms shall be checked by the Contractor and the necessary corrections made immediately before placing the concrete. When any form has been disturbed or any subgrade thereunder has become unstable, the form shall be reset and rechecked.

8.1.3.2 Placing concrete. The subgrade shall be moist, but not muddy, at the time of placing of the concrete. If required by the Engineer, the prepared subgrade shall be saturated with water the previous night, or not less than 6 nor more than 20 hours prior to placing the concrete. If the subgrade subsequently becomes too dry, it shall be sprinkled again ahead of placing the concrete, in such a manner as not to form mud or puddles of water.

Contractor shall give the Engineer at least 8 hours advance notice before placing concrete and the subgrade shall be checked and approved by the Engineer before any concrete is placed.

The concrete shall be mixed in quantities required for immediate use and shall be deposited on the subgrade to the required depth and width of the curb and gutter in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The concrete shall be placed as uniformly as possibly in order to minimize the amount of additional spreading necessary. While being placed, the concrete shall be vibrated with suitable tools so that the formation of voids or honeycomb pockets is prevented.

The concrete shall be especially well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been adjusted to the required grade and alignment.

8.1.3.3 Finishing. The curb shall be tooled to the required radii as soon as possible after the concrete takes its initial set. The gutter shall be shaped with a wood float at least 4 feet long. After the face forms and templates are removed, the joints shall be tooled and the surface shall be final finished with a hard bristle broom to remove all imperfections without additional mortar or dryer. In all cases the resulting surface shall be smooth and of uniform color, free from sags, twists, or warps, and true to the specified lines and grades shown on the plans.

8.1.3.4 Joints.

8.1.3.4.1 Expansion joints shall be formed with bituminous preformed expansion joints ¾ inch thick or as specified on the plans and precut to exact cross section of curb and shall be placed at all driveway radii and intersection radii and at intervals of not more than 500 feet, and at the location shown on the plans or standard drawings, so that they are not moved by depositing and compacting the concrete at these joints. Preformed expansion joint filler shall be of non-extruding type and shall conform to ASTM Designation D1751.

8.1.3.4.2 Contraction joints shall be sawed or formed with templates at intervals not greater than 15 feet and at locations shown on the plans or standard drawings. The joint shall be sawed 1½ inches deep. Contraction joints in proposed medians shall match the locations of the joints in the pavement. A template shall be ¼ inch thick, cut to the configuration of the curb section shown on the plans. Templates shall be secured so that they are not moved by depositing and compacting the concrete. As soon as the concrete has hardened sufficiently, the templates shall be removed from all contraction joints. The edges of the joint shall be rounded with an edging tool of ⅛ inch radius. Asphaltic material shall be used in filling these joints shall be as follows:

8.1.3.4.2.1 Hot pour polymer rubber asphaltic sealer. Immediately before applying the joint sealer, all loose debris, dust, and moisture shall be removed from the joint with filtered and dry compressed air at a minimum pressure of 80 psi. Any excess sealer shall be removed from the pavement immediately after sealing. The specified sealer requires a special pot and the recommended pour temperature is 390°F. This material shall conform to ASTM D3405 and a certification shall be required from the Contractor certifying the joint sealer meets this specification The City reserves the right to inspect and evaluate the equipment that will be used to perform this operation; or

8.1.3.4.2.2 Cold pour polymer fortified crack fill material. Immediately before applying the joint sealer, all loose debris, dust, and moisture shall be removed from the joint with filtered, dry compressed air at a minimum pressure of 80 psi. Fill each joint with sealer slightly above the pavement surface (some shrinkage will occur). Allow sealant to cure 2 to 12 hours. Do not apply sealer if ambient temperature is below 50°F. This material shall generally conform to ASTM D-1190 and a certification shall be required from the Contractor certifying the joint sear meets this specification.

8.1.3.5 Curing. The application of curing compound shall be in accordance with Chaper 6.5 of these Specifications.

8.1.3.6 Cold Weather Protection. Cold weather protection shall be as provided in Chapter 6.4 of these specifications.

8.1.3.7 Curb and Gutter. Curb and gutter laid by slip-form or extruding equipment will be accepted providing it complies with all the above requirements other than forms.

8.1.3.8 Backfilling. After curing, the curb shall be immediately backfilled to within 4 inches of the top of the curb to eliminate any possibility of washing beneath the curb. The remaining 4 inches shall be topsoil.

8.1.4 Method of Measurement. Measurement of portland cement concrete curb and gutter will be made for payment to the nearest linear foot of portland cement concrete curb complete, in place, and accepted. Portland cement concrete curb and gutter will not be measured at the locations of stormwater structures and will be considered incidental to placement of the stormwater structures at these locations.

8.1.5 Basis of Payment. The accepted quantities of portland cement concrete curb and gutter will be paid based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, backfill, and grading.

Payments will be made under:

Item COS-8.1.5	Portland Cement Concrete Curb and Gutter -- per linear foot

9 PORTLAND CEMENT CONCRETE PAVEMENT AND INTEGRAL CONCRETE CURB

9.1 PORTLAND CEMENT CONCRETE PAVEMENT

9.1.1 Scope of Work. The work shall consist of furnishing all labor, materials, and equipment necessary to perform all operations in connection with construction of Portland Cement Concrete pavement, in accordance with the specifications and drawings, subject to the terms and conditions of the contract.

9.1.2 Materials. All materials, additives, and other incidental items used in construction of the Concrete Pavements shall conform to this Specification and/or the current version at the time of bidding of the Missouri Department of Transportation General Specifications for Highway Construction as applicable. The Engineer reserves the right to approve all materials, require certifications, and documentation of inspections of materials as requested.

9.1.2.1 Class “A” or “X” Concrete shall be Portland Cement Concrete in accordance with Chapter 6 of these Specifications.

9.1.2.2 Reinforcing steel, if specified by the plans, shall consist of deformed bars of grade 60 steel conforming to the requirements of ASTM Designation A615 or of wire fabric conforming to ASTM Designation A185.

9.1.2.3 Expansion joints shall be preformed expansion joint fillers of a non-extruding type conforming to ASTM Designation D1751.

9.1.2.4 Joint sealing compound for contraction and construction joints exceeding ⅛ inch in width shall be one of the following types of material:

1. Hot pour polymer rubber asphaltic sealer. Immediately before applying the joint sealer, all loose debris, dust, and moisture shall be removed from the joint with filtered and dry compressed air at a minimum pressure of 80 psi. Any excess sealer shall be removed from the pavement immediately after sealing. The specified sealer requires a special pot and the recommended pour temperature is 390°F. This material shall conform to ASTM D3405 and a certification shall be required from the Contractor certifying the joint sealer meets this specification. The City reserves the right to inspect and evaluate the equipment that will be used to perform this operation; or

2. Cold pour polymer fortified crack fill material. Immediately before applying the joint sealer, all loose debris, dust, and moisture shall be removed from the joint with filtered, dry compressed air at a minimum pressure of 80 psi. Fill each joint with sealer slightly above the pavement surface (some shrinkage will occur). Allow sealant to cure 2 to 12 hours. Do not apply sealer if ambient temperature is below 50°F. This

material shall generally conform to ASTM D-1190 and a certification shall be required from the Contractor certifying the joint sealer meets this specification.

9.1.2.5 Metal supports for tiebars or reinforcing bars shall be channel shaped pressed out of 12-gauge sheet steel or heavier or as shown on the plans.

9.1.2.6 . Dowel bars and tie bars, where specified, for joints shall be in accordance with current version of the Missouri Department of Transportation General Specifications for Highway Construction Section 1057. Dowel bars for transverse and expansion joints shall meet the requirements of plain round bars of AASHTO M 31. Tie bars for longitudinal and construction joints shall be round deformed bars in accordance with AASHTO M 31. Dowel bars and tie bars shall be epoxy coated in accordance with AASHTO M 284/M 284M-2.

9.1.2.7 Expansion tubes or dowel caps shall be manufactured from 32-gauge sheet metal, shall be indented to provide a limiting stop for the dowel bar, and shall provide unobstructed expansion space of not less than 1inch to permit movement of the dowel bar. They shall be of proper size to fit the specified bars tightly and the closed end shall be watertight.

9.1.2.8 Concrete curing compound shall conform to Chapter 6.5 of these specifications.

9.1.3 Construction Methods.

9.1.3.1 Aggregate base shall be placed under all pavements in accordance with ST-1and shall extend 1 foot beyond the back of curbs or edge of pavement. The aggregate material shall be compacted to not less than 95% of Standard maximum density. Moisture shall be added to the material during compaction only when it is necessary to obtain the required density. All extra aggregate used under pavements shall be the Contractor’s responsibility. Once aggregate is in place, the inspector will perform the necessary tests to ensure proper depth, if aggregate is less than in the required depth, then aggregate shall be removed and subgrade lowered to obtain the proper requirement. Concrete pavement will not be placed until aggregate subgrade is approved by the City.

9.1.3.2 Forms shall be made of metal and shall have a depth equal to or greater than the prescribed edge thickness of the pavement slab. The minimum length of each section of form used shall be 10 feet. Each section of form shall be uniform and free from undesirable bends or warps.

The maximum deviation from planned grade of the top surface of any section shall not exceed ⅛ inch, or the inside face not more than ¼ inch from planned alignment. The method of connection between sections shall be such that the joint thus formed shall be free from movement in any direction. Forms shall be of such cross-section and strength and so secured as to resist the pressure of the concrete when planed, and the impact when planed, and the impact and vibration or any equipment which they support, without springing or settlement.

Each 10 foot length of form shall have at least 3 form braces and pin sockets which shall be spaced at intervals of not more than 5 feet, having the end brace and socket not more than 6

inches from the end of the form. Approved flexible forms shall be used for construction where the radius is 150 feet or less.

The subgrade under the forms shall be compacted and cut to grade so that the form when set will be uniformly supported for its entire length at the specified elevation. Forms shall be joined neatly and in such a manner that the joints are free from play or movement in any direction. The supply of forms shall be sufficient to permit their remaining in place for at least 12 hours after the concrete has been placed. All forms shall be cleaned and oiled prior to use.

The alignment and grade elevations of the forms shall be checked by the Contractor and the necessary corrections made immediately before placing the concrete. When any form has been disturbed or any subgrade thereunder has become unstable, the form shall be reset and rechecked.

9.1.3.3 Placing Concrete. The subgrade shall be moist, but not muddy, at the time of the placing of the concrete. If required by the Engineer, the prepared subgrade shall be saturated with water the previous night, or not less than 6 nor more than 20 hours prior to placing the concrete. If the subgrade subsequently becomes too dry, it shall be sprinkled again ahead of placing the concrete, in such a manner as not to form mud or puddles of water.

Contractor shall give the Engineer at least 8 hours advance notice before placing concrete and the subgrade shall be checked and approved by the Engineer before any concrete is placed.

The concrete shall be mixed in quantities required for immediate use and shall be deposited on the subgrade to the required depth and width of the construction lane in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The concrete shall be placed as uniformly as possible in order to minimize the amount of additional spreading necessary. While being placed, the concrete shall be vibrated with suitable tools so that the formation of voids or honeycomb pockets is prevented.

The concrete shall be well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along and outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been adjusted to the required grade and alignment.

9.1.3.4 Consolidating and Finishing. The pavement shall be struck off and consolidated with mechanical finishing machine or by hand-finishing methods. When a mechanical finishing machine is used, the concrete shall be struck off at such a height that after consolidation and final finishing it shall be at the elevations as shown on the plans. A depth of excess concrete shall be carried in front of the strike-off screed for the full width of the slab, whenever the screed is being used to strike off the pavement. The finishing machine shall be provided with a screed, which will consolidate the concrete by pressure. The concrete shall, through the use of this machine, be brought to a true and even surface, free from rock pockets, with the fewest possible number of passes of the machine. The edge of the screeds along the curb line may be notched out to allow

for sufficient concrete to form the integral curb. Hand-finishing tools shall be kept available for use in case the finishing machine breaks down.

When hand finishing is used, the pavement shall be struck off and consolidated by a vibrating screed or other approved equipment to the elevation shown on the plans. The vibrating screed must be approved by the Engineer, prior to placement of concrete. When the forward motion of the vibrating screed is stopped, the vibrator shall be shut off and not be allowed to idle on the concrete. Internal mechanical vibration shall be used alongside all formed surfaces. Vibration operation shall be completed prior to final hand finishing.

9.1.3.5 Floating, Straightening, and Edging. After the concrete has been struck off and consolidated, it shall be further smoothed by means of a wood or aluminum float at least 5 feet wide with a handle long enough to reach the entire width of the slab being placed. The float shall be operated so as to remove any excess water and laitance, as well as surface irregularities. After the floating operation, the pavement surface should be within the specified tolerances.

While the concrete is still plastic, the slab surface shall be tested for smoothness with a 10 foot straight edge swung from handles 3 feet longer than ½ the width of the slab. The straight edge shall be placed on the surface parallel to the centerline of the pavement and at not more than 5 foot intervals transversely. After each test, the straight edge shall be moved forward ½ its length and the operation repeated. When irregularities are discovered, they shall be corrected by adding or removing concrete. All disturbed places shall again be floated with the wooden float and again straight edged. The pavement surface shall have no depression in which water will stand. Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be carefully finished with an edger of the radius shown on the plans.

9.1.3.6 Final Surface Finish. Final surface texture of the driving surface shall be a wire comb finish. A wire comb shall be no less than 10 feet long with a single line of wires exposed to a length of approximately 4 inches. The wire shall be blue-tempered and polished spring steel with nominal dimensions of 0.028 inch thick and 0.100 to 0.125 inch wide. The wires shall be spaced to provide ½ inch clear space between wires and securely mounted in a rigid head. Final approval of the wire comb will be based on satisfactory performance during actual use. Successive passes of the comb shall be overlapped the minimum necessary to attain a continuously textured surface. The surface texture produced shall have an average texture depth of approximately 0.125 inch.

For areas outside of the driving surface and for all drives, entrances, and other areas as noted in the plans, a broom finish shall be used as the final finishing method. A hard bristle broom shall be used, which shall be kept clean and used in such a manner as to provide a uniform texture surface. The curb shall have the same final finish as the pavement.

The final surface of the concrete pavement and curb shall have a uniform gritty texture free from excessive roughness and true to the grades and cross section shown on the plans. The Engineer may require changes in the final finishing procedure as required to produce the desired final surface texture.

9.1.3.7 Joints. Longitudinal and transverse joints shall be constructed as shown on the plans or standard drawings.

Longitudinal joints are those joints parallel to the lane of construction. They may be either center joints or the construction joints between construction lanes.

Transverse joints shall be contraction joints or construction joints. Construction joints are put in transversely whenever construction operations require them.

Expansion joints may be either longitudinal or transverse. They are used only where specifically shown on the plans or standard drawings.

The edges of the pavement and those joints where such edging is shown on the plans shall be rounded with an edger having a radius of not larger than 1/8 inch. Transverse joints, except keyed and tied construction joints, shall be continuous across the entire paved area including the curb.

9.1.3.7.1 Transverse Joints. Transverse joints shall be contraction, expansion, or construction joints. Contraction and expansion joints shall be placed as per Standard Drawings or as indicated on the plans. They shall make a right angle with the centerline of the pavement and with the surface of the subgrade.

Expansion joints shall be installed in accordance with the size and locations shown on the plans, and shall conform to the requirements of these specifications. They shall extend the entire width and thickness of the pavement and shall conform to the exact configuration of the curb section. The filler shall be held accurately in place during the placing and finishing of the concrete by means of a bulkhead, a metal channel cap, or other approved methods.

Under no circumstances shall any concrete be left above or below the expansion material or across the joint at any point. Any concrete spanning the ends of the joint next to the forms shall be carefully cut away after the forms are removed.

Transverse contraction joint shall be of the sawed type, with a minimum depth of ⅓ of the slab thickness in accordance with Standard Drawings unless otherwise shown on the plans. Transverse joints larger than ⅛ inch in final width shall be filled in accordance with these Specifications.

Unless otherwise provided, all transverse contraction joints and longitudinal joints shall be sawed in a single cutting operation with all joint cuts to the dimensions shown on the plans. For intersections and irregular pavement, joints shall be sawed at locations as approved by the Engineer. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling but in no case more than 12 hours after initial placment of the concrete. Sawcuts may be made with a conventional saw using water and shall have a minimum width of ¼ inch. If “early entry” dry cut saws are used, saw cuts must be made within 6 hours of placement and saw cuts shall be a minimum of ⅛ inch in width. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing.

Sawing shall be discontinued when a crack develops ahead of the saw. The Engineer reserves the right to have the contractor install preformed type joints on multiple width construction when the use of sawed joints fails to prevent random cracking. Any pavement with random cracking not controlled by dowels or tie bars shall be either removed and replaced using dowels or tie bars as appropriate to the nearest controlled joint or repaired with some other method approved by the Engineer at the Contractor's expense.

Transverse construction joints of the type shown on the plans or standard drawings shall be placed wherever the placing of concrete is suspended for more than 30 minutes. A butt-type joint with dowels shall be used if the joint occurs at the location of a contraction joint. Keyed joints with tiebars are used if the joint occurs at any other location.

If joints are to be equipped with dowels, they shall be of the dimension and the spacing and location indicated per Standard Drawing Details for Public Improvements or as shown on the plans. They shall be firmly supported in place, and accurately aligned parallel to the pavement grade and the centerline of the pavement by means of a dowel support which will remain in the pavement and will ensure that the dowels are not displaced during construction. ½ of each dowel shall be painted and greased and in an expansion joint, one end shall be equipped with a tight-fitting expansion tube of the dimensions shown on the plans and conforming to the requirements of these Specifications.

9.1.3.7.2 Longitudinal Joints. Longitudinal joints shall be placed as shown on the plans or standard drawings. They shall be of the sawed or the keyed construction type, unless otherwise shown on the plans.

Sawed longitudinal center joints shall be sawed in accordance with the same time frame and methods as per Section 9.1.3.7.1 of these Specifications. The saw cut shall be a minimum of ⅛ inch in thickness and 1 inch deep in accordance with the Standard Drawing Details for Public Improvements unless otherwise shown on the plans.

Longitudinal keyed construction joints (i.e., joints between construction lanes) shall be of the dimensions shown on the plans or standard drawings.

9.1.3.7.3 Tiebars. Tiebars or tiebolts when shown on the Standard DrawingDetails for Public Improvements or plans and shall be of the materials as allowed in the Specificaitons. Tiebars shall be firmly supported by subgrade chairs or so installed as not to be displaced during construction operation.

9.1.3.7.4 Joint Sealer. After the curing period, all sawed and tooled joints exceeding ⅛inch in width in the pavement shall be cleaned and sealed as follows. Immediately before applying the joint sealer, all loose debris, dust, and moisture shall be removed from the joint with filtered and dry compressed air at a minimum pressure of 80 psi. Joints shall be lightly underfilled (about ½ inch) to prevent extrusion of sealer. Any excess material must be removed from the pavement as soon after sealing as possible. The type of sealer used must be one of the sealer materials listed in the material section for joint sealing compound.

9.1.3.8 Structures. All manholes, catch basins, or structures of a permanent nature encountered in the area to be paved shall be raised or lowered as the case may be, to the surface of the new pavement, as shown on the plans of Standard Drawings. Payment for this work shall be in accordance with Chapter 7 of these specifications.

9.1.3.9 Curing. The application of curing compound shall be in accordance with Chapter 6.5 of these Specifications.

9.1.3.10 Cold Weather Protection. Cold weather protection shall be in accordance with Chapter 6 of these specifications.

9.1.3.11 Tolerance in Pavement Thickness. It is the intent of these specifications that pavement shall be constructed strictly in accordance with the thickness shown on the plans. The thickness of the pavement will be measured, and where any pavement is found deficient in thickness, it may be compensated for at an adjusted unit price or shall be removed and replaced.

The thickness of the pavement will be determined by average caliper measurement of cores. For the purpose of determining the constructed thickness of the pavement, 10 cores per mile will be taken at random intervals in each traffic lane. In addition, cores may be taken at other locations as may be determined by the Engineer. If the measurement of any core is deficient in excess of ¼ inch from the plan thickness, additional cores will be taken at 25 foot intervals parallel to centerline ahead and back of the affected location until the extent of the deficiency has been determined.

It will be assumed that each core is representative of the pavement thickness for a distance extending ½ the distance to the next core, measured along centerline, or in the case of a beginning or ending core, the distance will extend to the end of the pavement section.

The drilling of cores in irregular areas, or on projects involving less than 2,500 square yards of concrete pavement, may be waived by the Engineer. In this case the designed thickness will be considered as the measured thickness.

9.1.3.12 Pavement Smoothness. This work shall consist of measuring the smoothness of the final pavement surface for all mainline paving and turning lanes.

9.1.3.12.1 Longitudinal Straightedging. Longitudinal Straightedging shall be measured using a 10-foot straightedge. The straightedge path in the longitudinal direction shall be parallel to the centerline and located three feet from the outside edge of the driving lane. Additional paths with suspected roughness may be selected at the Engineer’s discretion. Any variations in the longitudinal direction exceeding ⅛ inch in 10 feet shall be marked for correction.

9.1.3.12.2 Transverse Straightedging. The Engineer shall randomly check driving lanes for variations in the transverse direction with a 4-foot straightedge. Any variations in the transverse direction more than ¼ inch shall be marked for correction.

9.1.3.12.3 Method of Correction. Corrective action to smooth the pavement shall be accomplished by a method approved by the Engineer. Diamond grinding may be used for bumps, but the use of an impact device, such as a bush hammer or milling machine, will not be permitted. Total grinding depth shall be limited to ¼ inch. The final surface texture of corrected pavement shall be comparable to adjacent sections that do not require correcting. Satisfactory longitudinal grinding is acceptable as the final surface of the corrected pavements. The cost of correcting the smoothness and associated traffic control shall be at the Contractor's expense.

9.1.3.13 Protection and Opening to Traffic. The Contractor shall protect the pavement against all damage prior to final acceptance of the work by the Engineer. Traffic shall be excluded from the pavement by erecting and maintaining barricades and signs for at least 7 days, or until the concrete pavement achieves a strength of 3,000 pounds per square inch.

9.1.3.14 Paving by Slip Form. Slip-forming equipment will be accepted providing it produces a paving operation in compliance with all the foregoing requirements other than forms.

9.1.4 Method of Measurement.

9.1.4.1 Concrete Pavement. Measurement of concrete pavement with integral curb will be made for payment to the nearest $^{1}/_{10}$ square yard of surface area of concrete complete, in place, and accepted. Concrete pavement with integral curb shall be measured to the gutter flag. Integral curb shall be paid as a separate item.

9.1.4.2 Aggregate Base. Measurement of aggregate base will be made for payment to the nearest square yard complete, in place, and accepted. Measurement will be based on the final driving surface area of the pavement and will not include any additional quantity required. Aggregate base under the integral curb will be included in the price of Integral Curb as included in this Specificatiton.

9.1.5 Basis of Payment. The accepted quantities of concrete pavement and aggregate base will be paid based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, backfill, grading, smoothness testing, tie-bars, dowel bars, joint filler, and curing.

If any core measurement is deficient, the Director of Public Works shall have the option of requiring removal and replacement of the pavement at the Contractor's expense or requiring the Contractor to leave the deficient pavement in place and requiring the following deductions in payment.

Deficiency in Thickness	Deduction Percent of Contract Unit Price
0 - ¼ inch	None
Over ¼ inch but not over ½ inch	20
Over ½ inch but not over ¾ inch	50
Over ¾ inch but not over 1 inch	100

The above deductions will be applied to a section of pavement 25 feet long and extending from the edge of the pavement to a longitudinal joint in that section of pavement in which the deficient measurement was found. Deductions for deficient thickness or damaged pavement will be entered on any estimate after the information becomes available.

If removal of the payment is required, the Contractor will be required to remove the pavement and to replace it with one of a satisfactory quality and thickness which, when accepted, will be included in the pay quantities. No payment will be made for any costs incurred in the removal of the pavement deficient in thickness or for the original pavement placement.

Item COS-9.1.5.1.0 Concrete Pavement -- per square yard

*Where 0 represents the concrete thickness in inches.

Item COS-9.1.5.2 Aggregate Base - per square yard

9.1.6 Deficient Pavement on Private Projects. Prior to acceptance of private projects by the City, cores will be taken to determine pavement thickness. If the pavement is found to be deficient in thickness, the Director of Public Works has the option of requiring removal of the entire deficient pavement or having the Contractor or Developer remit to the City an amount equal to the value of the deduction shown in the Deficiency in Thickness table above. This amount is to offset future maintenance costs necessary because of the deficient pavement. Pavement deficient in thickness in excess of 1 inch will not be accepted.

9.2 INTEGRAL CURB

9.2.1 Scope of Work. The work shall consist of furnishing all labor, materials, and equipment necessary to construct integral curbs in accordance with the plans and specifications. Integral curbs shall be required along the edges of all street pavement as indicated on the plans, except at such location as the Engineer may direct. Depressed curbs shall be provided at all driveway entrances and sidewalks shown on the plans.

9.2.2 Materials.
All materials and other incidental items used in construction of the Concrete Pavements shall conform to this Specification and the current version at the time of bidding of the Missouri Department of Transportation General Specifications for Highway Construction as applicable. The Engineer reserves the right to approve all materials, require certifications, and documentation of inspections of materials as requested

9.2.2.1 Class “A” Concrete shall be Portland Cement Concrete in accordance with Chapter 6 of these Specifications.

9.2.2.2 Expansion joints shall be preformed expansion joint fillers of a non-extruding type conforming to ASTM Designation D1751.

9.2.2.3 Joint sealing compound for contraction and construction joints shall be one of the following types of material.

1. Hot pour polymer rubber asphaltic sealer. Immediately before applying the joint sealer, all loose debris, dust, and moisture shall be removed from the joint with filtered and dry compressed air at a minimum pressure of 80 psi. Any excess sealer shall be removed from the pavement immediately after sealing. The specified sealer requires a special pot and the recommended pour temperature is after sealing. The specific sealer requires a special pot and the recommended pour temperature is 390°F. This material shall conform to ASTM D3405 and a certification shall be required from the Contractor certifying the joint sealer meets this specification. The City reserves the right to inspect and evaluate the equipment that will be used to perform this operation; or

2. Cold pour polymer fortified crack fill material generally conforming with ASTM D-1190 approved by the Engineer. This material will have some shrinkage so crack must be slightly overfilled so that when cured in 2 to 12 hours, the result is about ½ to ¼ of an inch underfilled.

A certification is required from the Contractor certifying that the joint sealer meets this specification and is reasonable for its condition up to 6 months after acceptance of projects.

9.2.2.4 Concrete curing compound shall conform to Chapter 6.5 of these specifications.

9.2.3 Construction Methods.

The integral curb shall be constructed immediately following the finishing operation unless otherwise shown on the plans. Special care shall be taken so that the curb construction does not lag the pavement construction and form a “Cold Joint.”

Metal curb forms shall be required to form the backs of all curbs except where street returns of small radius or other special sections make the use of steel forms impractical.

In placing curb concrete, sufficient vibrating shall be done to secure adequate bond with the paving slab and eliminate all voids in the curb.

Curbs shall be formed to the cross section as shown on the drawings with a mule or templates supported on the side forms and with a wood float not less than four feet in length.

The finished surface of the curb and gutter shall be checked by the use of the10-foot straight edge and corrected if necessary. Where grades are flat and while the concrete is still plastic, the Engineer may require the Contractor to check the drainage at the gutter by pouring water at the gutter summit and observing its flow to the inlet. In order to prevent damage to the concrete surface, water should be poured into a piece of impervious paper or plastic.

In the construction of transverse joints of concrete integral curb pavement, special care must be taken to see that all transverse joints extend continuously through the pavement and curb.

Joint Sealer. After the curing period, all sawed and dummy groove joints in the pavement shall be cleaned and sealed as follows: Immediately before applying the joint sealer, all loose debris, dust, and moisture shall be removed from the joint with filtered and dry compressed air at a minimum pressure of 80 psi. Joints shall be lightly underfilled (about ½ inch) to prevent extrusion of sealer. Any excess material must be removed from the pavement as soon after sealing as possible. The type of sealer used must be one of the sealer materials listed in the material section for Joint Sealing compound.

9.2.4 Method of Measurement. Measurement of integral concrete curb will be made for payment to the nearest linear foot. Integral curb will be measured along the back of curb. When driveways are present, payment of integral curb will run through the driveway sections. Integral curb placed with concrete driveways will not be measured and will be included in payment of concrete driveway when applicable.

9.2.5 Basis of Payment. The accepted quantities of integral concrete curb will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work, including but not limited to: backfilling, aggregate base, and grading.

Payments will be made under:

Item COS-9.2.5 Integral Curb -- per linear foot

10 SIDEWALKS AND DRIVEWAYS

10.1 SCOPE OF WORK. Sidewalks, sidewalk ramps, and driveways shall be constructed or reconstructed to the configuration, and to the lines and grades shown by the plans and generally after the curbing is constructed. Sidewalk ramp construction shall comply fully with all requirements in the most current ADA Standards for Accessible Design and the Public Right of Way Accessibility Guidelines (PROWAG).

10.2 MATERIALS

10.2.1 Concrete Mix. Sidewalks and driveways are to be constructed using a minimum of 28 day 4,000-psi Portland cement concrete in accordance with Chapter 6 of the General Conditions and Technical Specifications.

10.2.2 Expansion Joints. Expansion joints shall be made with ½ inch thick bituminous preformed expansion joint filler of a non-extruding type conforming to ASTM D1751, for the full depth of the concrete and precut to the width of the sidewalk.

10.2.3 Joint Sealer. Joint sealer is generally not required unless shown on the plans.

10.2.4 Reinforcement. Reinforcement is only required when shown on the plans.

10.2. 5 Curing Compound. Concrete curing compound shall conform to Chapter 6.5 of the Specifications.

10.2.6 Detectable Warning Tiles. Detectable warning surfaces and their components shall be manufactured and/or supplied in a red color homogenous throughout the tile and matching the pattern shown in standard drawing ST-12 with a slip resistance surface.

10.3 CONSTRUCTION METHODS

10.3.1 Removal. Existing sidewalks, sidewalk ramps or driveways shall be removed to the nearest contraction or isolation joint, unless otherwise specified by the Engineer. . The curb and gutter section in front of a driveway (radius point to radius point) shall be saw cut full depth and removed before the driveway is constructed. Any curb and gutter broken or cracked outside the radius points during this removal and or reconstruction shall also be removed and replaced accordingly. Any damage to the existing street shall be the responsibility of the Contractor.

10.3.2 Grading and Subgrade Preparation. All excavation or embankment required in the grading and subgrade preparation shall be unclassified and cleared in accordance with Chapter 3-Earthwork.

10.3.2.1 Embankment material and placement shall be in accordance with Chapter 3-Earthwork.

10.3.2.2 Subgrade. The top 6 inches of the subgrade shall be compacted to obtain a density of 95 percent of maximum theoretical density before a minimum of 4 inches of compacted Type 1, Type 5, or Type 7 aggregate is placed.

10.3.3 Forms. All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than ¼ inch in horizontal or vertical alignment for each 10 feet in length.

10.3.3.1 Material and Size. Forms shall be made of metal unless otherwise approved by the Engineer and shall have a height equal to or greater than the depth of the sidewalk or driveway being constructed.

10.3.3.2 Strength. Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment, which they may support.

10.3.3.3 Installation. The forms shall be set true to line and grade, supported trough their length and joined neatly in such a manner that the joints are free from movement in any direction.

10.3.3.4. Preparation. Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.

10.3.4 Slip-Form Machine. A slip-form machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators and be capable of placing concrete to the correct cross section, line and grade within the allowable tolerances.

10.3.5 Joints. Unless directed by the Engineer the joints shall be formed at right angles to the alignment of the sidewalk and driveway and to the configuration specified by the plans or standard drawings.

10.3.5.1 Sidewalk Joint Patterns. Sidewalk surfaces shall be marked using a grooving tool to form the control joint; the groove shall not be wider than ¼ inch and edged with a 1/8-inch radius with a transverse joint spaced at a distance equal to the width of the sidewalk. Longitudinal joints spaced not less than 30 inches not more than 60 inches with transverse joints spaced to form a square pattern shall divide sidewalks greater than 6 feet in width. Edger tool marks shall remain showing unless the sidewalk is slip-formed and subsequently sawed. Curb joints should align with sidewalk joints where they abut.

10.3.5.2 Driveway Joint Patterns. In general, no driveway slab dimension shall exceed 10 feet without a joint, although widths no more than 24 times the slab thickness will be permitted to match existing joint patterns.

10.3.5.3 Expansion Joints. Expansion joints shall be placed at a minimum of every 100 feet or as directed by the Engineer. The preformed isolation joint material shall be left ½ inch below the surface to allow for the application of joint sealer in accordance with Chapter 6-Portland Cement

Concrete Pavement. The isolation joints shall be secured in a manner so depositing and consolidating the concrete will not disturb them and rounded with an edging tool of ¼ inch radius.

10.3.5.4 Control Joints. Joints are to be constructed such that they shall extend to ¼ the depth of the sidewalk. If a grooving tool is used to form the control joint, the groove shall not be wider than ¼ inch and edged with a ⅛ inch radius. If the control joints are sawed, the groove shall not be less than ⅛ inch wide. Joint sealer is not required.

10.3.6 Concrete Work. Deposit and consolidate concrete as close to the final position as possible, beginning at one corner of the forms. Perform necessary hand spreading with shovels or come-along, not with rakes or vibrators. Do not walk in the fresh concrete with boots or shoes coated with earth or foreign substances. When concrete is placed on a sloped surface, begin concrete placement at the lowest area.

10.3.6.1 Finishing. Strike off the concrete with a vibratory or a hand strike-off method when adequate consolidation is attained. Immediately after strike-off, the concrete may be bullfloated to remove any high or low spots. Minimize the use of the bullfloat. Do not finish concrete with water standing on the surface. All edges of the slab shall be carefully finished with a ¼ inch radius edger. After finishing the surface of the concrete shall be broomed perpendicular to the traffic flow with a fine clean broom to provide an antiskid surface, and the edges and joints retooled. In all cases the finished sidewalk and driveway shall have a true surface, free from sags, twists, or wraps, and shall have a uniform color and appearance.

10.3.6.2 Curing. The application of curing compound shall be in accordance with Chaper 6.5 of these Specifications.

10.3.6.3 Protection. The Contractor shall protect the concrete work against damage or defacement of any kind until which is damaged or defaced, shall be removed and replaced or repaired to the satisfaction of the Engineer, at the expense of the Contractor.

10.3.7 Backfill. A minimum of 24 hours shall elapse before forms are removed 5 days shall elapse or the concrete must have attained 75% of its 28 day compressive strength before pavement is backfilled unless otherwise approved by the Engineer. The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, splatters and overspray from the construction area within 10 days unless otherwise directed by the Engineer. The Contractor shall also be responsible for the repair of any street pavement disturbed by the construction.

10.3.8 Surface Tolerances. Sidewalks and driveways shall have a surface tolerance of ¼ inch in 10 feet when checked with a 10 foot straightedge. Vertical deflections at sidewalk joints shall not exceed ¼ inch.

10.3.9 Detectable Warning Surfaces. Detectable warning surfaces consisting of truncated domes aligned in a square grid pattern shall be provided where a curb ramp or landing connects to a crosswalk. Cast-in-place replaceable detectable warnings shall be used when new concrete is installed.

10.3.9.1 Location. The detectable warning surfaces shall be located so that the nearest edge is 6 inches minimum to 8 inches maximum from the face of the curb line and the far edge is no more than 5 feet from the back of the curb line. The detectable warning surface shall extend a minimum of 24 inches in the direction of travel and the full width of curb ramp.

10.3.9.2 Dome Size. Truncated domes shall have a diameter of 0.9 inch at the bottom, a diameter of 0.4 inch at the top, a height of 0.2 inch and a center-to-center spacing of 2.35 inches measured along diagonal of a square arrangement.

10.3.9.3 Visual Contrast. There shall be a minimum of 70% contrast in light reflectance between the detectable warning and the adjoining surface. The coloring shall be red (federal color code 20109) and made an integral part of the detectable warning surface.

10.4. Method of Measurement

10.4.1 Sidewalks. Measurement of sidewalks will be made for payment to the nearest square foot of surface area of concrete complete, in place, and accepted.

10.4.2 Sidewalk Ramps. Measurement of sidewalk ramps will be made for payment to the nearest square foot of surface area of concrete complete, in place, and accepted. Sidewalk ramps shall include detectable warning tiles and flare portion of the ramp. Measurement shall not include the gutter portion of the ramp.

10.4.3 Driveways. Measurement of driveways will be made for payment to the nearest square foot of surface area of concrete complete, in place, and accepted. Measurement shall not include the gutter portion of the driveway.

10.5 Basis of Payment The accepted quantities of sidewalks, sidewalk ramps, and driveways will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: excavation, aggregate bedding, concrete, and detectable warning tiles. When no pay item for sidewalks, sidewalk ramps, or driveways is included in the contract, those items will be considered incidental to the work and no direct payment will be made.

Payments will be made under:

Item COS-10.5.1.0	Concrete Sidewalk -- per square foot
Item COS-10.5.2.0	Concrete ADA Ramp -- per square foot
Item COS-10.5.3.0	Concrete Driveway -- per square foot

*Where 0 represents the concrete thickness in inches.

11 PLANT MIX BITUMINOUS BASE AND PAVEMENT

11.1 GENERAL

11.1.1 Description. This work shall consist of a bituminous mixture placed, spread, and compacted as shown on the plans, or as directed by the Engineer. The Contractor shall be responsible for Quality Control (QC) of the bituminous mixture, including the design and control of the quality of the material incorporated into the project. The Engineer may perform Quality Assurance (QA), including testing, at the Owner's discretion, to assure the quality of the material incorporated into the project.

11.2 MATERIAL

11.2.1 General. All material shall comply with the current version, at time of bid letting, of the Missouri Department of Transportation (MoDOT) Standard Specifications, Section 401, Plant Mix Bituminous Base and Asphalt, except as specifically noted herein. All materials incorporated into any mixtures shall be current MoDOT approved products and all aggregates must come from currently approved MoDOT sources and/or ledges. Sections of the MoDOT Specifications numbers referenced in this Specification are valid to MoDOT Specifications numbers in place at the time this Specification was published.

11.2.2 Required Mixtures. Required mixtures shall be located on the plans. When not designated, Surface Mixture shall only be BP-1 or BP-2. The grade of asphalt binder for all mixes shall be PG 64-22 or as otherwise specified in the Contract Documents. Use of approved MoDOT Section 403 Superpave mixture may be allowed with approval from the Engineer. Use of MoDOT Section 403 mixtures will not be allowed for use on residential streets. If MoDOT Section 403 mixtures are used, volumetric testing tolerance limits will be adjusted by the Engineer as applicable.

11.2.3 Reclaimed Asphalt and Asphalt Shingles. A maximum of 20% virgin effective binder replacement may be used in mixtures.

Reclaimed Asphalt Shingles (RAS) may be used up to 3% total in base mixtures only.

11.3 NOT USED

11.4 JOB MIX FORMULA

11.4.1 General. All job mixtures to be used on any Public Improvement Project shall be a currently approved MoDOT mix design. All materials for these mixtures must meet current MoDOT requirements, except as modified by this Specification, as applicable, including maximum RAS and recycled material contents as listed in Section 11.2. The Contractor is responsible for attaining MoDOT approval on all mixes prior to submittal to the City for approval and use. Commercial mix designs or BP-3 may be considered for use on small repair areas, parking lots, or other miscellaneous uses as approved in writing by the Engineer.

11.4.3 Mixture Approval. A current approved MoDOT mix design shall be provided to the Engineer a minimum of 10 working days prior to placing any mixture on the project. No mixture shall be placed until the mix design has been accepted by the Engineer in writing. When unsatisfactory results occur, or should a source of material be changed, a new job mix formula may be required. If requested, the Contractor shall provide the Engineer with data from MoDOT for source approvals and mix designs.

11.5 GRADATION AND DELETERIOUS CONTENT CONTROL

11.5.1 General. In producing mixtures for the project, the plant shall be operated such that no intentional deviations from the job-mix formula are made. When daily production exceeds 1000 tons, the Contractor shall determine on a daily basis at minimum, the gradation on the aggregate reclaimed from the Recycled Asphalt Products (RAP) by either extraction or binder ignition. The gradation results shall be used to determine the daily Specification compliance for the combined gradation. Mixtures as produced shall be subject to the following tolerances and control.

The combined gradation shall meet the gradation requirements for each respective mixture as required by MoDOT's Specifications for compositions of mixtures for the following sieves:

A. The largest sieve size for which any material is retained in the Job Mix Formula, the No. 8 sieve, and the No. 200 sieve. For BP-3 mixtures, the No. 16 sieve will be used in lieu of the No. 8 sieve.

B. The deleterious content of the material retained on the No. 4 sieve shall not exceed the limits specified as follows:

Deleterious Material	**Percent by Weight**
Deleterious Rock	8.0
Shale	1.0
Other Foreign Material	0.5

C. If the Plasticity Index (PI) of any fraction exceeds that of the material approved for the mix design, additional testing may be required as determined by the Engineer.

D. The quantity of asphalt binder introduced into the mixer shall be the quantity specified in the job-mix formula. No changes shall be made to the quantity of asphalt binder without written approval from the Engineer. The quantity of asphalt binder determined by tests on the final mixture shall not vary by more than ± 0.3% from the job-mix formula.

11.5.2 Sample Location. The gradations of the total aggregate will be determined from samples taken from the hot bins on batch-type plants or continuous mixing plants or from the composite cold feed belt on drum mix plants. The deleterious content of the total aggregate shall be determined from samples taken from the composite cold feed belt. When required, samples for plasticity index shall be taken from the stockpile. The RAP shall be sampled from the RAP feeding system on the asphalt plant.

11.5.3 Moisture Content. The bituminous mixture, when sampled and tested in accordance with AASHTO T 329, shall contain no more than 0.5% moisture by weight of the mixture.

11.5.4 Contamination. The bituminous mixture shall not be contaminated with deleterious agents such as unburned fuel, objectionable fuel residue or any other material not inherent in the job mix formula.

11.6 LABORATORY

11.6.1 The laboratory shall contain certified and calibrated equipment to perform all testing. The laboratory may be used at anytime by the City of Springfield or their designees to perform testing.

11.7 CONSTRUCTION REQUIREMENTS

11.7.1 Weather Limitations. Bituminous mixtures shall not be placed on any wet surface or frozen surface. The temperature of the surface on which the mixture is to be placed, shall be a minimum of 35°F prior to paving operations commencing. No paving will be permitted with an ambient air temperature under 45°F. If National Weather Service forecasted temperatures for the respective area fall below 45°F at any time during the paving period, the Contractor shall gain approval from the Inspector before paving begins. Temperatures shall be obtained in accordance with MoDOT Test Method TM 20.

11.7.2 Bituminous Mixing Plant. The plant shall be specifically designed for satisfactorily heating, drying, and mixing bituminous mixtures in accordance with Section 404 of the MoDOT Standard Specifications for Highway Construction. All information regarding calibrations, verifications, or other requirements shall be provided to the Engineer upon request. All asphalt plant tickets shall be provided to the Inspector in the field and shall provide the following information at minimum:

A. Gross and tare weights
B. Current date and time
C. Mix type
D. Unique ticket number
E. City Public Works (PW) number, FHWA Number (when applicable), Street, and County

11.7.4 Tack Coat. This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material. Tack Coat material shall be applied between all lifts of construction.

11.7.4.1 Material. All material shall conform to Section 407 of the MoDOT Standard Specifications for Highway Construction except as noted specifically herein. All Tack Coat applied for asphalt paving operations shall be emulsified asphalt of the following types: SS-1, SS-1H, or Low Track Tack Products as approved for use by MoDOT.

11.7.4.2 Application. Asphalt emulsion shall be applied uniformly with a pressure distributor that is accepted by the Engineer prior to use, and the Contractor shall furnish all equipment, material, and assistance necessary if calibration is required. The rate of effective application shall be within a minimum of 0.05 gallons per square yard and a maximum of 0.10 gallons per square yard as directed by the Engineer. For milled surfaces, a minimum of 0.08 gallons per square yard and a maximum of 0.15 gallons per square yard shall be applied. Water may be added to the emulsion resulting in a cut mixture that will contain no more than 50% water by volume. The asphalt emulsion will be heated at time of application and spread at temperature no less than 110°F and no more than the maximum temperature as allowed by MoDOT Standard Specifications or the manufacturer's recommendations. The surface to be tacked, shall be cleaned of all dirt and debris before placement of tack coat. Tack coat shall be properly cured before placement of the asphalt mixture. The Contractor shall take all means necessary to ensure proper curing and prevent trackout of tack coat and shall be responsible for any damage, marring, loose materials, or any other detrimental affects of tracking tack coat. Should the Contractor fail to properly prevent tack coat trackout, the Engineer may shut down all asphalt operations until such time the Contractor provides the Engineer written notice of the proposed changes that effectively demonstrate the ability to properly place and cure tack coat to prevent trackout.

11.7.6 Hauling Equipment. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth, metal beds that have been thinly coated with an approved bituminous mixture release agent. Use of diesel fuel or other detrimental products will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect mixture from weather.

11.7.7 Spreading. The base course or preceding course or layer shall be cleaned of all dirt, packed soil or any other foreign matter prior to tack coat application and spreading the bituminous mixture. The mixture shall be spread in the number of layers and in the quantity required to obtain the compacted thickness and cross section shown on the plans. When placing multiple layers with varying thicknesses, the thicker layer shall be placed first. The compacted thickness of a single layer of bituminous pavement mixture shall be no more than 2 inches for BP-1, BP-2, and BP-3 mixtures and 4 inches for Bituminous Base. Maximum thickness may be changed with written approval from the Engineer.

11.7.7.1 Irregularities. The mixture shall be spread without tearing the surface and struck off such that the surface is smooth and true to cross section, free from all irregularities, and of uniform density throughout. Care shall be used in handling the mixture to avoid segregation. Areas of segregated mixture shall be removed and replaced with a suitable mixture at the Contractor's expense. The outside edge alignment shall be uniform. Irregularities shall be corrected by adding or removing mixture before compacting. Segregated mixtures shall be removed and replaced to the limits determined by the Engineer.

11.7.7.2 Leveling Course. If required by the contract, a leveling course consisting of a layer of variable thickness shall be spread to the desired grade and cross section to eliminate irregularities in the existing surface. Spot-leveling operations over small areas, with feather-edging at high points and ends of spot areas, may be required prior to placing the leveling course. Rigid control of the placement thickness of the leveling course will be required. The mixture shall be free from segregation.

11.7.7.3 Base Widening. The specified total thickness of base widening shall be completed to the adjacent traveled way elevation as shown on the plans. Additional thickness of base widening may be placed as required prior to coldmilling, at the Contractor's expense, and shall subsequently be coldmilled to the same elevation as the traveled way, if conducive to expedite operations. On base-widening work, a succeeding layer of bituminous mixture may be placed the same day as the previous layer, if it can be shown that the desired results are being obtained. On small areas, and on areas that are inaccessible to mechanical spreading and finishing equipment, the mixture may be spread and finished by hand methods if permitted by the Engineer.

11.7.7.4 Edge Differential. For roadways constructed under traffic, no pavement edge differential shall be left in place for more than 7 days, unless approved by the Engineer. A pavement edge differential greater than 2 inches for any longitudinal joint within 10 feet of a travel way will not be allowed to be left in place. If operations result in traffic being exposed to an edge differential greater than 2 inches and within 10 feet of the travel way, the Contractor shall place edge treatment in accordance with the most recent version of Section 619 of the Missouri Standard Specifications for Highway Construction. Any work required to comply with edge differential requirements is considered incidental and no payment will be made.

11.7.8 NOT USED

11.7.9 Joints. The minimum unconfined joint density of all traveled way pavement within 6 inches of a longitudinal joint, including the pavement on the traveled way side of the shoulder joint, shall be no less than 2.0% below the specified density. Pay adjustments due to longitudinal joint density shall apply to the full width of the lane paved and shall apply to the day’s production from which the cores are obtained. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the layer. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. When a transverse vertical edge is to be left in place and opened to traffic, a temporary depth transition shall be constructed as approved by the Engineer. The longitudinal joints in one layer shall offset those in the layer immediately below by approximately 6 inches. The joints in the final surface layer shall be at the lane lines of the traveled way, except that the placement width shall be adjusted such that pavement marking shall not fall on a longitudinal joint. Each side of the joint shall be flush and along true lines.

11.7.10 Pavement Thickness. It is the intent of these Specifications that the asphalt shall be constructed strictly in accordance with the thickness shown on the plans for each bituminous course that comprises the overall pavement thickness. The thickness of an independent bituminous base or surface course will be measured and determined by the average caliper measurement of the density cores taken from the lift(s) comprising the respective asphalt course. If individual base or surface course varies from plan thickness by more than a ½ inch, the Engineer may require corrections or additional testing as applicable.

11.7.10 .1 Pavement Thickness - Full Depth After all bituminous courses have been placed in multi-lift construction, full depth cores may be taken at random locations determined by the Engineer. If the measurement of any core is deficient by a ½ inch from plan thickness, additional cores will be taken at 25 foot intervals parallel to centerline ahead and back of the affected location until the extent of the deficiency has been determined. It will be assumed that each core is representative of the total combined thickness for a distance extending ½ the distance to the next core, measured along centerline, or in the case of a beginning or ending core, the distance extending to the end of pavement section. In those areas of deficient thickness in excess of a ½ inch that cannot be corrected without affecting the plan crown and grade, the Engineer has the option of requiring that defective pavement will be removed and replaced with a bituminous course of proper thickness or leaving in place and requiring the following deductions in payment.

Deficiency in Thickness	Deduction Percent of Contract Unit Price
0 inch to ½ inch	None
Over ½ inch and not over ¾ inch	50
Over ¾ inch and not over 1 inch	100

No additional compensation will be allowed the Contractor for any plant mix bituminous pavement constructed in excess of the thickness requirements. The surface from which the cores have been taken shall be restored by the Contractor within 48 hours using a non-shrink grout acceptable to the Engineer.

If removal of the pavement is required, the Contractor will be required to remove the pavement and to replace it with one of a satisfactory quality and thickness which, when accepted, will be included in the pay quantities. No payment will be made for any costs incurred in the removal of the pavement deficient in thickness or for the original pavement placement.

11.8 QUALITY CONTROL AND TESTING

11.8.1 Quality Control Plan and Personnel. The Contractor shall maintain equipment and qualified personnel to perform Quality Control (QC) field inspection and sampling and testing in accordance with this Specification. All personnel performing testing on any Public Improvement Project shall have proper MoDOT or Technician Certifications as approved by the Engineer. The Contractor shall submit a Quality Control Plan to the Engineer for approval 10 business days prior to asphalt operations beginning. Asphalt operations shall not begin until the Engineer has accepted the Quality Control Plan. The Quality Control Plan shall at a minimum provide the following information:

- Asphalt plant location and access and/or safety guidelines including storage location and access to split samples
- Contact information for QC staff and preferred method of communication of results
- QC staff current Certifications
- Action Plan for when mixture falls outside tolerances during construction. Action Plan shall outline the specific process for testing if mixture falls outside the tolerance range including timeline, communication plan with contact information, and other details in accordance with this Specification.
- Calibration methods of testing equipment used in the provided laboratory
- Coring procedures and core patching material

An onsite pre-paving meeting with City and Contractor's staff shall be required to discuss communication channels, laydown operations, testing methods, and coring procedures before any paving operations begin. The Contractor shall coordinate the pre-paving meeting with the project Inspector.

11.8.2 Pavement Testing. During construction, the Engineer will designate as many tests as necessary to ensure that the course being constructed is of proper thickness, composition and density. Any test required, or performed by the Engineer may be used to determine acceptance of the asphalt mixture or determine removal limits. Any test affecting the amount of payment due to the Contractor for material left in place shall be located and/or performed from random sampling methods as determined by the Engineer.

11.8.2.1 Loose Mixture Testing. The Contractor shall test once per day for the gradation and deleterious content of the combined aggregate. The Contractor shall, at minimum, test once daily the asphalt mixture for the Asphalt Content, Voids (Va), Voids in Mineral Aggregate (VMA), Theoretical Maximum SG of Mixture (Gmm field). If daily production exceeds 3000 tons, additional tests shall be taken for each 3000 tons of production or portion thereof. The Contractor shall coordinate daily with the Inspector the location of the official, field sample for loose mixture testing. If no agreement can be made, the Inspector will require loose mixture samples from random numbers provided to the Contractor. If RAP is used and AASHTO T 308 is used to determine the asphalt content, the binder ignition oven shall be calibrated in accordance with MoDOT Test Method TM 77. At the Engineer's discretion, testing may be waived when production does not exceed 250 tons per day. The Contractor shall certify the proper proportions of a previously proven mixture were used.

11.8.2.2 Density Testing. Density of the roadway shall be sampled daily by taking field cores for each 500 tons produced daily, or portion of thereof, obtained by the Contractor at random locations selected by the Engineer. For full depth, new construction only, an unconfined joint density sample shall consist of cores taken from alternating sides of the lane at the same longitudinal location as the roadway cores where unconfined joints exists The average of daily Field Gmm test(s) shall be used in the calculation for the in-place density. Four inch diameter core samples shall be taken the full depth of the layer to be tested. The Contractor shall restore the surface from which samples have been taken immediately with the mixture under production or an approved non-shrink grout. All cores shall be taken in the presence of the Inspector. The Inspector reserves the right to measure, label, and/or maintain possession of cores until such time the Contractor will determine the density in the laboratory.

11.8.2.3 Retained Samples. One half of the Contractor's sample for gradation, deleterious content, plasticity index, and asphalt content and all cores shall be retained for the Engineer. The Contractor shall retain the samples 14 days after testing occurred or as directed by the Engineer.

11.8.2.4 Test and Frequencies

Tested Property	Test Method	Contractor Testing Frequency
Mat Density (% of Field Gmm)	AASHTO T166	1 per every 500 tons of daily production or portion thereof
Unconfined Joint Density (% of Field Gmm)	AASHTO T166	1 per every 500 tons daily production or portion thereof (new construction only)
Gradation & Deleterious Content	AASHTO T27, T11	1 per day when production exceeds 1000 tons
Asphalt Content	AASHTO T164, T287, T308	1 per day or every 3000 tons of daily production
Asphalt Content of RAP	AASHTO T164	1 per day when production exceeds 1000 tons
VMA @ Ndes	AASHTO T312	1 per day or every 3000 tons of daily production
Voids (Va) @ Ndes	AASHTO T312	1 per day or every 3000 tons of daily production
Theoretical Maximum SG of Mixture (Gmm)	AASHTO T209	1 per day or every 3000 tons of daily production

11.8.2.5 Failing Tests.

11.8.2.5.1 Loose Mixture Properties. If Voids, VMA, or Asphalt Content test result falls outside of the Specification tolerances as listed in 11.8.2.5.1.1, a review or adjustment of the plant settings and production shall be made and another sample shall be immediately taken and changes communicated in accordance with the Action Plan as submitted in the Quality Control Plan. This second test may be taken at the location of the plant as a truck sample. If the second test falls outside of the Specification tolerances as listed in 11.8.2.5.1.1, production shall immediately cease until the mixture can be brought back into Specification. Plant production for the following day shall not resume until the mixture is brought back into Specification and written approval is given by the Engineer to continue production.

11.8.2.5.1.1 Loose Mixture Payment Adjustments and Removal Limits. Payment for mixture placed at or below the required minimum tolerances will be adjusted or removed as follows:

Test Property	Tolerance Limit/Action Plan	Deduction	Removal Limit
Asphalt Content	±0.3% From Job Mix Formula	See Chapter 2 Article 14.02.C	See Chapter 2 Article 13
Vma @ Ndes	-1.0% to +2.0% From Job Mix Formula	See Chapter 2 Article 14.02.C	See Chapter 2 Article 13
Va @ Ndes	Below 2.5%	See Chapter 2 Article 14.02.C	Below 2.0%

Contractor shall notify the Inspector immediately of all tests that fall outside of the Specification tolerances in accordance with approved Action Plan as submitted in the QC Plan.

All volumetric targets are based on a mix design of target Voids of 3.5%. If a different mix design is approved with different target Voids or VMA, the targets will be adjusted by the Engineer.

11.8.2.6. Density. The compacted mixture shall have a minimum density of 92.0 % determined by the specific gravity method. The Contractor shall calculate the average Gmm from material obtained behind the paver for the test(s) representing that day's production. An average of all cores tested that day, including unconfined joint cores with 2% added to the original results of the joint cores only, shall determine the density representing that day's production. If the average test results for the day's production results in a test outside of the Specification tolerances and a total of 4 cores were not taken, the Engineer will provide random sample locations to cut additional cores until 4 total cores are taken to determine the density representing the day's production. If the average of the minimum 4 cores taken falls outside the Specifications, reduction in payment will be made for all mixture placed that day in accordance with the chart in Section 11.8.2.6.1. When any individual core shows an effective density of less than 89.5%, additional methods shall be used to determine the limits of the failure. The Engineer shall determine methods to identify the failing area. Areas of failing density shall be removed and replaced at the Contractor's expense.

11.8.2.6.1 Density Adjustment. Payment for mixture placed at or below the required minimum density will be adjusted as follows. Joint cores only apply to cores within 6 inches of unconfined joints and shall have 2% added to the test result for use of average results as listed below:

Mainline Density (from Field Gmm)	Percent of Contract Unit Price
92 or above	100%
91.9 to 91.5, inclusive	97%
91.4 to 91.0, inclusive	94%
90.9 to 90.5, inclusive	90%
90.4 to 90.0 , inclusive	85%
Below 90.0	Remove and Replace

11.8.2.7 Quality Assurance. Tests may be performed by a certified City representative (QA) or their designee at rates determined by the Engineer. A favorable QA comparison of a QC split sample will be defined as listed in Section 11.8.2.7.1 of these Specifications.

11.8.2.7.1 Unfavorable Comparison. After determining an unfavorable loose mixture comparison, all loose mixture samples taken at the paver shall provide enough material to complete 2 complete tests until the source of the unfavorable comparison is formally resolved. When density results do not compare, QA cores shall be taken at all QC core locations until such time the discrepancy in tests results is formally resolved. If QC and QA results do not compare favorably, but both tests result in no change in payment or acceptance, the QC and QA staff shall coordinate running a split sample including weighing density cores to identify any issues causing the discrepancies. If the QA results of a split sample indicate an unfavorable comparison and any of the QA results fall outside of the Specification limits and/or within the removal limits, the QC results will be considered disputed and will be reevaluated as per Section 11.8.2.7.1.1 and 11.8.2.7.1.2 as applicable.

For aggregate, if the results of the split sample are not within 5% on all sieves above the No. 200, 2% on the No. 200, within the Specification ranges on the deleterious content, and within 2 percentage points on the plasticity index from the Contractor's results, another split sample will be taken jointly with the Contractor and tested. If the second test results do not compare within the Specification tolerances adjustment shall be made and a third test performed. If the third test fails, the Engineer may require production to cease until corrections are made.

Test	Specification Range	Favorable QA Comparison*
Mat Density (% of Field Gmm)	92% or above	± 0.5% from adjacent QC core
Unconfined Joint Density (% of Field Gmm)	90% or above	± 0.5% from adjacent QC core
Gradation & Deleterious Content	See Section 11.5	See Section 11.5
Asphalt Content	±0.3% From Job Mix Formula	± 0.25% from QC Split
VMA @ Ndes	-1.0% to +2.0% From Job Mix Formula	± 1.0% from QC Split
Va @ Ndes	±1.0 % From Job Mix Formula	± 1.0% from QC Split

11.8.2.7.1.1 Disputed Loose Mixture QC/QA results shall be remediated for each day's production in the order as follows:

1. Both QC and QA shall perform a respective test in the presence of each other at the Contractor's or QA laboratories as applicable. Both QC and QA staff shall determine if any errors may have been made on the disputed test results and make adjustments accordingly.

2. If no agreement can be made and the QC or QA test results would result in removal and/or reduction in pay, dispute resolution process shall commence in accordance with 11.8.3 of the Specifications.

11.8.2.7.1.2 Disputed Density results shall be remediated for each day's production in the order as follows:

1. If the locations are still accessible and no additional lifts have been placed over the QC core locations, the Contractor will cut QA cores at the locations of the disputed QC cores. QA will run all cores and correlate the average of the QA cores using the Gmm field determined from the QA split sample for that day's production with the original QC density results. If the QA average density results fall within the tolerances in section 11.8.2.7.1. of these Specifications, then no further action is necessary and the QC results will be used.

2. If the prior locations of the QC cores have had additional lifts placed over them or favorable comparison is not achieved in step 1 above, an additional analysis will occur as follows: The Engineer will determine a minimum of 4 random locations to cut additional density cores. The Contractor will cut cores at these locations for the representative lift(s) in question and determine the average density based on the field Gmm from the remaining split sample. If there is not sufficient material from the split sample to determine a field Gmm, material broken down from the cut cores will be used. All tests will be done in the presence of a City representative and test samples shall be secured as instructed by the City representative. The results of this final test will determine the final pay and acceptance of the day's production.

11.8.3 Dispute Resolution. When there are significant discrepancies between the Engineer's and the Contractor's tests results and no agreement or determination can be made based on the Specifications as outlined herein, dispute resolution procedures, as provided in this Specification, will be used.

11.8.3.1 Cease Work. The Contractor's operations may be required to cease, as determined solely by the Engineer, until the dispute is resolved if the test results indicate the mixture is subject to failure.

11.8.3.2 Third Party Testing. The first step in dispute resolution will be to identify differences in procedures and correcting inappropriate procedures before moving to third party testing. If that does not resolve the dispute, either the Contractor or the Engineer may request third party involvement. The third-party tests methods and results will be considered final and used by the Engineer for determination of defective material as necessary for removal and/or for pay reduction.

11.8.3.3 Third Party Payment. The Contractor shall be responsible for the cost associated with any third party testing if the final result indicates the Engineer's test results were correct. Likewise the City will be responsible for any cost associated with the third party testing when the final result indicates the Contractor's results were correct.

11.8.3.4 Other Adjustments. The Contractor shall not be entitled to any additional payment for costs incurred due to use of the dispute resolution procedures such as, but not limited to, those for delay, cessation of operations, costs to subcontractors, etc.

11.8.9. Surface Smoothness. The finish of the pavement surface shall be substantially free from waves or irregularities, shall be true to the established crown and grade, and shall be in accordance with Chapter 9.1.3.12.

11.8.10 Defective Mixture. Any mixture showing an excess of bituminous material or that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with a satisfactory mixture, at the Contractor's expense, which shall be immediately compacted to conform with the surrounding area.

11.8.11 Method of Measurement.

11.8.11.1 Asphalt Pavement. Measurement of asphalt pavement will be made for payment to the nearest $^{1}/_{10}$ ton for the total tonnage of material accepted. The weight of the mixture will be determined by weighing each truck load on scales in accordance with Section 310 of the MoDOT Standard Specifications.

11.8.11.2 Asphalt Surface Course. Measurement of asphalt surface course will be made for payment to the nearest square yard of the final driving surface area complete, in place, and accepted.

11.8.11.3 Asphalt Base Course. Measurement of asphalt base course will be made for payment to the nearest square yard complete, in place, and accepted. Measurement will be based on the final driving surface area and will not include any additional quantity needed to construct the 1:1 slope.

11.8.11.4 Aggregate Base. Measurement of aggregate base will be made for payment to the nearest square yard complete, in place, and accepted. Measurement will be based on the final driving surface area of the pavement and will not include any additional quantity required.

11.8.11.5 Basis of Payment. The accepted quantities of asphalt will be paid for based on accepted plant tickets compiled in the field. The accepted quantities of asphalt surface course, asphalt base course, and aggregate base will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-11.8.11.5.1	Asphalt Pavement - per ton
Item COS-11.8.11.5.2.0*	Asphalt Surface Course - per square yard
Item COS-11.8.11.5.3 .0*	Asphalt Base Course - per square yard
Item COS-11.8.11.5.4.0*	Aggregate Base - per square yard

* Where 0 represents the thickness in inches

11.8.12 Method of Measurement and Payment, Tack Coat

11.8.12.1 Method of Measurement Tack Coat. Measurement of Tack Coat will not be made.

11.8.12.2 Basis of Payment Tack Coat. No payment will be made for Tack Coat and it will be considered incidental to other items in the contract.

13 SEEDING AND SODDING

13.1 SEEDING

13.1.1 Scope of Work. The work shall consist of furnishing all labor, equipment, and materials necessary for the preparation, soil amendments, fertilization, seeding and mulching of the areas specified in the contract to establish vegetation. All disturbed areas shall be seeded and mulched except for sodded areas, surfaced areas and solid rock. Disturbed areas outside of authorized construction limits shall be seeded and mulched, or sodded at the Contractor's expense. Establishment of grass growth is the complete responsibility of the Contractor and no additional payment shall be made for any re-work of grading areas, re-seeding, watering, or incidental cost incurred to establish vegetation.

13.1.2 Materials.

13.1.2.1 Topsoil. Topsoil furnished by the Contractor shall consist of a natural friable surface soil without admixtures of undesirable subsoil, refuse, or foreign materials. It shall be reasonably free from roots, clay, and coarse gravel stones larger than one inch in any dimension, noxious weeds, grass, brush, sticks, stubble or other material which would be detrimental to the proper development of vegetative growth. Topsoil shall be obtained from naturally well drained sites where topsoil occurs, at least 4 inches deep. Topsoil shall not be obtained from bogs or marshes. Topsoil shall not contain more than 40% clay as determined by the soil analysis. Topsoil shall also meet the following particle distribution:

Topsoil shall conform to the following grading:

Sieve	% Passing
2 inch	100
1 inch	90 - 100
No. 4	85 - 100
No. 10	55 - 100
No. 200	50 - 90

Topsoil shall contain not less than 5% or more than 20% organic matter by weight, as determined by loss-on-ignition of oven-dried samples in accordance with ASTMD-2974. Topsoil not meeting the minimum percent organic matter may be amended with compost meeting the specification herein to provide a product that meets the minimum percent organic matter. Compost is defined as a homogenous and friable mixture of partially decomposed organic matter, with or without soil, resulting from composting. Compost shall be derived from the decomposition of plant-derived materials. The compost shall have a carbon/nitrogen ratio less than 25, indicating a finished compost. Compost shall not be comprised from organic matter such as poultry manure that produces a strong odor at the time of placement.

13.1.2.1.1 Testing and Acceptance. The Engineer shall be notified on the location from which the Contractor proposes to furnish topsoil at least 30 calendar days prior to delivery of topsoil to the Project from that location. The topsoil and its source will be visuallly inspected by the Engineer for general acceptance of particle size and material composition. If visual inspection does not indicate acceptable material, additional testing results will be required to be supplied to the Engineer at the Contractor's expense for acceptance of soil particle size distribution.

The Contractor shall be required to perform a soil analysis to be taken at locations provided by the Engineer no less than 21 calendar days prior to placement of all permanent cover applications. For sites where topsoil is being imported, soil analysis shall be conducted at the time of topsoil placement or from an onsite stockpile. For sites where existing soil is being used, a soil analysis is required on all representative soil types. The Engineer will determine the sample locations.

For existing soil, collect one soil sample for each distinguishable representative soil type. One sample consists of mixing a minimum of three sub-samples taken uniformly over each distinguishable representative soil type. Imported soil samples should be taken from stockpiles where the material will be the top 6 inches of the seedbed. Take each sub-sample within the top 4 to 6 inches of the soil surface.

The soil analysis shall be run through the University of Missouri Extension Office, or other laboratory pre-approved by the Engineer, to determine that it meets the specifications and to determine rate of soil amendments as required for the proposed seed mixture. At a minimum, a standard soil analysis includes testing for soil texture class, percent clay, organic matter, pH, buffer pH, extractable phosphorus, potassium, magnesium, manganese, iron, zinc, calcium, cation exchange capacity (CEC) and soluble salt levels. The standard soil test shall also include recommendations for soil amendments for pH adjustments and soil nutrient needs such as: organic matter, lime requirements, and fertilizer for the specific seed mixture to be applied.

Soil amendments such as but not limited to; fertilizer, lime, or other additives, shall be applied at the recommended rate recommended by the soil analysis. Certifications for soil amendments including invoices for quantities specifically purchased for an individual project shall be provided to the Engineer before incorporation into the soil. Soil amendments shall come from a supplier as approved by the Engineer

13.1.2.2 Seed. Seed shall be of the following minimum percentages for mixture, purity, and germination.

Seed shall conform to the following:

For residential areas, parks, streetscapes, sidewalk projects or other highly visible areas, a Five Way Fescue or equivalent shall be used as directed by the Engineer and/or included in the plans. Five Way Fescue shall be defined as seed mixture that meets the following requirements:

- Scorpion 2, 20%
- Falcon, 20%
- Shenandoah, 20%
- Finelawn Elite 20%,
- Houndog 20%
- Noxious Weed Seeds Shall be less than 0.1% of the total volume of the seed mixture
- The total seed applied cannot be less than 150 lbs/acre

For all areas where a Five Way Fescue is not required, the Contractor shall submit a seed mixture that conforms to the following requirements:

- 25% of total seed composed of annual grasses
- 70% of total seed composed of perennial grasses
- 5% of total seed composed of perennial clover
- The total seed applied cannot be less than 150 lbs/acre

The submitted mixture shall be approved by the Engineer prior to placement and shall include all specific seed mixtures and weights as a percentage of the total mixture. Seed mixture shall be from a supplier as approved by the Engineer.

13.1.2.3 Fertilizer. Rate of application of fertilizer shall be based on soil analysis.

13.1.2.4 Lime. Rate of application of agricultural lime material shall be based on analysis of soil test and shall be used for soil neutralization with not less than 90% passing the No. 4 sieve.

13.1.2.5 Mulch. Mulch shall consist of the application of a vegetative covering of one of the following types. If a specific type of mulch is not specified, Type I mulch shall be required.

13.1.2.5.1 Type I Mulch. Type I Mulch (straw) shall be a cereal straw from stalks of oats, rye, wheat, barley, or clean fescue. The straw and fescue shall be clean and bright, relatively free of noxious and undesirable seed, and foreign material. It shall be dry enough to spread evenly over the entire area to be mulched. The mulch shall be wetted at the time of application.

13.1.2.5.2 Type III Mulch. Type III Mulch (Hydroseed) shall be a material consisting of fiber mulch Virgin wood fibers shall be produced by either the ground or cooked fiber process and have the following properties:

A. Moisture content- percent by weight, maximum-15
B. Organic Matter- Wood fiber, percent by weight minimum-80
C. PH 4.3-8.5

13.1.3 Method of Construction.

13.1.3.1 Seedbed preparation shall be accomplished by grading the disturbed areas and adding at least 4 inches of topsoil. The surface on which the topsoil is to be placed shall be free of all loose rock and foreign material greater in any dimension than ½ the depth of the topsoil to be added. Topsoil shall be placed and spread over the designated areas to a depth sufficiently greater than shown on the plans or specified so that after settling, the completed work will conform with the thickness and elevations shown on the plans. After spreading, all large clods and foreign material shall be removed by the contractor. No seed or mulch shall be placed until the Engineer accepts the grade and seedbed, and soil amendments have been approved for placement.

The seed shall be evenly distributed over the area. Mulch shall be applied as described below for that type of mulch specified.

13.1.3.2 Mulching Applications.

13.1.3.2.1 Type I Mulch must be applied at a rate of 2½ tons per acre. Immediately after placement of the mulch, the entire mulched area shall be thoroughly saturated with water.

13.1.3.2.2 Type III Mulch shall be green in color after application, and shall have the property to be evenly dispersed and suspended when agitated in water. Virgin wood fiber mulch containing 80% or greater organic matter shall be hydraulically applied at a rate of 2,000 pounds per acre. The mulch shall be mixed with water in a manner to provide homogeneous slurry. Equipment for mixing and applying the slurry shall be capable of applying a uniform mixture over the entire area to be mulched. The slurry mixture shall be agitated during application to keep the ingredients thoroughly mixed.

The seeded area shall be maintained as necessary to assure growth after application. Seeding shall be placed from September 1st to November 1st and March 15th to May 31st unless otherwise authorized by the Engineer. If a project is completed except for seeding and this project completion occurs during the period when seeding is not allowed, the contractor will be required to complete all seeding and have confirmed growth within 30 calendar days after the next seeding period begins. Ground cover must be established immediately upon completion of construction. If work is completed outside of the seeding season, then the Contractor shall use temporary seed such as; annual cereal grains or erosion control blankets to provide temporary ground cover.

13.1.4 Method of Measurement. No measurement will be made for seeding unless there are appreciable errors in the contract quantity or authorized changes are made. Appreciable errors will only be considered when Contractor's field measurements are provided to, and verified by, the Engineer prior to placement of any soil amendments/seed and results in errors of 10% or more of the original plan quantity. Measurement of seeding will be made for payment to the nearest $^{1}/_{10}$ acre of the area seeded.

13.1.5 Basis of Payment. The accepted quantities of seeding will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: topsoil, soil testing, seeding, liming, fertilizing, mulching, and maintenance of the seeded areas until the job is accepted by the Engineer. When no pay item for seeding is included in the contract seeding will be considered incidental to the work and no direct payment will be made. .

If a contractor working on a public contract is being assessed Liquidated Damages and the project is completed except for seeding, but the date is outside of the required planting period, then the Liquidated Damages will cease until the beginning of the next seeding period at which time, the Contractor will be required to have confirmed growth within 30 days. If confirmed growth does not occur over the entire project area within 30 days after the start of the next seeding season, Liquidated Damages will be assessed until such growth is confirmed.

Payments will be made under:

Item COS-13.1.5 Seeding -- per acre

13.2 NATIVE GRASS AND WILDFLOWERS

13.2.1 Scope of Work. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations related and incidental to complete installation of the native grasses and wildflowers, and guarantee/warranty as shown on the drawings and as specified herein. The items of work specifically included are Native Grasses and Wildflowers.

13.2.2 Materials

13.2.2.1 Herbicide. A broad-spectrum non-selective foliar applied herbicide such as “Roundup” manufactured by Monsanto Chemical Company, or equivalent.

13.2.2.2 Organic Soil Conditioner. A product of composted plant materials only, with total carbon to nitrogen ratio no greater than 10:1 per AOAC method. Shall be in uniform “beaded” homogenous matrix, all material must pass through a No. 4 sieve per ASTM method. All materials must be coated with a water-soluble biodegradable binder. Shall contain in available form: a minimum of 3% organic phosphate and 1% organic potash, 500/g aerobic-anaerobic bacteria, yeast and mold, 1% iron, .05% manganese and .05% zinc. Packaged weight will be no more than 50 lbs. With manufacturer’s name, product name, percentage of nutrients, and net weight of materials shown on label.

13.2.2.3 Water. The contactor will furnish water at the project site as required for the execution of all work until all work has been completed.

13.2.2.4 Seed Mix. Mix shall be fresh, clean, new crop seed. The Contractor is to provide recommendations for Native Seed Mix and rate typical for the region to include short stem grasses (min 3-5) and wildflowers (min 5-7) (*all quantities to be shown as Pure, Live Seed

(PLS) per acre. PLS shall be defined as the sprout-able seed of specified variety and calculated as the product of viable germination times the purity. The seed quantities indicated per acre for the native grasses and forb seed shall be the amount of Pure, Live Seed per acre for each species.) Seed must be labeled as Missouri Source seed "Yellow Tag". Each species indicated in construction documents must be approved by owner.

13.2.3 Method of Construction. When preparing the soil for native grasses and wildflower, repair any eroded areas and adjust grading as needed to provide adequate drainage and to meet grade at all walks and paved surfaces. All stones that are 2 inches in diameter need to be removed along with all existing vegetation, roots, brush, wire, grade stakes, and any other deleterious materials. Drag seeded areas with approved equipment to insure a smooth surface to all Grasses and Wildflowers. The areas that will receive new seed needs to mowed and have thatch removed during the active growing seasons. Once mowing has been completed, treat area with "Roundup" or equal to. After the first application wait 14 days and treat again. Reapply as necessary until all non-native vegetation is dead. After unwanted vegetation is removed, the Contractor will examine the site and determine the areas that need to be smoothed or filled. Any depression exceeding 2 inches deep, needs to be filled to allow for positive drainage. After existing plant material has been treated, stake zones for grasses and wildflowers to be approved by the Owner prior to seeding.

The Contractor will need to provide an approved plan for seeding at least two weeks prior to seeding. A 10 day notification period will be required prior to beginning seeding operations. The Contractor needs to utilize no-till planters and drills to install all seed. The planters and drill need are required to meet the following conditions; they shall be Rangeland or Truax type grass drill and no-till rangeland and grass drill planters shall be specifically designed for the seeding of native grasses and forbs. Seeding depth must be adjustable to provide final seed depth of less than ½ inch. Also, prior to starting work, all seeding equipment shall be calibrated and adjusted to sow seeds at the proper seed rate. Equipment shall be operated in a manner to insure complete coverage of entire area to be seeded. Any gaps between areas of growth that are greater than 5 square feet shall be reseeded and/or replanted.

To establish good seed coverage, make two passes in two different directions. Once seeding has been completed, roll the seeded areas to firmly bed the seed into the soil using a cultipacker to gently firm the soil around the seed. To protect seeded slopes from exceeding 4:1, install erosion control blankets and staple per manufacture's recommendations. Protect seeded slopes exceeding 6:1 against erosion with jute or coil-fiber erosion control mesh installed and stapled per manufactures recommendation. Protect slopes that are less than 6:1 from erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre to form a continuous blanket 1½ inches loose depth over seeded areas. Spread by hand, blower or other suitable equipment. Straw that is speeded needs to be anchored by one of the following methods; anchor straw mulch by crimping into topsoil by suitable mechanical equipment or anchor straw mulch by spraying with asphalt-emulsion tackifier at a rate of 10 to 13 gal per 1000 sq-ft. Take precautions to prevent damage or staining of structure or other planting adjacent to mulched areas.

Ground cover must be established immediately upon completion of construction. If work is completed outside of the seeding season as noted herein, then the contractor shall use temporary seed such as annual rye or erosion control blankets to provide temporary ground cover.

13.2.4 Method of Measurement. No measurement will be made for native seeding unless there are appreciable errors in the contract quantity or authorized changes are made. Appreciable errors will only be considered when Contractor's field measurements are provided to, and verified by, the Engineer prior to placement of any soil amendments/seed and results in errors of 10% or more of the original plan quantity. Measurement of native seeding will be made for payment to the nearest $^{1}/_{10}$ acre of the area seeded.

13.2.5 Basis of Payment. The accepted quantities of native seeding will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: topsoil, soil testing, seeding, liming, fertilizing, mulching, and maintenance of the seeded areas until the job is accepted by the Engineer. When no pay item for native seeding is included in the contract native seeding will be considered incidental to the work and no direct payment will be made.

If a contractor working on a public contract is being assessed Liquidated Damages and the project is complete except for seeding, but the date is outside of the required planting period, then the Liquidated Damages will cease until the beginning of the next seeding period at which time, the Contractor will be required to have confirmed growth within 30 days. If confirmed growth does not occur over the entire project area within 30 days after the start of the next seeding season, Liquidated Damages will be assessed until such growth is confirmed.

Payments will be made under:

Item COS-13.2.5 Native Seeding -- per acre

13.3 NOT USED

13.4 SODDING

13.4.1 Scope of Work. The work shall consist of preparing the areas for sodding and placing approved live sod. The entire area designated for sodding shall be covered with sod except where the item Strip Sodding is indicated in the contract.

13.4.2 Materials.

13.4.2.1 Sod. The sod shall be a turf-type tall fescue blend at least 2 years old, densely rooted and thrifty, unless otherwise specified in the contract. The sod shall contain a growth of not more than 10% of other grasses, be free from all prohibited and noxious weeds, and be reasonably free of all weeds. The sod shall be cut in strips of uniform thickness with a minimum depth of one and 1½ inches; each strip containing at least ½ square yard and not more than 1 square yard. Sod

shall be cut into strips. At the time of sod lifting, the top growth shall not exceed 3 inches in length. All sod shall conform to the laws of Missouri and shall be obtained from sources meeting the approval of the Department of Agriculture, Division of Plant Industries.

13.4.2.2 Fertilizer. Fertilizer shall be applied as recommended by the soil analysis.

13.4.3 Construction Requirements.

13.4.3.1 Sod shall not be placed during a drought nor placed during the period June 1st to September 1st unless authorized by the Engineer, and shall not be placed on frozen ground. No dry or frozen sod shall be used.

Ground cover must be established immediately upon completion of construction. If work is completed outside of the seeding or sodding season, then the contractor shall use temporary seed such as annual rye or erosion control blankets to provide temporary ground cover.

13.4.3.2 The sod-bed shall be prepared in accordance with Section 3 of the Specificatios and shall have a uniform surface free from rills, washes, and depressions and shall conform to the finished grade and cross section as shown on the plans. The area to be sodded shall be fertilized with the specific mixture by spreading evenly at the rate of 12 pounds per 1,000 square feet of area. Fertilizer will not be required where strip sodding is designated. The bed shall be in a firm but uncompacted condition with a relatively fine texture at the time of sodding. No sod shall be placed until the sodbed is approved by the Engineer. Sod shall be moist and shall be placed on a moist earth bed. Sod strips shall be laid along contour lines, by hand, commencing at the base of the area to be sodded and working upward. The transverse joints of sod strips shall be broken, and the sod carefully lay to produce tight joints. The sod shall be firmed, watered, and refirmed immediately after it is placed. The firming shall be accomplished by use of a lawn roller or tamper. On 3:1 slopes, or steeper, the sod shall be pegged with wood pegs approximately ½ inch by 12 inches driven into the ground, leaving about ½ inch of the peg above the sod, and spaced not more than 2 feet apart. Pegging of sod shall be done immediately after the sod has been firmed. When sodding is completed, the sodded areas shall be cleared of loose sod, excess soil, or other foreign material, and a thin application of topsoil shall be scattered over the sod as a top dressing, and the areas thoroughly moistened.

13.4.3.3 The contractor shall keep all sodded areas thoroughly moist for 3 weeks after laying. The sod shall be living at the time of final acceptance of the area.

13.4.4 Method of Measurement. Measurement of sod will be made for payment to the nearest square yard of the area sodded.

13.4.5 Basis of Payment. The accepted quantities of sod will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: soil testing, sod, liming, fertilizing, and maintenance of the sodded areas until the job is accepted by the Engineer.

If a contractor working on a public contract is being assessed Liquidated Damages and the project is complete except for sodding, but the date is outside of the required planting period, then the Liquidated Damages will cease until the beginning of the next planting period at which time, the Contractor will be required to have confirmed growth within 30 days. If confirmed growth does not occur over the entire project area within 30 days after the start of the next seeding season, Liquidated Damages will be assessed until such growth is confirmed.

Payments will be made under:

Item COS-13.4.5 Sod -- per square yard

14 TRAFFIC SIGNALS

14.1 GENERAL

14.1.1 Scope of Work. This work includes the furnishing and installing of traffic signal equipment as shown on the plans and shall include all materials, equipment, labor, tools, transportation, permits, licenses, and all other miscellaneous items necessary to provide an operable system as required by the contract documents. All work shall be in accordance with these specifications, all governing local ordinances and regulations, and the latest revisions of the *National Electrical Code* (NEC), *National Electrical Safety Code* (NESC), *National Electrical Manufacturers Association* (NEMA), *Manual on Uniform Traffic Control Devices* (MUTCD), other relevant standards as referenced, and the contract documents. References to certain sections of *Missouri Standard Specifications for Highway Construction*, including revisions current at the time projects are bid, are made herein. Other relevant standards and specifications include:

AASHTO	American Association of State Highway and Transportation Officials
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
Caltrans	California Department of Transportation
ICEA	Insulated Cable Engineers Association
IMSA	International Municipal Signal Association
ITE	Institute of Transportation Engineers
RETMA	Radio Electronics Television Manufacturers Association
UL	Underwriters Laboratories

The Engineer shall resolve any conflicts.

14.1.2 Crafts Must Be Certified And Registered: In accordance with the *Springfield City Code*, enforced by the Department of Building Development Services, “Before a person shall engage in the business of contracting for electrical work, such person shall register by name of business, name of officers, and address, and shall designate the name of the certified master electrician who shall be authorized to apply for permits and accept service of process and shall designate the names of other certified personnel responsible for the names of work crews. Electrical contractors shall be licensed and all work shall be by, or under, the supervision of the holder of a master electrician license and a certificate of qualification” [Section 36-1230-B].

14.1.3 General. Existing traffic signals shall be maintained in effective operation by the Contractor, except for shutdowns approved by the Engineer for alterations or final removal. After any modifications have been made or after work is begun on an existing signalized installation, the Contractor shall maintain the signals in accordance with the plans. The Contractor shall contact the Engineer for approval at least 5 business days, excluding weekends and City holidays, prior to operational shutdown of any traffic signal. The Contractor shall contact the Engineer for approval at least 2 days, excluding weekends and City holidays, prior to

disconnecting existing vehicle or pedestrian detection. All traffic signal equipment that the Contractor uses or installs on the project, whether furnished by the City or the Contractor, either on a temporary or permanent basis, shall, upon installation or upon initial use by the Contractor, be operated and maintained by the Contractor until the project is complete and accepted. Any malfunction of an existing signal installation resulting from the Contractor's operation, regardless of the nature of the work, shall be corrected at the Contractor's expense, as directed by the Engineer. All work within operational signal cabinets and splice cabinets shall be performed under the supervision of City Traffic Signal personnel, including, but not limited to signal timing, traffic cameras, interconnect, and ITS equipment. Programming of the controller and termination of fiber optic cable will be the responsibility of the City. If directed by the Engineer, the Contractor shall provide off-duty City police officers to control traffic during signal shutdown or turn on. If any adjustments are required to the operation of an existing signal installation due to the Contractor's operation, the Contractor shall provide a minimum of 2 business days notice to the Engineer for approval.

14.1.4 Temporary Traffic Signals. Installation of temporary traffic signals shall consist of, but not be limited to, furnishing and installing poles for span wire signals, span and tether wires, control and power cable, power supply and connection to a power source, the controller, signal heads, detectors, luminaires, and all mounting hardware, unless specified otherwise. Maintenance of the installation and all other equipment and material necessary to provide the temporary installation will be the responsibility of the Contractor. If the temporary traffic signal installation is not shown on the plans, the Contractor shall submit a plan to the Engineer for approval prior to the installation of temporary signals. Any existing or City furnished signal equipment to be used in the temporary signal shall be shown on the temporary signal plan. Temporary signals shall have the signal heads covered until placed in operation. A minimum of 2 signal faces shall be oriented toward each street approach positioned a minimum of 8 feet apart, center to center, and a minimum of 16 feet above the surface of the traveled way to the bottom of the backplate. Existing signals shall not be taken out of operation until the temporary signals are ready for operation and approved by the Engineer. A flashing operation shall be used during shutdown of the temporary signals. If directed by the Engineer, the Contractor shall provide off-duty City police officers to control traffic during signal shutdown or turn on. See *Standard Drawing TS-20: Span Wire Details – Wood Poles.*

14.1.4.1 All temporary signal equipment shall be removed by the Contractor after the new installation is in operation, or as directed by the Engineer. Contractor furnished equipment that will become the property of the City shall be of new stock and shall meet all applicable specifications. Contractor furnished equipment that will remain the property of the Contractor may be new or used, if approved by the Engineer. City owned equipment will remain the property of the City, unless specified otherwise, and shall be disposed of as shown on the plans or as directed by the Engineer.

14.1.4.2 Method of Measurement. No measurements will be made for temporary traffic signals.

14.1.4.3 Basis of Payment. Temporary traffic signals will be paid for at the lump sum contract price. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.1.4.3 Temporary Traffic Signal -- per lump sum

14.1.5 Removal of Signals. This work includes removing, salvaging, and disposal of traffic signal equipment including, but not limited to, cabinets, poles, structures, and wiring as indicated on the plans, including all necessary excavation and backfilling. Removal of PCC foundations shall extend a minimum of 24 inches below the finished final grade of the surrounding area. Prior to salvaging equipment, the Contractor shall meet on site with the Supervisor of Signal Operations to determine the condition of existing signal equipment and which equipment will be salvaged. The Contractor shall deliver the controller and cabinet, and equipment deemed salvageable to the City Signal Shop at 1134 W. Nichols Street. Salvageable signs may be reused as directed by the Engineer. Salvageable signal heads and signs shall be removed from the poles and mast arms, mounting brackets disassembled, and cable removed from heads, fittings, arms, posts, and conduits as necessary. Contact the Supervisor of Signal Operations at the City Signal Shop (417-864-1977) a minimum of 1 business day (24 hours) prior to removal of salvaged equipment to schedule delivery and inspection of equipment. It shall be the Contractor's responsibility to dispose of the remaining equipment. Replacement cost of damaged salvageable signal equipment will be withheld from Contractor's final payment.

14.1.6 Inspection of Work. Work performed and materials furnished will be subject to inspection by the Engineer at any time. The contractor shall give the Engineer a minimum 1 business day (24 hours) advance notice when work and materials are ready for inspection, testing, review, approval, or retesting as applicable. The Contractor shall provide such facilities as are deemed necessary by the Engineer for sufficient and safe access to the work or to the material.

14.1.6.1 Inspections, tests, measurements and other actions taken by the Engineer are for the sole purpose of assisting the Engineer to methodically assess, with reasonable assurance, whether or not work, materials, rate of progress, and quantities, comply with the Contract. These actions by the Engineer shall not relieve the Contractor from determining, independently, that full compliance with the Contract is met at all times, or relieve the Contractor from providing quality materials, workmanship, and processes in strict compliance with the Contract.

14.1.6.2 Upon request, the Contractor shall remove or uncover any portions of completed work for inspection by the Engineer. After inspection, the Contractor shall restore them to the standards required by the Contract.

14.1.6.3 Testing of Signal Equipment. After the project is open to normal traffic, the Contractor shall notify the Engineer in writing the date the signal, or signal system, will be ready for testing. Upon concurrence of the Engineer, the Contractor shall place the signal or signal system in operation for a consecutive 10 day test period. If the signal is to operate independently of other signals or signal systems, it shall be tested as a single installation. If the signal is part of a system, the test period shall not be started until all signals in the system are ready to be tested. A system shall be tested as a unit. Any failure or malfunction of the equipment during the test

period shall be corrected at the Contractor's expense and the signal system tested for an additional consecutive 10 day period. This procedure shall be repeated until the signal equipment has operated satisfactorily for 10 consecutive days. The City provides the traffic signal controller operation and controller trouble shooting during the test period.

14.1.7 Unauthorized Work. The City will not pay for unauthorized or defective work. Work and materials that do not conform to the requirements of the Contract, work done beyond lines and grades shown on the plans or established by the Engineer, or extra work and materials furnished without written approval of the Engineer will be considered defective and unauthorized work. Such work shall be at the Contractor's risk and expense and may be rejected, even if the work has been inspected, or progress payments made. Upon order of the Engineer, such work shall immediately be remedied, removed, replaced, or disposed of. All costs associated with such work shall be at the Contractor's sole expense.

14.2 EQUIPMENT

14.2.1 General.

14.2.1.1 Equipment and Material. Equipment and material shall be of new stock unless the contract provides for relocation of existing units or use of units furnished by others. New equipment and material shall be the product of reputable manufacturers, shall be in accordance with Caltrans 2070 Controller and Cabinet Specifications, the regulations of the National Board of Fire Underwriters, Standards referenced in 14.1.1, as applicable, all governing local ordinances and regulations, these specifications, the contract documents, and shall meet the approval of the Engineer.

14.2.1.2 Any equipment or materials proposed for use must be pre-approved by the Traffic Engineer. Two copies of the list of materials to be supplied by the Contractor shall be submitted to the Engineer and approved by the Engineer in writing before items are purchased. It is preferable that the list be submitted and approved before the Notice to Proceed is issued. If the list has not been submitted and approved prior to the effective date of the Notice to Proceed, no construction work of any nature will be permitted on the signal project until the list has been approved. Approval of the items on the list will not relieve the Contractor of responsibility for satisfactory performance of the installation.

14.2.1.3 Certification. If requested by the Engineer, the Contractor shall provide a manufacturer's certification in triplicate, showing typical test results representative of the equipment and materials, and certifying that the supplied equipment and materials conform to all the requirements specified.

14.2.1.4 Warranties. The Contractor shall furnish to the Engineer any guaranty or warranty furnished as a normal trade practice in connection with the purchase (by the Contractor or a subcontractor) of any equipment, materials, or items incorporated in the project. Further, the Contractor shall be responsible for the condition of all material and all work performed as part of this contract and such material and labor shall be guaranteed by the Contractor and his surety

against defective workmanship and/or material found to be defective in manufacture or which has been damaged in handling or placement after delivery for a period of 12 months after acceptance by the City. Contractor shall repair, replace, or otherwise make good at his own expense any such defect or failure which may become evident within the guarantee period, excepting as may be due to normal use or wear. Final determination of a material defect or failure will be made by the Engineer.

14.2.2.1 Cable. Except as noted, all conductors shall be soft drawn, Class B or C stranded copper wire in accordance with NEMA WC70/ICEA A-95-658. Solid conductors may be used only for grounding where connected to a ground rod.

14.2.2.2 Power Cable. Low voltage power cable shall be 600-volt, single conductor cable and thermoplastic or thermosetting cross-linked polyethylene insulated. All cable shall be plainly marked on the outside with the manufacturer's name and identification in accordance with industry practice. Insulation type shall be THHN/THWN-2 or XHHW-2. Black cables shall be used for the hot conductors and white cable shall be used for the neutral conductor. Green conductors shall be used for the equipment ground. Size and number of cables shall be as shown on the plans. Placing marking tape on cable will not meet the color-coding requirement of this section.

14.2.2.3 Multi-Conductor Signal Cable. Multi-conductor signal cable shall be rated at 600 volts and shall meet the requirements per the latest revision of IMSA Specification No. 20-1. The number and size of conductors shall be as specified on the plans.

14.2.2.4 Pushbutton Detector Cable. Pushbutton detector cable shall be two-conductor No. 14 AWG wire, with Type THHN insulation rated at 600 volts.

14.2.2.5 Induction Loop Cable. Induction loop detector cable shall be single-conductor No. 14 AWG wire, with Type THHN insulation rated at 600 volts.

14.2.2.6 Induction Loop Shielded Lead-In Cable. Lead-in cable used between the loop detector and the controller shall be two-conductor, twisted, shielded No. 14 AWG wire rated at 600 volts. The cable shall be in accordance with IMSA Specification No. 50-2.

14.2.2.7 Video Detection Cable. Control cables and power cables for video detection equipment shall be as specified by the manufacturer.

14.2.2.8 Luminaire Cable. Luminaire cable shall be 1c #8 THHN, 19-strand cable installed from the lighting controller to the base of the combination mast arm pole. Within the pole, from the base to the luminaire head, the cable installed shall be 1c #10 THHN, 19-strand, two black and one white conductor.

14.2.2.10 Equipment Grounding Conductor. A 1c#10 AWG THHN/THWN stranded copper green system ground cable shall be installed to provide a bonded system.

14.2.2.11.1 Fiber Optic Interconnect Cable. Fiber optic cable shall be all-dielectric, loose tube, contain the number and type of fibers as shown on the plan. The cable shall be new, unused, and of current design and manufacture. The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification. All fibers in the cable must be usable fibers and meet required specifications.

14.2.2.11.2 The fiber optic cable is to be of all-dielectric loose tube design and shall be designed for underground conduit applications. The cable shall contain a glass reinforced plastic central strength member. High tensile aramid and/or fiberglass yarn, helically stranded evenly around the buffer tubes, shall be utilized for additional tensile strength.

14.2.2.11.4 Each buffer tube shall be filled with a gel with anti-oxidant additives to prevent water intrusion and migration. The gel shall be chemically and mechanically compatible with all cable components, nonnutritive to fungus, nontoxic and non-hydroscopic. All voids in the cable including the core shall be filled with a filler that will prevent water ingress and migration.

14.2.2.11.4 The fiber optic cable jacket material shall be black high-density or medium density polyethylene (minimum 1.4 mm thickness) containing a suitable antioxidant system. The surface of the jacket shall be marked with the manufacturer's name, the words "Optical Cable", year of manufacturer and sequential length marks. The markings shall be repeated every one meter. The markings shall be in a contrasting color to the cable jacket for easy visibility. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

14.2.2.11.5 Each reel of fiber optic cable received from the manufacturer shall be accompanied by optical time domain reflectometer (OTDR) attenuation test data on each fiber.

14.2.2.11.6 The fiber optic cable shall contain the number and type of optical fibers as shown on the plans, 6 fibers per loose tube. Each tube shall be color coded (EIA/TIA Standard).

14.2.2.11.7 Quality Control Tests. The fiber optic cable shall meet or exceed the requirements of the standards specified:

A. Crush Resistance - EIA-455-41, the cable shall have a compressive strength of 1350 Ibs. at 20°C.
B. Impact Resistance - EIA.-455-25A - no significant attenuation will result from 25 impacts of the specified impact at a sample temperature of -30°C or +25°C.
C. Cyclic Flex Resistance (Test Conditions I and III) - no significant attenuation results after 25 flex cycles when tested in accordance with EIA-455-104A using a bend radius of 5 times the cable outside diameter.
D. Temperature Cycling - ElA~455-3A. no attenuation increase at -40°C and +70°C.
E. High and Low Temperature Bend Resistance (Test Level I) - No significant attenuation shall result from testing in accordance with ElA-455-37A at temperatures of -30°C + 60°C.
F. Water Penetration - The cable shall meet the requirements of ElA-455-82B.
G. Compound Flow (Drip) Resistance - Test results shall indicate compliance with the requirements of EIA-455-81A at a test temperature of 60°C.

14.2.2.11.8 Reel Lengths. Fiber optic cable shall be shipped on reels of 1100, 1700, 2200, 3300 or 4400 meters.

14.2.2.11.9 Single Mode Fiber Optic Cable. The fibers shall be designed for dual wavelength operation at both 1310 and 1550 nm. Each fiber shall have a mechanically strippable color-coated acrylic protective coating. The color of the inks applied to fibers shall be clearly distinguishable from one another (ElA/TIA Standard) and remain so after cleaning and end preparation for splicing. Each fiber shall have been subjected to and passed a tensile proof stress test equivalent to 100 ksi for 1.0 second dwell time without damage of any kind. The induced attenuation due to fiber wrapped around a mandrel of 75 mm diameter for 100 turns at 1310 nm shall not be greater than 0.05 DB.

14.2.2.11.10 Optical Fiber Parameters. The fiber shall meet the following specifications:

A. Core Diameter: 9µm ± 0.5 µm (Single-mode), 62.5 µm (Multi-mode)
B. Cladding Diameter: 125µm ± 3.0 µm
C. Coating Diameter: 250µm ± 15 µm.
D. Mode-Field Diameter at 1310 nm = 8.7 to 10 µm ± 0.5 µm
E. Core to Cladding Offset: 1.0 µm
F. Max. Attenuation at 1310 nm: 0.5 db/km.
G. Max. Attenuation at 1550 nm: 0.4 db/km.

14.2.2.12 Certification. All cables and conductors shall be accompanied by certification from the supplier indicating: (1) the supplier is familiar with the requirements of these specifications and, (2) cable furnished was from a lot manufactured by (manufacturer's name) whose test results are in accordance with these specifications.

14.2.2.13 Method of Measurement. No measurement will be made for cable. Contract quantities will be used for final payment except for authorized changes during construction or where appreciable errors are found in the contract quantities. The revision or correction will be computed and added or deducted from the contract quantities.

14.2.2.14 Basis of Payment. The accepted quantities of cable will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to sawcutting for detector loop cable installation. Payments will be made under:

Item COS-14.2.2.14.1.00.00	Power Cable -- per linear foot (plan quantity)
Item COS-14.2.2.14.2.00.00	Signal Cable -- per linear foot (plan quantity)
Item COS-14.2.2.14.3	2c #14 Cable for Pushbuttons -- per linear foot (plan quantity)
Item COS-14.2.2.14.4	1c #14 THHN Detector Loop Cable -- per linear foot (plan quantity)
Item COS-14.2.2.14.5	2c #14 Shielded Loop Lead-In Cable -- per linear foot (plan quantity)

Item COS-14.2.2.14.6	RG-8/U Coaxial Cable -- per linear foot (plan quantity)
Item COS-14.2.2.14.7.00.00	Luminaire Cable - per linear foot (plan quantity)
Item COS-14.2.2.14.8	3c #16 Interconnect Cable -- per linear foot (plan quantity)
Item COS-14.2.2.14.9	1c #10 Ground Cable -- per linear foot (plan quantity)
Item COS-14.2.2.14.10	24c (18SM//6MM) Fiber Optic Cable -- per linear foot (plan quantity)

*Where 00.00 represents the number of conductors and the wire gage respectively. For example, 1c #6 Power Cable would be item COS-14.2.2.14.1.1.6.

14.2.3 Conduit.

14.2.3.1 Rigid Steel Conduit. Rigid steel conduit shall conform to the requirements of ANSI C80.1 and shall be galvanized on both the inside and the outside surfaces. The weight (mass) of zinc coating shall be no less than 0.5 ounce per square foot of coated surface, as determined in accordance with AASHTO T 65. The interior or exterior surface, or both, may be given a coating of suitable material to facilitate installation of wires and cables and to permit the conduit to be readily distinguished from pipe used for purposes other than electrical.

14.2.3.2 Rigid Steel Conduit, Fittings. Fittings shall conform to the requirements of ANSI C80.4.

14.2.3.3 Inspection. Conduit and fittings will be inspected for compliance with the specifications, and any desired samples will be taken at either the project location or warehouse, at the option of the Engineer. Test specimens for determination of weight (mass) of coating will be not less than 2 inches long, and cut not less than 6 inches from the end of the length of conduit selected for testing. If the prescribed two additional samples for retests are taken, and either does not comply, the lot represented will be rejected.

14.2.3.4 Polyvinyl Chloride Conduit (PVC). PVC conduit, bends, couplings, and fittings shall be schedule 40 rigid polyvinyl chloride conforming to the requirements of Underwriters Laboratories Standard UL 651. The conduit may be continuous or in sections, and shall be gray in color. Each length of conduit, nipple and elbow shall be marked with the manufacturer’s name or trademark and Underwriters Laboratories label.

14.2.3.5 Fittings for Polyvinyl Conduit. Fittings for PVC conduit shall be in accordance with UL 514. Cement used for the fittings shall be in accordance with the conduit manufacturer’s recommendations.

14.2.3.6 High Density Polyethylene Conduit (HDPE). HDPE conduit shall be schedule 40 High Density Polyethylene, orange in color, conforming to the requirements of ASTM D 3035 SDR 11. Each length of conduit shall be marked with the manufacturer’s name or trademark and Underwriters Laboratories label.

14.2.3.7 Fittings for High Density Polyethylene Conduit. Fittings for HDPE conduit shall be

in accordance with ASTM D 2683 and the conduit manufacturer's recommendations. Transitions between HDPE and PVC conduits, if approved by the Engineer, shall conform to the manufacturer's recommendations.

14.2.3.8 Inspection of PVC and HDPE Conduit. The material will be inspected for compliance with the specification, and desired samples will be taken at either the project location or warehouse, at the option of the Engineer.

14.2.3.9 Certification. The Contractor shall furnish a manufacturer's certification that the material supplied is in accordance with all requirements. If requested by the Engineer, the Contractor shall also furnish typical test results representative of the material.

14.2.3.10 Dimensions. The dimensions of all conduit shall be in accordance with the plans.

14.2.3.11 Method of Measurement. No measurement will be made for conduit. Contract quantities will be used for final payment except for authorized changes during construction or where appreciable errors are found in the contract quantities. The revision or correction will be computed and added or deducted from the contract quantities.

14.2.3.12 Basis of Payment. The accepted quantities of conduit will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.3.12.1.00	Rigid Steel Conduit in Trench -- per linear foot (plan quantity)
Item COS-14.2.3.12.2.00	PVC Conduit in Trench -- per linear foot (plan quantity)
Item COS-14.2.3.12.3.00	HDPE Conduit in Trench -- per linear foot (plan quantity)
Item COS-14.2.3.12.4.00	HDPE Conduit, Bored -- per linear foot (plan quantity)

*Where 00 represents the conduit diameter in inches.

14.2.4.1 Pull Boxes. Pull boxes may be cast-in-place concrete, precast concrete, preformed polymer concrete or preformed fiberglass reinforced polymer concrete as shown on the plans. Each pull box shall be equipped with 4 galvanized steel or brass cable hooks with a minimum diameter of ⅜ inch and a minimum length of 5 inches.

14.2.4.2 Preformed Pull Boxes. Preformed pull boxes shall withstand a wheel load of 20,000 pounds. Pull box walls may be either flared or vertical. Pull boxes shall have a collar or ring at the top that will allow for securing the concrete apron

14.2.4.3 Cast-In-Place Concrete Pull Boxes. Cast-in-place concrete pull boxes shall be

constructed Class B concrete in accordance with MoDOT Standard Specifications. Pull boxes shall be cast in a neat and clean manner. See *Standard Drawing TS-3: Cast-in-Place Pull Box.*

14.2.4.4 Pull Box Covers. Preformed pull boxes shall be equipped with a bolt down cover. The threaded hole that receives the cover lock-down bolt shall be open at the bottom to allow the cleanout of sand, dirt and other debris. Lock-down bolts shall be stainless steel or brass with a penta-head. Frames and covers for cast-in-place and precast concrete pull boxes shall be cast iron in accordance with AASHTO M105, Class 30, and shall be of the dimensions shown on the plans. Preformed pull box covers shall be polymer concrete and shall meet a load category of Tier 15 and have a design load rating of 15,000 pounds and a test load of 22,500 pounds, all of which meet the ANSI/SCTE 77 specification. A lift opening shall be provided on all covers. Covers for pull boxes to be used for traffic signals shall be embossed with "TRAFFIC SIGNALS". Covers for pull boxes to be used for fiber optics shall be embossed with “TRAFFIC SIGNAL FIBER OPTICS”.

14.2.4.5 Method of Measurement. Measurement of pull boxes will be made for payment per each.

14.2.4.6 Basis of Payment. The accepted quantities of pull boxes will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.4.6.1.00	Pull Box, Preformed -- per each
Item COS-14.2.4.6.2.00	Pull Box, Cast-In-Place -- per each

*Where 00 represents the pull box type. For example, a Type I Pull Box, Preformed would be item COS-14.2.4.6.1.1.

14.2.5.1 Signal Post and Mast Arm Pre-Approval. Fabricators shall submit 5 copies of shop drawings and supporting calculations to the Engineer. Submittals shall be approved by the Engineer in writing prior to fabrication of the signal posts and mast arms. Shop drawings shall indicate complete design details required for post and mast arm fabrication, including material grades and thicknesses, welding and orientation of any longitudinal seams. The projected areas and weights (masses) of signs and signals used in the design of the post and mast arms shall be shown on the shop drawings. Design details for all possible post and mast arm combinations shown on the plans may be submitted. Shop drawings shall provide post and mast arm installation and hardware details. All welding procedures shall be prepared by the manufacturer as a written procedure specification and shall be submitted with the shop drawings for approval. Approval of the weld procedures will be required before approval of the shop drawings. Shop drawings shall indicate the specific approved welding procedure to be used for each joint. Shop drawings and supporting stress calculations shall be signed and sealed by a registered professional engineer in the State of Missouri. Manufacturers shall submit all required documentation, in accordance with 14.2.5.2.6. Upon written approval, pre-approved drawings may be used on any project where the design conditions of the shop drawings are not exceeded.

14.2.5.2.1 Steel Posts and Mast Arms. Steel posts and mast arms shall be round, continuously tapered, hollow shafts fabricated as one continuous shaft or as individual segments at least 10 feet long, joined together using electrically welded, intermediate, transverse, full penetration, circumferential joints. Steel posts and mast arms shall be fabricated from basic oxygen or open-hearth steel sheet. The continuous, tapered, hollow shafts or individual segments shall be manufactured from one or two lengths of steel sheet, with one or two continuous, welded, longitudinal seams. The longitudinal seams in the mast arm shall be located outside of the upper half of the cross section of the member. Where transverse, full penetration, circumferential welds are used, the fabricator shall furnish to the Engineer written certification that 100% of all such welds have been radiographed or ultrasonic tested by an independent testing agency using a qualified non-destructive testing technician, as described in Section 6.14.7 of ANSI/AWS D1.1 Structural Welding Code-Steel and equipment calibrated annually. The testing agency shall be approved by the Engineer prior to fabrication. Post base and mast arm attachment plates shall be plate steel attached to the larger end of the shafts by continuous welds on the inside and outside of the shaft. After manufacture, the material shall have a minimum yield strength of 48,000 psi.

14.2.5.2.2 A handhole equipped with a suitable metal cover shall be provided in the post near the base, and 12 inches above the mast arm connection if luminaire mounting is specified. A grounding lug or connector shall be provided inside the post near the handhole. A removable rain-tight metal pole cap shall be provided on the top of the post and on the small end of each mast arm. All handhole covers and metal caps shall be securely attached to the post or arm with a galvanized steel chain and shall be held in place by screws. The chain shall be attached to the inside of the post or arm and shall be of sufficient length to allow maintenance access. An aluminum or stainless steel identification tag shall be provided with all posts and mast arms as shown on *Standard Drawing TS-6: Steel Mast Arm*. The letters and numbers on the tag shall be embossed or engraved. The post tag shall be attached to the pole 6 inches above the top of the handhole. The mast arm tag shall be attached 3 inches from the base of the end cap. The base plate shall be equipped with 4 cast steel or cast iron nut covers in accordance with AASHTO M 103 or M 105, or 4 aluminum nut covers and shall have four galvanized or stainless steel screws for securing covers to the pole. All poles, shoe bases, base plates and cast steel or cast iron nut covers shall be fully galvanized after fabrication. All anchor bolt nuts shall be completely covered by nut covers. Luminaire bracket arms, when specified, shall be included with the post and mast arm. The Contractor may furnish posts with the shape, gage and dimensions meeting or exceeding those required by the plans and specifications, provided shop drawings are submitted and approved in accordance with 14.2.5.1.

14.2.5.2.3 Welding and fabrication of the assemblies shall be in accordance with the ANSI/AWS D1.1 Structural Welding Code-Steel. All requirements of the welding code for tubular structures will apply to the fabrication for the post and mast arm shafts, and shall include any welds used to attach these members to plates or other hardware. The manufacturer shall employ qualified personnel to perform all visual and nondestructive testing (NDT) required. In addition to the visual inspections and NDT that may otherwise be required by the welding code, the manufacturer shall perform 100% magnetic particle (MT) testing of circumferential fillet welds used to attach the flange plate to the larger end of the mast arm shaft. NDT personnel shall be

qualified as set forth in paragraph 6.14.7 of ANSI/AWS D1.1 Structural Welding Code-Steel. Qualifications of NDT personnel shall be submitted to the Engineer for approval.

14.2.5.2.4 The post and mast arm manufacturer shall be certified under the AISC certification program, Conventional Steel Building, or higher category. Evidence of current AISC certification will be required prior to the approval of shop drawings, and lapsing of the certification will be cause for non-approval of the manufacturer.

14.2.5.2.5 Steel posts, luminaire bracket arms, mast arms, nut covers and plate steel bases shall be hot-dip galvanized inside and out after fabrication, visual inspections and NDT testing. Galvanized material shall be handled in such a manner to avoid damage to the surface. Any galvanized material on which the coating has been damaged will be rejected or may, with approval from the Engineer, be repaired in a manner approved by the Engineer.

14.2.5.2.6 Luminaire Bracket Arms. Bracket arms shall be either single tube or truss type, arranged for 2-inch slipfitter luminaire mounting, and shall be attached to the poles in accordance with the manufacturer’s recommendations. Bracket arm mounting plates shall match the shape of the pole. A one-inch pipe nipple shall be welded in place in the wire entrance hole on the mounting plate. The welds shall be placed on the side of the plate away from the pole.

14.2.5.2.7 Fabricator's Certification. Prior to erection of the posts and mast arms, the Contractor shall furnish to the Engineer a fabricator's certification. The certification shall specifically state the fabricated posts and mast arms have been quality control inspected by the fabricator and all material and manufacturing processes used were in full compliance with the specification requirements and the approved shop drawings and weld procedures. Certification shall be accompanied by supporting documentation, including the results of the visual inspections and NDT in accordance with 14.2.5.2.3 and copies of the pre-approved shop drawings required by 14.2.5.1.

14.2.5.2.8 Method of Measurement. Measurement of all signal posts will be made for payment per each.

14.2.5.2.9 Basis of Payment. The accepted quantities of signal posts will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.5.2.9.1.00	Type A Signal Post, Aluminum -- per each
Item COS-14.2.5.2.9.2.00	Type A Signal Post with Mast Arm -- per each
Item COS-14.2.5.2.9.3.00.00	Type A Signal Post with Mast Arm & Luminaire Bracket Arm -- per each
Item COS-14.2.5.2.9.4.00	Type S Signal Post with Mast Arm -- per each
Item COS-14.2.5.2.9.5.00.00	Type S Signal Post with Mast Arm & Luminaire Bracket Arm -- per each

*Where 00 represents the signal post length or mast arm length in feet as appropriate. Where 00.00 represents the mast arm length in feet and the luminaire bracket arm length in feet respectively.

14.2.6.1 Power Supply. The power supply assembly shall consist of all equipment and materials necessary for the distribution of secondary electrical power to the traffic signal equipment and signal pole mounted lighting, as shown on the plans. The configuration and installation of the equipment mounted on the assembly shall meet the safety requirements and approval of Springfield City Utilities and the City of Springfield Building Development Services. All hinges, catches and other hardware shall be non-ferrous metal or stainless steel. All specified equipment and cable, the conduit attached to the pole or pedestal, and all necessary attachment hardware shall be included in the unit cost of the power supply.

14.2.6.2 Meter Boxes and Enclosures. Combination service entrance enclosures with separate lockable compartments for the meter socket/utility termination section, and the City service panel shall be used. The enclosure shall be NEMA 3R or NEMA 4, 120/240 VAC, single-phase, 3-wire, 100 amp, minimum 12 branch spaces. The enclosure shall accept either overhead or underground service feeds.

14.2.6.3 Circuit Breakers. All circuit breakers shall be molded-case thermal-magnetic circuit breakers. The number and trip rating of circuit breakers shall be as shown in Standard Drawings TS-7 and TS-10. All breakers shall be designed for panel mounting with cable connections on the line and load sides.

14.2.6.4 Type I Power Supply. The Type I power supply assembly shall consist of the combination enclosure, lighting controller (if specified on the plans), circuit breakers as specified in Standard Drawing TS-7: Power Supply Wiring, rigid steel conduit, weatherhead and all necessary hardware, accessories, and appurtenances to be mounted on a 30 foot Class 4 or 5 service pole. It shall also include the pole, ground rods, guy wires and anchors as required by the plans except those items furnished by City Utilities of Springfield. See *Standard Drawing TS-8: Type I Power Supply.*

14.2.6.5 Type II Power Supply. The Type II power supply assembly shall be Square D All-In-One, Catalog Number SC1624M100S, or approved equivalent, consisting of the combination enclosure, lighting controller (if specified on the plans), circuit breakers as specified in *Standard Drawing TS-7: Power Supply Wiring*, rigid steel conduit and all necessary hardware, accessories, and appurtenances to be mounted on a W6 x 9 or W6 x 15 galvanized steel post with a concrete footing. See *Standard Drawing TS-9: Type II Power Supply.*

14.2.6.6 Type III Power Supply and Lighting Controller. The Type III power supply assembly shallbe Milbank Catalog Number CP3B51115AAOSP, or approved equivalent, consisting of a NEMA Type 3R rainproof 0.125-inch natural aluminum pedestal with separate lockable compartments for the meter socket, utility termination section, and the City service panel. All hinges shall be continuous piano type stainless steel. The door for the City service compartment shall be provided with a Corbin lock for a standard No. 2 key. The service pedestal shall be rated 120/240-volt single phase 3 wire. The service pedestal shall be mounted on a

concrete base as shown on the plans. Anchor bolts from the pedestal manufacturer are to be provided. The service pedestal shall provide a 100 amp ringless meter socket, an identified 100-amp main breaker, minimum 12 blank breaker spaces, pre-wired twist lock photoelectric cell receptacle, photocell, contactor, test switch, and appropriate terminal blocks for up to four 240 volt luminaires. All distribution and control equipment shall be factory wired using 600-volt wire sized to meet applicable UL and NEC standards. Circuit breakers shall be installed as specified in *Standard Drawing TS-7: Power Supply Wiring*. The Contractor shall provide manufacturer's catalog cuts or drawings for approval before ordering pedestals. See Standard Drawing TS-9A: Type III Power Supply.

14.2.6.7.1 Lighting Controller. The lighting controller shall consist of a locking NEMA 3R or NEMA 4 dust-tight, watertight, 14 Ga aluminum or stainless steel enclosure mounted on the Type I service pole or Type II steel pedestal as shown on the plans. Included in the lighting controller shall be a main breaker, control breaker, auto-manual switch, contactor, photoelectric switch and socket, neutral terminal strip, lighting terminal strip, and all necessary hardware, accessories, and appurtenances. See *Standard Drawing TS-10: Lighting Controller.*

14.2.6.7.2 Photoelectric Controls. Photoelectric controls shall be of the cadmium-sulfide or solid-state type operating on 120 volts or 240 volts, as necessary, and shall operate on a line supply of 50 to 60 hertz. The load capacity of the photoelectric cell relays shall be a minimum of 1000 watts. Photoelectric cells shall operate a lighting system through mercury load relays or contactors as shown on the plans. The photoelectric cell circuitry shall be designed to be normally closed at night. The photoelectric cell shall be configured such that in the event of failure, the lights shall be on. The turn-on range shall be adjustable from 1.0 to 3.0 footcandles (10 to 32 lux). A turn-on setting of 1.0 footcandle (10 lux) and a turn-off setting of 2.0 footcandles (22 lux) shall be made at the factory. The photoelectric cell shall have a time delay to avoid operation due to lightning and transient light. A suitable bracket for mounting the photoelectric cell shall be provided. The photoelectric cell shall be mounted into a three-prong, twist lock socket. All top mount photoelectric controls shall face an open sky, and side mount photoelectric controls shall face north or east. Each photoelectric control unit shall include a lightning arrestor. Test switches used with photoelectric controls shall be three-position switches or two single-pole breakers as shown in *Standard Drawing TS-10: Lighting Controller*. Test switches shall be clearly labeled and mounted in the control cabinet.

14.2.6.7.3 Contactors. Contactors shall be NEMA Type 1 enclosed, magnetic-type, two-pole, single phase for 600-volt, 60-hertz service. The operating coil shall be designed for 120-volt or 240-volt operation, as shown on the plans. The contactor shall be electrically held, have the minimum rating and shall be housed in the control cabinet as shown in *Standard Drawing TS-10: Lighting Controller.* Mercury load relays shall be two-pole, normally-open, mercury contact, magnetic-type with load capacity as shown in *Standard Drawing TS-10: Lighting Controller.*

14.2.6.8 Electrical Permit. The Contractor shall obtain an electrical permit from the City of Springfield Building Development Services for new or relocated power supplies. Permit and inspection fees are the responsibility of the Contractor.

14.2.6.9 Method of Measurement. Measurement of all power supplies, meters and controllers will be made for payment per each.

14.2.6.10 Basis of Payment. The accepted quantities of power supplies, meters and controllers will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.6.10.1 .00	Power Supply -- per each
Item COS-14.2.6.10.2.00	Power Supply with Lighting Controller -- per each

*Where 00 represents the power supply type. For example, a Type II Power Supply with Lighting Controller would be item COS-14.2.6.10.2.2.

14.2.7.1 Pedestrian Push Button. Pedestrian push button detectors shall be the type and number shown on the plans.

14.2.7.2 Type I Pedestrian Push Button. Type I push buttons shall have pressure activated piezo driven solid state switches. Each detector shall be a removable switch assembly mounted in a rectangular cast aluminum case by means of 2 screws. The housing shall be shaped to fit the curvature of the post to which it is attached and shall provide a rigid installation. Saddles shall be provided to make a neat fit when required. The case shall have one outlet tapped for ½ inch pipe. The button shall be 2 inches in diameter and be stainless steel on a black powder coated aluminum body. Maximum operating force shall not exceed 3 lbs. Activation shall be confirmed by flashing LED and audible tone. The entire assembly shall be weatherproof, secure against electrical shock to the user and of such construction as to withstand continuous hard usage. Type I push buttons shall meet the requirements of the Americans with Disabilities Act current at the time the project is bid.

14.2.7.3 Type II Pedestrian Push Button. Type II push button stations shall consist of a system (electronic control equipment, mounting hardware, pushbuttons, and signs) capable of providing visual, audible, and tactile cues to pedestrians, and shall meet the following requirements:

A. Provide a push button locator tone.
B. Push button activation confirmation via audible tone, LED activation, and vibrotactile pulse.
C. Audible walk indication via voice message during walk phase.
D. Automatic volume adjustment in response to ambient sound level.
E. Tactile directional arrow activates with the WALK phase.
F. The ability to provide verbal countdown information, locator tone, or other custom sound during pedestrian clearance interval.
G. The push button system shall be capable of providing certain custom features including custom messages or sounds for locating tones, pedestrian information, clearance interval, and walk phase information.

The push button station shall have a pressure activated piezo driven solid state switch. The button shall be 2 inches in diameter and be stainless steel mounted in a black powder coated aluminum body. Maximum operating force shall not exceed 3 lbs. The switch body shall be of a one piece design and shall accommodate a weatherproof speaker and a mounting area for a pedestrian information sign. Activation shall be confirmed by flashing LED and audible tone. The entire assembly shall be weatherproof, vandal resistant, secure against electrical shock to the user and of such construction as to withstand continuous hard usage. All necessary equipment and materials, including control boards, power supplies, etc. shall be included in the cost of the pedestrian pushbutton system. Type II push buttons shall meet the requirements of the Americans with Disabilities Act current at the time the project is bid.

Substantiating documentation for meeting ISO, NEMA, IEC, and FCC requirements must be supplied from an outside Testing Services Laboratory.

14.2.7.3.1 General Description.

A. The System shall be backward compatible with the Polara Navigator 2-wire system or equivalent.
B. The System shall consist of a Central Control Unit and Pedestrian Push Button Stations, as described below, and a hand held infrared device for programming the system settings.
C. The System shall be manufactured by an ISO 9001:2008 registered company.

14.2.7.3.2 Design Compliance.

A. The System shall meet the functionality requirements of MUTCD 2009 – 4E.
B. The System shall meet NEMA TS 2 Section 2.1 Temperature & Humidity requirements.
C. The System shall meet NEMA TS 2 Section 2.1 Transient Voltage Protection requirements.
D. The System shall meet NEMA TS 2 Section 2.1 Mechanical Shock and Vibration requirements.
E. The System shall meet IEC 61000-4-4, IEC 61000-4-5 Transient Suppression requirements.
F. The System shall meet FCC Title 47, Part 15, Class A Electronic Noise requirements.
G. The Push Button Station (PBS) Enclosure shall meet NEMA 250 – Type 4X Enclosure requirements.
H. The Central Control Unit (CCU) & Ped Station Monitor (PSM) Enclosures shall meet NEMA 250 – Type 1 requirements.
I. The System shall meet NEMA TS 4 – Electrical Reliability requirements (applicable portions of Section 8).

14.2.7.3.3 Functional Requirements.

A. The System shall support from 2-16 PBS's per intersection (maximum of 4 push buttons per channel) controlled by a single base unit located in the traffic control cabinet.
B. The System shall be able to be set to vibrate a tactile arrow button during the WALK interval following a button push, and/or every time the walk comes up.
C. The System shall have the field-selectable function known as "Locating Tone". This means that during the FLASHING DON'T WALK and the DON'T WALK intervals, the system shall provide a locating tone that emanates from the Pedestrian Push Button Station. The system shall provide at least three different sounds to choose from.
D. The System shall have the field selectable function known as "Extended Push Activation". This means that the audible WALK message will only be activated and sound during the WALK interval if the button is depressed for a field selectable minimum period of time (from 0 to 6 seconds). Also, for the following walk phase, the volumes have a separately settable minimum and volume level.
E. The System shall have the field selectable function known as "Informational Message". This means that a custom message giving the location of the street to cross and the intersection (or other information) will be vocalized only when the button is depressed for a minimum field selectable time.
F. The System shall provide a "Wait" message that plays once the button is activated until the walk cycle goes into effect. This message must have the field selectable option of OFF or playing every 4, 6, 8 or 10 seconds.
G. The System shall have standard "Travel Direction" options that can be selected at the time of installation.
H. The System shall have at least five field selectable walk sound options including a cuckoo, a chirp, a rapid tick or custom voice message.
I. The System shall provide 3 Ped-clearance sound choices including audible countdown (field selectable). The audible countdown shall represent the time remaining during the pedestrian clearance interval. Timing is automatically adjusted to CLEARANCE INTERVAL timing.
J. The System shall provide two language capabilities, selectable by user (as a custom feature).
K. The System shall provide Emergency preemption message in conjunction with a preemption system (selectable feature).
L. LOCATE tone and "Walk", "Pedestrian Clearance" audible feature must have independent settable minimum and maximum volume limits.
M. All sounds for all PBS's must be synchronized.
N. The system shall have an ambient sensing microphone located in the pedestrian station in a non-visible, environmentally protected housing.
O. All sounds levels shall adjust automatically in response to ambient noise over a 60-dB range with additional control to have the sound level at ambient, 5dBA or 10dBA over ambient, to a maximum of 100 dBA.
P. The system shall have an independent ambient adjustment setting for the locate tone that allows the locate tone volume to be set to play below the ambient noise level.

Q. The system shall utilize high quality digital audio technology by using 12-bit samples at a 16k Hz sample rate audio amplifier and must have total harmonic distortion of less than 3%.
R. The firmware and voice messages shall be updatable via the USB port at the PBS. There shall be no requirement for the hardware to be changed out to update.
S. The System shall have the option to mute sounds on all crosswalks except activated crosswalk (selectable feature).
T. The System shall have no field replaceable fuses. All fuses shall be self-resetting.
U. The System shall have the ability to have two separate program configurations with all features available that can be turned on through an external input.
V. All field selectable options must be settable using an infrared remote or via Ethernet with password security.

14.2.7.3.4 Central Control Unit (CCU) The CCU is the power supply and control unit that provides power and data for the Push Button Stations.

A. Shall be installed inside the Traffic Cabinet and powered by the AC supply mains (115 VAC).
B. Shall control up to 16 PBS's in a maximum of 4 channels up to 4 PBS's per channel.
C. Shall control up to four Pedestrian channels, receiving its timing from the Walk and Don't Walk signals.
D. Shall be able to self test all PBS's and put a channel into recall should a PBS fail the self test.
E. Shall provide optically isolated general purpose inputs.
F. Shall be provided with a 4-cable interface harness assembly.
G. Shall be provided with an interface connection board.
H. Shall have Ethernet access to PBS's through the CCU to be able to change the settings of PBS as well as monitor the self test Events of the PBS's and report back to the Central Control Station.
I. Shall have internal memory to store a few hundred events with a date-time stamp for each event.
J. Shall have an internal real-time clock.
K. Firmware for the CCU shall be updated by USB port on the CCU.
L. The CCU shall have 2 built in conflict monitoring systems:
    1. Monitors the PBS and the ped-head lights and powers off the channel upon a conflict.
    2. Processors monitor each other and reset the CCU upon loss of internal communication.
M. Shall meet NEMA 250 – Type 1 enclosures requirements.

14.2.7.3.5 Pole Mounting Assembly (This equipment is typically mounted on a pole near the start of a crossing. It is commonly referred to as the "Pedestrian Push Button Station" or "PBS").

A. PBS shall be a single fixture that contains the vibro-tactile 2" ADA-compliant pedestrian push button with directional tactile arrow, a weatherproof speaker, and the appropriate sign for each location.

B. All audible sounds shall emanate from the PBS.
C. The external housing shall not have any polycarbonate or plastic parts.
D. PBS's must require only two wires coming from the traffic control cabinet for each phase / crosswalk.
E. Each PBS shall have a system unique ID.
F. SPEAKER: 8 Ohms, 12 Watt maximum, weather-proof.
G. PUSH BUTTON: ADA compliant with raised arrow on the button plunger. Cast Aluminum, Nickel plated and powder coated for color contrast. The arrow on the PBS shall be able to be changed to one of four directions.
H. PUSH BUTTON: Uses Piezo switch technology rated to greater than 20 million operations.
I. VIBRATOR POWER: Arrow button shall pulse at 20 Hz with a 0.003 inch displacement against an applied 2 lb force.
J. CONFLICT WALK MONITOR: Circuitry shall have a separate microcontroller that independently monitors the main microcontroller outputs and "Walk Mode" for conflict condition, the PBS is reset in case of a conflict detection.
K. The firmware and voice messages shall be updatable via the USB port at the PBS. There shall be no requirement for the hardware to be changed out to update.
L. VOLTAGE TRANSIENT PROTECTION: Meets applicable NEMA TS 2 requirements.
M. Meets or exceeds NEMA 250 type 4X enclosure requirements.
N. CONSTRUCTION:
    1. FRAME: Cast Aluminum, Powder Coated.
    2. MESSAGE SIGN: Aluminum, Powder Coated, Ink Markings.
    3. PUSH BUTTON: Aluminum, Powder Coated.
O. MESSAGE MARKING: At time of order, the customer may specify the Message Sign Markings to be the **International Walking Person** or the **Informational Explanations** for the three (3) distinct pedestrian displays (WALK, DON'T WALK, and PED CLEAR) that a pedestrian would see on an active pedestrian head.

14.2.7.3.6 Infrared Programming Device – (A hand held remote used for programming the APS system)

A. Shall use Infrared technology with an LCD display to program the PBS's as well as the CCU.
B. Shall be password protected.
C. Shall be capable of setting all volumes and features of the APS system specific to the PBS's.
D. Shall be capable of setting/updating a single PBS or all PBS's on the intersection for most functions from a single PBS (Global updating).
E. Shall have the ability to save 4 user defined and 3 factory pre-set program configurations.

14.2.7.4 Method of Measurement. Measurement of all pedestrian push buttons and equipment will be made for payment per each.

14.2.7.5 Basis of Payment. The accepted quantities of pedestrian push buttons and equipment will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.7.5.1.00	Pedestrian Push Button -- per each
Item COS-14.2.7.5.2	Pedestrian Central Control Unit (CCU) -- per each

*Where 00 represents pedestrian push button type.

14.2.8.1.1 Traffic Signal Heads. Each traffic signal face shall consist of a number of identical signal sections, rigidly fastened together in such a manner as to present a continuous pleasing appearance. The design of the signal shall be such that, with the aid of simple tools and the addition of certain standard parts, it shall be possible to make an assembly consisting of one, two, three, four or more signal sections as shown on the plans. All signal heads shall be weatherproof. Traffic signal housings, doors, and visors shall be black. All indications shall be 12 inches in diameter unless specified otherwise.

14.2.8.1.2 Housing, Door and Visor. All new signal sections shall be clean, smooth and free from imperfections. The connection between signal housings shall be weatherproof. Housings shall be rigidly fastened together by a three or four bolt assembly or other connectors approved by the Engineer. Doors that will exclude dust and moisture shall be used to ensure a weatherproof unit. Each door shall be attached to the housing by means of two stainless steel hinge pins. Two stainless steel wing screws are installed on the side of the door to provide for opening and closing the signal door without the use of any special tools. A tunnel visor shall be supplied with each signal section and each door shall have provisions for attachment of the tunnel visor. All visors shall be held in place by four stainless steel fastening screws or bolts and shall be capable of being removed without opening the signal head door. Internal bosses or inserts shall be provided in each housing for mounting a terminal block and for the attachment of backplates. The top and bottom exterior of the housing shall be flat to ensure perfect alignment of assembled sections. The housing of each section shall be one piece with sides, back, top and bottom integrally molded. The housing of each section shall be constructed of ultraviolet stabilized color-impregnated black polycarbonate resin. Scratches shall not expose uncolored material. The housing shall have a minimum thickness of 0.09 inch and shall be ribbed or plated to produce added strength. If signal housings are not ribbed, minimum 0.10 inch aluminum plates shall be furnished and installed inside and outside the section housing at all points of attachment of the mounting bracket. Complete signal faces shall provide positive locked positioning when used with serrated brackets, mast arm or span wire fittings. Mounting and servicing of signal head assemblies on signal supports shall be accomplished using ordinary tools.

14.2.8.1.3 Terminal Blocks. Each signal head shall be furnished with a six position terminal block for termination of field wiring. All terminal blocks shall be rigidly secured to the section housing**.**

14.2.8.1.4 Optical System. All signal indications in conventional signal heads shall be illuminated with LED modules. All 12-inch Circular LED Signal Indications shall meet the following specifications: IEC 1000-4-5, 3KV, 2 ohm source impedance, ANSI/IEEE C62, 41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave, NEMA TS-2 Sec. 2.1.6 and Sec. 2.1.8., enhanced Thermal management, and 15 year full performance warranty. All modules shall meet the ITE VTCSH-LED Circular Signal Supplement over the full temperature range of -40°C to +74°C, and shall meet or exceed ITE uniformity specifications with expanded view radiation pattern suitable for span wire and steep grade applications. Transient suppression shall exceed ITE and NEMA specifications (up to 6KV). The modules shall meet or exceed ITE moisture intrusion specifications and ITE failed state impedance specifications. Hard coated lenses shall be included with abrasion resistance.

All signal heads shall have a uniform non-pixilated illumination appearance.

14.2.8.1.5 Optically Limiting Signal Heads. The signal section shall be a self-contained assembly consisting of an optical unit, section housing, housing door, terminal block and necessary gaskets to ensure a weatherproof unit. The optically limiting signal head shall be capable of separate mounting or inclusion in a signal face containing two or more signal sections. If existing housings are to be combined with new housings, the new housings shall be adaptable to the existing. Each signal section shall be installed and directed and the optical limiter masked in accordance with manufacturer's recommendations to provide indications in accordance with the plans or as directed by the Engineer.

14.2.8.1.6 Backplates. Backplates shall be provided on signal heads as shown on the plans. Backplates shall be black in color and constructed of flat pre-cut or preformed thermoplastic. Flat pre-cut thermoplastic backplates shall have a minimum thickness of 0.250 inch. Preformed thermoplastic backplates shall have rolled out edges and a minimum final thickness of 0.10 inch. Stainless steel bolts, nuts and flat washers shall be used to fasten the backplate to the head.

14.2.8.2 Hardware. Hardware for mast arm mounting shall be Pelco Astro-Brac with cable mount kits or approved equal. Aluminum pipe brackets shall be a gusseted tube with a spun finish. Side mount brackets may be aluminum or molded, glass-impregnated polycarbonate no greater than 12 inches (300 mm) in length. Elbows, tees and crosses shall be straight threaded and furnished with a square head set screw at each connection point to ensure rigid mounting. Fittings attached to the signal housing shall incorporate serrations or, by the use of an adapter ring, shall be compatible with the serrations on the signal housing.

14.2.8.3 Countdown Pedestrian Signal Heads. All 16 inch × 18 inch Countdown Pedestrian Traffic Signal Modules shall fully and completely comply with all sections of ITE Pedestrian Traffic Control Signal Indications – LED Pedestrian Traffic Signal Modules Part 2 LED Pedestrian Traffic Signal Module specifications, current edition. All modules shall have a uniform non-pixilated illumination appearance. Modules shall be fully compliant with MUTCD 2009 Section 4E.07. The pedestrian signal housing shall be constructed of ultraviolet stabilized color-impregnated black polycarbonate resin. Scratches shall not expose uncolored material. LED color shall be Portland Orange for countdown and hand indications, Lunar White for the

person indication. They shall require no special wiring or electronic modules to operate. Heads shall only be mounted with upper and lower arms. Clam shell mounting will not be accepted.

14.2.8.4 Method of Measurement. Measurement of all signal heads will be made for payment per each.

14.2.8.5 Basis of Payment. The accepted quantities of signal heads will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.8.5.1.00	Signal Head -- per each
Item COS-14.2.8.5.2	16" Countdown Pedestrian Signal Head -- per each

*Where 00 represents the number of sections in the vehicular signal head. For example, a 3 Section Signal Head would be item COS-14.2.8.5.1.3.

14.2.9.1 Lighting. This work shall consist of furnishing and installing lighting equipment and material as shown on the plans. All work shall meet NEC, NESC and NEMA standards. See Section 14.2.6.7.1 for lighting controller requirements. Luminaire heads shall be furnished and installed by the Contractor, and shall be American Electric Lighting (AEL) Roadway Series 125-25-S-CA-MT2-R3-FG-M2-EC-SH with lamp, or equivalent by Cooper Lighting or G.E.

14.2.9.2 Method of Measurement. Measurement of all luminaires will be made for payment per each.

14.2.9.3 Basis of Payment. The accepted quantities of luminaires will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.
Payments will be made under:

Item COS-14.2.9.3.000	Luminaire -- per each

*Where 000 represents the wattage of the high pressure sodium luminaire.

14.2.10 Detectors.

14.2.10.1 Induction Loop Detectors. Induction loop vehicle detectors shall be Model 222. Model 222 loop detector units shall conform to requirements of Chapter 5, Sections 1 and 2 of CALTRANS “Transportation Electrical Equipment Specifications” (TEES) dated March 12, 2009 including all revisions and addenda thereto current at the time the project is advertised. Only detectors listed on the CALTRANS Qualified Products List will be accepted. All detector units shall have solid state outputs. In case of conflict, the City’s specifications shall govern.

14.2.10.2 Radar Presence Detectors. This item shall govern the specifications for an aboveground radar presence detector (RPD) system.

14.2.10.2.1 Sensor Outputs. The RPD shall present real-time presence data in 10 lanes. The RPD shall support a maximum of eight zones. The RPD shall support four channels and have user-selectable channel assignments. The RPD shall use OR logic to combine multiple zones to a channel output, and shall have channel output extend and delay functionality. The RPD algorithms shall mitigate detections from wrong way or cross traffic. The RPD system shall have fail-safe mode capabilities for contact closure outputs if communication is lost.

14.2.10.2.2 Detectable Area.

14.2.10.2.2.1 Detection Range. The RPD shall be able to detect and report presence in lanes with boundaries as close as 6 ft. (1.8 m) from the base of the pole on which the RPD is mounted. The RPD shall be able to detect and report presence in lanes located within the 140 ft. (30.5 m) arc from the base of the pole on which the RPD is mounted.

14.2.10.2.2.2 Field of View. The RPD shall be able to detect and report presence for vehicles within a 90 degree field of view.

14.2.10.2.2.3 Lane Configuration. The RPD shall be able to detect and report presence in up to 10 lanes. The RPD shall be able to detect and report presence in curved lanes and areas with islands and medians.

14.2.10.2.3 Cabinet Interface Device (CID).

14.2.10.2.3.1 Mounting. The CID shall be shelf-mounted. It shall be capable of being mounted on the side of the traffic cabinet with the aid of U-channel mounting brackets.

14.2.10.2.3.2 Power. The power supply voltage of the CID shall be 90 to 260 VAC. Its AC frequency shall be 50–60 Hz and the maximum power shall be 75 W at 80ºC. The CID's sensor connectors shall output 24 VDC.

14.2.10.2.3.3 Connections and Communication. The CID shall include the following connections for power and communication:

14.2.10.2.3.3.1 Power. The CID shall have an IEC AC input.

14.2.10.2.3.3.2 Terminal Block Connectors. The CID shall have four terminal block connectors for connecting to sensors. These connectors shall be for terminating cables that carry power and RS-485 communications to and from the sensors.

14.2.10.2.3.3.3 Data RJ-11 Connectors. The CID shall have four RJ-11 jacks for sending detection data from sensors to contact closure devices such as rack cards via jumper cables. This data shall be sent via RS-485. These jacks shall make up the physical interface of a dedicated data bus.

14.2.10.2.3.3.4 Control Connectors. The CID shall have four other communication ports. These ports shall make up the physical interface of a dedicated control bus and shall allow users to connect to the sensors and configure them.

- DB-9 port for communicating via RS-232
- Two RJ-11 jacks for communicating via RS-485
- USB mini-B connector
- T-bus port for connecting to a T-bus

14.2.10.2.3.3.5 Ethernet Connector. The CID shall have an RJ-45 10/100 Ethernet port to allow connection to a local network.

14.2.10.2.3.3.6 SDLC Port. The CID shall have an SDLC port for direct connection to a traffic controller.

14.2.10.2.3.4 Other features. The CID shall have the following other features:

14.2.10.2.3.4.1 LEDs. The CID shall have four multicolored LEDs with activity-indicating functions:

- An LED that indicates when the device has power
- An LED that indicates if the device has been disabled by surges
- An LED that indicates when data is being transmitted on the control bus
- An LED that indicates when data is being received on the control bus.

14.2.10.2.3.4.2 Data RJ-11 Jack Features. The four jacks that make up the physical interface of the data bus (and that each correspond to one sensor) shall have a switch for turning their corresponding sensor off and an LED that indicates when that sensor has power.

14.2.10.2.3.4.3 Power Switch. The CID shall have a switch for turning power off for the entire device.

14.2.10.2.3.4.4 OLED Panel with Keypad. The CID shall have a OLED panel on the device with a keypad for device configuration.

14.2.10.2.3.4.5 Web Interface. The CID shall have a web interface for device configuration, accessible through a web browser from a network-connected device.

14.2.10.2.3.4.6 Configuration. The CID configuration shall support up to 64 detector channels.

14.2.10.2.3.5 NEMA TS2-2003 Testing. The CID shall comply with the applicable standards stated in the NEMA TS2-2003 Standard. Test results shall be made available for each of the following tests:

- Shock pulses of 10g, 11 ms half sine wave
- Vibration of 0.5 Grms up to 30 Hz
- 300 V positive/negative pulses applied at one pulse per second at minimum and maximum DC supply voltage
- Cold temperature storage at -49°F (-45°C) for 24 hours
- High temperature storage at 185°F (85°C) for 24 hours
- Low temp, low DC supply voltage at -29.2°F (-34°C) and 10.8 VDC
- Low temp, high DC supply voltage at -29.2°F (-34°C) and 26.5 VDC
- High temp, high DC supply voltage at 165.2°F (74°C) and 26.5 VDC
- High temp, low DC supply voltage at 165.2°F (74°C) and 10.8 VDC

14.2.10.2.3.6 FCC Testing. The CID shall be FCC-compliant.

14.2.10.2.3.7 Testing. Before shipping, each CID shall have passed a manufacturer's test.

14.2.10.2.3.8 Extended Support. Extended support options shall be available. Contact the manufacturer's representative for more information.

14.2.10.2.3.9 Warranty. The CID shall be warranted to be free from material and workmanship defects for a period of one year from date of shipment.

14.2.10.2.3.10 Contact Closure Input File Cards. The controller module shall replace the need for contact closure input file cards.

14.2.10.2.4 Maintenance. The RPD shall not require cleaning or adjustment to maintain performance. The RPD shall not rely on battery backup to store configuration information, thus eliminating any need for battery replacement. Once the RPD is calibrated, it shall not require recalibration to maintain performance unless the roadway configuration changes.

14.2.10.2.5 Physical Properties. The RPD shall not exceed 4.2 lbs. (1.9 kg) in weight. The RPD shall not exceed 13.2 inches × 10.6 inches × 3.3 inches (33.5 cm × 26.9 cm × 8.4 cm) in its physical dimensions. All external parts of the RPD shall be ultraviolet-resistant, corrosion-resistant, and protected from fungus growth and moisture deterioration.

14.2.10.2.5.1 Enclosure.

- The RPD shall be enclosed in a Lexan EXL polycarbonate.

- The enclosure shall be classified "f1" outdoor weatherability in accordance with UL 746C.
- The RPD shall be classified as watertight according to the NEMA 250 Standard.
- The RPD enclosure shall conform to test criteria set forth in the NEMA 250 standard for type 4X enclosures. Test results shall be provided for each of the following type 4X criteria:
  - External Icing (NEMA 250 clause 5.6)
  - Hose-down (NEMA 250 clause 5.7)
  - 4X Corrosion Protection (NEMA 250 clause 5.10)
  - Gasket (NEMA 250 clause 5.14)
- The RPD shall be able to withstand a drop of up to 5 ft. (1.5 m) without compromising its functional and structural integrity.
- The RPD enclosure shall include a connector that meets the MIL-C-26482 specification. The MIL-C-26482 connector shall provide contacts for all data and power connections.

14.2.10.2.6 Power. The RPD shall consume less than 10 W. The RPD shall operate with a DC input between 9 VDC and 28 VDC.

14.2.10.2.7 Communication Ports. The RPD shall have two communication ports, and both ports shall communicate independently and simultaneously. Two independent communication ports allow one port to be used for configuration, verification and traffic monitoring without interrupting communications on the dedicated data port. The RPD shall support the upload of new firmware into the RPD's non-volatile memory over either communication port. The RPD shall support the user configuration of the following:

- Response delay
- Push port

The communication ports shall support a 9600 bps baud rate.

14.2.10.2.8 Radar Design. The RPD shall be designed with a matrix of radars. The matrix of radars enables the sensor to provide detection over a large area and to discriminate lanes.

14.2.10.2.8.1 Frequency Stability. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.

All transmit modulated signals shall be generated by means of digital circuitry, such as a direct digital synthesizer, that is referenced to a frequency source that is at least 50 parts per million (ppm) stable over the specified temperature range, and ages less than 6 ppm per year. Any upconversion of a digitally generated modulated signal shall preserve the phase stability and frequency stability inherent in the digitally generated signal.

This specification ensures that, during operation, the RPD strictly conforms to FCC requirements and that the radar signal quality is maintained for precise algorithmic quality. Analog and microwave components within an RPD have characteristics that change with temperature variations and age. If the output transmit signal is not referenced to a stable frequency source, then the RPD is likely to experience unacceptable frequency variations which may cause it to transmit out of its FCC allocated band and thus will be non-compliant with FCC regulations.

The RPD shall not rely on temperature compensation circuitry to maintain transmit frequency stability. Temperature-based compensation techniques have been shown to be insufficient to ensure transmit frequency stability. One reason this type of technique is not sufficient is that it does not compensate for frequency variations due to component aging.

The bandwidth of the transmit signal of the RPD shall not vary by more than 1% under all specified operating conditions and over the expected life of the RPD.

The bandwidth of an RPD directly affects the measured range of a vehicle. A change in bandwidth causes a direct error in the measured range, i.e., a 5% change in bandwidth would cause a range error of 10 feet (3 m) for a vehicle at 200 feet (61 m). If the bandwidth changes by more than 1% due to seasonal temperature variations and component aging, then the RPD will need to be frequently reconfigured to maintain the specified accuracy.

14.2.10.2.8.2 Antenna Design. The RPD antennas shall be designed on printed circuit boards.

The vertical beam width of the RPD at the 6dB points of the two-way pattern shall be 65 degrees or greater.

The antennas shall cover a 90 degree horizontal field of view.

- The sidelobes in the RPD two-way antenna pattern shall be -40dB or less.
- Low sidelobes ensure that the performance from the antenna beam widths is fully achieved.

14.2.10.2.8.3 Resolution. The RPD shall transmit a signal with a bandwidth of at least 245 MHz.

14.2.10.2.8.4 RF Channels. The RPD shall provide at least 8 RF channels so that multiple units can be mounted in the same vicinity without causing interference between them.

14.2.10.2.8.5 Verification. The RPD shall have a self-test that is used to verify correct hardware functionality. The RPD shall have a diagnostics mode to verify correct system functionality.

14.2.10.2.9 Configuration:

14.2.10.2.9.1 Auto-configuration. The RPD shall have a method for automatically defining traffic lanes, stop bars and zones without requiring user intervention. This auto-configuration process shall execute on a processor internal to the RPD and shall not require an external PC or other processor. The auto-configuration process shall work under normal intersection operation and may require several cycles to complete.

14.2.10.2.9.2 Manual Configuration. The auto-configuration method shall not prohibit the ability of the user to manually adjust the RPD configuration. The RPD shall support the configuring of lanes, stop bars and detection zones in 1 foot (0.3-m) increments.

14.2.10.2.9.3 Windows Mobile®-based Software. The RPD shall include graphical user interface software that displays all configured lanes and the current traffic pattern using a graphical traffic representation. The graphical interface shall operate on Windows Mobile, Windows XP and Windows Vista in the .NET framework.

The software shall support the following functionality:

- Operate over a TCP/IP connection
- Give the operator the ability to save/back up the RPD configuration to a file or load/restore the RPD configuration from a file
- Allow the backed-up sensor configurations to be viewed and edited
- Provide zone and channel actuation display
- Provide a virtual connection option so that the software can be used without connecting to an actual sensor
- Local or remote sensor firmware upgradability

14.2.10.2.10 Operating Conditions. The RPD shall maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and dusk. RPD operation shall continue in snow or in rain up to 1 inch (2.5 cm) per hour.

The RPD shall be capable of continuous operation over an ambient temperature range of -40°F to 165.2°F (-40°C to 74°C).

The RPD shall be capable of continuous operation over a relative humidity range of 5% to 95% (noncondensing).

14.2.10.2.11 Testing:

14.2.10.2.11.1 FCC. Each RPD shall be Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.249 as an intentional radiator. The FCC certification shall be displayed on an external label on each RPD according to the rules set forth by the FCC. The RPD shall comply with FCC regulations under all specified operating conditions and over the expected life of the RPD.

14.2.10.2.11.2 NEMA TS2-2003 Testing. The RPD shall comply with the applicable standards stated in the NEMA TS2-2003 Standard. Third party test results shall be made available for each of the following tests:

- Shock pulses of 10g, 10 ms half sine wave
- Vibration of 0.5 Grms up to 30 Hz
- 300 V positive/negative pulses applied at one pulse per second at minimum and maximum DC supply voltage

Cold temperature storage at -49°F (-45°C) for 24 hours

- High temperature storage at 185°F (85°C) for 24 hours
- Low temp, low DC supply voltage at -29.2°F (-34°C) and 10.8 VDC
- Low temp, high DC supply voltage at -29.2°F (-34°C) and 26.5 VDC
- High temp, high DC supply voltage at 165.2°F (74°C) and 26.5 VDC
- High temp, low DC supply voltage at 165.2°F (74°C) and 10.8 VDC

14.2.10.2.12 Manufacturing. The RPD shall be manufactured and assembled in the U.S.A. The internal electronics of the RPD shall utilize automation for surface mount assembly, and shall comply with the requirements set forth in IPC-A-610C Class 2, Acceptability of Electronic Assemblies.

The RPD shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Testing shall include the following:

- Functionality testing of all internal sub-assemblies
- Unit level burn-in testing of duration 48 hours or greater
- Final unit functionality testing prior to shipment

Test results and all associated data for the above testing shall be provided for each purchased RPD by serial number, upon request.

14.2.10.2.13 Support. The RPD manufacturer shall provide both training and technical support services.

14.2.10.2.13.1 Training. The manufacturer-provided training shall be sufficient to fully train installers and operators in the installation, configuration, and use of the RPD to ensure accurate RPD performance.

14.2.10.2.13.2 Technical Assistance. Manufacturer-provided technical support shall be available according to contractual agreements, and a technical representative shall be available to assist with the physical installation, alignment, and auto-configuration of each supplied RPD. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of RPDs should such services be required.

14.2.10.2.14 Documentation. RPD documentation shall include an instructional training guide and a comprehensive user guide as well as an installer quick-reference guide and a user quick-reference guide.
The RPD manufacturer shall supply the following documentation and test results at the time of the bid submittal:

- FCC CFR 47 certification (frequency compliance)
- IED 6100-4-5 class 4 test report (surge)

14.2.10.2.15 Warranty. The RPD shall be warranted free from material and workmanship defects for a period of two years from date of shipment.

14.2.10.3 Method of Measurement. Measurement of all radar presence detection systems will be made for payment per each complete intersection. No measurement will be made for induction loop detector units.

14.2.10.4 Basis of Payment. The accepted quantities of radar presence detection systems will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work. No direct payment will be made for induction loop detector units.

Payments will be made under:

Item COS-14.2.10.4.1 Radar Presence Detection System -- per each

14.2.11.1 Traffic Controller Assemblies. Traffic controller assemblies shall consist of a Type 2070 ATC controller unit, a wired cabinet and all auxiliary equipment required to control the system as specified in these specifications, and as shown on the plans and in the special provisions. Except as herein modified, Type 2070 ATC controller assemblies shall be in full compliance with the most current “Transportation Electrical Equipment Specifications (TEES)” and “Qualified Products List (QPL)” issued by the State of California, Business, Transportation & Housing Agency: Department of Transportation (Caltrans), and all revisions and addenda thereto current at the time the project is advertised. The Contractor shall provide a certification that the equipment proposed is included on the most current “Qualified Products List (QPL)” of

Caltrans. Exception: City specific equipment that is not defined in the Caltrans specification is exempt from this QPL requirement. In case of conflict, the City's specifications shall govern. Prior to shipping to the project site, each traffic controller assembly shall be delivered to the Traffic Signal Shop for testing. Minimum test period shall be 14 days.

14.2.11.2.1 Controller. Except as herein modified, the Microcomputer 2070 ATC controller with 1C module shall be in accordance with the Caltrans "Transportation Electrical Equipment Specifications (TEES)", dated March 12, 2009, and all applicable errata and addenda, which shall form a part of these specifications. Certification shall be provided that the equipment proposed is included on the most current "Qualified Products List (QPL)" of Caltrans. The Type 2070 ATC microcomputer controller shall be fully compatible with McCain Omni eX®software.

14.2.11.3.1 Type 2070 Controller Cabinets. Controller cabinets shall be the model shown on the plans. Controller cabinets, including the auxiliary door(s), shall be cast aluminum or 0.125 inch reinforced sheet aluminum alloy and be of clean-cut design and appearance. The cabinets to be furnished shall be in accordance with the most current "Transportation Electrical Equipment Specifications (TEES)" and "Qualified Products List (QPL)" issued by the State of California, Business, Transportation & Housing Agency: Department of Transportation (Caltrans), and all revisions and addenda thereto current at the time the project is advertised, except as modified in these specifications. In case of conflict, the City's specifications shall govern.

Bidders shall provide a certification that the equipment proposed is included on the most current "Qualified Products List (QPL)" of Caltrans. Exception: City specific equipment that is not defined in the Caltrans specification is exempt from this QPL requirement.

The additional requirements for the models 332L, 332D and 336L cabinet assemblies are as follows. All cabinets shall exhibit a "bare" aluminum finish. An auxiliary door equipped with a raintight gasket shall allow access to a police panel and shall be equipped with a lock whose key will not unlock the main door. Each cabinet door shall have a No. 2 Corbin cabinet lock and provisions for locking with a padlock. Two keys shall be furnished for each type of lock used. The doors shall be louvered to direct the incoming air upward. The cabinet shall be supplied with a replaceable furnace-type fiberglass filter mounted behind the louvers and shall cover the vent openings. A filter shell shall be provided to fit over the filter to provide mechanical support. The handles for each door shall swing outward. The 336L cabinet shall be provided with an M base adapter. All cabinets shall be supplied with anchor bolts.

Each 332L cabinet shall include 2 fluorescent lighting fixtures mounted inside the front and back portion of the cabinet. Model 332D cabinets shall have 4 fluorescent lighting fixtures. Model 336L cabinets will require only 1 fluorescent lighting fixture. These fixtures shall include a cool white lamp with protective cover and shall operate by a normal power UL listed ballast. The fixtures shall be installed to automatically power on when the cabinet door is opened and automatically power off when the cabinet door is closed. A manual on/off switch shall be provided for each fixture. Each switch should work each individual light.

14.2.11.4.1 Cabinet Components.

14.2.11.4.2 Pull Out Drawer. All cabinet types shall contain a pull out, hinged-top drawer, including sliding tracks, with lockout and a quick-disconnect feature, such as a Vent-Rak Retractable Writing Shelf, #D-4090-13, or equivalent. The pull-out drawer shall extend a minimum of 14 inches to facilitate removal of the processor by providing an aluminum platform covered with a formica-type, chemical-proof plastic sheet while the rear connector is being removed. The interior of the drawer shall be accessible by lifting the hinged platform. Minimum interior dimensions of the drawer shall be one inch high, 13 inches deep and 16 inches wide. The drawer shall be capable of supporting 40 pounds when fully extended and shall be mounted immediately below the controller assembly.

14.2.11.4.3 Service Panel Assembly. All cabinet assemblies shall be supplied with a service panel assembly Number 2L, (PDA#2L) with a solid-state relay. The service panel assembly shall not contain a mercury contactor. If the solid-state relay fails to open during either maintenance flash or a cabinet monitor unit fault condition, the cabinet must interrupt the 24 VDC control to the load switches. If an auxiliary output file is specified, C5 connections shall be included. The SPA shall contain a model 206L power supply (switching type) that is high efficiency and power factor corrected. A plug-able line voltage transient suppressor must be included to provide clean power.

14.2.11.4.4 Police Panel. Each controller cabinet shall be furnished with a clearly labeled switch that is mounted in the access or police panel to place the signals on flash. Operation of this switch shall not affect the electrical power supply to the controller. The switch shall be labeled FLASH/AUTOMATIC. This shall be the only control switch accessible from the police panel.

14.2.11.4.5 Termination. All output field conductors shall be terminated in the cabinet on a one-piece copper 600-volt heavy duty mechanical screw connector offset tang assembly. Each mechanical screw connector shall accommodate up to four No. 12 AWG conductors. Each clamp shall be captive to the contact screw and the screw captive to the contact. Field wiring shall not be spade lugged. The A.C. neutral bus and chassis ground bus shall be a 17-position solid copper neutral bar with set screws that allow the wires to be attached without tang or spade assemblies.

14.2.11.4.6 Output File. The output file shall be hand wired and printed circuit boards will not be allowed, except for red fail monitoring. The back of the load switch bay and the conflict monitor bay shall be enclosed to prevent wires interfering with plugging in of components. A 420-auxiliary output file is required for all 332L and 336L cabinets, unless otherwise specified.

14.2.11.4.7 Input Files. Both I and J input files shall be provided unless otherwise specified.

14.2.11.4.8 Cable Routing. All cables shall be located and secured such that the cables do not interfere with removal of the controller or the opening of the controller front panel.

14.2.11.4.9 Surge Protection. Each cabinet shall be provided with devices to protect the control equipment from surges and over voltages. This shall include incoming power lines, the input and output files and communication lines.

All input file inputs shall be protected with a 30V Metal-Oxide Varistor (MOV) with a 30 Joule rating, P/n ERZ-C20 DK 470 or equal. All load switch outputs shall be protected with a 150V MOV with an 80 Joule rating, P/n ERZ-C20 DK 241U or equal. Each MOV shall be connected from the A.C. positive field terminal to the chassis ground. Each output MOV shall be mounted on the field terminal side of the output assembly.

A. **14.2.11.5.1 332A Panel Termination.** The 332A panel termination shall have appropriate input surge protection and shall be mounted in the service panel assembly (SPA). The PDA#2L of each controller cabinet shall include a surge protection unit on the alternating current service input. The protector shall be installed between the applied line voltage and earth ground. The surge protector shall be capable of reducing the effect of lightning transient voltages applied to the A.C. line. The protection device shall be a two-stage series parallel device, and shall be an SHA 1250-TEES.

14.2.11.6 Cabinet Accessories. Each cabinet shall be equipped with the following, unless specified otherwise:

Model 222 Loop Detector Amplifiers. The loop detector amplifier units shall be as specified in the Caltrans Specifications. A quantity of 8 units shall be provided per cabinet.

Model 242 D.C. Isolator. The D.C. isolators shall be the Model 242 as specified in the Caltrans Specifications. A quantity of 3 units shall be provided per cabinet.

Model 200 Load Switch. The load switch shall be the Model 200 as specified in the Caltrans Specifications. A quantity of 16 units shall be provided per cabinet.

Model 204 Flasher. The flashers shall be the Model 204 as specified in the Caltrans Specifications. Each cabinet shall be supplied with 2 model 204 flashers.

Model 252 A.C. Isolator. The A.C. isolators shall be the Model 252 as specified in the Caltrans Specifications. The quantity of units shall be as described on the plans.

Model 430 Flash Transfer Relay. The flash transfer unit shall be the Model 430 as specified in the Caltrans Specifications. Each 336L cabinet shall be supplied with 4 model 430 flash transfer relays. Each 332L and 332D cabinet shall be supplied with 6 model 430 flash transfer relays.

14.2.11.7 Model 2010 Conflict Monitor. Each cabinet shall be supplied with a Model 2010 ECLip conflict monitor. The conflict monitor shall be external to the controller circuitry in accordance with the Caltrans specifications. The monitor shall cause immediate transfer to flashing operation when conflicting or absent indications occur or when a voltage fault occurs. When the conflict monitor actuates flashing operation, the controller shall freeze or stop timing in the condition causing the actuation until manually reset. A single indication (section) failure in any signal head shall not cause the monitor to actuate.

A connector and terminal assembly designated as P20 (Magnum P/N 722120 or equivalent), for monitoring the absence of red shall be an integral part of the output file. The connector shall

terminate and shall be compatible with the cable and connector of the conflict monitor unit. The pin assignments of the P20 connector and terminal assembly shall be provided with the cabinet plans. The P20 connector shall be designed such that the cable may only be inserted into the P20 connector in one direction. Unused red channels shall be programmed through jumpers. These jumpers shall cause 115V A.C. to be applied to any and all unused red monitoring channels. These jumpers and the respective attachment points shall be part of the output file.

14.2.11.8.1 Testing Requirements. All equipment shall be tested for conformance to these specifications. Testing may be done by an independent laboratory if the manufacturer does not have sufficient facilities to conduct the testing. A copy of the test results for all equipment shall be supplied by the manufacturer to the Engineer.

14.2.11.8.2 Conflict Monitor Test Cable. To facilitate testing of the conflict monitor, one additional 4-foot (1.2 m) connector cable shall be furnished by the manufacturer and installed in each cabinet. The cable shall utilize an 18 AWG (1.0 mm) wire to connect a 36-pin plug to the back panel terminals as specified below. The connector cable shall utilize a 36-circuit polarized nylon Waldon Molex type receptacle, P/N 03-06-1361, using a 0.062-inch (1.57 mm) female terminals made of 70/30 spring tempered 0.010 inch (0.254 mm) thick tin-plated brass with contact of resistance 0.0025 ohm millivolts, drop of 2.5 millivolts at one amp with 250 volts, 4 amps maximum per circuit. This connector cable shall "free float” in the bottom front 6 inches (150 mm) of the cabinet and shall not be used in the normal operation of the controller. A moisture-proof cap shall be provided to prevent the accumulation of moisture on the plug terminals. The cap shall remain attached to the connector when the cable is in use.

Receptacle Circuit	**Terminal Phase**	**Receptacle Circuit**	**Terminal Phase**
1	1 G	19	4 WALK
2	1 Y	20	8 WALK
3	2 G	21	1 AUX G[a]
4	2 Y	22	1 AUX Y[a]
5	3 G	23	3 AUX G[a]
6	3 Y	24	3 AUX Y[a]
7	4 G	25	5 AUX G[a]
8	4 Y	26	5 AUX Y[a]
9	5 G	27	6 AUX G[a]
10	5 Y	28	6 AUX Y[a]
11	6 G	29	I14-W STOP TIME
12	6 Y	30	DC GROUND
13	7 G	31	MONITOR RESET
14	7 Y	32	DC GROUND
15	8 G	33	2 AUX G[a]
16	8 Y	34	2 AUX Y[a]
17	2 WALK	35	4 AUX G[a]
18	6 WALK	36	4 AUX Y[a]

[a]Circuits used only in a 332A cabinet with an auxiliary output file

14.2.11.8.3.1 Controller Testing. Each Model 2070 ATC controller unit shall be tested over a temperature range of -29 to 165°F (-34 to 74°C). Proper operation of the unit shall be verified at both temperature extremes and at ambient temperature. Testing shall be conducted prior to final inspection, and will not constitute a substitute for any quality control testing or final inspection testing normally performed.

14.2.11.8.3.2 The environmental chamber(s) shall have provisions for remotely operating the Model 2070 ATC controller under test. Front panel displays shall be visible from a window in the environmental chamber. Signal outputs shall be brought out of the chamber to a display board if controllers cannot be directly observed. Cold and hot soak times shall be sufficient to allow all components in the device to reach the specified temperatures. A minimum soak time of three hours shall be used for all testing.

14.2.11.8.3.3 The manufacturer shall submit to the Engineer a proposed testing procedure and schedule 30 days prior to testing for evaluation. Test procedures, environmental chambers, automatic test equipment, display boards, power supplies and controls shall be described in detail.

14.2.11.8.3.4 The controller shall pass the following test at least five times at each temperature extreme and ambient:

A. Recovery from a short power interruption of approximately 500 milliseconds.
B. Recovery from a long power interruption of approximately 5 seconds.

14.2.11.8.3.5 The vendor shall provide a method of testing controller inputs and outputs. Diagnostic software and wraparound connector for controller harnesses may be used. If diagnostic software is not used, outputs shall be brought out to a display board. Inputs may be paralleled to each controller.

14.2.11.8.4 Cabinet Testing. Cabinets shall be tested at ambient conditions only. An automatic or semi-automatic method of checking cabinet wiring between equipment harnesses and field connections will be required.

14.2.11.8.5 The Engineer reserves the right to relieve any or all testing requirements if certain specifications are met.

14.2.11.9 Method of Measurement. Measurement of all controller equipment will be made for payment per each.

14.2.11.10 Basis of Payment. The accepted quantities of controller equipment will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.11.10.1.0000	Controller Cabinet -- per each
Item COS-14.2.11.10.2	Type 2070 Controller -- per each

*Where 0000 represents the cabinet type. For example 332D Controller Cabinet would be COS-14.2.11.10.1.332D.

14.2.12 Concrete for Bases. Concrete shall be Portland Cement Concrete in accordance with Chapter 6 of the General Conditions and Technical Specifications. Reinforcing steel for concrete bases shall be in accordance with AASHTO M 42 or AASHTO M 53. Anchor bolts for posts and mast arms and controllers shall be as shown on the manufacturer's approved shop drawings.

14.2.12.1 Method of Measurement. No measurement will be made for concrete for bases. Contract quantities will be used for final payment except for authorized changes during construction or where appreciable errors are found in the contract quantities. The revision or correction will be computed and added or deducted from the contract quantities.

14.2.12.2 Basis of Payment. The accepted quantities of concrete for bases will be paid for at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

Item COS-14.2.12.2	Concrete for Bases -- per cubic yard (plan quantity)

14.3 INSTALLATION

14.3.1.1 Pull Boxes. Pull boxes shall be installed at locations as shown on the plans. Pull box size and type shall be as shown on the plans. The top surface of all pull boxes shall be flush with surfaced areas and approximately one inch above earth or sodded areas. A stone drain consisting of ½ inch to ¾ inch clean limestone 18 inches deep shall be constructed under each pull box.

14.3.1.2 Conduit shall enter the pull box in the side of the box a minimum of 18 inches deep and at least 4 inches above the bottom of the box. Conduit shall extend into the box a minimum of 2 inches and a maximum of 4 inches. Where preformed pull boxes are used, the holes for the conduit shall be drilled as recommended by the manufacturer. The holes shall be round and no more than ½ inch larger than the conduit to prevent the entry of water, silt, mud, gravel, sand or other foreign material. If it becomes necessary to increase the excavation depth and extend the pull box, no direct payment will be made. The excavated opening outside the pull box shall be wide enough to allow compaction of the backfill material. Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling. The backfill material shall be placed in layers not to exceed 6 inches deep, and each layer shall be thoroughly compacted with a tamper before the next layer is placed. To avoid damage to the pull box, backfill shall not be compacted with a vehicle wheel or backhoe bucket.

14.3.1.3 Preformed Pull Boxes. Preformed pull boxes shall have a 12-inch wide concrete pad, 9 inches thick installed on all four sides of the pull box. Reinforcing steel shall be installed in the pad as shown on Standard *Drawing TS-2: Preformed Pull Boxes*.

14.3.1.4 Cast-In-Place Pull Boxes. Cast-in-place pull boxes shall be constructed of Class B concrete in a neat and workmanlike manner. Minimum wall thickness shall be 6 inches. Forms will be required for the inside surfaces of the pull box walls. If the excavation is irregular, forms will also be required for the outside surfaces of the walls. An outside form shall be installed across all trenches leading into the pull box excavation. Means shall be provided to hold forms rigidly in place, both inside and outside. The ends of all conduits through the walls shall fit tightly against the form. If directed by the Engineer, 5-inch × 5-inch × 4-inch styrofoam blocks may be installed in each wall of the pull box for future conduit access. Frames and covers shall be cast iron meeting the requirements of AASHTO M 105, Class 30. Dimensions shall be as shown on *Standard Drawing TS-3: Cast-in-Place Pull Boxes*.

14.3.1.5 If preformed pull boxes are specified, the Contractor may use standard concrete pull boxes in lieu of the preformed pull boxes, if approved by the Engineer.

14.3.2 Bases.

14.3.2.1 Concrete Bases. Excavation for bases shall be made in a neat and workmanlike manner. While concrete is being placed, forms shall be level and sufficiently rigid to prevent warping or deflection. Conduit and anchor bolts shall be held rigidly in place before and during concrete placement. Anchor bolts for the signal posts and the controller pedestals shall be set in place by means of a template constructed to space the anchor bolts in accordance with the pattern as shown on the manufacturer's approved shop drawings. Bottom of anchors shall be secured by wire or welded rebar. The center of the template and the center of the concrete base shall coincide, and all conduits shall exit the base as nearly as possible to the center of the base. Ends of conduit shall be capped before placing concrete. Anchor bolt size and anchor bolt projection shall be in accordance with manufacturer's recommended practices. Concrete shall be consolidated using an internal concrete vibrator. Reinforcing steel for concrete bases shall be in accordance with AASHTO M 42 or AASHTO M 53. A ¾ inch × 10 foot copper clad ground rod shall be driven beside each base, with a 1 inch PVC conduit provided in the base concrete to accommodate the grounding cable. An Engineer approved marker shall be set on the top of the base to identify the location of the grounding cable conduit. Grounding cable shall be bare 1c #6 solid copper attached to the ground rod with a ground rod clamp that is corrosion resistant, UL listed, and approved for direct burial in earth and concrete. During cold weather periods, concrete shall be placed only when the ambient air temperature is 35°F and rising. Concrete shall not be placed on frozen materials. The Contractor is responsible for any damage to the concrete due to weather conditions or other factors. Tops of all bases shall be finished level, or as directed by the Engineer, and the perimeter edged to a radius of ½ inch. Exposed surfaces of bases shall be given a rubbed finish as soon as practical after removing forms.

14.3.2.2 Post Bases. Concrete bases for posts shall be in accordance with the dimensions shown on the plans. The final 6 inches of base in or adjacent to a sidewalk shall be poured after the mast arm is erected or pedestal pole installed and the pole plumbed. Final top elevation shall match

sidewalk grade. If directed by the Engineer, the pole cap may be poured integral with the sidewalk. If the base is not adjacent to the sidewalk, the final top elevation shall be 4 inches above finished final grade of earth or sodded areas, or as directed by the Engineer. The top 12 inches of the base shall be formed square. Care shall be taken to ensure that proper signal head clearances over the roadway are maintained. Anchor bolts for steel posts and mast arms shall be as shown on the manufacturer's approved shop drawings. Leveling nuts and washers shall be provided for each anchor bolt. Size and number of conduits shall be as shown on the plans. Conduit shall extend above all post bases a nominal two inches. Install pre-formed expansion joint material between the pole foundation and any abutting concrete. See *Standard Drawings TS-13: Type A Signal Base* and *TS-14: Type D Signal Base*.

14.3.2.3 Controller Bases. Concrete bases for controllers shall be constructed as shown on the plans. Aprons will be considered part of the controller base. The size and number of anchor bolts for controller cabinets shall be as specified by the cabinet manufacturer. Size and number of conduits shall be as shown on the plans. Conduit shall extend above all controller bases no more than one inch. See *Standard Drawing TS-15: Controller Bases*.

14.3.3.1 Conduit System. The work shall consist of furnishing all labor, materials, equipment, and tools for excavation of trenches, pits and associated incidental elements relating to the construction of underground conduits and appurtenances and the backfilling of these excavations as shown on the plans, or as necessary to complete the project. Conduit shall be placed as shown on the plans. Unless otherwise specified, Schedule 40 PVC or Heavy Density Polyethylene (HDPE) conduit shall be used in underground applications. HDPE conduit shall be used as interconnect conduit. Conduits exposed to direct sunlight, such as conduit on power supplies, shall be Galvanized Rigid Steel conduit. Conduit shall be placed so that the top of the conduit is a minimum of 18 inches below finished grade and shall slope to drain. A change in direction of conduit shall be accomplished by bending the conduit uniformly to a radius that will fit the location, or by the use of standard bends or elbows. The minimum radius of the bend shall be six times the internal diameter of the conduit. All conduit and fittings shall be free from burrs and irregularities. All conduits shall be cleaned and swabbed before cables are installed. All fittings shall be tightly connected to the conduit. Open ends of conduit placed for future use shall be capped or plugged in a manner approved by the Engineer. If approved by the Engineer, conduit shown as trenched may be installed either by trenching or boring; however, payment will be made at the unit price specified in the contract for trenched conduit. Pull rope shall be installed in all conduits and shall be an incidental cost to the installation of the conduit.

14.3.3.2 Rigid Steel Conduit. All rigid steel conduit ends shall be provided with a threaded grounding bushing to protect the cable from abrasion. All metal conduits shall be electrically bonded by threaded grounding bushings and bare No. 6 AWG solid copper wire. All metal conduits in the controller base shall be electrically bonded to the power company ground. Nipples shall be used to eliminate cutting and threading where short lengths of conduit are required. If it becomes necessary to cut and thread steel conduit, exposed threads will not be permitted. Sharp kinks in the conduit or the substitution of non-metallic materials for rigid steel conduit will not be permitted. Bends in rigid steel conduit shall be made using pipe bending equipment designed for that purpose.

14.3.3.3 Trace Wire – PVC & HDPE Conduit. PVC or HDPE, either empty or containing only fiber optic cable, shall contain a No. 14 AWG THHN/THWN stranded copper tracer wire. The insulation for tracer wire shall be brown or blue. Tracer wire shall not be pulled into the controller cabinet or bases. An additional 3 feet of tracer wire shall be coiled in each pull box through which the fiber optic cable passes. Tracer wire in pull boxes shall be capped, not electrically bonded to any ground wires, and tagged "TRACER". No direct payment shall be made for tracer wire.

14.3.3.4 Polyvinyl Chloride Conduit. PVC conduit joints shall be cut square, reamed and chamfered, and shall be free of burrs and obstructions. Both joint surfaces shall be clean and free of moisture. Primer conforming to ASTM F-656 for PVC joints shall be applied to both joint surfaces. Joints shall be made while the cement is wet. Solvent cement conforming to ASTM D-2564 for PVC joints shall be applied to all joint surfaces. Bends in PVC conduit shall be made using factory fittings and elbows, or by the use of heating boxes, tubes, or blankets as approved by the Engineer.

14.3.3.5 High Density Polyethylene Conduit. HDPE is typically used for interconnect and in bored applications. It is preferable that HDPE conduit be continuous from pull box to pull box. The Engineer may allow splices in HDPE conduit using approved fittings and methods outlined in section 14.2.3.7, except that if a splice is allowed in bored conduit, it must be a fusion splice.

14.3.3.6 Conduit in Trench. Conduit runs shall be as straight as possible between points of termination, unless otherwise shown on the plans. Conduit shall be placed so that the top of the conduit is a minimum of 18 inches below finished grade or 24 inches below the lowest pavement level, if area is to be paved. Trenches shall be excavated to the width and depth necessary for conduit installation. Immediate cover for conduit under non-paved surfaces shall be 6 inches minimum of white sand. Immediate cover for conduit under paved surfaces shall be ½ inch clean rock fill. Backfill for the remainder of the trench shall use previously excavated earth, gravel, or sand containing no stone over 6 inches in its largest dimension. Cinders, broken concrete and other hard or objectionable material that might cause mechanical damage to the conduit shall not be used for backfilling. The bottom of the trench shall be free of such material before the conduit is placed. Backfill material shall be deposited in the trench in layers not exceeding 6 inches deep and each layer shall be compacted with a mechanical tamper to the approximate density of the adjacent material before the next layer is placed. All trenches shall be backfilled as soon as practical after the installation of conduit. Conduit shall not be placed without approval of the trench from the Engineer. Whenever excavation is made across parkways, driveways, or sodded areas, the sod, topsoil, crushed stone and gravel shall be replaced or restored as nearly as possible in its original position and the whole area involved shall be left in a neat and presentable condition. Seeding and Sodding shall be in accordance with Chapter 13 of the General Conditions and Technical Specifications. Trenching or excavation in sidewalk areas will require replacement of complete sidewalk slab sections. Concrete pavements and base courses and bituminous surfaces, including driveways, cut during trenching shall be repaired with new materials as required by the City’s specifications. See *Standard Drawing TS-16: Trench and Conduit Detail.*

14.3.3.7 Bored Conduit. If bored conduit is specified, the conduit shall be installed without

disturbing the existing surface. Methods for boring conduit must be approved by the Engineer. Pushing or jacking may only be used if approved by the Engineer. Minimum depth for bored conduit is 24 inches below lowest pavement level, including boring under driveways. Bored conduit shall extend at least two feet beyond the surface under which conduit is indicated to be bored in the plans. All work and incidentals included in the boring and placement of conduit in bored holes shall be considered completely covered by the respective bid items for bored conduit.

14.3.4 Reserved for Future. This section is reserved for future use.

14.3.5 Wiring.

14.3.5.1 Pulling. Cables shall be pulled through conduit by hand using a cable grip providing a firm hold on exterior coverings. Cable shall be pulled with minimal dragging on the ground or pavement. Frame-mounted pulleys or other suitable devices shall be used for pulling cables out of conduit into pull boxes. Only lubricants specifically designed for this purpose may be used to facilitate the pulling of cable. A pre-lubricated woven polyester pull tape with a minimum tensile strength of 1,250 pounds shall be used to pull cable through conduit. Polyester rope will not be permitted to facilitate pulling of cable. Slack in each cable, except fiber optic cable, shall be provided by a 4-foot loop coiled in each pull box, 3 feet in each signal base, and 6 feet in each controller cabinet. A cable-pulling machine may be used if approved by the Engineer. A pre-lubricated woven polyester pull tape with a minimum tensile strength of 1,250 pounds shall be left in each conduit run for future use.

14.3.5.2 Signal Cable. All cable runs shall be continuous and un-spliced from the connections made in the handhole compartment of the signal base to the terminal compartment in the controller cabinet. Conductor groupings and splicing may be made in the controller cabinet. These splices shall be insulated. All conductor cable combinations to the signal heads shall be as shown on the plans. No substitutions will be permitted. The termination of each cable in the signal bases shall be as follows:

5-CONDUCTOR TO VEHICLE AND PEDESTRIAN SIGNAL HEADS

	Three-Section Thru	**Pedestrian Head**
Black	Spare	Spare
White	Neutral	Neutral
Red	Red Ball	Don't Walk
Green	Green Ball	Walk
Orange	Amber Ball	Spare

7-CONDUCTOR TO VEHICLE SIGNAL HEADS*

	Protected Left	**Permissive Left**	**Prot./Perm. Left**
Black	Spare	Spare	Spare
White	Neutral	Neutral	Neutral
Red	Red Arrow	Red Arrow	Red Arrow

Green	Green Arrow	Spare	Green Arrow
Orange	Amber Arrow	Amber Arrow	Amber Arrow
Blue	Spare	Flashing Amber Arrow	Flashing Amber Arrow
White Black Trace	Spare	Spare	Spare

16-CONDUCTOR TO THE BASE OF THE POLE*

	With Protected Left Turns	With Permissive or Prot./Perm. Left Turns
Red	Thru Red	Thru Red
Orange	Thru Amber	Thru Amber
Green	Thru Green	Thru Green
White	Signal Neutral	Signal Neutral
Black Red Trace	Spare	Spare
Blue	4 & 8 Ped Don’t Walk	4 & 8 Ped Don't Walk
Black	4 & 8 Ped Walk	4 & 8 Ped Walk
Red Black Trace	Red Arrow	Red Arrow
Green Black Trace	Green Arrow	Green Arrow
Red White Trace	Spare	Spare
Green White Trace	Spare	Spare
White Black Trace	Ped Neutral	Ped Neutral
Orange Black Trace	Amber Arrow	Amber Arrow
Blue Black Trace	Spare	Flashing Amber Arrow
Black White Trace	2 & 6 Ped Walk	2 & 6 Ped Walk
Blue White Trace	2 & 6 Ped Don't Walk	2 & 6 Ped Don't Walk

* Conductors corresponding to phases or indications not present shall be considered spare.

Phasing shall be as specified in *Standard Drawing TS-17: Signal Phasing Layout* or as otherwise specified on the plans.

14.3.5.3 Power Cable. Power cable runs shall be continuous and unspliced from the power disconnect switch located on the power supply to controller cabinet terminals. Power cable shall be encased in conduit of the size shown on the plans. Energized power cables shall run to circuit breakers. The neutral cable shall be terminated on the neutral bus bar and the equipment ground conductor shall be terminated on the ground bus in the controller cabinet.

14.3.5.4 Pushbutton Detector Cable. Each pushbutton detector shall be connected to the controller by a separate two-conductor cable as shown on the plans.

14.3.5.5 Detector Lead-in Cable. Each detector loop shall be connected to the controller by a separate No. 14 AWG two-conductor shielded cable. These cables shall be continuous from the terminal compartment in the controller cabinet to a splice made with the detector leads in the first pull box or junction box adjacent to the detector. The splice shall be made using 3M DBY splice kits or approved equal.

14.3.5.6 Luminaire Cable. Where luminaires are required, pole and bracket cable shall be installed between the luminaire and the power cable at the base of the post. Each luminaire shall be connected to the power cable by No. 10 AWG conductors. A premolded fused connector assembly shall be installed on each conductor. A slug shall be installed in the connector on the neutral (white) conductor. The assembly and cable shall be insulated with a protective rubber boot designed for the premolded connector.

14.3.5.7 Identification. Each cable shall be properly labeled in the controller cabinet and all pull boxes by means of stamped non-conductive wraparound or sleeve type identification labels securely attached to all conductor cables. Information stamped on the labels shall identify equipment served by the conductor cable in accordance with designations used on the plans, such as:

POLE 1	Signal pole number 1
LUMINAIRE 1	Luminaire, signal pole number 1
PUSHBUTTON 42	Pedestrian pushbutton number 42
LOOP 22	Detector loop number 22
RADAR 1	Radar detector - signal pole number 1
CAMERA 1	Traffic monitoring camera number 1
EQUIP GRND 1	Equipment ground, signal pole number 1
TRACER	Tracer wire
COMM NATIONAL & GRAND	Interconnect to National & Grand

14.3.5.8.1 Fiber Optic Interconnect Cable. The Contractor shall provide trained and experienced personnel to supervise the installation of the fiber optic cable. Methods of fiber optic installation and all types of work with fiber optic cable shall be approved by the Engineer before implementation by the Contractor. The cable shall be installed in continuous runs in conduit and pull boxes between traffic signal controller cabinets or splice cabinets. No splices outside of the cabinets will be allowed. An additional 60 feet of cable shall be pulled into each cabinet for splicing. Slack cable in pull boxes shall be as directed by the Engineer. Without exception, fiber optic cables shall not be disconnected or cut without the express approval of the Engineer and Signal Shop personnel being on site.

14.3.5.8.2 Conduit. The conduit containing only fiber optic interconnect cable shall be polyvinyl chloride or high density polyethylene conduit in accordance with Section 14.2.3 and shall be orange in color. A No. 14 AWG stranded copper tracer wire shall be installed in the conduit.

14.3.5.8.3 Each end of the interconnect cable shall be sealed with a manufacturer-approved end cap or pulling grip for use during installation. Caps or grips may be removed only after complete installation of cable and for cable acceptance testing. End caps shall be installed to remain in place where fibers are not to be terminated.

14.3.5.8.4 The minimum bend radius and maximum pulling force of the interconnect cable shall not be exceeded during installation. The pulling of cable shall be hand-assisted at each pull box and cabinet. The cable shall not be kinked, crushed, or forced around a sharp corner. Pulling equipment may be used; however, all pulling equipment and hardware must maintain the cable’s

minimum bend radius. Such equipment that may contact the cable includes sheaves, capstans, bending shoes, and quadrant blocks designed for use with fiber optics. Where pulling equipment such as a winch is used, cable tension must be continuously monitored. This may include the use of a winch with a calibrated maximum tension or a dynamometer or in-line tensiometer. All pulling equipment must be approved by the Engineer.

14.3.5.8.5 Lubricants. If a lubricant is used, it shall be water-based as approved by the cable manufacturer and shall be compatible with the pre-lubricated conduit. If used, lubricant type and manufacturer shall be supplied to the Engineer for approval.

14.3.5.8.6 Installation of the fiber optic cable shall also be in accordance with the manufacturer's specifications and recommended practices. Should the manufacturer's specifications and/or recommended practices appear to conflict with any part of this specification, the matter shall be brought to the attention of the Engineer for resolution.

14.3.5.8.7 Identification. At each pull box and controller cabinet, the fiber optic cable shall be visibly marked "Caution - Fiber Optic Cable" by self-adhesive, weatherproof tags. This requirement is in addition to Section 14.3.5.7.

14.3.5.8.8 Testing. After the fiber optic cable installation, each fiber in each section shall be tested for attenuation and continuity, as a minimum. The City shall provide all personnel, equipment, instrumentation and supplies necessary to perform all testing unless otherwise specified in the contract documents. Any sections that fail the testing shall be replaced at the Contractor's expense, and retested.

14.3.6. Detectors.

14.3.6.1 Detector Type. Detection type shall be as shown on the plans.

14.3.6.2 Induction Loop Detectors. The location of traffic signal detector loops is critical; therefore, final location of detector loops shall be approved by the Engineer. The Contractor shall give the Engineer 2 business days notice before loop installation. Slots shall not be sawed until seven days after placement of Portland cement concrete. Sawed slots shall be made by wet cutting using a power concrete saw. Placement of loop slots across cracks and joints shall be avoided, unless an exception is approved by the Engineer. If the slot crosses an expansion joint, depth must be increased slightly to provide a little play in the cable for expansion. Before cable is placed in the slot, all debris and moisture must be removed. The cable is then placed in the slot and pushed into proper position by use of a blunt nonmetallic object. Care shall be taken to ensure that the loop cable does not float up in the slot. The loop slot shall be 1½ inches deep in concrete pavements, 3½ inches deep in asphalt pavements, and a maximum of ⅜ inch in width. Conduit shall be installed between the sawed loop slot and the first pull box. The conduit opening at the end of the lead-in slot shall be at the bottom of the sawed slot. After the loop cable is installed, and before the slot is sealed, the resistance of the loop to ground shall be checked. The resistance test shall be performed by the Contractor in the presence of the Engineer, or assigned personnel, and documented. After a satisfactory test, showing a resistance no less than 10 megaohms, the slot shall be sealed. The conduit opening at the end of the lead-in slot, and any

drilled conduit holes in the pavement, shall be sealed with a pliable duct sealant prior to the application of loop sealant. All sawed slots shall then be sealed with an approved detector loop sealant. Loop sealant shall be installed according to manufacturer's specifications and recommendations. Excessive overfill will not be permitted. All detector cable between the loop and lead-in cable shall be twisted at least three turns per foot. Unless otherwise specified by the Engineer, the slot shall be sawed such that the wire does not turn an angle greater than 45 degrees at the corners.

14.3.6.3 Radar Detection Systems. This item shall govern the installation of an aboveground radar presence detector (RPD) and cabling. The requirements in this specification are intended to ensure proper RPD installation. This work shall include the installation of one ¾ inch × 10 feet ground rod in the pull box nearest each detector. All other work for the radar detection system will be performed by City forces.

14.3.6.3.1 Mounting Assembly.

- The RPD shall be mounted directly onto a mounting assembly fastened to a mast arm, pole or other solid structure.
- The RPD mounting assembly shall provide the necessary degrees of rotation to ensure proper installation.
- The RPD mounting assembly shall be constructed of weather-resistant materials and shall be able to
- Support a 20-lb. (9.1 kg) load.

14.3.6.3.2 Mounting Location. The RPD shall be mounted at a height that is within the manufacturer's recommended mounting heights.

- The RPD shall be mounted at an offset from the first lane that is consistent with the RPD's minimum offset.
- The RPD shall be mounted so that at least 20 feet along the farthest lane to be monitored is within the field view of the RPD.
- The RPD shall be mounted with its cable connector down and shall be tilted so that the RPD is aimed at the center of the lanes to be monitored. Typically, the RPD is tilted off of vertical by 20-30 degrees.
- The RPD shall be mounted on a vertical signal pole or on the horizontal mast arm.
- The RPD shall be mounted so that its field of view is not occluded by poles, signs or other structures.
- RPDs that are mounted within 20 feet (6.1 m) of each other or that are monitoring the same intersection shall be configured to operate on different RF channels regardless of the pointing direction of the RPDs.

It is recommended that the manufacturer be consulted to verify final RPD placement if the RPD is to be mounted near large planar surfaces (sound barrier, building, parked vehicles, etc.) that run parallel to the monitored roadway.

14.3.6.3.3 Cabling. The cable end connector shall meet the MIL-C-26482 specification and shall be designed to interface with the appropriate MIL-C-26482 connector. The connector backshell shall be an environmentally sealed shell that offers excellent immersion capability. All conductors that interface with the connector shall be encased in a single jacket, and the outer diameter of this jacket shall be within the backshell's cable O.D. range to ensure proper sealing. The backshell shall have a strain relief with enough strength to support the cable slack under extreme weather conditions. Recommended connectors are Cannon's KPT series, and recommended backshells are Glenair Series 37 cable sealing backshells.

The cable shall be the Orion Wire Combo-2204-2002-PVCGY or an equivalent cable that conforms to the following specifications:

- The RS-485 conductors shall be a twisted pair.
- The RS-485 conductors shall have nominal capacitance conductor to conductor of less than 71pF/Ft at 1 Khz.
- The RS-485 conductors shall have nominal conductor DC resistance of less than 16.5 ohms/(304.8 m) at 68°F (20°C).
- The power conductors shall be one twisted pair with nominal conductor DC resistance of less than 11.5 ohms/(304.8 m) at 68°F (20°C).
- Each wire bundle or the entire cable shall be shielded with an aluminum/mylar shield with a drain wire.
- The cable shall be terminated only on the two farthest ends of the cable.
- The cable length shall not exceed 2000 ft (609.6 m) for the operational baud rate of RS-485 communications (9.6 Kbps).

If 12 VDC is being supplied for the RPD then the cable length shall not exceed 110 ft. (33.5 m).

If 24 VDC is being supplied for the RPD then the cable length shall not exceed 600 ft. (182.9 m).

Both communication and power conductors can be bundled together in the same cable as long as the above-mentioned conditions are met.

This work shall consist of furnishing, installing and placing into operation a vehicle detection system that detects vehicles by emitting a series of radar beams that create a radar zone, a two-dimensional image of an approach that can track vehicles, distinguish lanes, and accurately detect presence at the stop bar and providing detection outputs to a traffic signal controller. The system shall include all equipment shown on the plans and described in the bid specifications,

and shall include any incidental items necessary for the satisfactory operation and maintenance of the system. The radar detection system shall be installed per the manufacturer's recommendations. If requested by the Engineer, a factory certified representative from the supplier shall be available for on-site assistance for a minimum of one day during installation.

14.3.6.5 Pedestrian Pushbuttons. Pushbuttons and housings will be installed by City.

15 LANDSCAPING

15.1 TREE PRESERVATION PLAN [reference to APWA Tree Protection & Preservation] Plan shall meet the approval of the Engineer.

15.2 PLANTING

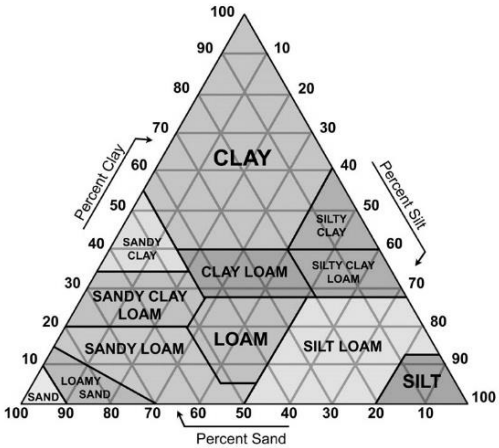
15.2.1 Scope of Work. The work shall consist of furnishing all labor, equipment, and materials necessary for the preparation, fertilization, seeding and planting of the areas specified in the contract.

15.2.2 Materials.

15.2.2.1 Topsoil. Topsoil furnished by the Contractor shall consist of a natural friable surface soil without admixtures of undesirable subsoil, refuse, or foreign materials. It shall be reasonably free from roots, clay, and coarse gravel stones larger than one inch in any dimension, noxious weeds, tall grass, brush, sticks, stubble or other material which would be detrimental to the proper development of vegetative growth. Topsoil shall be obtained from naturally well drained sites where topsoil occurs, at least 4- inches deep. Topsoil shall not be obtained from bogs or marshes. The organic content and particle size distributions shall be the result of natural soil formation. Manufactured soils where sand, composted organic material or other additives have been added to the soil to meet the requirements of imported topsoils shall not be accepted. Processing through a two inch screen is permissable to remove large stones and other debris.

Topsoil shall conform to the following criteria:

Soil Texture: USDA loam, sandy loam, sandy clay loam, clay loam or silt loam. Silt loam must have less than 30% clay, less than 60% silt and greater than 40% sand to be accepted.



Organic Matter: Topsoil shall contain not less than 5%, or more than 20% organic matter, by weight as determined by loss-on-ignition of oven-dried samples in accordance with ASTM D-2974.

PH Range: 5.5-7.5

Cation Exchange Capacity: 10-25 meq/100g

Soluble Salt Level: Less than 3 mmho/cm

15.2.2.1.1 Topsoil Testing and Acceptance. The Engineer shall be notified on the location from which the Contractor proposes to furnish topsoil at least 30 calendar days prior to delivery of topsoil to the Project from that location. The topsoil and its source will be visually inspected by the Engineer for acceptance. If visual inspection does not indicate acceptable material, additional testing results will be required to be supplied to the Engineer at the contractor's expense for acceptance

The Contractor will be required to perform a soil analysis to be taken at locations provided by the Engineer no less than 21 calendar days prior to placement of all permanent cover applications. For sites where topsoil is being imported, soil analysis shall be conducted at the time of topsoil placement or from an onsite stockpile. For sites where existing soil is being used, a soil analysis is required on all representative soil types. The Engineer will determine the sample locations.

For existing soil, collect one (1) soil sample for each distinguishable representative soil type. One (1) sample consists of mixing a minimum of three (3) sub-samples taken uniformly over each distinguishable representative soil type. Imported soil samples should be taken from stockpiles where the material will be the top six (6) inches of the seedbed. Take each sub-sample within the top four (4) to six (6) inches of the soil surface.

The soil analysis shall be run through the University of Missouri Extension Office or other laboratory pre-approved by the Engineer to determine that it meets the specifications and to determine rate of soil amendments as required for the proposed seed mixture. At a minimum, a standard soil analysis includes soil texture class, percent sand silt and clay, organic matter, pH, buffer pH, extractable phosphorus, potassium, magnesium, manganese, iron, zinc, calcium, Cation Exchange Capacity (CEC) and Soluble Salt levels. The standard soil test shall also include recommendations for soil amendments for pH adjustments and soil nutrient needs such as lime requirements and fertilizer.

When allowed by the Engineer, soil amendments such as but not limited to, fertilizer, lime, compost or other additives, shall be applied at the recommended rate required or recommended by the soil analysis. Certifications for soil amendments including invoices for quantities specifically purchased for an individual project shall be provided to the Engineer before incorporation into the soil. Soil amendments shall come from a supplier as approved by the Engineer.

15.2.2.2 Plants: Provide plants typical of their species or variety; with normal, densely developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, and frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestations. All plants shall have a fully developed form without voids and/or open spaces. All plants shall conform to the most current edition of the ANSI Z60.1, American Standard for Nursery Stock. All plants are subject to two acceptance inspections. One for the material and one for installation.

15.2.2.3 Balled and Burlapped. Balled and burlapped plants shall have firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the ANSI Z60.1, "American Standard for Nursery Stock." Broken, cracked, or crushed balls are not acceptable. The measurements for height shall be taken from the ground level to the average

height of the top of the plant and not the longest branch. Side branches shall be generous and well twigged. Shrubs shall be well densely foliaged to the ground.

15.2.2.4 Container-grown stock. Container-grown stock shall be grown in a container for sufficient length of time for the root system to have developed to hold the soil together, firm and whole. When using container-grown stock, the following must comply; no plants shall be loose in the container, and container stock shall not be root bound.

Plants larger than those specified in the plant list may be used when acceptable to the City's representative (at no additional expense). If the use of larger plants is accepted, all pertinent specifications herein shall apply to the larger size of the plant.

Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other branch injuries.

15.2.2.5 Mulch. Mulch must be free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following types: shredded hardwood shall be oak, cypress or cedar. The City's bulk wood mulch or MoMulch are acceptable and both are available at the City's Yard waste Recycling Center at the contractor's expense. The size shall be within the following rages, for length a 2 inch min, and 4 inch max. The width shall be between ½ inch min and 1 inch max. The mulch shall be of a natural color.

15.2.2.6 Water. Water needs to be provided by water hoses or other methods of transportation furnished by Contractor.

15.2.2.7 Herbicide. Herbicide needs to be Snapshot or Treflan pre-emergent and Roundup post-emergent as per label after mulch installation.

15.2.3 Methods of Construction. Time of planting: Do not plant trees, shrubs, and perennials/ground cover when ground is frozen. Spring tree plantings shall be concluded by April 30th and fall tree plantings shall start no sooner than November 1st. Shrub and perennial/ground cover plantings shall be completed any month of the year excluding January, February, July or August . Prepare the planting pits in accordance with the latest edition of Missouri Department of Conservation "How to Plant a Tree" publication. Planting shall be performed only by an experienced workman familiar with planting procedures under the supervision of a qualified supervisor and no planting of trees, shrubs, or ground cover when the ground is frozen. The Contractor shall stake all beds and tree locations for approval by the City's representative three (3) days prior to planting. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until alternate plant locations have been selected and approved by the City's representative.

Install plants in accordance with; the latest edition of Missouri Department of Conservation "How to Plant a Tree" publication. For proper installation, set plant materials in planting pit to proper grade and alignment. Also set plants upright, plumb, and faced to same direction as grown in nursery (as indicated by plant marking on base of trunk). Do not fill around plants that have settled. When trees require backfilling, do not use frozen or muddy mixtures. When

installing be sure to remove all containers, burlap, ropes, wires and other transport materials from around plant. Once backfill has occurred, where necessary, install mulch around trees and apply pre-emergent herbicide as per label after final installation of mulch.

The following provisions need to also be met. Stake and guy all trees as per plan details after planting as directed by the City. Prune plants only to remove dead or damaged branches in accordance with the latest edition of Missouri Department of Conservation "Basic Pruning Guidelines" publication. Check soil moisture not less than once per week until accepted. Water trees five (5) gallons per trunk caliper inch per week unless rainfall or irrigation has been sufficient. If irrigation system is present, notify city to request verification of possible needed adjustments. City is to make all such adjustments. Guard against soil saturation.

15.2.4 Method of Measurement.

15.2.4.1 Landscaping Topsoil. No measurement will be made for landscaping topsoil unless there are appreciable errors in the contract quantity or authorized changes are made. Appreciable errors will only be considered when Contractor's field measurements are provided to, and verified by, the Engineer prior to placement of any landscaping topsoil and results in errors of 10% or more of the original plan quantity. Measurements of landscaping topsoil will be made for payment to the nearest cubic foot.

15.2.4.2 Plants. Measurement of plants will be made for payment per plant.

15.2.4.3 Mulch. Measurement of mulch will be made for payment per cubic yard placed.

15.2.5 Basis of Payment. The accepted quantities of landscaping topsoil will be paid for at the unit price bid for the items stated in the contract. The accepted quantities of plants and mulch will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work including but not limited to: soil testing, planting, liming, fertilizing, and maintenance of the plants until the job is accepted by the Engineer.

If a contractor working on a public contract is being assessed Liquidated Damages and the project is complete except for planting, but the date is outside of the required planting period, then the Liquidated Damages will cease until the beginning of the next planting period at which time, the Contractor will be required to have confirmed installation within 30 days. If confirmed installation is not complete over the entire project area within 30 days after the start of the next planting season, Liquidated Damages will be assessed until such installation is confirmed.

Payments will be made under:

Item COS-15.2.5.1	Landscaping Topsoil – per cubic foot (plan quantity)
Item COS-15.2.5.2	Plants – per each
Item COS-15.2.5.3	Mulch – per cubic yard

16 TEMPORARY EROSION AND SEDIMENT CONTROL

16.1 GENERAL

16.1.1 Applicability. This Chapter applies to work being performed under contract to the City of Springfield (City). Public improvements on private developments shall comply with City Code Chapter 96 Article III Land Disturbance Activity.

16.1.2 Scope of Work. The work shall consist of furnishing all materials, equipment, and labor necessary to adhere to, install, and maintain best management practices (BMPs) as specified in the SWPPP or project plans or as directed by the Engineer or Inspector, and to complete and adhere to the requirements and conditions described herein. The Contractor is required to follow and abide by all applicable local, state, and federal rules and regulations.

16.1.3 Purpose. The purpose of erosion and sediment control is to protect water quality by minimizing the amount of sediment and other pollutants leaving the construction site as required by federal, state, and local regulations.

16. 2 DEFINITIONS.

16.2.1 Best Management Practices (BMPs). BMPs are structural or non-structural practices that prevent or minimize erosion and the discharge of sediment and other pollutants from the construction site. Examples of structural BMPs include silt fence and erosion control blanket. Examples of non-structural BMPs include sequencing (also referred to as scheduling or phasing) to reduce the amount and duration of soil exposure, and sweeping of streets.

16.2.2 Designated Responsible Person (DRP). The DRP is the person designated by the Contractor to be responsible for day-to-day operation and maintenance of BMPs. The DRP shall have a thorough and demonstrable knowledge of the SWPPP and erosion and sediment control practices in general.

16.2.3 Stormwater Pollution Prevention Plan (SWPPP). A SWPPP is a site-specific written document, including a site plan and narrative, identifying and describing the BMPs for the site. The SWPPP format and required components shall follow the City's SWPPP template.

16.3 MATERIALS.

16.3.1 BMP Materials. BMP selection, design, installation, and maintenance shall adhere to approved plans, or as approved by the Engineer.

16.4 PROJECTS DISTURBING 1 ACRE OR GREATER.

16.4.1 Land Disturbance Permit and SWPPP A City land disturbance permit is required for projects disturbing 1 acre or greater. The required SWPPP will be provided by the City. No disturbance of site vegetation or earth shall occur, except as necessary for installation of BMPs, until a land disturbance permit has been issued.

16.4.2 SWPPP Compliance. The Contractor shall be responsible for complying with the SWPPP provided and approved by the City for the project. The Contractor shall be responsible for providing information requested by the Engineer or Inspector for inclusion in the SWPPP, including but not limited to the following:

16. 4.2.1 Designated Responsible Person. The Contractor shall designate a DRP in the SWPPP.

16.4.2.2 Project Sequencing. The Contractor shall work with the Engineer and Inspector to establish and describe a sequencing plan as required in the SWPPP to minimize the extent and duration of soil exposure and minimize the discharge of sediment and other pollutants from the site.

16.4.2.3 Disposal of Material Off-Site. The Contractor shall specify the location of off-site fill areas. If the off-site fill areas do not meet the conditions for permit coverage under the land disturbance permit for the project, the Contractor shall provide documentation that off-site fill areas are covered by another land disturbance permit or are less than 1 acre.

16.4.3 Pre-Construction Requirements. The Contractor shall complete and adhere to the following requirements prior to disturbing any site vegetation or earth.

16.4.3.1 Pre-Permit Meeting. The Contractor is required to schedule and participate in a pre-permit meeting with the Water Quality Division of the Department of Environmental Services in order to review and discuss the SWPPP and associated requirements.

16.4.3.2 Initial BMP Inspection. The Contractor shall schedule an initial BMP inspection with the Stormwater Quality Division of the Department of Environmental Services prior to disturbance of any site vegetation or earth, except as needed to install BMPs. The requirements of the initial BMP inspection are as follows.

16.4.3.2.1 Installation of BMPs. The Contractor shall install the BMPs as shown and described in the SWPPP for the first phase of construction as described in the SWPPP sequencing plan.

16.4.3.2.2 Public Notification Sign. The Contractor shall post a public notification sign provided by the City, which displays the land disturbance permit number and contact information, at a location visible to the public.

164.3.2.3 SWPPP Storage. The Contractor shall provide a secure location protected from the weather for storing the SWPPP onsite.

16.4.32.4 Issuance of Land Disturbance Permit. Upon satisfactory completion of a pre-permit meeting and initial BMP inspection, the City will issue a land disturbance permit for the project.

16.4.4 Requirements and Conditions During Construction. The Contractor shall complete and adhere to the following requirements during construction.

16.4.4.1 SWPPP Storage. The Contractor shall ensure that the current copy of the SWPPP is stored in the designated location on-site.

16.4.4.2 Notification to Subcontractors. The Contractor shall notify each subcontractor performing work at the site, including utility crews, of the existence of the SWPPP and what actions or precautions shall be taken while on-site to minimize the potential for erosion, damaging of BMPs, and discharge of sediment or other pollutants from the site. The Contractor shall identify in the SWPPP each subcontractor engaged in activities at the site that could impact stormwater, and each subcontractor shall sign a Subcontractor Certification which shall be attached to the SWPPP.

16.4.4.3 BMP Implementation and Maintenance. The Contractor shall be responsible for implementing and adhering to non-structural BMPs described in the SWPPP throughout construction. The Contractor shall be responsible for ensuring that structural BMPs are installed and maintained as described in the SWPPP throughout construction. Maintenance includes but is not limited to removal of sediment as needed for BMP effectiveness, and replacement of BMPs whose functionality has become compromised with equal BMPs.

16.4.4.4 Sequencing and Stabilization. The Contractor shall be responsible for implementing and adhering to the sequencing plan described in the SWPPP and for temporary and permanent stabilization of disturbed areas. Seeding and sodding shall adhere to Chapter 13 of the General Conditions and Technical Specifications.

16.4.4.4.1 Temporary Stabilization. Temporary stabilization consisting of vegetation or other BMPs including but not limited to check dams, silt fences, or mulch, is required where soil disturbing activities will cease on any portion of the site and are not planned to resume for a period exceeding 14 calendar days. Temporary stabilization must be initiated immediately upon knowing the duration is more than 14 days, and must be completed within 7 calendar days. If the slope of the area is greater than 3:1 (3 feet horizontal to one foot vertical) or if the slope is greater than 3% and greater than 150 feet in length, then the Contractor shall establish temporary stabilization within 7 days of ceasing operations on that part of the site. Allowances to the 7 day completion period may be made due to weather and equipment malfunctions. The use of allowances shall be documented in the SWPPP. The requirement to immediately initiate stabilization is further defined in the SWPPP. The Contractor shall be responsible for maintaining and re-establishing temporary stabilization as needed.

16.4.4.4.2 Final Stabilization. Final stabilization of disturbed areas must be initiated immediately and completed with 7 calendar days whenever any clearing, grading, excavating or

other earth disturbing activities have permanently ceased on any portion of the site. Allowances to the 7 day completion period may be made due to weather and equipment malfunctions. The use of allowances shall be documented in the SWPPP. The requirement to immediately initiate stabilization is further defined in the SWPPP.

16.4.4.5 Pavement Cleaning. The Contractor shall clean paved surfaces, including but not limited to streets and sidewalks, as needed or as directed by the Engineer or Inspector to minimize dust and the discharge of sediment and other pollutants from the site and to clean up sediment tracked or discharged from the site.

16.4.4.6 Non-Sediment Pollution Control. The Contractor shall follow good housekeeping and pollution prevention measures as described in the SWPPP, including but not limited to collection and disposal of trash and construction debris, proper handling and storage of concrete wash-out, chemicals and hazardous materials, cleanup of spills or leaks, and providing and maintaining adequate temporary toilet facilities as needed.

16.4.5 Inspections. Inspections are required weekly or bi-weekly and after rain events. Depending on the nature of the project, the Contractor may be required to perform these inspections or the inspections may be performed by the City Inspector. Inspection responsibilities will be determined at the pre-permit meeting. The Contractor shall correct any deficiencies noted by the Inspector within the timeframe specified by the Inspector, not to exceed 7 calendar days unless documented weather conditions prevent correction.

16.4.6 Requirements and Conditions Upon Completion of Construction. The Contractor shall complete and adhere to the following requirements upon completion of construction.

16.4.6.1 Removal of Temporary BMPs. Upon satisfactory inspection by the Inspector of final stabilization on any portion of the site throughout the life of the project, the Contractor shall remove temporary BMPs. Temporary BMPs shall not be removed prior to satisfactory final stabilization.

16.4.6.2 Permit Termination. The Contractor shall be responsible for contacting the Stormwater Quality Division of the Department of Environmental Services to schedule an inspection to terminate the City land disturbance permit. The permit can be terminated when perennial vegetation, pavement, buildings, or structures using permanent materials cover all areas that have been disturbed. With respect to areas that have been vegetated, vegetation cover shall be at least 70% plant density over 100% of the site. Permit termination also requires removal of temporary BMPs and any accumulated sediment or debris in the stormwater system or waterway. Final payment will not be made until the permit is terminated.

16.4.6.3 Return of SWPPP. Final payment will not be made until the Contractor has returned the SWPPP to the City.

16.5 PROJECTS DISTURBING LESS THAN 1 ACRE

16.5.1 Land Disturbance Permit and SWPPP. A City land disturbance permit and SWPPP are not required.

16.5.2 BMP Implementation and Maintenance. The Contractor shall be responsible for implementing and adhering to any non-structural BMPs described on the project plans throughout construction. The Contractor shall be responsible for ensuring that any structural BMPs shown on the project plans are installed and maintained throughout construction. Maintenance includes but is not limited to removal of sediment as needed for BMP effectiveness, and replacement of BMPs whose functionality has become compromised with equal BMPs.

16.5.3 Disposal of Material Off-Site. Prior to removal of excavated or dredged material from the project site, the Contractor shall specify the location of off-site fill areas. Off-site fill areas shall be permitted by a state land disturbance permit and any applicable local land disturbance permit, or shall be less than 1 acre.

16.5.4 Pavement Cleaning. The Contractor shall clean paved surfaces, including but not limited to streets and sidewalks, as needed or as directed by the Engineer or Inspector to minimize dust and the discharge of sediment and other pollutants from the site and to clean up sediment tracked or discharged from the site.

16.5.5 Non-Sediment Pollution Control. The Contractor shall follow good housekeeping and pollution prevention measures as shown on the plans BMP Manual for Land Disturbance Activity including but not limited to collection and disposal of trash and construction debris, proper handling and storage of chemicals and hazardous materials, cleanup of spills or leaks, and providing and maintaining adequate temporary toilet facilities as needed.

16.5.6 Stabilization. The Contractor shall be responsible for stabilization of disturbed areas. Seeding and sodding shall adhere to Chapter 13 of the General Conditions and Technical Specifications.

16.5.7 Removal of Temporary BMPs. Upon completion and satisfactory inspection of final stabilization by the Inspector, the Contractor shall remove temporary BMPs.

16.5.8 Inspections. The City’s Inspector may conduct periodic erosion and sediment control inspections on projects disturbing less than 1 acre. The Contractor shall correct any deficiencies noted by the Inspector within the timeframe specified by the Inspector.

16.6 INDEMNITY

16.6.1 Indemnity. The Contractor shall indemnify and hold the City harmless for any penalties, fines, fees or costs, including costs of defense, which are charged or assessed by any federal, state or local agency including, but not limited to, the United States Environmental Protection Agency or the Missouri Department of Natural Resources.

16.7 ENFORCEMENT

16.7.1 Progressive Enforcement. If, at any time, the Contractor is found to be in violation of the requirements herein, the following Progressive Enforcement Policy will be followed.

16.7.1.1 Verbal or Written Notification. A verbal or written notification shall be issued to the Contractor. The Contractor shall correct the deficiency noted within the timeframe given by the Inspector or Engineer.

16.7.1.2 Notice of Violation (NOV). Upon failure of the Contractor to comply with a verbal or written notification, in the event of an egregious violation (as determined by the City or other government agencies), or in the event of repeated violations of a similar nature, a Notice of Violation may be issued. The Contractor shall comply with the terms of the NOV.

16.7.1.3 Stop Work Order. In the event that the Contractor disturbs any vegetation or earth prior to issuance of a land disturbance permit for sites disturbing 1 acre or greater, except as needed for installation of BMPs, a Stop Work Order may be issued. A Stop Work Order may also be issued upon failure of the Contractor to comply with an NOV. The City shall have the right to make the necessary corrections and deduct the related costs from the amount to be paid to the Contractor. The Stop Work Order shall remain in effect until all deficiencies have been corrected.

16.7.1.4 Further Enforcement Actions. Further enforcement actions may be taken in accordance with the General Conditions and Technical Specifications and City Code.

16.7.1.5 Liquidated Damages. At the City's discretion, Liquidated Damages may be recovered and withheld for each NOV. The amount of Liquidated Damages to be recovered and withheld may be in the amount of $500.00 per NOV.

16.8 MEASUREMENT AND PAYMENT

16.8.1 Method of Measurement.

16.8.1.1 Construction Exit. Measurement of Construction Exit will be made for payment per each construction exit.

16.8.1.2 Silt Fence or Compost Filter Sock. Measurement of Silt Fence or Compost Filter Sock will be made for payment to the nearest linear foot.

16.8.1.3 Inlet Protection. Measurement of Inlet Protection will be made for payment per each inlet.

16.8.1.4 Check Dam. Measurement of Check Dam will be made for payment per each check dam.

16.8.1.5 Sediment Basin. Measurement of Sediment Basin will be made for payment per each sediment basin.

16.8.1.6 Concrete Washout. No field measurement will be made for Concrete Washout.

16.8.2 Basis of Payment. The accepted quantities of erosion and sediment control items listed below will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. No direct payment will be made for concrete washout. Payment shall include all incidental items necessary to install, remove, and maintain all items to be in compliance with the plans and/or the SWPPP.

Payments will be made under:

Item COS-16.8.2.1	Construction Exit -- per each
Item COS-16.8.2.2	Silt Fence -- per linear foot
Item COS-16.8.2.3	Compost Filter Sock – per linear foot
Item COS-16.8.2.4	Inlet Protection -- per each
Item COS-16.8.2.5	Check Dam -- per each
Item COS-16.8.2.6	Sediment Basin -- per each

APPENDIX C

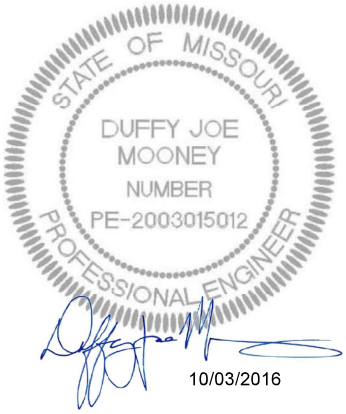
Contract Documents
Exhibit B

City Utilities
Technical Specifications
For Developer Installed
Natural Gas, Water & Electric Work

Revised October 3, 2016

SECTION 00007

SEALS PAGE



Duffy Joe Mooney – Professional Engineer MO #2003015012

Only the specifications pertaining to design of the natural gas and water distribution facilities and associated appurtenances have been prepared under my direct supervision and the seal above applies only to that design. The following Technical Specifications are true, complete, and accurate. This is the official document to be used for City Utilities developer installed natural gas and water work until such time City Utilities certifies a revision.

Thomas Frank Arnall – Professional Engineer MO #E-27611

Only the specifications pertaining to design of the electric facilities and associated appurtenances have been prepared under my direct supervision and the seal above applies only to that design. The following Technical Specifications are true, complete, and accurate. This is the official document to be used for City Utilities developer installed electric work until such time City Utilities certifies a revision.

END OF SECTION

SECTION 00010

INDEX TO CONTRACT DOCUMENTS

00001	PROJECT TITLE PAGE
00007	SEALS PAGE
00010	INDEX TO CONTRACT DOCUMENTS
00600	DOT DRUG TESTING REQUIREMENTS
00620	INSURANCE REQUIREMENTS
00820	GENERAL PROJECT REQUIREMENTS
00890	PERMITS
01110	WORK BY OTHERS
01300	COORDINATION
01310	PROJECT PROGRESS MEETINGS
01320	SCHEDULING OF WORK
01330	SUBMITTALS
01350	ENVIRONMENTAL PROTECTION PROCEDURES
01410	REGULATORY REQUIREMENTS
01420	WATER AND NATURAL GAS CONSTRUCTION STANDARDS
01425	REFERENCES
01450	CONTRACTOR'S QUALITY CONTROL
01460	INSPECTIONS
01525	FIELD OFFICES AND SHEDS
01720	FIELD ENGINEERING
01770	CONTRACT CLOSE-OUT/CLEANUP
02220	DEMOLITION AND CLEARING
02315	EXCAVATION AND BACKFILLING
02320	UTILITY CASINGS
02410	TUNNELING
02510	WATER PIPING
02515	DISINFECTION AND TESTING
02550	MECHANICAL - NATURAL GAS PIPING
02580	UNDERGROUND ELECTRIC CONDUIT AND EQUIPMENT
02700	PAVING AND SURFACING
02900	LANDSCAPING
03200	CONCRETE REINFORCEMENT
03300	CONCRETE
Attachment A	General Conditions

END OF SECTION

SECTION 00600

DOT DRUG TESTING REQUIREMENTS

1.01 This Contract includes work covered by the drug testing requirement of the Department of Transportation, 49 CFR. Part 199 and Part 40. Contractor shall comply with all aspects of those two parts of the Code of Federal Regulations. City Utilities will have the right to inspect for compliance.

1.02 Submit, after Notice of Award and prior to Notice to Proceed, an affidavit of compliance to DOT Regulations 49 CFR Parts 199 and 40, properly filled out, signed, and notarized, to City Utilities Safety Supervisor. Affidavit is included at the end of this section.

1.03 Once every three months, deliver to City Utilities the testing records (non-name specific) as requested for the purpose of monitoring the drug and alcohol training and testing program for compliance with DOT Regulations 49 CFR Parts 199 and 40. Said records shall be delivered within 30 days of the end of each three month period. Additionally, upon 48 hours' notice, deliver to City Utilities the Anti-Drug and Alcohol Misuse Plan for the purpose of monitoring compliance with DOT Regulations 49 CFR Parts 199 and 40.

END OF SECTION

AFFIDAVIT

Re: (Project)

_____

_____

I, _____, being duly sworn, do depose and say
(contractor official)

1) I am over the age of eighteen and understand the obligation of an oath;

2) I am _____ of the _____ and in such
(position) (contractor)
capacity I have personal knowledge of the facts and statements set for in this affidavit and each fact and statement as set forth herein is true to the best of my knowledge and belief;

3) That _____ has in place an Anti-Drug and Alcohol Misuse Plan
(contractor)
that conforms to the requirements of DOT Regulations 49 CFR Parts 199 and 40;

4) That the drug testing laboratory retained by _____
(contractor)
is _____ which is certified by HHS/NLCP;
(laboratory-name)

5) That _____ has retained _____
(contractor) (MRO)
of _____ as Medical Review Officer MRO)
(MRO FIRM)
for its drug testing program;

6) Once every three months, _____ shall
(contractor official)
deliver to City Utilities' Safety Department the testing records (non-name specific) as requested for the purpose of monitoring the drug and alcohol training and testing program for compliance with DOT Regulations 49 CFR Parts 199 and 40. Said records shall be delivered within 30 days of the end of each three-month period. Additionally, affiant shall, upon 48 hours notice, deliver to City Utilities' Safety Department the Anti-Drug and Alcohol Misuse Plan for the purpose of monitoring compliance with D.O.T. Regulations 49 CFR Parts 199 and 40.

The Affiant _____
(contractor official)

Subscribed and sworn to before me this _____day of _____ 20_____.

_____
Notary Public

(Seal)

My commission expires _____, 20_____.

QUARTERLY REPORT OF DOT DRUG TESTING

Company Name _____ Dates Covered By This Report _____

Number of Employees tested	Date tested	Type of test	Results of test	Action taken if test was positive.

Average number of employees covered by Pipeline and Hazardous Materials Safety Administration (DOT pipeline safety standards) for this reporting period.	

Number of blind samples submitted to testing laboratory for quality assurance if required.	

_____ SIGNATURE

_____ DATE

END OF SECTION

SECTION 00620

INSURANCE REQUIREMENTS

Without limiting any of the other obligations or liabilities of the Contractor, the Contractor shall secure and maintain at its own cost and expense, throughout the duration of this Contract and until the Work is completed and accepted by City Utilities, insurance of such types and in such amounts as may be necessary to protect it and the interests of City Utilities against all hazards or risks of loss as hereunder specified or which may arise out of the performance of the Contract Documents. The form and limits of such insurance, together with the underwriter thereof in each case, are subject to approval by City Utilities. Regardless of such approval, it shall be the responsibility of the Contractor to maintain adequate insurance coverage at all times during the term of the Contract. Failure of the Contractor to maintain coverage shall not relieve him of any contractual responsibility or obligation or liability under the Contract Documents.

The certificate of insurance, including evidence of the required endorsements hereunder or the policies shall be filed with City Utilities within ten (10) days after the date of the receipt of Notice of Award of the Contract to the Contractor and prior to the start of work. All insurance policies shall provide thirty (30) days written notice to be given by the insurance company in question prior to cancellation of such insurance. Such notices shall be mailed, certified mail, return receipt requested, to:

Risk Manager
City Utilities of Springfield, Missouri
301 E. Central Street
P.O. Box 551
Springfield, MO 65801-0551

The minimum coverage for the insurance referred to herein shall be in accordance with the requirements established below:

(A) Workers' Compensation* ** ..... Statutory
Employer's Liability
Bodily Injury by Accident—each accident $1,000,000
Bodily Injury by Disease—each employee limit $1,000,000
Bodily Injury by Disease—policy limit $1,000,000

*** Workers' Compensation: Policy or self-insurance plan with statutory limits formally approved by the State of Missouri will be required, even if no employees other than owners.**
**** Workers' Compensation coverage shall include a waiver of subrogation in favor of City Utilities where permitted by law.**

(B) Commercial General Liability Insurance*** ****, Including Premises, Operations, Products and Completed Operations, Contractual Liability, Broad Form Property Damage, Independent Contractors Explosion, Collapse, Underground Property Damage and; Such Coverage Shall Apply to Bodily Injury and Property Damage on an "Occurrence Form Basis" with each Occurrence Limit of..... $1,000,000
In the Aggregate..... $2,000,000

***** Certificate of Insurance must indicate in the description that Explosion, Collapse and Underground Property Damage is covered**.

(C) Automobile Liability Insurance**** Covering Bodily Injury And Property Damage for Owned, Non-owned and Hired Vehicles with a Combined Single Limit of: $1,000,000

(D) Umbrella or Excess Insurance**** (Following Form) $1,000,000

****** City Utilities shall be added as an Additional Insured on (B), (C), & (D) Insurance.**

Contractor shall require any and all subcontractors with whom he enters into a contract to perform Work on this Project, to protect, through insurance, against applicable hazards or risks and shall, upon request of City Utilities, provide evidence of such insurance. Contractor shall be liable for all deductible amounts from such insurance and shall indemnify and hold City Utilities harmless therefrom. These Insurance Requirements are intended to be minimum coverages, and City Utilities does not warrant that coverages or amounts will be sufficient protection for contractors or City Utilities. Contractors will be responsible for any deficiencies thereof.

NOTE:

Acord certificate changes regarding cancellation notifications do not lessen the responsibility of vendors to comply with obligations set forth in these insurance requirements. Specifically, the requirement "All insurance policies shall provide thirty (30) days written notice to be given by the insurance company in question prior to material reduction in coverage or protection of City Utilities or cancellation of such insurance." must be met wherever permitted by law.

Since the requirement cannot be met using the Acord certificate, the requirement can be met by specifically endorsing CU onto each policy to receive notifications.

SECTION 00820

GENERAL PROJECT REQUIREMENTS

PART I GENERAL

1.01 Work includes, but is not limited to installation, relocation and/or retirement of natural gas and/or water mains, services, electric conduit and associated appurtenances.

1.02 It is the intent of this Contract for the Contractor to install the natural gas, water and/or electric facilities to the full extent as shown on the Drawings. It is the Contractor's responsibility to build these same natural gas, water and/or electric lines to meet or exceed the requirements of the U.S. Department of Transportation and/or Missouri Public Service Commission and/or Missouri Department of Natural Resources regulations and/or City Utilities' Contract Documents, Technical Specifications, and Construction Standards, whichever is greater. Contractor shall make any minor changes in required fittings or in routing (horizontal or vertical) within the pipeline easements shown on the Drawings or within public rights-of-way as a result of field conditions at no additional cost to City Utilities. Some underground facilities are shown on the Drawings, but the Drawings may not accurately represent the locations of the underground facilities. There may be other underground facilities that are not shown on the Drawings. Contractor shall not use the Drawings to locate underground facilities. Contractor is responsible for locating all underground facilities in accordance with Section 01720.

1.03 NOTIFICATION AND CUSTOMER RELATIONS: Notify all residents affected by work done under this Contract at least 48 hours, but no more than 7 days, prior to starting work in the affected area. Notification shall be of a form and format approved by the Inspector. Execute the work in a customer/neighborhood friendly manner. In addition, notify adjacent utility customers and property owners of proposed location of work equipment parked overnight and of proposed material storage areas and stockpiles of sand, gravel and dirt. Adjust parking and material storage to maximize customer satisfaction and to minimize traffic congestion.

1.04 DEVELOPER INSTALLED QUALIFIED GAS AND WATER CONTRACTORS: All City Utilities natural gas and water utility installation shall be performed by a City Utilities Developer Installed Qualified Contractor. Qualified Contractor lists and application forms can be obtained from City Utilities Developer Services Department at (417) 831-8888.

1.05 Construction drawings shall be prepared and provided by City Utilities of Springfield.

PART II MATERIALS AND EQUIPMENT

2.01 Contractor shall provide all natural gas and water materials. Contractor is to supply all electrical materials per "Developer Installed Work" on drawing. City Utilities to supply the following products: junction cabinets, plastic transformer pads, secondary service pedestals, stand-off brackets for risers and street light bases.

2.02 Contractor shall supply any other work materials and supplies as may be required. This would include, but not be limited to: sand, chat or other granular fill material; paint; paint brushes; tools; concrete and forms; topsoil; fertilizer, mulch and grass seed; fencing materials; erosion control materials; skids; dunnage; and welding rod. When Contractor elects to install piping by means other than open trenching then Contractor shall supply casing pipe.

2.03 The Inspector will order materials from City Utilities' Storeroom for Contractor as needed for the project. Requests for materials should be submitted to the Inspector at least 24 hours in advance.

2.04 Contractor shall pick up requisitioned materials at the City Utilities stores facility designated by the Inspector. All materials for the project shall be picked up at one time. However, on larger projects

Inspector may designate several pick-ups as the job progresses. Contractor shall provide adequate transportation and labor to load and receive materials, except that City Utilities will provide a forklift and operator as necessary to load heavier items. Contractor shall provide wood blocking, straps, tarps, etc. required for hauling the materials. Materials may be picked up from 9:00 a.m. to 3:00 p.m. Monday through Friday, except holidays.

2.05 Generally, most materials issued shall be new. However, City Utilities reserves the right to issue used material which the Inspector has judged to be suitable for reuse.

2.06 All labor, tools, equipment and incidentals necessary to complete the work, as well as any materials not specifically provided by City Utilities, shall be completely covered by the prices in the Bid.

2.07 Contractor shall be responsible for the material, and for the replacement of lost, broken or stolen material. Contractor shall examine all material upon receipt, and by acceptance, certify suitability for use. Make objections to issued materials to the Inspector. Inspector will establish a reasonable allowance for pipe waste on each project.

2.08 Pick up items normally packaged in bulk quantities in such bulk quantities. Unused quantities shall be returned to the stores facility by the Contractor or transferred to the next job as long as additional work continues. The Inspector will make appropriate requisitions, transfers and returns for each project.

2.10 Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

PART III EXECUTION

3.01 Store fabricated products above ground, on blocking or skids, to prevent soiling or staining. Store loose granular materials in a well-drained area on solid surfaces. Arrange storage in a manner to provide easy access for inspection or inventory by either the Contractor or the Inspector.

3.02 Do not damage public or private property in handling or storage of materials. Do not hinder access to fire hydrants, fire and police alarms, mailboxes, water valves, natural gas valves and manholes. Do not use private property for storage of materials without express written permission of property owner. Provide Inspector with documentation of permission to store materials.

3.03 Do not store any material, equipment, buildings, tools, vehicles or any other items owned by the Contractor on property owned by City Utilities except at the specific sites designated by the Inspector or as shown on the Drawings for storage and use by the Contractor. If no sites are designated, then the Contractor is responsible for locating and procuring any required site or sites.

3.04 Make periodic inspection of stored products to ensure that products are maintained under specific conditions, and free from damage or deterioration.

3.05 Keep construction area as clean as possible. Control mud and dust to prevent customer dissatisfaction and complaints. Do not allow mud and dirt to enter Storm Sewer system. Keep trash, containers, packaging materials, etc., picked up on a daily basis.

3.06 Coordinate driveway closures with property owners. Give all property owners 48 hours advance notification prior to closing driveways.

3.07 At the end of the project, return all excess and/or salvage materials (used or new) to the City Utilities stores facility designated by the Inspector in a form (broken down into stock item components) and conditions suitable to the Storekeeper.

3.08 Inclusive in the work is close coordination with all appropriate jurisdictional agencies. The Contractor is responsible for determining paving requirements not specifically shown on the Drawings (temporary and permanent), construction standards, boring requirements, erosion and sediment control, traffic control and safety requirements of these agencies. No additional payment will be made for compliance to jurisdictional requirements. Contractor is responsible for coordinating the work as described herein.

END OF SECTION

SECTION 00890

PERMITS

PART I GENERAL

1.01 City Utilities will obtain railroad and Corps of Engineers. Contractor must obtain all other necessary permits and comply with all codes of construction as required by Section 01410.

END OF SECTION

SECTION 01110

WORK BY OTHERS

PART I GENERAL

1.01 City Utilities personnel shall operate all main line natural gas valves and perform all purging of natural gas mains. A 48-hour advance notification is required.

1.02 City Utilities personnel shall operate all main line water valves and provide labor and equipment for disinfection, flushing and sampling of all water mains. Such work shall require a 48-hour advance notification.

1.03 City Utilities will provide equipment, materials and labor for completion of main size taps on water mains unless otherwise specified in the Contract Documents (4" through 12" tap size). Such work shall require a 48-hour advance notification and will not be scheduled after 3:00 p.m. or outside normal working hours for City Utilities' crews. Contractor shall dig and prepare excavation with appropriately safe shoring and traffic control as necessary. Contractor shall install tapping sleeve, valve and other fittings and provide hoisting equipment for installation and removal of tapping machine.

1.04 City Utilities will provide equipment, materials and labor for tapping natural gas mains unless otherwise specified in the Contract Documents (sizes 2" through 12", 150 psig maximum pressure). Such work shall require a 48-hour advance notification and will not be scheduled after 3:00 p.m. or outside normal working hours for City Utilities' crews. Contractor shall dig and prepare excavation with appropriately safe shoring and traffic control as necessary. Contractor shall provide hoisting equipment for installation and removal of tapping machine.

1.05 City Utilities will provide equipment, materials and labor to perform all welding of steel natural gas pipes unless otherwise specified in the Contract Documents. Such work shall require a 48-hour advance notification and will not be scheduled after 3:00 p.m. or outside normal working hours for City Utilities' crews. Contractor shall dig and prepare excavation with appropriate safe shoring and traffic control as necessary.

1.06 City Utilities will perform all work that involves modifying components in service regulators such as orifice changes, etc.

1.07 City Utilities personnel shall unlock and assist conduit installation in and around all energized junction enclosures, pad-mounted transformers and secondary pedestals. Such Work shall require a 48-hour advance notification. The Contractor shall not dig within 5' of energized CU equipment or lines.

PART II MATERIALS NOT USED

PART III EXECUTION NOT USED

END OF SECTION

SECTION 01300

COORDINATION

PART I GENERAL - This Section includes coordination of trades and coordination with Owner, other contractors and jurisdictional agencies.

PART II MATERIALS - NOT USED

PART III EXECUTION

3.01 Coordinate the work of all trades under this contract.

3.02 Coordinate with existing operations on-site to access and use construction area during normal working hours.

3.03 Coordinate all activities through the Inspector.

3.04 Coordination with Others:

A. The Contractor, by agreeing to perform work under these Contract Specifications, hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work.

B. Other Contracts may be awarded during this Contract Time. Some of these Contracts may involve on-site activity which must be coordinated with this Contract. In addition, City Utilities crews may perform other work involving on-site construction which must be coordinated with this Contract.

3.05 Inclusive in the Work is close coordination with all appropriate jurisdictional agencies. No additional payment will be made for compliance to jurisdictional requirements. Contractor is responsible for coordinating the Work as described herein.

3.06 Resolution of Disputes:

A. The Contractor and Inspector shall attempt to resolve all disputes.

B. If resolution is not reached, the Contractor may request additional meetings with the Resident Engineer. If a resolution is not reached, the Contractor may request to meet with City Utilities' management. These meetings will be scheduled through the Resident Engineer.

C. In the event that the Contractor fails to satisfactorily resolve disputes or complete Work as called for in the Contract, such unresolved disputes or unfinished work may be held as sufficient ground by City Utilities to refuse to enter into any future contracts with the Contractor.

END OF SECTION

SECTION 01310

PROJECT PROGRESS MEETINGS

PART I GENERAL

1.01 A pre-construction meeting shall be scheduled prior to start of construction on the project to discuss any aspect of the prosecution of the work.

1.02 City Utilities or Contractor may at any time request a project meeting to discuss any aspect of work.

1.03 Contractor's resident superintendent must be present at any and all meetings.

PART II MATERIALS – NOT USED

PART III EXECUTION – NOT USED

END OF SECTION

SECTION 01320

SCHEDULING OF WORK

PART I GENERAL – Contractor shall plan, schedule and coordinate work associated with the project so as to minimize conflict with, and potential damage to, existing and new City Utilities facilities.

PART II MATERIALS - NOT USED

PART III EXECUTION

3.01 Contractor shall not begin construction on City Utilities natural gas, water and electric facilities until allowed to proceed by the Inspector.

3.02 Such work shall not begin until the following are complete:

A. Contractor has performed rough grading to within one (1) foot of final established grades of streets, right-of-ways and at utility ditch lines in the subdivision or at the project site.

B. Contractor has constructed sanitary sewers and storm water drainage facilities and/or drainage ways where such facilities are located within street rights-of-way or City Utilities' easements.

END OF SECTION

SECTION 01330

SUBMITTALS

PART I GENERAL

1.01 As required by Resident Engineer, submit to City Utilities for approval a list of all materials provided by Contractor to be installed on the Project. All natural gas piping and HDPE water piping will require a "Certificate of Quality" from the pipe manufacturer specific to that batch or 'lot' of pipe, if pipe is supplied by Contractor. All steel natural gas piping supplied by the Contractor shall require mill test reports to be supplied to City Utilities.

1.02 All material to be supplied by the Contractor that is not currently an approved brand shall require a submittal and prior approval by City Utilities. The current approved Material Specifications and Acceptable Brands are located online at **http://www.cityutilities.net/business/construction.htm**. **Materials supplied by City Utilities will also conform to these Specifications.**

1.03 Contact Resident Engineer about any questions regarding approved materials.

PART II MATERIALS – NOT USED

PART III EXECUTION – NOT USED

END OF SECTION

SECTION 01350

ENVIRONMENTAL PROTECTION PROCEDURES

PART I GENERAL

1.01 Conduct all construction activities in conformance with all federal, state and local laws, regulations and ordinances for the protection of the environment.

1.02 The work under this Contract may affect the City of Springfield's drinking water supply. Under no circumstances shall the Contractor or any of his subcontractors allow any debris, fuel, chemicals, liquids or other materials to enter this water supply through direct or indirect means. Contain and dispose of all materials by means acceptable to the appropriate jurisdictional agency. Have materials on-site for containment of spills such as hydraulic hose breaks, etc.

PART II MATERIALS

2.01 No hazardous or toxic materials will be allowed in any phase of the work.

2.02 Drilling mud used shall not be harmful to the environment and shall comply with all applicable regulations.

PART III EXECUTION

3.01 When required, the Contractor shall acquire a Land Disturbance Permit and provide a Storm Water Pollution Prevention Plan (SWPPP) outlining the Best Management Practices (i.e. mulch logs, silt fences, etc.) that the Contractor is to carry out for the duration of the project.

3.02 Contractor shall comply with all requirements of the jurisdictional agency's Land Disturbance Permit and/or SWPPP, when applicable.

3.03 Contractor shall install and maintain Best Management Practices for storm water sediment and erosion control during construction in accordance with the appropriate jurisdictional agency's construction standards. Best Management Practices shall also be utilized on projects when a SWPPP is not required.

3.04 All drilling mud shall be contained and reclaimed. Contractor is responsible for any spilled drilling mud.

END OF SECTION

SECTION 01410

REGULATORY REQUIREMENTS

PART I GENERAL

1.01 Conduct all construction activities in conformance with all applicable Federal, State and local laws, regulations and ordinances, including the Occupational Safety and Health Act of 1970 (OSHA) and applicable regulations of the Missouri Public Service Commission.

1.02 PERSONNEL QUALIFICATIONS

Any Contractor personnel performing a "Covered Task" as defined in the Missouri Public Service Commission Pipeline Safety Regulations, 4 CSR 240-40.030, Section 12(D) shall be appropriately Operator Qualified prior to performing such task.

Contractors may be qualified through City Utilities Operator Qualification Plan or by submitting their own Operator Qualification Plan for approval. If the Contractor chooses to be qualified through City Utilities Operator Qualification Plan, City Utilities will perform the testing and evaluations.

If the Contractor chooses to submit their own Plan, they must submit a written Operator Qualification Plan for evaluation that meets all Federal and Missouri Public Service Commission requirements.

A. The Operator Qualification plan shall include at a minimum:

1. List and description of covered tasks covered by the Operator Qualification Plan.

2. List and description of all training and evaluation modules that make up the full qualification for each covered task.

3. Listing of job classifications with accompanying covered tasks and qualification modules.

4. Description of the program under which employees are qualified and identification of any third-party vendors utilized for training and testing.

B. Per the Plan, employee information is required to be submitted with the plan. At a minimum this shall include:

1. List of employees (including pictures) assigned to the project.

2. Operator Qualification testing results for each employee assigned to the project.

3. When and where each employee on the project was qualified and by whom.

4. The expiration date of each current qualification for each employee assigned to the project.

5. List and description of covered tasks for which each individual is qualified.

This plan must be submitted to City Utilities and approved before any work may be performed. City Utilities reserves the right to deny any submitted plans and require an amended Plan to be resubmitted.

Any Contractor personnel installing HDPE water main must have attended a fusion training course and be qualified by City Utilities prior to performing any fusion work on City Utilities water distribution system. City Utilities offers this training, or, Contractor may submit training and qualification records for their personnel to City Utilities for approval.

PART II MATERIALS – NOT USED

PART III EXECUTION – NOT USED

END OF SECTION

SECTION 01420

NATURAL GAS, WATER AND ELECTRIC CONSTRUCTION STANDARDS

PART I GENERAL

Construction Standards may be found at **http://www.cityutilities.net/business/construction.htm.** Any other construction details otherwise encountered will be provided by the Project Manager. Copies of Natural Gas and Water Construction Standards are available at City Utilities' Gas and Water Operations Center, 1321 W. Calhoun. Copies of the Electric Construction Standards are available at Electric Operations at 828 N. Prince Lane. Construction Standards and other instructions, as approved at the time the project contract is signed or otherwise specified in the Drawings, shall be followed for all work on the project. City Utilities may make substitutions of equivalent materials or assemblies for those shown in the Construction Standards at no additional cost.

PART II MATERIALS - NOT USED

PART III EXECUTION - NOT USED

END OF SECTION

SECTION 01425

REFERENCES

PART I GENERAL

1.01 REFERENCES AND ABBREVIATIONS

The latest edition of the following specifications covers certain materials and methods to be utilized by the Contractor. Abbreviations as used in the Contract Documents mean the following:

1. AWWA: American Water Works Association
2. AGA: American Gas Association
3. AASHTO: American Association of State Highway & Transportation Officials
4. API: American Petroleum Institute
5. ASA: American Standards Association
6. DOT: United States Department of Transportation
7. AWS: American Welding Society
8. AREA: American Railway Engineering Association
9. ACI: American Concrete Institute
10. OSHA: Occupational Safety and Health Administration
11. ASTM: American Society for Testing and Materials
12. ANSI: American National Standards Institute
13. IEEE: The Institute for Electrical and Electronics Engineers
14. NACE: National Association Corrosion Engineers
15. MANGO: Missouri Association of Natural Gas Operators
16. NESC: National Electric Safety Code
17. PPI: Plastic Pipe Institute
18. DIPRA: Ductile Iron Pipe Research Association
19. UNIBELL: PVC Pipe Association

1.02 REFERENCES AND DATES

All standard references apply to the most current versions of these standards except where noted.

END OF SECTION

SECTION 01450

CONTRACTOR'S QUALITY CONTROL

PART I GENERAL

1.01 The Contractor's Resident Superintendent, to the extent qualified, may be used for quality control, supplemented as necessary by additional personnel for surveillance, special technicians or testing facilities to provide capability for the controls required by the Specifications.

PART II MATERIALS - NOT USED

PART III EXECUTION

3.01 Provide for inspection of all work to ensure that materials and supplies are placed and installed in accordance with the Drawings and Specifications. Do not build upon or conceal any feature of work containing uncorrected defects.

END OF SECTION

SECTION 01460

INSPECTIONS

PART I GENERAL

1.01 All work is subject to inspection, examination or test, at any time by the Resident Engineer.

1.02 The Inspector shall be the designated representative of the Resident Engineer.

1.03 The Resident Engineer and Inspector have the right and authority to determine whether the work is being done in accordance with the requirements of the Contract Documents, Drawings and Specifications.

PART II MATERIALS - NOT USED

PART III EXECUTION - NOT USED

END OF SECTION

SECTION 01525

FIELD OFFICES AND SHEDS

PART I GENERAL

1.01 The Contractor is responsible for supplying all of the facilities needed for the successful completion of the job. Maintain all working, storage and parking areas in a neat and orderly manner.

1.02 Obtain and maintain all utility services needed during construction.

1.03 FIELD OFFICES AND SUPERVISION

No field offices will be required unless otherwise specified in the Contract Documents. Provide Inspector with telephone numbers at which Contractor and his Resident Superintendent may be contacted at any time. Designate a minimum of two people as after hour contacts.

PART II MATERIALS AND EQUIPMENT

2.01 Furnish storage space, sanitary facilities, trash disposal and utilities.

2.02 The Contractor will be responsible for access to and from the site without causing damage to any adjacent facilities or surrounding land.

2.03 Provide gate locks to interlock with City Utilities' locks, if applicable. If locks are inappropriately secured prohibiting City Utilities access, they will be forcibly removed.

PART III EXECUTION

3.01 Workers' vehicles are to be parked legally in an area designated by the Contractor.

3.02 Upon completion of the project, remove all traces of temporary facilities. Fill all disturbed grass areas, grade and seed in conformance with Section 02900.

3.03 Maintain the continuity of security systems.

3.04 Upon completion of project, remove all traces of temporary utilities unless instructed otherwise by the Inspector.

END OF SECTION

SECTION 01720

FIELD ENGINEERING

PART I GENERAL

1.01 This section includes requirements for surveying and job layout.

PART II MATERIALS - NOT USED

PART III EXECUTION

3.01 The Contractor is solely responsible for locating all existing underground installations including, without limitation, service connections, in advance of excavating or trenching, by contacting the owners thereof, prospecting, and the use of the Missouri One-Call System and other appropriate locating services. The Contractor shall use its own information and shall not use the Drawings to locate underground facilities, since they may not accurately represent the locations of underground facilities or even the existence of all underground facilities. Contractor shall use all reasonable means necessary to avoid damage to underground facilities including, without limitation, hand-digging.

3.02 Damages to existing City Utilities natural gas, water or electric facilities shall be reported to the Inspector, 911, and City Utilities central dispatching (417) 863-9000. City Utilities will repair all natural gas, water and electric lines broken by tear-out, poor construction, blasting or any other reason due to the construction of these facilities. City Utilities crews will not perform service or meter box relocation work for the Contractor.

3.03 Contractor may elect to temporarily disconnect natural gas or water service lines during the course of the project to facilitate the installation of new mains. Notification shall be given to all customers affected as described in Sections 2515 and 2550. Customers shall be reinstated the same day to minimize disruptions. Some critical customers who may require water for life support, dialysis, etc. may not be able to be disconnected. If Contractor elects to temporarily disconnect the natural gas or water service lines, the fittings necessary to perform that work shall be supplied by the Contractor and approved by the Resident Engineer.

3.04 When blasting is to be performed, Contractor shall notify City Utilities 24 hours in advance so that the Inspector may be present to inspect natural gas and water facilities and arrange for natural gas and water leak surveys prior to and following blasting.

3.05 Instructions for Utility Staking

A. GENERAL

1. Staking is the responsibility of the Contractor unless otherwise specified in the Contract Documents. All utility staking shall be done under the direct supervision of a Professional Land Surveyor. All utilities shall be staked as shown on the individual project drawings issued with each staking assignment. Center line stakes, off-set stakes and stakes at each valve, fire hydrant, laterals, pedestals, junction boxes, street lights and other major fitting shall be set.

2. The entire natural gas, water and electric lines shall be staked. On joint trench projects, natural gas and water fitting locations, valves, beginning and end of main will require staking. Respective flagging colors shall be used as required.

3. Stakes shall be sufficient size to contain all required information legibly. The minimum size stake used for natural gas and water staking will be 1” x 2” x 18”. Laths will be used in high grass or brush.

B. OFFSETS – DEPTH

1. Stake all utilities as shown on the project drawings with offset staking at 50’ intervals. Offset stakes shall be set at nearest R/W or easement line to main but no less than 6 feet off centerline and perpendicular to line at points where the line changes direction. Centerline shall be staked at 50’ intervals to correspond with offset stakes. Stakes shall also be placed and appropriately marked at all valves, fire hydrants, tees, taps, meter pit locations, property corners on main sides, lateral/street crossing locations, easement lines and as needed to insure inter-visibility along long runs of main or rough terrains.

2. All cuts shown on stakes are to be to bottom of trench from existing grade at base of offset stake. Necessary cuts shall be calculated based on required cover over natural gas, water or electric facilities when site is finished grade. On joint trench installations, the required cover for water mains shall be used to determine the necessary cut.

C. CENTERLINE STAKING

1. Water main stakes shall be marked “Centerline Water” on one side and tie with blue flagging.

2. Natural gas main stakes shall be marked “Centerline Gas” on one side and tie with yellow flagging.

3. Electric conduit sakes shall be marked “Centerline Electric” on one side and tie with red flagging.

D. OFFSET STAKING

1. Offset stakes shall have the offset distance in a circle and the word Water, Gas, or Electric marked on the front side with the cut. Backside of stake is to show the station (if applicable). All cuts will be figured from the ground elevation at the base of the offset stake unless otherwise directed by City Utilities. Tie the flagging colors as per Centerline Staking.

E. LATERALS

1. Laterals shall be staked at the tee and at the end point of the lateral. Offset stakes shall be set at both ends of the lateral. Natural gas and water lateral end points will be staked per the Construction Standards unless otherwise dimensioned on drawing. The stakes will be marked “Gas Lateral” or “Water Lateral” and tied with respective flagging color. Taps for laterals will be staked on the centerline of the main and marked “Gas Tap” or “Water Tap” and tied with respective flagging color. Offsets will be required on the tap.

F. FIRE HYDRANTS

1. Fire hydrants will be staked per the Construction Standards unless otherwise dimensioned on drawing. The backside of the stake shall be marked “Fire Hydrant.” The front side of the stake will have a cut to the bottom of the trench, and a cut or a fill to the finish grade at that point. This cut or fill will coincide

with the bury line on a fire hydrant. Two offset stakes will also be set on property line/right-of-way, 10 foot either side of fire hydrant stake.

G. ELECTRICAL JUNCTION ENCLOSURES, TRANSFORMERS AND SECONDARY PEDESTALS

1. Unless otherwise noted, stake electrical junction enclosures, transformers, secondary pedestals and streetlights as shown on the applicable underground distribution standard drawing.

H. CUT SHEETS

1. Cut Sheets shall be kept on all construction staking and copies must be furnished to the City Utilities' Inspector upon request.

I. CONSTRUCTION STANDARDS

1. See Construction Standards for additional utility staking information.

2. Where natural gas and water mains and electric conduit are placed such that finished grade elevation will be higher than the paralleling centerline of street elevation, the utilities shall be installed below the street centerline elevation at the depths specified in the Construction Standards unless otherwise noted.

END OF SECTION

SECTION 01770

CONTRACT CLOSEOUT

PART I GENERAL

1.01 Prior to City Utilities accepting developer installed improvements, a continuous signal must be verified on the tracer wire.

1.02 Within 14 days after Substantial Completion of construction, City Utilities shall notify the Contractor in writing (i.e. punch list) of any defects or defaults in performance which may have been discovered upon final inspection. The Contractor shall remedy promptly all such defects or defaults before the Construction Project shall be accepted by City Utilities.

1.03 In the event the Contractor fails to remedy such defects or defaults within 30 days after notification, City Utilities may elect to correct these defects or defaults and deduct the cost of such corrections from any reimbursements due the Contractor, or may bill the Contractor for such corrections. In addition, the Contractor shall be removed from the list of City Utilities approved Contractors for a period of not less than one year from date of completion of project on which deficiencies occurred.

PART II MATERIALS - NOT USED

PART III EXECUTION

3.01 Completely remove all traces of equipment, excess materials and debris from the site after all punchlist items have been completed, inspected and approved by Inspector.

3.02 Clean-up site to Inspector's satisfaction and leave site as good as or better than original conditions.

END OF SECTION

SECTION 02220

DEMOLITION AND CLEARING

PART I GENERAL

1.01 DESCRIPTION: Work includes, but is not limited to:

A. Removal of designated items.

B. Protection of items not designated to be removed.

C. URBAN FOREST MANAGEMENT POLICY
In an effort to responsibly manage the urban forest, guide all work performed under this Contract to reduce damage to any trees. Perform all work in accordance with the guidelines in the booklet "Trenching and Tunneling Near Trees - A Field Pocket Guide for Qualified Utility Workers." Copies of this booklet are available for inspection at City Utilities Forester located at 828 N. Prince Lane, Springfield, MO. Copies are also available from the National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410.

PART II MATERIALS - NOT USED

PART III EXECUTION

3.01 CONSTRUCTION LIMITS

Inspector will establish the construction limits and designate items to be removed, and may designate items to remain.

3.02 REMOVAL OF ITEMS

A. Completely clear, grub and remove tree stumps, brush, hedge and other items within the construction limits not designated to remain.

B. Existing structures, including, but not limited to, pavement, curbs, sidewalks or other similar objects where portions of these objects are to be left in place, shall be removed to an existing joint or a new joint sawed to a minimum depth of one inch with a true line and vertical face.

C. Completely remove and dispose of all debris.

D. All concrete, masonry, drainage pipes, reinforcement steel, structural steel, castings, timbers, or other materials not salvageable shall be disposed of by the Contractor at his own expense. Contractor shall provide disposal location for all materials and obtain written approval from property owners for material deposited on private property. Submit written approval of the property owners to the Inspector.

3.03 PROTECTION OF REMAINING ITEMS

A. The Inspector may designate existing above-ground structures, trees, shrubs and plants that are to remain. Contractor shall preserve without damage these items throughout the construction period.

B. Contractor shall make temporary fence closures during construction and restore fences to original condition or better upon completion of the work.

C. Contractor shall protect and restore ornamental trees and shrubs.

END OF SECTION

SECTION 02315

EXCAVATION AND BACKFILLING FOR PIPING

PART I GENERAL

1.01 DESCRIPTION: Work includes, but is not limited to the following as they apply to all natural gas and water mains, services, and casing piping:

A. Trenching and trench backfilling.

B. Blasting and rock excavation.

C. Rough and finish grading.

D. Furnishing and installing granular fill.

1.02 REGULATORY COMPLIANCE

All excavation and backfill is subject to regulations and permits of appropriate jurisdictional agencies.

PART II MATERIALS AND EQUIPMENT

2.01 FILL MATERIAL

All fill material shall conform to City Utilities' Construction Standards and is subject to approval of the Inspector.

2.02 BACKFILL IN NON PAVED AREAS

A. Other than pipe bedding, backfill with suitable materials excavated from trench and processed as required, or borrowed from locations arranged and paid for by Contractor. Material shall be free from organic matter, refuse, ashes, cinders or other unsuitable materials, and shall not be frozen. Materials shall be free from gravel, stone or shale particles greater in any dimension than four inches for the first foot of backfill above the pipe embedment material to establish a clear zone. Backfill above the clear zone may have materials up to a maximum of twelve inches in any dimension. As an alternate to the clear zone requirement, Contractor may elect to provide an additional six inches of sand over and above the requirements called for in the Construction Standards. Backfill material shall contain sufficient fines to provide a dense mass capable of being compacted.

B. Casing piping installed by open trenching shall be bedded and backfilled with select backfill.

2.03 BACKFILL IN PAVED AREAS

A. Other than pipe bedding as called out in the applicable Construction Standards, backfill trenches in designated area with granular material that meets the appropriate jurisdictional agency's requirements.

B. Casing piping installed by open trenching of roadways shall be bedded and backfilled full depth with granular material meeting the specifications of the appropriate jurisdictional agency.

C. This material will be required under sidewalks, existing paved areas, proposed paved areas, unpaved "driven-over" areas utilized as drives or parking lots, and as necessary on excavations paralleling proposed or existing streets and drives to avoid settlement of curbs or paving.

D. When flowable fill is required, natural gas, water and electric lines shall be covered with a protective rock shield.

2.04 PIPE BEDDING MATERIALS

A. Bed all natural gas, water and electric lines in accordance with the Construction Standards.

PART III EXECUTION

3.01 TRENCHING

A. Centerline: Maintain centerline of the trench in a straight line with minimum bends or changes in direction. When trenching in pavement, saw cut the pavement in a straight line on both sides of the future excavations.

B. Length: Minimize the amount of open trench length at any time on the same street. Fill trenches as soon as practical after pipe is placed in the ditch and placement and bedding is approved by the Inspector. Coordinate closing of driveways with the individual property owners. Provide adequate access to all businesses during their operating hours.

C. Width: Maintain width of trench ample to permit pipe to be laid and jointed properly, and backfill to be placed and compacted as specified in accordance with applicable construction standards.

D. Depth: Depth shall be as shown in Construction Standards, unless otherwise indicated on the Drawings. Measurements shall be made from the low side of the trench. Areas where design depth differs from standard depth will be noted on construction Drawings however minor deviations in grade are to be expected in order to avoid other infrastructure and shall not constitute as additional work or payment due the Contractor.

Natural Gas Services on Private Property: Provide a minimum of 18 inches from the top of the pipe to existing grade unless service is inserted in existing steel service line. Maintain 12 inches minimum cover over inserted steel lines verified as described in natural gas piping section.

Extra depth ditch may be required to route under existing obstructions.

Where natural gas, water or electric lines are placed such that finished grade elevation will be higher than the paralleling centerline of street elevation, the utilities shall be installed below the street centerline elevation at the depths indicated in the constructions standards unless otherwise noted on the construction Drawings.

Where crossing roadways, piping shall be installed as required by the jurisdictional agency's permit.

E. Adjacent Structures, Water, Electric, Sewer, Natural Gas Line and Telephone Cable Crossings:

1. Follow such method of course as may be approved by the Inspector in passing all underground structures.

2. Exercise extreme care in crossing or paralleling water, sewer, natural gas lines and telephone cables. Cross or parallel all structures at Contractor's sole risk and responsibility. Should any damage occur to such lines, Contractor is fully liable and will pay full cost of repairing same.

3. Make all arrangements and pay for relocation and bracing where poles or anchors are affected by the trenching operation.

F. Foundation for Pipe:

1. Grade the trench bottom as required to achieve uniform and continuous bearing and support for the pipe on solid and undisturbed earth free from rocks and other obstructions that could cause point loads throughout the length of pipe. Finish subgrade to a straight line between pipe joints.

2. Place, grade and compact to a uniform depth a minimum of six inches of specified bedding material in the ditch bottom prior to placing any pipe in the ditch.

3. Where trench excavation is inadvertently carried below specified grade, backfill with approved trench excavated material in 6-inch lifts compacted to provide a firm and unyielding subgrade.

4. Where the bottom of trench at subgrade is found to be unstable or include ashes, cinders, refuse or other organic material, excavate and remove such unsuitable material and fill according to Item 3, above.

G. Trench Bracing and Shoring: Support all trenches in accordance with all pertinent and applicable codes, rules and regulations.

H. Protect the public from any excavations left open during times when Contractor is not working.

3.02 SPOIL AREAS

A. Store no spoil off the right-of-ways or easements unless prior written permission has been obtained from the property owner and a copy of said agreement provided to the Inspector.

B. Locate and maintain off-site spoil areas for excess excavated materials. Restore these areas to satisfactory condition before final payment is approved. Provide a certificate of acceptance from the owner of the spoil area to the Inspector.

3.03 PIPE BEDDING

Pipe bedding shall conform to all applicable Construction Standards.

3.04 BACKFILL AND COMPACTION

A. Do not backfill trench until work is inspected and approval to proceed with backfill has been given by the Inspector. Complete backfilling promptly after approval to proceed.

B. Place material and compact as necessary to avoid settlement of ditch line. Fill any settled areas for a period of one year after date of acceptance by City Utilities. Restore surface as needed.

3.05 ROCK EXCAVATION

A. All blasting is performed at the Contractor's sole risk. The Contractor is solely responsible for any and all damages caused by blasting to any adjacent structure or any other underground facilities. If damage does occur to any above or below ground facilities, including other City Utilities facilities, the Contractor is fully liable.

B. All excavation is considered unclassified. Presence of rock shall not relieve Contractor of depth requirements given in paragraph 3.01. There shall be no change in the Contract Price due to rock, regardless of type or hardness unless provided for in the Bid Documents.

C. In high hazard areas, remove rock by jackhammering as necessary. Make determination of whether or not rock can be blasted, but Contractor shall be fully liable for any damages.

D. Perform all blasting in accordance with the City of Springfield's General Ordinance #4714, even for areas outside the jurisdiction of the City of Springfield. Only persons holding blasting licenses as issued by the Springfield Fire Department may perform blasting. Contractor must present areas desired to be blasted to Resident Engineer for prior approval. Upon approval contractor must obtain any necessary blasting permits and submit a copy to the Resident Engineer.

3.06 OPEN CUTTING ROADWAYS

Open cut roadways only as approved by the governing authority. If approval to open cut is not received, crossing must be installed using approved trenchless methods.

3.07 TRAFFIC CONTROL

Control traffic in accordance with the latest edition of the Manual on Uniform Traffic Control Devices and with the approval of the jurisdictional agency.

END OF SECTION

SECTION 02320

UTILITY CASINGS

PART I GENERAL

1.01 SUMMARY

A. This section applies to casing pipe installed by tunneling or trenching.

B. Casings for natural gas, water and electric lines shall be installed per applicable Construction Standards.

1.02 REFERENCES

A. Applicable Standards:

1. American Petroleum Institute (API)

   a. API 1104 – Standard for Welding Pipelines and Related Facilities
   b. API RP 1102 – Standard for Steel Casings

2. American Society for Testing and Materials (ASTM)

   a. A36 – Structural steel
   b. A570 – Hot-rolled carbon steel sheet and strip, structural quality

3. American Water Works Association (AWWA)

   a. C206 – Field welding of steel water pipe

4. Steel Structures Painting Council (SSPC)

   a. SP-3 – Power tool cleaning

1.03 SUBMITTALS

Contractor may be required to submit shop drawings for proposed casing spacers and other items specified by Resident Engineer for approval prior to shipment.

PART II

MATERIALS - All materials shall conform to current City Utilities Specifications. HDPE 4710 DR 11-13.5 black with yellow stripes natural gas piping that meets ASTM D2513 is permissible for use as casing.

PART III. EXECUTION

3.01 INSTALLATION

A. All work shall, as a minimum, meet the requirements of API RP1102, the highway, railroad or utility having jurisdiction and shall be subject to their inspection and approval.

B. Casing pipes installed by tunneling shall conform to the following requirements and Section 02410:

1. Casings rejected due to misalignment or other failures to conform to specifications shall be abandoned in place. The ends of the abandoned casing shall be capped or plugged to provide a tight seal. Casing pipe shall not be recovered for reuse.

2. Casing spacers are not required when installing polyethylene natural gas or water pipe in a polyethylene casing unless called for on the Drawings.

C. Casing pipes installed by open cut shall conform to the following requirements and Section 02315:

1. Bottom of casing may be installed on graded, compacted earth or gravel bedding.

D. Joints

1. All joints along pipe casings shall be joined to conform with the requirements of Sections 02510 and 02550. Contractor personnel will not be required to be qualified for joining casing piping.

3.02 GROUTING

A. Where voids are present the casing pipe shall be grouted per the appropriate jurisdictional requirements.

END OF SECTION

SECTION 02410

TUNNELING

PART I GENERAL

1.01 DESCRIPTION

Includes augering, boring, driving, drilling, pipe bursting, moling or other methods approved by Resident Engineer.

1.02 INSTALLATION

A. Any natural gas pipe installed by tunneling shall either be encased in a steel casing or sleeved in polyethylene natural gas pipe according to Construction Standards, except as noted in Item B.

B. Only steel natural gas pipe with polymer concrete coating over fusion bonded epoxy coating with 'Powercrete' coated joints may be installed uncased as described in the Construction Standards. Manufacturer's cure times on field applied coatings shall be strictly adhered to.

C. All water and electric facilities intended to be cased shall be noted on the Drawings and shall be installed according to the Construction Standards.

D. Optional Casing Installations: In locations where tunneling is not required by the Contract Documents, Contractor may elect to tunnel natural gas or water lines, to avoid surface restoration, but only with Resident Engineer's approval. No extra payment will be made for such tunneling and Contractor shall supply or reimburse City Utilities for supplying additional casing materials.

PART II MATERIALS AND EQUIPMENT

2.01 Drilling Fluids: All drilling fluids must be environmentally acceptable and shall be completely contained throughout the drilling process.

PART III EXECUTION

3.01 DIAMETER OF TUNNEL EXCAVATIONS

A. Perform all directional drilling in accordance with ASTM F1962 and PPI standards.

B. Maintain diameter of tunnel excavations large enough to allow insertion of the pipe without causing damage to the pipe. Diameter of tunnel excavation shall minimize the amount of annular space between the excavation and the piping.

C. Maintain diameter of tunnel excavation no more than 2 inches greater than the size of the pipe except 1 ¼" and smaller pipe may be inserted in a 4" tunnel excavation or otherwise approved by Resident Engineer.

3.02 GENERAL TUNNELING SPECIFICATIONS

A. Tunnel depth shall be at standard depth to the top of casing pipe unless more cover is required by governing jurisdictional agencies, unless otherwise noted on the Drawings.

B. Establish initial angle of tunnel excavation to maintain design depth throughout the tunnel excavation.

C. In the event of unforeseen deflections encountered during the tunnel excavation, a vertical upward deflection of up to six inches, vertical downward deflection of up to 24 inches, and lateral deflections up to 18 inches are allowed, provided there is no conflict with existing or proposed facilities. Deflections greater than this are unacceptable, and will require reboring or trenching to the appropriate depth.

D. During directional drilling, the boring head shall be located utilizing underground locating equipment capable of pinpointing the drill head. This shall be done at least once for every ten feet of drilling length in both the horizontal and vertical directions and provided to Inspector in writing.

E. Contractor shall ensure sanitary sewer main and lateral crossings are not damaged by exposing them during the tunneling process or by video camera inspection after tunneling is complete. Contractor shall also take precautionary measures to avoid damaging all other foreign line crossings (stormwater, telephone, fiber optic, etc.). Contractor shall be responsible for the repair of any damage made to existing facilities.

F. Piping installed in tunnel excavation shall be pulled back in one continuous section, as one continuous operation unless otherwise directed by Resident Engineer.

G. Contractor shall utilize a swivel or other means to minimize rotation of the pipe during pullback.

H. Contractor shall provide adequate support rollers for the pipe during pullback. Rollers and cradles shall be of a type to prevent damage to the pipe and coating and of sufficient number to prevent overstressing of the pipe due to sag bends during pullback.

I. In the event the Contractor must abandon the tunnel excavation before completion of the full excavation, the Contractor shall seal the hole per the appropriate jurisdictional agency's guidelines. The Contractor shall then complete a new tunnel excavation at no extra cost to City Utilities.

J. Observe the bend radius of the piping being installed per the applicable Construction Standards and manufacturers recommendations.

K. Tracer wire shall be attached to the pull head of the drilling rig and be installed with all natural gas and water piping. Wire used is to be in accordance with the applicable Construction Standards.

L. When pulling polyethylene natural gas or water piping the Contractor shall not exceed the allowable tensile load values for safe pullback in accordance with ASTM F1804. Contractor shall use a weak link to prevent over-stressing the pipe during pullback. A mechanical break-away connector or a one foot section of smaller SDR or diameter plastic pipe placed between the pull head and leading edge of the pipe are acceptable weak links. Below are approximate values for safe pull forces for PE4710 and PE2708 1-12 Hour Pulls.

PE 4710 1-12 Hour Pulls at 73°F*			
Safe Pull Force (lbs)			
Size (in)	SDR 11	SDR 13.5	SDR 17
1	597	-	-
2	1,947	-	-
4	-	6,602	-
6	16,440	13,644	-
8	28,282	23,471	-
12	60,167	49,933	-
16	104,547	86,764	-
18	-	-	87,961

*See Service Temperature Design Factors for temperatures over 80°F

Service Temperature Design Factors for PE 4710	
Service Temperature	Safe Pull Force Multiplier
≤ 80 F	1.00
≤ 90 F	0.90
≤ 100 F	0.80
≤ 110 F	0.71
≤ 120 F	0.63
≤ 130 F	0.57
≤ 140 F	0.50

PE 2708 1-12 Hour Pulls				
Safe Pull Force (lbs)				
Size (in)	≤ 73°F	≤ 100°F	≤ 120°F	≤ 140°F
0.75	282	257	208	178
1.25	769	700	568	485
2	1,446	1,316	1,068	912
4	5,194	4,725	3,836	3,276
6	11,258	10,241	8,314	7,101
8	19,082	17,357	14,091	12,036

M. When polyethylene pipe is being installed, an additional 5% pipe length shall be installed at the entry and exit points to allow for relaxation due to temperature. MDPE and HDPE expansion/contraction according to PPI TR-21 handbook are expected to be 1.1 inch per 100 feet per 10 degrees temperature change. Allow piping to achieve the same temperature as the ground to counter act pipe creep prior to making tie-ins at the ends of the piping. The typical relaxation time should be twenty four hours.

END OF SECTION

SECTION 02510

WATER PIPING

PART I GENERAL

1.01 DESCRIPTION Includes, but is not limited to, installation of water mains, including pipe, valves and fittings. Also includes retirement of mains and service tie-overs as shown on the drawing.

1.02 RELATED WORK DESCRIBED ELSEWHERE:

A. Work by Others, Section 01110.

B. Field Engineering, Section 01720.

C. Demolition and Clearing, Section 02220.

D. Excavation and Backfilling, Section 02315.

E. Utility Casings, Section 02320.

F. Tunneling, Section 02410.

G. Disinfection and Testing, Section 02515.

H. Paving and Surfacing, Section 02700.

I. Concrete, Section 03300.

1.03 PRODUCT HANDLING

A. Use all means necessary to protect the material before, during and after installation.

1. Handle pipe with padded forklifts, wide non-abrasive slings, padded clamps or padded pipe hooks. Pipe must be secured so that it cannot fall while being handled. Conventional chains, chain hooks and non-padded forklifts are expressly forbidden.

2. All coated steel pipe and fittings shall be stored off the ground on wooden pallets or skids.

3. Contractor is responsible for all dents, gouges, coating defects and/or dimensional variations.

B. In the event of damage, Contractor shall immediately make all repairs and replacements to the approval of the Inspector.

PART II MATERIALS AND EQUIPMENT

2.01 All materials will conform to City Utilities material Specifications unless otherwise indicated on the Drawings or in these Specifications.

2.02 INSTALLATION IN CONTAMINATED AREAS

A. When contaminated soils are encountered unexpectedly, Contractor shall immediately notify Resident Engineer. Resident Engineer may require additional precautions to

protect water quality.

2.03 All valves shall be of open right (clockwise) design.

2.04 Ductile iron valves and fittings have a protective coating that shall be protected to minimize damage. Exterior coating defects shall be repaired with petrolatum wax tape.

PART III EXECUTION

3.01 INSTALLATION – GENERAL

Install pipe in strict accordance with the manufacturers' installation instructions and laying schedules. Run true to grade and alignment as shown on the Drawings with fittings and valves at the required locations. Match and make connections to existing fittings at the points of termination of the piping system. Make tie-ins onto existing live water mains under the supervision of the Inspector using approved equipment and materials. Do not operate any valves, blowoffs or similar equipment on the existing water system of City Utilities without prior approval by the Inspector.

3.02 INSTALLATION METHODS

Install pipe by trenching as specified in Technical Specifications, Section 02315, by tunneling as specified in Section 02410, and/or by casing as specified in Section 02320.

3.03 PIPE CLEANING AND PREPARATION

A. Thoroughly clean and inspect all pipe and fittings for damage before placing in the trench. If damage to pipe is found during inspection, repair or replace the pipe as directed by the Inspector.

B. Prevent foreign material from entering the pipe while it is being installed. Allow no debris, tools, clothing or other materials in the pipe.

C. When pipe laying is not in progress for an extended period of time such as nights and weekends, close the open ends of pipe with a water tight plug. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry. Chlorine tablets may be added to the ditch water per AWWA C651 to avoid additional contamination as further described in Section 02515. Do not use hypochlorite intended for use in swimming pools. Do not lay pipe in water or when trench conditions are unsuitable.

3.04 REPAIR OF COATING

In case of damage to the protective coating or lining of ductile iron pipe, repair the pipe in accordance with AWWA C104. Repair of coating damage to epoxy coated surfaces shall be made with petrolatum wax tape.

3.05 PIPE SUPPORT AND EMBEDMENT

Support the barrel of the pipe by the granular leveling course with bell holes excavated for the bell end. Having so supported the pipe, embed it with granular material after joining pipe.

3.06 JOINING PIPE

A. Push-on Joints – In accordance with manufacturers recommendations, lay pipe with bell ends facing in the direction of laying unless directed otherwise by the Inspector. After placing a length of pipe in the trench, clean and lubricate the gasket and gasket groove. Center the spigot end in the bell. Force pipe home giving care to not over-bell the pipe, and bring to correct line and grade. Prevent dirt from entering the joint space.

B. Threaded Joints - Pipe dope or thread tape shall be applied to the threads prior to joining. Threaded joints are only to be used on 2" and smaller water lines.

C. Compression (Pack or Mechanical) Joints - Install and tighten compression fittings per manufacturer's instructions.

D. Flange joints - Assemble joints above ground and lower into trench, unless otherwise acceptable to the Inspector. Tighten bolts per manufacturer's instructions.

E. Solvent Cement Joints - Shall not be used unless indicated on the Drawings.

F. Restrained Joints - Install per manufacturer's instructions and as detailed on the Drawings.

G. HDPE connections

1. Join HDPE pipe per ASTM F2620 and Plastic Pipe Institute (PPI) TR-33/2006 "Generic Butt Fusion Joining Procedures for Field Joining of Polyethylene Pipe" www.plasticpipe.org.

2. Butt fusions are the preferred method of joining with electro fusion and socket fusion also permissible when joining HDPE to HDPE. Data loggers shall be used when performing butt fusions with a hydraulic machine. City Utilities Inspector will provide the data logger. Hydraulic butt fusion equipment shall be McElroy or pre-approved equal. When equipment other than McElroy is proposed, the Contractor will be required to supply an equivalent data logger or other approved means of capturing fusion data and providing the fusion data to City Utilities Inspector. When joining HDPE to DI or PVC piping a MJ or threaded transition fitting shall be fused to the HDPE to make the change in materials.

3. Mechanical fittings are only permissible when called for on the Drawing or otherwise called for within the Specifications. A stainless steel stiffener sized to encompass the entire bearing length of the compression fitting to the HDPE pipe is required when using approved mechanical or compression fittings.

4. All fusion joints shall be made by competent joiners who shall have been tested and approved in advance by City Utilities, and who have properly maintained this qualification. The test shall include destructive test of joints of each type to be made on the project.

5. Contractor shall make all fusions in accordance with the current manufacturer's recommended procedures.

6. Contractor shall provide an approved machine when butt fusions are to be made. Contractor shall provide all necessary tools, approved by the Inspector, to complete all required fusion. Only tools specifically designed for the joining of polyethylene water pipe shall be used. All tools shall be kept clean.

7. Contractor shall provide an approved electrofusion machine when electrofusion fittings are to be installed. Contractor shall provide all necessary tools to complete all required fusions to the satisfaction of the Inspector.

8. The pipe shall be prepared using an approved scraper designed for use with polyethylene piping. Paint-type scrapers will not be allowed unless approved by Resident Engineer.

3.07 PERMISSIBLE DEFLECTION AT JOINTS

Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb valve stems, or where long-radius curves are permitted, deflect in accordance with the manufacturer's recommendations and Construction Standards for satisfactory joining.

3.08 TIE-IN POINTS AND CROSSINGS

Expose existing casings, mains, storm drains, other utilities, and other obstacles well in advance of trenching and pipe laying to avoid abrupt changes in vertical alignment and the use of unnecessary fittings at tie-in points and crossings.

3.09 CUTTING OF PIPE

Cut pipe for inserting valves, fittings or closure pieces without damage to the pipe or cement lining and leave a smooth end at right angles to the axis of the pipe. Make all cuts in accordance with the manufacturer's instructions. Only cut 16" or larger ductile iron pipe after it has been gauged to determine if the diameter of the pipe is within tolerance at the proposed cut location. HDPE pipe shall be cut with a guillotine style cutter or a chain saw with no lubricant in the bar oiler. Other methods will require approval by Inspector.

3.10 BENDING OF HDPE PIPING:

A. Install fittings at all locations as specified in the Drawings.

B. At locations where fittings are not specifically called for, HDPE pipe may be bent to route the line as required; however, bends which would produce excessive stress on the pipe shall not be allowed. The minimum bending radius shall adhere to the appropriate water Standard. Bends of a lesser radius shall not be permitted, and an appropriate fitting (elbow) shall be installed as necessary.

3.11 SQUEEZE-OFF OF HDPE PIPING:

A. Where available, City Utilities personnel shall utilize valves to control the flow of water in HDPE pipes. However, squeeze-off may be utilized where necessary to control the flow of water.

B. Contractor shall squeeze-off pipe using a properly designed tool and shall not damage the pipe. The tools shall be equipped with appropriate gap stops. The tools shall be squared and centered on the pipe and shall be located at least three pipe diameters away from the nearest fitting or fusion joint. All squeeze-off shall be performed with the Inspector present.

C. The same location of pipe shall not be squeezed-off more than once. All squeeze-off locations shall be marked on the pipe with electrical tape.

D. After squeeze-off, pipe shall be re-rounded. All squeeze-off operations shall conform to manufacturer's recommendations.

3.12 VALVE AND FITTING INSTALLATION

A. Valves and Fittings

Set and join valves, fittings, plugs and caps to pipe in accordance with the manufacturer's recommendation. Valves shall be installed so operating nut is plumb so valve key will easily operate the valve within the box. Valves shall be installed so that the operating nut is no more than eight feet below finished grade. If the valve is more than eight feet below finished grade the Contractor shall install a valve extension shaft.

B. Valve Boxes

Install the valve box so as not to transfer surface loads directly onto the valve. Center and plumb valve box over the operating nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed by the Inspector.

C. Anchorage for Valves and Fittings

All fittings shall have suitable thrust protection as indicated on the Drawing or in the Construction Standards.

3.13 SERVICE LINES AND METER SETS

A. Water services: The minimum size of service lines shall be 1" piping from main to meter set unless otherwise called for on the Drawings. Meter sets shall be constructed per the Drawings and applicable standards. Services and meters shall be installed according to the applicable Construction Standards and Drawings. New piping shall be installed from the outlet of the meter setting to the customer's property line and tied over to the existing customer piping if it exists. No heat bending of piping material shall be allowed.

B. Fire Services: The minimum size of fire service lines shall be 2" piping from the main to the customer's property line or easement line. The customer's piping shall be considered the property line or easement line unless a fire service valve is installed, in that case, the customer's ownership will be the point immediately downstream of the valve.

3.14 LOCATOR WIRE & WARNING TAPE

A. Install tracer wire per Construction Standards.

B. Warning tape shall be installed with all water mains and services that are installed by trenching per applicable Construction Standards.

3.15 WORK EQUIPMENT AND TOOLS

Furnish work equipment and tools necessary for the installation and connection of mains.

3.16 MAIN TAPS

City Utilities will furnish equipment and labor for tapping of water mains (2"-12" tap sizes). Such work shall require a 48-hour advance notification and will not be scheduled outside normal working hours for City Utilities' crews unless prior approval has been received. Contractor shall dig and prepare excavation with shoring and traffic control as necessary. Contractor shall install tapping fitting, valve and provide hoisting equipment for installation and removal of tapping

machine. Contractor may tap newly installed HDPE mains that are not in service using an EF branch saddle and tapping with a hole saw when approved by Resident Engineer. All shavings and debris shall be removed from the main after tap is made.

3.17 RETIRED WATER LINES

A. Other than minimum lengths as shown on the drawing and where retired water main conflicts with the installation of this projects' improvements, Contractor may leave retired water main in place. Contractor may elect to remove old main, in which case pipe shall become Contractor's to salvage. However, backfill, compact and restore all excavations performed in removing old pipe according to the Contract requirements, which may include backfilling with granular material under proposed or existing roadway areas and cleanup of established areas. No payment will be made to the Contractor for this pipe removal and excavation and restoration.

B. Plug and seal ends of all retired water lines with caps or plugs.

C. When necessary to complete installation of this project's improvements, remove retired water mains, services and meter pits, backfill and restore area per Contract requirements at no additional charge.

D. Retire asbestos cement (AC) pipe per Missouri Department of Natural Resources (MoDNR) requirements and as specified within this Section.

3.18 SERVICE RENEWALS AND TIE-OVERS

A. Install new meter set and new meter tile per standards, retire existing service and install new customer service piping from the outlet of the meter tile to behind the property line to reconnect the customer's piping per applicable standards. Meters shall be installed as close as practical to the customer's property line or easement line.

B. All plumbing work shall conform to all applicable code requirements.

C. Coordinate with Inspector regarding the routing of the customer line and the scheduling of the work.

D. Services shall be completely renewed main to meter and backside of service tied to customers piping as called for within this Specification unless specifically called out to remain and be tied over to the new main on the Drawings.

3.19 RETIREMENT OF EXISTING SERVICES AND METER SETTINGS

A. Where services are called to be retired, retire at the main by closing the curb stop valve and install locator marker ball. Where services are being retired as part of ongoing construction, install a section of one inch pipe vertically over the corporation stop one foot above the top of the corporation stop to serve as a marker. When the main is also being retired physical retirement of the services at the main is not required. Remove meters from the existing setting and return to City Utilities. Remove rings and lids for reuse in relocated service installations or for return to City Utilities material yard. When retiring a meter tile, the elevation shall be adjusted to a position below grade backfill according to Section 02315 and restore surface per Section 02700 or Section 02900.

B. When service lines and meter sets not shown on the Drawings are encountered during the course of construction, notify the Inspector to determine whether service is to be replaced or abandoned.

.

3.20 REMOVAL OF DAMAGED PIPE

A. HDPE pipe found to have surface damage at a depth equal to or greater than 10% of the wall thickness, as determined by the Inspector, shall not be acceptable. Contractor shall cut out and replace with undamaged section of HDPE pipe, at the expense of the Contractor.

B. Other piping materials found to have damage unacceptable to the Inspector, shall be cut out and replaced with undamaged pipe at the expense of the Contractor.

3.21 ASBESTOS CEMENT PIPE REPAIRS, DEMOLITION, AND DISPOSAL

Contractor is being made aware that work on asbestos cement (AC) pipe is governed by OSHA regulations and that compliance with OSHA regulations is the sole responsibility of the Contractor. Work on AC pipe shall only be performed by OSHA trained personnel overseen by a "competent person" as defined by OSHA. Contractor shall be or retain a Registered Asbestos Contractor with the Missouri Department of Natural Resources. Additionally, all work shall be in accordance with EPA's *National Emission Standards for Hazardous Air Pollutants (NESHAP),* EPA's *Governmental Employee Worker Protection Rule, and Missouri DNR's Air Asbestos Rule*.

A. Excavation - When excavating an AC water main, take precautions to prevent the backhoe teeth from scraping or gouging the pipe. Use a spotter to warn when the pipe is first exposed. Use heavy equipment to excavate laterally down to and around the pipe, and then complete the job by hand. This is especially important if the pipe is to be retired and removed.

B. Pipe Preparation - AC pipe must be kept wet at all times while cutting, scraping, chipping, or otherwise abrading the pipe. Water mixed with a surfactant (soap, detergent or other agent, designed to reduce surface tension of the water) must be used to wet the pipe. A Hudson type sprayer shall be used to apply the solution. The solution shall be applied frequently to areas of the pipe being abraded.

C. Cutting - Asbestos-containing pipe shall ***never*** be cut with a high-speed mechanical saw. Pipe shall be severed with a hand-operated pipe cutter or uncoupled and removed in entire joint lengths.

D. Coring (tapping) - When tapping into an AC pipe, do not use high-speed mechanical boring equipment. Minimize dust by using a hand-operated drill or auger. If the tapping hole is too large for a hand drill, use an electric drill specially equipped with a HEPA vacuum attachment. Treat all collected dust, crumbs, coupons, etc. as asbestos waste by collecting in and/or on plastic bags and sheeting.

E. Retirement/Removal - Unless otherwise indicated on the Drawings, all existing AC pipe shall be abandoned in place. "Abandoned in place" pertains only to those sections of pipe that have not been moved from their location of original installation. Pipe sections that have been removed or disconnected from their installed position must be removed from the trench and properly disposed of. Pipe sections and fragments removed from the trench must be immediately packaged for disposal and moved to a secure location. This may entail placing directly into a lined roll-off container and/or double wrapping or bagging individual pieces of pipe and/or pipe fragments in 6-mil plastic bags or sheeting. A

locator marker ball shall be placed at all locations where asbestos pipe has been exposed. All cost for the proper disposal of AC pipe shall be borne by the Contractor.

F. Decontamination - All tools and equipment used during the maintenance of the AC pipe shall be thoroughly cleaned with soap, water, and disposable towels. All materials such as towels used for cleaning, gloves, or plastic sheeting that becomes contaminated with asbestos containing material shall be packaged and disposed of properly.

G. Disposal - Contractor is responsible for ensuring all sections and pieces of AC pipe and materials that cannot be abandoned in place are properly packaged and disposed of at a licensed solid waste landfill approved by City Utilities. If desired, City Utilities will provide guidance to the Contractor on the landfill's waste approval process. However, costs for disposal are borne by the Contractor, unless otherwise indicated on the Drawings or in these Specifications. Contractor will document disposal by providing to City Utilities the waste manifest(s) signed and returned to the Contractor by the landfill representative.

H. Reporting - Contractor is responsible to report to City Utilities information necessary for reporting compliance to Missouri Department of Natural Resources. Contractor shall supply the name of the competent person who is performing any work on the pipe or any pipe removal, transport and disposal. The contractor shall provide the name and location of the disposal facility. This information shall be submitted to City Utilities Environmental Affairs at least 20 days prior to work on the pipe.

END OF SECTION

SECTION 02515

DISINFECTION AND TESTING

PART I GENERAL

1.01 This covers disinfection and testing of the water distribution system. City Utilities of Springfield will perform the disinfection and testing procedure after the contractor has completed the pressure test.

PART II MATERIALS AND EQUIPMENT

2.01 Contractor shall supply all necessary materials and equipment for the work described in Part III.

PART III EXECUTION

3.01 TESTING

A. Preventative Measures During Construction

During construction, the interior as well as all sealing surfaces of pipe, fittings, and other accessories should be kept as clean as possible. Inspect the interior of all pipes prior to installation. If dirt enters the pipe, it should be removed and the affected interior of the pipe swabbed with a 1%-5% chlorine solution. All openings in pipelines should be closed with watertight plugs whenever the trench is unattended. Plugs should be treated with a 1%-5% chlorine solution prior to being inserted into the mains to avoid contamination. Likewise, fittings such as tapping fittings, valves, leak clamps, etc. shall be swabbed or sprayed with a 1%-5% chlorine solution to prevent contamination. Sealing, lubricating, or gasket materials used in pipe installation should be stored and handled in a manner that avoids contamination and be suitable for use with potable water. During construction, standing water in the trench that has the potential to enter open pipe ends should be treated with calcium hypochlorite tablets not intended for use in swimming pools according to AWWA 651 to ensure contaminants are not introduced into the pipe.

B. Preliminary Flushing of Mains

Before pressure testing and disinfection, the main should be completely filled with water from the low point to the high point when possible, to eliminate air pockets and then flushed to purge the line of dirt and debris. The initial fill should be done slowly in order to eliminate all air pockets. The flow rate should not exceed 1 ft/s. All air relief valves, hydrants, and other access points should be opened during initial fill in order to ensure all air has been expelled. Ineffective removal of dirt and debris from lines prior to disinfection often leads to failed bacterial tests, requiring repeated disinfection. Preliminary flushing should follow the initial slow fill and should be done to achieve a flow rate of at least 2.5 ft/sec to scour the main and remove all foreign material. The initial fill shall be performed by the Contractor with the Inspector present. Preliminary flushing shall be performed by City Utilities Water Operations. Times shall be recorded for calculation of the amount of water used.

The following table shows the required flow rate to obtain a velocity of 2.5 ft/sec in commonly used sizes of pipe.

Flow Rates for Filling & Flushing

Pipe Size (inches)	1.0 ft/s Fill Velocity Flowrate (gpm)	2.5ft/s Flushing Velocity Flowrate (gpm)
2	10	25
4	39	98
6	88	220
8	157	391
12	352	881
16	626	1566
24	1409	3523
36	3171	7927
48	5637	14,093

C. Hydrostatic Testing

The purpose of the hydrostatic test is both to test for the ability of the pipeline to withstand the applied pressure and to test for leakage. Hydrostatic tests shall be conducted in accordance with the following:

Pipe Material	Criteria
HDPE	AWWA C906, 651 & Manual M55; PPI Handbook of Polyethylene pipe 2nd edition, ASTM F2164
PVC	AWWA C605, C900, & Manual M23
Ductile Iron	AWWA C600 & Manual M41

Pressure testing shall not begin until all concrete thrust blocks, collars and restraint have cured to achieve the desired compressive strength. After the pipe has been laid, the main shall be filled slowly from the low point to the high point when possible and all air purged from the line through available hydrants, blow offs, and air relief valves. Once all air has been removed close air reliefs and other valves. The maximum length of piping to be tested at once shall be 2500 feet unless approved by Resident Engineer. The main shall be tested at 150 psi gauged at the highest elevation of the water main under test or corrected for the elevation of the test gauge if not at the high point. A calibrated liquid filled gauge shall be used that has increments of 2 psi or less.

The following formula shall be used to correct for the elevation difference between the high point of the section being tested and the location of the testing pump and gauge:

$$\text{Test Pressure} = 150\ (\text{psi}) - \frac{[\text{high pt. elevation (ft.)} - \text{Test gauge elevation (ft)}]}{2.31\ (\text{ft/psi})}$$

If extreme terrain differences are encountered on the project the piping pressure test shall be done in segments to ensure that no segment is pressure tested more than 1.5 times the systems design pressure rating.

a) Procedure for PVC and DI Water Mains:

Gradually pressurize the test section to 150 psi at the highest point of the test section and maintain that pressure for two (2) hours or for the duration called for by the Resident Engineer. Add and measure make-up water as required to maintain test pressure. Clean potable water from an uncontaminated container shall be used for make-up water. Monitor and record the amount of make-up water utilized and document on the as-built drawing. Ensure that the amount of makeup water used to maintain the test pressure does not exceed the maximum allowable leakage in the applicable AWWA standards or as

calculated for each pipe size in the test section based on length. Use the table below to calculate the allowable makeup water volume for standard 150 psi test. Any allowable leakage noted on the Drawing is calculated for the entire piping length for the project.

Main Size	Maximum Allowable Make up Water PVC or DI Mains (gallons per hour per 1000 feet)
8	.66
12	.99
16	1.32
24	1.99
30	2.48
36	2.98
48	3.97

$$\text{Maximum Allowable makeup water (gal/hr)} = \frac{(\text{length})*(\text{diameter})*\sqrt{(\text{test pressure})}}{148{,}000}$$

If the test indicates leakage greater than the maximum allowable rate, locate and repair the defect. Run tests again after correction is made until leakage is within the allowable rate. Furnish all necessary labor and equipment for testing.

b) Procedure for HDPE Water Mains:

The test procedure for HDPE consists of an initial expansion and a test phase. Gradually pressurize the test section to 150 psi at the highest point of the test section adding make-up water as required to maintain test pressure for up to four hours. The test section pressure may be stabilized and the pipe expansion accomplished in less than the allotted four hour period but a minimum of one hour shall be used for the expansion period in all cases. After the expansion period (1-4 hours) is completed, the pressure shall remain steady for an additional one hour at the test pressure. If leaks are discovered, depressurize the test section before repairing leaks. Correctly made fusion joints should not leak. Leaking joints shall be cut out and replaced and retested.

If the pressure test is not completed due to leakage or other events, the test section should be depressurized for at least eight hours before retesting begins. Furnish all necessary labor and equipment for testing.

D. Tracer Wire Testing

Test tracer wire to verify a continuous signal on the wire. Contractor shall dig up and repair tracer wire where the signal isn't continuous.

E. HDPE Destructive Testing

City Utilities reserves the right to perform destructive testing on up to 10% of the HDPE fusion joints installed by the Contractor on the project. Contractor is responsible for cutting out the joint identified by the Inspector or Resident Engineer and replacing the section removed with a new section of fused HDPE pipe. The pipe joint shall be tested using a side-bend test. If the pipe joint fails, the Contractor shall be responsible for additional testing.

3.02 DISINFECTION

A. Disinfection of the water main and appurtenances shall be done in accordance with AWWA C-651 latest revision and this specification under the supervision of the City Utilities Inspector and Water Technician. After the pressure test, the Inspector will make arrangements with Water Operations to disinfect the installed lines. Contractor shall give City Utilities notice 48 hours in advance of the need for disinfection.

B. Perform disinfection operations after hydrostatic pressure tests have been completed. Do not perform disinfection until all line segments are ready for disinfecting, unless otherwise directed. Use no water from a new main for any purpose until disinfection is completed and accepted. City Utilities shall place out of service rings on all valves and fire hydrants until the main has been disinfected and ready for service.

C. Install and remove sample assemblies per construction drawings and standards to allow the main to be disinfected and sampled as directed by the Inspector. Points to sample the main will be required every 600 feet and at the end of all branch mains at a minimum. Service taps may be utilized as sample assembly points when appropriately located. Sample assembly to be shut off and the riser pipe cut and capped as close as possible to the main when retiring sample assembly. Provide a blow-off at the end of the main being disinfected to provide a means of flushing. Blow-off and sample assembly details are shown on the Standard Drawings.

D. Pretreatment of valves, sleeves, tees, and other fittings that present areas that can hold sediment or debris is encouraged. They should be treated with a 1%-5% chlorine solution prior to or during assembly. Tie in sections of piping or short segments of piping that do not lend themselves to standard disinfection shall be swabbed with a 1%-5% chlorine solution to provide disinfection.

E. All water mains shall be disinfected by City Utilities using the continuous feed method in accordance with AWWA C651 except as noted otherwise. The slug method prescribed in AWWA C651 may also be used with prior approval from the Resident Engineer when placing a main back in service in a quicker time frame is necessary. The continuous feed method that should be followed is described as follows: Sodium Hypochlorite in a liquid form shall be injected to perform the disinfection of the line. A chlorine solution may also be mixed using granular calcium hypochlorite to be injected into the water lines. The chlorine injected shall be no lower than 1% available chlorine (10,000ppm) and no higher than 10% available chlorine (100,000ppm). Chlorine shall be injected at the beginning of the main being tested through a sample assembly located within four feet from the main feed valve supplying water. The feed valve supplying water shall be opened just enough to produce a very low flow (not a heavy stream) through the main exiting at the blow-off or hydrant at the end of the line. The chlorine solution shall then be constantly injected by pumping while the concentrations of chlorine are tested to ensure a consistent concentration throughout the main is achieved. Sampling of the chlorine concentration during injection should start at the sample assembly located closest to the injection point then moving away from the injection point toward other assemblies and to the end of the main. Injection is complete once testing at all sample assembly locations (at least every 600 ft. and at the end of all branch mains) have indicated that chlorine concentrations are at least 25 ppm. This shall be verified once injection has ceased. When stopping the injection process the feed valve supplying water shall be shut off first followed by the chlorine feed. The blow-off or hydrant at the end of the line should be closed as soon as the injection has stopped. The chlorine concentrations shall be no lower than 10 ppm 24 hours following the injection. The results of this testing shall be provided to the Resident Engineer. The highly chlorinated water used for disinfection shall not remain in the water main longer than ninety six hours.

City Utilities may use high-test chlorine tablets to disinfect new water mains less than 50’

in length. The tablets can be secured to the top of each section of pipe with an approved food grade adhesive during main installation to supply the chlorine for disinfection. Use a minimum of one tablet per inch of pipe diameter per joint of pipe, up to 12" diameter pipe, based on the rate of ¼ once tablets with 65% available chlorine. Do not use the tablet method with polyethylene (HDPE) pipe or if trench water or foreign material enters the main. The use of 90% available chlorine tablets is not allowed. Store chlorine tablets in a sealed, opaque container until immediately before use.

F. Following disinfection, City Utilities Water Technician will flush and chemically de-chlorinate as needed the treated water from the line at all extremities until water in main has comparable chlorine residuals to surrounding system mains. The water in the main will then be sampled by the Water Technician 24 hours later at points at least every 600 feet and at the end of all branch mains, and examined for contamination per AWWA standards. Water will be sampled by the Water Technician a second time after another 24 hour retention period for contamination. During the sampling process water will not be flushed from the main except what is necessary to flush the sample assembly piping in order to retain the same water in the installed water pipe for the full sampling process. The feed valve may be opened slightly during the process if necessary to maintain pressure to obtain samples. After two consecutive sets of acceptable water quality samples, the main will then be approved and final tie-ins authorized to be made to the distribution system. Consideration shall be given by the Contractor for runoff water during the flushing process. Results of all water quality tests shall be provided to the Resident Engineer.

G. City Utilities will flush and sample a new main up to two times or four total quality sample tests. If water quality tests are still failing, the above disinfection process will be repeated. If the main still does not pass the water quality tests City Utilities may require the Contractor to pig the water main and continue to repeat the disinfection process until the main passes the quality tests. The Contractor will provide all labor, equipment, and all materials necessary to pig the main. This process shall continue until two consecutive water quality tests yield good results. Pigs used shall provide a general sweeping and swabbing of the line. They shall be foam (1-2lb/cubic foot density) with urethane coated nose cone wrapping and urethane rear sealing. Pigs should be able to pass through reduction of up to 60% to 65% of cross sectional area of nominal pipe. Pigs shall be able to traverse standard piping configurations such as 90° elbows, tees, crosses, wyes, gate valves, and ball valves. Contractor shall be responsible for all pigging activities including but not limited to breaking down of the line to insert and remove the pig, tracking of the pig, removal of stuck pig, disposal of the pig and material removed from the line.

3.03 CONTINUITY OF SERVICE

Prior to closing any valves, notify all affected customers 24 hours in advance and state how long the service will be curtailed. Cause no customer to be without service for more than eight hours. Schedule all tie-ins and other operations affecting customer service only as approved by the Inspector. Carefully plan such operations in advance, verify materials and conditions, and work continuously until all customers are in service. Some off-hour work and overtime labor may be required to avoid causing unnecessary hardship for business, schools, etc. Contractor shall bid accordingly.

END OF SECTION

SECTION 02550

MECHANICAL – NATURAL GAS PIPING

PART I GENERAL

1.01 DESCRIPTION: Includes, but is not limited to, installation, retirement and/or relocation of natural gas mains and services, including pipe, valves and fittings.

1.02 RELATED WORK DESCRIBED ELSEWHERE: Section 02220, Demolition and Clearing, Section 02315 Excavation and Backfilling, Section 02410 Tunneling.

1.03 PRODUCT HANDLING:

A. Use all means necessary to protect the material before, during and after installation.

1. Handle pipe with padded forklifts, wide non-abrasive slings, padded clamps or padded pipe hooks. Pipe must be secured so that it cannot fall while being handled. Conventional chains, chain hooks and non-padded forklifts are expressly forbidden.

2. Use wooden skids or padding for material storage. All steel pipe and fitting shall be stored off the ground on wooden pallets or skids.

3. Contractor is responsible for all dents, gouges, coating defects and/or dimensional variations.

B. In the event of damage, immediately make all repairs and replacements to the approval of the Inspector.

PART II PRODUCTS

2.01 Unless otherwise indicated on project Specifications, plastic natural gas pipe, along with plastic valves and fittings, shall be (polyethylene) PE 2708 material, and steel natural gas pipe shall be API5L Grade B or X42 with fusion bonded epoxy coating.

PART III EXECUTION

3.01 INSTALLATION – GENERAL:

Contractor shall install natural gas mains and services to make all required interconnections and at required grades with all fittings and valves at the required locations.

3.02 INSTALLATION METHODS:

A. Install natural gas pipe by trenching as set forth in Section 02315, Excavation and Backfilling; by tunneling, as set forth in Section 02410, Tunneling; or by Insertion.

B. The minimum allowable depth for a service line to be inserted on private property shall be 18” for insertion through plastic service lines and 12” for insertion through steel service lines. The minimum depth on Right of Way shall be 18”.

3.03 PIPE CLEANING:

A. Prevent foreign material from entering the pipe while it is being installed. If the pipe laying crew cannot put the pipe into the trench without getting foreign material in the pipe, then a heavy, tightly woven canvas bag of suitable size shall be placed over each

end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

B. When pipe laying is not in progress, close the open ends of pipe with a watertight plug or other approved means. This provision shall apply during meal breaks as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry. Pipe shall not be laid in water or when trench conditions are unsuitable.

3.04 NATURAL GAS MAIN DEHYDRATION:

A. Contractor shall be responsible for installing natural gas piping in a manner that does not allow water to enter the pipe. If the Inspector determines there is water in any natural gas piping two inches or larger in diameter, the Contractor shall be responsible for pigging that pipe in a manner approved by the Resident Engineer. The pipe shall be pigged repeatedly by the Contractor until the Resident Engineer has determined that the pipe is sufficiently dehydrated.

B. Pipeline pigs shall be Girard Poly Pig YBS-B, KRG or equal. Contractor shall supply all pigs. Inspector shall inspect pig after passage through pipe to determine if that pig may be reused.

C. Contractor shall be responsible for blocking passage of pig into pipes which do not need to be pigged. If pig passes into a pipe which does not need to be pigged, or if pig becomes stuck in the pipe, the Contractor shall retrieve the pig at his own expense, including but not limited to any excavation, pipe repair and landscape or pavement restoration.

D. If there is water in any natural gas piping, the Contractor shall be responsible for dehydration of the line as directed by the Inspector and to the Inspector's satisfaction.

3.05 STEEL PIPE JOINING METHODS:

A. City Utilities shall perform all joining of steel pipes and fittings, unless otherwise noted in the Bid Documents. When the Contractor is required to join steel pipe and fittings it shall be done by the shielded metal arc welding process and the following requirements shall apply:

B. Welding procedures:

1. All welding, including welder qualification testing, shall be done following City Utilities written welding procedure specification (which complies with API 1104), or Contractor may submit for approval his own written welding procedure and procedure qualification records with his bid documents. Resident Engineer shall determine acceptability of submitted procedures based on API 1104 in advance of welder qualification testing. If Contractor has submitted his own procedure, he must have his procedure qualified per API 1104 as in Item B.2 below.

2. All welding shall be done by competent welders who shall have been tested by an AWS certified welding inspector approved by City Utilities. The welding test shall comply with the requirements of the Missouri Public Service Commission Regulations and API 1104 and shall be administered by a welding inspector certified by the American Welding Society to have complied with the requirements of Section 6.1 of AWS QC1-88, "Standard for AWS Certification

of Welding Inspectors." A list of companies with certified welding inspectors approved by City Utilities will be made available to the Contractor upon request.

The Contractor shall arrange and pay for all welder and procedure qualification testing. This expense is coincident with the installation of steel natural gas main and shall not be considered grounds for additional charge to City Utilities. Welders shall perform a 12 inch multiple qualification test in accordance with API 1104 and have the results documented on a City Utilities approved form.

Contractor may choose to use an AWS inspector or testing company other than those listed by City Utilities but must obtain approval in advance from Resident Engineer.

3. No natural gas materials will be issued to the Contractor until the welding procedure and the minimum number of welders required by that procedure have been tested and then approved by Resident Engineer. City Utilities will provide pipe for weld tests from the storeroom at 1402 N. Newton. Contractor shall be responsible for cutting pipe nipples to length and picking up the pipe for the tests.

4. Welders must have natural gas or petroleum pipeline welding experience or have been previously qualified by City Utilities or MANGO.

5. Contractor shall furnish all oxygen, acetylene, fuel, welding rod, welding machines, beveling machines, weld clamps, all tools and other material required for welder qualification testing and welding work. Welders using defective or deficient equipment or lacking these necessary tools will not be tested.

6. If welding is interrupted during weather conditions which may cause uneven or accelerated cooling of the weld, the joint shall be wrapped with insulating material and the weld joint shall be preheated when welding resumes. Weld must be preheated, if required by the Welding Procedure Specification.

7. Short "pup" joints must be a minimum of one pipe diameter, or 24" whichever is longer.

C. Welding Codes:

All welding must comply with the requirements of the following codes and standards:

1. Missouri Public Service Commission Pipeline Safety Regulations, 4 CSR 240-40.030, Section (5) "Welding of Steel in Pipelines."

2. Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, Part 192, Subpart E and Appendix C.

3. API Standard 1104, Standard for Welding Pipelines and Related Facilities, latest edition.

4. ASME/ANSI B31.8. – Code for Pressure Piping.

5. Any other applicable local, state or federal regulations or codes.

D. Welding Equipment:

1. All machines and equipment used in connection with the welding work must be kept in good mechanical condition.

2. Non-arcing clamps are required for all pipe welding.

E. Preparation for Welding:

1. Field beveling of pipe ends: All steel pipe which is field cut must have the ends properly beveled per API Standard 1104, latest edition, before welding. Bevel the pipe ends by machine tool or machine oxygen cutting. The beveled ends should be smooth and uniform and dimensions shall be in accordance with the approved welding procedure. Mitered joints are not acceptable.

2. 90° welding elbows cut to make elbows of lower angle must be rebeveled as specified above. Elbows thus produced must have an inside arc length (crotch) of at least 1-inch.

3. Welders must shield from weld splatter the fusion-bond epoxy coating of pipe beyond the 2-inch cutback and alignment clamp by wrapping coated area with a leather protector.

4. Contractor shall provide protection for welders while working during cold, rainy or stormy weather, or other adverse weather conditions (blowing sand and dust, etc.) to assure good quality welds. Welding will not be done when the Inspector judges that weather conditions are severe enough to impair quality of the welds. Multiple welders may be required if the size of the pipe and the weather conditions dictate.

5. Prior to alignment, the beveled ends of each joint of pipe shall be thoroughly cleaned of paint, rust, mill scale, dirt or other matter.

6. Longitudinal seams of successive lengths of pipe shall be offset by a minimum 25 percent of the pipe diameter.

F. Repair of Defective Welds:

1. If non-destructive or visual inspection indicates a weld is defective, the Contractor shall cut a cylinder of pipe from the pipeline containing the defective weld and replace it with good pipe, welded properly, at no additional charge.

2. The Contractor may also elect to repair the weld in accordance with requirements of Section 7.0 of API Standard 1104, except all cracked welds shall be cut out and replaced as in F.1 above.

G. Arc Burns:

1. Contractor shall take necessary measures to avoid arcing between ground leads of the welding machines and the pipe or fittings. Striking the arc on the pipe or fittings at any point other than the welding groove shall not be permitted.

2. All arc burns on the pipe shall be removed by cutting out that portion of pipe as a cylinder and replacing with good pipe at no additional charge to City Utilities.

3. Arc burns in fittings, valves and tie-in welds may be repaired by grinding with prior authorization by the Inspector. The area repaired by grinding shall be checked for complete removal of the arc burn and metallurgical notch. The remaining wall thickness must then be verified.

3.06 FIELD BENDING OF STEEL PIPE:

A. The minimum radius of curvature for all diameters of steel pipe shall be 1553 times the outside diameter of the pipe.

B. Field bending of steel pipe below the minimum radius of curvature shall not be allowed unless otherwise specified in the bid documents.

3.07 REMOVAL OF DAMAGED PIPE

A. Natural gas pipe found to have surface damage at a depth equal to or greater than 10% of the wall thickness, as determined by the Inspector, shall not be acceptable. Contractor shall cut out and replace with undamaged section of pipe, at the expense of the Contractor

B. Other natural gas fittings or materials found to have damage unacceptable to the Inspector, shall be cut out and replaced at the expense of the Contractor.

3.08 PROCEDURES FOR COATING JOINTS AND FITTINGS AND REPAIRING ALL AREAS OF COATING DAMAGE ON STEEL PIPE:

A. Pipe shall be jeeped and holidays repaired prior to lowering into trench. Clean the outside of the area to be protected of all foreign substances such as dirt, scale or rust. Remove oil or grease by a solvent. Coat the area per Construction Standards or as otherwise indicated on the plans. Allow coated areas to air dry completely before being backfilled.

B. All pipe coatings shall be applied in accordance with manufacturer's recommended procedure, specifically including the recommended use of primers.

C. Field applied polymer concrete shall be used to coat joints on polymer concrete coated steel pipe for uncased bores. Coating shall be allowed to cure completely prior to insertion through the bore hole. Coating may not be applied to welds that have been made within the previous fifteen hours.

3.09 LOWERING-IN:

A. Steel pipeline shall be lowered into the ditch following field coating of weld joints and after pipe and coating have been inspected and approved by Inspector for lowering in. Adequacy of equipment used for lowering-in shall be subject to the approval of the Inspector.

B. During lowering-in, pipe shall be handled by use of rubber tire rollers or lowering-in belts of proper design to prevent damage to the coating.

C. Lowering-in must be done gradually and uniformly so as to allow even distribution of the total weight of the pipe to avoid undue stress on the pipe and to prevent damage to the pipe coating. Do not drop or subject the pipe to impact.

D. Remove all debris, skids, welding rods, etc. from the bottom of trench before lowering the pipe.

E. After lowering-in, the pipe coating shall be inspected for possible damage. If the pipe coating has been damaged, the pipe shall be raised again, inspected by jeeping, and the coating repaired.

3.10 PLASTIC PIPE JOINING METHODS:

A. Polyethylene pipe shall be joined by heat fusion or electrofusion. Joining of similar types of pipe shall typically be made by heat fusion. All joints consisting of dissimilar types of pipe shall be by electrofusion. Mechanical fittings are only permissible for temporary installations or when called for on the Drawings or otherwise called for within the Specifications.

B. All fusion joints shall be made by competent joiners who shall have been tested and approved in advance by City Utilities, and who have properly maintained this qualification. The test shall comply with the requirements of the Missouri Public Service Commission Regulations. The test shall include destructive test of joints of each type to be made on the project.

C. Heat Fusion Procedures:

1. Contractor shall make all fusions in accordance with City Utilities current recommended procedures.

2. Contractor shall provide all tools and an acceptable butt fusion machine capable of fusing all sizes of piping for the project. All tools shall be electrically heated only. Fuel-fired tools shall not be acceptable. Only tools specifically designed for the joining of polyethylene natural gas pipe shall be used. All tools shall be kept clean.

3. Data loggers shall be used when performing butt fusions with a hydraulic machine. City Utilities Inspector will provide the data logger. Hydraulic butt fusion equipment shall be McElroy or pre-approved equal. When equipment other than McElroy is proposed, the Contractor will be required to supply an equivalent data logger or other approved means of capturing fusion data and providing the fusion data to City Utilities Inspector.

D. Electrofusion:

1. Contractor shall provide all tools and an acceptable electrofusion machine capable of fusing all sizes of piping for the project.

2. The pipe shall be prepared using an approved scraper designed for use with medium density polyethylene piping. Paint-type scrapers will not be allowed.

3.11 VALVE AND FITTING INSTALLATION:

A. Contractor shall set valves and fittings and join to pipe as shown on the Drawings and Construction Standards.

B. Contractor shall install a valve box for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The box cover shall be flush with the surface of the finished grade or as directed by the Inspector.

3.12 BENDING OF POLYETHYLENE (PLASTIC) PIPE:

A. Install fittings at all locations as specified in the Drawings.

B. At locations where fittings are not specifically called for, plastic pipe may be bent to route the line as required; however, bends which would produce excessive stress on the pipe shall not be allowed. The bending radius shall adhere to the manufacturer's recommendations and the Natural Gas Construction Standards. Where bend radius will not conform to the Construction Standards and manufacturer's recommendations, an appropriate fitting (elbow) shall be installed as necessary.

3.13 CUTTING OF POLYETHYLENE (PLASTIC) PIPE:

A. Cut pipe square and remove all burrs and cuttings prior to joining.

B. Pipe may be cut with a hacksaw or carpenter's saw, or a specifically designed plastic pipe cutter may be used.

C. Standard metal pipe wheel-cutters are not acceptable.

3.14 SQUEEZE-OFF OF POLYETHYLENE (PLASTIC) PIPE:

A. Where available, City Utilities personnel shall utilize valves to control the flow of natural gas in plastic pipes. However, squeeze-off may be utilized where necessary.

B. Contractor shall squeeze-off pipe using a properly designed tool and shall not damage the pipe. The tools shall be equipped with appropriate gap stops. The tools shall be squared and centered on the pipe and shall be located at least three pipe diameters away from the nearest fitting or fusion joint. All squeeze-off shall be performed with the Inspector present.

C. The same location of pipe shall not be squeezed-off more than once. All squeeze-off locations shall be marked by wrapping the pipe with electrical tape.

D. After squeeze-off, pipe shall be re-rounded. All squeeze-off operations shall conform to ASTM F1041, latest revision.

3.15 LOCATOR WIRE:

A. Contractor shall install locator wire with all plastic main and service piping, except with plastic pipe inserted in steel pipe. When inserting in steel pipe the tracer wire shall be thermite welded to the casing pipe per Construction Standards to provide continuity. Plastic service lines that do not have existing tracer wire shall be replaced with a new service line with tracer wire. Contractor may elect to pipe burst the existing service line if it is of sufficient depth, and install a casing with tracer wire attached to the outside along with a new service line.

B. Installation shall be as indicated in Construction Standards.

C. Contractor shall connect wire to existing locator wire where present. Do not connect wire to any existing steel natural gas mains remaining in service. Connect wire utilizing a direct bury splice kit.

3.16 CATHODIC PROTECTION, ANODES AND TEST STATIONS:

A. Contractor shall replace damaged anodes and test stations and install new magnesium anodes and test stations at points designated on the Drawings per City Utilities Standards. The Inspector shall be present when test stations are installed.

B. Contractor shall connect test wires and anode wires to the natural gas line by thermite welding (cad welding) in accordance with City Utilities Construction Standards. Maximum charge to be utilized in the thermite welding procedure shall be 15 grams. Any procedure which is deemed harmful to the natural gas line will not be permitted. Fast quenching with water to achieve a quick cool down is not permitted.

C. Cutting of the steel portion of "Anodeless" risers is not allowed.

D. Contractor shall coat the thermite welded area per City Utilities Construction Standards.

3.17 PRESSURE TESTING:

A. New Installations:

1. Contractor shall subject all new piping installed to an air or nitrogen pressure test unless otherwise specified in the Contract Documents.

2. Contractor shall test all mains to be operated at 60 psig or less at 90 psig for a minimum of one hour or as directed on the Drawings or standards.

3. Contractor shall test all services at 90 psig for a minimum of fifteen minutes. Long or larger services may require additional time, per Construction Standards.

4. Contractor shall provide all material and equipment required for the pressure tests. Provide and install any required gauges and charts. Gauges shall be accurate to within one percent and shall register the applicable test pressure near the center of the scale.

5. Inspector shall determine acceptability of all pressure tests, including the calibration history of all gauges used.

B. Final Tie-Ins: Soap test all final connections which cannot be air pressure tested after the tie-in section is pressurized with natural gas.

C. Inspector may also test any of the work after it is pressurized with natural gas leak detecting equipment.

D. Leakage: If any of the above described tests on new installations result in leakage, the defective pipe, joint or fitting shall be located and repaired, and tests shall be made again after the correction is made.

3.18 PRESSURE CONTROL WORK:

A. Tapping and Stopping of Steel Mains:

1. All steel mains shall be tapped or stopped using the appropriate pressure control fitting.

2. Contractor shall furnish all equipment and labor required to place equipment and materials in advance of and as-needed by City Utilities Pressure Control personnel, including digging, hoisting, bolting and welding. City Utilities shall

be responsible for welding on all pressure control fittings unless indicated otherwise in the Bid Documents.

3. City Utilities Pressure Control personnel shall provide labor and equipment to make the tap or stoppling on 12" diameter and smaller piping with pressure 150 psig or less. When tapping or stoppling work is to be performed on mains larger than 12" or on mains operating above 150 psig, Contractor shall secure the services of an approved company to perform the operations. A list of approved companies is available from Resident Engineer.

B. Squeeze-Off of Polyethylene (Plastic) Mains and Services:

Contractor shall provide all necessary tools and labor to squeeze-off new and existing plastic mains and service, utilizing procedures as prescribed in Section 3.13.

C. Operations of Main Line Natural Gas Valves:

City Utilities shall operate all main line natural gas valves as required in coordination with Contractor's work.

D. Purging:

1. All mains shall be purged of air after a satisfactory pressure test is completed.

2. Contractor shall install all necessary fittings for purging.

3. City Utilities shall provide all necessary labor for purging all mains.

E. Notice Required:

1. Contractor shall coordinate the sequencing of all required Pressure Control work with the Inspector.

2. A 48-hour advance notice is required for any Pressure Control operation.

3. All tapping and stoppling operations shall be scheduled to commence in the morning hours so that work can be completed during the normal City Utilities work day. Tapping and stoppling operations will not begin after 12:00 noon.

3.19 CONTINUITY OF SERVICE:

A. Contractor shall follow direction of the Inspector to maintain a maximum degree of continuous service to City Utilities' customers.

B. Service shall not be interrupted overnight unless special arrangements are made with the involved customers by Contractor.

C. Once Contractor has begun a specific procedure which requires an interruption of service, Inspector shall have the authority to require the Contractor to work continuously until said service is restored at no additional charge.

D. Contractor shall notify customers 24 hours in advance of service interruptions.

3.20 RESTORATION OF SERVICE:

City Utilities will be responsible for relighting of all natural gas services. Contractor shall coordinate this work and give immediate notice to the Inspector whenever a service is ready to be relighted.

3.21 RETIRED NATURAL GAS MAIN AND SERVICES:

A. Other than minimum lengths as shown on the drawing and where retired natural gas main conflicts with the installation of this projects' improvements, Contractor may leave retired natural gas main in place. All retired natural gas mains shall have the ends plugged or sealed with caps or foam sealant, as approved by the Inspector.

B. When necessary to complete installation of this project's improvements, or otherwise at Contractor's discretion, Contractor shall remove and dispose of retired natural gas mains and services. The affected area shall be backfilled and restored per Contract requirements and meet all jurisdictional agency requirements. No additional charge shall be made by Contractor for any work associated with removal of pipe.

3.22 PIPING WITH ASBESTOS COATING REPAIRS, DEMOLITION, AND DISPOSAL

Contractor is being made aware that work on piping with asbestos material within the coating of the pipe is governed by OSHA regulations and that compliance with OSHA regulations is the sole responsibility of the Contractor. Work on pipe with asbestos coating shall only be performed by OSHA trained personnel overseen by a "competent person" as defined by OSHA. Contractor shall be or retain a Registered Asbestos Contractor with the Missouri Department of Natural Resources. Additionally, all work shall be in accordance with EPA's *National Emission Standards for Hazardous Air Pollutants (NESHAP),* EPA's *Governmental Employee Worker Protection Rule, and Missouri DNR's Air Asbestos Rule*.

A. Excavation - When excavating a natural gas pipe with asbestos coating, take precautions to prevent the backhoe teeth from scraping or gouging the pipe. Use a spotter to warn when the pipe is first exposed. Use heavy equipment to excavate laterally down to and around the pipe, and then complete the job by hand. This is especially important if the pipe is to be retired and removed.

B. Pipe Preparation - Piping with asbestos coatings must be kept wet at all times while cutting, scraping, chipping, or otherwise abrading the pipe coating. Water mixed with a surfactant (soap, detergent or other agent, designed to reduce surface tension of the water) must be used to wet the pipe. A Hudson type sprayer shall be used to apply the solution. The solution shall be applied frequently to areas of the pipe coating being removed.

C. Cutting - Piping with asbestos coating shall ***never*** be cut using a high-speed mechanical saw without first removing the coating.

D. Coring - When tapping or coring pipe with asbestos containing coating, remove all coating from the affected area prior to installing any tapping fittings on piping. A hammer or similar tool shall be used to break away large chunks of the coating from the pipe. A putty knife or similar tool shall be used to remove any remaining layers of the asphaltic coating. Plastic sheeting shall be placed beneath or beside the pipe to collect all coating as it is removed. Treat all collected coating, dust, crumbs as asbestos waste. Once coating removal is complete, ensure that all pieces of coating are retained on the plastic sheeting, placed in plastic bags and properly disposed.

E. Retirement/Removal - Unless otherwise indicated on the Drawings, all existing piping with asbestos containing coating shall be abandoned in place. . "Abandon in place" pertains only to those sections that have not been moved from their location of original installation. Pipe sections that have been removed or disconnected from their installed position must be

removed from the trench and properly disposed of. Pipe sections and fragments of coating removed from the trench must be immediately packaged for disposal and moved to a secure location. This may entail placing directly into a lined roll-off containing and/or double wrapping or bagging individual pieces of pipe and/or pipe fragments and/or coating fragments in 6-mil plastic bags or sheeting. All cost for the proper disposal of pipe and/or coatings which is removed without direction and written authorization of the Resident Engineer, shall be borne by the Contractor.

F. Decontamination - All tools and equipment used during the maintenance of piping with asbestos coating shall be thoroughly cleaned with soap, water, and disposable towels. All materials such as towels used for cleaning, gloves, or plastic sheeting that becomes contaminated with asbestos containing material shall be packaged and disposed of properly.

G. Disposal - Contractor is responsible for ensuring all sections and pieces of piping with asbestos containing coating that cannot be abandoned in place are properly packaged and disposed of at a licensed solid waste landfill approved by City Utilities. This also includes any coating debris collected. Prevent damage to the coating when transporting pipe sections. Frayed coating edges must be wrapped in plastic or secured with duct tape. The pipe length should be limited to 20 feet, or as dictated by the disposal Contractor. Do not transport pipe with loose coating unless it is adequately wrapped in plastic. If desired, City Utilities will provide guidance to the Contractor on the landfill's waste approval process. However, costs for disposal are borne by the Contractor, unless otherwise indicated on the Drawings or in these Specifications. Contractor will document disposal by providing to City Utilities the waste manifest(s) signed and returned to the Contractor by the landfill representative.

H. Reporting - Contractor is responsible to report to City Utilities information necessary for reporting compliance to Missouri Department of Natural Resources. Contractor shall supply the name of the competent person who is performing any work on the pipe or any pipe removal, transport and disposal. The contractor shall provide the name and location of the disposal facility. This information shall be submitted to City Utilities Environmental Affairs at least 20 days prior to work on the pipe.

END OF SECTION

SECTION 02580

UNDERGROUND ELECTRIC CONDUIT AND EQUIPMENT

PART I GENERAL

1.01 DESCRIPTION: Includes, but is not limited to, primary and secondary risers, trench, conduit, transformer pads, equipment pads, primary junction cabinets, secondary pedestals, secondary cabinets, secondary vaults, conduit elbows and streetlights.

1.02 RELATED WORK DESCRIBED ELSEWHERE:

Section 02220 – Demolition and Clearing

Section 02315 – Excavation and Backfilling

Section 02410 – Tunneling

Section 02700 – Paving and Surfacing

Section 02900 – Landscaping

Section 03300 – Concrete

PART II PRODUCTS

1.01 Materials will be approved by City Utilities. Contact City Utilities Transmission and Distribution Engineering for a list of approved materials.

A. Contractor to supply all electrical materials per "Developer Installed Work" on drawing.

B. City Utilities to supply: junction cabinets, plastic transformer pads, secondary service pedestals, stand-off brackets for risers and street light bases. Refer to section 01640.

PART III EXECUTION

3.01 INSTALLATION OF PVC CONDUIT PIPE:

A. The Contractor shall handle all PVC conduit with care to prevent damage. PVC conduits shall be placed in trench as shown in the Electric Construction Standards Drawings, and in locations as shown on plans issued by City Utilities. The joining of conduit pieces shall be accordance with manufacturer's recommendations and will be done only with joint cement and primer approved by City Utilities. Any conduit that is split, broken, crushed, or flattened shall not be installed.

B. The ends of all conduit runs shall be sealed using PVC conduit plugs and clearly labeled to indicate where they are going. The ends of all conduit runs shall have a conduit/cable marker attached to designate location.

C. Plastic warning tape shall be installed in trench between 6-inches and 12-inches below finished grade.

D. The PVC conduit shall be installed in such a manner as to insure an unobstructed raceway for pulling conductor in the conduit at some future time. During conduit installation contractor to install a pull-string by blowing a "Mouse" in conduit from point of beginning to point of termination. "Mouse" size to match conduit size. Install a

continuous run of binder twine with a breaking strength of at least 150 pounds in each conduit, extend a minimum of four feet of twine past each end. Do not blow the string into energized equipment.

E. Contractor shall prevent foreign material from entering the conduit while it is being placed in the line. Allow no debris, tools, clothing or other materials in the pipe.

F. When conduit laying is not in progress, open ends of the pipe shall be closed with a plug or cap to prevent entry of foreign materials.

3.03 PERMISSIBLE DEFLECTION:

A. Deflections shall not exceed the pipe manufacturer's specifications.

3.04 CONDUIT CUTTING:

A. All conduit cutting shall be done in strict accordance with the pipe manufacturer's specifications.

3.05 INSTALLATION OF ELBOWS-GALVANIZED AND PVC:

A. Install per Engineering drawings.

B. Verify depth of trench necessary to correctly install ells at proper depth in relation to final grade at junction enclosures, transformers and secondary pedestals.

C. Templates provided by City Utilities shall be used to arrange ells in the proper footprint. Bundling or taping of ells together in one bunch is not acceptable.

D. The tops of ells in a transformer should be set flush with the top of the pad.

E. The tops of ells in primary junction cabinets and primary fuse cabinets should be set at 18" below final grade. The tops of ells in secondary pedestals should be set at 12" below final grade.

3.06 GROUND RODS:

A. Contractor shall provide and install ground rods.

3.07 INSTALLATION OF ELECTRIC EQUIPMENT:

A. The Contractor shall handle all electric equipment with care to prevent damage. Equipment shall be installed as shown in the Electric Developer Construction Standard Drawings (http://www.cityutilities.net/business/construction.htm) and in accordance with Manufacturer's Recommendations.

B. The Inspector shall be notified as to the start of equipment installation so as to ensure proper installation of equipment.

END OF SECTION

SECTION 02700

PAVING AND SURFACING

PART I GENERAL

1.01 DESCRIPTION: Includes, but is not limited to, pavement replacement in streets, driveways and sidewalks. Pavement repairs required due to potholing for utilities are to be performed per this Specification.

1.02 RELATED WORK SPECIFIED ELSEWHERE: Excavation and Backfilling; Section 02315.

PART II MATERIALS AND EQUIPMENT

2.01 Meet appropriate jurisdictional agency paving standards.

PART III EXECUTION

3.01 GENERAL PAVING REPLACEMENT:

A. All paving replacements and associated costs are the sole responsibility of the Contractor. Paving must be restored according to the appropriate jurisdictional agency's requirements and be performed to their satisfaction.

B. When trench excavations are made on private property, parking lots or driveways, backfill immediately with compacted granular material according to excavation Specifications to restore access. Install a smooth final asphalt repair within 30 days of the trench backfill.

C. Install a smooth temporary patch across streets the same day as the trench is backfilled. Final repair shall be completed within 30 days of the trench being backfilled.

3.02 DRIVEWAY REPLACEMENTS:

A. Cut paved driveways in a straight line along both sides of the area to be excavated.

3.03 REGULATORY COMPLIANCE:

A. Comply with all applicable jurisdictional requirements.

END OF SECTION

SECTION 02900

LANDSCAPING

PART 1 GENERAL

1.01 DESCRIPTION: Includes, but is not limited to, the items listed below.

A. Performing preliminary cleanup.

B. Planting bushes, trees or plants.

C. Applying topsoil to disturbed areas on right-of-way and easements.

D. Hydraulic seeding of disturbed areas.

E. Cultivation and drilling of disturbed pasture or cropland areas.

F. Re-seeding during specified seeding windows.

G. All disturbed areas to be restored to as good as or better than original condition.

H. The Inspector will determine pre-existing conditions and will designate areas that need to be seeded, sodded and/or landscaped.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

A. Excavation and Backfilling; Section 02315.

B. Demolition and Clearing; Section 02220.

PART II MATERIALS AND EQUIPMENT

2.01 TOPSOIL:

A. Fertile, friable soil of loamy character, free of sub-soil, stumps, refuse and other foreign material.

B. Normal amount of natural humus and reasonably free of roots, hard dirt, heavy or stiff clay, coarse sand, noxious weeds, noxious weed seeds, sticks, brush and other litter.

C. Obtained from well-drained, arable land and be of an even texture.

D. Not infested with nematodes or with any other noxious animal life or toxic substances.

E. Sandy loam of low fertility, even though mixed with leaf mold, manure or other fertilizers is not acceptable.

2.02 GRASS SEED:

A. Clean, dry new crop seed.

B. Provide grass seed for established areas in a blend as specified below, unless directed otherwise by the landowner or Inspector:

1. 75% by weight of a three-way blend (equal parts) of turf fescues, consisting of any three of the following varieties: Olympic, Falcon, Bonanza, Rebel, Hound Dog, Astro 2000, Eldorado, Wrangler, FineLawn One, Anthem or Apache.

2. 15% by weight of Perennial Rye, consisting of one or more of the following varieties: Affinity, Derby, Regal, Manhattan or Chateau.

3. 10% by weight of Bluegrass, consisting of either Kentucky Bluegrass, Park Bluegrass or both.

4. Purity 98%.

5. Germination 85%.

C. Complies with standards of the Official Seed Analysis of North America.

D. Recommended for full sun exposure in Springfield, Missouri.

E. Seed shall be free from Johnson Grass, Canadian Thistle or field bind weed seed.

2.03 FERTILIZER:

Provide a mixture containing 13 pounds each of soluble nitrogen, phosphate and potash per 100 pounds.

2.04 MULCH FOR HYDRAULICALLY SEEDED AREAS:

Provide a mixture of 50% recycled slick paper mulch and 50% ground corrugated paper mulch by weight. The recycled slick paper mulch shall be produced from printer's slick paper containing wood cellulose and kaolin clay. Newsprint is not allowed. The slick paper mulch shall have a maximum moisture content of 8% by weight, and shall have a pH of 4.5 to 6.5. The corrugated paper mulch shall have a moisture capacity of 700 grams water per 100 grams dry mulch minimum, a dry moisture content of 12% maximum, and a pH of 5.0 to 8.0. All mulch materials must be free of any germination or growth-inhibiting substances, green in color, and have the property of being evenly dispersed and suspended when agitated in water.

Clean wheat straw shall be applied over the hydraulic mulch.

2.05 SOD:

Sod shall be placed as shown on the plans.

PART III EXECUTION

3.01 PRELIMINARY CLEANUP:

Clear disturbed areas, including those disturbed by trenching, storing of dirt, pipe laying, pipe storage, movement of equipment and other work of all rubbish, brush, rock, trash and excess dirt in a timely manner as soon as the ditch is backfilled, depending upon existing conditions and level of public concern. This may be required as often as daily. The Inspector will determine an appropriate schedule depending upon job conditions. Rake surface as necessary to remove all above items, including all rock measuring two-inches or more in its greatest dimension. In pasture and cropland areas, remove all above items in a timely fashion. Tractor-drawn equipment, including rock rakes and steel roller drum are allowed.

3.02 PLANTING:

Contractor shall replace individual trees, plants and shrubs as necessary or as directed by the Inspector. Plant in accordance with "Planting Trees and Shrubs" by the University of Missouri - Columbia Extension Division (Publication No. 6850). Replacement trees, plants and shrubs shall be nursery grown and of the same type, strain, size and value as those removed. Plant replacement trees, plants and shrubs as soon as possible after installation of mains, with due consideration given to optimal times of the year to plant the given species.

3.03 APPLICATION OF TOPSOIL:

Established lawn and parkway areas

After preliminary cleanup has been performed, apply topsoil meeting the requirements of PART II, MATERIALS AND EQUIPMENT to a minimum depth of four inches to disturbed areas. Pulverize topsoil and grade to match existing terrain. Rake surface smooth for sod or to provide a good seedbed for hydraulic seeding as specified below.

3.04 SEEDING:

Perform initial seeding as soon as practical after preliminary cleanup and application of topsoil. Restore all disturbed areas, except for pasture and cropland, by hydraulic seeding. Seeding windows are specified as follows: Perform autumn seeding between August 15 and October 15, and spring seeding between March 15 and May 15. If initial seeding is performed within either of the specified seeding windows, the only additional work required of the Contractor shall be warranty work. When seeding outside a normal seeding window quick germinating seed shall be used such as winter wheat or perennial rye to establish ground cover. Contractor may be required to provide and install erosion control blankets to protect these areas. Re-seeding during the next earliest seeding window shall be considered part of the work if initial seeding falls outside either of the specified seeding windows. The Inspector will determine if re-seeding is required.

A. HYDRAULIC SEEDING: Mix seed, fertilizer and mulch with water and constantly agitate so that a uniform mixture can be applied hydraulically to the specified areas. Do not add the seed to the water more than four hours before application. Calculate ratios of seed, fertilizer, mulch and water so that seed will be applied at the rate of twelve pounds minimum per 1000 square feet of area, fertilizer will be applied at the rate of eight pounds minimum per 1000 square feet of area, and mulch will be applied at the rate of 1000 pounds minimum dry weight per acre. Wet application rate of the mixture shall be 2000 pounds per acre minimum. Blow wheat straw mulch onto the hydraulic mulch within one hour of application of the hydraulic mulch.

B. Restoration of disturbed pasture and cropland areas:

1. Seed bed preparation: Tillage - prepare a seed bed by use of tillage operations that leaves a seed bed free of weeds. Leave the vegetative material destroyed by such operations on the surface. Several diskings or harrowings over same area may be required to provide a satisfactory seedbed.

2. Seeding method: Drilling - Plant the recommended seed with a grass drill equipped with double coulter furrow openers with depth bands and press wheels. Seed should be planted 1/4" to 1/2" deep. Cultipacking is required following seeding.

3. Fertilizer requirements: Apply fertilizer at the rate 8 pounds minimum per 1,000 square feet.

4. Seeding rates and mixture: Apply seed grass(es) at the rate (pure live seed or bulk seed per acre) of 30 lb/acre, or as recommended by the seed supplier.

5. Where permanent seeding must be delayed due to seasonal seeding or climate conditions, quick germinating seed such as winter wheat or perennial rye will be applied. Contractor may be required to provide erosion control blanket to provide protection to the disturbed areas until vegetation can be established. Subsequently drill temporary cover with no-till methods to establish permanent crop cover.

C. Restoration of slopes: When areas with slopes 3:1 or greater are restored a biodegradable erosion control blanket shall be installed over the seedbed to protect the slope (Propex CS2 or approved equal). Contractor shall supply the fabric and staples and install per manufacturer's recommendations.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART I GENERAL

1.01 Furnish all labor, materials and equipment necessary to complete the work as specified in this Section.

1.02 Comply with the provisions of the Concrete Reinforcing Steel Institutes "Manual of Standard Practice" unless more stringent requirements are shown.

PART II MATERIALS AND EQUIPMENT

2.01 Reinforcing bars will be sized according to the plans and will be ASTM A615, Grade 60, deformed bars.

2.02 Steel wire will be plain, cold-drawn and will conform to ASTM A82.

2.03 Use bolsters, chairs, spacers or other devices for spacing, supporting and fastening the reinforcing bars in place.

PART III EXECUTION

3.01 The reinforcement will be fabricated to the shapes and dimensions shown and placed where indicated. Lap splices will be made in conformance with ACI Standard 318.

3.02 The reinforcement will be free from all substances that would reduce or destroy the bond. After a substantial delay, steel left exposed will be inspected and cleaned.

3.03 Reinforcement detailing and placement, including concrete protection for steel reinforcement, unless otherwise indicated, will conform to ACI Standards 318 and 315 and will match reinforcement as shown on the Drawings.

3.04 Wire mesh reinforcement will be continuous between crack-control joints in slabs-on-grade. Laps will be at least one full mesh, staggered in both directions, and secured with wire or standard clips. Wire mesh will extend to within 2 inches of joints but not through joints.

3.05 Supports will be installed and intersections of reinforcement securely tied with steel wire to limit displacement to the tolerances permitted by ACI Standard 315. The number, type and spacing of supports will conform to ACI Standard 315, unless otherwise indicated.

3.06 Reinforcement for slabs-on-grade will be supported on precast concrete blocks. Size and spacing of blocks will be as required to provide firm support and the clearance specified or indicated. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.07 Reinforcement and other fixed metal items shall not be continuous through expansion or control joints.

END OF SECTION

SECTION 03300

CONCRETE

PART I GENERAL

1.01 DESCRIPTION

This Section covers all cast-in-place concrete, including reinforcing steel, forms, finishing and other appurtenant work for thrust blocks, thrust collars and other items shown on the Drawings. Also see Section 03200, Concrete Reinforcement.

1.02 RELATED WORK DESCRIBED ELSEWHERE

Water Piping, Section 02510.

PART II MATERIALS AND EQUIPMENT

2.01 MATERIALS:

Cement	ASTM C150, Type I or ASTM C715, Type IA.
Fine Aggregate	Clean natural sand, ASTM C33.
Coarse Aggregate	Crushed rock, washed gravel or other inert granular material conforming to ASTM C33.
Water	Potable
Reinforcing Steel Bars	ASTM A615, Grade 60

2.02 PRELIMINARY REVIEW

Submit the source and quality of concrete materials and the concrete mix along with test data proposed for the work to the Inspector for review, before any concrete is placed.

2.03 SLUMP

Keep concrete slump as low as possible consistent with proper handling and thorough compaction. Unless otherwise authorized by the Inspector, slump shall not exceed 4 inches except for flowable fill. Add no water to mix after the slump test without approval by Resident Engineer.

2.04 STRENGTH

The minimum acceptable compressive strengths as determined by ASTM C39 shall be as follows:

Age	Minimum Strength
7 days	2500 psi
28 days	3750 psi

Very high early strength concrete shall achieve a 2500 psi compressive strength within 3 hours. Contractor shall submit mix design for high early strength concrete to Inspector for review prior to placement along with compressive strength documentation.

Flowable fill compressive strength shall be demonstrated by failure to deform or crush under foot traffic.

2.05 STORAGE OF MATERIALS

Store cement in suitable moisture proof enclosures. Do not use cement which has become caked or lumpy. Store aggregates so that segregation and the inclusion of foreign materials are prevented. Do not use the bottom 6 inches of aggregate piles in contact with the ground.

Reinforcing steel shall be carefully handled and shall be stored on supports which will keep the steel from contact with the ground.

2.06 REINFORCEMENTS

Reinforcements shall be accurately formed and shall be free from loose rust, scale and contaminants which reduce bond.

PART III EXECUTION

3.01 BATCHING AND MIXING

Furnish concrete from an acceptable ready-mix concrete supplier or mix at the site. Concrete shall at a minimum conform to ASTM C94.

3.02 PLACING CONCRETE

Thrust blocks and thrust collars shall be placed between solid, undisturbed earth and the fitting or piping to be anchored. Thrust blocks shall be so placed that the pipe and joints will be accessible for repair and installed per Construction Standards. The minimum compressive strength for the concrete shall be achieved prior to relying on the concrete for any thrust restraint. The use of very high early strength concrete is permissible for installations where time constraints exist.

When the Drawings call for flowable fill or Contractor wishes to utilize flowable fill in lieu of compacted backfill, no additional payment will be made. Contractor shall make requests to utilize flowable fill to the Resident Engineer. Flowable fill mix and placement shall conform to Specifications of local jurisdictional agency or at a minimum the Missouri Standards Specifications for Highway Construction latest edition.

3.03 FINISHING

No surface treatment will be required for buried concrete not forming an integral part of a structure except that required to obtain the surface elevations or contours and surfaces free of laitance.

3.04 INSPECTION

No concrete shall be covered until installation has been approved by City Utilities.

3.05 REPAIR OF DEFECTIVE WORK

In the event that concrete installation is found to be sub-standard, the Contractor shall be required to remove and replace installation with proper materials and execution.

END OF SECTION

ATTACHMENT A

GENERAL CONDITIONS

This contract is subject to the terms and conditions of "City Utilities of Springfield, Missouri General Conditions," which may be found at **https://www.cityutilities.net/wp-content/uploads/purchasing-generalconditions.pdf.** Hard copies of the General Conditions may be requested from City Utilities' Purchasing Department, 301 E. Central, P.O. Box 551, Springfield, MO 65801-0551.